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An Interface for Managing Cloud Infrastructure

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Foreword

The *Cloud Infrastructure Management Interface (CIMI) Model and RESTful HTTP-based Protocol* specification (DSP0263) was prepared by the DMTF Cloud Management Working Group. It defines a logical model for the management of resources within the Infrastructure as a Service domain.

DMTF is a not-for-profit association of industry members dedicated to promoting enterprise and systems management and interoperability.

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Cloud Infrastructure Management Interface (CIMI) Model and RESTful HTTP-based Protocol

1 Scope

This specification describes the model and protocol for management interactions between a cloud Infrastructure as a Service (IaaS) Provider and the Consumers of an IaaS service. The basic resources of IaaS (machines, storage, and networks) are modeled with the goal of providing Consumer management access to an implementation of IaaS and facilitating portability between cloud implementations that support the specification. This document specifies a Representational State Transfer (REST)-style protocol using HTTP. However, the underlying model is not specific to HTTP, and it is possible to map it to other protocols as well.

CIMI addresses the management of the life cycle of an infrastructure provided by a Provider. CIMI does not extend beyond infrastructure management to the control of the applications and services that the Consumer chooses to run on the infrastructure provided as a service by the Provider. Although CIMI may be to some extent applicable to other cloud service models, such as Platform as a Service (PaaS) or Storage as a Service ("SaaS"), these uses are outside the design goals of CIMI.

1.1 Document structure

This document defines a model and a RESTful HTTP-based protocol.

The core REST patterns are defined first and, after each resource is defined, any HTTP-specific information for that resource is specified.

1.2 Document versioning scheme

This document adheres to the versioning scheme defined in clause 6.3 of DSP4004.

As the specification changes over time certain features might be deprecated. These are identified in the specification and should not be supported. Each of these deprecated features is clearly denoted in the clause in which they were previously defined.

1.3 Typographical conventions

This specification uses the following conventions:

In the narrative text of the specification:

- The regular or narrative font is Arial.
- Proper CIMI nouns such as Resource names, attribute names, operation names, reserved variable names are in `Courier` font. (e.g., `Machine`, `volumes`, `$expand`). The plural form applies to such names to indicate several instances of such Resources (e.g., `Machines, Systems)`.
- Example text is in small `Courier` font and over a darker background.
- Quotes are used for any text that needs be distinguished as a name or value of a particular concept (e.g., the "value constraints" attribute, the “Resource Name” column, a “false” value). In such cases, the string in quotes is always qualified by the concept it is an instance of.
- Names for CIMI concepts that may be common English words but have a very specific meaning in CIMI, are in narrative font but capitalized, e.g., Provider, Consumer, Resource, Collection.

When used in their common English sense they remain lowercase. However, CIMI modeling concepts that are used in a commonly understood manner remain in lowercase, such as: attribute, operation.

Inside tables describing the Resource data model:

- The narrative font is used for all terms, as the table structure qualifies them sufficiently.
- Where textual descriptions are introduced, the rules for narrative text apply.
- Names that are used as types (i.e., names of embedded structures as well as atomic types such as "integer", "string"), are in *italic*.
- Names that are just placeholders for actual names that may vary with each model instance, are shown between < > (e.g., <componentTemplate>).

Where the serialization of Resources is described, a pseudo-schema notation is used with the following conventions:

- Values in *italics* indicate data types instead of literal values.
- Characters are appended to items to indicate cardinality:
  - "?" (0 or 1)
  - "*" (0 or more)
  - "+" (1 or more)
- Vertical bars, "|", denote choice. For example, "a|b" means a choice between "a" and "b".
- The characters {, }, [, and] are block delimiters within the pseudo-schema. (Blocks may extend over multiple lines.)
- Parentheses, "(" and ")" are used in the pseudo-schema only to indicate the scope of the operators "?", "*", "+" and "|".
- Ellipses (i.e., "...") indicate points of extensibility. Note that the lack of an ellipses does not mean no extensibility point exists, rather it is just not explicitly called out - usually for the sake of brevity.
- The scope of "?", "*", "+" and "|" follows these rules:
  - If immediately following a block delimiter or an array closing symbol e.g., "], ?" the scope is the entire block.
  - If not following any closing block delimiter, the scope is everything that precedes it on the same single line.

Operation names Create, Update, Delete, Read are abstract operations that convey the semantics of concrete corresponding operations, such as HTTP methods or CIMI operation URIs.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated or versioned references, only the edition cited (including any corrigenda or DMTF update versions) applies. For references without a date or version, the latest published edition of the referenced document (including any corrigenda or DMTF update versions) applies.

DMTF DSP0223, *Generic Operations 1.0*,
http://www.dmtf.org/standards/published_documents/DSP0223_1.0.pdf

DMTF DSP0243, *Open Virtualization Format Specification 1.1*,
http://www.dmtf.org/sites/default/files/standards/documents/DSP0243_1.1.pdf

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http://www.dmtf.org/standards/published_documents/DSP1001_1.1.pdf

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3 Terms and definitions

In this document, some terms have a specific meaning beyond the normal English meaning. Those terms are defined in this clause.

The terms "shall" ("required"), "shall not," "should" ("recommended"), "should not" ("not recommended"), "may," "need not" ("not required"), "can" and "cannot" in this document are to be interpreted as described in ISO/IEC Directives, Part 2, Annex H. The terms in parenthesis are alternatives for the preceding term, for use in exceptional cases when the preceding term cannot be used for linguistic reasons. Note that ISO/IEC Directives, Part 2, Annex H specifies additional alternatives. Occurrences of such additional alternatives shall be interpreted in their normal English meaning.

The terms "clause," "subclause," "paragraph," and "annex" in this document are to be interpreted as described in ISO/IEC Directives, Part 2, Clause 5.

The terms "normative" and "informative" in this document are to be interpreted as described in ISO/IEC Directives, Part 2, Clause 3. In this document, clauses, subclauses, or annexes labeled "(informative)" do not contain normative content. Notes and examples are always informative elements.

The terms defined in DSP4004, DSP0223, and DSP1001 apply to this document. The following additional terms are used in this document.

3.1

authentication

The process of verifying a claim, made by a subject, that it should be allowed to act on behalf of a given principal (person, service, etc.). Typical authentication mechanisms involve the use of username/password combination or public/private key pairs.

458 **3.2**
459 **authorization**
460 The process of verifying that an authenticated principal (person, service, etc.) has permission to perform
461 certain operations (e.g., read, update) on specific Resources. (Also known as Access Control.)

462 **3.3**
463 **cloud**
464 Synonymous with “cloud computing” as defined in section 2 of the NIST Definition of Cloud Computing
465 [SP800-145].

466 **3.4**
467 **Cloud Service Consumer**
468 A category of actors that includes the Consumer Business Manager (who approves business and
469 financial expenditures for consumed services; accounts for used service instances; establishes business
470 relationships; sets up accounts, budget, and terms; etc.); the Consumer Service Administrator (who
471 requests service instances and changes to service instances; purchases services within the business
472 relationship; creates Service Users (including policies); allocates resources, such as computer and
473 storage; generates reports, such as usage; etc.); and Service Users (who use service instances provided
474 by a Cloud Service Provider). The term "Consumer" is used if the indicated action or activity could involve
475 one or more of the above actors. In cases where the distinction between the actors in this category is
476 relevant, the more detailed term is used.
477 For purposes of comparison and alignment, it should be noted that a Cloud Service Consumer is
478 equivalent to the “Cloud Consumer” actor defined in the NIST Reference Architecture [SP500-292].

479 **3.5**
480 **Cloud Service Provider**
481 A category of actors that includes the Service Operations Manager (who manages the technical
482 infrastructure required for providing cloud services; monitors and measures performance and utilization
483 against SLAs; provides reports from monitoring and measurement; etc.); Service Business Manager (who
484 offers all types of services developed by cloud service developers; accounts for services potentially
485 offered by service Providers themselves and services offered on behalf of cloud service developers;
486 establishes a portfolio of business relationships; and sets up accounts and terms for Consumers, etc.);
487 and Service Transition Manager (who enables a customer to use the cloud service, including
488 "onboarding", integration, and process adoption; defines and creates service offerings based on
489 Templates and Configurations that can be used by Consumers and are populated into the catalog; etc.).
490 The term "Provider" is used if the indicated action or activity could involve one or more of the above
491 actors. In cases where the distinction between the actors in the category is relevant, the more detailed
492 term is used.
493 For purposes of comparison and alignment, it should be noted that a Cloud Service Provider is equivalent
494 to the “Cloud Provider” actor defined in the NIST Reference Architecture [SP500-292].

495 **3.6**
496 **Collection**
497 A particular kind of Resource that contains a collection of other Resources and has a representation and
498 serialization defined in this specification. Synonym for “CIMI collection”.

499 **3.7**
500 **Configuration**
501 A set of metadata, the values of which serve as the parameters of a discrete conformation of a specific
502 type of virtual resource.

503 **3.8**
504 **Endpoint**
505 An element within a Network Segment from which communication can originate or to which
506 communication can be sent. Endpoints have a unique, protocol specific, address within a Segment by
507 which they are distinguished.

508 **3.9**
509 **Infrastructure as a Service (IaaS)**
510 A cloud computing service model defined in section 2 of the NIST Definition of Cloud Computing [SP800-
511 145].

512 **3.10**
513 **Interface**
514 An abstract element of virtual hardware that enables connection to a Network via Endpoints.

515 **3.11**
516 **message confidentiality**
517 A quality of a message that prevents anyone but the intended receiver(s) from viewing its contents.

518 **3.12**
519 **message integrity**
520 A quality of a message that allows a receiver of that message to determine whether the contents of the
521 message have been altered since its creation.

522 **3.13**
523 **Network**
524 A construct that supports communications between elements within a Cloud using one or more protocol
525 specific Segments that support addressable Endpoints.

526 **3.14**
527 **Resource**
528 A representation of an entity managed by the [Cloud Service] Provider that is generally available to the
529 [Cloud Service] Consumer to access or operate on by way of the interface described in this specification.
530 Synonym for “CIMI resource”.

531 **3.15**
532 **Segment**
533 A component of a Network that supports communication between Endpoints using a single protocol. Also
534 referred to as a Protocol Segment to emphasize that Segments are always bound to a single
535 communication protocol.

536 **3.16**
537 **Template**
538 A component Synonym for “CIMI template”. A Resource that represents the set of metadata and
539 instructions used to instantiate some other Resource (e.g., a `MachineTemplate` is used to create
540 `Machines`.

4 HTTP-based protocol

4.1 Introduction

All operations are based on the *HyperText Transfer Protocol (HTTP)*, version 1.1 [RFC2616]. Each request is sent by using an HTTP verb such as PUT, GET, DELETE, HEAD, or POST and includes a message body in either JSON or XML format. Each response uses a standard HTTP status code, whose semantics are interpreted in the context of the particular request that was made. Each Resource in the model has a MIME type that further contextualizes the payload of requests and responses.

Resources in the model are identified by URIs, and each Resource's representation shall contain an "ID" attribute, of type URI, that acts as a "self pointer." This URI shall be unique within the context of the Provider's implementation. Dereferencing (through an HTTP GET) the URI of a Resource yields a representation of the Resource containing attributes and links to associated Resources. To begin operations, a client shall know the URI to the main entry point of a Provider - also known as the "Cloud Entry Point" Resource. All other Resources within the environment shall then be discoverable by the way of the iterative following of links to associated Resources within each Resource retrieved.

4.1.1 Protocol evolution and client expectations

Future versions of this specification structure changes in such a way that clients that conform to an earlier version of this specification continue to work, and are not be adversely affected by the evolution of the protocol. Clients are expected to follow a few simple rules to ensure this compatibility:

1. Clients shall not assume that the serializations shown for responses in this specification are complete. In particular, clients shall accept responses that contain data mixed in with the serializations shown here, and shall ignore such data. However, per clause 4.2.1.3, clients shall include unknown data in PUT requests to update Resources.

2. Clients shall not assume anything about the operations supported by a server. They are expected to discover operations that are supported (and permissible) by navigating to Resources from the cloud entry point. The serializations of Resources encountered indicate which operations are supported by the server.

4.1.2 XML namespaces

Table 1 lists the XML namespaces that are used in this specification. The choice of any namespace prefix is arbitrary and not semantically significant.

Table 1 – XML namespaces

Prefix	XML Namespaces	Specification
cimi	http://schemas.dmtf.org/cimi/2	This specification
xs	http://www.w3.org/2001/XMLSchema	XML Schema Part2

4.1.3 URI space

While URIs returned by Providers are to be treated as opaque by Consumers, and Consumers shall not make assumptions about the layout of the URIs or the structures of the URIs for the Resources, a Consumer may augment URIs with any well-defined query parameters that are supported by the Provider as defined in clause 4.1.6.

The sample URIs used in this specification are not normative and the patterns used shall not be interpreted as guidance for implementations. For example, any of the following URIs might be used by Providers to reference a particular `Machine` Resource:

```
http://example.com/machines/12345
http://example.com/machines?id=12345
http://example.com/12345
http://example.com/Cloud/resource?id=12345
```

4.1.4 Media types

In this specification, Resource and response representations are encoded either in JSON, as specified in RFC4627 or in XML. If serialized in JSON, the media-type for CIMI resources shall be "application/json". If serialized in XML, the media-type shall be "application/xml".

In the JSON serialization of CIMI representations sent by Providers, there shall be an additional attribute on the root object called "`resourceURI`" that contains the unique URI that is associated with the type of CIMI resource being serialized.

Note that this requirement applies even if the `$select` attribute is used to subset the Resource being acted upon.

In the XML serialization of Collection representations sent by Providers there shall be a `resourceURI` attribute, as shown in the example XML serialization of Collections in clause 5.5.12.

This attribute is optional for Consumers to include. If included, this attribute's value shall match the "`typeURI`" attribute of the corresponding `ResourceMetadata` Resource (see clause 5.8), if `ResourceMetadata` is supported. This value shall also be equivalent to the wrapping element of the XML serialization; in other words, the namespace of the wrapper element concatenated a "/" and then its localName.

Any CIMI resource implemented by a Provider shall have representations in JSON and XML. The client implementation may thus use either JSON or XML in requests with any server implementation, and may request a specific serialization using server-driven content negotiation (using the Accept request header).

4.1.5 Request headers

This specification uses general-header, request-header, and entity-header headers as defined in RFC2616 in request messages to provide metadata about the message. Applications using messages defined in this specification shall use headers consistent with the requirements of RFC2616.

4.1.6 Request query parameters

Providers may choose to include query parameters as part of the URIs returned to Consumers. Consumers shall include those query parameters when sending messages to those URIs. CIMI defined query parameters are prefixed with a dollar sign ("$"). If Providers choose to define query parameters, they shall not be prefixed with a dollar sign to avoid conflicts with current and future CIMI defined query parameters.

To modify the behavior of the Provider when processing request messages, Consumers may augment request URIs as described in the following clauses. As stated in clause 4.1.3, URIs returned from Providers are to be treated as opaque by Consumers; however, it is the responsibility of the Consumer to understand the use of the query parameters defined in the following clauses and ensure correctness when making a request.

Unsupported, or unknown, query parameters shall be silently ignored by Providers. Consumers may examine the CloudEntryPoint's capabilities to determine whether support of these query parameters is enabled.

4.1.6.1 Filtering Collections

If retrieving the representation of a Collection, Consumers may include the `$filter` query parameter to reduce the number of entries of the Collection that are returned based on the data within the entries of the Collection. Providers shall interpret and process the `$filter` query parameter as described in this section. The `$filter` parameter shall be of the form:

```
?$filter=expression
```

where "expression" represents a mathematical expression denoting how the top-level attributes of the Resources within the Collection shall be filtered. The expression is defined by the following EBNF grammar:

```
Filter      ::= AndExpr ( 'or' Filter )* ;
AndExpr     ::= Comp ( 'and' AndExpr )*
Comp        ::= Attribute Op Value
              | Value Op Attribute
              | PropExpr
              | '(' Filter ')'
Op          ::= '<' | '<=' | '=' | '>=' | '>' | '!='
Attribute   ::= ? resource attribute name ?
Value       ::= IntValue | DateValue | StringValue | BoolValue
IntValue    ::= /[0-9]+/
DateValue   ::= ? as defined by XML Schema ?
StringValue ::= "..." | '...'
BoolValue   ::= 'true' | 'false'
PropExpr    ::= 'property[' StringValue ']' Op StringValue
```

Where `PropExpr` is used to find Resources that contain a property with a certain key/value combination. The key is the `StringValue` within the square brackets ([ ]) and the value is the `StringValue` after the `Op`. The Resource shall be considered to satisfy the search criteria if any of the properties in the Resources match the specified `PropExpr`.

Each of these shall be percent encoded in the URL as appropriate.

The choice of which operator (including 'and' and 'or') is limited based on the type of the value and attribute. The following example describes the allowable operators:

```
'or', 'and'                      : Boolean value/attribute
'<', '<=', '=', '>=', ">', '!='  : Integer and date value/attribute
'=', '!='                        : String value/attribute
```

Consumers may include multiple filters within a single URI. Providers shall treat multiple filters as a series of "and" expressions where an entry of the Collection shall only be included in the response message if it satisfies all of the filter expressions specified.

Examples:

In the following examples, the following sample base URIs are used.

The URI to the `MachineCollection` of the Cloud Entry Point is as follows:

```
/machines
```

660 The URI to a `Machine` is as follows:

661 ```
/machines/123
```

662 The URI to the `DiskCollection` of a `Machine` is as follows:

663 ```
/machines/123/disks
```

664 The URI to the `VolumeCollection` of a `Machine` is as follows:

665 ```
/machines/123/volumes
```

666 To filter the `MachineCollection` so that just `Machines` with a "name" attribute of "mine" are
667 returned, use the following filter:

668 ```
GET /machines?$filter=name='mine'
```

669 To filter a `DiskCollection` of a `Machine` so that just `Disks` with a format of "ntfs" are returned, the
670 following filter would be used:

671 ```
GET /machines/123/disks?$filter=format='ntfs'
```

672 If the `$filter` parameter is used, the Collection's "`count`" attribute shall contain the number of
673 Resources matching the filter expression.

674 #### 4.1.6.2 Subsetting Collections

675 If retrieving the representation of a Collection, Consumers may include query parameters to subset the
676 number of entities of the Collection that are returned. Providers shall interpret and process these query
677 parameters as described in this clause. While the previous clause discussed how to perform a filter over
678 the data within the Collection, this clause uses ordinal position within the Collection to achieve the desired
679 reduction.

680 This specification defined two query parameters that, if used, shall indicate the first and last ordinal
681 positions of the entities within the Collection that are returned. The query parameters shall be of the form:

682 ```
?$first=number
```

683 ```
?$last=number
```

684 Where "`$first`" indicates the (1-based) ordinal position of the first entity of the Collection to return and
685 "`$last`" indicates the (1-based) ordinal position of the last entity of the Collection to return. Consumers
686 are not required to use both at the same time. If `$first` is specified but `$last` is not, the implied value
687 for `$last` shall be the ordinal position of the last entity in the Collection. Conversely, if `$last` is
688 specified but `$first` is not, the implied value for `$first` shall be 1.

689 If Consumers include these query parameters, the ordinal positions of entries in the collection before
690 subsetting shall be stable when no changes are made to the collection or its entries. If filtering or sorting
691 are used in the same query, the subsetting applies to the collection resulting from those operations.

692 If any part of the range as expressed by `$first` and `$last` is outside of the bounds of the Collection,
693 just the Resources (if any) in the Collection that are contained within that range shall be returned. A fault
694 shall not be generated if any part, or all, of the expressed range is outside the bounds of the Collection.
695 Note that if `$first` is larger than `$last`, the range shall represent an empty range and therefore no
696 Resources are returned.

697 If either `$first` or `$last` are specified, and a filter expression (as defined in clause 4.1.6.1) is also
698 specified, the filter expression shall be performed first and then the ordinal constraints of `$first` and
699 `$last` shall be applied.
```

The inclusion of $first or $last does not affect the value of the Collection's returned "count" attribute: it shall contain the number of Resources in the Collection before subsetting. In case filtering is also used, “count” shall be the size of the Collection resulting from the filtering.

4.1.6.3 Subsetting Resources

If retrieving the representation of a Resource, Consumers may include the `$select` query parameter to specify a subset of the Resource to be acted upon. Providers shall interpret and process this query parameter as described in this section. This subsetting shall have the semantic equivalence of referencing a different Resource whose attributes are a subset of the original Resource as specified by the attribute names listed in the `$select` query parameter. The format of a `$select` query parameter is:

```
?$select=attributeName,...
```

The value of the `$select` query parameter shall be a comma-separated list of top-level attribute names of the Resource, possibly including the string “operations” in case the intent is to select the operations available to the Consumer for this Resource. Any attribute name erroneously appearing in the list that is not part of the Resource shall be ignored by the Provider. An attribute name of "*" is equivalent to specifying all of the attributes of the Resource including its operations. Any attribute name explicitly appearing more than once in a URI shall have its second (and subsequent) appearances ignored.

The `$select` query parameter may appear more than once in a URI. This is semantically equivalent to all of the attribute names appearing as values of a single `$select` query parameter. For example:

```
?$select=name&$select=state
```

is equivalent to:

```
?$select=name,state
```

The order of attribute names in the `$select` query parameter is not relevant for serialization purposes. The attributes are serialized per the serialization rules/order as specified by the Resource definition.

Note that per clause 4.1.4, if a Resource representation is sent by a Provider it shall always include the `resourceURI` attribute even if it is not specified in the `$select` query parameter.

For example, to subset the list of Machine attributes being acted upon to just the "name" and "description", the following query parameter would be used:

```
?$select=name,description
```

See clause 4.2.1.3.1 for more information about the impact of using this query parameter when updating a Resource.

If `$select` is used in the URI for a Collection resource, the subsettings shall apply to the attributes of the Collection resource itself as for any other Resource. For example, to subset a Collection resource in order to only return the number of its items, plus the operations available on this Collection:

```
?$select=count,operations
```

However, exceptionally for Collection resources, if some attribute provided in the `$select` list is not a top-level attribute of the Collection resource but instead is an attribute of the entities that are items of the Collection, the subsetting shall apply to each item of the Collection regarding this attribute. For example, if retrieving the `DiskCollection`, the following query parameter:

```
?$select=name,capacity
```

returns a collection of the `Disks` associated with a `Machine` but each entity of the collection just has the `name` and `capacity` attributes and nothing else, not even the `operations` or `id` attributes.

Optionally, an implementation may also support the alternative attribute name notation: <collectionName>/<attributeName> for subsetting the items inside a collection. For example, the following subsetting on items of a Disks Collection is equivalent to the one done in the previous example, while in addition listing the operations of the Collection resource itself (not of its items):

```
?$select=disks/name,disks/capacity,operations
```

This notation, if supported (see the “QueryPathNotation” capability in 5.11.1), allows for disambiguating subsettings if the same attribute name can be found for the Collection and for each item in the collection (which is always the case for id and operations).

4.1.6.4 Expanding references

If retrieving the representation of a Resource, Consumers may include the $expand query parameter to specify which of the top-level "reference" attributes of the Resource shall be "expanded". Providers shall interpret and process this query parameter as described in this clause. To expand a reference means that the attributes of the Resource being referenced shall be included in the serialization of that attribute. This feature allows for a more optimized retrieval of Resources.

The serialization shall be performed as follows:

JSON serialization:

```
"name": { "href": string }
```

shall be expanded to be:

```
"name": {
  "href": string,
  ... attributes of referenced resource...
}
```

XML serialization:

```
<name href="xs:anyURI"/>
```

shall be expanded to be:

```
<name href="xs:anyURI">
  ... attributes of the referenced resource...
</name>
```

Note that in the XML case the nested elements shall not contain the wrapper element of the referenced Resource (e.g., <Machine> in the case of a reference to a Machine Resource).

The format of a $expand query parameter shall be:

```
?$expand=attributeName,...
```

The value of the $expand query parameter is a comma-separated list of attribute names. Any attribute name erroneously appearing in the list that is not part of the Resource, or is not a reference, shall be ignored by the Provider. An attribute name of "*", or no attribute name list at all, is equivalent to specifying all of the attributes. Any attribute name explicitly appearing more than once in a URI shall have its second (and subsequent) appearances ignored.

The $expand query parameter may appear more than once in a URI, which is semantically equivalent to all of the attribute names appearing as values of a single $expand query parameter.

If the Resource being retrieved is a Collection, the attribute names listed in the `$expand` shall apply to the attributes of the entities within the Collection. For example, specifying:

```
?$expand=volumes
```

if retrieving the `MachineCollection` has the same net effect as applying the "`expand`" semantics to the specified attribute ("`volumes`" in this example) of each `Machine` within the Collection. To be clear, `$expand` acts on the attributes of the Resources in the Collection, not on the wrapping Collection Resource itself.

4.1.6.5 Specifying the Resource format

If retrieving the representation of a Resource, the HTTP Accept header is used to specify the encoding style of the response. While it is recommended that Consumers use the Accept header, there might be situations where Consumers are unable to control the values specified in that header. In these cases Consumers may use the `$format` query parameter to override the Accept header values. Providers shall interpret and process the `$format` query parameter as described in this clause.

The `$format` parameter shall be of the form:

```
?$format=encoding
```

Where "`encoding`" is the requested representation of the response. This specification defines two possible values: "`json`" and "`xml`". Providers may support others. The value of the `$format` query parameter shall be case insensitive.

If both an Accept header and `$format` query parameter are present in a request message, the `$format` value shall take precedence. If the `$format` query parameter appears more than once, the second, and subsequent, appearances shall be ignored.

4.1.6.6 Sorting Collections

If retrieving the representation of a Collection, Consumers may include the `$orderby` query parameter to sort the entries of the Collection that are returned based on different attributes or in a different order (descending). Providers shall interpret and process the `$orderby` query parameter as described in this section. The `$orderby` parameter shall be of the form:

```
?$orderby=attributeName[:asc|:desc], …

```

The `$orderby` expression may include multiple, comma-separated attribute names. Each attribute name may be optionally followed immediately by a colon and “`asc`” to denote ascending order (default), or “`desc`” to denote descending order for that attribute. If neither `asc` nor `desc` is specified, the order shall be "`ascending`”.

The attributes included in the `$orderby` shall be of the following types as defined in clause 5.5: boolean, dateTime, duration, integer, or string.

The sort shall be performed based on the attribute type.

The following rules apply to the ascending sort order:

- boolean – ‘false’ shall come before ‘true’.
- dateTime – An earlier datetime shall come before a later datetime.
- duration – A shorter duration shall come before a longer duration.

- integer – Smaller integers shall come before larger integers. Negative integers shall come before positive integers.
- string – Ordering is based on a binary comparison of the transformed strings according to the rules of the Normalization Form KD of the Unicode standard as defined in Unicode Standard Annex (UAX), annex #15 .

For the `desc` sort order, the reverse of the above shall be performed.

Examples:

To sort the result set of the `MachinesCollection` Resource on the "`created`" attribute in descending order, the following expression would be used:

```
GET /machines?$orderby=created:desc
```

To sort the result set of the `MachinesCollection` Resource on the "`cpu`" attribute in descending order, followed by the "`memory`" attribute in ascending order, the following expression would be used:

```
GET /machines?$orderby=cpu:desc,memory:asc
```

If collection subsetting is used in the same query, the subsetting applies to the sorted collection. When no `$orderby` is specified, the order of entries in the returned Collection is not defined.

4.1.7 Response headers

As defined in RFC2616, this specification uses general-header, response-header, and entity-header headers in response messages to provide metadata about the message. Applications that use messages defined in this specification shall use headers consistent with the IANA HTTP Header Registry.

4.1.7.1 Job header

If the server supports the `Job` Resource, response messages shall include a header defined by this specification to indicate the URI for the job created to process the associated request message.

```
CIMI-Job-URI = "CIMI-Job-URI" ":" string
```

4.1.7.2 ETag support

An ETag header may be provided by a Provider with each Resource as specified in RFC2616. If a Provider does provide an ETag header, it shall also support If-Match header processing on behalf of the Consumer.

4.2 Protocol operations

This clause defines the set of common HTTP operations that a Provider may expose. At its core, there are four basic CRUD (Create, Read, Update, and Delete) operations. The manner in which these are used is consistent across all Resources within the model; therefore, their use is defined once and is to be applied consistently. Some Resources support specialized operations that do not fit well into a CRUD style of operation and those follow a similar high-level pattern, but each operation is allowed to have slight variations to accommodate its specific needs. The specifics of these special operations are detailed within the clause that defines the Resource.

If appropriate, some of the Resource representations include an "operations" attribute. Providers shall only include the "operations" attribute if the specified operations are accessible to the current client for that particular Resource. This situation means that based on many factors (e.g., authorization rights of the

clients, current state of the Resource, etc.), a different set of "operations" shall be returned on each serialization of the Resource.

Each operation shall include a "rel" and an "href" field. The "rel" field shall uniquely identify the operation name (e.g., "add", "edit"), while the "href" field is the URI to which the operation's request message shall be sent. Note that the "href" field's URI may be different from the URI of the Resource itself. Each operation may have an “available” field to indicate that the operation can be performed by the Consumer. The "available" field is of type boolean with a default value of "true". If “available” is set to “false” it indicates that the operation is not currently available. This would normally indicate a temporary condition. For example, some Machine operations may not be available depending on the state of the Machine.

The operations attribute shall be serialized as follows:

JSON serialization:

```
{ "operations": [
    { "rel": string, "href": string, (“available”: boolean)? }, +
  ]
}
```

XML serialization:

```
<Resource xmlns="http://schemas.dmtf.org/cimi/2">
  <operation rel="xs:anyURI" href="xs:anyURI" (available=”xs:boolean”)? /> *
</Resource>
```

For example, the "edit" operation would appear as:

JSON serialization:

```
{ "operations": [
    { "rel": "edit", "href": "<editURI>" }
  ]
}
```

XML serialization:

```
<Resource xmlns="http://schemas.dmtf.org/cimi/2">
  <operation rel="edit" href="<editURI>"/>
</Resource>
```

Additional "`rel`" values may be defined by Providers; however, they shall be fully qualified URIs and not relative URIs.

4.2.1 Common CRUD operations

Each of the Resources supported by this protocol shall adhere to the interaction patterns defined in the following clauses.

4.2.1.1 Creating a new Resource

To create a new instance of a Resource type, an HTTP POST request is sent to a designated "`addURI`" for that Resource type. In many cases, the Collection resource that maintains, or groups, all instances of that Resource type includes an "add" operation. The "add" operation references the `addURI` that is to be used.

The HTTP POST request shall include:

- CIMI serialization of the request to create a new Resource in the HTTP Body
- HTTP Content-Type header
- HTTP Content-Length header

For example, the request can be:

```
POST <addURI> HTTP/1.1
Host: <hostname>
Accept: application/(json|xml)
Content-Type: application/(json|xml)
Content-Length: <length>

<serialization of request to create a new resource>
```

This example has an Accept header with one of the CIMI supported media types: application/json or application/xml. If the Provider chooses to reply with a serialization, this serialization should be of the specified media type. Omission of the Accept header allows the Provider to reply with a serialization of any media type. If the Resource has a "`State`" attribute, its value shall be "CREATING" while the Provider is processing this operation.

Many of the create requests are defined such that a Template of the new Resource is passed. These create requests allow for the Template to be passed in "by-reference" or "by-value." For example, creating a new `Machine` looks like this (here using XML):

```
<MachineCreate xmlns="http://schemas.dmtf.org/cimi/2">
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <property key="xs:string"> xs:string </property> *
  <machineTemplate href="xs:anyURI"? >
    ... template attributes ... ?
  </machineTemplate>
</MachineCreate>
```

Note that in the XML case the creation of a new `Machine` requires a wrapper element named `MachineCreate` per the rules specified in clause 5.5.12.1.

More generally, creating a new Resource shall follow one of these two serialization patterns (here illustrated in JSON):

(1) Resource creation by passing a Template by value:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/ResourceCreate",
  "name": "myResourceName", ?
  "description": "My resource description", ?
  "properties": { "prop1name" : "prop1value" , + }, ?
  "resourceTemplate": {
    <here the template is passed by value>
  }
}
```

(2) Resource creation by passing a template by reference:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/ResourceCreate ",
  "name": "myResourceName", ?
  "description": "My resource description", ?
  "properties": { "prop1name" : "prop1value" , + }, ?
  "resourceTemplate": { "href": string ,
    <here some template attribute/value pairs may be added to override values in the
referenced template>
  }
}
```

In case the created Resource is itself a Template, only the first creation pattern - by value - applies.

In both patterns (1) and (2) the `resourceURI` attribute specifies the operation here generically identified as "ResourceCreate", e.g., `MachineCreate`.

In both patterns (1) and (2) an element corresponding to the Resource Template (here identified generically as "resourceTemplate" e.g., `MachineTemplate`) is specifying the Template to be used, either by value (1) or by reference (2).

Direct setting of attributes in the new Resource:

In a creation request it is possible to set the value of some attributes of the newly created Resource, regardless of what values the Template instantiation might have set if used alone. Three common attributes of the newly created Resource may be set: `name`, `description`, and `properties`.

The semantics shall be same as of a partial update of the Resource for these attributes (described in a next subclause), immediately following the Resource creation from the Template alone.

Defining or referring to the Resource Template:

In pattern (1) above, the Provider may choose to create a Template Resource from the value given, but such creation is temporary in nature. The Provider shall not expose such a transient Resource to the Consumer and no such transient Resource shall be included in any query results back to the Consumer.

In pattern (2) above, additional attribute name/value pairs may be given inside the ResourceTemplate element that also contains the reference to the external (pre-existing) Template in order to override similar attributes defined in the Template. More precisely:

- Any top-level attribute of complex or simple type in the referred Template shall be overridden by providing its name/value pair in the create request inside the resourceTemplate element and immediately under it. For a top-level attribute of a complex type (e.g., arrays, Collections, structures), the provided complex value shall also set all underlying attributes – e.g., array elements.
- The semantics shall be same as of modifying (overriding) parts of the referred Template just before it is used for instantiation, but these overrides shall not persist in the referred Template and shall only concern this particular instantiation.

In pattern (2) above, Consumers may erase any Template attributes by specifying either

```
"attribute": null
```

for the attribute in the JSON serialization, or

```
<attribute/>
```

in the XML serialization for that attribute.

Some of the create requests allow for configuration type of Resources to be passed by-reference or by-value as well - e.g., `Credential` on a `Machine` create operation. The processing rules defined above applies in those cases as well.

If the response has a 201 status code, the response shall include:

- HTTP Location header with a reference to the new Resource

If the response to a create request includes a serialization of the new Resource, the response shall additionally include:

- HTTP Content-Type header
- HTTP Content-Length header

For example, the response can be:

```
HTTP/1.1 201 Created
Location: <location>
Content-Type: application/(json|xml)
Content-Length: <length>

<serialization of new resource>
```

4.2.1.2 Retrieving a representation of a Resource

To retrieve a representation of Resource, an HTTP GET request is sent to the Resource's URI.

For example, the request can be:

```
GET <ResourceURI> HTTP/1.1
Host: <hostname>
Accept: application/(json|xml)
```

If the response has a 200 status code, the response shall include:

- HTTP Content-Type header
- HTTP Content-Length header

For example, the response can be:

```
HTTP/1.1 200 OK
Content-Type: application/(json|xml)
Content-Length: <length>

<serialization of resource>
```

4.2.1.3 Updating a Resource

To update a Resource's state, an HTTP PUT request containing the complete, updated representation is sent to a designated `editURI` for that Resource type. Consumers shall include all non-empty attributes of the Resource in the PUT request - including ones that it might not support or understand that were returned in a GET response. This is to ensure that a client does not inadvertently modify (erase) data in a Resource by excluding it from the full representation of the Resource.

In many cases, this `editURI` is the same as the URI of Resource itself. Retrieving the Resource representation shall include an "edit" operation, which contains the `editURI` that is to be used, if the requester is allowed to modify the Resource.

While processing a PUT request, if the server detects that an attempt is being made to update a read-only, or immutable, attribute, it shall silently ignore that attribute update request and shall not generate an error. This rule applies to Resource partial updates as well.

Because of potential conflicts that might occur due to multiple concurrent updates, Consumers should use the partial update mechanism, defined in 4.2.1.3.1, to reduce the chances of mistakenly updating attributes with out-of-date data.

The HTTP PUT request shall include:

- CIMI serialization of the updated Resource in the HTTP Body
- HTTP Content-Type header
- HTTP Content-Length header

For example, the request can be:

```
PUT <editURI> HTTP/1.1
Host: <hostname>
Accept: application/(json|xml)
Content-Type: application/(json|xml)
Content-Length: <length>

<serialization of request to update a resource>
```

If the response includes a serialization of the updated Resource and has a status code of 200, this response shall include:

- HTTP Content-Type header
- HTTP Content-Length header

For example, the response can be:

```
HTTP/1.1 200 OK
Content-Type: application/(json|xml)
Content-Length: <length>

<serialization of updated resource>
```

4.2.1.3.1 Partial updates to a Resource

For clarity, this clause explains how to use the `$select` query parameter (see clause 4.1.6.3) to subset a Resource for the purposes of only operating on a selected set of top-level attributes.

To update only certain top-level attributes of a Resource, a Consumer may include only the altered attributes in the representation of the Resource within the HTTP request body. If this request is made, the URI to the Resource shall include the attributes to be modified as a comma-separated list of query parameters; in other words, the URI shall be of the form:

```
http://example.com/resource?$select=attribute1,attribute2,...
```

Only the attributes listed in the URI's query parameters shall be modified; attributes not listed in the URI shall not be directly modified by the request. Note that this circumstance does not preclude the modification of one attribute causing side-effects that result in the modification of an attribute not listed in the query parameters.

Any attribute listed in the URI but not included within the HTTP request body shall be reset to a Resource specific value (e.g., removed).

From an HTTP perspective, the updated subsetted Resource is a distinct one. The semantics of a normal HTTP PUT are adhered to; it is a complete replacement update of the specified Resource. From the Consumer's perspective, the partial update is interpreted and executed by the Cloud Service Provider, and some part of the Resource is changed.

Adhering to the generic PUT semantics defined previously, any attribute of the original (full) Resource included within the HTTP request body shall result in an error being generated if that attribute is not listed in the `$select` query parameter - see clause 5.4. Note that this is due to these attributes being unknown to this subsetted Resource.

The following sample request updates just the name and description attributes of a `Machine`:

```
PUT /machines/myMachine?$select=name,description HTTP/1.1
Host: <hostname>
Accept: application/xml
Content-Type: application/xml
Content-Length: <length>
<Machine>
  <name>My New Machine</name>
</Machine>
```

The `name` attribute is set to "`My New Machine`" and the `description` attribute is erased.

4.2.1.4 Deleting a Resource

To delete a Resource, an HTTP DELETE request is sent to a designated `deleteURI` for that Resource type. In many cases, this `deleteURI` is the same as the URI of Resource itself. Retrieving the Resource representation shall include a "delete" operation, which contains the `deleteURI` that is to be used, if the requester is allowed to delete the Resource.

For example, the request can be:

```
DELETE <deleteURI> HTTP/1.1
Host: <hostname>
```

If the Resource has a `State` attribute, its value shall be "DELETING", while the Provider is processing this operation.

For example, the response can be:

```
HTTP/1.1 200 OK
```

4.2.1.5 Other operations

While some modifications to the Resources in the model can be done by the way of a simple update (PUT) operation to the Resource's `editURI`, sometimes a more complex set of actions needs to be taken. In these cases, the operations shall be modeled as HTTP POSTs to the operation specific URI of the Resource.

For each of the Resources that define additional operations, a description of the HTTP request and response bodies is provided. However, the general HTTP interaction are as described below.

The request shall be of the following form:

```
POST <operationURI> HTTP/1.1
Host: <hostname>
Accept: application/(json|xml)
Content-Type: application/(json|xml)
Content-Length: <length>

<serialization of request to perform some action>
```

The form of the response varies depending on the operation and is defined by the operation itself.

Note that the definition of the Create operation (see clause 4.2.1.1) follows this same pattern. It is just called out for ease of reference.

4.2.1.6 Synchronous operations

If a Provider supports the `Job` Resource, each incoming PUT, DELETE, POST request shall result in a Job Resource being created and an absolute URI reference to that Job Resource shall be returned back to the client by the way of the CIMI-Job-URI HTTP Header in the HTTP response message:

```
CIMI-Job-URI: <uri-to-Job>
```

In this case, the requested operation shall be complete and the Job URI shall point to a completed Job. If the Job is not complete, the server shall return a 202 and follow the instructions for Asynchronous operations.

4.2.1.7 Asynchronous operations

In some cases, an operation requested by the client may take an undetermined amount of time to be completed. For example, creating a new `Machine` or starting an existing Machine may take a relatively long time to be completed. In these cases, it is not practical to complete these operations within a reasonable HTTP request timeout interval, so the Provider shall return an HTTP "202 Accepted" response code.

As with synchronous operations, if a Provider supports the `Job` Resource, it shall create a `Job` Resource for the incoming request and return a reference to that `Job` Resource back to the client by the way of the CIMI-Job-URI HTTP Header in the HTTP response message. Additionally, in the case of a "202 Accepted" response code, the Provider may also return any of the following in the HTTP response body:

- A representation of the `Job` Resource, if one was created.
- A partial representation of the response message as if the operation were a synchronous operation. For example, when creating a new `Machine`, the response message may include a partial representation of the new `Machine` in the response message. The list of attributes of the Resource that is returned is implementation specific and based upon how much information is available at the time the response message is generated, but it shall be consistent with the definition of the full Resource representation. In the case of a create operation, the Provider may also include an HTTP Location header referencing the "to be created" Resource, if it is known.
- An empty response body.

Note that the decision as to whether any particular operation is synchronous or asynchronous is at the server's discretion.

4.2.2 Error handling

In cases where an error occurs during the processing of a request, the Provider shall include a representation of a `Job` Resource describing the status of the failed operation. This representation of a `Job` shall be included even in cases where the Provider does not expose `Job` Resources. This is to ensure that Consumers are provided with sufficient information, in a consistent manner, as to the reason for the failure regardless of whether the Provider exposes `Jobs`. A transient `Job` Resource may be created by the Provider just for error reporting. In case a `Job` Resource is not intended to be used for more than error reporting, the returned "id" attribute shall be an empty path (i.e., "") and the `nestedJobs` array shall be expanded (see 4.1.6.4) to inline the representation of the pseudo subordinate `Jobs`.

4.3 OVF support

The *Open Virtualization Format (OVF) Specification* (DSP0243) describes an open, secure, portable, efficient, and extensible format for the packaging and distribution of software to be run in virtual machines. OVF support in CIMI allows an OVF package to be used to create CIMI management resources by importing the package. Additionally, CIMI management resources can be exported into an OVF package. The actual support for the OVF package is typically provided by a hypervisor that is managed by the CIMI provider. The import of an OVF package exposes CIMI specific constructs and parameters as a result of the import without altering the original OVF package. Thus the CIMI resources that are created as a result of the import form a “View” of what the hypervisor did; however, other (non-CIMI mapped) information from the OVF package may have been used by the hypervisor in its import. This other information is implementation dependent and is not further touched upon by this standard.

An OVF package can support single virtual machines (VMs) corresponding to a single CIMI `Machine` or `MachineTemplate` (see clause 5.14.1) or may also support a complex hierarchy of VMs and their related Resources corresponding to a CIMI `System` or `SystemTemplate` (see clause 5.13.1) and related CIMI management resources.

OVF support is covered in more detail in 0.

5 Model

This model assumes that a business relationship has already been established between the Consumer and the Provider. This relationship may include financial terms, creating separately administered clouds that the consuming organization is paying for, and the establishment of authentication credentials to access the administrative entry point for each cloud. The scope of this model is one separately administered cloud.

The CIMI model is described here by using a tabular representation. Each table is modeling a significant cloud resource for which independent access and manipulation is expected. Relationships between resources use a referential mechanism based on unique identifiers that is expected to be already supported by the implementation environment and protocol (e.g., URIs for HTTP).

The model is self-describing and allows for querying its own metadata, e.g., to discover which extensions have been implemented. The model is also extensible in different ways (see clause 5.1).

Along with this model, a serialization of its entities is defined (both in XML and JSON).

An alternative UML diagram representation is provided for each major group of resources.

5.1 Resource wrappers

The serialization of Resource instances in the model follow these conventions. Consider the serialization of a Resource named "`MyResource`":

JSON serialization:

The Resource is serialized as an object wrapping all its attributes, but without a wrapper name. The Resource includes a `resourceURI` with a URI for the type of Resource being serialized. For example:

```
{ "resourceURI": "http://example.com/MyResource",
  "attribute": "value"
}
```

XML serialization:

The Resource is serialized as an element with name equal to the Resource name; for example:

```
<MyResource xmlns="http://example.com">
  <attribute> value </attribute>
</MyResource>
```

5.2 Extensibility

There are two types of extensibility mechanisms defined by the CIMI model; one is intended for use by Consumers whilst the other is to be used by Providers.

The first allows for a CIMI Consumer to add additional data to a Resource. Each Resource in the CIMI model has an attribute called "`properties`". Consumers, when creating or updating a Resource, may store any name/value pair in the `properties` attribute. CIMI Providers shall store and return these values to the Consumer. There is no obligation for the Provider to understand or take any action based on these values; they are there for the Consumer's convenience. Providers shall not add elements to this `properties` attribute.

The second type of extensibility mechanism allows for Provider defined extensions and this specification includes the `ResourceMetadata` Resource for this purpose. `ResourceMetadata` may be used to

- express constraints on the existing CIMI defined Resource attributes (e.g., express a maximum for the 'cpu' attribute of the `MachineConfiguration` Resource)
- introduce new attributes for CIMI defined Resources together with any constraints governing these (e.g., a new 'location' attribute for the `Volume` Resource that takes values from a defined set of strings)
- introduce new operations for any of the CIMI defined Resources (e.g., define a new 'compress' operation for the `Volume` Resource)
- express any Provider specific capabilities or features (e.g., the length of time that a `Job` Resource is retained after `Job` completion and before this is deleted)

It is recommended that Providers use the `ResourceMetadata` Resource to advertise these attributes, operations, and capabilities along with any constraints that might need to be understood by Consumers. The `ResourceMetadata` Resource is defined in clause 5.8.

If a Provider receives a message containing an unknown or unsupported attribute, it shall reject the request. If a Consumer receives a message containing an unknown or unsupported attribute, it shall silently ignore the attribute. However, Consumers are required to include those attributes in messages

sent back to the Provider. Note in these cases the Consumer is not required to understand or process the unsupported attribute, but merely echo it back to the Provider.

5.3 Identifiers

All identifiers (e.g., Resource names, attributes, operations, parameter names) defined by this specification, or defined by the way of an extension, shall adhere to the following rules:

- Identifier names shall be treated as case sensitive.
- Identifier names shall only use the following set of characters:
  - Uppercase ASCII (U+0041 through U+005A)
  - Lowercase ASCII (U+061 through U+007A)
  - Digits (U+0030 through U+0039)
  - Underscore (U+005F)
- Identifier names shall not start with a Digit (U+0030 through U+0039).

Note that these rules do not apply to the "name" common attribute defined in clause 5.7.1.

5.4 Attribute constraints

Each attribute of the Resources in the CIMI model is augmented by a set of constraints that further qualify the attribute that is being defined. For each attribute, there is a Provider and a Consumer set of constraints because each might differ. The following constraints are possible:

support optional:

This constraint indicates that support for this attribute is optional. If supported, Providers should advertise its support through `ResourceMetadata`. See clause 5.2 for information concerning the processing of unsupported and unknown attributes. See clause 5.5.15 regarding empty attribute values.

Non-empty, Consumer-supported, writeable (i.e., read-write and write-only) attributes shall always be included as part of the Resource representation sent from Consumers to Providers, including create requests.

Non-empty, Provider-supported attributes shall always be included as part of the Resource representation sent from Providers to Consumers.

support mandatory:

This constraint indicates that support for this attribute is required by compliant implementations. If present on a nested attribute, this attribute is required to be supported only if the parent attribute is supported. See clause 5.5.15 regarding empty attribute values.

Non-empty, mandatory, writeable (i.e., read-write and write-only) attributes shall always be included as part of the Resource representation sent from Consumers to Providers - including create requests.

Non-empty, Provider, mandatory attributes shall always be included as part of the Resource representation sent from Providers to Consumers.

immutable:

This Provider constraint indicates that the attribute, once set, shall never change for the lifetime of the Resource.

mutable:

This Provider constraint indicates that the attribute may be modified. Providers shall always have the ability to modify these attributes. Whether Consumers have the ability to modify these attributes shall be indicated by the read-only, read-write, and write-only constraints.

read-only:

This Consumer constraint indicates that the attribute may be retrieved but not updated by Consumers. Read-only attributes are not required to appear in the serialization of Resources in create or update request messages. If present, they shall be silently ignored by the Provider. Read-only attributes shall appear in the serialization of Resources sent from Providers.

read-write:

This Consumer constraint indicates that the attribute may be retrieved and/or updated by Consumers. Read-write attributes shall appear in the serialization of Resources sent to and from Providers. Providers may further constrain whether Consumers can update these attributes and should indicate this by the way of `ResourceMetadata`.

write-only:

This Consumer constraint indicates that the attribute may be updated by Consumers but are not retrievable by Consumers, typically for security reasons. Write-only attributes shall appear in the serialization of Resources sent to Providers but shall never appear in the serialization of Resources sent from Providers.

5.5 Data types and their serialization

Unless specifically asked to not include certain attributes in the Resource representation, the absence of an optional attribute in the representation means that the attribute has no value (i.e., is undefined), meaning there is no notion of an optional attribute having an implied value. Note that a client cannot distinguish (from just looking at the returned representation) whether a particular attribute is not supported from one that does not exist. Likewise, an absent attribute from a Resource representation as the input to an update operation means that the Consumer is requesting that the Provider remove that attribute.

The following clauses describe the data types and values that are used within the model definition tables.

5.5.1 boolean

A value as defined by xs:boolean per XML Schema – Part 2, with the exception that the only allowable values are either "true" or "false." The value is case sensitive.

If serialized in JSON, these values shall be of JSON type: *boolean*

If serialized in XML, these values shall be of XML Schema type: *xs:boolean*

5.5.2 dateTime

A value as defined by xs:dateTime per XML Schema – Part 2, which is consistent with DMTF DSP4004 and ISO 8601. The timestamp should preserve time zone information, i.e., include a local time component and an offset from UTC.

Any constraints on the specific ranges allowed for any particular attribute are specified by that attribute's definition or at runtime by the Provider by the way of the metadata discovery mechanisms defined by this specification.

For example, Monday, May 25, 2012, at 1:30:15 PM EST is represented as:

```
2012-05-25T13:30:15-05:00
```

If serialized in JSON, these values shall be of JSON type: *string*

If serialized in XML, these values shall be of XML Schema type: *xs:dateTime*

5.5.3 duration

A value as defined by xs:duration per XML Schema – Part 2. Any constraints on the specific ranges allowed for any particular attribute shall be specified by that attribute's definition or at runtime by the Provider by the way of the metadata discovery mechanisms defined by this specification.

If serialized in JSON, these values shall be of JSON type: *string*

If serialized in XML, these values shall be of XML Schema type: *xs:duration*

5.5.4 integer

A value as defined by xs:integer per XML Schema – Part 2. Any constraints on the specific ranges allowed for any particular attribute shall be specified by that attribute's definition or at runtime by the Provider by the way of the metadata discovery mechanisms defined by this specification.

If serialized in JSON, these values shall be of JSON type: *number*

If serialized in XML, these values shall be of XML Schema type: *xs:integer*

5.5.5 string

A value as defined by xs:string per XML Schema – Part 2. Any constraints on this type for any particular attribute shall be specified by that attribute's definition or at runtime by the Provider by the way of the metadata discovery mechanisms defined by this specification.

If serialized in JSON, these values shall be of JSON type: *string*

If serialized in XML, these values shall be of XML Schema type: *xs:string*

If serializing an attribute of type string, the serialization shall omit this attribute in case of an empty string.

5.5.6 ref

A reference to another Resource.

References allow for Consumers to navigate to Resources. By starting at the Cloud Entry Point and following the references that appear in the retrieved Resources, Consumers are able to recursively discover and navigate to all other Resources.

As a general rule, if an attribute is of type "`ref`", its value shall be held by an attribute named "`href`" (both in JSON and XML).

JSON serialization:

In the JSON serialization the `href` property appears as of type "`string`." If an attribute is of type "`ref`", the name of this attribute shall appear as a key, with the `href` property as a nested value. For example, a Resource attribute "`myvolume`" of type "`ref`" is serialized as:

```
"myvolume": { "href": string }
```

XML serialization:

In the XML serialization the `href` attribute appears as type "`xs:anyURI`." If an attribute is of type "`ref`," the name of this attribute shall appear as name of an XML element with the `href` property as an (XML) attribute. For example, a Resource attribute "`myvolume`" of type "`ref`" is serialized as:

```
<myvolume href="xs:anyURI"/>
```

References in both JSON and XML have an extensibility point that allows for additional information (such as the target Resource to be included "by value") if supported. For convenience, the JSON and XML representations, as shown above, exclude the implicit extensibility points that would allow for the attributes of the target Resource to be included if desired. So, more accurately the above representations might be written as follows:

For JSON:

```
"myvolume": { "href": string, ... }
```

and in XML:

```
<myvolume href="xs:anyURI"> xs:any* </myvolume>
```

However, for brevity the extensibility points are excluded from the serialization of the Resources.

5.5.7 map

A list of key/value pairs. The same "key" shall not be used more than once within an attribute. The "key" is case sensitive.

If serializing an attribute of type map, the serialization shall omit this attribute in case of an empty map.

5.5.8 structure

Attributes of this type are complex attributes made up of a set of nested attributes. For each attribute of this type, there is an additional table defining those nested attributes.

A nested structure can be considered a complex type definition. Structures may be named or unnamed. Table 2 is an example of named structure:

Table 2 – Named structure

Name	*summary*	
Attribute	**Type**	**Description**
low	*number*	Number of “low” occurrences
medium	*number*	Number of “medium” occurrences
high	*number*	Number of “high” occurrences
critical	*number*	Number of “critical” occurrences

JSON serialization:

In JSON, the name of the structure (i.e., of the type it represents) never appears. In other words, whether the structure is named or not does not matter. An attribute named “`systemIncidents`” of type "`summary`" (as above) is serialized as follows:

```
"systemIncidents": {
  "low": number,
  "medium": number,
  "high": number,
  "critical": number
```

```
}
```

XML serialization:

In XML, the name of the structure (i.e., of the type it represents) never appears. In other words, whether the structure is named or not does not matter. The same previous "`systemIncidents`" example is serialized so that the structure sub-attributes become XML attributes of a <`systemIncidents`> XML element wrapper:

```
<systemIncidents low="xs:integer" medium="xs:integer" high="xs:integer"
         critical="xs:integer"/>
```

NOTE A large number of sub-attributes of atomic type in a structure may be represented alternatively as XML child elements for better readability. Both options are available; however, the same structure shall be serialized the same way across Resources.

5.5.9 byte[ ]

An arbitrary set of bytes meant to represent a block of binary data. Any constraints on this type for any particular attribute shall be specified by that attribute's definition or at runtime by the Provider by the way of the metadata discovery mechanisms defined by this specification.

If serialized in JSON, these values shall be of JSON type: *string*

If serialized in XML, these values shall be of XML Schema type: *xs:hexBinary*

5.5.10 URI

The format and syntax of the attributes of type "URI" is defined by RFC3986.

Unless otherwise noted, this specification does not mandate whether Providers use relative or absolute URI in the HTTP response bodies.

If URIs are specified as relative URIs, they shall be relative to the `baseURI`.

The algorithm used for converting a relative URI to an absolute URI shall be as described in section 5.2 of RFC3986. Table 3 illustrates how relative URIs are resolved against base URIs:

Table 3 – Converting a relative URI to an absolute URI

Base URI	Relative URI	Absolute URI
`http://example.com/`	`p1/file`	`http://example.com/p1/file`
`http://example.com/c1/`	`p1/file`	`http://example.com/c1/p1/file`
`http://example.com/c1/c2/`	`p1/file`	`http://example.com/c1/c2/p1/file`

If relative URIs are used, the `baseURI` shall end with a trailing slash and relative URIs shall not begin with a leading slash. This format is consistent with most URI resolve utilities and produces the same results as a simple string concatenation algorithm.

If serialized in JSON, these values shall be of JSON type: *string*

If serialized in XML, these values shall be of XML Schema type: *xs:anyURI*

5.5.11 Array

An array represents an ordered list of items of the same type. An array shall always appear as an attribute of a Resource, and is only accessible as such (it is not a separately addressable Resource). If a Resource is deleted, the items in its arrays shall also be deleted. However, in case these items were just

references to other Resources, these referred Resources are not affected. (See the semantics of references in 5.7.)

Attributes that are arrays are defined by using the notation `itemType[]`, where `itemType` is the type name for each item of the array. If the type is a structure, not a simple data type, it is recommended as a convention in the model that the name of an array be the plural of a name that characterizes each item. For example, an array of volume items or of references to these may be named "volumes."

JSON serialization:

Within this specification, arrays in JSON are serialized with a wrapper property. The wrapper name shall be same as the attribute name for the array. For example, a "`things`" attribute of type "`thing[]`" is serialized as:

```
"things" : [
  { ... }, +
] ?
```

If the items in the array are structures, the structure name shall not be present in the JSON serialization.

In the case of an array of references, i.e., where the "`ref`" type applies to each element of the array, each element shall simply be serialized as an `href` property within a JSON array. For example, an array "`things`" of type "`ref[]`" is serialized as:

```
"things": [
  { "href": string },  +
] ?
```

NOTE If serializing arrays, conformant implementations shall not include empty arrays (i.e., arrays that contain no child properties) in the JSON serialization. Notice that the child of the "`things`" property is defined with a "+", meaning at least one child is required. This requirement ensures that the JSON serialization is minimized and only includes the wrapping "`things`" element if, and only if, there is at least one "`thing`" in the array.

XML serialization:

The XML serialization of arrays requires each item of the array to be represented as an element. These elements shall be consecutive and contiguous in the serialization and the name of each element (tag name) shall be the name of the element type (the name that appears before "`[]`" in the array type). For example, a "`things`" attribute shall be serialized as a list of items named "`thing`":

```
<thing>
  ...
</thing> *
```

There is no wrapper element for an array in XML.

In the case of an array of references, i.e., where the "`ref`" type applies to each element of the array, the array is serialized as a list of XML elements without wrapper. Each element is named per an array “item name" specified in the attribute's definition. For example, an array "`things`" of type "`ref[]`" where the array “item name" is "`thing`" is serialized as:

```
<thing href="xs:anyURI"/> +
```

5.5.12 Collection

A Collection is a group of Resources of the same type. In contrast with arrays, Collections are themselves Resources that have their own URI and can be independently accessed. Collections also allow for an

optimized and convenient interaction pattern by providing a specialized set of operations that avoid replacing a large number of items when updating the set, as with arrays.

This specification uses Collections if the set of grouped items is modified often and potentially by multiple Consumers. Conversely, arrays are used if it is expected that the list of items is not modified often or can be easily modified by substitution of the entire list, and thus the overhead of managing these items as separate Resources might be unjustified and burdensome.

An item in a Collection, i.e. a Collection item, is an embedded structure that contains a reference to a Resource and optionally additional attributes (see “accessory” attributes, defined later). For convenience, the Resource referred to by a Collection item is called here a Resource item of the Collection.

A Resource may be referenced by more than one Collection. If such a Resource is deleted, every Collection that references this Resource shall remove the corresponding item. While different Collections contain entries of different Resource types, all Collections follow the pattern described below:

- A Collection shall contain an `id` attribute that acts as a "self pointer." Retrieving the data at this reference shall return the Collection. In the XML representation, each Collection shall be wrapped by a `<Collection>` element.
- A Collection shall contain a `count` attribute that indicates the number of Resources in the Collection at the time the Collection was queried.
- Adding new Resources to the Collection shall be done either via the "add" operation defined within the Collection (when the Resource is also created) or via the “insert” operation (when the Resource already exists).

Deleting an item from the Collection shall be done either via a "delete" operation on the Resource item itself (if the Resource has to be discarded) or via the “remove” Collection operation (if the Resource must still exist outside the Collection).Collections that are attributes of other Resources are represented with attribute type "`collection[itemType]`." The Resource type of the Collection items are specified inside the brackets; for example an attribute that is a Collection of Machines is expressed as "`collection[Machine]`." Attributes of such types are serialized as a reference to a Collection Resource instead of holding the Collection itself as value. For brevity, while these attributes are "references" the word "ref" or "reference" does not appear in the model definition tables - instead the type of such an attribute is making abstraction of the reference and more explicitly shows as "`collection[itemType]`".

In the serializations below, the Collection items are represented by items in the *ResourceSpecificGroupingName* JSON array, and by *ResourceSpecificElementName* elements *in the* XML representation.

Serialization:

The serialization of Collections shall adhere to the following pattern:

JSON serialization:

```
{ "resourceURI": string,
  "id": string,
  "updated": string, ?
  "parent": string, ?
  "count": number,
  "resourceSpecificGroupingName": [
    { "resourceURI": string,
```

```
      "id": string,
      "name": string, ?
      "description": string, ?
      "created": string, ?
      "updated": string, ?
      "parent": string, ?
      "properties": { string: string, + }, ?
      ... resource specific data ...
      "operations": [
        { "rel": "edit", "href": string }, ?
        { "rel": "delete", "href": string } ?
      ] ?
      ...
    } +
  ], ?
  "operations": [
    { "rel": "add", "href": string } ?
    { "rel": "insert", "href": string } ?
    { "rel": "remove", "href": string } ?
   ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="xs:anyURI" xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <updated> xs:dateTime </updated> ?
  <parent> xs:anyURI </parent> ?
  <count> xs:integer </count>
  <ResourceSpecificElementName>
    <id> xs:anyURI </id>
    <name> xs:string </name> ?
    <description> xs:string </description> ?
    <created> xs:dateTime </created> ?
    <updated> xs:dateTime </updated> ?
    <parent> xs:anyURI </parent> ?
    <property key="xs:string"> xs:string </property> *
    ... resource specific data ...
    <operation rel="edit" href="xs:anyURI"/> ?
    <operation rel="delete" href="xs:anyURI"/> ?
    <xs:any>*
```

```
  </ResourceSpecificElementName> *
  <operation rel="add" href="xs:anyURI"/> ?
  <operation rel="insert" href="xs:anyURI"/> ?
  <operation rel="remove" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

Where the `resourceURI` attributes shall contain the Collection or Resource specific URIs for that type of Collection, and `resourceSpecificGroupingName` and `ResourceSpecificElementName` shall be replaced with the name of the Collection-specific Resource name, e.g., `machines` in JSON or `Machine` in XML.

The above serialization shows that each entry in a Collection may contain "resource specific data" beside the reference to the Resource item and the common attributes. This placeholder represents two kinds of data:

a) Optionally some *accessory attributes* that represent accessory information for the use of this reference in the context of the Resource owning that Collection (the accessory attributes) – e.g., the "initial location" of a referenced `Volume`, in a Collection of Volumes associated with a `Machine`. Accessory attributes – if any - are part of the definition of each specific Collection..

b) All or a subset of the attributes of the corresponding Resource items. How much of the Resource item is expanded in the serialization of the Collection is controlled by expansion mechanisms described later.

If accessory attributes exist for items in a Collection, the "*resourceSpecificGroupingName" or "ResourceSpecificElementName"* is not just identifying the Resource type of Collection items, but is a unique name specific to this combination of accessory attributes and Resource type – e.g., for Volumes with initial location, it may be "locatedVolume". Also the resourceURI of the Collection is unique to this combination. Because of this accessory attribute, the Collection of Volumes is said to be "enhanced", as opposed to "basic" for a Collection without accessory attribute.

The serialization of Collections follows these additional rules:

- A Provider may limit the number of Resources returned in the Collection. The Consumer can determine this has occurred by comparing the number of returned Resources with the value of the "Count" attribute and any Collection subsetting query parameters it specified. In this case, the Consumer is advised to specify filter query parameters (see 4.1.6.1) to reduce the number of entries returned, or retrieve them in batches by issuing multiple requests with Collection subsetting query parameters (see 4.1.6.2)
- As with all Resources in the CIMI model, each Resource in the Collection shall have an `id` attribute that acts as a "self pointer." Retrieving the data at this reference shall return just that one Resource and not any parent Resource, such as the Collection or array attribute.
- The serialization of a Collection may be controlled (see 4.1.6.4 $`expand` query parameter) to show more or less of each Resource item. By default, each entry in the Collection will show just a reference (URL) to the Resource item, along with the "common" attributes of the Resource item. Alternatively, the Resource item may be expanded partially or fully when querying the Collection.
- As with all arrays, if there are no Resources in the Collection, the serialization of the list shall be omitted.

5.5.12.1 Adding an item to a Collection

Invoking the "add" operation of a Collection shall create a new Resource and add it to the Collection. The contents of the request body shall be either a representation of the new Resource being added to the Collection, or a representation of the Template associated with the new Resource being created and resource specific data attributes.

If creating a new Resource the "add" operation shall contain:

- The "common attributes" as defined by clause 5.7.1
- The Resource specific data needed to create it. This data shall either be a reference to the Resource-specific Template Resource or the Resource-specific Template Resource itself inlined.
- Accessory attributes–if any–that represent accessory information for the use of the reference in the context of the Resource owning that Collection (the associative attributes)
- In the XML case, a wrapper element (named after the pattern <*ResourceName*Create>)

For example, to create a new `Machine` (which requires the use of a Template) and add it to the `MachineCollection`, the "add" operation of the `MachineCollection` shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/MachineCreate", ?
  "name": string, ?
  "description": string, ?
  "properties": { string: string, + }, ?
  "machineTemplate": { "href": string ?}
  ...
}
```

XML serialization:

```
<MachineCreate xmlns="http://schemas.dmtf.org/cimi/2">
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <property key="xs:string"> xs:string </property> *
  <machineTemplate href="xs:anyURI"? />
  <xs:any>*
</MachineCreate>
```

The `MachineCollection` has a new `Machine`:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Machine",
  "id": string,
  "name": string,
  ...
}
```

XML serialization:

```
<Machine xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name>
  ...
</Machine>
```

The processing of the "add" operation shall adhere to the semantics defined in clause 4.2.1.1.

Regardless of whether a Template is used, the "add" operation shall create the new Resource and add it to the Collection and a reference (URI) to the new entry shall be returned in the response message in the HTTP Location header.

5.5.12.2 Inserting an item in a Collection

Invoking the "insert" operation of a Collection shall add to the Collection a new reference to an existing Resource. The contents of the request body shall specify the URL of the existing Resource being added.

In order to add an existing `Volume` to the `volumes` Collection of a `Machine`, the request body of the "insert" operation shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Volume",
  "initialLocation": string,
  "volume": { "href": string }
}
```

XML serialization:

```
<Volume xmlns="http://schemas.dmtf.org/cimi/2">
  <initialLocation> xs:string </initialLocation>
  <volume href="xs:string"/>
</Volume>
```

Note that “initialLocation” is an accessory attributes to each reference of Volume. The definition of the `volumes` Collection of the `Machine` Resource describes the accessory attribute(s) for this Collection.

5.5.12.3 Removing an item from a Collection

Invoking the "remove" operation of a Collection shall delete the specified item in the Collection, i.e. the Resource reference along with accessory attributes if any, without destroying the referenced Resource item itself. The contents of the request body shall be the URL of the Resource item being removed.

In order to remove a `Volume` from the `volumes` Collection of a `Machine`, the request body of the "remove" operation shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Volume",
  "volume": { "href": string }
}
```

XML serialization:

```
<Volume xmlns="http://schemas.dmtf.org/cimi/2">
    <volume href="xs:string"/>
</Volume>
```

Removing the referenced Resource (here a `Volume`) deletes the related entry from the Collection. This deletes the reference but not the Resource itself.

Deleting the referenced Resource via a DELETE operation on the Resource itself (here a `Volume`) also deletes the related entry from the Collections that reference this Resource – i.e., it has the effect of a "remove" on the Collection, in addition to deleting the referenced Resource.

5.5.13 "Any" type

Some attributes are polymorphic and can hold various data types, the list of which is indicated in their description. In such cases, the type of the attribute shall be indicated as "any" in the model representation.

5.5.14 valueScope

The valueScope type is a specialized map. Its goal is to define possible values for a list of attributes of a Resource. The possible values for an attribute are called the "value scope" of the attribute, and a combination of attribute value scopes (in form of a map) in a Resource or in the ResourceMetadata is called the value scope of the Resource.

Each item in a valueScope is a key/value pair where:

- The key is the name of an attribute of a Resource – or "**scoped attribute**" – for which a set of possible values is defined.
- The value is a structure that defines the "**scope**", i.e., a range, an enumeration or a single assigned value for the scoped attribute.

The scope structure:

A "scope" structure – or the value part of a key-value item in a valueScope – can take one of four forms:

1) An assigned single value, along with its (optional) `units`, e.g., for a scoped attribute named "cpu":

```
"cpu": { "value": 2000, "units": "megahertz" }
```

2) A range of values, along with its optional `units`, and an optional `increment` e.g., for a scoped attribute named "memory". The range may be open-ended: either the `minimum` or the `maximum` may be missing. The `increment` specifies the allowed values starting from the `minimum` and upward - i.e., the allowed values are of the form: minimum+N*(increment), where N>=0, or starting from the `maximum` and downward in case there is no `minimum`, i.e., allowed values are of the form: maximum-N*(increment),.

```
"memory": { "minimum": 4000, "maximum": 10000, "units": "kibibytes", "default":
4000, "increment": 2000 }
```

3) An enumeration (or `values`), along with its (optional) `units`, e.g., for a scoped attribute named "cpuArch":

```
"cpuArch": { "values": [ "68000", "Alpha", "ARM", " PA_RISC"], "default": "PA_RISC"
}
```

4) Simply a required `units`, e.g., for a scoped attribute named "capacity":

```
"capacity": { "units": "megabytes" }
```

If a valueScope is associated with a Resource type, it shall be in form of an attribute named "vscope", of type array of valueScope (i.e., valueScope[]).

An example of valueScope for the MachineConfiguration Resource:

```
"vscope" : [ {
"cpu": { "value": 1 },
"memory": { "minimum": 4, "maximum": 32, "units": "GbB", "default": 4, "increment":
2 },
"cpuArch": { "values": [ "68000", "Alpha", "ARM", " PA_RISC", "i5"], "default":
"i5" }
} ]
```

Semantics

A value scope may be defined either for the attributes of a Resource type described in ResourceMetadata, or for attribute(s) of a particular Resource, or for both. The semantics is as follows:

- If a value scope is associated with a Resource (i.e., this Resource has a "vscope" attribute), a scoped attribute of this Resource shall only take values and units within its scope, when updated or when set (if it were not set at creation time).
- If a value scope is associated with a Resource type as described in ResourceMetadata (i.e., the ResourceMetadata instance for this Resource type has a "vscope" attribute), any Resource of this type shall have its attributes take values within the defined scope.
- If both a Resource and its related ResourceMetadata have some value scope associated with them, then the value scope of the Resource should be defined so that any attribute value within this value scope is also within the value scope of its related ResourceMetadata (i.e., the value scope of the Resource attribute is included in the value scope of the ResourceMetadata for this attribute if any. The actual value scope of an attribute that is scoped both in its Resource and in its ResourceMetadata , is the intersection of the two value scopes.

The semantics of a value scope for Consumer and Provider is as follows:

- If an attribute of a Resource is scoped, a Consumer shall set a value (creation or update request) compatible with the value scope of this attribute, including constraints specified by an increment if it is present.
- For any other case where the Consumer sets an incompatible value, the Provider shall return a 4xx error code.

Usage in a template

When defined in a template Resource, or a Resource used in a template (e.g., MachineConfiguration), the value scope is intended to restrict also the similar attributes in Resources generated from this template. In such a case, the attributes of the generated Resource that were scoped in the template of this Resource, are also scoped similarly in the generated Resource. In order to make this scope more explicit, a Provider should replicate in the generated Resource the value scope – or the relevant part of it – defined in the template.

In order to better enforce the value scope of Resources, a Provider may predefine a set of templates that a Consumer may use. This Provider may prevent the Consumer from creating additional templates while letting the Consumer modify (within scope) the attributes of the predefined templates.

For example, a Provider may create a set of predefined MachineConfiguration Resources with a read-only `vscope` attribute. The Provider may further prevent Consumers from creating new MachineConfiguration instances – or only by offering a "copy" operation on existing ones. In this way, the Provider effectively constrains the Consumer to only use the predefined MachineConfiguration Resources

yet allows the Consumer to modify the configuration attributes within the value scope of each predefined MachineConfiguration.

Semantics of valueScope array in a Resource

The value scope of a Resource shall be represented by an array of valueScope instances, even if in many cases this array will contain a single valueScope instance. This allows for expressing dependencies between values of different attributes of a same Resource. In such cases, the scoped attributes of the Resource must satisfy either valueScope instance in this array.

In the following example, `vscope` is an array of two valueScope items:

```
"vscope":  [ {
"cpuSpeed": { "minimum": 2, "maximum": 4, "units": "GHz", "default": 2.5},
"memory": {"minimum": 2000000, "maximum": 10000000, "units": "KbB", "increment": 2000000 },
"cpuArch": { "value": "i5" }
}, {
"memory": { "minimum": 4000000, "maximum": 32000000, "units": "KbB" },
"cpuArch": { "values": [ "68000", "Alpha", " PA_RISC"] }
} ]
```

This valueScope means that the Provider supports MachineConfigurations with either `cpuArch` of value `i5`, or of a value that is one of { `"68000", "Alpha", " PA_RISC" }`. In the first case (`i5`), the memory must be within the 2GbB-10GbB range and `cpuSpeed` must be between 2-4 GHz, while in the second case the memory must be within the 4GbB-32GbB range.

The following pseudo-schemas describe the serialization of the valueScope map in both JSON and XML:

JSON serialization:

```
( "value": any,
"units": string ? ) |
( "values": [ any,+ ],
"units": string ,?
"default": string ? ) |
( "minimum": number, ?
"maximum": number, ?
"units": string ,?
"default": number, ?
"increment": number ? )
```

XML serialization:

```
( <value> xs:any </value>
<units> xs:string </units> ? ) |
(<value> xs:any </value> +
<units> xs:string </units> ?
<default> xs:any </default> ? ) |
```

```
(<minimum> xs:integer </minimum> ?
<maximum> xs:integer </maximum> ?
<units> xs:string </units> ?
<default> xs:integer </default> ?
<increment> xs:integer </increment> ? )
```

A Provider who supports value scopes shall set the ValueScopes capability (ResourceMetadata) to “true”.

5.5.15 Empty attribute values

Attributes of the following types are omitted in cases where they have an empty value: string, map, array, and Collection. Apart from being “Provider optional” or “Consumer optional”, an empty value is the third reason that the serialization schema contains an ‘?’ or an ‘*’ for an attribute.

Other attribute types do not have empty values and shall not be omitted from the serialization for this reason.

5.6 Units

Some of the Resources defined by this specification have attributes that describe an amount of something that belongs to, or is associated with, that Resource. For example, the `Machine` Resource has a `memory` attribute that describes "the size of the memory allocated to this machine." The allowable units of these attributes are listed in Table 4. Their meaning is defined in IEC 80000-13:2008. Their numerical equivalents are provided here for convenience:

Table 4 – Numerical equivalents for attributes

String	Numerical Value	String	Numerical Value
kilobyte	10^3	kibibyte	2^10
megabyte	10^6	mebibyte	2^20
gigabyte	10^9	gibibyte	2^30
terabyte	10^12	tebibyte	2^40
petabyte	10^15	pebibyte	2^50
exabyte	10^18	exbibyte	2^60
zettabyte	10^21	zebibyte	2^70
yottabye	10^24	yobibyte	2^80

5.7 Resources

CIMI Resources are representations of actual – either virtual or physical – resources available in a Cloud. Resources are identified and separately accessible by their URI. Every Resource has a type which is described in this section. A Resource type defines a set of attributes and of operations.

5.7.1 Common Resource attributes

Resources, except for the Collection Resource, shall support the following common attributes defined in Table 5.A Collection Resource shall support the `id` attribute, the `updated` attribute and the `parent` attribute, as defined in Table 5.

Table 5 – Common attributes

Attribute	Type	Description
id	*URI*	The unique URI identifying this Resource; assigned upon Resource creation. This attribute value shall be **unique** in the Provider’s cloud. **Constraints:** **Provider:** support mandatory; immutable

<table>
<tr><th>Attribute</th><th>Type</th><th>Description</th></tr>
<tr><td></td><td></td><td>Consumer: support mandatory; read-only</td></tr>
<tr><td>name</td><td>string</td><td>The human-readable name of this Resource; assigned by the creator as a part of the Resource creation input.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>description</td><td>string</td><td>The human-readable description of this Resource; assigned by the creator as a part of the Resource creation input.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>created</td><td>dateTime</td><td>The timestamp when this Resource was created. The format should be unambiguous, and the value is immutable.
<u>Constraints:</u>
Provider: support optional; immutable
Consumer: support optional; read-only</td></tr>
<tr><td>updated</td><td>dateTime</td><td>The time at which the last explicit attribute update was made on the Resource. The initial value is the time the resource is created. Note, while operations, such as "stop", do implicitly modify the 'state' attribute, they do not change the 'updated' time.
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-only</td></tr>
<tr><td>parent</td><td>ref</td><td>A reference to a Resource of which this Resource is a component (see “composition” relationship, section 5.10.2) – i.e. a reference to its first parent Resource.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support optional; read-only</td></tr>
<tr><td>properties</td><td>map</td><td>A map of key/value pairs (each entry called a "property"), some of which may control one or more aspects this Resource. Properties may also serve as an extension point, allowing Consumers to record additional information about the Resource.
The same "key" shall not be used more than once within a "properties" attribute.
Each property shall contain the following nested data:
<table>
<tr><th>Name</th><th colspan="2">property</th></tr>
<tr><th>Data</th><th>Type</th><th>Description</th></tr>
<tr><td>key</td><td>string</td><td>The name of the property.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
<tr><td>value</td><td>string</td><td>The value of the property.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
</table>
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>vscope</td><td>valueScope[]</td><td>A value scope for this Resource. When the Resource is a template or used in a template, the value scope constrains the similar attributes in generated Resources and is replicated (or its relevant subset) in the generated Resources. This attribute is only defined for primary Resources.
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-only</td></tr>
</table>

The following pseudo-schemas describe the serialization of these attributes in both JSON and XML:

JSON serialization:

```
"id": string,
"name": string, ?
"description": string, ?
"created": string, ?
"updated": string, ?
"properties": { string: string, + }, ?
"vscope" : [ valueScope, * ], ?
```

XML serialization:

```
<id> xs:anyURI </id>
<name> xs:string </name> ?
<description> xs:string </description> ?
<created> xs:dateTime </created> ?
<updated> xs:dateTime </updated> ?
<property key="xs:string"> xs:string </property> *
<vscope> valueScope </vscope> *
```

5.8 Operations

All Resource operations defined by this specification are optional for Providers to support. Consumers, by the way of examination of a Resource's ResourceMetadata, can determine which operations are supported. However, even for those operations that are supported Consumers still need to examine each Resource's representation to determine which operations are supported at that moment. Whether an operation is supported is based on a number of factors, including the state of the Resource and access control rights of the Consumer. Also see clause 4.2. Operations and states are coupled; i.e., if implementing a state-changing Resource operation defined in this specification, the corresponding state(s) shall also be implemented. See the Resource-specific “Operations” clauses for additional detail.

The "State" attribute of Resources that have this attribute shall only change value if

- an operation is performed on this Resource and this operation requires a state change, or
- an error occurred, in this case the “State” attribute shall obtain the value “ERROR”.

For example, for a ‘start’ operation on a `Machine` both the STARTING and the STARTED states are required to be supported by the `Machine`, while the `Machine` can only leave the STARTED state after another state changing operation is requested, unless an error occurs.

Providers can define additional operations and states. Such extensions shall fall into one of these categories:

a) A new operation that starts from a CIMI-defined state, or leads to a CIMI-defined state, or both. In the latter case, if a CIMI-defined operation already exists for this transition between two CIMI-defined states, it shall also be supported by the Provider in addition to the new operation.

b) A new Resource state. In that case, a new operation that leads to that state shall also be created. In other words, a Provider-defined operation has to be performed before a Provider-defined state can be reached.

c) A new operation that transitions between two Provider-defined states.

5.9 Alternative model formats

It is expected that this specification is implemented by using a variety of technologies. As a convenience, the definition of the model elements are provided in alternative formats that are easily consumable by technology-specific tooling.

In the event of inconsistencies between the various formats, the normative text within this specification takes precedence over the XML Schemas and alternative formats, which in turn take precedence over examples.

5.10 Relationships between Resources

5.10.1 Referencing across Resources

Resources may refer each other. This referencing expresses a directional relationship in which there is a *referring* Resource and a *referred* Resource. Depending on the cardinality of such relationships, there are two representations:

- For 1-to-1 referencing, the URL of the referred Resource appears as an attribute in the referring Resource.
- For 1-to-n referencing, the referred Resources (all of the same type) are grouped in a Collection, the URL of which appears as an attribute in the referring Resource. In that case, the *referring* Resource does not refer directly to the referred Resources, but instead to a Collection Resource that contains references to the *referred* Resources.

If a *referred* Resource is deleted but not the *referring* Resource(s), then in case of a 1-to-1 relationship the reference shall be set to empty in every *referring* Resource, and in case of a 1-to-n relationship the reference shall be removed from any Collection where it appears as an item.

5.10.2 Composition Relationship between Resources

A Resource is component of another Resource if its `parent` attribute refers to the latter Resource. This relationship is transitive.

If a Resource is deleted, its component Resource(s) is(are) also automatically deleted.

In case of a Collection Resource that is referred by a Resource R,.Expressing a composition relationship from the Collection Resource items to R is done by setting the `parent` attribute of each Resource item to the Collection Resource and by setting the `parent` attribute of the Collection Resource to the Resource R. A Resource is said to be parent of its components.

For example a Machine is parent of its related Disk Resources via the `disks` Collection: the `parent` attribute of a Disk is set to the `disks` Collection, and the `parent` attribute of the `disks` Collection is set to the Machine.

5.11 Resource metadata

Implementations of this specification should allow for Consumers to discover the metadata associated with each supported Resource type, for a given Cloud Entry Point. Doing so allows for the discovery of Provider¨defined constraints on the CIMI defined attributes as well as discovery of any new extension attributes or operations that the Provider may have defined. A `ResourceMetadata` instance contains metadata describing a particular Resource type – e.g., `Network`, or `Machine` – including any Provider-specific capabilities or featuresNote that while this specification declares the `ResourceMetadata` as mutable attributes, it is expected that only administrative users associated with the Provider will update them. Consequently they remain read-only for Consumers.

Each Resource's metadata shall contain the following pieces of information:

1881 **Table 6 – ResourceMetadata attributes**

Name	ResourceMetadata	
Type URI	http://schemas.dmtf.org/cimi/2/ResourceMetadata	
Attribute	**Type**	**Description**
typeURI	*URI*	A unique URI associated with, and denoting, the described Resource type. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
name	*string*	The name of the described Resource type. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
attributes	*attribute[]*	A set of Provider-defined metadata that can be used by clients to discover any metadata associated with each attribute of the described Resource type, including the set of extension attributes not defined in this specification. Each attribute shall contain the following nested data: **Name** *attribute* **Data** / **Type** / **Description** name / *string* / The name of the attribute. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write namespace / *URI* / The namespace in which this attribute is defined. It is recommended that a dereference of this URI returns information about the attribute. This shall not be present if describing a CIMI-defined attribute, but shall be present if describing a non-CIMI defined attribute. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write type / *string* / The data type of the attribute. This shall not be present if describing a CIMI-defined attribute, but shall be present if describing a non-CIMI-defined attribute. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write required / *boolean* / Indicates whether this Resource requires this attribute to be present. If absent the implied value is "false." **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
vscope	*valueScope[]*	The `vscope` attribute may be present on a `ResourceMetadata` Resource. In that case, the value scope represented by this attribute does not apply to the attributes of the `ResourceMetadata` Resource itself, but instead to the attributes of the described Resource, i.e., it is a value scope that applies to all Resources of the type identified by the `typeURI` attribute. Consequently this value scope is about the list of attributes described in the `attributes` attribute. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
capabilities	*capability[]*	A set of Provider-defined metadata that can be used by Consumer to discover any capability or feature provided by this Provider. Each capability shall contain the following nested data: **Name** *capability*

<table>
<tr><th>Name</th><td colspan="2">ResourceMetadata</td></tr>
<tr><th>Type URI</th><td colspan="2">http://schemas.dmtf.org/cimi/2/ResourceMetadata</td></tr>
<tr><th>Attribute</th><th>Type</th><th>Description</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>Data</th><th>Type</th><th>Description</th></tr>
<tr><td>name</td><td>string</td><td>The name of the capability.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>uri</td><td>URI</td><td>A URI that uniquely identifies the capability at a global level.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
<tr><td>description</td><td>string</td><td>The human-readable description of the semantic of the capability.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>value</td><td>any</td><td>The value of the capability. The specific type varies depending on the definition of the capability. If not present the capability defaults to a "boolean" type with a value of "true" indicating that the specific capability is supported by the Provider.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
</table>
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write
</td></tr>
<tr><td>actions</td><td>action[]</td><td>A set of Provider-defined operations that can be used by consumers to act on the Resource. This set represents all operations defined for this described Resource type, which may be a superset of those operations a particular Consumer is actually allowed to use. The subset of allowed operations for a particular Consumer shall be those operations returned to this Consumer if querying an instance of the described Resource type. Note that this attribute is called "actions" so as not to conflict with the ResourceMetadata Resource's own operations.
Each operation shall contain the following nested data:
<table>
<tr><th>Name</th><td colspan="2">action</td></tr>
<tr><th>Data</th><th>Type</th><th>Description</th></tr>
<tr><td>name</td><td>string</td><td>The name of the operation.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
<tr><td>uri</td><td>URI</td><td>A URI that uniquely identifies the operation at a global level.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
<tr><td>description</td><td>string</td><td>The human-readable description of the semantic of the operation.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>method</td><td>string</td><td>The protocol-dependent verb to use to perform the operation.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
<tr><td>inputMessage</td><td>string</td><td>The body mimeType of the request message; it may depend on the model format chosen by the Provider.
<u>Constraints:</u></td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td>Name</td><td colspan="3">ResourceMetadata</td></tr>
<tr><td>Type URI</td><td colspan="3">http://schemas.dmtf.org/cimi/2/ResourceMetadata</td></tr>
<tr><td>Attribute</td><td>Type</td><td colspan="2">Description</td></tr>
<tr><td></td><td></td><td colspan="2">
<table>
<tr><td></td><td></td><td>Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
<tr><td>outputMessage</td><td>string</td><td>The body mimeType of the response message; it may depend on the model format chosen by the Provider.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
</table>
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write
</td></tr>
</table>

When implementing or using `ResourceMetadata`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 6 as well as in the tables describing embedded Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML:

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/ResourceMetadata",
  "id": string,
  "typeURI": string,
  "name": string,
  "attributes" : [
    { "name": string,
      "namespace": string, ?
      "type": string, ?
      "required": boolean, ? } *
        ], ?
  "vscope" : [ valueScope, * ], ?
  "capabilities": [
    { "name": string, ?
      "uri": string,
      "description": string, ?
      "value": any } *
  ], ?
  "actions" : [
    { "name": string,
      "uri": string,
      "description": string, ?
      "method": string,
      "inputMessage": string, ?
```

```
      "outputMessage": string ? }, *
  ], ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<ResourceMetadata xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name>
  <typeURI> xs:anyURI </typeURI>
  <attribute name="xs:string" namespace="xs:anyURI"? type="xs:string"?
             required="xs:boolean"? /> *
      </attribute> *
  <vscope> valueScope </vscope> *
  <capability name="xs:string"? uri="xs:anyURI" description="xs:string"?>
    xs:any*
  </capability> *
  <action name="xs:string" uri="xs:anyURI" description="xs:string"?
          method="xs:string" inputMessage="xs:string"?
          outputMessage="xs:string"? /> *
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</ResourceMetadata>
```

Additional metadata about the Resource or attributes may be included by the Provider.

5.11.1 Capabilities

Table 7 describes the capability URIs defined by this specification. Providers may define new URIs and it is recommended that these URIs be dereferencable such that Consumers can discover the details of the new capability. The "Resource Name" column contains the name of the Resource that may contain the specified capability within its `ResourceMetadata`. The "Capability Name" column contains the name of the specified capability and shall be unique within the scope of the corresponding Resource. Each capability's URI shall be constructed by appending the "Resource Name", a slash (/), and the "Capability Name" to "http://schemas.dmtf.org/cimi/2/capability/". For example, the `Machine's` "InitialState" capability shall have a URI of:

```
http://schemas.dmtf.org/cimi/2/capability/Machine/InitialState
```

Capabilities that apply to the Provider in general, and are not specific to any one Resource, shall be associated with the `CloudEntryPoint` Resource (in case a capability applies only to the `CloudEntryPoint` Resource itself, its definition indicates this).

Each one of these capabilities may be set to some value, or may be absent. The meaning of an absent capability is defined as follows:

- For boolean-valued capabilities: same as a “false” value.
- For other capabilities that use a single value or a list of values among an enumeration: same as no particular preference or restriction being enforced for this value.

Table 7 – Capability URIs

Resource Name	Capability Name	Description
CloudEntryPoint	ExpandParameter	If true, the Provider shall support the `$expand` query parameter.
CloudEntryPoint	FilterParameter	If true, the Provider shall support the `$filter` query parameter.
CloudEntryPoint	FirstParameter	If true, the Provider shall support both the `$first` and `$last` query parameters.
CloudEntryPoint	SelectParameter	If true, the Provider shall support the `$select` query parameter.
CloudEntryPoint	FormatParameter	If true, the Provider shall support the `$format` query parameter.
CloudEntryPoint	OrderByParameter	If true, the Provider shall support the `$orderby` query parameter.
CloudEntryPoint	QueryPathNotation	If true, the Provider shall support the use of path-like notation with query parameter `$select` (see 4.1.6.3) to disambiguate between attributes of a Collection Resource and attributes of each items in the Collection if subsetting.
CloudEntryPoint	MaxPropertyItems	If set, the Provider shall support a ‘Properties’ attribute with a number of elements less than or equal to the size specified by this capability.
CloudEntryPoint	ValueScopes	If true, the Provider shall support the use of attributes of type valueScope, for any Resource that may be created via a template.
CloudEntryPoint	MinimalListing	If true, only the Resources that are direct components of the CEP (i.e. with their `parent` reference set to a CEP Collection URI) shall be referred by the top Collections of the CEP. If false, every top CEP Collection for a particular Resource type will refer to all the Resources of this type within the CEP usage domain.
System	SystemComponentTemplateByValue	If true, the Provider shall support the specification of ComponentTemplates by value in SystemTemplates.
Machine	DefaultInitialState	If this capability is set, unless otherwise provided (e.g., by a MachineTemplate "initialState" attribute), the Provider shall set a new Machine to this state value, assuming the value is compatible with the InitialStates capability, if set.
Machine	InitialStates	If this capability is set, and if using a MachineTemplate that has an “initialState” attribute, a Consumer shall use an initialState value from the set of values of this capability.
Machine	MachineConfigByValue	If true, the Provider shall support specifying MachineConfigurations by value. If true, the MachineTemplateByValue shall also have the value true.
Machine	MachineCredentialByValue	If true, the Provider shall support specifying Credentials by value in Machine create operations. If true, the

Resource Name	Capability Name	Description
		MachineTemplateByValue capability shall also have the value true.
Machine	MachineImageByValue	If true, the Provider shall support specifying MachineImages by value in Machine create operations. If true, the MachineTemplateByValue capability shall also have the value true.
Machine	MachineVolumeTemplatesByValue	If true, the Provider shall support specifying VolumeTemplates by value in Machine create operations. If, then the MachineTemplateByValue capability shall also have the value true.
Machine	MachineTemplateByValue	If true, the Provider shall support specifying MachineTemplates by value in Machine create operations.
Machine	MachineStopForce	If true, the Provider shall support the “force” option on the stop and restart operations on Machines.
Machine	MachineStopForceDefault	If true, the Provider shall forcefully stop Machines if no other indication is provided. Otherwise, the Provider shall gracefully stop Machines.
Machine	RestoreFromImage	If true, the Provider supports restoring Machines from MachineImages that are not SNAPSHOT MachineImages.
Machine	UserData	If set, indicates which userData injection method shall be used by the Provider.
Machine	MachineAvailabilityLevel	If true, the Provider supports the notion of an availability level for the Machine Resource. The availability level and its value constraints are advertised as an extension attribute by the way of the Machine and MachineTemplate ResourceMetadata.
Credential	CredentialTemplateByValue	If true, the Provider shall support specifying CredentialTemplates by value in Credential create operations.
Volume	SharedVolumeSupport	If true, the Provider shall support that a single Volume Resource can be shared by multiple Machines.
Volume	VolumeConfigByValue	If true, the Provider shall support specifying VolumeConfigurations by value in the Volume create operation. If true, the VolumeTemplateByValue capability shall have the value true.
Volume	VolumeImageByValue	If true, the Provider shall support specifying VolumeImages by value in the Volume create operation. If true, the VolumeTemplateByValue capability shall have the value true.
Volume	VolumeSnapshot	If true, the Provider shall support creating a new VolumeImage by referencing an existing Volume.
Volume	VolumeTemplateByValue	If true, the Provider shall support specifying the VolumeTemplates by value in Volume create operations.
Volume	VolumeAvailabilityLevel	If true, the Provider supports the notion of an availability level for the Volume Resource. The availability level and its value constraints are advertised as an extension attribute by the way of the Volume and VolumeTemplate ResourceMetadata.
Network	NetworkTemplateByValue	If true, the Provider shall support specifying Network Templates by value in Network create operations.
Network	DefaultInitialState	If this capability is set, unless otherwise provided (e.g., by a NetworkTemplate "initialState" attribute), the Provider shall set a new Network to this state value, assuming the value is compatible with the InitialStates capability, if set.
Network	InitialStates	If this capability is set, and if using a NetworkTemplate that has an “initialState” attribute, a Consumer shall use an initialState value from the set of values of this

Resource Name	Capability Name	Description
		capability.
NetworkInterface	NetworkInterfaceTemplateByValue	If true, the Provider shall support specifying NetworkInterface Templates by value in NetworkInterface create operations.
NetworkInterface	DefaultInitialState	If this capability is set, unless otherwise provided (e.g., by a NetworkInterfaceTemplate "initialState" attribute), the Provider shall set a new NetworkInterface to this state value, assuming the value is compatible with the InitialStates capability, if set.
NetworkInterface	InitialStates	If this capability is set, and if using a NetworkInterfaceTemplate that has an “initialState” attribute, a Consumer shall use an initialState value from the set of values of this capability.
NetworkService	NetworkServiceTemplateByValue	If true, the Provider shall support specifying NetworkService Templates by value in NetworkService create operations.
NetworkService	DefaultInitialState	If this capability is set, unless otherwise provided (e.g., by a NetworkServiceTemplate "initialState" attribute), the Provider shall set a new NetworkService to this state value, assuming the value is compatible with the InitialStates capability, if set.
NetworkService	InitialStates	If this capability is set, and if using a NetworkServiceTemplate that has an “initialState” attribute, a Consumer shall use an initialState value from the set of values of this capability.
ProtocolEndpoint	ProtocolEndpointTemplateByValue	If true, the Provider shall support specifying ProtocolEndpoint Templates by value in ProtocolEndpoint create operations.
ProtocolEndpoint	DefaultInitialState	If this capability is set, unless otherwise provided (e.g., by a ProtocolEndpointTemplate "initialState" attribute), the Provider shall set a new ProtocolEndpoint to this state value, assuming the value is compatible with the InitialStates capability, if set.
ProtocolEndpoint	InitialStates	If this capability is set, and if using a ProtocolEndpointTemplate that has an “initialState” attribute, a Consumer shall use an initialState value from the set of values of this capability.
ProtocolSegment	ProtocolSegmentTemplateByValue	If true, the Provider shall support specifying ProtocolSegment Templates by value in ProtocolSegment create operations.
ProtocolSegment	DefaultInitialState	If this capability is set, unless otherwise provided (e.g., by a ProtocolSegmentTemplate "initialState" attribute), the Provider shall set a new ProtocolSegment to this state value, assuming the value is compatible with the InitialStates capability, if set.
ProtocolSegment	InitialStates	If this capability is set, and if using a ProtocolSegmentTemplate that has an “initialState” attribute, a Consumer shall use an initialState value from the set of values of this capability.
Job	JobRetention	If set, the value of this capability shall indicate the minimum number of minutes a job shall be retained by the Provider before it is deleted.
Meter	MeterConfigByValue	If true, the Provider shall support specifying MeterConfigurations by value in Meter create operations.
Meter	MeterTemplateByValue	If true, the Provider shall support specifying MeterTemplates by value in Meter create operations.
EventLog	Linked	If true, the Provider shall delete EventLogs that are associated with Resources if the Resource is deleted.

The following examples show the `ResourceMetadata` for a `Machine` that advertises some of its capabilities:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/ResourceMetadata",
  "id": "http://example.com/types/Machine",
  "typeURI": "http://schemas.dmtf.org/cimi/2/Machine",
  "name": "Machine",
  "capabilities": [
    { "uri":
      "http://schemas.dmtf.org/cimi/2/capability/Machine/MachineConfigByValue",
      "value": true },
    { "uri":
      "http://schemas.dmtf.org/cimi/2/capability/Machine/MachineImageByValue",
      "value": true },
    { "uri":
      "http://schemas.dmtf.org/cimi/2/capability/Machine/DefaultInitialState",
      "value": "STARTED" }
  }
}
```

XML serialization:

```
<ResourceMetadata xmlns="http://schemas.dmtf.org/cimi/2">
  <id> http://example.org/types/Machine </id>
  <typeURI> http://schemas.dmtf.org/cimi/2/Machine </typeURI>
  <name> Machine </name>
  <capability
uri="http://schemas.dmtf.org/cimi/2/capability/Machine/MachineConfigByValue">
    true
  </capability>
  <capability
uri="http://schemas.dmtf.org/cimi/2/capability/Machine/MachineImageByValue">
    true
  </capability>
  <capability
uri="http://schemas.dmtf.org/cimi/2/capability/Machine/DefaultInitialState">
    STARTED
  </capability>
</ResourceMetadata>
```

5.11.2 ResourceMetadataCollection Resource

A `ResourceMetadataCollection` Resource represents the Collection of `ResourceMetadata` Resources within a Provider and follows the Collection pattern defined in clause 5.5.12. Note that

modifications of the Resources within this Collection are typically reserved for administrator types of CIMI Consumers. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/ResourceMetadataCollection",
  "id": string,
  "count": number,
  "resourceMetadatas": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/ResourceMetadata",
      "id": string,
      ... remaining ResourceMetadata attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/2/ResourceMetadataCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <ResourceMetadata>
    <id> xs:anyURI </id>
    ... remaining ResourceMetadata attributes ...
  </ResourceMetadata> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.12 Cloud Entry Point

The Cloud Entry Point (`CloudEntryPoint` Resource) represents the entry point into the cloud defined by the CIMI Model. It provides a Consumer with a single address (URI) from which the Consumer can discover and access all Resources usable by this Consumer. A Cloud Provider may provide different CEPs to different Consumers. The Cloud Entry Point (CEP) implements a catalog of Resources, such as `Systems`, `SystemTemplates`, `Machines`, `MachineTemplates`, etc., that can be queried and browsed by the Consumer.

Figure 1 illustrates the `CloudEntryPoint` and its relationship to other Resources. Although this drawing is in the style of a Resource Relationship diagram, the use of UML is neither rigorous nor normative.

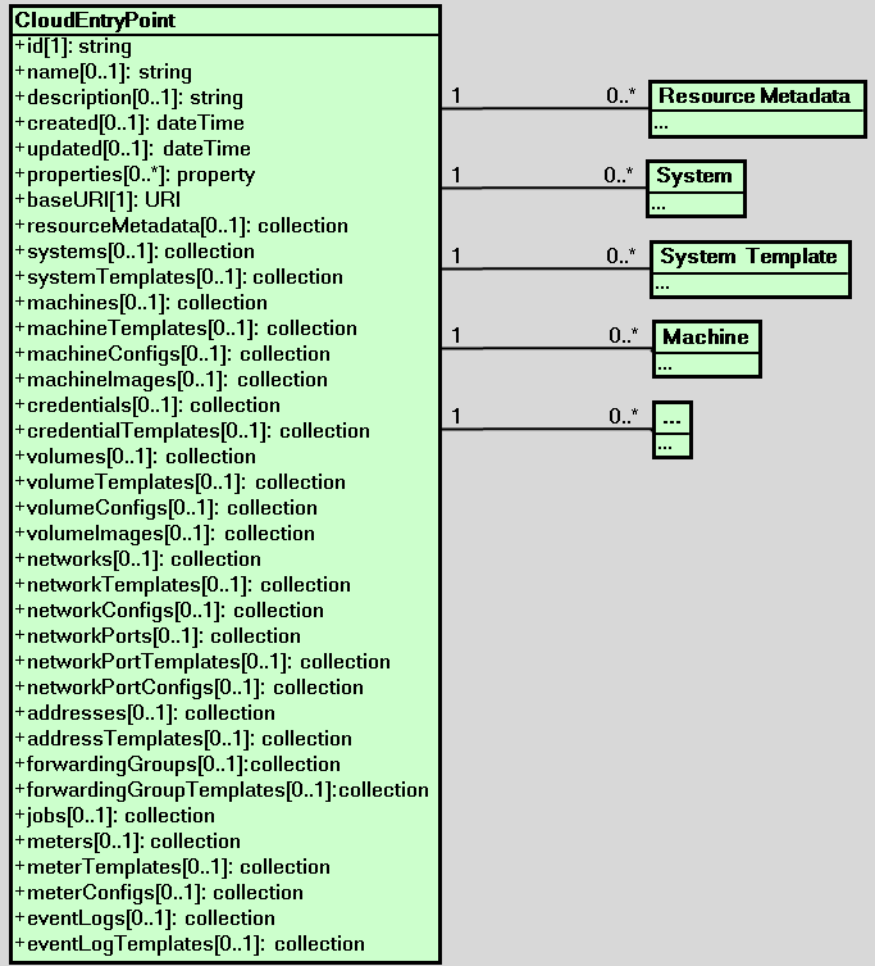


Figure 1 - Cloud Entry Point

If a Consumer issues a read on the `CloudEntryPoint` Resource, the Provider shall return a `CloudEntryPoint` Resource that only catalogs Resources on which this Consumer is allowed to perform operations. Table 8 describes the attributes for the `CloudEntryPoint` Resource.

If the delete operation is advertised on the CEP, deleting the `CloudEntryPoint` Resource is also deleting all referred Resources.

Table 8 – CloudEntryPoint attributes

Name	CloudEntryPoint	
Type URI	http://www.dmf.org/cimi/2/CloudEntryPoint	
Attribute	**Type**	**Description**
baseURI	*URI*	An absolute URI that references the "base URI" of the Provider. This URI shall be used to convert relative URIs to Resources within this Provider to absolute URIs. See the "URIs" clause of 5.5. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
resourceMetadata	*collection [Resource Metadata]*	A reference to `ResourceMetadata` Collection of this Cloud Entry Point. The Collection contains a description of the Resources supported by the Provider. If a Resource does not have any metadata, it shall not appear in this list, e.g., it has no constraints beyond what the CIMI

Name	CloudEntryPoint	
Type URI	http://www.dmf.org/cimi/2/CloudEntryPoint	
Attribute	**Type**	**Description**
		specification defines nor does it have any extension attributes. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
systems	*collection [System]*	A reference to the `SystemCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
systemTemplates	*collection [System Template]*	A reference to the `SystemTemplateCollection` of this CloudEntry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
machines	*collection [Machine]*	A reference to the `MachineCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
machineTemplates	*collection [Machine Template]*	A reference to the `MachineTemplateCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
machineConfigs	*collection [Machine Configuration]*	A reference to the `MachineConfigurationCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
machineImages	*collection [Machine Image]*	A reference to the `MachineImageCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
credentials	*collection [Credential]*	A reference to the `CredentialCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
credentialTemplates	*collection [Credential Template]*	A reference to the `CredentialTemplateCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
volumes	*collection [Volume]*	A reference to the `VolumeCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
volumeTemplates	*collection [Volume Template]*	A reference to the `VolumeTemplateCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
volumeConfigs	*collection [Volume Configuration]*	A reference to the `VolumeConfigurationCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
volumeImages	*collection*	A reference to the `VolumeImageCollection` of this Cloud Entry

Name	CloudEntryPoint	
Type URI	http://www.dmf.org/cimi/2/CloudEntryPoint	
Attribute	**Type**	**Description**
	[Volume Image]	Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
networks	*collection [Network]*	A reference to the `NetworkCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
networkTemplates	*collection [Network Template]*	A reference to the `NetworkTemplateCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
segments	*collection [Protocol Segment]*	A reference to the `ProtocolSegmentCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
segmentTemplates	*collection [Protocol Segment Template]*	A reference to the `ProtocolSegmentTemplateCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
endpoints	*collection [Protocol Endpoint]*	A reference to the `ProtocolEndpointCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
endpointTemplates	*collection [Protocol Endpoint Templates]*	A reference to the `ProtocolEndpointTemplateCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
interfaces	*collection [Network Interface]*	A reference to the `NetworkInterfaceCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
interfaceTemplates	*collection [Network Interface Templates]*	A reference to the `NetworkInterfaceTemplateCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
networkServices	*collection [Network Service]*	A reference to the `NetworkServiceCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
networkServiceTemplates	*collection [Network Service Template]*	A reference to the `NetworkServiceTemplateCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only

Name	CloudEntryPoint	
Type URI	http://www.dmf.org/cimi/2/CloudEntryPoint	
Attribute	**Type**	**Description**
jobs	*collection [Job]*	A reference to the `JobsCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
meters	*collection [Meter]*	A reference to the `MeterCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
meterTemplates	*collection [Meter Template]*	A reference to the `MeterTemplateCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
meterConfigs	*collection [Meter Configuration]*	A reference to the `MeterConfigurationCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
eventLogs	*collection [EventLog]*	A reference to the `EventLogCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
eventLogTemplates	*collection [EventLog Template]*	A reference to the `EventLogTemplateCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only

Each of the Collections mentioned in Table 8 are defined within the related Resource definition clauses. For example, the `MachineCollection` Resource is defined in clause 5.14.2 as part of the Machine-related Resources.When implementing or using `CloudEntryPoint`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 8 as well as in the tables describing embedded Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML:

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/CloudEntryPoint",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "baseURI": string,
  "resourceMetadata": { "href": string }, ?
  "systems": { "href": string }, ?
  "systemTemplates": { "href": string }, ?
```

```
  "machines": { "href": string }, ?
  "machineTemplates": { "href": string }, ?
  "machineConfigs": { "href": string }, ?
  "machineImages": { "href": string }, ?
  "credentials": { "href" string }, ?
  "credentialTemplates": { "href" string }, ?
  "volumes": { "href": string }, ?
  "volumeTemplates": { "href": string }, ?
  "volumeConfigs": { "href": string }, ?
  "volumeImages": { "href": string }, ?
  "networks": { "href": string }, ?
  "networkTemplates": { "href": string }, ?
  "segments": { "href": string }, ?
  "segmentTemplates": { "href": string }, ?
  "endpoints": { "href": string }, ?
  "endpointTemplates": { "href": string }, ?
  "interfaces": { "href": string }, ?
  "interfaceTemplates": { "href": string }, ?
  "networkServices": { "href": string }, ?
  "networkServiceTemplates": { "href": string }, ?
  "jobs": { "href": string }, ?
  "meters": { "href": string }, ?
  "meterTemplates": { "href": string }, ?
  "meterConfigs": { "href": string }, ?
  "eventLogs": { "href": string }, ?
  "eventLogTemplates": { "href": string }, ?
  "operations": [
    { "rel": "edit", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<CloudEntryPoint xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
```

```
  <property key="xs:string"> xs:string </property> *
  <baseURI> xs:anyURI </baseURI>
  <resourceMetadata href="xs:anyURI"/> ?
  <systems href="xs:anyURI"/> ?
  <systemTemplates href="xs:anyURI"/> ?
  <machines href="xs:anyURI"/> ?
  <machineTemplates href="xs:anyURI"/> ?
  <machineConfigs href="xs:anyURI"/> ?
  <machineImages href="xs:anyURI"/> ?
  <credentials href="xs:anyURI"/> ?
  <credentialTemplates href="xs:anyURI"/> ?
  <volumes href="xs:anyURI"/> ?
  <volumeTemplates href="xs:anyURI"/> ?
  <volumeConfigs href="xs:anyURI"/> ?
  <volumeImages href="xs:anyURI"/> ?
  <networks href="xs:anyURI"/> ?
  <networkTemplates href="xs:anyURI"/> ?
  <segments href="xs:anyURI"/> ?
  <segmentTemplates href="xs:anyURI"/> ?
  <endpoints href="xs:anyURI"/> ?
  <endpointTemplates href="xs:anyURI"/> ?
  <interfaces href="xs:anyURI"/> ?
  <interfaceTemplates href="xs:anyURI"/> ?
  <networkServices href="xs:anyURI"/> ?
  <networkServiceTemplates href="xs:anyURI"/> ?
  <jobs href="xs:anyURI"/> ?
  <meters href="xs:anyURI"/> ?
  <meterTemplates href="xs:anyURI"/> ?
  <meterConfigs href="xs:anyURI"/> ?
  <eventLogs href="xs:anyURI"/> ?
  <eventLogTemplates href="xs:anyURI"/> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <xs:any>*
</CloudEntryPoint>
```

5.12.1 Operations

This Resource supports the Read and Update operations.

5.13 System Resources and relationships

Figure 2 illustrates the Resources involved in constructing a `System` and their relationships. Although this drawing is in the style of a Resource Relationship diagram, the use of UML is neither rigorous nor normative.

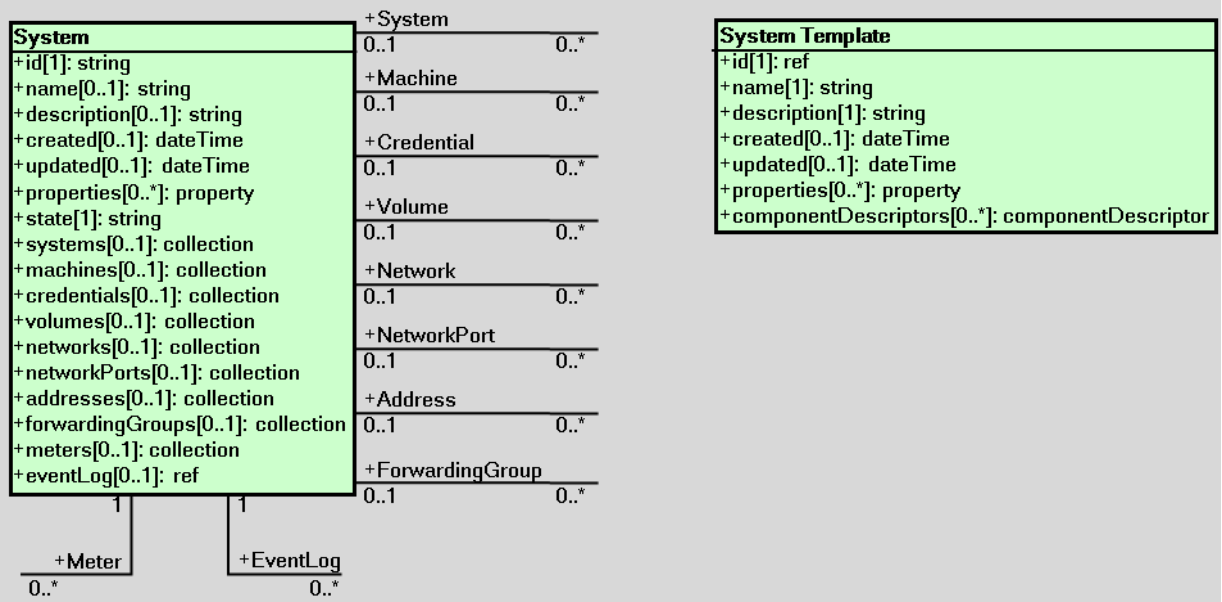


Figure 2 - System Resources

5.13.1 System

A `System` is a realized Resource that consists of one or more `Networks`, `Volumes`, `Machines`, (and others) that could be connected and associated with each other. A `System` can be created from the interpretation of a `SystemTemplate`. A `System` can be operated and managed as a single Resource and usually forms a stack of service. For example, a shopping cart system consists of machines for web servers and databases, network addresses for public access, and volumes for database files. A `System` has several "top-level" attributes that are Collections of references to Resources of various types. Each one of these Collections shall contain references to Resource items of the related type that are either components of the System, or used by the System. In the following, the term “component” [of a System] means a Resource that has the System as parent Resource (either directly or transitively as defined in 5.10.2). Every Resource item in a top-level Collection attribute of a System has `parent` set to this Collection.

By default, all Resources that are created as the result of a System creation are also (components of the `System`. A Resource that is component of a `System` has its life cycle directly tied to the life cycle of the `System` as a consequence of the composition semantics. In particular, if a `System` is deleted, all of its component Resources are deleted. Generally, operations on a `System` translate into operations on its component Resources.

However, a Resource component of a `System` may in turn use some other Resources that are not component of this `System`, e.g., a `Machine` in a `System` can use a `Volume` that is neither component of the Machine, nor a component of the System.

A Resource referred by a System may be used by the System without being its component. Such a Resource has its `parent` attribute set to a Resource other than the System (e.g. the CEP) or other than any of its components, Such a used Resource may be directly referred to in the top-collection of the System.

2170 For example, a Network may be created independently from any System, directly by adding to the
2171 `networks` CEP collection. A Consumer may then want a System to use that Network while keeping the
2172 Network external to the System i.e. not as a component that would be deleted when the System is
2173 deleted. Such a Network may still be inserted in the `networks` System collection, while having its
2174 `parent` attribute referring to the CEP as originally set. Alternatively, the Network could be made a
2175 component of the System by setting its `parent` attribute to the System Resource.

2176

2177 Note that a Resource may not be component of more than one `System` at any point in time (unless there
2178 is an component relationship between these `Systems`.)

2179 Table 9 describes the System attributes.

2180 **Table 9 – System attributes**

Name	System	
Type URI	http://schemas.dmtf.org/cimi/2/System	
Attribute	**Type**	**Description**
state	*string*	The operational state of the System. Allowed values are: (See 5.14.1.) **CREATING**: The System is in the process of being created. **STARTING/STARTED/STOPPING/STOPPED/PAUSING/PAUSED/SUSPENDING/SUSPENDED**: The `System` shall be in one of these states if all the `Machines` referenced by the `System` are in that state. See clause 5.14.1 for the list of available actions based on the state of a `Machine`. Such transitional states may just indicate that all `Machines` in a `System` are undergoing the same operation (e.g., "start"), without the `System` being actually operated on (e.g., no "start" done at `System` level). An actual operation on a `System` may be traced by querying the "job" entity. **MIXED**: The `System` shall be in this state if either no `Machines` are referenced by this `System` or `Machines` referenced by this `System` are in varying states. Such varying states are likely to occur when an operation is in progress on a `System`, resulting in transitions of its `Machine` states toward a new common state (e.g., STOPPED, STARTED) but at a different pace, or sequentially one after the other. **DELETING**: The `System` is in the process of being deleted. **ERROR**: The Provider has detected an error in the System. The operations that result in transitions to the above defined states are defined in clause 5.13.1.2. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
systems	*collection [System]*	A list of references to nested `Systems` that are either components of or used by this `System`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
machines	*collection [Machine]*	A list of references to `Machines` that are either components of or used by this `System`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
credentials	*collection [Credential]*	A list of references to `Credentials` that are either components of or used by this `System`. **Constraints:** **Provider:** support optional; mutable

Name	System	
Type URI	http://schemas.dmtf.org/cimi/2/System	
Attribute	**Type**	**Description**
		Consumer: support optional; read-only
volumes	*collection [Volume]*	A list of references `Volumes` that are either components of or used by this `System`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
networks	*collection [Network]*	A list of references to `Network` that are either components of or used by this `System`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
networkServices	*collection [Network Service]*	A reference to the `NetworkServiceCollection` that are either components of or used by this `System`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
services	*Collection [SystemService]*	A list of references to `SystemService` Resources that represent services supported by this `System`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
meters	*collection [Meter]*	A list of references to `Meters` monitored for this `System`, with component semantics. Note that these Meters are for the System and not for any individual component in the `System`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
eventLog	*ref*	A reference to the EventLog of this System. Note that this EventLog is for the System and not for any individual component in the System. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only

When implementing or using `System`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 9 as well as in the tables describing embedded Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/System",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "parent": string, ?
```

```
  "properties": { string: string, + }, ?
  "state": string,
  "systems": { "href": string }, ?
  "machines": { "href": string }, ?
  "credentials": { "href": string }, ?
  "volumes": { "href": string }, ?
  "networks": { "href": string }, ?
  "networkServices": { "href": string }, ?
  "meters": { "href": string }, ?
  "eventLog": { "href": string }, ?
  "operations": [
    { "rel": "edit", "href": string, ("available": boolean)?  }, ?
    { "rel": "delete", "href": string, ("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/start", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/stop", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/restart", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/pause", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/suspend", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/export", "href": string,
("available": boolean)? } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<System xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <parent> xs:anyURI </parent> ?
  <property key="xs:string"> xs:string </property> *
  <state> xs:string </state>
  <systems href="xs:anyURI"/> ?
  <machines href="xs:anyURI"/> ?
  <credentials href="xs:anyURI"/> ?
```

```
  <volumes href="xs:anyURI"/> ?
  <networks href="xs:anyURI"/> ?
  <networkServices href="xs:anyURI"/> ?
  <meters href="xs:anyURI"/> ?
  <eventLog href="xs:anyURI"/> ?
  <operation rel="edit" href="xs:anyURI" (available=”xs:boolean”)? /> ?
  <operation rel="delete" href="xs:anyURI" (available=”xs:boolean”)? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/start"
             href="xs:anyURI" (available=”xs:boolean”)? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/stop"
             href="xs:anyURI" (available=”xs:boolean”)? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/restart"
             href="xs:anyURI" (available=”xs:boolean”)? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/pause"
             href="xs:anyURI" (available=”xs:boolean”)? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/suspend"
             href="xs:anyURI" (available=”xs:boolean”)? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/export"
             href="xs:anyURI" (available=”xs:boolean”)? /> ?
  <xs:any>*
</System>
```

5.13.1.1 Attributes of type Collection

The following clause describes the Collection Resources components of `Systems`.

5.13.1.1.1 systems Collection

The Resource type for each item of this Collection is “`System`”. There is no accessory attribute for the items in this Collection, therefore, it is a basic System Collection, the serialization of which follows the rules in 5.5.12. See the SystemCollection Resource clause.

5.13.1.1.2 machines Collection

The Resource type for each item of this Collection is “`Machine`”. There is no accessory attribute for the items in this Collection, therefore, it is a basic Machine Collection (serialized as described in 5.5.12). See the MachineCollection Resource clause.

5.13.1.1.3 credentials Collection

The Resource type for each item of this Collection is “`Credential`”. There is no accessory attribute for the items in this Collection, therefore, it is a basic `Credential` Collection (serialized as described in 5.5.12). See the CredentialCollection Resource clause.

5.13.1.1.4 volumes Collection

The Resource type for each item of this Collection is “`Volume`”. There is no accessory attribute for the items in this Collection, therefore, it is a basic `Volume` Collection (serialized as described in 5.5.12). See the VolumeCollection Resource clause.

5.13.1.1.5 networks Collection

The Resource type for each item of this Collection is "`Network`". There is no accessory attribute for the items in this Collection, therefore, it is a basic `NetworkCollection` Resource as described in clause.5.16.2

5.13.1.1.6 networkServices Collection

The Resource type for each item of this Collection is "`NetworkService`". There is no accessory attribute for the items in this Collection, therefore, it is a basic `NetworkServiceCollection` as described in clause 5.16.18.

5.13.1.1.7 meters Collection

The Resource type for each item of this Collection is "`Meter`" as defined in clause 5.17.3. There is no accessory attribute for the items in this Collection, thereforem it is a basic `Meter` Collection (serialized as described in 5.5.12). See the MeterCollection Resource clause.

5.13.1.2 Operations

The `System` Resource supports the Read, Update, and Delete operations. Create is supported through the `SystemCollection` Resource.

The following custom operations are also defined:

start/stop/restart/pause/suspend

/link@rel: `http://schemas.dmtf.org/cimi/2/action/xxx`

Where "xxx" is either "`start`", "`stop`", "`restart`", "`pause`", or "`suspend`".

This operation shall recursively perform the requested operation on each component of the `System` (`Machine` or sub-`System`). Note that not all `Machines` need to be in the same state for this operation to be available and the impact of this operation varies depending on the component's current state; see clause 5.14.1.2 for more details about performing operations on `Machines`. If the operation fails for a `Machine`, that `Machine` shall not be affected by the operation.

export

/link@rel: `http://schemas.dmtf.org/cimi/2/action/export`

This operation shall export a `System` along with all Resources component of or used by this System. If an export package exists at that URI, it is updated with the values of the `System` and any component management Resources. Otherwise, a new export package is created at that URI with a Media Type as specified by the "format" parameter. Other formats may be used if supported, but are not specified by this standard.

Input parameters:

1) "format" - type: string - optional
2) Indicates the Media Type of the exported data. If not present, the default value shall be "application/ovf."
3)
4) "destination" - type: URI - optional
5) Indicates the location to where the exported data is placed. If not present, the HTTP response Location header shall contain the URL to the exported data. Based on the specific protocol specified within the URI, the Consumer might need to provide additional information (such as

credentials) in the "properties" field. In the case of HTTP, a PUT shall be used to place the data at the specified location.

Output parameters: None.

HTTP protocol

To export a `System`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/export" URI of the `System` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "action": "http://schemas.dmtf.org/cimi/2/action/export",
  "format": string, ?
  "destination": string, ?
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/export </action>
  <format> xs:string </format> ?
  <destination> xs:anyURI </destination> ?
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

5.13.2 SystemCollection Resource

A `SystemCollection` Resource represents a Collection of `System` Resources and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/SystemCollection",
  "id": string,
  "count", number,
  "systems": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/System",
      "id": string,
      ... remaining System attributes ...
    }, +
  ], ?
  "operations": [
    { "rel": "add", "href": string }, ?
```

```
       { "rel": "remove", "href": string } ?
{ "rel": "insert", "href": string } ?     { "rel":
"http://schemas.dmtf.org/cimi/2/action/import", "href": string } ?
  ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/2/SystemCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <System>
    <id> xs:anyURI </id>
    ... remaining System attributes ...
  </System> *
  <operation rel="add" href="xs:anyURI"/> ?
  <operation rel="remove" href="xs:anyURI"/> ?
  <operation rel="insert" href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/import"
href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.13.2.1 Operations

NOTE The "add" operation requires that a SystemTemplate be used (see 4.2.1.1).

Resources created during the process of creating a `System` shall be components of the `System` (see 5.13.1). For example, a `componentDescriptor` that references a `MachineTemplate`, and within that `MachineTemplate` is a reference to a `VolumeTemplate`, results in a reference to the new `Machine` being added to the `System.machines` attribute and a reference to the new `Volume` being added to the `System.volumes` attribute. However, if this `MachineTemplate` refers to an existing `Volume`, this `Volume` shall not be added to the top-level `System` attributes.

The following custom operations are also defined:

import

/link@rel:`http://schemas.dmtf.org/cimi/2/action/import`

This operation shall import a `System`. Not only is a `System` created, but `Machines`, `Volumes`, and `Networks` and possibly recursive `Systems` and their components may also be created corresponding to imported descriptor entries. More detail about this process is in 0.

1) Input parameters:"source" - type: URI - mandatory
2) Indicates the location from which the imported data is retrieved. Based on the specific protocol specified within the URI, the Consumer might need to provide additional information (such as credentials) in the "properties" field.

Output parameters: None.

HTTP protocol

To import a `System`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/import" URI of the System `Collection` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "action": "http://schemas.dmtf.org/cimi/2/action/import",
  "source": string, ?
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/import </action>
  <source> xs:anyURI </source> ?
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

5.13.3 SystemService Resource

A SystemService Resource represents some management service for all or part of the Resources in a System. A SystemService Resource can define diverse types of management services and typically holds:

(a) Topology information about the service: a list of the Resources concerned by this management service, e.g. lists of Machines and Volumes subject to disaster recovery policy, along with the Network that connects them, e.g. a Network that supports a load balancing service with an external access endpoint.
(b) Policy information: configuration data for the service itself.

System components may be listed under more than one `SystemService` Resources. For example, a `Machine` may be under a recovery service, while also participating into a load balancing service.

After deployment, management services can be updated although in a way that may be restricted by the Provider. Modifying a service configuration can be done in one of the two following ways:

(1) Direct attribute update (HTTP PUT): Some attributes of the service may be directly updated by the Consumer, if read-write. Such updates typically concern configuration data (see (b) above). The Provider will typically advertise the allowed range of values with a valueScope field.
(2) Operations: Some components of the service may only be modified by operations advertised by the Provider for this type of service. Such operations are used for changes that affect the managed Resources inside the System, e.g. adding a Machine in a pool under load balancing, or forcing a synchronization with a recovery image. This specification defines a non-exclusive list of most common update operations for a basic set of services.

The following list of services are defined in this specification, not exclusive of others:

- LoadBalancing service
- LocalRecovery service
- DisasterRecovery service
- Backup service
- Autoscaling service

Each one of the above management services requires specific attributes that define a particular service type. All SystemService Resources share a `serviceType` attribute that identifies the service type. The following sections describe the SystemService Resources for some of the service types.

5.13.3.1 LocalRecovery service Resource

This service allows for all or part of the Resources in a System to recover from failure – e.g. a failed Machine, or a failed Volume, or both – by maintaining local, up-to-date images of these Resources, inside the same System. This service Resource represents the actual service as supported by the Provider, showing which System Resources are concerned, and the attributes or configuration attributes of the service.

Table XX – SystemService attributes for LocalRecovery service

Name	SystemService	
Type URI	http://schemas.dmtf.org/cimi/2/SystemService	
Attribute	**Type**	**Description**
serviceType	*URI*	http://schemas.dmtf.org/cimi/2/SystemService/localrecovery/active or http://schemas.dmtf.org/cimi/2/SystemService/localrecovery/passive
machines	*Collection[Recoverable Machine]*	A reference to the list of references to `Machines` in the `System` that are managed under this `SystemService`, meaning these benefit from recovery service. Adding a `Machine` reference to this collection means that the `Machine` becomes managed under this `SystemService`. • If the serviceType is ending with "/localrecovery/active": Then each one of the listed `Machines` has a backup `Machine`. In case of failure the backup `Machine` (referred to by the `recoverableMachine` collection item) shall take over i.e. added to this collection, with a new backup created for it. • If the serviceType is ending with "/localrecovery/passive": Then each one of the listed `Machines` has an up-to-date `MachineImage`. In case of failure the backup `Machine` is created from the `MachineImage` and shall replace the failed `Machine`, i.e. be added to this collection, This Resource items in this Collection are not components of the `SystemService` Resource: deleting the `SystemService` does not cause the deletion of the referred Machines. The details of the `SystemService` behavior (e.g. failover detection, etc.) depends on the Provider's implementation. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
networkServices	*collection [Network Service]*	A reference to the `NetworkServiceCollection` within the System that support this `SystemService`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
heartbeat	Integer	Heartbeat frequency, in term of millisecs between an heartbeat and the next.

Name	SystemService	
Type URI	http://schemas.dmtf.org/cimi/2/SystemService	
Attribute	**Type**	**Description**
		Constraints: **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
replicationType	String	The kind of disk replication data (it does not refer to the Volume Resource) allowable values are: **synchronous**, **asynchronous**, **none**, **onlyAtClusterCreation** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
RPO	Integer	Recovery Point Objective (duration in minutes) in case of asynchronous replica of the disks. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only

5.13.3.1.1 `RecoverableMachine` Collection

The referred Resource type for each item of this Collection is "`Machine`". However because there are accessory attributes, this is not a basic but an enhanced Machine Collection. The accessory attribute is defined in Table 14:

Table 10 – `RecoverableMachine` accessory attributes

Name	RecoverableMachine	
Type URI		
Attribute	**Type**	**Description**
backupmachine	*Ref*	An additional reference to the backup Machine in the same System, that supports the Machine referenced by this collection item. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support optional; read-write

<SERIALIZATIONS TO BE ADDED>

5.13.3.1.2 Operations

The localrecovery SystemService Resource supports the Read, Update, and Delete operations. Create is supported through the SystemService Collection Resource.

The recoverable Machines collection (`SystemService.machines`) supports the Insert and Remove operations, for adding or removing Machines in the recovery service.

The following custom operations are also defined on this SystemService Resource:

forceSync

/link@rel: `http://schemas.dmtf.org/cimi/2/action/forceSync`

This operation shall synchronize the state of a node onto its backup node, regardless of the scheduled synchronization time as dictated by the recovery policies.

Input parameters: primary node.

Output parameters: None.

HTTP protocol

<TO BE COMPLETED>

swapBackup

/link@rel: `http://schemas.dmtf.org/cimi/2/action/swapBackup`

This operation shall swap a Machine and its backup Machine – i.e. replace the Machine with its backup and vice-versa.

Some Providers can choose to not make available this operation, not allowing the Consumer to choose which backup node turn in primary one.

Input parameters:"node" - type: ref - mandatory
A reference to the Machine to be replaced by its backup

<TO BE COMPLETED>

Output parameters: None.

5.13.3.2 DisasterRecovery service Resource

This service allows for a System to recover from a data center failure – by maintaining a remote, up-to-date images of the System.

…

5.13.3.3 LocalBalancing service Resource

This service allows for a System to balance user requests over a pool of equivalent Machines.

Table XX – SystemService attributes for LocalBalancing service

Name	SystemService	
Type URI	http://schemas.dmtf.org/cimi/2/SystemService	
Attribute	**Type**	**Description**
serviceType	*URI*	http://schemas.dmtf.org/cimi/2/SystemService/loadbalancing
machines	*Collection[Machine]*	A reference to the list of references to `Machines` in the `System` that are managed under this `SystemService`. Adding a `Machine` reference to this collection means that the `Machine` becomes managed under this `SystemService`. ….
networkServices	*collection [Network Service]*	A reference to the `NetworkServiceCollection` within the System that support this `SystemService`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only

5.13.3.4 Backup service

This service allows for backing-up Resources (Machines, Volumes) in a System according to some policy.

5.13.3.5 Autoscaling service

This service allows for automatically scaling a pool of Machines in a System to accommodate user requests. It otherwise provides same capabilities as the LocalBalancing service.

5.13.4 SystemTemplate Resource

The `SystemTemplate` Resource contains the set of individual descriptors that are necessary to create the components of a `System`. Each component descriptor can be considered to be the persisted view of the create operation that instantiates the component. In practice, the Provider interprets the set of component descriptors as a set of creation operations to be executed in an order compatible with the dependencies (e.g., attachments or references between components) that are expressed between these components.

A `SystemTemplate` may include symbolic component references in the descriptors, used to express links between components of the resulting System. A component reference uses the "name" of the target (referred) component. For example, `<volume href="#newVolume"/>` would reference a `Volume` named "newVolume." The reference name –#newVolume – is replaced by the actual Resource URL in the instantiated System.

Table 11 describes the `SystemTemplate` attributes.

Table 11 – SystemTemplate attributes

Name	SystemTemplate	
Type URI	http://schemas.dmtf.org/cimi/2/SystemTemplate	
Attribute	**Type**	**Description**
component Descriptors	*component Descriptor*[]	The list of component descriptors describing the components of a `System` instance realized from this `SystemTemplate`. For each component descriptor, the corresponding component is created when a `System` instance is created. Each component descriptor refers to a Template (either by reference or by value), and may also provide additional metadata (name, description, properties). The creation order of components is not specified in `SystemTemplate`; in particular the order of the component descriptors in this array is not meaningful in terms of creation order.

Name	*componentDescriptor*	
Data	**Type**	**Description**
name	*string*	The value of the "name" attribute that is associated with a `System` component created from this component descriptor. Note: This name is not to be confused with the name that may be present in the component Template – e.g., a `MachineTemplate` – from which this component is instantiated. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support optional; read-write

<table>
<tr><td>Name</td><td colspan="4">SystemTemplate</td></tr>
<tr><td>Type URI</td><td colspan="4">http://schemas.dmtf.org/cimi/2/SystemTemplate</td></tr>
<tr><td>Attribute</td><td>Type</td><td colspan="3">Description</td></tr>
<tr><td></td><td></td><td>description</td><td>string</td><td>The value of the "description" attribute that is associated with a <code>System</code> component created from this component descriptor.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support optional; read-write</td></tr>
<tr><td></td><td></td><td>properties</td><td>map</td><td>The key/value pairs that is associated with a <code>System</code> component created from this component descriptor.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support optional; read-write</td></tr>
<tr><td></td><td></td><td>type</td><td>URI</td><td>The TypeURI of the component to be created from this component descriptor, e.g., for a <code>Machine</code>: http://schemas.dmtf.org/cimi/2/Machine
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
<tr><td></td><td></td><td><component Template></td><td><any></td><td>A reference either to a component Template or to the Template data itself inlined (i.e., the Template "value").
Note that the exact name of this attribute varies depending on the type of Resource being created, e.g., <code>MachineTemplate</code> for a <code>Machine</code>.
This attribute shall contain either:
A Template that is provided inline. Such an embedded Template may contain component references, each one of which shall resolve to the URI of a component with same name once created from this <code>SystemTemplate</code>.
A reference to an externally defined Template. Some attribute name/value pairs may be added inside the componentTemplate element to override similar attributes in the referred Template (as described in 4.2.1.1). This example shows how component references can be added to an external Template.
Example (JSON):
<pre>"machineTemplate": {
    "href":
"http://example.com/machineTemplates/72000",
     "credential": { "href": "#MyCredential"
}

  }</pre>Note: The “credential” attribute in this example assumes that there is another componentDescriptor item named “MyCredential" of type “Credential” in the SystemTemplate. It shall set or override similar attribute in the referred MachineTemplate if instantiating the Machine component.

<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
</table>

<table>
<tr><td>Name</td><td colspan="3">SystemTemplate</td></tr>
<tr><td>Type URI</td><td colspan="3">http://schemas.dmtf.org/cimi/2/SystemTemplate</td></tr>
<tr><td>Attribute</td><td>Type</td><td colspan="2">Description</td></tr>
<tr><td></td><td></td><td colspan="2">
<table>
<tr><td>quantity</td><td>integer</td><td>The number of component instances to be created from this component descriptor. By default, this number is equal to 1. If the value is 2 or more, the actual name assigned to each instance is the "name" value concatenated with a sequential number (e.g., if name="mymachine", and quantity=3, the names are: mymachine1, mymachine2, mymachine3.)
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write</td></tr>
</table>
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write
</td></tr>
<tr><td>serviceDescriptors</td><td>serviceDescriptor[]</td><td colspan="2">The list of service descriptors for the services to be supported by a <code>System</code> instance realized from this <code>SystemTemplate</code>. For each service descriptor, the corresponding <code>SystemService</code> is created when a <code>System</code> instance is created. The names of the System components subject to the service are listed using the symbolic component reference notation previously described (“#<name>”). Because each type of service has different configuration attributes, these are listed separately for service type, in ‘service type accessory attributes” tables outside this SystemTempalte table.
<table>
<tr><td>Name</td><td colspan="2">serviceDescriptor</td></tr>
<tr><td>Data</td><td>Type</td><td>Description</td></tr>
<tr><td>name</td><td>string</td><td>The value of the "name" attribute that is associated with a <code>SystemService</code> instance created from this service descriptor.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>description</td><td>string</td><td>The value of the "description" attribute that is associated with a <code>SystemService</code> instance created from this service descriptor.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>properties</td><td>map</td><td>The key/value pairs that is associated with a <code>SystemService</code> instance created from this service descriptor.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>serviceType</td><td>URI</td><td>The serviceType of the service to be created from this service descriptor, e.g., for a <code>SystemService</code> of type “localRecovery”:
<code>http://schemas.dmtf.org/cimi/2/SystemService/localrecovery</code>
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
<tr><td><service-specific-attribute></td><td></td><td>This is where additional service-specific attributes are listed (see section 5.13.6).</td></tr>
</table>
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write
</td></tr>
<tr><td>meterTemplates</td><td>MeterTemplates[]</td><td colspan="2">A list of references to <code>MeterTemplates</code> that shall be used to create and connect a set of new <code>Meters</code> to the new <code>System</code>.
Note that the attributes of the <code>MeterTemplate</code> may be specified rather than a</td></tr>
</table>

Name	SystemTemplate	
Type URI	http://schemas.dmtf.org/cimi/2/SystemTemplate	
Attribute	**Type**	**Description**
		reference to an existing `MeterTemplate` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
eventLog Template	*ref*	A reference to an `EventLogTemplate` that shall be used to create and connect a new `EventLog` to the new `System`. Note that the attributes of the `EventLogTemplate` may be specified rather than a reference to an existing `EventLogTemplate` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
import Image	*URI*	If the Template is the result of an import – e.g., of an OVF package - this attribute should be used. If present, it shall reference the import source (e.g., OVF package) used to create this Template. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only

When implementing or using `SystemTemplate`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 11 as well as in the tables describing embedded Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/SystemTemplate",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "parent": string, ?
  "properties": { string: string, + }, ?
  "componentDescriptors": [
    { "name": string, ?
      "description": string, ?
      "properties": { string: string, + }, ?
      "type": string,
      "componentTemplate": {
        "href": string, ?
        ... ComponentTemplate attributes ... ?
      },
   "quantity": number ?
    }, +
```

```
  ], ?
  "serviceDescriptors": [
    { "name": string, ?
      "description": string, ?
      "properties": { string: string, + }, ?
      "serviceType": string,
      …
    }, +
  ], ?
  "meterTemplates": [
    { "href": string, ?
      ... MeterTemplate attributes ... ?
    }, *
  ], ?
  "eventLogTemplate": {
    "href": string, ?
    ... EventLogTemplate attributes ... ?
  }, ?
  "importImage": string , ?

  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/export", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<SystemTemplate xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <parent> xs:anyURI </parent> ?
  <property key="xs:string"> xs:string </property> *
  <componentDescriptor>
    <name> xs:string </name> ?
```

```
    <description> xs:string </description> ?
    <property key="xs:string"> xs:string </property> *
    <type> xs:anyURI </type>
    <componentTemplate href="xs:anyURI"? >
      ... ComponentTemplate attributes ... ?
    </componentTemplate> *

    <quantity> xs:integer </quantity>
  </componentDescriptor> *
  <serviceDescriptor>
    <name> xs:string </name> ?
    <description> xs:string </description> ?
    <property key="xs:string"> xs:string </property> *
    <serviceType> xs:anyURI </serviceType>
    …
  </serviceDescriptor> *

  <meterTemplate href="xs:anyURI"? >
    ... MeterTemplate attributes ... ?
  </meterTemplate> *
  <eventLogTemplate href="xs:anyURI"? >
    ... EventLogTemplate attributes ... ?
  </eventLogTemplate> ?
  <importImage > xs:anyURI </importImage> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/export"
href="xs:anyURI"/> ?
  <xs:any>*
</SystemTemplate>
```

5.13.4.1 Operations

This Resource supports the Read, Update, and Delete operations. Create is supported through the `SystemTemplateCollection` Resource.

The following custom operations are also defined:

export

/link@rel: `http://schemas.dmtf.org/cimi/2/action/export`

This operation shall export a `SystemTemplate` along with all its component Resources as well as the used Resources that are listed in its top-level Collections . If an export package exists at that URI, it is updated with the values of the `SystemTemplate` and any component management Resources.

Otherwise a new export package is created at that URI with a Media Type as specified by the "format" parameter. Other formats may be used if supported, but are not specified by this standard.

Input parameters:

1) "format" - type: string - optional
2) Indicates the Media Type of the exported data. If not present, the default value shall be "application/ovf."
3) "destination" - type: URI - optional
4) Indicates the location to where the exported data is placed. If not present, the HTTP response Location header shall contain the URL to the exported data. Based on the specific protocol specified within the URI, the Consumer might need to provide additional information (such as credentials) in the "properties" field. In the case of HTTP, a PUT shall be used to place the data at the specified location.

Output parameters: None.

HTTP protocol

To export a `SystemTemplate`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/export" URI of the `SystemTemplate` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "action": "http://schemas.dmtf.org/cimi/2/action/export",
  "format": string, ?
  "destination": string, ?
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/export </action>
  <format> xs:string </format> ?
  <destination> xs:anyURI </destination> ?
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

5.13.5 SystemTemplateCollection Resource

A `SystemTemplateCollection` Resource represents the Collection of `SystemTemplate` Resources within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/SystemTemplateCollection",
```

```
  "id": string,
  "count": number,
  "systemTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/SystemTemplate",
      "id": string,
      ... remaining SystemTemplate attributes ...
    }, +
  ], ?
  "operations": [
    { "rel": "add", "href": string }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/import", "href": string } ?
  ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/2/SystemTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <SystemTemplate>
    <id> xs:anyURI </id>
    ... remaining SystemTemplate attributes ...
  </SystemTemplate> *
  <operation rel="add" href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/import"
href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.13.5.1 Operations

The following custom operations are defined:

import

/link@rel: `http://schemas.dmtf.org/cimi/2/action/import`

This operation shall import a `SystemTemplate`. Not only is a `SystemTemplate` created, but `MachineTemplates`, `VolumeTemplates`, and `NetworkTemplates` and possibly recursive `SystemTemplates` and their components may also be created, corresponding to imported descriptor entries. More detail about this process is in 0.

Input parameters:

1) "source" - type: URI - mandatory

2) Indicates the location from which the imported data is retrieved. Based on the specific protocol specified within the URI, the Consumer might need to provide additional information (such as credentials) in the "properties" field.

Output parameters: None.

HTTP protocol

To import a `SystemTemplate`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/import" URI of the `SystemTemplateCollection` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "action": "http://schemas.dmtf.org/cimi/2/action/import",
  "source": string, ?
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/import </action>
  <source> xs:anyURI </source> ?
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

5.13.6 Service-specific Descriptor attributes

This section defines the additional attributes specific to each service type that need be added to a serviceDescriptor for this service type in the SystemTemplate.

5.13.6.1 Attributes for the LocalRecovery service type

Service type: `http://schemas.dmtf.org/cimi/2/SystemService/localrecovery`

Table XX – Additional attributes for LocalRecovery service

Service type	`localrecovery`	
Attribute	**Type**	**Description**
machines	*String[]*	Symbolic references to the `Machine` components in the `System` that are subject to the service. Uses the symbolic component reference notation previously described (“#<name>”). **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
network	*string*	Symbolic reference to the `Network` Resource in the `System` that enables this service. The `Network` shall provide the necessary connections between

Service type	localrecovery	
Attribute	**Type**	**Description**
		Machines to support this Service..
heartbeat	Integer	Heartbeat frequency, in term of millisecs between an heartbeat and the next. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
replicationType	String	The kind of disk replication data (it does not refer to the Volume Resource) allowable values are: **synchronous**, **asynchronous**, **none**, **onlyAtClusterCreation** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read- write
RPO	Integer	Recovery Point Objective (duration in minutes) in case of asynchronous replica of the disks. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write

2724

2725 #### 5.13.6.2 Attributes for the LocalBalancing service type

2726 Service type: `http://schemas.dmtf.org/cimi/2/SystemService/localbalancing`

2727 **Table XX – Additional attributes for LocalBalancing service**

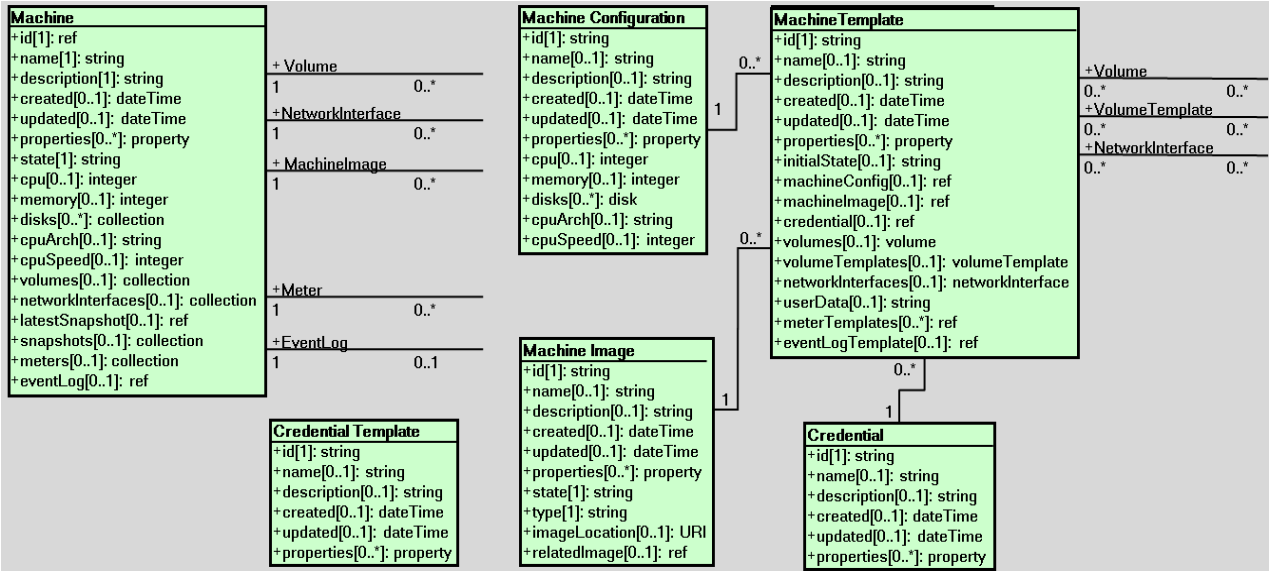
Service type	localbalancing	
Attribute	**Type**	**Description**
machines	*String[]*	Symbolic references to the `Machine` components in the `System` that are subject to the service. Uses the symbolic component reference notation previously described ("#<name>"). When a `Machine` name is listed for which there are several instances specified in the componentDescriptor (`quantity` attribute), all of them are subject to the service. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
network	*string*	Symbolic references to the `Network` Resource in the `System` that enables this service. The `Network` shall include a LoadBalancing `NetworkService`.

2728

2729

2730 5.14 Machine Resources and relationships

2731 Figure 3 illustrates the Resources involved in constructing a `Machine` and their relationships. Although
2732 this drawing is in the style of a Resource Relationship diagram, the use of UML is neither rigorous nor
2733 normative.



2734 **Figure 3 - Machine Resources**

2735 ### 5.14.1 Machine

2736 An instantiated compute Resource that encapsulates both CPU and Memory. Table 12 describes the
2737 `Machine` attributes.

2738 **Table 12 – Machine attributes**

Name	Machine	
Type URI	http://schemas.dmtf.org/cimi/2/Machine	
Attribute	**Type**	**Description**
state	*string*	The operational state of the Machine. Allowed values are: **CREATING**: The `Machine` is in the process of being created. **STARTING**: The `Machine` is in the process of being started. **STARTED**: The `Machine` is available and ready for use. **STOPPING**: The `Machine` is in the process of being stopped. **STOPPED**: This value is the virtual equivalent of powering off a physical `Machine`. There is no saved CPU or memory state. Clause 5.14.2.1 defines the initial state of a `Machine`. **PAUSING**: The `Machine` in the process of being PAUSED. **PAUSED**: In this state the `Machine` and its virtual resources remain instantiated and resources remain allocated, similar to the "STARTED" state, but the `Machine` and its virtual resources are not enabled to perform tasks. This is equivalent to a “stand-by” state. **SUSPENDING**: The `Machine` is in the process of being suspended. **SUSPENDED**: In this state the `Machine` and its virtual resources are stored on non-volatile storage. The `Machine` and its resources are not enabled to perform tasks. **CAPTURING:** If the Machine is undergoing the “capture” operation its state may be set to “CAPTURING”. If some operations that were accepted by the Machine before the capture are no longer available during the capture, the Machine shall be in state “CAPTURING. **RESTORING:** The `Machine` is in the process of being restored from a `MachineImage`. **DELETING**: The `Machine` is in the process of being deleted. **ERROR**: The Provider has detected an error in the `Machine`.

Name	Machine	
Type URI	http://schemas.dmtf.org/cimi/2/Machine	
Attribute	**Type**	**Description**
		FAILED: the `Machine` is not operational due to some error condition and in accordance to the Provider's policies it is considered *failed*. This state calls for a recovery procedure, if any. The operations that result in transitions to the above defined states are defined in clause 5.14.1.2. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
cpu	*integer*	The amount of CPU that this `Machine` has. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
memory	*integer*	The size of the memory (RAM) in kibibytes allocated to this `Machine`. If this value is increased, it implies that the `Machine` is allocated more RAM, and vice versa if the value is decreased. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
disks	*collection [Disk]*	A reference to the list of disks (local storage) that are part of the `Machine`. Adding an element to this list creates a disk. The `Disk` Resources are components of the Machine. Note: The `Disk` Resource type is defined in clause 5.14.1.1.1. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
cpuArch	*string*	The CPU architecture that is supported by `Machines` created by using this configuration. Allowed values are: **68000**, **Alpha**, **ARM**, **Itanium**, **MIPS**, **PA_RISC**, **POWER**, **PowerPC**, **x86**, **x86_64**, **z/Architecture**, **SPARC**. Providers may define additional values. **Constraints:** **Provider:** support optional; immutable **Consumer:** support optional; read-only
cpuSpeed	*integer*	The approximate CPU speed of this `Machine` - in megahertz. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
volumes	*collection [located Volume]*	A reference to the list of references to `Volumes` that are connected to this `Machine`. Adding a `Volume` to this list means that the `Machine` has some access to the data on the `Volume`. Removing a `Volume` from this list means that the `Machine` no longer has access to the data on the `Volume`. Note: . This Collection has the semantics of usage of the `Volumes` by the `Machine` (deleting the Machine does not cause the deletion of the referred Volumes). It is defined in clause **Error! Reference source not found.**. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only

Name	Machine	
Type URI	http://schemas.dmtf.org/cimi/2/Machine	
Attribute	**Type**	**Description**
interfaces	*collection [NetworkInterface]*	A reference to a list of references to `NetworkInterfaces` on this `Machine`. Each `NetworkInterface` Resource is a component of the Machine Resource. Each `NetworkInterface` instance represents an association between the `Machine` and a `Network`. `NetworkInterfaces` are defined in clause 5.16.13. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
latestSnapshot	*ref*	A reference to the SNAPSHOT representing the latest state captured for this `Machine` (either most recent `Snapshot` or the last `Snapshot` reverted to). **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
snapshots	*collection [MachineImage]*	A reference to the list of references to the `MachineImages` of type SNAPSHOT taken of this `Machine`. This Collection has the semantics of usage of SNAPSHOT `MachineImages` by the `Machine` (The deletion of the Machine does not cause the deletion of the referred Snapshots.) **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
meters	*collection [Meter]*	A reference to the list of `Meters` monitored for this `Machine`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
eventLog	*ref*	A reference to the `EventLog` of this `Machine`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only

When implementing or using `Machine`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 12, as well as in the tables describing embedded Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML:

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Machine",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "parent": string, ?
  "properties": { string: string, + }, ?
  "vscope" : [ valueScope, * ], ?
  "state": string,
  "cpu": number,
  "memory": number,
```

```
  "disks" : { "href": string }, ?
  "cpuArch": string, ?
  "cpuSpeed": number, ?
  "volumes": { "href": string }, ?
  "interfaces": { "href": string }, ?
  "latestSnapshot": { "href": string }, ?
  "snapshots": { "href": string }, ?
  "meters": { "href": string }, ?
  "eventLog": { "href": string }, ?
  "operations": [
    { "rel": "edit", "href": string, ("available": boolean)? }, ?
    { "rel": "delete", "href": string, ("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/start", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/stop", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/restart", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/pause", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/suspend", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/snapshot", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/restore", "href": string,
("available": boolean)? } ?
  ]
  ...
}
```

XML media type: application/xml

XML serialization:

```
<Machine xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <parent> xs:anyURI </parent> ?
  <property key="xs:string"> xs:string </property> *
  <vscope> valueScope </vscope> *
  <state> xs:string </state>
  <cpu> xs:integer </cpu>
```

```
  <memory> xs:integer </memory>
  <disks href="xs:anyURI"/> ?
  <cpuArch> xs:string </cpuArch> ?
  <cpuSpeed> xs:integer </cpuSpeed> ?
  <volumes href="xs:anyURI"/> ?
  <interfaces href="xs:anyURI"/> ?
  <latestSnapshot href="xs:anyURI"/> ?
  <snapshots href="xs:anyURI"/> ?
  <meters href="xs:anyURI"/> ?
  <eventLog href="xs:anyURI"/> ?
  <operation rel="edit" href="xs:anyURI" (available="xs:boolean")? /> ?
  <operation rel="delete" href="xs:anyURI" (available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/start" href="xs:anyURI"
(available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/stop" href="xs:anyURI"
(available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/restart"
href="xs:anyURI" (available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/pause" href="xs:anyURI"
(available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/suspend"
href="xs:anyURI" (available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/capture"
href="xs:anyURI" (available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/snapshot"
href="xs:anyURI" (available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/restore"
href="xs:anyURI" (available="xs:boolean")? /> ?
  <xs:any>*
</Machine>
```

5.14.1.1 Collections

The following clause describes the Collection Resources components of `Machines`.

5.14.1.1.1 Disk Collection

The Resource type for each item of this Collection is "`Disk`", defined in Table 13:

Table 13 – Disk attributes

Name	Disk	
Type URI	http://schemas.dmtf.org/cimi/2/Disk	
Attribute	**Type**	**Description**
capacity	*integer*	The initial capacity, in kilobytes, of the disk. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
initialLocation	*string*	Operating System-specific location (path) in its namespace where this disk first appears. After deployment, Consumers may consider moving the location of this Disk..

		Support of this attribute indicates that the Provider can report this information back to the Consumer. **Constraints:** **Provider:** support optional; immutable **Consumer:** support optional; read-only

In the following serializations, the Disk resource is expanded: each item of the Collection shows the Disk attributes, not a reference.

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/DiskCollection",
  "id": string,
  "count": number,
  "disks": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/Disk",
      "id": string,
      "name": string, ?
      "description": string, ?
      "created": string, ?
      "updated": string, ?
      "properties": { string: string, + }, ?
      "capacity": number,
      "initialLocation": string, ?
      "operations": [
        { "rel": "edit", "href": string }, ?
        { "rel": "delete", "href": string } ?
      ] ?
      ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/2/DiskCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <Disk>
    <id> xs:anyURI </id>
    <name> xs:string </name> ?
    <description> xs:string </description> ?
    <created> xs:dateTime </created> ?
```

```
    <updated> xs:dateTime </updated> ?
    <property key="xs:string"> xs:string </property> *
    <capacity> xs:integer </capacity>
    <initialLocation> xs:string </initialLocation> ?
    <operation rel="edit" href="xs:anyURI"/> ?
    <operation rel="delete" href="xs:anyURI"/> ?
    <xs:any>*
  </Disk> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.14.1.1.2 volumes Collection

The referred Resource type for each item of this Collection is "`Volume`". However because there is an accessory attribute (initialLocation), this is not a basic but an enhanced Volume Collection. The name "locatedVolume" is used to define the type of each Collection item. The accessory attribute is defined in Table 14:

Table 14 – `locatedVolume` accessory attributes

Name	locatedVolume	
Type URI	http://schemas.dmtf.org/cimi/2/locatedVolume	
Attribute	**Type**	**Description**
initialLocation	*string*	Operating System-specific location (path) in its namespace where this `Volume` first appears. Note, once deployed, Consumers might move the location of this `Volume`. Support of this attribute indicates that the Provider can report this information back to the Consumer. **Constraints:** **Provider:** support optional; immutable **Consumer:** support optional; read-only

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/locatedVolumeCollection",
  "id": string,
  "updated": string,
  "parent": string,
  "count": number,
  "locatedVolumes": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/locatedVolume",
      "id": string,
      "name": string, ?
      "description": string, ?
      "created": string, ?
      "updated": string, ?
      "parent": string, ?
      "properties": { string: string, + }, ?
```

```
      "initialLocation": string, ?
      "volume": { "href": string },
      "operations": [
        { "rel": "edit", "href": string }, ?
        { "rel": "delete", "href": string } ?
      ] ?
      ...
    }, +
  ], ?
  "operations": [
    { "rel": "add", "href": string } ?
    { "rel": "insert", "href": string } ?
    { "rel": "remove", "href": string } ?
  ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/2/locatedVolumeCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <updated> xs:dateTime </updated>
  <parent> xs:anyURI </parent>
  <count> xs:integer </count>
  <locatedVolume>
    <id> xs:anyURI </id>
    <name> xs:string </name> ?
    <description> xs:string </description> ?
    <created> xs:dateTime </created> ?
    <updated> xs:dateTime </updated> ?
    <parent> xs:anyURI </parent> ?
    <property key="xs:string"> xs:string </property> *
    <initialLocation> xs:string </initialLocation> ?
    <volume href="xs:anyURI"/>
    <operation rel="edit" href="xs:anyURI"/> ?
    <operation rel="delete" href="xs:anyURI"/> ?
    <xs:any>*
  </locatedVolume> *
  <operation rel="add" href="xs:anyURI"/> ?
  <operation rel="insert" href="xs:anyURI"/> ?
```

```
  <operation rel="remove" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.14.1.1.3 interfaces Collection

The Resource type for each item of this Collection is "`NetworkInterface`", defined in clasue 5.16.13. The Collection is a basic `NetworkInterfaceCollection` as described in clause 5.16.14.

5.14.1.1.4 snapshots Collection

The Resource type for each item of this Collection is "`MachineImage`". It is a basic `MachineImage` Collection. Its serialization is described in the `MachineImageCollection` Resource clause.

5.14.1.1.5 meters Collection

The Resource type for each item of this Collection is "`Meter`" as defined in clause 5.17.3. There is no accessory attribute for the items in this Collection, therefore it is a basic `Meter` Collection (serialized as described in 5.5.12). See the MeterCollection Resource clause.

5.14.1.2 Operations

This Resource supports the Read, Update, and Delete operations. Create is supported through the MachineCollection Resource.

The following custom operations are also defined:

start

/link@rel: `http://schemas.dmtf.org/cimi/2/action/start`

This operation shall start a `Machine`.

Input parameters: None.

Output parameters: None.

During the processing of this operation, the `Machine` shall be in the "STARTING" state.

Upon successful completion of this operation, the `Machine` shall be in the "STARTED" state.

If a `Machine` is in the "STOPPED" state, starting it shall be the virtual equivalent of powering on a physical machine. There is no restored CPU or Memory state, so the guest OS typically performs boot or installation tasks.

If the `Machine` was in the "SUSPENDED" or "PAUSED" state, starting it shall have the effect of resuming it.

HTTP protocol

To start a `Machine`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/start" URI of the `Machine` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
```

```
  "action": "http://schemas.dmtf.org/cimi/2/action/start",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/start </action>
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

Upon successful processing of the request, the HTTP response body may be empty.

stop

/link@rel: `http://schemas.dmtf.org/cimi/2/action/stop`

This operation shall stop a `Machine`.

Input parameters:

1) "force" - type: boolean - optional
2) A flag to indicate whether the Provider shall simulate a power off condition (force=true) or shall simulate a shutdown operation that allows applications to save their state and the file system to be made consistent (force=false). Inclusion of this parameter by Consumers is optional and if not specified, the Provider may choose either mechanism. Providers are encouraged to advertise this choice by the way of the MachineStopForceDefault capability.

Output parameters: None.

During the processing of this operation, the `Machine` shall be in the "STOPPING" state.

Upon successful completion of this operation, the `Machine` shall be in the "STOPPED" state. Stopping a `Machine` with force=true shall be the virtual equivalent of powering off a physical machine. There is no saved CPU or Memory state. Stopping a `Machine` with force=false shall result in a machine with consistent file systems.

A Consumer may reissue a stop operation if the state is STOPPING, perhaps with force=true, but Providers shall not issue a force=true stop operation on their own.

HTTP protocol

To stop a `Machine`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/stop" URI of the `Machine` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
  "action": "http://schemas.dmtf.org/cimi/2/action/stop",
  "force": boolean, ?
```

```
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/stop </action>
  <force> xs:boolean </force> ?
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

Upon successful processing of the request, the HTTP response body may be empty.

restart

/link@rel: `http://schemas.dmtf.org/cimi/2/action/restart`

This operation shall restart a `Machine`. If the `Machine` is in the "STARTED" state, this operation shall have the effect of executing the "stop" and then "start" operations. If the `Machine` is in the "STOPPED" state, this operation shall have the effect of executing the "start" operation.

Input parameters:

1) "force" - type: boolean - optional
2) A flag to indicate whether the Provider shall simulate a power off condition (force=true) or shall simulate a shutdown operation that allows applications to save their state and the file system to be made consistent (force=false). Inclusion of this parameter by Consumers is optional and if not specified, the Provider may choose either mechanism. Providers are encouraged to advertise this choice by the way of the MachineStopForceDefault capability.

Output parameters: None.

During the processing of this operation, the `Machine` shall be in the “STOPPING” and/or “STARTING” states, as appropriate depending on its initial state.

Upon successful completion of this operation, the `Machine` shall be in the "STARTED" state. Restarting a `Machine` shall be the virtual equivalent of powering off, and then powering on a physical machine. There is no restored CPU or Memory state, so the guest OS typically performs boot or installation tasks.

HTTP protocol

To restart a `Machine`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/restart" URI of the `Machine` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
  "action": "http://schemas.dmtf.org/cimi/2/action/restart",
  "force": boolean, ?
  "properties": { string: string, + } ?
```

```
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/restart </action>
  <force> xs:boolean </force> ?
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

Upon successful processing of the request, the HTTP response body may be empty.

pause

/link@rel: `http://schemas.dmtf.org/cimi/2/action/pause`

This operation shall pause a `Machine`.

Input parameters: None.

Output parameters: None.

During the processing of this operation, the `Machine` shall be in the "PAUSING" state.

Upon successful completion of this operation, the `Machine` shall be in the "PAUSED" state. Pausing a `Machine` shall keep the `Machine` and its resources instantiated, but the `Machine` shall not be available to perform any tasks. The current state of the CPU and Memory shall be retained in volatile memory.

HTTP protocol

To pause a `Machine`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action.pause" URI of the `Machine` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
  "action": "http://schemas.dmtf.org/cimi/2/action/pause",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/pause </action>
  <property key="xs:string"> xs:string </property> *
```

```
  <xs:any>*
</Action>
```

Upon successful processing of the request, the HTTP response body may be empty.

suspend

/link@rel: `http://schemas.dmtf.org/cimi/2/action/suspend`

This operation shall suspend a `Machine`.

Input parameters: None.

Output parameters: None.

During the processing of this operation, the `Machine` shall be in the "SUSPENDING" state.

Upon successful completion of this operation, the `Machine` shall be in the "SUSPENDED" state. Suspending a `Machine` shall keep the `Machine` and its resources instantiated, but the `Machine` shall not be available to perform any tasks. The current state of the CPU and Memory shall be retained in non-volatile memory.

HTTP protocol

To suspend a `Machine`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/suspend" URI of the `Machine` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
  "action": "http://schemas.dmtf.org/cimi/2/action/suspend",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/suspend </action>
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

Upon successful processing of the request, the HTTP response body may be empty.

capture

/link@rel: `http://schemas.dmtf.org/cimi/2/action/capture`

This operation shall create a new `MachineImage` from an existing `Machine`. This operation is defined within the `MachineImage` Resource; see 5.14.7.1 for more details. Note that while this operation is

performed against a `MachineImage`, its presence in the `Machine` serialization is used to advertise support for the operation.

Snapshotting a Machine

/link@rel: `http://schemas.dmtf.org/cimi/2/action/snapshot`

This operation shall create a new SNAPSHOT `MachineImage` from an existing `Machine`. This operation is defined within the `MachineImage` Resource; see 5.14.7.1 for more details. Note that while this operation is performed against a `MachineImage`, its presence in the `Machine` serialization is used to advertise support for the operation.

Restoring a Machine

/link@rel: `http://schemas.dmtf.org/cimi/2/action/restore`

This operation shall restore a `Machine` from a previously created `MachineImage`.

Input parameters:

1) "image" - type: URI - mandatory
2) A reference to the Machine Image.

Output parameters: None.

During the processing of this operation, the `Machine` shall be in the "RESTORING" state.

Upon successful completion of this operation, the `Machine` shall be in the same state as the state specified in the `MachineImage`, if specified. See 5.14.2.1 for more details.

Note that Providers can indicate support for restoring from non-SNAPSHOT `MachineImages` by the way of the Machine "RestoreFromImage" capability. If the RestoreFromImage capability is not supported, and the restore operation is supported, the restore operation can only restore from a SNAPSHOT `MachineImage`.

HTTP protocol

To restore a `Machine`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/restore" URI of the `Machine` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
  "action": "http://schemas.dmtf.org/cimi/2/action/restore",
  "image": { "href": string },
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/restore </action>
```

```
  <image href="xs:anyURI"/>
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

Where the "image" URI is a reference to the `MachineImage` to be used.

Upon successful processing of the request, the HTTP response body may be empty.

5.14.2 MachineCollection Resource

A `MachineCollection` Resource represents the Collection of `Machine` Resources within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/MachineCollection",
  "id": string,
  "updated": string,
  "parent": string,
  "count": number,
  "machines": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/Machine",
      "id": string,
      "name": string, ?
      "description": string, ?
      "created": string, ?
      "updated": string, ?
      "parent": string, ?
      "properties": { string: string, + }, ?
      "machine": { "href": string },
      "operations": [
        { "rel": "edit", "href": string }, ?
        { "rel": "delete", "href": string } ?
      ] ?
     }, +
   ], ?
  "operations": [
     { "rel": "add", "href": string }, ?
     { "rel": "insert", "href": string }, ?
     { "rel": "remove", "href": string } ?
   ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/2/MachineCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <updated> xs:dateTime </updated>
  <parent> xs:anyURI </parent>
  <count> xs:integer </count>
  <Machine>
    <id> xs:anyURI </id>
    <name> xs:string </name> ?
    <description> xs:string </description> ?
    <created> xs:dateTime </created> ?
    <updated> xs:dateTime </updated> ?
    <parent> xs:anyURI </parent> ?
    <property key="xs:string"> xs:string </property> *
    <machine href="xs:anyURI"/>
    <operation rel="edit" href="xs:anyURI"/> ?
    <operation rel="delete" href="xs:anyURI"/> ?
    <xs:any>*
  </Machine> *
  <operation rel="add" href="xs:anyURI"/> ?
  <operation rel="insert" href="xs:anyURI"/> ?
  <operation rel="remove" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.14.2.1 Operations

NOTE The "add" operation requires that a MachineTemplate be used (see 4.2.1.1).

Upon successful processing of the "add" operation, unless otherwise specified by the way of the `MachineTemplate` "initialState" attribute, the state of the new `Machine` shall be the value of the DefaultInitialState capability, if defined. If no DefaultInitialState capability is defined, the default value shall be "STOPPED." The semantics of "initialState" shall be equivalent to the Provider issuing the appropriate actions against the new `Machine` to move it into that state. Note that this controls the actions of the hypervisor and the state of the resources within the `Machine` (e.g., the operating system) are also influenced by the data within the `MachineImage` used to create the new `Machine`. For example, if a new `Machine's` initialState is "STARTED" and a SNAPSHOT `MachineImage` was used to create the new `Machine`, the `Machine` would not be "booted" but rather resume executing from the saved state in the `MachineImage`.

If a Provider is unable to change the state of the new `Machine` to the appropriate "initialState" (either as specified by the `MachineTemplate` or as implied by the previous stated rules), the `Machine` creation shall fail.

If a Provider is unable to create the new `Machine` due to invalid or inconsistent credentials in the `MachineTemplate`, the `Machine` creation process shall fail. If any credentials are included in the `MachineTemplate`, they shall be part of the new `Machine` regardless of the type of `MachineImage` used.

5.14.3 MachineTemplate

A `MachineTemplate` represents the set of metadata and instructions used in the creation of a `Machine`. Table 15 describes the `MachineTemplate` attributes.

Table 15 – MachineTemplate attributes

Name	MachineTemplate	
Type URI	http://schemas.dmtf.org/cimi/2/MachineTemplate	
Attribute	**Type**	**Description**
initialState	*string*	The initial state of the new `Machine`. Possible values include the non-transient states as specified by the `Machine` "state" attribute (e.g., STARTED, STOPPED) and are determined by the actions supported by the Provider. Providers should advertise the list of available values through the `Machine's` "initialStates" capability. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
machineConfig	*ref*	A reference to the `MachineConfiguration` that is used to create a `Machine` from this `MachineTemplate`. Note that the attributes of the `MachineConfiguration` may be specified rather than a reference to an existing `MachineConfiguration` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
machineImage	*ref*	A reference to the `MachineImage` that is used to create a `Machine` from this `MachineTemplate`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
credential	*ref*	A reference to the `Credential` that is used to create the initial login credentials for the new `Machine`. Note that the attributes of the `Credential` may be specified rather than a reference to an existing `Credential` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write

<table>
<tr><th>Name</th><td colspan="2">MachineTemplate</td></tr>
<tr><th>Type URI</th><td colspan="2">http://schemas.dmtf.org/cimi/2/MachineTemplate</td></tr>
<tr><th>Attribute</th><th>Type</th><th>Description</th></tr>
<tr><td>volumes</td><td>volume[]</td><td>A list of structures, each containing a reference to an existing <code>Volume</code> and potentially describing aspects of the way that the given <code>Volume</code> is to be connected to the <code>Machine</code> during its creation from this <code>MachineTemplate</code>. Each volume structure has the following attributes:
<table>
<tr><th>Name</th><td colspan="2">volume</td></tr>
<tr><th>Attribute</th><th>Type</th><th>Description</th></tr>
<tr><td>initialLocation</td><td>string</td><td>An Operating System-specific location (path) in its namespace where the Volume appears.
Support of this attribute indicates that the Provider allows for Consumers to choose where the Volume appears.
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>volume</td><td>ref</td><td>Reference to the <code>Volume</code> that is connected.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
</table>
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>volumeTemplates</td><td>volumeTemplate[]</td><td>A list of structures, each containing a reference to a <code>VolumeTemplate</code> from which a <code>Volume</code> is created and connected to the <code>Machine</code> resulting from this <code>MachineTemplate</code>. Each structure can potentially also include aspects of the way in which each created <code>Volume</code> is connected to the created <code>Machine</code>.
If the <code>Machine</code> is created as part of a <code>System</code> creation, the <code>Volumes</code> created from these Templates are considered as part of that <code>System</code> without the need for these <code>VolumeTemplates</code> to also be listed in the volumeTemplates attribute of the relevant <code>SystemTemplate</code>. If the same <code>VolumeTemplate</code> reference is listed in both the volumeTemplates attribute of a <code>SystemTemplate</code> and in the volumeTemplates attribute of a <code>MachineTemplate</code> component of that <code>SystemTemplate</code>, this means that multiple, distinct <code>Volume</code> instances are created as part of the overall <code>System</code> creation. Each volumeTemplate structure has the following attributes:
<table>
<tr><th>Name</th><td colspan="2">volumeTemplate</td></tr>
<tr><th>Attribute</th><th>Type</th><th>Description</th></tr>
<tr><td>initialLocation</td><td>string</td><td>An Operating System-specific location (path) in its namespace where the Volume appears.
Support of this attribute indicates that the Provider allows for Consumers to choose where the Volume appears.
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>volumeTemplate</td><td>ref</td><td>Reference to the <code>VolumeTemplate</code> that is used to create a new <code>Volume</code>.
Note that the attributes of the <code>VolumeTemplate</code> may be specified rather than a reference to an existing <code>VolumeTemplate</code> Resource.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
</table>
</td></tr>
</table>

Name	MachineTemplate	
Type URI	http://schemas.dmtf.org/cimi/2/MachineTemplate	
Attribute	**Type**	**Description**
		Constraints: **Provider:** support optional; mutable **Consumer:** support optional; read-write
interfaceTemplates	*Network Interface Template[]*	A list of references to `NetworkInterfaceTemplates` that shall be used to create a new set of `NetworkInterface` Resources for the new `Machine`. Note that the attributes of a `NetworkInterfaceTemplate` may be given instead of a reference to an existing `NetworkInterfaceTemplate` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
userData	*string*	A Base64 encoded string whose decoded version is to be injected into Machines created by using this Template. See the discussion of injection of user-defined data below. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
meterTemplates	*meterTemplates[]*	A list of references to `MeterTemplates` that shall be used to create and connect a set of new `Meters` to the new `Machine`. Note that the attributes of the `MeterTemplate` may be specified rather than a reference to an existing `MeterTemplate` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
eventLogTemplate	*ref*	A reference to an `EventLogTemplate` that shall be used to create and connect a new `EventLog` to the new `Machine`. Note that the attributes of the `EventLogTemplate` may be specified rather than a reference to an existing `EventLogTemplate` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write

When implementing or using `MachineTemplate`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 15, as well as in the tables describing embedded Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML:

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/MachineTemplate",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "vscope" : [ valueScope, * ], ?
  "initialState": string, ?
```

```
  "machineConfig": {
    "href": string | ... MachineConfiguration attributes ...
  }, ?
  "machineImage": {
    "href": string | ... MachineImage attributes ...
  }, ?
  "credential": {
    "href": string | ... CredentialTemplate attributes ...
  }, ?
  "volumes": [
    { "initialLocation": string?, "href": string }, +
  ], ?
  "volumeTemplates": [
    { "initialLocation": string?,
      "href": string, ?
      ... VolumeTemplate attributes ... ?
    }, +
  ], ?
  "interfaceTemplates": [
    { "href": string, ?
      ... NetworkInterfaceTemplate attributes ... ?
    }, *
  ], ?
  "userData": string, ?
  "meterTemplates": [
    { "href": string, ?
      ... MeterTemplate attributes ... ?
    }, *
  ], ?
  "eventLogTemplate": {
    "href": string, ?
    ... EventLogTemplate attributes ... ?
  }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<MachineTemplate xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <vscope> valueScope </vscope> *
  <initialState> xs:string </initialState> ?
  <machineConfig href="xs:anyURI"?>
    ... MachineConfiguration attributes ... ?
  </machineConfig> ?
  <machineImage href="xs:anyURI"?>
    ... MachineImage attributes ... ?
  </machineImage> ?
  <credential href="xs:anyURI"?>
    ... CredentialTemplate attributes ... ?
  </credential> ?
  <volume initialLocation="xs:string"? href="xs:anyURI" /> *
  <volumeTemplate initialLocation="xs:string"? href="xs:anyURI"? >
    ... VolumeTemplate attributes ... ?
  </volumeTemplate> *
  <interfaceTemplate href="xs:anyURI"? >
    ... NetworkInterfaceTemplate attributes ... ?
  </interfaceTemplate> *
  <userData> xs:string </userData> ?
  <meterTemplate href="xs:anyURI"? >
    ... MeterTemplate attributes ... ?
  </meterTemplate> *
  <eventLogTemplate href="xs:anyURI"? >
    ... EventLogTemplate attributes ... ?
  </eventLogTemplate> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</MachineTemplate>
```

Injection of user-defined data

To simplify the customization of individual `Machines`, it is possible to pass arbitrary data into the new `Machine` by using the userData parameter. The value of this parameter shall be the Base64-encoded payload. The Provider shall arrange for this data to be available from inside the `Machine` by using one of the following methods:

1. *Metadata server*: The data can be retrieved from within the instance by using an HTTP GET request to http://169.254.169.254/cimi/latest/user-data.
2. *Disk*: The `Machine` has access to a Disk with an ISO 9660 file system on it. The data can be found in a file at <*location*>/cimi/user-data.
3. *Image modification*: The Provider modifies the root file system of the machine image just before launching the `Machine`. In UNIX-like operating systems, the data can be found in the file /var/lib/cimi/user-data.

It is strongly recommended that Providers implement a `metadata server`, or, failing that, injection by the way of `Disk`, as `image modification` is brittle and may not work for every operating system in use. The Provider shall indicate which of these three methods is supported with the `Machine` 'UserData' capability in the `ResourceMetadata` for `Machines`. The value for this feature shall be one of metadata, disk, or imgmod, corresponding to the three methods listed above.

The Provider shall preserve this data across restarts of the `Machine`. The data is the Base64-decoded version of the data that was passed into the `MachineCreate` request.

5.14.3.1 Operations

This Resource supports the Read, Update, and Delete operations. Create is supported through the MachineTemplateCollection Resource.

5.14.4 MachineTemplateCollection Resource

A `MachineTemplateCollection` Resource represents the Collection of `MachineTemplate` Resources within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/MachineTemplateCollection",
  "id": string,
  "count": number,
  "machineTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/MachineTemplate",
      "id": string,
      ... remaining MachineTemplate attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/2/MachineTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <MachineTemplate>
    <id> xs:anyURI </id>
    ... remaining MachineTemplate attributes ...
  </MachineTemplate> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.14.4.1 Operations

This Resource supports the Read and Update operations. Creation of new `MachineTemplate` Resources is supported by the way of a POST to the "add" operation's URI as described in clause 4.2.1.1.

5.14.5 MachineConfiguration Resource

The `MachineConfiguration` Resource represents the set of configuration values that define the (virtual) hardware resources of a to-be-realized Machine Instance. `MachineConfigurations` are created by Providers and may, at the Providers discretion, be created by Consumers.

Table 16 describes the `MachineConfiguration` attributes.

Table 16 – MachineConfiguration attributes

Name	MachineConfiguration	
Type URI	http://schemas.dmtf.org/cimi/2/MachineConfiguration	
Attribute	**Type**	**Description**
cpu	*integer*	The amount of CPU that a `Machine` realized from this configuration. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
memory	*integer*	The amount of RAM, in kibibytes, that a `Machine` realized from this configuration. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support optional; read-write
disks	disk[]	A list of structures, each containing the attributes defining the disks to be created for the `Machine` instantiated with this `MachineConfiguration` Resource. The disks are local storage to the Machine. Each disks attribute has the following sub-attributes:

Name	*disk*	
Attribute	**Type**	**Description**
capacity	*integer*	The initial capacity, in kilobytes, of the disk described by this attribute. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
format	*string*	The format/type of this disk (e.g., ext4, NTFS).

<table>
<tr><td>Name</td><td colspan="3">MachineConfiguration</td></tr>
<tr><td>Type URI</td><td colspan="3">http://schemas.dmtf.org/cimi/2/MachineConfiguration</td></tr>
<tr><td>Attribute</td><td>Type</td><td colspan="2">Description</td></tr>
<tr><td></td><td></td><td colspan="2">
<table>
<tr><td></td><td></td><td><u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
<tr><td>initialLocation</td><td>string</td><td>An Operating System-specific location (path) in its namespace where this <code>Disk</code> first appears. After creation of a <code>Machine</code>, Consumers may change the location of this <code>Disk</code>.
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write</td></tr>
</table>
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>cpuArch</td><td>string</td><td colspan="2">The CPU architecture that is supported by <code>Machines</code> created by using this configuration. Allowed values are: 68000, Alpha, ARM, Itanium, MIPS, PA_RISC, POWER, PowerPC, x86, x86_64, z/Architecture, SPARC. Providers may define additional values.
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>cpuSpeed</td><td>integer</td><td colspan="2">The approximate CPU speed of this Machine in megahertz.
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write</td></tr>
</table>

NOTE The disk attributes "format" does not appear on Machine Resources because after the `Machine` is created, the user of the `Machine` is able modify this attribute of a disk, possibly without the Provider's knowledge. Therefore these attributes might not be an aspect of the `Machine` that the Provider can reliably manage.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/MachineConfiguration",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "vscope" : [ valueScope, * ], ?
  "cpu": number,
  "memory": number,
  "disks" : [
    { "capacity": number,
      "format": string,
      "initialLocation": string?
    }, +
  ], ?
  "cpuArch": string, ?
```

```
  "cpuSpeed": number, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<MachineConfiguration xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <vscope> valueScope </vscope> *
  <cpu> xs:integer </cpu>
  <memory> xs:integer </memory>
  <disk>
    <capacity> xs:integer </capacity>
    <format> xs:string </format>
    <initialLocation> xs:string </initialLocation> ?
  </disk> *
  <cpuArch> xs:string </cpuArch> ?
  <cpuSpeed> xs:integer </cpuSpeed> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</MachineConfiguration>
```

5.14.5.1 Operations

This Resource supports the Read, Update, and Delete operations. Create is supported through the `MachineConfigurationCollection` Resource.

5.14.6 MachineConfigurationCollection Resource

A `MachineConfigurationCollection` Resource represents the Collection of `MachineConfiguration` Resources within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI":
    "http://schemas.dmtf.org/cimi/2/MachineConfigurationCollection",
  "id": string,
  "count": number,
  "machineConfigurations": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/MachineConfiguration",
      "id": string,
      ... remaining MachineConfiguration attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/2/MachineConfigurationCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <MachineConfiguration>
    <id> xs:anyURI </id>
    ... remaining MachineConfiguration attributes ...
  </MachineConfiguration> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.14.6.1 Operations

This Resource supports the Read and Update operations. Creation of new `MachineConfiguration` Resources is supported by the way of a POST to the "add" operation's URI as described in clause 4.2.1.1.

5.14.7 MachineImage Resource

This Resource represents the information necessary for hardware virtualized Resources to create a `Machine` Instance; it contains configuration data such as startup instructions, including possible combinations of the following items, depending on the “type” of `MachineImage` created:

- The software image (i.e., a copy of an installed `Machine`), that is to be instantiated on the disk and other virtual resources. The image can be a snapshot that consists of disk images plus memory and other resource state information.
- Installation software, which, when executed on the hardware (virtual) resources, builds the machine instance.

- Both a disk image and a set of software and parameters to install new components not included in the original disk image.

Table 17 describes the `MachineImage` attributes.

Table 17 – MachineImage attributes

Name	MachineImage	
Type URI	http://schemas.dmtf.org/cimi/2/MachineImage	
Attribute	**Type**	**Description**
state	*string*	The operational state of the `MachineImage`. Allowed values are: **CREATING**: The `MachineImage` is in the process of being created. **AVAILABLE**: The `MachineImage` is available and ready for use. Unless otherwise specified, the MachineImage shall initially be in this state after successful creation. **DELETING**: The `MachineImage` is in the process of being deleted. **ERROR**: The Provider has detected an error in the `MachineImage`. The operations that result in transitions to the above defined states are defined in clause 5.14.7.1 **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
type	*string*	The type of `MachineImage` that is represented by this Resource. This specification defines the following values: **IMAGE**: This type represents the persisted data of a stopped `Machine`. Unlike "snapshots", it does not contain any runtime information. If this value is used, the "relatedImage" attribute shall not be present. **SNAPSHOT**: This type represents the persisted data of a `Machine`. If the `Machine` was not in a stopped state when his Image was created, it also contains runtime information. If this value is used, the "relatedImage" attribute shall reference the most recently created (or reverted to) snapshot Image for that `Machine`, which allows for easy discovery of the "previous" snapshot. The "relatedImage" attribute shall not be set by Consumers. **PARTIAL_SNAPSHOT**: This type follows the same semantics as the "SNAPSHOT" `MachineImage` except that it contains just the changes (deltas) made to the `Machine` based on the referenced "relatedImage" `MachineImage` rather than a complete representation of the `Machine`. If a `MachineImage` is deleted, the following semantics shall apply: • Any "SNAPSHOT" `MachineImages` that have a "relatedImage" value that references the deleted `MachineImage` shall have that value changed to the "relatedImage" attribute of the delete `MachineImage`. • Any "PARTIAL_SNAPSHOT" `MachineImages` that have a "relatedImage" value that references the deleted `MachineImage` shall also be deleted. This detail applies recursively to any subsequent "PARTIAL_SNAPSHOT" `MachineImages` as well. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
imageLocation	*URI*	A reference to the location of the binary data that makes up this image. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
relatedImage	*ref*	A reference to another MachineImage Resource that is related to this one. The specific meaning of this value varies depending on the type of `MachineImage`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only

The following pseudo-schemas describe the serialization of the Resource in both JSON and XML:

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/MachineImage",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "state": string,
  "type": string,
  "imageLocation": string,
  "relatedImage": { "href": string }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<MachineImage xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <state> xs:string </state>
  <type> xs:string </type>
  <imageLocation> xs:anyURI </imageLocation>
  <relatedImage href="xs:anyURI"/> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</MachineImage>
```

5.14.7.1 Operations

This Resource supports the Read, Update, and Delete operations. Create is supported through the `MachineImageCollection` Resource.

If creating a new `MachineImage`, the representation of the new `MachineImage` may include a reference in the "imageLocation" attribute. Providers shall inspect this reference (most likely by the way of an HTTP HEAD) to determine if any special processing is required. This specification defines the following additional steps that Providers shall take depending on the type of Resource being referenced:

`http://schemas.dmtf.org/cimi/2/Machine`

If the "imageLocation" is a reference to a `Machine`, the Provider shall create a new `MachineImage` based on the `Machine` being referenced. The machine is captured or snapshotted, depending on whether the request was sent to the "http://schemas.dmtf.org/cimi/2/action/capture" or the "http://schemas.dmtf.org/cimi/2/action/snapshot" URI of the Machine. However the resulting resource, although linked to the Machine from which it was originated, shall be a MachineImage for all purposes and can be used for creating new machines.

If creating a SNAPSHOT and upon completion of the create operation, the `MachineImage's` "imageLocation" attribute shall not reference the `Machine` (as the `Machine` might change over time), but instead it shall reference (or contain the data of) the static representation of the `Machine`. Additionally, the referenced `Machine's MachineSnapshotCollection` shall be updated to include a reference to this newly created SNAPSHOT `MachineImage` Resource. If the Machine is unable to accept operations at any point while it is being captured to create the MachineImage, the Machine shall be in state “CAPTURING”.

5.14.8 MachineImageCollection Resource

A `MachineImageCollection` Resource represents the Collection of `MachineImage` Resources within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/MachineImageCollection",
  "id": string,
  "count": number,
  "machineImages": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/MachineImage",
      "id": string,
      ... remaining MachineImage attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/2/MachineImageCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
```

```
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <MachineImage>
    <id> xs:anyURI </id>
    ... remaining MachineImage attributes ...
  </MachineImage> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.14.8.1 Operations

This Resource supports the Read and Update operations. Creation of new `MachineImage` Resources is supported by the way of a POST to the "add" operation's URI as described in clause 4.2.1.1, where the request body and the way it is processed are described in clause 5.14.7.1.

5.14.9 Credential Resource

A `Credential` Resource contains the information required to create the initial administrative superuser of a newly created `Machine` or to represent the credentials needed to perform some operation. Due to the variation between operating systems and Providers, this specification does not mandate one particular set of attributes that all implementations need to support. However, Providers are expected to extend this Resource with additional attributes to meet their requirements.

For example, a Provider might extend this Resource with username and password attributes, which would then be the login information for new `Machines`. These extension attributes would appear as siblings to the common attributes like "name"' and "description."

Table 18 describes the `Credential` attributes.

Table 18 – Credential attributes

Name	Credential	
Type URI	http://schemas.dmtf.org/cimi/2/Credential	
Attribute	**Type**	**Description**
TBD		The exact set of attributes is determined by the Provider.

Some common extension attributes that Providers might use include:

Table 19 – UserName/Password attributes

Attribute	**Type**	**Description**
userName	*string*	Initial superuser's user name. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
password	*string*	Initial superuser's password. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; write-only

Table 20 – Public key attributes

Attribute	**Type**	**Description**
key	*byte[]*	The digit of the public key for the initial superuser.

Attribute	Type	Description
		Constraints: **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write

When implementing or using `Credential`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in the above table, as well as in the table describing related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3)

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Credential",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<Credential xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</Credential>
```

5.14.9.1 Operations

This Resource supports the Read, Update, and Delete operations. Create is supported through the `CredentialCollection` Resource.

5.14.10 CredentialCollection Resource

A `CredentialCollection` Resource represents the Collection of `Credential` Resources within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/CredentialCollection",
  "id": string,
  "count": number,
  "credentials": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/Credential",
      "id": string,
      ... remaining Credential attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/2/CredentialCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <Credential>
    <id> xs:anyURI </id>
    ... remaining Credential attributes ...
  </Credential> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.14.10.1 Operations

NOTE The "add" operation requires that a CredentialTemplate be used (see 4.2.1.1).

5.14.11 CredentialTemplate Resource

This Resource captures the configuration values for realizing a `Credential` Resource. A `CredentialTemplate` may be used to create multiple `Credentials`. Table 21 describes the `CredentialTemplate` attributes.

3683 **Table 21 – CredentialTemplate attributes**

Name	CredentialTemplate	
Type URI	http://schemas.dmtf.org/cimi/2/CredentialTemplate	
Attribute	**Type**	**Description**
TBD		The exact set of attributes is determined by the provider.

3684 When implementing or using `CredentialTemplate`, Providers and Consumers shall adhere to the
3685 syntax and semantics of its attributes as described in Table 21 as well as in the table describing related
3686 Collections. Both Consumer and Provider shall serialize this Resource as described below. The following
3687 pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML:

3688 **JSON media type:** application/json

3689 **JSON serialization:**

```
3690 { "resourceURI": "http://schemas.dmtf.org/cimi/2/CredentialTemplate",
3691   "id": string,
3692   "name": string, ?
3693   "description": string, ?
3694   "created": string, ?
3695   "updated": string, ?
3696   "properties": { string: string, + }, ?
3697   "operations": [
3698     { "rel": "edit", "href": string }, ?
3699     { "rel": "delete", "href": string } ?
3700   ] ?
3701   ...
3702 }
```

3703 **XML media type:** application/xml

3704 **XML serialization:**

```
3705 <CredentialTemplate xmlns="http://schemas.dmtf.org/cimi/2">
3706   <id> xs:anyURI </id>
3707   <name> xs:string </name> ?
3708   <description> xs:string </description> ?
3709   <created> xs:dateTime </created> ?
3710   <updated> xs:dateTime </updated> ?
3711   <property key="xs:string"> xs:string </property> *
3712   <operation rel="edit" href="xs:anyURI"/> ?
3713   <operation rel="delete" href="xs:anyURI"/> ?
3714   <xs:any>*
3715 </CredentialTemplate>
```

3716 #### 5.14.11.1 Operations

3717 This Resource supports the Read, Update, and Delete operations. Create is supported through the
3718 `CredentialTemplateCollection` Resource.

5.14.12 CredentialTemplateCollection Resource

A `CredentialTemplateCollection` Resource represents the Collection of `CredentialTemplate` Resources within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI":
    "http://schemas.dmtf.org/cimi/2/CredentialTemplateCollection",
  "id": string,
  "count": number,
  "credentialTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/CredentialTemplate",
      "id": string,
      ... remaining CredentialTemplate attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/2/CredentialTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <CredentialTemplate>
    <id> xs:anyURI </id>
    ... remaining CredentialTemplate attributes ...
  </CredentialTemplate> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

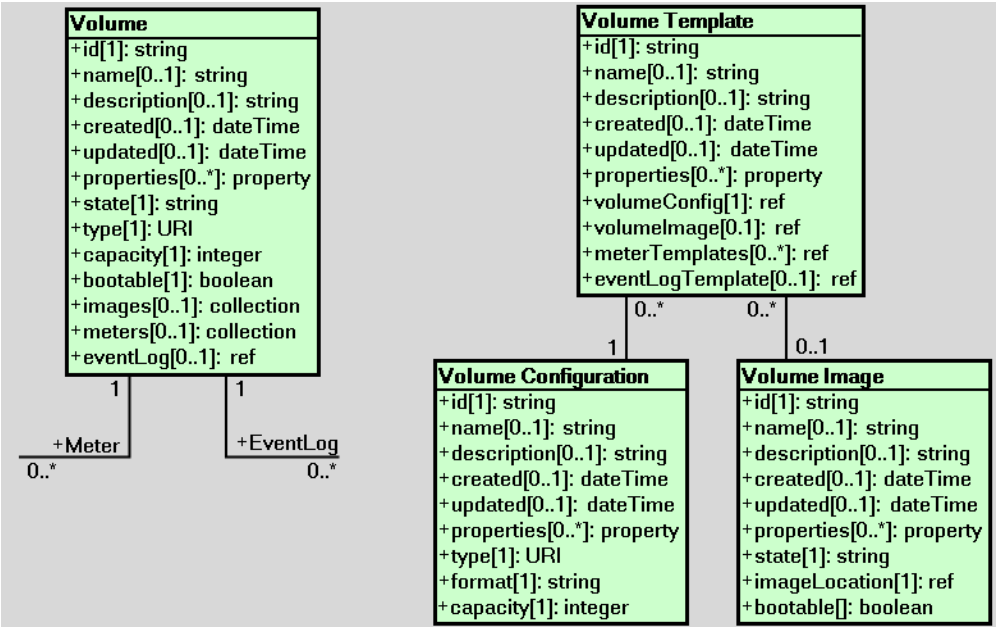
5.14.12.1 Operations

This Resource supports the Read and Update operations. Creation of new `CredentialTemplate` Resources is supported by the way of a POST to the "add" operation's URI as described in clause 4.2.1.1.

5.15 Volume Resources and relationships

Figure 4 illustrates the Resources involved in constructing a `Volume` and their relationships. Although this drawing is in the style of a Resource Relationship diagram, the use of UML is neither rigorous nor normative.

3758



3759 **Figure 4 - Volume Resources**

3760 ### 5.15.1 Volume

3761 A `Volume` represents storage at either the block or the file-system level. `Volumes` can be connected to
3762 `Machines`. Once connected, `Volumes` can be accessed by processes on that `Machine`. Table 22
3763 describes the `Volume` attributes.

3764 **Table 22 – Volume attributes**

Name	Volume	
Type URI	http://schemas.dmtf.org/cimi/2/Volume	
Attribute	**Type**	**Description**
state	*string*	The operational state of the `Volume`. Allowed values are: **CREATING**: The `Volume` is in the process of being created. **AVAILABLE**: The `Volume` is available and ready for use. Unless otherwise specified, the `Volume` shall be in this state initially after successful creation. **CAPTURING**: The `Volume` is in the process of being captured (snapshotted) into a new `VolumeImage`. **RESTORING**: The Volume is in the process of being restored. **DELETING**: The `Volume` is in the process of being deleted. **ERROR**: The Provider has detected an error in the `Volume`. **The operations that result in transitions to the above defined states are defined in clause 5.15.1.2** **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
type	*URI*	A URI that indicates the type of `Volume` to be created. This specification defines the following URI: **http://schemas.dmtf.org/cimi/2/mapped**: Indicates a `Volume` that shall be used for shared storage that might be available to multiple `Machines`, but which does not require an explicit mount operation from within the guest operating system. Additional values may be defined. If certain types of `Volumes` require additional data, it is expected that this Resource is extended. For example, a "sharedFileSystem" type might require additional networking information and credentials to be specified.

Name	Volume	
Type URI	http://schemas.dmtf.org/cimi/2/Volume	
Attribute	**Type**	**Description**
		Constraints: **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
capacity	*integer*	The maximum size, if limited, of the `Volume` in kilobytes. If this value is increased, the `Volume` can contain more data. Decreasing this value may require evaluations. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
bootable	*boolean*	This property indicates whether this `Volume` is bootable. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
images	*collection [VolumeImage]*	A reference to the list of references to `VolumeImages` that represent snapshots taken from the `Volume`. Note: . This Collection has the semantics of usage of `VolumeImages` by the `Volume` (deleting the `Volume` does not cause the deletion of the referred `VolumeImages`) **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
meters	*collection [Meter]*	A reference to the list of `Meters` monitored for this `Volume`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
eventLog	*ref*	A reference to the `EventLog` of this `Volume`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only

When implementing or using `Volume`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in the above table as well as in the tables describing embedded Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML:

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Volume",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "state": string,
  "type": string,
  "capacity": number,
  "bootable": boolean,
  "images": { "href": string }, ?
```

```
  "meters": { "href": string }, ?
  "eventLog": { "href": string }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<Volume xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <state> xs:string </state>
  <type> xs:anyURI </type>
  <capacity> xs:integer </capacity>
  <bootable> xs:boolean </bootable>
  <images href="xs:anyURI"/> ?
  <meters href="xs:anyURI"/> ?
  <eventLog href="xs:anyURI"/> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</Volume>
```

5.15.1.1 Collections

The following clauses describe the Collection Resources owned by `Volumes`.

5.15.1.1.1 images Collection

The Resource type for each item of this Collection is "`VolumeImage`". There is no accessory attribute for the items in this Collection, therefore it is a basic `VolumeImage` Collection (serialized as described in 5.5.12).

See the `VolumeImageCollection` Resource clause.

NOTE Previous versions of this specification included an "add" operation on this Resource. It is now deprecated in favor of creating a new `VolumeImage` with the imageLocation attribute pointing to the `Volume` to be captured.

5.15.1.1.2 meters Collection

The Resource type for each item of this Collection is "`Meter`" as defined in clause 5.17.3. There is no accessory attribute for the items in this Collection, therefore it is a basic `Meter` Collection (serialized as described in 5.5.12).

See the MeterCollection Resource clause.

5.15.1.2 Operations

This Resource supports the Read, Update, and Delete operations. Create is supported through the `VolumeCollection` Resource.

In addition also the following custom operations are supported.

snapshot

/link@rel: `http://schemas.dmtf.org/cimi/2/action/snapshot`

This operation shall create a new `VolumeImage` from an existing `Volume`. This operation is defined within the `VolumeImage` Resource; see 5.15.7.1 for more details. Note that while this operation is performed against a `VolumeImage`, its presence in the `Volume` serialization is used to advertise support for the operation.

If the Volume is unable to accept operations at any point while it is creating the VolumeImage, the Volume shall be in the state "CAPTURING".

restore

/link@rel: `http://schemas.dmtf.org/cimi/2/action/restore`

This operation shall restore a `Volume` from a previously created `VolumeImage`.

Input parameters:

1) "image" - type: ref - mandatory
2) A reference to the Volume Image.

Output parameters: None.

During the processing of this operation, the `Volume` shall be in the "RESTORING" state.

Upon successful completion of this operation, the `Volume` shall again be in the state "AVAILABLE".

HTTP protocol

To restore a `Volume`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/restore" URI of the `Volume` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
  "action": "http://schemas.dmtf.org/cimi/2/action/restore",
  "image": { "href" : string },
  "properties": { string: string, + } ?
  ...
```

```
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/restore </action>
  <image href="xs:anyURI"/>
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

Where the "image" ref content is a reference to the `VolumeImage` to be used.

Upon successful processing of the request, the HTTP response body may be empty.

5.15.2 VolumeCollection Resource

A `VolumeCollection` Resource represents the Collection of `Volumes` within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/VolumeCollection",
  "id": string,
  "count": number,
  "volumes": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/Volume",
      "id": string,
      ... remaining Volume attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/2/VolumeCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <Volume>
    <id> xs:anyURI </id>
    ... remaining Volume attributes ...
  </Volume> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
```

```
</Collection>
```

5.15.2.1 Operations

NOTE The "add" operation requires that a VolumeTemplate be used (see 4.2.1.1).

5.15.3 VolumeTemplate Resource

This Resource captures the configuration values for realizing a Volume. A `VolumeTemplate` may be used to create multiple `Volumes`. Table 23 describes the `VolumeTemplate` attributes.

Table 23 – VolumeTemplate attributes

Name	VolumeTemplate	
Type URI	http://schemas.dmtf.org/cimi/2/VolumeTemplate	
Attribute	**Type**	**Description**
volumeConfig	*ref*	A reference to the `VolumeConfiguration` that is used to create a `Volume` from this `VolumeTemplate`. Note that the attributes of the `VolumeConfiguration` may be specified rather than a reference to an existing `VolumeConfiguration` Resource. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
volumeImage	*ref*	A reference to the `VolumeImage` that is used to create a `Volume` from this `VolumeTemplate`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
meterTemplates	*Meter Templates[]*	A list of references to `MeterTemplates` that shall be used to create and connect a set of new `Meters` to the new `Volume`. Note that the attributes of the `MeterTemplate` may be specified rather than a reference to an existing `MeterTemplate` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
eventLog Template	*ref*	A reference to an `EventLogTemplate` that shall be used to create and connect a new `EventLog` to the new `Volume`. Note that the attributes of the `EventLogTemplate` may be specified rather than a reference to an existing `EventLogTemplate` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write

When implementing or using `VolumeTemplate`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in the above table as well as in the tables describing embedded Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/VolumeTemplate",
  "id": string,
  "name": string, ?
  "description": string, ?
```

```
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "volumeConfig": {
    "href": string | ... VolumeConfiguration attributes ...
  },
  "volumeImage": { "href": string }, ?
  "meterTemplates": [
    { "href": string, ?
      ... MeterTemplate attributes ... ?
    }, *
  ], ?
  "eventLogTemplate": {
    "href": string, ?
    ... EventLogTemplate attributes ... ?
  }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<VolumeTemplate xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <volumeConfig href="xs:anyURI"?>
    ... VolumeConfiguration attributes ... ?
  </volumeConfig>
  <volumeImage href="xs:anyURI"/> ?
  <meterTemplate href="xs:anyURI"? >
    ... MeterTemplate attributes ... ?
  </meterTemplate> *
  <eventLogTemplate href="xs:anyURI"? >
```

```
    ... EventLogTemplate attributes ... ?
  </eventLogTemplate> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</VolumeTemplate>
```

5.15.3.1 Operations

This Resource supports the Read, Update, and Delete operations. Create is supported through the `VolumeTemplateCollection` Resource.

5.15.4 VolumeTemplateCollection Resource

A `VolumeTemplateCollection` Resource represents the Collection of `VolumeTemplate` Resources within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/VolumeTemplateCollection",
  "id": string,
  "count": number,
  "volumeTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/VolumeTemplate",
      "id": string,
      ... remaining volumeTemplate attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/2/VolumeTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <VolumeTemplate>
    <id> xs:anyURI </id>
    ... remaining VolumeTemplates attributes ...
  </VolumeTemplate> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.15.4.1 Operations

This Resource supports the Read and Update operations. Creation of new `VolumeTemplate` Resources is supported by the way of a POST to the "add" operation's URI as described in clause 4.2.1.1.

5.15.5 VolumeConfiguration Resource

The `VolumeConfiguration` Resource represents the set of configuration values needed to create a `Volume` with certain characteristics. `VolumeConfigurations` are created by Providers and may, at the Providers discretion, be created by Consumers.

Table 24 describes the `VolumeConfiguration` attributes.

Table 24 – VolumeConfiguration attributes

Name	VolumeConfiguration	
Type URI	http://schemas.dmtf.org/cimi/2/VolumeConfiguration	
Attribute	**Type**	**Description**
type	*URI*	A URI that indicates the type of `Volume` to be created. This specification defines the following URI: `http://schemas.dmtf.org/cimi/2/mapped`: Indicates a `Volume` that shall be used for shared storage that might be available to multiple `Machines`, but which does not require an explicit mount operation from within the guest operating system. Additional values may be defined. If certain types of `Volumes` require additional data, it is expected that this Resource is extended. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
format	*string*	The format of the file system that is placed on `Volumes` created from this configuration. This attribute is only meaningful for `VolumeConfigurations` that describe block devices. This attribute is optional; the absence of this attribute indicates that Volumes created from this configuration are not formatted with a file system. Example values: "ext4," "ntfs." **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
capacity	*integer*	The default size in kilobytes, if limited, of the `Volume` created from this `VolumeConfiguration`. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write

The following pseudo-schemas describe the serialization of the Resource in both JSON and XML:

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/VolumeConfiguration",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "type": string,
```

```
  "format": string,
  "capacity": number,
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<VolumeConfiguration xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <type> xs:anyURI </type>
  <format> xs:string </format>
  <capacity> xs:integer </capacity>
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</VolumeConfiguration>
```

5.15.5.1 Operations

This Resource supports the Read, Update, and Delete operations. Create is supported through the `VolumeConfigurationCollection` Resource.

5.15.6 VolumeConfigurationCollection Resource

A `VolumeConfigurationCollection` Resource represents the Collection of `VolumeConfiguration` Resources within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI":
    "http://schemas.dmtf.org/cimi/2/VolumeConfigurationCollection",
  "id": string,
  "count": number,
  "volumeConfigurations": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/VolumeConfiguration",
```

```
      "id": string,
      ... remaining VolumeConfiguration attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/2/VolumeConfigurationCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <VolumeConfiguration>
    <id> xs:anyURI </id>
    ... remaining VolumeConfiguration attributes ...
  </VolumeConfiguration> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.15.6.1 Operations

This Resource supports the Read and Update operations. Creation of new `VolumeImage` Resources is supported by the way of a POST to the "add" operations' URI as described in clause 4.2.1.1.

5.15.7 VolumeImage Resource

This Resource represents an image that could be placed on a preloaded volume. Table 25 describes the `VolumeImage` attributes.

Table 25 – VolumeImage attributes

Name	VolumeImage	
Type URI	http://schemas.dmtf.org/cimi/2/VolumeImage	
Attribute	**Type**	**Description**
state	*string*	The operational state of the `VolumeImage`. Allowed values are: **CREATING**: The `VolumeImage` is in the process of being created. **AVAILABLE**: The `VolumeImage` is available and ready for use. Unless otherwise specified, the `VolumeImage` shall initially be in this state after successful creation. **DELETING**: The `VolumeImage` is in the process of being deleted. **ERROR**: The Provider has detected an error in the `VolumeImage`. The operations that result in transitions to the above defined states are defined in clause 5.15.7.1 **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
imageLocation	*URI*	A reference to the location of the binary data that makes up this image. **Constraints:**

Name	VolumeImage	
Type URI	http://schemas.dmtf.org/cimi/2/VolumeImage	
Attribute	**Type**	**Description**
		Provider: support mandatory; mutable **Consumer:** support mandatory; read-write
bootable	*boolean*	This property indicates whether Volumes created from this `VolumeImage` are bootable. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write

The following pseudo-schemas describe the serialization of the Resource in both JSON and XML:

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/VolumeImage",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "state": string,
  "imageLocation": string,
    "bootable": boolean,
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<VolumeImage xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <state> xs:string </state>
  <imageLocation>xs:anyURI</imageLocation>
  <bootable> xs:boolean </bootable>
```

```
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</VolumeImage>
```

5.15.7.1 Operations

This Resource supports the Read, Update, and Delete operations. Create is supported through the `VolumeImageCollection` Resource.

5.15.8 VolumeImageCollection Resource

A `VolumeImageCollection` Resource represents the Collection of `VolumeImage` Resources within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/VolumeImageCollection",
  "id": string,
  "count": number,
  "volumeImages": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/VolumeImage",
      "id": string,
      ... remaining VolumeImage attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/2/VolumeImageCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <VolumeImage>
    <id> xs:anyURI </id>
    ... remaining VolumeImage attributes ...
  </VolumeImage> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.15.8.1 Operations

This Resource supports the Read and Update operations. Creation of new `VolumeImage` Resources is supported by the way of a POST to the "add" operation's URI as described in clause 4.2.1.1.

During the creation of a new `VolumeImage` Resource, if the "imageLocation" attribute refers to an existing `Volume`, this operation shall be interpreted as a request to create a snapshot of the `Volume`. Once completed, the "imageLocation" attribute of the new `VolumeImage` Resource shall not refer to the original `Volume`; instead it shall refer to a static copy of the `Volume`. Additionally, the referenced Volume's `VolumeImageCollection` shall be updated to include a reference to this newly created snapshot `VolumeImage` Resource. During this process, the Provider may put the `Volume` into a "CAPTURING" state if necessary.

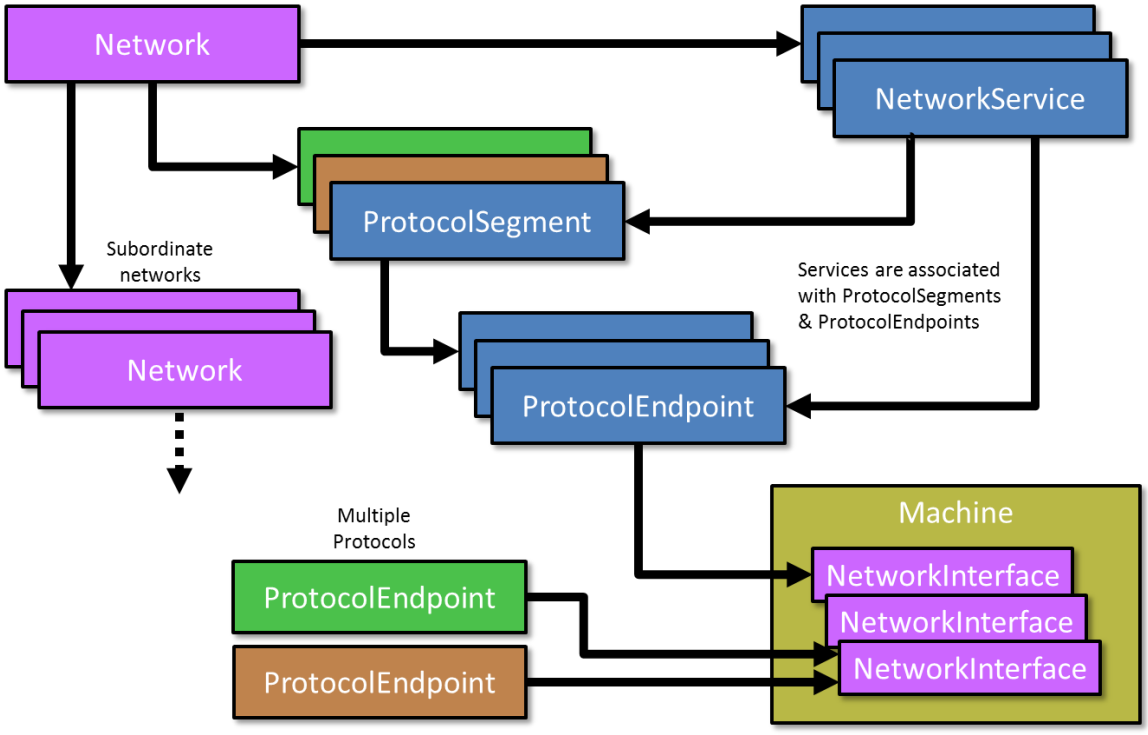
5.16 Network Resources and relationships

A Network is a logical construct that allows communication between defined Endpoints within a Segment. Each Segment uses a single, fixed, protocol to communicate and access is provided by associating an Endpoint with an Interface.

Only Endpoints within a Segment can communicate implicitly. All other communication must be explicitly enabled using Network Services.

- Each Network has one or more Segments
- Each Segment supports communication using a single protocol
- Each Segment may have one or more addressable Endpoints
- Each Endpoint is associated with a single Segment
- Each Endpoint may be associated with a single Interface
- An Interface can be associated with more than one Endpoint
- A Network may contain subordinate Networks to form hierarchical structures (similar to Systems)
- One or more Services may be associated with a Network to provide additional functionality

Figure 5 illustrates the Resources involved in constructing Networks. Although this drawing is in the style of a Resource Relationship diagram, the use of UML is neither rigorous nor normative.



4170 **Figure 5 - Network Resources**

4171 ### 5.16.1 Network

4172 Table 26 describes the `Network` Resource attributes.

4173 **Table 26 – Network attributes**

Name	Network	
Type URI	http://schemas.dmtf.org/cimi/2/Network	
Attribute	**Type**	**Description**
state	*string*	The operational state of the `Network`. Allowed values are: **CREATING**: The `Network` is in the process of being created. **STARTING**: The `Network` is in the process of being started. **STARTED**: The `Network` is available and ready for use. **STOPPING**: The `Network` is in the process of being stopped. **STOPPED**: The `Network` is stopped and not available for use. **DELETING**: The `Network` is in the process of being deleted. **ERROR**: The Provider has detected an error in the `Network`. The operations that result in transitions to the above defined states are defined in clause 5.16.1.2. Clause 5.16.2.1 defines the initial state of a Network. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
segments	*collection [Protocol Segment]*	A reference to a Collection of Segments contained within this Network. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
services	*collection [Network Service]*	A reference to a Collection of Services that may be applied to this Network. **Constraints:** **Provider:** support mandatory; mutable

Name	Network	
Type URI	http://schemas.dmtf.org/cimi/2/Network	
Attribute	**Type**	**Description**
		Consumer: support mandatory; read-only
subnetworks	*collection [Network]*	A reference to a Collection of subordinate Networks contained within this Network. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
meters	*collection [Meter]*	A reference to the list of `Meters` monitored for this `Network`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
eventLog	*ref*	A reference to the `EventLog` of this `Network`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only

The Provider shall supply at least one `Network` Resource in the CEP `Networks` Collection to represent communication channels that are external to the Consumers cloud. Typically this would be a connection to the Internet. As an alternative the Provider may supply a `NetworkTemplate` Resource by which such external Networks can be created when required.

When implementing or using `Network` Resources, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 26 as well as in the tables describing embedded Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Network",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "parent": string, ?
  "properties": { string: string, + }, ?
  "state": string,
  "segments": { "href": string },
  "sevices": { "href": string },
  "subnetworks": { "href": string }, ?
  "meters": { "href": string }, ?
  "eventLog": { "href": string }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/start", "href": string }, ?
```

```
    { "rel": "http://schemas.dmtf.org/cimi/2/action/stop", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<Network xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <parent> xs:anyURI </parent> ?
  <property key="xs:string"> xs:string </property> *
  <state> xs:string </state>
  <segments href="xs:anyURI"/>
  <services href="xs:anyURI"/>
  <subnetworks href="xs:anyURI"/> ?
  <meters href="xs:anyURI"/> ?
  <eventLog" href="xs:anyURI"/> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/start"
   href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/stop"
   href="xs:anyURI"/> ?
  <xs:any>*
</Network>
```

5.16.1.1 Collections

The following clauses describe the Collection Resources that are components of `Networks`.

5.16.1.1.1 `segments` Collection

The Resource type for each item of this Collection is "`ProtocolSegment`". There is no accessory attribute for the items in this Collection, therefore it is a basic `ProtocolSegmentCollection`, as described in 5.16.6.

5.16.1.1.2 `services` Collection

The Resource type for each item of this Collection is "`NetworkService`". There is no accessory attribute for the items in this Collection, therefore it is a basic `NetworkServiceCollection`, as described in 5.16.18

5.16.1.1.3 `subnetworks` Collection

The Resource type for each item of this Collection is "`Network`". There is no accessory attribute for the items in this Collection, therefore it is a basic `NetworkCollection`, as described in 5.16.2.

5.16.1.1.4 `meters` Collection

The Resource type for each item of this Collection is "`Meter`" as defined in clause 5.17.3. There is no accessory attribute for the items in this Collection, therefore it is a basic `MeterCollection` as described in 5.5.12.

See the MeterCollection Resource clause.

5.16.1.2 Operations

`Network` Resources support the Read, Update, and Delete operations. Create is supported through the `NetworkCollection` Resource, as described in 5.16.2.

The following custom operations are also defined:

start

/link@rel: `http://schemas.dmtf.org/cimi/2/action/start`

This operation shall recursively start and enable all the components within a Network.

Input parameters: None.

Output parameters: None.

During the processing of this operation, the `Network` shall be in the "STARTING" state.

Upon successful completion of this operation, the `Network` shall be in the "STARTED" state.

HTTP protocol

To start a `Network`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/start" URI of the `Network` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
  "action": "http://schemas.dmtf.org/cimi/2/action/start",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/start </action>
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
```

```
</Action>
```

Upon successful processing of the request, the HTTP response body may be empty.

stop

/link@rel: `http://schemas.dmtf.org/cimi/2/action/stop`

This operation shall recursively stop and disable all components of a `Network`.

Input parameters: None.

Output parameters: None.

During the processing of this operation, the `Network` shall be in the "STOPPING" state.

Upon successful completion of this operation, the `Network` shall be in the "STOPPED" state.

HTTP protocol

To stop a `Network`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/stop" URI of the `Network` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
  "action": "http://schemas.dmtf.org/cimi/2/action/stop",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/stop </action>
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

Upon successful processing of the request, the HTTP response body may be empty.

5.16.2 NetworkCollection Resource

A `NetworkCollection` Resource represents the Collection of `Networks` and follows the Collection pattern that is defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/NetworkCollection",
  "id": string,
  "count": number,
  "networks": [
```

```
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/Network",
      "id": string,
      ... remaining Network attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/2/NetworkCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <Network>
    <id> xs:anyURI </id>
    ... remaining Network attributes ...
  </Network> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.16.2.1 Operations

NOTE The "add" operation requires that a `NetworkTemplate` be used (see 5.16.3).

Upon successful processing of the "add" operation, unless otherwise specified by the way of the `NetworkTemplate` "initialState" attribute, the state of the new `Network` shall be the value of the DefaultInitialState capability of the `Network` Resource's `ResourceMetadata`, if defined. If no DefaultInitialState capability is defined, the default value shall be "STOPPED." The semantics of "initialState" shall be equivalent to the Provider issuing the appropriate actions against the new `Network` to move it into that state.

If a Provider is unable to change the state of the new `Network` to the appropriate "initialState" (either as specified by the `NetworkTemplate` or as implied by the previous stated rules), the `Network` creation shall fail.

5.16.3 NetworkTemplate Resource

The NetworkTemplate is a set of configuration values for realizing a `Network`. An instance of `NetworkTemplate` may be used to create multiple `Networks`. Table 27 describes the `NetworkTemplate` attributes.

4346 **Table 27 – NetworkTemplate attributes**

Name	NetworkTemplate	
Type URI	http://schemas.dmtf.org/cimi/2/NetworkTemplate	
Attribute	**Type**	**Description**
initialState	*string*	Sets the initial state of a Network created using this Template. The allowed values are restricted to the non-transient states specified for the `state` attribute of the `Network` Resource, described in Table 26. Providers should advertise the list of available values via the `Network ResourceMetadata initialStates` Capability. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
segments	*Protocol Segment[]*	A list of references to existing `ProtocolSegment` Resources to be inserted into the "`segments`" collection of the `Network` Resource created using this Template. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
segmentTemplates	*Protocol Segment Templates[]*	A list of references to `ProtocolSegmentTemplates`, from each of which a `ProtocolSegment` Resource is created and its reference inserted into the "`segments`" collection of the `Network` Resource created using this `NetworkTemplate`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
services	*Network Service[]*	A list of references to `NetworkService` Resources to be added to the "`services`" collection of the `Network` Resource created using this Template. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
serviceTemplates	*Network Service Templates[]*	A list of references to `NetworkServiceTemplates`, from each of which a `NetworkService` Resource is created and its reference inserted into the "`services`" collection of the `Network` Resource created using this Template. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
subnetworks	*Networkt[]*	A list of references to `Network` Resources to be added to the `subnetworks` collection of the `Network` created from this `NetworkTemplate` **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
subnetworkTemplates	*Network Templates[]*	A list of references to `NetworkTemplates`, from each of which a `Network` Resource is created and added to the `subnetworks` collection of the `Network` created using this `NetworkTemplate`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
meterTemplates	*meter Templates[]*	A list of references to `MeterTemplates` that shall be used to create and connect a set of new `Meters` to the new `Network`. Note that the attributes of the `MeterTemplate` may be specified rather than a reference to an existing `MeterTemplate` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write

Name	NetworkTemplate	
Type URI	http://schemas.dmtf.org/cimi/2/NetworkTemplate	
Attribute	**Type**	**Description**
eventLogTemplate	*ref*	A reference to an `EventLogTemplate` that shall be used to create and connect a new `EventLog` to the new `Network`. Note that the attributes of the `EventLogTemplate` may be specified rather than a reference to an existing `EventLogTemplate` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write

When implementing or using `NetworkTemplate`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 27 as well as in the tables describing embedded Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/NetworkTemplate",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "initialState": string, ?
  "segments": { "href": string }, ?
  "segmentTemplates": [
    { "href": string, ?
      ... ProtocolSegmentTemplate attributes ... ?
    }, *
  ], ?
  "services": { "href": string }, ?
  "serviceTemplates": [
    { "href": string, ?
      ... NetworkServiceTemplate attributes ... ?
    }, *
  ], ?
  "subnetworks": { "href": string }, ?
  "subnetworkTemplates": [
    { "href": string, ?
      ... NetworkTemplate attributes ... ?
    }, *
  ], ?
```

```
  "meterTemplates": [
    { "href": string, ?
      ... MeterTemplate attributes ... ?
    }, *
  ], ?
  "eventLogTemplate": {
    "href": string, ?
    ... EventLogTemplate attributes ... ?
  }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<NetworkTemplate xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <initialState> xs:string </initialState> ?
  <segments href="xs:anyURI"/> ?
  <segmentTemplates href="xs:anyURI"? >
    ... ProtocolSegmentTemplate attributes ... ?
  </segmentTemplates> *
  <services href="xs:anyURI"/> ?
  <serviceTemplates href="xs:anyURI"? >
    ... NetworkServiceTemplates attributes ... ?
  </serviceTemplates> *
  <subnetworks href="xs:anyURI"/> ?
  <subnetworkTemplates href="xs:anyURI"? >
    ... NetworkTemplate attributes ... ?
  </subnetworkTemplate> *
  <meterTemplate href="xs:anyURI"? >
    ... MeterTemplate attributes ... ?
```

```
  </meterTemplate> *
  <eventLogTemplate href="xs:anyURI"? >
    ... EventLogTemplate attributes ... ?
  </eventLogTemplate> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</NetworkTemplate>
```

5.16.3.1 Operations

The `NetworkTemplate` Resource supports the Read, Update and Delete operations. Create is supported through the `NetworkTemplateCollection` Resource.

5.16.4 NetworkTemplateCollection Resource

A `NetworkTemplateCollection` Resource represents the Collection of `NetworkTemplates` within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/NetworkTemplateCollection",
  "id": string,
  "count": number,
  "networkTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/NetworkTemplate",
      "id": string,
      ... remaining NetworkTemplate attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/2/NetworkTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <NetworkTemplate>
    <id> xs:anyURI </id>
    ... remaining NetworkTemplate attributes ...
  </NetworkTemplate> *
  <operation rel="add" href="xs:anyURI"/> ?
```

```
  <xs:any>*
</Collection>
```

5.16.4.1 Operations

The `NetworkTemplateCollection` Resource supports the Read and Update operations. Creation of new `NetworkTemplate` Resources is supported by the way of a POST to the "add" operation's URI as described in clause 4.2.1.1.

5.16.5 Segments

A Segment is an individual channel within a Network that utilizes a single communication protocol. Segments are `ProtocolSegment` Resources, the attributes of which are described in Table 28 below**Error! Reference source not found.**.

Table 28 – ProtocolSegment attributes

Name	ProtocolSegment	
Type URI	http://schemas.dmtf.org/cimi/2/ProtocolSegment	
Attribute	**Type**	**Description**
state	*string*	The operational state of the Segment. Allowed values are: **CREATING**: The Segment is in the process of being created. **STARTED**: The Segment is available (enabled) and ready for use. **STOPPED**: The Segment is stopped (disabled) and not available for use. **DELETING**: The Segment is in the process of being deleted. **ERROR**: The Provider has detected an error in the Segment. The operations that result in transitions to the above defined states are defined in clause 5.16.5.3. Clause 5.16.6.1 defines the initial state of a Segment. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
protocol	*string*	The official name of the protocol supported by this segment. Allowed values are: **Ethernet**: As defined by IEEE 802.3. **IPv4**: Internet Protocol version 4, as defined in RFC 791. **IPv6**: Internet Protocol Version 6 as defined in RFC 2460. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
noDefault Routing	*boolean*	If set to TRUE the default communication between Endpoints within the Segment is disabled. Communication between Endpoints in this case must be performed by a Service. The default value is FALSE which enables communication between endpoints. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
endpoints	*collection [Protocol Endpoint]*	A reference to a list of references to Endpoints associated with this Segment. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
parameters	*map*	A polymorphic attribute the contents of which depend on the specific network protocol. As examples this would include "netmask" for IPv4 and "bandwidth" for "Ethernet". See the adjacent tables for details of the data to be included **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only

Name	ProtocolSegment	
Type URI	http://schemas.dmtf.org/cimi/2/ProtocolSegment	
Attribute	**Type**	**Description**
meters	*collection [Meter]*	A reference to the list of `Meters` monitored for this Segment. **Constraints:** **Provider:** support optional; mutable .**Consumer:** support optional; read-only
eventLog	*ref*	A reference to the `EventLog` of this `Segment`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only

When implementing or using `ProtocolSegment` Resources, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 28 as well as in the tables describing embedded Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/ProtocolSegment",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "state": string,
  "protocol": string,
  "noDefaultRouting": boolean,
  "endpoints": { "href": string },
.."parameters": { string: string, + }, ?
  "meters": { "href": string }, ?
  "eventLog": { "href": string }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/start", "href": string }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/stop", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<ProtocolSegment xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <state> xs:string </state>
  <protocol> xs:string </protocol>
  <noDefaultRouting> xs:boolean </noDefaultRouting >
  <endpoints href="xs:anyURI"/>
  <parameters key="xs:string"> xs:string </parameters> *
  <meters href="xs:anyURI"/> ?
  <eventLog" href="xs:anyURI"/> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/start"
href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/stop"
href="xs:anyURI"/> ?
  <xs:any>*
</ProtocolSegment>
```

5.16.5.1 Protocol specific parameters

Each Segment may require additional data that is specific to a communication protocol. This additional data is specified using the `parameters` attribute of the `ProtocolSegment`.This specification defines the following key – value pairs that must be supplied for the indicated protocols:

Table 29 - IPv6 ProtocolSegment parameters

Name	IPv6ProtocolParameters	
Key	**Value Type**	**Description**
prefixLength	*integer*	The length of the prefix for IPv6 addresses that is used to specify a subnet. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
subnetAddress	*string*	The IPv6 subnet address for this subnet. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only

4527 **Table 30 – IPv4 ProtocolSegment parameters**

Name	IPv4ProtocolParameters	
Key	**Value Type**	**Description**
netmask	*string*	The IPv4 subnetwork mask that defines the subnet. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
subnetAddress	*string*	The IPv4 subnet address for this subnet. **Constraints:** **Provider:** support optional; immutable **Consumer:** support optional; read-only

4528 **Table 31 – Ethernet ProtocolSegment parameters**

Name	EthernetProtocolParameters	
Key	**Value Type**	**Description**
speed	*integer*	The current bandwidth of the Segment in Bits per second. If no accurate determination of speed is possible this attribute should contain the nominal bandwidth. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
mtu	*integer*	The active or negotiated maximum transmission unit (MTU) that can be supported by this Segment. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write

4529 Note that Providers may support additional key – value pairs for the `parameter` attribute to extend the
4530 existing protocols. Consumers are not required to process any additional key – value pairs but must
4531 retrun them to the Provider in the serialization of `ProtocolSegments`.

4532 #### 5.16.5.2 Collections

4533 The following clauses describe the Collection Resources that are components of `ProtocolSegments`.

4534 ##### 5.16.5.2.1 `endpoints` Collection

4535 The Resource type for each item of this Collection is a "`ProtocolEndpoint`" as defined in clause
4536 5.16.9. There is no accessory attribute for the items in this Collection, therefore it is a basic
4537 `ProtocolEndpointCollection` Resource, serialized as described in 5.16.10.

4538 ##### 5.16.5.2.2 `meters` Collection

4539 The Resource type for each item of this Collection is "`Meter`" as defined in clause 5.17.3. There is no
4540 accessory attribute for the items in this Collection, therefore it is a basic `Meter` Collection (serialized as
4541 described in 5.5.12).

4542 #### 5.16.5.3 Operations

4543 The `ProtocolSegment` Resource supports the Read, Update, and Delete operations. Create is
4544 supported through the `ProtocolSegmentCollection` Resource.

Deleting a `ProtocolSegment` shall remove that Segment from the global (Cloud Entry Point) `ProtocolSegmentCollection` and also all references to the Segment in Collections of other Resources (e.g.from corresponding Network `segments` Collection).

The following custom operations are also defined:

start

/link@rel: `http://schemas.dmtf.org/cimi/2/action/start`

This operation shall start a `ProtocolSegment`.

Input parameters: None.

Output parameters: None.

Upon successful completion of this operation, the `ProtocolSegment` shall be in the "STARTED" state.

HTTP protocol

To start a `ProtocolSegment`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/start" URI of the `ProtocolSegment` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
  "action": "http://schemas.dmtf.org/cimi/2/action/start",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/start </action>
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

Upon successful processing of the request, the HTTP response body may be empty.

stop

/link@rel: `http://schemas.dmtf.org/cimi/2/action/stop`

This operation shall stop a `ProtocolSegment`.

Input parameters: None.

Output parameters: None.

Upon successful completion of this operation, the `ProtocolSegment` shall be in the "STOPPED" state.

HTTP protocol

To stop a `ProtocolSegment`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/stop" URI of the `ProtocolSegment` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
  "action": "http://schemas.dmtf.org/cimi/2/action/stop",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/stop </action>
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

Upon successful processing of the request, the HTTP response body may be empty.

5.16.6 ProtocolSegmentCollection Resource

A `ProtocolSegmentCollection` Resource represents the Collection of `ProtocolSegments` within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/ProtocolSegmentCollection",
  "id": string,
  "count": number,
  "segments": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/ProtocolSegment",
      "id": string,
      ... remaining ProtocolSegment attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
resourceURI="http://schemas.dmtf.org/cimi/2/ProtocolSegmentCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <ProtocolSegment>
    <id> xs:anyURI </id>
    ... remaining ProtocolSegment attributes ...
  </ProtocolSegment> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.16.6.1 Operations

NOTE The "add" operation requires that a ProtocolSegmentTemplate be used (see clause 5.16.7).

~~If `ProtocolSegments` are created through the global (Cloud Entry Point) `ProtocolSegmentCollection`'s "add" operation, they are automatically associated with the corresponding Network, by addition of the ProtocolSegment's reference in the networkPorts Collection of the Network.~~

Upon successful processing of the "add" operation, unless otherwise specified by the `ProtocolSegmentTemplate` "initialState" attribute, the state of the new `ProtocolSegment` shall be the value of the DefaultInitialState capability of the `ProtocolSegment` Resource's `ResourceMetadata`, if defined. If no DefaultInitialState capability is defined, the default value shall be "STOPPED." The semantics of "initialState" shall be equivalent to the Provider issuing the appropriate actions against the new `ProtocolSegment` to move it into that state.

If a Provider is unable to change the state of the new `ProtocolSegment` to the appropriate "initialState" (either as specified by the `ProtocolSegmentTemplate` or as implied by the previous stated rules), the `ProtocolSegment` creation shall fail.

5.16.7 ProtocolSegmentTemplate Resource

The `ProtocolSegmentTemplate` is a set of configuration values for realizing a `ProtocolSegment`. A `ProtocolSegmentTemplate` may be used to create multiple `ProtocolSegments`. Table 32 describes the `ProtocolSegmentTemplate` attributes.

4648 **Table 32 – ProtocolSegmentTemplate attributes**

Name	ProtocolSegmentTemplate	
Type URI	http://schemas.dmtf.org/cimi/2/ProtocolSegmentTemplate	
Attribute	**Type**	**Description**
network	*ref*	A reference to the Network to which the Segment created using this Template belongs. If this Template is used to create a new Segment through the global (Cloud Entry Point) `ProtocolSegmentCollection`, this attribute shall be present. If this Template is referenced from a `NetworkTemplate` and used to create a new Segment during the creation of a Network, this attribute shall either be absent or have the same value as the "`id`" attribute of the `Network` to which this Segment is being added. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
initialState	*string*	Sets the initial state of the Segment created using this Template. The allowed values are restricted to the non-transient states specified for the `state` attribute of the `ProtocolSegment` Resource, described in 5.16.5. Providers should advertise the list of available values via the `ProtocolSegment ResourceMetadata initialStates` Capability. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
protocol	*string*	Sets the protocol supported by the Segment created using this Template. The allowed values are those specified for the `protocol` attribute of the `ProtocolSegment` Resource, described in clause 5.16.5. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
noDefault Routing	*boolean*	Enables or disables default routing for the Segment created using this Template. Values are as described for the `noDefaultRouting` attribute of the `ProtocolSegment` Resource, described in clause 5.16.5. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
endpoints	*Protocol Endpoint[]*	A list of references to `ProtocolEndpoints` to be inserted into the `endpoints` Collection of the Segment created using this Template. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
endpoint Templates	*Protocol Endpoint Template[]*	A list of references to `ProtocolEndpointTemplates` that specify a set of Endpoints to be created and inserted into the `endpoints` Collection for the Segement created using this Template. Note that the Template attributes may be explicitly listed rather than providing a reference to an existing `ProtocolEndpointTemplate` Resource. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
parameters	*map*	A polymorphic attribute the contents of which depend on the specific protocol supported. The allowed key – value pairs are as specified in section 5.16.5.1. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write

Name	ProtocolSegmentTemplate	
Type URI	http://schemas.dmtf.org/cimi/2/ProtocolSegmentTemplate	
Attribute	**Type**	**Description**
meterTemplates	*meterTemplates []*	A list of references to `MeterTemplates` that shall be used to create and connect a set of new `Meters` to the new `ProtocolSegment`. Note that the attributes of the `MeterTemplate` may be specified rather than a reference to an existing `MeterTemplate` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
eventLogTemplate	*ref*	A reference to an `EventLogTemplate` that shall be used to create and connect a new `EventLog` to the new `ProtocolSegment`. Note that the attributes of the `EventLogTemplate` may be specified rather than a reference to an existing `EventLogTemplate` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write

When implementing or using `ProtocolSegmentTemplate` Resources, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 32 as well as in the tables describing embedded Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/ProtocolSegmentTemplate",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "network": { "href": string }, ?
  "initialState": string, ?
  "protocol": string,
  "noDefaultRouting": boolean,
  "endpoints": { "href": string }, *
  "endpointTemplates": [
    { "href": string, ?
      ... ProtocolEndpointTemplate attributes ... ?
    }, *
  ], ?
.."parameters": { string: string, + }, ?
  "meterTemplates": [
    { "href": string, ?
      ... MeterTemplate attributes ... ?
```

```
    }, *
  ], ?
  "eventLogTemplate": {
    "href": string, ?
    ... EventLogTemplate attributes ... ?
  }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<ProtocolSegmentTemplate xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <network href="xs:anyURI"/> ?
  <initialState> xs:string </initialState> ?
  <protocol> xs:string </protocol>
  <noDefaultRouting> xs:boolean </noDefaultRouting >
  <endpoints href="xs:anyURI"/> *
  <endpointTemplate href="xs:anyURI"? >
    ... ProtocolEndpointTemplate attributes ... ?
  </endpointTemplate> *
  <parameters key="xs:string"> xs:string </parameters> *
  <meterTemplate href="xs:anyURI"? >
    ... MeterTemplate attributes ... ?
  </meterTemplate> *
  <eventLogTemplate href="xs:anyURI"? >
    ... EventLogTemplate attributes ... ?
  </eventLogTemplate> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
```

```
</ProtocolSegmentTemplate>
```

5.16.7.1 Collections

The `ProtocolSegmentTemplate`.Resource has no attributes of type Collection.

5.16.7.2 Operations

The `ProtocolSegmentTemplate` Resource supports the Read, Update, and Delete operations. Create is supported through the `ProtocolSegmentTemplateCollection` Resource.

5.16.8 ProtocolSegmentTemplateCollection Resource

A `ProtocolSegmentTemplateCollection` Resource represents the Collection of `ProtocolSegmentTemplates` within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI":
    "http://schemas.dmtf.org/cimi/2/ProtocolSegmentTemplateCollection",
  "id": string,
  "count": number,
  "protocolSegmentTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/ProtocolSegmentTemplate",
      "id": string,
      ... remaining ProtocolSegmentTemplate attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection

resourceURI="http://schemas.dmtf.org/cimi/2/ProtocolSegmentTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <ProtocolSegmentTemplate>
    <id> xs:anyURI </id>
    ... remaining ProtocolSegmentTemplate attributes ...
  </ProtocolSegmentTemplate> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.16.8.1 Operations

The `ProtocolSegmentTemplateCollection` Resource supports the Read and Update operations. Creation of new `ProtocolSegmentTemplate` Resources is supported by the way of a POST to the "add" operation's URI as described in clause 4.2.1.1.

5.16.9 Endpoints

An Endpoint is an addressable element within a protocol that is a source, destination , or source and destination for communication. Endpoints are `ProtocolEndpoint` Resources, the attributes of which are described in Table 33.

Table 33 – ProtocolEndpoint attributes

Name	ProtocolSegment	
Type URI	http://schemas.dmtf.org/cimi/2/ProtocolEndpoint	
Attribute	**Type**	**Description**
state	*string*	The operational state of the Endpoint. Allowable values are: **CREATING**: The Endpoint is in the process of being created. **ENABLED**: The Endpoint is available and ready for use. **DISABLED**: The Endpoint is not available for use. **DELETING**: The Endpoint is in the process of being deleted. **ERROR**: The Provider has detected an error in the Endpoint. The operations that result in transitions to the above defined states are defined in clause 5.16.9.3. Clause 5.16.10.1 defines the initial state of an Endpoint. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
protocol	*string*	The official name of the protocol supported by this segment. This attribute is intended as a convienience only and if specified its value must be identical to the value of the `protocol` attribute of the Segment with which the Endpoint is associated. Possible values are those specified in the `ProtocolSegment` Resource described in section 5.16.5. **Constraints:** **Provider:** support optional; immutable **Consumer:** support optional; read-only
address	*string*	The address assigned to this Endpoint in the format required by the supported protocol. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
origin	*string*	A string representing how protocol specific data is assigned to this Endpoint. Allowable values are: [**STATIC** | **DYNAMIC**] In general the Consumer is responsible for assignment of static data, usually from within the guest software. The Provider may assign data dynamically when the end point is created, or it may be assigned via a Service associated with the Segment to which the Endpoint belongs. (E.g. DHCP). **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
interface	*Network Interface*	A reference to the Interface that is used to connect to the Network using this Endpoint. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only

parameters	*map*	A polymorphic attribute the contents of which depend on the specific network protocol. As examples this would include "netmask" for IPv4 and "bandwidth" for "Ethernet". See the adjacent tables for details of the data to be included **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
meters	*collection [Meter]*	A reference to the list of `Meters` monitored for this Endpoint. **Constraints:** **Provider:** support optional; mutable .**Consumer:** support optional; read-only
eventLog	*ref*	A reference to the `EventLog` of this `Endpoint`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only

When implementing or using `ProtocolEndpoint`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 33 as well as in the tables describing embedded Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/ProtocolEndpoint",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "state": string,
  "protocol": string, ?
  "address": string,
  "origin": string,
  "interface": { "href": string },
.."parameters": { string: string, + }, ?
  "meters": { "href": string }, ?
  "eventLog": { "href": string }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/enable", "href": string },
?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/disable", "href": string }
?
  ] ?
  ...
```

```
}
```

XML media type: application/xml

XML serialization:

```
<ProtocolEndpoint xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <state> xs:string </state>
  <protocol> xs:string </protocol> ?
  <address> xs:string </address>
  <origin> xs:string </origin>
  <interface href="xs:anyURI"/>
  <parameters key="xs:string"> xs:string </parameters> *
  <meters href="xs:anyURI"/> ?
  <eventLog" href="xs:anyURI"/> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/enable"
href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/disable"
href="xs:anyURI"/> ?
  <xs:any>*
</ProtocolEndpoint>
```

5.16.9.1 Protocol specific parameters

Each Endpoint may require additional data that is specific to the communication protocol supported. This additional data is specified using the `parameters` attribute of a `ProtocolEndpoint`.This specification defines the following key – value pairs that provide supplemental information for Endpoints of specific protocol types:

Table 34 - IPv6 ProtocolEndpoint parameters

Name	IPv6ProtocolEndpointParameters	
Key	**Value Type**	**Description**
addressType	*string*	The IPv6 address type as specified by RFC4291, Section 2.4. Allowed values: [Unspecified | Loopback | Multicast | Link Local Unicast | Global Unicast | Embedded IPv4 Address | Site Local Unicast] If specified this value must match the type of address specified by the `address` attribute of the IPv6 Endpoint with which it is associated. **Constraints:** **Provider:** support optional; immutable **Consumer:** support optional; read-only

prefixLength	*integer*	The length of the prefix for IPv6 addresses that is used to specify a subnet. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only

Table 35 – IPv4 ProtocolEndpoint parameters

Name	IPv4ProtocolEndpointParameters	
Key	**Value Type**	**Description**
hostname	*string*	The DNS resolvable name associated with this address. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write

Table 36 – Ethernet ProtocolEndpoint parameters

Name	EthernetProtocolEndpointParameters	
Key	**Value Type**	**Description**
aliases	*string[]*	Other unicast addresses that may be used to communicate with the Endpoint **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
groupAddresses	*string[]*	Multicast addresses to which the Endpoint listens. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write

Note that Providers may support additional key – value pairs for the `parameter` attribute to extend the existing protocols. Consumers are not required to process any additional key – value pairs but must retrun them to the Provider in the serialization of `ProtocolEndpoints`.

5.16.9.2 Collections

The following clauses describe the Collection Resources that are components of `ProtocolEndpoints`.

5.16.9.2.1 `meters` Collection

The Resource type for each item of this Collection is "`Meter`" as defined in clause 5.17.3. There is no accessory attribute for the items in this Collection, therefore it is a basic `Meter` Collection (serialized as described in 5.5.12).

5.16.9.3 Operations

The `ProtocolEndpoints` Resource supports the Read, Update, and Delete operations. Create is supported through the `ProtocolEndpointCollection` Resource.

Deleting a `ProtocolEndpoint` shall remove that Endpoint from the global (Cloud Entry Point) `ProtocolEndpointCollection`. Additionally, references to the Endpoint in `ProtocolEndpointCollections` of all other Resources (e.g. `ProtocolSegments`, `NetworkServices`) must be removed.

The following custom operations are also defined:

enable

/link@rel: `http://schemas.dmtf.org/cimi/2/action/enable`

This operation shall enable a `ProtocolEndpoint`.

Input parameters: None.

Output parameters: None.

Upon successful completion of this operation, the `ProtocolEndpoint` shall be in the "ENABLED" state.

HTTP protocol

To enable a `ProtocolEndpoint`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/enable" URI of the `ProtocolEndpoint` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
  "action": "http://schemas.dmtf.org/cimi/2/action/enable",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/enable </action>
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

Upon successful processing of the request, the HTTP response body may be empty.

disable

/link@rel: `http://schemas.dmtf.org/cimi/2/action/disable`

This operation shall disable a `ProtocolEndpoint`.

Input parameters: None.

Output parameters: None.

Upon successful completion of this operation, the `ProtocolEndpoint` shall be in the "DISABLED" state.

HTTP protocol

To stop a `ProtocolEndpoint`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/disable" URI of the `ProtocolEndpoint` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
  "action": "http://schemas.dmtf.org/cimi/2/action/disable",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/disable </action>
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

Upon successful processing of the request, the HTTP response body may be empty.

5.16.10 ProtocolEndpointCollection Resource

A `ProtocolEndpointCollection` Resource represents the Collection of `ProtocolEndpoints` within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/ProtocolEndpointCollection",
  "id": string,
  "count": number,
  "endpoints": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/ProtocolEndpoint",
      "id": string,
      ... remaining ProtocolEndpoint attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
resourceURI="http://schemas.dmtf.org/cimi/2/ProtocolEndpointCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <ProtocolEndpoint>
```

```
    <id> xs:anyURI </id>
    ... remaining ProtocolEndpoint attributes ...
  </ProtocolEndpoint> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.16.10.1 Operations

NOTE The "add" operation requires that a ProtocolEndpointTemplate be used (see clause 5.16.11).

Upon successful processing of the "add" operation, unless otherwise specified by the `ProtocolEndpointTemplate` "initialState" attribute, the state of the new `ProtocolEndpoint` shall be the value of the DefaultInitialState capability of the `ProtocolEndpoint` Resource's `ResourceMetadata`, if defined. If no DefaultInitialState capability is defined, the default value shall be "DISABLED." The semantics of "initialState" shall be equivalent to the Provider issuing the appropriate actions against the new `ProtocolEndpoint` to move it into that state.

If a Provider is unable to change the state of the new `ProtocolEndpoint` to the appropriate "initialState" (either as specified by the `ProtocolEndpointTemplate` or as implied by the previous stated rules), the `ProtocolEndpoint` creation shall fail.

5.16.11 ProtocolEndpointTemplate Resource

The `ProtocolEndpointTemplate` is a set of configuration values for realizing a `ProtocolEndpoint`. A `ProtocolEndpointTemplate` may be used to create multiple `ProtocolEndpoints`. Table 37Table 32 describes the `ProtocolEndpointTemplate` attributes.

Table 37 – ProtocolEndpointTemplate attributes

Name	ProtocolEndpointTemplate	
Type URI	http://schemas.dmtf.org/cimi/2/ProtocolEndpointTemplate	
Attribute	**Type**	**Description**
initialState	*string*	Sets the initial state of the Endpoint created using this Template. The allowed values are restricted to the non-transient states specified for the `state` attribute of the `ProtocolEndpoint` Resource, described in clause 5.16.9. Providers should advertise the list of available values via the `ProtocolEndpoint ResourceMetadata initialStates` Capability. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
address	*string*	If the `origin` attribute value is “STATIC” this attribute contains the address to be assigned to this Endpoint in the format required by the supported protocol. If the `origin` attribute value is “DYNAMIC” this attribute must not be supplied by the Template. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write

Name	ProtocolEndpointTemplate	
Type URI	http://schemas.dmtf.org/cimi/2/ProtocolEndpointTemplate	
Attribute	**Type**	**Description**
origin	*string*	A string representing how protocol specific data is assigned to this Endpoint. Allowable values are: [**STATIC** | **DYNAMIC**] If the value of this attribute is "STATIC" then all protocol specific data for thei Endpoint must be supplied by this Template. If the value of this attribute is "DYNAMIC" then the protocol specific data for this Endpoint is allocated by other mechanisms and must not be supplied by this Template. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
interface	*Network Interface*	A reference to a `NetworkInterface` Resource with which this new Endpoint is associated. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
parameters	*map*	A polymorphic attribute the contents of which depend on the specific protocol supported. The allowed key – value pairs are as specified in clause 5.16.9. Whether this data is required to be supplied by this Template is determined by the value of the "`origin`" attribute described above. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
meterTemplates	*meterTemplates []*	A list of references to `MeterTemplates` that shall be used to create and connect a set of new `Meters` to the new `ProtocolEndpoint`. Note that the attributes of the `MeterTemplate` may be specified rather than a reference to an existing `MeterTemplate` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
eventLogTemplate	*ref*	A reference to an `EventLogTemplate` that shall be used to create and connect a new `EventLog` to the new `ProtocolEndpoint`. Note that the attributes of the `EventLogTemplate` may be specified rather than a reference to an existing `EventLogTemplate` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write

When implementing or using `ProtocolEndpointTemplate` Resources, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 37 as well as in the tables describing embedded Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/ProtocolEndpointTemplate",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
```

```
  "initialState": string, ?
  "address": string, ?
  "origin": string,
  "interface": { "href": string }, ?
.."parameters": { string: string, + }, ?
  "meterTemplates": [
    { "href": string, ?
      ... MeterTemplate attributes ... ?
    }, *
  ], ?
  "eventLogTemplate": {
    "href": string, ?
    ... EventLogTemplate attributes ... ?
  }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<ProtocolEndpointTemplate xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <initialState> xs:string </initialState> ?
  <address> xs:string </address> ?
  <origin> xs:string </origin>
  <interface href="xs:anyURI"/> ?
  <parameters key="xs:string"> xs:string </parameters> *
  <meterTemplate href="xs:anyURI"? >
    ... MeterTemplate attributes ... ?
  </meterTemplate> *
  <eventLogTemplate href="xs:anyURI"? >
    ... EventLogTemplate attributes ... ?
```

```
  </eventLogTemplate> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</ProtocolEndpointTemplate>
```

5.16.11.1 Collections

The `ProtocolEndpointTemplate` Resource has no attributes of type Collection.

5.16.11.2 Operations

The `ProtocolEndpointTemplate` Resource supports the Read, Update, and Delete operations. Create is supported through the `ProtocolEndpointTemplateCollection` Resource.

5.16.12 ProtocolEndpointTemplateCollection Resource

A `ProtocolEndpointTemplateCollection` Resource represents the Collection of `ProtocolEndpointTemplates` within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI":
    "http://schemas.dmtf.org/cimi/2/ProtocolEndpointTemplateCollection",
  "id": string,
  "count": number,
  "protocolSegmentTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/ProtocolEndpointTemplate",
      "id": string,
      ... remaining ProtocolEndpointTemplate attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection

resourceURI="http://schemas.dmtf.org/cimi/2/ProtocolEndpointTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <ProtocolEndpointTemplate>
    <id> xs:anyURI </id>
    ... remaining ProtocolEndpointTemplate attributes ...
```

```
  </ProtocolEndpointTemplate> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.16.12.1 Operations

The `ProtocolEndpointTemplateCollection` Resource supports the Read and Update operations. Creation of new `ProtocolEndpointTemplate` Resources is supported by the way of a POST to the "add" operation's URI as described in clause 4.2.1.1.

5.16.13 Interfaces

An Interface provides a connection to a Network by associating Endpoints with Machines.The model is basically that of a virtual Network Interface Card (vNIC) that can support multiple communication protocols at multiple levels. Interfaces are `NetworkInterface` Resources, the attributes of which are described in Table 38 below.

Table 38 – NetworkInterface attributes

Name	NetworkInterface	
Type URI	http://schemas.dmtf.org/cimi/2/NetworkInterface	
Attribute	**Type**	**Description**
state	*string*	The operational state of the Interface. Allowable values are: **CREATING**: The Interface is in the process of being created. **ENABLED**: The Interface is available and ready for use. **DISABLED**: The Interface is not available for use. **DELETING**: The Interface is in the process of being deleted. **ERROR**: The Provider has detected an error in the Interface. The operations that result in transitions to the above defined states are defined in clause 5.16.13.2. Clause 5.16.14.1 defines the initial state of a Interface. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
endpoints	*collection [Protocol Endpoint]*	A reference to a list of references to `ProtocolEndpoints` this Interface supports. Note: This Collection represents an association between the Interface and a list of Endpoints in one or more Segments. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
speed	*integer*	The current bandwidth of the Interface in Bits per Second. For Interfaces that vary in bandwidth or for those where no accurate estimation can be made, this attribute should contain the nominal bandwidth.. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
mtu	*integer*	The size in bytes of the active or negotiated maximum transmission unit (MTU) that can be supported by this Interface. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
meters	*collection [Meter]*	A reference to the list of `Meters` monitored for this Interface. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only

Name	NetworkInterface	
Type URI	http://schemas.dmtf.org/cimi/2/NetworkInterface	
Attribute	**Type**	**Description**
eventLog	*ref*	A reference to the `EventLog` of this Interface. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only

When implementing or using `NetworkInterface`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 38 as well as in the tables describing embedded Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/NetworkInterface",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "state": string,
  "endpoints": { "href": string }, ?
  "speed": number, ?
  "mtu": number ?,
  "meters": { "href": string }, ?
  "eventLog": { "href": string }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/enable", "href": string },
?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/disable", "href": string }
?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<NetworkInterface xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
```

```
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <state> xs:string </state>
  <endpoint href="xs:anyURI"/> ?
  <speed> xs:integer </speed> ?
  <mtu> xs:integer </mtu> ?
  <meters href="xs:anyURI"/> ?
  <eventLog" href="xs:anyURI"/> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/enable"
href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/disable"
href="xs:anyURI"/> ?
  <xs:any>*
</NetworkInterface>
```

5.16.13.1 Collections

The following clauses describe the Collection Resources that are components of `NetworkInterfaces`.

5.16.13.1.1 `meters` Collection

The Resource type for each item of this Collection is "`Meter`" as defined in clause 5.17.3. There is no accessory attribute for the items in this Collection, therefore it is a basic `Meter` Collection (serialized as described in 5.5.12).

5.16.13.2 Operations

The `NetworkInterfaces` Resource supports the Read, Update, and Delete operations. Create is supported through the `NetworkInterfaceCollection` Resource.

Deleting a `NetworkInterface` shall remove that Endpoint from the global (Cloud Entry Point) `NetworkInterfaceCollection`. Additionally, references to the Endpoint in `NetworkInterfaceCollections` of all other Resources (e.g. `ProtocolEndpoints`, `NetworkServices`) must be removed.

The following custom operations are also defined:

enable

/link@rel: `http://schemas.dmtf.org/cimi/2/action/enable`

This operation shall enable a `NetworkInterface`.

Input parameters: None.

Output parameters: None.

Upon successful completion of this operation, the `NetworkInterface` shall be in the "ENABLED" state.

HTTP protocol

To enable a `NetworkInterface`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/enable" URI of the `NetworkInterface` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
  "action": "http://schemas.dmtf.org/cimi/2/action/enable",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/enable </action>
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

Upon successful processing of the request, the HTTP response body may be empty.

disable

/link@rel: `http://schemas.dmtf.org/cimi/2/action/disable`

This operation shall disable a `NetworkInterface`.

Input parameters: None.

Output parameters: None.

Upon successful completion of this operation, the `NetworkInterface` shall be in the "DISABLED" state.

HTTP protocol

To stop a `NetworkInterface`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/disable" URI of the `NetworkInterface` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
  "action": "http://schemas.dmtf.org/cimi/2/action/disable",
  "properties": { string: string, + } ?
  ...
```

```
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/disable </action>
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

Upon successful processing of the request, the HTTP response body may be empty.

5.16.14 NetworkInterfaceCollection Resource

A `NetworkInterfaceCollection` Resource represents the Collection of `NetworkInterfaces` within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/NetworkInterfaceCollection",
  "id": string,
  "count": number,
  "interfaces": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/NetworkInterface",
      "id": string,
      ... remaining NetworkInterface attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
resourceURI="http://schemas.dmtf.org/cimi/2/NetworkInterfaceCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <NetworkInterface>
    <id> xs:anyURI </id>
    ... remaining NetworkInterface attributes ...
  </NetworkInterface> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.16.14.1 Operations

NOTE The "add" operation requires that a NetworkInterfaceTemplate be used (see clause 5.16.15).

Upon successful processing of the "add" operation, unless otherwise specified by the `NetworkInterfaceTemplate` "initialState" attribute, the state of the new `NetworkInterface` shall be the value of the DefaultInitialState capability of the `NetworkInterface` Resource's `ResourceMetadata`, if defined. If no DefaultInitialState capability is defined, the default value shall be "DISABLED." The semantics of "initialState" shall be equivalent to the Provider issuing the appropriate actions against the new `NetworkInterface` to move it into that state.

If a Provider is unable to change the state of the new `NetworkInterface` to the appropriate "initialState" (either as specified by the `NetworkInterfaceTemplate` or as implied by the previous stated rules), the `NetworkInterface` creation shall fail.

5.16.15 NetworkInterfaceTemplate Resource

The `NetworkInterfaceTemplate` is a set of configuration values for realizing a `NetworkInterface`. A `NetworkInterfaceTemplate` may be used to create multiple `NetworkInterfaces`. Table 39 describes the `NetworkInterfaceTemplate` attributes.

Table 39 – NetworkInterfaceTemplate attributes

Name	NetworkInterfaceTemplate	
Type URI	http://schemas.dmtf.org/cimi/2/NetworkInterfaceTemplate	
Attribute	**Type**	**Description**
initialState	*string*	Sets the initial state of the Endpoint created using this Template. The allowed values are restricted to the non-transient states specified for the `state` attribute of the `NetworkInterface` Resource, described in 5.16.13 . Providers should advertise the list of available values via the `NetworkInterface ResourceMetadata initialStates` Capability. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
endpoints	*collection [Protocol Endpoint]*	A reference to a list of references to `ProtocolEndpoints` this Interface supports. Note: This Collection represents an association between the Interface and a list of Endpoints in one or more Segments. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
speed	*integer*	The initial bandwidth of the Interface in Bits per Second. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
mtu	*integer*	The size in bytes of the initial maximum transmission unit (MTU) that can be supported by this Interface. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
meterTemplates	*meterTemplates []*	A list of references to `MeterTemplates` that shall be used to create and connect a set of new `Meters` to the new `NetworkInterface`. Note that the attributes of the `MeterTemplate` may be specified rather than a reference to an existing `MeterTemplate` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write

Name	NetworkInterfaceTemplate	
Type URI	http://schemas.dmtf.org/cimi/2/NetworkInterfaceTemplate	
Attribute	**Type**	**Description**
eventLogTemplate	*ref*	A reference to an `EventLogTemplate` that shall be used to create and connect a new `EventLog` to the new `NetworkInterface`. Note that the attributes of the `EventLogTemplate` may be specified rather than a reference to an existing `EventLogTemplate` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write

When implementing or using `NetworkInterfaceTemplate` Resources, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 39 as well as in the tables describing embedded Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/NetworkInterfaceTemplate",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "initialState": string, ?
  "endpoints": { "href": string }, ?
  "speed": number, ?
  "mtu": number ?,
  "meterTemplates": [
    { "href": string, ?
      ... MeterTemplate attributes ... ?
    }, *
  ], ?
  "eventLogTemplate": {
    "href": string, ?
    ... EventLogTemplate attributes ... ?
  }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<NetworkInterfaceTemplate xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <initialState> xs:string </initialState> ?
  <endpoint href="xs:anyURI"/> ?
  <speed> xs:integer </speed> ?
  <mtu> xs:integer </mtu> ?
  <meterTemplate href="xs:anyURI"? >
    ... MeterTemplate attributes ... ?
  </meterTemplate> *
  <eventLogTemplate href="xs:anyURI"? >
    ... EventLogTemplate attributes ... ?
  </eventLogTemplate> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</NetworkInterfaceTemplate>
```

5.16.15.1 Collections

The following clauses describe Collection Resources that are components of `NetworkInterfaceTemplates`.

5.16.15.1.1 `endpoints` Collection

The Resource type for each item of this Collection is "`ProtocolEndpoint`" as defined in clause 5.16.9. There is no accessory attribute for the items in this Collection, therefore it is a basic `ProtocolEndpointCollection` (serialized as described in 5.16.10).

5.16.15.2 Operations

The `NetworkInterfaceTemplate` Resource supports the Read, Update, and Delete operations. Create is supported through the `NetworkInterfaceTemplateCollection` Resource.

5.16.16 NetworkInterfaceTemplateCollection Resource

A `NetworkInterfaceTemplateCollection` Resource represents the Collection of `NetworkInterfaceTemplates` within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI":
    "http://schemas.dmtf.org/cimi/2/NetworkInterfaceTemplateCollection",
  "id": string,
  "count": number,
  "protocolSegmentTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/NetworkInterfaceTemplate",
      "id": string,
      ... remaining NetworkInterfaceTemplate attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection

resourceURI="http://schemas.dmtf.org/cimi/2/NetworkInterfaceTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <NetworkInterfaceTemplate>
    <id> xs:anyURI </id>
    ... remaining NetworkInterfaceTemplate attributes ...
  </NetworkInterfaceTemplate> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.16.16.1 Operations

The `NetworkInterfaceTemplateCollection` Resource supports the Read and Update operations. Creation of new `NetworkInterfaceTemplate` Resources is supported by the way of a POST to the "add" operation's URI as described in clause 4.2.1.1.

5.16.17 Services

Services provide all additional functionality within Networks beyond basic rounting within a single Segment. Services can be applied to individual Segments or Endpoints, collections of Segments or Endpoints, or combinations of these elements. The actual function provide by a Service is determined by policies (see clause 5.16.21). Services are `NetworkService` Resources, the attributes of which are described in Table 40 below**Error! Reference source not found.**.

5319 **Table 40 – NetworkService attributes**

Name	NetworkService	
Type URI	http://schemas.dmtf.org/cimi/2/NetworkService	
Attribute	**Type**	**Description**
state	*string*	The operational state of the Service. Allowed values are: **CREATING**: The Service is in the process of being created. **STARTED**: The Service is available (enabled) and ready for use. **STOPPED**: The Service is stopped (disabled) and not available for use. **DELETING**: The Service is in the process of being deleted. **ERROR**: The Provider has detected an error in the Service. The operations that result in transitions to the above defined states are defined in clause 5.17. Clause 5.16.18.1 defines the initial state of a Service. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
type	*string*	Indicates the type of service provided by this `NetworkService`. Allowed values: [Load Balancer | QoS | Firewall | VPN | DHCP | DNS | NAT | Gateway | Layer4 Port Forwarding | IP Routing | Virtual Network Device | Other] **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
endpoints	*collection [Protocol Endpoint]*	A reference to a list of references to individual Endpoints to which the Service is provided. **Constraints:** **Provider:** support optional; mutable .**Consumer:** support optional; read-write
segments	*collection [Protocol Segment]*	A reference to a list of references to complete Segments to which the service is provided. The Service is provided to all Endpoints within each Segment. **Constraints:** **Provider:** support optional; mutable .**Consumer:** support optional; read-write
policies	*map*	*** TBD *** Format & requirements yet to be determined form NSMWG work **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
meters	*collection [Meter]*	A reference to the list of `Meters` monitored for this Service. **Constraints:** **Provider:** support optional; mutable .**Consumer:** support optional; read-only
eventLog	*ref*	A reference to the `EventLog` of this `Service`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only

5320 When implementing or using `NetworkService` Resources, Providers and Consumers shall adhere to
5321 the syntax and semantics of its attributes as described in Table 40 as well as in the tables describing
5322 embedded Resources or related Collections. Both Consumer and Provider shall serialize this Resource
5323 as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the
5324 Resource in both JSON and XML.

5325 **JSON media type:** application/json

5326 **JSON serialization:**

5327
```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/NetworkService",
```
5328
```
  "id": string,
```
5329
```
  "name": string, ?
```

```
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "state": string,
  "type": string,
  "endpoints": { "href": string }, ?
  "segments": { "href": string }, ?

.."policies": { string: string, + }, ?

  "meters": { "href": string }, ?
  "eventLog": { "href": string }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/start", "href": string }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/stop", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<NetworkService xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <state> xs:string </state>
  <type> xs:string </type>
  <endpoints href="xs:anyURI"/> *
  <segments href="xs:anyURI"/> *

  <policies key="xs:string"> xs:string </policies> *

  <meters href="xs:anyURI"/> ?
  <eventLog" href="xs:anyURI"/> ?
```

```
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/start"
href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/stop"
href="xs:anyURI"/> ?
  <xs:any>*
</NetworkService>
```

5.16.17.1 Collections

The following clauses describe the Collection Resources that are components of `NetworkServices`.

5.16.17.1.1 `endpoints` Collection

The Resource type for each item of this Collection is a "`ProtocolEndpoint`" as defined in clause 5.16.9. There is no accessory attribute for the items in this Collection, therefore it is a basic `ProtocolEndpointCollection` Resource, serialized as described in 5.16.10.

5.16.17.1.2 `segments` Collection

The Resource type for each item of this Collection is a "`ProtocolSegment`" as defined in clause 5.16.55.16.9. There is no accessory attribute for the items in this Collection, therefore it is a basic `ProtocolSegmentCollection` Resource, serialized as described in 5.16.6.

5.16.17.1.3 `meters` Collection

The Resource type for each item of this Collection is "`Meter`" as defined in clause 5.17.3. There is no accessory attribute for the items in this Collection, therefore it is a basic `Meter` Collection (serialized as described in 5.5.12).

5.16.17.2 Operations

The `NetworkService` Resource supports the Read, Update, and Delete operations. Create is supported through the `NetworkServiceCollection` Resource.

Deleting a `NetworkService` shall remove that Service from the global (Cloud Entry Point) `NetworkServiceCollection` and also all references to the Service in Collections of other Resources (e.g.from corresponding Network `services` Collections).

The following custom operations are also defined:

start

/link@rel: `http://schemas.dmtf.org/cimi/2/action/start`

This operation shall start a `NetworkService`.

Input parameters: None.

Output parameters: None.

Upon successful completion of this operation, the `NetworkService` shall be in the "STARTED" state.

HTTP protocol

To start a NetworkService, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/start" URI of the NetworkService where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
  "action": "http://schemas.dmtf.org/cimi/2/action/start",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/start </action>
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

Upon successful processing of the request, the HTTP response body may be empty.

stop

/link@rel: http://schemas.dmtf.org/cimi/2/action/stop

This operation shall stop a NetworkService.

Input parameters: None.

Output parameters: None.

Upon successful completion of this operation, the NetworkService shall be in the "STOPPED" state.

HTTP protocol

To stop a NetworkService, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/stop" URI of the NetworkService where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
  "action": "http://schemas.dmtf.org/cimi/2/action/stop",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
```

```
  <action> http://schemas.dmtf.org/cimi/2/action/stop </action>
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

Upon successful processing of the request, the HTTP response body may be empty.

5.16.18 NetworkServiceCollection Resource

A `NetworkServiceCollection` Resource represents the Collection of `NetworkServices` within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/NetworkServiceCollection",
  "id": string,
  "count": number,
  "services": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/NetworkService",
      "id": string,
      ... remaining NetworkService attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
resourceURI="http://schemas.dmtf.org/cimi/2/NetworkServiceCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <NetworkService>
    <id> xs:anyURI </id>
    ... remaining NetworkService attributes ...
  </NetworkService> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.16.18.1 Operations

NOTE The "add" operation requires that a NetworkServiceTemplate be used (see clause 5.16.19).

Upon successful processing of the "add" operation, unless otherwise specified by the `NetworkServiceTemplate` "initialState" attribute, the state of the new `NetworkService` shall be

5480 the value of the DefaultInitialState capability of the `NetworkService` Resource's
5481 `ResourceMetadata`, if defined. If no DefaultInitialState capability is defined, the default value shall be
5482 "STOPPED." The semantics of "initialState" shall be equivalent to the Provider issuing the appropriate
5483 actions against the new `NetworkService` to move it into that state.

5484 If a Provider is unable to change the state of the new `NetworkService` to the appropriate "initialState"
5485 (either as specified by the `NetworkServiceTemplate` or as implied by the previous stated rules),
5486 the `NetworkService` creation shall fail.

5487 5.16.19 NetworkServiceTemplate Resource

5488 The `NetworkServiceTemplate` is a set of configuration values for realizing a `NetworkService`.
5489 A `NetworkServiceTemplate` may be used to create multiple `NetworkServices`. Table 41
5490 describes the `NetworkServiceTemplate` attributes.

5491 **Table 41 – NetworkServiceTemplate attributes**

Name	NetworkServiceTemplate	
Type URI	http://schemas.dmtf.org/cimi/2/NetworkServiceTemplate	
Attribute	**Type**	**Description**
network	*ref*	A reference to the Network to which the Service created using this Template belongs. If this Template is used to create a new Service through the global (Cloud Entry Point) `NetworkServiceCollection`, this attribute shall be present. If this Template is referenced from a `NetworkTemplate` and used to create a new Service during the creation of a Network, this attribute shall either be absent or have the same value as the "`id`" attribute of the `Network` to which this Service is being added. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
initialState	*string*	Sets the initial state of the Service created using this Template. The allowed values are restricted to the non-transient states specified for the `state` attribute of the `NetworkService` Resource, described in clause 5.16.17. Providers should advertise the list of available values via the `NetworkService ResourceMetadata initialStates` Capability. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
type	*string*	Sets the protocol supported by the Service created using this Template. The allowed values are those specified for the `protocol` attribute of the `NetworkService` Resource, described in 5.16.17 **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
endpoints	*Protocol Endpoint[]*	A list of references to `ProtocolEndpoints` to be inserted into the `endpoints` Collection of the Service created using this Template. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
segments	*Protocol Segment[]*	A list of references to `ProtocolSegments` to be inserted into the `segments` Collection of the Service created using this Template. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write

Name	NetworkServiceTemplate	
Type URI	http://schemas.dmtf.org/cimi/2/NetworkServiceTemplate	
Attribute	**Type**	**Description**
policies	*map*	*** TBD *** Format & requirements yet to be determined form NSMWG work **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
meterTemplates	*meterTemplates []*	A list of references to `MeterTemplates` that shall be used to create and connect a set of new `Meters` to the new `NetworkService`. Note that the attributes of the `MeterTemplate` may be specified rather than a reference to an existing `MeterTemplate` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
eventLogTemplate	*ref*	A reference to an `EventLogTemplate` that shall be used to create and connect a new `EventLog` to the new `NetworkService`. Note that the attributes of the `EventLogTemplate` may be specified rather than a reference to an existing `EventLogTemplate` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write

When implementing or using `NetworkServiceTemplate` Resources, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 41**Table 32** as well as in the tables describing embedded Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/NetworkServiceTemplate",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "network": { "href": string }, ?
  "initialState": string, ?
  "type": string,
  "endpoints": { "href": string }, *
  "segments": { "href": string }, *

..."policies": { string: string, + }, ?

  "meterTemplates": [
    { "href": string, ?
      ... MeterTemplate attributes ... ?
```

```
    }, *
  ], ?
  "eventLogTemplate": {
    "href": string, ?
    ... EventLogTemplate attributes ... ?
  }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<NetworkServiceTemplate xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <network href="xs:anyURI"/> ?
  <initialState> xs:string </initialState> ?
  <type> xs:string </type>
  <endpoints href="xs:anyURI"/> *
  <segments href="xs:anyURI"/> *

  <policies key="xs:string"> xs:string </policies> *

  <meterTemplate href="xs:anyURI"? >
    ... MeterTemplate attributes ... ?
  </meterTemplate> *
  <eventLogTemplate href="xs:anyURI"? >
    ... EventLogTemplate attributes ... ?
  </eventLogTemplate> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</NetworkServiceTemplate>
```

5.16.19.1 Collections

The `NetworkServiceTemplate`.Resource has no attributes of type Collection.

5.16.19.2 Operations

The `NetworkServiceTemplate` Resource supports the Read, Update, and Delete operations. Create is supported through the `NetworkServiceTemplateCollection` Resource.

5.16.20 NetworkServiceTemplateCollection Resource

A `NetworkServiceTemplateCollection` Resource represents the Collection of `NetworkServiceTemplates` within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI":
    "http://schemas.dmtf.org/cimi/2/NetworkServiceTemplateCollection",
  "id": string,
  "count": number,
  "protocolSegmentTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/NetworkServiceTemplate",
      "id": string,
      ... remaining NetworkServiceTemplate attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection

resourceURI="http://schemas.dmtf.org/cimi/2/NetworkServiceTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <NetworkServiceTemplate>
    <id> xs:anyURI </id>
    ... remaining NetworkServiceTemplate attributes ...
  </NetworkServiceTemplate> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.16.20.1 Operations

The `NetworkServiceTemplateCollection` Resource supports the Read and Update operations. Creation of new `NetworkServiceTemplate` Resources is supported by the way of a POST to the "add" operation's URI as described in clause 4.2.1.1.

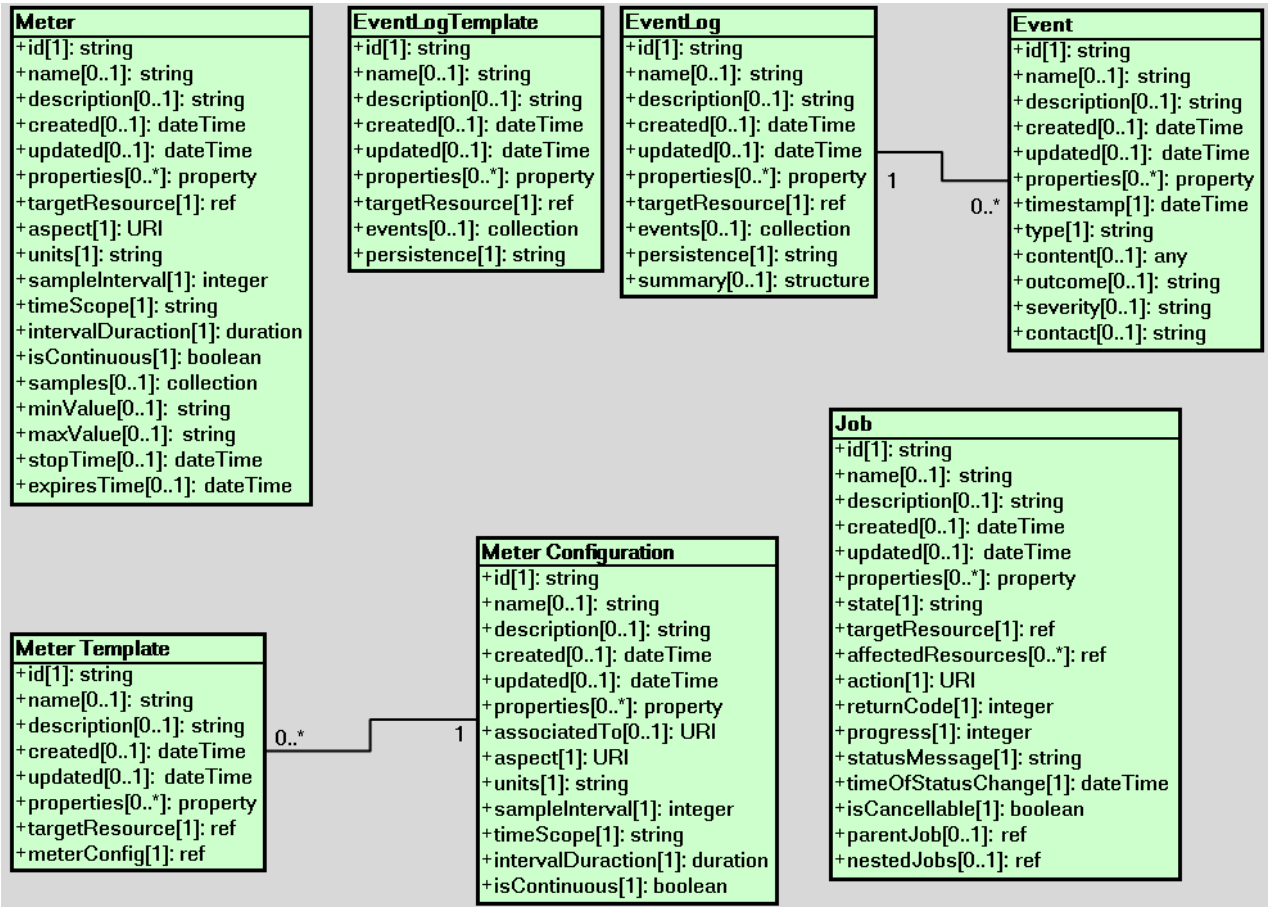
5.16.21 Policies

***** TBD *****

Format & requirements yet to be determined form NSMWG work*Error! Reference source not found.*.

5.17 Monitoring Resources and relationships

Figure 6 illustrates the Resources involved in tracking the progress of operations, as well as, metering and monitoring the status of other Resources. Although this drawing is in the style of a Resource



Relationship diagram, the use of UML is neither rigorous nor normative.

Figure 6 - Monitoring Resources

5.17.1 Job Resource

This Resource represents a process (i.e., a sequence of one or more operations directed to accomplish a specific goal) that is performed by the Provider.

If a Provider supports exposing `Job` Resources to Consumers, each request from a Consumer that the Provider responds to with a 202 status code, shall result in a `Job` Resource being created and an absolute URI reference to that `Job` Resource shall be made available to the requesting Consumer. Providers may create additional `Job` Resources for Provider-initiated operations if the Provider chooses to expose these Jobs to Consumers.

If a `Job` is not completed successfully (e.g., it is in the FAILED or STOPPED state), this specification does not place any requirements on the Provider to ensure that the affected Resources are left in certain states. Based on the environmental conditions at that time, the Provider might choose to "undo" any impact of the operation; simply halt processing; attempt some kind of "cleanup" action; or choose to do something else. However, Providers shall list all Resources impacted by the `Job` in the "affectedResources" attribute, thus allowing Consumers an opportunity to examine the state of each Resource themselves. In cases where a Resource has been deleted, references to that Resource shall not appear in the "affectedResources" attribute.

The `Job` Resource allows for nesting of `Jobs`. The determination of when a single operation is converted into multiple nested `Jobs` is out of scope of this specification. However, if there are nested Jobs, the top-most Job Resource shall report the overall status of all Jobs and shall only be in a "SUCCESS" state if all nested `Jobs` are also in "SUCCESS" state. If nested `Jobs` are created, there is no requirement for the top-most `Job` Resource to reference all affected Resources in its "affectedResources" attribute. The Consumer needs to traverse the entire set of nested `Jobs` to determine the complete list of Resources impacted by the `Jobs`.

Table 42 describes the `Job` attributes.

Table 42 – Job attributes

Name	Job	
Type URI	http://schemas.dmtf.org/cimi/2/Job	
Attribute	**Type**	**Description**
state	*string*	The state of the process associated with this operation. Allowed values are: **QUEUED**: Indicates that the operation has not yet begun processing. **RUNNING**: Indicates that the operation is still being executed. **FAILED**: Indicates that the operation failed to be completed successfully. **SUCCESS**: Indicates that the operation was successfully completed. **STOPPING**: Indicates that the operation is in the process of being stopped. **STOPPED**: Indicates that the operation was stopped before completion. The operations that result in transitions to the above defined states are defined in clause 5.17.1.1 **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
targetResource	*ref*	A reference to the top-level Resource upon which the operation is being performed. Typically, this Resource would be the Resource on which the operation was invoked. Note that if an "add" Job is executed against a "Collection" Resource (e.g., MachineCollection), the targetResource attribute shall reference the Collection Resource as that is the Resource on which the operation was performed. Additionally, the newly created Resource shall appear in the "affectedResources" attribute. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
affectedResources	*ref[]*	A list of references to Resources that have been impacted by this `Job`. Note that this list shall always contain the "targetResource" reference. Array item name: affectedResource **Constraints:**

Name	Job	
Type URI	http://schemas.dmtf.org/cimi/2/Job	
Attribute	**Type**	**Description**
		Provider: support mandatory; mutable **Consumer:** support mandatory; read-only
action	*URI*	A URI that indicates the type of action being performed. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
returnCode	*integer*	The operation return code. The specific value is specific to the implementation. Values in the range of 0 to 9999 are reserved for use by this specification. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
progress	*integer*	An integer value in the range 0 … 100 that indicates the progress of this `Job`. This value shall be 100 if the `Job` is no longer executing, regardless of the outcome. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
statusMessage	*string*	A human-readable string that provides information about the operation. It is used to further qualify or provide additional information about the current status of the operation. For example, this attribute may indicate the reason why the operation failed, or whether the operation was cancelled by the Consumer or the Provider. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
timeOfStatusChange	*dateTime*	A timestamp indicating the last time that the status of the operation changed. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
parentJob	*ref*	A reference to the `Job` of which this Resource is a subordinate. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
nestedJobs	*ref[]*	An array of references to a set of subordinate `Job` Resources. Array item name: nestedJob **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only

When implementing or using `Job`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 42 as well as in the tables describing referred Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Job",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
```

```
  "state": string,
  "targetResource": { "href": string },
  "affectedResources": [ { "href": string }, + ],
  "action": string,
  "returnCode": number,
  "progress": number,
  "statusMessage": string,
  "timeOfStatusChange": date,
  "parentJob": { "href": string }, ?
  "nestedJobs": [
    { "href": string }, +
  ], ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/stop", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<Job xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateIime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <state> xs:string </state>
  <targetResource href="xs:anyURI"/>
  <affectedResource href="xs:anyURI"/> +
  <action> xs:anyURI </action>
  <returnCode> xs:integer </returnCode>
  <progress> xs:integer <progress>
  <statusMessage> xs:string </statusMessage>
  <timeOfStatusChange> xs:dateTime </timeOfStatusChange>
  <parentJob href="xs:anyURI"/> ?
  <nestedJob href="xs:anyURI"/> *
  <operation rel="edit" href="xs:anyURI"/> ?
```

```
  <operation rel="delete" href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/stop"
href="xs:anyURI"/> ?
  <xs:any>*
</Job>
```

5.17.1.1 Operations Resource

This Resource supports the Read, Update, and Delete operations. Deleting a `Job` that is in the "RUNNING" state shall be the equivalent of first stopping the `Job` and then deleting it. A request to delete a running `Job` that does not support the "stop" action shall fail.

The following custom operations are also defined:

stop

/link@rel: `http://schemas.dmtf.org/cimi/2/action/stop`

This operation shall stop a `Job`.

Input parameters: None.

Output parameters: None.

During the processing of this operation, the `Job` shall be in the "STOPPING" state.

Upon successful completion of this operation, the `Job` shall be in the "STOPPED" state.

HTTP protocol

To stop a `Job`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/stop" URI of the `Job` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
  "action": "http://schemas.dmtf.org/cimi/2/action/stop",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/stop </action>
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

Upon successful processing of the request, the HTTP response body may be empty.

5.17.2 JobCollection Resource

A `JobCollection` Resource represents the Collection of `Jobs` within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/JobCollection",
  "id": string,
  "count": integer,
  "jobs": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/Job",
      "id": string,
      ... remaining Job attributes ...
    }, +
  ] ?
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/2/JobCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <Job>
    <id> xs:anyURI </id>
    ... remaining Job attributes ...
  </Job> *
  <xs:any>*
</Collection>
```

5.17.3 Meter Resource

This Resource represents an available `Meter` of some property associated to a given Resource.

If a `Meter's` "targetResource" is deleted all `Meters` associated with that Resource shall also be deleted. In other words, deleting a Resource-specific `MetersCollection` (e.g., a `Machine's MetersCollection`) shall also result in the deletion of the `Meters` referenced from that Collection.

Table 43 describes the `Meter` attributes.

Table 43 – Meter attributes

Name	Meter	
Type URI	http://schemas.dmtf.org/cimi/2/Meter	
Attribute	**Type**	**Description**
targetResource	*ref*	A reference to the Resource to which the `Meter` is related. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only

Name	Meter	
Type URI	http://schemas.dmtf.org/cimi/2/Meter	
Attribute	**Type**	**Description**
aspect	*URI*	A unique identifier representing the aspect of the Resource being metered. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
units	*string*	The name of the used units, e.g., kilobits per second, CPU usage percentage, etc. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
sampleInterval	*integer*	The time between consecutive samples in seconds. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
timeScope	*string*	The time scope to which this meter's value applies. Two possible values: "Point" indicates that the Meter applies to a point in time. "Interval" indicates that the `Meter` applies to a time interval. For instance, it would be possible to define a `Meter` whose purpose is to provide the daily average CPU usage. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
intervalDuration	*duration*	The interval duration when the timeScope is set to "Interval". Possible values: hourly, daily, weekly, monthly, or yearly. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
isContinuous	*boolean*	This value indicates whether the `Meter` value is continuous or scalar. Performance Meters are an example of a linear metric. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
samples	*collection [Sample]*	A reference to the list of taken samples **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
minValue	*string*	The expected minimal measure value. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
maxValue	*string*	The expected maximum measure value. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
stopTime	*dateTime*	The time from which the meter stops tracking samples. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
expiresTime	*dateTime*	The time from which the `Meter` is not monitored anymore. It implies the deletion of the Meter after this time. Note that a `Meter` might be deleted before this time if the Resource being metered is deleted. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write

5750 When implementing or using `Meter`, Providers and Consumers shall adhere to the syntax and semantics
5751 of its attributes as described in Table 43 as well as in the tables describing related Collections. Both

Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Meter",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "targetResource": { "href": string },
  "aspect": string,
  "units": string,
  "sampleInterval": number,
  "timeScope": string,
  "intervalDuration": string,
  "isContinuous": boolean,
  "samples": { "href": string }, ?
  "minValue": string, ?
  "maxValue": string, ?
  "stopTime": string, ?
  "expiresTime": string, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/start", "href": string }, ?
    { "rel": "http://schemas.dmtf.org/cimi/2/action/stop", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<Meter xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
```

```
  <property key="xs:string"> xs:string </property> *
  <targetResource href="xs:anyURI"/>
  <aspect> xs:anyURI </aspect>
  <units> xs:string </units>
  <sampleInterval> xs:integer </sampleInterval>
  <timeScope> xs:string <timeScope>
  <intervalDuration xs:duration </intervalDuration>
  <isContinuous> xs:boolean </isContinuous>
  <samples href="xs:anyURI"/> ?
  <minValue> xs:string </minValue> ?
  <maxValue> xs:string </maxValue> ?
  <stopTime> xs:dateTime </stopTime> ?
  <expiresTime> xs:dateTime </expiresTime> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/start"
href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/2/action/stop"
href="xs:anyURI"/> ?
  <xs:any>*
</Meter>
```

5.17.3.1 Collections

The following clauses describe the Collection resources that are components of `Meters`.

5.17.3.1.1 SampleCollection Resource

The Resource type for each item of this Collection is "`Sample`", defined in Table 44:

Table 44 – Sample attributes

Name	Sample	
Type URI	http://schemas.dmtf.org/cimi/2/Sample	
Attribute	**Type**	**Description**
timestamp	*dateTime*	Indicates when the measure was taken (timeScope="Point"). If the timeScope is "Interval", it indicates the end of the time interval. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
value	*string*	Indicates the sampled value of the measure. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only

When implementing or using `Sample`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 44 as well as in the tables describing related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the `Sample` Collection in both JSON and XML.

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/SampleCollection",
  "id": string,
  "count": number,
  "samples": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/Sample",
      "id": string,
      "name": string, ?
      "description": string, ?
      "created": string, ?
      "updated": string, ?
      "properties": { string: string, + }, ?
      "timestamp": string,
      "value": string
      ...
    }, +
  ], ?
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/2/SampleCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <Sample>
    <id> xs:anyURI </id>
    <name> xs:string </name> ?
    <description> xs:string </description> ?
    <created> xs:dateTime </created> ?
    <updated> xs:dateTime </updated> ?
    <property key="xs:string"> xs:string </property> *
    <sample timestamp="xs:dateTime" value="xs:string"/>
    <xs:any>*
  </Sample> *
```

```
  <xs:any>*
</Collection>
```

5.17.3.2 Operations

This Resource supports the Read, Update, and Delete operations. Create is supported via the `MeterCollection` Resource. The deletion of a Meter shall remove the `Meter` from the targetResource's "meter" attribute.

The following custom operations are also defined:

start

/link@rel: `http://schemas.dmtf.org/cimi/2/action/start`

This operation shall start a `Meter`.

Input parameters: None.

Output parameters: None.

Upon successful completion of this operation, the `Meter` shall start recording samples related to its associated Resource.

HTTP protocol

To start a `Meter`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/start" URI of the `Meter` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
  "action": "http://schemas.dmtf.org/cimi/2/action/start",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/start </action>
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

Upon successful processing of the request, the HTTP response body may be empty.

stop

/link@rel: `http://schemas.dmtf.org/cimi/2/action/stop`

This operation shall stop a `Meter`.

Input parameters: None.

Output parameters: None.

Upon successful completion of this operation, the `Meter` shall no longer be recording samples related to its associated Resource.

HTTP protocol

To stop a `Meter`, a POST is sent to the "http://schemas.dmtf.org/cimi/2/action/stop" URI of the `Meter` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Action",
  "action": "http://schemas.dmtf.org/cimi/2/action/stop",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/2">
  <action> http://schemas.dmtf.org/cimi/2/action/stop </action>
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

Upon successful processing of the request, the HTTP response body may be empty.

5.17.4 MeterCollection Resource

A `MeterCollection` Resource represents the Collection of `Meters` within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/MeterCollection",
  "id": string,
  "count": number,
  "meters": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/Meter",
      "id": string,
      ... remaining Meter attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
```

```
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/2/MeterCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <Meter>
    <id> xs:anyURI </id>
    ... remaining Meter attributes ...
  </Meter> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.17.4.1 Operations

NOTE The "add" operation requires that a `MeterTemplate` be used (see 4.2.1.1).

If `Meters` are created through the global (Cloud Entry Point) `MeterCollection's` "add" operation, they shall be added automatically to the corresponding targetResource's "`Meters`" Collection Resource as well.

5.17.5 MeterTemplate Resource

A `MeterTemplate` represents the information needed to create a new `Meter`. Table 45 describes the `MeterTemplate` attributes.

Table 45 – MeterTemplate attributes

Name	MeterTemplate	
Type URI	http://schemas.dmtf.org/cimi/2/MeterTemplate	
Attribute	**Type**	**Description**
targetResource	*ref*	A reference to the Resource that is metered. The type of the Resource shall be one of the "associatedTo" types listed in the `MeterConfiguration` referenced. If this Template is used to create a new `Meter` through the global (Cloud Entry Point) `MetersCollection`, this attribute shall be present. If this Template is used to create a new Meter through a targetResource's `MetersCollection`, this attribute shall either be absent or have the same value as the "id" of the targetResource to which this Meter is being added. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
meterConfig	*ref*	A reference to the `MeterConfiguration` that is used to create a `Meter` from this `MeterTemplate`. Note that the attributes of the `MeterConfiguration` may be specified rather than a reference to an existing `MeterConfiguration` Resource. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write

When implementing or using `MeterTemplate`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 45 as well as in the tables describing referred

Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/MeterTemplate",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "targetResource": { string },
  "meterConfig": {
    "href": string | ... MeterConfiguration attributes ...
  },
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<MeterTemplate xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <targetResource href="xs:anyURI"/>
  <meterConfig href="xs:anyURI"?>
    ... MeterConfiguration attributes ... ?
  </meterConfig>
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</MeterTemplate>
```

5.17.6 MeterTemplateCollection Resource

A `MeterTemplateCollection` Resource represents the Collection of `MeterTemplate` Resources within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/MeterTemplateCollection",
  "id": string,
  "count": number,
  "meterTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/MeterTemplate",
      "id": string,
      ... remaining MeterTemplate attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/2/MeterTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <MeterTemplate>
    <id> xs:anyURI </id>
    ... remaining MeterTemplate attributes ...
  </MeterTemplate> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.17.6.1 Operations

This Resource supports the Read and Update operations. Creation of new `MeterTemplate` Resources is supported by the way of a POST to the "add" operation's URI as described in clause 4.2.1.1.

5.17.7 MeterConfiguration Resource

A `MeterConfiguration` represents the definition of a `Meter`. Table 46 describes the `MeterConfiguration` attributes.

6028 **Table 46 – MeterConfiguration attributes**

Name	MeterConfiguration	
Type URI	http://schemas.dmtf.org/cimi/2/MeterConfiguration	
Attribute	**Type**	**Description**
associatedTo	*URI[]*	An array of URIs that indicate the types of Resources to which a `Meter` created from this configuration can be applied. The value space of these URIs is identical to that of `ResourceMetadata`.typeURI, which is a URI that uniquely identifies a Resource type. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
aspect	*URI*	A unique identifier representing the aspect of the Resource being metered. See Table 47 below for the set of CIMI-defined URIs. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
units	*string*	The human-readable name of the used units, e.g., kilobits per second, CPU usage percentage, etc. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
sampleInterval	*integer*	The time between consecutive samples in seconds. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
timeScope	*string*	The time scope to which the `Meter` value applies. Two possible values: "Point" indicates that the `Meter` applies to a point in time. "Interval" indicates that the `Meter` applies to a time interval. For instance, it would be possible to define a `MeterConfiguration` whose purpose is to provide the daily average CPU usage. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
intervalDuration	*duration*	The interval duration when the timeScope is set to "Interval." Possible values: hourly, daily, weekly, monthly, or yearly. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
isContinuous	*boolean*	This value indicates whether the `Meter` value is continuous or scalar. Performance `Meters` are an example of a linear metric. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write

6029 The following pseudo-schemas describe the serialization of the Resource in both JSON and XML:

6030 **JSON media type:** application/json

6031 **JSON serialization:**

```
6032  { "resourceURI": "http://schemas.dmtf.org/cimi/2/MeterConfiguration",
6033    "id": string,
6034    "name": string, ?
6035    "description": string, ?
6036    "created": string, ?
6037    "updated": string, ?
6038    "properties": { string: string, + }, ?
```

```
  "associatedTo": [
    { "href": string }, +
  ], ?
  "aspect": string,
  "units": string,
  "sampleInterval": number,
  "timeScope": string,
  "intervalDuration": string,
  "isContinuous": boolean,
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<MeterConfiguration xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <associatedTo href="xs:anyURI"/> *
  <aspect> xs:anyURI </aspect>
  <units> xs:string </units>
  <sampleInterval> xs:integer </sampleInterval>
  <timeScope> xs:string </timeScope>
  <intervalDuration> xs:duration </intervalDuration>
  <isContinuous> xs:boolean </isContinuous>
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</MeterConfiguration>
```

Table 47 describes the "aspect" URIs defined by this specification. Providers may define new aspect URIs and it is recommended that these URIs be dereferencable such that Consumers can discover the details of the new aspect. For brevity the "URI" column in the table only shows the last part of the URI. It should be appended to: "http://schemas.dmtf.org/cimi/2/aspect/".

6078 **Table 47 – aspect URIs**

Aspect	Description
cpu	The percentage CPU usage of the Resource. Typically associated with `CloudEntryPoint`, `System`, and `Machine` Resources. For Resources that group other Resources (e.g., `CloudEntryPoint` or System `Resources`), this aspect provides the aggregated percentage usage of the CPU.
memory	The amount of memory being used by the Resource. Typically associated with `CloudEntryPoint`, `System`, and `Machine` Resources. For Resources that group other Resources (e.g., `CloudEntryPoint` or `System` Resources), this aspect provides the aggregated usage of the memory.
disk	The amount of disk being used by the Resource. Typically associated with `CloudEntryPoint`, `System`, `Machine`, and `Volume` Resources. For Resources that group other Resources (e.g., `CloudEntryPoint` or `System` Resources), this aspect provides the aggregated disk usage.
bandwidth	The amount of network traffic. Typically associated with `CloudEntryPoint`, `System`, and `Network` Resources. For `CloudEntryPoint` and `System` Resources, this aspect provides the aggregated bandwidth of all the networks under them.
inputBandwidth	The amount of input bandwidth used by the Resource. Typically associated with `Machine`, `NetworkPort`, and `Volume` Resources. For `Machine` Resources, this aspect provides the aggregated input bandwidth usage of all its network interfaces .
outputBandwidth	The amount of output bandwidth used by the Resource. Typically associated with `Machine`, `NetworkPort`, and `Volume` Resources. For `Machine` Resources, this aspect provides the aggregated output bandwidth usage of all its network interfaces.

6079 #### 5.17.7.1 Operations

6080 This Resource supports the Read, Update, and Delete operations. Create is supported through the
6081 `MeterConfigurationCollection` Resource.

6082 ### 5.17.8 MeterConfigurationCollection Resource

6083 A `MeterConfigurationCollection` Resource represents the Collection of
6084 `MeterConfigurations` within a Provider and follows the Collection pattern defined in clause 5.5.12.
6085 This Resource shall be serialized as follows:

6086 **JSON serialization:**

```
6087 { "resourceURI": "http://schemas.dmtf.org/cimi/2/MeterConfigurationCollection",
6088   "id": string,
6089   "count": number,
6090   "meterConfigurations": [
6091     { "resourceURI": "http://schemas.dmtf.org/cimi/2/MeterConfiguration",
6092       "id": string,
6093       ... remaining MeterConfiguration attributes ...
6094     }, +
6095   ], ?
6096   "operations": [ { "rel": "add", "href": string } ? ]
6097   ...
6098 }
```

6099 **XML serialization:**

```
6100 <Collection
```

```
    resourceURI="http://schemas.dmtf.org/cimi/2/MeterConfigurationCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <MeterConfiguration>
    <id> xs:anyURI </id>
    ... remaining MeterConfiguration attributes ...
  </MeterConfiguration> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.17.8.1 Operations

This Resource supports the Read and Update operations. Creation of new `MeterConfiguration` Resources is supported by the way of a POST to the "add" operation's URI as described in clause 4.2.1.1.

5.17.9 EventLog Resource

A Resource that represents a registry of Events.

If an `EventLog`'s "targetResource" is deleted the `EventLog` associated with that Resource may also be deleted. In other words, deleting a Resource (e.g., a `Machine`) may also result in the deletion of the `EventLog` referenced from that Resource. This behavior is denoted by the `EventLog` "Linked" capability.

If an EventLog is deleted, all of its Events shall also be deleted.

Table 48 describes the `EventLog` attributes.

Table 48 – EventLog attributes

Name	EventLog	
Type URI	http://schemas.dmtf.org/cimi/2/EventLog	
Attribute	**Type**	**Description**
targetResource	*ref*	A reference to the Resource to which the `Events` are related. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
events	*collection [Event]*	A reference to the list of occurred `Events`. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
persistence	*string*	A value that indicates the persistence of the `Events` within the `EventLog`. For instance, daily, weekly, monthly, or yearly. Events that exceed the persistence duration may be deleted. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write

Name	EventLog	
Type URI	http://schemas.dmtf.org/cimi/2/EventLog	
Attribute	**Type**	**Description**
summary	*<unnamed structure>*	A summary of all the events present in the `EventLog` when the read operation is performed, grouped by severity. Each summary attribute is an (unnamed) structure that has the following sub-attributes:

Attribute	**Type**	**Description**
low	*integer*	Number of occurred `Events` with a low severity. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
medium	*integer*	Number of occurred `Events` with a medium severity. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
high	*integer*	Number of occurred `Events` with a high severity. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
critical	*integer*	Number of occurred `Events` with a critical severity. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only

Constraints:
Provider: support mandatory; mutable
Consumer: support mandatory; read-only

When implementing or using `EventLog`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 48 as well as in the tables describing embedded Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/EventLog",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "targetResource": { "href": string },
  "events": { "href": string },
  "persistence": string,
  "summary": {
    "low": number,
    "medium": number,
    "high": number,
    "critical": number
```

```
  }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<EventLog xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <targetResource href="xs:anyURI"/>
  <events href="xs:anyURI"/>
  <persistence> xs:string </persistence>
  <summary>
    <low> xs:integer </low>
    <medium> xs:integer </medium>
    <high> xs:integer <high>
    <critical> xs:integer </critical>
  </summary>
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</EventLog>
```

5.17.9.1 Collections

The following clauses describe the Collection Resources EventLogs.

5.17.9.1.1 events Collection

The Resource type for each item of this Collection is "`Event`" as defined in clause 5.17.13.

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/EventCollection",
  "id": string,
  "count": number,
  "events": [
```

```
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/Event",
      "id": string,
      ... remaining Event attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/2/EventCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <Event>
    <id> xs:anyURI </id>
    ... remaining Event attributes ...
  </Event> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.17.9.2 Operations

This Resource supports the Read, Update, and Delete operations.

5.17.10 EventLogCollection Resource

An `EventLogCollection` Resource represents the Collection of `EventLogs` within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/EventLogCollection",
  "id": string,
  "count": number,
  "eventLogs": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/EventLog",
      "id": string,
      ... remaining EventLog attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/2/EventLogCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <EventLog>
    <id> xs:anyURI </id>
    ... remaining EventLog attributes ...
  </EventLog> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.17.11 EventLogTemplate Resource

An `EventLogTemplate` represents the information needed to create a new `EventLog`. Table 49 describes the `EventLogTemplate` attributes.

Table 49 – EventLogTemplate attributes

Name	EventLogTemplate	
Type URI	http://schemas.dmtf.org/cimi/2/EventLogTemplate	
Attribute	**Type**	**Description**
targetResource	*ref*	A reference to the Resource to which the EventLog shall be connected. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
persistence	*string*	A value that indicates the persistence of the Events in the new `EventLog`. For instance, daily, weekly, monthly, or yearly. `Events` that exceed the persistence duration may be deleted. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write

When implementing or using `EventLogTemplate`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 49 as well as in the tables describing referred Resources or related Collections. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/EventLogTemplate",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
```

```
  "targetResource": { string },
  "persistence": string,
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<EventLogTemplate xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <targetResource href="xs:anyURI"/>
  <persistence> xs:string </persistence>
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</MeterTemplate>
```

5.17.12 EventLogTemplateCollection Resource

An `EventLogTemplateCollection` Resource represents the Collection of `EventLogTemplate` Resources within a Provider and follows the Collection pattern defined in clause 5.5.12. This Resource shall be serialized as follows:

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/EventLogTemplateCollection",
  "id": string,
  "count": number,
  "eventLogTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/2/EventLogTemplate",
      "id": string,
      ... remaining EventLogTemplate attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
```

```
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/2/EventLogTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <EventLogTemplate>
    <id> xs:anyURI </id>
    ... remaining EventLogTemplate attributes ...
  </EventLogTemplate> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.17.12.1 Operations

This Resource supports the Read and Update operations. Creation of new `EventLogTemplate` Resources is supported by the way of a POST to the "add" operation's URI as described in clause 4.2.1.1.

5.17.13 Event Resource

A Resource that represents the occurrence of an event within the managed infrastructure. Some examples of `Event` are:

- Machine X has been rebooted by guest OS.
- Machine X is not responding to platform services.
- A new vCPU has been added to machine X following defined elasticity rules.

The scope of the `Event` concept is any information that the Provider is able to track within its infrastructure and that can constitute useful information for the Consumer. Possible examples include, but are not limited to, errors and inconveniences that occur in the (virtual) resources assigned to Consumers; Provider-initiated actions, such as maintenance tasks; etc.

Table 50 describes the `Event` attributes.

Table 50 – Event attributes

Name	Event	
Type URI	http://schemas.dmtf.org/cimi/2/Event	
Attribute	**Type**	**Description**
timestamp	*dateTime*	The time of occurrence of the actual `Event`. NOTE: This attribute should not be confused with the time of creation of the `Event` Resource instance, which is captured in the common "created" attribute. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support optional; read-only

Name	Event	
Type URI	http://schemas.dmtf.org/cimi/2/Event	
Attribute	**Type**	**Description**
type	*URI*	A URI that uniquely identifies the type of the `Event`. If the "content" attribute is present, this URI determines the actual data structure used for this content, e.g., to which schema it is associated. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
content	*any*	A polymorphic attribute that represents detailed event data, the type of which varies with the `Event` "type." Typically, a data structure; for example: In the case of a monitoring event, the content shall hold the target Resource ID and type, measured attribute(s), and status value(s). In the case of an audit event conforming to the CADF model, the content shall hold the detailed event structure that complies with CADF event schema. In the case of a CIM Indication, the content shall hold the structure and attributes defined for such events. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
outcome	*string*	A string value that characterizes the general significance of the `Event`. A core set is defined that may be used regardless of the `Event` type. For each `Event` type, the definition of a core outcome value maybe refined in the context of this type, provided it does not conflict with the general meaning of the outcome given below. Core outcomes are: **Pending**: The `Event` is about an action or process that is still ongoing. **Unknown**: The `Event` is about a request or action that is not known by the Provider. **Status**: The `Event` reports on the state or status of a Resource. **Success**: The `Event` reports on a successful outcome of some action or process. **Warning**: The `Event` reports on a situation that requires attention or remedial action. **Failure**: The `Event` reports on a failed outcome of some action or process. This set of core outcome values may be extended to accommodate possible outcomes of a specific `Event` type. In this case, the extended set of values shall apply to all `Events` of this type. **Constraints:** **Provider:** support optional; immutable **Consumer:** support optional; read-only
severity	*string*	A value indicating the `Event` severity. Possible values are: **critical** **high** **medium** **low** The meaning of the severity level may vary depending on the `Event` "type." If such an attribute is not relevant to a particular type of `Event`, it should be omitted. **Constraints:** **Provider:** support optional; immutable **Consumer:** support optional; read-only
contact	*string*	A reference to a contact point or processing point to handle the `Event`. The actual type of this content (e.g., email address, phone number of helpdesk or staff, message queue, URL…) is dependent on, and determined by the `Event` "type." This attribute is mutable as it may be determined after `Event` creation by the Provider. **Constraints:** **Provider:** support optional; immutable **Consumer:** support optional; read-only

NOTE There exists a legacy of several `Event` models that have been standardized or designed for various domains relevant to IT. The objective in CIMI is not to elect one particular `Event` model, but to select as top-level `Event` attributes the most immediately relevant data useful for `Event` processing in a Cloud environment.

Additional `Event` data may still be represented in the variable content attribute that allows for mapping other `Event` models into a CIMI `Event`.

When implementing or using `Event`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 50. Both Consumer and Provider shall serialize this Resource as described below. The following pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/2/Event",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "timestamp": string,
  "type": string,
  "content": any, ?
  "outcome": string, ?
  "severity": string, ?
  "contact": string, ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<Event xmlns="http://schemas.dmtf.org/cimi/2">
  <id> xs:anyURI </id>
  <name> xs:string </name> ?
  <description> xs:string </description> ?
  <created> xs:dateTime </created> ?
  <updated> xs:dateTime </updated> ?
  <property key="xs:string"> xs:string </property> *
  <timestamp> xs:dateTime </timestamp>
  <type> xs:string </type>
  <content> xs:any* </content> ?
  <outcome> xs:string </outcome> ?
  <severity> xs:string </severity> ?
  <contact> xs:string </contact> ?
  <xs:any>*
</Event>
```

Table 51 describes the "type" URIs that are defined or acknowledged by this specification. Additional types may be added by a Provider, for example to characterize external events mapped into CIMI `Events`. It is recommended that these URIs be dereferencable such that Consumers can discover a more detailed description of the type. `Event` types defined by this specification share the same base URI: http://schemas.dmtf.org/cimi/2/event/. For brevity, if the "Event Type" column in the table only shows a relative URI (e.g., state) it shall be appended to the end of this base URI.

Table 51 – type URIs

<table>
<tr><th>Event Type</th><th>Description</th></tr>
<tr><td>state</td><td>Events of this type report state information about CIMI run-time resources such as instances of Machines, Systems, Networks, and Volumes. This information includes reports on any change in the "state" of these Resources.
The content element associated with this <code>Event</code> type has the following structure:
<table>
<tr><th>Data</th><th>Type</th><th>Description</th></tr>
<tr><td>resName</td><td>string</td><td>The name of the Resource about the state of which is reported.
<u>Constraints:</u>
Provider: support optional; immutable
Consumer: support optional; read-only</td></tr>
<tr><td>resource</td><td>ref</td><td>The reference to the Resource about the state of which is reported. (Note: This reference may become invalid because the event might outlive the Resource.)
<u>Constraints:</u>
Provider: support mandatory; immutable
Consumer: support optional; read-only</td></tr>
<tr><td>resType</td><td>URI</td><td>URI denoting this Resource type (same as the type URI associated with the Resource type for this Resource).
<u>Constraints:</u>
Provider: support optional; immutable
Consumer: support optional; read-only.</td></tr>
<tr><td>state</td><td>string</td><td>The state reported for the Resource. Shall be the same as the "state" attribute value (if any) of the run-time Resource at the time the event is generated.
<u>Constraints:</u>
Provider: support mandatory; immutable
Consumer: support optional; read-only</td></tr>
<tr><td>previous</td><td>string</td><td>The previous state value, if the event reports a state change.
<u>Constraints:</u>
Provider: support optional; immutable
Consumer: support optional; read-only.</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Event Type</th><th>Description</th></tr>
<tr><td>alarm</td><td>Events of this type report errors or alarms occurring during management operations of Cloud resources. This information includes failures to provision resources, failures to fulfill requests to the CIMI interface, and any critical situation that needs be addressed in a timely manner.
The content element associated with this event type has the following structure:
<table>
<tr><th>Data</th><th>Type</th><th>Description</th></tr>
<tr><td>resName</td><td>string</td><td>The name of the Resource associated with this alarm, if applicable.
<u>Constraints:</u>
Provider: support optional; immutable
Consumer: support optional; read-only.</td></tr>
<tr><td>resource</td><td>ref</td><td>The reference to the Resource associated with this alarm, if applicable. (Note: This reference may become invalid because the event might outlive the Resource.)
<u>Constraints:</u>
Provider: support mandatory; immutable
Consumer: support optional; read-only</td></tr>
<tr><td>restype</td><td>URI</td><td>URI denoting this Resource type associated with this alarm, if applicable (same as the type URI associated with the Resource type for this Resource).
<u>Constraints:</u>
Provider: support optional; immutable
Consumer: support optional; read-only</td></tr>
<tr><td>code</td><td>string</td><td>An alarm code.
<u>Constraints:</u>
Provider: support mandatory; immutable
Consumer: support optional; read-only</td></tr>
<tr><td>detail</td><td>string</td><td>The detailed information associated with the alarm.
<u>Constraints:</u>
Provider: support optional; immutable
Consumer: support optional; read-only</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Event Type</th><th>Description</th></tr>
<tr><td>model</td><td>Events of this type report changes in the CIMI resource model, which includes creation, modification, and destruction of Resource instances; and updates to metadata (Resource extensions, capabilities and constraints, etc.).
The content element associated with this event type has the following structure:
<table>
<tr><th>Data</th><th>Type</th><th>Description</th></tr>
<tr><td>resName</td><td>string</td><td>The name of the main model Resource affected by the modification.
<u>Constraints:</u>
Provider: support optional; immutable
Consumer: support optional; read-only</td></tr>
<tr><td>resource</td><td>ref</td><td>The reference to the main model Resource affected by the modification. (Note: This reference may become invalid because the event might outlive the Resource.)
<u>Constraints:</u>
Provider: support mandatory; immutable
Consumer: support optional; read-only</td></tr>
<tr><td>resType</td><td>URI</td><td>URI denoting this Resource type (same as the type URI associated with the Resource type for this Resource).
<u>Constraints:</u>
Provider: support optional; immutable
Consumer: support optional; read-only</td></tr>
<tr><td>change</td><td>string</td><td>The kind of modification reported (create/update/delete).
<u>Constraints:</u>
Provider: support mandatory; immutable
Consumer: support optional; read-only</td></tr>
<tr><td>detail</td><td>string</td><td>The detailed information associated with the change, typically the data for an update or creation, as used in a request.
<u>Constraints:</u>
Provider: support optional; immutable
Consumer: support optional; read-only</td></tr>
</table></td></tr>
<tr><td>access</td><td>Events of this type keep track of all requests to access some Resource of a CIMI provider.
The content element associated with this event type has the following structure:
<table>
<tr><th>Data</th><th>Type</th><th>Description</th></tr>
<tr><td>operation</td><td>string</td><td>The method or name of the operation intended for this access (for the HTTP protocol, the HTTP method for the request).
<u>Constraints:</u>
Provider: support mandatory; immutable
Consumer: support optional; read-only</td></tr>
<tr><td>resource</td><td>ref</td><td>The reference of the Resource supporting the operation (for the HTTP protocol, the Resource URI or the URI associated with the operation). (Note: This reference may become invalid because the event might outlive the Resource.)
<u>Constraints:</u>
Provider: support mandatory; immutable
Consumer: support optional; read-only</td></tr>
<tr><td>detail</td><td>string</td><td>The detailed information associated with the change, typically the data for an update or creation, as used in a request
<u>Constraints:</u>
Provider: support optional; immutable
Consumer: support optional; read-only</td></tr>
<tr><td>initiator</td><td>string</td><td>The details identifying the request initiator, in case that information can be associated with the request.
<u>Constraints:</u>
Provider: support optional; immutable
Consumer: support optional; read-only</td></tr>
</table></td></tr>
<tr><td>http://schemas.dmtf.org/cloud/audit/1.0/</td><td>Events of this type represent events that have audit significance, as defined by CADF (…). This type can be subdivided further by extending the URI path (e.g., http://schemas.dmtf.org/cloud/audit/1.0/event/security, for security audit events).
The content element associated with this event type has the same structure as the event serialization defined in CADF (DSP0262)</td></tr>
</table>

The following pseudo-schemas describe the serialization of the "content" property for various types of events:

"state" event:

JSON serialization:

```
{ "id": string,
  ...
  "type": "http://schemas.dmtf.org/cimi/2/event/state",
  "content": {
    "resName": string,
    "resource" : { "href" : string },
    "resType" : string,
    "state" : string,
    "previous" : string ?
  }
  ...
}
```

XML serialization:

```
<Event xmlns="http://schemas.dmtf.org/cimi/2">
  ...
  <type> http://schemas.dmtf.org/cimi/2/event/state </type>
  <content>
    <resName> xs:string </resName>
    <resource href="xs:anyURI"/>
    <resType> xs:anyURI </resType>
    <state> xs:string </state>
    <previous> xs:string </previous> ?
  </content> ?
  ...
</Event>
```

"alarm" event:

JSON serialization:

```
{ "id": string,
  ...
  "type": "http://schemas.dmtf.org/cimi/2/event/alarm",
  "content": {
    "resName": string ?
    "resource" : { "href" : string }, ?
    "resType" : string ?
```

```
    "code" : string,
    "detail" : string ?
  }
  ...
}
```

XML serialization:

```
<Event xmlns="http://schemas.dmtf.org/cimi/2">
  ...
  <type> http://schemas.dmtf.org/cimi/2/event/alarm </type>
  <content>
    <resname> xs:string </resname> ?
    <resource href="xs:anyURI"/> ?
    <restype> xs:anyURI </restype> ?
    <code> xs:string </code>
    <detail> xs:string </detail> ?
  </content> ?
  ...
</Event>
```

"model" event:

JSON serialization:

```
{ "id": string,
  ...
  "type": "http://schemas.dmtf.org/cimi/2/event/model",
  "content": {
    "resName": string, ?
    "resource" : { "href" : string }, ?
    "resType" : string, ?
    "change" : string,
    "detail" : string ?
  }
  ...
}
```

XML serialization:

```
<Event xmlns="http://schemas.dmtf.org/cimi/2">
  ...
  <type> http://schemas.dmtf.org/cimi/2/event/model </type>
  <content>
    <resname> xs:string </resname> ?
    <resource href="xs:anyURI"/> ?
```

```
    <restype> xs:anyURI </restype> ?
    <change> xs:string </change>
    <detail> xs:string </detail> ?
  </content> ?
  ...
</Event>
```

"access" event:

JSON serialization:

```
{ "id": string,
  ...
  "type": "http://schemas.dmtf.org/cimi/2/event/access",
  "content": {
    "operation": string,
    "resource" : { "href" : string },
    "detail" : string, ?
    "initiator" : string ?
    }
  ...
}
```

XML serialization:

```
<Event xmlns="http://schemas.dmtf.org/cimi/2">
  ...
  <type> http://schemas.dmtf.org/cimi/2/event/access </type>
  <content>
    <operation> xs:string </operation>
    <resource href="xs:anyURI"/>
    <detail> xs:string </detail> ?
    <initiator> xs:string </initiator> ?
  </content> ?
  ...
</Event>
```

5.17.13.1 Operations

This resource supports the Read, Update, and Delete operations.

6 Security considerations

There are many security mechanisms that can be used in conjunction with this specification. This specification does not mandate any particular mechanism. Providers shall provide enough information about their security mechanisms so that the Consumer can implement the necessary algorithms to successfully communicate with the Provider.

6488 An implementation may set limits on the length of attribute values it accepts. An implementation may set
6489 limits on the size of arrays it accepts. An implementation may set limits on the size of the request body or
6490 the length of request URIs it accepts. These limits may not all be advertised in the ResourceMetadata,
6491 although this specification recommends Providers to do so. A Provider that receives a request that
6492 exceeds any of these limits, shall return a response with an appropriate standard HTTP status code.

6493
6494

ANNEX A
(normative)
OVF support in CIMI

This annex defines how elements of an OVF descriptor are mapped to CIMI resources and their attributes. This definition allows the import of an OVF package to create multiple CIMI resources. This is done by specifying a reference to an OVF package in the import operation of a `SystemCollection` or `SystemTemplateCollection` (the Media Type at that URI shall be "application/ovf"). Refer to DSP0243 for more information about OVF.

Support for OVF import and export is optional for a Provider and it is an implementation choice as to how many of the attributes in the OVF package are exposed through CIMI resources. A Provider may support the import of OVF package for only `Systems`, only `SystemTemplates` or both. Support for the actual import and export of an OVF package is handled by a hypervisor under the management of the CIMI implementation, and thus the CIMI resources that are created reflect what the hypervisor did upon import and form a "View" into the results.

The import of an OVF package can be reflected in the creation of Templates that can be later used to create `Systems`, `Machines` and other component Resources. The import of an OVF package can also be used to directly create `Systems`, `Machines`, and other component Resources, bypassing the step of creating Templates.

Clause 5.13.5 details how to import an OVF file to create a `SystemTemplate` (and component Resources). The `SystemTemplate` thus created contains a reference to a `MachineTemplate` for every `VirtualSystem` that is defined in the OVF descriptor `VirtualSystemCollection`. Note that CIMI currently allows `Systems` of `Systems`, so for each `VirtualSystemCollection` encountered in a nested set of collections, a separate `SystemTemplate` is created within the parent `SystemTemplate` with `MachineTemplates` for each of the contained `VirtualSystems` in that `VirtualSystemCollection`.

The values of the attributes for the `MachineTemplate` are taken from the `VirtualHardwareSection` of the `VirtualSystem` description (required in OVF). If more than one `VirtualHardwareSection` is used for a given `VirtualSystem` (allowed in OVF), the result is implementation dependent, but the implementation might choose a `MachineTemplate` from an existing (perhaps static) set that best matches a `VirtualHardwareSection`. Items in the `VirtualHardwareSection` are mapped to CIMI `MachineConfiguration` properties and the corresponding `MachineConfiguration` Resource is created and linked to from the created `MachineTemplate` for that `VirtualSystem`.

The CIMI `VolumeTemplates` are created according to the `DiskSection` of an OVF descriptor and can be shared among more than one `VirtualSystem` (CIMI `MachineTemplates`) defined in an OVF package. In addition, a new CIMI `MachineImage` Resource may be created from the `DiskSection` if an `ovf:fileRef` for the virtual disk content is specified.

The CIMI `NetworkTemplates` are created according to the `NetworkSection` of an OVF descriptor along with the `Connection` elements in the `VirtualHardwareSection` elements that refer to these named networks.

Clause 5.13.2.1 details how to import an OVF file to create a `System` (and component Resources). The `System` thus created contains a reference to a `Machine` for every `VirtualSystem` that is defined in an OVF descriptor `VirtualSystemCollection`. Note that CIMI currently allows `Systems` of `Systems`, so for each `VirtualSystemCollection` encountered in a nested set of collections, a

6539 separate System is created within the parent `System` with `Machines` for each of the contained
6540 `VirtualSystems` in that `VirtualSystemCollection`.

6541 The values of the attributes for the `Machine` are taken from the `VirtualHardwareSection` of the
6542 `VirtualSystem` description (required in OVF). If more than one `VirtualHardwareSection` is
6543 used for a given `VirtualSystem` (allowed in OVF), the result is implementation dependent. Items in
6544 the `VirtualHardwareSection` are mapped to CIMI `MachineConfiguration` properties and
6545 the corresponding `MachineConfiguration` Resource is created and linked to from the created
6546 `Machine` for that VirtualSystem.

6547 The CIMI `Volumes` are created according to the `DiskSection` of an OVF descriptor and can be
6548 shared among more than one `VirtualSystem` (CIMI `Machines`) defined in an OVF package. In
6549 addition, a new CIMI `MachineImage` Resource may be created from the `DiskSection` if an
6550 `ovf:fileRef` attribute for the virtual disk content is specified.

6551 The CIMI `Networks` are created according to the `NetworkSection` of an OVF descriptor along with
6552 the `Connection` elements in the `VirtualHardwareSection` that refer to these named networks.

6553

ANNEX B
(informative)
XML Schema

The XML Schema for the XML serialization of the CIMI model can be found at:

http://schemas.dmtf.org/cimi/2/dsp8009_1.0.xsd

The schema provided does not intend to reflect every single modeling constraint and requirement specified in the model. This schema is designed to apply more broadly to any model-related serialized material found in Consumer requests as well as in Provider responses, and is intended to provide a preliminary, non-exhaustive syntactic check on these. In particular, future updates of this specification may intermix new XML elements into the Resources using the current CIMI namespace to Resources. The schema that is provided is just a starting point for those who would find it useful and it might need to be modified based on specific application's needs.

ANNEX C
(informative)
Change log

Version	Date	Description
1.0.0a	2012-08-28	DMTF Draft Standard
1.0.1a	2012-09-12	DMTF Draft Standard
1.1.0a	2013-07-22	DMTF Work in Progress release
1.1.0	2013-10-22	DMTF Draft Standard
2.0.0a	2014-09-24	DMTF Work in Progress release
2.0.0b	2014-11-05	DMTF Work in Progress release
2.0.0c	2015-03-20	DMTF Work in Progress release

Bibliography

DMTF Standard: *Cloud Infrastructure Management Interface (CIMI) Model and RESTful HTTP-based Protocol* specification V1.0 (DSP0263)

http://dmtf.org/sites/default/files/standards/documents/DSP0263_1.0.0.pdf

DMTF Standard: *Cloud Infrastructure Management Interface (CIMI) Model and RESTful HTTP-based Protocol* specification V1.1 (DSP0263)

https://members.dmtf.org/apps/org/workgroup/cmwg/download.php/73648/DSP0263_1.1.0b_RC2.pdf