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

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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.

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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.

3.2

authorization

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

3.3

cloud

Synonymous with “cloud computing” as defined in section 2 of the NIST Definition of Cloud Computing [SP800-145].

3.4

Cloud Service Consumer

A category of actors that includes the Consumer Business Manager (who approves business and financial expenditures for consumed services; accounts for used service instances; establishes business relationships; sets up accounts, budget, and terms; etc.); the Consumer Service Administrator (who requests service instances and changes to service instances; purchases services within the business relationship; creates Service Users (including policies); allocates resources, such as computer and storage; generates reports, such as usage; etc.); and Service Users (who use service instances provided by a Cloud Service Provider). The term "Consumer" is used if the indicated action or activity could involve

one or more of the above actors. In cases where the distinction between the actors in this category is relevant, the more detailed term is used.

For purposes of comparison and alignment, it should be noted that a Cloud Service Consumer is equivalent to the “Cloud Consumer” actor defined in the NIST Reference Architecture [SP500-292].

3.5

Cloud Service Provider

A category of actors that includes the Service Operations Manager (who manages the technical infrastructure required for providing cloud services; monitors and measures performance and utilization against SLAs; provides reports from monitoring and measurement; etc.); Service Business Manager (who offers all types of services developed by cloud service developers; accounts for services potentially offered by service Providers themselves and services offered on behalf of cloud service developers; establishes a portfolio of business relationships; and sets up accounts and terms for Consumers, etc.); and Service Transition Manager (who enables a customer to use the cloud service, including "onboarding", integration, and process adoption; defines and creates service offerings based on Templates and Configurations that can be used by Consumers and are populated into the catalog; etc.). The term "Provider" is used if the indicated action or activity could involve one or more of the above actors. In cases where the distinction between the actors in the category is relevant, the more detailed term is used.

For purposes of comparison and alignment, it should be noted that a Cloud Service Provider is equivalent to the “Cloud Provider” actor defined in the NIST Reference Architecture [SP500-292].

3.6

Collection

A particular kind of Resource that contains a collection of other Resources and has a representation and serialization defined in this specification. Synonym for “CIMI collection”.

3.7

Configuration

A set of metadata, the values of which serve as the parameters of a discrete conformation of a specific type of virtual resource.

3.8

Infrastructure as a Service (IaaS)

A cloud computing service model defined in section 2 of the NIST Definition of Cloud Computing [SP800-145].

3.9

message confidentiality

A quality of a message that prevents anyone but the intended receiver(s) from viewing its contents.

3.10

message integrity

A quality of a message that allows a receiver of that message to determine whether the contents of the message have been altered since its creation.

3.11

Resource

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

3.12

Template

Synonym for “CIMI template”. A Resource that represents the set of metadata and instructions used to instantiate some other Resource (e.g., a `MachineTemplate` is used to create `Machines`). Templates may aggregate other metadata Resources such as other Templates, Configurations, and Images. For example, a `MachineTemplate` refers to a `MachineConfiguration` and a `MachineImage`.

How a specific protocol mapping, or implementation, chooses to supply Templates as inputs to the instantiation process may vary. However, some common patterns should be considered:

1. By reference - allow Consumers to reference a Template (that exists as a Resource in the Provider) as part of the instantiation operation.

2. By value - allow Consumers to dynamically provide the Template information as part of the instantiation operation.

3. Reference with overrides - allow Consumers to reference a Template (that exists as a Resource in the Provider) and provide additional values that override the attributes of that Template as part of the instantiation operation.

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/1	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
```

The URI to a `Machine` is as follows:

```
/machines/123
```

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

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

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

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

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

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

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

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

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

4.1.6.2 Subsetting Collections

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

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

```
?$first=number
?$last=number
```

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

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

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

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

743 **XML serialization:**

744
```
<name href="xs:anyURI"/>
```

745 shall be expanded to be:

746
```
<name href="xs:anyURI">
```
747
```
  ... attributes of the referenced resource...
```
748
```
</name>
```

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

751 The format of a $expand query parameter shall be:

752
```
?$expand=attributeName,...
```

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

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

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

762
```
?$expand=volumes
```

763 if retrieving the MachineCollection has the same net effect as applying the "expand" semantics to
764 the specified attribute ("volumes" in this example) of each Machine within the Collection. To be clear,
765 $expand acts on the attributes of the Resources in the Collection, not on the wrapping Collection
766 Resource itself.

767 #### 4.1.6.5 Specifying the Resource format

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

773 The $format parameter shall be of the form:

774
```
?$format=encoding
```

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

778 If both an Accept header and $format query parameter are present in a request message, the
779 $format value shall take precedence. If the $format query parameter appears more than once, the
780 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/1">
  <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/1">
  <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/1">
  <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 5.5.12.2.

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/1/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/1/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 temporal 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.

Examples:

Here is an example of creation pattern (1) using a `MachineTemplate` by value (in JSON):

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/1/MachineCreate ",
  "name": "myMachine123",
  "description": "A machine to be connected to a pre-existing network",
  "machineTemplate": {
    <here a template passed "by value" i.e., the attribute/value pairs for the
MachineTemplate template. An example is of the networkInterfaces below: >
    "networkInterfaces": [
       { "addresses": [ { "address": { "href": "http://example.com/addresses/add1"
}},{ "address": { "href": "http://example.com/addresses/add2" }} ],
        "network": { "href": "http://example.com/networks/net1" },
        "state": "ACTIVE" }
       ]

  }
}
```

In the previous example:

The attributes `name` and `description` are instance-level settings because they are outside the machineTemplate element (i.e., they set attribute values in the new created Resource, not in the Template used to create the Resource). The name of the new `Machine` is "`myMachine123`".

This `Machine` is connected to an existing `Network` of reference (`http://example.com/networks/net1`), as specified in the Template complex attribute.

Here is an example of creation pattern (2) using a `MachineTemplate` by reference:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/1/MachineCreate ",
  "name": "myMachine456",
  "description": "A machine connected to a pre-existing volume",
  "machineTemplate": { "href": "http://example.com/machineTemplates/72000",
    "credential": { "href": "http://example.com/myCredential" }
    "networkInterfaces": [
       { "addresses": [ { "address": { "href": "http://example.com/addresses/add4"
}},{ "address": { "href": "http://example.com/addresses/add5" }} ],
        "network": { "href": "http://example.com/networks/net1" },
        "state": "ACTIVE" }
       ]

  }
}
```

In the above example, a new machine named "`myMachine456`" is created, also connected to the same existing `Network` as in example (1), but with a different set of `Addresses`. Two kinds of attributes are provided with values at creation time in this example:

- Instance-level attribute settings: these shall directly update similar attributes in the created Resource, here `name` and `description`.
- Template-level overrides: The referred `MachineTemplate` is used for creating the `Machine`, but the `credential` attribute in this Template is (temporarily) overridden by the credential provided in the creation request as is the `networkInterfaces` array. In case such attributes were not present in the referred Template; they are added (temporarily) just for this `Machine` creation.

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 ANNEX A.

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. It is inspired from Entity-Relationship modeling, where each entity 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)

1264 – Digits (U+0030 through U+0039)
1265 – Underscore (U+005F)

1266 • Identifier names shall not start with a Digit (U+0030 through U+0039).

1267 Note that these rules do not apply to the "name" common attribute defined in clause 5.7.2.

1268 5.4 Attribute constraints

1269 Each attribute of the Resources in the CIMI model is augmented by a set of constraints that further qualify
1270 the attribute that is being defined. For each attribute, there is a Provider and a Consumer set of
1271 constraints because each might differ. The following constraints are possible:

1272 **support optional:**

1273 This constraint indicates that support for this attribute is optional. If supported, Providers should advertise
1274 its support through `ResourceMetadata`. See clause 5.2 for information concerning the processing of
1275 unsupported and unknown attributes. See clause 5.5.15 regarding empty attribute values.

1276 Non-empty, Consumer-supported, writeable (i.e., read-write and write-only) attributes shall always be
1277 included as part of the Resource representation sent from Consumers to Providers, including create
1278 requests.

1279 Non-empty, Provider-supported attributes shall always be included as part of the Resource representation
1280 sent from Providers to Consumers.

1281 **support mandatory:**

1282 This constraint indicates that support for this attribute is required by compliant implementations. If present
1283 on a nested attribute, this attribute is required to be supported only if the parent attribute is supported.
1284 See clause 5.5.15 regarding empty attribute values.

1285 Non-empty, mandatory, writeable (i.e., read-write and write-only) attributes shall always be included as
1286 part of the Resource representation sent from Consumers to Providers - including create requests.

1287 Non-empty, Provider, mandatory attributes shall always be included as part of the Resource
1288 representation sent from Providers to Consumers.

1289 **immutable:**

1290 This Provider constraint indicates that the attribute, once set, shall never change for the lifetime of the
1291 Resource.

1292 **mutable:**

1293 This Provider constraint indicates that the attribute may be modified. Providers shall always have the
1294 ability to modify these attributes. Whether Consumers have the ability to modify these attributes shall be
1295 indicated by the read-only, read-write, and write-only constraints.

1296 **read-only:**

1297 This Consumer constraint indicates that the attribute may be retrieved but not updated by Consumers.
1298 Read-only attributes are not required to appear in the serialization of Resources in create or update
1299 request messages. If present, they shall be silently ignored by the Provider. Read-only attributes shall
1300 appear in the serialization of Resources sent from Providers.

1301 **read-write:**

1302 This Consumer constraint indicates that the attribute may be retrieved and/or updated by Consumers.
1303 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."

If an attribute is of type of references (`ref[]`) – and more generally array of an atomic type - the definition in the model shall include an "`Array item name`" that may be used in its serialization.

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`", where "`thing`" is the name of a structure:

```
<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 the "`Array item name`" value 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

Like arrays, Collections are groupings 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.

Collections are also used to represent 1-n relationships between Resources: a Resource that is associated with a set of same-typed Resources, shall use a Collection attribute to represent such an association, the items of which refer to each one of the Resources of the associated set.

Each element in a Collection is called a Collection item or entry. A Collection item is actually a reference to a Resource, not the Resource itself. For convenience, each referred Resource is called here a Resource item of the Collection, and these Resource items are still considered being grouped by the Collection (instead of just their references). These Resources items are assumed to be of a complex type and are separately addressable and manageable. A primary Resource (see definition in Resources section) can be an item in more than one Collection. If such a Resource is deleted, all the Collections that share this Resource item shall remove their reference to that Resource.

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 through either the "add" operation defined within the Collection (when the Resource is also created) or the “insert” operation (when the Resource already exists).
- Deleting Resources from the Collection shall be done either through a "delete" operation on the Resource itself (if the Resource has to be discarded) or the “remove” Collection operation (if the Resource must still exist outside the Collection).
- Collections shall be deleted if their owning Resource is deleted.
- Unless the Resource items in the collection are secondary Resources (see later), deleting a Collection does not cause the deletion of the collected Resources.

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 - simply the type "`collection[itemType]`" appears. Also, the description of the attribute will be directly of the Collection it refers to instead of being described as a reference to such a Collection.

Serialization:

The serialization of Collections shall adhere to the following pattern:

JSON serialization:

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

```
    { "resourceURI": string,
      "id": string,
      "name": string, ?
      "description": string, ?
      "created": string, ?
      "updated": 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/1">
  <id> xs:anyURI </id>
  <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> ?
    <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.

Examples:

5.5.12.1.1 Machine Collection

The Resource type for each item of this Collection is "`Machine`". There is no accessory attributes in this Collection, which is then called a "basic" Machine Collection. In the example below, each Machine item in the Collection is not expanded except for its common attributes. An expanded serialization showing all or parts of each Machine is also an option.

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/1/MachineCollection",
  "id": string,
  "count": number,
  "Machines": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/Machine",
      "id": string,
      "name": string, ?
      "description": string, ?
      "created": string, ?
      "updated": 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/1/MachineCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <id> xs:anyURI </id>
  <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> ?
    <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>
```

5.5.12.1.2 Volume Collection in a Machine

The Resource type for each item of this Collection is "`Volume`". Because this Collection is representing an association between a Machine and a set of Volumes, the initial location of these Volumes is added as an accessory attribute. In the example below, each Volume item in the Collection is not expanded except for its common attributes. An expanded serialization showing all or parts of each Volume is also an option.

Note that the last part of the Collection `resourceURI` is not just `VolumeCollection` but `locatedVolumeCollection`, in order to uniquely identify the combination of {initial location + Volume}.

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/1/locatedVolumeCollection",
  "id": string,
  "count": number,
  "locatedVolumes": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/locatedVolume",
      "id": string,
      "name": string, ?
      "description": string, ?
      "created": string, ?
      "updated": 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/1/locatedVolumeCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <id> xs:anyURI </id>
  <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> ?
    <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>
```

5.5.12.2 Adding items to Collections

Invoking the "add" operation of a Collection shall create and add a new Resource 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 the Collection is a Collection of primary Resources, then the Resource shall be added also to the CEP Collection that collects these Resources.

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

- The "common attributes" as defined by clause 5.7.2
- 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/1/MachineCreate", ?
  "name": string, ?
  "description": string, ?
  "properties": { string: string, + }, ?
  "machineTemplate": { "href": string ?}
  ...
}
```

XML serialization:

```
<MachineCreate xmlns="http://schemas.dmtf.org/cimi/1">
  <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/1/Machine",
  "id": string,
  "name": string,
  ...
}
```

XML serialization:

```
<Machine xmlns="http://schemas.dmtf.org/cimi/1">
  <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.

5.5.12.3 Inserting items in Collections

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/1/Volume",
  "initialLocation": string,
  "volume": { "href": string }
}
```

XML serialization:

```
<Volume xmlns="http://schemas.dmtf.org/cimi/1">
  <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.

5.5.12.4 Removing items to Collections

Invoking the "remove" operation of a Collection shall delete the corresponding reference entry in the Collection, along with accessory attributes if any. The contents of the request body shall be the URL of the Resource 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/1/Volume",
  "volume": { "href": string }
}
```

XML serialization:

```
<Volume xmlns="http://schemas.dmtf.org/cimi/1">
    <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

5.7.1 Primary and secondary Resources

The Resources described by this document are classified either as primary or as secondary Resources.

- A primary Resource is one that is listed in the Cloud Entry Point, i.e., there is a Collection in the `CloudEntryPoint` Resource that uses this Resource type for its items. The `CloudEntryPoint` itself is a primary CIMI Resource.
- All other Resources (including Collection Resources) shall be secondary CIMI resources. A secondary Resource is always dependent on another Resource (typically a primary Resource) that “owns” it. Deletion of an owning Resource (primary or secondary) causes the deletion of the owned secondary Resource.

For example, `Machine` is a primary CIMI resource as the `CloudEntryPoint` has a Collection with `Machine` as its element type. However, for example, `Disk` is a secondary CIMI resource because the `CloudEntryPoint` does not have a Collection with `Disk` as its element type. A Disk does not exist separately from a Machine, and is automatically deleted when the Machine is deleted.

5.7.2 Common attributes

Resources share the following common attributes; see Table 5. There are different requirements for primary and secondary CIMI resources.

1964 **Table 5 – Common attributes**

<table>
<tr><th>Attribute</th><th>Type</th><th>Description</th></tr>
<tr><td>id</td><td>URI</td><td>The unique URI identifying this Resource; assigned upon Resource creation. This attribute value shall be unique in the Provider's cloud.
<u>Constraints for primary and secondary Resources:</u>
Provider: support mandatory; immutable
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 for primary Resources:</u>
Provider: support mandatory; mutable
Consumer: support optional; read-write
<u>Constraints for secondary Resources:</u>
Provider: support optional; 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 for primary Resources:</u>
Provider: support mandatory; mutable
Consumer: support optional; read-write
<u>Constraints for secondary Resources:</u>
Provider: support optional; 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 for primary and secondary Resources:</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 for primary and secondary Resources:</u>
Provider: support optional; 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><td colspan="2">property</td></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 for primary Resources:</u>
Provider: support mandatory; mutable
Consumer: support optional; read-write
<u>Constraints for secondary Resources:</u>
Provider: support optional; mutable
Consumer: support optional; read-write</td></tr>
</table>

Attribute	Type	Description
vscope	*valueScope[]*	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. **Constraints for primary Resources:** **Provider:** support optional; mutable **Consumer:** support optional; read-only

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.

This model is also available in a CIM/MOF format [DSP0259].

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 Relationship semantics 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 remove from any Collection where it appears as an item.

5.10.2 Component Resources

The reference relationship from one Resource to another (either 1-1 or 1-n) may have the semantics of a "composition" (or whole-part relationship in UML), also called “ownership”. A Resource that is a component of another Resource is “owned” by this Resource, and is subject to the same access conditions from a Consumer. Deleting a Resource causes the deletion of all its components.

Composition interferes with the quality of a Resource – secondary or primary – in the following way:

- Secondary Resources: a secondary Resource is always a component of at least one primary Resource. Secondary Resources can only own secondary Resources.
- Primary Resources: a primary Resource may be a component of one or more primary Resources, but never of a secondary Resource.

A reference from primary Resource to secondary Resource shall have composition semantics by default. The composition semantics of a reference between primary Resources shall be explicitly indicated in the definition of the *referring* Resource.

Note that the composition relationship is transitive: a component of a component of a Resource is also a component of this Resource. It is also possible for a Resource to be owned by two or more Resources that are not component of each other, meaning that either owning Resource, when deleted, will also delete the component Resource. The references to this deleted component must then be removed from the remaining owners.

5.10.3 Associated Resources

A reference between two primary Resources may have the semantics of a simple "association". In contrast with a component relationship, the referred Resource is not affected if deleting the referring Resource (i.e., the Delete operation is a "shallow delete" by default).

Note that in the case of a 1-n association, deleting the *referring* Resource shall delete the Collection Resource that is mediating the relationship but not the *referred* Resource items themselves.

A reference from primary Resource to primary Resource shall have association semantics by default. If it has composition semantics this shall be explicitly indicated in the definition of the *referring* Resource.

Unless specified otherwise, the same Resource can be referred to by more than one *referring* Resource.

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 features. The mechanism by which this metadata is made available is protocol specific.

Note 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:

Table 6 – ResourceMetadata attributes

Name	ResourceMetadata	
Type URI	http://schemas.dmtf.org/cimi/1/ResourceMetadata	
Attribute	**Type**	**Description**
id	*URI*	The unique URI identifying this Resource; assigned upon Resource creation. This attribute value is **immutable**, and shall be **unique** in the Provider's cloud. **Constraints:** **Provider:** support mandatory; immutable **Consumer:** support mandatory; read-only
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

<table>
<tr><th>Name</th><td colspan="2">ResourceMetadata</td></tr>
<tr><th>Type URI</th><td colspan="2">http://schemas.dmtf.org/cimi/1/ResourceMetadata</td></tr>
<tr><th>Attribute</th><th>Type</th><th>Description</th></tr>
<tr><td>attributes</td><td>attribute[]</td><td>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:
<table>
<tr><th>Name</th><td colspan="2">attribute</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 attribute.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
<tr><td>namespace</td><td>URI</td><td>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.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
<tr><td>type</td><td>string</td><td>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.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
<tr><td>required</td><td>boolean</td><td>Indicates whether this Resource requires this attribute to be present. If absent the implied value is "false."
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>vscope</td><td>valueScope[]</td><td>The <code>vscope</code> attribute may be present on a <code>ResourceMetadata</code> Resource. In that case, the value scope represented by this attribute does not apply to the attributes of the <code>ResourceMetadata</code> 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 <code>typeURI</code> attribute. Consequently this value scope is about the list of attributes described in the <code>attributes</code> attribute.
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>capabilities</td><td>capability[]</td><td>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:
<table>
<tr><th>Name</th><td colspan="2">capability</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 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</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Name</th><td colspan="2">ResourceMetadata</td></tr>
<tr><th>Type URI</th><td colspan="2">http://schemas.dmtf.org/cimi/1/ResourceMetadata</td></tr>
<tr><th>Attribute</th><th>Type</th><th>Description</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td></td><td></td><td>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>
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>
</td></tr>
</table>

Name	ResourceMetadata	
Type URI	http://schemas.dmtf.org/cimi/1/ResourceMetadata	
Attribute	**Type**	**Description**
		Provider: support optional; mutable **Consumer:** support optional; read-write

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/1/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/1">
  <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/1/capability/". For example, the `Machine's` "InitialState" capability shall have a URI of:

```
http://schemas.dmtf.org/cimi/1/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 primary Resource.
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 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.

Resource Name	Capability Name	Description
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	NetworkConfigByValue	If true, the Provider shall support specifying NetworkConfigurations by value in Network create operations.
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 capability.
NetworkPort	NetworkPortConfigByValue	If true, the Provider shall support specifying NetworkPortConfigurations by value in NetworkPort create operations.
NetworkPort	NetworkPortTemplateByValue	If true, the Provider shall support specifying NetworkPortTemplates by value in NetworkPort create operations.
NetworkPort	DefaultInitialState	If this capability is set, unless otherwise provided (e.g., by a NetworkPortTemplate "initialState" attribute), the Provider shall set a new NetworkPort to this state value, assuming the value is compatible with the InitialStates capability, if set.

Resource Name	Capability Name	Description
NetworkPort	InitialStates	If this capability is set, and if using a NetworkPortTemplate that has an "initialState" attribute, a Consumer shall use an initialState value from the set of values of this capability.
ForwardingGroup	MixedNetwork	If true, a Provider shall support ForwardingGroups that can have both private and public connections at the same time. Otherwise, ForwardingGroups shall have only private or public connections at the same time.
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/1/ResourceMetadata",
  "id": "http://example.com/types/Machine",
  "typeURI": "http://schemas.dmtf.org/cimi/1/Machine",
  "name": "Machine",
  "capabilities": [
    { "uri":
      "http://schemas.dmtf.org/cimi/1/capability/Machine/MachineConfigByValue",
      "value": true },
    { "uri":
      "http://schemas.dmtf.org/cimi/1/capability/Machine/MachineImageByValue",
      "value": true },
    { "uri":
      "http://schemas.dmtf.org/cimi/1/capability/Machine/DefaultInitialState",
      "value": "STARTED" }
  }
}
```

XML serialization:

```
<ResourceMetadata xmlns="http://schemas.dmtf.org/cimi/1">
  <id> http://example.org/types/Machine </id>
  <typeURI> http://schemas.dmtf.org/cimi/1/Machine </typeURI>
  <name> Machine </name>
  <capability
uri="http://schemas.dmtf.org/cimi/1/capability/Machine/MachineConfigByValue">
    true
  </capability>
```

```
  <capability
uri="http://schemas.dmtf.org/cimi/1/capability/Machine/MachineImageByValue">
    true
  </capability>
  <capability
uri="http://schemas.dmtf.org/cimi/1/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/1/ResourceMetadataCollection",
  "id": string,
  "count": number,
  "resourceMetadatas": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/ResourceMetadata",
      "id": string,
      ... remaining ResourceMetadata attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/1/ResourceMetadataCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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. The Cloud Entry Point 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.

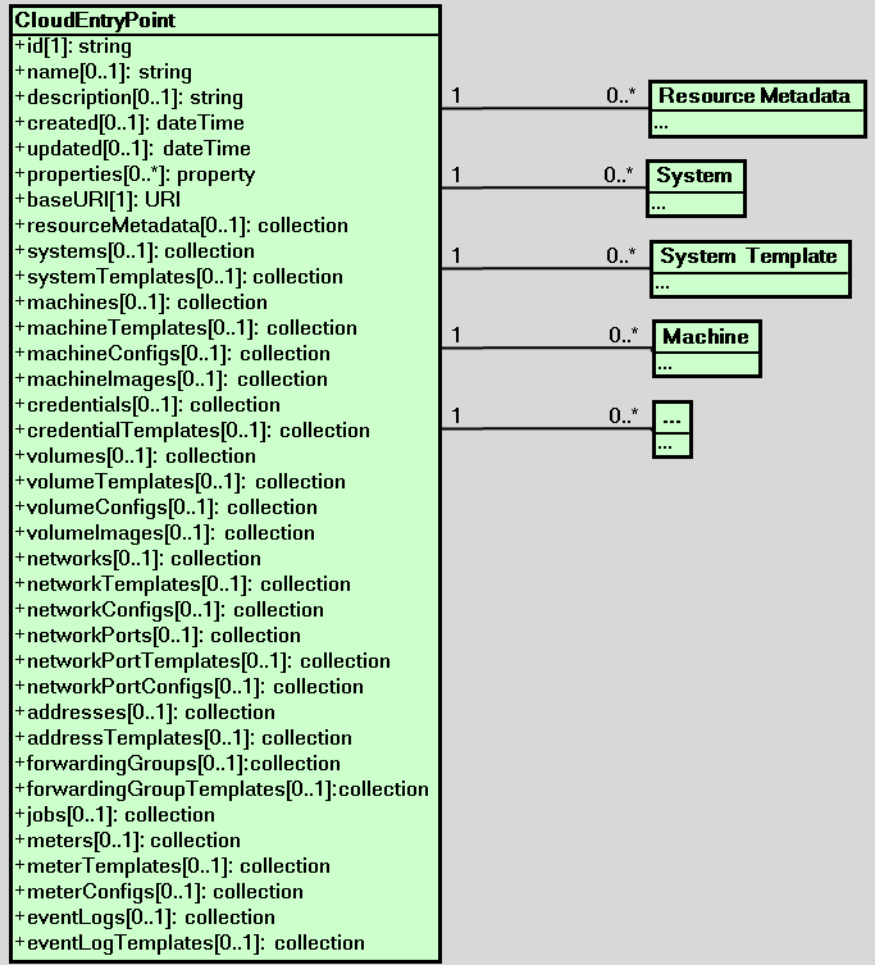


Figure 1 - Cloud Entry Point

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.

The relationships from the `CloudEntryPoint` Resource to all Resources in its Collections has a composition semantics. Unless indicated otherwise, deleting the `CloudEntryPoint` Resource is also deleting all referred Resources.

2230 **Table 8 – CloudEntryPoint attributes**

Name	CloudEntryPoint	
Type URI	http://www.dmf.org/cimi/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 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

Name	CloudEntryPoint	
Type URI	http://www.dmf.org/cimi/CloudEntryPoint	
Attribute	**Type**	**Description**
		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 [Volume Image]*	A reference to the `VolumeImageCollection` of this Cloud Entry 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
networkConfigs	*collection [Network Configuration]*	A reference to the `NetworkConfigurationCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
networkPorts	*collection [NetworkPort]*	A reference to the `NetworkPortCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
networkPortTemplates	*collection [NetworkPort Template]*	A reference to the `NetworkPortTemplateCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
networkPortConfigs	*collection [NetworkPort Configuration]*	A reference to the `NetworkPortConfigurationCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
addresses	*collection [Address]*	A reference to the `AddressCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
addressTemplates	*collection [Address Template]*	A reference to the `AddressTemplateCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only

Name	CloudEntryPoint	
Type URI	http://www.dmf.org/cimi/CloudEntryPoint	
Attribute	**Type**	**Description**
forwardingGroups	*collection [Forwarding Group]*	A reference to the `ForwardingGroupCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
forwardingGroupTemplates	*collection [Forwarding Group Template]*	A reference to the `ForwardingGroupTemplateCollection` of this Cloud Entry Point. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
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/1/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 }, ?
  "networkConfigs": { "href": string }, ?
  "networkPorts": { "href": string }, ?
  "networkPortTemplates": { "href": string }, ?
  "networkPortConfigs": { "href": string }, ?
  "addresses": { "href": string }, ?
  "addressTemplates": { "href": string }, ?
  "forwardingGroups" { "href": string }, ?
  "forwardingGroupTemplates" { "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/1">
  <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"/> ?
  <networkConfigs href="xs:anyURI"/> ?
  <networkPorts href="xs:anyURI"/> ?
  <networkPortTemplates href="xs:anyURI"/> ?
  <networkPortConfigs href="xs:anyURI"/> ?
  <addresses href="xs:anyURI"/> ?
  <addressTemplates href="xs:anyURI"/> ?
  <forwardingGroups href="xs:anyURI"/> ?
  <forwardingGroupTemplates 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.

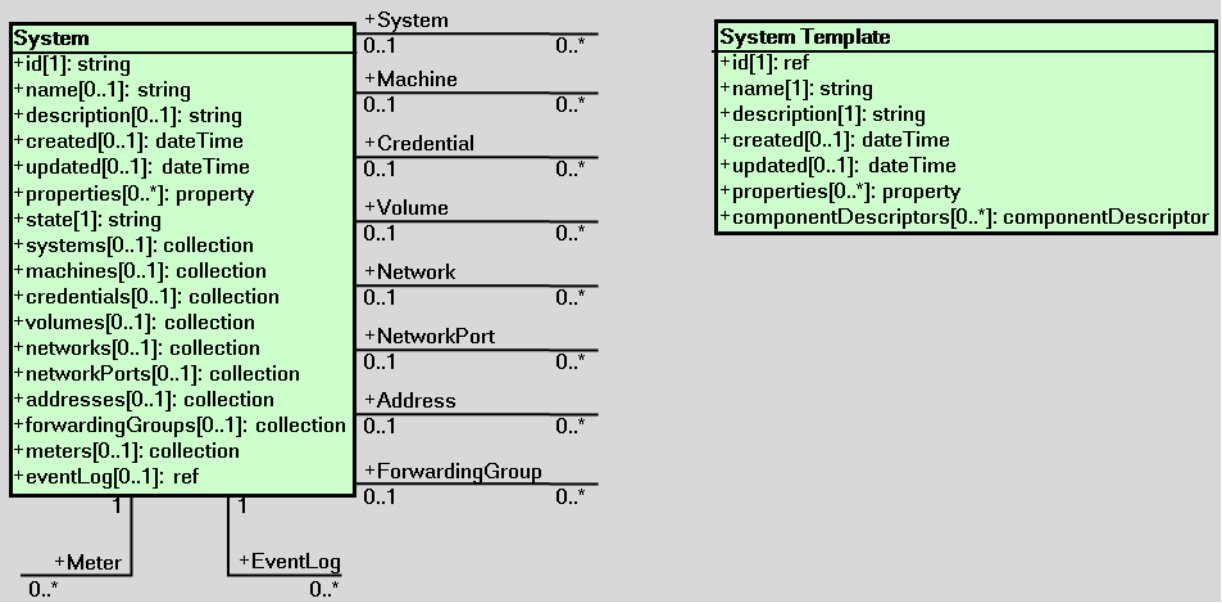


Figure 2 - System Resources

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` may directly provide a user-facing component, or may provide an infrastructure component.

A `System` has several "top-level" attributes that are Collections of references to Resources that are components of (owned by) the `System`. A Resource that is owned by a `System` has its life cycle directly tied to the life cycle of the `System`. In particular, if a `System` is deleted, all of its owned Resources shall also be deleted. Generally, operations on a `System` translate into operations on its owned Resources.

However, a Resource owned by a `System` may in turn refer to some other Resources that are not owned by this `System`, e.g., a `Machine` in a `System` can refer to a `Volume` that is not listed in the `volumes` Collection of the System. Instead, this Volume is simply associated with this Machine with no component semantics. Consequently it is not owned by this `System`. More precisely, the following rules apply:

- By default, all Resources that are created as the result of a System creation are also owned by the `System`. (This rule can be overridden by removal of a Resource from the top-level `System` Collection attributes.)
- Ownership of a Resource by a `System` is expressed by including the reference to the Resource in the appropriate top-level System Collection attribute, or by the transitive property of the ownership relationship across layers of components.

A Resource shall not be owned by more than one `System` at any point in time (unless there is an ownership relationship between these `Systems`). Note that a Resource does not need to owned by a `System` (i.e., part of any of its Collection attributes) to be referenced/used by a Resource in the `System`. Table 9 describes the System attributes.

Table 9 – System attributes

bg	System	
Type URI	http://schemas.dmtf.org/cimi/1/System	
Attribute	**Type**	**Description**
state	*string*	The operational state of the System. Allowable values include: (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` owned by this `System`. Adding an item (of type `System`) to this list is logically equivalent to associating the referenced `System` to this `System` with a component semantics. Removing an item from this list is logically equivalent to de-associating the referenced `System` from this `System`, i.e., it is no longer a component of this System. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
machines	*collection [Machine]*	A list of references to `Machines` owned by this `System`. Adding an item (of type `Machine`) to this list is logically equivalent to associating the `Machine` to this `System` with a component semantics. Removing an item from this list is logically equivalent to de-associating the `Machine` from this `Systemize`. it is no longer a component of this System (unless there is another chain of component relationships to this Machine – e.g., via a sub-System).

bg	System	
Type URI	http://schemas.dmtf.org/cimi/1/System	
Attribute	**Type**	**Description**
		Constraints: **Provider:** support optional; mutable **Consumer:** support optional; read-only
credentials	*collection [Credential]*	A list of references to `Credentials` owned by this `System`. Adding an item (of type `Credential`) to this list is logically equivalent to associating the `Credential` to this `System` with a component semantics. Removing an item from this list is logically equivalent to de-associating the `Credential` from this `System`, i.e., it is no longer a component of this System (unless there is another chain of component relationships to this `Credential` – e.g., via a sub-System). **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
volumes	*collection [Volume]*	A list of references `Volumes` owned by this `System`. Adding an item (of type `Volume`) to this list is logically equivalent to associating the `Volume` to this `System` with a component semantics. Removing an item from this list is logically equivalent to de-associating the `Volume` from this `Systemi`ze. it is no longer a component of this System (unless there is another chain of component relationships to this `Volume` – e.g., via a sub-System). **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
networks	*collection [Network]*	A list of references `Networks` owned by this `System`. Adding an item (of type `Network`) to this list is logically equivalent to associating the `Network` to this `System` with a component semantics. Removing an item from this list is logically equivalent to de-associating the `Network` from this `System`, i.e., it is no longer a component of this System (unless there is another chain of component relationships to this `Network` – e.g., via a sub-System).. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
networkPorts	*collection [NetworkPort]*	A list of references `NetworkPorts` owned by this `System`. Adding an item (of type `NetworkPort`) to this list is logically equivalent to associating the `NetworkPort` to this `System` with a component semantics. Removing an item from this list is logically equivalent to de-associating the `NetworkPort` from this `System`, i.e., it is no longer a component of this System (unless there is another chain of component relationships to this `NetworkPort` – e.g., via a sub-System). **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
addresses	*collection [Address]*	A list of references `Addresses` owned by this `System`. Adding an item (of type `Address`) to this list is logically equivalent to associating the `Address` to this `System` with a component semantics. Removing an item from this list is logically equivalent to de-associating the `Address` from this `System`, i.e., it is no longer a component of this System (unless there is another chain of component relationships to this `Address` – e.g., via a sub-System). **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
forwardingGroups	*collection [Forwarding*	A list of references `ForwardingGroups` owned by this `System`. Adding an item (of type `ForwardingGroup`) to this list is logically equivalent to

bg	System	
Type URI	http://schemas.dmtf.org/cimi/1/System	
Attribute	**Type**	**Description**
	Group]	associating the `ForwardingGroup` to this `System` with a component semantics. Removing an item from this list is logically equivalent to de-associating the `ForwardingGroup` from this `System`, i.e., it is no longer a component of this System (unless there is another chain of component relationships to this `ForwardingGroup` – e.g., via a sub-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/1/System",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "state": string,
  "systems": { "href": string }, ?
  "machines": { "href": string }, ?
  "credentials": { "href": string }, ?
  "volumes": { "href": string }, ?
  "networks": { "href": string }, ?
  "networkPorts": { "href": string }, ?
  "addresses": { "href": string }, ?
  "forwardingGroups": { "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/1/action/start", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/1/action/stop", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/1/action/restart", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/1/action/pause", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/1/action/suspend", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/1/action/export", "href": string,
("available": boolean)? } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<System xmlns="http://schemas.dmtf.org/cimi/1">
  <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>
  <systems href="xs:anyURI"/> ?
  <machines href="xs:anyURI"/> ?
  <credentials href="xs:anyURI"/> ?
  <volumes href="xs:anyURI"/> ?
  <networks href="xs:anyURI"/> ?
  <networkPorts href="xs:anyURI"/> ?
  <addresses href="xs:anyURI"/> ?
  <forwardingGroups 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/1/action/start"
             href="xs:anyURI" (available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/1/action/stop"
             href="xs:anyURI" (available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/1/action/restart"
             href="xs:anyURI" (available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/1/action/pause"
             href="xs:anyURI" (available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/1/action/suspend"
             href="xs:anyURI" (available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/1/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 owned by `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 `Network` Collection (serialized as described in 5.5.12). See the NetworkCollection Resource clause.

5.13.1.1.6 networkPorts Collection

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

5.13.1.1.7 addresses Collection

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

5.13.1.1.8 forwardingGroups Collection

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

5.13.1.1.9 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/1/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/1/action/export`

This operation shall export a `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
   Indicates the Media Type of the exported data. If not present, the default value shall be "application/ovf."

2) "destination" - type: URI - optional
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/1/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/1/action/export",
  "format": string, ?
  "destination": string, ?
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/1">
  <action> http://schemas.dmtf.org/cimi/1/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/1/SystemCollection",
  "id": string,
  "count", number,
  "systems": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/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/1/action/import", "href": string } ?
  ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/1/SystemCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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/1/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 "owned" by 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/1/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 ANNEX A.

1) Input parameters:"source" - type: URI - mandatory
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/1/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/1/action/import",
  "source": string, ?
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/1">
  <action> http://schemas.dmtf.org/cimi/1/action/import </action>
  <source> xs:anyURI </source> ?
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

5.13.3 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 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.

A `SystemTemplate` shall not contain two component descriptors of the same type that would result in the same non-null value for the "name" attribute of resulting components. Attempting to create or to update a `SystemTemplate` that fails this rule shall result in an error.

Table 10 describes the `SystemTemplate` attributes.

2617 **Table 10 – SystemTemplate attributes**

Name	SystemTemplate	
Type URI	http://schemas.dmtf.org/cimi/1/SystemTemplate	
Attribute	**Type**	**Description**
component Descriptors	*componentDescriptor*[]	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
description	*string*	The value of the "description" attribute that is associated with a `System` component created from this component descriptor. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support optional; read-write
properties	*map*	The key/value pairs that is associated with a `System` component created from this component descriptor. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support optional; read-write
type	*URI*	The TypeURI of the component to be created from this component descriptor, e.g., for a `Machine`: http://schemas.dmtf.org/cimi/1/Machine **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
<component Template>	<any>	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., `MachineTemplate` for a `Machine`. 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 `SystemTemplate`. • 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):* `"machineTemplate": {`

<table>
<tr><td>Name</td><td colspan="3">SystemTemplate</td></tr>
<tr><td>Type URI</td><td colspan="3">http://schemas.dmtf.org/cimi/1/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></td><td></td><td>"href": "http://example.com/machineTemplates/72000", "credential": { "href": "#MyCredential" } }

}

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>
<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>meter Templates</td><td>Meter Templates[]</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 reference to an existing <code>MeterTemplate</code> Resource.
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>eventLog Template</td><td>ref</td><td colspan="2">A reference to an <code>EventLogTemplate</code> that shall be used to create and connect a new <code>EventLog</code> to the new <code>System</code>.
Note that the attributes of the <code>EventLogTemplate</code> may be specified rather than a reference to an existing <code>EventLogTemplate</code> Resource.
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>import Image</td><td>ref</td><td colspan="2">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.
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-only</td></tr>
</table>

When implementing or using `SystemTemplate`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 10 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/1/SystemTemplate",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "componentDescriptors": [
    { "name": string, ?
      "description": string, ?
      "properties": { string: string, + }, ?
      "type": string,
      "componentTemplate": {
        "href": string, ?
        ... ComponentTemplate attributes ... ?
      },
       "quantity": number ?
    }, +
  ], ?
  "meterTemplates": [
    { "href": string, ?
      ... MeterTemplate attributes ... ?
    }, *
  ], ?
  "eventLogTemplate": {
    "href": string, ?
    ... EventLogTemplate attributes ... ?
  }, ?
  "importImage": { "href": string }, ?

  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string }, ?
```

```
    { "rel": "http://schemas.dmtf.org/cimi/1/action/export", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<SystemTemplate xmlns="http://schemas.dmtf.org/cimi/1">
  <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> *
  <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> *
  <meterTemplate href="xs:anyURI"? >
    ... MeterTemplate attributes ... ?
  </meterTemplate> *
  <eventLogTemplate href="xs:anyURI"? >
    ... EventLogTemplate attributes ... ?
  </eventLogTemplate> ?
  <importImage href="xs:anyURI"? >
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/1/action/export"
href="xs:anyURI"/> ?
  <xs:any>*
</SystemTemplate>
```

5.13.3.1 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/1/action/export`

This operation shall export a `SystemTemplate`. 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
   Indicates the Media Type of the exported data. If not present, the default value shall be "application/ovf."
2) "destination" - type: URI - optional
   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/1/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/1/action/export",
  "format": string, ?
  "destination": string, ?
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/1">
  <action> http://schemas.dmtf.org/cimi/1/action/export </action>
  <format> xs:string </format> ?
  <destination> xs:anyURI </destination> ?
  <property key="xs:string"> xs:string </property> *
```

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

5.13.4 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/1/SystemTemplateCollection",
  "id": string,
  "count": number,
  "systemTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/SystemTemplate",
      "id": string,
      ... remaining SystemTemplate attributes ...
    }, +
  ], ?
  "operations": [
    { "rel": "add", "href": string }, ?
    { "rel": "http://schemas.dmtf.org/cimi/1/action/import", "href": string } ?
  ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/1/SystemTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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/1/action/import"
href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.13.4.1 Operations

The following custom operations are defined:

import

/link@rel: `http://schemas.dmtf.org/cimi/1/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 ANNEX A.

Input parameters:

1) "source" - type: URI - mandatory
   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/1/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/1/action/import",
  "source": string, ?
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/1">
  <action> http://schemas.dmtf.org/cimi/1/action/import </action>
  <source> xs:anyURI </source> ?
  <property key="xs:string"> xs:string </property> *
  <xs:any>*
</Action>
```

5.14 Machine Resources and relationships

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

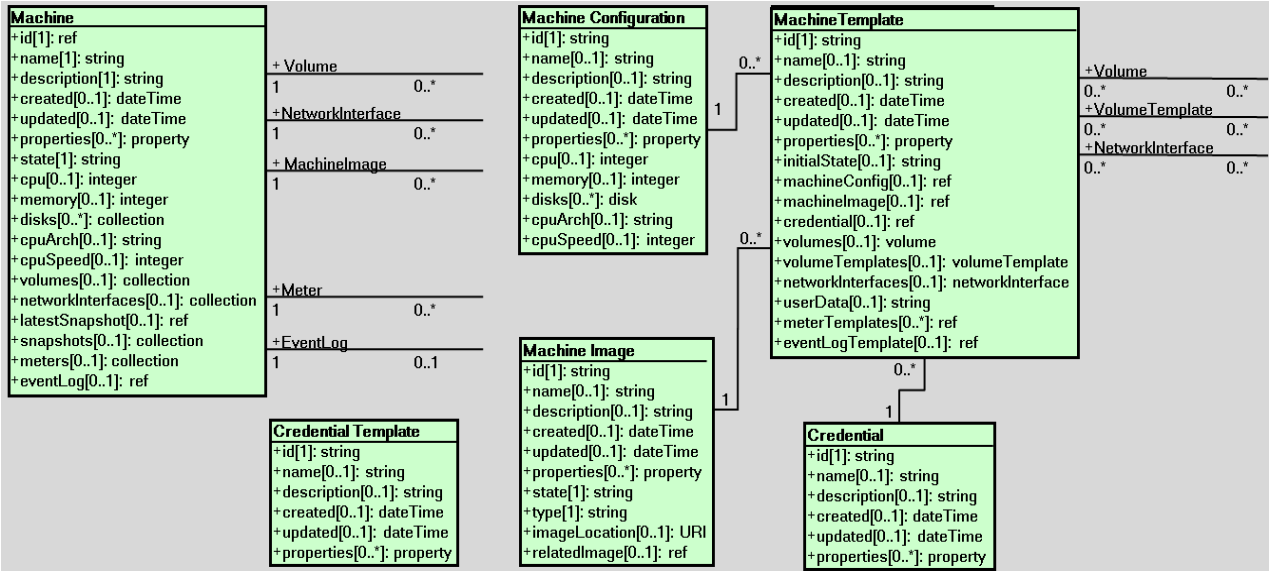


Figure 3 - Machine Resources

5.14.1 Machine

An instantiated compute Resource that encapsulates both CPU and Memory. Table 11 describes the `Machine` attributes.

Table 11 – Machine attributes

Name	Machine	
Type URI	http://schemas.dmtf.org/cimi/1/Machine	
Attribute	**Type**	**Description**
state	*string*	The operational state of the Machine. Allowable values include: **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. **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/1/Machine	
Attribute	**Type**	**Description**
		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` Resource is a secondary Resource with component semantics w/r to 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. Allowable values include: **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 an association between the `Machine` and `Volumes` (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
networkInterfaces	*collection [Network Interface]*	A reference to the list of `NetworkInterfaces` on this `Machine`. The `NetworkInterface` Resource is a secondary Resource with component semantics with regard to the Machine. Each `NetworkInterface` instance represents an association between the `Machine` and a `Network`. It is defined in clause 5.14.1.1.3. **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).

Name	Machine	
Type URI	http://schemas.dmtf.org/cimi/1/Machine	
Attribute	**Type**	**Description**
		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 an association between the `Machine` and SNAPSHOT `MachineImages`. (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 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/1/Machine",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "vscope" : [ valueScope, * ], ?
  "state": string,
  "cpu": number,
  "memory": number,
  "disks" : { "href": string }, ?
  "cpuArch": string, ?
  "cpuSpeed": number, ?
  "volumes": { "href": string }, ?
  "networkInterfaces": { "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/1/action/start", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/1/action/stop", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/1/action/restart", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/1/action/pause", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/1/action/suspend", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/1/action/snapshot", "href": string,
("available": boolean)? }, ?
    { "rel": "http://schemas.dmtf.org/cimi/1/action/restore", "href": string,
("available": boolean)? } ?
  ]
  ...
}
```

XML media type: application/xml

XML serialization:

```
<Machine xmlns="http://schemas.dmtf.org/cimi/1">
  <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> *
  <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"/> ?
  <networkInterfaces 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/1/action/start" href="xs:anyURI"
(available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/1/action/stop" href="xs:anyURI"
(available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/1/action/restart"
href="xs:anyURI" (available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/1/action/pause" href="xs:anyURI"
(available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/1/action/suspend"
href="xs:anyURI" (available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/1/action/capture"
href="xs:anyURI" (available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/1/action/snapshot"
href="xs:anyURI" (available="xs:boolean")? /> ?
  <operation rel="http://schemas.dmtf.org/cimi/1/action/restore"
href="xs:anyURI" (available="xs:boolean")? /> ?
  <xs:any>*
</Machine>
```

5.14.1.1 Collections

The following clause describes the Collection Resources owned by `Machines`.

5.14.1.1.1 Disk Collection

The Resource type for each item of this Collection is "`Disk`", defined in Table 12:

Table 12 – Disk attributes

Name	Disk	
Type URI	http://schemas.dmtf.org/cimi/1/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/1/DiskCollection",
```

```
  "id": string,
  "count": number,
  "disks": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/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/1/DiskCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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 13:

Table 13 – `locatedVolume` accessory attributes

Name	locatedVolume	
Type URI	http://schemas.dmtf.org/cimi/1/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/1/locatedVolumeCollection",
  "id": string,
  "count": number,
  "locatedVolumes": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/locatedVolume",
      "id": string,
      "name": string, ?
      "description": string, ?
      "created": string, ?
      "updated": 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/1/locatedVolumeCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <id> xs:anyURI </id>
  <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> ?
    <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 networkInterfaces Collection

The Resource type for each item of this Collection is “NetworkInterface”, defined in Table 14:

Table 14 – NetworkInterface attributes

Name	NetworkInterface	
Type URI	http://schemas.dmtf.org/cimi/1/NetworkInterface	
Attribute	**Type**	**Description**
addresses	*collection [Address]*	A reference to the list of references to the `Addresses` for this network interface. Note: This Collection represents an association between the `NetworkInterface` and a list of `Addresses`. The Address collection type is described in the Address section.. **Constraints:** **Provider:** support mandatory; mutable

Name	NetworkInterface	
Type URI	http://schemas.dmtf.org/cimi/1/NetworkInterface	
Attribute	**Type**	**Description**
		Consumer: support mandatory; read-only
network	*ref*	A reference to a `Network` for this network interface. This reference has association semantics. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
networkPort	*ref*	A reference to the `NetworkPort` for this network interface. This reference has association semantics. If this attribute is provided, the "network" attribute in the referenced `NetworkPort` shall have the same value as the "network" attribute in this network Interface. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
state	*string*	The state of the `MachineNetworkInterface`. Allowable values include: **ACTIVE**: An active interface is the primary interface, able to forward traffic. **PASSIVE**: A passive interface is in a standby mode ready to forward traffic if the primary interface fails. **DISABLED:** A disabled interface is one that is not able to forward traffic. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
macAddress	*string*	Address assigned by the hypervisor when a machine is created or a unique address can be manually assigned. While this attribute can be specified, in most cases it is expected to be supplied by the Provider. Specifying this value is typically only done if the Template is only used for one particular Machine. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
mtu	*integer*	To set the largest supported maximum transmission unit packet size. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write

JSON serialization:

```
{ "resourceURI":
    "http://schemas.dmtf.org/cimi/1/NetworkInterfaceCollection",
  "id": string,
  "count": number,
  "networkInterfaces": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/NetworkInterface",
      "id": string,
      "name": string, ?
      "description": string, ?
      "created": string, ?
      "updated": string, ?
      "properties": { string: string, + }, ?
      "addresses": { "href": string },
      "network": { "href": string },
      "networkPort": { "href": string }, ?
```

```
      "state": string, ?
      "macAddress": string, ?
      "mtu": number, ?
      "operations": [
        { "rel": "edit", "href": string }, ?
        { "rel": "delete", "href": string } ?
      ] ?
      ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
resourceURI="http://schemas.dmtf.org/cimi/1/NetworkInterfaceCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <NetworkInterface>
    <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> *
    <addresses href="xs:anyURI"/>
    <network href="xs:anyURI"/>
    <networkPort href="xs:anyURI"/> ?
    <state> xs:string </state> ?
    <macAddress> xs:string </macAddress> ?
    <mtu> xs:integer </mtu> ?
    <operation rel="edit" href="xs:anyURI"/> ?
    <operation rel="delete" href="xs:anyURI"/> ?
    <xs:any>*
  </NetworkInterface> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.14.1.1.4 addresses Collection

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

5.14.1.1.5 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.

5.14.1.1.6 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/1/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/1/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/1/Action",
  "action": "http://schemas.dmtf.org/cimi/1/action/start",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/1">
  <action> http://schemas.dmtf.org/cimi/1/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/1/action/stop`

This operation shall stop a `Machine`.

Input parameters:

1) "force" - type: boolean - optional
   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/1/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/1/Action",
  "action": "http://schemas.dmtf.org/cimi/1/action/stop",
  "force": boolean, ?
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/1">
  <action> http://schemas.dmtf.org/cimi/1/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/1/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
   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/1/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/1/Action",
  "action": "http://schemas.dmtf.org/cimi/1/action/restart",
  "force": boolean, ?
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/1">
  <action> http://schemas.dmtf.org/cimi/1/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/1/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/1/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/1/Action",
  "action": "http://schemas.dmtf.org/cimi/1/action/pause",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/1">
  <action> http://schemas.dmtf.org/cimi/1/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/1/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/1/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/1/Action",
  "action": "http://schemas.dmtf.org/cimi/1/action/suspend",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/1">
  <action> http://schemas.dmtf.org/cimi/1/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/1/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/1/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/1/action/restore`

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

Input parameters:

1) "image" - type: URI - mandatory
   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/1/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/1/Action",
  "action": "http://schemas.dmtf.org/cimi/1/action/restore",
  "image": { "href": string },
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/1">
  <action> http://schemas.dmtf.org/cimi/1/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/1/MachineCollection",
  "id": string,
  "count": number,
  "machines": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/Machine",
      "id": string,
      ... remaining Machine attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  "operations": [ { "rel": "insert", "href": string } ? ]
  "operations": [ { "rel": "remove", "href": string } ? ]

  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/1/MachineCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <Machine>
    <id> xs:anyURI </id>
    ... remaining Machine attributes ...
  </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).

Within the `NetworkInterface` portion of the `MachineTemplate`, there may be a reference to an `Address` Resource. If one is not provided, the Provider shall create one on the Consumer's behalf. In these cases, and unless some action is taken to change this behavior, the `Address` is bound to the new `Machine` that is created and shall be deleted by the Provider if the `Machine` is deleted. Additionally, if these Provider-created `Address` Resources are disassociated from the `Machine`, the Provider shall delete them. If the Consumer does provide an `Address` Resource, the `Address` shall not be deleted if the `Machine` is deleted and it is then up to the Consumer to delete the `Address` through some other mechanism.

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/1/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

<table>
<tr><th>Name</th><td colspan="2">MachineTemplate</td></tr>
<tr><th>Type URI</th><td colspan="2">http://schemas.dmtf.org/cimi/1/MachineTemplate</td></tr>
<tr><th>Attribute</th><th>Type</th><th>Description</th></tr>
<tr><td></td><td></td><td>MachineConfiguration Resource.
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>machineImage</td><td>ref</td><td>A reference to the MachineImage that is used to create a Machine from this MachineTemplate.
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>credential</td><td>ref</td><td>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.
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>volumes</td><td>volume[]</td><td>A list of structures, each containing a reference to an existing Volume and potentially describing aspects of the way that the given Volume is to be connected to the Machine during its creation from this MachineTemplate. 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 Volume 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>
</table>

<table>
<tr><th>Name</th><td colspan="2">MachineTemplate</td></tr>
<tr><th>Type URI</th><td colspan="2">http://schemas.dmtf.org/cimi/1/MachineTemplate</td></tr>
<tr><th>Attribute</th><th>Type</th><th>Description</th></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> contained by 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>
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write</td></tr>
</table>

<table>
<tr><th>Name</th><td colspan="2">MachineTemplate</td></tr>
<tr><th>Type URI</th><td colspan="2">http://schemas.dmtf.org/cimi/1/MachineTemplate</td></tr>
<tr><th>Attribute</th><th>Type</th><th>Description</th></tr>
<tr><td>networkInterfaces</td><td>networkInterface[]</td><td>A list of structures, each containing references to the Resources and attributes defining a network interface to be created on a <code>Machine</code> instantiated from this <code>MachineTemplate</code>. The Resources referenced by each networkInterface structure are a <code>Network</code>, a <code>NetworkPort</code>, and a list of <code>Addresses</code>:
<table>
<tr><th>Name</th><td colspan="2">networkInterface</td></tr>
<tr><th>Attribute</th><th>Type</th><th>Description</th></tr>
<tr><td>addresses</td><td>ref[]</td><td>A list of references to the <code>Addresses</code> for this network interface.
Array item name: address
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-only</td></tr>
<tr><td>network</td><td>ref</td><td>A reference to the <code>Network</code> for this network interface.
It is expected that <code>NetworkPorts</code> and <code>Networks</code> are defined separately and prior to the <code>Machines</code> that connect to them.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-write</td></tr>
<tr><td>networkPort</td><td>ref</td><td>A reference to the <code>NetworkPort</code> for this network interface.
Note this is a reference to a <code>NetworkPort</code> and not a <code>NetworkPortTemplate</code>. It is expected that <code>NetworkPorts</code> and <code>Networks</code> are defined separately and prior to the <code>Machines</code> that connect to them.
If this attribute is provided, the "network" attribute in the referenced <code>NetworkPort</code> shall have the same value as the "network" attribute in this network Interface.
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>state</td><td>string</td><td>The state of the network interface. Allowable values include:
ACTIVE: An active interface is the primary interface, able to forward traffic.
PASSIVE: A passive interface is in a standby mode ready to forward traffic if the primary interface fails.
<u>DISABLED: A disabled interface is one that is not able to forward traffic.</u>
<u>Constraints:</u>
Provider: support optional; mutable
Consumer: support optional; read-write</td></tr>
<tr><td>mtu</td><td>integer</td><td>To set the largest supported packet size.
<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>userData</td><td>string</td><td>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.</td></tr>
</table>

Name	MachineTemplate	
Type URI	http://schemas.dmtf.org/cimi/1/MachineTemplate	
Attribute	**Type**	**Description**
		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/1/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 ... ?
    }, +
  ], ?
  "networkInterfaces": [
    { "addresses": [
        {"href": string}, +
      ],
      "network": {"href": string},
      "networkPort": {"href": string}, ?
      "state": string,
      "mtu": number ?
    }, +
  ], ?
  "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/1">
  <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> *
  <networkInterface>
    <address href="xs:anyURI"/> *
    <network href="xs:anyURI"/>
    <networkPort href="xs:anyURI"/> ?
    <state> xs:string </state>
    <mtu> xs:integer </mtu> ?
  </networkInterface> *
  <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/1/MachineTemplateCollection",
  "id": string,
  "count": number,
  "machineTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/MachineTemplate",
      "id": string,
      ... remaining MachineTemplate attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/1/MachineTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
```

```
  <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/1/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). **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
initialLocation	*string*	An Operating System-specific location (path) in its namespace where this `Disk` first appears. After creation of a `Machine`, Consumers may change the location of this

Name	MachineConfiguration	
Type URI	http://schemas.dmtf.org/cimi/1/MachineConfiguration	
Attribute	**Type**	**Description**
		`Disk`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
cpuArch	string	The CPU architecture that is supported by `Machines` created by using this configuration. Allowable values include: **68000**, **Alpha**, **ARM**, **Itanium**, **MIPS**, **PA_RISC**, **POWER**, **PowerPC**, **x86**, **x86_64**, **z/Architecture**, **SPARC**. Providers may define additional values. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
cpuSpeed	*integer*	The approximate CPU speed of this Machine in megahertz. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write

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/1/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/1">
  <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/1/MachineConfigurationCollection",
  "id": string,
  "count": number,
```

```
  "machineConfigurations": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/MachineConfiguration",
      "id": string,
      ... remaining MachineConfiguration attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/1/MachineConfigurationCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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.

3624 **Table 17 – MachineImage attributes**

Name	MachineImage	
Type URI	http://schemas.dmtf.org/cimi/1/MachineImage	
Attribute	**Type**	**Description**
state	*string*	The operational state of the `MachineImage`. Allowable values include: **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

Name	MachineImage	
Type URI	http://schemas.dmtf.org/cimi/1/MachineImage	
Attribute	**Type**	**Description**
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/1/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/1">
  <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/1/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/1/action/capture" or the "http://schemas.dmtf.org/cimi/1/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/1/MachineImageCollection",
  "id": string,
  "count": number,
  "machineImages": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/MachineImage",
      "id": string,
      ... remaining MachineImage attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/1/MachineImageCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
```

```
  <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/1/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/1/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/1">
  <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/1/CredentialCollection",
  "id": string,
  "count": number,
  "credentials": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/Credential",
      "id": string,
      ... remaining Credential attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/1/CredentialCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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.

3800 **Table 21 – CredentialTemplate attributes**

Name	CredentialTemplate	
Type URI	http://schemas.dmtf.org/cimi/1/CredentialTemplate	
Attribute	**Type**	**Description**
TBD		The exact set of attributes is determined by the provider.

3801 When implementing or using `CredentialTemplate`, Providers and Consumers shall adhere to the
3802 syntax and semantics of its attributes as described in Table 21 as well as in the table describing related
3803 Collections. Both Consumer and Provider shall serialize this Resource as described below. The following
3804 pseudo-schemas (see notation in 1.3) describe the serialization of the Resource in both JSON and XML:

3805 **JSON media type:** application/json

3806 **JSON serialization:**

3807
```
{ "resourceURI": "http://schemas.dmtf.org/cimi/1/CredentialTemplate",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

3820 **XML media type:** application/xml

3821 **XML serialization:**

3822
```
<CredentialTemplate xmlns="http://schemas.dmtf.org/cimi/1">
  <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>*
</CredentialTemplate>
```

3833 #### 5.14.11.1 Operations

3834 This Resource supports the Read, Update, and Delete operations. Create is supported through the
3835 `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/1/CredentialTemplateCollection",
  "id": string,
  "count": number,
  "credentialTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/CredentialTemplate",
      "id": string,
      ... remaining CredentialTemplate attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/1/CredentialTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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.

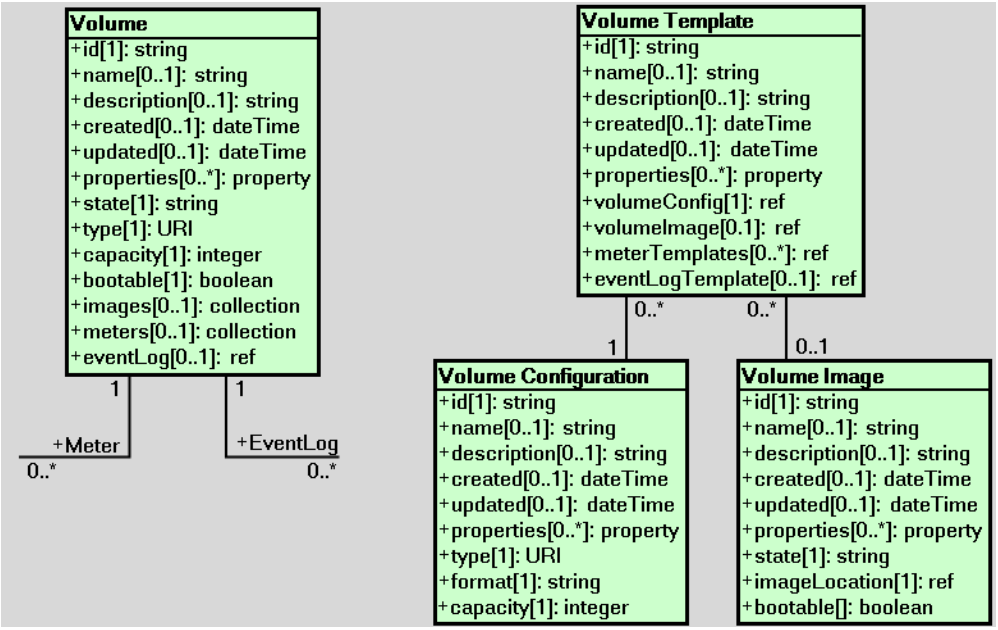


Figure 4 - Volume Resources

5.15.1 Volume

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

Table 22 – Volume attributes

Name	Volume	
Type URI	http://schemas.dmtf.org/cimi/1/Volume	
Attribute	**Type**	**Description**
state	*string*	The operational state of the `Volume`. Allowable values include: **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/1/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. **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 an association between the `Volume` and `VolumeImages` (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

Name	Volume	
Type URI	http://schemas.dmtf.org/cimi/1/Volume	
Attribute	**Type**	**Description**
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/1/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/1">
  <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/1/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/1/action/restore`

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

Input parameters:

1) "image" - type: URI - mandatory
   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/1/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/1/Action",
  "action": "http://schemas.dmtf.org/cimi/1/action/restore",
  "image": string,
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/1">
  <action> http://schemas.dmtf.org/cimi/1/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 `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/1/VolumeCollection",
  "id": string,
  "count": number,
  "volumes": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/Volume",
      "id": string,
      ... remaining Volume attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/1/VolumeCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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/1/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

Name	VolumeTemplate	
Type URI	http://schemas.dmtf.org/cimi/1/VolumeTemplate	
Attribute	**Type**	**Description**
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/1/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/1">
  <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/1/VolumeTemplateCollection",
  "id": string,
  "count": number,
  "volumeTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/VolumeTemplate",
      "id": string,
      ... remaining volumeTemplate attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/1/VolumeTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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.

4117 **Table 24 – VolumeConfiguration attributes**

Name	VolumeConfiguration	
Type URI	http://schemas.dmtf.org/cimi/1/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/1/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

4118 The following pseudo-schemas describe the serialization of the Resource in both JSON and XML:

4119 **JSON media type:** application/json

4120 **JSON serialization:**

```
4121  { "resourceURI": "http://schemas.dmtf.org/cimi/1/VolumeConfiguration",
4122    "id": string,
4123    "name": string, ?
4124    "description": string, ?
4125    "created": string, ?
4126    "updated": string, ?
4127    "properties": { string: string, + }, ?
4128    "type": string,
4129    "format": string,
4130    "capacity": number,
4131    "operations": [
4132      { "rel": "edit", "href": string }, ?
4133      { "rel": "delete", "href": string } ?
4134    ] ?
4135    ...
4136  }
```

XML media type: application/xml

XML serialization:

```
<VolumeConfiguration xmlns="http://schemas.dmtf.org/cimi/1">
  <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/1/VolumeConfigurationCollection",
  "id": string,
  "count": number,
  "volumeConfigurations": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/VolumeConfiguration",
      "id": string,
      ... remaining VolumeConfiguration attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/1/VolumeConfigurationCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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/1/VolumeImage	
Attribute	**Type**	**Description**
state	*string*	The operational state of the `VolumeImage`. Allowable values include: **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:** **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/1/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/1">
  <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/1/VolumeImageCollection",
  "id": string,
  "count": number,
  "volumeImages": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/VolumeImage",
      "id": string,
      ... remaining VolumeImage attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/1/VolumeImageCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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

Figure 5 illustrates the Resources involved in constructing `Networks` and their `NetworkPorts` and their relationships. Although this drawing is in the style of a Resource Relationship diagram, the use of UML is neither rigorous nor normative.

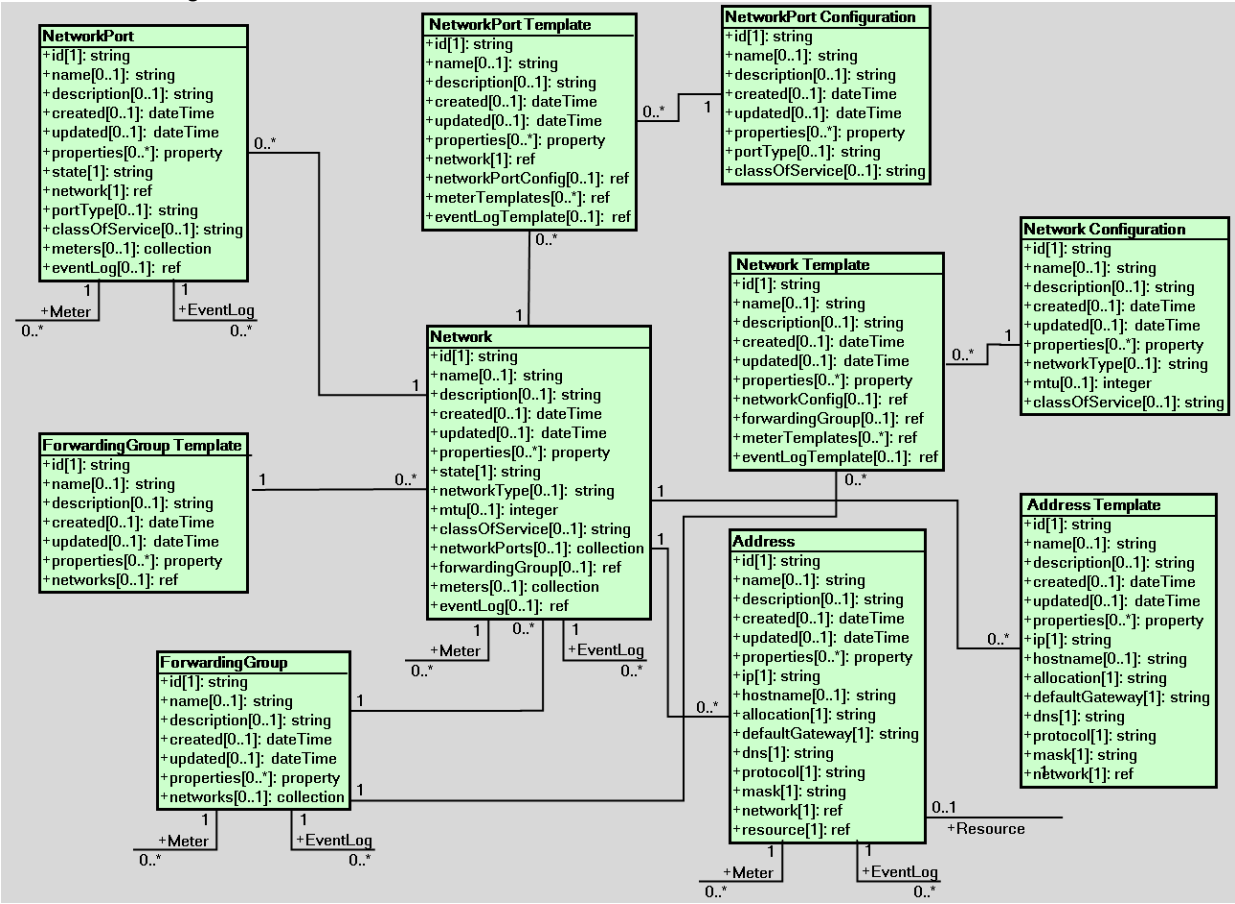


Figure 5 - Network Resources

5.16.1 Network

A `Network` is a Collection of interconnected logical services with the purpose of forwarding data traffic between end points.

`Networks` in a `ForwardingGroup` should all have the same "networkType" attributes, which prevents a `Network` with a "private" access attribute from being publicly forwarded because it is a member of a `ForwardingGroup` that also contains `Networks` with a "public" access attribute.

Table 26 describes the `Network` attributes.

Table 26 – Network attributes

Name	Network	
Type URI	http://schemas.dmtf.org/cimi/1/Network	
Attribute	**Type**	**Description**
state	*string*	The operational state of the `Network`. Allowable values include: **CREATING**: The `Network` is in the process of being created.

Name	Network	
Type URI	http://schemas.dmtf.org/cimi/1/Network	
Attribute	**Type**	**Description**
		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
networkType	*string*	An indicator of whether the `Machine` Resource has access to a Public or Private `Network`. Allowable values include: **PUBLIC**: represents an open and Internet routable network. **PRIVATE**: identifies a local non-routed network. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support optional; read-write
mtu	*integer*	(Maximum Transmission Unit) The largest Packet size supported on this `Network`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
classOfService	*string*	The Provider's supported category associated with a Collection of attributes characterizing a level of a quality experience. Example values: **GOLD**: High bandwidth, low latency, low jitter **SILVER**: An improved service experience over bronze for voice or video traffic **BRONZE**: Best effort The list of possible values, and their implied quality of service, is out of scope of this specification. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
networkPorts	*collection [NetworkPort]*	A reference to the list of references to `NetworkPorts` that are associated with this `Network`. This reference has component semantics for the referred `NetworkPorts`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
forwardingGroup	*ref*	A reference to a `ForwardingGroup` of which this `Network` is a part. **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

When implementing or using `Network`, 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/1/Network",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "state": string,
  "networkType": string, ?
  "mtu": number, ?
  "classOfService": string, ?
  "networkPorts": { "href": string }, ?
  "forwardingGroup": { "href": string }, ?
  "meters": { "href": string }, ?
  "eventLog": { "href": string }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string }, ?
    { "rel": "http://schemas.dmtf.org/cimi/1/action/start", "href": string }, ?
    { "rel": "http://schemas.dmtf.org/cimi/1/action/stop", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<Network xmlns="http://schemas.dmtf.org/cimi/1">
  <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>
  <networkType> xs:string </networkType> ?
  <mtu> xs:integer </mtu> ?
```

```
  <classOfService> xs:string </classOfService> ?
  <networkPorts href="xs:anyURI"/> ?
  <forwardingGroup 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/1/action/start"
href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/1/action/stop"
href="xs:anyURI"/> ?
  <xs:any>*
</Network>
```

5.16.1.1 Collections

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

5.16.1.1.1 `networkPorts` Collection

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

See the NetworkPortCollection Resource clause.

As specified in clause 5.5.12, if a `Network` is deleted, all of its Collections, and Resources in those Collections, shall also be deleted. This means that all of the `NetworkPorts` related to that `Network` shall also be deleted.

5.16.1.1.2 `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.

5.16.1.2 Operations

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

The following custom operations are also defined:

start

/link@rel: `http://schemas.dmtf.org/cimi/1/action/start`

This operation shall start 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/1/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/1/Action",
  "action": "http://schemas.dmtf.org/cimi/1/action/start",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/1">
  <action> http://schemas.dmtf.org/cimi/1/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/1/action/stop`

This operation shall stop a `Network`. If stopped, a `Network` shall not allow data to flow through it.

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/1/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/1/Action",
  "action": "http://schemas.dmtf.org/cimi/1/action/stop",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/1">
  <action> http://schemas.dmtf.org/cimi/1/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` within a Provider 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/1/NetworkCollection",
  "id": string,
  "count": number,
  "networks": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/Network",
      "id": string,
      ... remaining Network attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/1/NetworkCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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 4.2.1.1).

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.

Table 27 – NetworkTemplate attributes

Name	NetworkTemplate	
Type URI	http://schemas.dmtf.org/cimi/1/NetworkTemplate	
Attribute	**Type**	**Description**
initialState	*string*	The initial state of the new `Network`. Possible values include the non-transient states as specified by the `Network` "state" attribute (i.e., STARTED, STOPPED) and shall be determined by the actions supported by the Provider. Providers should advertise the list of available values by the way of the `Network ResourceMetadata` "initialStates" capability. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
networkConfig	*ref*	A reference to the `NetworkConfiguration` that is used to create a `Network` from this `NetworkTemplate`. Note that the attributes of the `NetworkConfiguration` may be specified rather than a reference to an existing `NetworkConfiguration` Resource. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
networkPorts	*network Port[]*	A list of reference to `NetworkPorts` to be added to `NetworkPort` collection of the `Network` during its creation from this `NetworkTemplate`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write

Name	NetworkTemplate	
Type URI	http://schemas.dmtf.org/cimi/1/NetworkTemplate	
Attribute	**Type**	**Description**
networkPortTemplates	*networkPortTemplate[]*	A list of references to `NetworkPortTemplate`s, from every template referenced, a `NetworkPort` is created and added to the `NetworkPort` collection of the `Network` resulting from this `NetworkTemplate`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
forwardingGroup	*ref*	A reference to a `ForwardingGroup` of which this `Network` is a part. Note that `Networks` forward to themselves; therefore, this attribute only appears in cases where the `Network` that is created from this Template forwards to one or more additional `Networks`. **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 `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
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/1/NetworkTemplate",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "initialState": string, ?
  "networkConfig": {
    "href": string |... NetworkingConfiguration attributes ...
  }, ?
  "forwardingGroup": { "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:

```
<NetworkTemplate xmlns="http://schemas.dmtf.org/cimi/1">
  <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> ?
  <networkConfig href="xs:anyURI"?>
    ... NetworkConfiguration attributes ... ?
  </networkConfig> ?
  <forwardingGroup 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>*
</NetworkTemplate>
```

5.16.3.1 Operations

This 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/1/NetworkTemplateCollection",
  "id": string,
  "count": number,
  "networkTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/NetworkTemplate",
      "id": string,
      ... remaining NetworkTemplate attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/1/NetworkTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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

This 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 NetworkConfiguration Resource

The following set of configuration values (shown in Table 28) represent the information needed to create a `Network` with certain characteristics.

Table 28 – NetworkConfiguration attributes

Name	NetworkConfiguration	
Type URI	http://schemas.dmtf.org/cimi/1/NetworkConfiguration	
Attribute	**Type**	**Description**
networkType	*string*	An indicator of whether the `Network` is a Public or Private Network. Allowable values include: **PUBLIC**: represents an open and Internet routable network. **PRIVATE**: identifies a local non-Internet network. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
mtu	*integer*	(Maximum Transmission Unit) The largest supported packet size. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
classOfService	*string*	The Provider's supported category associated with a Collection of attributes characterizing a level of a quality experience. Example values: **GOLD**: High bandwidth, low latency, low jitter **SILVER**: An improved service experience over bronze for voice or video traffic **BRONZE**: Best effort The list of possible values, and their implied quality of service, is out of scope of this specification. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; 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/1/NetworkConfiguration",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "networkType": string, ?
  "mtu": number, ?
  "classOfService": string, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
```

```
}
```

XML media type: application/xml

XML serialization:

```
<NetworkConfiguration xmlns="http://schemas.dmtf.org/cimi/1">
  <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> *
  <networkType> xs:string </networkType> ?
  <mtu> xs:integer <mtu> ?
  <classOfService> xs:string </classOfService> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</NetworkConfiguration>
```

5.16.5.1 Operations

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

5.16.6 NetworkConfigurationCollection Resource

A `NetworkConfigurationCollection` Resource represents the Collection of `NetworkConfigurations` 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/1/NetworkConfigurationCollection",
  "id": string,
  "count": number,
  "networkConfigurations": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/NetworkConfiguration",
      "id": string,
      ... remaining NetworkConfiguration attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/1/NetworkConfigurationCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <NetworkConfiguration>
    <id> xs:anyURI </id>
    ... remaining NetworkConfiguration attributes ...
  </NetworkConfiguration> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.16.6.1 Operations

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

5.16.7 NetworkPort

A `NetworkPort` is a realized connection point between a `Network` and a Resource, such as a `Machine`. Table 29 describes the `NetworkPort` attributes.

Table 29 – NetworkPort attributes

Name	NetworkPort	
Type URI	http://schemas.dmtf.org/cimi/1/NetworkPort	
Attribute	**Type**	**Description**
state	*string*	The operational state of the `NetworkPort`. Allowable values include: **CREATING**: The `NetworkPort` is in the process of being created. **STARTED**: The `NetworkPort` is available (enabled) and ready for use. **STOPPED**: The `NetworkPort` is stopped (disabled) and not available for use. **DELETING**: The `NetworkPort` is in the process of being deleted. **ERROR**: The Provider has detected an error in the `NetworkPort`. The operations that result in transitions to the above defined states are defined in clause 5.16.7.2. Clause 5.16.8.1 defines the initial state of a NetworkPort. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
network	*ref*	A reference to the `Network` associated with this `NetworkPort`. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
portType	*string*	A port is used as either an Access port (a member of the network) or a Trunk port that becomes a transport for multiple networks. Allowable values include: **ACCESS**: a member of a network. **TRUNK**: transport more than one network. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
classOfService	*string*	The Provider-supported category associated with a collection of attributes characterizing a level of a quality experience. Example values: **GOLD**: High bandwidth, low latency, low jitter **SILVER**: An improved service experience over bronze for voice or video traffic **BRONZE**: Best effort The list of possible values, and their implied quality of service, is out of scope of this specification. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
meters	*collection [Meter]*	A reference to the list of `Meters` monitored for this `NetworkPort`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only
eventLog	*ref*	A reference to the `EventLog` of this `NetworkPort`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-only

When implementing or using `NetworkPort`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 29 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/1/NetworkPort",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "state": string,
  "network": { "href": string },
  "portType": string, ?
  "classOfService": string, ?
  "meters": { "href": string }, ?
  "eventLog": { "href": string }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string }, ?
    { "rel": "http://schemas.dmtf.org/cimi/1/action/start", "href": string }, ?
    { "rel": "http://schemas.dmtf.org/cimi/1/action/stop", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<NetworkPort xmlns="http://schemas.dmtf.org/cimi/1">
  <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>
  <network href="xs:anyURI"/>
  <portType> xs:string </portType> ?
  <classOfService> xs:string </classOfService> ?
  <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/1/action/start"
href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/1/action/stop"
href="xs:anyURI"/> ?
  <xs:any>*
</NetworkPort>
```

5.16.7.1 Collections

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

5.16.7.1.1 `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).

5.16.7.2 Operations

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

Deleting a `NetworkPort` shall remove that NetworkPort from the global (Cloud Entry Point) `NetworkPortCollection` as well as from its corresponding `Network's NetworkPortsCollection`.

The following custom operations are also defined:

start

/link@rel: `http://schemas.dmtf.org/cimi/1/action/start`

This operation shall start a `NetworkPort`.

Input parameters: None.

Output parameters: None.

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

HTTP protocol

To start a `NetworkPort`, a POST is sent to the "http://schemas.dmtf.org/cimi/1/action/start" URI of the `NetworkPort` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/1/Action",
  "action": "http://schemas.dmtf.org/cimi/1/action/start",
  "properties": { string: string, + } ?
```

```
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/1">
  <action> http://schemas.dmtf.org/cimi/1/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/1/action/stop`

This operation shall stop a `NetworkPort`. If stopped, the `NetworkPort` shall not be available for use and no network traffic shall flow through it.

Input parameters: None.

Output parameters: None.

Upon successful completion of this operation, the `NetworkPort` shall be in the "STOPPED" state.

HTTP protocol

To stop a `NetworkPort`, a POST is sent to the "http://schemas.dmtf.org/cimi/1/action/stop" URI of the `NetworkPort` where the HTTP request body shall be as described below.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/1/Action",
  "action": "http://schemas.dmtf.org/cimi/1/action/stop",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/1">
  <action> http://schemas.dmtf.org/cimi/1/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.

5.16.8 NetworkPortCollection Resource

A `NetworkPortCollection` Resource represents the Collection of `NetworkPorts` 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/1/NetworkPortCollection",
  "id": string,
  "count": number,
  "networkPorts": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/NetworkPort",
      "id": string,
      ... remaining NetworkPort attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/1/NetworkPortCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <NetworkPort>
    <id> xs:anyURI </id>
    ... remaining NetworkPort attributes ...
  </NetworkPort> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.16.8.1 Operations

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

If `NetworkPorts` are created through the global (Cloud Entry Point) `NetworkPortCollection's` "add" operation, they are automatically associated with the corresponding Network, by addition of the NetworkPort's reference in the networkPorts Collection of the Network.

Upon successful processing of the "add" operation, unless otherwise specified by the `NetworkPortTemplate` "initialState" attribute, the state of the new `NetworkPort` shall be the value of the DefaultInitialState capability of the `NetworkPort` 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 `NetworkPort` to move it into that state.

4781 If a Provider is unable to change the state of the new `NetworkPort` to the appropriate "initialState"
4782 (either as specified by the `NetworkPortTemplate` or as implied by the previous stated rules), the
4783 `NetworkPort` creation shall fail.

4784 5.16.9 NetworkPortTemplate Resource

4785 The `NetworkPortTemplate` is a set of Configuration values for realizing a `NetworkPort`. A
4786 `NetworkPortTemplate` may be used to create multiple `NetworkPorts`. Table 30 describes the
4787 `NetworkPortTemplate` attributes.

4788 **Table 30 – NetworkPortTemplate attributes**

Name	NetworkPortTemplate	
Type URI	http://schemas.dmtf.org/cimi/1/NetworkPortTemplate	
Attribute	**Type**	**Description**
initialState	*string*	The initial state of the new `NetworkPort`. Possible values include the non-transient states as specified by the `NetworkPort` "state" attribute (i.e., STARTED, STOPPED) and shall be determined by the actions supported by the Provider. Providers should advertise the list of available values via the `NetworkPort ResourceMetadata` "initialStates" capability. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
network	*ref*	A reference to the network to be associated with this `NetworkPort`. If this Template is used to create a new `NetworkPort` through the global (Cloud Entry Point) `NetworkPort` Collection, this attribute shall be present. If this Template is referred in a NetworkTemplate and used to create a new `NetworkPort` during the creation of a `Network`, this attribute shall either be absent or have the same value as the "id" of the `Network` to which this `NetworkPort` is being added. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
networkPortConfig	*ref*	A reference to the `NetworkPortConfiguration` that is used to create a `NetworkPort` from this `NetworkPortTemplate`. Note that the attributes of the `NetworkPortConfiguration` may be specified rather than a reference to an existing `NetworkPortConfiguration` Resource. **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 `NetworkPort`. 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 `NetworkPort`. 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 `NetworkPortTemplate`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 30 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/1/NetworkPortTemplate",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "initialState": string, ?
  "network": { "href": string }, ?
  "networkPortConfig": {
    "href": string | ... NetworkPortConfiguration 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:

```
<NetworkPortTemplate xmlns="http://schemas.dmtf.org/cimi/1">
  <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> ?
  <network href="xs:anyURI"/> ?
  <networkPortConfig href="xs:anyURI"?>
    ... NetworkPortConfiguration attributes ... ?
  </networkPortConfig>
  <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>*
</NetworkPortTemplate>
```

5.16.9.1 Operations

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

5.16.10 NetworkPortTemplateCollection Resource

A `NetworkPortTemplateCollection` Resource represents the Collection of `NetworkPortTemplates` 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/1/NetworkPortTemplateCollection",
  "id": string,
  "count": number,
  "networkPortTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/NetworkPortTemplate",
      "id": string,
      ... remaining NetworkPortTemplate attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/1/NetworkPortTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <NetworkPortTemplate>
    <id> xs:anyURI </id>
    ... remaining NetworkPortTemplate attributes ...
  </NetworkPortTemplate> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.16.10.1 Operations

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

5.16.11 NetworkPortConfiguration Resource

The set of configuration values representing the information needed to create a `NetworkPort` with certain characteristics. Table 31 describes the `NetworkPortConfiguration` attributes.

Table 31 – NetworkPortConfiguration attributes

Name	NetworkPortConfiguration	
Type URI	http://schemas.dmtf.org/cimi/1/NetworkPortConfiguration	
Attribute	**Type**	**Description**
portType	*string*	A port is used as an Access port (a member of the network) or a Trunk port that becomes a transport for multiple networks. Allowable values include: **ACCESS**: a member of a network. **TRUNK**: transport more than one network. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
classOfService	*string*	The Provider-supported category associated with a collection of attributes characterizing a level of a quality experience Example values: **GOLD**: High bandwidth, low latency, low jitter **SILVER**: An improved service experience over bronze for voice or video traffic **BRONZE**: Best effort The list of possible values, and their implied quality of service, is out of scope of this specification. **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/1/NetworkPortConfiguration",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "portType": string, ?
  "classOfService": string, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<NetworkPortConfiguration xmlns="http://schemas.dmtf.org/cimi/1">
  <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> *
  <portType> xs:string </portType> ?
  <classOfService> xs:string </classOfService> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</NetworkPortConfiguration>
```

5.16.11.1 Operations

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

5.16.12 NetworkPortConfigurationCollection Resource

A `NetworkPortConfigurationCollection` Resource represents the Collection of `NetworkPortConfigurations` 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/1/NetworkPortConfigurationCollection",
  "id": string,
  "count": number,
  "networkPortConfigurations": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/NetworkPortConfiguration",
      "id": string,
      ... remaining NetworkPortConfiguration attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
resourceURI="http://schemas.dmtf.org/cimi/1/NetworkPortConfigurationCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <NetworkPortConfiguration>
    <id> xs:anyURI </id>
    ... remaining NetworkPortConfiguration attributes ...
  </NetworkPortConfiguration> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.16.12.1 Operations

This Resource supports the Read and Update operations. Creation of new `NetworkPortConfiguration` 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 Address Resource

An `Address` represents an IP address, and its associated metadata, for a particular Network. If a Consumer creates an `Address` Resource, it is the semantic equivalent of asking for a static IP address that can then be associated with Resources at a later point in time. `Addresses` that are manually

4964 created by Consumers shall not be deleted automatically if the Resource (e.g., a `Machine`) that is using
4965 that `Address` is deleted because these manually created `Addresses` are expected to have a lifetime
4966 that is different from the Resources that use them. `Addresses` that are created by Providers on the
4967 Consumer's behalf shall be deleted at the Provider's discretion. In particular, the Provider shall delete
4968 `Addresses` that it created on behalf of the Consumer if the Resource that is using that `Address` is
4969 deleted or if the `Address` becomes disassociated from the Resource.

4970 `Addresses` that are created by Providers may be converted to ones that are under the Consumer's
4971 control (i.e., are not deleted until explicitly requested by the Consumer) by changing the "allocation"
4972 attribute from "dynamic" to "static," if this feature supported by Providers.

4973 Table 32 describes the `Address` attributes.

4974 **Table 32 – Address attributes**

Name	Address	
Type URI	http://schemas.dmtf.org/cimi/1/Address	
Attribute	**Type**	**Description**
ip	*string*	The IP address assigned to a virtual interface. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
hostname	*string*	The DNS resolvable name associated with this network interface. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
allocation	*string*	The value is either "**dynamic**" or "**static**". Expresses whether this `Address` is controlled by the Provider or Consumer. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
defaultGateway	*string*	An IP address of a router that serves other networks. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
dns	*string[]*	The IP addresses of the Domain Name Services for host name to IP resolution. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
protocol	*string*	The selected network protocol, such as IPv4 or IPv6. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
mask	*string*	The network mask associated with this `Address`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
network	*ref*	A reference to the `Network` with which this `Address` is associated. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
resource	*ref*	A reference to the Resource that is using this `Address`. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only

4975 When implementing or using `Address`, Providers and Consumers shall adhere to the syntax and
4976 semantics of its attributes as described in Table 32 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) describe the serialization of the Resource in both JSON and XML.

JSON media type: application/json

JSON serialization:

```
{ "resourceURI": "http://schemas.dmtf.org/cimi/1/Address",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "ip": string,
  "hostname": string, ?
  "allocation": string,
  "defaultGateway": string, ?
  "dns": [ string, + ], ?
  "protocol": string,
  "mask": string, ?
  "network": { "href": string },
  "resource": { "href": string }, ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<Address xmlns="http://schemas.dmtf.org/cimi/1">
  <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> *
  <ip> xs:string </ip>
  <hostname> xs:string </hostname> ?
  <allocation> xs:string </allocation>
  <defaultGateway> xs:string </defaultGateway> ?
```

```
  <dns> xs:string </dns> *
  <protocol> xs:string </protocol>
  <mask> xs:string </mask> ?
  <network href="xs:anyURI"/>
  <resource href="xs:anyURI"/> ?
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</Address>
```

5.16.13.1 Operations

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

5.16.14 AddressCollection Resource

An `AddressCollection` Resource represents the Collection of `Addresses` within a Provider that are owned/managed by the Consumer or 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/1/AddressCollection",
  "id": string,
  "count": number,
  "addresses": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/Address",
      "id": string,
      ... remaining Address attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/1/AddressCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <Address>
    <id> xs:anyURI </id>
    ... remaining Address attributes ...
  </Address> *
  <operation rel="add" href="xs:anyURI"/> ?
```

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

5.16.14.1 Operations

NOTE The "add" operation requires that an AddressTemplate be used (see 4.2.1.1).

5.16.15 AddressTemplate Resource

This Resource captures the configuration values for realizing an Address. An `AddressTemplate` may be used to create multiple `Addresses`. Table 33 describes the `AddressTemplate` attributes.

Table 33 – AddressTemplate attributes

Name	AddressTemplate	
Type URI	http://schemas.dmtf.org/cimi/1/AddressTemplate	
Attribute	**Type**	**Description**
ip	*string*	The IP address assigned to a virtual interface. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
hostname	*string*	The DNS resolvable name associated with this network interface. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
allocation	*string*	A value of either "**dynamic**" or "**static**". Expresses whether this address is controlled by the Provider or Consumer. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only
defaultGateway	*string*	An IP address of a router that serves other networks. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
dns	*string[]*	The IP addresses of the Domain Name Services for host name to IP resolution. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
protocol	*string*	The selected network protocol, such as IPv4 or IPv6. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write
mask	*string*	The network mask associated with this `Address`. **Constraints:** **Provider:** support optional; mutable **Consumer:** support optional; read-write
network	*ref*	A reference to the Network with which this Address is associated. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write

When implementing or using `AddressTemplate`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 33 as well as in the table describing the related `AddressTemplateCollection`. 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.

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/1/AddressTemplate",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "ip": string,
  "hostname": string, ?
  "allocation": string,
  "defaultGateway": string, ?
  "dns": [ string, + ], ?
  "protocol": string,
  "mask": string, ?
  "network": { "href": string },
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<AddressTemplate xmlns="http://schemas.dmtf.org/cimi/1">
  <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> *
  <ip> xs:string </ip>
  <hostname> xs:string </hostname> ?
  <allocation> xs:string </allocation>
  <defaultGateway> xs:string </defaultGateway>
  <dns> xs:string </dns> +
  <protocol> xs:string </protocol>
  <mask> xs:string </mask>
```

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

5.16.15.1 Operations

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

5.16.16 AddressTemplateCollection Resource

An `AddressTemplateCollection` Resource represents the Collection of `AddressTemplate` 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/1/AddressTemplateCollection",
  "id": string,
  "count": number,
  "addressTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/AddressTemplate",
      "id": string,
      ... remaining AddressTemplate attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/1/AddressTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <AddressTemplate>
    <id> xs:anyURI </id>
    ... remaining AddressTemplate attributes ...
  </AddressTemplate> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.16.16.1 Operations

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

5.16.17 ForwardingGroup Resource

A `ForwardingGroup` represents a collection of `Networks` that route to each other.

`Networks` in a `ForwardingGroup` should all have the same "networkType" attributes, which prevents a `Network` with a "private" networkType attribute from being publicly forwarded because it is a member of a `ForwardingGroup` that also contains `Networks` with a "public" networkType attribute.

Providers shall not allow two `Networks` to be forwardable to each other unless they are explicitly connected by being part of a common `ForwardingGroup`.

Table 34 describes the `ForwardingGroup` attributes.

Table 34 – ForwardingGroup attributes

Name	ForwardingGroup	
Type URI	http://schemas.dmtf.org/cimi/1/ForwardingGroup	
Attribute	**Type**	**Description**
networks	*collection [Network]*	A reference to the list of references to the `Networks` in this `ForwardingGroup`. **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-only

When implementing or using `ForwardingGroup`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 34 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/1/ForwardingGroup",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "networks": [
    { "href": string }, +
   ], ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
```

```
  ...
}
```

XML media type: application/xml

XML serialization:

```
<ForwardingGroup xmlns="http://schemas.dmtf.org/cimi/1">
  <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"> *
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</ForwardingGroup>
```

5.16.17.1 Collections

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

5.16.17.1.1 `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 `Network` Collection (serialized as described in 5.5.12).

See the NetworkCollection Resource clause.

5.16.17.2 Operations

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

5.16.18 ForwardingGroupCollection Resource

A `ForwardingGroupCollection` Resource represents the Collection of `ForwardingGroups` 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/1/ForwardingGroupCollection",
  "id": string,
  "count": number,
  "forwardingGroups": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/ForwardingGroup",
      "id": string,
      ... remaining ForwardingGroup attributes ...
```

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

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/1/ForwardingGroupCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <ForwardingGroup>
    <id> xs:anyURI </id>
    ... remaining ForwardingGroup attributes ...
  </ForwardingGroup> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

5.16.18.1 Operations

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

5.16.19 ForwardingGroupTemplate Resource

This Resource captures the configuration values for realizing a `ForwardingGroup`. A `ForwardingGroupTemplate` may be used to create multiple `ForwardingGroups`. Table 35 describes the `ForwardingGroupTemplate` attributes.

Table 35 – ForwardingGroupTemplate attributes

Name	ForwardingGroupTemplate	
Type URI	http://schemas.dmtf.org/cimi/1/ForwardingGroupTemplate	
Attribute	**Type**	**Description**
networks	*ref[]*	An array of references to the `Networks` in this `ForwardingGroup`. Array item name: network **Constraints:** **Provider:** support mandatory; mutable **Consumer:** support mandatory; read-write

When implementing or using `ForwardingGroupTemplate`, Providers and Consumers shall adhere to the syntax and semantics of its attributes as described in Table 35 as well as in the tables describing referred Resources. 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/1/ForwardingGroupTemplate",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "properties": { string: string, + }, ?
  "networks": [
    { "href": string }, +
   ], ?
  "operations": [
    { "rel": "edit", "href": string }, ?
    { "rel": "delete", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<ForwardingGroupTemplate xmlns="http://schemas.dmtf.org/cimi/1">
  <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"> *
  <operation rel="edit" href="xs:anyURI"/> ?
  <operation rel="delete" href="xs:anyURI"/> ?
  <xs:any>*
</ForwardingGroupTemplate>
```

5.16.19.1 Operations

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

5.16.20 ForwardingGroupTemplateCollection Resource

A `ForwardingGroupTemplateCollection` Resource represents the Collection of `ForwardingGroupTemplate` 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/1/ForwardingGroupTemplateCollection",
  "id": string,
  "count": number,
  "forwardingGroupTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/ForwardingGroupTemplate",
      "id": string,
      ... remaining ForwardingGroupTemplate attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
 resourceURI="http://schemas.dmtf.org/cimi/1/ForwardingGroupTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <id> xs:anyURI </id>
  <count> xs:integer </count>
  <ForwardingGroupTemplate>
    <id> xs:anyURI </id>
    ... remaining ForwardingGroupTemplate attributes ...
  </ForwardingGroupTemplate> *
  <operation rel="add" href="xs:anyURI"/> ?
  <xs:any>*
</Collection>
```

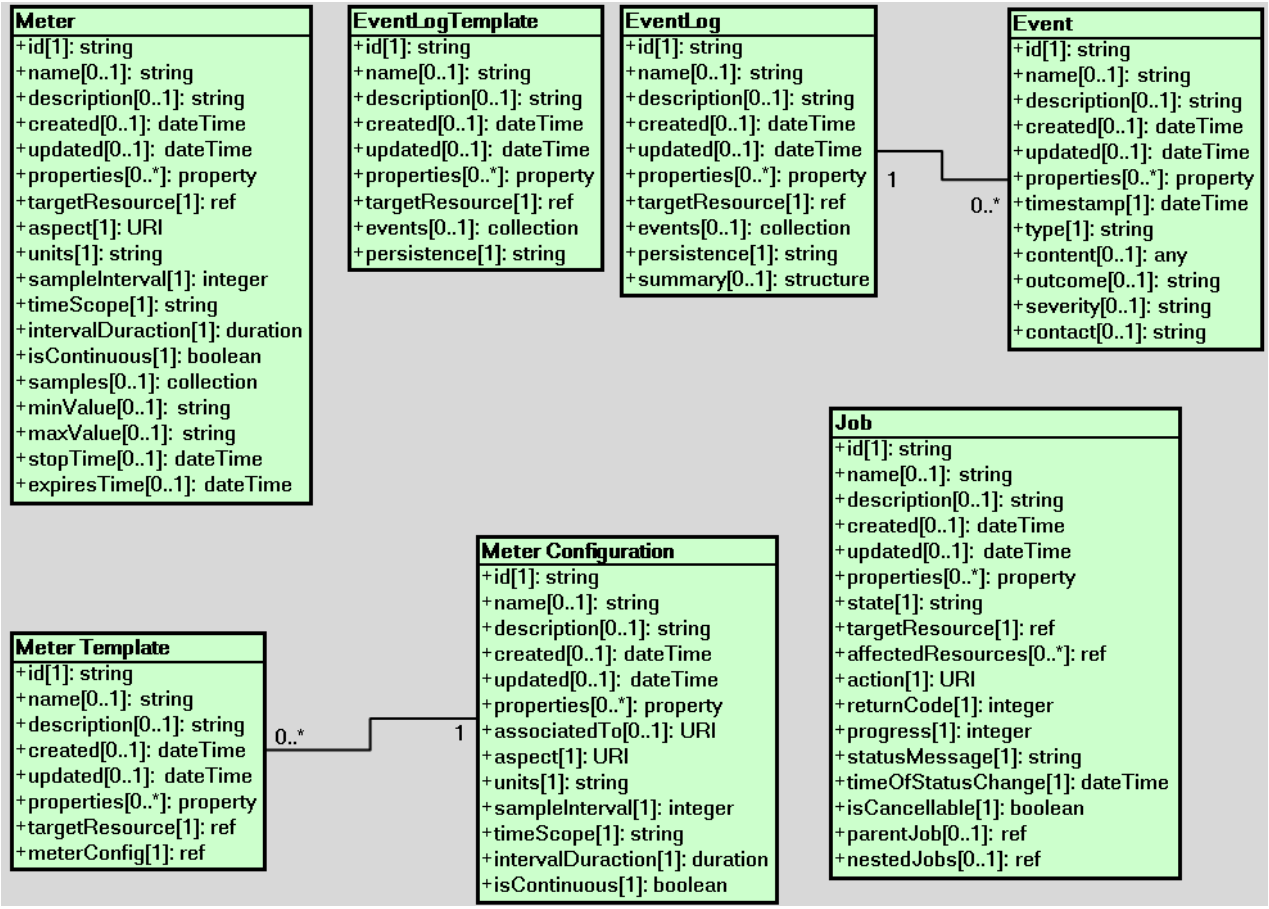
5.16.20.1 Operations

This Resource supports the Read and Update operations. Creation of new `ForwardingGroupTemplate` 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 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.

5320



5321 **Figure 6 - Monitoring Resources**

5322 ### 5.17.1 Job Resource

5323 This Resource represents a process (i.e., a sequence of one or more operations directed to accomplish a
5324 specific goal) that is performed by the Provider.

5325 If a Provider supports exposing `Job` Resources to Consumers, each request from a Consumer that the
5326 Provider responds to with a 202 status code, shall result in a `Job` Resource being created and an
5327 absolute URI reference to that `Job` Resource shall be made available to the requesting Consumer.
5328 Providers may create additional `Job` Resources for Provider-initiated operations if the Provider chooses
5329 to expose these Jobs to Consumers.

5330 If a `Job` is not completed successfully (e.g., it is in the FAILED or STOPPED state), this specification
5331 does not place any requirements on the Provider to ensure that the affected Resources are left in certain
5332 states. Based on the environmental conditions at that time, the Provider might choose to "undo" any
5333 impact of the operation; simply halt processing; attempt some kind of "cleanup" action; or choose to do
5334 something else. However, Providers shall list all Resources impacted by the `Job` in the
5335 "affectedResources" attribute, thus allowing Consumers an opportunity to examine the state of each
5336 Resource themselves. In cases where a Resource has been deleted, references to that Resource shall
5337 not appear in the "affectedResources" attribute.

5338 The `Job` Resource allows for nesting of `Jobs`. The determination of when a single operation is
5339 converted into multiple nested `Jobs` is out of scope of this specification. However, if there are nested

5340 Jobs, the top-most Job Resource shall report the overall status of all Jobs and shall only be in a
5341 "SUCCESS" state if all nested `Jobs` are also in "SUCCESS" state. If nested `Jobs` are created, there is
5342 no requirement for the top-most `Job` Resource to reference all affected Resources in its
5343 "affectedResources" attribute. The Consumer needs to traverse the entire set of nested `Jobs` to
5344 determine the complete list of Resources impacted by the `Jobs`.

5345 Table 36 describes the `Job` attributes.

5346 **Table 36 – Job attributes**

Name	Job	
Type URI	http://schemas.dmtf.org/cimi/1/Job	
Attribute	**Type**	**Description**
state	*string*	The state of the process associated with this operation. Allowable values include: **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:** **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

Name	Job	
Type URI	http://schemas.dmtf.org/cimi/1/Job	
Attribute	**Type**	**Description**
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 36 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/1/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/1/action/stop", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<Job xmlns="http://schemas.dmtf.org/cimi/1">
  <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/1/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/1/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/1/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/1/Action",
  "action": "http://schemas.dmtf.org/cimi/1/action/stop",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/1">
  <action> http://schemas.dmtf.org/cimi/1/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/1/JobCollection",
  "id": string,
  "count": integer,
  "jobs": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/Job",
      "id": string,
      ... remaining Job attributes ...
    }, +
```

```
  ] ?
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/1/JobCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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 37 describes the `Meter` attributes.

Table 37 – Meter attributes

Name	Meter	
Type URI	http://schemas.dmtf.org/cimi/1/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
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

Name	Meter	
Type URI	http://schemas.dmtf.org/cimi/1/Meter	
Attribute	**Type**	**Description**
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

When implementing or using `Meter`, 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 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/1/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/1/action/start", "href": string }, ?
    { "rel": "http://schemas.dmtf.org/cimi/1/action/stop", "href": string } ?
  ] ?
  ...
}
```

XML media type: application/xml

XML serialization:

```
<Meter xmlns="http://schemas.dmtf.org/cimi/1">
  <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/1/action/start"
href="xs:anyURI"/> ?
  <operation rel="http://schemas.dmtf.org/cimi/1/action/stop"
href="xs:anyURI"/> ?
  <xs:any>*
</Meter>
```

5.17.3.1 Collections

The following clauses describe the Collection resources owned by `Meters`.

5.17.3.1.1 SampleCollection Resource

The Resource type for each item of this Collection is "`Sample`", defined in Table 38:

Table 38 – Sample attributes

Name	Sample	
Type URI	http://schemas.dmtf.org/cimi/1/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 38 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/1/SampleCollection",
  "id": string,
  "count": number,
  "samples": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/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/1/SampleCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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/1/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/1/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/1/Action",
  "action": "http://schemas.dmtf.org/cimi/1/action/start",
  "properties": { string: string, + } ?
  ...
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/1">
  <action> http://schemas.dmtf.org/cimi/1/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/1/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/1/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/1/Action",
  "action": "http://schemas.dmtf.org/cimi/1/action/stop",
  "properties": { string: string, + } ?
  ...
```

```
}
```

XML media type: application/xml

XML serialization

```
<Action xmlns="http://schemas.dmtf.org/cimi/1">
  <action> http://schemas.dmtf.org/cimi/1/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/1/MeterCollection",
  "id": string,
  "count": number,
  "meters": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/Meter",
      "id": string,
      ... remaining Meter attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/1/MeterCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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 39 describes the `MeterTemplate` attributes.

Table 39 – MeterTemplate attributes

Name	MeterTemplate	
Type URI	http://schemas.dmtf.org/cimi/1/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 39 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/1/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/1">
  <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/1/MeterTemplateCollection",
  "id": string,
  "count": number,
  "meterTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/MeterTemplate",
      "id": string,
      ... remaining MeterTemplate attributes ...
    }, +
  ], ?
```

```
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/1/MeterTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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 40 describes the `MeterConfiguration` attributes.

Table 40 – MeterConfiguration attributes

Name	MeterConfiguration	
Type URI	http://schemas.dmtf.org/cimi/1/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 41 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

Name	MeterConfiguration	
Type URI	http://schemas.dmtf.org/cimi/1/MeterConfiguration	
Attribute	**Type**	**Description**
		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

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/1/MeterConfiguration",
  "id": string,
  "name": string, ?
  "description": string, ?
  "created": string, ?
  "updated": string, ?
  "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/1">
  <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 41 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/1/aspect/".

Table 41 – 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 .

Aspect	Description
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.

5.17.7.1 Operations

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

5.17.8 MeterConfigurationCollection Resource

A `MeterConfigurationCollection` Resource represents the Collection of `MeterConfigurations` 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/1/MeterConfigurationCollection",
  "id": string,
  "count": number,
  "meterConfigurations": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/MeterConfiguration",
      "id": string,
      ... remaining MeterConfiguration attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/1/MeterConfigurationCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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>
```

5829 #### 5.17.8.1 Operations

5830 This Resource supports the Read and Update operations. Creation of new `MeterConfiguration`
5831 Resources is supported by the way of a POST to the "add" operation's URI as described in clause
5832 4.2.1.1.

5833 ### 5.17.9 EventLog Resource

5834 A Resource that represents a registry of Events.

5835 If an `EventLog`'`s` "targetResource" is deleted the `EventLog` associated with that Resource may also
5836 be deleted. In other words, deleting a Resource (e.g., a `Machine`) may also result in the deletion of the
5837 `EventLog` referenced from that Resource. This behavior is denoted by the `EventLog` "Linked"
5838 capability.

5839 If an EventLog is deleted, all of its Events shall also be deleted.

5840 Table 42 describes the `EventLog` attributes.

5841 **Table 42 – EventLog attributes**

Name	EventLog	
Type URI	http://schemas.dmtf.org/cimi/1/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

<table>
<tr><th>Name</th><td colspan="2">EventLog</td></tr>
<tr><th>Type URI</th><td colspan="2">http://schemas.dmtf.org/cimi/1/EventLog</td></tr>
<tr><th>Attribute</th><th>Type</th><th>Description</th></tr>
<tr><td>summary</td><td><unnamed structure></td><td>A summary of all the events present in the <code>EventLog</code> when the read operation is performed, grouped by severity.
Each summary attribute is an (unnamed) structure that has the following sub-attributes:
<table>
<tr><th>Attribute</th><th>Type</th><th>Description</th></tr>
<tr><td>low</td><td>integer</td><td>Number of occurred <code>Events</code> with a low severity.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-only</td></tr>
<tr><td>medium</td><td>integer</td><td>Number of occurred <code>Events</code> with a medium severity.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-only</td></tr>
<tr><td>high</td><td>integer</td><td>Number of occurred <code>Events</code> with a high severity.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-only</td></tr>
<tr><td>critical</td><td>integer</td><td>Number of occurred <code>Events</code> with a critical severity.
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-only</td></tr>
</table>
<u>Constraints:</u>
Provider: support mandatory; mutable
Consumer: support mandatory; read-only</td></tr>
</table>

When implementing or using `EventLog`, 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 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/1/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/1">
  <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 owned by 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/1/EventCollection",
  "id": string,
  "count": number,
  "events": [
```

```
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/Event",
      "id": string,
      ... remaining Event attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/1/EventCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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/1/EventLogCollection",
  "id": string,
  "count": number,
  "eventLogs": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/EventLog",
      "id": string,
      ... remaining EventLog attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
}
```

XML serialization:

```
<Collection resourceURI="http://schemas.dmtf.org/cimi/1/EventLogCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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 43 describes the `EventLogTemplate` attributes.

Table 43 – EventLogTemplate attributes

Name	EventLogTemplate	
Type URI	http://schemas.dmtf.org/cimi/1/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 43 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/1/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/1">
  <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/1/EventLogTemplateCollection",
  "id": string,
  "count": number,
  "eventLogTemplates": [
    { "resourceURI": "http://schemas.dmtf.org/cimi/1/EventLogTemplate",
      "id": string,
      ... remaining EventLogTemplate attributes ...
    }, +
  ], ?
  "operations": [ { "rel": "add", "href": string } ? ]
  ...
```

```
}
```

XML serialization:

```
<Collection
    resourceURI="http://schemas.dmtf.org/cimi/1/EventLogTemplateCollection"
    xmlns="http://schemas.dmtf.org/cimi/1">
  <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 44 describes the `Event` attributes.

Table 44 – Event attributes

Name	Event	
Type URI	http://schemas.dmtf.org/cimi/1/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/1/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 44. 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/1/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/1">
  <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>
```

6082 Table 45 describes the "type" URIs that are defined or acknowledged by this specification. Additional
6083 types may be added by a Provider, for example to characterize external events mapped into CIMI
6084 `Events`. It is recommended that these URIs be dereferencable such that Consumers can discover a
6085 more detailed description of the type. `Event` types defined by this specification share the same base
6086 URI: http://schemas.dmtf.org/cimi/1/event/. For brevity, if the "Event Type" column in the table only shows
6087 a relative URI (e.g., state) it shall be appended to the end of this base URI.

6088 **Table 45 – 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 primary 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/1/event/state",
  "content": {
    "resName": string,
    "resource" : { "href" : string },
    "resType" : string,
    "state" : string,
    "previous" : string ?
  }
  ...
}
```

XML serialization:

```
<Event xmlns="http://schemas.dmtf.org/cimi/1">
  ...
  <type> http://schemas.dmtf.org/cimi/1/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/1/event/alarm",
  "content": {
    "resName": string ?
    "resource" : { "href" : string }, ?
    "resType" : string ?
```

```
    "code" : string,
    "detail" : string ?
  }
  ...
}
```

XML serialization:

```
<Event xmlns="http://schemas.dmtf.org/cimi/1">
  ...
  <type> http://schemas.dmtf.org/cimi/1/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/1/event/model",
  "content": {
    "resName": string, ?
    "resource" : { "href" : string }, ?
    "resType" : string, ?
    "change" : string,
    "detail" : string ?
  }
  ...
}
```

XML serialization:

```
<Event xmlns="http://schemas.dmtf.org/cimi/1">
  ...
  <type> http://schemas.dmtf.org/cimi/1/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/1/event/access",
  "content": {
    "operation": string,
    "resource" : { "href" : string },
    "detail" : string, ?
    "initiator" : string ?
    }
  ...
}
```

XML serialization:

```
<Event xmlns="http://schemas.dmtf.org/cimi/1">
  ...
  <type> http://schemas.dmtf.org/cimi/1/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.

An implementation may set limits on the length of attribute values it accepts. An implementation may set limits on the size of arrays it accepts. An implementation may set limits on the size of the request body or the length of request URIs it accepts. These limits may not all be advertised in the ResourceMetadata, although this specification recommends Providers to do so. A Provider that receives a request that exceeds any of these limits, shall return a response with an appropriate standard HTTP status code.

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 5.13.4 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

6255 an OVF descriptor `VirtualSystemCollection`. Note that CIMI currently allows `Systems` of
6256 `Systems`, so for each `VirtualSystemCollection` encountered in a nested set of collections, a
6257 separate System is created within the parent `System` with `Machines` for each of the contained
6258 `VirtualSystems` in that `VirtualSystemCollection`.

6259 The values of the attributes for the `Machine` are taken from the `VirtualHardwareSection` of the
6260 `VirtualSystem` description (required in OVF). If more than one `VirtualHardwareSection` is
6261 used for a given `VirtualSystem` (allowed in OVF), the result is implementation dependent. Items in
6262 the `VirtualHardwareSection` are mapped to CIMI `MachineConfiguration` properties and
6263 the corresponding `MachineConfiguration` Resource is created and linked to from the created
6264 `Machine` for that VirtualSystem.

6265 The CIMI `Volumes` are created according to the `DiskSection` of an OVF descriptor and can be
6266 shared among more than one `VirtualSystem` (CIMI `Machines`) defined in an OVF package. In
6267 addition, a new CIMI `MachineImage` Resource may be created from the `DiskSection` if an
6268 `ovf:fileRef` attribute for the virtual disk content is specified.

6269 The CIMI `Networks` are created according to the `NetworkSection` of an OVF descriptor along with
6270 the `Connection` elements in the `VirtualHardwareSection` that refer to these named networks.

6271

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/1/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
1.0.0	2012-08-28	
1.0.1	2012-09-12	Errata
1.1.0	2013-10-22	DMTF Standard
2.0.0a	2014-09-22	Released as work in progress
		-

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