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Foreword

The *Open Virtualization Format Specification* (DSP0243) was prepared by the System Virtualization, Partitioning, and Clustering Working Group of the DMTF.

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Introduction

The *Open Virtualization Format (OVF) Specification* describes an open, secure, portable, efficient and extensible format for the packaging and distribution of software to be run in virtual machines. The key properties of the format are as follows:

- **Optimized for distribution**

  OVF supports content verification and integrity checking based on industry-standard public key infrastructure, and it provides a basic scheme for management of software licensing.

- **Optimized for a simple, automated user experience**

  OVF supports validation of the entire package and each virtual machine or metadata component of the OVF during the installation phases of the virtual machine (VM) lifecycle management process. It also packages with the package relevant user-readable descriptive information that a virtualization platform can use to streamline the installation experience.

- **Supports both single VM and multiple-VM configurations**

  OVF supports both standard single VM packages and packages containing complex, multi-tier services consisting of multiple interdependent VMs.

- **Portable VM packaging**

  OVF is virtualization platform neutral, while also enabling platform-specific enhancements to be captured. It supports the full range of virtual hard disk formats used for hypervisors today, and it is extensible, which allow it to accommodate formats that may arise in the future. Virtual machine properties are captured concisely and accurately.

- **Vendor and platform independent**

  OVF does not rely on the use of a specific host platform, virtualization platform, or guest operating system.

- **Extensible**

  OVF is immediately useful — and extensible. It is designed to be extended as the industry moves forward with virtual appliance technology. It also supports and permits the encoding of vendor-specific metadata to support specific vertical markets.

- **Localizable**

  OVF supports user-visible descriptions in multiple locales, and it supports localization of the interactive processes during installation of an appliance. This capability allows a single packaged appliance to serve multiple market opportunities.

- **Open standard**

  OVF has arisen from the collaboration of key vendors in the industry, and it is developed in an accepted industry forum as a future standard for portable virtual machines.

It is not an explicit goal for OVF to be an efficient execution format. A hypervisor is allowed but not required to run software in virtual machines directly out of the Open Virtualization Format.

Open Virtualization Format Specification

1 Scope

The *Open Virtualization Format (OVF) Specification* describes an open, secure, portable, efficient and extensible format for the packaging and distribution of software to be run in virtual machines.

This version of the specification (2.0) is intended to allow OVF 1.x tools to work with OVF 2.0 descriptors in the following sense:

- Existing OVF 1.x tools should be able to parse OVF 2.0 descriptors.
- Existing OVF 1.x tools should be able to give warnings/errors if dependencies to 2.0 features are required for correct operation.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC/IEEE 9945:2009: Information technology -- Portable Operating System Interface (POSIX®) Base Specifications, Issue 7
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=50516

DMTF DSP0004, *Common Information Model (CIM) Infrastructure Specification 2.7*,
http://www.dmtf.org/standards/published_documents/DSP0004_2.7.pdf

DMTF DSP0230, *WS-CIM Mapping Specification 1.1*,
http://www.dmtf.org/standards/published_documents/DSP0230_1.1.pdf

DMTF DSP1041, *Resource Allocation Profile (RAP) 1.1*,
http://www.dmtf.org/standards/published_documents/DSP1041_1.1.pdf

DMTF DSP1043, *Allocation Capabilities Profile (ACP) 1.0*,
http://www.dmtf.org/standards/published_documents/DSP1043_1.0.pdf

DMTF DSP1047, Storage Resource Virtualization Profile 1.0,
http://www.dmtf.org/standards/published_documents/DSP1047_1.0.pdf

DMTF DSP8023, *Open Virtualization Format (OVF) 2 XML Schema*,
http://schemas.dmtf.org/ovf/envelope/2/dsp8023.xsd

DMTF DSP8049, *Network Port Profile XML Schema,*
http://schemas.dmtf.org/ovf/networkportprofile/1/dsp8049.xsd

IETF RFC1738, T. Berners-Lee, *Uniform Resource Locators (URL)*, December 1994,
http://tools.ietf.org/html/rfc1738

IETF RFC1952, P. Deutsch, *GZIP file format specification version 4.3*, May 1996,
http://tools.ietf.org/html/rfc1952

IETF Standard 68, *Augmented BNF for Syntax Specifications: ABNF*,
http://tools.ietf.org/html/rfc5234

IETF RFC2616, R. Fielding et al, *Hypertext Transfer Protocol – HTTP/1.1*, June 1999, http://tools.ietf.org/html/rfc2616

IETF Standard 66, *Uniform Resource Identifiers (URI): Generic Syntax*, http://tools.ietf.org/html/rfc3986

ISO 9660, 1988 Information processing-Volume and file structure of CD-ROM for information interchange, http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=17505

ISO, ISO/IEC Directives, Part 2, *Rules for the structure and drafting of International Standards*, http://isotc.iso.org/livelink/livelink.exe?func=ll&objId=4230456&objAction=browse&sort=subtype

W3C, *XML Schema Part 1: Structures Second Edition.* 28 October 2004. W3C Recommendation. URL: http://www.w3.org/TR/2004/REC-xmlschema-1-20041028/

W3C, *XML Schema Part 2: Datatypes Second Edition.* 28 October 2004. W3C Recommendation. URL: http://www.w3.org/TR/2004/REC-xmlschema-2-20041028/

XML Encryption Syntax and Processing Version 1.1, 13 March 2012, W3C Candidate Recommendation http://www.w3.org/TR/2012/CR-xmlenc-core1-20120313/

FIPS 180-2: Secure Hash Standard (SHS) http://csrc.nist.gov/publications/fips/fips180-2/fips180-2withchangenotice.pdf

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1
can

used for statements of possibility and capability, whether material, physical, or causal

3.2
cannot

used for statements of possibility and capability, whether material, physical, or causal

3.3
conditional

indicates requirements to be followed strictly to conform to the document when the specified conditions are met

3.4
mandatory

indicates requirements to be followed strictly to conform to the document and from which no deviation is permitted

3.5
may

indicates a course of action permissible within the limits of the document

3.6
need not

indicates a course of action permissible within the limits of the document

3.7

optional

indicates a course of action permissible within the limits of the document

3.8

shall

indicates requirements to be followed strictly to conform to the document and from which no deviation is permitted

3.9

shall not

indicates requirements to be followed strictly to conform to the document and from which no deviation is permitted

3.10

should

indicates that among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required

3.11

should not

indicates that a certain possibility or course of action is deprecated but not prohibited

3.12

appliance

see *virtual appliance*

3.13

deployment platform

the product that installs an OVF package

3.14

guest software

the software that runs inside a virtual machine
The guest is typically an operating system and some user-level applications and services.

3.15

OVF package

OVF XML descriptor file accompanied by zero or more files

3.16

OVF descriptor

OVF XML descriptor file

3.17

platform

see *deployment platform*

3.18

virtual appliance

a service delivered as a complete software stack installed on one or more virtual machines
A virtual appliance is typically expected to be delivered in an OVF package.

3.19
virtual hardware
the processor, memory and I/O resources of a virtual computer system

3.20
virtual machine
as defined in System Virtualization Profile

3.21
virtual machine collection
a collection comprised of a set of virtual machines. This service component can be a:

- simple set of one or more virtual machines, or
- a complex service component built out of a combination of virtual machines and other virtual machine collections that enables nested complex service components.

4 Symbols and Abbreviated Terms

The following symbols and abbreviations are used in this document.

4.1.1
CIM
Common Information Model

4.1.2
IP
Internet Protocol

4.1.3
OVF
Open Virtualization Format

4.1.4
VM
Virtual Machine

5 OVF Packages

5.1 OVF Package Structure

An OVF package shall consist of the following files:

- one OVF descriptor with extension `.ovf`
- zero or one OVF manifest with extension `.mf`
- zero or one OVF certificate with extension `.cert`
- zero or more disk image files
- zero or more additional resource files, such as ISO images

The file extensions `.ovf`, `.mf` and `.cert` shall be used.

EXAMPLE 1: The following list of files is an example of an OVF package:

```
  package.ovf
  package.mf
  de-DE-resources.xml
  vmdisk1.vmdk
  vmdisk2.vhd
  resource.iso
```

An OVF package can be stored as either a single unit or a set of files, as described in 5.3 and 5.4. Both modes shall be supported.

An OVF package may have a manifest file containing the SHA digests of individual files in the package. OVF packages authored according to this version of the specification shall use SHA256 digests; older OVF packages are allowed to use SHA1. The manifest file shall have an extension `.mf` and the same base name as the `.ovf` file and be a sibling of the `.ovf` file. If the manifest file is present, a consumer of the OVF package shall verify the digests by computing the actual SHA digests and comparing them with the digests listed in the manifest file. The manifest file shall contain SHA digests for all distinct files referenced in the `References` element of the OVF descriptor, see clause 7.1, and for no other files.

The syntax definitions below use ABNF with the exceptions listed in ANNEX A.

The format of the manifest file is as follows:

```
  manifest_file = *( file_digest )
  file_digest   = algorithm "(" file_name ")" "=" sp digest nl
  algorithm     = "SHA1" | "SHA256"
  digest        = *( hex-digit )
  hex-digit     = "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9" | "a" |
"b" | "c" | "d" | "e" | "f"
  sp            = %x20
  nl            = %x0A
```

EXAMPLE 2: The following example show the partial contents of a manifest file:

```
 SHA256(package.ovf)= 9902cc5ec4f4a00cabbff7b60d039263587ab430d5fbdbc5cd5e8707391c90a4
 SHA256(vmdisk.vmdk)= aab66c4d70e17cec2236a651a3fc618cafc5ec6424122904dc0b9c286fce40c2
```

An OVF package may be signed by signing the manifest file. The digest of the manifest file is stored in a certificate file with extension `.cert` file along with the base64-encoded X.509 certificate. The `.cert` file shall have the same base name as the `.ovf` file and be a sibling of the `.ovf` file. A consumer of the OVF package shall verify the signature and should validate the certificate. The format of the certificate file shall be as follows:

```
  certificate_file   = manifest_digest certificate_part
  manifest_digest    = algorithm "(" file_name ")" "=" sp signed_digest nl
  algorithm          = "SHA1" | "SHA256"
  signed_digest      = *( hex-digit)
  certificate_part   = certificate_header certificate_body certificate_footer
  certificate_header = "-----BEGIN CERTIFICATE-----" nl
  certificate_footer = "-----END CERTIFICATE-----" nl
  certificate_body   = base64-encoded-certificate nl
                       ; base64-encoded-certificate is a base64-encoded X.509
                       ; certificate, which may be split across multiple lines
  hex-digit          = "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9" | "a"
| "b" | "c" | "d" | "e" | "f"
  sp                 = %x20
  nl                 = %x0A
```

EXAMPLE 3: The following list of files is an example of a signed OVF package:

```
  package.ovf
  package.mf
  package.cert
  de-DE-resources.xml
  vmdisk1.vmdk
  vmdisk2.vmdk
  resource.iso
```

EXAMPLE 4: The following example shows the contents of a sample OVF certification file, where the SHA1 digest of the manifest file has been signed with a 512 bit key:

```
SHA1(package.mf)= 7f4b8efb8fe20c06df1db68281a63f1b088e19dbf00e5af9db5e8e3e319de
7019db88a3bc699bab6ccd9e09171e21e88ee20b5255cec3fc28350613b2c529089
-----BEGIN CERTIFICATE-----
MIIBgjCCASwCAQQwDQYJKoZIhvcNAQEEBQAwODELMAkGA1UEBhMCQVUxDDAKBgNV
BAgTA1FMRDEbMBkGA1UEAxMSU1NMZWF5L3JzYSB0ZXN0IENBMB4XDTk1MTAwOTIz
MzIwNVoXDTk4MDcwNTIzMzIwNVowYDELMAkGA1UEBhMCQVUxDDAKBgNVBAgTA1FM
RDEZMBcGA1UEChMQTWluY29tIFB0eS4gTHRkLjELMAkGA1UECxMCQ1MxGzAZBgNV
BAMTElNTTGVheSBkZW1vIHNlcnZlcjBcMA0GCSqGSIb3DQEBAQUAA0sAMEgCQQC3
LCXcScWua0PFLkHBLm2VejqpA1F4RQ8q0VjRiPafjx/Z/aWH3ipdMVvuJGa/wFXb
/nDFLDlfWp+oCPwhBtVPAgMBAAEwDQYJKoZIhvcNAQEEBQADQQArNFsihWIjBzb0
DcsU0BvL2bvSwJrPEqFlkDq3F4M6EgutL9axEcANWgbbEdAvNJD1dmEmoWny27Pn
Ims6ZOZB
-----END CERTIFICATE-----
```

The manifest and certificate files, when present, shall not be included in the `References` section of the OVF descriptor (see 7.1). This ensures that the OVF descriptor content does not depend on whether the OVF package has a manifest or is signed, and the decision to add a manifest or certificate to a package can be deferred to a later stage.

The file extensions `.mf` and `.cert` may be used for other files in an OVF package, as long as they do not occupy the sibling URLs or path names where they would be interpreted as the package manifest or certificate.

5.2 Virtual Disk Formats

OVF does not require any specific disk format to be used, but to comply with this specification the disk format shall be given by a URI which identifies an unencumbered specification on how to interpret the disk format. The specification need not be machine readable, but it shall be static and unique so that the URI may be used as a key by software reading an OVF package to uniquely determine the format of the disk. The specification shall provide sufficient information so that a skilled person can properly interpret the disk format for both reading and writing of disk data. The URI should be resolvable.

5.3 Distribution as a Single File

An OVF package may be stored as a single file using the TAR format. The extension of that file shall be `.ova` (open virtual appliance or application).

EXAMPLE: The following example shows a sample filename for an OVF package of this type:

```
    D:\virtualappliances\myapp.ova
```

For OVF packages stored as single file, all file references in the OVF descriptor shall be relative-path references and shall point to files included in the TAR archive. Relative directories inside the archive are allowed, but relative-path references shall not contain ".." dot-segments.

Ordinarily, a TAR extraction tool would have to scan the whole archive, even if the file requested is found at the beginning, because replacement files can be appended without modifying the rest of the archive. Entries in an OVF TAR file shall exist only once.

In addition, the entries shall be in one of the following orders inside the archive:

1) OVF descriptor
2) The remaining files shall be in the same order as listed in the References section (see 7.1). Note that any external string resource bundle files for internationalization shall be first in the References section (see clause 10).

1) OVF descriptor
2) OVF manifest
3) OVF certificate
4) The remaining files shall be in the same order as listed in the `References` section (see 7.1). Note that any external string resource bundle files for internationalization shall be first in the `References` section (see clause 10).

1) OVF descriptor
2) The remaining files shall be in the same order as listed in the `References` section (see 7.1). Note that any external string resource bundle files for internationalization shall be first in the `References` section (see clause 10).
3) OVF manifest
4) OVF certificate

For deployment, the ordering restriction ensures that it is possible to extract the OVF descriptor from an OVF TAR file without scanning the entire archive. For generation, the ordering restriction ensures that an OVF TAR file can easily be generated on-the-fly. The restrictions do not prevent OVF TAR files from being created using standard TAR packaging tools.

The TAR format used shall comply with the USTAR (Uniform Standard Tape Archive) format as defined by the ISO/IEC/IEEE 9945:2009.

5.4 Distribution as a Set of Files

An OVF package can be made available as a set of files, for example on a standard Web server.

EXAMPLE: An example of an OVF package as a set of files on Web server follows:

```
    http://mywebsite/virtualappliances/package.ovf
    http://mywebsite/virtualappliances/vmdisk1.vmdk
    http://mywebsite/virtualappliances/vmdisk2.vmdk
    http://mywebsite/virtualappliances/resource.iso
    http://mywebsite/virtualappliances/de-DE-resources.xml
```

6 OVF Descriptor

The OVF descriptor contains the metadata about the package and its contents. This is an extensible XML document for encoding information, such as product details, virtual hardware requirements, and licensing.

The `DMTF DSP8023` schema definition file for the OVF descriptor contains the elements and attributes. The OVF descriptor shall validate with the DMTF DSP8023.

Clauses 7, 8, and 9, describe the semantics, structure, and extensibility framework of the OVF descriptor. These clauses are not a replacement for reading the schema definitions, but they complement the schema definitions.

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

Table 1 – XML Namespace Prefixes

Prefix	XML Namespace
ovf	http://schemas.dmtf.org/ovf/envelope/2
ovfenv	http://schemas.dmtf.org/ovf/environment/1
rasd	http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_ResourceAllocationSettingData.xsd
vssd	http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_VirtualSystemSettingData.xsd
epasd	http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_EthernetPortAllocationSettingData.xsd
sasd	http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_StorageAllocationSettingData.xsd
cim	http://schemas.dmtf.org/wbem/wscim/1/common.xsd

7 Envelope Element

The `Envelope` element describes all metadata for the virtual machines (including virtual hardware), as well as the structure of the OVF package itself.

The outermost level of the envelope consists of the following parts:

- A version indication, defined by the XML namespace URIs.
- A list of file references to all external files that are part of the OVF package, defined by the `References` element and its `File` child elements. These are typically virtual disk files, ISO images, and internationalization resources.
- A metadata part, defined by section elements, as defined in clause 9.
- A description of the content, either a single virtual machine (`VirtualSystem` element) or a collection of multiple virtual machines (`VirtualSystemCollection` element).
- A specification of message resource bundles for zero or more locales, defined by a `Strings` element for each locale.

EXAMPLE: An example of the structure of an OVF descriptor with the top-level `Envelope` element follows:

```
<?xml version="1.0" encoding="UTF-8"?>
<Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:vssd="http://schemas.dmtf.org/wbem/wscim/1/cim-
schema/2/CIM_VirtualSystemSettingData"
    xmlns:rasd="http://schemas.dmtf.org/wbem/wscim/1/cim-
schema/2/CIM_ResourceAllocationSettingData"
    xmlns:ovf="http://schemas.dmtf.org/ovf/envelope/2"
    xmlns="http://schemas.dmtf.org/ovf/envelope/2"
    xml:lang="en-US">
    <References>
      <File ovf:id="de-DE-resources.xml" ovf:size="15240"
            ovf:href="http://mywebsite/virtualappliances/de-DE-resources.xml"/>
      <File ovf:id="file1" ovf:href="vmdisk1.vmdk" ovf:size="180114671"/>
      <File ovf:id="file2" ovf:href="vmdisk2.vmdk" ovf:size="4882023564"
ovf:chunkSize="2147483648"/>
      <File ovf:id="file3" ovf:href="resource.iso" ovf:size="212148764"
ovf:compression="gzip"/>
      <File ovf:id="icon" ovf:href="icon.png" ovf:size="1360"/>
    </References>
    <!-- Describes meta-information about all virtual disks in the package -->
    <DiskSection>
        <Info>Describes the set of virtual disks</Info>
        <!-- Additional section content -->
    </DiskSection>
    <!-- Describes all networks used in the package -->
    <NetworkSection>
         <Info>List of logical networks used in the package</Info>
        <!-- Additional section content -->
    </NetworkSection>
    <SomeSection ovf:required="false">
        <Info>A plain-text description of the content</Info>
        <!-- Additional section content -->
    </SomeSection>
    <!-- Additional sections can follow -->
    <VirtualSystemCollection ovf:id="Some Product">
        <!-- Additional sections including VirtualSystem or VirtualSystemCollection-->
    </VirtualSystemCollection >
    <Strings xml:lang="de-DE">
      <!-- Specification of message resource bundles for de-DE locale -->
    </Strings>
</Envelope>
```

The optional `xml:lang` attribute on the `Envelope` element shall specify the default locale for messages in the descriptor. The optional `Strings` elements shall contain string resource bundles for different locales. See clause 10 for more details on internationalization support.

7.1 File References

The file reference part defined by the `References` element allows a tool to easily determine the integrity of an OVF package without having to parse or interpret the entire structure of the descriptor. Tools can safely manipulate (for example, copy or archive) OVF packages with no risk of losing files.

External string resource bundle files for internationalization shall be placed first in the `References` element, see clause 10 for details.

Each `File` element in the reference part shall be given an identifier using the `ovf:id` attribute. The identifier shall be unique inside an OVF package. Each `File` element shall be specified using the `ovf:href` attribute, which shall contain a URL. Relative-path references and the URL schemes `"file"`, `"http"`, and `"https"` shall be supported, see RFC1738 and RFC3986. Other URL schemes should not be used. If no URL scheme is specified, the value of the `ovf:href` attribute shall be interpreted as a path name of the referenced file relative to the location of the OVF descriptor itself. The relative path name shall use the syntax of relative-path references in RFC3986. The referenced file shall exist. Two different `File` elements shall not reference the same file with their `ovf:href` attributes.

The size of the referenced file may be specified using the `ovf:size` attribute. The unit of this attribute shall be bytes. If present, the value of the `ovf:size` attribute should match the actual size of the referenced file.

Each file referenced by a `File` element may be compressed using gzip (see RFC1952). When a `File` element is compressed using gzip, the `ovf:compression` attribute shall be set to “`gzip`”. Otherwise, the `ovf:compression` attribute shall be set to “`identity`” or the entire attribute omitted. Alternatively, if the href is an HTTP or HTTPS URL, then the compression may be specified by the HTTP server by using the HTTP header `Content-Encoding: gzip` (see RFC2616). Using HTTP content encoding in combination with the `ovf:compression` attribute is allowed, but in general does not improve the compression ratio. When compression is used, the `ovf:size` attribute shall specify the size of the actual compressed file.

Files referenced from the reference part may be split into chunks to accommodate file size restrictions on certain file systems. Chunking shall be indicated by the presence of the `ovf:chunkSize` attribute; the value of ovf:`chunkSize` shall be the size of each chunk, except the last chunk, which may be smaller.

When `ovf:chunkSize` is specified, the `File` element shall reference a chunk file representing a chunk of the entire file. In this case, the value of the `ovf:href` attribute specifies only a part of the URL, and the syntax for the URL resolving to the chunk file shall be as follows.

```
  chunk-url     = href-value "." chunk-number
  chunk-number  = 9(decimal-digit)
  decimal-digit = "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9"
```

The syntax is defined in ABNF notation with the exceptions listed in ANNEX A. The href-value shall be the value of the `ovf:href` attribute. The chunk-number shall be the 0-based position of the chunk starting with the value 0 and increasing with increments of 1 for each chunk.

If chunking is combined with compression, the entire file shall be compressed before chunking and each chunk shall be an equal slice of the compressed file, except for the last chunk which may be smaller.

If the OVF package has a manifest file, the file name in the manifest entries shall match the value of the `ovf:href` attribute for the file, except if the file is split into multiple chunks, in which case the `chunk-url` shall be used, and the manifest file shall contain an entry for each individual chunk. If chunked files are used, the manifest file may contain an entry for the entire file; and if present this digest shall also be verified.

EXAMPLE 1: The following example shows different types of file references:

```
  <File ovf:id="disk1" ovf:href="disk1.vmdk"/>
  <File ovf:id="disk2" ovf:href="disk2.vmdk" ovf:size="5368709120"
                                             ovf:chunkSize="2147483648"/>
  <File ovf:id="iso1" ovf:href="resources/image1.iso"/>
  <File ovf:id="iso2" ovf:href="http://mywebsite/resources/image2.iso"/>
```

EXAMPLE 2: The following example shows manifest entries corresponding to the file references above:

```
  SHA1(disk1.vmdk)= 3e19644ec2e806f38951789c76f43e4a0ec7e233
  SHA1(disk2.vmdk.000000000)= 4f7158731ff434380bf217da248d47a2478e79d8
  SHA1(disk2.vmdk.000000001)= 12849daeeaf43e7a89550384d26bd437bb8defaf
  SHA1(disk2.vmdk.000000002)= 4cdd21424bd9eeafa4c42112876217de2ee5556d
  SHA1(resources/image1.iso)= 72b37ff3fdd09f2a93f1b8395654649b6d06b5b3
  SHA1(http://mywebsite/resources/image2.iso)=
d3c2d179011c970615c5cf10b30957d1c4c968ad
```

7.2 Content Element

Virtual machine configurations in an OVF package are represented by a `VirtualSystem` or `VirtualSystemCollection` element. These elements shall be given an identifier using the `ovf:id` attribute. Direct child elements of a `VirtualSystemCollection` shall have unique identifiers.

In the OVF schema, the `VirtualSystem` and `VirtualSystemCollection` elements are part of a substitution group with the `Content` element as head of the substitution group. The `Content` element is abstract and cannot be used directly. The OVF descriptor shall have one or more `Content` elements.

The `VirtualSystem` element describes a single virtual machine and is simply a container of section elements. These section elements describe virtual hardware, resources, and product information and are described in detail in clauses 8 and 9.

An example of a `VirtualSystem` element structure is as follows:

```
   <VirtualSystem ovf:id="simple-app">
       <Info>A virtual machine</Info>
       <Name>Simple Appliance</Name>
       <SomeSection>
           <!-- Additional section content -->
       </SomeSection>
       <!-- Additional sections can follow -->
```

```
    </VirtualSystem>
```

The `VirtualSystemCollection` element is a container of multiple `VirtualSystem` or `VirtualSystemCollection` elements. Thus, arbitrary complex configurations can be described. The section elements at the `VirtualSystemCollection` level describe appliance information, properties, resource requirements, and so on, and are described in detail in clause 9.

An example of a `VirtualSystemCollection` element structure is as follows:

```
   <VirtualSystemCollection ovf:id="multi-tier-app">
       <Info>A collection of virtual machines</Info>
       <Name>Multi-tiered Appliance</Name>
       <SomeSection>
           <!-- Additional section content -->
       </SomeSection>
       <!-- Additional sections can follow -->
       <VirtualSystem ovf:id="...">
           <!-- Additional sections -->
       </VirtualSystem>
       <!-- Additional VirtualSystem or VirtualSystemCollection elements can follow-->
   </VirtualSystemCollection>
```

All elements in the `Content` substitution group contain an `Info` element and may contain a `Name` element. The `Info` element contains a human readable description of the meaning of this entity. The `Name` element is an optional localizable display name of the content. See clause 10 for details on how to localize the `Info` and `Name` element.

7.3 Extensibility

This specification allows custom meta-data to be added to OVF descriptors in several ways:

- New section elements may be defined as part of the `Section` substitution group, and used where the OVF schemas allow sections to be present. All subtypes of `Section` contain an `Info` element that contains a human readable description of the meaning of this entity. The values of `Info` elements can be used, for example, to give meaningful warnings to users when a section is being skipped, even if the parser does not know anything about the section. See clause 10 for details on how to localize the `Info` element.

- The OVF schemas use an open content model, where all existing types may be extended at the end with additional elements. Extension points are declared in the OVF schemas with `xs:any` declarations with `namespace="##other"`.

- The OVF schemas allow additional attributes on existing types.

Custom extensions shall not use XML namespaces defined in this specification. This applies to both custom elements and custom attributes.

On custom elements, a Boolean `ovf:required` attribute specifies whether the information in the element is required for correct behavior or optional. If not specified, the `ovf:required` attribute defaults to TRUE. A consumer of an OVF package that detects an extension that is required and that it does not understand shall fail.

For known `Section` elements, if additional child elements that are not understood are found and the value of their `ovf:required` attribute is TRUE, the consumer of the OVF package shall interpret the entire section as one it does not understand. The check is not recursive; it applies only to the direct children of the `Section` element. This behavior ensures that older parsers reject newer OVF specifications, unless explicitly instructed not to do so.

On custom attributes, the information in the attribute shall not be required for correct behavior.

EXAMPLE 1:

```
    <!—- Optional custom section example -->
    <otherns:IncidentTrackingSection ovf:required="false">
        <Info>Specifies information useful for incident tracking purposes</Info>
        <BuildSystem>Acme Corporation Official Build System</BuildSystem>
        <BuildNumber>102876</BuildNumber>
        <BuildDate>10-10-2008</BuildDate>
    </otherns:IncidentTrackingSection>
```

EXAMPLE 2:

```
    <!—- Open content example (extension of existing type) -->
    <AnnotationSection>
        <Info>Specifies an annotation for this virtual machine</Info>
        <Annotation>This is an example of how a future element (Author) can still be
           parsed by older clients</Annotation>
        <!-- AnnotationSection extended with Author element -->
        <otherns:Author ovf:required="false">John Smith</otherns:Author>
    </AnnotationSection>
```

EXAMPLE 3:

```
    <!—- Optional custom attribute example -->
    <Network ovf:name="VM network" otherns:desiredCapacity="1 Gbit/s">
        <Description>The main network for VMs</Description>
    </Network>
```

7.4 Conformance

This specification defines three conformance levels for OVF descriptors, with 1 being the highest level of conformance:

- OVF descriptor uses only sections and elements and attributes that are defined in this specification.
  Conformance Level: 1.
- OVF descriptor uses custom sections or elements or attributes that are not defined in this specification, and all such extensions are optional as defined in 7.3.
  Conformance Level: 2.
- OVF descriptor uses custom sections or elements that are not defined in this specification and at least one such extension is required as defined in 7.3. The definition of all required extensions shall be publicly available in an open and unencumbered XML Schema. The complete specification may be inclusive in the XML schema or available as a separate document.
  Conformance Level: 3.

The use of conformance level 3 limits portability and should be avoided if at all possible.

The conformance level is not specified directly in the OVF descriptor but shall be determined by the above rules.

8 Virtual Hardware Description

8.1 VirtualHardwareSection

Each VirtualSystem element may contain one or more VirtualHardwareSection elements, each of which describes the virtual hardware required by the virtual system. The virtual hardware required by a virtual machine is specified in `VirtualHardwareSection` elements. This specification supports abstract or incomplete hardware descriptions in which only the major devices are described. The virtualization platform may create additional virtual hardware controllers and devices, as long as the required devices listed in the descriptor are realized.

This virtual hardware description is based on the CIM classes `CIM_VirtualSystemSettingData`, `CIM_ResourceAllocationSettingData`, `CIM_EthernetPortAllocationSettingData`, and `CIM_StorageAllocationSettingData`. The XML representation of the CIM model is based on the WS-CIM mapping (DSP0230). Note: This means that the XML elements that belong to the class complex type should be ordered by Unicode code point (binary) order of their CIM property name identifiers.

EXAMPLE: Example of `VirtualHardwareSection`:

```
       <VirtualHardwareSection>
          <Info>Memory = 4 GB, CPU = 1 GHz, Disk = 100 GB, 1 Ethernet nic</Info>
          <Item>
             <rasd:AllocationUnits>Hertz*10^9</rasd:AllocationUnits>
             <rasd:Description>Virtual CPU</rasd:Description>
             <rasd:ElementName>1 GHz virtual CPU</rasd:ElementName>
             <rasd:InstanceID>1</rasd:InstanceID>
             <rasd:Reservation>1</rasd:Reservation>
             <rasd:ResourceType>3</rasd:ResourceType>
             <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
             <rasd:VirtualQuantityUnit>Count</ rasd:VirtualQuantityUnit>
          </Item>
          <Item>
             <rasd:AllocationUnits>byte*2^30</rasd:AllocationUnits>
             <rasd:Description>Memory</rasd:Description>
             <rasd:ElementName>1 GByte of memory</rasd:ElementName>
             <rasd:InstanceID>2</rasd:InstanceID>
             <rasd:Limit>4</rasd:Limit>
             <rasd:Reservation>4</rasd:Reservation>
             <rasd:ResourceType>4</rasd:ResourceType>
          </Item>
          <EthernetPortItem>
             <epasd:Address>00-16-8B-DB-00-5E</epasd:Address>
             <rasd:AllocationUnits>bit / second *2^30 </rasd:AllocationUnits>  VERIFY
the PUnit for Gbits per second
             <epasd:Connection>VM Network</epasd:Connection>
             <epasd:Description>Virtual NIC</epasd:Description>

             <epasd:ElementName>Ethernet Port</epasd:ElementName>
             <epasd:InstanceID>3</epasd:InstanceID>
             <epasd:NetworkPortProfileID>1</epasd:NetworkPortProfileID>
             <epasd:NetworkPortProfileIDType>4</epasd:NetworkPortProfileIDType>
             <epasd:ResourceType>10</epasd:ResourceType>
             <epasd:VirtualQuantity>1</epasd:VirtualQuantity>
             <epasd:VirtualQuantityUnits>Count</epasd:VirtualQuantityUnits>
          </EthernetPortItem>
          <StorageItem>
             <sasd:AllocationUnits>byte*2^30</sasd:AllocationUnits>
             <sasd:Description>Virtual Disk</sasd:Description>
             <sasd:ElementName>100 GByte Virtual Disk</sasd:ElementName>
             <sasd:InstanceID>4</sasd:InstanceID>
             <sasd:Reservation>100</sasd:Reservation>
             <sasd:ResourceType>31</sasd:ResourceType>
             <sasd:VirtualQuantity>1</sasd:VirtualQuantity>
             <sasd:VirtualQuantityUnit>Count</sasd:VirtualQuantityUnit>
          </StorageItem>
       </VirtualHardwareSection>
```

A `VirtualSystem` element shall have a `VirtualHardwareSection` direct child element. `VirtualHardwareSection` shall not be a direct child element of a `VirtualSystemCollection` element and of an `Envelope` element.

Multiple `VirtualHardwareSection` element occurrences are allowed within a single `VirtualSystem` element. The consumer of the OVF package should select the most appropriate virtual hardware description for the particular virtualization platform. A `VirtualHardwareSection` element may contain an `ovf:id` attribute which can be used to identify the element. If present the attribute value must be unique within the `VirtualSystem`.

The `ovf:transport` attribute specifies the types of transport mechanisms by which properties are passed to the virtual machine in an OVF environment document. This attribute supports a pluggable and extensible architecture for providing guest/platform communication mechanisms. Several transport types may be specified separated by single space character. See 9.5 for a description of properties and clause 11 for a description of transport types and OVF environments.

A `VirtualHardwareSection` element contains sub elements that describe virtual system and virtual hardware resources (CPU, memory, network, and storage).

A `VirtualHardwareSection` element shall have zero or one `System` direct child element, followed by zero or more `Item` direct child elements, zero or more `EthernetPortItem` direct child elements, and zero or more `StorageItem` direct child elements.

The `System` element is an XML representation of the values of one or more properties of the CIM class `CIM_VirtualSystemSettingData`. The `vssd:VirtualSystemType,` a direct child element of `System` element, specifies a virtual system type identifier, which is an implementation defined string that uniquely identifies the type of the virtual system. For example, a virtual system type identifier could be `vmx-4` for VMware's fourth-generation virtual hardware or `xen-3` for Xen's third-generation virtual hardware. Zero or more virtual system type identifiers may be specified separated by single space character. In order for the OVF virtual system to be deployable on a target platform, the virtual machine on the target platform should support at least one of the virtual system types identified in the `vssd:VirtualSystemType` elements. The virtual system type identifiers specified in `vssd:VirtualSystemType` elements are expected to be matched against the values of property VirtualSystemTypesSupported of CIM class CIM_VirtualSystemManagementCapabilities.

The virtual hardware characteristics are described as a sequence of `Item` elements. The `Item` element is an XML representation of an instance of the CIM class `CIM_ResourceAllocationSettingData`. The element can describe all memory and CPU requirements as well as virtual hardware devices.

Multiple device subtypes may be specified in an `Item` element, separated by a single space character.

EXAMPLE:

```
    <rasd:ResourceSubType>buslogic lsilogic</rasd:ResourceSubType>
```

The network hardware characteristics are described as a sequence of `EthernetPortItem` elements. The `EthernetPortItem` element is an XML representation of the values of one or more properties of the CIM class CIM_EthernetPortAllocationSettingData.

The storage hardware characteristics are described as a sequence of `StorageItem` elements. The `StorageItem` element is an XML representation of the values of one or more properties of the CIM class CIM_StorageAllocationSettingData.

8.2 Extensibility

The optional `ovf:required` attribute on the `Item, EthernetPortItem, or StorageItem` element specifies whether the realization of the element (for example, a CD-ROM or USB controller) is required for correct behavior of the guest software. If not specified, `ovf:required` defaults to TRUE.

On child elements of the `Item, EthernetPortItem, or StorageItem` element, the optional Boolean attribute `ovf:required` shall be interpreted, even though these elements are in a different RASD WS-CIM namespace. A tool parsing an `Item` element should act according to Table 2.

Table 2 – Actions for Child Elements with `ovf:required` Attribute

Child Element	`ovf:required` Attribute Value	Action
Known	TRUE or not specified	Shall interpret `Item, EthernetPortItem, or StorageItem`
Known	FALSE	Shall interpret `Item, EthernetPortItem, or StorageItem`
Unknown	TRUE or not specified	Shall fail `Item, EthernetPortItem, or StorageItem`
Unknown	FALSE	Shall ignore Child Element

8.3 Virtual Hardware Elements

The element type of the `Item` element in a `VirtualHardwareSection` element is CIM_ResourceAllocationSettingData_Type as defined in http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_ResourceAllocationSettingData.xsd.

The child elements of `Item` represent the values of one or more properties exposed by the `CIM_ResourceAllocationSettingData` class. They have the semantics of defined settings as defined in DSP1041, any profiles derived from DSP1041 for specific resource types, and this document.

EXAMPLE: The following example shows a description of memory size:

```
<Item>
    <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
    <rasd:Description>Memory Size</rasd:Description>
    <rasd:ElementName>256 MB of memory</rasd:ElementName>
    <rasd:InstanceID>2</rasd:InstanceID>
    <rasd:ResourceType>4</rasd:ResourceType>
    <rasd:VirtualQuantity>256</rasd:VirtualQuantity>
</Item>
```

The element type of the `EthernetPortItem` element in a `VirtualHardwareSection` element is CIM_EthernetPortAllocationSettingData_Type as defined in http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_EthernetPortAllocationSettingData.xsd.

The child elements represent the values of one or more properties exposed by the `CIM_EthernetPortAllocationSettingData` class. They have the semantics of defined settings as defined in DSP1050, any profiles derived from DSP1050 for specific Ethernet port resource types, and this document.

EXAMPLE: The following example shows a description of a virtual Ethernet adapter:

```
<EthernetPortItem>
    <epasd:Address>00-16-8B-DB-00-5E</epasd:Address>
    <epasd:Connection>VM Network</epasd:Connection>
    <epasd:Description>Virtual NIC</epasd:Description>
```

```
        <epasd:ElementName>Ethernet Port 1</epasd:ElementName>
        <epasd:InstanceID>3</epasd:InstanceID>
        <epasd:NetworkPortProfileID>1</epasd:NetworkPortProfileID>
        <epasd:NetworkPortProfileIDType>4</epasd:NetworkPortProfileIDType>
        <epasd:VirtualQuantityUnits>1</epasd:VirtualQuantityUnits>
    </EthernetPortItem>
```

The element type of the `StorageItem` element in a `VirtualHardwareSection` element is CIM_StorageAllocationSettingData_Type as defined in http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_StorageAllocationSettingData.xsd.

The child elements represent the values of one or more properties exposed by the `CIM_StorageAllocationSettingData` class. They have the semantics of defined settings as defined in DSP1047, any profiles derived from DSP1047 for specific storage resource types, and this document.

EXAMPLE: The following example shows a description of a virtual storage:

```
    <StorageItem>
        <sasd:AllocationUnits>byte*2^30</sasd:AllocationUnits>
        <sasd:Description>Virtual Disk</sasd:Description>
        <sasd:ElementName>100 GByte Virtual Disk</sasd:ElementName>
        <sasd:InstanceID>4</sasd:InstanceID>
        <sasd:Reservation>100</sasd:Reservation>
        <sasd:ResourceType>31</sasd:ResourceType>
        <sasd:VirtualQuantity>1</sasd:VirtualQuantity>
    </StorageItem>
```

The `Description` element is used to provide additional metadata about the Item, EthernetPortItem, or StorageItem element itself. This element enables a consumer of the OVF package to provide descriptive information about all items, including items that were unknown at the time the application was written.

The `Caption`, `Description` and `ElementName` elements are localizable using the `ovf:msgid` attribute from the OVF envelope namespace. See clause 10 for more details on internationalization support.

The optional `ovf:configuration` attribute contains a list of configuration names. See 9.8 on deployment options for semantics of this attribute. The optional `ovf:bound` attribute is used to specify ranges; see 8.4.

Devices such as disks, CD-ROMs, and networks need a backing from the deployment platform. The requirements on a backing are either specified using the `HostResource` or the `Connection` element.

For an Ethernet adapter, a logical network name is specified in the `Connection` element. Ethernet adapters that refer to the same logical network name within an OVF package shall be deployed on the same network.

The `HostResource` element is used to refer to resources included in the OVF descriptor as well as logical devices on the deployment platform. Values for `HostResource` elements referring to resources included in the OVF descriptor are formatted as URIs as specified in Table 3.

Table 3 – HostResource Element

Content	Description
`ovf:/file/<id>`	A reference to a file in the OVF, as specified in the References section. <id> shall be the value of the `ovf:id` attribute of the `File` element being referenced.
`ovf:/disk/<id>`	A reference to a virtual disk, as specified in the DiskSection or SharedDiskSection. <id> shall be the value of the `ovf:diskId` attribute of the `Disk` element being referenced.

If no backing is specified for a device that requires a backing, the deployment platform shall make an appropriate choice, for example, by prompting the user. More than one backing for a device shall not be specified.

Table 4 gives a brief overview on how elements from rasd, epasd, and sasd namespaces are used to describe virtual devices and controllers.

Table 4 – Elements for Virtual Devices and Controllers

Element	Usage
`Description`	A human-readable description of the meaning of the information. For example, “Specifies the memory size of the virtual machine”.
`ElementName`	A human-readable description of the content. For example, “256MB memory”.
`InstanceID`	A unique instance ID of the element within the section.
`HostResource`	Abstractly specifies how a device shall connect to a resource on the deployment platform. Not all devices need a backing. See Table 3.

`ResourceType`
`OtherResourceType`
`ResourceSubtype`
	Specifies the kind of device that is being described.

`AutomaticAllocation`	For devices that are connectable, such as floppies, CD-ROMs, and Ethernet adaptors, this element specifies whether the device should be connected at power on.
`Parent`	The InstanceID of the parent controller (if any).
`Connection`	For an Ethernet adapter, this specifies the abstract network connection name for the virtual machine. All Ethernet adapters that specify the same abstract network connection name within an OVF package shall be deployed on the same network. The abstract network connection name shall be listed in the NetworkSection at the outermost envelope level.
`Address`	Device specific. For an Ethernet adapter, this specifies the MAC address.
`AddressOnParent`	For a device, this specifies its location on the controller.
`AllocationUnits`	Specifies the unit of allocation used. For example, “byte * 2^20”.
`VirtualQuantity`	Specifies the quantity of resources presented. For example, “256”.
`Reservation`	Specifies the minimum quantity of resources guaranteed to be available.
`Limit`	Specifies the maximum quantity of resources that are granted.
`Weight`	Specifies a relative priority for this allocation in relation to other allocations.

Only fields directly related to describing devices are mentioned. Refer to the CIM MOF for a complete description of all fields, each field corresponds to the identically named property in the `CIM_ResourceAllocationSettingData` class or a class derived from it.

8.4 Ranges on Elements

The optional `ovf:bound` attribute may be used to specify ranges for the `Item` elements. A range has a minimum, normal, and maximum value, denoted by `min`, `normal`, and `max`, where `min <= normal <= max`. The default values for `min` and `max` are those specified for `normal`.

A platform deploying an OVF package should start with the normal value and adjust the value within the range for ongoing performance tuning and validation.

For the `Item, EthernetPortItem, and StorageItem` elements in `VirtualHardwareSection` and `ResourceAllocationSection` elements, the following additional semantics are defined:

- Each `Item, EthernetPortItem, or StorageItem` element has an optional `ovf:bound` attribute. This value may be specified as `min`, `max`, or `normal`. The value defaults to `normal`. If the attribute is not specified or is specified as `normal`, then the item shall be interpreted as being part of the regular virtual hardware or resource allocation description.

- If the `ovf:bound` value is specified as either `min` or `max`, the item is used to specify the upper or lower bound for one or more values for a given InstanceID. Such an item is called a range marker.

The semantics of range markers are as follows:

- `InstanceID` and `ResourceType` shall be specified, and the `ResourceType` shall match other `Item` elements with the same `InstanceID`.
- More than one `min` range marker nor more than one `max` range marker for a given RASD, EPASD, or SASD (identified with `InstanceID`) shall not be specified..
- An `Item, EthernetPortItem, or StorageItem` element with a range marker shall have a corresponding `Item, EthernetPortItem, or StorageItem` element without a range marker, that is, an `Item, EthernetPortItem, and StorageItem` element with no `ovf:bound` attribute or `ovf:bound` attribute with value normal. This corresponding item specifies the default value.
- For an `Item, EthernetPortItem, and StorageItem` element where only a `min` range marker is specified, the `max` value is unbounded upwards within the set of valid values for the property.
- For an `Item, EthernetPortItem, and StorageItem` where only a `max` range marker is specified, the `min` value is unbounded downwards within the set of valid values for the property.
- The default value shall be inside the range.
- Non-integer elements shall not be used in the range markers for RASD, EPASD, or SASD.

EXAMPLE: The following example shows the use of range markers:

```
      <VirtualHardwareSection>
          <Info>...</Info>
          <Item>
              <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
              <rasd:ElementName>512 MB memory size</rasd:ElementName>
              <rasd:InstanceID>0</rasd:InstanceID>
              <rasd:ResourceType>4</rasd:ResourceType>
              <rasd:VirtualQuantity>512</rasd:VirtualQuantity>
           </Item>
           <Item ovf:bound="min">
              <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
              <rasd:ElementName>384 MB minimum memory size</rasd:ElementName>
              <rasd:InstanceID>0</rasd:InstanceID>
              <rasd:Reservation>384</rasd:Reservation>
              <rasd:ResourceType>4</rasd:ResourceType>
           </Item>
           <Item ovf:bound="max">
              <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
              <rasd:ElementName>1024 MB maximum memory size</rasd:ElementName>
              <rasd:InstanceID>0</rasd:InstanceID>
              <rasd:Reservation>1024</rasd:Reservation>
              <rasd:ResourceType>4</rasd:ResourceType>
           </Item>
    </VirtualHardwareSection>
```

9 Core Metadata Sections in version 2

Table 5 shows the core metadata sections that are defined in the `ovf` namespace.

Table 5 – Core Metadata Sections in version 2

Section	Locations	Multiplicity
`DiskSection` Describes meta-information about all virtual disks in the package	Envelope	Zero or one
`NetworkSection` Describes logical networks used in the package	Envelope	Zero or one
`ResourceAllocationSection` Specifies reservations, limits, and shares on a given resource, such as memory or CPU for a virtual machine collection	VirtualSystemCollection	Zero or one
`AnnotationSection` Specifies a free-form annotation on an entity	VirtualSystem VirtualSystemCollection	Zero or one
`ProductSection` Specifies product-information for a package, such as product name and version, along with a set of properties that can be configured	VirtualSystem VirtualSystemCollection	Zero or more
`EulaSection` Specifies a license agreement for the software in the package	VirtualSystem VirtualSystemCollection	Zero or more
`StartupSection` Specifies how a virtual machine collection is powered on	VirtualSystemCollection	Zero or one
`DeploymentOptionSection` Specifies a discrete set of intended resource requirements	Envelope	Zero or one
`OperatingSystemSection` Specifies the installed guest operating system of a virtual machine	VirtualSystem	Zero or one
`InstallSection` Specifies that the virtual machine needs to be initially booted to install and configure the software	VirtualSystem	Zero or one
`EnvironmentFilesSection` Specifies additional files from an OVF package to be included in the OVF environment	VirtualSystem	Zero or one
`BootDeviceSection` Specifies boot device order to be used by a virtual machine	VirtualSystem	Zero or more
`SharedDiskSection` Specifies virtual disks shared by more than one VirtualSystems at runtime	Envelope	Zero or one
`ScaleOutSection` Specifies that a VirtualSystemCollection contain a set of children that are homogeneous with respect to a prototype	VirtualSystemCollection	Zero or more
`PlacementGroupSection` Specifies a placement policy for a group of VirtualSystems or VirtualSystemCollections	Envelope	Zero or more
`PlacementSection` Specifies membership of a particular placement policy group	VirtualSystem VirtualSystemCollection	Zero or one
`EncryptionSection` Specifies encryption scheme for encrypting parts of an OVF descriptor or files that it refers to.	Envelope	Zero or one

The following subclauses describe the semantics of the core sections and provide some examples. The sections are used in several places of an OVF envelope; the description of each section defines where it may be used. See the OVF schema for a detailed specification of all attributes and elements.

In the OVF schema, all sections are part of a substitution group with the `Section` element as head of the substitution group. The `Section` element is abstract and cannot be used directly.

9.1 DiskSection

A `DiskSection` describes meta-information about virtual disks in the OVF package. Virtual disks and their metadata are described outside the virtual hardware to facilitate sharing between virtual machines within an OVF package. Virtual disks in `DiskSection` can be referenced by multiple virtual machines, but seen from the guest software each virtual machine get individual private disks. Any level of sharing done at runtime is deployment platform specific and not visible to the guest software. See clause 9.13 for details on how to configure sharing of virtual disk at runtime with concurrent access.

EXAMPLE: The following example shows a description of virtual disks:

```
<DiskSection>
    <Info>Describes the set of virtual disks</Info>
    <Disk ovf:diskId="vmdisk1" ovf:fileRef="file1" ovf:capacity="8589934592"
          ovf:populatedSize="3549324972"
          ovf:format=
              "http://www.vmware.com/interfaces/specifications/vmdk.html#sparse">
    </Disk>
    <Disk ovf:diskId="vmdisk2" ovf:capacity="536870912"
    </Disk>
    <Disk ovf:diskId="vmdisk3" ovf:capacity="${disk.size}"
          ovf:capacityAllocationUnits="byte * 2^30"
    </Disk>
</DiskSection>
```

`DiskSection` is a valid section at the outermost envelope level only.

Each virtual disk represented by a `Disk` element shall be given an identifier using the `ovf:diskId` attribute; the identifier shall be unique within the `DiskSection`.

The capacity of a virtual disk shall be specified by the `ovf:capacity` attribute with an `xs:long` integer value. The default unit of allocation shall be bytes. The optional string attribute `ovf:capacityAllocationUnits` may be used to specify a particular unit of allocation. Values for `ovf:capacityAllocationUnits` shall match the format for programmatic units defined in DSP0004 with the restriction that the base unit shall be `"byte"`.

The `ovf:fileRef` attribute denotes the virtual disk content by identifying an existing `File` element in the `References` element, the `File` element is identified by matching its `ovf:id` attribute value with the `ovf:fileRef` attribute value. Omitting the `ovf:fileRef` attribute shall indicate an empty disk. In this case, the disk shall be created and the entire disk content zeroed at installation time. The guest software will typically format empty disks in some file system format.

The format URI (see 5.2) of a non-empty virtual disk shall be specified by the `ovf:format` attribute.

Different `Disk` elements shall not contain `ovf:fileRef` attributes with identical values. `Disk` elements shall be ordered such that they identify any `File` elements in the same order as these are defined in the `References` element.

For empty disks, rather than specifying a fixed virtual disk capacity, the capacity for an empty disk may be given using an OVF property, for example `ovf:capacity="${disk.size}"`. The OVF property shall resolve to an `xs:long` integer value. See 9.5 for a description of OVF properties. The `ovf:capacityAllocationUnits` attribute is useful when using OVF properties because a user may be prompted and can then enter disk sizing information in ,for example, gigabytes.

For non-empty disks, the actual used size of the disk may optionally be specified using the `ovf:populatedSize` attribute. The unit of this attribute shall be bytes. The `ovf:populatedSize` attribute may be an estimate of used disk size but shall not be larger than `ovf:capacity`.

In `VirtualHardwareSection`, virtual disk devices may have a `rasd:HostResource` element referring to a `Disk` element in `DiskSection`; see 8.3. The virtual disk capacity shall be defined by the `ovf:capacity` attribute on the `Disk` element. If a `rasd:VirtualQuantity` element is specified along with the `rasd:HostResource` element, the virtual quantity value shall not be considered and may have any value.

OVF allows a disk image to be represented as a set of modified blocks in comparison to a parent image. The use of parent disks can often significantly reduce the size of an OVF package if it contains multiple disks with similar content, such as a common base operating system. Actual sharing of disk blocks at runtime is optional and deployment platform specific and shall not be visible to the guest software.

For the `Disk` element, a parent disk may optionally be specified using the `ovf:parentRef` attribute, which shall contain a valid `ovf:diskId` reference to a different `Disk` element. If a disk block does not exist locally, lookup for that disk block then occurs in the parent disk. In `DiskSection`, parent `Disk` elements shall occur before child `Disk` elements that refer to them. Similarly, in `References` element, the `File` elements referred from these `Disk` elements shall respect the same ordering. The ordering restriction ensures that in an OVA archive, parent disks always occur before child disks, making it possible for a tool to consume the archive in a streaming mode, see also clause 5.3.

9.2 NetworkSection

The `NetworkSection` element shall list all logical networks used in the OVF package.

```
<NetworkSection>
   <Info>List of logical networks used in the package</Info>
   <Network ovf:name="VM Network">
      <Description>The network that the service will be available on</Description>
      <NetworkPortProfile>
         <Item>
            <epasd:AllocationUnits>GigaBits per Second</epasd:AllocationUnits>
            <epasd:ElementName>Network Port Profile 1</epasd:ElementName>
            <epasd:InstanceID>1</epasd:InstanceID>
            <epasd:NetworkPortProfileID>1</epasd:NetworkPortProfileID>
            <epasd:NetworkPortProfileIDType>4</epasd:NetworkPortProfileIDType>
            <epasd:Reservation>1</epasd:Reservation>
         </Item>
      </NetworkPortProfile>
   </Network>
</NetworkSection>
```

`NetworkSection` is a valid element at the outermost envelope level. A `Network` element is a child element of `NetworkSection`. Each `Network` element in the `NetworkSection` shall be given a unique name using the ovf:name attribute. The name shall be unique within an ovf envelope.

All networks referred to from `Connection` elements in all `VirtualHardwareSection` elements shall be defined in the `NetworkSection`.

Starting with version 2.0 of this specification, each logical network may contain a set of networking attributes that should be applied when mapping the logical network at deployment time to a physical or virtual network. Networking attributes are specified by embedding or referencing zero or more instances of network port profile as specified by `NetworkPortProfile` or `NetworkPortProfileURI` child element of the `Network` element.

The `NetworkPortProfile` child element of the `Network` element defines the contents of a network port profile. The `NetworkPortProfileURI` child element of the `Network` element defines the reference to a network port profile.

Examples of using the DSP8049 and EPASD are in ANNEX D.

9.3 ResourceAllocationSection

The `ResourceAllocationSection` element describes all resource allocation requirements of a `VirtualSystemCollection` entity. These resource allocations shall be performed when deploying the OVF package.

```
<ResourceAllocationSection>
   <Info>Defines reservations for CPU and memory for the collection of VMs</Info>
   <Item>
      <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
      <rasd:ElementName>300 MB reservation</rasd:ElementName>
      <rasd:InstanceID>0</rasd:InstanceID>
      <rasd:Reservation>300</rasd:Reservation>
      <rasd:ResourceType>4</rasd:ResourceType>
   </Item>
   <Item ovf:configuration="..." ovf:bound="...">
      <rasd:AllocationUnits>hertz * 10^6</rasd:AllocationUnits>
      <rasd:ElementName>500 MHz reservation</rasd:ElementName>
      <rasd:InstanceID>0</rasd:InstanceID>
      <rasd:Reservation>500</rasd:Reservation>
      <rasd:ResourceType>3</rasd:ResourceType>
   </Item>
   <EthernetPortItem>
       <epasd:Address>00-16-8B-DB-00-5E</epasd:Address>
       <epasd:Connection>VM Network</epasd:Connection>
       <epasd:Description>Virtual NIC</epasd:Description>
       <epasd:ElementName>Ethernet Port 1</epasd:ElementName>
       <epasd:InstanceID>3</epasd:InstanceID>
       <epasd:NetworkPortProfileID>1</epasd:NetworkPortProfileID>
       <epasd:NetworkPortProfileIDType>4</epasd:NetworkPortProfileIDType>
       <epasd:VirtualQuantityUnits>1</epasd:VirtualQuantityUnits>
    </EthernetPortItem>
    <StorageItem>
       <sasd:AllocationUnits>byte*2^30</sasd:AllocationUnits>
       <sasd:Description>Virtual Disk</sasd:Description>
       <sasd:ElementName>100 GByte Virtual Disk</sasd:ElementName>
       <sasd:InstanceID>4</sasd:InstanceID>
       <sasd:Reservation>100</sasd:Reservation>
       <sasd:ResourceType>31</sasd:ResourceType>
       <sasd:VirtualQuantity>1</sasd:VirtualQuantity>
    </StorageItem>
</ResourceAllocationSection>
```

`ResourceAllocationSection` is a valid element for a `VirtualSystemCollection` entity.

The optional `ovf:configuration` attribute contains a list of configuration names. See 9.8 on deployment options for semantics of this attribute.

The optional `ovf:bound` attribute contains a value of `min`, `max`, or `normal`. See 8.4 for semantics of this attribute.

9.4 AnnotationSection

The `AnnotationSection` element is a user-defined annotation on an entity. Such annotations may be displayed when deploying the OVF package.

```
<AnnotationSection>
    <Info>An annotation on this service. It can be ignored</Info>
    <Annotation>Contact customer support if you have any problems</Annotation>
</AnnotationSection >
```

AnnotationSection is a valid element for a VirtualSystem and a VirtualSystemCollection entity.

See clause 10 for details on how to localize the Annotation element.

9.5 ProductSection

The ProductSection element specifies product-information for an appliance, such as product name, version, and vendor.

```
<ProductSection ovf:class="com.mycrm.myservice" ovf:instance="1">
   <Info>Describes product information for the service</Info>
   <Product>MyCRM Enterprise</Product>
   <Vendor>MyCRM Corporation</Vendor>
   <Version>4.5</Version>
   <FullVersion>4.5-b4523</FullVersion>
   <ProductUrl>http://www.mycrm.com/enterprise</ProductUrl>
   <VendorUrl>http://www.mycrm.com</VendorUrl>
   <Icon ovf:height="32" ovf:width="32" ovf:mimeType="image/png" ovf:fileRef="icon">
   <Category>Email properties</Category>
   <Property ovf:key="admin.email" ovf:type="string" ovf:userConfigurable="true">
        <Label>Admin email</Label>
        <Description>Email address of administrator</Description>
   </Property>
   <Category>Admin properties</Category>
   <Property ovf:key="app_log" ovf:type="string" ovf:value="low"
ovf:userConfigurable="true">
        <Description>Loglevel for the service</Description>
   </Property>
   <Property ovf:key="app_isSecondary" ovf:value="false" ovf:type="boolean">
        <Description>Cluster setup for application server</Description>
   </Property>
   <Property ovf:key="app_ip" ovf:type="string" ovf:value="${appserver-vm}">
        <Description>IP address of the application server VM</Description>
   </Property>
</ProductSection>
```

The optional Product element specifies the name of the product, while the optional Vendor element specifies the name of the product vendor. The optional Version element specifies the product version in short form, while the optional FullVersion element describes the product version in long form. The optional ProductUrl element specifies a URL which shall resolve to a human readable description of the product, while the optional VendorUrl specifies a URL which shall resolve to a human readable description of the vendor.

The optional AppUrl element specifies a URL resolving to the deployed product instance. The optional Icon element specifies display icons for the product.

The Property elements specify application-level customization parameters and are particularly relevant to appliances that need to be customized during deployment with specific settings such as network identity, the IP addresses of DNS servers, gateways, and others.

The ProductSection is a valid section for a VirtualSystem and a VirtualSystemCollection entity.

The Property elements may be grouped by using Category elements. The set of Property elements grouped by a Category element is the sequence of Property elements following the Category element, until but not including an element that is not a Property element. For OVF packages containing a large number of Property elements, this may provide a simpler installation experience. Similarly, each Property element may have a short label defined by its Label child element in addition to a description defined by its Description child element. See clause 10 for details on how to localize the Category element and the Description and Label child elements of the Property element.

Each Property element in a ProductSection shall be given an identifier that is unique within the ProductSection using the ovf:key attribute.

Each Property element in a ProductSection shall be given a type using the ovf:type attribute and optionally type qualifiers using the ovf:qualifiers attribute. Valid types are listed in Table 6, and valid qualifiers are listed in Table 7.

The optional attribute ovf:value is used to provide a default value for a property. One or more optional Value elements may be used to define alternative default values for different configurations, as defined in 9.8.

The optional attribute ovf:userConfigurable determines whether the property value is configurable during the installation phase. If ovf:userConfigurable is FALSE or omitted, the ovf:value attribute specifies the value to be used for that customization parameter during installation. If ovf:userConfigurable is TRUE, the ovf:value attribute specifies a default value for that customization parameter, which may be changed during installation.

A simple OVF implementation such as a command-line installer typically uses default values for properties and does not prompt even though ovf:userConfigurable is set to TRUE. To force prompting at startup time, omitting the ovf:value attribute is sufficient for integer types, because the empty string is not a valid integer value. For string types, prompting may be forced by adding a qualifier requiring a non-empty string, see Table 7.

The optional Boolean attribute ovf:password indicates that the property value may contain sensitive information. The default value is FALSE. OVF implementations prompting for property values are advised to obscure these values when ovf:password is set to TRUE. This is similar to HTML text input of type password. Note that this mechanism affords limited security protection only. Although sensitive values are masked from casual observers, default values in the OVF descriptor and assigned values in the OVF environment are still passed in clear text.

Zero or more ProductSections may be specified within a VirtualSystem or VirtualSystemCollection. Typically, a ProductSection corresponds to a particular software product that is installed. Each product section at the same entity level shall have a unique ovf:class and ovf:instance attribute pair. For the common case where only a single ProductSection is used, the ovf:class and ovf:instance attributes are optional and default to the empty string. The ovf:class property should be used to uniquely identify the software product using the reverse domain name convention. Examples of values are com.vmware.tools and org.apache.tomcat. If multiple instances of the same product are installed, the ovf:instance attribute shall be used to identify the different instances.

Property elements are exposed to the guest software through the OVF environment, as described in clause 11. The value of the ovfenv:key attribute of a Property element exposed in the OVF environment shall be constructed from the value of the ovf:key attribute of the corresponding Property element defined in a ProductSection entity of an OVF descriptor as follows:

```
key-value-env = [class-value "."] key-value-prod ["." instance-value]
```

The syntax definition above use ABNF with the exceptions listed in ANNEX A, where:

- class-value is the value of the ovf:class attribute of the Property element defined in the ProductSection entity. The production [class-value "."] shall be present if and only if class-value is not the empty string.

- `key-value-prod` is the value of the `ovf:key` attribute of the `Property` element defined in the `ProductSection` entity.
- `instance-value` is the value of the `ovf:instance` attribute of the `Property` element defined in the `ProductSection` entity. The production `["." instance-value]` shall be present if and only if `instance-value` is not the empty string.

EXAMPLE: The following OVF environment example shows how properties can be propagated to the guest software:

```
<Property ovf:key="com.vmware.tools.logLevel"    ovf:value="none"/>
<Property ovf:key="org.apache.tomcat.logLevel.1" ovf:value="debug"/>
<Property ovf:key="org.apache.tomcat.logLevel.2" ovf:value="normal"/>
```

The consumer of an OVF package should prompt for properties where `ovf:userConfigurable` is TRUE. These properties may be defined in multiple `ProductSections` as well as in sub-entities in the OVF package.

If a `ProductSection` exists, then the first `ProductSection` entity defined in the top-level `Content` element of a package shall define summary information that describes the entire package. After installation, a consumer of the OVF package could choose to make this information available as an instance of the CIM_Product class.

`Property` elements specified on a `VirtualSystemCollection` are also seen by its immediate children (see clause 11). Children may refer to the properties of a parent `VirtualSystemCollection` using macros on the form `${name}` as value for `ovf:value` attributes.

Table 6 lists the valid types for properties. These are a subset of CIM intrinsic types defined in DSP0004, which also define the value space and format for each intrinsic type. Each `Property` element shall specify a type using the `ovf:type` attribute.

Table 6 – Property Types

Type	Description
`uint8`	Unsigned 8-bit integer
`sint8`	Signed 8-bit integer
`uint16`	Unsigned 16-bit integer
`sint16`	Signed 16-bit integer
`uint32`	Unsigned 32-bit integer
`sint32`	Signed 32-bit integer
`uint64`	Unsigned 64-bit integer
`sint64`	Signed 64-bit integer
`String`	String
`Boolean`	Boolean
`real32`	IEEE 4-byte floating point
`real64`	IEEE 8-byte floating point

Table 7 lists the supported CIM type qualifiers as defined in DSP0004. Each `Property` element may optionally specify type qualifiers using the `ovf:qualifiers` attribute with multiple qualifiers separated by commas; see production `qualifierList` in ANNEX A “MOF Syntax Grammar Description” in DSP0004.

Table 7 – Property Qualifiers

Type	Description

`String`	`MinLen(min)`
	`MaxLen(max)`
	`ValueMap{...}`

`uint8`
`sint8`
`uint16`
`sint16`
`uint32`
`sint32`
`uint64`
`sint64`
	`ValueMap{...}`

9.6 EulaSection

A `EulaSection` contains the legal terms for using its parent `Content` element. This license shall be shown and accepted during deployment of an OVF package. Multiple `EulaSections` may be present in an OVF. If unattended installations are allowed, all embedded license sections are implicitly accepted.

```
<EulaSection>
    <Info>Licensing agreement</Info>
    <License>
Lorem ipsum dolor sit amet, ligula suspendisse nulla pretium, rhoncus tempor placerat
fermentum, enim integer ad vestibulum volutpat. Nisl rhoncus turpis est, vel elit,
congue wisi enim nunc ultricies sit, magna tincidunt. Maecenas aliquam maecenas ligula
nostra, accumsan taciti. Sociis mauris in integer, a dolor netus non dui aliquet,
sagittis felis sodales, dolor sociis mauris, vel eu libero cras. Interdum at. Eget
habitasse elementum est, ipsum purus pede porttitor class, ut adipiscing, aliquet sed
auctor, imperdiet arcu per diam dapibus libero duis. Enim eros in vel, volutpat nec
pellentesque leo, scelerisque.
    </License>
</EulaSection>
```

The `EulaSection` is a valid section for a `VirtualSystem` and a `VirtualSystemCollection` entity.

See clause 10 for details on how to localize the `License` element.

See also clause 10 for description of storing EULA license contents in an external file without any XML header or footer. This allows inclusion of standard license or copyright text files in unaltered form.

9.7 StartupSection

The `StartupSection` specifies how a virtual machine collection is powered on and off.

```
   <StartupSection>
       <Item ovf:id="vm1" ovf:order="0" ovf:startDelay="30" ovf:stopDelay="0"
             ovf:startAction="powerOn" ovf:waitingForGuest="true"
ovf:stopAction="powerOff"/>
       <Item ovf:id="teamA" ovf:order="0"/>
       <Item ovf:id="vm2" ovf:order="1" ovf:startDelay="0" ovf:stopDelay="20"
             ovf:startAction="powerOn" ovf:stopAction="guestShutdown"/>
   </StartupSection>
```

Each `Content` element that is a direct child of a `VirtualSystemCollection` may have a corresponding `Item` element in the `StartupSection` entity of the `VirtualSystemCollection` entity. Note that `Item` elements may correspond to both `VirtualSystem` and `VirtualSystemCollection` entities. When a start or stop action is performed on a `VirtualSystemCollection` entity, the respective actions on the `Item` elements of its `StartupSection` entity are invoked in the specified order. Whenever an `Item` element corresponds to a (nested) `VirtualSystemCollection` entity, the actions on the `Item` elements of its `StartupSection` entity shall be invoked before the action on the `Item` element corresponding to that `VirtualSystemCollection` entity is invoked (i.e., depth-first traversal).

The following required attributes on `Item` are supported for a `VirtualSystem` and `VirtualSystemCollection`:

- `ovf:id` shall match the value of the `ovf:id` attribute of a `Content` element which is a direct child of this `VirtualSystemCollection`. That `Content` element describes the virtual machine or virtual machine collection to which the actions defined in the `Item` element apply.
- `ovf:order` specifies the startup order using non-negative integer values. If the `ovf:order` ="0" then the order is not specified. If the `ovf:order` is non-zero then the of execution of the start action shall be the numerical ascending order of the values. The `Items` with same order identifier may be started concurrently.

  The order of execution of the stop action should be the numerical descending order of the values. In implementation specific scenarios the order of execution of the stop action may be non-descending.

The following optional attributes on `Item` are supported for a `VirtualSystem`.

- `ovf:startDelay` specifies a delay in seconds to wait until proceeding to the next order in the start sequence. The default value is 0.
- `ovf:waitingForGuest` enables the platform to resume the startup sequence after the guest software has reported it is ready. The interpretation of this is deployment platform specific. The default value is FALSE.
- `ovf:startAction` specifies the start action to use. Valid values are `powerOn` and `none`. The default value is `powerOn`.
- `ovf:stopDelay` specifies a delay in seconds to wait until proceeding to the previous order in the stop sequence. The default value is 0.
- `ovf:stopAction` specifies the stop action to use. Valid values are `powerOff`, `guestShutdown`, and `none`. The interpretation of `guestShutdown` is deployment platform specific. The default value is `powerOff`.

If the `StartupSection` is not specified then an `ovf:order="0"` is implied.

9.8 DeploymentOptionSection

The `DeploymentOptionSection` specifies a discrete set of intended resource configurations. The author of an OVF package can include sizing metadata for different configurations. A consumer of the OVF shall select a configuration, for example, by prompting the user. The selected configuration shall be available in the OVF environment file, enabling the guest software to adapt to the selected configuration. See clause 11.

The `DeploymentOptionSection` specifies an ID, label, and description for each configuration.

```
<DeploymentOptionSection>
        <Configuration ovf:id="minimal">
                <Label>Minimal</Label>
                <Description>Some description</Description>
        </Configuration>
        <Configuration ovf:id="normal" ovf:default="true">
                <Label>Typical</Label>
                <Description>Some description</Description>
        </Configuration>
        <!-- Additional configurations -->
    </DeploymentOptionSection>
```

The `DeploymentOptionSection` has the following semantics:

- If present, the `DeploymentOptionSection` is valid only at the envelope level, and only one section shall be specified in an OVF descriptor.
- The discrete set of configurations is described with `Configuration` elements, which shall have identifiers specified by the `ovf:id` attribute that are unique in the package.
- A default `Configuration` element may be specified with the optional `ovf:default` attribute. If no default is specified, the first element in the list is the default. Specifying more than one element as the default is invalid.
- The `Label` and `Description` elements are localizable using the `ovf:msgid` attribute. See clause 10 for more details on internationalization support.

Configurations may be used to control resources for virtual hardware and for virtual machine collections. `Item, EthernetPortItem, and StorageItem` elements in `VirtualHardwareSection` elements describe resources for VirtualSystem entities, while `Item, EthernetPortItem, and StorageItem` elements in `ResourceAllocationSection` elements describe resources for virtual machine collections. For these two `Item, EthernetPortItem, or StorageItem` types, the following additional semantics are defined:

- Each `Item EthernetPortItem, and StorageItem` has an optional `ovf:configuration` attribute, containing a list of configurations separated by a single space character. If not specified, the item shall be selected for any configuration. If specified, the item shall be selected only if the chosen configuration ID is in the list. A configuration attribute shall not contain an ID that is not specified in the `DeploymentOptionSection`.
- Within a single `VirtualHardwareSection` or `ResourceAllocationSection`, multiple `Item, EthernetPortItem, and StorageItem` elements are allowed to refer to the same InstanceID. A single combined `Item, EthernetPortItem, or StorageItem` for the given InstanceID shall be constructed by picking up the child elements of each `Item, EthernetPortItem, or StorageItem` element, with child elements of a former `Item, EthernetPortItem, or StorageItem` element in the OVF descriptor not being picked up if there is a like-named child element in a latter `Item, EthernetPortItem, or StorageItem` element. Any attributes specified on child elements of `Item, EthernetPortItem, or StorageItem` elements that are not picked up that way, are not part of the combined `Item, EthernetPortItem, or StorageItem` element.
- All `Item, EthernetPortItem, StorageItem` elements shall specify ResourceType, and `Item, EthernetPortItem, and StorageItem` elements with the same InstanceID shall agree on ResourceType.

EXAMPLE 1: The following example shows a `VirtualHardwareSection`:

```
      <VirtualHardwareSection>
          <Info>...</Info>
          <Item>
              <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
              <rasd:ElementName>512 MB memory size and 256 MB
reservation</rasd:ElementName>
              <rasd:InstanceID>0</rasd:InstanceID>
              <rasd:Reservation>256</rasd:Reservation>
              <rasd:ResourceType>4</rasd:ResourceType>
              <rasd:VirtualQuantity>512</rasd:VirtualQuantity>
           </Item>
           ...
           <Item ovf:configuration="big">
              <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
              <rasd:ElementName>1024 MB memory size and 512 MB
reservation</rasd:ElementName>
              <rasd:InstanceID>0</rasd:InstanceID>
              <rasd:Reservation>512</rasd:Reservation>
              <rasd:ResourceType>4</rasd:ResourceType>
              <rasd:VirtualQuantity>1024</rasd:VirtualQuantity>
           </Item>
        </VirtualHardwareSection>
```

Note that the attributes `ovf:configuration` and `ovf:bound` on `Item` may be used in combination to provide very flexible configuration options.

Configurations can further be used to control default values for properties and whether properties are user configurable. For `Property` elements inside a `ProductSection`, the following additional semantic is defined:

- It is possible to specify alternative default property values for different configurations in a `DeploymentOptionSection`. In addition to a `Label` and `Description` element, each `Property` element may optionally contain `Value` elements. The `Value` element shall have an `ovf:value` attribute specifying the alternative default and an `ovf:configuration` attribute specifying the configuration in which this new default value should be used. Multiple `Value` elements shall not refer to the same configuration.
- Starting with version 2.0 of this specification, a `Property` element may optionally have an `ovf:configuration` attribute specifying the configuration in which this property should be user configurable. The value of `ovf:userConfigurable` is implicitly set to FALSE for all other configurations, in which case the default value of the property may not be changed during installation.

EXAMPLE 2: The following shows an example `ProductSection`:

```
<ProductSection>
   <Property ovf:key="app.adminEmail" ovf:type="string" ovf:userConfigurable="true"
             ovf:configuration="standard">
        <Label>Admin email</Label>
        <Description>Email address of service administrator</Description>
   </Property>
   <Property ovf:key="app.log" ovf:type="string" ovf:value="low"
             ovf:userConfigurable="true">
        <Label>Loglevel</Label>
        <Description>Loglevel for the service</Description>
        <Value ovf:value="none" ovf:configuration="minimal">
   </Property>
</ProductSection>
```

In the example above, the `app.adminEmail` property is only user configurable in the `standard` configuration, while the default value for the `app.log` property is changed from `low` to `none` in the `minimal` configuration.

9.9 OperatingSystemSection

An `OperatingSystemSection` specifies the operating system installed on a virtual machine.

```
<OperatingSystemSection ovf:id="76">
   <Info>Specifies the operating system installed</Info>
   <Description>Microsoft Windows Server 2008</Description>
</OperatingSystemSection>
```

The values for `ovf:id` should be taken from the `ValueMap` of the `CIM_OperatingSystem.OsType` property. The description should be taken from the corresponding `Values` of the `CIM_OperatingSystem.OsType` property.

The `OperatingSystemSection` is a valid section for a `VirtualSystem` entity only.

9.10 InstallSection

The `InstallSection`, if specified, indicates that the virtual machine needs to be booted once in order to install and/or configure the guest software. The guest software is expected to access the OVF environment during that boot, and to shut down after having completed the installation and/or configuration of the software, powering off the guest.

If the `InstallSection` is not specified, this indicates that the virtual machine does not need to be powered on to complete installation of guest software.

```
<InstallSection ovf:initialBootStopDelay="300">
   <Info>Specifies that the virtual machine needs to be booted once after having
created the guest software in order to install and/or configure the software
   </Info>
</InstallSection>
```

`InstallSection` is a valid section for a `VirtualSystem` entity only.

The optional `ovf:initialBootStopDelay` attribute specifies a delay in seconds to wait for the virtual machine to power off. If not set, the implementation shall wait for the virtual machine to power off by itself. If the delay expires and the virtual machine has not powered off, the consumer of the OVF package shall indicate a failure.

Note that the guest software in the virtual machine can do multiple reboots before powering off.

Several VMs in a virtual machine collection may have an `InstallSection` defined, in which case the above step is done for each VM, potentially concurrently.

9.11 EnvironmentFilesSection

Clause 11 describes how the OVF environment file is used to deliver runtime customization parameters to the guest operating system. In version 1 of this specification, the OVF environment file is the only file delivered to the guest operating system outside of the virtual disk structure. In order to provide additional deployment time customizations, the `EnvironmentFilesSection` enables the OVF package authors to specify additional files in the OVF package, outside of the virtual disks, that also is provided to the guest operating system at runtime via a transport.

This enables increased flexibility in image customization outside of virtual disk capture, allowing OVF package authors to customize solutions by combining existing virtual disks without modifying them.

For each additional file provided to the guest, the `EnvironmentFilesSection` shall contain a `File` element with required attributes `ovf:fileRef` and `ovf:path`. The `ovf:fileRef` attribute shall denote the actual content by identifying an existing `File` element in the `References` element, the `File` element is identified by matching its `ovf:id` attribute value with the `ovf:fileRef` attribute value. The `ovf:path` attribute denotes the relative location on the transport where this file will be placed, using the syntax of relative-path references in RFC3986.

The referenced `File` element in the `References` element identify the content using one of the URL schemes `"file"`, `"http"`, or `"https"`. For the `"file"` scheme, the content is static and included in the OVF package. For the `"http"` and `"https"` schemes, the content shall be downloaded prior to the initial boot of the virtual system.

The `iso` transport shall support this mechanism, see clause 11.2 for details. For this transport, the root location relative to `ovf:path` values shall be directory `ovffiles` contained in the root directory of the ISO image. The guest software can access the information using standard guest operating system tools.

Other custom transport may support this mechanism. Custom transports will need to specify how to access multiple data sources from a root location.

EXAMPLE:

```
<Envelope>
  <References>
    ...
     <File ovf:id="config" ovf:href="config.xml" ovf:size="4332"/>
    <File ovf:id="resources" ovf:href="http://mywebsite/resources/resources.zip"/>
  </References>
  ...
  <VirtualSystem ovf:id="...">
    ...
     <ovf:EnvironmentFilesSection ovf:required="false" ovf:transport="iso">
       <Info>Config files to be included in OVF environment</Info>
       <ovf:File ovf:fileRef="config" ovf:path="setup/cfg.xml"/>
       <ovf:File ovf:fileRef="resources" ovf:path="setup/resources.zip"/>
     </ovf:EnvironmentFilesSection>
     ...
  </VirtualSystem>
  ...
</Envelope>
```

In the example above, the file `config.xml` in the OVF package will be copied to the OVF environment ISO image and be accessible to the guest software in location `/ovffiles/setup/cfg.xml`, while the file `resources.zip` will be accessible in location `/ovffiles/setup/resources.zip`.

9.12 BootDeviceSection

Individual virtual machines will generally use the default device boot order provided by the virtualization platform's virtual BIOS. The `BootDeviceSection` allows the OVF package author to specify particular boot configurations and boot order settings. This enables booting from non-default devices such as a NIC using PXE, a USB device or a secondary disk. Moreover there could be multiple boot configurations with different boot orders. For example, a virtual disk may be need to be patched before it is bootable and a patch ISO image could be included in the OVF package.

The Common Information Model (CIM) defines artifacts to deal with boot order use cases prevalent in the industry for BIOSes found in desktops and servers. The boot configuration is defined by the class `CIM_BootConfigSetting` which in turn contains one or more `CIM_BootSourceSetting` classes as defined in the WS-CIM schema. Each class representing the boot source in turn has either the specific device or a "device type" such as disk or CD/DVD as a boot source.

In the context of this specification, the `InstanceID` field of `CIM_BootSourceSetting` is used for identifying a specific device as the boot source. The `InstanceID` field of the device as specified in the `Item` description of the device in the `VirtualHardwareSection` is used to specify the device as a boot source. In case the source is desired to be a device type, the `StructuredBootString` field is used to denote the type of device with values defined by the CIM boot control profile. When a boot source is a device type, the deployment platform should try all the devices of the specified type.

In the example below, the Pre-Install configuration specifies the boot source as a specific device (network), while the Post-Install configuration specifies a device type (hard disk).

EXAMPLE:
```
  <Envelope>
  ...
  <VirtualSystem ovf:id="...">
    ...
    <ovf:BootDeviceSection>
      <Info>Boot device order specification</Info>
      <bootc:CIM_BootConfigSetting>
        <bootc:Caption>Pre-Install</bootc:Caption>
        <bootc:Description>Boot Sequence for fixup of disk</bootc:Description>
        <boots:CIM_BootSourceSetting>
          <boots:Caption>Fix-up DVD on the network</boots:Caption>
          <boots:InstanceID>3</boots:InstanceID>           <!— Network device-->
        </boots:CIM_BootSourceSetting>
        <boots:CIM_BootSourceSetting>
          <boots:Caption>Boot virtual disk</boots:Caption>
          <boots:StructuredBootString>CIM:Hard-Disk</boots:StructuredBootString>
        </boots:CIM_BootSourceSetting>
      </bootc:CIM_BootConfigSetting>
    </ovf:BootDeviceSection>
    ...
  </VirtualSystem>
</Envelope>
```

9.13 SharedDiskSection

The existing `DiskSection` in clause 9.1 describes virtual disks in the OVF package. Virtual disks in the `DiskSection` can be referenced by multiple virtual machines, but seen from the guest software each virtual machine gets individual private disks. Any level of sharing done at runtime is deployment platform specific and not visible to the guest software.

Certain applications such as clustered databases rely on multiple virtual machines sharing the same virtual disk at runtime. `SharedDiskSection` allows the OVF package author to specify `Disk` elements shared by more than one VirtualSystem at runtime, these could be virtual disks backing by an external `File` reference, or empty virtual disks without backing. It is recommended that the guest software use cluster-aware file system technology to be able to handle concurrent access.

EXAMPLE:
```
<ovf:SharedDiskSection>
    <Info>Describes the set of virtual disks shared between VMs</Info>
    <ovf:SharedDisk ovf:diskId="datadisk" ovf:fileRef="data"
                     ovf:capacity="8589934592" ovf:populatedSize="3549324972"
          ovf:format=
              "http://www.vmware.com/interfaces/specifications/vmdk.html#sparse"/>
    <ovf:SharedDisk ovf:diskId="transientdisk" ovf:capacity="536870912"/>
</ovf:SharedDiskSection>
```

`SharedDiskSection` is a valid section at the outermost envelope level only.

Each virtual disk is represented by a `SharedDisk` element that shall be given an identifier using the `ovf:diskId` attribute; the identifier shall be unique within the combined content of `DiskSection` and `SharedDiskSection`. The `SharedDisk` element has the same structure as the `Disk` element in `DiskSection`, with the addition of an optional boolean attribute `ovf:readOnly` stating whether shared disk access is read-write or read-only.

Shared virtual disks are referenced from virtual hardware using the `HostResource` element as described in clause 8.3.

It is optional for the virtualization platform to support `SharedDiskSection`. The platform should give an appropriate error message based on the value of the `ovf:required` attribute on the `SharedDiskSection` element.

9.14 ScaleOutSection

The number of VirtualSystems and VirtualSystemCollections contained in an OVF package is generally fixed and determined by the structure inside the Envelope element. The `ScaleOutSection` allows a VirtualSystemCollection to contain a set of children that are homogeneous with respect to a prototypical VirtualSystem or VirtualSystemCollection. The `ScaleOutSection` shall cause the deployment platform to replicate the prototype a number of times, thus allowing the number of instantiated virtual machines to be configured dynamically at deployment time.

EXAMPLE:
```
<VirtualSystemCollection ovf:id="web-tier">
  ...
  <ovf:ScaleOutSection ovf:id="web-server">
    <Info>Web tier</Info>
    <ovf:Description>Number of web server instances in web tier</ovf:Description>
    <ovf:InstanceCount ovf:default="4" ovf:minimum="2" ovf:maximum="8"/>
  </ovf:ScaleOutSection>
  ...
  <VirtualSystem ovf:id="web-server">
    <Info>Prototype web server</Info>
    ...
  </VirtualSystem>
</VirtualSystemCollection>
```

In the example above, the deployment platform creates a web tier containing between two and eight web server virtual machine instances, with a default instance count of four. The deployment platform makes an appropriate choice (e.g., by prompting the user). Assuming three replicas were created, the OVF environment available to the guest software in the first replica has the following content structure:

EXAMPLE:
```
<Environment ... ovfenv:id=”web-server-1”>
  ...
  <Entity ovfenv:id=”web-server-2”>
    ...
  </Entity>
  <Entity ovfenv:id=”web-server-3”>
    ...
  </Entity>
</Environment>
```

This mechanism enables dynamic scaling of virtual machine instances at deployment time. Scaling at runtime is not within the scope of this specification.

The `ScaleOutSection` is a valid section inside VirtualSystemCollection only.

The `ovf:id` attribute on `ScaleOutSection` identifies the VirtualSystem or VirtualSystemCollection prototype to be replicated.

For the InstanceCount element, the `ovf:minimum` and `ovf:maximum` attribute values shall be non-negative integers and `ovf:minimum` shall be less than or equal to the value of `ovf:maximum`. The `ovf:minimum` value may be zero in which case the VirtualSystemCollection may contain zero instances of the prototype. If the `ovf:minimum` attribute is not present, it shall be assumed to have a value of one. If the `ovf:maximum` attribute is not present, it shall be assumed to have a value of unbounded. The `ovf:default` attribute is required and shall contain a value within the range defined by `ovf:minimum` and `ovf:maximum`.

Each replicated instance shall be assigned a unique `ovf:id` value within the VirtualSystemCollection. The unique `ovf:id` value shall be constructed from the prototype `ovf:id` value with a sequence number appended as follows:

```
  replica-ovf-id = prototype-ovf-id "-" decimal-number
  decimal-number = decimal-digit | (decimal-digit decimal-number)
  decimal-digit  = "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9"
```

The syntax definitions above use ABNF with the exceptions listed in ANNEX A. The first replica shall have sequence number one and following sequence numbers shall be incremented by one for each replica. Note that after deployment, no VirtualSystem will have the prototype `ovf:id` value itself.

If the prototype being replicated has a starting order in the `StartupSection`, all replicas shall share this value. It is not possible to specify a particular starting sequence among replicas.

Property values for Property elements in the prototype are prompted for once per replica created. If the OVF package author requires a property value to be shared among instances, that Property may be declared at the containing VirtualSystemCollection level and referenced by replicas as described in clause 9.5.

Configurations from the DeploymentOptionSection may be used to control values for InstanceCount. The InstanceCount element may have an `ovf:configuration` attribute specifying the configuration in which this element should be used. Multiple elements shall not refer to the same configuration, and a configuration attribute shall not contain an `ovf:id` value that is not specified in the DeploymentOptionSection.

EXAMPLE:
```
<VirtualSystemCollection ovf:id="web-tier">
  ...
  <DeploymentOptionSection>
    <Info>Deployment size options</Info>
    <Configuration ovf:id="minimal">
      <Label>Minimal</Label>
      <Description>Minimal deployment scenario</Description>
    </Configuration>
    <Configuration ovf:id="common" ovf:default="true">
      <Label>Typical</Label>
      <Description>Common deployment scenario</Description>
    </Configuration>
    ...
  </DeploymentOptionSection>
  ...
  <ovf:ScaleOutSection ovf:id="web-server">
    <Info>Web tier</Info>
    <ovf:Description>Number of web server instances in web tier</ovf:Description>
      <ovf:InstanceCount ovf:default="4"/>
      <ovf:InstanceCount ovf:default="1" ovf:configuration="minimal"/>
  </ovf:ScaleOutSection>
...
</VirtualSystemCollection>
```

In the example above, the default replica count is four, unless the minimal deployment scenario is chosen, in which case the default is one.

9.15 PlacementGroupSection and PlacementSection

Certain types of applications require the ability to specify that two or more VirtualSystems should be deployed closely together since they rely on very fast communication or a common hardware dependency such as a reliable communication link. Other types of applications require the ability to specify that two or more VirtualSystems should be deployed apart due to high-availability or disaster recovery considerations.

`PlacementGroupSection` allow an OVF package author to define a placement policy for a group of VirtualSystems, while `PlacementSection` allow the author to annotate elements with membership of a particular placement policy group.

Zero or more `PlacementGroupSections` may be declared at the Envelope level, while `PlacementSection` may be declared at the VirtualSystem or VirtualSystemCollection level. Declaring a VirtualSystemCollection member of a placement policy group applies transitively to all child VirtualSystem and child Virtual System Collections elements. The `ovf:id` attribute on `PlacementGroupSection` is used to identify the particular placement policy; the attribute value shall be unique within the OVF package. Placement policy group membership is specified using the `ovf:group` attribute on `PlacementSection`; the attribute value shall match the value of an `ovf:id` attribute on a `PlacementGroupSection`.

This version of the specification defines the placement policies `"affinity"` and `"availability"`, specified with the required `ovf:policy` attribute on `PlacementGroupSection`.

Placement policy `"affinity"` describe that VirtualSystems should be placed as closely together as possible. The deployment platform should attempt to keep these virtual machines located as adjacently as possible, typically on the same physical host or with fast network connectivity between hosts.

Placement policy `"availability"` describe that VirtualSystems should be placed separately. The deployment platform should attempt to keep these virtual machines located apart, typically on the different physical hosts.

EXAMPLE:
```
<Envelope ...>
  ...
  <ovf:PlacementGroupSection ovf:id="web" ovf:policy="availability">
    <Info>Placement policy for group of VMs</Info>
    <ovf:Description>Placement policy for web tier</ovf:Description>
  </ovf:PlacementGroupSection>
      ...
  <VirtualSystemCollection ovf:id="web-tier">
    ...
    <ovf:ScaleOutSection ovf:id="web-node">
      <Info>Web tier</Info>
      ...
    </ovf:ScaleOutSection>
    ...
    <VirtualSystem ovf:id="web-node">
      <Info>Web server</Info>
      ...
      <ovf:PlacementSection ovf:group="web">
        <Info>Placement policy group reference</Info>
      </ovf:PlacementSection>
      ...
    </VirtualSystem>
  </VirtualSystemCollection>
</Envelope>
```

In the example above, all virtual machines in the compute tier should be placed separately for high availability. This example also use the `ScaleOutSection` defined in clause 9.14, in which case each replica get the policy assigned.

9.16 Encryption Section

For licensing and other reasons it is desirable to have an encryption scheme enabling free exchange of OVF appliances while ensuring that only the intended parties can use them. The XML Encryption Syntax and Processing standard is utilized to encrypt either the files in the reference section or any parts of the XML markup of an OVF document.

The various aspects of OVF encryption are as shown below:

1. block encryption
   The OVF document author shall utilize block encryption algorithms as specified in the XML encryption 1.1 documents (ref) for this purpose.
2. key derivation
   The OVF author may use the appropriate key for this purpose. If the key is derived using a passphrase then the author shall use one of the key derivations specified in the XML Encryption 1.1 standard.
3. key transport.
   If the encryption key is embedded in the OVF document, the specified key transport mechanisms shall be used.

This specification defines a new section called the EncryptionSection as a focal point for the encryption functionality. This new section provides a single location for placing the encryption algorithm related markup and the corresponding reference list to point to the OVF content that has been encrypted.

Note that depending on which parts of the OVF markup has been encrypted, an OVF descriptor may not validate against the OVF schemas until decrypted.

Below is an example of an OVF encryption section with encryption methods utilized in the OVF document, and the corresponding reference list pointing to the items that have been encrypted.

EXAMPLE:

```
  <ovf:EncryptionSection>
<!--- This section contains two different methods of encryption and the corresponding
backpointers to the data that is encrypted ->
  <!--- Method#1: Pass phrase based Key derivation ->
<!--- The following derived key block defines PBKDF2 and the corresponding back
pointers to the encrypted data elements -->
  <!--- Use a salt value “ovfpassword” and iteration count of 4096 --->
 <xenc11:DerivedKey>
       <xenc11:KeyDerivationMethod
Algorithm=”http://www.rsasecurity.com/rsalabs/pkcs/schemas/pkcs-5#pbkdf2”/>
<pkcs-5:PBKDF2-params>
          <Salt>
                 <Specified>ovfpassword</Specified>
              </Salt>
              <IterationCount>4096</IterationCount>
              <KeyLength>16</KeyLength>
              <PRF Algorithm=”http://www.w3.org/2001/04/xmldsig-more#hmac-sha256”/>
       </pkcs-5:PBKDF2-params>
…
<!—- The ReferenceList element below contains references to the file Ref-109.vhd via
the URI syntax which is specified by XML Encryption.
--->
<xenc:ReferenceList>
   <xenc:DataReference URI=”#first.vhd” />
<xenc:DataReference URI=… />
<xenc:DataReference URI=… />
</xenc:ReferenceList>
   </xenc11:DerivedKey>
    <!-- Method#2: The following example illustrates use of a symmetric key
transported using the public key within a certificate ->
```

```
<xenc:EncryptedKey>
       <xenc:EncryptionMethod     Algorithm=”http://www.w3.org/2001/04/xmlenc#rsa-
1_5”/>
          <ds:KeyInfo xmlns:ds=’http://www.w3.org/2000/09/xmldsig#’
              <ds:X509Data>
              <ds:X509Certificate> … </ds:X509Certificate>
       </ds:X509Data>
       </ds:KeyInfo>
       <xenc:CipherData>
   <xenc:CipherValue> … </xenc:CipherValue>
       </xenc:CipherData>
<!—- The ReferenceList element below contains reference #second-xml-fragment” to the
XML fragment that has been encrypted using the above method --->
   <xenc:ReferenceList>
       <xenc:DataReference URI=’#second-xml-fragment’ />
       <xenc:DataReference URI=’…’ />
       <xenc:DataReference URI=’…’ />
   </xenc:ReferenceList>
    </xenc:EncryptedKey>
  </ovf:EncryptionSection>
```

Below is an example of the encrypted file which is referenced in the EncryptionSection above using URI='Ref-109.vhd' syntax.

EXAMPLE:

```
<ovf:References>
<ovf:File ovf:id="Xen:9cb10691-4012-4aeb-970c-3d47a906bfff/0b13bdba-3761-8622-22fc-
2e252ed9ce14" ovf:href="Ref-109.vhd">
<!-- the encrypted file referenced by the package is enclosed by an EncryptedData with
a CipherReference to the actual encrypted file. The EncryptionSection in this example
has a back pointer to it under the PBKDF2 algorithm via Id=”first.vhd”. This tells the
decrypter how to decrypt the file -->
<xenc:EncryptedData Id="first.vhd" Type='http://www.w3.org/2001/04/xmlenc#Element' >
                 <xenc:EncryptionMethod
Algorithm="http://www.w3.org/2001/04/xmlenc#aes128-cbc" />
                    <xenc:CipherData>
                           <xenc:CipherReference URI='Ref-109.vhd'/>
                    </xenc:CipherData>
</xenc:EncryptedData>
</ovf:File>
</ovf:References>
```

Below is an example of the encrypted OVF markup which is referenced in the EncryptionSection above using URI=’#second-xml-fragment’ syntax.

EXAMPLE:

```
<!—-  the EncryptedData element below encompasses encrypted xml from the original
document. It is provided with the Id “first-xml-fragment” which allows it to be
referenced from the EncryptionSection. -->
<xenc:EncryptedData Type=http://www.w3.org/2001/04/xmlenc#Element Id=”second-xml-
fragment”>
<!-- Each EncryptedData specifies its own encryption method. -->
   <xenc:EncryptionMethod Algorithm=http://www.w3.org/2001/04-xmlenc#aes128-cbc/>
   <xenc:CipherData>
       <!--- Encrypted content --->
       <xenc:CipherValue>DEADBEEF</xenc:CipherValue>
   </xenc:CipherData>
  </xenc:EncryptedData>
```

10 Internationalization

The following elements support localizable messages using the optional `ovf:msgid` attribute:

- `Info` element on `Content`
- `Name` element on `Content`
- `Info` element on `Section`
- `Annotation` element on `AnnotationSection`
- `License` element on `EulaSection`
- `Description` element on `NetworkSection`
- `Description` element on `OperatingSystemSection`
- `Description`, `Product`, `Vendor`, `Label`, and `Category` elements on `ProductSection`
- `Description` and `Label` elements on `Property`
- `Description` and `Label` elements on `DeploymentOptionSection`
- `ElementName, Caption` and `Description` subelements on the `System` element in `VirtualHardwareSection`
- `ElementName, Caption` and `Description` subelements on `Item` elements in `VirtualHardwareSection`
- `ElementName, Caption` and `Description` subelements on `Item` elements in `ResourceAllocationSection`

The `ovf:msgid` attribute contains an identifier that refers to a message that may have different values in different locales.

EXAMPLE 1:

```
<Info ovf:msgid="info.text">Default info.text value if no locale is set or no locale
match</Info>
<License ovf:msgid="license.tomcat-6_0"/>  <!-- No default message -->
```

The `xml:lang` attribute on the `Envelope` element shall specify the default locale for messages in the descriptor. The attribute is optional with a default value of `"en-US"`.

10.1 Internal Resource Bundles

Message resource bundles can be internal or external to the OVF descriptor. Internal resource bundles are represented as `Strings` elements at the end of the `Envelope` element.

EXAMPLE 2:

```
  <ovf:Envelope xml:lang="en-US">
      ...
      ... sections and content here ...
      ...
      <Info msgid="info.os">Operating System</Info>
      ...
      <Strings xml:lang="da-DA">
          <Msg ovf:msgid="info.os">Operativsystem</Msg>
          ...
      </Strings>
      <Strings xml:lang="de-DE">
          <Msg ovf:msgid="info.os">Betriebssystem</Msg>
          ...
      </Strings>
  </ovf:Envelope>
```

10.2 External Resource Bundles

External resource bundles shall be listed first in the `References` section and referred to from `Strings` elements. An external message bundle follows the same schema as the embedded one. Exactly one `Strings` element shall be present in an external message bundle, and that `Strings` element may not have an `ovf:fileRef` attribute specified.

EXAMPLE 3:

```
<ovf:Envelope xml:lang="en-US">
   <References>
      ...
      <File ovf:id="it-it-resources" ovf:href="resources/it-it-bundle.msg"/>
   </References>
    ... sections and content here ...
    ...
    <Strings xml:lang="it-IT" ovf:fileRef="it-it-resources"/>
        ...
</ovf:Envelope>
```

EXAMPLE 4: Example content of external resources/it-it-bundle.msg file, which is referenced in previous example:

```
<Strings
  xmlns:ovf="http://schemas.dmtf.org/ovf/envelope/1"
  xmlns="http://schemas.dmtf.org/ovf/envelope/1"
  xml:lang="it-IT">
      <Msg ovf:msgid="info.os">Sistema operativo</Msg>
      ...
</Strings>
```

The embedded and external `Strings` elements may be interleaved, but they shall be placed at the end of the `Envelope` element. If multiple occurrences of a msg:id attribute with a given locale occur, a latter value overwrites a former.

10.3 Message Content in External File

Starting with version 2.0 of this specification, the content of all localizable messages may be stored in an external file using the optional `ovf:fileRef` attribute on the `Msg` element. For the `License` element on `EulaSection` in particular, this allows inclusion of a standard license text file in unaltered form without any XML header or footer.

The `ovf:fileRef` attribute denotes the message content by identifying an existing `File` element in the `References` element, the `File` element is identified by matching its `ovf:id` attribute value with the `ovf:fileRef` attribute value. The content of an external file referenced using `ovf:fileRef` shall be interpreted as plain text in UTF-8 Unicode.

If the referenced file is not found, the embedded content of the `Msg` element shall be used.

The optional `ovf:fileRef` attribute may appear on `Msg` elements in both internal and external `Strings` resource bundles.

EXAMPLE 5:

```
<Envelope xml:lang="en-US">
  <References>
    <File ovf:id="license-en-US" ovf:href="license-en-US.txt"/>
    <File ovf:id="license-de-DE" ovf:href="license-de-DE.txt"/>
  </References>
  ...
  <VirtualSystem ovf:id="...">
     <EulaSection>
        <Info>Licensing agreement</Info>
        <License ovf:msgid="license">Unused</License>
```

```
       </EulaSection>
       ...
    </VirtualSystem>
    ...
    <Strings xml:lang="en-US">
      <Msg ovf:msgid="license" ovf:fileRef="license-en-US">Invalid license</Msg>
    </Strings>
    <Strings xml:lang="de-DE">
      <Msg ovf:msgid="license" ovf:fileRef="license-de-DE">Ihre Lizenz ist nicht
gültig</Msg>
    </Strings>
</Envelope>
```

In the example above, the default license agreement is stored in plain text file `license-en-US.txt`, while the license agreement for the `de-DE` locale is stored in file `license-de-DE.txt`.

Note that the above mechanism works for all localizable elements and not just `License`.

11 OVF Environment

The OVF environment defines how the guest software and the deployment platform interact. This environment allows the guest software to access information about the deployment platform, such as the user-specified values for the properties defined in the OVF descriptor.

The environment specification is split into a *protocol* part and a *transport* part. The *protocol* part defines the format and semantics of an XML document that can be made accessible to the guest software. The *transport* part defines how the information is communicated between the deployment platform and the guest software.

The `dsp8027_1.1.0.xsd` XML schema definition file for the OVF environment contains the elements and attributes.

11.1 Environment Document

The environment document is an extensible XML document that is provided to the guest software about the environment in which it is being executed. The way that the document is obtained depends on the transport type.

EXAMPLE: An example of the structure of the OVF environment document follows:

```
<?xml version="1.0" encoding="UTF-8"?>
<Environment xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
             xmlns:ovfenv="http://schemas.dmtf.org/ovf/environment/1"
             xmlns="http://schemas.dmtf.org/ovf/environment/1"
             ovfenv:id="identification of VM from OVF descriptor">
    <!-- Information about virtualization platform -->
    <PlatformSection>
       <Kind>Type of virtualization platform</Kind>
       <Version>Version of virtualization platform</Version>
       <Vendor>Vendor of virtualization platform</Vendor>
       <Locale>Language and country code</Locale>
       <TimeZone>Current timezone offset in minutes from UTC</TimeZone>
    </PlatformSection>
    <!--- Properties defined for this virtual machine -->
    <PropertySection>
       <Property ovfenv:key="key" ovfenv:value="value">
       <!-- More properties -->
    </PropertySection>
    <Entity ovfenv:id="id of sibling virtual system or virtual system collection">
      <PropertySection>
         <!-- Properties from sibling -->
      </PropertySection>
    </Entity>
</Environment>
```

The value of the `ovfenv:id` attribute of the `Environment` element shall match the value of the `ovf:id` attribute of the `VirtualSystem` entity describing this virtual machine.

The `PlatformSection` element contains optional information provided by the deployment platform. Elements `Kind`, `Version`, and `Vendor` describe deployment platform vendor details; these elements are experimental. Elements `Locale` and `TimeZone` describe the current locale and time zone; these elements are experimental.

The `PropertySection` element contains `Property` elements with key/value pairs corresponding to all properties specified in the OVF descriptor for the current virtual machine, as well as properties specified for the immediate parent `VirtualSystemCollection`, if one exists. The environment presents properties as a simple list to make it easy for applications to parse. Furthermore, the single list format supports the override semantics where a property on a `VirtualSystem` may override one defined on a parent `VirtualSystemCollection`. The overridden property shall not be in the list. Overriding may occur if a property in the current virtual machine and a property in the parent `VirtualSystemCollection` has identical `ovf:key`, `ovf:class`, and `ovf:instance` attribute values; see 9.5. In this case, the value of an overridden parent property may be obtained by adding a differently named child property referencing the parent property with a macro; see 9.5.

An `Entity` element shall exist for each sibling `VirtualSystem` and `VirtualSystemCollection`, if any are present. The value of the `ovfenv:id` attribute of the `Entity` element shall match the value of the `ovf:id` attribute of the sibling entity. The `Entity` elements contain the property key/value pairs in the sibling's OVF environment documents, so the content of an `Entity` element for a particular sibling shall contain the exact `PropertySection` seen by that sibling. This information can be used, for example, to make configuration information such as IP addresses available to `VirtualSystems` being part of a multi-tiered application.

Table 8 shows the core sections that are defined.

Table 8 – Core Sections

Section	Location	Multiplicity
`PlatformSection` Provides information from the deployment platform	Environment	Zero or one
`PropertySection` Contains key/value pairs corresponding to properties defined in the OVF descriptor	Environment Entity	Zero or one

The environment document is extensible by providing new section types. A consumer of the document should ignore unknown section types and elements.

11.2 Transport

The environment document information can be communicated in a number of ways to the guest software. These ways are called transport types. The transport types are specified in the OVF descriptor by the `ovf:transport` attribute of `VirtualHardwareSection`. Several transport types may be specified, separated by a single space character, in which case an implementation is free to use any of them. The transport types define methods by which the environment document is communicated from the deployment platform to the guest software.

To enable interoperability, this specification defines an `"iso"` transport type which all implementations that support CD-ROM devices are required to support. The `iso` transport communicates the environment document by making a dynamically generated ISO image available to the guest software. To support the `iso` transport type, prior to booting a virtual machine, an implementation shall make an ISO read-only disk image available as backing for a disconnected CD-ROM. If the `iso` transport is selected for a `VirtualHardwareSection`, at least one disconnected CD-ROM device shall be present in this section.

The generated ISO image shall comply with the ISO 9660 specification with support for Joliet extensions.

The ISO image shall contain the OVF environment for this particular virtual machine, and the environment shall be present in an XML file named `ovf-env.xml` that is contained in the root directory of the ISO image. The guest software can now access the information using standard guest operating system tools.

If the virtual machine prior to booting had more than one disconnected CD-ROM, the guest software may have to scan connected CD-ROM devices in order to locate the ISO image containing the `ovf-env.xml` file.

The ISO image containing the OVF environment shall be made available to the guest software on every boot of the virtual machine.

Support for the `"iso"` transport type is not a requirement for virtual hardware architectures or guest operating systems which do not have CD-ROM device support.

To be compliant with this specification, any transport format other than `iso` shall be given by a URI which identifies an unencumbered specification on how to use the transport. The specification need not be machine readable, but it shall be static and unique so that it may be used as a key by software reading an OVF descriptor to uniquely determine the format. The specification shall be sufficient for a skilled person to properly interpret the transport mechanism for implementing the protocols. The URIs should be resolvable.

ANNEX A
(informative)

Symbols and Conventions

XML examples use the XML namespace prefixes defined in Table 1. The XML examples use a style to not specify namespace prefixes on child elements. Note that XML rules define that child elements specified without namespace prefix are from the namespace of the parent element, and not from the default namespace of the XML document. Throughout the document, whitespace within XML element values is used for readability. In practice, a service can accept and strip leading and trailing whitespace within element values as if whitespace had not been used.

Syntax definitions in this document use Augmented BNF (ABNF) as defined in IETF RFC5234 with the following exceptions:

- Rules separated by a bar (|) represent choices, instead of using a forward slash (/) as defined in ABNF.
- Any characters must be processed case sensitively, instead of case-insensitively as defined in ABNF.
- Whitespace (i.e., the space character U+0020 and the tab character U+0009) is allowed between syntactical elements, instead of assembling elements without whitespace as defined in ABNF.

ANNEX B (normative)

OVF XSD

Normative copies of the XML schemas for this specification may be retrieved by resolving the following URLs:

```
http://schemas.dmtf.org/ovf/envelope/2/dsp8023.xsd
http://schemas.dmtf.org/ovf/environment/1/dsp8027.xsd
```

Any `xs:documentation` content in XML schemas for this specification is informative and provided only for convenience.

Normative copies of the XML schemas for the WS-CIM mapping (DSP0230) of `CIM_ResourceAllocationSystemSettingsData`, `CIM_VirtualSystemSettingData`, `CIM_EthernetPortAllocationSettingData`, `CIM_StorageAllocationSettingData` and `CIM_OperatingSystem`, may be retrieved by resolving the following URLs:

```
http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_VirtualSystemSettingData.xsd
http://schemas.dmtf.org/wbem/wscim/1/cim-
schema/2/CIM_ResourceAllocationSettingData.xsd
http://schemas.dmtf.org/wbem/wscim/1/cim-
schema/2/CIM_EthernetPortAllocationSettingData.xsd
http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_StorageAllocationSettingData.xsd
```

This specification is based on the following CIM MOFs:

```
  CIM_VirtualSystemSettingData.mof
  CIM_ResourceAllocationSettingData.mof
  CIM_EthernetPortAllocationSettingData.mof
  CIM_StorageAllocationSettingData.mof
  CIM_OperatingSystem.mof
```

ANNEX C (informative)

OVF Mime Type Registration Template

Registration Template

To: ietf-types@iana.org

Subject: Registration of media type Application/OVF

Type name: Application

Subtype name: OVF

Required parameters: none

Optional parameters: none

Encoding considerations: binary

Security considerations:

- An OVF package contains active content that is expected to be launched in a virtual machine. The OVF standard, section 5.1 states: “An OVF package may be signed by signing the manifest file. The digest of the manifest file is stored in a certificate file with extension .cert file along with the base64-encoded X.509 certificate. The .cert file shall have the same base name as the .ovf file and be a sibling of the .ovf file. A consumer of the OVF package shall verify the signature and should validate the certificate.
- An OVF package may contain passwords as part of the configuration information. The OVF standard, section 9.5 states: “The optional Boolean attribute ovf:password indicates that the property value may contain sensitive information. The default value is FALSE. OVF implementations prompting for property values are advised to obscure these values when ovf:password is set to TRUE. This is similar to HTML text input of type password. Note that this mechanism affords limited security protection only. Although sensitive values are masked from casual observers, default values in the OVF descriptor and assigned values in the OVF environment are still passed in clear text. “

Interoperability considerations:

- OVF has demonstrated interoperability via multiple, interoperating implementations in the market.

Published specification:

- DSP0243_2.0.0.pdf

Applications that use this media type:

- Implementations of the DMTF Standard: Cloud Infrastructure Management Interface (CIMI) (DSP0263_1.0.0.pdf)
- Implementations of the SNIA Cloud Data Management Interface (CDMI) – OVF Extension

Additional information:
- Magic number(s): none
- File extension(s): .ova
- Macintosh file type code(s): none
- Person & email address to contact for further information:

- Intended usage: (One of COMMON, LIMITED USE or OBSOLETE.)
- Restrictions on usage: (Any restrictions on where the media type can be used go here.)
- Author:
- Change controller:

ANNEX D (informative)

Network Port Profile Examples

D.1 Example 1 (OVF Descriptor for One Virtual System and One Network with an Inlined Network Port Profile)

The example below shows an OVF descriptor that describes a virtual system and a network it connects to. The virtual system description in this example uses an inlined network port profile that is described as an XML element that contains child XML elements from epasd namespace. The network described in the network section uses the same network port profile description. The network port profile described in this example is used to reserve 1 Gbps of bandwidth.

```
<?xml version="1.0" encoding="UTF-8"?>
<Envelope xsi:schemaLocation="http://schemas.dmtf.org/ovf/envelope/2
file:///C:/dsp8023_2.0.0_wgv0.9.5.xsd" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:ovf="http://schemas.dmtf.org/ovf/envelope/2" xmlns="http://schemas.dmtf.org/ovf/envelope/2"
xmlns:vssd="http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_VirtualSystemSettingData"
xmlns:rasd="http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_ResourceAllocationSettingData"
xmlns:epasd="http://schemas.dmtf.org/wbem/wscim/1/cim-
schema/2/CIM_EthernetPortAllocationSettingData"
xmlns:sasd="http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_StorageAllocationSettingData">
<!-- References to all external files -->
    <References>
        <File ovf:id="file1" ovf:href="vmdisk1.vmdk" ovf:size="2000000000"/>
    </References>
    <!-- Describes meta-information for all virtual disks in the package -->
    <DiskSection>
        <Info>Describes the set of virtual disks</Info>
        <Disk ovf:diskId="vmdisk1" ovf:fileRef="file1" ovf:capacity="4294967296"
ovf:format="http://www.examplecompany.com/interfaces/specifications/vmdk.html#sparse"/>
    </DiskSection>
    <!-- Describes all networks used in the package -->
    <NetworkSection>
        <Info>List of logical networks used in the package</Info>
        <Network ovf:name="VM Network">
            <Description>The network that the VMs connect to</Description>
            <NetworkPortProfile>
                <!-- Network port profile describing bandwidth reservation. Network port profile
is identified by UUID. -->
                <Item>
                    <epasd:AllocationUnits>bit / second * 10^9</epasd:AllocationUnits>
                    <epasd:ElementName>Network Port Profile 1</epasd:ElementName>
                    <epasd:InstanceID>1</epasd:InstanceID>
                    <epasd:NetworkPortProfileID>aaaaaaaa-bbbb-cccc-dddd-
eeeeeeeeeeee</epasd:NetworkPortProfileID>
                    <epasd:NetworkPortProfileIDType>3</epasd:NetworkPortProfileIDType>
                    <epasd:Reservation>1</epasd:Reservation>
                </Item>
            </NetworkPortProfile>
        </Network>
    </NetworkSection>
    <VirtualSystem ovf:id="vm">
        <Info>Describes a virtual machine</Info>
        <Name>Virtual Appliance One</Name>
        <ProductSection>
            <Info>Describes product information for the appliance</Info>
            <Product>The Great Appliance</Product>
            <Vendor>Some Great Corporation</Vendor>
            <Version>13.00</Version>
            <FullVersion>13.00-b5</FullVersion>
            <ProductUrl>http://www.somegreatcorporation.com/greatappliance</ProductUrl>
            <VendorUrl>http://www.somegreatcorporation.com/</VendorUrl>
            <Property ovf:key="admin.email" ovf:type="string">
```

```
                <Description>Email address of administrator</Description>
            </Property>
            <Property ovf:key="app.ip" ovf:type="string" ovf:defaultValue="192.168.0.10">
                <Description>The IP address of this appliance</Description>
            </Property>
        </ProductSection>
        <AnnotationSection ovf:required="false">
            <Info>A random annotation on this service. It can be ignored</Info>
            <Annotation>Contact customer support if you have any problems</Annotation>
        </AnnotationSection>
        <EulaSection>
            <Info>License information for the appliance</Info>
            <License>Insert your favorite license here</License>
        </EulaSection>
        <VirtualHardwareSection>
            <Info>Memory = 4 GB, CPU = 1 GHz, Disk = 100 GB, 1 Ethernet nic</Info>
            <Item>
                <rasd:AllocationUnits>Hertz*10^9</rasd:AllocationUnits>
                <rasd:Description>Virtual CPU</rasd:Description>
                <rasd:ElementName>1 GHz virtual CPU</rasd:ElementName>
                <rasd:InstanceID>1</rasd:InstanceID>
                <rasd:Reservation>1</rasd:Reservation>
                <rasd:ResourceType>3</rasd:ResourceType>
                <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
            </Item>
            <Item>
                <rasd:AllocationUnits>byte*2^30</rasd:AllocationUnits>
                <rasd:Description>Memory</rasd:Description>
                <rasd:ElementName>1 GByte of memory</rasd:ElementName>
                <rasd:InstanceID>2</rasd:InstanceID>
                <rasd:ResourceType>4</rasd:ResourceType>
                <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
            </Item>
            <EthernetPortItem>
                <epasd:Address>00-16-8B-DB-00-5E</epasd:Address>
                <epasd:AllocationUnits>bit / second * 10^9 </epasd:AllocationUnits>
                <epasd:Connection>VM Network</epasd:Connection>
                <epasd:Description>Virtual NIC</epasd:Description>
                <epasd:ElementName>Ethernet Port</epasd:ElementName>

                <epasd:InstanceID>3</epasd:InstanceID>
                <epasd:NetworkPortProfileID>aaaaaaaa-bbbb-cccc-dddd-
eeeeeeeeeeee</epasd:NetworkPortProfileID>
                <epasd:NetworkPortProfileIDType>3</epasd:NetworkPortProfileIDType>
                <epasd:Reservation>1</epasd:Reservation>
                <epasd:ResourceType>10</epasd:ResourceType>
                <epasd:VirtualQuantityUnits>1</epasd:VirtualQuantityUnits>
            </EthernetPortItem>
            <StorageItem>
                <sasd:AllocationUnits>byte*2^30</sasd:AllocationUnits>
                <sasd:Description>Virtual Disk</sasd:Description>
                <sasd:ElementName>100 GByte Virtual Disk</sasd:ElementName>
                <sasd:InstanceID>4</sasd:InstanceID>
                <sasd:Reservation>100</sasd:Reservation>
                <sasd:ResourceType>31</sasd:ResourceType>
                <sasd:VirtualQuantity>1</sasd:VirtualQuantity>
            </StorageItem>
        </VirtualHardwareSection>
        <OperatingSystemSection ovf:id="58" ovf:required="false">
            <Info>Guest Operating System</Info>
            <Description>OS</Description>
        </OperatingSystemSection>
    </VirtualSystem>
</Envelope>
```

D.2 Example 2 (OVF Descriptor for One Virtual System and One Network with a Locally Referenced Network Port Profile)

The example below shows an OVF descriptor that describes a virtual system and a network it connects to. The virtual system description in this example uses a network port profile that is described in a local file that is contained in the same OVF package. The network described in the network section uses the same network port profile description. The network port profile described in this example is used to reserve 1 Gbps of bandwidth.

```
<?xml version="1.0" encoding="UTF-8"?>
<Envelope xsi:schemaLocation="http://schemas.dmtf.org/ovf/envelope/2
file:///C:/dsp8023_2.0.0_wgv0.9.5.xsd" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:ovf="http://schemas.dmtf.org/ovf/envelope/2" xmlns="http://schemas.dmtf.org/ovf/envelope/2"
xmlns:vssd="http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_VirtualSystemSettingData"
xmlns:rasd="http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_ResourceAllocationSettingData"
xmlns:epasd="http://schemas.dmtf.org/wbem/wscim/1/cim-
schema/2/CIM_EthernetPortAllocationSettingData"
xmlns:sasd="http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_StorageAllocationSettingData">
<!-- References to all external files -->
    <References>
        <File ovf:id="file1" ovf:href="vmdisk1.vmdk" ovf:size="2000000000"/>
        <File ovf:id="networkportprofile1" ovf:href="NetworkPortProfile1.xml"/>
    </References>
    <!-- Describes meta-information for all virtual disks in the package -->
    <DiskSection>
        <Info>Describes the set of virtual disks</Info>
        <Disk ovf:diskId="vmdisk1" ovf:fileRef="file1" ovf:capacity="4294967296"
ovf:format="http://www.examplecompany.com/interfaces/specifications/vmdk.html#sparse"/>
    </DiskSection>
    <!-- Describes all networks used in the package -->
    <NetworkSection>
        <Info>List of logical networks used in the package</Info>
        <Network ovf:name="VM Network">
            <Description>The network that VMs connect to</Description>
            <NetworkPortProfileURI>file:networkportprofile1</NetworkPortProfileURI>
        </Network>
    </NetworkSection>
    <VirtualSystem ovf:id="vm">
        <Info>Describes a virtual machine</Info>
        <Name>Virtual Appliance One</Name>
        <ProductSection>
            <Info>Describes product information for the appliance</Info>
            <Product>The Great Appliance</Product>
            <Vendor>Some Great Corporation</Vendor>
            <Version>13.00</Version>
            <FullVersion>13.00-b5</FullVersion>
            <ProductUrl>http://www.somegreatcorporation.com/greatappliance</ProductUrl>
            <VendorUrl>http://www.somegreatcorporation.com/</VendorUrl>
            <Property ovf:key="admin.email" ovf:type="string">
                <Description>Email address of administrator</Description>
            </Property>
            <Property ovf:key="app.ip" ovf:type="string" ovf:defaultValue="192.168.0.10">
                <Description>The IP address of this appliance</Description>
            </Property>
        </ProductSection>
        <AnnotationSection ovf:required="false">
            <Info>A random annotation on this service. It can be ignored</Info>
            <Annotation>Contact customer support if you have any problems</Annotation>
        </AnnotationSection>
        <EulaSection>
            <Info>License information for the appliance</Info>
            <License>Insert your favorite license here</License>
        </EulaSection>
        <VirtualHardwareSection>
            <Info>Memory = 4 GB, CPU = 1 GHz, Disk = 100 GB, 1 Ethernet nic</Info>
            <Item>
                <rasd:AllocationUnits>Hertz*10^9</rasd:AllocationUnits>
                <rasd:Description>Virtual CPU</rasd:Description>
                <rasd:ElementName>1 GHz virtual CPU</rasd:ElementName>
                <rasd:InstanceID>1</rasd:InstanceID>
                <rasd:Reservation>1</rasd:Reservation>
                <rasd:ResourceType>3</rasd:ResourceType>
                <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
            </Item>
            <Item>
                <rasd:AllocationUnits>byte*2^30</rasd:AllocationUnits>
                <rasd:Description>Memory</rasd:Description>
                <rasd:ElementName>1 GByte of memory</rasd:ElementName>
                <rasd:InstanceID>2</rasd:InstanceID>
                <rasd:ResourceType>4</rasd:ResourceType>
                <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
            </Item>
            <EthernetPortItem>
                <epasd:Address>00-16-8B-DB-00-5E</epasd:Address>
                <epasd:Connection>VM Network</epasd:Connection>
                <epasd:Description>Virtual NIC</epasd:Description>
                <epasd:ElementName>Ethernet Port</epasd:ElementName>

                <epasd:InstanceID>3</epasd:InstanceID>
                <epasd:NetworkPortProfileID>file:networkportprofile1</epasd:NetworkPortProfileID>
                <epasd:NetworkPortProfileIDType>2</epasd:NetworkPortProfileIDType>
                <epasd:ResourceType>10</epasd:ResourceType>
                <epasd:VirtualQuantityUnits>1</epasd:VirtualQuantityUnits>
            </EthernetPortItem>
            <StorageItem>
                <sasd:AllocationUnits>byte*2^30</sasd:AllocationUnits>
                <sasd:Description>Virtual Disk</sasd:Description>
                <sasd:ElementName>100 GByte Virtual Disk</sasd:ElementName>
                <sasd:InstanceID>4</sasd:InstanceID>
                <sasd:Reservation>100</sasd:Reservation>
                <sasd:ResourceType>31</sasd:ResourceType>
                <sasd:VirtualQuantity>1</sasd:VirtualQuantity>
            </StorageItem>
        </VirtualHardwareSection>
        <OperatingSystemSection ovf:id="58" ovf:required="false">
            <Info>Guest Operating System</Info>
            <Description>OS</Description>
        </OperatingSystemSection>
    </VirtualSystem>
</Envelope>
```

D.3 Example 3 (OVF Descriptor for One Virtual System and One Network with a Network Port Profile referenced by a URI)

The example below shows an OVF descriptor that describes a virtual system and a network it connects to. The virtual system description in this example uses a network port profile that is described by a URI. The network described in the network section uses the same network port profile description. The network port profile described in this example is used to reserve 1 Gbps of bandwidth.

```
<?xml version="1.0" encoding="UTF-8"?>
<Envelope xsi:schemaLocation="http://schemas.dmtf.org/ovf/envelope/2
file:///C:/dsp8023_2.0.0_wgv0.9.5.xsd" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:ovf="http://schemas.dmtf.org/ovf/envelope/2" xmlns="http://schemas.dmtf.org/ovf/envelope/2"
xmlns:vssd="http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_VirtualSystemSettingData"
xmlns:rasd="http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_ResourceAllocationSettingData"
xmlns:epasd="http://schemas.dmtf.org/wbem/wscim/1/cim-
schema/2/CIM_EthernetPortAllocationSettingData"
xmlns:sasd="http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_StorageAllocationSettingData">
<!-- References to all external files -->
    <References>
        <File ovf:id="file1" ovf:href="vmdisk1.vmdk" ovf:size="2000000000"/>
    </References>
    <!-- Describes meta-information for all virtual disks in the package -->
    <DiskSection>
        <Info>Describes the set of virtual disks</Info>
        <Disk ovf:diskId="vmdisk1" ovf:fileRef="file1" ovf:capacity="4294967296"
ovf:format="http://www.examplecompany.com/interfaces/specifications/vmdk.html#sparse"/>
    </DiskSection>
    <!-- Describes all networks used in the package -->
    <NetworkSection>
        <Info>List of logical networks used in the package</Info>
        <Network ovf:name="VM Network">
            <Description>The network that the VMs connect to</Description>

    <NetworkPortProfileURI>http://www.dmtf.org/networkportprofiles/networkportprofile1.xml</Netwo
rkPortProfileURI>
        </Network>
    </NetworkSection>
    <VirtualSystem ovf:id="vm">
        <Info>Describes a virtual machine</Info>
        <Name>Virtual Appliance One</Name>
        <ProductSection>
            <Info>Describes product information for the appliance</Info>
            <Product>The Great Appliance</Product>
            <Vendor>Some Great Corporation</Vendor>
            <Version>13.00</Version>
            <FullVersion>13.00-b5</FullVersion>
            <ProductUrl>http://www.somegreatcorporation.com/greatappliance</ProductUrl>
            <VendorUrl>http://www.somegreatcorporation.com/</VendorUrl>
            <Property ovf:key="admin.email" ovf:type="string">
                <Description>Email address of administrator</Description>
            </Property>
            <Property ovf:key="app.ip" ovf:type="string" ovf:defaultValue="192.168.0.10">
                <Description>The IP address of this appliance</Description>
            </Property>
        </ProductSection>
        <AnnotationSection ovf:required="false">
            <Info>A random annotation on this service. It can be ignored</Info>
            <Annotation>Contact customer support if you have any problems</Annotation>
        </AnnotationSection>
        <EulaSection>
            <Info>License information for the appliance</Info>
            <License>Insert your favorite license here</License>
        </EulaSection>
        <VirtualHardwareSection>
            <Info>Memory = 4 GB, CPU = 1 GHz, Disk = 100 GB, 1 Ethernet nic</Info>
            <Item>
                <rasd:AllocationUnits>Hertz*10^9</rasd:AllocationUnits>
                <rasd:Description>Virtual CPU</rasd:Description>
                <rasd:ElementName>1 GHz virtual CPU</rasd:ElementName>
                <rasd:InstanceID>1</rasd:InstanceID>
                <rasd:Reservation>1</rasd:Reservation>
                <rasd:ResourceType>3</rasd:ResourceType>
                <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
            </Item>
            <Item>
                <rasd:AllocationUnits>byte*2^30</rasd:AllocationUnits>
                <rasd:Description>Memory</rasd:Description>
                <rasd:ElementName>1 GByte of memory</rasd:ElementName>
                <rasd:InstanceID>2</rasd:InstanceID>
                <rasd:ResourceType>4</rasd:ResourceType>
                <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
            </Item>
            <EthernetPortItem>
                <epasd:Address>00-16-8B-DB-00-5E</epasd:Address>
                <epasd:Connection>VM Network</epasd:Connection>
                <epasd:Description>Virtual NIC</epasd:Description>
                <epasd:ElementName>Ethernet Port</epasd:ElementName>

                <epasd:InstanceID>3</epasd:InstanceID>

    <epasd:NetworkPortProfileID>http://www.dmtf.org/networkportprofiles/networkportprofile1.xml</
epasd:NetworkPortProfileID>
                <epasd:NetworkPortProfileIDType>2</epasd:NetworkPortProfileIDType>
                <epasd:ResourceType>10</epasd:ResourceType>
                <epasd:VirtualQuantityUnits>1</epasd:VirtualQuantityUnits>
            </EthernetPortItem>
            <StorageItem>
                <sasd:AllocationUnits>byte*2^30</sasd:AllocationUnits>
                <sasd:Description>Virtual Disk</sasd:Description>
                <sasd:ElementName>100 GByte Virtual Disk</sasd:ElementName>
                <sasd:InstanceID>4</sasd:InstanceID>
                <sasd:Reservation>100</sasd:Reservation>
                <sasd:ResourceType>31</sasd:ResourceType>
                <sasd:VirtualQuantity>1</sasd:VirtualQuantity>
            </StorageItem>
        </VirtualHardwareSection>
        <OperatingSystemSection ovf:id="58" ovf:required="false">
            <Info>Guest Operating System</Info>
            <Description>OS</Description>
        </OperatingSystemSection>
    </VirtualSystem>
</Envelope>
```

D.4 Example 4 (OVF Descriptor for Two Virtual Systems and One Network with Two Network Port Profiles referenced by URIs)

The example below shows an OVF descriptor that describes two virtual systems and a network they connect to. Each virtual system description in this example uses a network port profile that is described by a URI. The network described in the network section uses the same two network port profiles. The two network port profiles described in this example are used to reserve 1 Gbps of bandwidth and describe general network traffic respectively. Annex D.5 and D.6 are examples of these network port profiles.

```
<?xml version="1.0" encoding="UTF-8"?>
<Envelope xsi:schemaLocation="http://schemas.dmtf.org/ovf/envelope/2
file:///C:/dsp8023_2.0.0_wgv0.9.5.xsd" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:ovf="http://schemas.dmtf.org/ovf/envelope/2" xmlns="http://schemas.dmtf.org/ovf/envelope/2"
xmlns:vssd="http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_VirtualSystemSettingData"
xmlns:rasd="http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_ResourceAllocationSettingData"
xmlns:epasd="http://schemas.dmtf.org/wbem/wscim/1/cim-
schema/2/CIM_EthernetPortAllocationSettingData"
xmlns:sasd="http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_StorageAllocationSettingData">
<!-- References to all external files -->
    <References>
        <File ovf:id="file1" ovf:href="vmdisk1.vmdk" ovf:size="2000000000"/>
    </References>
    <!-- Describes meta-information for all virtual disks in the package -->
    <DiskSection>
        <Info>Describes the set of virtual disks</Info>
        <Disk ovf:diskId="vmdisk1" ovf:fileRef="file1" ovf:capacity="4294967296"
ovf:format="http://www.examplecompany.com/interfaces/specifications/vmdk.html#sparse"/>
    </DiskSection>
    <!-- Describes all networks used in the package -->
    <NetworkSection>
        <Info>List of logical networks used in the package</Info>
        <Network ovf:name="VM Network">
            <Description>The network that the VMs connect to</Description>
            <!-- Network port profile for storage traffic -->

    <NetworkPortProfileURI>http://www.dmtf.org/networkportprofiles/networkportprofile1.xml</Netwo
rkPortProfileURI>
            <!-- Network port profile for networking traffic -->

    <NetworkPortProfileURI>http://www.dmtf.org/networkportprofiles/networkportprofile2.xml</Netwo
rkPortProfileURI>
        </Network>
    </NetworkSection>
    <VirtualSystemCollection ovf:id="vsc1">
        <Info>Collection of 2 VMs</Info>
        <VirtualSystem ovf:id="storage server">
            <Info>Describes a virtual machine</Info>
            <Name>Virtual Appliance One</Name>
            <ProductSection>
                <Info>Describes product information for the appliance</Info>
                <Product>The Great Appliance</Product>
                <Vendor>Some Great Corporation</Vendor>
                <Version>13.00</Version>
                <FullVersion>13.00-b5</FullVersion>
                <ProductUrl>http://www.somegreatcorporation.com/greatappliance</ProductUrl>
                <VendorUrl>http://www.somegreatcorporation.com/</VendorUrl>
                <Property ovf:key="admin.email" ovf:type="string">
                    <Description>Email address of administrator</Description>
                </Property>
                <Property ovf:key="app.ip" ovf:type="string" ovf:defaultValue="192.168.0.10">
                    <Description>The IP address of this appliance</Description>
                </Property>
            </ProductSection>
            <AnnotationSection ovf:required="false">
                <Info>A random annotation on this service. It can be ignored</Info>
                <Annotation>Contact customer support if you have any problems</Annotation>
            </AnnotationSection>
            <EulaSection>
                <Info>License information for the appliance</Info>
                <License>Insert your favorite license here</License>
            </EulaSection>
            <VirtualHardwareSection>
                <Info>Memory = 4 GB, CPU = 1 GHz, Disk = 100 GB, 1 Ethernet nic</Info>
                <Item>
                    <rasd:AllocationUnits>Hertz*10^9</rasd:AllocationUnits>
                    <rasd:Description>Virtual CPU</rasd:Description>
                    <rasd:ElementName>1 GHz virtual CPU</rasd:ElementName>
                    <rasd:InstanceID>1</rasd:InstanceID>
                    <rasd:Reservation>1</rasd:Reservation>
                    <rasd:ResourceType>3</rasd:ResourceType>
                    <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
                </Item>
                <Item>
                    <rasd:AllocationUnits>byte*2^30</rasd:AllocationUnits>
                    <rasd:Description>Memory</rasd:Description>
                    <rasd:ElementName>1 GByte of memory</rasd:ElementName>
                    <rasd:InstanceID>2</rasd:InstanceID>
                    <rasd:ResourceType>4</rasd:ResourceType>
                    <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
                </Item>
                <EthernetPortItem>
                    <epasd:Address>00-16-8B-DB-00-5E</epasd:Address>
                    <epasd:Connection>VM Network</epasd:Connection>
                    <epasd:Description>Virtual NIC</epasd:Description>

                    <epasd:ElementName>Ethernet Port</epasd:ElementName>

                    <epasd:InstanceID>3</epasd:InstanceID>

    <epasd:NetworkPortProfileID>http://www.dmtf.org/networkportprofiles/networkportprofile1.xml</
epasd:NetworkPortProfileID>
                    <epasd:NetworkPortProfileIDType>2</epasd:NetworkPortProfileIDType>
                    <epasd:ResourceType>10</epasd:ResourceType>
                    <epasd:VirtualQuantityUnits>1</epasd:VirtualQuantityUnits>
                </EthernetPortItem>
                <StorageItem>
                    <sasd:AllocationUnits>byte*2^30</sasd:AllocationUnits>
                    <sasd:Description>Virtual Disk</sasd:Description>
                    <sasd:ElementName>100 GByte Virtual Disk</sasd:ElementName>
                    <sasd:InstanceID>4</sasd:InstanceID>
                    <sasd:Reservation>100</sasd:Reservation>
                    <sasd:ResourceType>31</sasd:ResourceType>
                    <sasd:VirtualQuantity>1</sasd:VirtualQuantity>
                </StorageItem>
            </VirtualHardwareSection>
            <OperatingSystemSection ovf:id="58" ovf:required="false">
                <Info>Guest Operating System</Info>
                <Description>OS</Description>
            </OperatingSystemSection>
        </VirtualSystem>
        <VirtualSystem ovf:id="web-server">
                <Info>Describes a virtual machine</Info>
                <Name>Virtual Appliance Two</Name>
                <ProductSection>
                <Info>Describes product information for the appliance</Info>
                <Product>The Great Appliance</Product>
                <Vendor>Some Great Corporation</Vendor>
                <Version>13.00</Version>
                <FullVersion>13.00-b5</FullVersion>
                <ProductUrl>http://www.somegreatcorporation.com/greatappliance</ProductUrl>
                <VendorUrl>http://www.somegreatcorporation.com/</VendorUrl>
                <Property ovf:key="admin.email" ovf:type="string">
                    <Description>Email address of administrator</Description>
                </Property>
                <Property ovf:key="app.ip" ovf:type="string" ovf:defaultValue="192.168.0.10">
                    <Description>The IP address of this appliance</Description>
                </Property>
            </ProductSection>
            <AnnotationSection ovf:required="false">
                <Info>A random annotation on this service. It can be ignored</Info>
                <Annotation>Contact customer support if you have any problems</Annotation>
            </AnnotationSection>
            <EulaSection>
                <Info>License information for the appliance</Info>
                <License>Insert your favorite license here</License>
            </EulaSection>
            <VirtualHardwareSection>
                <Info>Memory = 4 GB, CPU = 1 GHz, Disk = 100 GB, 1 Ethernet nic</Info>
                <Item>
                    <rasd:AllocationUnits>Hertz*10^9</rasd:AllocationUnits>
                    <rasd:Description>Virtual CPU</rasd:Description>
                    <rasd:ElementName>1 GHz virtual CPU</rasd:ElementName>
                    <rasd:InstanceID>1</rasd:InstanceID>
                    <rasd:Reservation>1</rasd:Reservation>
                    <rasd:ResourceType>3</rasd:ResourceType>
                    <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
                </Item>
                <Item>
                    <rasd:AllocationUnits>byte*2^30</rasd:AllocationUnits>
                    <rasd:Description>Memory</rasd:Description>
                    <rasd:ElementName>1 GByte of memory</rasd:ElementName>
                    <rasd:InstanceID>2</rasd:InstanceID>
                    <rasd:ResourceType>4</rasd:ResourceType>
                    <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
                </Item>
                <EthernetPortItem>
                    <epasd:Address>00-16-8B-DB-00-5F</epasd:Address>
                    <epasd:Connection>VM Network</epasd:Connection>
                    <epasd:Description>Virtual NIC</epasd:Description>

                    <epasd:ElementName>Ethernet Port</epasd:ElementName>
                    <!-- Virtual NIC for networking traffic -->
                    <epasd:InstanceID>3</epasd:InstanceID>

    <epasd:NetworkPortProfileID>http://www.dmtf.org/networkportprofiles/networkportprofile2.xml</
epasd:NetworkPortProfileID>
                    <epasd:NetworkPortProfileIDType>2</epasd:NetworkPortProfileIDType>
                    <epasd:ResourceType>10</epasd:ResourceType>
                    <epasd:VirtualQuantityUnits>1</epasd:VirtualQuantityUnits>
                </EthernetPortItem>
                <StorageItem>
                    <sasd:AllocationUnits>byte*2^30</sasd:AllocationUnits>
                    <sasd:Description>Virtual Disk</sasd:Description>
                    <sasd:ElementName>100 GByte Virtual Disk</sasd:ElementName>
                    <sasd:InstanceID>4</sasd:InstanceID>
                    <sasd:Reservation>100</sasd:Reservation>
                    <sasd:ResourceType>31</sasd:ResourceType>
                    <sasd:VirtualQuantity>1</sasd:VirtualQuantity>
                </StorageItem>
            </VirtualHardwareSection>
            <OperatingSystemSection ovf:id="58" ovf:required="false">
                <Info>Guest Operating System</Info>
                <Description>OS</Description>
            </OperatingSystemSection>
        </VirtualSystem>
    </VirtualSystemCollection>
</Envelope>
```

D.5 Example 5 (networkportprofile1.xml)

Network Port profile example for bandwidth reservation.

```
<?xml version="1.0" encoding="UTF-8"?>
<NetworkPortProfile xsi:schemaLocation="http://schemas.dmtf.org/ovf/networkportprofile/1
http://schemas.dmtf.org/ovf/networkportprofile/1/dsp8049.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="http://schemas.dmtf.org/ovf/networkportprofile/1"
xmlns:rasd="http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_ResourceAllocationSettingData"
xmlns:epasd="http://schemas.dmtf.org/wbem/wscim/1/cim-
schema/2/CIM_EthernetPortAllocationSettingData">
        <Item>
                <epasd:AllocationUnits>bit / second * 10^9</epasd:AllocationUnits>
                <epasd:ElementName>Network Port Profile 1</epasd:ElementName>
                <epasd:InstanceID>1</epasd:InstanceID>
                <epasd:NetworkPortProfileID>aaaaaaaa-bbbb-cccc-dddd-
eeeeeeeeeeee</epasd:NetworkPortProfileID>
                <epasd:NetworkPortProfileIDType>3</epasd:NetworkPortProfileIDType>
                <epasd:Reservation>1</epasd:Reservation>
        </Item>
</NetworkPortProfile>
```

D.6 Example 6 (networkportprofile2.xml)

Network Port Profile example showing priority setting.

```
<?xml version="1.0" encoding="UTF-8"?>
<NetworkPortProfile xsi:schemaLocation="http://schemas.dmtf.org/ovf/networkportprofile/1
http://schemas.dmtf.org/ovf/networkportprofile/1/dsp8049.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="http://schemas.dmtf.org/ovf/networkportprofile/1"
xmlns:rasd="http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_ResourceAllocationSettingData"
xmlns:epasd="http://schemas.dmtf.org/wbem/wscim/1/cim-
schema/2/CIM_EthernetPortAllocationSettingData">
        <Item>
                <epasd:AllowedPriorities>0</epasd:AllowedPriorities>
                <epasd:AllowedPriorities>1</epasd:AllowedPriorities>
                <epasd:DefaultPriority>0</epasd:DefaultPriority>
                <epasd:ElementName>Network Port Profile 2</epasd:ElementName>
                <epasd:InstanceID>2</epasd:InstanceID>
                <epasd:NetworkPortProfileID>aaaaaaaa-bbbb-cccc-dddd-
ffffffffffff</epasd:NetworkPortProfileID>
                <epasd:NetworkPortProfileIDType>3</epasd:NetworkPortProfileIDType>
        </Item>
</NetworkPortProfile>
```

ANNEX E (informative)

Change Log

Version	Date	Description
1.0.0	2009-02-22	
1.1.0	2010-01-12	DMTF Standard release
2.0.0	2012-12-13	DMTF Standard release

Bibliography

ISO 9660, *Joliet Extensions Specification*, May 1995, http://littlesvr.ca/isomaster/resources/JolietSpecification.html

W3C, *Best Practices for XML Internationalization*, October 2008, http://www.w3.org/TR/2008/NOTE-xml-i18n-bp-20080213/

DMTF DSP1044, *Processor Device Resource Virtualization Profile 1.0* http://www.dmtf.org/standards/published_documents/DSP1044_1.0.pdf

DMTF DSP1045, *Memory Resource Virtualization Profile 1.0* http://www.dmtf.org/standards/published_documents/DSP1045_1.0.pdf

DMTF DSP1047, *Storage Resource Virtualization Profile 1.0* http://www.dmtf.org/standards/published_documents/DSP1047_1.0.pdf

DMTF DSP1022, *CPU Profile 1.0*, http://www.dmtf.org/standards/published_documents/DSP1022_1.0.pdf

DMTF DSP1026, *System Memory Profile 1.0*, http://www.dmtf.org/standards/published_documents/DSP1026_1.0.pdf

DMTF DSP1014, *Ethernet Port Profile 1.0*, http://www.dmtf.org/standards/published_documents/DSP1014_1.0.pdf

DMTF DSP1050, *Ethernet Port Resource Virtualization Profile 1.1* http://www.dmtf.org/standards/published_documents/DSP1050_1.1.pdf

DMTF DSP8049, *Network Port Profile XML Schema 1.0* http://schema.dmtf.org/ovf/networkportprofile/1/DSP8049_1.0.xsd