Open Virtualization Format Specification
DMTF is a not-for-profit association of industry members dedicated to promoting enterprise and systems management and interoperability. Members and non-members may reproduce DMTF specifications and documents, provided that correct attribution is given. As DMTF specifications may be revised from time to time, the particular version and release date should always be noted.

Implementation of certain elements of this standard or proposed standard may be subject to third party patent rights, including provisional patent rights (herein "patent rights"). DMTF makes no representations to users of the standard as to the existence of such rights, and is not responsible to recognize, disclose, or identify any or all such third party patent right, owners or claimants, nor for any incomplete or inaccurate identification or disclosure of such rights, owners or claimants. DMTF shall have no liability to any party, in any manner or circumstance, under any legal theory whatsoever, for failure to recognize, disclose, or identify any such third party patent rights, or for such party’s reliance on the standard or incorporation thereof in its product, protocols or testing procedures. DMTF shall have no liability to any party implementing such standard, whether such implementation is foreseeable or not, nor to any patent owner or claimant, and shall have no liability or responsibility for costs or losses incurred if a standard is withdrawn or modified after publication, and shall be indemnified and held harmless by any party implementing the standard from any and all claims of infringement by a patent owner for such implementations.

For information about patents held by third-parties which have notified the DMTF that, in their opinion, such patent may relate to or impact implementations of DMTF standards, visit http://www.dmtf.org/about/policies/disclosures.php.
# CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>Foreword</td>
<td>5</td>
</tr>
<tr>
<td>33</td>
<td>Introduction</td>
<td>6</td>
</tr>
<tr>
<td>34</td>
<td>1 Scope</td>
<td>7</td>
</tr>
<tr>
<td>35</td>
<td>2 Normative References</td>
<td>7</td>
</tr>
<tr>
<td>36</td>
<td>3 Terms and Definitions</td>
<td>8</td>
</tr>
<tr>
<td>37</td>
<td>4 Symbols and Abbreviated Terms</td>
<td>10</td>
</tr>
<tr>
<td>38</td>
<td>5 OVF Packages</td>
<td>10</td>
</tr>
<tr>
<td>39</td>
<td>5.1 OVF Package Structure</td>
<td>10</td>
</tr>
<tr>
<td>40</td>
<td>5.2 Virtual Disk Formats</td>
<td>12</td>
</tr>
<tr>
<td>41</td>
<td>5.3 Distribution as a Single File</td>
<td>12</td>
</tr>
<tr>
<td>42</td>
<td>5.4 Distribution as a Set of Files</td>
<td>13</td>
</tr>
<tr>
<td>43</td>
<td>6 OVF Descriptor</td>
<td>13</td>
</tr>
<tr>
<td>44</td>
<td>7 Envelope Element</td>
<td>14</td>
</tr>
<tr>
<td>45</td>
<td>7.1 File References</td>
<td>15</td>
</tr>
<tr>
<td>46</td>
<td>7.2 Content Element</td>
<td>16</td>
</tr>
<tr>
<td>47</td>
<td>7.3 Extensibility</td>
<td>17</td>
</tr>
<tr>
<td>48</td>
<td>7.4 Conformance</td>
<td>18</td>
</tr>
<tr>
<td>49</td>
<td>8 Virtual Hardware Description</td>
<td>19</td>
</tr>
<tr>
<td>50</td>
<td>8.1 VirtualHardwareSection</td>
<td>19</td>
</tr>
<tr>
<td>51</td>
<td>8.2 Extensibility</td>
<td>20</td>
</tr>
<tr>
<td>52</td>
<td>8.3 Virtual Hardware Elements</td>
<td>20</td>
</tr>
<tr>
<td>53</td>
<td>8.4 Ranges on Elements</td>
<td>23</td>
</tr>
<tr>
<td>54</td>
<td>9 Core Metadata Sections</td>
<td>25</td>
</tr>
<tr>
<td>55</td>
<td>9.1 DiskSection</td>
<td>26</td>
</tr>
<tr>
<td>56</td>
<td>9.2 NetworkSection</td>
<td>27</td>
</tr>
<tr>
<td>57</td>
<td>9.3 ResourceAllocationSection</td>
<td>27</td>
</tr>
<tr>
<td>58</td>
<td>9.4 AnnotationSection</td>
<td>28</td>
</tr>
<tr>
<td>59</td>
<td>9.5 ProductSection</td>
<td>28</td>
</tr>
<tr>
<td>60</td>
<td>9.6 EulaSection</td>
<td>31</td>
</tr>
<tr>
<td>61</td>
<td>9.7 StartupSection</td>
<td>32</td>
</tr>
<tr>
<td>62</td>
<td>9.8 DeploymentOptionSection</td>
<td>33</td>
</tr>
<tr>
<td>63</td>
<td>9.9 OperatingSystemSection</td>
<td>35</td>
</tr>
<tr>
<td>64</td>
<td>9.10 InstallSection</td>
<td>35</td>
</tr>
<tr>
<td>65</td>
<td>10 Internationalization</td>
<td>36</td>
</tr>
<tr>
<td>66</td>
<td>11 OVF Environment</td>
<td>37</td>
</tr>
<tr>
<td>67</td>
<td>11.1 Environment Document</td>
<td>38</td>
</tr>
<tr>
<td>68</td>
<td>11.2 Transport</td>
<td>39</td>
</tr>
<tr>
<td>69</td>
<td>ANNEX A (informative) Symbols and Conventions</td>
<td>41</td>
</tr>
<tr>
<td>70</td>
<td>ANNEX B (normative) OVF XSD</td>
<td>42</td>
</tr>
<tr>
<td>71</td>
<td>ANNEX C (informative) Change Log</td>
<td>43</td>
</tr>
<tr>
<td>72</td>
<td>Bibliography</td>
<td>44</td>
</tr>
<tr>
<td>73</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Tables

Table 1 – XML Namespace Prefixes ................................................................. 14
Table 2 – Actions for Child Elements with ovf:required Attribute .................... 20
Table 3 – HostResource Element .................................................................. 22
Table 4 – Elements for Virtual Devices and Controllers .................................. 23
Table 5 – Core Metadata Sections .................................................................. 25
Table 6 – Property Types .............................................................................. 31
Table 7 – Property Qualifiers ........................................................................ 31
Table 8 – Core Sections .................................................................................. 39
Foreword

The Open Virtualization Format Specification (DSP0243) was prepared by the OVF Work Group of the DMTF.

This specification has been developed as a result of joint work with many individuals and teams, including:

- Simon Crosby, XenSource
- Ron Doyle, IBM
- Mike Gering, IBM
- Michael Gionfriddo, Sun Microsystems
- Steffen Grarup, VMware (Co-Editor)
- Steve Hand, Symantec
- Mark Hapner, Sun Microsystems
- Daniel Hiltgen, VMware
- Michael Johanssen, IBM
- Lawrence J. Lamers, VMware (Chair)
- John Leung, Intel Corporation
- Fumio Machida, NEC Corporation
- Andreas Maier, IBM
- Ewan Mellor, Citrix Systems Inc.
- John Parchem, Microsoft
- Shishir Pardikar, Citrix Systems Inc.
- Stephen J. Schmidt, IBM
- René W. Schmidt, VMware (Co-Editor)
- Andrew Warfield, Citrix Systems Inc.
- Mark D. Weitzel, IBM
- John Wilson, Dell
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.
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.

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.

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, stored on the virtual disks, that runs when a virtual machine is powered on
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 hardware (including the CPU, controllers, Ethernet devices, and disks) that is seen by the guest software

3.20 virtual machine
the complete environment that supports the execution of guest software
A virtual machine is a full encapsulation of the virtual hardware, virtual disks, and the metadata associated with it. Virtual machines allow multiplexing of the underlying physical machine through a software layer called a hypervisor.

3.21 virtual machine collection
a service comprised of a set of virtual machines
The service can be a simple set of one or more virtual machines, or it can be a complex service built out of a combination of virtual machines and other virtual machine collections. Because virtual machine collections can be composed, it enables complex nested 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.vmdk
resource.iso
```

NOTE: The previous example uses VMDK disk files, but multiple disk formats are supported.

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-1 digests of individual files in the package. 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-1 digests and comparing them with the digests listed in the manifest file.

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"
digest        = 40( hex-digit ) ; 160-bit digest in 40-digit hexadecimal
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:

```
SHA1(package.ovf)= 237de026fb285b85528901da058475e56034da95
SHA1(vmdisk1.vmdk)= 393a66df214e192ffbfedb78528b5be75cc9e1c3
```

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"
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
```
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. It is recommended that these URIs are 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. For OVF TAR files, duplication is not allowed within the archive. In addition, the files shall be in the following order inside the archive:

1) OVF descriptor
2) OVF manifest (optional)
3) OVF certificate (optional)
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).
5) OVF manifest (optional)
6) OVF certificate (optional)

Note that the certificate file is optional. If no certificate file is present, the manifest file is also optional. If the manifest or certificate files are present, they shall either both be placed after the OVF descriptor, or both be placed at the end of the archive.

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

The dsp8023_1.1.0.xsd XML schema definition file for the OVF descriptor contains the elements and attributes.

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 document of an OVF descriptor shall contain one Envelope element, which is the only element allowed at the top level.

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

<table>
<thead>
<tr>
<th>Prefix</th>
<th>XML Namespace</th>
</tr>
</thead>
<tbody>
<tr>
<td>ovf</td>
<td><a href="http://schemas.dmtf.org/ovf/envelope/1">http://schemas.dmtf.org/ovf/envelope/1</a></td>
</tr>
<tr>
<td>ovfenv</td>
<td><a href="http://schemas.dmtf.org/ovf/environment/1">http://schemas.dmtf.org/ovf/environment/1</a></td>
</tr>
<tr>
<td>rasd</td>
<td><a href="http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_ResourceAllocationSettingData">http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_ResourceAllocationSettingData</a></td>
</tr>
<tr>
<td>vssd</td>
<td><a href="http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_VirtualSystemSettingData">http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2/CIM_VirtualSystemSettingData</a></td>
</tr>
<tr>
<td>cim</td>
<td><a href="http://schemas.dmtf.org/wbem/wscim/1/common">http://schemas.dmtf.org/wbem/wscim/1/common</a></td>
</tr>
</tbody>
</table>

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
<?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/1"
          xmlns="http://schemas.dmtf.org/ovf/envelope/1"
          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 -->
</Envelope>
```
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 that is 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 is always bytes. If present, the value of the ovf:size attribute shall 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 is as follows. The syntax uses ABNF with the exceptions listed in ANNEX A.

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

In this syntax, href-value is the value of the ovf:href attribute, and chunk-number is the 0-based position of the chunk starting with the value 0 and increases with increments of 1 for each chunk.

Chunking can be combined with compression, the entire file is then 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. For chunked files, the manifest file is allowed to contain an entry for the entire file; 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)= 3e19644ec2e806f38951789c76f43e4a0ec7ae233
SHA1(disk2.vmdk.000000000)= 4f7158731ff3d4380bf217da248d47a2473798d04
SHA1(disk2.vmdk.000000001)= 1289daeeaf43e7a8950384d26b437bb8defaf
SHA1(disk2.vmdk.000000002)= 4add2124b9eeafa4c42112876217deee5565d
SHA1(resources/image1.iso)= 72b37ff3fdd09f2a93ef1b83956f649b606b5b3
SHA1(http://mywebsite/resources/image2.iso)=
d3c2d79011c970615c5cf10b30957d1c4c968ad
```

### 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.

The structure of a VirtualSystem element is as follows:
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.

The structure of a VirtualSystemCollection element 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 shall 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>
  <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
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 hypervisor is allowed to 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 and CIM_ResourceAllocationSettingData. The XML representation of the CIM model is based on the WS-CIM mapping (DSP0230).

EXAMPLE: Example of VirtualHardwareSection:

```
<VirtualHardwareSection ovf:id="minimal" ovf:transport="iso">
  <Info>500Mb, 1 CPU, 1 disk, 1 nic virtual machine</Info>
  <System>
    <vssd:ElementName>Virtual System Type</vssd:ElementName>
    <vssd:InstanceID>0</vssd:InstanceID>
    <vssd:VirtualSystemType>vmx-4</vssd:VirtualSystemType>
  </System>
  <Item>
    <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
    <rasd:Description>Memory Size</rasd:Description>
    <rasd:ElementName>512 MB of memory</rasd:ElementName>
    <rasd:InstanceID>2</rasd:InstanceID>
    <rasd:ResourceType>4</rasd:ResourceType>
    <rasd:VirtualQuantity>512</rasd:VirtualQuantity>
  </Item>
  <!-- Additional Item elements can follow -->
</VirtualHardwareSection>
```

A VirtualSystem element shall have a VirtualHardwareSection direct child element. VirtualHardwareSection is disallowed as 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.

The `vssd:VirtualSystemType` 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 is should support at least one of the virtual system types identified in the `vssd:VirtualSystemType` elements. The virtual system type identifiers specified in `VirtualSystemTypesSupported` elements are expected to be matched against the values of property `Vssd: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:**

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

### 8.2 Extensibility

The optional `ovf:required` attribute on the `Item` 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` 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>
<thead>
<tr>
<th>Child Element</th>
<th><code>ovf:required</code> Attribute Value</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Known</td>
<td>TRUE or not specified</td>
<td>Shall interpret Item</td>
</tr>
<tr>
<td>Known</td>
<td>FALSE</td>
<td>Shall interpret Item</td>
</tr>
<tr>
<td>Unknown</td>
<td>TRUE or not specified</td>
<td>Shall fail Item</td>
</tr>
<tr>
<td>Unknown</td>
<td>FALSE</td>
<td>Shall ignore Item</td>
</tr>
</tbody>
</table>

### 8.3 Virtual Hardware Elements

The general form of any `Item` element in a `VirtualHardwareSection` element is as follows:

```xml
<Item ovf:required="..." ovf:configuration="..." ovf:bound="...">
  <rasd:Address> ... </rasd:Address>
  <rasd:AddressOnParent> ... </rasd:AddressOnParent>
  <rasd:AllocationUnits> ... </rasd:AllocationUnits>
  <rasd:AutomaticAllocation> ... </rasd:AutomaticAllocation>
  <rasd:AutomaticDeallocation> ... </rasd:AutomaticDeallocation>
</Item>
```
The elements represent the 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 Description element is used to provide additional metadata about the 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>
<thead>
<tr>
<th>Content</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ovf:/file/&lt;id&gt;</td>
<td>A reference to a file in the OVF, as specified in the References section.</td>
</tr>
<tr>
<td></td>
<td>&lt;id&gt; shall be the value of the ovf:id attribute of the File element being</td>
</tr>
<tr>
<td></td>
<td>referenced.</td>
</tr>
<tr>
<td>ovf:/disk/&lt;id&gt;</td>
<td>A reference to a virtual disk, as specified in the DiskSection.</td>
</tr>
<tr>
<td></td>
<td>&lt;id&gt; shall be the value of the ovf:diskId attribute of the Disk element</td>
</tr>
<tr>
<td></td>
<td>being referenced.</td>
</tr>
</tbody>
</table>

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. Specifying more than one backing for a device is not allowed.

Table 4 gives a brief overview on how elements are used to describe virtual devices and controllers.
### Table 4 – Elements for Virtual Devices and Controllers

<table>
<thead>
<tr>
<th>Element</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>rasd:Description</td>
<td>A human-readable description of the meaning of the information. For example, “Specifies the memory size of the virtual machine”.</td>
</tr>
<tr>
<td>rasd:ElementName</td>
<td>A human-readable description of the content. For example, “256MB memory”.</td>
</tr>
<tr>
<td>rasd:InstanceID</td>
<td>A unique instance ID of the element within the section.</td>
</tr>
<tr>
<td>rasd:HostResource</td>
<td>Abstractly specifies how a device shall connect to a resource on the deployment platform. Not all devices need a backing. See Table 3.</td>
</tr>
<tr>
<td>rasd:ResourceType</td>
<td>Specifies the kind of device that is being described.</td>
</tr>
<tr>
<td>rasd:OtherResourceType</td>
<td></td>
</tr>
<tr>
<td>rasd:ResourceSubtype</td>
<td></td>
</tr>
<tr>
<td>rasd:AutomaticAllocation</td>
<td>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.</td>
</tr>
<tr>
<td>rasd:Parent</td>
<td>The InstanceID of the parent controller (if any).</td>
</tr>
<tr>
<td>rasd:Connection</td>
<td>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.</td>
</tr>
<tr>
<td>rasd:Address</td>
<td>Device specific. For an Ethernet adapter, this specifies the MAC address.</td>
</tr>
<tr>
<td>rasd:AddressOnParent</td>
<td>For a device, this specifies its location on the controller.</td>
</tr>
<tr>
<td>rasd:AllocationUnits</td>
<td>Specifies the units of allocation used. For example, “byte * 2^20”.</td>
</tr>
<tr>
<td>rasd:VirtualQuantity</td>
<td>Specifies the quantity of resources presented. For example, “256”.</td>
</tr>
<tr>
<td>rasd:Reservation</td>
<td>Specifies the minimum quantity of resources guaranteed to be available.</td>
</tr>
<tr>
<td>rasd:Limit</td>
<td>Specifies the maximum quantity of resources that are granted.</td>
</tr>
<tr>
<td>rasd:Weight</td>
<td>Specifies a relative priority for this allocation in relation to other allocations.</td>
</tr>
</tbody>
</table>

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.

### 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 is recommended to start with the normal value and adjust the value within the range for ongoing performance tuning and validation.

For the `Item` elements in `VirtualHardwareSection` and `ResourceAllocationSection` elements, the following additional semantics are defined:
Each Item 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 is 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.
- Specifying more than one min range marker or more than one max range marker for a given RASD (identified with InstanceID) is invalid.
- An Item element with a range marker shall have a corresponding Item element without a range marker, that is, an Item element with no ovf:bound attribute or ovf:bound attribute with value normal. This corresponding item specifies the default value.
- For an Item 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 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.
- The use of non-integer elements in range marker RASDs is invalid.

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

```xml
<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:Reservation>384</rasd:Reservation>
    <rasd:ResourceType>4</rasd:ResourceType>
  </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

Table 5 shows the core metadata sections that are defined.

<table>
<thead>
<tr>
<th>Section</th>
<th>Locations</th>
<th>Multiplicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>DiskSection</td>
<td>Envelope</td>
<td>Zero or one</td>
</tr>
<tr>
<td>Describes meta-information about all virtual disks in the package</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NetworkSection</td>
<td>Envelope</td>
<td>Zero or one</td>
</tr>
<tr>
<td>Describes logical networks used in the package</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ResourceAllocationSection</td>
<td>VirtualSystemCollection</td>
<td>Zero or one</td>
</tr>
<tr>
<td>Specifies reservations, limits, and shares on a given resource, such as memory or CPU for a virtual machine collection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AnnotationSection</td>
<td>VirtualSystem</td>
<td>Zero or one</td>
</tr>
<tr>
<td>Specifies a free-form annotation on an entity</td>
<td>VirtualSystemCollection</td>
<td></td>
</tr>
<tr>
<td>ProductSection</td>
<td>VirtualSystem</td>
<td>Zero or more</td>
</tr>
<tr>
<td>Specifies product-information for a package, such as product name and version, along with a set of properties that can be configured</td>
<td>VirtualSystemCollection</td>
<td></td>
</tr>
<tr>
<td>EulaSection</td>
<td>VirtualSystem</td>
<td>Zero or more</td>
</tr>
<tr>
<td>Specifies a license agreement for the software in the package</td>
<td>VirtualSystemCollection</td>
<td></td>
</tr>
<tr>
<td>StartupSection</td>
<td>VirtualSystemCollection</td>
<td>Zero or one</td>
</tr>
<tr>
<td>Specifies how a virtual machine collection is powered on</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DeploymentOptionSection</td>
<td>Envelope</td>
<td>Zero or one</td>
</tr>
<tr>
<td>Specifies a discrete set of intended resource requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OperatingSystemSection</td>
<td>VirtualSystem</td>
<td>Zero or one</td>
</tr>
<tr>
<td>Specifies the installed guest operating system of a virtual machine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>InstallSection</td>
<td>VirtualSystem</td>
<td>Zero or one</td>
</tr>
<tr>
<td>Specifies that the virtual machine needs to be initially booted to install and configure the software</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.

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

```xml
<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 is represented by a **Disk** element that 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 is always bytes. `ovf:populatedSize` is allowed to 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. For a 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.

9.2 NetworkSection

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

```xml
<NetworkSection>
  <Info>List of logical networks used in the package</Info>
  <Network ovf:name="red">
    <Description>The network the Red service is available on</Description>
  </Network>
  <Network ovf:name="blue">
    <Description>The network the Blue service is available on</Description>
  </Network>
</NetworkSection>
```

NetworkSection is a valid element at the outermost envelope level.

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

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.

```xml
<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>
</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>
  <FileVersion>4.5-b4523</FileVersion>
  <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}">
      <!-- properties -->
    </Property>
  </Icon>
</ProductSection>
<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; this element is experimental. The optional Icon element specifies display icons for the product; this element is experimental.

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.

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

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. The ovf:key attribute shall not contain the period character (\'\'.\') or the colon character (\'\':\').

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 specific 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 and ovf:instance attributes shall not contain the colon character (':'). It is recommended
that the ovf:class property 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 is used to identify the different
instances. If only one instance of a product is installed, the ovf:instance attribute should not be set.

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]

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:

```xml
<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>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>uint8</td>
<td>Unsigned 8-bit integer</td>
</tr>
<tr>
<td>sint8</td>
<td>Signed 8-bit integer</td>
</tr>
<tr>
<td>uint16</td>
<td>Unsigned 16-bit integer</td>
</tr>
<tr>
<td>sint16</td>
<td>Signed 16-bit integer</td>
</tr>
<tr>
<td>uint32</td>
<td>Unsigned 32-bit integer</td>
</tr>
<tr>
<td>sint32</td>
<td>Signed 32-bit integer</td>
</tr>
<tr>
<td>uint64</td>
<td>Unsigned 64-bit integer</td>
</tr>
<tr>
<td>sint64</td>
<td>Signed 64-bit integer</td>
</tr>
<tr>
<td>string</td>
<td>String</td>
</tr>
<tr>
<td>boolean</td>
<td>Boolean</td>
</tr>
<tr>
<td>real32</td>
<td>IEEE 4-byte floating point</td>
</tr>
<tr>
<td>real64</td>
<td>IEEE 8-byte floating point</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>string</td>
<td>MinLen(min)</td>
</tr>
<tr>
<td></td>
<td>MaxLen(max)</td>
</tr>
<tr>
<td></td>
<td>ValueMap{...}</td>
</tr>
<tr>
<td>uint8</td>
<td>ValueMap{...}</td>
</tr>
<tr>
<td>sint8</td>
<td>ValueMap{...}</td>
</tr>
<tr>
<td>uint16</td>
<td>ValueMap{...}</td>
</tr>
<tr>
<td>sint16</td>
<td>ValueMap{...}</td>
</tr>
<tr>
<td>uint32</td>
<td>ValueMap{...}</td>
</tr>
<tr>
<td>sint32</td>
<td>ValueMap{...}</td>
</tr>
<tr>
<td>uint64</td>
<td>ValueMap{...}</td>
</tr>
<tr>
<td>sint64</td>
<td>ValueMap{...}</td>
</tr>
</tbody>
</table>

### 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.

```xml
<EulaSection>
  <Info>Licensing agreement</Info>
</EulaSection>
```
Lorem ipsum dolor sit amet, ligula suspendisse nulla pretium, rhoncus tempor placerat fermentum, enim integer ad vestibuim volutpat. Nisl rhoncus turpis est, vel elit, congue wisi enim nunc ultricies sit, magna tincidunt. Maecenas aliquam maecenas ligula nostra, accumsan taciti. Socris mauris in integer, a dolor netus non duir 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.

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

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

### 9.7 StartupSection

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

```xml
<License>
Lorem ipsum dolor sit amet, ligula suspendisse nulla pretium, rhoncus tempor placerat fermentum, enim integer ad vestibuim volutpat. Nisl rhoncus turpis est, vel elit, congue wisi enim nunc ultricies sit, magna tincidunt. Maecenas aliquam maecenas ligula nostra, accumsan taciti. Socris mauris in integer, a dolor netus non duir 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>
```

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. The order of execution of the start action is the numerical ascending order of the values. Items with same order identifier may be started up concurrently. The order of execution of the stop action is the numerical descending order of the values.

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 not specified, an implicit default Item is created for each entity in the collection with ovf:order="0". Thus, for a trivial startup sequence no StartupSection needs to be specified.

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 is visible in the OVF environment, enabling 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="Typical" ovf:default="true">
    <Label>Typical</Label>
    <Description>Some description</Description>
  </Configuration>
</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 elements in VirtualHardwareSection elements describe resources for VirtualSystem entities,
Item elements in ResourceAllocationSection elements describe resources for virtual machine collections. For these two Item types, the following additional semantics are defined:

- Each Item 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 elements are allowed to refer to the same InstanceID. A single combined Item for the given InstanceID shall be constructed by picking up the child elements of each Item element, with child elements of a former Item element in the OVF descriptor not being picked up if there is a like-named child element in a latter Item element. Any attributes specified on child elements of Item elements that are not picked up that way, are not part of the combined Item element.

- All Item elements shall specify ResourceType, and Item elements with the same InstanceID shall agree on ResourceType.

EXAMPLE 1: The following example shows a VirtualHardwareSection:

```xml
<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. For Property elements inside a ProductSection, the following additional semantic is defined:
It is possible to use 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.

EXAMPLE 2: The following shows an example ProductSection:

```xml
<ProductSection>
  <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">
      ...
    </Value>
  </Property>
</ProductSection>
```

9.9 OperatingSystemSection

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

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

The valid values for ovf:id are defined by the ValueMap qualifier in the CIM_OperatingSystem.OsType property.

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.

```xml
<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.
An `ovf:initialBootStopDelay` attribute value of zero indicates that the boot stop delay is not specified.

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.

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:**

```xml
<Info ovf:msgid="info.text">Default info.text value if no locale is set or no locale match</Info>
```

**EXAMPLE 2:**

```xml
<ovf:Envelope xml:lang="en-US">...
... sections and content here ...
```
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:

```xml
<ovf:Envelope xml:lang="en-US">
  <References>
    ...
    <File ovf:id="it-it-resources" ovf:href="resources/it-it-bundle.msg"/>
  </References>
  ...
</ovf:Envelope>
```

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

```xml
<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.

## 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
<?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">
    <!-- 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 -->
        </Property>
    </PropertySection>
    <Entity ovfenv:id="id of sibling virtual system or virtual system collection">
        <!-- Properties from sibling -->
    </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 VirtualSystem being part of a multi-tiered application.

Table 8 shows the core sections that are defined.

<table>
<thead>
<tr>
<th>Section</th>
<th>Location</th>
<th>Multiplicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>PlatformSection</td>
<td>Environment</td>
<td>Zero or one</td>
</tr>
<tr>
<td>Provides information from the deployment platform</td>
<td>Environment</td>
<td>Zero or one</td>
</tr>
<tr>
<td>PropertySection</td>
<td>Environment Entity</td>
<td>Zero or one</td>
</tr>
<tr>
<td>Contains key/value pairs corresponding to properties defined in the OVF descriptor</td>
<td>Environment</td>
<td>Zero or one</td>
</tr>
</tbody>
</table>

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. It is recommended that these URIs are 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 Augmented BNF (ABNF) use 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/1/dsp8023_1.1.0.xsd
- http://schemas.dmtf.org/ovf/environment/1/dsp8027_1.1.0.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 and CIM_VirtualSystemSettingData may be retrieved by resolving the following URLs:

- http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2.22.0/CIM_VirtualSystemSettingData.xsd
- http://schemas.dmtf.org/wbem/wscim/1/cim-schema/2.22.0/CIM_ResourceAllocationSettingData.xsd

This specification is based on the following CIM MOFs:

- CIM_VirtualSystemSettingData.mof
- CIM_ResourceAllocationSettingData.mof
- CIM_OperatingSystem.mof
### Change Log

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0.0</td>
<td>2009-02-22</td>
<td></td>
</tr>
<tr>
<td>1.1.0</td>
<td>2010-01-12</td>
<td>DMTF Standard</td>
</tr>
<tr>
<td>1.1.1</td>
<td>2013-08-22</td>
<td>DMTF Standard</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– subclause 9.10 initialBootStopDelay stated meaning of zero value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– Incorporate ANSI editor changes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– Addressed Mantis 0000691 regarding use of ‘:’ and ‘.’ characters</td>
</tr>
</tbody>
</table>
Bibliography

1460 DMTF DSP1044, *Processor Device Resource Virtualization Profile 1.0*
1461 [http://www.dmtf.org/standards/published_documents/DSP1044_1.0.pdf](http://www.dmtf.org/standards/published_documents/DSP1044_1.0.pdf)
1462 DMTF DSP1045, *Memory Resource Virtualization Profile 1.0*
1464 DMTF DSP1047, *Storage Resource Virtualization Profile 1.0*
1466 DMTF DSP1022, *CPU Profile 1.0*,
1467 [http://www.dmtf.org/standards/published_documents/DSP1022_1.0.pdf](http://www.dmtf.org/standards/published_documents/DSP1022_1.0.pdf)
1468 DMTF DSP1026, *System Memory Profile 1.0*,
1469 [http://www.dmtf.org/standards/published_documents/DSP1026_1.0.pdf](http://www.dmtf.org/standards/published_documents/DSP1026_1.0.pdf)
1470 DMTF DSP1014, *Ethernet Port Profile 1.0*,
1471 [http://www.dmtf.org/standards/published_documents/DSP1014_1.0.pdf](http://www.dmtf.org/standards/published_documents/DSP1014_1.0.pdf)
1472 DSP1050, *Ethernet Port Resource Virtualization Profile 1.0*
1473 [http://www.dmtf.org/standards/published_documents/DSP1050_1.0.pdf](http://www.dmtf.org/standards/published_documents/DSP1050_1.0.pdf)

1474