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## Open Virtualization Format White Paper

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## Abstract

The Open Virtualization Format (OVF) White Paper describes the application of DSP0243, DSP8023, and DSP8027, the specifications that make up the Open Virtualization Format (OVF) standard. The intended audience is anyone who wants to understand the OVF package and its application to specific use cases. Some familiarity with virtualization and the general concepts of the CIM model is assumed.

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## Foreword

95 The Open Virtualization Format White Paper (DSP2017) was prepared by the OVF Work Group of the  
96 DMTF.

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

99	Lawrence Lamers	VMware Inc. (Chair)
100	Marvin Waschke	DMTF Fellow (co-Editor)
101	Peter Wörndle	Ericsson AB (co-Editor)
102	Eric Wells	Hitachi, Ltd. (co-Editor)
103		
104	Hemal Shah	Broadcom Corporation
105	Shishir Pardikar	Citrix Systems Inc.
106	Richard Landau	DMTF Fellow
107	Robert Freund	Hitachi, Ltd.
108	Jeff Wheeler	Huawei
109	Monica Martin	Microsoft Corporation
110	Cheng Wei	Microsoft Corporation
111	Srinivas Maturi	Oracle
112	Steffen Grarup	VMware Inc.
113	Rene Schmidt	VMware Inc.
114	Ghazanfar Ali	ZTE Corporation

115

116

# Open Virtualization Format White Paper

## 117 1 Introduction

### 118 1.1 Overview

119 The Open Virtualization Format specification (OVF) provides the industry with a standard packaging  
120 format for software solutions based on virtual systems, solving critical business needs for software  
121 vendors and cloud computing service providers.

122 An OVF package can be used by an independent software vendor (ISV) to publish a software solution; by  
123 a data center operator to transport a software solution from one data center to another; by a customer to  
124 archive a software solution; or any other use case that can be met by having a standardized package for  
125 a software solution.

126 The following use cases are the main basis for OVF work:

- 127 1) the ability for ISVs to package a software solution that is capable of being used on more than  
128 one hypervisor
- 129 2) the ability to package a virtual system or collection of virtual systems so they can be moved  
130 from one data center to another

131 Other use cases and derivative use cases (i.e., subsets) are also applicable.

132 OVF version 1 has been widely adopted by the industry and is now an international standard.

133 OVF version 2 adds enhanced packaging capabilities, making it applicable to the broader range of use  
134 cases that are emerging as industry enters the cloud computing era.

135 OVF 2 adds the following features:

- 136 • Support for Network Ports
- 137 • Scaling at deployment time
- 138 • Support for basic placement policies
- 139 • Encryption of OVF packages
- 140 • Disk sharing at runtime
- 141 • Advanced Device Boot Order
- 142 • Advanced Data Transfer to Guest Software
- 143 • Support for Improved Internationalization - I18N
- 144 • Support of HASH Improved
- 145 • Updated CIM schema

146 OVF has adopted the Common Information Model (CIM), where appropriate, to allow management  
147 software to clearly understand and easily map resource properties by using an open standard. The  
148 `CIM_ResourceAllocationSettingData` class and its subclasses for specific device types is used to  
149 specify the resources needed for the virtual system to operate.

150 OVF 2 supports network configuration and the IEEE Edge Virtual Bridging Discovery and Configuration  
151 protocols that use *Network Port Profile* (DSP8049). The `CIM_EthernetPortAllocationSettingData` class  
152 provides the essential properties.

153 This document aims to give details of the motivation, goals, design and expected usage of OVF, and  
154 should be read in accompaniment with the OVF specification of the same revision number.

## 155 1.2 Design considerations

156 The rapid adoption of virtual infrastructure has highlighted the need for a standard, portable metadata  
157 format for the distribution of virtual systems onto and between virtualization platforms. The ability to  
158 package a software application together with the operating system on which it is certified, into a format  
159 that can be easily transferred from an ISV, through test and development and into production as a pre-  
160 configured, pre-packaged unit with no external dependencies, is extremely attractive. Such pre-deployed,  
161 ready to run applications packaged with the configuration of the virtual systems required to run them are  
162 called virtual appliances. In order to make this concept practical on a broad scale, it is important that the  
163 industry adopts a vendor-neutral standard for packaging such virtual appliances and the metadata  
164 required to automatically and securely install, configure, and run them on any virtualization platform.

165 From the user's point of view, OVF is a packaging format for virtual appliances. Once installed, an OVF  
166 package adds to the user's infrastructure a self-contained, self-consistent, software application that  
167 provides a particular service or services. For example, an OVF package might contain a fully functional  
168 and tested web-server, database, and OS combination, such as a LAMP stack (Linux + Apache + MySQL  
169 + PHP), or it may contain a virus checker, including its update software, spyware detector, etc.

170 Whereas many virtual appliances contain only a single virtual system, modern enterprise applications are  
171 modeled as service oriented architectures (SOA) with multiple tiers, each containing one or more virtual  
172 systems. A single virtual system model is thus not sufficient to distribute a multi-tier service. In addition,  
173 complex applications require install-time customization of networks and other customer specific  
174 properties. Furthermore, a virtual appliance is packaged in a run-time format with disk images and  
175 configuration data suitable for a particular hypervisor. Run-time formats are optimized for execution and  
176 not for distribution. For efficient software distribution, a number of additional features become critical,  
177 including portability, platform independence, verification, signing, versioning, and licensing terms.

178 The OVF specification describes a hypervisor-neutral, efficient, extensible, and open format for the  
179 packaging and distribution of virtual appliances composed of one or more virtual systems. It aims to  
180 facilitate the automated and secure management not only of individual virtual systems, but also of the  
181 virtual appliance as a functional unit.

182 To be successful, OVF has been developed and endorsed by ISVs, virtual appliance vendors, operating  
183 system vendors, as well as virtual platform vendors. The OVF specification promotes customer  
184 confidence through the collaborative development of common standards for portability and interchange of  
185 virtual systems between different vendors' virtualization platforms.

186 The OVF format is intended to be immediately useful, to solve an immediate business need, and to  
187 facilitate the rapid adoption of a common, backwards compatible, yet rich format for packaging virtual  
188 appliances.

189 The OVF specification is complimentary to existing IT management standards and frameworks and  
190 promotes best-of-breed competition through openness and extensibility. The explicit copyright notice  
191 attached to this document is intended to avoid arbitrary, independent, piece-wise extensions to the format  
192 while permitting free distribution and implementation of the specification.

193

194



## 195 2 OVF key concepts

### 196 2.1 Virtual appliances

197 A virtual appliance is a pre-configured software stack comprising one or more virtual systems. Each  
198 virtual system is an independently installable run-time entity consisting of an operating system,  
199 applications and application-specific data, as well as metadata describing the virtual hardware that is  
200 required by the virtual system. Many infrastructure applications and even end-user applications that are  
201 accessible over a network, such as a DNS server, a bug tracking database, or a complete CRM solution  
202 composed of web, application and database tiers, can be delivered as virtual appliances. Delivering  
203 complex software systems and services as a pre-configured software stack can dramatically increase  
204 robustness and simplify installation.

205 Virtual appliances are changing the software distribution paradigm because they allow optimization of the  
206 software stack for the specific application and to deliver a turnkey service to the end user. For solution  
207 providers, building a virtual appliance is simpler and more cost effective than building a hardware  
208 appliance. The application is pre-packaged with the operating system that it uses, reducing compatibility  
209 testing and certification, allowing the software to be pre-installed in the environment in which it runs – by  
210 the ISV that develops the solution. For end users, virtual appliances offer an opportunity to dramatically  
211 simplify the software management lifecycle through the adoption of standardized, automated, and  
212 efficient processes that replace the individual OS and application specific management tasks used  
213 previously.

214 Virtual appliances need not be developed and delivered by third-party ISVs – the concept is equally  
215 useful and often used within an enterprise in which a virtual system template for a particular service is  
216 assembled, tested, and certified by an IT organization and then packaged for repeated, “cookie cutter”  
217 deployment throughout the enterprise.

218 Commonly, a software service is implemented as a multi-tier application running in multiple virtual  
219 systems and communicating across the network by using a SOA model. Services are often composed of  
220 other services, which themselves might also be multi-tier applications, or composed of other services.  
221 Indeed the SOA model naturally fits into a virtual appliance-based infrastructure, because virtual  
222 appliances are typified by the use of network facing, XML-based management and service interfaces that  
223 allow composition of appliances to deliver a complete application.

224 For example, consider a typical web application that consists of three tiers: a web tier that implements the  
225 presentation logic; an application server tier that implements the business logic; and a back-end database  
226 tier. A straightforward implementation divides this configuration into three virtual systems, one for each  
227 tier. In this way, the application can scale from a fraction of a single physical host to three physical hosts.  
228 Another approach is to treat each tier as a service in itself. Hence, each tier can scale to a multi-virtual  
229 system service that provides a clustered solution. Again, taking the web application as an example, a  
230 common scenario is to have many web servers, fewer applications servers, and one or two database  
231 servers. Implemented as virtual systems, each tier can scale across as many or as few physical machines  
232 as required, and each tier can support multiple instances of virtual systems that service requests.

233 One OVF may contain a single or many virtual systems. It is left to developers to decide which  
234 arrangement best suits their application. OVFs must be installed before they can be run; a particular  
235 virtualization platform may run the virtual system from the OVF, but this configuration is not required. If  
236 this configuration is chosen, the OVF itself can no longer be viewed as a “golden image” version of the  
237 appliance because run-time state for the virtual system(s) pervades the OVF. Moreover the digital  
238 signature that allows the platform to check the integrity of the OVF is invalid.

239 As a transport mechanism, OVF differs from VMware's VMDK Virtual Disk Format and Microsoft's VHD  
240 Virtual Hard Disk format or the open source QCOW format. These are run-time virtual system image  
241 formats, operating at the scope of a single virtual disk. Though they are frequently used as transport  
242 formats today, they are not designed to solve portability problems. They do not help with a virtual system

243 that has multiple disks, or multiple virtual systems, or they need customization of the virtual system during  
 244 installation. They are of no help if the virtual system is intended to run on multiple virtualization platforms  
 245 (even if the virtualization platforms claim support of the particular virtual hard disk format used).

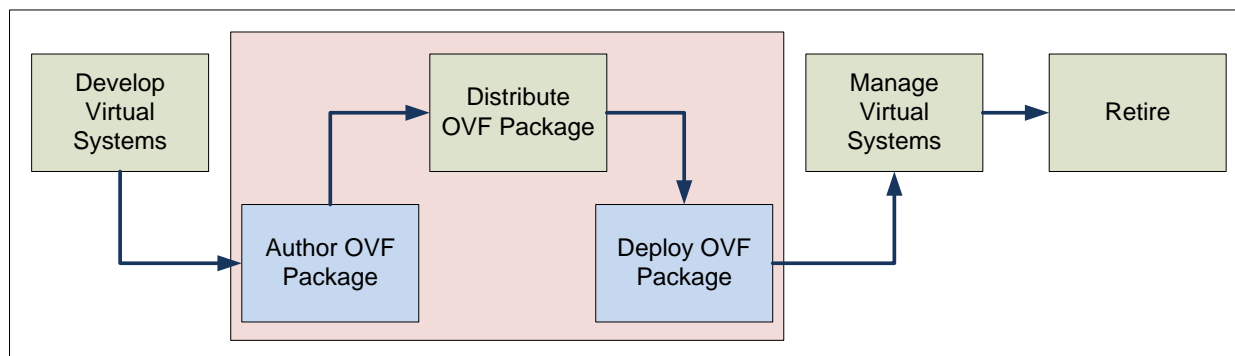
246 Within the OVF remit is the concept of the certification and integrity of a packaged virtual appliance. This  
 247 concept allows the platform to determine the provenance of the appliance and permits the end-user to  
 248 make the appropriate trust decisions. The OVF specification has been constructed so that the appliance  
 249 is responsible for its own configuration and modification. In particular, this means that the virtualization  
 250 platform does not need to be able to read from the appliance's file systems. This decoupling of platform  
 251 from the appliance means that OVF packages may be implemented by using any operating system, and  
 252 installed on any virtualization platform that supports the OVF format. A specific mechanism is provided for  
 253 appliances to detect and react to the platform on which they are installed. This mechanism allows  
 254 platforms to extend this specification in unique ways without breaking compatibility of appliances across  
 255 the industry.

256 The OVF format has several specific features that are designed for complex, multi-tier services and their  
 257 associated distribution, installation, configuration, and execution:

- 258 • Provides direct support for the configuration of multi-tier applications and the composition of  
 259 virtual systems to deliver composed services.
- 260 • Permits the specification of both virtual system and application-level configuration.
- 261 • Has robust mechanisms for validation of the contents of the OVF, and full support for  
 262 unattended installation to ease the burden of deployment for users, and thereby enhance the  
 263 user's experience.
- 264 • Uses commercially accepted procedures for integrity checking of the OVF contents, through the  
 265 use of signatures and trusted third parties. This serves to reassure the consumer that an  
 266 appliance has not been modified since it signed by the creator of the appliance. This assurance  
 267 is seen as critical to the success of the virtual appliance market, and to the viability of  
 268 independent creation and online download of appliances.
- 269 • Allows commercial interests of the appliance vendor and user to be respected, by providing a  
 270 basic method for presentation and acknowledgement of licensing terms associated with the  
 271 appliance.

## 272 2.2 Life cycle

273 The life cycle for a virtual system is illustrated in Figure 1:



274

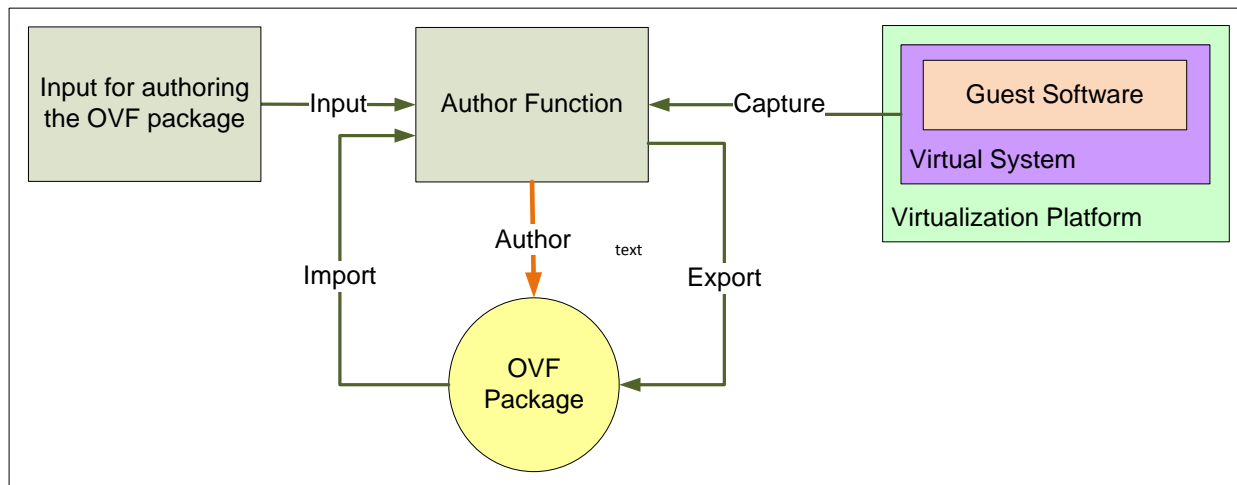
275

**Figure 1 – OVF package life cycle**

276 An OVF package is built from components that have been developed or acquired by the OVF author.  
 277 These are packaged into a set of files that comprise a virtual appliance, consisting of one or more virtual

278 machines and virtual machine collections and the relevant configuration and deployment metadata. For  
 279 example, a clustered database component might be acquired from a third-party ISV. The installed service  
 280 is then managed and eventually retired. Distribution, management, and retirement are outside the scope  
 281 of OVF and are specific to the virtualization product used and the virtual appliance installed from the OVF.  
 282 Management includes ongoing maintenance, configuration, and upgrade of the appliance. These  
 283 activities depend on the installed service and environment, not the OVF package. The OVF specification  
 284 focuses specifically on the authoring and deployment phases.

285 The OVF author function is illustrated in Figure 2.



286

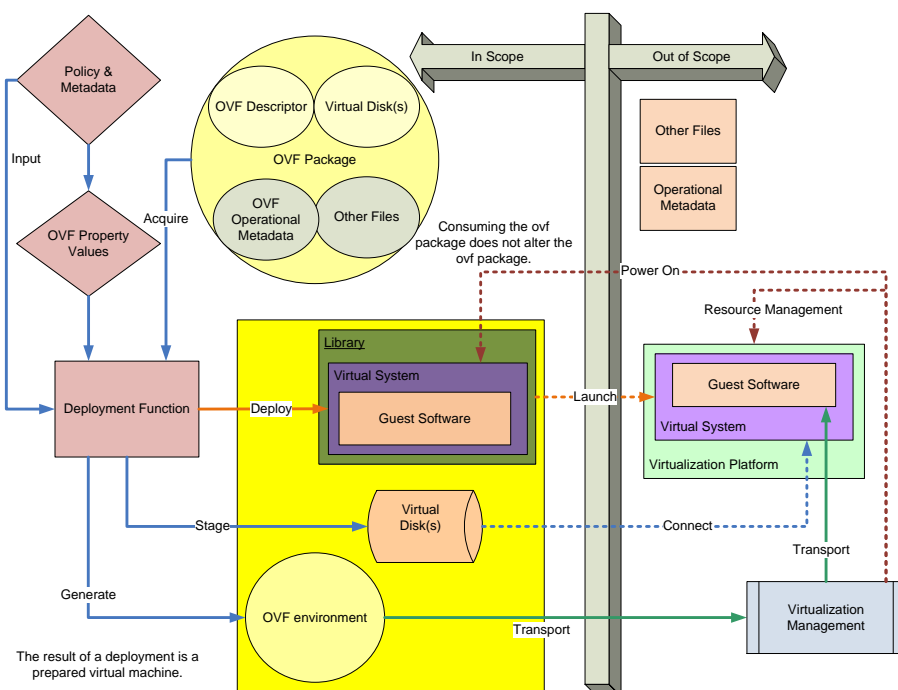
287

**Figure 2 – OVF author function**

288 An OVF package is authored in one of two ways. The straightforward method is to use a text editor or an  
 289 XML authoring tool to create an OVF descriptor, assemble the required disk images and other files, and  
 290 then create a tar file or file system that contains the OVF package.

291 An alternative method is to export an OVF package from a virtualization platform. The OVF descriptor  
 292 may then be edited to include additional information. This method may be chosen for various reasons,  
 293 including improving portability between virtualization platforms or providing options for configuration.

294 The OVF deployment function is illustrated in Figure 3 This diagram is also instructive as to the scope of  
295 work that is covered by the OVF work group.



296

297

**Figure 3 – OVF deployment function**

298 The OVF operational metadata is information that may be needed for the proper operation of the virtual  
299 system or collection of virtual systems. The OVF operational metadata is a subset of the operational  
300 metadata that may be available when the virtual system is powered on.

301 As shown in the diagram, the OVF deployment function transports the OVF environment to the  
302 virtualization platform. The OVF specification is flexible on the exact nature of the transport, but it can be  
303 thought of as placing media, like a CD ROM, into a virtual reader on the virtual machine and the media  
304 being read by the guest operating system each time the system starts up. The metadata in the OVF  
305 environment is used for configuration after operating system startup and for meeting other requirements  
306 of guest software and virtualization platform for the proper operation of the virtual appliance.

### 307 **3 XML backgrounder**

#### 308 **3.1 Use of XML Schema**

309 The OVF standard makes use of XML and XML Schema Definition Language (XSD or XSDL). XML is a  
310 markup language that defines a grammar for expressing XML elements and attributes, but says little  
311 about the structure of the elements and attributes in documents or the permissible data types for element  
312 and attribute values. Document Type Definitions (DTDs) have been part of XML from its inception and  
313 were intended to add structure and data types to XML, but they were found to be inadequate in many  
314 situations. In response, the W3C developed XSD, written itself in XML, which is a rich language for  
315 specifying XML document structure and data types. XSD and DTD can be used together, but XSD has  
316 become more common. XSD files are customarily given an “.xsd” extension.

317 An XSD file is metadata that describes the structure and data types of elements and data structures that  
318 are allowed in an XML document. XSD also supports inheritance and other object-oriented constructs.  
319 These constructs simplify the creation of elaborate and complex XSDs, making them easier to write, more  
320 compact, and have fewer errors. Checking an XML document against the XML grammar only tests the  
321 document's syntax, but not the correctness of the structure and data in the document. Validating an XML  
322 document against an XSD checks the structure and data. When an XML document is consumed by  
323 another process, documents that are valid against an XSD are more likely to be processed without errors.  
324 In addition, some tools can generate XML document processors from XSDs. These tools can greatly  
325 accelerate development.

326 OVF uses XSD to specify the structure and data types of OVF descriptors, the XML documents in an OVF  
327 package that describe arbitrarily complex patterns for the instantiation of virtual systems. OVF descriptors  
328 have the file extension ".ovf". The official XSD for OVF 2.0.0 is found at  
329 <http://schemas.dmtf.org/ovf/envelope/2/dsp8023.xsd>. Users of OVF should use an XSD validation tool to  
330 check their OVF descriptors against the OVF XSD schema. A successfully validated descriptor is a  
331 necessary, but not sufficient, condition for OVF standard conformance. Some constraints in the standard  
332 specification go beyond the dsp8023.xsd and these must be checked manually for full conformance.

## 333 **3.2 General XML concepts used in OVF**

### 334 **3.2.1 Element**

335 An XML element is a data container in the OVF descriptor. Each element that is not empty begins with a  
336 start tag, followed by the elements contents, and the element is then closed with an end tag. The start tag  
337 consists of the element name, optionally followed by element attributes and surrounded by angled  
338 brackets, i.e., <elementname> or <elementname attributes>. The end tag consists of only the element  
339 name preceded by a / and enclosed in angle brackets, i.e., </elementname>. An element can contain  
340 other elements, text, attributes, or a combination of all of these.

341 XML elements follow these naming rules:

- 342 • Names can contain letters, numbers, and other characters.
- 343 • Names cannot start with a number or punctuation character.
- 344 • Names cannot start with the letters xml (or XML, or Xml, etc.).
- 345 • Names cannot contain spaces.
- 346 • Any name can be used; no words are reserved.

### 347 **3.2.2 Attribute**

348 XML elements can have attributes that provide additional information about an element. Attributes often  
349 provide information that is not a part of the data. Attribute values are always quoted by using single or  
350 double quotation marks.

### 351 **3.2.3 Substitution group**

352 A substitution group is an object-oriented feature of XSD that allows you to specify elements that can  
353 replace another element in documents generated from that schema. The replaceable element is called  
354 the head element and is defined in the schema's global scope. The elements of the substitution group are  
355 of the same type as the head element or a type that is derived from the head element's type.

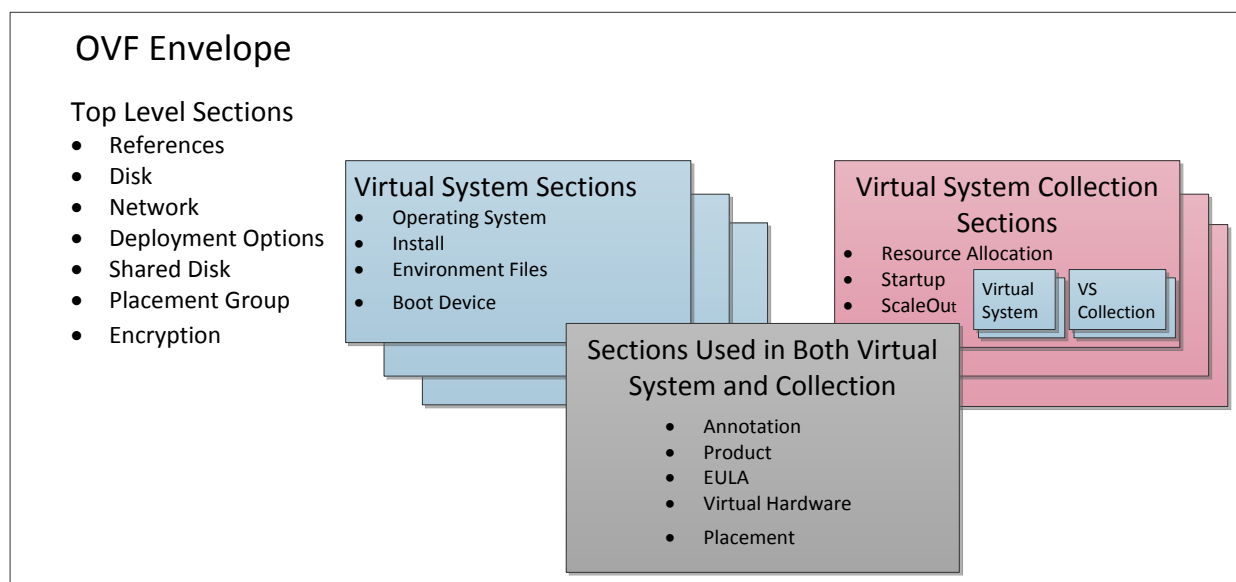
356 In essence, a substitution group allows you to build a collection of elements that can substitute for a  
357 generic element. For example, if you are building an ordering system for a company that sells three types  
358 of widgets, you might define a generic widget element that contains common data for all three widget  
359 types. Then you can define a substitution group for the generic widget that contains more specific widget  
360 types that are derived from the generic widget. In the schema, an order can be defined as a sequence of  
361 generic widgets. In an XML file conformant with the schema, an order can be a sequence of widgets from  
362 the substitution group rather than generic widgets. Often the head element for a substitution group is  
363 declared to be abstract, so generic widgets cannot appear in the XML file.

## 364 4 OVF package

365 The OVF package provides a means to distribute software solutions deployed in a virtual system or  
 366 collection of virtual systems. The OVF package consists of an OVF descriptor and related virtual disks.  
 367 The OVF package exists as either a set of files referenced by a URL or a compressed file with the '.ova'  
 368 extension.

### 369 4.1 Structure of an OVF descriptor

370 An OVF descriptor is a XML file. The root element of an OVF descriptor is the `Envelope`. The two most  
 371 important child elements of an `Envelope` element are the `VirtualSystem` and  
 372 `VirtualSystemCollection` elements. The `Envelope` element also contains sections that apply to all  
 373 in `VirtualSystem` and `VirtualSystemCollection` elements the package. The `Envelope` element  
 374 may contain both `VirtualSystem` and `VirtualSystemCollection` elements. The  
 375 `VirtualSystemCollection` elements are a recursive construct that may, like the `Envelope` element,  
 376 contain both `VirtualSystem` and `VirtualSystemCollection` elements. The OVF Schema defines  
 377 a number of different sections. Some of these sections may only appear in the `Envelope` element.  
 378 Others may only appear in the `VirtualSystem` element. Yet others may only appear in  
 379 `VirtualSystemCollection` element. Some sections may appear in both `VirtualSystem` and  
 380 `VirtualSystemCollection` elements. This structure is summarized in Figure 4.



381

382

Figure 4 – OVF package structure

### 383 4.2 Global attributes defined in OVF Schema

384 The following OVF attributes defined in the OVF Schema are global attributes. OVF element specific OVF  
 385 attributes are also defined. (See 4.4.and 4.3.)

- 386 • `required` attribute – indicates that the deployment should fail if the element is not present or is  
 387 not understood. This attribute is an XSD Boolean with allowed values are 'true', 'false', '0', '1'. If  
 388 not specified, the value is 'true' or '1'. This OVF attribute should not be confused with the XSD  
 389 value `required` for the XSD `use` attribute. The two terms are similar but different in  
 390 significance.

- 391 • `transport` attribute – is a space-separated list of supported transport types used to convey  
392 the information to the guest software. See 4.7.3 and 6.2.
- 393 • `configuration` attribute – identifies a configuration defined in a `Configuration` element in  
394 the `DeploymentOptionSection` element. See 4.4.6. The `configuration` attribute is used  
395 in the following places:
  - 396 • in the `VirtualHardwareSection` elements for `Item`, `EthernetPortItem`,  
397 `StorageItem` elements
  - 398 • in the `ResourceAllocationSection` element for `Item`, `EthernetPortItem`,  
399 `StorageItem` elements
  - 400 • in the `ScaleOutSection` elements for `InstanceCount` elements
  - 401 • in the `ProductSection` elements for `Property` elements
- 402 • `bound` attribute – is a range marker entry used to indicate minimum, normal, and maximum  
403 values for resource allocation setting data. The allowed values are 'min', 'normal', and 'max'.  
404 See 4.6.1 The `bound` attribute is used in two places to set limits on resource allocation:
  - 405 • in the `VirtualHardwareSection` elements for `Item`, `EthernetPortItem`,  
406 `StorageItem` elements
  - 407 • in the `ResourceAllocationSections` element for `Item`, `EthernetPortItem`,  
408 `StorageItem` elements

### 409 4.3 Extensibility in OVF

410 The OVF Schema use the XSD elements 'any' and 'anyAttribute' to extend the OVF descriptor and  
411 the OVF environment to provide custom metadata. This feature allows OVF packages to meet a wide  
412 variety of use cases in the industry.

413 The following definitions come from the XML schema reference website. See  
414 [http://www.w3schools.com/schema/schema\\_elements\\_ref.asp](http://www.w3schools.com/schema/schema_elements_ref.asp).

- 415 • `any` – This definition enables the author to extend the XML document with elements not  
416 specified by the schema.
- 417 • `anyAttribute` – This definition enables the author to extend the XML document with  
418 attributes not specified by the schema.
- 419 • `##any` - Elements from any namespace are allowed. (This definition is the default.)
- 420 • `##other` - Elements from any namespace that is not the namespace of the parent element can  
421 be present.

422 An extension at the `Envelope` element level is done by defining a new member of the `ovf:Section`  
423 substitution group. An extension at the `Content` element level is done by defining a new member of the  
424 `ovf:Section` substitution group. See 3.2.3. These new section elements can be used where sections are  
425 allowed to be present by the OVF Schema. The `Info` element in each new section element can be used  
426 to give meaningful warnings to users when a new section element is being skipped because it is not  
427 understood by the deployment platform.

428 A type defined in the OVF Schema may be extended at the end with additional elements. Extension  
429 points are declared with an `xs:any` with a `namespace="##other"`.

430 Additional attributes are allowed in the OVF Schema. Extension points are declared with an  
431 `xs:anyAttribute`.

432 The `ovf:required` attribute specifies whether the information in the element is required or optional. The  
 433 `ovf:required` attribute defaults to TRUE. If the deployment platform detects an element extension that  
 434 is required and that it does not understand, it fails the deployment.

435 On custom attributes, the information in the attribute is not required for correct behavior.

436 **EXAMPLE 1:**

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

444 **EXAMPLE 2:**

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

453 **EXAMPLE 3:**

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

## 458 4.4 OVF top level elements

459 The root element defined by the OVF Schema is the `Envelope` element. OVF elements that are direct  
 460 children of an `Envelope` element are listed below in the order that they occur in the OVF descriptor:

- 461 • `References` element
- 462 • `Section` elements - a substitution group for section elements
- 463 • `Content` elements - a substitution group for content elements
- 464 • `Strings` element

465 Elements that are a substitution group for a `Section` element that is a direct child of the `Envelope`  
 466 element:

- 467 • `DiskSection` element
- 468 • `NetworkSection` element
- 469 • `DeploymentOptionSection` element
- 470 • `SharedDiskSection` element
- 471 • `PlacementGroupSection` element
- 472 • `EncryptionSection` element

473 Elements that are a substitution group for a `Content` element:

- 474 • `VirtualSystem` element
- 475 • `VirtualSystemCollection` element (may be nested)



476 Elements that are a substitution group for a Section element used in a Content element are listed below  
477 in the order that they occur in an OVF descriptor:

- 478 • AnnotationSection element
- 479 • ProductSection element
- 480 • OperatingSystemSection element
- 481 • EulaSection element
- 482 • VirtualHardwareSection element
- 483 • ResourceAllocationSection element
- 484 • InstallSection element
- 485 • StartupSection element
- 486 • EnvironmentFilesSection element
- 487 • BootDeviceSection element
- 488 • ScaleOutSection element
- 489 • PlacementSection element

490 The additional elements defined in the OVF Schema are listed below. Note that these elements can be  
491 used in a namespace other than ovf:.

- 492 • Annotation
- 493 • AppUrl
- 494 • bootc:CIM\_BootConfigSetting
- 495 • Category
- 496 • Configuration
- 497 • Content
- 498 • Description
- 499 • Disk
- 500 • EthernetPortItem
- 501 • File
- 502 • FullVersion
- 503 • Icon
- 504 • Info
- 505 • InstanceCount
- 506 • Item
- 507 • Label
- 508 • License
- 509 • Msg
- 510 • Name
- 511 • Network
- 512 • NetworkPortProfile
- 513 • NetworkPortProfileURI
- 514 • Product
- 515 • ProductUrl
- 516 • Property
- 517 • SharedDisk
- 518 • StorageItem
- 519 • System
- 520 • Value
- 521 • Vendor
- 522 • VendorUrl
- 523 • Version
- 524 • xenc:EncryptedKey
- 525 • xenc11:DerivedKey

526 An example of the basic structure of an OVF descriptor shown in Figure 4 is illustrated below.

```

527
528 ovf:Envelope
529 <xs:element name="References" type="ovf:References_Type">
530
531 <xs:element ref="ovf:Section" minOccurs="0" maxOccurs="unbounded">
532 <DiskSection>
533   <Info> Describes all virtual disks used with the package </Info>
534 <NetworkSection>
535   <Info>List of logical networks used in the package</Info>
536 <DeploymentOptionSection>
537   <Info>List of deployment options available in the package</Info>
538
539 <xs:element ref="ovf:Content">
540   <VirtualSystemCollection ovf:id="Acme VSC">
541     <Info>The packaging of the first virtual appliance</Info>
542     -----
543     <VirtualSystem ovf:id="Acme VS 1">
544       <Info>The packaging of the virtual machine 1</Info>
545     <VirtualSystem ovf:id="Acme VS 2">
546       <Info>The packaging of the virtual machine 2</Info>
547     -----
548     <VirtualSystemCollection ovf:id="Widget VSC">
549       <Info>The packaging of the second virtual appliance</Info>
550       <VirtualSystem ovf:id="Acme VS 3">
551         <Info>The packaging of the virtual machine 3</Info>
552       <VirtualSystem ovf:id="Acme VS 3">
553         <Info>The packaging of the virtual machine 4</Info>
554       -----
555 <xs:element name="Strings" type="ovf:Strings_Type" minOccurs="0"
556 maxOccurs="unbounded">
557   <Info> Root element of I18N string bundle</Info>

```

#### 558 4.4.1 VirtualSystem element

559 A `VirtualSystem` element is a substitution element for a `Content` element. It contains a number of  
560 `Section` elements that define a single virtual system. These section elements describe virtual hardware,  
561 the resource allocation, and product information applicable to the virtual system.

#### 562 4.4.2 VirtualSystemCollection element

563 A `VirtualSystemCollection` element is a substitution element for a `Content` element. It contains  
564 one or more `VirtualSystem` elements and a number of `Section` elements that define a collection of  
565 virtual systems. These section elements describe virtual hardware, the resource allocation, and product  
566 information applicable to the virtual system collection.

#### 567 4.4.3 References element

568 The `References` element contains the references to all external files.

#### 569 4.4.4 DiskSection element

570 The `DiskSection` element defines the virtual disks used by the virtual systems in the OVF package.

571 Any virtual disk format may be used, as long as the virtual disk format specification is public and available  
572 without restrictions. This supports the full range of virtual hard disk formats used for hypervisors today,  
573 and it is extensible to allow for future formats.

574 The virtual disk format may be a simple, basic disk block format agnostic to the guest software installed.  
575 For example, VMware VMDK formats deal with 512-byte disk sectors stored in 64KB blocks, in a number  
576 of flat, sparse, and compressed variants. At deployment time, the virtualization platform creates virtual  
577 disks in a basic disk block format it prefers. The run-time virtual disk format may be identical to the  
578 distribution format, but is often different because it may not be efficient to run out of a compressed virtual  
579 disk format. The guest software that is installed has its own file system format, e.g., NTFS, EXT3, or ZFS.  
580 The OVF virtual disk though does not need to know the file system format.

581 The following example shows a description of virtual disks:

```
582 <DiskSection>
583   <Info>Describes the set of virtual disks</Info>
584   <Disk ovf:diskId="vmdisk1" ovf:fileRef="file1" ovf:capacity="8589934592"
585     ovf:populatedSize="3549324972"
586     ovf:format=
587       "http://www.vmware.com/interfaces/specifications/vmdk.html#sparse">
588   </Disk>
589   <Disk ovf:diskId="vmdisk2" ovf:capacity="536870912"
590   </Disk>
591   <Disk ovf:diskId="vmdisk3" ovf:capacity="${disk.size}"
592     ovf:capacityAllocationUnits="byte * 2^30"
593   </Disk>
594 </DiskSection>
```

#### 595 4.4.5 NetworkSection element

596 The `NetworkSection` element describes the network and network connections used when the OVF  
597 package is deployed. The network may be defined in simplistic terms, e.g., as a Red, Green, Blue  
598 network. The Ethernet Port characteristics are defined by the  
599 `CIM_EthernetPortAllocationSettingData` class. It may also be defined in greater detail with the  
600 use of the *Network Port Profile* (DSP8049), which may be included in an OVF package.

601 There is a basic assumption that a flat layer 2 network is available for which the Ethernet ports to  
602 connect. There is no assumption made regarding the services or characteristics of that network. The  
603 speed of the Ethernet port can be set by using the `CIM_EthernetPortAllocationSettingData`.

#### 604 4.4.5.1 OVF networks

605 The following example is a snippet of an OVF descriptor for the Network Section. It simply states that the  
606 "Red" network is what the Ethernet ports defined in the virtual systems are attached to. The  
607 `epasd:Connection` property specifies the network to which the Ethernet port is connected. The  
608 simplistic assumption is that all Ethernet ports are connected to a layer 2 network. If more than one  
609 network is defined, e.g., "Red" and "Green", there is an assumption that the "Red" and "Green" networks  
610 are not connected. A connection to an external network, e.g., a data center LAN or a WAN, is considered  
611 part of the deployment provisioning and not specified in the OVF descriptor. In this case the agreement  
612 between the consumer of the OVF package and the hosting service determines the network  
613 characteristics and services.

```

614 <!-- Describes all networks used in the package -->
615 <NetworkSection>
616   <Info>Logical networks used in the package</Info>
617   <Network ovf:name="Red Network">
618     <Description>The network that the virtual systems are attached to.
619     on</Description>
620   </Network>
621 </NetworkSection>
622

```

623 The following example is a snippet of an item in an OVF descriptor `VirtualHardwareSection` in a  
624 `VirtualSystem` element that illustrates how the virtual system is attached to the “Red” network by using  
625 the `Connection` property from the `CIM_EthernetPortAllocationSettingData` class.

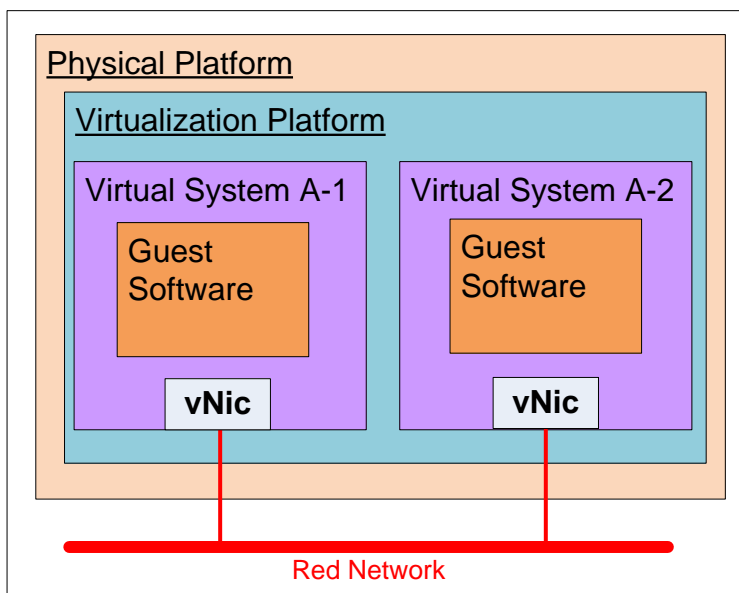
```

626 <EthernetPortItem>
627   <epasd:AddressOnParent>7</epasd:AddressOnParent>
628   <epasd:AutomaticAllocation>true</epasd:AutomaticAllocation>
629   <epasd:Connection>Red Network</epasd:Connection>
630   <epasd:Description>Virtual Ethernet adapter</epasd:Description>
631   <epasd:ElementName>Virtual NIC 1</epasd:ElementName>
632   <epasd:InstanceID>8</epasd:InstanceID>
633   <epasd:ResourceType>10</epasd:ResourceType>
634 </EthernetPortItem>

```

635 More than one network may be defined.

636 Figure 5 illustrates a simplistic network. The “Red” network is what the Ethernet port connects to.

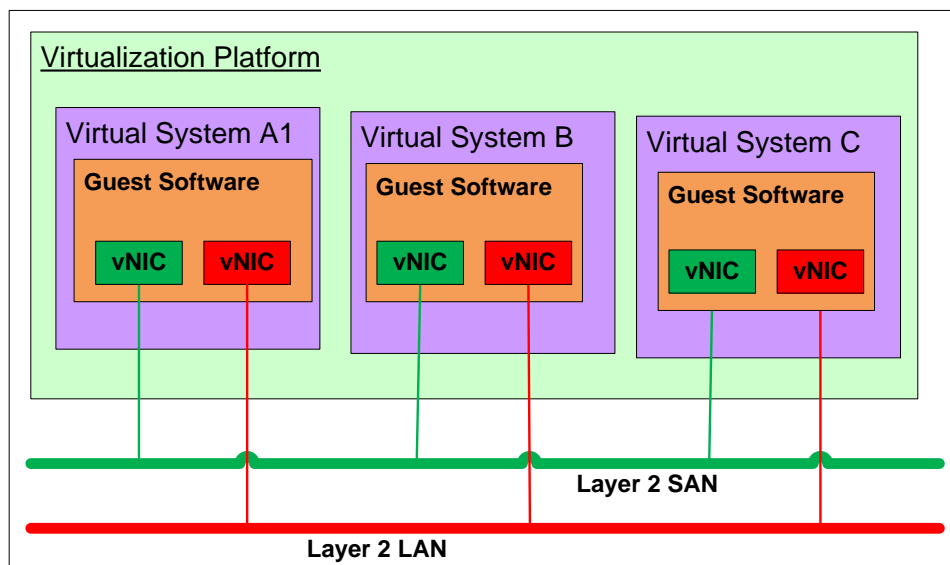


637

638

**Figure 5 – Network connections**

639 Figure 6 illustrates a dual network configuration: a “Green” network for storage connections and a “Red”  
640 network for local area network connections.



641

642

Figure 6 – LAN-SAN network connections

643 **4.4.5.2 Network Port Profile**

644 The *Network Port Profile* (DSP8049) defines a configuration of network ports properties of a network that  
 645 is used for communication by the virtual systems defined in the OVF package. See the *Virtual Networking*  
 646 *Management White Paper* (DSP2025) for additional information.

647 A complete listing of the properties in the `EthernetPortAllocationSettingData` class that can be  
 648 specified is shown below. The allowed values for each property are defined in the DSP0243, DSP1041,  
 649 DSP1050, and the CIM Schema. Only a subset of these properties is used in most OVF descriptors.

```

650 <EthernetPortItem>
651   <epasd:Address>
652   <epasd:AddressOnParent>
653   <epasd:AllocationUnits>
654   <epasd:AllowedPriorities>
655   <epasd:AllowedToReceiveMACAddresses>
656   <epasd:AllowedToReceiveVLANs>
657   <epasd:AllowedToTransmitMACAddresses>
658   <epasd:AllowedToTransmitVLANs>
659   <epasd:AutomaticAllocation>
660   <epasd:AutomaticDeallocation>
661   <epasd:Caption>
662   <epasd:ChangeableType>
663   <epasd:ConfigurationName>
664   <epasd:Connection>
665   <epasd:ConsumerVisibility>
666   <epasd:DefaultPortVID>
667   <epasd:DefaultPriority>
668   <epasd:Description>
669   <epasd:DesiredVLANEndpointMode>
670   <epasd:ElementName>
671   <epasd:GroupID>
    
```

```
672 <epasd:HostResource>
673 <epasd:InstanceID>
674 <epasd:Limit>
675 <epasd:ManagerID>
676 <epasd:MappingBehavior>
677 <epasd:NetworkPortProfileID>
678 <epasd:NetworkPortProfileIDType>
679 <epasd:OtherEndpointMode>
680 <epasd:OtherNetworkPortProfileIDTypeInfo>
681 <epasd:OtherResourceType>
682 <epasd:Parent>
683 <epasd:PoolID>
684 <epasd:PortCorrelationID>
685 <epasd:PortVID>
686 <epasd:Promiscuous>
687 <epasd:ReceiveBandwidthLimit>
688 <epasd:ReceiveBandwidthReservation>
689 <epasd:Reservation>
690 <epasd:ResourceSubType>
691 <epasd:ResourceType>
692 <epasd:SourceMACFilteringEnabled>
693 <epasd:VSITypeID>
694 <epasd:VSITypeIDVersion>
695 <epasd:VirtualQuantity>
696 <epasd:VirtualQuantityUnits>
697 <epasd:Weight>
698 </EthernetPortItem>
```

#### 699 4.4.6 DeploymentOptionsSection element

700 The `DeploymentOptionsSection` element is a direct child element of the `Envelope` element. The  
701 `Configuration` element is a direct child element of the `DeploymentOptionsSection` element. A  
702 `DeploymentOptionsSection` element contains one or more `Configuration` elements.

703 The `Configuration` element is used to specify a resource configuration used when an OVF package is  
704 deployed. A choice of one of the configurations is made at deployment. The user input can be requested  
705 through the use of the `userConfigurable` attribute.

706 The `DeploymentOptionsSection` element lists the IDs, labels and descriptions of the configurations  
707 available in the OVF package.

708 A default configuration is indicated by setting the `default` attribute to `true`. In the absence of other  
709 input, the default configuration is used. If a default is not indicated, the first configuration is taken as the  
710 default.

711 Each configuration has a unique `ID` attribute that identifies that configuration. This value of the `ID`  
712 attribute is specified in a `configuration` attribute in other section elements, such as a  
713 `VirtualHardwareSection` element, a `ProductSection` element, or a `ScaleOutSection`  
714 element.

715 If an element is to appear in more than one configuration, the `configuration` attribute of the elements  
716 is a list of space-separated configuration IDs.

717 The deployment function needs to select a configuration either from user input or from other metadata.  
718 When a configuration is selected, elements with a `configuration` attribute set to the selected  
719 configuration are used for the deployment. Elements without a `configuration` attribute are also  
720 deployed, but those with a different configuration attribute are not deployed. Thus, selecting a single  
721 configuration during deployment may affect the configuration of many different items in different sections  
722 of the OVF package.

723 A snippet from an OVF descriptor `DeploymentOptionsSection` element that illustrates the use of the  
724 `Configuration` element is shown below. Note that the default configuration for the memory resource  
725 allocation is highlighted in blue and the “big” configuration is highlighted in gray. The deployment function  
726 chooses the default configuration unless there is consumer input to choose the “big” configuration.

```
727
728 <DeploymentOptionsSection>
729   <Configuration ovf:id="big">
730     <Label>Big</Label>
731     <Description>Apply reservations for Memory</Description>
732   </Configuration>
733   ...
734 </DeploymentOptionsSection>
735
736 <VirtualHardwareSection>
737   <Info>...</Info>
738
739   <Item>
740     <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
741     <rasd:ElementName>512 MB memory size-no reservation</rasd:ElementName>
742     <rasd:InstanceID>0</rasd:InstanceID>
743     <rasd:ResourceType>4</rasd:ResourceType>
744     <rasd:VirtualQuantity>512</rasd:VirtualQuantity>
745   </Item>
746
747   <Item ovf:configuration="big">
748     <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
749     <rasd:ElementName>512 MB memory size &256 MB
750 reservation</rasd:ElementName>
751     <rasd:InstanceID>0</rasd:InstanceID>
752     <rasd:Reservation>256</rasd:Reservation>
753   </Item>
754 </VirtualHardwareSection>
```

755  
756 The resulting CIM instance for the resource allocation is illustrated below.

```
757 <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
758 <rasd:ElementName>512 MB memory size & 256 MB reservation </rasd:ElementName>
759 <rasd:InstanceID>0</rasd:InstanceID>
760 <rasd:Reservation>256</rasd:Reservation>
761 <rasd:ResourceType>4</rasd:ResourceType>
762 <rasd:VirtualQuantity>512</rasd:VirtualQuantity>
```

763 The text highlighted in gray is from the “big” configuration. The text highlighted in blue is from the default  
764 configuration.

765 The following example illustrates a `DeploymentOptionsSection` element with three `Configuration`  
 766 elements. Note that the “normal” configuration is designated as the default, so if no configuration is  
 767 selected, the deployment uses the elements with a `configuration` attribute of “normal”.

```
768 <DeploymentOptionSection>
769     <Configuration ovf:id="minimal">
770         <Label>Minimal</Label>
771         <Description>Smallest practical implementation</Description>
772     </Configuration>
773     <Configuration ovf:id="normal" ovf:default="true">
774         <Label>Normal</Label>
775         <Description>A typical implementation</Description>
776     </Configuration>
777     <Configuration ovf:id="large">
778         <Label>Large</Label>
779         <Description>A scaled up implementation</Description>
780     </Configuration>
781 </DeploymentOptionSection>
```

782 The following example illustrates the use of the `configuration` attribute to define the resource  
 783 allocations for the three configurations above. The `VirtualHardwareSection` element uses the  
 784 `CIM_ResourceAllocationDespcriptor` properties to specify the desired memory resource  
 785 configuration. Each `Item` element in the `VirtualHardwareSection` refers to a configuration defined  
 786 in the `DeploymentOptionsSection` element above.

```
787 <VirtualHardwareSection>
788     <Info>...</Info>
789     <Item ovf:configuration="normal">
790         <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
791         <rasd:ElementName>512 MB memory size and 256 MB reservation</rasd:ElementName>
792         <rasd:InstanceID>0</rasd:InstanceID>
793         <rasd:Reservation>256</rasd:Reservation>
794         <rasd:ResourceType>4</rasd:ResourceType>
795         <rasd:VirtualQuantity>512</rasd:VirtualQuantity>
796     </Item>
797     <Item ovf:configuration="minimal">
798         <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
799         <rasd:ElementName>256 MB memory size and 128 MB reservation</rasd:ElementName>
800         <rasd:InstanceID>1</rasd:InstanceID>
801         <rasd:Reservation>128</rasd:Reservation>
802         <rasd:ResourceType>4</rasd:ResourceType>
803         <rasd:VirtualQuantity>256</rasd:VirtualQuantity>
804     </Item>
805     <Item ovf:configuration="large">
806         <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
807         <rasd:ElementName>1024 MB memory size and 512 MB reservation</rasd:ElementName>
808         <rasd:InstanceID>0</rasd:InstanceID>
809         <rasd:Reservation>512</rasd:Reservation>
810         <rasd:ResourceType>4</rasd:ResourceType>
811         <rasd:VirtualQuantity>1024</rasd:VirtualQuantity>
```



```
812     </Item>
813 </VirtualHardwareSection>
```

814 In the example above, the memory size is controlled by the configuration selected during deployment. If a  
815 configuration is not selected, the memory size defaults to the “normal” configuration.

816 The following example shows the use of a configuration attribute in a `ProductSection`.

```
817 <ProductSection>
818     <Property ovf:key="app_log" ovf:type="string" ovf:value="low"
819         ovf:configuration="normal">
820         <Label>Loglevel</Label>
821         <Description>Loglevel for the service</Description>
822         <Value ovf:value="none" ovf:configuration="minimal">
823         <Value ovf:value="high" ovf:configuration="large">
824     </Property>
825 </ProductSection>
```

826 In this example, the value of “app\_log” changes based on the configuration selected. As with virtual  
827 hardware, if a configuration is not selected, the value of the “app\_log” property defaults to the “normal”  
828 configuration value, i.e., “low”.

#### 829 4.4.7 SharedDiskSection element

830 The `SharedDiskSection` element allows a virtual disk to be referenced by multiple virtual systems to  
831 satisfy the needs of clustered databases. The file sharing system technology used is platform specific.

832 The `SharedDiskSection` element is a valid only at the envelope level.

833 Each shared disk has a unique identifier for the OVF package. The `SharedDiskSection` element adds  
834 a Boolean `ovf:readOnly` attribute that indicates whether read-write (i.e., `FALSE`), or read-only (i.e.,  
835 `TRUE`) access is allowed.

836 The following example illustrates the basics of a `SharedDiskSection` element.

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

844 The following example illustrates the use of shared disks. The disks for installations of the operating  
845 system (system), the cluster software (crs\_home), and database (db\_home) are backed by external `File`  
846 references. The shared virtual disks in this example have no backing by an external `File` reference; the  
847 deployment engine creates the shared disk appropriately to be shared by more than one virtual system.

```
848 <ovf:References>
849     <ovf:File ovf:id="system" ovf:href="system.img" ovf:compression="gzip"/>
850     <ovf:File ovf:id="crs_home" ovf:href="crs_home.img" ovf:compression="gzip"/>
851     <ovf:File ovf:id="db_home" ovf:href="db_home.img" ovf:compression="gzip"/>
852 </ovf:References>
853 <ovf:DiskSection>
854     <ovf:Info>Virtual Disks</ovf:Info>
```

```
855     <ovf:Disk ovf:diskId="system" ovf:fileRef="system" ovf:capacity="5368709120"
856     ovf:format="Raw disk image"/>
857     <ovf:Disk ovf:diskId="crs_home" ovf:fileRef="crs_home" ovf:capacity="2147483648"
858     ovf:format="Raw disk image"/>
859     <ovf:Disk ovf:diskId="db_home" ovf:fileRef="db_home" ovf:capacity="4294967296"
860     ovf:format="Raw disk image"/>
861 </ovf:DiskSection>
862 <ovf:SharedDiskSection>
863     <ovf:Info>Virtual Disks shared at runtime</ovf:Info>
864     <ovf:SharedDisk ovf:diskId="crs_asm" ovf:capacity="4294967296" ovf:format="Raw disk
865     image"/>
866     <ovf:SharedDisk ovf:diskId="db_asm" ovf:capacity="12884901888" ovf:format="Raw disk
867     image"/>
868 </ovf:SharedDiskSection>
869 .....
870 <ovf:VirtualSystemCollection ovf:id="rac_db_asm">
871     <ovf:Info>Sample Oracle RAC using ASM</ovf:Info>
872     .....
873     <ovf:ScaleOutSection ovf:id="rac_db">
874         <ovf:Info>RAC DB</ovf:Info>
875         <ovf:Description>Number of instances</ovf:Description>
876         <ovf:InstanceCount ovf:default="2" ovf:minimum="2"
877         ovf:maximum="4"</ovf:InstanceCount>
878     </ovf:ScaleOutSection>
879     .....
880     <ovf:VirtualSystem ovf:id="rac_db">
881         <ovf:Info>RAC DB Instance</ovf:Info>
882         .....
883         <ovf:VirtualHardwareSection>
884             <ovf:Info>System requirements: 8192 MB, 2 CPUs, 5 disks, 2 nics
885             </ovf:Info>
886             .....
887             <ovf:Item>
888                 <rasd:Description>Disk 1</rasd:Description>
889                 <rasd:ElementName>Disk 1</rasd:ElementName>
890                 <rasd:HostResource>ovf:/disk/system</rasd:HostResource>
891                 <rasd:ResourceType>17</rasd:ResourceType>
892             </ovf:Item>
893             <ovf:Item>
894                 <rasd:Description>Disk 2</rasd:Description>
895                 <rasd:ElementName>Disk 2</rasd:ElementName>
896                 <rasd:HostResource>ovf:/disk/crs_home</rasd:HostResource>
897                 <rasd:ResourceType>17</rasd:ResourceType>
898             </ovf:Item>
899             <ovf:Item>
900                 <rasd:Description>Disk 3</rasd:Description>
901                 <rasd:ElementName>Disk 3</rasd:ElementName>
902                 <rasd:HostResource>ovf:/disk/db_home</rasd:HostResource>
903                 <rasd:ResourceType>17</rasd:ResourceType>
```

```

904     </ovf:Item>
905     <ovf:Item>
906         <rasd:Description>Disk 4</rasd:Description>
907         <rasd:ElementName>Disk 4</rasd:ElementName>
908         <rasd:HostResource>ovf:/disk/crs_asm</rasd:HostResource>
909         <rasd:ResourceType>17</rasd:ResourceType>
910     </ovf:Item>
911     <ovf:Item>
912         <rasd:Description>Disk 5</rasd:Description>
913         <rasd:ElementName>Disk 5</rasd:ElementName>
914         <rasd:HostResource>ovf:/disk/db_asm</rasd:HostResource>
915         <rasd:ResourceType>17</rasd:ResourceType>
916     </ovf:Item>
917     .....
918 </ovf:VirtualHardwareSection>
919 </ovf:VirtualSystem>
920 </ovf:VirtualSystemCollection>

```

#### 921 4.4.8 PlacementGroupSection element

922 The PlacementGroupSection element defines an ID for a placement group and its associated  
 923 placement policy(s). The placement group is associated with a VirtualSystemCollection or  
 924 VirtualSystem through the use of the PlacementSection element.

925 An example of PlacementGroupSection elements is shown below.

```

926 <ovf:PlacementGroupSection ovf:id="PG2" ovf:policy="availability">
927     <Info>Placement policy for group of virtual systems that need availability</Info>
928     <ovf:Description>Placement policy for a database tier</ovf:Description>
929 </ovf:PlacementGroupSection>
930     ...
931 <ovf:PlacementGroupSection ovf:id="PG1" ovf:policy="affinity">
932     <Info>Placement policy for group of virtual systems that need affinity</Info>
933     <ovf:Description>Placement policy for a web tier</ovf:Description>
934 </ovf:PlacementGroupSection>

```

935 The PlacementGroupSection element is a direct child element of the Envelope element. See 4.5.5.

## 936 4.5 OVF section elements used in Virtual System and Virtual System Collection

937 The following OVF descriptor section elements may appear within a VirtualSystem or  
 938 VirtualSystemCollection element.

### 939 4.5.1 AnnotationSection element

940 The AnnotationSection element is user-defined and can appear in VirtualSystem and  
 941 VirtualSystemCollection elements. An AnnotationSection element contains one Annotation  
 942 element. Annotation elements are localizable. A suggested use for Annotation elements is to display  
 943 them to the consumers as the package is deployed. Note that the Annotation element specified in OVF  
 944 is not an XML Schema Annotation element.

```

945 <AnnotationSection>
946     <Info>An annotation on this service. It can be ignored</Info>

```

```

947     <Annotation>Contact customer support if you have any problems</Annotation>
948 </AnnotationSection >

```

#### 949 4.5.2 ProductSection element

950 The `ProductSection` element provides product information such as name and vendor of the appliance  
 951 and a set of properties that can be used to customize the appliance. These properties are be configured  
 952 at installation time of the appliance, typically by prompting the user. This is discussed in more detail  
 953 below.

```

954 <ProductSection ovf:class="com.mycrm.myservice" ovf:instance="1">
955   <Info>Describes product information for the service</Info>
956   <Product>MyCRM Enterprise</Product>
957   <Vendor>MyCRM Corporation</Vendor>
958   <Version>4.5</Version>
959   <FullVersion>4.5-b4523</FullVersion>
960   <ProductUrl>http://www.mycrm.com/enterprise</ProductUrl>
961   <VendorUrl>http://www.mycrm.com</VendorUrl>
962   <Icon ovf:height="32" ovf:width="32" ovf:mimeType="image/png" ovf:fileRef="icon">
963   <Category>Email properties</Category>
964   <Property ovf:key="adminEmail" ovf:type="string" ovf:userConfigurable="true">
965     <Label>Admin email</Label>
966     <Description>Email address of administrator</Description>
967   </Property>
968   <Category>Admin properties</Category>
969   <Property ovf:key="appLog" ovf:type="string" ovf:value="low"
970   ovf:userConfigurable="true">
971     <Description>Loglevel for the service</Description>
972   </Property>
973   <Property ovf:key="appisSecondary" ovf:value="false" ovf:type="boolean">
974     <Description>Cluster setup for application server</Description>
975   </Property>
976   <Property ovf:key="appIp" ovf:type="string" ovf:value="{appserver-vm}">
977     <Description>IP address of the application server VM</Description>
978   </Property>
979 </ProductSection>

```

980 Note that the `ovf:key` attribute does not contain the period character ('.') or the colon character (':') and  
 981 the `ovf:class` and `ovf:instance` attributes do not contain the colon character (':').

982 If only one instance of a product is installed, the `ovf:instance` attribute is not used.

983 The following illustrates the use of OVF Properties in a `ProductSection` element:

```

984 <ProductSection>
985   <Property ovf:key="adminEmail" ovf:type="string" ovf:userConfigurable="true"
986   ovf:configuration="standard">
987     <Label>Admin email</Label>
988     <Description>Email address of service administrator</Description>
989   </Property>
990   <Property ovf:key="appLog" ovf:type="string" ovf:value="low"
991   ovf:userConfigurable="true">

```

```

992     <Label>Loglevel</Label>
993     <Description>Loglevel for the service</Description>
994     <Value ovf:value="none" ovf:configuration="minimal">
995     </Property>
996 </ProductSection>

```

997 In the example above, the `adminEmail` property is only user configurable in the standard configuration,  
 998 while the default value for the `appLog` property is changed from “low” to “none” in the minimal  
 999 configuration.

### 1000 4.5.3 EulaSection element

1001 The `EulaSection` contains the human readable licensing agreement for its parent, usually a  
 1002 `VirtualSystem` or `VirtualSystemCollection` element. Each parent element may have more than  
 1003 one `EulaSection` element. The contents of the `License` element of each `EulaSection` element  
 1004 are displayed to the user for acceptance when the OVF package is deployed. If unattended deployment is  
 1005 supported, provision is made for implicit acceptance of the Eula.

1006 Eulas may be externalized for localization or to point to an external license document. See 5.2 for more  
 1007 details about internationalization.

1008 This is an example `EulaSection` element:

```

1009 <EulaSection>
1010     <Info>Licensing agreement</Info>
1011     <License>
1012     Lorem ipsum dolor sit amet, ligula suspendisse nulla pretium, rhoncus tempor placerat
1013     fermentum, enim integer ad vestibulum volutpat. Nisl rhoncus turpis est, vel elit,
1014     congue wisi enim nunc ultricies sit, magna tincidunt. Maecenas aliquam maecenas ligula
1015     nostra, accumsan taciti. Sociis mauris in integer, a dolor netus non dui aliquet,
1016     sagittis felis sodales, dolor sociis mauris, vel eu libero cras. Interdum at. Eget
1017     habitasse elementum est, ipsum purus pede porttitor class, ut adipiscing, aliquet sed
1018     auctor, imperdiet arcu per diam dapibus libero duis. Enim eros in vel, volutpat nec
1019     pellentesque leo, scelerisque.
1020     </License>
1021 </EulaSection>

```

### 1022 4.5.4 VirtualHardwareSection element

1023 The `VirtualHardwareSection` element describes the virtual hardware that is using the CIM resource  
 1024 allocation setting data model. This model is based on `CIM_ResourceAllocationSettingData`  
 1025 classes that specify CIM properties to describe the type and quantity of the resource being requested.  
 1026 The CIM Schema is available at <http://www.dmtf.org/standards/cim>.

1027 The minimum required resource allocation setting data for a virtual processor device is illustrated below.  
 1028 This is not user friendly, so it helps to add the `rasd:Description` and `rasd:ElementName`.

```

1029 <Item>
1030     <rasd:InstanceID>0</epasd:InstanceID>
1031     <rasd:ResourceType>3</epasd:ResourceType>
1032 </Item>

```

1033 This `VirtualHardwareSection` element describes the virtual devices in the hardware abstraction  
 1034 layer that is used by a virtual system. The `CIM_ResourceAllocationSettingData` has a list of  
 1035 devices. Some devices, such as the Ethernet port and Storage, are subclassed with an extended set of  
 1036 properties.

1037 In this particular case, a fairly typical set of hardware (500 MB of guest memory, 1 CPU, 1 NIC, and one  
 1038 virtual disk) is specified. The network and disk identifiers from the outer sections are referenced here. An  
 1039 incomplete or missing hardware section may cause the deployment to fail.

1040 The following illustrates a `VirtualHardwareSection` element.

```

1041 <VirtualHardwareSection>
1042   <Info>Memory = 4 GB, CPU = 1 GHz, Disk = 100 GB, 1 Ethernet nic</Info>
1043   <Item>
1044     <rasd:AllocationUnits>Hertz*10^9</rasd:AllocationUnits>
1045     <rasd:Description>Virtual CPU</rasd:Description>
1046     <rasd:ElementName>1 GHz virtual CPU</rasd:ElementName>
1047     <rasd:InstanceID>1</rasd:InstanceID>
1048     <rasd:Reservation>1</rasd:Reservation>
1049     <rasd:ResourceType>3</rasd:ResourceType>
1050     <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
1051     <rasd:VirtualQuantityUnit>Count</ rasd:VirtualQuantityUnit>
1052   </Item>
1053   <Item>
1054     <rasd:AllocationUnits>byte*2^30</rasd:AllocationUnits>
1055     <rasd:Description>Memory</rasd:Description>
1056     <rasd:ElementName>1 GByte of memory</rasd:ElementName>
1057     <rasd:InstanceID>2</rasd:InstanceID>
1058     <rasd:Limit>4</rasd:Limit>
1059     <rasd:Reservation>41</rasd:Reservation>
1060     <rasd:ResourceType>4</rasd:ResourceType>
1061   </Item>
1062   <EthernetPortItem>
1063     <epasd:AllocationUnits>bit / second *2^30 </rasd:AllocationUnits>
1064     <epasd:Connection>VM Network</epasd:Connection>
1065     <epasd:Description>Virtual NIC</epasd:Description>
1066     <epasd:ElementName>Ethernet Port</epasd:ElementName>
1067     <epasd:NetworkPortProfileID>1</epasd:NetworkPortProfileID>
1068     <epasd:NetworkPortProfileIDType>4</epasd:NetworkPortProfileIDType>
1069     <epasd:ResourceType>10</epasd:ResourceType>
1070     <epasd:VirtualQuantity>1</epasd:VirtualQuantity>
1071     <epasd:VirtualQuantityUnits>Count</epasd:VirtualQuantityUnits>
1072   </EthernetPortItem>
1073   <StorageItem>
1074     <sasd:AllocationUnits>byte*2^30</sasd:AllocationUnits>
1075     <sasd:Description>Virtual Disk</sasd:Description>
1076     <sasd:ElementName>100 GByte Virtual Disk</sasd:ElementName>
1077
1078     <sasd:Reservation>100</sasd:Reservation>
1079     <sasd:ResourceType>31</sasd:ResourceType>
1080     <sasd:VirtualQuantity>1</sasd:VirtualQuantity>
1081     <sasd:VirtualQuantityUnit>Count</sasd:VirtualQuantityUnit>
1082   </StorageItem>
1083 </VirtualHardwareSection>

```

1084 An example of a `ResourceSubType` CIM property follows:

```
1085 <rasd:ResourceSubType>buslogic lsillogic</rasd:ResourceSubType>
```

1086 The following example illustrates a `VirtualHardwareSection` element with a default and a 'big'  
1087 configuration. See 4.4.6 for information about how configuration options are used.

```
1088 <VirtualHardwareSection>
1089   <Info>...</Info>
1090   <Item>
1091     <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
1092     <rasd:ElementName>512 MB memory size and 256 MB reservation</rasd:ElementName>
1093     <rasd:InstanceID>0</rasd:InstanceID>
1094     <rasd:Reservation>256</rasd:Reservation>
1095     <rasd:ResourceType>4</rasd:ResourceType>
1096     <rasd:VirtualQuantity>512</rasd:VirtualQuantity>
1097   </Item>
1098   ...
1099   <Item ovf:configuration="big">
1100     <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
1101     <rasd:ElementName>1024 MB memory size and 512 MB reservation</rasd:ElementName>
1102     <rasd:InstanceID>0</rasd:InstanceID>
1103     <rasd:Reservation>512</rasd:Reservation>
1104     <rasd:ResourceType>4</rasd:ResourceType>
1105     <rasd:VirtualQuantity>1024</rasd:VirtualQuantity>
1106   </Item>
1107 </VirtualHardwareSection>
```

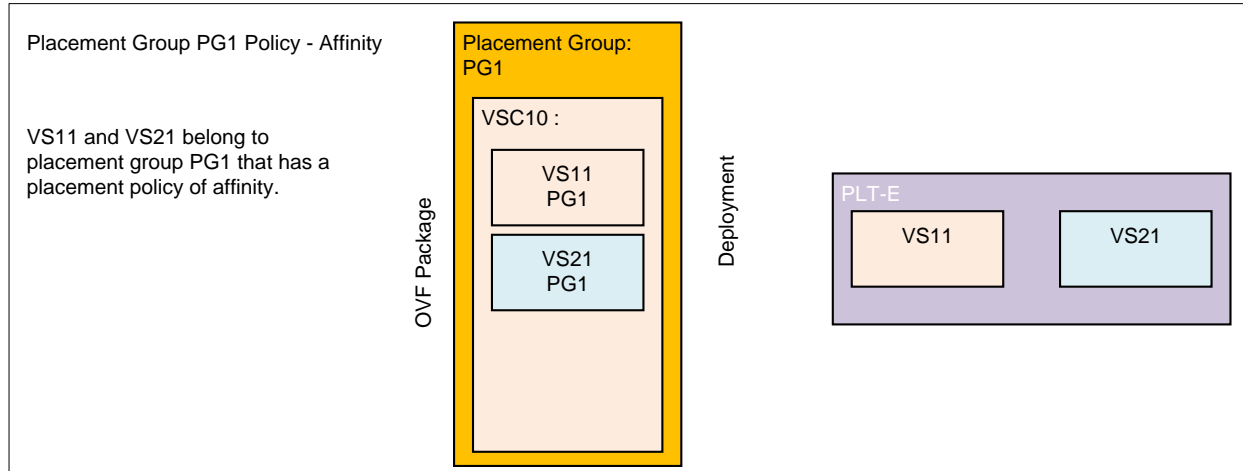
#### 1108 4.5.5 PlacementSection element

1109 The `PlacementSection` element specifies the placement group of which a Virtual System or Virtual  
1110 System Collection is a member. The placement policy(s) specified in the placement group (see 4.4.8) is  
1111 applied by the deployment function. The following OVF descriptor snippet illustrates a placement section  
1112 in each of two virtual systems.

```
1113 <VirtualSystemCollection ovf:id="VSC10">
1114   <VirtualSystem ovf:id="VS11">
1115     <Info>Web server</Info>
1116     ...
1117     <ovf:PlacementSection ovf:group="PG1">
1118       <Info>Placement policy group reference</Info>
1119     </ovf:PlacementSection>
1120     ...
1121   </VirtualSystem>
1122   <VirtualSystem ovf:id="VS21">
1123     <Info>Web server</Info>
1124     ...
1125     <ovf:PlacementSection ovf:group="PG1">
1126       <Info>Placement policy group reference</Info>
1127     </ovf:PlacementSection>
1128     ...
1129   </VirtualSystem>
```

1130 </VirtualSystemCollection>

1131 In this example, the virtual systems, when instantiated, should be placed according to the placement  
 1132 policies specified in the “PG1” placement group. As shown in 4.4.8, the placement group ‘PG1’ has an  
 1133 affinity placement policy. Figure 7 illustrates an affinity placement.



1134

1135

**Figure 7 – Affinity placement**

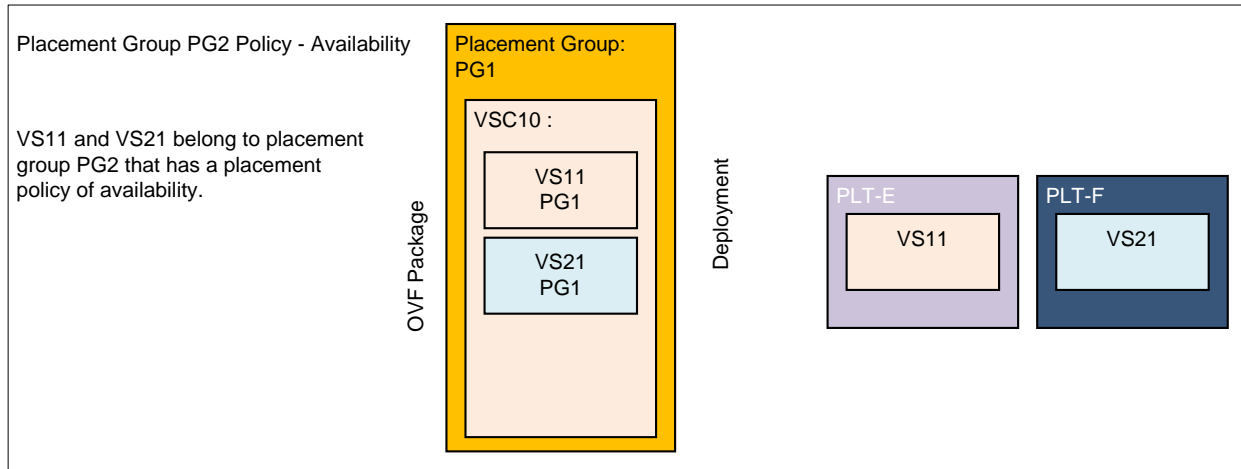
1136 The following OVF descriptor snippet illustrates a placement section in each of two virtual systems.

```

1137 <VirtualSystemCollection ovf:id="VSC10">
1138   <VirtualSystem ovf:id="VS11">
1139     <Info>Web server</Info>
1140     ...
1141     <ovf:PlacementSection ovf:group="PG2">
1142       <Info>Placement policy group reference</Info>
1143     </ovf:PlacementSection>
1144     ...
1145   </VirtualSystem>
1146   <VirtualSystem ovf:id="VS21">
1147     <Info>Web server</Info>
1148     ...
1149     <ovf:PlacementSection ovf:group="PG2">
1150       <Info>Placement policy group reference</Info>
1151     </ovf:PlacementSection>
1152     ...
1153   </VirtualSystem>
1154 </VirtualSystemCollection>
  
```

1155 In this example, the virtual systems, when instantiated, should be placed according to the placement  
 1156 policies specified in the “PG2” placement group. As shown in 4.4.8, the placement group ‘PG2’ has an  
 1157 availability placement policy. Figure 8 illustrates an availability placement.





1158

1159

**Figure 8 – Availability placement**

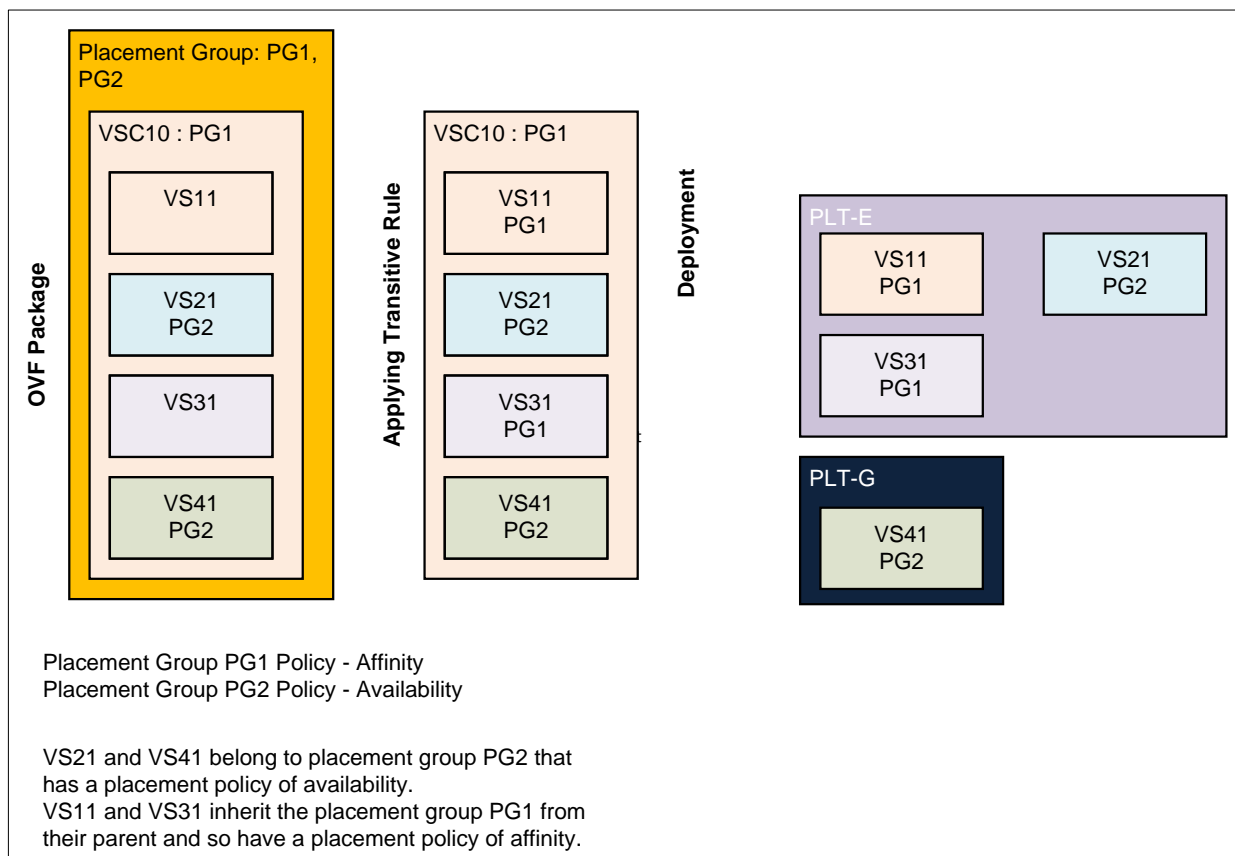
1160 The following OVF descriptor snippet illustrates a placement section in each of two virtual systems.

```

1161 <VirtualSystemCollection ovf:id="VSC10">
1162   <ovf:PlacementSection ovf:group="PG1">
1163     <Info>Placement policy group reference</Info>
1164   </ovf:PlacementSection>
1165
1166   <VirtualSystem ovf:id="VS11">
1167     <Info>Web server</Info>
1168     ...
1169   </VirtualSystem>
1170   <VirtualSystem ovf:id="VS21">
1171     <Info>Web server</Info>
1172     ...
1173     <ovf:PlacementSection ovf:group="PG2">
1174       <Info>Placement policy group reference</Info>
1175     </ovf:PlacementSection>
1176     ...
1177   </VirtualSystem>
1178   <VirtualSystem ovf:id="VS31">
1179     <Info>Web server</Info>
1180     ...
1181   </VirtualSystem>
1182   <VirtualSystem ovf:id="VS41">
1183     <Info>Web server</Info>
1184     ...
1185     <ovf:PlacementSection ovf:group="PG2">
1186       <Info>Placement policy group reference</Info>
1187     </ovf:PlacementSection>
1188     ...
1189   </VirtualSystem>
1190 </VirtualSystemCollection>
  
```

1191 In this example, the virtual systems, when instantiated, should be placed according to the placement  
 1192 policies specified in the “PG1” and “PG2” placement groups. As shown in 4.4.8, the placement group ‘PG1’  
 1193 has an affinity placement policy. As shown in 4.4.8, the placement group ‘PG2’ has an availability  
 1194 placement policy. Figure 9 illustrates the placement of virtual systems in this more complex example. It  
 1195 also illustrates the application of the transitivity rule.

1196



1197

1198

**Figure 9 – Affinity and availability placement**

1199 **4.5.6 EncryptionSection element**

1200 There are several reasons why it is desirable to have an encryption scheme enabling exchange of OVF  
 1201 appliances while ensuring that only the intended consumers can use them. The encryption scheme  
 1202 proposed in this specification utilizes existing encryption standards to incorporate this functionality in the  
 1203 specification,

1204 The `EncryptionSection` element provides a single location for placing the encryption algorithm-related  
 1205 markup and the corresponding reference list to point to the OVF content that has been encrypted.

1206 A document typically uses a single method of encryption, with a single key. However, the specification  
 1207 allows the flexibility to encrypt different portions of the OVF descriptor with different keys derived by using  
 1208 different methods and communicated to the end user in different ways.

1209 It is important to keep in mind that depending on which parts of the OVF descriptor have been encrypted,  
 1210 an OVF descriptor may not validate against the OVF Schemas until decrypted.

1211 The encryption uses XML Encryption standard 1.1 to encrypt either the files in the reference section or  
1212 any parts of the XML markup of an OVF document.

1213 From an encryption standpoint, the important aspects that the standard defines are the

- 1214 a) algorithm used for the derivation of the key used in the encryption
- 1215 b) block encryption algorithm used to encrypt the content that uses the key
- 1216 c) method of transporting keys embedded in the OVF XML document.

1217 For each method of encryption used within the document, all the aspects that are necessary need to be  
1218 defined by the OVF package author. For instance, the author may choose to embed the key used in the  
1219 document, or the author may choose to communicate the key to desired end user by other means.

1220 The other aspect is a list of references to the markup sections in the OVF envelope, or the files in the  
1221 reference section that are encrypted by using the specific method. In order to be able to encrypt arbitrary  
1222 sections within the OVF Descriptor, use is made of the XML ID attribute within the `ReferenceList`  
1223 elements.

1224 The following example illustrates the conceptual structure of an `Encryption` section.

```
1225 <! --- Start of encryption section ---!>
1226   <! ---- Start of Markup for encryption method 1 ----!>
1227     <! ---- Markup defining key derivation aspects per XML encryption 1.1 ----!>
1228     <! ---- Markup defining the usage of the key for encryption per XML encryption 1.1
1229     ---!>
1230     <! ---- Optionally, the markup for key transportation per XML encryption 1.1 ---!>
1231     <! ---- Start of markup for pointers to the list of XML fragments encrypted using
1232     method 1---!>
1233       <! --- Pointer 1 ---!>
1234         .
1235         .
1236       <! --- Pointer N ---!>
1237     <! ---- End of markup for pointers to the list of XML fragments encrypted using
1238     method 1 ---!>
1239     <! ---- End of Markup for method 1 of encryption ----!>
1240
1241     <! ---- Start of the markup for encryption method N ----!>
1242       <! ---- Markup defining key derivation aspects per XML encryption 1.1 ----!>
1243       <! ---- Markup defining the usage of the key for encryption per XML encryption
1244       1.1 ---!>
1245       <! ---- Optionally, the markup for key transportation per XML encryption 1.1 -
1246       --!>
1247       <! ---- Start of markup for pointers to the list of XML fragments encrypted
1248       using method 1---!>
1249         <! --- Pointer 1 ---!>
1250           .
1251           .
1252         <! --- Pointer N ---!>
1253       <! ---- End of Markup for encryption method N ----!>
1254 <! --- End of encryption section ---!>
```

1255 Below is an example of an OVF encryption section with encryption methods utilized in the OVF  
1256 document, and the corresponding reference list pointing to the items that have been encrypted.

```

1257     <ovf:EncryptionSection>
1258 <!-- This section contains two different methods of encryption and the corresponding
1259 backpointers to the data that is encrypted. -->
1260     <!-- Method#1: Pass phrase based key derivation -->
1261 <!-- The following derived key block defines PBKDF2 and the corresponding
1262 backpointers to the encrypted data elements. -->
1263     <!-- Use a salt value "ovfpassword" and iteration count of 4096. --->
1264     <xenc11:DerivedKey>
1265         <xenc11:KeyDerivationMethod
1266 Algorithm="http://www.rsasecurity.com/rsalabs/pkcs/schemas/pkcs-5#pbkdf2"/>
1267 <pkcs-5:PBKDF2-params>
1268     <Salt>
1269         <Specified>ovfpassword</Specified>
1270     </Salt>
1271         <IterationCount>4096</IterationCount>
1272         <KeyLength>16</KeyLength>
1273         <PRF Algorithm="http://www.w3.org/2001/04/xmldsig-more#hmac-sha256"/>
1274     </pkcs-5:PBKDF2-params>
1275     ...
1276 <!-- The ReferenceList element below contains references to the file Ref-109.vhd via
1277 the URI syntax that is specified by XML Encryption.
1278 --->
1279 <xenc:ReferenceList>
1280     <xenc:DataReference URI="#first.vhd" />
1281 <xenc:DataReference URI=... />
1282 <xenc:DataReference URI=... />
1283 </xenc:ReferenceList>
1284 </xenc11:DerivedKey>
1285     <!-- Method#2: The following example illustrates use of a symmetric key
1286 transported by using the public key within a certificate. -->
1287 <xenc:EncryptedKey>
1288     <xenc:EncryptionMethod Algorithm="http://www.w3.org/2001/04/xmlenc#rsa-
1289 1_5"/>
1290     <ds:KeyInfo xmlns:ds='http://www.w3.org/2000/09/xmldsig#'
1291         <ds:X509Data>
1292             <ds:X509Certificate> ... </ds:X509Certificate>
1293         </ds:X509Data>
1294     </ds:KeyInfo>
1295     <xenc:CipherData>
1296 <xenc:CipherValue> ... </xenc:CipherValue>
1297     </xenc:CipherData>
1298 <!-- The ReferenceList element below contains reference #second-xml-fragment" to the
1299 XML fragment that has been encrypted by using the above method. --->
1300 <xenc:ReferenceList>
1301     <xenc:DataReference URI='#second-xml-fragment' />
1302 <xenc:DataReference URI='...' />
1303 <xenc:DataReference URI='...' />
1304 </xenc:ReferenceList>
1305 </xenc:EncryptedKey>
1306 </ovf:EncryptionSection>

```

1307 Below is an example of the encrypted file that is referenced in the EncryptionSection  
 1308 above by using URI='Ref-109.vhd' syntax.

1309 EXAMPLE:

```
1310 <ovf:References>
1311 <ovf:File ovf:id="Xen:9cb10691-4012-4aeb-970c-3d47a906bfff/0b13bdba-3761-8622-22fc-
1312 2e252ed9ce14" ovf:href="Ref-109.vhd">
1313 <!-- The encrypted file referenced by the package is enclosed by an EncryptedData with
1314 a CipherReference to the actual encrypted file. The EncryptionSection in this example
1315 has a backpointer to it under the PBKDF2 algorithm via Id="first.vhd". This tells the
1316 decrypter how to decrypt the file. -->
1317 <xenc:EncryptedData Id="first.vhd" Type='http://www.w3.org/2001/04/xmlenc#Element' >
1318     <xenc:EncryptionMethod
1319 Algorithm="http://www.w3.org/2001/04/xmlenc#aes128-cbc" />
1320     <xenc:CipherData>
1321         <xenc:CipherReference URI='Ref-109.vhd' />
1322     </xenc:CipherData>
1323 </xenc:EncryptedData>
1324 </ovf:File>
1325 </ovf:References>
```

1326 Below is an example of the encrypted OVF markup that is referenced in the  
 1327 EncryptionSection above by using URI='#second-xml-fragment' syntax.

1328 EXAMPLE:

```
1329 <!-- The EncryptedData element below encompasses encrypted xml from the original
1330 document. It is provided with the Id "second-xml-fragment", which allows it to be
1331 referenced from the EncryptionSection. -->
1332 <xenc:EncryptedData Type=http://www.w3.org/2001/04/xmlenc#Element Id="second-xml-
1333 fragment">
1334 <!-- Each EncryptedData specifies its own encryption method. -->
1335     <xenc:EncryptionMethod Algorithm=http://www.w3.org/2001/04/xmlenc#aes128-cbc/>
1336     <xenc:CipherData>
1337         <!-- Encrypted content --->
1338         <xenc:CipherValue>DEADBEEF</xenc:CipherValue>
1339     </xenc:CipherData>
1340 </xenc:EncryptedData>
```

1341

## 1342 4.6 OVF section elements used in virtual system collection

### 1343 4.6.1 ResourceAllocationSection element

1344 The ResourceAllocationSection element sets resource constraints that apply to a virtual system  
 1345 collection. In contrast, the VirtualHardwareSection element applies to a specific virtual system.

1346 The ResourceAllocationSection element can use the bound attribute to set a minimum, a  
 1347 maximum, or both for the allocation of a resource that applies in aggregate to all the virtual systems in the  
 1348 virtual system collection.

1349 The following example illustrates a ResourceAllocationSection element. The processor allocation  
 1350 illustrates the use of the bound attribute.

```
1351 <ResourceAllocationSection>
1352     <Info>Defines reservations for CPU and memory for the collection of VMs</Info>
1353     <Item>
1354         <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
```

```

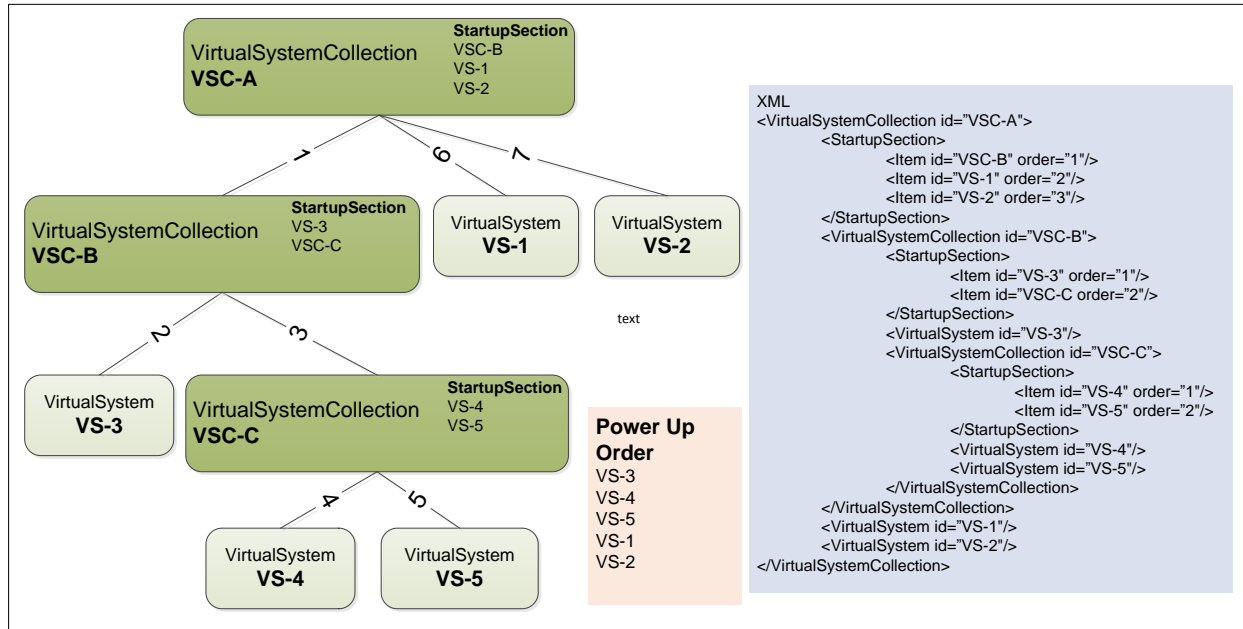
1355     <rasd:ElementName>300 MB reservation</rasd:ElementName>
1356     <rasd:InstanceID>0</rasd:InstanceID>
1357     <rasd:Reservation>300</rasd:Reservation>
1358     <rasd:ResourceType>4</rasd:ResourceType>
1359   </Item>
1360   <Item ovf:bound="min">
1361     <rasd:AllocationUnits>MHz</rasd:AllocationUnits>
1362     <rasd:ElementName>500 MHz reservation</rasd:ElementName>
1363     <rasd:InstanceID>1</rasd:InstanceID>
1364     <rasd:Reservation>500</rasd:Reservation>
1365     <rasd:ResourceType>3</rasd:ResourceType>
1366   </Item>
1367   <Item ovf:bound="max">
1368     <rasd:AllocationUnits>MHz</rasd:AllocationUnits>
1369     <rasd:ElementName>1500 MHz reservation</rasd:ElementName>
1370     <rasd:InstanceID>1</rasd:InstanceID>
1371     <rasd:Reservation>1500</rasd:Reservation>
1372     <rasd:ResourceType>3</rasd:ResourceType>
1373   </Item>
1374 </ResourceAllocationSection>

```

#### 1375 **4.6.2 StartupSection element**

1376 The `StartupSection` element controls powering on and off of virtual system collections and is  
 1377 executed after `InstallSection` element(s). The `StartupSection` element is a list of `Item`  
 1378 elements. `Item` elements have attributes that control the order and timing of powering up and down. The  
 1379 `Item` elements in a `StartupSection` element are scoped to that element. Do not confuse these  
 1380 elements with `Item` elements in a `VirtualHardwareSection` element or  
 1381 `ResourceAllocationSection` element.

1382 The `Item` elements within a `StartupSection` element reference either a `VirtualSystem` element or  
 1383 a `VirtualSystemCollection` element. A `StartupSection` element may control powering up and  
 1384 down of both virtual systems and virtual system collections contained in the virtual system collection  
 1385 parent. This format allows for recursive startup structures. See Figure 10.



1386

1387

Figure 10 – StartupSection traversal

1388 The order of startup is determined by the value of the `order` attributes of the `Item` elements in a  
 1389 `StartupSection` element in a `VirtualSystemCollection` element. The `order` attribute is a  
 1390 nonnegative integer.

1391 If the `order` attribute of an `Item` element has a value of '0' (zero), the virtual system or virtual system  
 1392 collection may be powered up at any time. The virtualization platform does not have to wait to start items  
 1393 that have a higher order value.

1394 If the `order` attribute of an `Item` element has a nonzero value, the virtual systems are started in  
 1395 ascending numeric order. Virtual systems that have the same value of the `order` attribute may be started  
 1396 concurrently.

1397 It is recommended that virtual systems are stopped in descending numeric order. Virtual systems with  
 1398 `Item` elements with an `order` attribute value of '0' (zero) may be stopped at any time.

1399 However, virtual systems are permitted to stop in a nondescending order in an implementation specific  
 1400 manner unless the `shutdownorder` attribute is specified. The `shutdownorder` attribute allows the  
 1401 shutdown order to be specified.

1402 Several optional attributes of the `Item` element support more detailed control of starting and stopping.  
 1403 The `startDelay` and `stopDelay` attributes specify the seconds to wait until executing the next step in  
 1404 the sequence. Both delays default to zero.

1405 The `startAction` and `stopAction` attributes specify the actions to use in starting and stopping. Valid  
 1406 values for `startAction` are `powerOn` and `none`. The default value is 'powerOn'. Valid values for  
 1407 the `stopAction` attribute are 'powerOn', 'guestShutdown', and 'none'. The default value is  
 1408 'powerOff'. If the `stopAction` attribute is set to 'guestShutdown', the action taken is deployment  
 1409 platform specific.

1410 The `waitingForGuest` attribute is a Boolean that allows the deployment platform to wait until the guest  
 1411 software reports readiness. The default value is 'FALSE'. The communication mechanism is platform  
 1412 specific.

1413 The following example illustrates a `StartupSection` element.

```

1414 <StartupSection>
1415   <Item ovf:id="vm1" ovf:order="0" ovf:startDelay="30" ovf:stopDelay="0"
1416     ovf:startAction="powerOn" ovf:waitingForGuest="true" ovf:stopAction="powerOff"/>
1417   <Item ovf:id="teamA" ovf:order="0"/>
1418   <Item ovf:id="vm2" ovf:order="1" ovf:startDelay="0" ovf:stopDelay="20"
1419     ovf:startAction="powerOn" ovf:stopAction="guestShutdown"/>
1420 </StartupSection>

```

### 1421 4.6.3 ScaleOutSection element

1422 The `ScaleOutSection` element allows dynamic configuration of the number of instantiated virtual  
 1423 systems in a `VirtualSystemCollection` element. Without a `ScaleOut` element in the  
 1424 `VirtualSystemCollection` element, the number of virtual systems and virtual system collections is  
 1425 fixed. The `ScaleOutSection` element specifies a minimum and maximum number of replicas to be  
 1426 created. At deployment time, the deployment platform chooses a value between the minimum and  
 1427 maximum `InstanceCount`. The consumer can be queried for the value or the deployment platform can  
 1428 make a determination based on other metadata. The `ScaleOutSection` element only appears in  
 1429 `VirtualSystemCollection` elements, although both virtual system and virtual system collections may  
 1430 be replicated.

1431 The following example illustrates a `ScaleOutSection` element.

```

1432 <VirtualSystemCollection ovf:id="web-tier">
1433   ...
1434   <ovf:ScaleOutSection ovf:id="web-server">
1435     <Info>Web tier</Info>
1436     <ovf:Description>Number of web server instances in web tier</ovf:Description>
1437     <ovf:InstanceCount ovf:default="4" ovf:minimum="2" ovf:maximum="8"/>
1438   </ovf:ScaleOutSection>
1439   ...
1440   <VirtualSystem ovf:id="web-server">
1441     <Info>Prototype web server</Info>
1442     ...
1443   </VirtualSystem>
1444 </VirtualSystemCollection>

```

1445 In the example above, the deployment platform creates a web tier that contains between two and eight  
 1446 web server virtual machine instances, with a default count of four. The deployment platform makes an  
 1447 appropriate choice (e.g., by prompting the user). Assuming three replicas were created, the OVF  
 1448 environment that is available to the guest software in the first replica has the following content structure:

```

1449 <Environment ... ovfenv:id="web-server-1">
1450   ...
1451   <Entity ovfenv:id="web-server-2">
1452     ...
1453   </Entity>
1454   <Entity ovfenv:id="web-server-3">
1455     ...
1456   </Entity>
1457 </Environment>

```



1458 Note that the OVF `id` of the replicas is derived from the `id` of the prototype virtual system by adding a  
 1459 sequence number. After deployment, all replica virtual systems have a sequence number suffix and no  
 1460 virtual system has the base `id` of the prototype. If there is a `StartupSection` element, each replica has  
 1461 the same startup number. It is not possible to specify a startup order among replicas.

1462 EXAMPLE:

```

1463 <VirtualSystemCollection ovf:id="web-tier">
1464   ...
1465   <DeploymentOptionSection>
1466     <Info>Deployment size options</Info>
1467     <Configuration ovf:id="minimal">
1468       <Label>Minimal</Label>
1469       <Description>Minimal deployment scenario</Description>
1470     </Configuration>
1471     <Configuration ovf:id="common" ovf:default="true">
1472       <Label>Typical</Label>
1473       <Description>Common deployment scenario</Description>
1474     </Configuration>
1475     ...
1476   </DeploymentOptionSection>
1477   ...
1478   <ovf:ScaleOutSection ovf:id="web-server">
1479     <Info>Web tier</Info>
1480     <ovf:Description>Number of web server instances in web tier</ovf:Description>
1481     <ovf:InstanceCount ovf:default="4"/>
1482     <ovf:InstanceCount ovf:default="1" ovf:configuration="minimal"/>
1483   </ovf:ScaleOutSection>
1484   ...
1485 </VirtualSystemCollection>

```

1486 In the example above, a `DeploymentOptionSection` element is used to control values for the  
 1487 `InstanceCount` element in a `ScaleOutSection` element. Values in a `ScaleOutSection` element  
 1488 can also be controlled through OVF property elements. The OVF properties are prompted for one time  
 1489 for each replica. If the author wants an OVF property to be shared among replicas, it can be placed in the  
 1490 containing `VirtualSystemCollection` element.

## 1491 4.7 OVF section elements used in virtual system

### 1492 4.7.1 OperatingSystemSection element

1493 The `OperatingSystemSection` element specifies the guest operating system used in a virtual system.  
 1494 The selection of operating systems comes from the `CIM_OperatingSystem.OSType` property. The  
 1495 OVF version and OVF id correspond to the `Value` and `ValueMap` of that property.

1496 The `id` attribute is required and refers to an integer from the `ValueMap`. The `version` attribute is  
 1497 optional and refers to the corresponding `Value` for the `ValueMap`. The `version` attribute is a symbolic  
 1498 string and cannot be internationalized.

1499 Both the `Info` (derived from `Section`) and `Description` elements may be externalized for localization.  
 1500 See 5.2.

1501 This example is of a section that specifies a Microsoft Windows Server 2008:

```
1502 <OperatingSystemSection ovf:id="76" ovf:version="Microsoft Windows Server 2008">
1503   <Info>Specifies the operating system installed</Info>
1504   <Description>Microsoft Windows Server 2008</Description>
1505 </OperatingSystemSection>
```

#### 1506 4.7.2 InstallSection element

1507 The `InstallSection` element is optional and is used only in `VirtualSystem` elements. If present, it is  
1508 processed before the `StartupSection` element.

1509 The `InstallSection` elements enable the OVF package author to specify that a virtual system needs  
1510 to reboot before powering off in order to complete the installation. Typically, when the boot occurs, the  
1511 guest software executes scripts or other software from the OVF environment to complete the installation.  
1512 The absence of an `InstallSection` element implies that a boot is not necessary to complete the  
1513 installation. For example, if the virtual system has no guest software or the guest software is installed in  
1514 the system image, an `InstallSection` element is not needed.

1515 The virtual systems in a virtual system collection may each have an `InstallSection` element defined.  
1516 The reboots may be concurrent.

1517 The value of the `initialBootStopDelay` attribute is the duration in seconds that the virtualization  
1518 platform waits for the virtual system to power off. If the delay expires and the virtual system has not  
1519 powered off, the installation is deemed to have failed. The default value for `initialBootStopDelay` is  
1520 zero, meaning that there is no limit on the delay and the virtualization platform waits until the virtual  
1521 system powers itself off. The guest software on the virtual system could boot multiple times before  
1522 powering off.

1523 In the example below, the virtualization platform waits 5 minutes (300 seconds) for the guest software to  
1524 power off the virtual system. If the virtual machine does not power off in 5 minutes, the installation is  
1525 deemed a failure. During the 5-minute wait interval, the virtual system could reboot several times.

```
1526 <InstallSection ovf:initialBootStopDelay="300">
1527   <Info>Specifies that the virtual machine needs to be booted after having
1528   created the guest software in order to install and/or configure the software
1529   </Info>
1530 </InstallSection>
```

#### 1531 4.7.3 EnvironmentFilesSection element

1532 The `EnvironmentFilesSection` element allows the conveyance of additional environment files to the  
1533 guest software permitting additional customization. These files are conveyed by using the same transport  
1534 media as the OVF environment file.

1535 The OVF environment file is generated by the deployment function; however, any additional environment  
1536 files are not and must be provided by the OVF package author. The additional environment files are  
1537 specified in the `EnvironmentFilesSection` element with a `File` element that has an `ovf:fileRef`  
1538 attribute and `ovf:path` attribute for each file.

1539 The `ovf:fileRef` attribute points to a `File` element in the `References` element. The `File` element is  
1540 identified by matching its `ovf:id` attribute value with the `ovf:fileRef` attribute value.

1541 The `ovf:path` attribute indicates the relative location in the transport media where the file is placed.

```
1542 <Envelope>
1543   <References>
```

```

1544     ...
1545     <File ovf:id="config" ovf:href="config.xml" ovf:size="4332"/>
1546     <File ovf:id="resources" ovf:href="http://mywebsite/resources/resources.zip"/>
1547   </References>
1548   ...
1549   <VirtualSystem ovf:id="...">
1550     ...
1551     <ovf:EnvironmentFilesSection ovf:required="false" ovf:transport="iso">
1552       <Info>Config files to be included in OVF environment</Info>
1553       <ovf:File ovf:fileRef="config" ovf:path="setup/cfg.xml"/>
1554       <ovf:File ovf:fileRef="resources" ovf:path="setup/resources.zip"/>
1555     </ovf:EnvironmentFilesSection>
1556     ...
1557   </VirtualSystem>
1558   ...
1559 </Envelope>

```

1560 In the example above, the file `config.xml` in the OVF package is copied to the OVF environment ISO  
 1561 image and is accessible to the guest software in location `/ovffiles/setup/cfg.xml`, while the file  
 1562 `resources.zip` is accessible in location `/ovffiles/setup/resources.zip` at deployment.

#### 1563 4.7.4 BootDeviceSection element

1564 Earlier versions of OVF allowed virtual systems to boot only from the default boot device. This was found  
 1565 to be a limitation in various scenarios that are encountered in OVF deployment.

- 1566 a) There was no way to specify whether a virtual system needed to be set up to PXE boot from a  
 1567 NIC. Also, there was no way to specify whether a virtual system needed to be set up to boot  
 1568 from a secondary disk or a USB device. Thus, there was a need to be able to specify these  
 1569 alternative boot sources with their corresponding settings.
- 1570 d) A further need was identified, through implementation experience, to be able to specify multiple  
 1571 alternative boot configurations. For instance during the “preparation” phase of the OVF, it may  
 1572 be necessary for a virtual system to be patched by using a fix-up disk.

1573 The Common Information Model (CIM) defines artifacts to deal with boot order use cases prevalent in the  
 1574 industry for BIOSes found in desktops and servers. The `CIM_BootSourceSetting` class defines an  
 1575 individual boot source device, like an NIC or a disk, that is to be used as the boot source. Each of the  
 1576 devices is identified by a unique ID specified in the `CIM_BootSourceSetting` class.

1577 A boot configuration is defined by a sequence of boot devices under an aggregation class,  
 1578 `CIM_BootConfigSetting`. Thus a sequence of one or more `CIM_BootSourceSetting` properties is  
 1579 aggregated into the `CIM_BootConfigSetting` class.

1580 The OVF envelope allows multiple such boot configurations to be aggregated into the  
 1581 `BootDeviceSection` element. Each such `BootDeviceSection` element can be part of a  
 1582 `VirtualHardwareSection` element.

1583 A deployment function attempts to set up a boot source sequence for a virtual system as defined in the  
 1584 boot configuration that it has chosen. The issue of choosing a boot configuration comes into play only  
 1585 when there are more than one boot configurations. The deployment function makes that choice based on  
 1586 the state of the deployment and the caption element in the boot configuration structure.

1587 In the example below, the Pre-Install configuration specifies the boot source as a specific device  
 1588 (network), while the Post-Install configuration specifies a device type (hard disk).

```
1589 EXAMPLE:
1590 <Envelope>
1591   ...
1592   <VirtualSystem ovf:id="...">
1593     ...
1594     <ovf:BootDeviceSection>
1595       <Info>Boot device order specification</Info>
1596       <bootc:CIM_BootConfigSetting>
1597         <bootc:Caption>Pre-Install</bootc:Caption>
1598         <bootc:Description>Boot Sequence for fixup of disk</bootc:Description>
1599         <boots:CIM_BootSourceSetting>
1600           <boots:Caption>Fix-up DVD on the network</boots:Caption>
1601           <boots:InstanceID>3</boots:InstanceID>           <!-- Network device-->
1602         </boots:CIM_BootSourceSetting>
1603         <boots:CIM_BootSourceSetting>
1604           <boots:Caption>Boot virtual disk</boots:Caption>
1605           <boots:StructuredBootString>CIM:Hard-Disk</boots:StructuredBootString>
1606         </boots:CIM_BootSourceSetting>
1607       </bootc:CIM_BootConfigSetting>
1608     </ovf:BootDeviceSection>
1609     ...
1610   </VirtualSystem>
1611 </Envelope>
```

## 1612 5 Authoring an OVF package

### 1613 5.1 Creation

1614 The creation of an OVF package involves

- 1615 i) packaging a set of VMs onto a set of virtual disks
- 1616 ii) encoding of those virtual disks appropriately
- 1617 iii) attaching an OVF descriptor with a specification of the virtual hardware, licensing, and other  
1618 customization metadata
- 1619 iv) possibly including the attachment of a digital signature for the package

1620 The process of deploying an OVF package occurs when a virtualization platform consumes the OVF and  
1621 creates a set of virtual machines from its contents.

1622 Creating an OVF can be made as simple as exporting an existing virtual machine from a virtualization  
1623 platform into an OVF package, and adding to it the relevant metadata needed for correct installation and  
1624 execution. This transforms the virtual machine from its current run-time state on a particular hypervisor  
1625 into an OVF package. During this process, the virtual machine's disks can be compressed to make them  
1626 more convenient to distribute.

1627 For commercial-grade virtual appliances, a standard build environment can be used to produce an OVF  
1628 package. For example, the OVF descriptor can be managed by using a source control system, and the  
1629 OVF package can be built by using a reproducible scripting environment (such as `make` files) or through  
1630 the use of appliance building toolkits that are available from multiple vendors.

1631 When an OVF package is created, it can be accompanied with appliance-specific, post-installation  
 1632 configuration metadata. This includes metadata for optional localization of the interface language(s) of the  
 1633 appliance, review/signoff and/or enforcement of the EULA, and resource configuration. It can also involve  
 1634 the addition of special drivers, agents, and other tools to the guest to enhance (for example) I/O,  
 1635 timekeeping, memory management, monitoring, and ordered shutdown.

1636 The process of authoring the OVF descriptor is essentially putting together the building blocks for the  
 1637 virtual appliance. As indicated earlier, a virtual appliance is defined by the description of the virtual  
 1638 systems composing the appliance, metadata regarding the appliance and the guest software, and a set of  
 1639 referenced files. The OVF descriptor is the central element to aggregate and reference all required  
 1640 information. The major building blocks of the OVF descriptor are sections. Clause 4 introduces the  
 1641 various sections that can be used to describe the virtual appliance.

## 1642 5.2 Internationalization

1643 The OVF specification supports localizable messages by using the optional `ovf:msgid` attribute.  
 1644 Localized messages can be used to display the user messages in the local language during deployment.

```
1645 <Envelope ...>
1646   ...
1647   <Info ovf:msgid="info.os">Operating System</Info>
1648   ...
1649   <Strings xml:lang="da-DA">
1650     <Msg ovf:msgid="info.os">Operativsystem</Msg>
1651     ...
1652   </Strings>
1653   <Strings xml:lang="de-DE">
1654     <Msg ovf:msgid="info.os">Betriebssystem</Msg>
1655     ...
1656   </Strings>
1657 </Envelope>
```

1658 The example above defines an `Info` element within a section. The information in this section is related to  
 1659 the operating system of the virtual system. The attribute `ovf:msgid="info.os"` indicates that the  
 1660 string between the start-tag and the end-tag of the `Info` element can be replaced with a localized  
 1661 message. The localized message is referred to by its message ID of `info.os`. If there is a suitable  
 1662 localized message set in a `Strings` section, the default message “Operating System” is replaced by the  
 1663 localized message taken from the `Strings` section corresponding to the current region.

1664 In the example above the localized strings are stored inside the OVF descriptor. Localized strings can  
 1665 also be stored outside the OVF descriptor by using external string bundles. For example:

```
1666 <Envelope ...>
1667   <References>
1668     ...
1669     <File ovf:id="da-DA-resources" ovf:href="danish.msg"/>
1670     <File ovf:id="de-DE-resources" ovf:href="german.msg"/>
1671     ...
1672   </References>
1673   ...
1674   <Info ovf:msgid="info.os">Operating System</Info>
1675   ...
1676   <Strings xml:lang="da-DA" ovf:fileRef="da-da-resources"/>
1677   <Strings xml:lang="de-DE" ovf:fileRef="de-de-resources"/>
1678 </Envelope>
```

1679 The localized message for “Operating System” is defined in the files `danish.msg` and `german.msg`. The  
 1680 format of the external message file `german.msg` is described in the example below.

```
1681 <Strings
1682   xmlns:ovf="http://schemas.dmtf.org/ovf/envelope/1"
1683   xmlns="http://schemas.dmtf.org/ovf/envelope/1"
1684   xml:lang="de-DE">
1685     ...
1686     <Msg ovf:msgid="info.os">Betriebssystem</Msg>
1687     ...
1688 </Strings>
```

1689 In the top `Strings` section, the `xml:lang` attribute is used to define the locale of the particular external  
 1690 message file. The external message file contains `Msg` elements for the localized messages that are used  
 1691 in the OVF descriptor.

1692 Another method of using localized resources is to reference external files based on the current location.  
 1693 This method can be used, for example, to display a license text based on the location. The license text is  
 1694 contained in a text file per location. The following example shows how to reference an external plain text  
 1695 file to display a localized license.

```
1696 <Envelope xml:lang="en-US">
1697   <References>
1698     <File ovf:id="license-en-US" ovf:href="license-en-US.txt"/>
1699     <File ovf:id="license-de-DE" ovf:href="license-de-DE.txt"/>
1700   </References>
1701   ...
1702   <VirtualSystem ovf:id="...">
1703     <EulaSection>
1704       <Info>Licensing agreement</Info>
1705       <License ovf:msgid="license">Unused</License>
1706     </EulaSection>
1707     ...
1708   </VirtualSystem>
1709   ...
1710   <Strings xml:lang="en-US">
1711     <Msg ovf:msgid="license" ovf:fileRef="license-en-US">Invalid license</Msg>
1712   </Strings>
1713   <Strings xml:lang="de-DE">
1714     <Msg ovf:msgid="license" ovf:fileRef="license-de-DE">Ihre Lizenz ist nicht
1715     gültig</Msg>
1716   </Strings>
1717 </Envelope>
```

1718 The `License` element contains an `ovf:msgid` attribute. In the `Strings` sections, the `ovf:msgid` for  
 1719 the different locations is linked to a file reference by using the `ovf:fileRef` attribute. The  
 1720 `ovf:fileRef` attribute has a corresponding entry in the `References` section of the OVF descriptor.  
 1721 The entry in the `References` section resolves to an external text file that contains the license text.

### 1722 5.3 Extensibility

1723 The OVF specification allows custom metadata to be added to OVF descriptors in several ways:

- 1724 • New section elements may be defined as part of the `Section` substitution group, and used  
1725 wherever the OVF Schemas allow sections to be present.
- 1726 • The OVF Schemas use an open content model, where all existing types may be extended at the  
1727 end with additional elements. Extension points are declared in the OVF Schemas with `xs:any`  
1728 declarations with `namespace="##other"`.
- 1729 • The OVF Schemas allow additional attributes on existing types.

1730 A design goal of the OVF specification is to ensure backward and forward compatibility. For forward  
1731 compatibility, this means that an OVF descriptor using features of a later specification (or custom  
1732 extensions) can be understood by an OVF consumer that is written to either i) an earlier version of the  
1733 specification, or ii) has no knowledge of the particular extensions. The OVF consumer should be able to  
1734 reliably, predictably, and in a user-friendly manner, decide whether to reject or accept an OVF package  
1735 that contains extensions.

### 1736 5.3.1 Substitution group

1737 OVF supports an open-content model that allows additional sections to be added, as well as allowing  
1738 existing sections to be extended with new content. On extensions, a Boolean `ovf:required` attribute  
1739 specifies whether the information in the element is required for correct behavior or is optional.

1740 Additional sections can be inserted into the OVF descriptor by defining new members of the  
1741 `ovf:Section` substitution group. This means the new section extends the base schema for a `Section`  
1742 element. New sections can be used to define metadata that is not related to the existing sections defined  
1743 in the OVF specification. The new `Section` has an `<Info>` element that is used to display information to  
1744 the consumer regarding the section in case the deployment function does not understand the section.

1745 The example shows the addition of a new `Section <ns:BuildInformationSection>`. The  
1746 `Section` uses the namespace `ns`. The namespace is referenced in a parent element e.g., in the  
1747 `<Envelope>` element: `<Envelope xmlns="http://schemas.dmtf.org/ovf/envelope/2"`  
1748 `xmlns:ns="http://acme.org/ovf/extension/ns">`. As required by the `ovf:Section`  
1749 `substitutionGroup`, the new section contains an `<Info>` element. The elements `BuildNumber`,  
1750 `BuildDate`, `BuildSystem` are new elements. The elements are defined in the namespace schema  
1751 referred. The `ovf:required` attribute is set to "false" to indicate that the deployment function warns but  
1752 does not fail if it cannot implement the section.

1753 Example of adding a new section:

```
1754 <ns:BuildInformationSection ovf:required="false">
1755   <Info>Specifies information on how a virtual machine was created</Info>
1756   <BuildNumber> ... </BuildNumber >
1757   <BuildDate> ... </BuildDate >
1758   <BuildSystem> ... </BuildSystem>
1759   ...
1760 </ns:BuildInformationSection>
```

1761 The XSD schema for the additional section in the example above looks as follows.

```
1762 <?xml version="1.0" encoding="UTF-8"?>
1763 <xs:schema xmlns:ns=http://acme.org/ovf/extension/ns
1764   xmlns:ovf=http://schemas.dmtf.org/ovf/envelope/2
1765   xmlns:xs=http://www.w3.org/2001/XMLSchema
1766   targetNamespace=http://acme.org/ovf/extension/ns
1767   elementFormDefault="qualified"
1768   attributeFormDefault="qualified">
```

```

1769 <xs:import namespace=http://schemas.dmtf.org/ovf/envelope/2
1770     schemaLocation="dsp8023.xsd"/>
1771     <xs:element name="BuildInformationSection" type="ns:BuildInformationSection_Type"
1772     substitutionGroup="ovf:Section">
1773         <xs:annotation>
1774             <xs:documentation>Element substitutable for Section since
1775             BuildInformationSection_Type is a derivation of Section_Type
1776             </xs:documentation>
1777         </xs:annotation>
1778     </xs:element>
1779     <xs:complexType name="BuildInformationSection_Type">
1780         <xs:annotation>
1781             <xs:documentation>An ACME specific section.</xs:documentation>
1782         </xs:annotation>
1783         <xs:complexContent>
1784             <xs:extension base="ovf:Section_Type">
1785                 <xs:sequence>
1786                     <xs:element name="BuildNumber" maxOccurs="unbounded">
1787                         <xs:complexType>
1788                             <xs:anyAttribute namespace="##any" processContents="lax"/>
1789                         </xs:complexType>
1790                     </xs:element>
1791                     <xs:element name="BuildDate" maxOccurs="unbounded">
1792                         <xs:complexType>
1793                             <xs:anyAttribute namespace="##any" processContents="lax"/>
1794                         </xs:complexType>
1795                     </xs:element>
1796                     <xs:element name="BuildSystem" maxOccurs="unbounded">
1797                         <xs:complexType>
1798                             <xs:anyAttribute namespace="##any" processContents="lax"/>
1799                         </xs:complexType>
1800                     </xs:element>
1801                 </xs:sequence>
1802                 <xs:anyAttribute namespace="##any" processContents="lax"/>
1803             </xs:extension>
1804         </xs:complexContent>
1805     </xs:complexType>
1806 </xs:schema>

```

1807 The schema defines a `BuildInformationSection` substitution group for the `ovf:Section` section.  
1808 The `BuildInformationSection` substitution group is of the `BuildInformationSection_Type`  
1809 type. `BuildInformationSection_Type` type defines `ovf:Section_Type` as a base type and  
1810 extends the `ovf:Section_Type` by the `BuildNumber`, `BuildDate` and `BuildSystem` elements.

### 1811 5.3.2 Elements

1812 New elements within existing sections can be added at the end of the section. The `Envelope`,  
1813 `VirtualSystem`, `VirtualSystemCollection`, `Content` and `Strings` sections do not support the  
1814 addition of additional elements at the end of the section. The used namespace needs to be referenced in



1815 a parent element and must be different from the OVF namespace. Additional elements can be used to  
 1816 extend the information given for a particular section in the OVF descriptor.

1817 An illustration of extending an existing section is given below.

```
1818 <AnnotationSection>
1819     <Info>Specifies an annotation for this virtual machine</Info>
1820     <Annotation>This is an example of how a future element (Author) can still be
1821     parsed by older clients</Annotation>
1822     <!-- AnnotationSection extended with Author element -->
1823     <ns:Author ovf:required="false">John Smith</ns:Author>
1824 </AnnotationSection>
```

1825 The example shows an additional element in the `Annotation` section. The element extends the  
 1826 `Annotation` section with information regarding the `Author` of the descriptor. The new element belongs  
 1827 to the `ns` namespace.

### 1828 5.3.3 Attributes

1829 A third option of extending an OVF descriptor with additional information is to add custom attributes into  
 1830 existing elements. These attributes can be used to extend the information given by an existing element.

```
1831 <!-- Optional custom attribute example -->
1832     <Network ovf:name="VM network" ns:desiredCapacity="1 Gbit/s">
1833         <Description>The main network for VMs</Description>
1834     </Network>
```

1835 The example above shows the addition of a `desiredCapacity` attribute for the `Network` element. The  
 1836 new attribute is defined in the `ns` namespace.

1837 See ANNEX E for more detailed examples of OVF document extensions.

## 1838 5.4 Conformance

1839 The OVF specification defines three conformance levels for OVF descriptors, with 1 being the highest  
 1840 level of conformance:

- 1841 • OVF descriptor only contains metadata defined in the OVF specification, i.e., no custom  
 1842 extensions are present.  
 1843 Conformance Level: 1.
- 1844 • OVF descriptor contains metadata with custom extensions, but all such extensions are optional.  
 1845 Conformance Level: 2.
- 1846 • OVF descriptor contains metadata with custom extensions, and at least one such extension is  
 1847 required.  
 1848 Conformance Level: 3.

1849 The use of conformance level 3 limits portability, which means that the OVF package might not be  
 1850 deployed on any other virtualization platform other than the one supporting the custom extensions.

## 1851 5.5 Virtual hardware description

1852 The hardware description shown below is very general. In particular, it specifies that a virtual disk and a  
 1853 network adaptor is needed. It does not specify what the specific hardware should be. For example, a  
 1854 SCSI or IDE disk, or an E1000 or Vlan network card is appropriate. More specifically, it can be  
 1855 assumed that if the specification is generic, the appliance undertakes discovery of the devices present,  
 1856 and load relevant drivers. In this case, it is assumed that the appliance creator has developed the

1857 appliance with a broad set of drivers, and has tested the appliance on relevant virtual hardware to ensure  
1858 that it works.

1859 If an OVF package is deployed on a virtualization platform that does not offer the same hardware devices  
1860 and/or categories of devices that are required by the guest software that is included in the appliance,  
1861 nontrivial and nonobvious installation failures can occur. The risk is that it fails to install and/or boot, and  
1862 that the user is not able to debug the problem. With this situation comes the risk of increased volume in  
1863 customer support calls, and general customer dissatisfaction. A more constrained and detailed virtual  
1864 hardware specification can reduce the chance of incorrect execution (because the specific devices  
1865 required are listed), but this specification limits the number of systems that the appliance may be able  
1866 install on and/or boot.

1867 It should be borne in mind that simplicity, robustness, and predictability of installation are key reasons that  
1868 ISVs are moving to the virtual appliance model. Therefore, appliance developers should create  
1869 appliances for which the hardware specification is more rather than less generic, unless the appliance  
1870 has very specific hardware needs. At the outset, the portability of the appliance is based on the guest  
1871 software used in the virtual machines and the range of virtual hardware the guest software supports.

1872 Ideally, the appliance vendor creates a virtual machine that has device drivers for the virtual hardware of  
1873 all of the vendor's desired target virtualization platforms. However, many virtualization platform vendors  
1874 today do not distribute drivers independently to virtual appliance vendors/creators. Instead, to further  
1875 simplify the management of the virtual hardware-to-appliance interface, the OVF model supports an  
1876 explicit installation mode, in which each virtual machine is booted once right after installation, to permit  
1877 localization/customization for the specific virtualization platform. This mode allows the virtual machine to  
1878 detect the virtualization platform and install the correct set of device drivers, including any platform-  
1879 specific drivers that are made available to the guest when it first reboots (for example, via floppy or CD  
1880 drives attached to the guest on first boot). In addition, for sysprepped Windows VMs, which need only re-  
1881 installation and customization with naming etc., the reboot technique allows naming and tailoring of the  
1882 image to be achieved in an automated fashion.

1883 The following example illustrates multiple virtual hardware profiles for different virtualization platforms  
1884 specified in the same descriptor.

```
1885 <VirtualHardwareSection>  
1886   <Info>500Mb, 1 CPU, 1 disk, 1 nic virtual machine, Platform A</Info>  
1887   <System>  
1888     ...  
1889   </System>  
1890   <Item>  
1891     ...  
1892   </Item>  
1893   ...  
1894 </VirtualHardwareSection>  
1895 <VirtualHardwareSection>  
1896   <Info>500Mb, 1 CPU, 1 disk, 1 nic virtual machine, Platform B</Info>  
1897   <System>  
1898     ...  
1899   </System>  
1900   <Item>  
1901     ...  
1902   </Item>  
1903   ...  
1904 </VirtualHardwareSection>
```

1905 This type of profile allows the vendor to tailor the hardware description to support different virtualization  
 1906 platforms and features. A specific virtualization platform may choose between any of the specific virtual  
 1907 hardware sections that it can support, with the assumption that the OVF deployment function chooses the  
 1908 latest or most capable feature set that is available on the local platform.

1909 The example below shows how a specific type of virtual hardware can be defined. Multiple options for the  
 1910 `rasd:ResourceSubType` can be separated by a single space character. The deployment function can  
 1911 then choose the virtual hardware type to instantiate.

```
1912 <Item>
1913     <rasd:ElementName>SCSI Controller 0</rasd:ElementName>
1914     <rasd:InstanceID>1000</rasd:InstanceID>
1915     <rasd:ResourceSubType>LsiLogic BusLogic</rasd:ResourceSubType>
1916     <rasd:ResourceType>6</rasd:ResourceType>
1917 </Item>
1918 <Item>
1919     <rasd:ElementName>Harddisk 1</rasd:ElementName>
1920     <rasd:HostResource>ovf:/disk/vmdisk1</rasd:HostResource>
1921     <rasd:InstanceID>22001</rasd:InstanceID>
1922     <rasd:Parent>1000</rasd:Parent>
1923     <rasd:ResourceType>17</rasd:ResourceType>
1924 </Item>
```

## 1925 5.6 Example descriptors

1926 The following examples have been provided as complete examples of an OVF descriptor. These  
 1927 examples pass XML validation.

1928 ANNEX A illustrates an OVF descriptor for a single virtual system.

1929 ANNEX B illustrates a multiple virtual system OVF descriptor.

1930 ANNEX C illustrates an OVF descriptor for a single virtual system with multiple applications contained in  
 1931 it; i.e., a LAMP stack.

1932 ANNEX D illustrates an OVF descriptor for a multiple virtual system with multiple applications contained in  
 1933 it, i.e., a LAMP stack with two virtual systems.

## 1934 6 Deploying an OVF package

### 1935 6.1 Deployment

1936 Deployment transforms the virtual machines in an OVF package into the run-time format understood by  
 1937 the target virtualization platform, with the appropriate resource assignments and supported by the correct  
 1938 virtual hardware. During deployment, the platform validates the OVF integrity, making sure that the OVF  
 1939 package has not been modified in transit, and checks that it is compatible with the local virtual hardware.  
 1940 It also assigns resources to, and configures the virtual machines for, the particular environment on the  
 1941 target virtualization platform. This process includes assigning and configuring the networks (physical and  
 1942 virtual) too which the virtual machines are connected; assigning storage resources for the VMs, including  
 1943 virtual hard disks, as well as any transient data sets, connections to clustered or networked storage and  
 1944 the like; configuring CPU and memory resources; and customizing application level properties. OVF does  
 1945 not support the conversion of guest software between processor architectures or hardware platforms.  
 1946 Deployment instantiates one or more virtual machines with a hardware profile that is compatible with the  
 1947 requirements captured in the OVF descriptor, and a set of virtual disks with the content specified in the  
 1948 OVF package.

1949 The deployment experience of an OVF package depends on the virtualization platform on which it is  
1950 deployed. It could be command-line based, scripted, or a graphical deployment wizard. The typical OVF  
1951 deployment tool shows, or prompts for, the following information:

- 1952 • Show information about the OVF package (from the `ProductSection`), and ask the user to  
1953 accept the licensing agreement, or address an unattended installation.
- 1954 • Validate that the virtual hardware is compatible with the specification in the OVF.
- 1955 • Ask the user for the storage location of the virtual machines and the physical networks to which  
1956 the logical networks in the OVF package are connected.
- 1957 • Ask the user to enter the specific values for the properties configured in the `ProductSection`.

1958 After this configuration, it is expected that the virtual machines can be started successfully to obtain  
1959 (using standard procedures such as DHCP) an identity that is valid on the local network. Properties are  
1960 used to prompt for specific IP network configuration and other values that are particular to the deployment  
1961 environment. After the appliance is booted for the first time, additional configuration of software inside the  
1962 appliance can be done through a management interface provided by the appliance itself, such as a web  
1963 interface.

## 1964 **6.2 OVF environment descriptor**

1965 The OVF environment descriptor is an XML document that describes metadata about the software  
1966 installed on the virtual disks. The OVF specification defines the common sections used for deploying  
1967 software, such as virtual hardware, disks, networks, resource requirements, and customization  
1968 parameters. The descriptor is designed to be extensible so further information can be added later.

1969 A virtual appliance often needs to be customized to function properly in the particular environment where  
1970 it is deployed. The OVF environment provides a standard and extensible way for the virtualization  
1971 platform to communicate deployment configuration to the guest software.

1972 The OVF environment is an XML document containing deployment time customization information for the  
1973 guest software. Examples of information that could be provided in the XML document include:

- 1974 • Operating system level configuration, such as host names, IP address, subnets, gateways, etc.
- 1975 • Application-level configuration, such as DNS name of active directory server, databases, and  
1976 other external services

1977 The set of properties that are to be configured during deployment is specified in the OVF descriptor by  
1978 using the `ProductSection` metadata, and is entered by the user using a wizard style interface during  
1979 deployment.

1980 For instance, the OVF environment allows guest software to automate the network settings between  
1981 multitiered services, and the web server may automatically configure itself with the IP address of the  
1982 database server without any manual user interaction.

1983 Defining a standard OVF environment does pose some challenges, because no standard cross-vendor  
1984 para-virtualized device exists for communicating between the guest software running in a virtual machine  
1985 and the underlying virtualization platform. The approach taken by the OVF specification is to split the OVF  
1986 environment definitions into two parts:

- 1987 • a standard *protocol* that specifies what information is available and in what format it is available
- 1988 • a *transport* that specifies how the information is obtained

1989 The specification requires all implementations to support an ISO transport that makes the OVF  
1990 environment (XML document) available to the guest software on a dynamically generated ISO image.

### 1991 6.3 Resource configuration options during deployment

1992 The OVF package has the ability to include resource configuration options for a virtual appliance. This  
 1993 makes it easy for the package consumer to get an initial setup without having to make individual resource  
 1994 decisions based on the intended use. The `Description` and `Label` elements provide a human-  
 1995 readable list of resource configurations, for example:

- 1996 • Software evaluation setup
- 1997 • 10-100 person workgroup setup
- 1998 • 100-1000 person workgroup setup
- 1999 • Large enterprise workgroup setup

2000 The deployment function prompts for selection of a configuration. The list of configurations described  
 2001 above is expected to be used for a suitable initial resource configuration.

2002 Example list of configurations:

```

2003 <DeploymentOptionSection>
2004   <Configuration ovf:id="eval">
2005     <Label>Software Evaluation</Label>
2006     <Description>Software evaluation setup</Description>
2007   </Configuration>
2008   <Configuration ovf:id="small" ovf:default="yes">
2009     <Label>Small</Label>
2010     <Description>10-100 person workgroup setup</Description>
2011   </Configuration>
2012   <Configuration ovf:id="medium">
2013     <Label>Medium</Label>
2014     <Description>100-1000 person workgroup setup</Description>
2015   </Configuration>
2016   <Configuration ovf:id="large">
2017     <Label>Large</Label>
2018     <Description>Large enterprise workgroup setup</Description>
2019   </Configuration>
2020 </DeploymentOptionSection>
  
```

2021 The following snippet of an OVF descriptor illustrates the configuration option use for a resource  
 2022 requirement. In this case, if the consumer chose 'eval', the resource allocation data used is that in the  
 2023 Item `ovf:configuration='eval'`.

2024 Resource requirement example:

```

2025 <ResourceAllocationSection>
2026   <Info>Defines reservations for CPU and memory</Info>
2027   <Item>
2028     ... default configuration ...
2029   </Item>
2030   <Item ovf:configuration="eval">
2031     ... replaces the default configuration if the "eval" configuration is selected
2032   ...
2033   </Item>
2034 </ResourceAllocationSection>
  
```

2035 The following snippet of an OVF descriptor illustrates the configuration option use for a  
 2036 VirtualHardwareSection. In this case, if the consumer chose 'large', the resource allocation data  
 2037 used is that in the Item `ovf:configuration='large'`.

2038 VirtualHardwareSection example:

```

2039 <VirtualHardwareSection>
2040   <Info>...</Info>
2041   <Item>
2042     <rasd:AllocationUnits>hertz * 10^6</rasd:AllocationUnits>
2043     <rasd:ElementName>1 CPU and 500 MHz reservation</rasd:ElementName>
2044     <rasd:InstanceID>1</rasd:InstanceID>
2045     <rasd:Reservation>500</rasd:Reservation>
2046     <rasd:Limit>1100</rasd:Reservation>
2047     <rasd:ResourceType>3</rasd:ResourceType>
2048     <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
2049   </Item>
2050   ...
2051   <Item ovf:configuration="large">
2052     <rasd:AllocationUnits>hertz * 10^6</rasd:AllocationUnits>
2053     <rasd:ElementName>1 CPU and 800 MHz reservation</rasd:ElementName>
2054     <rasd:InstanceID>1</rasd:InstanceID>
2055     <rasd:Reservation>800</rasd:Reservation>
2056     <rasd:ResourceType>3</rasd:ResourceType>
2057     <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
2058   </Item>
2059 </VirtualHardwareSection>

```

## 2060 6.4 Product customization during deployment using Property elements

2061 The OVF descriptor can contain a description of the guest software that includes information about  
 2062 customization provided through the OVF environment. This information is provided by the use of  
 2063 Property elements in the ProductSection of the OVF descriptor.

2064 Each Property element has five possible attributes: `ovf:key`, `ovf:type`, `ovf:qualifiers`,  
 2065 `ovf:value`, and `ovf:userConfigurable`.

2066 The `ovf:key` attribute is a unique identifier for the Property element.

2067 The `ovf:type` attribute indicates the type of value the Property element contains.

2068 The `ovf:qualifiers` attribute specifies additional information regarding the `ovf:type` attribute so that  
 2069 CIM value maps can be used.

2070 The `ovf:value` attribute is used to provide a value for a Property element.

2071 The `ovf:userConfigurable` attribute determines whether the value provided is a default value and  
 2072 changeable at deployment or is not changeable.

2073 An example of the use of Property elements follows.

```

2074 <ProductSection>
2075   <Info>Describes product information for the service</Info>

```

```

2076 <Product>MyService Web Portal</Product>
2077 <Vendor>Some Random Organization</Vendor>
2078 <Version>4.5</Version>
2079 <FullVersion>4.5-b4523</FullVersion>
2080 <ProductUrl>http://www.vmware.com/go/ovf</ProductUrl>
2081 <VendorUrl>http://www.vmware.com/</VendorUrl>
2082 <Property ovf:key="adminEmail" ovf:type="string"
2083     ovf:userConfigurable="true">
2084     <Description>Email address of administrator</Description>
2085 </Property>
2086 <Property ovf:key="appIp" ovf:type="string"
2087     ovf:userConfigurable="true">
2088     <Description>IP address of the application</Description>
2089 </Property>
2090 <Property ovf:key="Gateway" ovf:type="string" ovf:value="192.168.0.1"
2091     ovf:userConfigurable="false" >
2092     <Description>Gateway address to be used</Description>
2093 </Property>
2094 <Property ovf:key=" SoftwareResourceType" ovf:type="uint16"
2095     ovf:qualifiers="uint16,uint16,uint16,uint16,uint16,uint16,uint16,uint16,uint16,
2096     uint16,"
2097     ovf:value="Unknown", "Buffer", "Queue", "Protocol Endpoint", "Remote Interface",
2098     "Pool", "Cache", "File", "Database",
2099     ovf:userConfigurable="false" >
2100     <Description>Value Map example based on SoftwareResourceType property in
2101     CIM_SoftwareResource class</Description>
2102 </Property>
2103 </ProductSection>

```

2104 In the `CIM_SoftwareResource` class, there is a property `SoftwareResourceType` that is shown in  
 2105 the snippet from the CIM Schema below.

```

2106 [Description (
2107     "The type of the software resource. Although the behavior "
2108     "of the different software resource types is modeled "
2109     "similarly, different names for resources transferring "
2110     "data over time or/and space have been established. "
2111     "SoftwareResourceType conveys their original, most common "
2112     "name. \n"
2113     ValueMap { "0", "2", "3", "4", "5", "6", "7", "8", "9",
2114     "10..32767", "32768..65535" },
2115     Values { "Unknown", "Buffer", "Queue", "Protocol Endpoint",
2116     "Remote Interface", "Pool", "Cache", "File", "Database",
2117     "DMTF Reserved", "Vendor Reserved" }}
2118     uint16 SoftwareResourceType;

```

2119 The `ovf:type` corresponds to the index of the `ValueMap` so it is `uint16`.

2120 ANNEX D contains a detailed example of customization of a complex multitiered application.

## 2121 7 Portability

2122 OVF is an enabling technology for enhancing portability of virtual appliances and their associated virtual  
2123 machines. An OVF package contains a recipe for creating virtual machines that can be interpreted  
2124 concisely by a virtualization platform. The packaged metadata enables a robust and user-friendly  
2125 experience when installing a virtual appliance. In particular, the metadata can be used by the  
2126 management infrastructure to confidently decide whether a particular VM described in an OVF can be  
2127 installed or whether it is rejected, and potentially to guide appropriate conversions and localizations to  
2128 make it runnable in the specific execution context that it is to be installed.

2129 There are many factors that are beyond the control of the OVF format specification, and even a fully  
2130 compliant implementation of it, that determine the portability of a packaged virtual machine. That is, the  
2131 act of packaging a virtual machine into an OVF package does not guarantee universal portability or  
2132 installability across all hypervisors. Below are some of the factors that could limit portability:

- 2133 • The VMs in the OVF could contain virtual disks in a format that is not understood by the  
2134 hypervisor attempting the installation. While it is reasonable to expect that most hypervisors are  
2135 able to import and export VMs in any of the major virtual hard disk formats, newer formats may  
2136 arise that are supported by the OVF and not a particular hypervisor.
- 2137 • The installed guest software may not support the virtual hardware presented by the hypervisor.  
2138 By way of example, the Xen hypervisor does not by default offer a virtualized floppy disk device  
2139 to guests. One could conceive of a guest VM that requires interaction with a floppy disk  
2140 controller and therefore it is not able to execute the VM correctly.
- 2141 • The installed guest software does not support the CPU architecture. For example, the guest  
2142 software might execute CPU operations specific to certain processor models or require specific  
2143 floating point support, or contain opcodes specific to a particular vendor's CPU.
- 2144 • The virtualization platform might not understand a feature requested in the OVF descriptor. For  
2145 example, composed services may not be supported. Because the OVF standard evolves  
2146 independently of virtualization products, at any point an OVF might be unsupported on a  
2147 virtualization platform that predates that OVF specification.

2148 The portability of an OVF can be categorized into the following classes:

- 2149 • **Portability class 1.** Runs on multiple families of virtual hardware. For example, the appliance  
2150 could be runnable on Xen, Sun, Microsoft, and VMware hypervisors. For level 3 compatibility,  
2151 the guest software has been developed to support the devices of multiple hypervisors. A clean  
2152 install and boot of a guest software, during which the guest software performs hardware device  
2153 discovery and installs any specialized drivers required to interact with the virtual platform, is an  
2154 example of Level 3 portability of an OVF. The “sysprep” level of portability for Microsoft  
2155 Windows® operating systems is another example. Such guest software instances can be re-  
2156 installed, re-named, and re-personalized on multiple hardware platforms, including virtual  
2157 hardware.
- 2158 • **Portability class 2.** Runs on a specific family of virtual hardware. This is typically due to lack of  
2159 driver support by the installed guest software.
- 2160 • **Portability class 3.** Only runs on a particular virtualization product and/or CPU architecture  
2161 and/or virtual hardware selection. This is typically due to the OVF containing suspended virtual  
2162 machines or snapshots of powered on virtual machines, including the current run-time state of  
2163 the CPU and real or emulated devices. Such a state ties the OVF to a very specific virtualization  
2164 and hardware platform.

2165 For use within an organization, class 2 or class 3 compatibility may be good enough because the OVF  
2166 package is distributed within a controlled environment where specific purchasing decisions of hardware or  
2167 virtualization platforms can ensure consistency of the underlying feature set for the OVF. A simple export



2168 of a virtual machine creates an OVF with class 3 or class 2 portability (tied to a specific set of virtual  
2169 hardware); however, it is easy to extend the metaphor to support the export of class 1 portability, for  
2170 example through the use of utilities such as “sysprep” for Windows.

2171 For commercial appliances independently created and distributed by ISVs, class 1 portability is desirable.  
2172 Indeed, class 1 portability ensures that the appliance is readily available for the broadest possible  
2173 customer base both for evaluation and production. Toolkits are used to create certified “known good”  
2174 class 1 packages of the appliance for broad distribution and installation on multiple virtual platforms, or  
2175 class 2 portability packages if the appliance is to be consumed within the context of a narrower set of  
2176 virtual hardware, such as within a particular development group in an enterprise.

2177 The OVF virtual hardware description is designed to support class 1 through class 3 portability. For class  
2178 1 portability, it is possible to include only very general descriptions of hardware requirements, or to  
2179 specify multiple alternative virtual hardware descriptions. The appliance provider is in full control of how  
2180 flexible or restrictive the virtual hardware specification is made. A narrow specification can be used to  
2181 constrain an appliance to run on only known-good virtual hardware, while limiting its portability somewhat.  
2182 A broad specification makes the appliance useful across as wide a set of virtual hardware as possible.  
2183 This ensures that customers have the best possible user experience, which is one of the main  
2184 requirements for the success of the virtual appliance concept.

## ANNEX A (informative)

### Single virtual system example

2185  
2186  
2187  
2188

2189 Most of the descriptor is boilerplate. It starts out by describing the set of files in addition to the descriptor  
2190 itself. In this case, there is a single file (`vmdisk1.vmdk`). It then describes the set of virtual disks and the  
2191 set of networks used by the appliance. Each file, disk, and network resource is given a unique identifier.  
2192 These are all in separate namespaces, but the best practice is to use distinct names.

2193 The content of the example OVF is a single virtual machine. The content contains five sections.

2194 The following listing shows a complete OVF descriptor for a typical single virtual machine appliance:

```
2195 <?xml version="1.0" encoding="UTF-8"?>
2196 <Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
2197     xmlns="http://schemas.dmtf.org/ovf/1/envelope"
2198     xmlns:ovf="http://schemas.dmtf.org/ovf/1/envelope"
2199     xmlns:vssd="http://schemas.dmtf.org/wbem/wscim/1/cim-
2200 schema/2/CIM_VirtualSystemSettingData"
2201     xmlns:rasd="http://schemas.dmtf.org/wbem/wscim/1/cim-
2202 schema/2/CIM_ResourceAllocationSettingData">
2203
2204     <!-- References to all external files -->
2205     <References>
2206         <File ovf:id="file1" ovf:href="vmdisk1.vmdk" ovf:size="180114671"/>
2207     </References>
2208     <!-- Describes meta-information for all virtual disks in the package -->
2209     <DiskSection>
2210         <Info>Describes the set of virtual disks</Info>
2211         <Disk ovf:diskId="vmdisk1" ovf:fileRef="file1" ovf:capacity="4294967296"
2212 ovf:format="http://www.vmware.com/interfaces/specifications/vmdk.html#sparse"/>
2213     </DiskSection>
2214     <!-- Describes all networks used in the package -->
2215     <NetworkSection>
2216         <Info>List of logical networks used in the package</Info>
2217         <Network ovf:name="VM Network">
2218             <Description>The network that the services are available on</Description>
2219         </Network>
2220     </NetworkSection>
2221     <VirtualSystem ovf:id="vm">
2222         <Info>Describes a virtual machine</Info>
2223         <Name>Virtual Appliance One</Name>
2224         <ProductSection>
2225             <Info>Describes product information for the appliance</Info>
2226             <Product>The Great Appliance</Product>
2227             <Vendor>Some Great Corporation</Vendor>
2228             <Version>13.00</Version>
```

```

2230     <FullVersion>13.00-b5</FullVersion>
2231
2232 <ProductUrl>http://www.somegreatcorporation.com/greatappliance</ProductUrl>
2233     <VendorUrl>http://www.somegreatcorporation.com/</VendorUrl>
2234     <Property ovf:key="adminEmail" ovf:type="string">
2235         <Description>Email address of administrator</Description>
2236     </Property>
2237     <Property ovf:key="appIp" ovf:type="string"
2238 ovf:defaultValue="192.168.0.10">
2239         <Description>The IP address of this appliance</Description>
2240     </Property>
2241 </ProductSection>
2242 <AnnotationSection ovf:required="false">
2243     <Info>A random annotation on this service. It can be ignored</Info>
2244     <Annotation>Contact customer support if you have any problems</Annotation>
2245 </AnnotationSection>
2246 <EulaSection>
2247     <Info>License information for the appliance</Info>
2248     <License>Insert your favorite license here</License>
2249 </EulaSection>
2250 <VirtualHardwareSection>
2251     <Info>256MB, 1 CPU, 1 disk, 1 nic</Info>
2252     <Item>
2253         <rasd:Description>Number of virtual CPUs</rasd:Description>
2254         <rasd:ElementName>1 virtual CPU</rasd:ElementName>
2255         <rasd:InstanceID>1</rasd:InstanceID>
2256         <rasd:ResourceType>3</rasd:ResourceType>
2257         <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
2258     </Item>
2259     <Item>
2260         <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
2261         <rasd:Description>Memory Size</rasd:Description>
2262         <rasd:ElementName>256 MB of memory</rasd:ElementName>
2263         <rasd:InstanceID>2</rasd:InstanceID>
2264         <rasd:ResourceType>4</rasd:ResourceType>
2265         <rasd:VirtualQuantity>256</rasd:VirtualQuantity>
2266     </Item>
2267     <Item>
2268         <rasd:AutomaticAllocation>true</rasd:AutomaticAllocation>
2269         <rasd:Connection>VM Network</rasd:Connection>
2270         <rasd:ElementName>Ethernet adapter on "VM Network"</rasd:ElementName>
2271         <rasd:InstanceID>4000</rasd:InstanceID>
2272         <rasd:ResourceType>10</rasd:ResourceType>
2273     </Item>
2274     <Item>
2275         <rasd:ElementName>Harddisk 1</rasd:ElementName>
2276         <rasd:HostResource>ovf:/disk/vmdisk1</rasd:HostResource>
2277         <rasd:InstanceID>22001</rasd:InstanceID>
2278         <rasd:ResourceType>17</rasd:ResourceType>
2279     </Item>

```

```
2280     </VirtualHardwareSection>
2281     <OperatingSystemSection ovf:id="58" ovf:required="false">
2282         <Info>Guest Operating System</Info>
2283         <Description>Windows 2000 Advanced Server</Description>
2284     </OperatingSystemSection>
2285 </VirtualSystem>
2286 </Envelope>
```

2287

**ANNEX B  
(informative)**

**Multitiered pet store example**

2288  
2289  
2290  
2291

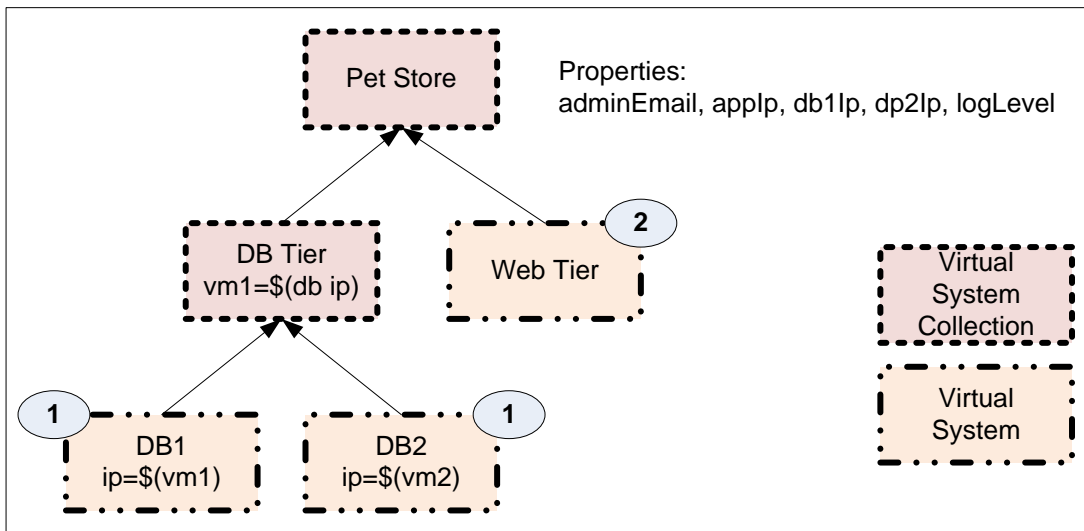
2292 This example demonstrates several advanced OVF concepts:

- 2293 • Multi-VM packages - use of the VirtualMachineCollection entity subtype.
- 2294 • Composite service organization - use of a nested VirtualMachineCollection entity subtype.
- 2295 • Propagation of a user-defined deployment configuration.
- 2296 • Deployment time customization of the service using the OVF environment.
- 2297 • The use of virtual disk chains to minimize downloads.
- 2298 • Nesting of ProductSection elements for providing information about the installed software in
- 2299 an individual virtual machine.

2300 The example service is called Pet Store and consists of a front-end web-server and a database. The  
2301 database server is itself a complex multitiered server consisting of two VMs for fault-tolerance.

**2302 B.1 Architecture and packaging**

2303 The Pet Store OVF package consists of three virtual systems (WebTier, DB1, and DB2) and two virtual  
2304 system collections (Pet Store and DBTier). Figure B-1 shows the structure of the OVF package as well as  
2305 the properties and startup order of the virtual machines.



2306

**Figure B-1 – Pet Store OVF package**

2307

2308 The complete OVF descriptor is listed at the end of this document. The use of properties and disk layout  
2309 of the OVF is discussed in more details in the following clauses.

**2310 B.2 Properties**

2311 The Pet Store service has five user-configurable properties. These are the key control parameters for the  
2312 service that need to be configured in order for it to start up correctly in the deployed environment. The  
2313 properties are passed up to the guest software in the form of an OVF environment document. The guest

2314 software is written to read the OVF environment on startup, extract the values of the properties, and apply  
 2315 them to the software configuration. Thus, the OVF descriptor reflects the properties that are handled by  
 2316 the guest software.

2317 For this particular service, there are two different software configurations: one for the Web tier and one for  
 2318 the Database tier. The properties supported in each software configuration are:

2319 Table B-1 illustrates the properties for the Web Guest Software:

2320 **Table B-1 – Web tier configuration**

Property	Description
<i>applp</i>	IP address of the Web Server
<i>dblp</i>	IP address of the database server to which to connect
<i>adminEmail</i>	Email address for support
<i>logLevel</i>	Logging level

2321  
 2322 All properties defined on the immediate parent `VirtualSystemCollection` container are available to  
 2323 a child `VirtualSystem` or `VirtualSystemCollection`. Thus, the OVF descriptor does not need to  
 2324 contain an explicit `ProductSection` for each VM, as demonstrated for WebVM.

2325 Table B-2 illustrates the properties for the Database Guest Software:

2326 **Table B-2 – Database tier configuration**

Property	Description
<i>ip</i>	IP address of the virtual machine
<i>primaryAtBoot</i>	Whether the instance acts as the primary or secondary when booting
<i>ip2</i>	IP address of the twin database VM that acts as the hot-spare or primary
<i>log</i>	Logging level (called log here)

2327 The clustered database is organized as a virtual system collection itself with a specific set of properties  
 2328 for configuration: `vm1`, `vm2`, and `log`. This organization separates the database implementation from the  
 2329 rest of the software in the OVF package and allows virtual appliances (guest software + virtual machine  
 2330 configurations) to be easily composed and thereby promotes reuse.

2331 The database software is an off-the-shelf software package and the vendor has chosen "com.mydb.db"  
 2332 as the unique name for all the properties. This string can be seen in the OVF descriptor with the inclusion  
 2333 of the `ovf:class` attribute on the `ProductSection`.

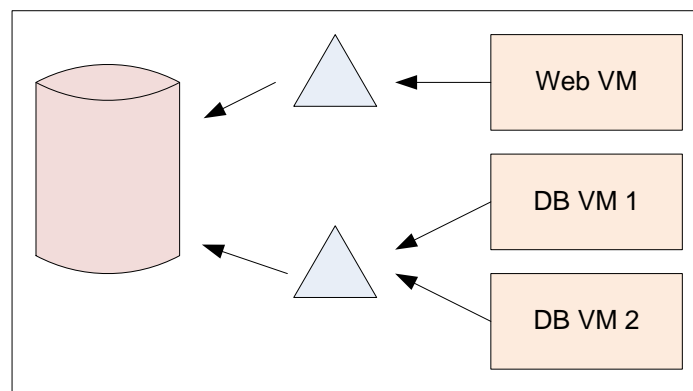
2334 The `${<name>}` property syntax is used to propagate values from the outer level into the inner nodes in  
 2335 the OVF descriptor's entity hierarchy. This mechanism allows linking up different components without  
 2336 having to pre-negotiate naming conventions or changing guest software. Only properties defined on the  
 2337 immediate parent `VirtualSystemCollection` container are available to a child entity. Thus,  
 2338 properties defined on Petstore are not available to a DB1. This ensures that the interface for a

2339 VirtualSystemCollection is encapsulated and well described in its parent  
 2340 VirtualSystemCollection, which makes the software composable and easy to reuse.

2341 The OVF descriptor uses fixed non-user assignable properties to ensure that the two database virtual  
 2342 machines boot up into different roles even though they are, initially, booting of the exact same software  
 2343 image. The property named *com.mydb.db.primaryAtBoot* is specified with a fixed, non-user configurable  
 2344 value but is different for the two images. The software inspects this value at boot time and customizes its  
 2345 operation accordingly.

### 2346 B.3 Disk layout

2347 The Petstore OVF package uses the ability to share disks and encode a delta disk hierarchy to minimize  
 2348 the size and thereby the download time for the package. In this particular case, we only have two different  
 2349 images (Database and Web), and if we further assume they are built on top of the same base OS  
 2350 distribution, we can encode this in the OVF descriptor as shown in Figure B-2.



2351

2352

**Figure B-2 – Pet Store virtual disk layout**

2353 Thus, while the package contains three distinct virtual machines, the total download size is significantly  
 2354 smaller. In fact, only one full VM and then two relative small deltas need to be downloaded.

2355 The physical layout of the virtual disks on the deployment system is independent of the disk structure in  
 2356 the OVF package. The OVF package describes the size of the virtual disk and the content (i.e., bits that  
 2357 needs to be on the disk). It also specifies that each virtual machine gets independent disks. Thus, a  
 2358 virtualization platform could install the above package as three VMs with three independent flat disks, or it  
 2359 could chose to replicate the above organization, or something third, as long as each virtual machine sees  
 2360 a disk with the content described on initial boot and that changes written by one virtual machine do not  
 2361 affect the others.

### 2362 B.4 Pet Store OVF descriptor

```

2363 <?xml version="1.0" encoding="UTF-8"?>
2364 <Envelope
2365   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
2366   xmlns="http://schemas.dmtf.org/ovf/envelope/1"
2367   xmlns:ovf="http://schemas.dmtf.org/ovf/envelope/1"
2368   xmlns:vssd="http://schemas.dmtf.org/wbem/wscim/1/cim-
2369 schema/2/CIM_VirtualSystemSettingData"
2370   xmlns:rasd="http://schemas.dmtf.org/wbem/wscim/1/cim-
2371 schema/2/CIM_ResourceAllocationSettingData">
2372   <!-- References to all external files -->
2373   <References>
2374     <File ovf:id="base" ovf:href="base.vmdk" ovf:size="180114671"/>
2375     <File ovf:id="webdelta" ovf:href="webapp-delta.vmdk" ovf:size="123413"/>
  
```

```

2376     <File ovf:id="dbdelta" ovf:href="dbapp-delta.vmdk" ovf:size="343243"/>
2377 </References>
2378 <!-- Describes meta-information about all virtual disks in the package.
2379 This example is encoded as a delta-disk hierarchy.
2380 -->
2381 <DiskSection>
2382     <Info>Describes the set of virtual disks</Info>
2383     <Disk ovf:diskId="base" ovf:fileRef="base" ovf:capacity="4294967296"
2384         ovf:populatedSize="1924967692"
2385
2386 ovf:format="http://www.vmware.com/specifications/vmdk.html#streamOptimized"/>
2387     <Disk ovf:diskId="web" ovf:fileRef="webappdelta" ovf:parentRef="base"
2388         ovf:capacity="4294967296"
2389
2390 ovf:format="http://www.vmware.com/specifications/vmdk.html#streamOptimized"/>
2391     <Disk ovf:diskId="db" ovf:fileRef="dbdelta" ovf:parentRef="base"
2392         ovf:capacity="4294967296"
2393
2394 ovf:format="http://www.vmware.com/specifications/vmdk.html#streamOptimized"/>
2395 </DiskSection>
2396 <!-- Describes all networks used in the package -->
2397 <NetworkSection>
2398     <Info>List of logical networks used in the package</Info>
2399     <Network ovf:name="VM Network">
2400         <Description ovf:msgid="network.description">The network that the services
2401             are available on</Description>
2402     </Network>
2403 </NetworkSection>
2404 <!-- Deployment options for the packages -->
2405 <DeploymentOptionSection>
2406     <Info>List of deployment options available in the package</Info>
2407     <Configuration ovf:id="minimal">
2408         <Label ovf:msgid="minimal.label">Minimal</Label>
2409         <Description ovf:msgid="minimal.description">Deploy service with minimal
2410             resource use</Description>
2411     </Configuration>
2412     <Configuration ovf:id="standard" ovf:default="true">
2413         <Label ovf:msgid="standard.label">Standard</Label>
2414         <Description ovf:msgid="standard.description">Deploy service with standard
2415             resource use</Description>
2416     </Configuration>
2417 </DeploymentOptionSection>
2418 <!-- PetStore Virtual System Collection -->
2419 <VirtualSystemCollection ovf:id="PetStore">
2420     <Info>The packaging of the PetStoreService multitier application</Info>
2421     <Name>PetStore Service</Name>
2422     <!-- Overall information about the product -->
2423     <ProductSection>
2424         <Info>Describes product information for the service</Info>
2425         <Product>PetStore Web Portal</Product>
2426         <Vendor>Some Random Organization</Vendor>
2427         <Version>4.5</Version>
2428         <FullVersion>4.5-b4523</FullVersion>
2429         <ProductUrl>http://www.vmware.com/go/ovf</ProductUrl>
2430         <VendorUrl>http://www.vmware.com/</VendorUrl>
2431         <Category ovf:msgid="category.email">Email properties</Category>
2432         <Property ovf:key="adminEmail" ovf:type="string"
2433 ovf:userConfigurable="true">
2434             <Label ovf:msgid="property.email.label">Admin email</Label>
2435             <Description ovf:msgid="property.email.description">Email address of
2436                 service administrator</Description>
2437         </Property>

```



```

2438     <Category ovf:msgid="category.network">Network properties</Category>
2439     <Property ovf:key="appIp" ovf:type="string"
2440         ovf:userConfigurable="true">
2441         <Label ovf:msgid="property.appIp.label">IP</Label>
2442         <Description ovf:msgid="property.appIp.description">IP address of the
2443             service</Description>
2444     </Property>
2445     <Property ovf:key="dbIp" ovf:type="string" ovf:userConfigurable="true">
2446         <Label ovf:msgid="property.dpip.label">IP for DB</Label>
2447         <Description ovf:msgid="property.dpip.description">Primary IP address
of
2448         the database</Description>
2449     </Property>
2450     <Property ovf:key="db2Ip" ovf:type="string"
2451         ovf:userConfigurable="true">
2452         <Label ovf:msgid="property.dpip2.label">IP for DB2</Label>
2453         <Description ovf:msgid="property.dpip2.description">A secondary IP
2454             address for the database</Description>
2455     </Property>
2456     <Category ovf:msgid="category.logging">Logging properties</Category>
2457     <Property ovf:key="logLevel" ovf:type="string" ovf:value="normal"
2458         ovf:userConfigurable="true">
2459         <Label ovf:msgid="property.loglevel.label">Loglevel</Label>
2460         <Description ovf:msgid="property.loglevel.description">Logging level
for
2461         the service</Description>
2462         <Value ovf:value="low" ovf:configuration="minimal"/>
2463     </Property>
2464 </ProductSection>
2465 <AnnotationSection ovf:required="false">
2466     <Info>A annotation on this service</Info>
2467     <Annotation ovf:msgid="annotation.annotation">Contact customer support for
2468         any urgent issues</Annotation>
2469 </AnnotationSection>
2470 <ResourceAllocationSection ovf:required="false">
2471     <Info>Defines minimum reservations for CPU and memory</Info>
2472     <Item>
2473         <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
2474         <rasd:ElementName>512 MB reservation</rasd:ElementName>
2475         <rasd:InstanceID>0</rasd:InstanceID>
2476         <rasd:Reservation>512</rasd:Reservation>
2477         <rasd:ResourceType>4</rasd:ResourceType>
2478     </Item>
2479     <Item ovf:configuration="minimal">
2480         <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
2481         <rasd:ElementName>384 MB reservation</rasd:ElementName>
2482         <rasd:InstanceID>0</rasd:InstanceID>
2483         <rasd:Reservation>384</rasd:Reservation>
2484         <rasd:ResourceType>4</rasd:ResourceType>
2485     </Item>
2486     <Item>
2487         <rasd:AllocationUnits>MHz</rasd:AllocationUnits>
2488         <rasd:ElementName>1000 MHz reservation</rasd:ElementName>
2489         <rasd:InstanceID>1</rasd:InstanceID>
2490         <rasd:Reservation>500</rasd:Reservation>
2491         <rasd:ResourceType>3</rasd:ResourceType>
2492     </Item>
2493     <Item ovf:bound="min">
2494         <rasd:AllocationUnits>MHz</rasd:AllocationUnits>
2495         <rasd:ElementName>500 MHz reservation</rasd:ElementName>
2496         <rasd:InstanceID>1</rasd:InstanceID>
2497         <rasd:Reservation>500</rasd:Reservation>
2498         <rasd:ResourceType>3</rasd:ResourceType>
2499     </Item>
2500 </ResourceAllocationSection>
2501 </ProductSection>

```

```

2502     <Item ovf:bound="max">
2503         <rasd:AllocationUnits>MHz</rasd:AllocationUnits>
2504         <rasd:ElementName>1500 MHz reservation</rasd:ElementName>
2505         <rasd:InstanceID>1</rasd:InstanceID>
2506         <rasd:Reservation>1500</rasd:Reservation>
2507         <rasd:ResourceType>3</rasd:ResourceType>
2508     </Item>
2509 </ResourceAllocationSection>
2510 <StartupSection>
2511     <Info>Specifies how the composite service is powered-on and off</Info>
2512     <Item ovf:id="DBTier" ovf:order="1" ovf:startDelay="120"
2513         ovf:startAction="powerOn" ovf:waitingForGuest="true"
2514 ovf:stopDelay="120"
2515         ovf:stopAction="guestShutdown"/>
2516     <Item ovf:id="WebTier" ovf:order="2" ovf:startDelay="120"
2517         ovf:startAction="powerOn" ovf:waitingForGuest="true"
2518 ovf:stopDelay="120"
2519         ovf:stopAction="guestShutdown"/>
2520 </StartupSection>
2521 <VirtualSystem ovf:id="WebTier">
2522     <Info>The virtual machine containing the WebServer application</Info>
2523     <ProductSection>
2524         <Info>Describes the product information</Info>
2525         <Product>Apache Webserver</Product>
2526         <Vendor>Apache Software Foundation</Vendor>
2527         <Version>6.5</Version>
2528         <FullVersion>6.5-b2432</FullVersion>
2529     </ProductSection>
2530     <OperatingSystemSection ovf:id="97">
2531         <Info>Guest Operating System</Info>
2532         <Description>Linux 2.4.x</Description>
2533     </OperatingSystemSection>
2534     <VirtualHardwareSection>
2535         <Info>256 MB, 1 CPU, 1 disk, 1 nic virtual machine</Info>
2536         <System>
2537             <vssd:ElementName>Virtual Hardware Family</vssd:ElementName>
2538             <vssd:InstanceID>0</vssd:InstanceID>
2539             <vssd:VirtualSystemType>vmx-04</vssd:VirtualSystemType>
2540         </System>
2541         <Item>
2542             <rasd:Description>Number of virtual CPUs</rasd:Description>
2543             <rasd:ElementName>1 virtual CPU</rasd:ElementName>
2544             <rasd:InstanceID>1</rasd:InstanceID>
2545             <rasd:ResourceType>3</rasd:ResourceType>
2546             <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
2547         </Item>
2548         <Item>
2549             <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
2550             <rasd:Description>Memory Size</rasd:Description>
2551             <rasd:ElementName>256 MB of memory</rasd:ElementName>
2552             <rasd:InstanceID>2</rasd:InstanceID>
2553             <rasd:ResourceType>4</rasd:ResourceType>
2554             <rasd:VirtualQuantity>256</rasd:VirtualQuantity>
2555         </Item>
2556         <Item>
2557             <rasd:AutomaticAllocation>true</rasd:AutomaticAllocation>
2558             <rasd:Connection>VM Network</rasd:Connection>
2559             <rasd:ElementName>Ethernet adapter on "VM
2560 Network"</rasd:ElementName>
2561             <rasd:InstanceID>3</rasd:InstanceID>
2562             <rasd:ResourceSubType>PCNet32</rasd:ResourceSubType>
2563             <rasd:ResourceType>10</rasd:ResourceType>

```

```

2564         </Item>
2565     <Item>
2566         <rasd:AddressOnParent>1</rasd:AddressOnParent>
2567         <rasd:ElementName>SCSI Controller 0 - LSI Logic</rasd:ElementName>
2568         <rasd:InstanceID>1000</rasd:InstanceID>
2569         <rasd:ResourceSubType>LsiLogic</rasd:ResourceSubType>
2570         <rasd:ResourceType>6</rasd:ResourceType>
2571     </Item>
2572 <Item>
2573     <rasd:AddressOnParent>0</rasd:AddressOnParent>
2574     <rasd:ElementName>Harddisk 1</rasd:ElementName>
2575     <rasd:HostResource>ovf:/disk/web</rasd:HostResource>
2576     <rasd:InstanceID>22001</rasd:InstanceID>
2577     <rasd:Parent>1000</rasd:Parent>
2578     <rasd:ResourceType>17</rasd:ResourceType>
2579 </Item>
2580 </VirtualHardwareSection>
2581 </VirtualSystem>
2582 <!-- Database Tier -->
2583 <VirtualSystemCollection ovf:id="DBTier">
2584     <Info>Describes a clustered database instance</Info>
2585     <ProductSection ovf:class="com.mydb.db">
2586         <Info>Product Information</Info>
2587         <Product>Somebody Clustered SQL Server</Product>
2588         <Vendor>TBD</Vendor>
2589         <Version>2.5</Version>
2590         <FullVersion>2.5-b1234</FullVersion>
2591         <Property ovf:key="vm1" ovf:value="{dbIp}" ovf:type="string"/>
2592         <Property ovf:key="vm2" ovf:value="{db2Ip}" ovf:type="string"/>
2593         <Property ovf:key="log" ovf:value="{logLevel}" ovf:type="string"/>
2594     </ProductSection>
2595     <StartupSection>
2596         <Info>Specifies how the composite service is powered-on and off</Info>
2597         <Item ovf:id="DB1" ovf:order="1" ovf:startDelay="120"
2598             ovf:startAction="powerOn" ovf:waitingForGuest="true"
2599             ovf:stopDelay="120" ovf:stopAction="guestShutdown"/>
2600         <Item ovf:id="DB2" ovf:order="2" ovf:startDelay="120"
2601             ovf:startAction="powerOn" ovf:waitingForGuest="true"
2602             ovf:stopDelay="120" ovf:stopAction="guestShutdown"/>
2603     </StartupSection>
2604     <!-- DB VM 1 -->
2605     <VirtualSystem ovf:id="DB1">
2606         <Info>Describes a virtual machine with the database image
2607 installed</Info>
2608         <Name>Database Instance I</Name>
2609         <ProductSection ovf:class="com.mydb.db">
2610             <Info>Specifies the OVF properties available in the OVF
2611 environment</Info>
2612             <Property ovf:key="ip" ovf:value="{vm1}" ovf:type="string"/>
2613             <Property ovf:key="ip2" ovf:value="{vm2}" ovf:type="string"/>
2614             <Property ovf:key="primaryAtBoot" ovf:value="yes"
2615 ovf:type="string"/>
2616         </ProductSection>
2617         <VirtualHardwareSection>
2618             <Info>256 MB, 1 CPU, 1 disk, 1 nic virtual machine</Info>
2619             <System>
2620                 <vssd:ElementName>Virtual Hardware Family</vssd:ElementName>
2621                 <vssd:InstanceID>0</vssd:InstanceID>
2622                 <vssd:VirtualSystemType>vmx-04</vssd:VirtualSystemType>
2623             </System>
2624             <Item>
2625                 <rasd:Description>Number of virtual CPUs</rasd:Description>
2626                 <rasd:ElementName>1 virtual CPU</rasd:ElementName>
2627                 <rasd:InstanceID>1</rasd:InstanceID>

```

```

2628         <rasd:ResourceType>3</rasd:ResourceType>
2629         <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
2630     </Item>
2631     <Item>
2632         <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
2633         <rasd:Description>Memory Size</rasd:Description>
2634         <rasd:ElementName>256 MB of memory</rasd:ElementName>
2635         <rasd:InstanceID>2</rasd:InstanceID>
2636         <rasd:ResourceType>4</rasd:ResourceType>
2637         <rasd:VirtualQuantity>256</rasd:VirtualQuantity>
2638     </Item>
2639     <Item>
2640         <rasd:AutomaticAllocation>true</rasd:AutomaticAllocation>
2641         <rasd:Connection>VM Network</rasd:Connection>
2642         <rasd:ElementName>Ethernet adapter on "VM
2643 Network"</rasd:ElementName>
2644         <rasd:InstanceID>3</rasd:InstanceID>
2645         <rasd:ResourceSubType>PCNet32</rasd:ResourceSubType>
2646         <rasd:ResourceType>10</rasd:ResourceType>
2647     </Item>
2648     <Item>
2649         <rasd:AddressOnParent>1</rasd:AddressOnParent>
2650         <rasd:ElementName>SCSI Controller 0 - LSI
2651 Logic</rasd:ElementName>
2652         <rasd:InstanceID>1000</rasd:InstanceID>
2653         <rasd:ResourceSubType>LsiLogic</rasd:ResourceSubType>
2654         <rasd:ResourceType>6</rasd:ResourceType>
2655     </Item>
2656     <Item>
2657         <rasd:AddressOnParent>0</rasd:AddressOnParent>
2658         <rasd:ElementName>Harddisk 1</rasd:ElementName>
2659         <rasd:HostResource>ovf:/disk/db</rasd:HostResource>
2660         <rasd:InstanceID>22001</rasd:InstanceID>
2661         <rasd:Parent>1000</rasd:Parent>
2662         <rasd:ResourceType>17</rasd:ResourceType>
2663     </Item>
2664 </VirtualHardwareSection>
2665 <OperatingSystemSection ovf:id="97">
2666     <Info>Guest Operating System</Info>
2667     <Description>Linux 2.4.x</Description>
2668 </OperatingSystemSection>
2669 </VirtualSystem>
2670 <!-- DB VM 2 -->
2671 <VirtualSystem ovf:id="DB2">
2672     <Info>Describes a virtual machine with the database image
2673 installed</Info>
2674     <Name>Database Instance II</Name>
2675     <ProductSection ovf:class="com.mydb.db">
2676         <Info>Specifies the OVF properties available in the OVF
2677 environment</Info>
2678         <Property ovf:key="ip" ovf:value="{vm2}" ovf:type="string"/>
2679         <Property ovf:key="ip2" ovf:value="{vm1}" ovf:type="string"/>
2680         <Property ovf:key="primaryAtBoot" ovf:value="no"
2681 ovf:type="string"/>
2682     </ProductSection>
2683 </VirtualHardwareSection>
2684     <Info>256 MB, 1 CPU, 1 disk, 1 nic virtual machine</Info>
2685     <System>
2686         <vssd:ElementName>Virtual Hardware Family</vssd:ElementName>
2687         <vssd:InstanceID>0</vssd:InstanceID>
2688         <vssd:VirtualSystemType>vmx-04</vssd:VirtualSystemType>
2689     </System>

```

```

2690         <Item>
2691             <rasd:Description>Number of virtual CPUs</rasd:Description>
2692             <rasd:ElementName>1 virtual CPU</rasd:ElementName>
2693             <rasd:InstanceID>1</rasd:InstanceID>
2694             <rasd:ResourceType>3</rasd:ResourceType>
2695             <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
2696         </Item>
2697         <Item>
2698             <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
2699             <rasd:Description>Memory Size</rasd:Description>
2700             <rasd:ElementName>256 MB of memory</rasd:ElementName>
2701             <rasd:InstanceID>2</rasd:InstanceID>
2702             <rasd:ResourceType>4</rasd:ResourceType>
2703             <rasd:VirtualQuantity>256</rasd:VirtualQuantity>
2704         </Item>
2705         <Item>
2706             <rasd:AutomaticAllocation>>true</rasd:AutomaticAllocation>
2707             <rasd:Connection>VM Network</rasd:Connection>
2708             <rasd:ElementName>Ethernet adapter on "VM
2709 Network"</rasd:ElementName>
2710             <rasd:InstanceID>3</rasd:InstanceID>
2711             <rasd:ResourceSubType>PCNet32</rasd:ResourceSubType>
2712             <rasd:ResourceType>10</rasd:ResourceType>
2713         </Item>
2714         <Item>
2715             <rasd:AddressOnParent>1</rasd:AddressOnParent>
2716             <rasd:ElementName>SCSI Controller 0 - LSI
2717 Logic</rasd:ElementName>
2718             <rasd:InstanceID>1000</rasd:InstanceID>
2719             <rasd:ResourceSubType>LsiLogic</rasd:ResourceSubType>
2720             <rasd:ResourceType>6</rasd:ResourceType>
2721         </Item>
2722         <Item>
2723             <rasd:AddressOnParent>0</rasd:AddressOnParent>
2724             <rasd:ElementName>Harddisk 1</rasd:ElementName>
2725             <rasd:HostResource>ovf:/disk/db</rasd:HostResource>
2726             <rasd:InstanceID>22001</rasd:InstanceID>
2727             <rasd:Parent>1000</rasd:Parent>
2728             <rasd:ResourceType>17</rasd:ResourceType>
2729         </Item>
2730     </VirtualHardwareSection>
2731     <OperatingSystemSection ovf:id="97">
2732         <Info>Guest Operating System</Info>
2733         <Description>Linux 2.4.x</Description>
2734     </OperatingSystemSection>
2735 </VirtualSystem>
2736 </VirtualSystemCollection>
2737 </VirtualSystemCollection>
2738 <!-- External I18N bundles -->
2739 <Strings xml:lang="de-DE" ovf:fileRef="de-DE-bundle.xml"/>
2740 <!-- Embedded I18N bundles -->
2741 <Strings xml:lang="da-DA">
2742     <Msg ovf:msgid="network.description">Netværket servicen skal være tilgængelig
2743 på</Msg>
2744     <Msg ovf:msgid="annotation.annotation">Kontakt kundeservice i tilfælde af
2745 kritiske problemer</Msg>
2746     <Msg ovf:msgid="property.email.description">Email adresse for
2747 administrator</Msg>
2748     <Msg ovf:msgid="property.appIp.description">IP adresse for service</Msg>
2749     <Msg ovf:msgid="property.dpIp">Primær IP adresse for database</Msg>
2750     <Msg ovf:msgid="property.dpIp2.description">Sekundær IP adresse for
2751 database</Msg>
2752     <Msg ovf:msgid="property.loglevel.description">Logningsniveau for
2753 service</Msg>

```

```

2754     <Msg ovf:msgid="minimal.label">Minimal</Msg>
2755     <Msg ovf:msgid="minimal.description">Installer service med minimal brug af
2756         resourcer</Msg>
2757     <Msg ovf:msgid="standard.label">Normal</Msg>
2758     <Msg ovf:msgid="standard.description">Installer service med normal brug af
2759         resourcer</Msg>
2760 </Strings>
2761 </Envelope>

```

## 2762 B.5 Complete OVF environment

2763 The following example lists the OVF environments that are seen by the WebTier and DB1 virtual  
 2764 machines. (DB2 is virtually identical to the one for DB1 and is omitted.)

2765 OVF environment for the WebTier virtual machine:

```

2766 <?xml version="1.0" encoding="UTF-8"?>
2767 <Environment
2768     xmlns="http://schemas.dmtf.org/ovf/environment/1"
2769     xmlns:ovfenv="http://schemas.dmtf.org/ovf/environment/1"
2770     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
2771     ovfenv:id="WebTier">
2772
2773     <!-- Information about hypervisor platform -->
2774     <PlatformSection>
2775         <Kind>ESX Server</Kind>
2776         <Version>3.0.1</Version>
2777         <Vendor>VMware, Inc.</Vendor>
2778         <Locale>en_US</Locale>
2779     </PlatformSection>
2780
2781     <!-- Properties defined for this virtual machine -->
2782     <PropertySection>
2783         <Property ovfenv:key="adminEmail" ovfenv:value="ovf-admin@vmware.com"/>
2784         <Property ovfenv:key="appIp" ovfenv:value="10.20.132.101"/>
2785         <Property ovfenv:key="dbIp" ovfenv:value="10.20.132.102"/>
2786         <Property ovfenv:key="db2Ip" ovfenv:value="10.20.132.103"/>
2787         <Property ovfenv:key="logLevel" ovfenv:value="warning"/>
2788     </PropertySection>
2789
2790     <Entity ovfenv:id="DBTier">
2791         <PropertySection>
2792             <Property ovfenv:key="adminEmail" ovfenv:value="ovf-admin@vmware.com"/>
2793             <Property ovfenv:key="appIp" ovfenv:value="10.20.132.101"/>
2794             <Property ovfenv:key="dbIp" ovfenv:value="10.20.132.102"/>
2795             <Property ovfenv:key="db2Ip" ovfenv:value="10.20.132.103"/>
2796             <Property ovfenv:key="logLevel" ovfenv:value="warning"/>
2797             <Property ovfenv:key="com.mydb.db.vm1" ovfenv:value="10.20.132.102"/>
2798             <Property ovfenv:key="com.mydb.db.vm2" ovfenv:value="10.20.132.103"/>
2799             <Property ovfenv:key="com.mydb.db.log" ovfenv:value="warning"/>
2800         </PropertySection>
2801     </Entity>
2802 </Environment>

```

2803 OVF environment for the DB1 virtual machine:

```

2804 <?xml version="1.0" encoding="UTF-8"?>
2805 <Environment
2806     xmlns="http://schemas.dmtf.org/ovf/environment/1"
2807     xmlns:ovfenv="http://schemas.dmtf.org/ovf/environment/1"
2808     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

```

```
2809     ovfenv:id="DB1">
2810
2811     <!-- Information about hypervisor platform -->
2812     <PlatformSection>
2813         <Kind>ESX Server</Kind>
2814         <Version>3.0.1</Version>
2815         <Vendor>VMware, Inc.</Vendor>
2816         <Locale>en_US</Locale>
2817     </PlatformSection>
2818
2819     <!-- Properties defined for this virtual machine -->
2820     <PropertySection>
2821         <Property ovfenv:key="com.mydb.db.vm1" ovfenv:value="10.20.132.102"/>
2822         <Property ovfenv:key="com.mydb.db.vm2" ovfenv:value="10.20.132.103"/>
2823         <Property ovfenv:key="com.mydb.db.log" ovfenv:value="warning"/>
2824         <Property ovfenv:key="com.mydb.db.ip" ovfenv:value="10.20.132.102"/>
2825         <Property ovfenv:key="com.mydb.db.ip2" ovfenv:value="10.20.132.103"/>
2826         <Property ovfenv:key="com.mydb.db.primaryAtBoot" ovfenv:value="yes"/>
2827     </PropertySection>
2828
2829     <Entity ovfenv:id="DB2">
2830         <PropertySection>
2831             <Property ovfenv:key="com.mydb.db.vm1" ovfenv:value="10.20.132.102"/>
2832             <Property ovfenv:key="com.mydb.db.vm2" ovfenv:value="10.20.132.103"/>
2833             <Property ovfenv:key="com.mydb.db.log" ovfenv:value="warning"/>
2834             <Property ovfenv:key="com.mydb.db.ip" ovfenv:value="10.20.132.103"/>
2835             <Property ovfenv:key="com.mydb.db.ip2" ovfenv:value="10.20.132.102"/>
2836             <Property ovfenv:key="com.mydb.db.primaryAtBoot" ovfenv:value="no"/>
2837         </PropertySection>
2838     </Entity>
2839 </Environment>
2840
```

## ANNEX C (informative)

2841  
2842  
2843  
2844

### Single virtual system LAMP stack example

2845 In this example, we provide two concrete examples of how an OVF descriptor for a LAMP virtual  
2846 appliance could look. We show both a single-VM LAMP virtual appliance and a multi-VM LAMP virtual  
2847 appliance. LAMP is an abbreviation for a service built by using the Linux operating system, Apache web  
2848 server, MySQL database, and the PHP web development software packages.

2849 This examples show how the `ProductSection` can be used to specify both operating system and  
2850 application-level deployment parameters. For example, these parameters can be used to optimize the  
2851 performance of a service when deployed into a particular environment. The descriptors are complete, but  
2852 otherwise kept minimal; for example, there are no EULA sections.

#### 2853 C.1 Deployment-time customization

2854 A part of the deployment phase of an OVF package is to provide customization parameters. The  
2855 customization parameters are specified in the OVF descriptor and are provided to the guest software  
2856 using the OVF environment. This deployment time customization is in addition to the virtual machine level  
2857 parameters, which includes virtual switch connectivity and physical storage location.

2858 For a LAMP-based virtual appliance, the deployment time customization includes the IP address and port  
2859 number of the service, network information, such as gateway and subnet, and also parameters, so the  
2860 performance can be optimized for a given deployment. The properties that are exposed to the deployer  
2861 vary from vendor to vendor and service to service. In our example descriptors, we use the following set of  
2862 parameters described in Table C-1 for the four different LAMP components:

2863

**Table C-1 – LAMP configuration**

Product	Property	Description
Linux	hostname	Network identity of the application, including IP address
	ip	
	subnet	
	gateway	
	dns	
Linux	netCoreRmemMax	Parameters to optimize the transfer rate of the IP stack
	netCoreWmemMax	



Product	Property	Description
Apache	httpPort	Port numbers for web server
	httpsPort	
	startThreads	Parameters to optimize the performance of the web server
	minSpareThreads	
	maxSpareThreads	
	maxClients	
MySQL	queryCacheSize	Parameters to optimize the performance of database
	maxConnections	
	waitTimeout	
PHP	sessionTimeout	Parameters to customize the behavior of the PHP engine, including how sessions timeout and number of sessions
	concurrentSessions	
	memoryLimit	

2864 The parameters in *italic* are required configurations from the user. Otherwise, they have reasonable  
 2865 defaults, so the user does not necessarily need to provide a value.

2866 The customization parameters for each software product are encapsulated in separate product sections.  
 2867 For example, for the Apache web server the following section is used:

```

2868 <ProductSection ovf:class="org.apache.httpd">
2869   <Info>Product customization for the installed Apache Web Server</Info>
2870   <Product>Apache Distribution Y</Product>
2871   <Version>2.6.6</Version>
2872   <Property ovf:key="httpPort" ovf:type="uint16" ovf:value="80"
2873     ovf:userConfigurable="true">
2874     <Description>Port number for HTTP requests</Description>
2875   </Property>
2876   <Property ovf:key="httpsPort" ovf:type="uint16" ovf:value="443"
2877     ovf:userConfigurable="true">
2878     <Description>Port number for HTTPS requests</Description>
2879   </Property>
2880   <Property ovf:key="startThreads" ovf:type="uint16" ovf:value="50"
2881     ovf:userConfigurable="true">
2882     <Description>Number of threads created on startup. </Description>
2883   </Property>
2884   <Property ovf:key="minSpareThreads" ovf:type="uint16" ovf:value="15"
2885     ovf:userConfigurable="true">
2886     <Description> Minimum number of idle threads to handle request
2887 spikes.</Description>
2888   </Property>
2889   <Property ovf:key="maxSpareThreads" ovf:type="uint16" ovf:value="30"
2890     ovf:userConfigurable="true">
2891     <Description>Maximum number of idle threads </Description>
2892   </Property>
2893   <Property ovf:key="maxClients" ovf:type="uint16" ovf:value="256"
2894     ovf:userConfigurable="true">
2895     <Description>Limit the number of simultaneous requests that are served.
2896 </Description>
2897   </Property>
2898 </ProductSection>

```

2899 The `ovf:class="org.apache.httpd"` attribute specifies the prefix for the properties. Hence, the  
2900 Apache database is expected to look for the following properties in the OVF environment:

```

2901 <Environment
2902   ...
2903   <!-- Properties defined for this virtual machine -->
2904   <PropertySection>
2905     <Property ovfenv:name="org.apache.httpd.httpPort" ovfenv:value="80"/>
2906     <Property ovfenv:name="org.apache.httpd.httpsPort" ovfenv:value="443"/>
2907     <Property ovfenv:name="org.apache.httpd.startThreads" ovfenv:value="50"/>
2908     <Property ovfenv:name="org.apache.httpd.minSpareThreads" ovfenv:value="15"/>
2909     <Property ovfenv:name="org.apache.httpd.maxSpareThreads" ovfenv:value="30"/>
2910     <Property ovfenv:name="org.apache.httpd.maxClients" ovfenv:value="256"/>
2911     ...
2912   </PropertySection>
2913   ...
2914 </Environment>

```

## 2915 C.2 Simple LAMP OVF descriptor

2916 A complete OVF descriptor for a single VM virtual appliance with the LAMP stack is listed below:

```

2917 <?xml version="1.0" encoding="UTF-8"?>
2918 <Envelope
2919   xmlns="http://schemas.dmtf.org/ovf/envelope/1"
2920   xmlns:ovf="http://schemas.dmtf.org/ovf/envelope/1"

```

```

2921     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
2922     xmlns:vssd="http://schemas.dmtf.org/wbem/wscim/1/cim-
2923 schema/2/CIM_VirtualSystemSettingData"
2924     xmlns:rasd="http://schemas.dmtf.org/wbem/wscim/1/cim-
2925 schema/2/CIM_ResourceAllocationSettingData"
2926     <!-- References to all external files -->
2927     <References>
2928         <File ovf:id="lamp" ovf:href="lamp.vmdk" ovf:size="180114671"/>
2929     </References>
2930     <!-- Describes meta-information about all virtual disks in the package. -->
2931     <DiskSection>
2932         <Info>List of the virtual disks used in the package</Info>
2933         <Disk ovf:diskId="lamp" ovf:fileRef="lamp" ovf:capacity="4294967296"
2934             ovf:populatedSize="1924967692"
2935         ovf:format="http://www.vmware.com/specifications/vmdk.html#streamOptimized"/>
2936     </DiskSection>
2937     <!-- Describes all networks used in the package -->
2938     <NetworkSection>
2939         <Info>Logical networks used in the package</Info>
2940         <Network ovf:name="VM Network">
2941             <Description>The network that the LAMP Service is available
2942             on</Description>
2943         </Network>
2944     </NetworkSection>
2945     <VirtualSystem ovf:id="MyLampService">
2946         <Info>Single-VM Virtual appliance with LAMP stack</Info>
2947         <Name>LAMP Virtual Appliance</Name>
2948         <!-- Overall information about the product -->
2949         <ProductSection>
2950             <Info>Product information for the service</Info>
2951             <Product>Lamp Service</Product>
2952             <Version>1.0</Version>
2953             <FullVersion>1.0.0</FullVersion>
2954         </ProductSection>
2955         <!-- Linux component configuration parameters -->
2956         <ProductSection ovf:class="org.linuxdistx">
2957             <Info>Product customization for the installed Linux system</Info>
2958             <Product>Linux Distribution X</Product>
2959             <Version>2.6.3</Version>
2960             <Property ovf:key="hostname" ovf:type="string">
2961                 <Description>Specifies the hostname for the appliance</Description>
2962             </Property>
2963             <Property ovf:key="ip" ovf:type="string">
2964                 <Description>Specifies the IP address for the appliance</Description>
2965             </Property>
2966             <Property ovf:key="subnet" ovf:type="string">
2967                 <Description> Specifies the subnet to use on the deployed network
2968                 </Description>
2969             </Property>
2970             <Property ovf:key="gateway" ovf:type="string">
2971                 <Description> Specifies the gateway on the deployed network
2972                 </Description>
2973             </Property>
2974             <Property ovf:key="dns" ovf:type="string">
2975                 <Description> A comma separated list of DNS servers on the deployed
2976                 network </Description>
2977             </Property>
2978             <Property ovf:key="netCoreRmemMaxMB" ovf:type="uint16" ovf:value="16"
2979                 ovf:userConfigurable="true">
2980                 <Description> Specify TCP read max buffer size in mega bytes. Default
2981                 is
2982                 16. </Description>
2983             </Property>
2984

```

```
2985         <Property ovf:key="netCoreWmemMaxMB" ovf:type="uint16" ovf:value="16"
2986             ovf:userConfigurable="true">
2987             <Description> Specify TCP write max buffer size in mega bytes. Default
2988 is             16. </Description>
2989         </Property>
2990     </ProductSection>
2991     <!-- Apache component configuration parameters -->
2992     <ProductSection ovf:class="org.apache.httpd">
2993         <Info>Product customization for the installed Apache Web Server</Info>
2994         <Product>Apache Distribution Y</Product>
2995         <Version>2.6.6</Version>
2996         <Property ovf:key="httpPort" ovf:type="uint16" ovf:value="80"
2997             ovf:userConfigurable="true">
2998             <Description>Port number for HTTP requests</Description>
2999         </Property>
3000         <Property ovf:key="httpsPort" ovf:type="uint16" ovf:value="443"
3001             ovf:userConfigurable="true">
3002             <Description>Port number for HTTPS requests</Description>
3003         </Property>
3004         <Property ovf:key="startThreads" ovf:type="uint16" ovf:value="50"
3005             ovf:userConfigurable="true">
3006             <Description>Number of threads created on startup. </Description>
3007         </Property>
3008         <Property ovf:key="minSpareThreads" ovf:type="uint16" ovf:value="15"
3009             ovf:userConfigurable="true">
3010             <Description> Minimum number of idle threads to handle request spikes.
3011             </Description>
3012         </Property>
3013         <Property ovf:key="maxSpareThreads" ovf:type="uint16" ovf:value="30"
3014             ovf:userConfigurable="true">
3015             <Description>Maximum number of idle threads </Description>
3016         </Property>
3017         <Property ovf:key="maxClients" ovf:type="uint16" ovf:value="256"
3018             ovf:userConfigurable="true">
3019             <Description>Limit the number of simultaneous requests that are
3020             served. </Description>
3021         </Property>
3022     </ProductSection>
3023     <!-- MySQL component configuration parameters -->
3024     <ProductSection ovf:class="org.mysql.db">
3025         <Info>Product customization for the installed MySql Database Server</Info>
3026         <Product>MySQL Distribution Z</Product>
3027         <Version>5.0</Version>
3028         <Property ovf:key="queryCacheSizeMB" ovf:type="uint16" ovf:value="32"
3029             ovf:userConfigurable="true">
3030             <Description>Buffer to cache repeated queries for faster access (in
3031             MB)</Description>
3032         </Property>
3033         <Property ovf:key="maxConnections" ovf:type="uint16" ovf:value="500"
3034             ovf:userConfigurable="true">
3035             <Description>The number of concurrent connections that can be
3036             served</Description>
3037         </Property>
3038         <Property ovf:key="waitTimeout" ovf:type="uint16" ovf:value="100"
3039             ovf:userConfigurable="true">
3040             <Description>Number of seconds to wait before timing out a connection
3041             </Description>
3042         </Property>
3043     </ProductSection>
3044     <!-- PHP component configuration parameters -->
3045     <ProductSection ovf:class="net.php">
3046
```

```

3047 <Info>Product customization for the installed PHP component</Info>
3048 <Product>PHP Distribution U</Product>
3049 <Version>5.0</Version>
3050 <Property ovf:key="sessionTimeout" ovf:type="uint16" ovf:value="5"
3051     ovf:userConfigurable="true">
3052     <Description> How many minutes a session has to be idle before it is
3053     timed out </Description>
3054 </Property>
3055 <Property ovf:key="concurrentSessions" ovf:type="uint16" ovf:value="500"
3056     ovf:userConfigurable="true">
3057     <Description> The number of concurrent sessions that can be served
3058     </Description>
3059 </Property>
3060 <Property ovf:key="memoryLimit" ovf:type="uint16" ovf:value="32"
3061     ovf:userConfigurable="true">
3062     <Description> How much memory in megabytes a script can consume before
3063     being killed </Description>
3064 </Property>
3065 </ProductSection>
3066 <OperatingSystemSection ovf:id="99">
3067     <Info>Guest Operating System</Info>
3068     <Description>Linux 2.6.x</Description>
3069 </OperatingSystemSection>
3070 <VirtualHardwareSection>
3071     <Info>Virtual Hardware Requirements: 256MB, 1 CPU, 1 disk, 1 NIC</Info>
3072     <System>
3073         <vssd:ElementName>Virtual Hardware Family</vssd:ElementName>
3074         <vssd:InstanceID>0</vssd:InstanceID>
3075         <vssd:VirtualSystemType>vmx-04</vssd:VirtualSystemType>
3076     </System>
3077     <Item>
3078         <rasd:Description>Number of virtual CPUs</rasd:Description>
3079         <rasd:ElementName>1 virtual CPU</rasd:ElementName>
3080         <rasd:InstanceID>1</rasd:InstanceID>
3081         <rasd:ResourceType>3</rasd:ResourceType>
3082         <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
3083     </Item>
3084     <Item>
3085         <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
3086         <rasd:Description>Memory Size</rasd:Description>
3087         <rasd:ElementName>256 MB of memory</rasd:ElementName>
3088         <rasd:InstanceID>2</rasd:InstanceID>
3089         <rasd:ResourceType>4</rasd:ResourceType>
3090         <rasd:VirtualQuantity>256</rasd:VirtualQuantity>
3091     </Item>
3092     <Item>
3093         <rasd:AutomaticAllocation>true</rasd:AutomaticAllocation>
3094         <rasd:Connection>VM Network</rasd:Connection>
3095         <rasd:ElementName>Ethernet adapter on "VM Network"</rasd:ElementName>
3096         <rasd:InstanceID>3</rasd:InstanceID>
3097         <rasd:ResourceType>10</rasd:ResourceType>
3098     </Item>
3099     <Item>
3100         <rasd:ElementName>SCSI Controller 0 - LSI Logic</rasd:ElementName>
3101         <rasd:InstanceID>4</rasd:InstanceID>
3102         <rasd:ResourceSubType>LsiLogic</rasd:ResourceSubType>
3103         <rasd:ResourceType>6</rasd:ResourceType>
3104     </Item>
3105     <Item>
3106         <rasd:ElementName>Harddisk 1</rasd:ElementName>
3107         <rasd:HostResource>ovf:/disk/lamp</rasd:HostResource>
3108         <rasd:InstanceID>5</rasd:InstanceID>
3109         <rasd:Parent>4</rasd:Parent>
3110         <rasd:ResourceType>17</rasd:ResourceType>

```

```
3111         </Item>
3112     </VirtualHardwareSection>
3113 </VirtualSystem>
3114 </Envelope>
```

3115

## ANNEX D (informative)

### Multiple virtual system LAMP stack example

This example is what an OVF descriptor for a LAMP virtual appliance could look like in a multi-VM LAMP virtual appliance. LAMP is an abbreviation for a service built using the Linux operating system, Apache web server, MySQL database, and the PHP web development software packages.

#### D.1 Two-tier LAMP OVF descriptor

In a two-tier LAMP stack, the application tier (Linux, Apache, PHP) and the database tier (Linux, MySQL server) are run as separate virtual machines for greater scalability.

The OVF format makes it largely transparent to the user how a service is implemented. In particular, the deployment experience when a user is installing a single-VM or a two-tier LAMP appliance is very similar. The only visible difference is that the user needs to supply two IP addresses and two DNS host names.

As compared to the single-VM descriptor, the following changes are made:

- All the user-configurable parameters are put in the `VirtualSystemCollection` entity. The `ProductSection` elements for Apache, MySQL, and PHP are unchanged from the single VM case.
- The Linux software in the two virtual machines needs to be configured slightly different (IP and hostname) while sharing most parameters. A new `ProductSection` is added to the `VirtualSystemCollection` to prompt the user, and the `${property}` expression is used to assign the values in each `VirtualSystem` entity.
- Disk chains are used to keep the download size comparable to that of a single VM appliance. Because the Linux installation is stored on a shared base disk, effectively only one copy of Linux needs to be downloaded.

The complete OVF descriptor is shown below:

```

3141 <?xml version="1.0" encoding="UTF-8"?>
3142 <Envelope
3143   xmlns="http://schemas.dmtf.org/ovf/envelope/1"
3144   xmlns:ovf="http://schemas.dmtf.org/ovf/envelope/1"
3145   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
3146   xmlns:vssd="http://schemas.dmtf.org/wbem/wscim/1/cim-
3147 schema/2/CIM_VirtualSystemSettingData"
3148   xmlns:rasd="http://schemas.dmtf.org/wbem/wscim/1/cim-
3149 schema/2/CIM_ResourceAllocationSettingData"
3150   <!-- References to all external files. -->
3151   <References>
3152     <File ovf:id="lamp-base" ovf:href="lampdb.vmdk" ovf:size="180114671"/>
3153     <File ovf:id="lamp-db" ovf:href="lampdb.vmdk" ovf:size="1801146"/>
3154     <File ovf:id="lamp-app" ovf:href="lampapp.vmdk" ovf:size="34311371"/>
3155   </References>
3156   <!-- Describes meta-information about all virtual disks in the package.
3157     This example is encoded as a delta-disk hierarchy.
3158   -->
3159   <DiskSection>
3160     <Info>List of the virtual disks used in the package</Info>
3161     <Disk ovf:diskId="lamp-base" ovf:fileRef="lamp-base" ovf:capacity="4294967296"
3162       ovf:populatedSize="1924967692"
3163

```

```

3164 ovf:format="http://www.vmware.com/specifications/vmdk.html#streamOptimized"/>
3165     <Disk ovf:diskId="lamp-db" ovf:fileRef="lamp-db" ovf:capacity="4294967296"
3166         ovf:populatedSize="19249672"
3167     />
3168 ovf:format="http://www.vmware.com/specifications/vmdk.html#streamOptimized"
3169     ovf:parentRef="lamp-base"/>
3170     <Disk ovf:diskId="lamp-app" ovf:fileRef="lamp-app" ovf:capacity="4294967296"
3171         ovf:populatedSize="2349692"
3172     />
3173 ovf:format="http://www.vmware.com/specifications/vmdk.html#streamOptimized"
3174     ovf:parentRef="lamp-base"/>
3175 </DiskSection>
3176 <!-- Describes all networks used in the package -->
3177 <NetworkSection>
3178     <Info>Logical networks used in the package</Info>
3179     <Network ovf:name="VM Network">
3180         <Description>The network that the LAMP Service is available
3181         on</Description>
3182     </Network>
3183 </NetworkSection>
3184 <VirtualSystemCollection ovf:id="LampService">
3185     <Info>Virtual appliance with a 2-tier distributed LAMP stack</Info>
3186     <Name>LAMP Service</Name>
3187     <!-- Overall information about the product -->
3188     <ProductSection ovf:class="org.mylamp">
3189         <Info>Product information for the service</Info>
3190         <Product>My Lamp Service</Product>
3191         <Version>1.0</Version>
3192         <FullVersion>1.0.0</FullVersion>
3193     </ProductSection>
3194     <ProductSection ovf:class="org.linuxdist">
3195         <Info>Product customization for Operating System Level</Info>
3196         <Product>Linux Distribution X</Product>
3197         <Version>2.6.3</Version>
3198         <Property ovf:key="dbHostname" ovf:type="string">
3199             <Description>Specifies the hostname for database virtual
3200             machine</Description>
3201         </Property>
3202         <Property ovf:key="appHostname" ovf:type="string">
3203             <Description>Specifies the hostname for application server virtual
3204             machine</Description>
3205         </Property>
3206         <Property ovf:key="dbIp" ovf:type="string">
3207             <Description>Specifies the IP address for the database virtual
3208             machine</Description>
3209         </Property>
3210         <Property ovf:key="appIp" ovf:type="string">
3211             <Description>Specifies the IP address for application server
3212             VM</Description>
3213         </Property>
3214         <Property ovf:key="subnet" ovf:type="string">
3215             <Description> Specifies the subnet to use on the deployed network
3216             </Description>
3217         </Property>
3218         <Property ovf:key="gateway" ovf:type="string">
3219             <Description> Specifies the gateway on the deployed network
3220             </Description>
3221         </Property>
3222         <Property ovf:key="dns" ovf:type="string">
3223             <Description> A comma separated list of DNS servers on the deployed
3224             network </Description>
3225         </Property>

```



```

3226     <Property ovf:key="netCoreRmemMaxMB" ovf:type="uint16" ovf:value="16"
3227         ovf:userConfigurable="true">
3228         <Description> Specify TCP read max buffer size in mega bytes. Default
3229 is         16. </Description>
3230     </Property>
3231     <Property ovf:key="netCoreWmemMaxMB" ovf:type="uint16" ovf:value="16"
3232         ovf:userConfigurable="true">
3233         <Description> Specify TCP write max buffer size in mega bytes. Default
3234 is         16. </Description>
3235     </Property>
3236 </ProductSection>
3237 <!-- Apache component configuration parameters -->
3238 <ProductSection ovf:class="org.apache.httpd">
3239     <Info>Product customization for the installed Apache Web Server</Info>
3240     <Product>Apache Distribution Y</Product>
3241     <Version>2.6.6</Version>
3242     <Property ovf:key="httpPort" ovf:type="uint16" ovf:value="80"
3243         ovf:userConfigurable="true">
3244         <Description>Port number for HTTP requests</Description>
3245     </Property>
3246     <Property ovf:key="httpsPort" ovf:type="uint16" ovf:value="443"
3247         ovf:userConfigurable="true">
3248         <Description>Port number for HTTPS requests</Description>
3249     </Property>
3250     <Property ovf:key="startThreads" ovf:type="uint16" ovf:value="50"
3251         ovf:userConfigurable="true">
3252         <Description>Number of threads created on startup. </Description>
3253     </Property>
3254     <Property ovf:key="minSpareThreads" ovf:type="uint16" ovf:value="15"
3255         ovf:userConfigurable="true">
3256         <Description>Minimum number of idle threads to handle request spikes.
3257         </Description>
3258     </Property>
3259     <Property ovf:key="maxSpareThreads" ovf:type="uint16" ovf:value="30"
3260         ovf:userConfigurable="true">
3261         <Description>Maximum number of idle threads </Description>
3262     </Property>
3263     <Property ovf:key="maxClients" ovf:type="uint16" ovf:value="256"
3264         ovf:userConfigurable="true">
3265         <Description>Limits the number of simultaneous requests that are
3266         served. </Description>
3267     </Property>
3268 </ProductSection>
3269 <!-- MySQL component configuration parameters -->
3270 <ProductSection ovf:class="org.mysql.db">
3271     <Info>Product customization for the installed MySql Database Server</Info>
3272     <Product>MySQL Distribution Z</Product>
3273     <Version>5.0</Version>
3274     <Property ovf:key="queryCacheSizeMB" ovf:type="uint16" ovf:value="32"
3275         ovf:userConfigurable="true">
3276         <Description>Buffer to cache repeated queries for faster access (in
3277         MB)</Description>
3278     </Property>
3279     <Property ovf:key="maxConnections" ovf:type="uint16" ovf:value="500"
3280         ovf:userConfigurable="true">
3281         <Description>The number of concurrent connections that can be
3282         served</Description>
3283     </Property>
3284     <Property ovf:key="waitTimeout" ovf:type="uint16" ovf:value="100"
3285         ovf:userConfigurable="true">
3286         <Description>Number of seconds to wait before timing out a connection
3287         </Description>
3288     </Property>
3289 </ProductSection>

```

```

3290     </Property>
3291 </ProductSection>
3292 <!-- PHP component configuration parameters -->
3293 <ProductSection ovf:class="net.php">
3294     <Info>Product customization for the installed PHP component</Info>
3295     <Product>PHP Distribution U</Product>
3296     <Version>5.0</Version>
3297     <Property ovf:key="sessionTimeout" ovf:type="uint16" ovf:value="5"
3298         ovf:userConfigurable="true">
3299         <Description> How many minutes a session has to be idle before it is
3300             timed out </Description>
3301     </Property>
3302     <Property ovf:key="concurrentSessions" ovf:type="uint16" ovf:value="500"
3303         ovf:userConfigurable="true">
3304         <Description> The number of concurrent sessions that can be served
3305             </Description>
3306     </Property>
3307     <Property ovf:key="memoryLimit" ovf:type="uint16" ovf:value="32"
3308         ovf:userConfigurable="true">
3309         <Description> How much memory in megabytes a script can consume before
3310             being killed </Description>
3311     </Property>
3312 </ProductSection>
3313 <StartupSection>
3314     <Info>Startup order of the virtual machines</Info>
3315     <Item ovf:id="DbServer" ovf:order="1" ovf:startDelay="120"
3316         ovf:startAction="powerOn" ovf:waitingForGuest="true"
3317         ovf:stopDelay="120"
3318         ovf:stopAction="guestShutdown"/>
3319     <Item ovf:id="AppServer" ovf:order="2" ovf:startDelay="120"
3320         ovf:startAction="powerOn" ovf:waitingForGuest="true"
3321         ovf:stopDelay="120"
3322         ovf:stopAction="guestShutdown"/>
3323 </StartupSection>
3324 <VirtualSystem ovf:id="AppServer">
3325     <Info>The configuration of the AppServer virtual machine</Info>
3326     <Name>Application Server</Name>
3327     <!-- Linux component configuration parameters -->
3328     <ProductSection ovf:class="org.linuxdistx">
3329         <Info>Product customization for the installed Linux system</Info>
3330         <Product>Linux Distribution X</Product>
3331         <Version>2.6.3</Version>
3332         <Property ovf:key="hostname" ovf:type="string"
3333             ovf:value="\${appHostName}"/>
3334         <Property ovf:key="ip" ovf:type="string" ovf:value="\${appIp}"/>
3335         <Property ovf:key="subnet" ovf:type="string" ovf:value="\${subnet}"/>
3336         <Property ovf:key="gateway" ovf:type="string" ovf:value="\${gateway}"/>
3337         <Property ovf:key="dns" ovf:type="string" ovf:value="\${dns}"/>
3338         <Property ovf:key="netCoreRmemMaxMB" ovf:type="string"
3339             ovf:value="\${netCoreRmemMaxMB}"/>
3340         <Property ovf:key="netCoreWmemMaxMB" ovf:type="string"
3341             ovf:value="\${netCoreWmemMaxMB}"/>
3342     </ProductSection>
3343     <OperatingSystemSection ovf:id="99">
3344         <Info>Guest Operating System</Info>
3345         <Description>Linux 2.6.x</Description>
3346     </OperatingSystemSection>
3347     <VirtualHardwareSection>
3348         <Info>Virtual Hardware Requirements: 256 MB, 1 CPU, 1 disk, 1
3349         NIC</Info>
3350         <System>
3351             <vssd:ElementName>Virtual Hardware Family</vssd:ElementName>

```

```

3352         <vssd:InstanceID>0</vssd:InstanceID>
3353         <vssd:VirtualSystemType>vmx-04</vssd:VirtualSystemType>
3354     </System>
3355     <Item>
3356         <rasd:Description>Number of virtual CPUs</rasd:Description>
3357         <rasd:ElementName>1 virtual CPU</rasd:ElementName>
3358         <rasd:InstanceID>1</rasd:InstanceID>
3359         <rasd:ResourceType>3</rasd:ResourceType>
3360         <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
3361     </Item>
3362     <Item>
3363         <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
3364         <rasd:Description>Memory Size</rasd:Description>
3365         <rasd:ElementName>256 MB of memory</rasd:ElementName>
3366         <rasd:InstanceID>2</rasd:InstanceID>
3367         <rasd:ResourceType>4</rasd:ResourceType>
3368         <rasd:VirtualQuantity>256</rasd:VirtualQuantity>
3369     </Item>
3370     <Item>
3371         <rasd:AutomaticAllocation>true</rasd:AutomaticAllocation>
3372         <rasd:Connection>VM Network</rasd:Connection>
3373         <rasd:ElementName>Ethernet adapter on "VM
3374 Network"</rasd:ElementName>
3375         <rasd:InstanceID>3</rasd:InstanceID>
3376         <rasd:ResourceSubType>PCNet32</rasd:ResourceSubType>
3377         <rasd:ResourceType>10</rasd:ResourceType>
3378     </Item>
3379     <Item>
3380         <rasd:ElementName>SCSI Controller 0 - LSI Logic</rasd:ElementName>
3381         <rasd:InstanceID>4</rasd:InstanceID>
3382         <rasd:ResourceSubType>LsiLogic</rasd:ResourceSubType>
3383         <rasd:ResourceType>6</rasd:ResourceType>
3384     </Item>
3385     <Item>
3386         <rasd:ElementName>Harddisk 1</rasd:ElementName>
3387         <rasd:HostResource>ovf:/disk/lamp-app</rasd:HostResource>
3388         <rasd:InstanceID>5</rasd:InstanceID>
3389         <rasd:Parent>4</rasd:Parent>
3390         <rasd:ResourceType>17</rasd:ResourceType>
3391     </Item>
3392 </VirtualHardwareSection>
3393 </VirtualSystem>
3394 <VirtualSystem ovf:id="DB Server">
3395     <Info>The configuration of the database virtual machine</Info>
3396     <Name>Database Server</Name>
3397     <!-- Linux component configuration parameters -->
3398     <ProductSection ovf:class="org.linuxdistx">
3399         <Info>Product customization for the installed Linux system</Info>
3400         <Product>Linux Distribution X</Product>
3401         <Version>2.6.3</Version>
3402         <Property ovf:key="hostname" ovf:type="string"
3403             ovf:value="{dbHostName}"/>
3404         <Property ovf:key="ip" ovf:type="string" ovf:value="{dbIp}"/>
3405         <Property ovf:key="subnet" ovf:type="string" ovf:value="{subnet}"/>
3406         <Property ovf:key="gateway" ovf:type="string" ovf:value="{gateway}"/>
3407         <Property ovf:key="dns" ovf:type="string" ovf:value="{dns}"/>
3408         <Property ovf:key="netCoreRmemMaxMB" ovf:type="string"
3409             ovf:value="{netCoreRmemMaxMB}"/>
3410         <Property ovf:key="netCoreWmemMaxMB" ovf:type="string"
3411             ovf:value="{netCoreWmemMaxMB}"/>
3412     </ProductSection>
3413     <OperatingSystemSection ovf:id="99">
3414         <Info>Guest Operating System</Info>
3415         <Description>Linux 2.6.x</Description>

```

```

3416     </OperatingSystemSection>
3417     <VirtualHardwareSection>
3418         <Info>Virtual Hardware Requirements: 256 MB, 1 CPU, 1 disk, 1
3419 nic</Info>
3420         <System>
3421             <vssd:ElementName>Virtual Hardware Family</vssd:ElementName>
3422             <vssd:InstanceID>0</vssd:InstanceID>
3423             <vssd:VirtualSystemType>vmx-04</vssd:VirtualSystemType>
3424         </System>
3425         <Item>
3426             <rasd:Description>Number of virtual CPUs</rasd:Description>
3427             <rasd:ElementName>1 virtual CPU</rasd:ElementName>
3428             <rasd:InstanceID>1</rasd:InstanceID>
3429             <rasd:ResourceType>3</rasd:ResourceType>
3430             <rasd:VirtualQuantity>1</rasd:VirtualQuantity>
3431         </Item>
3432         <Item>
3433             <rasd:AllocationUnits>byte * 2^20</rasd:AllocationUnits>
3434             <rasd:Description>Memory Size</rasd:Description>
3435             <rasd:ElementName>256 MB of memory</rasd:ElementName>
3436             <rasd:InstanceID>2</rasd:InstanceID>
3437             <rasd:ResourceType>4</rasd:ResourceType>
3438             <rasd:VirtualQuantity>256</rasd:VirtualQuantity>
3439         </Item>
3440         <Item>
3441             <rasd:AutomaticAllocation>true</rasd:AutomaticAllocation>
3442             <rasd:Connection>VM Network</rasd:Connection>
3443             <rasd:ElementName>Ethernet adapter on "VM
3444 Network"</rasd:ElementName>
3445             <rasd:InstanceID>3</rasd:InstanceID>
3446             <rasd:ResourceType>10</rasd:ResourceType>
3447         </Item>
3448         <Item>
3449             <rasd:ElementName>SCSI Controller 0 - LSI Logic</rasd:ElementName>
3450             <rasd:InstanceID>4</rasd:InstanceID>
3451             <rasd:ResourceSubType>LsiLogic</rasd:ResourceSubType>
3452             <rasd:ResourceType>6</rasd:ResourceType>
3453         </Item>
3454         <Item>
3455             <rasd:ElementName>Harddisk 1</rasd:ElementName>
3456             <rasd:HostResource>ovf:/disk/lamp-db</rasd:HostResource>
3457             <rasd:InstanceID>5</rasd:InstanceID>
3458             <rasd:Parent>4</rasd:Parent>
3459             <rasd:ResourceType>17</rasd:ResourceType>
3460         </Item>
3461     </VirtualHardwareSection>
3462 </VirtualSystem>
3463 </VirtualSystemCollection>
3464 </Envelope>
3465

```

3466  
3467  
3468

## ANNEX E (informative) Extensibility example

3469 The OVF specification allows custom metadata to be added to OVF descriptors in several ways:

- 3470 • New section elements can be defined as part of the `Section` substitution group, and used  
3471 wherever the OVF Schemas allow sections to be present.
- 3472 • The OVF Schemas use an open content model, where all existing types can be extended at the  
3473 end with additional elements. Extension points are declared in the OVF Schemas with `xs:any`  
3474 declarations with `namespace="##other"`.
- 3475 • The OVF Schemas allow additional attributes on existing types.

3476 Custom metadata is not allowed to use OVF XML namespaces. On custom elements, a Boolean  
3477 `ovf:required` attribute specifies whether the information in the element is required for correct behavior  
3478 or optional.

3479 The open content model in the OVF Schemas only allows extending existing types at the end. Using XML  
3480 Schema 1.0, it is not easy to allow for a more flexible open content model, due to the Unique Particle  
3481 Attribution rule and the necessity of adding `xs:any` declarations everywhere in the schema. The XML  
3482 Schema 1.1 draft standard contains a much more flexible open content mechanism, using  
3483 `xs:openContent mode="interleave"` declarations.

### 3484 E.1 Custom schema

3485 A custom XML schema defining two extension types is listed below. The first declaration defines a  
3486 custom member of the OVF `Section` substitution group, while the second declaration defines a simple  
3487 custom type.

```

3488 <?xml version="1.0" encoding="UTF-8"?>
3489 <xs:schema
3490   targetNamespace="http://schemas.customextension.org/1"
3491   xmlns:custom="http://schemas.customextension.org/1"
3492   xmlns="http://schemas.customextension.org/1"
3493   xmlns:ovf="http://schemas.dmtf.org/ovf/envelope/1"
3494   xmlns:xs="http://www.w3.org/2001/XMLSchema"
3495   attributeFormDefault="qualified"
3496   elementFormDefault="qualified">
3497
3498   <!-- Define a custom member of the ovf:Section substitution group -->
3499   <xs:element name="CustomSection" type="custom:CustomSection_Type"
3500 substitutionGroup="ovf:Section"/>
3501
3502   <xs:complexType name="CustomSection_Type">
3503     <xs:complexContent>
3504       <xs:extension base="ovf:Section_Type">
3505         <xs:sequence>
3506           <xs:element name="Data" type="xs:string"/>
3507         </xs:sequence>
3508         <xs:anyAttribute namespace="##any" processContents="lax"/>
3509       </xs:extension>
3510     </xs:complexContent>
3511   </xs:complexType>
3512
3513   <!-- Define other simple custom type not part of ovf:Section substitution group --
3514 >
3515   <xs:complexType name="CustomOther_Type">

```

```

3517     <xs:sequence>
3518         <xs:element name="Data" type="xs:string"/>
3519     </xs:sequence>
3520     <xs:attribute ref="ovf:required"/>
3521     <xs:anyAttribute namespace="##any" processContents="lax"/>
3522 </xs:complexType>
3523
3524 </xs:schema >

```

## 3525 E.2 Descriptor with custom extensions

3526 A complete OVF descriptor using the custom schema above is listed below. The descriptor validates  
 3527 against the OVF Schema and the custom schema, but apart from extension examples, the descriptor is  
 3528 kept minimal and is as such not useful.

3529 The descriptor contains all three extension types: a custom OVF `Section` element, a custom element at  
 3530 an extension point, and a custom attribute.

```

3531 <?xml version="1.0" encoding="UTF-8"?>
3532 <Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
3533     xmlns:vssd="http://schemas.dmtf.org/wbem/wscim/1/cim-
3534     schema/2/CIM_VirtualSystemSettingData"
3535     xmlns:rasd="http://schemas.dmtf.org/wbem/wscim/1/cim-
3536     schema/2/CIM_ResourceAllocationSettingData"
3537     xmlns:ovf="http://schemas.dmtf.org/ovf/envelope/1"
3538     xmlns="http://schemas.dmtf.org/ovf/envelope/1"
3539     xmlns:custom="http://schemas.customextension.org/1">
3540
3541     <!-- Dummy References element -->
3542     <References/>
3543
3544     <!-- EXAMPLE: Optional custom OVF section element with validation against custom
3545     schema -->
3546     <custom:CustomSection ovf:required="false">
3547         <Info>Description of custom extension</Info>
3548         <custom:Data>somevalue</custom:Data>
3549     </custom:CustomSection>
3550
3551     <!-- Describes all networks used in the package -->
3552     <NetworkSection>
3553         <Info>Logical networks used in the package</Info>
3554         <!-- EXAMPLE: Optional custom attribute -->
3555         <Network ovf:name="VM Network" custom:desiredCapacity="1 Gbit/s"/>
3556         <!-- EXAMPLE: Optional custom metadata inserted at extension point with
3557         validation against custom schema -->
3558         <custom:CustomOther xsi:type="custom:CustomOther_Type" ovf:required="false">
3559             <custom:Data>somevalue</custom:Data>
3560         </custom:CustomOther>
3561     </NetworkSection>
3562
3563     <!-- Dummy Content element -->
3564     <VirtualSystem ovf:id="Dummy">
3565         <Info>Dummy VirtualSystem</Info>
3566     </VirtualSystem>
3567 </Envelope>

```

3568 The OVF environment XML Schemas contain extension mechanisms matching those of the OVF  
 3569 envelope XML Schemas, so OVF environment documents are similarly extensible.

## ANNEX F (informative) Change log

3570

3571

3572

3573

Version	Date	Description
1.0.0	2009-02-17	
1.0.1	2011-10-20	Errata publication
2.0.0	2013-02-19	wgv 0.2.0 fixed formatting, variables and annex headers, no text changes, baseline for compare
2.0.0	2013-02-20	wgv 0.2.1 added figures 2 & 3, added figure and table labels, inserted Forward
2.0.0	2013-02-21	wgv -0.2.2 updated operational metadata definition and Figure 3, fixed Petstore OVF descriptor
2.0.0	2013-03-26	wgv 0.2.5 updated document structure in clause 3.
2.0.0	2013-03-28	wgv 0.2.6 added in Marvin's edits in clause 2.
2.0.0	2013-05-07	wgv 0.2.7 added Maturi's SharedDiskSection, Shishir's Encryption & Boot Order, Larry extensibility
2.0.0	2013-05-27	wgv 0.2.8 added Marv's input on OperatingSystemSection and EULA section and Peter's input on authoring clause.
2.0.0	2013-05-30	wgv 0.2.9 Marv's updates on Install and Startup sections
2.0.0	2013-06-19	wgv 0.2.10 Marv's Annotation and Scale Out, Larry's PlacementGroup and Placement
2.0.0	2013-06-19	wgv 0.2.11 Peter's updates
2.0.0	2013-07-01	wgv 0.6.0 updates and clean up in preparation for work in progress
2.0.0a	2013-07-03	wgv 0.7.0 Work in progress release
2.0.0	2013-10-08	wgv 0.7.1 Output of editing session clause 5.3 and 3.2.3 edited
2.0.0	2013-10-20	wgv 0.7.2 Update with Marv's deployment section, worked on global attributes, formatting.
2.0.0	2013-10-24	wgv 0.7.3 updates to clause 3.2 for attributes and elements.
2.0.0	2013-11-27	wgv 0.7.4 updates from editing session – fixes to XSD/XML primer parts
2.0.0	2013-11-27	wgv 0.7.5 updates from November F2F
2.0.0	2013-12-12	wgv 0.7.6 general editing, update Fig 5, add Fig 6, example to Deployment
2.0.0	2014-01-12	wgv 0.7.7 Bright Leaf scrub for WIP release
2.0.0b	2014-01-30	wgv 0.8.0 Work group approval document for WIP release

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