FOUNDATION FOR INTELLIGENT PHYSICAL AGENTS

FIPA Device Ontology Specification

Document title	FIPA Device Ontology Specification		
Document number	XC00091D	**Document source**	FIPA TC Gateways
Document status	Experimental	**Date of this status**	2002/11/01
Supersedes	None		
Contact	fab@fipa.org		
Change history	See *Informative Annex D — ChangeLog*		

http://www.fipa.org/
Geneva, Switzerland

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Contents

1 Scope

This document deals with the definition of an ontology for devices. It contains specifications for:

- Defining the properties of devices.

Additionally, it provides an example to illustrate the usage of the ontology via a profile of a hypothetical smart phone, an example of using the ontology through CC/PP and other informative examples.

2 Overview

The capabilities of different devices are best expressed using some ontology, against which the profiles of those devices are validated. This document contains specifications for a device ontology.

Provided that two devices D1 and D2 have a connection, they may exchange device profiles (either directly or through a brokering agency) and acquire a list of services provided by the other device. The list of services may include both hardware and software services, for example: a software component that provides access to a hardware component of the device (such as microphone, headset or GPS service). The profile needs to support the identification of services for various input and output capabilities, such as audio input and output. An informative example of a profile for a hypothetical device is given in Section 5.

The `fipa-device` ontology can be used by agents when communicating about devices. Agents pass profiles of devices to each other and validate them against the `fipa-device` ontology. The profiles come in handy for example in a situation where memory- or processing-intensive actions take place; agent A1 can ask agent A2 whether device D has enough capabilities to handle some task A1 has in mind. Section 6 gives a set of informative examples showing how profiles based on `fipa-device` ontology can be exploited.

Related work is done both in W3C [CC/PP] and WAP Forum [UAProf]. There is an overlap between the definitions found in those documents and this specification. However, direct references to those specifications are not used here. That is because, unlike the ontology presented in this specification, they rely on specific frameworks and languages, namely RDF and XML. Section 7 gives an informative example on how to use the `fipa-device` ontology via CC/PP descriptions.

3 Device Ontology

3.1 Object Descriptions

This section describes a set of frames that represent the classes of objects in the domain of discourse within the framework of the `fipa-device` ontology.

The following terms are used to describe the objects of the domain:

- **Frame**. This is the mandatory name of this entity that must be used to represent each instance of this class.

- **Ontology**. This is the name of the ontology, whose domain of discourse includes the parameters described in the table.

- **Parameter**. This is the mandatory name of a parameter of this frame.

- **Description**. This is a natural language description of the semantics of each parameter.

- **Presence**. This indicates whether each parameter is mandatory or optional.

- **Type**. This is the type of the values of the parameter: Integer, Word, String, URL, Term, Set or Sequence.

- **Reserved Values**. This is a list of FIPA-defined constants that can assume values for this parameter.

3.1.1 Relationships between Frames

Figure 1 depicts the frames used in this ontology with associations among them.

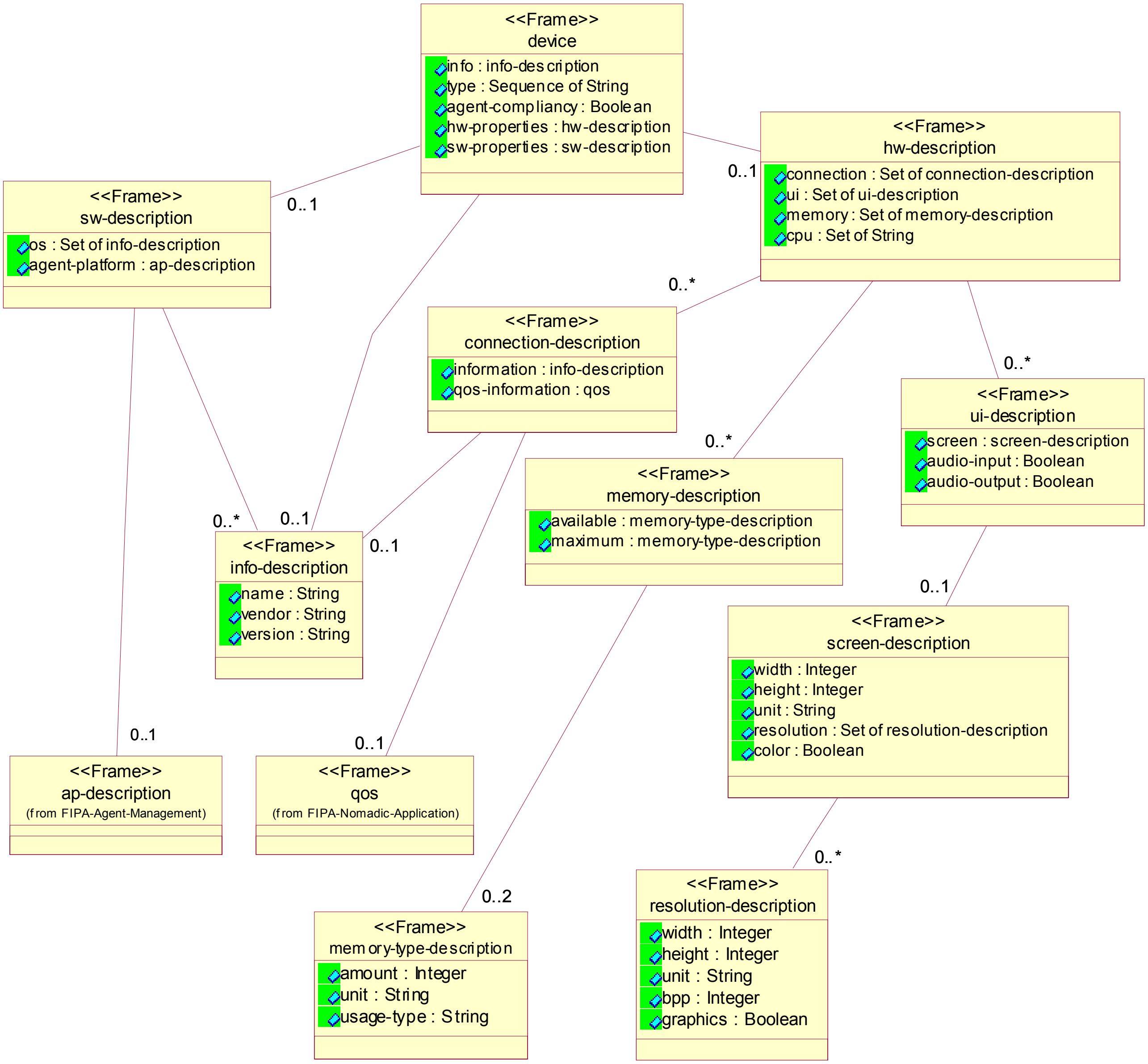


Figure 1: Relationships between Frames in the `fipa-device` Ontology

3.1.2 Device Description

This type of object represents the description that can be used to define the device with its most general properties.

Frame	device
Ontology	fipa-device

Parameter	Description	Presence	Type	Reserved Values
info	General information for the device.	Mandatory	info-description	
type	The type(s) of the device. General type(s) of devices like 3G phones, PDA's etc. To be used as a sequence from general to more specific types.	Optional	Sequence of string	
agent-compliancy	Capability to host a FIPA-agent platform or participate in a distributed one.	Optional	boolean	true false
hw-properties	List of properties describing the hardware features of the device in question.	Optional	hw-description	
sw-properties	List of properties describing the software features of the device in question.	Optional	sw-description	

3.1.3 Product Info Description

This type of object represents the description that can be used to define the name, vendor and version of some product.

Frame	info-description
Ontology	fipa-device

Parameter	Description	Presence[1]	Type	Reserved Values
name	The name of the product in question.	Optional	string	
vendor	The vendor of the product in question.	Optional	string	
version	The version of the product in question.	Optional	string	

[1] While all of these parameters are optional, a valid info-description object will contain at least one parameter.

3.1.4 Hardware Description

This type of object represents the description that can be used to define the hardware capabilities of a given device.

Frame Ontology	hw-description fipa-device			
Parameter	**Description**	**Presence**[2]	**Type**	**Reserved Values**
connection	The type of the connection the device uses.	Optional	Set of connection-description	
ui	List of the user interfaces that the device offers.	Optional	Set of ui-description	
memory	The amount of memory that the device has.	Optional	Set of memory-description	
cpu	The type of the central processing unit that the device has.	Optional	Set of String	

3.1.5 Connection Type Description

This type of object represents the description that can be used to define the connection-related details of a given device.

Frame Ontology	connection-description fipa-device			
Parameter	**Description**	**Presence**[3]	**Type**	**Reserved Values**
information	General information for the connection.	Optional	info-description	
qos-information	Detailed information about the Quality of Service of this connection type	Optional	qos[4]	

[2] While all of these parameters are optional, a valid hw-properties object will contain at least one parameter.

[3] While all of these parameters are optional, a valid connection-description object will contain at least one parameter.

[4] The frame for qos is found in [FIPA00014].

3.1.6 User Interface Description

This type of object represents the description that can be used to define the user interface(s) of a given device.

Frame **Ontology**	`ui-description` `fipa-device`

Parameter	Description	Presence[5]	Type	Reserved Values
`screen`	Information characterizing the screen of the device.	Optional	`screen-description`	
`audio-input`	Specifies whether the device in question is capable of receiving audio input.	Optional	`boolean`	`true` `false`
`audio-output`	Specifies whether the device in question is capable of producing audio output.	Optional	`boolean`	`true` `false`

3.1.7 Screen Description

This type of object represents the description that can be used to define the screen of a given device.

Frame **Ontology**	`screen-description` `fipa-device`

Parameter	Description	Presence[6]	Type	Reserved Values
`width`	The width of the screen. This value must be positive.	Optional	`integer`	
`height`	The height of the screen. This value must be positive.	Optional	`integer`	

`unit`	The unit for the `width` and `height` parameters of this frame.	Optional	`string`	`mm`
				`cm`
				`inch`

`resolution`	The resolution description for the screen.	Optional	Set of `resolution-description`	
`color`	Has the value `true` if the device has a color screen; `false` if it has a monochrome screen.	Optional	`boolean`	`true` `false`

[5] While all of these parameters are optional, a valid `ui-description` object will contain at least one parameter.

[6] While all of these parameters are optional, a valid `user-interface` object will contain at least one parameter.

[8] While all of these parameters are optional, a valid `user-interface` object will contain at least one parameter.

3.1.8 Resolution Description

This type of object represents the description that can be used to define the resolution details of a given display.

Frame	resolution-description
Ontology	fipa-device

Parameter	Description	Presence[8]	Type	Reserved Values
width	Number of resolution units horizontally. This value must be positive.	Optional	integer	
height	Number of resolution units vertically. This value must be positive.	Optional	integer	
unit	The unit for the resolution.	Optional	string	pixels characters
bpp	Bits per pixel.	Optional	integer	
graphics	Has the value true if the device is capable of displaying graphics; false if the device is capable of displaying only characters.	Optional	boolean	true false

3.1.9 Memory Description

This type of object represents the description that can be used to define the maximum memory of a given device, as well as the memory available at the time of query.

Frame	memory-description
Ontology	fipa-device

Parameter	Description	Presence[9]	Type	Reserved Values
available	The amount of memory available.	Optional	memory-type-description	
maximum	The maximum amount of memory.	Optional	memory-type-description	

3.1.10 Memory Type Description

This type of object represents the description that can be used to define the amount, unit, and usage type of some memory.

Frame	memory-type-description
Ontology	fipa-device

Parameter	Description	Presence[10]	Type	Reserved Values
amount	The amount of memory. This value must not be negative.	Optional	integer	
unit	The unit used to express the amount of memory.	Optional	string	B KB MB
usage-type	The usage type of the memory. Either application, storage, or both.	Optional	Set of string	application storage

[9] While all of these parameters are optional, a valid memory-description object will contain at least one parameter.

[10] While all of these parameters are optional, a valid user-interface object will contain at least one parameter.

3.1.11 Software Properties Description

This type of object represents the description that can be used to define the software capabilities of a given device.

Frame	sw-description
Ontology	fipa-device

Parameter	Description	Presence[11]	Type	Reserved Values
os	Details of the operating system that the device has.	Optional	Set of info-description	
agent-platform	Description of the agent platform the device in question has. Can be used only if agent-compliancy of device level is either `true` or unspecified.	Optional	Set of ap-description[12]	

3.2 Function Descriptions

The following tables define usage and semantics of the functions that are part of the `fipa-device` ontology.

The following terms are used to describe the functions of the `fipa-device` domain:

- **Function**. This is the symbol that identifies the function in the ontology.

- **Ontology**. This is the name of the ontology, whose domain of discourse includes the function described in the table.

- **Supported by**. This is the type of agent that supports this function.

- **Description**. This is a natural language description of the semantics of the function.

- **Domain**. This indicates the domain over which the function is defined. The arguments passed to the function must belong to the set identified by the domain.

- **Range**. This indicates the range to which the function maps the symbols of the domain. The result of the function is a symbol belonging to the set identified by the range.

- **Arity**. This indicates the number of arguments that a function takes. If a function can take an arbitrary number of arguments, then its arity is undefined.

3.2.1 Request Device Information

Function	device-information
Ontology	fipa-device
Description	An agent can make a query in order to request the device information.
Domain	None
Range	device
Arity	0

3.3 Exceptions

The exceptions for the `fipa-device` ontology follow the same form and rules as specified in [FIPA00023].

[11] While all of these parameters are optional, a valid `sw-properties` object will contain at least one parameter.

[12] The frame for `ap-description` is found in [FIPA00023].

3.3.1 Not Understood Exception Propositions

The same set of not understood exception propositions as in the `fipa-agent-management` ontology is used in the `fipa-device` ontology (see [FIPA00023]).

3.3.2 Refusal Exception Propositions

The same set of refusal exception propositions as defined in the `fipa-agent-management` ontology is used in `fipa-device` ontology (see [FIPA00023]).

3.3.3 Failure Exception Propositions

Communicative Act **Ontology**	`failure` `fipa-agent-management`

Predicate symbol	**Arguments**	**Description**
`internal-error`	`string`	See [FIPA00023]
`not-available`	`string`	Getting the device information failed; the string identifies the failure reason.

4 References

[CC/PP] Composite Capabilities/Preference Profiles, World Wide Web Consortium, 2001.
`http://www.w3.org/Mobile/CCPP/`

[FIPA00014] FIPA Nomadic Application Support Specification. Foundation for Intelligent Physical Agents, 2000.
`http://www.fipa.org/specs/fipa00014/`

[FIPA00023] FIPA Agent Management Specification. Foundation for Intelligent Physical Agents, 2000.
`http://www.fipa.org/specs/fipa00023/`

[UAProf] User Agent Profile Specification. Wireless Application Protocol Forum, 1999.
`http://www.wapforum.org/`

5 Informative Annex A — Profile of a Hypothetical Smart Phone

5.1 Profile Description

This section describes a profile that represents the hypothetical smart phone. The validation of this profile is based on the `fipa-device` ontology.

The following terms are used to describe the objects of the domain:

- **Profile**. This is the mandatory name of this entity that must be used to represent each instance of this class.

- **Ontology**. This is the name of the ontology, whose domain of discourse includes the parameters described in the table.

- **Parameter**. This is the mandatory name of a parameter of this profile.

- **Value.** This is the value given to a parameter.

5.1.1 SmartPhone xyz

Here the profile of the hypothetical SmartPhone xyz is presented.

Profile **Ontology**	fipa.profiles.device.smartphonexyz fipa-device

Parameter					**Value**
info-description	name				SmartPhone
	vendor				Smartphones Ltd
	version				xyz
type					mobile-phone PDA GPS
agent-compliancy					true
hw-description	connection-description	info-description	name		Bluetooth
			version		x.x
	connection-description	info-description	name		Infrared Data Association
			version		y.y
	connection-description	info-description	name		High Speed Circuit Switched Data
			version		z.z
	ui-description	screen-description	width		500
			height		800
			unit		mm
			resolution-description	width	1024
				height	768
				unit	pixels
				bpp	32
				graphics	true
			color		true
		audio-input			true
		audio-output			true
	memory-description	memory-type-description	amount		8
			unit		MB
			usage-type		storage
		memory-type-description	amount		3856
			unit		KB
			usage-type		storage
	cpu				64-bit ARM9-based RISC
sw-description	info-description	name			SmartOS abc
		vendor			ABCVendor Corp.
		version			8.1
	agent-platform[13]	name			FIPA-OS v2.1.1

The values on the rightmost column can change at any time. For example, if extra memory is inserted to the device or if another version of operating system is installed, the values for those parameters change. The parameters themselves, however, are more static. They stay the same despite the changes in single device profiles, since they are defined in the `fipa-device` ontology that is independent of them.

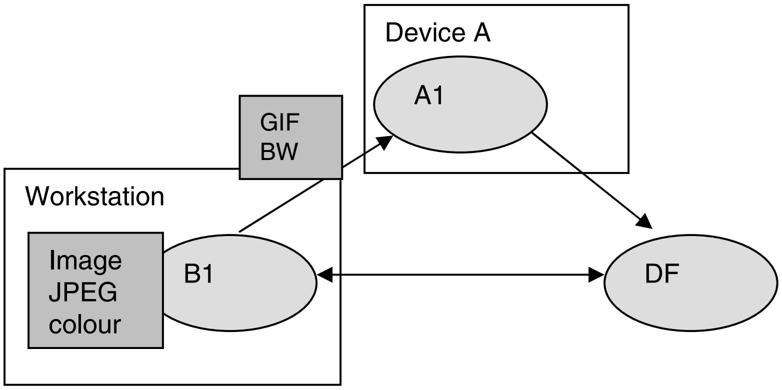
The values for parameters can be further divided into static and dynamic depending on the ability to change them in runtime. For example `agent-compliancy` and `memory-type-description` describing the memory available can change without booting the device. Hence they are dynamic information. On the other hand, `screen-description` and `cpu` are static information; they cannot change while the machine is running.

[13] The ontology against which this parameter is validated is found in [FIPA00023].

6 Informative Annex B — Examples

This section presents examples and use cases for device profiles based on the device ontology. The term agent is used to depict any software entity capable of reasoning over the profile, and the term Directory Facilitator (DF) is used to depict a general directory service.

6.1 Content Adaptation I



Agent A1 sends its device profile to DF and registers to the system. Agent B1 interacts with agent A1 residing on device A. Agent B1 queries A's device profile either from the DF or directly from device A. Agent B1, which aims to send an image (640x480x24bits) to the user, analyses the device profile user interface capabilities:

hw-description	ui-description	screen-description	width		2.26
			height		3.02
			unit		inch
			resolution-description	width	320
				height	240
				unit	pixels
				bpp	4
			color		false
		audio-input			true
		audio-output			true

sw-description	supported-mime-types	text/html image/gif image/wbmp text/ascii

The device operating system (or browser) is capable of handling ACSII text, html and also supports the GIF and Windows BMP mime-types. The agent reads from the device profile that the target device has a greyscale display and reduces the colours of the image to 4 greyscales (dithering), because it is not reasonable to send large images with excess unusable bits. The image size is reduced from 640x480 to 320x240 to fit the device's small screen.

In order to adapt the dialogue between agents, the dialogue service needs knowledge about the human-agent interface, especially information about the input and output capabilities of devices. For instance, if the user is using pen based input or touch-screen, the service may rely more on image maps to trigger actions, and if the user is interacting with keyboard, the service might use more text based input.

Now the same example is presented in more detail and using FIPA ACL. However, mime-type treatment is excluded.

1. The agent residing at a mobile device named *dummy* (A1 in the picture above) registers with the DF:

```
(request
  :sender
    (agent-identifier
      :name dummy@foo.com :addresses (sequence iiop://foo.com/acc))
  :receiver (set
    (agent-identifier
      :name df@foo.com :addresses (sequence iiop://foo.com/acc)))
  :language fipa-sl
  :protocol fipa-request
  :ontology fipa-agent-management
  :content "(
    (action
      (agent-identifier
         :name df@foo.com :addresses (sequence iiop://foo.com/acc))
      (register
        (df-agent-description
          :name
           (agent-identifier
            :name dummy@foo.com
            :addresses (sequence iiop://foo.com/acc))
          :protocol (set fipa-request fipa-query)
          :ontology (set fipa-device)
          :language (set fipa-sl kif)
          :services (set
            (service-description
              :name device
              :type device-stuff
              :ontology (set fipa-device))))))))")
```

2. Then, the agent *velmu* (B1 in the picture above) searches with the DF for a list of agents that support `fipa-device` ontology:

```
(request
  :sender
    (agent-identifier
      :name dummy@helluli.com
      :addresses (sequence iiop://helluli.com/acc))
  :receiver (set
    (agent-identifier
      :name df@foo.com
      :addresses (sequence iiop://foo.com/acc)))
  :language fipa-sl
  :protocol fipa-request
  :ontology fipa-agent-management
  :content "(
    (action
      (agent-identifier
        :name df@foo.com
        :addresses (sequence iiop://foo.com/acc))
      (search
        (df-agent-description
          :ontology (set fipa-device)
          :language (set fipa-sl))
        (search-constraint :max-depth 2))))")
```

3. *velmu* gets an answer, that dummy at foo.com supports `fipa-device` ontology:

```
(inform
  :sender
    (agent-identifier
      :name df@foo.com
      :addresses (sequence iiop://foo.com/acc))
  :receiver (set
    (agent-identifier
      :name velmu@foo.com
      :addresses (sequence iiop://foo.com/acc)))
  :language fipa-sl
  :protocol fipa-request
  :ontology fipa-agent-management
  :content "(
    (result
      (action
        (agent-identifier
          :name df@foo.com
          :addresses (sequence iiop://foo.com/acc))
        (search
          (df-agent-description
            :ontology (set fipa-device)
            :language (set fipa-sl))
          (search-constraint :max-depth 2))))
     (set
       (df-agent-description
         :name
           (agent-identifier
             :name dummy@foo.com
             :addresses (sequence iiop://foo.com/acc))
         :ontology (set fipa-device)
         :languages (set fipa-sl kif)
         :protocol (set fipa-request fipa-query)
         :services (set
            (service-description
              :name device
              :type device-stuff
              :ontology (set fipa-device)))))))))")
```

4. *velmu* aims to send an image (640 x 480 x 24 bit) to the device where dummy is located: *velmu* queries the dummy in order to find out the capabilities of device in which dummy is located:

```
(request
  :sender
    (agent-identifier
      :name velmu@foo.com
      :addresses (sequence iiop://helluli.com/acc))
  :receiver (set
    (agent-identifier
      :name dummy@foo.com
      :addresses (sequence iiop://foo.com/acc)))
  :language fipa-sl
  :protocol fipa-request
  :ontology fipa-device
  :content " (
    (action
      (agent-identifier :name dummy@foo.com)
      (device-information)))")
```

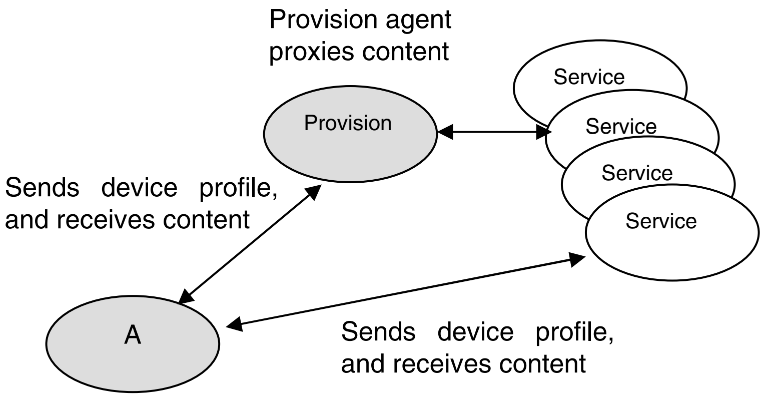
5. *dummy* sends appropriate information:

```
(inform
  :sender
    (agent-identifier
      :name dummy@foo.com
      :addresses (sequence iiop://foo.com/acc))
  :receiver (set
    (agent-identifier
      :name velmu@foo.com
```

```
         :addresses (sequence iiop://helluli.com/acc)))
     :language fipa-sl
     :protocol fipa-query
     :ontology fipa-device
     :content "(
       (result
          (action
            (agent-identifier :name dummy@foo.com)
            (device-information))
          (device
             :hw-properties
              (hw-description
                :cpu "i286"
                :ui (set
                  (ui-description
                    :screen
                      (screen-description
                        :width 57
                        :height 78
                        :unit mm
                        :color false
                        :resolution (set
                          (resolution-description
                            :width 320
                            :height 240
                            :unit pixels
                            :bpp 4
                            :graphics true)))
                    :audio-input true
                    :audio-output true))))))")
```

velmu analyses the information, and finds that the target device has a greyscale display and reduces the colours of the image to four greyscales (dithering), because it is not reasonable to send large images with excess unusable bits. Furthermore, the image size is reduced from 640 x 480 to 320 x 240 to fit the device’s screen.

6.2 Content Adaptation II

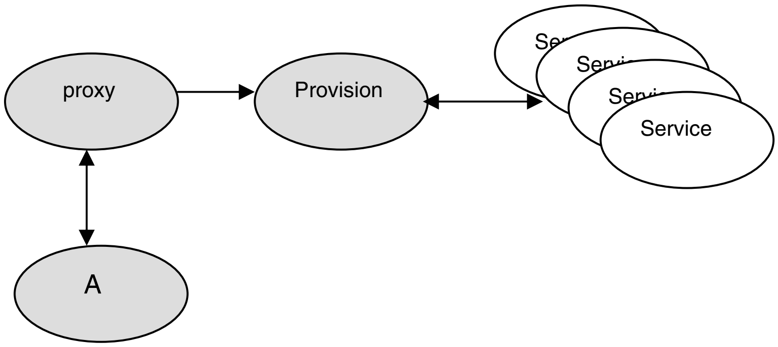

Provision agent proxies content
Provision
Service
Service
Service
Service
Sends device profile, and receives content
A
Sends device profile, and receives content

A new client logs in to an agent service domain providing tourism services. The service provision agent receives the device profile from the device software system accessing the agent-based services using ACL. The provision agent first stores the profile into a local cache (for example, CC/PP caching) and then checks the services available for this particular type of client. The device profile indicates that the device is part of an agent platform, which makes it eligible to access directly all of the agent based services, depending on whether or not it hosts or is capable of hosting the correct interface agents or layers. The agent on the device may contact the service agents directly and send the device profile for adaptation.

type				PDA GPS
agent-compliancy				true
hw-description	connection-description	info-description	name	GPRS
			version	x.x
	memory-description	memory-type-description	amount	8000
			unit	KB
			usage-type	application
		memory-type-description	amount	4000
			unit	KB
			usage-type	application
sw-description	agent-platform		name	FIPA-OS v2.0

However, the client profile does not specify any streaming codecs in the sw-description frame that the services support, so the provision agent excludes all streaming services from the service list when the client requests it.

6.3 Content Adaptation III



Another client is not capable of hosting an agent platform or being a part of an existing platform, but hosts browser software that supports html content with streaming audio. The specific output capabilities of the browser are extracted from the `sw-description` extension fields.

The client contacts the provision agent through a proxy that, using some proprietary format, accepts the device profile. Now, the provision agent has to exclude those services that cannot be accessed using proxies that mediate between non-agent and agent based resources.

6.4 Service Advertisement and Software Updates

The Provision agent may detect that a new service, which is compatible with a new XYZ Communicator, has become available. The new product is based on Java Midlet technology, and supports the downloading of new software (jar-files). Now, when clients using the XYZ device log into the system, they are displayed (if their user profile allows it) information about the new service. The system checks the `sw-description` frame extension fields for Java environment and the device name and version from the `info-description` frame.

info-description	name	XYZ Communicator
	vendor	Smartphones Ltd
	version	xyz

sw-description	java-env	configuration	CLDC-1.0
		profile	MIDP-1.0
		locale	en-US
	supported-mime-types		text/vnd.sun.j2me.app-descriptor

7 Informative Annex C — Usage of FIPA Device Ontology through CC/PP

A technology called CC/PP (Composite Capabilities/Preference Profiles) is developed in W3C [CC/PP]. The frames in this specification received some of their concepts from CC/PP specifications. There are, however, differences and this is mainly due to the different goals of FIPA and W3C.

For example, in CC/PP the ontology is divided into three following categories at the highest level: Terminal Hardware, Terminal Software and Terminal Browser. Of these only Terminal Hardware and Terminal Software were adopted here. Terminal Browser was left out because FIPA is not as focused to www as W3C is. On the other hand, in this specification there is a parameter called agent-compliancy that is not found in [CC/PP]. The value of agent-compliancy parameter informs whether the device in question is capable of hosting one or more FIPA agents or not.

Despite the differences between the approaches the `fipa-device` ontology could be used in a CC/PP profile. This can be accomplished in a similar fashion as with UAProf (see [CC/PP]). So, if a developer wants to inform that some device is FIPA-compliant, then it can be achieved with a CC/PP profile as follows:

```
<RDF xmlns="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
     xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
     xmlns:ccpp="http://www.w3.org/2000/07/04-ccpp#"
     xmlns:fipa="http://www.fipa.org/profiles/device-20010202#">
     xmlns:uaprof="http://www.wapforum.org/UAPROF/ccppschema-19991014#">

  <Description about="http://www.foo.com/profiles/ProfileX">
    <ccpp:component>
      <Description about="http://www.foo.com/TerminalHardware">
        <type resource="http://www.foo.com/Schema#HardwarePlatform"/>
        <ccpp:Defaults rdf:resource="http://www.foo.com/profiles/hwproperties"/>
        <fipa:compliancy>true</fipa:compliancy>
      </Description>
    </ccpp:component>

    <ccpp:component>
      <Description about="http://www.foo.com/TerminalSoftware">
        <type resource="http://www.foo.com/Schema#SoftwarePlatform"/>
        <ccpp:Defaults rdf:resource="http://www.foo.com/profiles/swproperties"/>
        <fipa:ap-description><name>FIPA-OS v2.1.1</name></fipa:ap-description>
      </Description>
    </ccpp:component>

    <ccpp:component>
      <Description about="http://www.foo.com/Browser">
        <type resource="http://www.foo.com/Schema#BrowserUA"/>
        <ccpp:Defaults rdf:resource="http://www.foo.com/profiles/browserproperties"/>
        <uaprof:BrowserName>Internet Explorer</uaprof:BrowserName>
        <uaprof:BrowserVersion>5.0</uaprof:BrowserVersion>
      </Description>
    </ccpp:component>
  </Description>
</RDF>
```

Here the `fipa-namespace` is used to refer that the device characterized in ProfileX is FIPA-compliant and that the agent platform it has is the same FIPA-OS v2.1.1 used earlier as an example. Other CC/PP –defined properties are (supposedly) found in the URI's declared in `rdf:resource` attributes of the `ccpp:Defaults` elements. Agent compliancy seems to be the property that most clearly distinguishes the ontology and profiles presented in this paper from the comparable ones defined in W3C and WAP Forum.

The namespace declaration in the fourth row defines a URI that should contain a CC/PP schema (`http://www.fipa.org/profiles/device-20010202#`). The schema in that location corresponds to the ontology presented in this paper, but in CC/PP terms. More specifically, there are specified only those elements that are not found in CC/PP schema itself. FIPA agent-compliancy is naturally an example of these.

8 Informative Annex D — ChangeLog

8.1 2002/11/01 – version D by TC X2S

Entire document:	**All symbols changed to lower case**
Page 9, line 165:	**Added Section 3.2 and a function called `device-information`**
Page 9: line 165:	**Added Section 3,3 and appropriate exception cases**
Page 13, lines 244-393:	Changed Content Adaptation I example to use `device-information` function
Page 15, lines 359-393:	Changed Content Adaptation I example message 5 updated to properly reply to message 4