ISO/IEC 29341-8-11

Edition 1.0 2008-11

INTERNATIONAL STANDARD

Information technology – UPnP Device Architecture – Part 8-11: Internet Gateway Device Control Protocol – Layer 3 Forwarding Service

ISO/IEC 29341-8-11:2008(E)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub
The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub
Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org
The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv
If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

ISO/IEC 29341-8-11

Edition 1.0 2008-11

INTERNATIONAL STANDARD

Information technology – UPnP Device Architecture – Part 8-11: Internet Gateway Device Control Protocol – Layer 3 Forwarding Service

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRICE CODE E

ICS 35.200

ISBN 2-8318-1009-8

CONTENTS

LIST OF TABLES

INFORMATION TECHNOLOGY – UPNP DEVICE ARCHITECTURE –

Part 8-11: Internet Gateway Device Control Protocol – Layer 3 Forwarding Service

FOREWORD

1) ISO (International Organization for Standardization) and IEC (International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards. Their preparation is entrusted to technical committees; any ISO and IEC member body interested in the subject dealt with may participate in this preparatory work. International governmental and non-governmental organizations liaising with ISO and IEC also participate in this preparation.

2) In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

3) The formal decisions or agreements of IEC and ISO on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC and ISO member bodies.

4) IEC, ISO and ISO/IEC publications have the form of recommendations for international use and are accepted by IEC and ISO member bodies in that sense. While all reasonable efforts are made to ensure that the technical content of IEC, ISO and ISO/IEC publications is accurate, IEC or ISO cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.

5) In order to promote international uniformity, IEC and ISO member bodies undertake to apply IEC, ISO and ISO/IEC publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any ISO/IEC publication and the corresponding national or regional publication should be clearly indicated in the latter.

6) ISO and IEC provide no marking procedure to indicate their approval and cannot be rendered responsible for any equipment declared to be in conformity with an ISO/IEC publication.

7) All users should ensure that they have the latest edition of this publication.

8) No liability shall attach to IEC or ISO or its directors, employees, servants or agents including individual experts and members of their technical committees and IEC or ISO member bodies for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication of, use of, or reliance upon, this ISO/IEC publication or any other IEC, ISO or ISO/IEC publications.

9) Attention is drawn to the normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

IEC and ISO draw attention to the fact that it is claimed that compliance with this document may involve the use of patents as indicated below.

ISO and IEC take no position concerning the evidence, validity and scope of the putative patent rights. The holders of the putative patent rights have assured IEC and ISO that they are willing to negotiate free licences or licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statements of the holders of the putative patent rights are registered with IEC and ISO.

Intel Corporation has informed IEC and ISO that it has patent applications or granted patents.

Information may be obtained from:

Intel Corporation
Standards Licensing Department
5200 NE Elam Young Parkway
MS: JFS-98
USA – Hillsboro, Oregon 97124

Microsoft Corporation has informed IEC and ISO that it has patent applications or granted patents as listed below:

6101499 / US; 6687755 / US; 6910068 / US; 7130895 / US; 6725281 / US; 7089307 / US; 7069312 / US; 10/783 524 /US

Information may be obtained from:

Microsoft Corporation
One Microsoft Way
USA – Redmond WA 98052

Philips International B.V. has informed IEC and ISO that it has patent applications or granted patents.

Information may be obtained from:

Philips International B.V. – IP&S
High Tech campus, building 44 3A21
NL – 5656 Eindhoven

NXP B.V. (NL) has informed IEC and ISO that it has patent applications or granted patents.

Information may be obtained from:

NXP B.V. (NL)
High Tech campus 60
NL – 5656 AG Eindhoven

Matsushita Electric Industrial Co. Ltd. has informed IEC and ISO that it has patent applications or granted patents.

Information may be obtained from:

Matsushita Electric Industrial Co. Ltd.
1-3-7 Shiromi, Chuoh-ku
JP – Osaka 540-6139

Hewlett Packard Company has informed IEC and ISO that it has patent applications or granted patents as listed below:

5 956 487 / US; 6 170 007 / US; 6 139 177 / US; 6 529 936 / US; 6 470 339 / US; 6 571 388 / US; 6 205 466 / US

Information may be obtained from:

Hewlett Packard Company
1501 Page Mill Road
USA – Palo Alto, CA 94304

Samsung Electronics Co. Ltd. has informed IEC and ISO that it has patent applications or granted patents.

Information may be obtained from:

Digital Media Business, Samsung Electronics Co. Ltd.
416 Maetan-3 Dong, Yeongtang-Gu,
KR – Suwon City 443-742

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those identified above. IEC and ISO shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 29341-8-11 was prepared by UPnP Implementers Corporation and adopted, under the PAS procedure, by joint technical committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

The list of all currently available parts of the ISO/IEC 29341 series, under the general title *Universal plug and play (UPnP) architecture*, can be found on the IEC web site.

This International Standard has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the second title page.

ORIGINAL UPNP DOCUMENTS
(informative)

Reference may be made in this document to original UPnP documents. These references are retained in order to maintain consistency between the specifications as published by ISO/IEC and by UPnP Implementers Corporation. The following table indicates the original UPnP document titles and the corresponding part of ISO/IEC 29341:

UPnP Document Title	ISO/IEC 29341 Part
UPnP Device Architecture 1.0	ISO/IEC 29341-1
UPnP Basic:1 Device	ISO/IEC 29341-2
UPnP AV Architecture:1	ISO/IEC 29341-3-1
UPnP MediaRenderer:1 Device	ISO/IEC 29341-3-2
UPnP MediaServer:1 Device	ISO/IEC 29341-3-3
UPnP AVTransport:1 Service	ISO/IEC 29341-3-10
UPnP ConnectionManager:1 Service	ISO/IEC 29341-3-11
UPnP ContentDirectory:1 Service	ISO/IEC 29341-3-12
UPnP RenderingControl:1 Service	ISO/IEC 29341-3-13
UPnP MediaRenderer:2 Device	ISO/IEC 29341-4-2
UPnP MediaServer:2 Device	ISO/IEC 29341-4-3
UPnP AV Datastructure Template:1	ISO/IEC 29341-4-4
UPnP AVTransport:2 Service	ISO/IEC 29341-4-10
UPnP ConnectionManager:2 Service	ISO/IEC 29341-4-11
UPnP ContentDirectory:2 Service	ISO/IEC 29341-4-12
UPnP RenderingControl:2 Service	ISO/IEC 29341-4-13
UPnP ScheduledRecording:1	ISO/IEC 29341-4-14
UPnP DigitalSecurityCamera:1 Device	ISO/IEC 29341-5-1
UPnP DigitalSecurityCameraMotionImage:1 Service	ISO/IEC 29341-5-10
UPnP DigitalSecurityCameraSettings:1 Service	ISO/IEC 29341-5-11
UPnP DigitalSecurityCameraStillImage:1 Service	ISO/IEC 29341-5-12
UPnP HVAC_System:1 Device	ISO/IEC 29341-6-1
UPnP HVAC_ZoneThermostat:1 Device	ISO/IEC 29341-6-2
UPnP ControlValve:1 Service	ISO/IEC 29341-6-10
UPnP HVAC_FanOperatingMode:1 Service	ISO/IEC 29341-6-11
UPnP FanSpeed:1 Service	ISO/IEC 29341-6-12
UPnP HouseStatus:1 Service	ISO/IEC 29341-6-13
UPnP HVAC_SetpointSchedule:1 Service	ISO/IEC 29341-6-14
UPnP TemperatureSensor:1 Service	ISO/IEC 29341-6-15
UPnP TemperatureSetpoint:1 Service	ISO/IEC 29341-6-16
UPnP HVAC_UserOperatingMode:1 Service	ISO/IEC 29341-6-17
UPnP BinaryLight:1 Device	ISO/IEC 29341-7-1
UPnP DimmableLight:1 Device	ISO/IEC 29341-7-2
UPnP Dimming:1 Service	ISO/IEC 29341-7-10
UPnP SwitchPower:1 Service	ISO/IEC 29341-7-11
UPnP InternetGatewayDevice:1 Device	ISO/IEC 29341-8-1
UPnP LANDevice:1 Device	ISO/IEC 29341-8-2
UPnP WANDevice:1 Device	ISO/IEC 29341-8-3
UPnP WANConnectionDevice:1 Device	ISO/IEC 29341-8-4
UPnP WLANAccessPointDevice:1 Device	ISO/IEC 29341-8-5
UPnP LANHostConfigManagement:1 Service	ISO/IEC 29341-8-10
UPnP Layer3Forwarding:1 Service	ISO/IEC 29341-8-11
UPnP LinkAuthentication:1 Service	ISO/IEC 29341-8-12
UPnP RadiusClient:1 Service	ISO/IEC 29341-8-13
UPnP WANCableLinkConfig:1 Service	ISO/IEC 29341-8-14
UPnP WANCommonInterfaceConfig:1 Service	ISO/IEC 29341-8-15
UPnP WANDSLLinkConfig:1 Service	ISO/IEC 29341-8-16
UPnP WANEthernetLinkConfig:1 Service	ISO/IEC 29341-8-17
UPnP WANIPConnection:1 Service	ISO/IEC 29341-8-18
UPnP WANPOTSLinkConfig:1 Service	ISO/IEC 29341-8-19
UPnP WANPPPConnection:1 Service	ISO/IEC 29341-8-20
UPnP WLANConfiguration:1 Service	ISO/IEC 29341-8-21
UPnP Printer:1 Device	ISO/IEC 29341-9-1
UPnP Scanner:1.0 Device	ISO/IEC 29341-9-2
UPnP ExternalActivity:1 Service	ISO/IEC 29341-9-10
UPnP Feeder:1.0 Service	ISO/IEC 29341-9-11
UPnP PrintBasic:1 Service	ISO/IEC 29341-9-12
UPnP Scan:1 Service	ISO/IEC 29341-9-13
UPnP QoS Architecture:1.0	ISO/IEC 29341-10-1
UPnP QosDevice:1 Service	ISO/IEC 29341-10-10
UPnP QosManager:1 Service	ISO/IEC 29341-10-11
UPnP QosPolicyHolder:1 Service	ISO/IEC 29341-10-12
UPnP QoS Architecture:2	ISO/IEC 29341-11-1
UPnP QOS v2 Schema Files	ISO/IEC 29341-11-2

UPnP Document Title	ISO/IEC 29341 Part
UPnP QosDevice:2 Service	ISO/IEC 29341-11-10
UPnP QosManager:2 Service	ISO/IEC 29341-11-11
UPnP QosPolicyHolder:2 Service	ISO/IEC 29341-11-12
UPnP RemoteUIClientDevice:1 Device	ISO/IEC 29341-12-1
UPnP RemoteUIServerDevice:1 Device	ISO/IEC 29341-12-2
UPnP RemoteUIClient:1 Service	ISO/IEC 29341-12-10
UPnP RemoteUIServer:1 Service	ISO/IEC 29341-12-11
UPnP DeviceSecurity:1 Service	ISO/IEC 29341-13-10
UPnP SecurityConsole:1 Service	ISO/IEC 29341-13-11

1. Overview and Scope

This service definition is compliant with the UPnP Device Architecture version 1.0.

This OPTIONAL service models all layer-3 packet forwarding services applicable across all connection service instances of **urn:schemas-upnp-org:device:*WANDevice***

Generic Layer 3 packet forwarding services include all IP / layer-3 routing services. However, any such services that are configurable on a per connection instance basis, will be modeled in the context of the connection service itself. Network Address Translation (NAT) and Realm Specific IP (RSIP) are examples of such services.

The service is defined to be included under the root device
urn:schemas-upnp-org:device:*InternetGatewayDevice*

2. Service Modeling Definitions

2.1. ServiceType

The following service type identifies a service that is compliant with this template:

urn:schemas-upnp-org:service:*Layer3Forwarding:1*.

2.2. State Variables

Table 1: State Variables

Variable Name	Req. or Opt.[1]	Data Type	Allowed Value	Default Value[2]	Eng. Units
`DefaultConnectionService`	R	string	Undefined	Empty string	N/A
Non-standard state variables implemented by an UPnP vendor go here.	*X*	*TBD*	*TBD*	*TBD*	*TBD*

[1] R = Required, O = Optional, X = Non-standard.

[2] Values listed in this column are required. To specify standard optional values or to delegate assignment of values to the vendor, you must reference a specific instance of an appropriate table below.

2.2.1. DefaultConnectionService

This variable specifies a connection service instance in a ***WANConnectionDevice,*** one or more of which could be defined in a ***WANDevice***. A comma-separated 2-tuple uniquely identifies the service:

uuid:*device-UUID*:*WANConnectionDevice:v* ,

urn:**upnp-org**:**serviceId**:*serviceID*

An example of a 2-tuple string follows:
"uuid:44f5824f- c57d-418c-a131-f22b34e14111:WANConnectionDevice:1,urn:upnp-org:serviceId:WANPPPConn1"

This is useful in the case of a dial-on-demand scenario where a client attempts to access Internet without explicitly initiating a connection (as would be the case for a legacy or non-UPnP networked device on the residential LAN). If multiple connections are configured, and a default connection is not set, the gateway selects a connection instance in an implementation dependent manner. **Only one instance of *WAN*Connection* service per *InternetGatewayDevice* (across multiple *WANDevice* and *WANConnectionDevice* instances) can be set as the default connection**. If a default connection is not set, and only one ***WAN*Connection*** instance is configured, it is automatically assumed to be the default connection. If the connection that is set as a default connection is not configured correctly on the gateway, then a dial-on-demand / implicit connection initiation attempt will fail.. If no connections are configured on the gateway and a client initiates an implicit dial-on-demand, the attempt to access the Internet will fail.

NOTE: In the case of bridged, relayed or spoofed connections, there is an implicit one-to-one correspondence between a control point and an active connection. In essence, the gateway performs source address based routing. Sharing of connections is not possible in these scenarios. Consequently, if the `DefaultConnectionService` points to an **active** connection service instance of one of the types listed above, dial-on-demand for a legacy or non-UPnP client will not work.

2.2.2. Relationships Between State Variables

None.

2.3. Eventing and Moderation

Table 2: Event Moderation

Variable Name	Evented	Moderated Event	Max Event Rate[1]	Logical Combination	Min Delta per Event[2]
`DefaultConnectionService`	Yes	No	N/A	N/A	N/A
Non-standard state variables implemented by an UPnP vendor go here.	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*

[1] Determined by N, where Rate = (Event)/(N secs).
[2] (N) * (allowedValueRange Step).

2.3.1. Event Model

`DefaultConnectionService` is evented whenever its value changes. Eventing is not moderated.

2.4. Actions

Immediately following this table is detailed information about these actions, including short descriptions of the actions, the effects of the actions on state variables, and error codes defined by the actions.

Table 3: Actions

Name	Req. or Opt. [1]
`SetDefaultConnectionService`	*R*
`GetDefaultConnectionService`	*R*
Non-standard actions implemented by an UPnP vendor go here.	X

[1] R = Required, O = Optional, X = Non-standard.

2.4.1. SetDefaultConnectionService

Action selects a connection service instance on one of the ***WANConnectionDevice*** instances to be the default connection. If this is not specified, the selection of the default gateway is implementation dependent. If the connection specified is not configured, dial-on-demand connection attempts to the Internet will fail.

2.4.1.1. Arguments

Table 4: Arguments for `SetDefaultConnectionService`

Argument	Direction	relatedStateVariable
`NewDefaultConnectionService`	*IN*	`DefaultConnectionService`

2.4.1.2. Dependency on State (if any)

2.4.1.3. Effect on State (if any)

Sets / changes the default connection for the gateway.

2.4.1.4. Errors

errorCode	errorDescription	Description
402	Invalid Args	One of following: not enough IN arguments, too many IN arguments, no IN argument by that name, one or more IN arguments are of the wrong data type. See also the UPnP Device Architecture.
501	Action Failed	May be returned in current state if service prevents invoking of that action.
720	InvalidDeviceUUID	The UUID of a device specified in the action arguments is invalid
721	InvalidServiceID	The Service ID of a service specified in the action arguments is invalid
723	InvalidConnServiceSelection	The selected connection service instance cannot be set as a default connection

2.4.2. GetDefaultConnectionService

This action retrieves the 2-tuple string representing the default connection service in the gateway.

2.4.2.1. Arguments

Table 5: Arguments for `GetDefaultConnectionService`

Argument	Direction	relatedStateVariable
`NewDefaultConnectionService`	*OUT*	`DefaultConnectionService`

2.4.2.2. Dependency on State (if any)

2.4.2.3. Effect on State

None.

2.4.2.4. Errors

errorCode	errorDescription	Description
402	Invalid Args	One of following: not enough IN arguments, too many IN arguments, no IN argument by that name, one or more IN arguments are of the wrong data type. See also the UPnP Device Architecture.
501	Action Failed	May be returned in current state if service prevents invoking of that action.

2.4.3. Non-Standard Actions Implemented by a UPnP Vendor

To facilitate certification, non-standard actions implemented by UPnP vendors should be included in this service template. The UPnP Device Architecture lists naming requirements for non-standard actions (see the section on Description).

2.4.4. Relationships Between Actions

2.4.5. Common Error Codes

The following table lists error codes common to actions for this service type. If an action results in multiple errors, the most specific error should be returned.

Table 6: Common Error Codes

errorCode	errorDescription	Description
401	Invalid Action	See UPnP Device Architecture section on Control.
402	Invalid Args	See UPnP Device Architecture section on Control.
404	Invalid Var	See UPnP Device Architecture section on Control.
501	Action Failed	See UPnP Device Architecture section on Control.
600-699	TBD	Common action errors. Defined by UPnP Forum Technical Committee.
701-799		Common action errors defined by the UPnP Forum working committees.
800-899	*TBD*	*(Specified by UPnP vendor.)*

2.5. Theory of Operation

A gateway could perform sophisticated routing functions, especially if it has multiple LAN and WAN interfaces. However, the IGD Working Committee decided to restrict the scope of the first version of gateway DCP to simpler usage scenarios. NAT functionality is configurable on a per connection basis and is consequently modeled in the appropriate connection service.

Per the current specification, the following precedence is implied in determining routes to a destination IP address on the WAN:

1. If a control point successfully invokes `RequestConnection`[1] on a connection service instance, subsequent IP packets from that control point MUST be routed on that connection instance.
2. If `RequestConnection` is not called, and if `DefaultConnectionService` points to a usable connection service instance, packets from a node on the residential LAN MUST be routed on that connection instance.
3. If `RequestConnection` is not called, and if `DefaultConnectionService` is not specified, packets MUST be routed based on the reachable route for the destination IP address in the packet..

[1] Refer to the ***WAN**Connection*** service definition for more information on `RequestConnection`.

3. XML Service Description

```
<?xml version="1.0"?>
<scpd xmlns="urn:schemas-upnp-org:service-1-0">
  <specVersion>
    <major>1</major>
    <minor>0</minor>
  </specVersion>
  <actionList>
    <action>
    <name>SetDefaultConnectionService</name>
      <argumentList>
        <argument>
          <name>NewDefaultConnectionService</name>
          <direction>in</direction>
   <relatedStateVariable>DefaultConnectionService</relatedStateVariable>
        </argument>
      </argumentList>
    </action>
    <action>
    <name>GetDefaultConnectionService</name>
      <argumentList>
        <argument>
          <name>NewDefaultConnectionService</name>
          <direction>out</direction>
   <relatedStateVariable>DefaultConnectionService</relatedStateVariable>
        </argument>
      </argumentList>
    </action>
    <!-- Declarations for other actions added by UPnP vendor (if any) go
here -->
  </actionList>
  <serviceStateTable>
   <stateVariable sendEvents="yes">
      <name>DefaultConnectionService</name>
      <dataType>string</dataType>
   </stateVariable>
   <!-- Declarations for other state variables added by UPnP vendor (if
any) go here -->
  </serviceStateTable>
</scpd>
```

4. Test

SetDefaultConnectionService / GetDefaultConnectionService

Test Sequence 1: To test success path
Semantic class: 2
Pre-conditions: None.

SetDefaultConnectionService Success = 200

In-Arg	Values	State Variables	Current State	Expected State
DefaultConnectionService	A string representing a valid connection service instance per semantics defined in the service description document			
Out-Arg	**Expected Value**			
		Error Code (if any)	NA	NA

GetDefaultConnectionService Success = 200

In-Arg	Values	State Variables	Current State	Expected State
Out-Arg	**Expected Value**			
DefaultConnectionService	String set in the preceding Set action	**Error Code (if any)**	NA	NA

Test Sequence 2: To test error 720
Semantic class: 2
Pre-conditions: None.

GetDefaultConnectionService Success = 200

In-Arg	Values	State Variables	Current State	Expected State
Out-Arg	**Expected Value**			
DefaultConnectionService	A string representing a valid connection service instance per semantics defined in the service description document OR an empty string representing an uninitialized default connection	**Error Code (if any)**	NA	NA

SetDefaultConnectionService Success = 200

In-Arg	Values	State Variables	Current State	Expected State
DefaultConnectionService	A string representing a connection service instance per semantics defined in the service description document but with an invalid value for device container			
Out-Arg	**Expected Value**			
		Error Code (if any)	720	NA

GetDefaultConnectionService Success = 200

In-Arg	Values	State Variables	Current State	Expected State
Out-Arg	**Expected Value**			
DefaultConnectionService	String retrieved in preceding Get action	**Error Code (if any)**	NA	NA