



BSI Standards Publication

Information technology — UPnP Device Architecture

Part 24-10: Internet gateway device control protocol — Level 2 —
Wide area network internet protocol — Connection service

National foreword

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A list of organizations represented on this committee can be obtained on request to its secretary.

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**Information technology — UPnP
Device Architecture —**

**Part 24-10:
Internet gateway device control
protocol — Level 2 — Wide area
network internet protocol —
Connection service**

Technologies de l'information — Architecture de dispositif UPnP —

*Partie 24-10: Protocole de contrôle de dispositif de passerelle
Internet — Niveau 2 — Protocole internet de réseau étendu —
Service de connexion*





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CONTENTS

1	Scope.....	1
2	Normative references.....	1
3	Terms, definitions, symbols and abbreviated terms.....	2
4	Notations and conventions.....	4
4.1	Notation	4
4.2	Data types.....	4
4.2.1	Primary data types.....	4
4.2.2	Secondary data types.....	5
4.3	Vendor-defined extensions.....	6
5	Service model.....	6
5.1	Service type	6
5.2	Changes from <u>WANIPConnection:1</u>	6
5.2.1	Backward compatibility.....	6
5.2.2	Generic requirements and other changes.....	6
5.2.3	New state variables.....	6
5.2.4	New actions	6
5.2.5	Changes in existing actions and procedures	7
5.3	Service Architecture.....	7
5.3.1	Introduction.....	7
5.3.2	Main feature sets	8
5.4	State variables	9
5.4.1	State variable overview	9
5.4.2	<u>ConnectionType</u>	11
5.4.3	<u>PossibleConnectionTypes</u>	11
5.4.4	<u>ConnectionStatus</u>	11
5.4.5	<u>Uptime</u>	12
5.4.6	<u>LastConnectionError</u>	12
5.4.7	<u>AutoDisconnectTime</u>	12
5.4.8	<u>IdleDisconnectTime</u>	13
5.4.9	<u>WarnDisconnectDelay</u>	13
5.4.10	<u>RSIPAvailable</u>	13
5.4.11	<u>NATEnabled</u>	13
5.4.12	<u>ExternalIPAddress</u>	13
5.4.13	<u>PortMappingNumberOfEntries</u>	13
5.4.14	<u>PortMappingEnabled</u>	14
5.4.15	<u>PortMappingLeaseDuration</u>	14
5.4.16	<u>RemoteHost</u>	14
5.4.17	<u>ExternalPort</u>	14
5.4.18	<u>InternalPort</u>	15
5.4.19	<u>PortMappingProtocol</u>	15
5.4.20	<u>InternalClient</u>	15
5.4.21	<u>PortMappingDescription</u>	15
5.4.22	<u>SystemUpdateID</u>	15
5.4.23	<u>A_ARG_TYPE_Manage</u>	16

5.4.24	<u>A_ARG_TYPE_PortListing</u>	16
5.5	Eventing and Moderation	17
5.5.1	Eventing of <u>PossibleConnectionTypes</u>	18
5.5.2	Eventing of <u>ConnectionStatus</u>	18
5.5.3	Eventing of <u>ExternalIPAddress</u>	18
5.5.4	Eventing of <u>PortMappingNumberOfEntries</u>	18
5.5.5	Eventing of <u>SystemUpdateID</u>	18
5.5.6	Relationships among State Variables.....	18
5.6	Actions	19
5.6.1	<u>SetConnectionType()</u>	20
5.6.2	<u>GetConnectionTypeInfo()</u>	21
5.6.3	<u>RequestConnection()</u>	22
5.6.4	<u>RequestTermination()</u>	23
5.6.5	<u>ForceTermination()</u>	24
5.6.6	<u>SetAutoDisconnectTime()</u>	25
5.6.7	<u>SetIdleDisconnectTime()</u>	26
5.6.8	<u>SetWarnDisconnectDelay()</u>	27
5.6.9	<u>GetStatusInfo()</u>	27
5.6.10	<u>GetAutoDisconnectTime()</u>	28
5.6.11	<u>GetIdleDisconnectTime()</u>	29
5.6.12	<u>GetWarnDisconnectDelay()</u>	30
5.6.13	<u>GetNATRSIPStatus()</u>	31
5.6.14	<u>GetGenericPortMappingEntry()</u>	31
5.6.15	<u>GetSpecificPortMappingEntry()</u>	33
5.6.16	<u>AddPortMapping()</u>	34
5.6.17	<u>AddAnyPortMapping()</u>	38
5.6.18	<u>DeletePortMapping()</u>	40
5.6.19	<u>DeletePortMappingRange()</u>	42
5.6.20	<u>GetExternalIPAddress()</u>	43
5.6.21	<u>GetListOfPortMappings()</u>	44
5.6.22	Relationships Between Actions.....	45
5.6.23	Error Code Summary.....	45
5.7	Service Behavioral Model	47
5.7.1	Connection Initiation	47
5.7.2	Connection Termination	48
6	XML Service Description.....	49
Annex A (informative)	Theory of Operation	61
Annex B (informative)	Bibliography.....	65
Figure 1	— UPNP IGD component relationships for NAT processing.....	10
Figure 2	— Example of relationship between <u>AddPortMapping()</u> action and port triggering	35
Figure 3	— Summary of <u>AddPortMapping()</u> results.....	37
Figure 4	— Summary of <u>AddAnyPortMapping()</u> results	40
Figure 5	— State diagram for IP connection.....	47
Figure A.1	— NAT is an IP address translator.....	63
Figure A.2	— NAT issue with bundled session applications.....	64

Table 1 — CSV examples	5
Table 2 — State Variables	9
Table 3 — allowedValueList for the ConnectionType state variable	11
Table 4 — allowedValueList for the ConnectionStatus state variable	11
Table 5 — allowedValueList for the LastConnectionError state variable	12
Table 6 — allowedValueRange for the PortMappingLeaseDuration state variable	14
Table 7 — allowedValueRange for the InternalPort state variable	15
Table 8 — allowedValueList for the PortMappingProtocol state variable	15
Table 9 — Eventing and Moderation	17
Table 10 — Actions	19
Table 11 — Common parameters	19
Table 12 — Arguments for SetConnectionType()	20
Table 13 — Error Codes for SetConnectionType()	21
Table 14 — Arguments for GetConnectionTypeInfo()	21
Table 15 — Error Codes for GetConnectionTypeInfo()	22
Table 16 — Error Codes for RequestConnection()	23
Table 17 — Error Codes for RequestTermination()	24
Table 18 — Error Codes for ForceTermination()	25
Table 19 — Arguments for SetAutoDisconnectTime()	25
Table 20 — Error Codes for SetAutoDisconnectTime()	26
Table 21 — Arguments for SetIdleDisconnectTime()	26
Table 22 — Error Codes for SetIdleDisconnectTime()	27
Table 23 — Arguments for SetWarnDisconnectDelay()	27
Table 24 — Error Codes for SetWarnDisconnectDelay()	27
Table 25 — Arguments for GetStatusInfo()	28
Table 26 — Error Codes for GetStatusInfo()	28
Table 27 — Arguments for GetAutoDisconnectTime()	28
Table 28 — Error Codes for GetAutoDisconnectTime()	29
Table 29 — Arguments for GetIdleDisconnectTime()	29
Table 30 — Error Codes for GetIdleDisconnectTime()	30
Table 31 — Arguments for GetWarnDisconnectDelay()	30
Table 32 — Error Codes for GetWarnDisconnectDelay()	30
Table 33 — Arguments for GetNATRSIPStatus()	31
Table 34 — Error Codes for GetNATRSIPStatus()	31
Table 35 — Arguments for GetGenericPortMappingEntry()	32
Table 36 — Error Codes for GetGenericPortMappingEntry()	33
Table 37 — Arguments for GetSpecificPortMappingEntry()	33
Table 38 — Error Codes for GetSpecificPortMappingEntry()	34
Table 39 — Arguments for AddPortMapping()	35
Table 40 — Error Codes for AddPortMapping()	37
Table 41 — Arguments for AddAnyPortMapping()	38
Table 42 — Error Codes for AddAnyPortMapping()	40

ISO/IEC 29341-24-10:2017(E)

Table 43 — Arguments for <u>DeletePortMapping()</u>	41
Table 44 — Error Codes for <u>DeletePortMapping()</u>	41
Table 45 — Arguments for <u>DeletePortMappingRange()</u>	42
Table 46 — Error Codes for <u>DeletePortMappingRange()</u>	43
Table 47 — Arguments for <u>GetExternalIPAddress()</u>	43
Table 48 — Error Codes for <u>GetExternalIPAddress()</u>	44
Table 49 — Arguments for <u>GetListOfPortMappings()</u>	44
Table 50 — Error Codes for <u>GetListOfPortMappings()</u>	45
Table 51 — Error Code Summary	46
Table A.1 — Connection Procedures	61

Foreword

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The list of all currently available parts of ISO/IEC 29341 series, under the general title *Information technology — UPnP Device Architecture*, can be found on the [ISO web site](#).

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Original UPnP Document

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 and later by UPnP Forum. 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 29341-1:2008
UPnP Device Architecture Version 1.0	ISO/IEC 29341-1:2011
UPnP Device Architecture 1.1	ISO/IEC 29341-1-1:2011
UPnP Device Architecture 2.0	ISO/IEC 29341-1-2
UPnP Basic:1 Device	ISO/IEC 29341-2
UPnP AV Architecture:1	ISO/IEC 29341-3-1:2008
UPnP AV Architecture:1	ISO/IEC 29341-3-1:2011
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:1 Device	ISO/IEC 29341-3-2
UPnP MediaRenderer:2 Device	ISO/IEC 29341-3-2:2011
UPnP MediaServer:1 Device	ISO/IEC 29341-3-3
UPnP AVTransport:2 Service	ISO/IEC 29341-4-10:2008
UPnP AVTransport:2 Service	ISO/IEC 29341-4-10:2011
UPnP ConnectionManager:2 Service	ISO/IEC 29341-4-11:2008
UPnP ConnectionManager:2 Service	ISO/IEC 29341-4-11:2011
UPnP ContentDirectory:2 Service	ISO/IEC 29341-4-12
UPnP RenderingControl:2 Service	ISO/IEC 29341-4-13:2008
UPnP RenderingControl:2 Service	ISO/IEC 29341-4-13:2011
UPnP ScheduledRecording:1	ISO/IEC 29341-4-14
UPnP ScheduledRecording:2	ISO/IEC 29341-4-14:2011
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 29341-4-4:2008
UPnP AV Datastructure Template:1	ISO/IEC 29341-4-4:2011
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 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 HVAC_ZoneThermostat:1 Device	ISO/IEC 29341-6-2

UPnP BinaryLight:1 Device	ISO/IEC 29341-7-1
UPnP Dimming:1 Service	ISO/IEC 29341-7-10
UPnP SwitchPower:1 Service	ISO/IEC 29341-7-11
UPnP DimmableLight:1 Device	ISO/IEC 29341-7-2
UPnP InternetGatewayDevice:1 Device	ISO/IEC 29341-8-1
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 LANDevice:1 Device	ISO/IEC 29341-8-2
UPnP WANPPPConnection:1 Service	ISO/IEC 29341-8-20
UPnP WLANConfiguration:1 Service	ISO/IEC 29341-8-21
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 Printer:1 Device	ISO/IEC 29341-9-1
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 Scanner:1.0 Device	ISO/IEC 29341-9-2
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 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 QOS v2 Schema Files	ISO/IEC 29341-11-2
UPnP RemoteUIClientDevice:1 Device	ISO/IEC 29341-12-1
UPnP RemoteUIClient:1 Service	ISO/IEC 29341-12-10
UPnP RemoteUIServer:1 Service	ISO/IEC 29341-12-11
UPnP RemoteUIServerDevice:1 Device	ISO/IEC 29341-12-2
UPnP DeviceSecurity:1 Service	ISO/IEC 29341-13-10
UPnP SecurityConsole:1 Service	ISO/IEC 29341-13-11
UPnP ContentDirectory:3 Service	ISO/IEC 29341-14-12:2011
UPnP MediaServer:3 Device	ISO/IEC 29341-14-3:2011
UPnP ContentSync:1	ISO/IEC 29341-15-10:2011
UPnP Low Power Architecture:1	ISO/IEC 29341-16-1:2011
UPnP LowPowerProxy:1 Service	ISO/IEC 29341-16-10:2011

ISO/IEC 29341-24-10:2017(E)

UPnP LowPowerDevice:1 Service	ISO/IEC 29341-16-11:2011
UPnP QoS Architecture:3	ISO/IEC 29341-17-1:2011
UPnP QoSDevice:3 Service	ISO/IEC 29341-17-10:2011
UPnP QoSManager:3 Service	ISO/IEC 29341-17-11:2011
UPnP QoSPolicyHolder:3 Service	ISO/IEC 29341-17-12:2011
UPnP QoSDevice:3 Addendum	ISO/IEC 29341-17-13:2011
UPnP RemoteAccessArchitecture:1	ISO/IEC 29341-18-1:2011
UPnP InboundConnectionConfig:1 Service	ISO/IEC 29341-18-10:2011
UPnP RADAConfig:1 Service	ISO/IEC 29341-18-11:2011
UPnP RADASync:1 Service	ISO/IEC 29341-18-12:2011
UPnP RATAConfig:1 Service	ISO/IEC 29341-18-13:2011
UPnP RAClient:1 Device	ISO/IEC 29341-18-2:2011
UPnP RAServer:1 Device	ISO/IEC 29341-18-3:2011
UPnP RADiscoveryAgent:1 Device	ISO/IEC 29341-18-4:2011
UPnP SolarProtectionBlind:1 Device	ISO/IEC 29341-19-1:2011
UPnP TwoWayMotionMotor:1 Service	ISO/IEC 29341-19-10:2011
UPnP AV Architecture:2	ISO/IEC 29341-20-1
UPnP AVTransport:3 Service	ISO/IEC 29341-20-10
UPnP ConnectionManager:3 Service	ISO/IEC 29341-20-11
UPnP ContentDirectory:4 Device	ISO/IEC 29341-20-12
UPnP RenderingControl:3 Service	ISO/IEC 29341-20-13
UPnP ScheduledRecording:2 Service	ISO/IEC 29341-20-14
UPnP MediaRenderer:3 Service	ISO/IEC 29341-20-2
UPnP MediaServer:4 Device	ISO/IEC 29341-20-3
UPnP AV Datastructure Template:1	ISO/IEC 29341-20-4
UPnP InternetGatewayDevice:2 Device	ISO/IEC 29341-24-1
UPnP WANIPConnection:2 Service	ISO/IEC 29341-24-10
UPnP WANIPv6FirewallControl:1 Service	ISO/IEC 29341-24-11
UPnP WANConnectionDevice:2 Service	ISO/IEC 29341-24-2
UPnP WANDevice:2 Device	ISO/IEC 29341-24-3
UPnP Telephony Architecture:2	ISO/IEC 29341-26-1
UPnP CallManagement:2 Service	ISO/IEC 29341-26-10
UPnP MediaManagement:2 Service	ISO/IEC 29341-26-11
UPnP Messaging:2 Service	ISO/IEC 29341-26-12
UPnP PhoneManagement:2 Service	ISO/IEC 29341-26-13
UPnP AddressBook:1 Service	ISO/IEC 29341-26-14
UPnP Calendar:1 Service	ISO/IEC 29341-26-15
UPnP Presense:1 Service	ISO/IEC 29341-26-16
UPnP TelephonyClient:2 Device	ISO/IEC 29341-26-2
UPnP TelephonyServer:2 Device	ISO/IEC 29341-26-3
UPnP Friendly Info Update:1 Service	ISO/IEC 29341-27-1
UPnP MultiScreen MultiScreen Architecture:1	ISO/IEC 29341-28-1
UPnP MultiScreen Application Management:1 Service	ISO/IEC 29341-28-10
UPnP MultiScreen Screen:1 Device	ISO/IEC 29341-28-2
UPnP MultiScreen Application Management:2 Service	ISO/IEC 29341-29-10
UPnP MultiScreen Screen:2 Device	ISO/IEC 29341-29-2
UPnP IoT Management and Control Architecture Overview:1	ISO/IEC 29341-30-1

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UPnP DataStore:1 Service	ISO/IEC 29341-30-10
UPnP IoT Management and Control Data Model:1 Service	ISO/IEC 29341-30-11
UPnP IoT Management and Control Transport Generic:1 Service	ISO/IEC 29341-30-12
UPnP IoT Management and Control:1 Device	ISO/IEC 29341-30-2
UPnP Energy Management:1 Service	ISO/IEC 29341-31-1

1 Scope

This document specifies the characteristics of the UPnP networked service named WANIPConnection, version 2. This service definition is compliant with *UPnP Device Architecture 1.0* [1]. It is one component of the Device Control Protocol for the UPnP Internet Gateway Device (see [3]).

This service enables a UPnP control point to:

- configure and control an IP connection between a LAN client on one side of an Internet gateway (see [3]) and a WAN host on the other side;
- manage any physical WAN interface—such as DSL or cable—that supports an IP connection.

This service is required in a WANConnectionDevice (see [5]) when the device supports an IP connection.

2 Normative references

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

[1] *UPnP Device Architecture, version 1.0*, UPnP Forum, June 8, 2000.

Available at: <http://upnp.org/specs/arch/UPnP-arch-DeviceArchitecture-v1.0.pdf>.

[2] *UPnP Device Architecture, version 1.1*, UPnP Forum, October 15, 2008.

Available at: <http://upnp.org/specs/arch/UPnP-arch-DeviceArchitecture-v1.1.pdf>.

[3] InternetGatewayDevice:2, version 1.00, UPnP Forum, December 10, 2010.

Available at <http://upnp.org/specs/gw/UPnP-gw-InternetGatewayDevice-v2-Device.pdf>

[4] WANDevice:2, UPnP Forum, December 10, 2010

Available at <http://upnp.org/specs/gw/UPnP-gw-WANDevice-v2-Device.pdf>

[5] WANConnectionDevice:2, UPnP Forum, December 10, 2010

Available at <http://upnp.org/specs/gw/UPnP-gw-WANIPConnection-v2-Service.pdf>

[6] WANIPConnection:1, UPnP Forum, November 12, 2001

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ISO/IEC 29341-24-10:2017(E)

2004.

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[12] *XML Schema Part 2: Data Types, Second Edition*, Paul V. Biron, Ashok Malhotra, W3C Recommendation, 28 October 2004.

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3 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the terms and definitions given in [1], [2], [3] and the following apply.

3.1 Provision

3.1.1

A
allowed

3.1.2

conditionally allowed

CA

The definition or behavior depends on a condition. If the specified condition is met, then the definition or behavior is allowed, otherwise it is not allowed.

3.1.3

conditionally required

CR

The definition or behavior depends on a condition. If the specified condition is met, then the definition or behavior is required, otherwise it is not allowed.

3.1.4

not allowed

The definition or behavior is prohibited by this specification. Opposite of required.

3.1.5

R
required

3.1.6

X
vendor-defined, non-standard

3.2 Terms specific to network connections

3.2.1

client

a host located on the local network that connects to a remote host on the Internet through an Internet Gateway Device

3.2.2

IGD control point

UPnP control point that uses the UPnP IGD protocol to control an Internet Gateway Device

3.2.3

2-box model

configuration where the client and IGD control point are located in one physical device and the Internet Gateway Device is located in a second physical device

3.2.4

3-box model

configuration where the client, IGD control point and Internet Gateway Device are located in three separate physical devices.

3.2.5

port forwarding

port mapping rule which allows a remote host to reach a client port via a NAT enabled router

3.2.6

port triggering

method of automating port forwarding in which outbound traffic on predetermined ports causes inbound traffic to specific incoming ports to be dynamically forwarded to the initiating host, while the outbound ports are in use

3.3 Abbreviated terms

3.3.1

CSV

Comma Separated Value

3.3.2

IETF

Internet Engineering Task Force

3.3.3

IGD

Internet Gateway Device

3.3.4

MAC

Media Access Control

3.3.5

NAPT

Network Address Port Translation

3.3.6

NAT

Network Address Translation

3.3.7

POTS

Plain Old Telephone Service

3.3.8

PPP

Point-to-Point Protocol

3.3.9

RSIP

Realm Specific Internet Protocol

3.3.10

RTSP

Real Time Streaming Protocol

3.3.11

SIP

Session Initiation Protocol

3.3.12

SNMP

Simple Network Management Protocol

3.3.13

SOAP

Simple Object Access Protocol

ISO/IEC 29341-24-10:2017(E)

3.3.14

SSDP

Simple Service Discovery Protocol

3.3.15

UI

User Interface

3.3.16

UUID

Universally Unique Identifier

3.3.17

VC

Virtual Channel

3.3.18

VCI

Virtual Channel Identifier

3.3.19

VPI

Virtual Path Identifier

3.3.20

VPN

Virtual Private Network

4 Notations and conventions

4.1 Notation

- UPnP interface names defined in [1] are styled in **green bold underlined** text.
- UPnP interface names defined outside of [1] are styled in **red italic underlined** text.
- Simple Service Discovery Protocol (SSDP) names are styled in **blue underlined** text.
- Some additional non-interface names and terms are styled in *italic* text.
- Words that are emphasized are also styled in *italic* text. The difference between italic terms and italics for emphasis will be apparent by context.
- Strings that are to be taken literally are enclosed in “double quotes”.

4.2 Data types

4.2.1 Primary data types

Primary data type definitions come from two sources:

- State variable and action argument data types are defined in [1].
- Basic data types for XML element and attribute values are defined in [12]. The XML data types are essential, since all communications between UPnP services and control points are encoded in XML.

For the UPnP-defined data type **boolean**, it is strongly recommended to use the value “**0**” for false, and the value “**1**” for true. The values “**true**”, “**false**”, “**yes**” and “**no**” are deprecated—they shall not appear in output, but shall be accepted on input.

For the data type `xsd:boolean`, it is strongly recommended to use the value “0” for false, and the value “1” for true. The values “true” and “false” are allowed, but not recommended.

4.2.2 Secondary data types

4.2.2.1 CSV lists

The Comma Separated Value list allows a single string to contain multiple values represented in a list form. Lists may either be homogeneous (all values are the same type) or heterogeneous (values of different types are allowed). Lists may also consist of repeated occurrences of homogeneous or heterogeneous subsequences, all of which have the same syntax and semantics (same number of values, same value types and in the same order). The basic data type of a homogeneous list is **string** or `xsd:string` and is denoted by CSV (x), where x is the type of the individual values. The data type of a heterogeneous list is also **string** or `xsd:string` and is denoted by CSV (x, y, z), where x, y and z are the types of the individual values. The data type of a repeated subsequence list is **string** or `xsd:string` and denoted by CSV ({x, y, z}), where x, y and z are the types of the individual values in the subsequence and the subsequence may be repeated zero or more times. If the number of values in a heterogeneous list is too large to show each type individually or to represent as a repeated subsequence, it is denoted by CSV (heterogeneous), and the variable description includes additional information as to the expected sequence of values appearing in the list and their corresponding types.

- The containing string can be either of type **string** or `xsd:string`.
- Commas separate values within a list.
- The escape character is the backslash, "\", U+005C
 - To represent a comma character within a single value, escape it as "\",
 - To represent the backslash character as itself, escape it as "\\"
- Integer values are represented in CSVs with the same syntax as the integer data type specified in [1]
- Boolean values are represented in CSVs as "0" for false or "1" for true.
- White space before, after, or interior to any numeric data type is not allowed.
- White space before, after, or interior to any other data type is part of the value.

Table 1 — CSV examples

Type of Refinement String	Value	Comments
CSV (int) or CSV (<code>xsd:integer</code>)	"1,-5,006,0,+7"	List of 5 integers.
CSV (boolean) or CSV (<code>xsd:Boolean</code>)	"0,1,1,0"	List of 4 booleans
CSV (string) or CSV (<code>xsd:string</code>)	"Smith\\, Fred,Jones\\, Davey"	List of 2 names, "Smith, Fred" and "Jones, Davey"
CSV (i4, string, ui2) or CSV (<code>xsd:int, xsd:string, xsd:unsignedShort</code>)	"-29837, string with leading blanks,0"	Note that the second value is " string with leading blanks"
CSV (i4) or CSV (<code>xsd:int</code>)	"3, 4"	Illegal CSV. White space is not allowed as part of an integer value.
CSV (string) or CSV (<code>xsd:string</code>)	" , ,"	List of 3 empty string values
CSV ({string, string, ui2}) or CSV (<code>{xsd:string, xsd:string, xsd:unsignedShort}</code>)	"Alice,Marketing,5,Sue,R&D,21,Dave,Finance,7".	List of unspecified number of people and associated attributes. Each person is described by 3 elements: a name, a department and years-of-service

4.2.2.2 Other

There are no other secondary data types than CSV lists.

4.3 Vendor-defined extensions

When vendors add vendor-defined state variables, actions or properties, their assigned names and XML representation shall follow the naming conventions and XML rules for non-standard vendor extensions in [1].

5 Service model

5.1 Service type

A service that complies with this specification shall identify itself with the URN:

urn:[schemas-upnp-org:service:WANIPConnection:2](#)

All uses of the name [WANIPConnection](#) in this document specifically refer to version [WANIPConnection:2](#) of this service type.

5.2 Changes from [WANIPConnection:1](#)

5.2.1 Backward compatibility

[WANIPConnection:2](#) is backward-compatible with [WANIPConnection:1](#) ([6]), except where access control has been added.

5.2.2 Generic requirements and other changes

- The NAT behaviour should follow IETF RFCs [15] and [16],
- When a control point creates a port forwarding rule for inbound traffic, this rule shall also be applied when NAT port triggering occurs for outbound traffic,
- UPnP IGD implementing [WANIPConnection:2](#) shall expose UPnP services only over the LAN interface. The [WANIPConnection:2](#) implementation shall reject UPnP requests from the WAN interfaces,
- Upon startup, The UPnP IGD Device implementation, implementing the [WANIPConnection:2](#) service, shall broadcast an [ssdp:byebye](#) before sending the initial [ssdp:alive](#) onto the local network. Sending an [ssdp:byebye](#) as part of the normal start up process for a UPnP device ensures that UPnP control points with information about the previous device instance will safely discard state information about the previous device instance before communicating with the new device instance.
- Deprecated error codes. [WANIPConnection](#) shall not report the following error codes, though control points are still required to support them for legacy services.
 - 724 [SamePortValuesRequired](#)
 - 725 [OnlyPermanentLeasesSupported](#)
 - 726 [RemoteHostOnlySupportsWildcard](#)
 - 727 [ExternalPortOnlySupportsWildcard](#)

For details, see 5.6.16.

- Clarifications to [WANIPConnection:1](#) ([6]).

5.2.3 New state variables

- [SystemUpdateID](#) is used to track changes which could affect NAT port mappings,
- [A_ARG_TYPE_Manage](#) is a parameter used in new actions which allows a control point to request access level elevation,
- [A_ARG_TYPE_PortListing](#) is a data structure used to return a list of port mappings.

5.2.4 New actions

- [DeletePortMappingRange\(\)](#) allows removal of a range of port mappings,
- [GetListOfPortMappings\(\)](#) allows retrieval of a list of existing port mappings,
- [AddAnyPortMapping\(\)](#) allows the control point to request a specific external port, and if the port is not free the gateway assigns a free port.

5.2.5 Changes in existing actions and procedures

- [PortMappingLeaseDuration](#) can be either a value between 1 and 604800 seconds or the zero value (for infinite lease time). Note that an infinite lease time can be only set by out-of-band mechanisms like WWW-administration, remote management or local management,
- If a control point uses the value 0 to indicate an infinite lease time mapping, it is required that gateway uses the maximum value instead (e.g. 604800 seconds),
- [WANIPConnection:2](#) introduces access control features. [3] recommends access control requirements and authorization levels to be applied by *default*. However, services may choose a different security policy,
- [WANIPConnection:2](#) of the service uses access restriction for certain actions and parameters. In the 2-box model, where the control point is in the same device that desires to receive communication through the NAT, [3] recommends that access control is not needed. But in the 3-box model, where the control point is configuring NAT port mappings for a third device, [3] recommends that authentication and authorization is used.
- To summarize, [3] recommends that unauthenticated and unauthorized control points are only allowed to control port mappings which have [InternalClient](#) value equals to the control point's IP address. However, services may choose a different security policy,
- [3] recommends that unauthenticated and unauthorized control points are only allowed to invoke actions with [NewExternalPort](#) and [NewInternalPort](#) values greater than or equal to 1024. However, services may choose a different security policy,
- NAT port mapping rules can be created by other mechanisms besides [WANIPConnection](#). Therefore, it is possible that port mappings done by independent mechanisms may overlap or conflict. It is left to vendors to determine a suitable algorithm to resolve conflicting mappings. A new error code has been created (729 [ConflictWithOtherMechanisms](#)) in order to allow [WANIPConnection](#) to deny a request due to conflict with other mechanisms,
- [WANIPConnection](#) shall support both wildcard and specific IP address values for [RemoteHost](#) (only the wildcard value was required in [WANIPConnection:1](#)),
- [WANIPConnection](#) shall support specific port values for [ExternalPort](#),
- The error code 731 [ReadOnly](#) (indicating that it is not possible to modify the value because it is read only) has been created for the [SetConnectionType\(\)](#) action,
- The error code 728 [NoPortMapsAvailable](#) (There are not enough free ports available to complete the port mapping) has been created for the [AddPortMapping\(\)](#) and [AddAnyPortMapping\(\)](#) actions,
- The error code 730 [PortMappingNotFound](#) (There are not port mappings in the specified range) has been created for the [DeletePortMappingRange\(\)](#) and [GetListOfPortMappings\(\)](#) actions,
- The error code 732 [WildcardNotPermittedInIntPort](#) (The internal port cannot be wildcarded) has been created for the [AddPortMapping\(\)](#) and [AddAnyPortMapping\(\)](#) actions,
- The error code 733 [InconsistentParameters](#) ([NewStartPort](#) and [NewEndPort](#) values are not consistent) has been created for the [DeletePortMappingRange\(\)](#) and [GetListOfPortMappings\(\)](#) actions.

5.3 Service Architecture

5.3.1 Introduction

All IP Internet connections are set up from a WAN interface of the [InternetGatewayDevice](#) or bridged through the gateway to Internet Service Providers (ISPs). [WANDevice](#) is a container for all UPnP services associated with a physical WAN device. It is assumed that clients are connected to [InternetGatewayDevice](#) via a LAN (IP-based network).

An instance of a [WANIPConnection](#) service is activated (refer to the state variable table) for each actual Internet connection instance on a [WANConnectionDevice](#). [WANIPConnection](#) service provides IP-level connectivity with an ISP for networked clients on the LAN.

ISO/IEC 29341-24-10:2017(E)

In accordance with [1], the maximum number of [WANIPConnection](#) service instances is static and specified in the [InternetGatewayDevice](#) description document.

A [WANConnectionDevice](#) may include a [WAN{POTS/DSL/Cable/Ethernet}LinkConfig](#) service that encapsulates Internet access properties pertaining to the physical link of a particular WAN access type. These properties are common to all instances of [WANIPConnection](#) in a [WANConnectionDevice](#).

A [WANDevice](#) provides a [WANCommonInterfaceConfig](#) service that encapsulates Internet access properties common across all [WANConnectionDevice](#) instances.

5.3.2 Main feature sets

This service has three main feature sets.

- a) The first feature set focuses on managing connections when the connection is not always on. This service is impacted only if the instance of [WANIPConnection](#) is in [IP Routed](#) mode. An IP connection can be started with [RequestConnection\(\)](#) action, and [RequestTermination\(\)](#) or [ForceTermination\(\)](#) can be used to disconnect an active connection. In addition to these actions, it is possible to set the duration for the connection or to set the idle time after which the connection may be terminated automatically.
- b) The second feature set includes a number of actions that allow retrieval of status information from the gateway including: getting connection type, disconnect times, external IP address, NAT and RSIP status. These can be used to determine the state of the gateway and its settings.

The NAT Traversal or port mapping functionality allows creation of mappings for both TCP and UDP protocols between an external IGD port (called [ExternalPort](#)) and an internal client address associated with one of its ports (respectively called [InternalClient](#) and [InternalPort](#)). It is also possible to narrow the mapping by limiting the mapping to a specific remote host¹. This feature is used to allow external hosts to reach hosts located behind NATs.

Getting information about existing port mapping can be done with the following actions:

- [GetGenericPortMappingEntry\(\)](#) is used to retrieve port mapping entries based on a table index. The table consists of all port mapping entries. The size of the table and its indexes are updated as the number of port mapping entries changes,
- [GetSpecificPortMappingEntry\(\)](#) allows retrieval of a port mapping entry based on the [ExternalPort](#), the [PortMappingProtocol](#), and the [RemoteHost](#),
- [GetListOfPortMappings\(\)](#) returns a list of port mapping entries based on a range of [ExternalPort](#) and the [PortMappingProtocol](#) values.

Creation and deletion of port mapping entries is done with the following actions:

- [AddPortMapping\(\)](#) allows creation of a single port mapping by specifying all parameters in one call, this action returns an error if the mapping is already reserved. Please note that as of [WANIPConnection:2](#), it is recommended to use [AddAnyPortMapping\(\)](#) instead of [AddPortMapping\(\)](#),
- [AddAnyPortMapping\(\)](#) allows requests for a preferred port mapping; if it is not free, the gateway will make an alternative reservation,
- [DeletePortMapping\(\)](#) allows deletion of a single port mapping entry,
- [DeletePortMappingRange\(\)](#) allows removal of a range of port mapping entries.

NAT port mapping rules can be created by other mechanisms besides [WANIPConnection](#). Therefore, it is possible that port mappings done by independent mechanisms may overlap or conflict. It is left to vendors to determine suitable algorithm on how to resolve conflicting

¹ When the [RemoteHost](#) parameter corresponds to a wildcard value, the port mapping rule has an endpoint independent filtering behaviour, and when the [RemoteHost](#) parameter corresponds to a specific remote host, the port mapping rule has an address dependent filtering behaviour (see [13] terminology).

mappings. A new error code has been created (729 [PortMappingNotAllowed](#)) in order to allow [WANIPConnection](#) to deny a request due to conflict with other mechanisms.

c) The third feature set covers security policies

The [WANIPConnection](#) service defines security policy classifying actions at two levels:

- Actions that require specific authentication. The access control requirements are specifically referenced within each action's description,
- Access restrictions to actions and parameters based on the control point's IP address. The restrictions are handled locally within this service. In port mappings, there are three UPnP entities involved: The *IGD control point* which edits port mappings, the *client* which needs the port mapping, and the *gateway* service that executes the port mapping. When the control point and the client are located in the same physical device, this is called the 2-box model. If the control point is located in another device, then this is called the 3-box model. [3] recommends that no authentication or authorization is needed in 2-box model in most actions. [3] recommends that control point configuring the gateway is authenticated and authorized in 3-box model. However, services may choose a different security policy.

For security reasons, UPnP IGD shall expose UPnP services only over the LAN interface. IGD shall reject UPnP requests from the WAN interfaces.

5.4 State variables

5.4.1 State variable overview

There are three kinds of state variables in [WANIPConnection:2](#):

- Basic connection settings and connections status,
- Disconnection time settings,
- Specific variables for NAT traversal / port mapping creation and deletion.

Note: For first-time reader, it may be more insightful to read Annex A first and then the action definitions before reading the state variable definitions.

Table 2 — State Variables

Variable Name	R/A	Data Type	Reference
ConnectionType	R	string	See 5.4.2
PossibleConnectionTypes	R	string (CSV)	See 5.4.3
ConnectionStatus	R	string	See 5.4.4
Uptime	R	ui4	See 5.4.5
LastConnectionError	R	string	See 5.4.6
AutoDisconnectTime	A	ui4	See 5.4.7
IdleDisconnectTime	A	ui4	See 5.4.8
WarnDisconnectDelay	A	ui4	See 5.4.9
RSIPAvailable	R	boolean	See 5.4.10
NATEnabled	R	boolean	See 5.4.11
ExternalIPAddress	R	string	See 5.4.12
PortMappingNumberOfEntries	R	ui2	See 5.4.13
PortMappingEnabled	R	boolean	See 5.4.14
PortMappingLeaseDuration	R	ui4	See 5.4.15

Variable Name	R/A	Data Type	Reference
<u>RemoteHost</u>	<u>R</u>	<u>string</u>	See 5.4.16
<u>ExternalPort</u>	<u>R</u>	<u>ui2</u>	See 5.4.17
<u>InternalPort</u>	<u>R</u>	<u>ui2</u>	See 5.4.18
<u>PortMappingProtocol</u>	<u>R</u>	<u>string</u>	See 5.4.19
<u>InternalClient</u>	<u>R</u>	<u>string</u>	See 5.4.20
<u>PortMappingDescription</u>	<u>R</u>	<u>string</u>	See 5.4.21
<u>SystemUpdateID</u>	<u>R</u>	<u>ui4</u>	See 5.4.22
<u>A_ARG_TYPE_Manage</u>	<u>R</u>	<u>boolean</u>	See 5.4.23
<u>A_ARG_TYPE_PortListing</u>	<u>R</u>	<u>string</u> (XML fragment)	See 5.4.24
<i>Non standard state variables implemented by an UPnP vendor go here</i>	<i>X</i>	<i>TBD</i>	<i>TBD</i>

Figure 1 shows the relationships among gateway system components and WANIPConnection state variables for NAT processing. The relationships are the same in both the 2-box model and 3-box model.

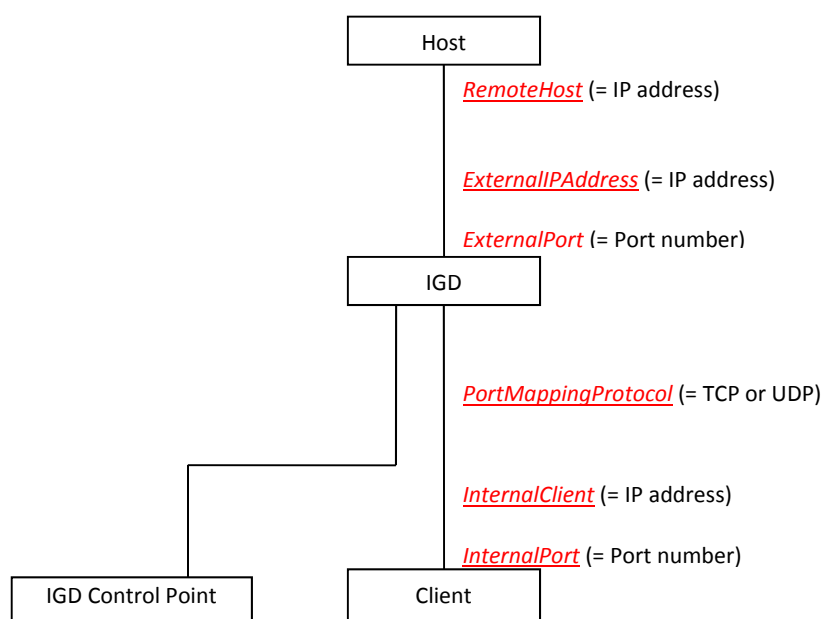


Figure 1 — UPnP IGD component relationships for NAT processing

NAT-related state variables:

- RemoteHost is the WAN IP address (destination) of connections initiated by a client in the local network.
- ExternalIPAddress is the WAN IP address of the Client as seen by the remote host.
- ExternalPort is a source TCP or UDP port number of the Client as seen by the remote host.
- InternalClient is the local IP address of the client.
- InternalPort is the local TCP or UDP port number of the client.