
WANIPConnection:2 Service

For UPnP Version 1.0

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Contents

Contents.....	3
List of Tables.....	6
List of Figures	8
1 Overview and Scope.....	9
1.1 Introduction.....	9
1.2 Changes since <u>WANIPConnection:1</u>	9
1.3 Notation.....	11
1.3.1 Data Types.....	11
1.3.2 Derived data types.....	12
1.4 Vendor-defined Extensions.....	13
1.5 References.....	13
1.5.1 Normative References.....	13
1.5.2 Informative references	14
2 Service Modeling Definitions (Normative).....	15
2.1 Service Type	15
2.2 Terms and Abbreviations	15
2.2.1 Abbreviations.....	15
2.2.2 Terms	17
2.3 <u>WANIPConnection</u> Service Architecture	18
2.3.1 State Variables	19
2.3.2 State Variable Overview.....	19
2.3.3 <u>ConnectionType</u>	20
2.3.4 <u>PossibleConnectionTypes</u>	21
2.3.5 <u>ConnectionStatus</u>	21
2.3.6 <u>Uptime</u>	22
2.3.7 <u>LastConnectionError</u>	22
2.3.8 <u>AutoDisconnectTime</u>	22
2.3.9 <u>IdleDisconnectTime</u>	23
2.3.10 <u>WarnDisconnectDelay</u>	23
2.3.11 <u>RSIPAvailable</u>	23
2.3.12 <u>NATEnabled</u>	23
2.3.13 <u>ExternalIPAddress</u>	23
2.3.14 <u>PortMappingNumberOfEntries</u>	23
2.3.15 <u>PortMappingEnabled</u>	23
2.3.16 <u>PortMappingLeaseDuration</u>	24
2.3.17 <u>RemoteHost</u>	24
2.3.18 <u>ExternalPort</u>	24
2.3.19 <u>InternalPort</u>	25
2.3.20 <u>PortMappingProtocol</u>	25
2.3.21 <u>InternalClient</u>	25
2.3.22 <u>PortMappingDescription</u>	25

2.3.23	<i>SystemUpdateID</i>	25
2.3.24	<i>A_ARG_TYPE_Manage</i>	26
2.3.25	<i>A_ARG_TYPE_PortListing</i>	26
2.4	Eventing and Moderation	27
2.4.1	Eventing of <i>PossibleConnectionTypes</i>	28
2.4.2	Eventing of <i>ConnectionStatus</i>	28
2.4.3	Eventing of <i>ExternalIPAddress</i>	29
2.4.4	Eventing of <i>PortMappingNumberOfEntries</i>	29
2.4.5	Eventing of <i>SystemUpdateID</i>	29
2.4.6	Relationships among State Variables	29
2.5	Actions	29
2.5.1	<i>SetConnectionType()</i>	32
2.5.2	<i>GetConnectionTypeInfo()</i>	33
2.5.3	<i>RequestConnection()</i>	34
2.5.4	<i>RequestTermination()</i>	35
2.5.5	<i>ForceTermination()</i>	37
2.5.6	<i>SetAutoDisconnectTime()</i>	38
2.5.7	<i>SetIdleDisconnectTime()</i>	39
2.5.8	<i>SetWarnDisconnectDelay()</i>	40
2.5.9	<i>GetStatusInfo()</i>	41
2.5.10	<i>GetAutoDisconnectTime()</i>	42
2.5.11	<i>GetIdleDisconnectTime()</i>	43
2.5.12	<i>GetWarnDisconnectDelay()</i>	44
2.5.13	<i>GetNATRSIPStatus()</i>	45
2.5.14	<i>GetGenericPortMappingEntry()</i>	46
2.5.15	<i>GetSpecificPortMappingEntry()</i>	47
2.5.16	<i>AddPortMapping()</i>	49
2.5.17	<i>AddAnyPortMapping()</i>	53
2.5.18	<i>DeletePortMapping()</i>	56
2.5.19	<i>DeletePortMappingRange()</i>	57
2.5.20	<i>GetExternalIPAddress()</i>	59
2.5.21	<i>GetListOfPortMappings()</i>	60
2.5.22	Relationships Between Actions	62
2.5.23	Error Code Summary	62
2.6	Service Behavioral Model	64
2.6.1	Connection Initiation	64
2.6.2	Connection Termination	65
3	Theory of Operation (Informative)	67
3.1.1	Connection Scenarios	67
3.1.2	Non-UPnP compliant clients	68
3.1.3	VPN connections	68
3.2	NAT & NAT traversal	69
3.2.1	NAT & NATP	69
3.2.2	NAT traversal	70

3.3	UPnP IGD & NAT Traversal.....	71
4	XML Service Description	72

List of Tables

Table 2-1:	Abbreviations.....	15
Table 2-2:	State Variables	19
Table 2-3:	allowedValueList for the <u>ConnectionType</u> state variable	20
Table 2-4:	allowedValueList for the <u>ConnectionStatus</u> state variable	21
Table 2-5:	allowedValueList for the <u>LastConnectionError</u> state variable	22
Table 2-6:	allowedValueRange for the <u>PortMappingLeaseDuration</u> state variable	24
Table 2-7:	allowedValueRange for the <u>InternalPort</u> state variable	25
Table 2-8:	allowedValueList for the <u>PortMappingProtocol</u> state variable	25
Table 2-9:	Eventing and Moderation.....	27
Table 2-10:	Actions	29
Table 2-11:	Common parameters	30
Table 2-12:	Arguments for <u>SetConnectionType()</u>	32
Table 2-13:	Error Codes for <u>SetConnectionType()</u>	33
Table 2-14:	Arguments for <u>GetConnectionTypeInfo()</u>	33
Table 2-15:	Error Codes for <u>GetConnectionTypeInfo()</u>	34
Table 2-16:	Error Codes for <u>RequestConnection()</u>	35
Table 2-17:	Error Codes for <u>RequestTermination()</u>	36
Table 2-18:	Error Codes for <u>ForceTermination()</u>	37
Table 2-19:	Arguments for <u>SetAutoDisconnectTime()</u>	38
Table 2-20:	Error Codes for <u>SetAutoDisconnectTime()</u>	39
Table 2-21:	Arguments for <u>SetIdleDisconnectTime()</u>	39
Table 2-22:	Error Codes for <u>SetIdleDisconnectTime()</u>	40
Table 2-23:	Arguments for <u>SetWarnDisconnectDelay()</u>	40
Table 2-24:	Error Codes for <u>SetWarnDisconnectDelay()</u>	41
Table 2-25:	Arguments for <u>GetStatusInfo()</u>	41
Table 2-26:	Error Codes for <u>GetStatusInfo()</u>	42
Table 2-27:	Arguments for <u>GetAutoDisconnectTime()</u>	42
Table 2-28:	Error Codes for <u>GetAutoDisconnectTime()</u>	43
Table 2-29:	Arguments for <u>GetIdleDisconnectTime()</u>	43
Table 2-30:	Error Codes for <u>GetIdleDisconnectTime()</u>	44
Table 2-31:	Arguments for <u>GetWarnDisconnectDelay()</u>	44
Table 2-32:	Error Codes for <u>GetWarnDisconnectDelay()</u>	45
Table 2-33:	Arguments for <u>GetNATRSIPStatus()</u>	45
Table 2-34:	Error Codes for <u>GetNATRSIPStatus()</u>	46
Table 2-35:	Arguments for <u>GetGenericPortMappingEntry()</u>	46

Table 2-36:	Error Codes for <u>GetGenericPortMappingEntry()</u>	47
Table 2-37:	Arguments for <u>GetSpecificPortMappingEntry()</u>	48
Table 2-38:	Error Codes for <u>GetSpecificPortMappingEntry()</u>	49
Table 2-39:	Arguments for <u>AddPortMapping()</u>	50
Table 2-40:	Error Codes for <u>AddPortMapping()</u>	52
Table 2-41:	Arguments for <u>AddAnyPortMapping()</u>	53
Table 2-42:	Error Codes for <u>AddAnyPortMapping()</u>	55
Table 2-43:	Arguments for <u>DeletePortMapping()</u>	56
Table 2-44:	Error Codes for <u>DeletePortMapping()</u>	57
Table 2-45:	Arguments for <u>DeletePortMappingRange()</u>	58
Table 2-46:	Error Codes for <u>DeletePortMappingRange()</u>	59
Table 2-47:	Arguments for <u>GetExternalIPAddress()</u>	59
Table 2-48:	Error Codes for <u>GetExternalIPAddress()</u>	60
Table 2-49:	Arguments for <u>GetListOfPortMappings()</u>	60
Table 2-50:	Error Codes for <u>GetListOfPortMappings()</u>	61
Table 2-51:	Error Code Summary	62
Table 3-1:	Connection Procedures	67

List of Figures

Figure 2-1:	UPnP IGD terminology for NAT rules.....	17
Figure 2-2:	Example of relationship between <u>AddPortMapping()</u> action and port triggering.....	49
Figure 2-3:	Summary of <u>AddPortMapping()</u> results.....	51
Figure 2-4:	Summary of <u>AddAnyPortMapping()</u> results	55
Figure 2-5:	State diagram for IP connection.....	64
Figure 3-1:	NAT is an IP address translator	70
Figure 3-2:	NAT issue with bundled session applications	70

1 Overview and Scope

This service definition is compliant with the UPnP Device Architecture version 1.0. It defines a service type referred to herein as [WANIPConnection](#) service.

1.1 Introduction

This service-type enables a UPnP control point to configure and control IP connections on the WAN interface of a UPnP compliant [InternetGatewayDevice](#)¹. Any type of WAN interface (e.g., DSL or cable) that can support an IP connection can use this service.

The service is REQUIRED if an IP connection is used for WAN access, and is specified in urn:[schemas-upnp-org:device:WANConnectionDevice](#), one or more instances of which are specified under the device: urn:[schemas-upnp-org:device:WANDevice](#)

An instance of [WANDevice](#) is specified under the root device:

urn:[schemas-upnp-org:device:InternetGatewayDevice](#)

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.

In accordance with UPnP Device Architecture version 1.0, 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.

1.2 Changes since [WANIPConnection:1](#)

This chapter lists the changes made over version 1 of this service. This service is fully compliant with [WANIPConnection:1](#) service, except in cases where access control has been added.

Generic requirements and other changes:

- The NAT behaviour SHOULD follow IETF RFCs [RFC 5382] and [RFC 4787],
- When a control point creates a port forwarding rule for inbound traffic, this rule MUST also be applied when NAT port triggering occurs for outbound traffic,
- UPnP IGD MUST expose UPnP services only over the LAN interface. IGD MUST reject UPnP requests from the WAN interfaces,
- Upon startup, UPnP IGD DCP MUST 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.

¹ Refer to companion documents defined by the UPnP Internet Gateway working committee for more details on specific devices and services referenced in this document.

- From version 2, error codes 724 *SamePortValuesRequired*, 725 *OnlyPermanentLeasesSupported*, 726 *RemoteHostOnlySupportsWildcard* and 727 *ExternalPortOnlySupportsWildcard* are deprecated from IGD, but control points are REQUIRED to support those error codes due to legacy support. For details, see 2.5.16.
- Clarifications to specification 1.0.

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.

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.

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),
- IGD 2 introduces access control features. [IGD2] RECOMMENDS access control requirements and authorization levels to be applied by *default*. However, devices MAY choose a different security policy,
- This version 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, [IGD2] 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, [IGD2] RECOMMENDS that authentication and authorization is used.
- To summarize, [IGD2] 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, devices MAY choose a different security policy,
- [IGD2] 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, devices MAY choose a different security policy,
- NAT port mapping rules can be created by other mechanisms besides UPnP IGD. 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 an IGD to deny a request due to conflict with other mechanisms,
- IGD 2 MUST support both wildcard and specific IP address values for *RemoteHost* (only the wildcard value was REQUIRED in release 1.0),
- IGD 2 MUST 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 wild-carded) 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.

1.3 Notation

- In this document, features are described as Required, Recommended, or Optional as follows:

The key words “MUST,” “MUST NOT,” “REQUIRED,” “SHALL,” “SHALL NOT,” “SHOULD,” “SHOULD NOT,” “RECOMMENDED,” “MAY,” and “OPTIONAL” in this specification are to be interpreted as described in [RFC 2119].

In addition, the following keywords are used in this specification:

PROHIBITED – The definition or behavior is an absolute prohibition of this specification. Opposite of REQUIRED.

CONDITIONALLY REQUIRED – The definition or behavior depends on a condition. If the specified condition is met, then the definition or behavior is REQUIRED, otherwise it is PROHIBITED.

CONDITIONALLY OPTIONAL – The definition or behavior depends on a condition. If the specified condition is met, then the definition or behavior is OPTIONAL, otherwise it is PROHIBITED.

These keywords are thus capitalized when used to unambiguously specify requirements over protocol and application features and behavior that affect the interoperability and security of implementations. When these words are not capitalized, they are meant in their natural-language sense.

- Strings that are to be taken literally are enclosed in “double quotes”.
- Words that are emphasized are printed in *italic*.
- Keywords that are defined by the UPnP Working Committee are printed using the *forum* character style.
- Keywords that are defined by the UPnP Device Architecture are printed using the *arch* character style.
- A double colon delimiter, “::”, signifies a hierarchical parent-child (parent::child) relationship between the two objects separated by the double colon. This delimiter is used in multiple contexts, for example: Service::Action(), Action()::Argument, parentProperty::childProperty.

1.3.1 Data Types

This specification uses data type definitions from two different sources. The UPnP Device Architecture defined data types are used to define state variable and action argument data types [DEVICE1.0]. The XML Schema namespace is used to define property data types [XML SCHEMA-2].

For UPnP Device Architecture defined Boolean data types, it is strongly RECOMMENDED to use the value “0” for false, and the value “1” for true. The values “true”, “yes”, “false”, or “no” MAY also be used but are NOT RECOMMENDED. The values “yes” and “no” are deprecated and MUST NOT be sent out by devices but MUST be accepted on input.

For XML Schema defined Boolean data types, it is strongly RECOMMENDED to use the value “0” for false, and the value “1” for true. The values “true”, “yes”, “false”, or “no” MAY also be used but are NOT RECOMMENDED. The values “yes” and “no” are deprecated and MUST NOT be sent out by devices but MUST be accepted on input.

1.3.2 Derived data types

This section defines a derived data type that is represented as a string data type with special syntax. This specification uses string data type definitions that originate from two different sources. The UPnP Device Architecture defined string data type is used to define state variable and action argument string data types. The XML Schema namespace is used to define property xsd:string data types. The following definition applies to both string data types.

1.3.2.1 Comma Separated Value (CSV) Lists

The UPnP IGD services use state variables, action arguments and properties that represent lists – or onedimensional arrays – of values. The UPnP Device Architecture, Version 1.0 [DEVICE1.0], does not provide for either an array type or a list type, so a list type is defined here. 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 data type of a homogeneous list is string or xsd:string and 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 denoted by CSV (x, y, z), where x, y and z are the types of the individual values. If the number of values in the heterogeneous list is too large to show each type individually, that variable type is represented as 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 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.

- A list is represented as a string type (for state variables and action arguments) or xsd:string type (for properties).
- Commas separate values within a list.
- Integer values are represented in CSVs with the same syntax as the integer data type specified in [DEVICE1.0] (that is: optional leading sign, optional leading zeroes, numeric ASCII)
- Boolean values are represented in state variable and action argument CSVs as either “0” for false or “1” for true. These values are a subset of the defined Boolean data type values specified in [DEVICE1.0]: 0, false, no, 1, true, yes.
- Boolean values are represented in property CSVs as either “0” for false or “1” for true. These values are a subset of the defined Boolean data type values specified in [XML SCHEMA-2]: 0, false, 1, true.
- Escaping conventions for the comma and backslash characters are defined in Section 1.2.2, “Strings Embedded in Other Strings”.
- 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.

Type of Refinement String	Value	Comments
CSV (string) or CSV (xsd:string)	“+artist,-date”	List of 2 property sort criteria.
CSV (int) or CSV (xsd:integer)	“1,-5,006,0,+7”	List of 5 integers.
CSV (boolean) or CSV (xsd:Boolean)	“0,1,1,0”	List of 4 booleans
CSV (string) or CSV (xsd:string)	“Smith\, Fred,Jones\, Davey”	List of 2 names, “Smith, Fred” and “Jones, Davey”
CSV (i4,string,ui2) or CSV (xsd:int, xsd:string, xsd:unsignedShort)	“-29837, string with leading blanks,0”	Note that the second value is “ string with leading blanks”
CSV (i4) or CSV (xsd:int)	“3, 4”	Illegal CSV. White space is not allowed as part of an integer value.
CSV (string) or CSV (xsd:string)	“,,”	List of 3 empty string values
CSV (heterogeneous)	“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 string , a department string and years-of-service ui2 or a name xsd:string, a department xsd:string and years-of-service xsd:unsignedShort

1.4 Vendor-defined Extensions

Whenever vendors create additional vendor-defined state variables, actions or properties, their assigned names and XML representation MUST follow the naming conventions and XML rules as specified in [DEVICE1.0], Section 2.5, “Description: Non-standard vendor extensions”.

1.5 References

1.5.1 Normative References

[DEVICE1.0] – UPnP Device Architecture, version 1.0, UPnP Forum, June 8, 2000.

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

[DEVICE1.1] – UPnP Device Architecture, version 1.1, UPnP Forum, October 15, 2008.

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

[IGD2] – UPnP *InternetGatewayDevice:2*, version 1.00, UPnP Forum, December 10, 2010.

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

[ISO 8601] – Data elements and interchange formats – Information interchange -- Representation of dates and times, International Standards Organization, December 21, 2000.

Available at: [ISO 8601:2000](http://www.iso.org/iso/8601_2000.html).

[RFC 1035] – IETF RFC 1035, Domain names - implementation and specification, P. Mockapetris, November 1987.

Available at: <http://tools.ietf.org/html/rfc1035>.

[RFC 2119] – IETF RFC 2119, Key words for use in RFCs to Indicate Requirement Levels, S. Bradner, March 1997.

Available at: <http://tools.ietf.org/html/rfc2119>.

[RFC 3986] – IETF RFC 3986, Uniform Resource Identifier (URI): Generic Syntax, T. Berners-Lee, R. Fielding, L. Masinter, January 2006.

Available at: <http://tools.ietf.org/html/rfc3986>.

[RFC 3339] – IETF RFC 3339, Date and Time on the Internet: Timestamps, G. Klyne, Clearswift Corporation, C. Newman, Sun Microsystems, July 2002.

Available at: <http://tools.ietf.org/html/rfc3339>.

[XML] – Extensible Markup Language (XML) 1.0 (Third Edition), François Yergeau, Tim Bray, Jean Paoli, C. M. Sperberg-McQueen, Eve Maler, eds., W3C Recommendation, February 4, 2004.

Available at: <http://www.w3.org/TR/2004/REC-xml-20040204>.

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

Available at: <http://www.w3.org/TR/2004/REC-xmlschema-2-20041028>.

1.5.2 Informative references

[RFC 3102] – IETF RFC 3102, Realm Specific IP: Framework, M.Borella, J. Lo, D. Grabelsky, G. Montenegro, October 2001.

Available at: <http://tools.ietf.org/html/rfc3102>.

[RFC 3103] – IETF RFC 3103, Realm Specific IP: Protocol Specification, M. Borella, D. Grabelsky, J. Lo, K. Taniguchi, October 2001.

Available at: <http://tools.ietf.org/html/rfc3103>.

[RFC 5382] – IETF RFC 5382, NAT Behavioral Requirements for TCP, S. Guha, K. and Biswas and B. Ford and S. Sivakumar and P. Srisuresh, October 2008.

Available at: <http://tools.ietf.org/html/rfc5382>.

[RFC 4787] – IETF RFC 4787, Network Address Translation (NAT) Behavioral Requirements for Unicast UDP, F. Audet and C. Jennings, January 2007.

Available at: <http://tools.ietf.org/html/rfc4787>.

2 Service Modeling Definitions (Normative)

2.1 Service Type

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

urn:schemas-upnp-org:service:WANIPConnection:2

WANIPConnection service is used herein to refer to this service type.

2.2 Terms and Abbreviations

2.2.1 Abbreviations

Table 2-1: Abbreviations

Abbreviation	Description
CSV	Comma Separated Value
DCP	Device Control Protocol
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name Service
DSL	Digital Subscriber Line
FTP	File Transfer Protocol
HTTP	HyperText Transfer Protocol
IETF	Internet Engineering Task Force
IGD	Internet Gateway Device
IP	Internet Protocol
ISP	Internet Service Provider
LAN	Local Area Network
MAC	Media Access Control
NAPT	Network Address Port Translation
NAT	Network Address Translation
POTS	Plain Old Telephone Service
PPP	Point-to-Point Protocol
RSIP	Realm Specific Internet Protocol
RTSP	Real Time Streaming Protocol
SIP	Session Initiation Protocol
SNMP	Simple Network Management Protocol
SOAP	Simple Object Access Protocol
SSDP	Simple Service Discovery Protocol

Abbreviation	Description
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
UI	User Interface
UPnP	Universal Plug and Play
URN	Universal Resource Name
UUID	Universally Unique Identifier
VC	Virtual Channel
VCI	Virtual Channel Identifier
VPI	Virtual Path Identifier
VPN	Virtual Private Network
WAN	Wide Area Network
XML	eXtensible Markup Language

2.2.2 Terms

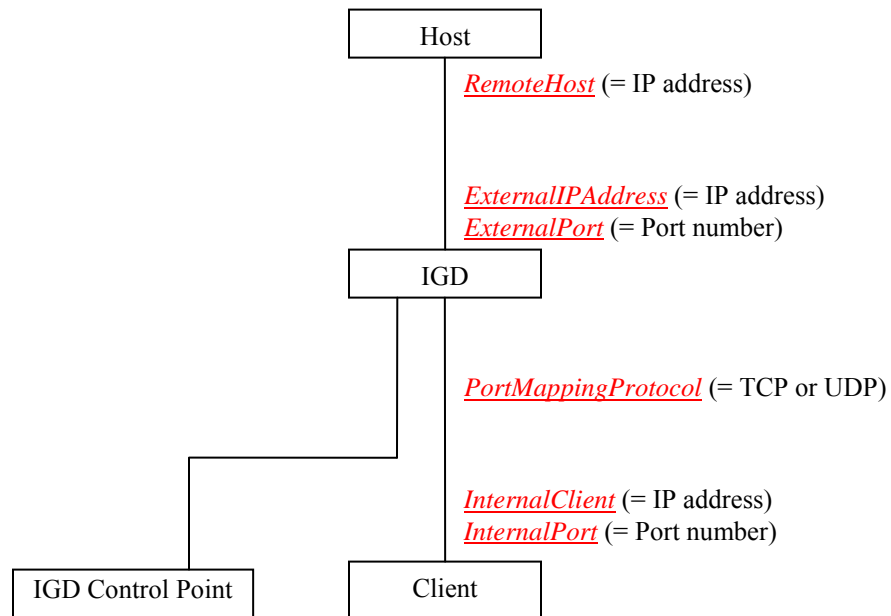


Figure 2-1: UPnP IGD terminology for NAT rules

Client is a host located in the local network connecting to the Internet e.g. to the remote host.

IGD Control Point is a UPnP control point using UPnP IGD to control an Internet Gateway device (IGD).

Both *Client* and *IGD control point* MAY or MAY NOT be located in the same physical device:

- **2-Box scenario** means that the *client* and the *IGD control point* are located in a single physical device,
- **3-Box scenario** means that the *IGD control point*, the *client*, and the Internet Gateway Device are all in separate physical devices having different IP address.

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.

PortMappingProtocol is either TCP or UDP.

Port forwarding refers to a port mapping rule which allows a remote host to reach a port on a client with private IP address (inside a LAN) via a NAT enabled router (ex: IGD).

Port triggering is a way to automate port forwarding in which outbound traffic on predetermined ports ('triggering ports') causes inbound traffic to specific incoming ports to be dynamically forwarded to the initiating host, while the outbound ports are in use.

2.3 WANIPConnection Service Architecture

This service has three main features.

The first set of functionalities 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.

The second feature 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 since release 2.0 of the specification, 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 UPnP IGD. 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 mappings. A new error code has been created (729 PortMappingNotAllowed) in order to allow an IGD to deny a request due to conflict with other mechanisms.

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

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 (cf. [RFC 4787] terminology).

control point which edits port mappings, the *client* which needs the port mapping, and the *gateway* device 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. [IGD2] RECOMMENDS that no authentication nor authorization is needed in 2-box model in most actions. [IGD2] RECOMMENDS that control point configuring the gateway is authenticated and authorized in 3-box model. However, devices MAY choose a different security policy. For security reasons, UPnP IGD MUST expose UPnP services only over the LAN interface. IGD MUST reject UPnP requests from the WAN interfaces.

2.3.1 State Variables

The state variables in this service can be divided into the following types:

- 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 the theory of operations first and then the action definitions before reading the state variable definitions.

2.3.2 State Variable Overview

Table 2-2: State Variables

Variable Name	R/O ¹	Data Type	Reference
<u>ConnectionType</u>	<u>R</u>	<u>string</u>	See Section 2.3.3
<u>PossibleConnectionTypes</u>	<u>R</u>	<u>string</u> (CSV)	See Section 2.3.4
<u>ConnectionStatus</u>	<u>R</u>	<u>string</u>	See Section 2.3.5
<u>Uptime</u>	<u>R</u>	<u>ui4</u>	See Section 2.3.6
<u>LastConnectionError</u>	<u>R</u>	<u>string</u>	See Section 2.3.7
<u>AutoDisconnectTime</u>	<u>O</u>	<u>ui4</u>	See Section 2.3.8
<u>IdleDisconnectTime</u>	<u>O</u>	<u>ui4</u>	See Section 2.3.9
<u>WarnDisconnectDelay</u>	<u>O</u>	<u>ui4</u>	See Section 2.3.10
<u>RSIPAvailable</u>	<u>R</u>	<u>boolean</u>	See Section 2.3.11
<u>NATEnabled</u>	<u>R</u>	<u>boolean</u>	See Section 2.3.12
<u>ExternalIPAddress</u>	<u>R</u>	<u>string</u>	See Section 2.3.13
<u>PortMappingNumberOfEntries</u>	<u>R</u>	<u>ui2</u>	See Section 2.3.14
<u>PortMappingEnabled</u>	<u>R</u>	<u>boolean</u>	See Section 2.3.15
<u>PortMappingLeaseDuration</u>	<u>R</u>	<u>ui4</u>	See Section 2.3.16
<u>RemoteHost</u>	<u>R</u>	<u>string</u>	See Section 2.3.17
<u>ExternalPort</u>	<u>R</u>	<u>ui2</u>	See Section 2.3.18

Variable Name	R/O ¹	Data Type	Reference
<i>InternalPort</i>	<i>R</i>	<i>ui2</i>	See Section 2.3.19
<i>PortMappingProtocol</i>	<i>R</i>	<i>string</i>	See Section 2.3.20
<i>InternalClient</i>	<i>R</i>	<i>string</i>	See Section 2.3.21
<i>PortMappingDescription</i>	<i>R</i>	<i>string</i>	See Section 2.3.22
<i>SystemUpdateID</i>	<i>R</i>	<i>ui4</i>	See Section 2.3.23
<i>A_ARG_TYPE_Manage</i>	<i>R</i>	<i>boolean</i>	See Section 2.3.24
<i>A_ARG_TYPE_PortListing</i>	<i>R</i>	<i>string</i> (XML fragment)	See Section 2.3.25
<i>Non standard state variables implemented by an UPnP vendor go here</i>	<i>X</i>	<i>TBD</i>	<i>TBD</i>

¹ *R* = REQUIRED, *O* = OPTIONAL, *CR* = CONDITIONALLY REQUIRED, *CO* = CONDITIONALLY OPTIONAL, *X* = Non-standard, add *-D* when deprecated (e.g., *R-D*, *O-D*).

2.3.3 **ConnectionType**

This state variable is a *string* that contains information on the connection types used in the gateway.

Table 2-3: allowedValueList for the *ConnectionType* state variable

Value	R/O ¹
<i>Unconfigured</i>	<i>R</i>
<i>IP_Routed</i> (DEFAULT)	<i>R</i>
<i>IP_Bridged</i>	<i>R</i>
<i>Vendor-defined</i>	<i>X</i>

2.3.3.1 **Unconfigured**

Valid connection types cannot be identified. This MAY be due to the fact that the *LinkType* variable (if specified in the *WAN*LinkConfig* service) is uninitialized.

THIS VALUE IS DEPENDENT ON THE DEPLOYMENT AND TESTING SHOULD BE DEFERED TO THE VENDOR.

2.3.3.2 **IP_Routed**

The Internet Gateway is an IP router between the LAN and the WAN connection.

THIS VALUE IS ONLY APPLICABLE FOR AN IGD DEVICE SUPPORTING NAT. SHOULD NOT BE TESTED IN OTHER DEVICE CONFIGURATIONS.

2.3.3.3 **IP_Bridged**

The Internet Gateway is an Ethernet bridge between the LAN and the WAN connection. A router at the other end of the WAN connection from the IGD routes IP packets.

THIS VALUE IS ONLY APPLICABLE FOR AN IGD DEVICE CONFIGURED AS AN ETHERNET BRIDGE. SHOULD NOT BE TESTED IN OTHER DEVICE CONFIGURATIONS.

2.3.4 PossibleConnectionTypes

This variable represents a CSV list indicating the types of connections possible in the context of a specific modem and link type. Possible values are a subset or proper subset of values listed in Table 2-3.

NOTE: Refer to the WANConnectionDevice specification for valid combinations of LinkType and PossibleConnectionTypes for different modems that can support IP based connections.

2.3.5 ConnectionStatus

This state variable is a string that contains information on the status of the connection.

Table 2-4: allowedValueList for the ConnectionStatus state variable

Value	R/O
<u>Unconfigured</u>	<u>R</u>
<u>Connecting</u>	<u>Q</u>
<u>Connected</u>	<u>R</u>
<u>PendingDisconnect</u>	<u>Q</u>
<u>Disconnecting</u>	<u>Q</u>
<u>Disconnected</u>	<u>R</u>
<u>Vendor-defined</u>	<u>X</u>

NOTE: Whether or not a control point gets notified of the intermediary states of a connection transition MAY depend on the gateway implementation.

2.3.5.1 Unconfigured

This value indicates that other variables in the service table are uninitialized or in an invalid state. Examples of such variables include PossibleConnectionTypes and ConnectionType.

2.3.5.2 Connecting

The WANConnectionDevice is in the process of initiating a connection for the first time after the connection became disconnected.

2.3.5.3 Connected

At least one client has successfully initiated an Internet connection using this instance.

2.3.5.4 PendingDisconnect

The connection is active (packets are allowed to flow through), but will transition to Disconnecting state after a certain period (indicated by WarnDisconnectDelay).

2.3.5.5 Disconnecting

The WANConnectionDevice is in the process of terminating a connection. On successful termination, ConnectionStatus transitions to Disconnected.

2.3.5.6 **Disconnected**

No ISP connection is active (or being activated) from this connection instance. No packets are transiting the gateway.

2.3.6 **Uptime**

The variable *Uptime* represents time in seconds that this connections has stayed up. The type of this variable is [ui4](#).

2.3.7 **LastConnectionError**

This variable is a [string](#) that provides information about the cause of failure for the last connection setup attempt. The restricted list of enumeration values are listed in Table 2-5.

Table 2-5: allowedValueList for the *LastConnectionError* state variable

Value	R/O
<i>ERROR_NONE</i>	<u>R</u>
<i>ERROR_COMMAND_ABORTED</i>	<u>Q</u>
<i>ERROR_NOT_ENABLED_FOR_INTERNET</i>	<u>Q</u>
<i>ERROR_ISP_DISCONNECT</i>	<u>Q</u>
<i>ERROR_USER_DISCONNECT</i>	<u>Q</u>
<i>ERROR_IDLE_DISCONNECT</i>	<u>Q</u>
<i>ERROR_FORCED_DISCONNECT</i>	<u>Q</u>
<i>ERROR_NO_CARRIER</i>	<u>Q</u>
<i>ERROR_IP_CONFIGURATION</i>	<u>Q</u>
<i>ERROR_UNKNOWN</i>	<u>Q</u>
<i>Vendor-defined</i>	<u>X</u>

2.3.8 **AutoDisconnectTime**

The *AutoDisconnectTime* variable represents time in seconds (since the establishment of the connection – measured from the time *ConnectionStatus* transitions to *Connected*), after which connection termination is automatically initiated by the gateway. This occurs irrespective of whether the connection is being used or not. A value of zero for *AutoDisconnectTime* indicates that the connection is not to be turned off automatically. However, this MAY be overridden by:

- An implementation specific WAN/Gateway device policy,
- *EnabledForInternet* variable (see *WANCommonInterfaceConfig**) being set to “0” (false) by a control point,
- Connection termination initiated by ISP.

If *WarnDisconnectDelay* is non-zero, the connection state is changed to *PendingDisconnect*. It stays in this state for *WarnDisconnectDelay* seconds (if no connection requests are made) before switching to *Disconnected*. The data type of this variable is [ui4](#).

2.3.9 **IdleDisconnectTime**

IdleDisconnectTime represents the idle time of a connection in seconds (since the establishment of the connection), after which connection termination is initiated by the gateway. A value of zero for this variable allows infinite idle time – connection will not be terminated due to idle time.

NOTE: Layer 2 heartbeat packets are included as part of an idle state i.e., they do not reset the idle timer. The data type of this variable is **ui4**.

If *WarnDisconnectDelay* is non-zero, the connection state is changed to *PendingDisconnect*. It stays in this state for *WarnDisconnectDelay* seconds (if no connection requests are made) before switching to *Disconnected*.

2.3.10 **WarnDisconnectDelay**

This variable represents time in seconds the *ConnectionStatus* remains in the *PendingDisconnect* state before transitioning to *Disconnecting* state to drop the connection. For example, if this variable was set to 5 seconds, and one of the clients terminates an active connection, the gateway will wait (with *ConnectionStatus* as *PendingDisconnect*) for 5 seconds before actual termination of the connection. A value of zero for this variable indicates that no warning will be given to clients before terminating the connection. The data type of this variable is **ui4**.

2.3.11 **RSIPAvailable**

This variable indicates if Realm-specific IP (RSIP) is available as a feature on the Internet Gateway Device. The type of this variable is **boolean**. RSIP has been defined by IETF ([RFC 3102], [RFC 3103]) to allow host-NATing using a standard set of message exchanges. It also allows end-to-end applications that otherwise break if NAT is introduced (e.g. IPsec-based VPNs). A gateway that does not support RSIP MUST set this variable to 0.

2.3.12 **NATEnabled**

This **boolean** type variable indicates if Network Address Translation (NAT) is enabled for this connection.

2.3.13 **ExternalIPAddress**

ExternalIPAddress is a **string** containing the external IP address used by NAT for the connection. The format of this string is standard IP address representation and MUST be formatted as:

- a set of four decimal digit groups separated by "." as defined in [RFC 3986],
- or an empty string.

When the external IP address could not be retrieved by the gateway (for example, because the interface is down or because there was a failure in the last connection setup attempt), then the *ExternalIPAddress* MUST be equal to the empty string.

2.3.14 **PortMappingNumberOfEntries**

This variable indicates the number of NAT port mapping entries (number of elements in the array) configured on this connection.

2.3.15 **PortMappingEnabled**

This variable allows security conscious users to disable and enable dynamic NAT port mappings on the IGD. The type of this variable is **boolean**.

2.3.16 PortMappingLeaseDuration

Table 2-6: allowedValueRange for the PortMappingLeaseDuration state variable

Value		R/O
minimum	<u>0</u>	<u>R</u>
maximum	<u>604800</u>	<u>R</u>
default	<i>Vendor-defined</i> (RECOMMENDED value is 3600)	<u>R</u>

This variable determines the lifetime in seconds of a port-mapping lease. Non-zero values indicate the duration after which a port mapping will be removed, unless a control point refreshes the mapping.

In IGD release 1.0, a value of 0 was used to create a static port mapping. In version 2.0, it is no longer possible to create static port mappings via UPnP actions. Instead, an out-of-band mechanism is REQUIRED to do so (cf. WWW-administration, remote management or local management). In order to be backward compatible with legacy control points, the value of 0 MUST be interpreted as the maximum value (e.g. 604800 seconds, which corresponds to one week).

NOTE: Port mappings are NOT REQUIRED to be persistent across device resets or reboots. It is up to the control points to recreate their port mappings when needed.

2.3.17 RemoteHost

This variable represents the source of inbound IP packets. This variable can contain a host name or a standard IPv4 address representation. This state variable MUST be formatted as:

- a domain name of a network host like it is defined in [RFC 1035],
- or as a set of four decimal digit groups separated by "." as defined in [RFC 3986],
- or an empty string.

This will be a wildcard in most cases (an empty string). In version 2.0, NAT vendors are REQUIRED to support non-wildcarded IP addresses in addition to wildcards. A non-wildcard value will allow for “narrow” port mappings, which MAY be desirable in some usage scenarios. When RemoteHost is a wildcard, all traffic sent to the ExternalPort on the WAN interface of the gateway is forwarded to the InternalClient on the InternalPort (this corresponds to the endpoint independent filtering behaviour defined in the [RFC 4787]). When RemoteHost is specified as a specific external IP address as opposed to a wildcard, the NAT will only forward inbound packets from this RemoteHost to the InternalClient. All other packets will be dropped (this corresponds to the address dependent filtering behaviour defined in [RFC 4787]).

2.3.18 ExternalPort

This variable is of type [ui2](#) and represents the external port that the NAT gateway would “listen” on for connection requests to a corresponding InternalPort on an InternalClient. Inbound packets to this external port on the WAN interface of the gateway SHOULD be forwarded to InternalClient on the InternalPort on which the message was received. If this value is specified as a wildcard (i.e. 0), connection request on all external ports (that are not otherwise mapped) will be forwarded to InternalClient. In the wildcard case, the value(s) of InternalPort on InternalClient are ignored by the IGD for those connections that are forwarded to InternalClient. Obviously only one such entry can exist in the NAT at any time and conflicts are handled with a “first write wins” behavior. In version 2.0, NAT vendors are REQUIRED to support non-wildcarded ports.

2.3.19 InternalPort

This variable is of type [ui2](#) and represents the port on [InternalClient](#) that the gateway SHOULD forward connection requests to. A value of 0 is not allowed. NAT implementations that do not permit different values for [ExternalPort](#) and [InternalPort](#) will return an error.

Table 2-7: allowedValueRange for the [InternalPort](#) state variable

Value		R/O
minimum	1	R
maximum	65535	R

2.3.20 PortMappingProtocol

This [string](#) variable represents the protocol of the port mapping. Possible values are [TCP](#) or [UDP](#).

Table 2-8: allowedValueList for the [PortMappingProtocol](#) state variable

Value	R/O
TCP	R
UDP	R
Vendor-defined	X

2.3.21 InternalClient

This variable is a string containing the IP address or DNS host name of an [InternalClient](#) (on the residential LAN). This variable can contain a host name or a standard IPv4 address representation. This state variable MUST be formatted as:

- a domain name of a network host like it is defined in [RFC 1035],
- or as a set of four decimal digit groups separated by "." as defined in [RFC 3986].

Note that if the gateway does not support DHCP, it does not have to support DNS host names. Consequently, support for an IP address is REQUIRED, and support for DNS host names is RECOMMENDED. This value cannot be a wildcard (i.e. empty string). It MUST be possible to set the [InternalClient](#) to the broadcast IP address 255.255.255.255 for UDP mappings. This is to enable multiple NAT clients to use the same well-known port simultaneously.

2.3.22 PortMappingDescription

This is a [string](#) representation of a port mapping. The format of the description string is not specified and is application dependent. If specified, the description string can be displayed to a user via the UI of a control point, enabling easier management of port mappings. The description string for a port mapping (or a set of related port mappings) is NOT REQUIRED to be unique across multiple instantiations of an application on multiple nodes in the residential LAN.

2.3.23 SystemUpdateID

The type of this variable is [ui4](#), and it is used to notify of changes done in NAT or firewall rules.

Examples:

- the user changed the firewall level settings of his IGD, and the NAT port mappings rules are no more valid,

- the user disabled the UPnP IGD NAT traversal facilities through the WWW-administration of the IGD,
- the user updated a NAT rule thanks to the WWW-administration of his IGD, and that NAT rule was previously created by a UPnP IGD control point.

Whenever a change is done, the value of this variable is incremented by 1 and evented. A change can be an addition, a removal, an update, or the fact that a rule is disabled or enabled. So, control points are encouraged to check if their port mappings are still valid when notified.

This variable is evented when something which affects the port mappings validity occurs. Even if the event affects several port mappings rules, the variable is evented once (and not for each impacted port mappings rules).

Moreover, a control point needs to detect if the IGD has rebooted in order to check if its NAT port mappings rules are still valid. In [UPnP Device Architecture 1.0](#) (cf. [DEVICE1.0]), there are no mechanisms to detect when a device has rebooted. In [UPnP Device Architecture 1.1](#) (cf. [DEVICE1.1]), it is possible to detect rebooting thanks to [BOOTID](#). However, [UPnP Device Architecture 1.1](#) is NOT REQUIRED for implementing the [WANIPConnection](#) service.

Therefore, in order to allow control points to distinguish between the reboot of the IGD and the refreshment of the advertisement, the UPnP IGD MUST broadcast an [ssdp:byebye](#) before sending the initial [ssdp:alive](#) onto the local network upon startup. 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.

2.3.24 [A ARG TYPE Manage](#)

This argument type is used to describe management intent when issuing certain actions with elevated level of access. The type of this argument is [boolean](#).

2.3.25 [A ARG TYPE PortListing](#)

This argument type contains the list of port mapping entries.

2.3.25.1 XML Schema Definition

This is a string containing an XML fragment. The XML fragment in this argument MUST validate against the XML schema for [PortMappingList](#) in the XML namespace "urn:[schemas-upnp-org:gw:WANIPConnection](#)" which is located at: "<http://www.upnp.org/schemas/gw/WANIPConnection-v2.xsd>".

2.3.25.1.1 Description of fields in the [PortMappingList](#) structure

The fields in the XML fragment are:

[PortMappingList](#) is a REQUIRED structure defined as an XML element. There SHALL be only one element of this kind.

[PortMappingEntry](#) is a REQUIRED structure defined as an XML element. There can be zero to 65535 elements of this kind.

[NewRemoteHost](#) is a REQUIRED structure defined as an XML attribute. Its type corresponds to the [RemoteHost](#) state variable (type [string](#)).

[NewExternalPort](#) is a REQUIRED structure defined as an XML attribute. Its type corresponds to the [ExternalHost](#) state variable (type [ui2](#)).

NewProtocol is a REQUIRED structure defined as XML attribute. Its type corresponds to the PortMappingProtocol state variable (type string).

NewInternalPort is a REQUIRED structure defined as XML attribute. Its type corresponds to the InternalPort state variable (type ui2).

NewInternalClient is a REQUIRED structure defined as XML attribute. Its type corresponds to the InternalClient state variable (type string).

NewEnabled is a REQUIRED structure defined as XML attribute. Its type corresponds to the PortMappingEnabled state variable (type boolean).

NewDescription is a REQUIRED structure defined as XML attribute. Its type corresponds to the PortMappingDescription state variable (type string).

NewLeaseTime is a REQUIRED structure defined as XML attribute. Its type corresponds to the PortMappingLeaseDuration state variable (type ui4).

2.3.25.2 Sample XML document

```
<?xml version="1.0" encoding="UTF-8"?>
<p:PortMappingList xmlns:p="urn:schemas-upnp-org:gw:WANIPConnection"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="urn:schemas-upnp-org:gw:WANIPConnection
http://www.upnp.org/schemas/gw/WANIPConnection-v2.xsd">
  <p:PortMappingEntry>
    <p:NewRemoteHost>202.233.2.1</p:NewRemoteHost>
    <p:NewExternalPort>2345</p:NewExternalPort>
    <p:NewProtocol>TCP</p:NewProtocol>
    <p:NewInternalPort>2345</p:NewInternalPort>
    <p:NewInternalClient>192.168.1.137</p:NewInternalClient>
    <p:NewEnabled>1</p:NewEnabled>
    <p:NewDescription>doom</p:NewDescription>
    <p:NewLeaseTime>345</p:NewLeaseTime>
  </p:PortMappingEntry>
  <p:PortMappingEntry>
    <p:NewRemoteHost>134.231.2.11</p:NewRemoteHost>
    <p:NewExternalPort>12345</p:NewExternalPort>
    <p:NewProtocol>TCP</p:NewProtocol>
    <p:NewInternalPort>12345</p:NewInternalPort>
    <p:NewInternalClient>192.168.1.137</p:NewInternalClient>
    <p:NewEnabled>1</p:NewEnabled>
    <p:NewDescription>doom</p:NewDescription>
    <p:NewLeaseTime>345</p:NewLeaseTime>
  </p:PortMappingEntry>
</p:PortMappingList>
```

Note that this XML fragment is returned as part of SOAP response, and so needs to be XML escaped. Moreover, note that the XML declaration, `<?xml version="1.0" encoding="UTF-8"?>`, is OPTIONAL.

2.4 Eventing and Moderation

Table 2-9: Eventing and Moderation

Variable Name	Evented	Moderated	Criteria
<u>ConnectionType</u>	<u>NO</u>	<u>NO</u>	N/A

Variable Name	Evented	Moderated	Criteria
<u>PossibleConnectionTypes</u>	<u>YES</u>	<u>NO</u>	N/A
<u>ConnectionStatus</u>	<u>YES</u>	<u>NO</u>	N/A
<u>Uptime</u>	<u>NO</u>	<u>NO</u>	N/A
<u>LastConnectionError</u>	<u>NO</u>	<u>NO</u>	N/A
<u>AutoDisconnectTime</u>	<u>NO</u>	<u>NO</u>	N/A
<u>IdleDisconnectTime</u>	<u>NO</u>	<u>NO</u>	N/A
<u>WarnDisconnectDelay</u>	<u>NO</u>	<u>NO</u>	N/A
<u>RSIPAvailable</u>	<u>NO</u>	<u>NO</u>	N/A
<u>NATEnabled</u>	<u>NO</u>	<u>NO</u>	N/A
<u>ExternalIPAddress</u>	<u>YES</u>	<u>NO</u>	N/A
<u>PortMappingNumberOfEntries</u>	<u>YES</u>	<u>NO</u>	N/A
<u>PortMappingEnabled</u>	<u>NO</u>	<u>NO</u>	N/A
<u>PortMappingLeaseDuration</u>	<u>NO</u>	<u>NO</u>	N/A
<u>RemoteHost</u>	<u>NO</u>	<u>NO</u>	N/A
<u>ExternalPort</u>	<u>NO</u>	<u>NO</u>	N/A
<u>InternalPort</u>	<u>NO</u>	<u>NO</u>	N/A
<u>PortMappingProtocol</u>	<u>NO</u>	<u>NO</u>	N/A
<u>InternalClient</u>	<u>NO</u>	<u>NO</u>	N/A
<u>PortMappingDescription</u>	<u>NO</u>	<u>NO</u>	N/A
<u>SystemUpdateID</u>	<u>YES</u>	<u>NO</u>	N/A
<u>A_ARG_TYPE_Manage</u>	<u>NO</u>	<u>NO</u>	N/A
<u>A_ARG_TYPE_PortListing</u>	<u>NO</u>	<u>NO</u>	N/A
<i>Non-standard state variables implemented by an UPnP vendor go here.</i>	<i>TBD</i>	<i>TBD</i>	<i>TBD</i>

¹ R = REQUIRED, O = OPTIONAL, X = Non-standard.

2.4.1 Eventing of PossibleConnectionTypes

This event is created whenever the list of PossibleConnectionTypes has changed.

2.4.2 Eventing of ConnectionStatus

This variable is evented whenever ConnectionStatus has changed.

2.4.3 Eventing of ExternalIPAddress

This variable is evented whenever the external IP address of the gateway has changed.

2.4.4 Eventing of PortMappingNumberOfEntries

This variable is evented when the number of port mapping entries changes. SystemUpdateID and PortMappingNumberOfEntries MUST be evented at the same time when mapping rules are added or removed.

2.4.5 Eventing of SystemUpdateID

This variable is evented when NAT or firewall rules have been changed. The eventing of this variable MUST be done in the same time when PortMappingNumberOfEntries is evented.

2.4.6 Relationships among State Variables

If ConnectionStatus is set to Unconfigured, all other variables are set to their default values.

If ConnectionStatus is set to Disconnected, Uptime is set to its default value.

If NATEnabled is set to 0, other port mapping related set actions are essentially disabled. Get actions MAY still succeed. Moreover, SystemUpdateID is incremented by 1 and evented.

For port mappings, the PortMappingLeaseDuration variable counts down from the value set by the AddPortMapping() or AddAnyPortmapping() action. The value counts down independent of the state of PortMappingEnabled for that specific port mapping. If a GetGenericPortMappingEntry() or GetSpecificPortMappingEntry() action is invoked, the remaining time on a port-mapping lease is returned to the control point. For example if a port mapping is added with a lease duration of 1500 seconds and GetSpecificPortMappingEntry() is invoked on that port mapping 500 seconds later, PortMappingLeaseDuration will return 1000 as its value (+/- a few seconds accounting for clock drift). When PortMappingLeaseDuration counts to zero, the entry will be deleted by the IGD, independent of the state of PortMappingEnabled for that specific port mapping. The IGD will correspondingly modify local NAT (and firewall settings if appropriate) to stop forwarding packets as was specified in the deleted port mapping. This will also cause PortMappingNumberOfEntries to be decremented by 1 and evented. SystemUpdateID is incremented by 1 and evented every time a change is made to port mappings. Port mappings will not be automatically reinitiated by the IGD – it is the responsibility of a control point to refresh the port mapping a few “threshold” seconds before the port mapping is set to expire (i.e. PortMappingLeaseDuration equals zero) to prevent service disruption. The value of “threshold” seconds is implementation dependent.

2.5 Actions

Table 2-10: Actions

Name	Device R/O ¹	Control Point R/O ²
<u>SetConnectionType()</u>	R	O
<u>GetConnectionTypeInfo()</u>	R	O
<u>RequestConnection()</u>	R	O
<u>RequestTermination()</u>	O	O
<u>ForceTermination()</u>	R	O

Name	Device R/O ¹	Control Point R/O ²
<u>SetAutoDisconnectTime()</u>	O	O
<u>SetIdleDisconnectTime()</u>	O	O
<u>SetWarnDisconnectDelay()</u>	O	O
<u>GetStatusInfo()</u>	R	R
<u>GetAutoDisconnectTime()</u>	O	O
<u>GetIdleDisconnectTime()</u>	O	O
<u>GetWarnDisconnectDelay()</u>	O	O
<u>GetNATRSIPStatus()</u>	R	R
<u>GetGenericPortMappingEntry()</u>	R	R
<u>GetSpecificPortMappingEntry()</u>	R	R
<u>AddPortMapping()</u>	R	R
<u>AddAnyPortMapping()</u>	R	R
<u>DeletePortMapping()</u>	R	R
<u>DeletePortMappingRange()</u>	R	O
<u>GetExternalIPAddress()</u>	R	R
<u>GetListOfPortMappings()</u>	R	O
<i>Non-standard actions implemented by an UPnP vendor go here.</i>	X	X

¹ For a device this column indicates whether the action MUST be implemented or not, where **R** = REQUIRED, **O** = OPTIONAL, **CR** = CONDITIONALLY REQUIRED, **CO** = CONDITIONALLY OPTIONAL, **X** = Non-standard, add **-D** when deprecated (e.g., **R-D**, **O-D**).

² For a control pont this column indicates whether a control point MUST be capable of invoking this action, where **R** = REQUIRED, **O** = OPTIONAL, **CR** = CONDITIONALLY REQUIRED, **CO** = CONDITIONALLY OPTIONAL, **X** = Non-standard, add **-D** when deprecated (e.g., **R-D**, **O-D**).

Table 2-11: Common parameters

Variable Name	Related state variable	Reference
<u>NewRemoteHost</u>	<u>RemoteHost</u>	<p>This argument refers to the remote host which sends packets to the IGD. If a wildcard is defined then packets MAY be sent by any host, but if a specific IP address is defined, then only packets sent by this IP address are forwarded.</p> <p>This argument is of type string in format of “x.x.x.x”. The wildcard value corresponds to an empty string. This MAY also be DNS name in dotted notation. See <u>RemoteHost</u> state variable definition for details.</p>

Variable Name	Related state variable	Reference
<u>NewExternalPort</u>	<u>ExternalPort</u>	This argument defines the external port value of a port mapping. This port number is visible to external hosts during NAT operation. This argument is of type ui2 .
<u>NewProtocol</u>	<u>PortMappingProtocol</u>	This argument defines whether this port mapping is used by TCP or UDP connection. This argument is type of string and allowed values are “ <u>TCP</u> ” and “ <u>UDP</u> ”.
<u>NewInternalPort</u>	<u>InternalPort</u>	This argument defines the port number of the internal client where IGD forwards the incoming traffic. This argument is of type ui2 .
<u>NewInternalClient</u>	<u>InternalClient</u>	This argument defines the IP address of the internal host where IGD forwards incoming traffic. This argument is of type string in format of “x.x.x.x”. This MAY also be DNS name in dotted notation. See <u>InternalClient</u> state variable definition for details.
<u>NewEnabled</u>	<u>PortMappingEnabled</u>	This argument defines if this specific port mapping is enabled or disabled. This argument is type of boolean .
<u>NewPortMappingDescription</u>	<u>PortMappingDescription</u>	This argument provides a description of a port mapping entry. The type is string and formatting is left to applications.
<u>NewLeaseDuration</u>	<u>PortMappingLeaseDuration</u>	This argument defines the duration of the port mapping. The value of this argument MUST be greater than 0. A <u>NewLeaseDuration</u> with value 0 means static port mapping, but static port mappings can only be created through an out-of-band mechanism. If this parameter is set to 0, default value of 604800 MUST be used. The RECOMMENDED value for <u>NewLeaseDuration</u> is 3600 seconds.
<u>NewStartPort</u>	<u>ExternalPort</u>	This argument is type of ui2 , and it is used to describe the beginning of a port mapping range. Its allowed value range is the same as for <u>ExternalPort</u> state variable, but it MUST be less than or equal to <u>NewEndPort</u> .
<u>NewEndPort</u>	<u>ExternalPort</u>	This argument is type of ui2 , and it is used to describe the end of a port mapping range. Its allowed value range is the same as for <u>ExternalPort</u> state variable, but it MUST be greater than or equal to <u>NewStartPort</u> .

Variable Name	Related state variable	Reference
<u>NewManage</u>	<u>A_ARG_TYPE_Manage</u>	This argument is type of boolean , and if a control point wants to get or to remove only its own port mappings it SHOULD be set to “ 0 ” (false). If the intent is to manage port mappings for other clients, then <u>NewManage</u> SHOULD be set to “ 1 ” (true). This flag does not supersede access control based on control points IP address.

2.5.1 SetConnectionType()

This action sets up a specific connection type. Clients on the LAN MAY initiate or share connection only after this action completes and ConnectionType is set to a value other than Unconfigured. ConnectionType can be a read-only variable in cases where some form of auto configuration is employed.

2.5.1.1 Arguments

Table 2-12: Arguments for SetConnectionType()

Argument	Direction	relatedStateVariable
<u>NewConnectionType</u>	<u>IN</u>	<u>ConnectionType</u>

2.5.1.2 NewConnectionType

This argument defines what type of connection is to be established. See definition in chapter 2.3.3.

2.5.1.3 Service Requirements

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST return the 606 Action not authorized error code (defined in [DEVICE1.0]).

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

If the control point uses a NewConnectionType value which is not in the allowedValueList of the ConnectionType state variable, the gateway SHALL return the 601 Argument Value Out of Range error code (defined in [DEVICE1.0]).

2.5.1.4 Control Point Requirements When Calling The Action

Before invoking this action, a control point SHOULD verify that it has sufficient permission.

2.5.1.5 Dependency on Device State

If ConnectionStatus is neither Disconnected nor Unconfigured, this action cannot be completed.

2.5.1.6 Effect on Device State

This action sets the connection to a specific type. No connections can be established if ConnectionType is set to Unconfigured.

2.5.1.7 Errors

Table 2-13: Error Codes for **SetConnectionType()**

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	<u>Action not authorized</u>	The action requested REQUIRES authorization and the sender was not authorized.
703	<u>InactiveConnection StateRequired</u>	Current value of <u>ConnectionStatus</u> SHOULD be either <u>Disconnected</u> or <u>Unconfigured</u> to permit this action.
731	<u>ReadOnly</u>	Not possible to modify the value because it is read only.

2.5.2 **GetConnectionTypeInfo()**

This action retrieves the values of the current connection type and allowable connection types.

2.5.2.1 Arguments

Table 2-14: Arguments for **GetConnectionTypeInfo()**

Argument	Direction	relatedStateVariable
<u>NewConnectionType</u>	<u>OUT</u>	<u>ConnectionType</u>
<u>NewPossibleConnectionTypes</u>	<u>OUT</u>	<u>PossibleConnectionTypes</u>

2.5.2.2 **NewConnectionType**

This argument is defined in chapter 2.3.3.

2.5.2.3 **NewPossibleConnectionTypes**

This argument is defined in chapter 2.3.4.

2.5.2.4 Service Requirements

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST return the 606 Action not authorized error code (defined in [DEVICE1.0]).

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

2.5.2.5 Control Point Requirements When Calling The Action

Before invoking this action, a control point SHOULD verify that it has sufficient permission.

2.5.2.6 Dependency on Device State

None.

2.5.2.7 Effect on Device State

None.

2.5.2.8 Errors

Table 2-15: Error Codes for [GetConnectionTypeInfo\(\)](#)

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	Action not authorized	The action requested REQUIRES authorization and the sender was not authorized.

2.5.3 [RequestConnection\(\)](#)

A client sends this action to initiate a connection on an instance of a connection service that has a configuration already defined. [RequestConnection\(\)](#) causes the [ConnectionStatus](#) to immediately change to [Connecting](#) (if implemented) unless the action is not permitted in the current state of the IGD or the specific service instance. This change of state will be evented. [RequestConnection\(\)](#) SHOULD synchronously return at this time in accordance with UPnP architecture requirements that mandate that an action can take no more than 30 seconds to respond synchronously. However, the actual connection setup MAY take several seconds more to complete. If the connection setup is successful, [ConnectionStatus](#) will change to [Connected](#) and will be evented. If the connection setup is not successful, [ConnectionStatus](#) will eventually revert back to [Disconnected](#) and will be evented. [LastConnectionError](#) will be set appropriately in either case. While this MAY be obvious, it is worth noting that a control point MUST NOT source packets to the Internet until [ConnectionStatus](#) is updated to [Connected](#), or the IGD MAY drop packets until it transitions to the [Connected](#) state.

The process of requesting a connection is described in chapter 2.6.1.

2.5.3.1 Arguments

None.

2.5.3.2 Service Requirements

The IGD SHOULD implement a timeout mechanism to ensure that it does not remain in the [Connecting](#) state forever. The timeout value is implementation dependent.

When [ConnectionStatus](#) is in [PendingDisconnect](#) state, if any client sends [RequestConnection\(\)](#) command, the gateway MAY choose to discontinue the termination process by changing [ConnectionStatus](#) to [Connected](#). If connection is not restored, the gateway will return error code indicating that the connection was in the process of being torn down.

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST return the 606 [Action not authorized](#) error code (defined in [DEVICE1.0]).

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

2.5.3.3 Control Point Requirements When Calling The Action

Control points SHOULD manage a timeout for initiated connections to recover from catastrophic failures on the IGD. The timeout value is implementation dependent.

The IGD MAY take several seconds (or even a few minutes) to transition from the *Connecting* state to the *Connected* state. Control points SHOULD moderate the polling frequency of the *ConnectionStatus* variable on the IGD so as to not create data storms on the network.

Before invoking this action, a control point SHOULD verify that it has sufficient permission.

2.5.3.4 Dependency on Device State

The gateway MUST be configured before attempting connection. The state variable *ConnectionStatus* MUST be equal to either *Disconnected*, *PendingDisconnect* or *Connected* value, and the state variable *ConnectionType* MUST be equal to *IP_Routed*.

The *EnabledForInternet* flag in *WANCommonInterfaceConfig* MUST be set to “**1**” (true).

2.5.3.5 Effect on Device State

If successful, *ConnectionStatus* is changed to *Connected*.

2.5.3.6 Errors

Table 2-16: Error Codes for *RequestConnection()*

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	<i>Action not authorized</i>	The action requested REQUIRES authorization and the sender was not authorized.
704	<i>ConnectionSetupFailed</i>	There was a failure in setting up the IP or PPP connection with the service provider.
705	<i>ConnectionSetupInProgress</i>	The connection is already in the process of being setup (Current <i>ConnectionStatus</i> is <i>Connecting</i>).
706	<i>ConnectionNotConfigured</i>	Current <i>ConnectionStatus</i> is <i>Unconfigured</i> .
707	<i>DisconnectInProgress</i>	The connection is in the process of being torn down (Current <i>ConnectionStatus</i> is <i>Disconnecting</i>).
708	<i>InvalidLayer2Address</i>	Corresponding Link Config service has an invalid VPI/VCI or phone number.
709	<i>InternetAccessDisabled</i>	The <i>EnabledForInternet</i> flag is set to “ 0 ” (false).
710	<i>InvalidConnectionType</i>	This action is not permitted for the specified <i>ConnectionType</i> (Current <i>ConnectionType</i> is <i>Unconfigured</i> or <i>IP_Bridged</i>).

2.5.4 RequestTermination()

A client MAY send this command to any connection instance in *Connected* or *Connecting* state to change *ConnectionStatus* to *Disconnected* (through the *Disconnecting* state, if implemented). Connection state

changes to *PendingDisconnect* (if implemented) depend on the value of *WarnDisconnectDelay* variable. Connection termination will depend on whether other clients intend to continue to use the connection by invoking the *RequestConnection()* action. The process of terminating a connection is described in chapter 2.6.2.

2.5.4.1 Arguments

None.

2.5.4.2 Service Requirements

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST return the 606 *Action not authorized* error code (defined in [DEVICE1.0]).

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

2.5.4.3 Control Point Requirements When Calling The Action

Before invoking this action, a control point SHOULD verify that it has sufficient permission.

2.5.4.4 Dependency on Device State

ConnectionType MUST be equal to *IP_Routed* to allow this action to work.

ConnectionStatus MUST be equal to *Connected* or *Connecting* to allow this action to work.

If the connection state is *Connecting* when a client issues a *RequestTermination()*, the state transitions to *Disconnected* directly – it does not go to *PendingDisconnect* even if *WarnDisconnectDelay* is nonzero.

2.5.4.5 Effect on Device State

If successful, *ConnectionStatus* is changed to *Disconnected*.

2.5.4.6 Errors

Table 2-17: Error Codes for *RequestTermination()*

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	<i>Action not authorized</i>	The action requested REQUIRES authorization and the sender was not authorized.
706	<i>ConnectionNotConfigured</i>	Current <i>ConnectionStatus</i> is <i>Unconfigured</i> .
707	<i>DisconnectInProgress</i>	The connection is in the process of being torn down (Current <i>ConnectionStatus</i> is <i>Disconnecting</i> or <i>PendingDisconnect</i>).
710	<i>InvalidConnectionType</i>	This command is valid only when <i>ConnectionType</i> is <i>IP_Routed</i> .

ErrorCode	errorDescription	Description
711	<u>ConnectionAlreadyTerminated</u>	An attempt was made to terminate a connection that is no longer active (Current <u>ConnectionStatus</u> is <u>Disconnected</u>).

2.5.5 ForceTermination()

A client MAY send this command to any connection instance in Connected, Connecting or PendingDisconnect state to change ConnectionStatus to Disconnected (goes via Disconnecting state if implemented). Connection state immediately transitions to Disconnecting (or to Disconnected if Disconnecting is not implemented) irrespective of the setting of WarnDisconnectDelay variable. The process of terminating a connection is described in chapter 2.6.2.

2.5.5.1 Arguments

None.

2.5.5.2 Service Requirements

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST return the 606 Action not authorized error code (defined in [DEVICE1.0]).

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

2.5.5.3 Control Point Requirements When Calling The Action

Before invoking this action, a control point SHOULD verify that it has sufficient permission.

2.5.5.4 Dependency on Device State

ConnectionType MUST be equal to IP_Routed to allow this action to work.

ConnectionStatus MUST be equal to Connected, Connecting or PendingDisconnect to allow this action to work.

2.5.5.5 Effect on Device State

If successful, ConnectionStatus is changed to Disconnected.

2.5.5.6 Errors

Table 2-18: Error Codes for ForceTermination()

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	<u>Action not authorized</u>	The action requested REQUIRES authorization and the sender was not authorized.

ErrorCode	errorDescription	Description
706	<u>ConnectionNotConfigured</u>	Current <u>ConnectionStatus</u> is <u>Unconfigured</u> .
707	<u>DisconnectInProgress</u>	The connection is in the process of being torn down (Current <u>ConnectionStatus</u> is <u>Disconnecting</u>).
710	<u>InvalidConnectionType</u>	This command is valid only when <u>ConnectionType</u> is <u>IP_Routed</u> .
711	<u>ConnectionAlreadyTerminated</u>	An attempt was made to terminate a connection that is no longer active (Current <u>ConnectionStatus</u> is <u>Disconnected</u>).

2.5.6 SetAutoDisconnectTime()

This action sets the time (in seconds) after which an active connection is automatically disconnected. The actual disconnect will occur after WarnDisconnectDelay time elapses (if implemented). The process of terminating a connection is described in chapter 2.6.2.

2.5.6.1 Arguments

Table 2-19: Arguments for SetAutoDisconnectTime()

Argument	Direction	relatedStateVariable
<u>NewAutoDisconnectTime</u>	<u>IN</u>	<u>AutoDisconnectTime</u>

2.5.6.2 NewAutoDisconnectTime

This argument sets the autodisconnect time for the connection. See definition in chapter 2.3.8.

2.5.6.3 Service Requirements

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST return the 606 Action not authorized error code (defined in [DEVICE1.0]).

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

2.5.6.4 Control Point Requirements When Calling The Action

Before invoking this action, a control point SHOULD verify that it has sufficient permission.

2.5.6.5 Dependency on Device State

None.

2.5.6.6 Effect on Device State

After expiration of specified time, ConnectionStatus is changed to Disconnected (via PendingDisconnect and Disconnecting state if it is implemented). The intermediate connection states before the connection is terminated will depend on WarnDisconnectDelay.

2.5.6.7 Errors

Table 2-20: Error Codes for [*SetAutoDisconnectTime\(\)*](#)

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	<i>Action not authorized</i>	The action requested REQUIRES authorization and the sender was not authorized.

2.5.7 [*SetIdleDisconnectTime\(\)*](#)

This action specifies the idle time (in seconds) after which a connection MAY be disconnected. The actual disconnect will occur after [*WarnDisconnectDelay*](#) time elapses. The process of terminating a connection is described in chapter 2.6.2.

2.5.7.1 Arguments

Table 2-21: Arguments for [*SetIdleDisconnectTime\(\)*](#)

Argument	Direction	relatedStateVariable
<i>NewIdleDisconnectTime</i>	<i>IN</i>	<i>IdleDisconnectTime</i>

2.5.7.2 [*NewIdleDisconnectTime*](#)

This argument set the time of the connection idle before the connection is terminated. See definition in chapter 2.3.9.

2.5.7.3 Service Requirements

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST return the 606 [*Action not authorized*](#) error code (defined in [DEVICE1.0]).

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

2.5.7.4 Control Point Requirements When Calling The Action

Before invoking this action, a control point SHOULD verify that it has sufficient permission.

2.5.7.5 Dependency on Device State

None.

2.5.7.6 Effect on Device State

After expiration of specified time, [*ConnectionStatus*](#) is changed to [*Disconnected*](#) (via [*PendingDisconnect*](#) and [*Disconnecting*](#) state if it is implemented). The intermediate connection states before the connection is terminated will depend on [*WarnDisconnectDelay*](#).

2.5.7.7 Errors

Table 2-22: Error Codes for SetIdleDisconnectTime()

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	<u>Action not authorized</u>	The action requested REQUIRES authorization and the sender was not authorized.

2.5.8 SetWarnDisconnectDelay()

This action specifies the number of seconds of warning to each (potentially) active user of a connection before a connection is terminated.

2.5.8.1 Arguments

Table 2-23: Arguments for SetWarnDisconnectDelay()

Argument	Direction	relatedStateVariable
<u>NewWarnDisconnectDelay</u>	<u>IN</u>	<u>WarnDisconnectDelay</u>

2.5.8.2 NewWarnDisconnectDelay

This argument sets the time when IGD is expected to warn before a connection is terminated. See definition in chapter 2.3.10.

2.5.8.3 Service Requirements

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST return the 606 Action not authorized error code (defined in [DEVICE1.0]).

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

2.5.8.4 Control Point Requirements When Calling The Action

Before invoking this action, a control point SHOULD verify that it has sufficient permission.

2.5.8.5 Dependency on Device State

None.

2.5.8.6 Effect on Device State

After the time specified in seconds expires, the connection is terminated. ConnectionStatus is changed to Disconnected (via Disconnecting state if it is implemented).

2.5.8.7 Errors

Table 2-24: Error Codes for SetWarnDisconnectDelay()

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	<u>Action not authorized</u>	The action requested REQUIRES authorization and the sender was not authorized.

2.5.9 GetStatusInfo()

This action retrieves the values of state variables pertaining to connection status.

2.5.9.1 Arguments

Table 2-25: Arguments for GetStatusInfo()

Argument	Direction	relatedStateVariable
<u>NewConnectionStatus</u>	<u>OUT</u>	<u>ConnectionStatus</u>
<u>NewLastConnectionError</u>	<u>OUT</u>	<u>LastConnectionError</u>
<u>NewUptime</u>	<u>OUT</u>	<u>Uptime</u>

2.5.9.2 NewConnectionStatus

This argument shows the current state of the connection. See definition in chapter 2.3.5.

2.5.9.3 NewLastConnectionError

See explanation of this argument from chapter 2.3.7.

2.5.9.4 NewUptime

See explanation of this argument from 2.3.6.

2.5.9.5 Service Requirements

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST return the 606 Action not authorized error code (defined in [DEVICE1.0]).

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

2.5.9.6 Control Point Requirements When Calling The Action

Before invoking this action, a control point SHOULD verify that is has sufficient permission.

2.5.9.7 Dependency on Device State

None.

2.5.9.8 Effect on Device State

None.

2.5.9.9 Errors

Table 2-26: Error Codes for GetStatusInfo()

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	<u>Action not authorized</u>	The action requested REQUIRES authorization and the sender was not authorized.

2.5.10 GetAutoDisconnectTime()

This action retrieves the value of AutoDisconnectTime set by SetAutoDisconnectTime(). This value indicates the duration after the connection is terminated.

2.5.10.1 Arguments

Table 2-27: Arguments for GetAutoDisconnectTime()

Argument	Direction	relatedStateVariable
<u>NewAutoDisconnectTime</u>	<u>OUT</u>	<u>AutoDisconnectTime</u>

2.5.10.2 NewAutoDisconnectTime

This argument defines duration in seconds after connection is closed automatically. See definition in chapter 2.3.8.

2.5.10.3 Service Requirements

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST return the 606 Action not authorized error code (defined in [DEVICE1.0]).

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

2.5.10.4 Control Point Requirements When Calling The Action

Before invoking this action, a control point SHOULD verify that is has sufficient permission.

2.5.10.5 Dependency on Device State

None.

2.5.10.6 Effect on Device State

None.

2.5.10.7 Errors

Table 2-28: Error Codes for [GetAutoDisconnectTime\(\)](#)

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	Action not authorized	The action requested REQUIRES authorization and the sender was not authorized.

2.5.11 [GetIdleDisconnectTime\(\)](#)

This action retrieves the value of [IdleDisconnectTime](#). This value indicates how long a connection can stay in idle state before the connection termination.

2.5.11.1 Arguments

Table 2-29: Arguments for [GetIdleDisconnectTime\(\)](#)

Argument	Direction	relatedStateVariable
NewIdleDisconnectTime	OUT	IdleDisconnectTime

2.5.11.2 [NewIdleDisconnectTime](#)

This argument returns value of [IdleDisconnectTime](#) state variable defined in chapter 2.3.9.

2.5.11.3 Service Requirements

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST return the 606 [Action not authorized](#) error code (defined in [DEVICE1.0]).

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

2.5.11.4 Control Point Requirements When Calling The Action

Before invoking this action, a control point SHOULD verify that it has sufficient permission.

2.5.11.5 Dependency on Device State

None.

2.5.11.6 Effect on Device State

None.

2.5.11.7 Errors

Table 2-30: Error Codes for GetIdleDisconnectTime()

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	<u>Action not authorized</u>	The action requested REQUIRES authorization and the sender was not authorized.

2.5.12 GetWarnDisconnectDelay()

This action retrieves the values of WarnDisconnectDelay. This value indicates how long before a disconnection, the user is warned.

2.5.12.1 Arguments

Table 2-31: Arguments for GetWarnDisconnectDelay()

Argument	Direction	relatedStateVariable
<u>NewWarnDisconnectDelay</u>	<u>OUT</u>	<u>WarnDisconnectDelay</u>

2.5.12.2 NewWarnDisconnectDelay

This argument returns the value of WarnDisconnectDelay state variable defined in chapter 2.3.10.

2.5.12.3 Service Requirements

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST return the 606 Action not authorized error code (defined in [DEVICE1.0]).

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

2.5.12.4 Control Point Requirements When Calling The Action

Before invoking this action, a control point SHOULD verify that it has sufficient permission.

2.5.12.5 Dependency on Device State

None.

2.5.12.6 Effect on Device State

None.

2.5.12.7 Errors

Table 2-32: Error Codes for [*GetWarnDisconnectDelay\(\)*](#)

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	<i>Action not authorized</i>	The action requested REQUIRES authorization and the sender was not authorized.

2.5.13 [*GetNATRSIPStatus\(\)*](#)

This action retrieves the current state of NAT and RSIP on the gateway for this connection.

2.5.13.1 Arguments

Table 2-33: Arguments for [*GetNATRSIPStatus\(\)*](#)

Argument	Direction	relatedStateVariable
<i>NewRSIPAvailable</i>	<i>OUT</i>	<i>RSIPAvailable</i>
<i>NewNATEnabled</i>	<i>OUT</i>	<i>NATEnabled</i>

2.5.13.2 [*NewRSIPAvailable*](#)

This argument is type of [*boolean*](#) and describes if Realm Specific IP service has been enabled. See definition in chapter 2.3.11.

2.5.13.3 [*NewNATEnabled*](#)

This argument is type of [*boolean*](#) and describes if NAT has been enabled. See definition in chapter 2.3.12.

2.5.13.4 Service Requirements

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST return the 606 [*Action not authorized*](#) error code (defined in [DEVICE1.0]).

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

2.5.13.5 Control Point Requirements When Calling The Action

Before invoking this action, a control point SHOULD verify that is has sufficient permission.

2.5.13.6 Dependency on Device State

None.

2.5.13.7 Effect on Device State

None.

2.5.13.8 Errors

Table 2-34: Error Codes for [GetNATRSIPStatus\(\)](#)

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	Action not authorized	The action requested REQUIRES authorization and the sender was not authorized.

2.5.14 [GetGenericPortMappingEntry\(\)](#)

This action retrieves NAT port mappings one entry at a time. Control points can call this action with an incrementing array index until no more entries are found on the gateway. If [PortMappingNumberOfEntries](#) is updated during a call, the process MAY have to start over. Entries in the array are contiguous. As entries are deleted, the array is compacted, and the evented variable [PortMappingNumberOfEntries](#) is decremented. Port mappings are logically stored as an array on the IGD and retrieved using an array index ranging from 0 to [PortMappingNumberOfEntries](#)-1.

Returned port mappings rules correspond to those created by UPnP IGD control point, but also to those created by other mechanisms (ex: WWW-administration, remote management, local management...) MUST be returned. In the meantime, NAT rules created through port triggering are not returned.

The returned port mappings also depends on the authentication of the control point (cf. chapter 2.5.14.3).

2.5.14.1 Arguments

Table 2-35: Arguments for [GetGenericPortMappingEntry\(\)](#)

Argument	Direction	relatedStateVariable
NewPortMappingIndex	IN	PortMappingNumberOfEntries
NewRemoteHost	OUT	RemoteHost
NewExternalPort	OUT	ExternalPort
NewProtocol	OUT	PortMappingProtocol
NewInternalPort	OUT	InternalPort
NewInternalClient	OUT	InternalClient
NewEnabled	OUT	PortMappingEnabled
NewPortMappingDescription	OUT	PortMappingDescription
NewLeaseDuration	OUT	PortMappingLeaseDuration

See description of arguments from Table 2-11.

2.5.14.2 [NewPortMappingIndex](#)

This argument is the type of [ui2](#) and its allowed value range is from 0 to [PortMappingNumberOfEntries](#)-1. This parameter is an index to the table of all existing port mappings.

2.5.14.3 Service Requirements

This action returns an entry from the table of all port mapping entries based on NewPortMappingIndex argument.

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST NOT return the port mapping entry and MUST return the 606 Action not authorized error code (defined in [DEVICE1.0]).

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

In particular, [IGD2] RECOMMENDS that unauthenticated and unauthorized control points are only allowed to retrieve port mapping entries which have:

- InternalPort and ExternalPort values greater than or equal to 1024,
- InternalClient value equals to the control point's IP address.

2.5.14.4 Control Point Requirements When Calling The Action

Before invoking this action, a control point SHOULD verify that it has sufficient permission.

2.5.14.5 Dependency on Device State

None.

2.5.14.6 Effect on Device State

None.

2.5.14.7 Errors

Table 2-36: Error Codes for GetGenericPortMappingEntry()

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	<u>Action not authorized</u>	The action requested REQUIRES authorization and the sender was not authorized. This error can be returned e.g. if a control point is not authorized for the operation because of its IP address or because it tries to use well-known ports.
713	<u>SpecifiedArrayIndexInvalid</u>	The specified array index is out of bounds.

2.5.15 GetSpecificPortMappingEntry()

This action reports the port mapping specified by the unique tuple of RemoteHost, ExternalPort and PortMappingProtocol.

The returned port mappings also depends on the authentication of the control point (cf. chapter 2.5.15.2).

2.5.15.1 Arguments

Table 2-37: Arguments for [GetSpecificPortMappingEntry\(\)](#)

Argument	Direction	relatedStateVariable
NewRemoteHost	<i>IN</i>	RemoteHost
NewExternalPort	<i>IN</i>	ExternalPort
NewProtocol	<i>IN</i>	PortMappingProtocol
NewInternalPort	<i>OUT</i>	InternalPort
NewInternalClient	<i>OUT</i>	InternalClient
NewEnabled	<i>OUT</i>	PortMappingEnabled
NewPortMappingDescription	<i>OUT</i>	PortMappingDescription
NewLeaseDuration	<i>OUT</i>	PortMappingLeaseDuration

See explanation of these arguments from Table 2-11: Common parameters.

2.5.15.2 Service Requirements

This action MUST return the complete list of port mappings regardless of the creator. Returned port mappings rules correspond to those created by UPnP IGD control point, but also to those created by other mechanisms (ex: WWW-administration, remote management, local management...) MUST be returned. In the meantime, NAT rules created through port triggering are not returned.

If [NewRemoteHost](#) is equal to empty string value, [GetSpecificPortMappingEntry\(\)](#) action MUST return only port mappings with a [RemoteHost](#) equal to empty string value.

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST NOT return the port mapping entry and MUST return the 606 [Action not authorized](#) error code (defined in [DEVICE1.0]).

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

In particular, [IGD2] RECOMMENDS that unauthenticated and unauthorized control points are only allowed to retrieve port mapping entries which have:

- [InternalPort](#) value greater than or equals to 1024,
- [InternalClient](#) value equals to the control point's IP address.

Moreover, [IGD2] RECOMMENDS that unauthenticated and unauthorized control points are only allowed to invoke this action with [NewExternalPort](#) value greater than or equals to 1024.

If the control point uses a [NewProtocol](#) value which is not in the allowedValueList of the [PortMappingProtocol](#) state variable, the gateway MUST return the 601 [Argument Value Out of Range](#) error code (defined in [DEVICE1.0]).

2.5.15.3 Control Point Requirements When Calling The Action

Before invoking this action, a control point SHOULD verify that it has sufficient permission.

2.5.15.4 Dependency on Device State

None.

2.5.15.5 Effect on Device State

None.

2.5.15.6 Errors

Table 2-38: Error Codes for GetSpecificPortMappingEntry()

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	<u>Action not authorized</u>	The action requested REQUIRES authorization and the sender was not authorized. This error can be returned e.g. if a control point is not authorized for the operation because of its IP address or because it tries to use well-known ports.
714	<u>NoSuchEntryInArray</u>	The specified value does not exist in the array.

2.5.16 AddPortMapping()

This action creates a new port mapping or overwrites an existing mapping with the same internal client. If the ExternalPort and PortMappingProtocol pair is already mapped to another internal client, an error is returned.

When a control point creates a port forwarding rule with AddPortMapping() action for inbound traffic, this rule MUST also be applied when NAT port triggering occurs for outbound traffic (cf. example in Figure 2-2).

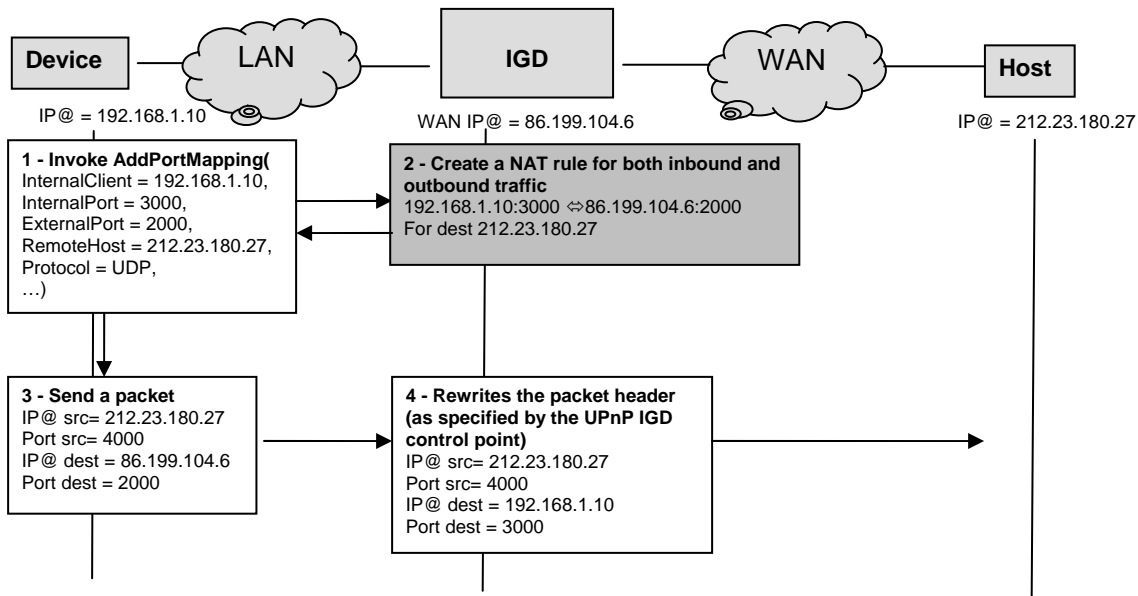


Figure 2-2: Example of relationship between AddPortMapping() action and port triggering

NOTE: Not all NAT implementations will support:

- Wildcard value (i.e. 0) for ExternalPort,
- InternalPort values that are different from ExternalPort.

Since the release 2.0 of the specification, it is encouraged to use the AddAnyPortMapping() action instead of AddPortMapping().

From this version, error code 724 MUST NOT be used, as the gateway is REQUIRED not to restrict port mappings to ExternalPort and InternalPort values being the same.

From this version, error code 725 MUST NOT be used as the gateway is REQUIRED to support both wildcard and specific lease duration values for PortMappingLeaseDuration.

From this version, error code 726 MUST NOT be used as the gateway is REQUIRED to support both wildcard and specific IP address values for RemoteHost.

From this version, error code 727 MUST NOT be used as the gateway is REQUIRED to support both wildcard and specific port values for ExternalPort.

2.5.16.1 Arguments

Table 2-39: Arguments for AddPortMapping()

Argument	Direction	relatedStateVariable
<u>NewRemoteHost</u>	<u>IN</u>	<u>RemoteHost</u>
<u>NewExternalPort</u>	<u>IN</u>	<u>ExternalPort</u>
<u>NewProtocol</u>	<u>IN</u>	<u>PortMappingProtocol</u>
<u>NewInternalPort</u>	<u>IN</u>	<u>InternalPort</u>
<u>NewInternalClient</u>	<u>IN</u>	<u>InternalClient</u>
<u>NewEnabled</u>	<u>IN</u>	<u>PortMappingEnabled</u>
<u>NewPortMappingDescription</u>	<u>IN</u>	<u>PortMappingDescription</u>
<u>NewLeaseDuration</u>	<u>IN</u>	<u>PortMappingLeaseDuration</u>

See description of these arguments from Table 2-11: Common parameters

2.5.16.2 Service Requirements

This action has restrictions on its arguments as follows:

- NewPortMappingLeaseDuration value can be between 1 second and 604800 seconds, however value “0” can exist for port mappings made out of band,
- Infinite mappings cannot be made in WANIPConnection:2 and value “0” MUST be interpreted as 604800 seconds,
- It is RECOMMENDED that a lease time of 3600 seconds would be used as a default value.

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST NOT add the port mapping entry and MUST return the 606 Action not authorized error code (defined in [DEVICE1.0]).

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

In particular, [IGD2] RECOMMENDS that unauthenticated and unauthorized control points are only allowed to invoke this action with:

- NewExternalPort and NewInternalPort values greater than or equal to 1024,
- NewInternalClient value equals to the control point's IP address.

If the control point uses a NewProtocol value which is not in the allowedValueList of the PortMappingProtocol state variable, the gateway MUST return the 601 Argument Value Out of Range error code (defined in [DEVICE1.0]).

In cases where the ExternalPort, PortMappingProtocol and InternalClient are the same, but RemoteHost is different, the vendor can choose to support both mappings simultaneously, or reject the second mapping with an appropriate error.

Protocol	ExternalPort	RemoteHost	InternalClient	Result
≠	≠	≠	≠	Success
≠	≠	≠	=	Success
≠	≠	=	≠	Success
≠	≠	=	=	Success
≠	=	≠	≠	Success
≠	=	≠	=	Success
≠	=	=	≠	Success
≠	=	=	=	Success
=	≠	≠	≠	Success
=	≠	≠	=	Success
=	≠	=	≠	Success
=	≠	=	=	Success
=	=	≠	≠	Failure
=	=	≠	=	Failure or success (vendor specific)
=	=	=	≠	Failure
=	=	=	=	Success (overwrite)

Figure 2-3: Summary of AddPortMapping() results

2.5.16.3 Control Point Requirements When Calling The Action

When issuing AddPortMapping() action, control points are REQUIRED to use following parameter values:

- NewPortMappingLeaseDuration value MUST be between 1 second and 604800 seconds,
- It is RECOMMENDED that NewPortMappingLeaseDuration value would be no more than 3600 seconds.

Before invoking this action, a control point SHOULD verify that it has sufficient permission.

It is REQUIRED that control points support error codes 724, 725, 726 and 727 due to legacy support. WANIPConnection:2 services MUST NOT use those error codes.

2.5.16.4 Dependency on Device State

In order to have a successful port mapping request, the desired port mapping MUST be free.

2.5.16.5 Effect on Device State

The effect is that a NAT portforwarding rule is set.

2.5.16.6 Errors

Table 2-40: Error Codes for AddPortMapping()

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	<u>Action not authorized</u>	The action requested REQUIRES authorization and the sender was not authorized. This error can be returned e.g. if a control point is not authorized for the operation because of its IP address or because it tries to use well-known ports.
715	<u>WildcardNotPermittedInSrcIP</u>	The source IP address cannot be wild-carded (<u>InternalClient</u> equals to an empty string).
716	<u>WildcardNotPermittedInExtPort</u>	The external port cannot be wild-carded.
718	<u>ConflictInMappingEntry</u>	The port mapping entry specified conflicts with a mapping assigned previously to another client.
724	<u>SamePortValuesRequired</u>	Internal and External port values MUST be the same. This error code MUST NOT be used by <u>WANIPConnection:2</u> services, but Control points are REQUIRED to support this error code.
725	<u>OnlyPermanentLeasesSupported</u>	The NAT implementation only supports permanent lease times on port mappings. This error code MUST NOT be used by <u>WANIPConnection:2</u> services, but Control points are REQUIRED to support this error code.
726	<u>RemoteHostOnlySupportsWildcard</u>	<u>RemoteHost</u> MUST be a wildcard and cannot be a specific IP address or DNS name. This error code MUST NOT be used by <u>WANIPConnection:2</u> services, but Control points are REQUIRED to support this error code.

ErrorCode	errorDescription	Description
727	<u>ExternalPortOnlySupportsWildca rd</u>	<u>ExternalPort</u> MUST be a wildcard and cannot be a specific port value. This error code MUST NOT be used by <u>WANIPConnection:2</u> services, but Control points are REQUIRED to support this error code.
728	<u>NoPortMapsAvailable</u>	There are not enough free ports available to complete port mapping.
729	<u>ConflictWithOtherMechanisms</u>	Attempted port mapping is not allowed due to conflict with other mechanisms.
732	<u>WildCardNotPermittedInIntPort</u>	The internal port cannot be wild-carded.

2.5.17 [AddAnyPortMapping\(\)](#)

Like [AddPortMapping\(\)](#) action, [AddAnyPortMapping\(\)](#) action also creates a port mapping specified with the same arguments. The behaviour differs only on the case where the specified port is not free, because in that case the gateway reserves any free [NewExternalPort](#) and [NewProtocol](#) pair and returns the [NewReservedPort](#). It is up to the vendors to define an algorithm which finds a free port.

It is encouraged to use this new action instead of the former one [AddPortMapping\(\)](#) action, because it is more efficient, and it will be compatible with future potential solutions based on port range NAT solution also called "fractional address" within the IETF. The goal of "fractional address" NAT solution is to cope with the IPv4 public address exhaustion, by providing the same IPv4 public address to several IGDs, where each IGD is allocated with a different port range.

NOTE: Not all NAT implementations will support:

- Wildcard value (i.e. 0) for [ExternalPort](#),
- [InternalPort](#) values that are different from [ExternalPort](#).

Regarding the last point, this behaviour is not encouraged because the goal of [AddAnyPortMapping\(\)](#) is to provide a free port if the desired port is not free, so the [InternalPort](#) is potentially different from the [ExternalPort](#). Nevertheless, in order to be backward compatible with [AddPortMapping\(\)](#) action, this behaviour is supported. If parameters [NewInternalClient](#), [NewExternalPort](#) and [NewProtocol](#) are the same as an existing port mapping and control point is authorized for the operation, the port mapping is updated instead of creating new one.

When a control point creates a port forwarding rule with [AddAnyPortMapping\(\)](#) for inbound traffic, this rule MUST also be applied when NAT port triggering occurs for outbound traffic (cf. example in Figure 2-2).

2.5.17.1 Arguments

Table 2-41: Arguments for [AddAnyPortMapping\(\)](#)

Argument	Direction	relatedStateVariable
<u>NewRemoteHost</u>	<u>IN</u>	<u>RemoteHost</u>
<u>NewExternalPort</u>	<u>IN</u>	<u>ExternalPort</u>
<u>NewProtocol</u>	<u>IN</u>	<u>PortMappingProtocol</u>
<u>NewInternalPort</u>	<u>IN</u>	<u>InternalPort</u>
<u>NewInternalClient</u>	<u>IN</u>	<u>InternalClient</u>
<u>NewEnabled</u>	<u>IN</u>	<u>PortMappingEnabled</u>
<u>NewPortMappingDescription</u>	<u>IN</u>	<u>PortMappingDescription</u>

Argument	Direction	relatedStateVariable
<u>NewLeaseDuration</u>	<u>IN</u>	<u>PortMappingLeaseDuration</u>
<u>NewReservedPort</u>	<u>OUT</u>	<u>ExternalPort</u>

See explanation of arguments from Table 2-11 except NewReservedPort.

2.5.17.2 NewReservedPort

This argument’s type is ui2 and is used to describe the number of the port reserved.

2.5.17.3 Service Requirements

This action has restrictions on its arguments as follows:

- NewPortMappingLeaseDuration value can be between 1 second and 604800 seconds, however value “0” can exist for port mappings made out of band,
- Static mappings cannot be made in WANIPConnection:2. Value “0” MUST be interpreted as 604800 seconds,
- It is RECOMMENDED that a lease time of 3600 seconds be used as a default value,
- If NewExternalPort is specified as a wildcard (i.e. 0) and if the gateway supports that feature, the action will return 0 in the NewReservedPort parameter.

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST NOT add the port mapping entry and MUST return the 606 Action not authorized error code (defined in [DEVICE1.0]).

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

In particular, [IGD2] RECOMMENDS that unauthenticated and unauthorized control points are only allowed to invoke this action with:

- NewExternalPort and NewInternalPort values greater than or equal to 1024,
- NewInternalClient value equals to the control point's IP address.

Moreover, [IGD2] RECOMMENDS that unauthenticated and unauthorized control points are only allowed to create port mapping entries which have ExternalPort value greater than or equals to 1024.

If the control point uses a NewProtocol value which is not in the allowedValueList of the PortMappingProtocol state variable, the gateway MUST return the 601 Argument Value Out of Range error code (defined in [DEVICE1.0]).

In cases where the ExternalPort, PortMappingProtocol and InternalClient are the same, but RemoteHost is different, the vendor can choose to support both mappings simultaneously, or to create a new one (with an alternative ExternalPort) for the second mapping.

Protocol	ExternalPort	RemoteHost	InternalClient	Result
≠	≠	≠	≠	Success (ReservedPort = ExternalPort)
≠	≠	≠	=	Success (ReservedPort = ExternalPort)
≠	≠	=	≠	Success (ReservedPort = ExternalPort)
≠	≠	=	=	Success (ReservedPort = ExternalPort)

≠	=	≠	≠	Success (ReservedPort = ExternalPort)
≠	=	≠	=	Success (ReservedPort = ExternalPort)
≠	=	=	≠	Success (ReservedPort = ExternalPort)
≠	=	=	=	Success (ReservedPort = ExternalPort)
=	≠	≠	≠	Success (ReservedPort = ExternalPort)
=	≠	≠	=	Success (ReservedPort = ExternalPort)
=	≠	=	≠	Success (ReservedPort = ExternalPort)
=	≠	=	=	Success (ReservedPort = ExternalPort)
=	=	≠	≠	Success (ReservedPort ≠ ExternalPort)
=	=	≠	=	Success (vendor specific either ReservedPort ≠ ExternalPort or ReservedPort = ExternalPort)
=	=	=	≠	Success (ReservedPort ≠ ExternalPort)
=	=	=	=	Success (overwrite)

Figure 2-4: Summary of **AddAnyPortMapping()** results

2.5.17.4 Control Point Requirements When Calling The Action

When issuing **AddAnyPortMapping()** action, control points are REQUIRED to use the following parameter values:

- **NewLeaseDuration** value MUST be between 1 second and 604800 seconds,
- It is RECOMMENDED that **NewLeaseDuration** value be no more than 3600 seconds.

Before invoking this action, a control point SHOULD verify that it has sufficient permission.

2.5.17.5 Dependency on Device State

In order to have a successful port mapping request, there MUST be free port mappings available.

2.5.17.6 Effect on Device State

The effect is that a NAT portforwarding rule is set.

2.5.17.7 Errors

Table 2-42: Error Codes for **AddAnyPortMapping()**

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.

ErrorCode	errorDescription	Description
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	<u>Action not authorized</u>	The action requested REQUIRES authorization and the sender was not authorized. This error can be returned e.g. if a control point is not authorized for the operation because of its IP address or because it tries to use well-known ports.
715	<u>WildcardNotPermittedInSrcIP</u>	The source IP address cannot be wild-carded (<u>InternalClient</u> equals to an empty string).
716	<u>WildcardNotPermittedInExtPort</u>	The external port cannot be wild-carded.
728	<u>NoPortMapsAvailable</u>	There are not enough free ports available to complete port mapping.
729	<u>ConflictWithOtherMechanisms</u>	Attempted port mapping is not allowed due to conflict with other mechanisms.
732	<u>WildcardNotPermittedInIntPort</u>	The internal port cannot be wild-carded.

2.5.18 DeletePortMapping()

This action deletes a previously instantiated port mapping. As each entry is deleted, the array is compacted, the evented variable PortMappingNumberOfEntries is decremented and the evented variable SystemUpdateID is incremented.

2.5.18.1 Arguments

Table 2-43: Arguments for DeletePortMapping()

Argument	Direction	relatedStateVariable
<u>NewRemoteHost</u>	<u>IN</u>	<u>RemoteHost</u>
<u>NewExternalPort</u>	<u>IN</u>	<u>ExternalPort</u>
<u>NewProtocol</u>	<u>IN</u>	<u>PortMappingProtocol</u>

See description from Table 2-11.

2.5.18.2 Service Requirements

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST NOT delete the port mapping entry and MUST return the 606 Action not authorized error code (defined in [DEVICE1.0]).

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

In particular, [IGD2] RECOMMENDS that unauthenticated and unauthorized control points are only allowed to delete port mapping entries which have:

- InternalPort value greater than or equals to 1024,
- InternalClient value equals to the control point's IP address.

Moreover, [IGD2] RECOMMENDS that unauthenticated and unauthorized control points are only allowed to invoke this action with *NewExternalPort* value greater than or equals to 1024. If the control point uses a *NewProtocol* value which is not in the allowedValueList of the *PortMappingProtocol* state variable, the gateway MUST return the 601 *Argument Value Out of Range* error code (defined in [DEVICE1.0]).

2.5.18.3 Control Point Requirements When Calling The Action

Before invoking this action, a control point SHOULD verify that it has sufficient permission.

2.5.18.4 Dependency on Device State

There needs to be existing port mapping entry in order to this action to succeed.

2.5.18.5 Effect on Device State

Inbound connections are no longer permitted on the port mapping being deleted.

2.5.18.6 Errors

Table 2-44: Error Codes for *DeletePortMapping()*

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	<i>Action not authorized</i>	The action requested REQUIRES authorization and the sender was not authorized. This error can be returned e.g. if a control point is not authorized for the operation because of its IP address or because it tries to use well-known ports.
714	<i>NoSuchEntryInArray</i>	The specified value does not exist in the array.

2.5.19 *DeletePortMappingRange()*

This action deletes port mapping entries defined by a range. As the range is deleted, the array is compacted, the evented variable *PortMappingNumberOfEntries* is decremented, and the evented variable *SystemUpdateID* is incremented. When issued, this action will remove all port mapping entries between *NewStartPort* and *NewEndPort*.

The *NewManage* argument is used to describe the intent of this action:

- If *NewManage* is set to “**0**” (false), then the gateway SHALL only remove port mappings having the *InternalClient* value matching IP address of the control point,
- If *NewManage* is set to “**1**” (true), the gateway SHALL remove all port mappings between *NewStartPort* and *NewEndPort* values.

The deleted port mappings also depends on the authentication of the control point (cf. chapter 2.5.19.2).

2.5.19.1 Arguments

Table 2-45: Arguments for *DeletePortMappingRange()*

Argument	Direction	relatedStateVariable
<i>NewStartPort</i>	<i>IN</i>	<i>ExternalPort</i>
<i>NewEndPort</i>	<i>IN</i>	<i>ExternalPort</i>
<i>NewProtocol</i>	<i>IN</i>	<i>PortMappingProtocol</i>
<i>NewManage</i>	<i>IN</i>	<i>A_ARG_TYPE_Manage</i>

See description of arguments from Table 2-11.

2.5.19.2 Service Requirements

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST return the 606 *Action not authorized* error code (defined in [DEVICE1.0]). However, if the control point does not have the necessary permission to delete a port mapping entry in the specified range, the device SHOULD skip it and check next port mapping entries in the range. Finally, if no port mapping entries are found in the specified range, the device MUST return the 730 *PortMappingNotFound* error code.

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

In particular, [IGD2] RECOMMENDS that unauthenticated and unauthorized control points are only allowed to delete port mapping entries which have:

- *InternalPort* value greater than or equals to 1024,
- *InternalClient* value equals to the control point's IP address.

Moreover, [IGD2] RECOMMENDS that unauthenticated and unauthorized control points are only allowed to invoke this action with *NewStartPort* and *NewEndPort* values greater than or equal to 1024.

If the control point is not authenticated, the *NewManage* argument SHOULD be ignored.

If the control point uses a *NewProtocol* value which is not in the allowedValueList of the *PortMappingProtocol* state variable, the gateway MUST return the 601 *Argument Value Out of Range* error code (defined in [DEVICE1.0]).

It is advised that when using this action, application developers SHOULD take caution not to inadvertently destroy port mappings made by other control points from the same IP address.

This action MUST be done as atomic operation where all deletable port mappings are deleted according the given criteria.

2.5.19.3 Control Point Requirements When Calling The Action

Before invoking this action, a control point SHOULD verify that it has sufficient permission.

2.5.19.4 Dependency on Device State

There needs to be existing at least one port mapping entry in the range in order to this action succeeds.

2.5.19.5 Effect on Device State

Inbound connections are no longer permitted on the port mapping being deleted.

2.5.19.6 Errors

Table 2-46: Error Codes for DeletePortMappingRange()

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	<u>Action not authorized</u>	The action requested REQUIRES authorization and the sender was not authorized. This error can be returned e.g. if a control point is not authorized for the operation because of its IP address or because it tries to use well-known ports.
730	<u>PortMappingNotFound</u>	This error message is returned if no port mapping is found in the specified range.
733	<u>InconsistentParameters</u>	<u>NewStartPort</u> and <u>NewEndPort</u> values are not consistent.

2.5.20 GetExternalIPAddress()

This action retrieves the value of the external IP address on this connection instance.

2.5.20.1 Arguments

Table 2-47: Arguments for GetExternalIPAddress()

Argument	Direction	relatedStateVariable
<u>NewExternalIPAddress</u>	<u>OUT</u>	<u>ExternalIPAddress</u>

2.5.20.2 Argument Descriptions

See description in Table 2-11.

2.5.20.3 Service Requirements

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST return the 606 Action not authorized error code (defined in [DEVICE1.0]).

[IGD2] RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

2.5.20.4 Control Point Requirements When Calling The Action

Before invoking this action, a control point SHOULD verify that it has sufficient permission.

2.5.20.5 Dependency on Device State

None.

2.5.20.6 Effect on Device State

None.

2.5.20.7 Errors

Table 2-48: Error Codes for [GetExternalIPAddress\(\)](#)

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	<i>Action not authorized</i>	The action requested REQUIRES authorization and the sender was not authorized.

2.5.21 [GetListOfPortMappings\(\)](#)

This action returns a list of port mappings matching the arguments. The operation of this action has two modes depending on [NewManage](#) value:

- If the [NewManage](#) argument is set to “0” (false), then this action returns a list of port mappings that have [InternalClient](#) value matching to the IP address of the control point between [NewStartPort](#) and [NewEndPort](#).
- If the [NewManage](#) argument is set to “1” (true), then the gateway MUST return all port mappings between [NewStartPort](#) and [NewEndPort](#).

With the argument [NewNumberOfPorts](#), a control point MAY limit the size of the list returned in order to limit the length of the list returned. If [NewNumberOfPorts](#) is equal to 0, then the gateway MUST return all port mappings between [NewStartPort](#) and [NewEndPort](#).

The returned port mappings also depends on the authentication of the control point (cf. chapter 2.5.21.3).

2.5.21.1 Arguments

Table 2-49: Arguments for [GetListOfPortMappings\(\)](#)

Argument	Direction	relatedStateVariable
NewStartPort	<i>IN</i>	ExternalPort
NewEndPort	<i>IN</i>	ExternalPort
NewProtocol	<i>IN</i>	PortMappingProtocol
NewManage	<i>IN</i>	<i>A ARG TYPE Manage</i>
NewNumberOfPorts	<i>IN</i>	PortMappingNumberOfEntries
NewPortListing	<i>OUT</i>	<i>A ARG TYPE PortListing</i>

See descriptions for [NewStartPort](#) and [NewEndPort](#) in Table 2-11.

2.5.21.2 [NewPortListing](#)

This argument returns a list of port mappings matching the input arguments. This is a XML fragment defined in [A ARG TYPE PortListing](#) state variable description.

2.5.21.3 Service Requirements

Before processing the action request, the device MUST apply the chosen security policy, and authenticate and authorize the control point as required by the security policy. If the control point does not have the necessary permission to perform the action with the requested parameters, the device MUST return the 606 *Action not authorized* error code (defined in [DEVICE1.0]). However, if the control point does not have the necessary permission to retrieve a specific port mapping entry in the specified range, the device SHOULD skip it and check next port mapping entries in the range. Finally, if no port mapping entries are found in the specified range, the device MUST return the 730 *PortMappingNotFound* error code.

[IGD2]RECOMMENDS access control requirements and authentication levels to be applied by *default* for this action. However, devices MAY choose a different security policy.

In particular, [IGD2] RECOMMENDS that unauthenticated and unauthorized control points are only allowed to invoke this action with *NewStartPort* and *NewEndPort* values greater than or equal to 1024. Moreover, [IGD2] RECOMMENDS that unauthenticated and unauthorized control points are only allowed to retrieve port mapping entries which have:

- *InternalPort* value greater than or equals to 1024,
- *InternalClient* value equals to the control point's IP address.

If the control point is not authenticated, the *NewManage* argument SHOULD be ignored.

If the control point uses a *NewProtocol* value which is not in the allowedValueList of the *PortMappingProtocol* state variable, the gateway MUST return the 601 *Argument Value Out of Range* error code (defined in [DEVICE1.0]).

2.5.21.4 Control Point Requirements When Calling The Action

Before invoking this action, a control point SHOULD verify that it has sufficient permission.

2.5.21.5 Dependency on Device State

None.

2.5.21.6 Effect on Device State

None.

2.5.21.7 Errors

Table 2-50: Error Codes for *GetListOfPortMappings()*

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	<i>Action not authorized</i>	The action requested REQUIRES authorization and the sender was not authorized. This error can be returned e.g. if a control point is not authorized for the operation because of its IP address or because it tries to use well-known ports.
730	<i>PortMappingNotFound</i>	This error message is returned if no port mapping is found in the specified range.

ErrorCode	errorDescription	Description
733	<u>InconsistentParameters</u>	<u>NewStartPort</u> and <u>NewEndPoint</u> values are not consistent.

2.5.22 Relationships Between Actions

Actions initiated by a client MAY have different results depending on whether the state of the gateway was changed as a result of another client's actions.

For example, the action RequestConnection() might not be successful in changing the ConnectionStatus to Connected if the gateway receives RequestTermination() on the same connection (while it is in the process of connecting) from another client.

2.5.23 Error Code Summary

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 2-51: Error Code Summary

ErrorCode	errorDescription	Description
400-499	TBD	See UPnP Device Architecture section on Control.
500-599	TBD	See UPnP Device Architecture section on Control.
600-699	TBD	See UPnP Device Architecture section on Control.
606	<u>Action not authorized</u>	The action requested REQUIRES authorization and the sender was not authorized. This error can be returned e.g. if a control point is not authorized for the operation because of its IP address or because it tries to use well-known ports.
700		Reserved for future extensions.
703	<u>InactiveConnectionStateRequired</u>	Current value of <u>ConnectionStatus</u> SHOULD be either <u>Disconnected</u> or <u>Unconfigured</u> to permit this action.
704	<u>ConnectionSetupFailed</u>	There was a failure in setting up the IP or PPP connection with the service provider.
705	<u>ConnectionSetupInProgress</u>	The connection is already in the process of being setup.
706	<u>ConnectionNotConfigured</u>	Current <u>ConnectionStatus</u> is <u>Unconfigured</u> .
707	<u>DisconnectInProgress</u>	The connection is in the process of being torn down.
708	<u>InvalidLayer2Address</u>	Corresponding Link Config service has an invalid VPI/VCI or phone number.
709	<u>InternetAccessDisabled</u>	The <u>EnabledForInternet</u> flag is set to "0" (false).
710	<u>InvalidConnectionType</u>	This action is not permitted for the specified <u>ConnectionType</u> .

ErrorCode	errorDescription	Description
711	<u>ConnectionAlreadyTerminated</u>	An attempt was made to terminate a connection that is no longer active.
713	<u>SpecifiedArrayIndexInvalid</u>	The specified array index is out of bounds.
714	<u>NoSuchEntryInArray</u>	The specified value does not exist in the array.
715	<u>WildCardNotPermittedInSrcIP</u>	The source IP address cannot be wild-carded.
716	<u>WildCardNotPermittedInExtPort</u>	The external port cannot be wild-carded.
718	<u>ConflictInMappingEntry</u>	The port mapping entry specified conflicts with a mapping assigned previously to another client.
724	<u>SamePortValuesRequired</u>	Internal and External port values MUST be the same. This error code MUST NOT be used by <u>WANIPConnection:2</u> services, but Control points are REQUIRED to support this error code.
725	<u>OnlyPermanentLeasesSupported</u>	The NAT implementation only supports permanent lease times on port mappings. This error code MUST NOT be used by <u>WANIPConnection:2</u> services, but Control points are REQUIRED to support this error code.
726	<u>RemoteHostOnlySupportsWildcard</u>	<u>RemoteHost</u> MUST be a wildcard and cannot be a specific IP address or DNS name. This error code MUST NOT be used by <u>WANIPConnection:2</u> services, but Control points are REQUIRED to support this error code.
727	<u>ExternalPortOnlySupportsWildcard</u>	<u>ExternalPort</u> MUST be a wildcard and cannot be a specific port value. This error code MUST NOT be used by <u>WANIPConnection:2</u> services, but Control points are REQUIRED to support this error code.
728	<u>NoPortMapsAvailable</u>	There are not enough free ports available to complete port mapping.
729	<u>ConflictWithOtherMechanisms</u>	Attempted port mapping is not allowed due to conflict with other mechanisms.
730	<u>PortMappingNotFound</u>	This error message is returned if no port mapping is found in the specified range.
731	<u>ReadOnly</u>	Not possible to modify the value because it is read only.
732	<u>WildCardNotPermittedInIntPort</u>	The internal port cannot be wild-carded.
733	<u>InconsistentParameters</u>	<u>NewStartPort</u> and <u>NewEndPort</u> values are not consistent.

NOTE: 800-899 Error Codes are not permitted for standard actions. See UPnP Device Architecture section on Control for more details.

2.6 Service Behavioral Model

2.6.1 Connection Initiation

When a WANConnectionDevice is initialized, an instance of WANIPConnection service will be initialized. If an IP connection is automatically initiated i.e. ‘always on’ as soon as the underlying link is up, no action is needed from a UPnP control point to initiate the connection. However, the IP connection MAY become inactive (Disconnected) because of network or server issues.

A UPnP client sends the RequestConnection() action to a specific instance of the WANIPConnection service on a particular WANConnectionDevice to inform the gateway of its intent to use Internet access.

When a client sends a RequestConnection() command to a Disconnected connection, the WANConnectionDevice initiates the connection to ISP and MAY set ConnectionStatus to Connecting. Depending on whether the connection is successful, ConnectionStatus is changed to Connected or Disconnected.

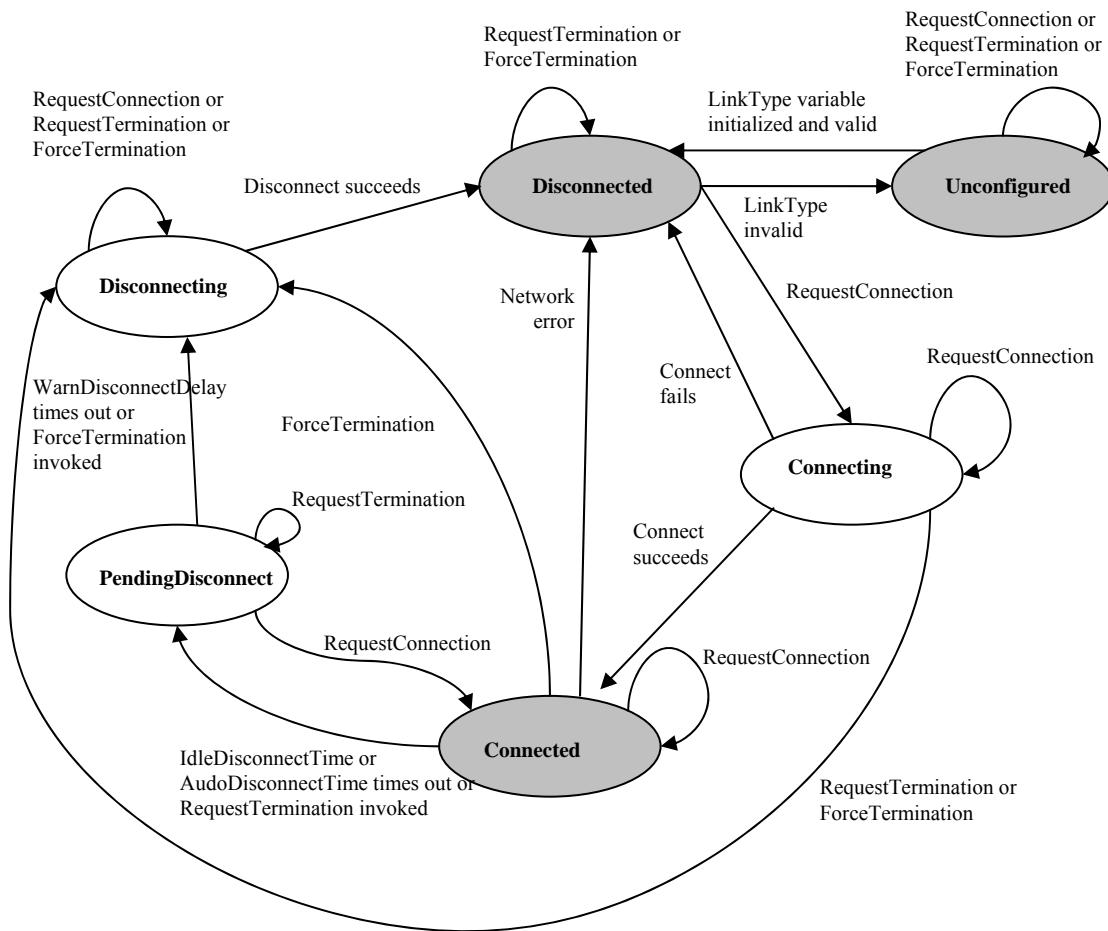


Figure 2-5: State diagram for IP connection

When a connection service gets a RequestConnection() command, if the ConnectionStatus is:

- Unconfigured, Connecting or Disconnecting: an error is returned,
- Disconnected: a connection is attempted (ConnectionStatus MAY transition to Connecting). If this is successful, ConnectionStatus changes to Connected,

- PendingDisconnect: it is changed to Connected.

When the ConnectionStatus is Connected: the client is allowed to use the connection if ConnectionType is IP_Routed, otherwise an error is returned.

Figure 2-5 illustrates the state transition diagram when all states are implemented by the gateway. REQUIRED states are in shaded ovals.

RequestConnection() MAY fail (causing an error code to be returned) under the following conditions:

1. Network failure,
2. ConnectionStatus is Unconfigured, Connecting or Disconnecting,
3. EnabledForInternet variable in WANCommonInterfaceConfig is set to “0” (false),
4. Invalid ConnectionType (either Unconfigured or IP_Bridged).

The connection set up MAY be aborted by a client (by issuing RequestTermination() or ForceTermination()).

2.6.2 Connection Termination

Connection termination can be explicit (by a client sending RequestTermination() or ForceTermination() action) or implicit (because of AutoDisconnectTime or IdleDisconnectTime coming into effect).

A UPnP client sends RequestTermination() or ForceTermination() action to a specific instance of the WANIPConnection service on a particular WANConnectionDevice to inform the gateway that this client no longer needs IP services.

A RequestTermination() command is acted upon only if the ConnectionType is IP_Routed and ConnectionStatus is Connecting or Connected, while a ForceTermination() command is acted upon only if the ConnectionType is IP_Routed and ConnectionStatus is Connected, Connecting or PendingDisconnect.

A connection termination MAY be initiated due to:

1. A RequestTermination() or ForceTermination() command from a client,
2. AutoDisconnectTime or IdleDisconnectTime coming into effect,
3. A deployment specific gateway policy,
4. EnabledForInternet variable (in WANCommonInterfaceConfig service) being set to “0” (false),
5. An ISP initiated connection termination or network failure.

At this point ConnectionStatus transitions (resulting in notification to clients registered for this event) immediately to one of the following:

- PendingDisconnect (if this state is implemented): This occurs if WarnDisconnectDelay is non-zero and the cause for termination is 1 or 2 (as mentioned above). The IP connection is still active in this state. This is useful for giving clients using a connection a chance to react when a connection termination is in progress. If the termination is due to a gateway policy (3 above), a specific implementation of the gateway MAY choose to warn the clients by transitioning to this state.
 - If clients choose to ignore the notification, the connection will be terminated after the time (in seconds) specified as WarnDisconnectDelay. ConnectionStatus transitions to Disconnecting.
 - If any client sends RequestConnection() command at this point, the gateway MAY choose to discontinue the termination process by changing ConnectionStatus to Connected. If connection is not restored, the gateway will return error code indicating that the connection was in the process of being torn down.
- Disconnecting – this can happen in the following cases –

- ForceTermination() command was called,
 - RequestTermination() called, and if no other clients are using the connection, the gateway MAY choose to skip PendingDisconnect state,
 - WarnDisconnectDelay is zero and the cause for termination is RequestTermination() or 2 (as mentioned above),
 - Termination was triggered by EnabledForInternet variable being set to “0” (false),
 - Termination was triggered by ISP,
 - Termination occurred due to a gateway policy, and the specific implementation chose not to warn the clients by switching directly to this state – essentially overriding the value of WarnDisconnectDelay.
- Disconnected – if the above two OPTIONAL states are not implemented.

When transitioning to this state, the connection is terminated immediately.

If the connection state is Connecting when a client issues a RequestTermination(), the state transitions to Disconnecting directly – it does not go to PendingDisconnect even if WarnDisconnectDelay is nonzero.

As mentioned before, in the case of termination because of a gateway policy the action (whether clients are warned or not) depends upon the gateway implementation.

When a client receives a PendingDisconnect notification, it can do one of two things:

- Ignore it and let the disconnect proceed,
- Send a RequestConnection() command – the client can keep the connection from disconnecting – this is implementation dependent as pointed out earlier.

3 Theory of Operation (Informative)

WANIPConnection service is used to control IP connections and related functions. Its operation can be divided into three categories:

- Connection management,
- Status information of the gateway,
- NAT traversal control.

The connection management starts with initializing a WANDevice, which is initialized with one or more instances of WANConnectionDevice depending on the number of physical links the gateway is configured to support. For example, cable modem would typically implement one WANConnectionDevice instance, but multiple instances MAY exist for supporting VCs in the case of DSL.

Refer to the WANPPPConnection service definition for more details on connection setup procedures. A table summarizing connection procedures follows.

Table 3-1: Connection Procedures

Value of <u>ConnectionType</u>	Control point capabilities	Step N°	Follow-up steps for a control point
<u>IP Routed</u>	IP Stack	1	Set the default gateway address to the Internet Gateway address
		2	Send IP packets through the gateway
<u>IP Bridged</u>	IP Stack	1	Get the ISP IP address (through DHCP?) and set it as the default gateway address.
		2	Send IP packets to ISP IP address

3.1.1 Connection Scenarios

As previously mentioned, the possible connection types for a WANIPConnection are IP Routed and IP Bridged. The connection scenarios for these two types of connections and the role of connection related actions are described in more detail below.

3.1.1.1 IP ROUTED

Unlike the WANPPPConnection, a WANIPConnection instance typically does not require a priori configuration. If the IP Routed connection is the default connection on the IGD, a control point on the LAN that desires to use the connection is NOT REQUIRED to send the RequestConnection() action even if the connection is not Connected. If the connection is Disconnected, the IGD will initiate a WAN connection upon receiving any outbound packets from the control point (assuming the ‘dial-on-demand’ option is enabled on the IGD) or upon receiving a RequestConnection() action. This MAY cause the IGD to obtain an IP address via DHCP from the ISP. It results in a transition of ConnectionStatus to Connected. The IGD shares the routable WAN IP address with control points on the LAN using Network Address Translation (NAT). The control points on the LAN are assigned private IP addresses in response to their DHCP requests (control points MAY self-assign non-routable IP addresses in certain IGD configurations).

If the IGD supports multiple WAN connection instances, the RequestConnection() action is intended for a control point to specify a WANIPConnection instance (that in all likelihood is different from the default connection).

A control point MAY use RequestTermination() or ForceTermination() to disconnect the IGD from the WAN (this involves releasing any previously acquired IP resources from the ISP).

RequestTermination(): A control point can invoke this action, if available, to terminate an active connection. As an example, if three control points were sharing a WAN connection instance and if each were to call **RequestTermination()**, the IGD MAY release IP resources acquired from the ISP on the three instances of **RequestTermination()** to conserve IP resources. If **WarnDisconnectDelay** is implemented and is non-zero the IGD is REQUIRED to change the **ConnectionStatus** from **Connected** to **PendingDisconnect** and wait until **WarnDisconnectDelay** seconds elapse before transitioning to the **Disconnected** state.

ForceTermination(): The IGD will immediately release all WAN IP resources, disregarding the value of **WarnDisconnectDelay** variable.

An example of an implementation of this connection type is a routing IGD modeling a PC or embedded gateway with a cable modem as a WAN interface.

3.1.1.2 **IP BRIDGED**

In this scenario, all Ethernet packets from a control point on the LAN are bridged to the WAN by the IGD. If this were the default connection, all Ethernet traffic across all LAN interfaces will be bridged to the WAN side. The actions **RequestConnection()**, **RequestTermination()** and **ForceTermination()** are not relevant in this case since the IGD is not IP addressable by the control point over the LAN. Therefore, UPnP IGD would be inactive and not in use.

If the gateway is IP addressable, it is possible to use UPnP IGD for gateway configuration with appropriate actions. For instance, a control point MAY use the **RequestConnection()** action to select a specific WAN connection instance, followed typically by a DHCP renewal request. All Ethernet packets (including DHCP requests) from this control point get redirected (bridged) through the default WAN connection. This assumes that the IGD is capable of source (MAC) address based bridging. The control point that is actively using the connection MAY issue **RequestTermination()** or **ForceTermination()** actions through a secondary interface (if the control point is multi-homed) to end the use of this connection and change the **ConnectionStatus** to **Disconnected**. Alternatively, a control point that is not using the connection MAY issue **RequestTermination()** or **ForceTermination()** to disconnect IGD from the WAN.

An example of an implementation of this scenario would be a bridging IGD with an integrated cable modem on the WAN interface that, in turn, has an Ethernet link to CM Termination System (CMTS). If an IGD supports multiple WAN connection instances and has one active (IP) bridged connection, it cannot allow other WAN connections to be simultaneously active unless it supports source (MAC) address based bridging on that bridged connection, where the source MAC address identifies a control point. The **RequestConnection()** action returns an error if this were the case.

3.1.2 Non-UPnP compliant clients

The gateway SHOULD support non-UPnP compliant devices by making it possible for a client to start accessing the Internet (effectively Dial-on-Demand) without sending **RequestConnection()** command. The client in this scenario cannot specify which particular **WANConnectionDevice** or **WANIPConnection** it wants to use. The **WANIPConnection** to be used is identified using the **DefaultConnectionService** identified in **Layer3Forwarding** service. Also, the client will not be able to terminate the connection or use the other features of **WANIPConnection** service (like detecting connection speed or specifying a new port mapping).

3.1.3 VPN connections

VPN sessions MAY be established on an IP connection initiated at the gateway. There are two cases to consider:

- A VPN client is initiated by a client on the residential LAN. In this case, the VPN is transparent to the **WANIPConnection** instance and is not visible in the UPnP context.
- A VPN client is initiated on the gateway. In this case, the VPN session would use an **WANIPConnection** instance. A VPN service to model this scenario is not standardized in this Working Committee – it is possible however, as a vendor extension. One possible way to do this

is to provide a VPN service in InternetGatewayDevice outside of WANDevice. The state table for this service would support configuration attributes that are essential for setting up a VPN connection. These would include parameters such as:

- IP address(es) of VPN Gateway,
- Security Protocols to be used,
- Authentication and Privacy parameters specific to a security protocol,
- Session time-out delay.

In addition, it would also contain a ConnectionService variable that specifies a WANIPConnection service instance in a WANConnectionDevice. A comma-separated 2-tuple uniquely identifies the service:

uuid:device-UUID:WANConnectionDevice:v , urn:upnp-org:serviceId:serviceID.

The VPN service would support a RequestConnection() action that would in turn invoke the RequestConnection() of the corresponding WANIPConnection service like any other UPnP client.

NOTES:

- For IP Bridged connections, it is assumed that either all LAN ports (LANDevices) or none of the LAN ports are bridged to the connection. RequestConnection() is a NOP in this case.
- In the case of Always-On IP connections, an implementation MAY return an appropriate error code if ForceTermination() is not supported.

3.2 NAT & NAT traversal

3.2.1 NAT & NAPT

NAT (Network Address Translation) is a popular tool for alleviating the IPv4 address shortage. For example, NAT allows to enable multiple hosts on a private network to access the Internet using a single public IP address.

NAT involves re-writing the source and/or destination IP addresses, and usually also the TCP/UDP port numbers of IP packets as they pass through the NAT. Checksums (both IP and TCP/UDP) MUST also be rewritten to take into account the changes. A NAT which also rewrites the ports is called a NAPT (Network Address Port Translation). NAPT is the most widely used NAT mechanism in residential gateways.

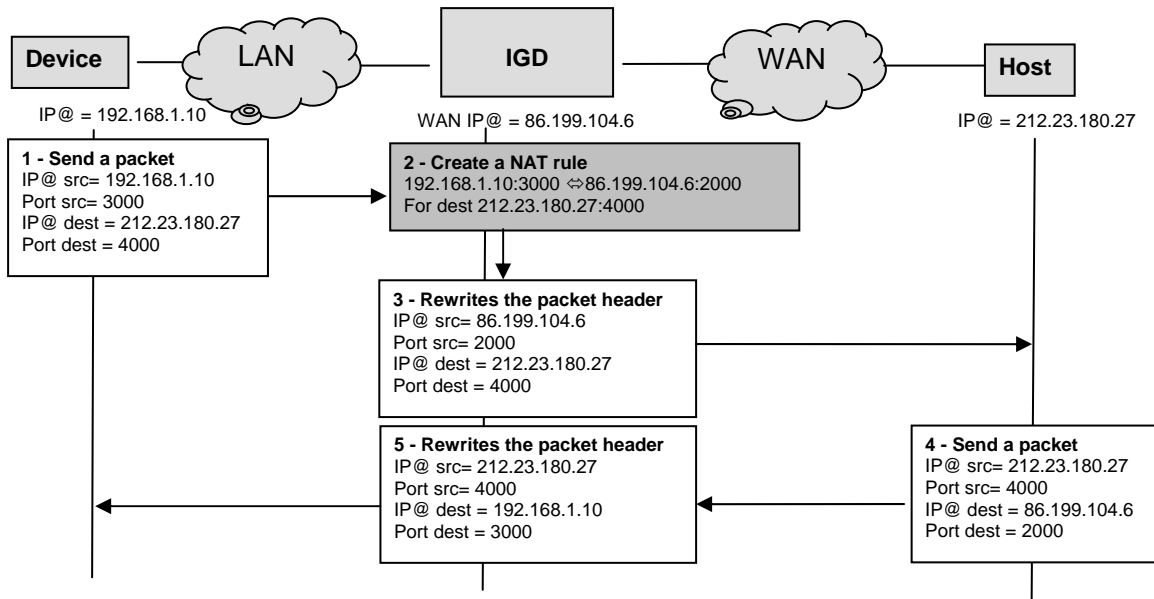


Figure 3-1: NAT is an IP address translator

3.2.2 NAT traversal

Even if this solution is largely used in the residential gateways which access the WAN, it does not solve all the problems. There are some remaining issues like:

- **Expiration of the mapping timer:** In order to manage its resources, a NAT destroys a NAT rule after a period of inactivity between the internal endpoint and the external endpoint,
- **IP addresses carried in payloads:** Protocols like SIP, H.323, SNMP do not respect the layered model, and they re-use the IP packet's address in their payload. NAT causes problems for these protocols, because the private IP addresses in the payload are no longer valid once a packet crosses the NAT,
- **Issues with bundled session applications:** Bundled session applications are applications which use a control connection to establish a media stream (cf. FTP (in passive mode), H.323, SIP and RTSP for example). In the example below, the device contacts a host on the WAN, and this remote host is responsible for establishing the session on another port. It does not work because there is no NAT binding for the requested session.

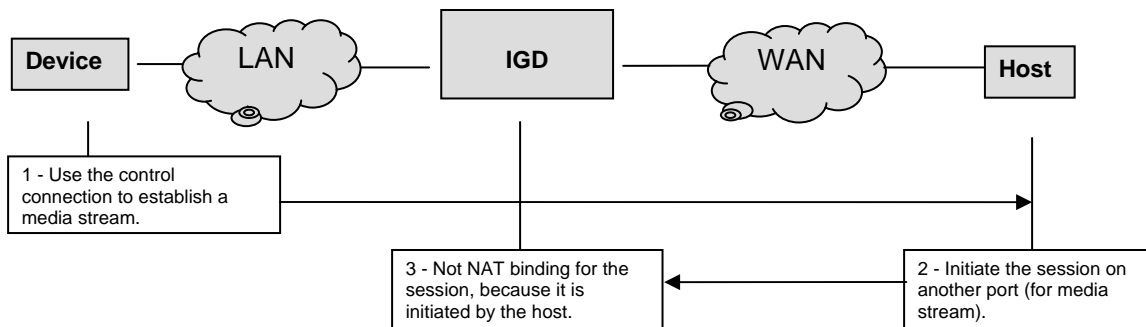


Figure 3-2: NAT issue with bundled session applications

UPnP IGD provides a compelling NAT traversal mechanism to cope with those NAT issues by allowing an application (e.g. a control point) to control the mapping timer, to create NAT rules for upcoming session on another port and to get the external IP address of the residential gateway in order to use it directly in the payload.

3.3 UPnP IGD & NAT Traversal

The purpose of NAT traversal and port mappings is to support the programmatic creation of short-lived dynamic port mappings from any control point on the residential network for applications such as multiplayer games, Internet chat, and Peer-to-Peer messaging that use external ports for short session-based communication.

A port mapping is essentially an 8-tuple of the type:

<PortMappingEnabled, PortMappingLeaseDuration, RemoteHost, ExternalPort, InternalPort, PortMappingProtocol, InternalClient, PortMappingDescription>

The port mapping is used by clients to enable forwarding of inbound service requests, if NAT is used as the address translation mechanism between the residential (private) LAN and the Internet. Each 8-tuple configures NAT to listen for packets on the external interface of the WANConnectionDevice on behalf of a specific client and dynamically forward connection requests to that client.

If a firewall is co-resident on the gateway, it is assumed that the gateway will appropriately configure the firewall for the port mapping.

For example, a client on a residential LAN could run an HTTP server and configure the gateway to forward requests from specific hosts on the Internet (WAN) on specific WAN interfaces.

4 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>SetConnectionType</name>
      <argumentList>
        <argument>
          <name>NewConnectionType</name>
          <direction>in</direction>
          <relatedStateVariable>
            ConnectionType
          </relatedStateVariable>
        </argument>
      </argumentList>
    </action>

    <action>
      <name>GetConnectionTypeInfo</name>
      <argumentList>
        <argument>
          <name>NewConnectionType</name>
          <direction>out</direction>
          <relatedStateVariable>
            ConnectionType
          </relatedStateVariable>
        </argument>

        <argument>
          <name>NewPossibleConnectionTypes</name>
          <direction>out</direction>
          <relatedStateVariable>
            PossibleConnectionTypes
          </relatedStateVariable>
        </argument>
      </argumentList>
    </action>

    <action>
      <name>RequestConnection</name>
    </action>

    <action>
      <name>RequestTermination</name>
    </action>

    <action>
      <name>ForceTermination</name>
    </action>
  </actionList>
</scpd>

```

```

</action>

<action>
  <name>SetAutoDisconnectTime</name>
  <argumentList>
    <argument>
      <name>NewAutoDisconnectTime</name>
      <direction>in</direction>
      <relatedStateVariable>
        AutoDisconnectTime
      </relatedStateVariable>
    </argument>
  </argumentList>
</action>

<action>
  <name>SetIdleDisconnectTime</name>
  <argumentList>
    <argument>
      <name>NewIdleDisconnectTime</name>
      <direction>in</direction>
      <relatedStateVariable>
        IdleDisconnectTime
      </relatedStateVariable>
    </argument>
  </argumentList>
</action>

<action>
  <name>SetWarnDisconnectDelay</name>
  <argumentList>
    <argument>
      <name>NewWarnDisconnectDelay</name>
      <direction>in</direction>
      <relatedStateVariable>
        WarnDisconnectDelay
      </relatedStateVariable>
    </argument>
  </argumentList>
</action>

<action>
  <name>GetStatusInfo</name>
  <argumentList>
    <argument>
      <name>NewConnectionStatus</name>
      <direction>out</direction>
      <relatedStateVariable>
        ConnectionStatus
      </relatedStateVariable>
    </argument>

    <argument>
      <name>NewLastConnectionError</name>
      <direction>out</direction>
      <relatedStateVariable>
        LastConnectionError
      </relatedStateVariable>
    </argument>
  </argumentList>
</action>

```

```

    </relatedStateVariable>
  </argument>

  <argument>
    <name>NewUptime</name>
    <direction>out</direction>
    <relatedStateVariable>
      Uptime
    </relatedStateVariable>
  </argument>
</argumentList>
</action>

<action>
  <name>GetAutoDisconnectTime</name>
  <argumentList>
    <argument>
      <name>NewAutoDisconnectTime</name>
      <direction>out</direction>
      <relatedStateVariable>
        AutoDisconnectTime
      </relatedStateVariable>
    </argument>
  </argumentList>
</action>

<action>
  <name>GetIdleDisconnectTime</name>
  <argumentList>
    <argument>
      <name>NewIdleDisconnectTime</name>
      <direction>out</direction>
      <relatedStateVariable>
        IdleDisconnectTime
      </relatedStateVariable>
    </argument>
  </argumentList>
</action>

<action>
  <name>GetWarnDisconnectDelay</name>
  <argumentList>
    <argument>
      <name>NewWarnDisconnectDelay</name>
      <direction>out</direction>
      <relatedStateVariable>
        WarnDisconnectDelay
      </relatedStateVariable>
    </argument>
  </argumentList>
</action>

<action>
  <name>GetNATRSIPStatus</name>
  <argumentList>
    <argument>
      <name>NewRSIPAvailable</name>

```

```

        <direction>out</direction>
        <relatedStateVariable>
            RSIPAvailable
        </relatedStateVariable>
    </argument>

    <argument>
        <name>NewNATEnabled</name>
        <direction>out</direction>
        <relatedStateVariable>
            NATEnabled
        </relatedStateVariable>
    </argument>
</argumentList>
</action>

<action>
    <name>GetGenericPortMappingEntry</name>
    <argumentList>
        <argument>
            <name>NewPortMappingIndex</name>
            <direction>in</direction>
            <relatedStateVariable>
                PortMappingNumberOfEntries
            </relatedStateVariable>
        </argument>

        <argument>
            <name>NewRemoteHost</name>
            <direction>out</direction>
            <relatedStateVariable>
                RemoteHost
            </relatedStateVariable>
        </argument>

        <argument>
            <name>NewExternalPort</name>
            <direction>out</direction>
            <relatedStateVariable>
                ExternalPort
            </relatedStateVariable>
        </argument>

        <argument>
            <name>NewProtocol</name>
            <direction>out</direction>
            <relatedStateVariable>
                PortMappingProtocol
            </relatedStateVariable>
        </argument>

        <argument>
            <name>NewInternalPort</name>
            <direction>out</direction>
            <relatedStateVariable>
                InternalPort
            </relatedStateVariable>
    </argumentList>
</action>

```

```

</argument>

<argument>
  <name>NewInternalClient</name>
  <direction>out</direction>
  <relatedStateVariable>
    InternalClient
  </relatedStateVariable>
</argument>

<argument>
  <name>NewEnabled</name>
  <direction>out</direction>
  <relatedStateVariable>
    PortMappingEnabled
  </relatedStateVariable>
</argument>

<argument>
  <name>NewPortMappingDescription</name>
  <direction>out</direction>
  <relatedStateVariable>
    PortMappingDescription
  </relatedStateVariable>
</argument>

<argument>
  <name>NewLeaseDuration</name>
  <direction>out</direction>
  <relatedStateVariable>
    PortMappingLeaseDuration
  </relatedStateVariable>
</argument>
</argumentList>
</action>

<action>
  <name>GetSpecificPortMappingEntry</name>
  <argumentList>
    <argument>
      <name>NewRemoteHost</name>
      <direction>in</direction>
      <relatedStateVariable>
        RemoteHost
      </relatedStateVariable>
    </argument>

    <argument>
      <name>NewExternalPort</name>
      <direction>in</direction>
      <relatedStateVariable>
        ExternalPort
      </relatedStateVariable>
    </argument>

    <argument>
      <name>NewProtocol</name>

```

```

        <direction>in</direction>
        <relatedStateVariable>
            PortMappingProtocol
        </relatedStateVariable>
    </argument>

    <argument>
        <name>NewInternalPort</name>
        <direction>out</direction>
        <relatedStateVariable>
            InternalPort
        </relatedStateVariable>
    </argument>

    <argument>
        <name>NewInternalClient</name>
        <direction>out</direction>
        <relatedStateVariable>
            InternalClient
        </relatedStateVariable>
    </argument>

    <argument>
        <name>NewEnabled</name>
        <direction>out</direction>
        <relatedStateVariable>
            PortMappingEnabled
        </relatedStateVariable>
    </argument>

    <argument>
        <name>NewPortMappingDescription</name>
        <direction>out</direction>
        <relatedStateVariable>
            PortMappingDescription
        </relatedStateVariable>
    </argument>

    <argument>
        <name>NewLeaseDuration</name>
        <direction>out</direction>
        <relatedStateVariable>
            PortMappingLeaseDuration
        </relatedStateVariable>
    </argument>
</argumentList>
</action>

<action>
    <name>AddPortMapping</name>
    <argumentList>
        <argument>
            <name>NewRemoteHost</name>
            <direction>in</direction>
            <relatedStateVariable>
                RemoteHost
            </relatedStateVariable>
        </argument>
    </argumentList>
</action>

```

```

</argument>

<argument>
  <name>NewExternalPort</name>
  <direction>in</direction>
  <relatedStateVariable>
    ExternalPort
  </relatedStateVariable>
</argument>

<argument>
  <name>NewProtocol</name>
  <direction>in</direction>
  <relatedStateVariable>
    PortMappingProtocol
  </relatedStateVariable>
</argument>

<argument>
  <name>NewInternalPort</name>
  <direction>in</direction>
  <relatedStateVariable>
    InternalPort
  </relatedStateVariable>
</argument>

<argument>
  <name>NewInternalClient</name>
  <direction>in</direction>
  <relatedStateVariable>
    InternalClient
  </relatedStateVariable>
</argument>

<argument>
  <name>NewEnabled</name>
  <direction>in</direction>
  <relatedStateVariable>
    PortMappingEnabled
  </relatedStateVariable>
</argument>

<argument>
  <name>NewPortMappingDescription</name>
  <direction>in</direction>
  <relatedStateVariable>
    PortMappingDescription
  </relatedStateVariable>
</argument>

<argument>
  <name>NewLeaseDuration</name>
  <direction>in</direction>
  <relatedStateVariable>
    PortMappingLeaseDuration
  </relatedStateVariable>
</argument>

```

```

    </argumentList>
  </action>

  <action>
    <name>DeletePortMapping</name>
    <argumentList>
      <argument>
        <name>NewRemoteHost</name>
        <direction>in</direction>
        <relatedStateVariable>
          RemoteHost
        </relatedStateVariable>
      </argument>

      <argument>
        <name>NewExternalPort</name>
        <direction>in</direction>
        <relatedStateVariable>
          ExternalPort
        </relatedStateVariable>
      </argument>

      <argument>
        <name>NewProtocol</name>
        <direction>in</direction>
        <relatedStateVariable>
          PortMappingProtocol
        </relatedStateVariable>
      </argument>
    </argumentList>
  </action>

  <action>
    <name>GetExternalIPAddress</name>
    <argumentList>
      <argument>
        <name>NewExternalIPAddress</name>
        <direction>out</direction>
        <relatedStateVariable>
          ExternalIPAddress
        </relatedStateVariable>
      </argument>
    </argumentList>
  </action>

  <action>
    <name>DeletePortMappingRange</name>
    <argumentList>
      <argument>
        <name>NewStartPort</name>
        <direction>in</direction>
        <relatedStateVariable>
          ExternalPort
        </relatedStateVariable>
      </argument>

      <argument>

```

```

        <name>NewEndPoint</name>
        <direction>in</direction>
        <relatedStateVariable>
            ExternalPort
        </relatedStateVariable>
    </argument>

    <argument>
        <name>NewProtocol</name>
        <direction>in</direction>
        <relatedStateVariable>
            PortMappingProtocol
        </relatedStateVariable>
    </argument>

    <argument>
        <name>NewManage</name>
        <direction>in</direction>
        <relatedStateVariable>
            A_ARG_TYPE_Manage
        </relatedStateVariable>
    </argument>
</argumentList>
</action>

<action>
    <name>GetListOfPortMappings</name>
    <argumentList>
        <argument>
            <name>NewStartPort</name>
            <direction>in</direction>
            <relatedStateVariable>
                ExternalPort
            </relatedStateVariable>
        </argument>

        <argument>
            <name>NewEndPoint</name>
            <direction>in</direction>
            <relatedStateVariable>
                ExternalPort
            </relatedStateVariable>
        </argument>

        <argument>
            <name>NewProtocol</name>
            <direction>in</direction>
            <relatedStateVariable>
                PortMappingProtocol
            </relatedStateVariable>
        </argument>

        <argument>
            <name>NewManage</name>
            <direction>in</direction>
            <relatedStateVariable>
                A_ARG_TYPE_Manage
            </relatedStateVariable>
        </argument>
    </argumentList>
</action>

```

```

    </relatedStateVariable>
  </argument>

  <argument>
    <name>NewNumberOfPorts</name>
    <direction>in</direction>
    <relatedStateVariable>
      PortMappingNumberOfEntries
    </relatedStateVariable>
  </argument>

  <argument>
    <name>NewPortListing</name>
    <direction>out</direction>
    <relatedStateVariable>
      A_ARG_TYPE_PortListing
    </relatedStateVariable>
  </argument>
</argumentList>
</action>

<action>
  <name>AddAnyPortMapping</name>
  <argumentList>
    <argument>
      <name>NewRemoteHost</name>
      <direction>in</direction>
      <relatedStateVariable>
        RemoteHost
      </relatedStateVariable>
    </argument>

    <argument>
      <name>NewExternalPort</name>
      <direction>in</direction>
      <relatedStateVariable>
        ExternalPort
      </relatedStateVariable>
    </argument>

    <argument>
      <name>NewProtocol</name>
      <direction>in</direction>
      <relatedStateVariable>
        PortMappingProtocol
      </relatedStateVariable>
    </argument>

    <argument>
      <name>NewInternalPort</name>
      <direction>in</direction>
      <relatedStateVariable>
        InternalPort
      </relatedStateVariable>
    </argument>

  <argument>

```

```

        <name>NewInternalClient</name>
        <direction>in</direction>
        <relatedStateVariable>
            InternalClient
        </relatedStateVariable>
    </argument>

    <argument>
        <name>NewEnabled</name>
        <direction>in</direction>
        <relatedStateVariable>
            PortMappingEnabled
        </relatedStateVariable>
    </argument>

    <argument>
        <name>NewPortMappingDescription</name>
        <direction>in</direction>
        <relatedStateVariable>
            PortMappingDescription
        </relatedStateVariable>
    </argument>

    <argument>
        <name>NewLeaseDuration</name>
        <direction>in</direction>
        <relatedStateVariable>
            PortMappingLeaseDuration
        </relatedStateVariable>
    </argument>

    <argument>
        <name>NewReservedPort</name>
        <direction>out</direction>
        <relatedStateVariable>
            ExternalPort
        </relatedStateVariable>
    </argument>
</argumentList>
</action>

    <!-- Declarations for other actions defined by UPnP vendor (if any)
    go here -->

</actionList>

<serviceStateTable>

    <stateVariable sendEvents="no">
        <name>ConnectionType</name>
        <dataType>string</dataType>
        <defaultValue>IP_Routed</defaultValue>
        <allowedValueList>
            <allowedValue>Unconfigured</allowedValue>
            <allowedValue>IP_Routed</allowedValue>
            <allowedValue>IP_Bridged</allowedValue>
        </allowedValueList>
    </stateVariable>

```

```

</stateVariable>

<stateVariable sendEvents="yes">
  <name>PossibleConnectionTypes</name>
  <dataType>string</dataType>
</stateVariable>

<stateVariable sendEvents="yes">
  <name>ConnectionStatus</name>
  <dataType>string</dataType>
  <allowedValueList>
    <allowedValue>Unconfigured</allowedValue>
    <allowedValue>Connecting</allowedValue>
    <allowedValue>Connected</allowedValue>
    <allowedValue>PendingDisconnect</allowedValue>
    <allowedValue>Disconnecting</allowedValue>
    <allowedValue>Disconnected</allowedValue>
  </allowedValueList>
</stateVariable>

<stateVariable sendEvents="no">
  <name>Uptime</name>
  <dataType>ui4</dataType>
</stateVariable>

<stateVariable sendEvents="no">
  <name>LastConnectionError</name>
  <dataType>string</dataType>
  <allowedValueList>
    <allowedValue>ERROR_NONE</allowedValue>
    <allowedValue>ERROR_COMMAND_ABORTED</allowedValue>
    <allowedValue>ERROR_NOT_ENABLED_FOR_INTERNET</allowedValue>
    <allowedValue>ERROR_USER_DISCONNECT</allowedValue>
    <allowedValue>ERROR_ISP_DISCONNECT</allowedValue>
    <allowedValue>ERROR_IDLE_DISCONNECT</allowedValue>
    <allowedValue>ERROR_FORCED_DISCONNECT</allowedValue>
    <allowedValue>ERROR_NO_CARRIER</allowedValue>
    <allowedValue>ERROR_IP_CONFIGURATION</allowedValue>
    <allowedValue>ERROR_UNKNOWN</allowedValue>
  </allowedValueList>
</stateVariable>

<stateVariable sendEvents="no">
  <name>AutoDisconnectTime</name>
  <dataType>ui4</dataType>
</stateVariable>

<stateVariable sendEvents="no">
  <name>IdleDisconnectTime</name>
  <dataType>ui4</dataType>
</stateVariable>

<stateVariable sendEvents="no">
  <name>WarnDisconnectDelay</name>
  <dataType>ui4</dataType>
</stateVariable>

```

```

<stateVariable sendEvents="no">
  <name>RSIPAvailable</name>
  <dataType>boolean</dataType>
</stateVariable>

<stateVariable sendEvents="no">
  <name>NATEnabled</name>
  <dataType>boolean</dataType>
</stateVariable>

<stateVariable sendEvents="yes">
  <name>ExternalIPAddress</name>
  <dataType>string</dataType>
</stateVariable>

<stateVariable sendEvents="yes">
  <name>PortMappingNumberOfEntries</name>
  <dataType>ui2</dataType>
</stateVariable>

<stateVariable sendEvents="no">
  <name>PortMappingEnabled</name>
  <dataType>boolean</dataType>
</stateVariable>

<stateVariable sendEvents="no">
  <name>PortMappingLeaseDuration</name>
  <dataType>ui4</dataType>
  <defaultValue>Vendor-defined</defaultValue>
  <allowedValueRange>
    <minimum>0</minimum>
    <maximum>604800</maximum>
  </allowedValueRange>
</stateVariable>

<stateVariable sendEvents="no">
  <name>RemoteHost</name>
  <dataType>string</dataType>
</stateVariable>

<stateVariable sendEvents="no">
  <name>ExternalPort</name>
  <dataType>ui2</dataType>
</stateVariable>

<stateVariable sendEvents="no">
  <name>InternalPort</name>
  <dataType>ui2</dataType>
  <allowedValueRange>
    <minimum>1</minimum>
    <maximum>65535</maximum>
  </allowedValueRange>
</stateVariable>

<stateVariable sendEvents="no">
  <name>PortMappingProtocol</name>
  <dataType>string</dataType>

```

```

    <allowedValueList>
      <allowedValue>TCP</allowedValue>
      <allowedValue>UDP</allowedValue>
    </allowedValueList>
  </stateVariable>

  <stateVariable sendEvents="no">
    <name>InternalClient</name>
    <dataType>string</dataType>
  </stateVariable>

  <stateVariable sendEvents="no">
    <name>PortMappingDescription</name>
    <dataType>string</dataType>
  </stateVariable>

  <stateVariable sendEvents="yes">
    <name>SystemUpdateID</name>
    <dataType>ui4</dataType>
  </stateVariable>

  <stateVariable sendEvents="no">
    <name>A_ARG_TYPE_Manage</name>
    <dataType>boolean</dataType>
  </stateVariable>

  <stateVariable sendEvents="no">
    <name>A_ARG_TYPE_PortListing</name>
    <dataType>string</dataType>
  </stateVariable>

  <!-- Declarations for other state variables defined by UPnP vendor
  (if any) go here -->

  </serviceStateTable>
</scpd>

```