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INTERNATIONAL STANDARD

Information technology – UPnP Device Architecture – Part 8-1: Internet Gateway Device Control Protocol – Internet Gateway Device



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Part 8-1: Internet Gateway Device Control Protocol – Internet Gateway Device

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

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ORIGINAL UPNP DOCUMENTS
(informative)

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

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

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

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1. Overview and Scope

This device template is compliant with the UPnP Device Architecture, Version 1.0.

This document defines the REQUIRED **ROOT** device
urn:schemas-upnp-org:device:*InternetGatewayDevice.*

The ***InternetGatewayDevice*** encapsulates all sub-devices and services for the Internet Gateway Device Control Protocol (DCP).

The Internet Gateway is an "edge" interconnect device between a residential Local Area Network (LAN) and the Wide Area Network (WAN), providing connectivity to the Internet. The gateway MAY be physically implemented as a dedicated, standalone device or modeled as a set of UPnP devices and services on a PC. This version of the DCP does not cover small business networks. Discovery and access to these services from outside the home network is not recommended, unless adequate authentication, authorization and access control mechanisms are built into the device, beyond what is currently specified within the UPnP architecture framework.

Figure 1 below is a conceptual illustration of a generic Internet Gateway device consisting of one or more physical WAN and LAN interfaces.

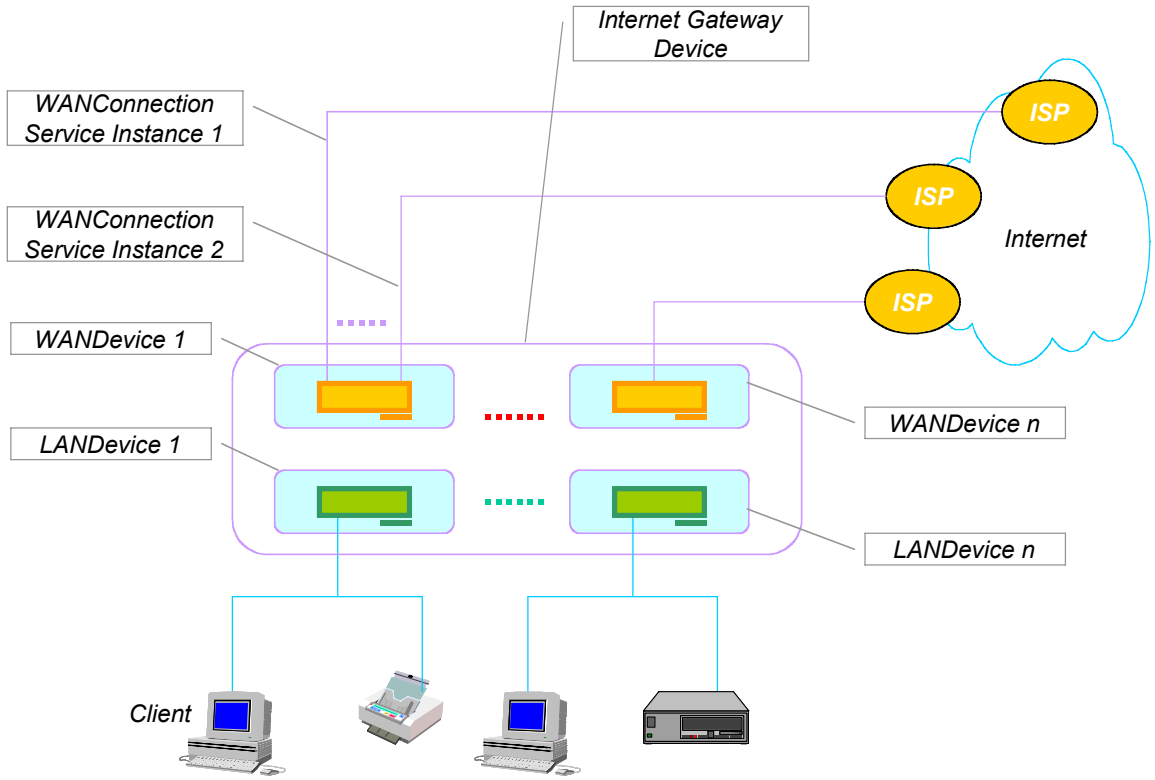


Figure 1: *InternetGatewayDevice* with LAN and WAN Interfaces

1.1. Requirements for an Internet Gateway Device

The following list of requirements has been identified on the capabilities of an Internet Gateway in coming up with the devices and services hierarchy for the gateway DCP.

- The ***InternetGatewayDevice*** MUST support 1 WAN interface, but MAY support more than one physical WAN interface to connect to the Internet.
- The ***InternetGatewayDevice*** MUST support 1 LAN interface, but MAY support more than one physical LAN interface to connect to the residential network.

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An implementation MAY host the WAN interface and LAN interface (mentioned above) on the same physical network interface card (NIC).

- Each WAN interface MUST support one Internet connection, but MAY simultaneously support more than one Internet connection. Each of these connections will be modeled as instances of a service in the DCP.
- The ***InternetGatewayDevice*** must be IP addressable from the residential LAN at all times to be UPnP compliant. More specifically, in the case of gateways with broadband modems on the WAN side, the ***InternetGatewayDevice*** must be addressable
  - When the device is not configured for WAN access or does not have any WAN connectivity
  - Before, during and after modem and link configuration with a head-end device in the Internet service provider's central office.
- Connectivity on the WAN side MUST enable nodes on the residential LAN to access resources on the Internet. A gateway MAY support modems and/or connections on a modem to a service provider, not resulting in Internet connectivity – for example, POTS dial-up access to a modem bank of a home security monitoring service provider. Such connections are outside the scope and requirements of the gateway DCP.

In this document, an Internet connection implies IP connectivity to an Internet Service Provider. Figure 2 illustrates the hierarchy of devices and services in an ***InternetGatewayDevice***. A physical modem on the WAN side and a connection interface/port on the LAN side of the ***InternetGatewayDevice*** are modeled by a ***WANDevice*** and a ***LANDevice*** instance respectively. Depending on the hardware capabilities of an Internet Gateway, more than 1 instance of ***WANDevice*** and/or ***LANDevice*** are possible in an actual implementation of the gateway DCP description document. Virtual connection interfaces – such as Virtual Circuits (VC) on a DSL modem, are modeled by one or more instances of ***WANConnectionDevice***. Sub-devices and services mentioned in this document are defined in companion documents that together specify the DCP for an Internet Gateway.

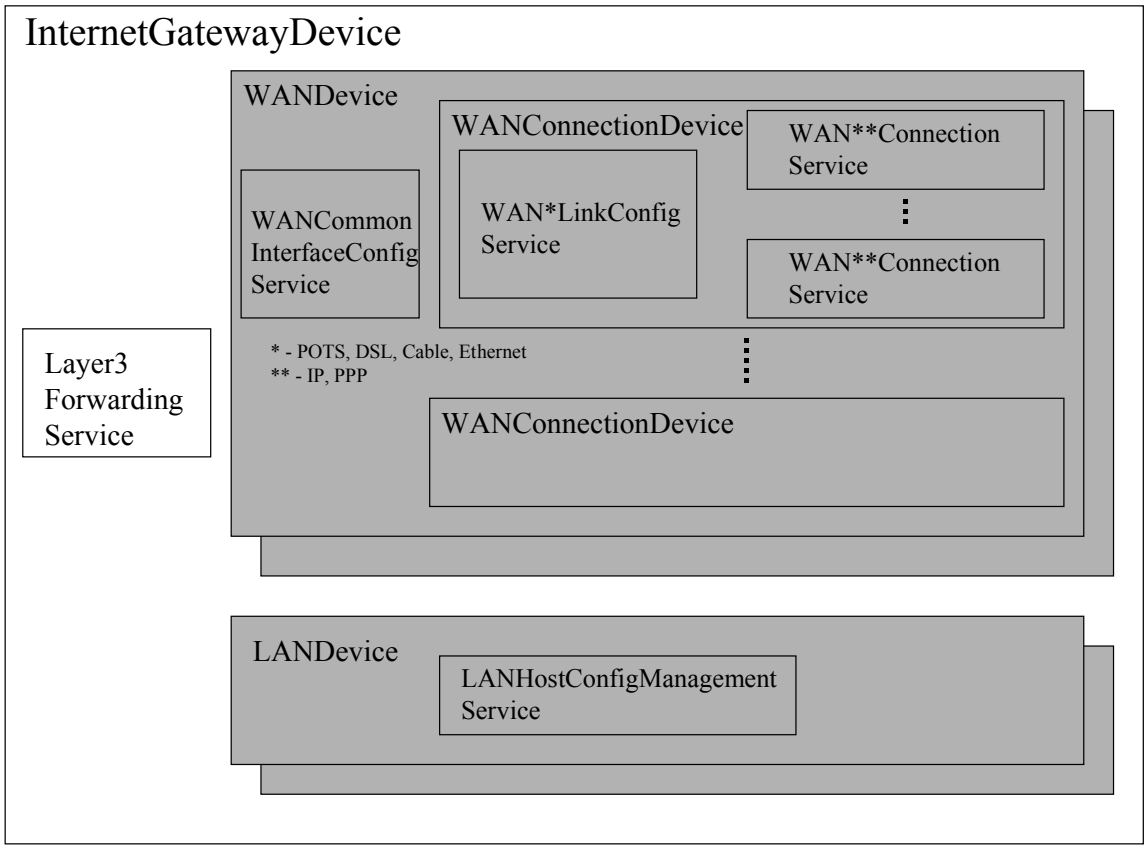


Figure 2: *InternetGatewayDevice* Devices and Services Hierarchy

1.2. Focus and Goals for DCP version 1.0

The Gateway Working Committee (IGD WC) agreed to focus on the following set of requirements in coming up with the hierarchy of devices and services for DCP v1.0.

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- Sharing and configurable initiation of Internet data access among networked devices in the residential network.
- Richer end-user experience for UPnP enabled devices
  - Provide status and events on connections
  - Control of initiation and termination of connections
- Management of host configuration services
  - DHCP, Dynamic DNS (DDNS)
- Preserve ability of non-UPnP devices to initiate and/or share Internet access.

1.3. Non-Goals for DCP version 1.0

The following work items were discussed and considered to be beyond the scope of this version of the DCP.

- Configuration and connection management services for an ISDN modem
- Access control and user/device authentication services
- Advanced routing mechanisms across multiple, simultaneous, active connections on multiple WAN interfaces
- LAN interface physical layer services
- Fine-grained configuration and management of features specific to Ethernet bridging across multiple LAN segments / subnets and/or between LAN segments and WAN Internet connection(s).
- VPN services (outside-in or a VPN client initiating from the Internet Gateway)
- Services enabling bandwidth management on active Internet connections
- Exclusivity on initiation and sharing of active connections
- Modeling of firewall features
  - Too many technologies and component layers makes it hard to model
  - May be offered as vendor extensions
- Issues that come up in the context of multiple, simultaneously active Internet Gateway devices – for example, default gateway conflict resolution, load balancing and fail over
- Other non-connectivity related gateway functions
  - Multimedia translation and caching
  - Interfacing to “service” gateways

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2. Device Definitions

2.1. Device Type

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

urn:**schemas-upnp-org:device**:*InternetGatewayDevice:1*

2.2. Device Model

Products that expose devices of the type **urn:schemas-upnp-org:device:***InternetGatewayDevice:1* must implement minimum version numbers of all required embedded devices and services specified in the table below.

Table 1: Device Requirements

DeviceType	Root	Req. or Opt.[1]	ServiceType	Req. or Opt.[1]	Service ID[2]
			Layer3Forwarding:1	*O*	*L3Forwarding1*
			Non-standard services embedded by an UPnP vendor go here.	*X*	*TBD*
WANDevice:1		*R*	*WANCommonInterfaceConfig:1*	*R*	*WANCommonIFC1*
			Non-standard services embedded by an UPnP vendor go here.	*X*	*TBD*
WANConnectionDevice:1 (an instance of WANDevice may include one or more WANConnectionDevice instances)		*R*	*WANPOTSLinkConfig:1*	*O for POTS modems*	*WANPOTSLinkC1*
			WANDSLLinkConfig:1	*O for DSL modems*	*WANDSLLinkC1*
			WANCableLinkConfig:1	*O for Cable modems*	*WANCableLinkC1*
			WANEthernetLinkConfig:1	*O for Ethernet attached modems*	*WANEthLinkC1*
			WANPPPConnection:1	*R for modems that support PPP based connections*	*Multiple instances possible within a WANConnectionDevice. ServiceIDs for multiple instances will be WANPPPConn1, WANPPPConn2, WANPPPConn3 and so on.*
			WANIPConnection:1	*R for modems that support IP based connections*	*Only 1 instance per WANConnectionDevice is envisioned at this time, although the design could support multiple instances in future. ServiceIDs for multiple instances*

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					will be WANIPConn1, WANIPConn2, WANIPConn3 and so on.
			Non-standard services embedded by an UPnP vendor go here.	*X*	*TBD*
LANDevice:1		*O*	*LANHostConfigManagement:1*	*O*	*LANHostCfg1*
Non-standard devices embedded by a UPnP vendor go here.	*TBD*	*X*	*TBD*	*TBD*	*TBD*

[1] R = Required, O = Optional, X = Non-standard.
[2] Prefixed by urn:**upnp-org**:**serviceId**: .

2.2.1. Description of Device Requirements

As shown in the table above, the DCP defines 2 ***Connection*** services and 4 ***LinkConfig*** services to accommodate various types of WAN interfaces and connection types. The following table briefly describes the purpose of each of the services. An actual implementation of the DCP will instance only those ***Connection*** and ***LinkConfig*** services that are appropriate for the gateway device being modeled.

Service Name	Service Description
`WANPPPConnection`	PPP connections originating at the gateway or relayed or bridged through the gateway
`WANIPConnection`	IP connections originating or relayed or bridged through the gateway
`WANPOTSLinkConfig`	Configuration parameters associated with a WAN link on a Plain Old Telephone Service (POTS) modem
`WANDSLLinkConfig`	Configuration parameters associated with a WAN link on a Digital Subscriber Link (DSL) modem
`WANCableLinkConfig`	Configuration parameters associated with a WAN link on a cable modem
`WANEthernetLinkConfig`	Configuration parameters associated with an Ethernet- attached external modem (cable or DSL). If proprietary mechanisms are available to discover and configure an external modem, it is recommended that modem-specific ***LinkConfig*** services be modeled instead of this service.

2.2.2. Relationships Between Services

Layer3Forwarding identifies a default service, which is a specific instance of ***WAN{PPP/IP}Connection*** in a ***WANConnectionDevice***. ***WANCommonInterfaceConfig*** defines variables and actions common across all instances of ***WAN{PPP/IP}Connections*** in a ***WANDevice***. There may also be dependencies between a specific instance of ***WAN*LinkConfig*** and ***WAN**Connection*** service in a ***WANConnectionDevice***.

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2.3. Theory of Operation

Each ***WANDevice*** in Figure 1 can be viewed as an instantiation of a physical WAN interface. If an ***InternetGatewayDevice*** provides multiple WAN physical interfaces to UPnP clients, each of these will typically be included in the device description document as distinct ***WANDevice*** instances. However, an implementation may choose to encapsulate more than one physical WAN interface in a single ***WANDevice***. This may be done, for example, in applications that use asymmetric connections like a satellite downlink and POTS uplink. Another example would be where multiple physical WAN interfaces are pooled and presented as one device. Aspects such as load balancing between the pooled resources would be transparent to UPnP clients in this case.

All Internet connections are set up from or through a WAN interface of the ***InternetGatewayDevice*** 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). Each link on a WAN interface is modeled by an instance of ***WANConnectionDevice*** in ***WANDevice***. A ***WANConnectionDevice*** in turn contains one link-specific ***WAN*LinkConfig***[1] service (where * can be POTS, DSL, Cable or Ethernet) and one or more instances of ***WAN**Connection*** service (where ** can be PPP or IP).

In accordance with UPnP Device Architecture version 1.0, the maximum number of ***WAN**Connection*** service instances is static and specified in the ***InternetGatewayDevice*** description document.

A ***WANDevice*** provides a ***WANCommonInterfaceConfig*** service that encapsulates Layer 1 and Layer 2 properties relevant to Internet access common to the specific WAN access type and across multiple ***WAN**Connection*** service instances.

The gateway device may also support multiple physical LAN interfaces. It may support distinct subnets of client nodes on the residential network. Each ***LANDevice*** – identified in the device description document with a UDN – typically corresponds to a physical LAN interface (or port) on the ***InternetGatewayDevice***. However, an implementation may choose to encapsulate more than one physical LAN interface in a single ***LANDevice*****.** This would be the case if two LAN subnets that are bridged are to be presented as a single logical LAN interface. Devices on a LAN may configure, initiate and/or share Internet connections.

The ***InternetGatewayDevice*** may also support Layer-3 packet transformation and forwarding functions managed and applicable across all connection instances. These functions are currently modeled in ***Layer3Forwarding*** service. Layer-3 packet forwarding functions that are specific to a connection will be modeled in each ***WAN**Connection*** service instance.

[1] The WC has not defined link configuration services for interfaces types other than those listed above. If needed, these can be implemented as vendor-proprietary extensions.

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3. XML Device Description

```
<?xml version="1.0"?>
<root xmlns="urn:schemas-upnp-org:device-1-0">
  <specVersion>
    <major>1</major>
    <minor>0</minor>
  </specVersion>
  <URLBase>base URL for all relative URLs</URLBase>
  <device>
    <deviceType>urn:schemas-upnp-
org:device:InternetGatewayDevice:1</deviceType>
    <friendlyName>short user-friendly title</friendlyName>
    <manufacturer>manufacturer name</manufacturer>
    <manufacturerURL>URL to manufacturer site</manufacturerURL>
    <modelDescription>long user-friendly title</modelDescription>
    <modelName>model name</modelName>
    <modelNumber>model number</modelNumber>
    <modelURL>URL to model site</modelURL>
    <serialNumber>manufacturer's serial number</serialNumber>
    <UDN>uuid:UUID</UDN>
    <UPC>Universal Product Code</UPC>
    <iconList>
      <icon>
        <mimetype>image/format</mimetype>
        <width>horizontal pixels</width>
        <height>vertical pixels</height>
        <depth>color depth</depth>
        <url>URL to icon</url>
      </icon>
      <!-- XML to declare other icons, if any, go here -->
    </iconList>
    <serviceList>
      <service>
        <serviceType>urn:schemas-upnp-
org:service:Layer3Forwarding:1</serviceType>
        <serviceId>urn:upnp-org:serviceId:L3Forwarding1</serviceId>
        <SCPDURL>URL to service description</SCPDURL>
        <controlURL>URL for control</controlURL>
        <eventSubURL>URL for eventing</eventSubURL>
      </service>
          <!-- Declarations for other services added by UPnP vendor (if
any) go here -->
    </serviceList>
    <deviceList>
      <device>
        <deviceType>urn:schemas-upnp-org:device:WANDevice:1</deviceType>
        <friendlyName>short user-friendly title</friendlyName>
        <manufacturer>manufacturer name</manufacturer>
        <manufacturerURL>URL to manufacturer site</manufacturerURL>
        <modelDescription>long user-friendly title</modelDescription>
        <modelName>model name</modelName>
        <modelNumber>model number</modelNumber>
        <modelURL>URL to model site</modelURL>
        <serialNumber>manufacturer's serial number</serialNumber>
        <UDN>uuid:UUID</UDN>
        <UPC>Universal Product Code</UPC>
        <iconList>
          <icon>
            <mimetype>image/format</mimetype>
            <width>horizontal pixels</width>
            <height>vertical pixels</height>
```

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```
        <depth>color depth</depth>
        <url>URL to icon</url>
      </icon>
      XML to declare other icons, if any, go here
    </iconList>
    <serviceList>
      <service>
        <serviceType>urn:schemas-upnp-
org:service:WANCommonInterfaceConfig:1</serviceType>
        <serviceId>urn:upnp-org:serviceId:WANCommonIFC1</serviceId>
        <SCPDURL>URL to service description</SCPDURL>
        <controlURL>URL for control</controlURL>
        <eventSubURL>URL for eventing</eventSubURL>
      </service>
      <!-- Declarations for other services added by UPnP vendor (if
any) go here -->
    </serviceList>
    <deviceList>
     <device>
       <deviceType>urn:schemas-upnp-
org:device:WANConnectionDevice:1</deviceType>
       <friendlyName>short user-friendly title</friendlyName>
       <manufacturer>manufacturer name</manufacturer>
       <manufacturerURL>URL to manufacturer site</manufacturerURL>
       <modelDescription>long user-friendly title</modelDescription>
       <modelName>model name</modelName>
       <modelNumber>model number</modelNumber>
       <modelURL>URL to model site</modelURL>
       <serialNumber>manufacturer's serial number</serialNumber>
       <UDN>uuid:UUID</UDN>
       <UPC>Universal Product Code</UPC>
       <iconList>
       <icon>
           <mimetype>image/format</mimetype>
           <width>horizontal pixels</width>
           <height>vertical pixels</height>
           <depth>color depth</depth>
           <url>URL to icon</url>
       </icon>
       XML to declare other icons, if any, go here
       </iconList>
       <serviceList>
          <service>
            <serviceType>urn:schemas-upnp-
org:service:WANPOTSLinkConfig[2]:1</serviceType>
            <serviceId>urn:upnp-
org:serviceId:WANPOTSLinkC1</serviceId>
            <SCPDURL>URL to service description</SCPDURL>
            <controlURL>URL for control</controlURL>
            <eventSubURL>URL for eventing</eventSubURL>
          </service>
          <service>
            <serviceType>urn:schemas-upnp-
org:service:WANPPPConnection[3]:1</serviceType>
            <serviceId>urn:upnp-org:serviceId:WANPPPConn1</serviceId>
            <SCPDURL>URL to service description</SCPDURL>
            <controlURL>URL for control</controlURL>
```

[2] NOTE to implementers: This template is representative of one device type – a POTS modem in this case. Depending on the type of modem, substitute or add device specific service names.

[3] NOTE to implementers: This template is representative of one connection type – dial-up PPP in this case. Depending on the type of connection, substitute or add device specific service names.

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```
                    <eventSubURL>URL for eventing</eventSubURL>
                  </service>
                  <!-- Description of embedded devices added by UPnP vendor
        (if any) go here -->
                </serviceList>
                <deviceList>  </deviceList>
                <presentationURL>URL for presentation</presentationURL>
              </device>
              <presentationURL>URL for presentation</presentationURL>
            </deviceList>
        </device>
        <device>
            <deviceType>urn:schemas-upnp-org:device:LANDevice:1</deviceType>
            <friendlyName>short user-friendly title</friendlyName>
            <manufacturer>manufacturer name</manufacturer>
            <manufacturerURL>URL to manufacturer site</manufacturerURL>
            <modelDescription>long user-friendly title</modelDescription>
            <modelName>model name</modelName>
            <modelNumber>model number</modelNumber>
            <modelURL>URL to model site</modelURL>
            <serialNumber>manufacturer's serial number</serialNumber>
            <UDN>uuid:UUID</UDN>
            <UPC>Universal Product Code</UPC>
            <iconList>
              <icon>
                <mimetype>image/format</mimetype>
                <width>horizontal pixels</width>
                <height>vertical pixels</height>
                <depth>color depth</depth>
                <url>URL to icon</url>
              </icon>
              <!-- XML to declare other icons, if any, go here -->
            </iconList>
            <serviceList>
              <service>
                <serviceType>urn:schemas-upnp-
        org:service:LANHostConfigManagement:1</serviceType>
                <serviceId>urn:upnp-org:serviceId:LANHostCfg1</serviceId>
                <SCPDURL>URL to service description</SCPDURL>
                <controlURL>URL for control</controlURL>
                <eventSubURL>URL for eventing</eventSubURL>
              </service>
              <!-- Declarations for other services added by UPnP vendor (if
        any) go here -->
            </serviceList>
            <deviceList>
              <!-- Description of embedded devices added by UPnP vendor (if
        any) go here -->
            </deviceList>
            <presentationURL>URL for presentation</presentationURL>
        </device>
        <!-- Description of embedded devices added by UPnP vendor (if any) go
    here -->
      </deviceList>
      <presentationURL>URL for presentation</presentationURL>
    </device>
</root>
```

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4. Test

No semantic tests are defined for this device.

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