UPnP+ and the Internet of Things

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UPnP Forum
www.upnp.org
Overview

• UPnP is one of the most widely adopted connectivity standards worldwide
• The Internet of Things requires a robust discovery, service & service framework
• The UPnP Forum developed UPnP+ with the Internet of Things in mind
• UPnP+: Builds upon the foundation of UPnP with increased focus on cloud, security, scalability and services
• Over 2 billion devices powered by UPnP
• The UPnP Forum has 15 years experience developing connectivity frameworks
• Built on a foundation of flexible and scalable data models
• Existing device control protocols for home automation devices
• Available in open source and commercial environments, across every major operating system and programming language
The Next Frontier: Internet of Things

- The Internet of Things is expected to be a $19 trillion market opportunity
- Every industry across the industrial, enterprise and consumer market sectors will be impacted by the Internet of Things
- There is no universal standard for discovery and service delivery in the Internet of Things
- UPnP’s maturity and market acceptance make it the logical choice for the Internet of Things
The Need for a Smarter Home

- More and more devices are connecting to the home network and the out to the Internet
- The Smart Home is moving from Islands of Things to the Internet of Things (IoT)
- IoT is driving a whole new market segment and ecosystem of devices
- Manufacturers and developers want open connectivity based on industry standards

Consumers want

- New products to integrate with what they already have
- Everything to work together
- Access and control from anywhere and at any time
- Everything to be easy to use
- Useful information to help guide them through the buying process
How UPnP Forum Has Met The Challenge

• New Testing Tools
• Enhancements to the UPnP Device Control Protocols (DCPs) and UPnP architecture
• UPnP®+ for Cloud and remote access
• Rigid Cloud Security
• Enhanced compatibility and interoperability through UPnP Bridging
• UPnP+ for the Internet of Things (IoT)
• IoT Management and Control (Device Control Protocol)
• Enhanced Device Protection
• Enhanced Device Management
• Enhanced Services for networking and A/V
• Data Modeling for new devices
• Better management for low power devices
• Integration with resource constrained devices
• Better integration and control for home power management and the utilities
New Usage Scenarios

Social Media Integration
- Universal connectivity through UPnP+ Cloud
- Interaction using Extensible Messaging and Presence Protocol (XMPP)
- Sharing using secure Virtual Chat Rooms
- Management using secure Role-based Access Control

Cohesive Device Interaction And Control
- Universal connectivity through UPnP® Bridging
- Bidirectional integration and communications to other non-IP networks (Bluetooth, ZigBee, Z-Wave, CoAP, etc.)
- Access, control, and monitoring through a single Control Point interface

Device Modeling
- Standardized support for the creation of new Data Models or SensorTypes
- Extensible interoperability and manageability with the rest of the UPnP ecosystem
- New levels of innovation and connected solutions within a set of standardized Data Models
What is UPnP+?

- **UPnP+** is a new certification level for UPnP devices and services.
- **UPnP+** uses a simple and complete certification program with new enriched test tools that are available now.
- **UPnP+** is fully backwards-compatible with existing UPnP devices and services.
- **UPnP+** supports full integration of IPv6 with seamless backwards compatibility to IPv4.
- **UPnP+** provides an improved interoperability baseline incorporating the latest specifications including A/V, Device Protection, and Energy Management.
Why is UPnP+ necessary?

Audio/Video Devices
- Remote Cloud Access
- Richer content support: Playlist, Multitracks,...
- Updated to IPv6 & HTML5

Gateways
- Tighter security
- Updated to IPv6

Internet of Things
- NEW DEVICES!!!
- Flexible architecture
- Flexible data model
- Strict security
- Virtual Cloud device

... and interoperability
What is UPnP+ Cloud?

• Adds cloud services extending the utility of UPnP devices over the Internet
• Builds upon mature UPnP core technologies that already provide a base for IoT
• Enables existing UPnP specifications and devices to be UPnP Cloud capable
• Enables device and service discovery through the UPnP Cloud
• Combines UPnP and XMPP ecosystems to enable new IoT possibilities
• Connects UPnP Devices (UCCD) and Control Points (UCC-CP) as XMPP clients via an XMPP server
• Leverages commonly used web technologies to create secure communication between devices
• Uses role-based access control with read-only actions for untrusted devices
• Supports simple, data-based device descriptions for the incorporation of resource-constrained devices
• Provides a path for low-risk and rapid implementations of UPnP Cloud solutions
What is UPnP Bridging?

- Allows different local communication and protocol networks to interact as one, even if they do not use IP-based networking
- Includes seamless bridging to existing device network protocols such as Bluetooth, Z-Wave, or ZigBee
- Provides a development platform for “home automation hub” manufacturers to integrate with the billions of UPnP devices already in the home
- Aggregates the control point and management interfaces to include disparate technologies and connectivity implementations
How does UPnP+ deliver these benefits?

• Uses role-based access control with read-only action for untrusted devices
• Adds cloud services extending the utility of UPnP devices over the Internet
• Supports IPv6 as well as IPv4 (for legacy devices)

⇒ Uses a simple and complete certification program with new enriched test tools
UPnP+ Certification Overview

**Framework**
- UDA 2.0
  - Dual IPv4/IPv6 Support
  - Cloud-Capable

**Floating Services**
- DeviceProtection
- FriendlyInfoUpdate
- EnergyManagement
- BasicManagement

**Latest Version of DCPs**
- AV:4
  - MediaRenderer:3
  - MediaServer:4
- IGD:2
- Optional or Conditionally Required Services
  - ConfigurationManagement
  - SoftwareManagement
  - QOS
UPnP Cloud Overview

Devices have 2 interfaces
1. LAN side (traditional UPnP)
2. Cloud side (UDA 2.0 Cloud)
3. Unique device identifiable on both interfaces
• **UPnP Cloud Capable Devices (UCCD) and Control Points (UCC-CP)** as XMPP clients, for example “user@upnpcloud.com/urn:upnp-...MediaServer:4...uuid”
Do we really need to ask this question? It is considered essential for IoT to be successful.

- need to protect against malware
- unauthorized access
- DoS attacks
- Privacy is also a consideration.

UPnP+ provides

- Device Management Services
- Secured communication (LAN and Cloud)
- Role based access
UPnP Cloud Architecture uses XMPP for cloud connection. Since servers have FQDN this works for any device connected to internet.

These connections are considered quite secure:

- XMPP requires SASL for authentication and TLS for link encryption.
- Eventing uses XMPP PubSub with whitelisting.
- Device sharing is private until a user decides to share outside of their account such as in a secure room.
Cloud Use Cases

• Sample use cases enabled:

• Share information by means of the cloud only, by turning off UDA (LAN) interface.

• ROOMS
  • Create a virtual, secure room, where you can share your TV (or Moms TV).
  • Invite a visitor to that room to use your TV to display their pictures (or display your pictures to Moms TV).
  • The visitor can use a guest WiFi network or the 3G/4G network on his mobile phone (do not have to share your WiFi password!)
  • The room can be destroyed once sharing is complete.

• Send your content to your home storage.
LAN Security – DeviceProtection

- DeviceProtection provides role-based access control
  - 3 default roles supported “Public”, “Basic”, “Admin”
  - Can also add user-defined roles
- When using device protection, unsecured control points still can use the device, i.e. default role of “Public”
  - However, the functionality is then restricted to “open” actions – depending on the authenticated role of the control point
- Most actions are profiled so data can be read, but not modified
  - Example 1: a “Public” control point can browse AV-CDS content, but cannot delete or add content
  - Example 2: a “Public” control point may observe the status of a software update but only “Admin” can trigger update.
Ready today

Demo
Demo Setup

Devices have 2 interfaces
1. LAN side (traditional UPnP)
2. Cloud side (UDA 2.0 Cloud)
3. Unique device identifiable on both interfaces
Demo Setup
Future Connected Devices

Devices with WAN Connectivity

WAN Discovery, IP protocols, Open Source

Cloud services Inc. 2\textsuperscript{nd} and 3\textsuperscript{rd} tier

IP-enabled Home Devices

Non-IP-enabled Home Devices

Non-WAN aware devices bridged

Non-IP protocols bridged
UPnP+ Sensor Bridging

- Provide expanded support for low power sensors that need bridging to the rest of the Internet
  - Low Power efficient bridge
  - Pass-thru and/or storage of existing data

Non-IP Devices

UPnP Sensor Bridge
Any logical device with non-IP PHY and IP

- Low Power Data Push
- Bridged Network Access
- Sensor Data Forwarding
- Data Store (Optional)

UPnP+ Ecosystem

Standard-based Access Anywhere
Bridging concepts

- UPnP embraces other technologies by Bridging.
  - Different transports
  - Different DataModels
- Different technologies mapped to same technology:
  All data can be accessed in and outside the home in the same way: unifying the different technologies in the system
UPnP Sensor Network Infrastructure

UPnP Home Assistant Device
- Bridged Network Device Abstractions
- AV Device Services
- Data Store Service (opt)

UPnP Sensor Bridge Device
- Bridged Network Access
- Sensor Connection Methods
- Sensor Data Forwarding
- Data Store Service (opt)

Non-UPnP Networks

Service Providers

Internet

UPnP Home Network

UPnP Mobile Devices
- Sensor Data Forwarding
- Sensor Data Retrieval

Service Provider Sensor Networks

Advanced Metering Infrastructure

Home AV Devices
UPnP IoT Architecture Overview

Major activity areas
1. Data Model and Database
2. Other protocols (COAP, ZigBee)
3. Cloud enhancements (XMPP)
4. Application Management
An IoT Sensor is defined as a set of SensorURNs

Generic SensorURNs can be used by multiple devices
  - Standard SensorURNs

Defining a set of sample devices that use those SensorURNs
  - Standard SensorTypes

Manufacturers can create their own SensorTypes and still maintain interoperability
  - Just have to use standard SensorURNs

SensorTypes and SensorURNs are like “interfaces”
IoT Management and Control Bridge via Apps

Applications
UPnP DCPs
UPnP infrastructure
Bridged network infrastructure
SensorManagement is a UPnP Device

- 2 Mandatory Services
  - ConfigurationManagement
  - SensorTransportGeneric

- 2 Optional Services
  - DataStore
  - DeviceProtection

Interfaces look like this ->
DataModel Refrigerator Example

Refrigerator is a modelled device – can be generic or specific

Features are named collection of sensors/actuators

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Ongoing work

- Extend list of Common Device Identifiers
  - Support more devices!
- Extend list of Data Items
  - Support more types of actuators/sensors
- Extend list of locations
- Incorporate scripting engine
Sources of Models

- Member companies – vendor specific models
- Some popular home devices and bridges –
  - HUE, StriimLight, WeMo, ..
- Other SDOs
  - ongoing evaluation based on IPR and accessibility
- Short list of Generic Models and Features
  - UPnP IoT Data Model Task Force
UPnP has been connecting things for a dozen years with **seamless service discovery and control**.

**Sustainable Data Model Strategy**

- Get Input
- Validate Input
- Add to internal database
- SC selectively adopts key models
- User provides credentials
- User fills out online form

**UPnP Data Model**

- Documentation automatically generated from database

**Additional Data Model Catalog**

- Data models can contain atomic elements and other data models
- UPnP selects official models
- All models are owned and authenticated to owner
- User driven
- Self documenting
- Ensures compatibility
- Must be member to submit a model
- Integrate UPnP member registration right in the process
IoT Summary

Technology is ready:

• Specs are publicly available at www.upnp.org
• Demo source code available: https://github.com/upnpforum
• Works in the home and over the Internet
• Sharing with others is 100% under user control
• Certification program is up and running
• Process in place to incorporate new data models
UPnP+ Next Steps

New Features to Fit Industry Needs

- Cloud
- IGD
- IoT
- Live Register for Data Model
- Cloud Proxy
- NAT Direct (ICE/STUN/TURN)
- RESTful Interface
- Group & Script for Control Point
- Group & Script SensorMgmt
Thank you

Questions?
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• Follow us on Twitter @UPnP Forum or join the Forum’s Facebook community at http://www.facebook.com/UPnPForum
• [https://github.com/upnpforum](https://github.com/upnpforum)

• UPnP Cloud Device Applications
  • Sample desktop applications implementing UPnP Cloud Architecture (UCA). The repository contains the implementation of the following UPnP devices: DimmableLight, MediaServer, MediaRenderer and a light bulb modelled as a SensorManagement device.

• UPnP Cloud Controller Application for Android
  • Sample Android application capable of controlling several types of network devices connected using UPnP protocol for both local (UDA) and cloud devices (UCA).
Other Resources

• Website: www.upnp.org
• UPnP Forum Invites Orgs to use UPnP+ Certification
• Overview: UPnP+ Initiative
  • http://upnp.org/latestupdates/upnpplus/
• Presentation: UPnP Internet of Things Overview
• Presentation: UPnP: The Discovery & Service Layer for IoT
• Presentation: Bringing UPnP to the Cloud and IOT
  • http://upnp.org/resources/documents/Bringing_UPnP_to_the_Cloud_and_IoT_May2014.pdf
• Whitepaper: UPnP Enabling Standard IoT: Future-proofing device communications
  • http://upnp.org/resources/whitepapers/UPnPEnablingIoT_2014.pdf