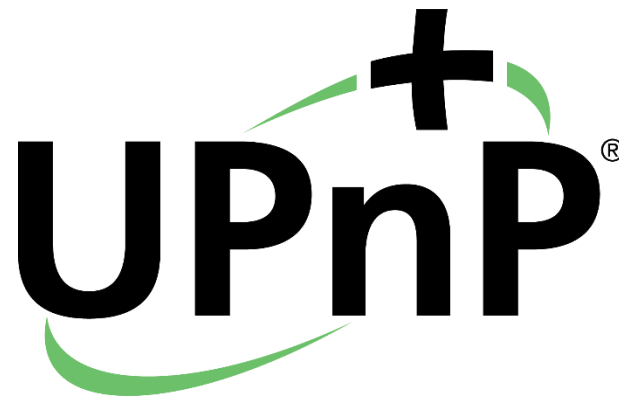


UPnP+ and the Internet of Things

July 2015



UPnP Forum
www.upnp.org

- 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

UPnP: A Proven Foundation For Connectivity

- 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

- 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

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

Framework

UDA 2.0

- Dual IPv4/IPv6 Support
- Cloud-Capable

Floating Services

DeviceProtection

FriendlyInfoUpdate

EnergyManagement

BasicManagement

Latest Version of DCPs

AV:4

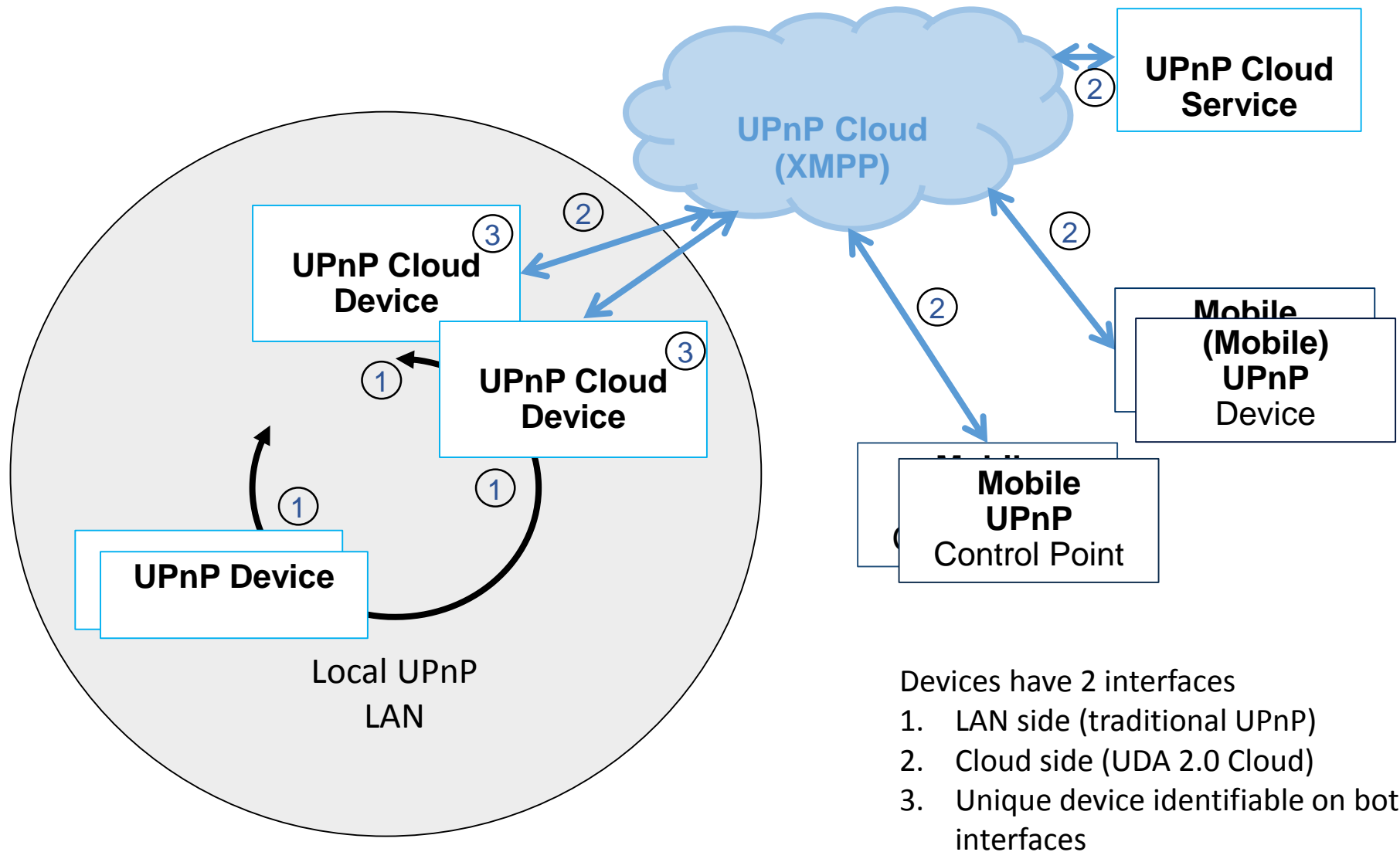
- MediaRenderer:3
- MediaServer:4

IGD:2

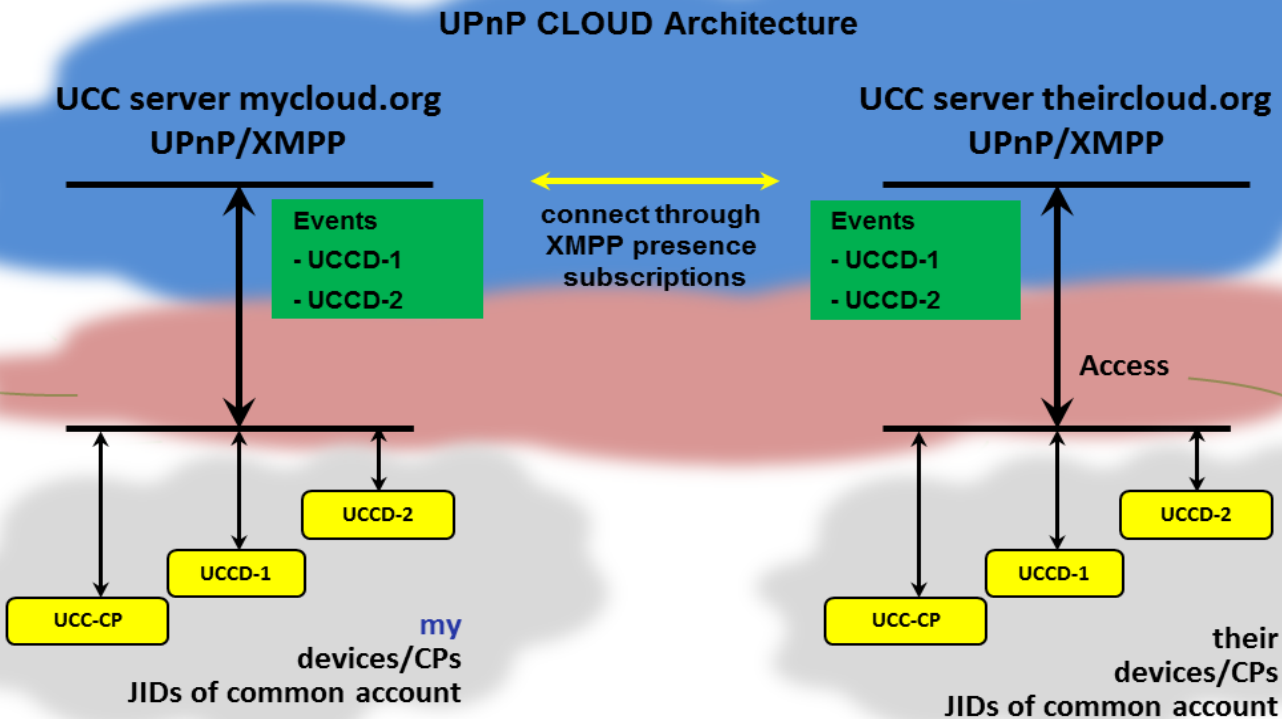
Optional or Conditionally Required Services

- ConfigurationManagement
- SoftwareManagement
- QOS

UPnP Cloud Overview



- 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:

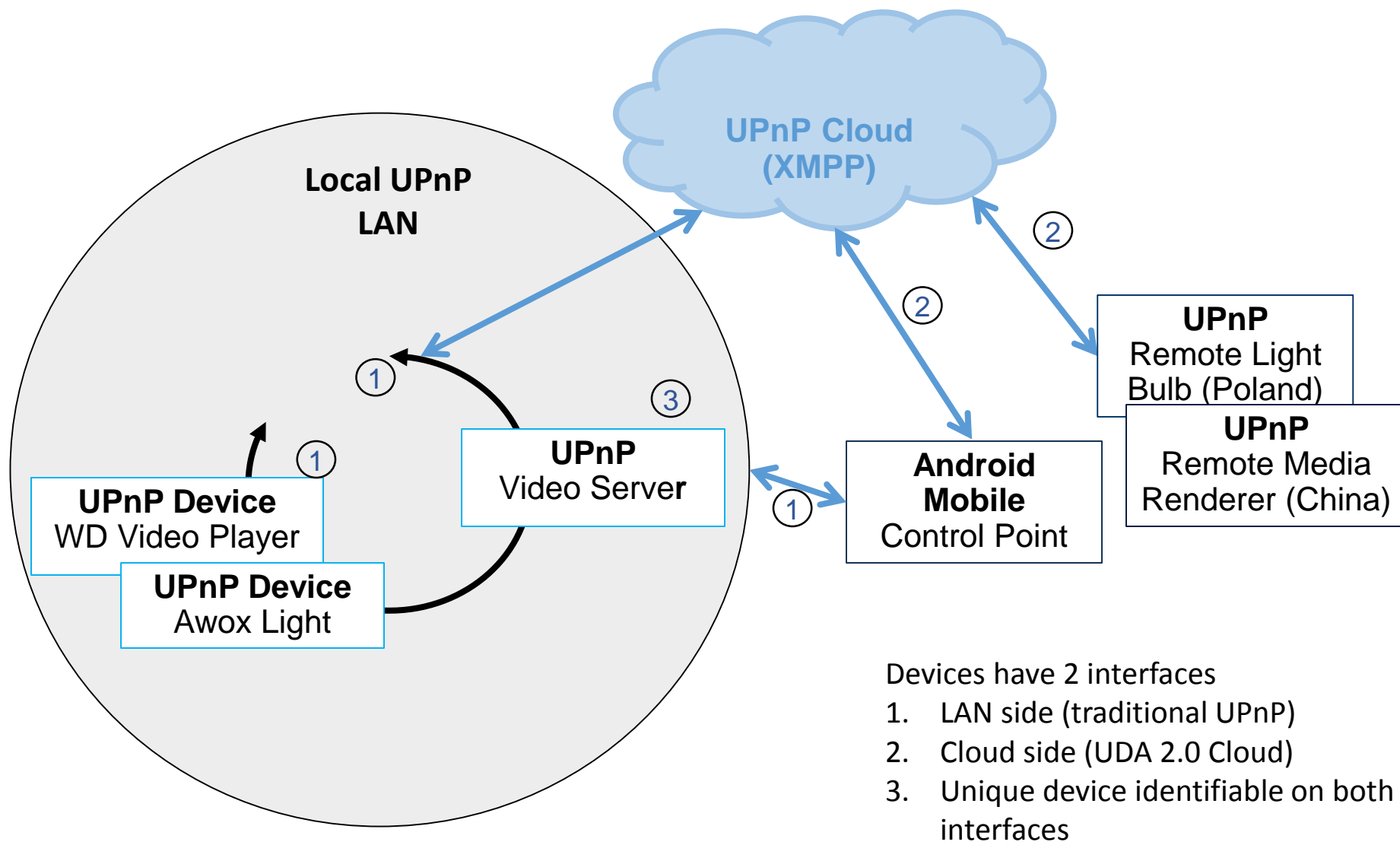
- XMPP requires SASL for authentication and TLS for link encryption.
- Eventing uses XMPP PubSub with whitelisting.
- Device sharing is private until a user decides to share outside of their account such as in a secure room.

- 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.

- 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.

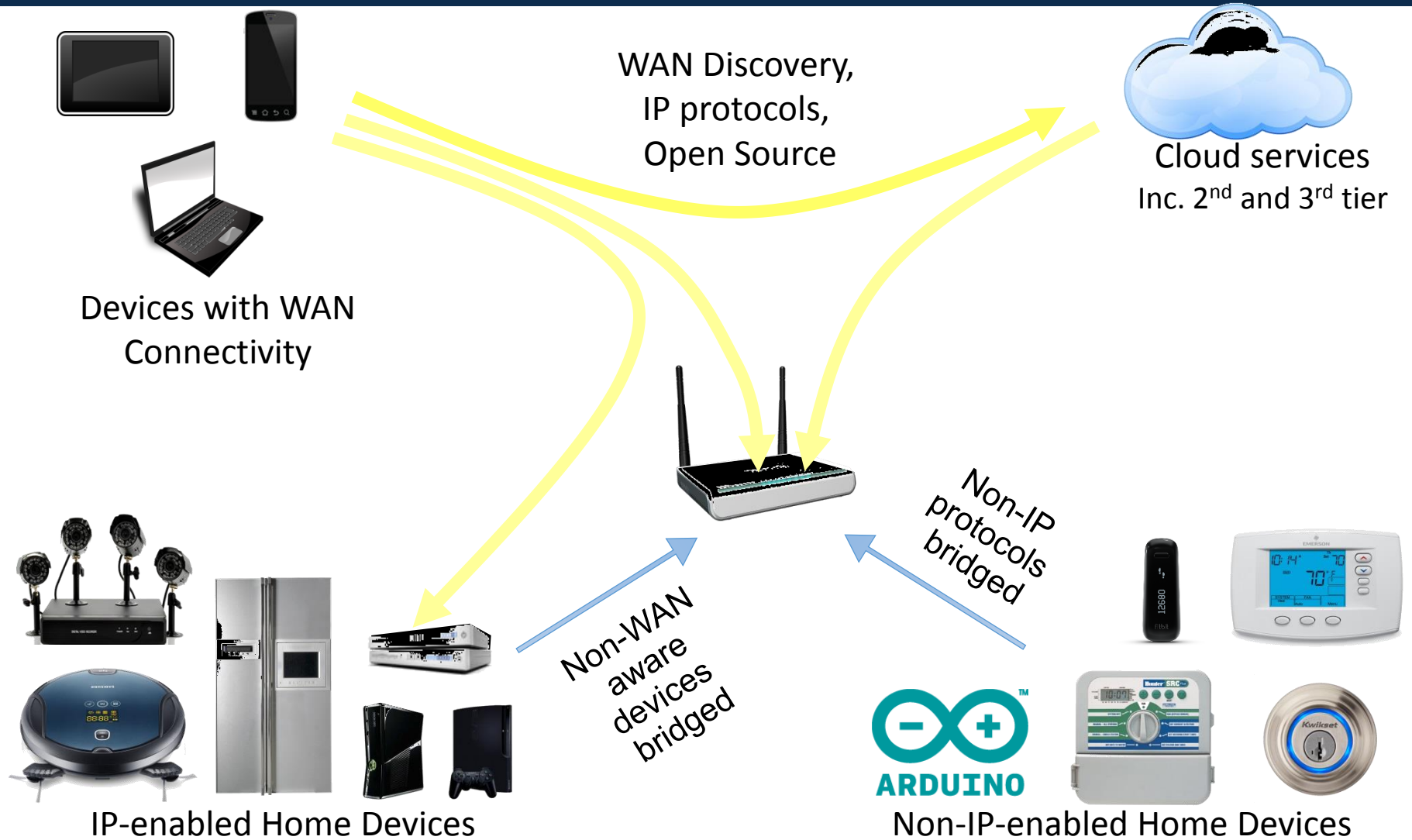
Ready today

Demo



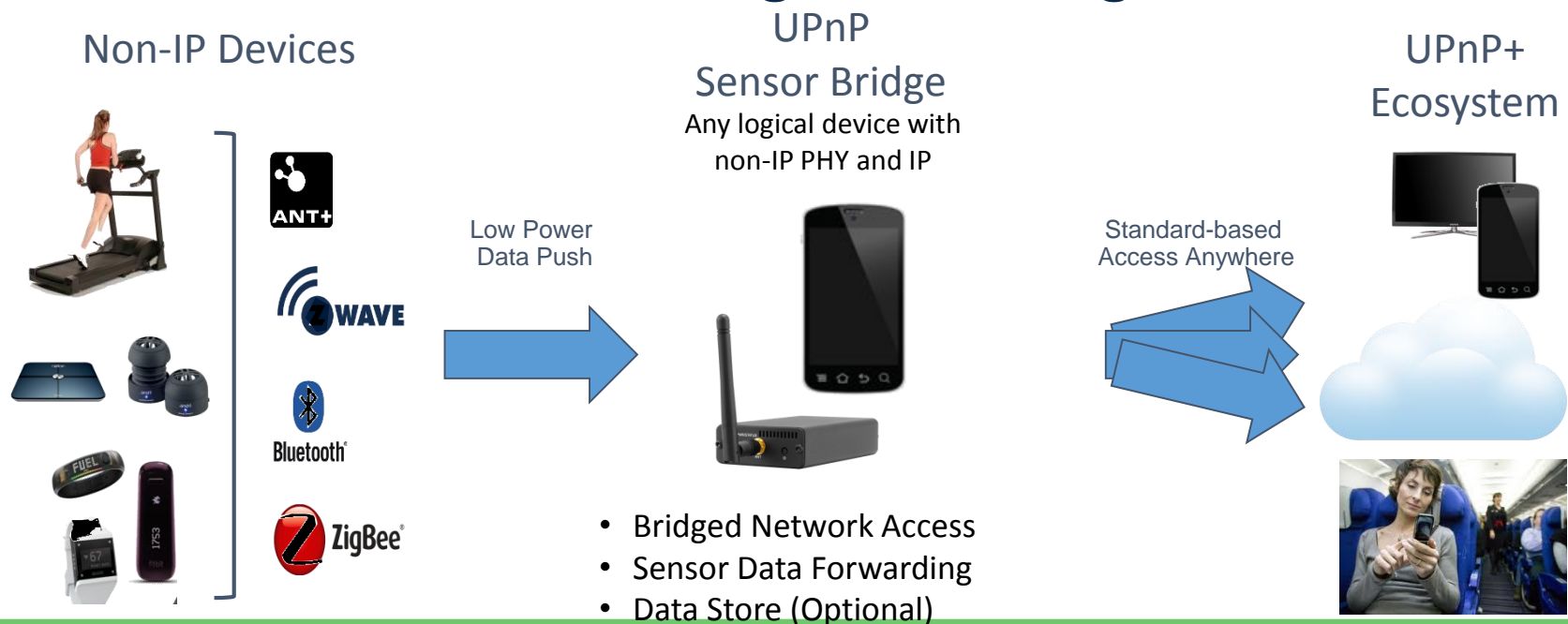
Demo Setup

Future Connected Devices



UPnP+ Sensor Bridging

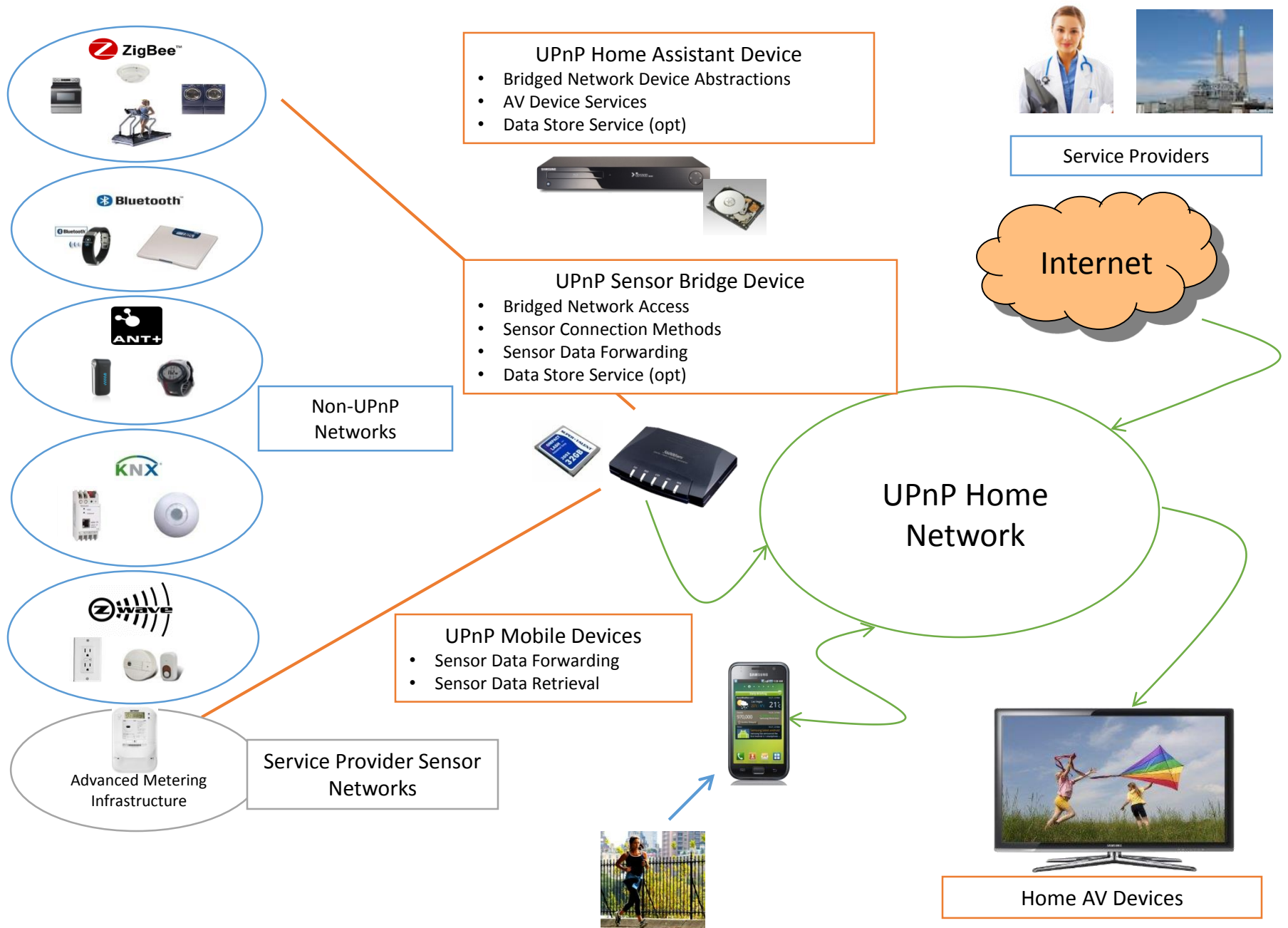
- Provide expanded support for low power sensors that need bridging to the rest of the Internet
 - Low Power efficient bridge
 - Pass-thru and/or storage of existing data



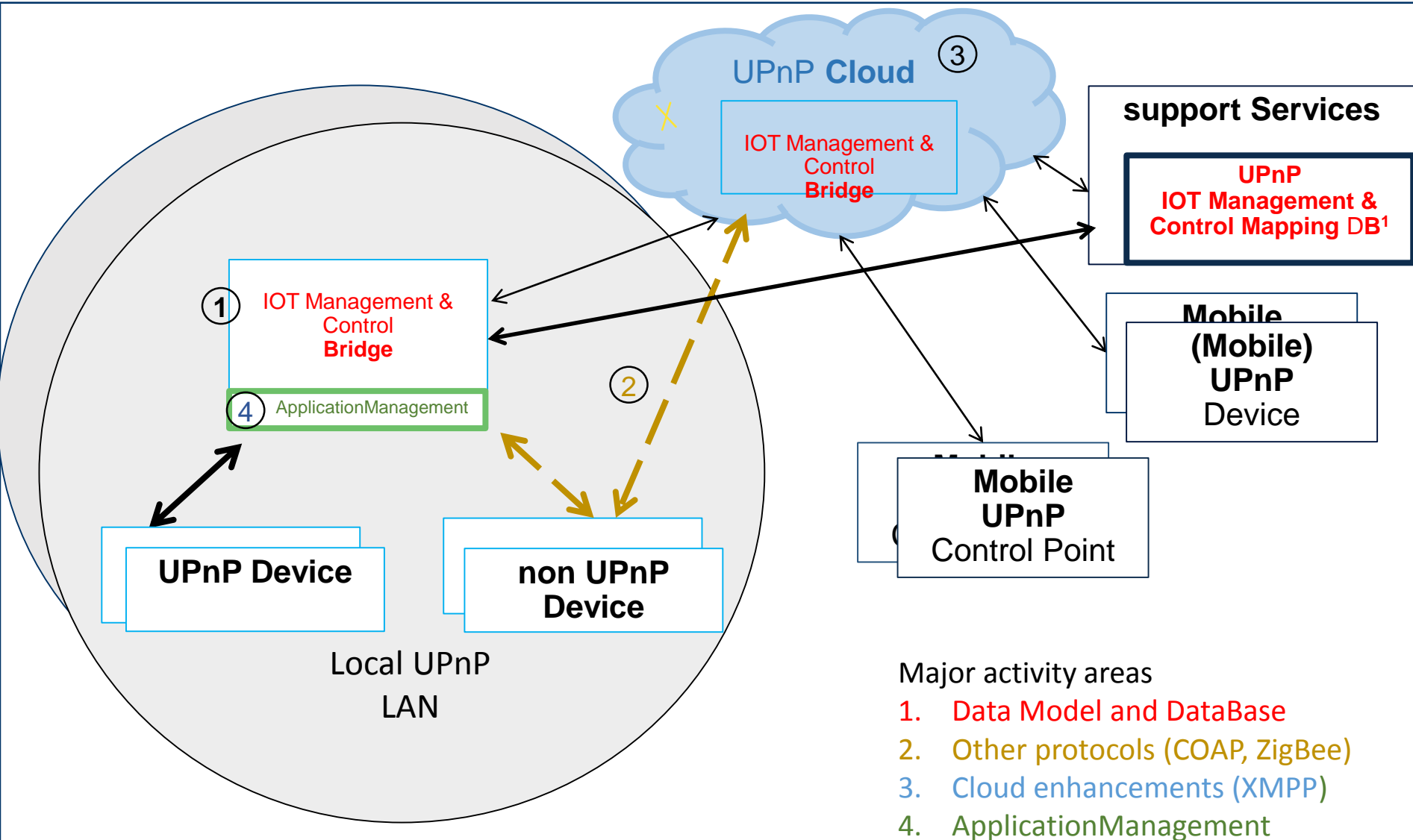
- UPnP embraces other technologies by Bridging.
 - Different transports
 - Different DataModels
- Different technologies mapped to same technology:

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

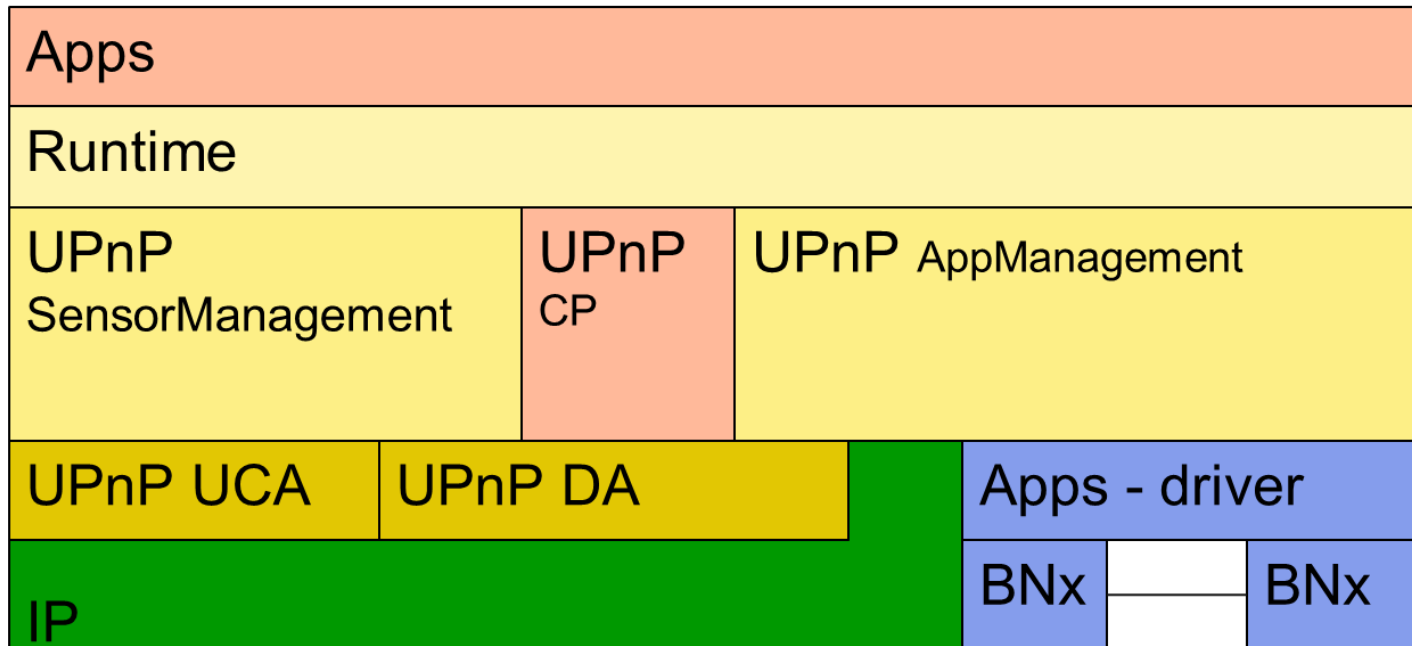


UPnP IoT Architecture Overview



- 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

urn:schemas-upnp-org:device:SensorManagement:1

urn:schemas-upnp-org:service:ConfigurationManagement:1

urn:schemas-upnp-org:service:SensorTransportGeneric:1

urn:schemas-upnp-org:service:DataStore:1

urn:schemas-upnp-org:service:DeviceProtection:1

Vendor Defined Services

urn:vendor-com:service:...:v



- Allowed service

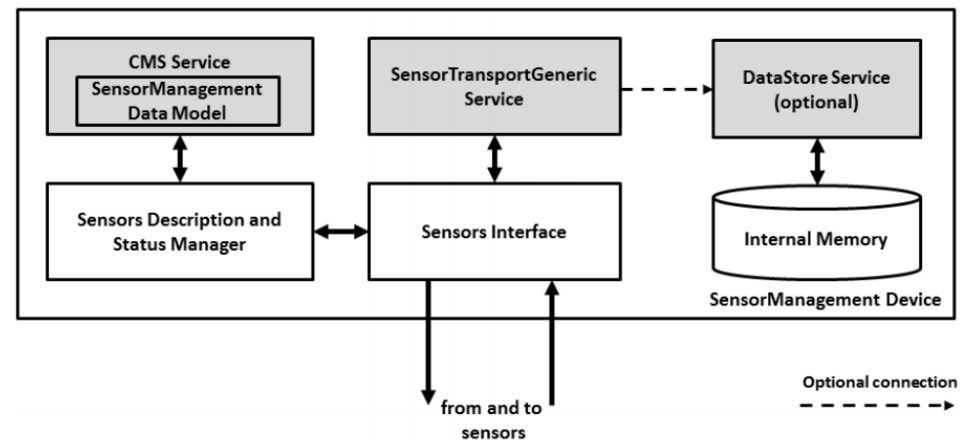


- Vendor Defined service

SensorManagement is a UPnP Device

- 2 Mandatory Services
 - ConfigurationManagement
 - SensorTransportGeneric
- 2 Optional Services
 - DataStore
 - DeviceProtection

Interfaces look like this ->

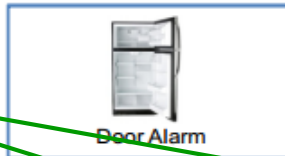


DataModel Refrigerator Example



Sensor 1 - Status	
AccumulatedPowerUsed	(kW-h, Cumulative)
FreezerTemp	(degC, Average)
GroceryTemp	(degC, Average)
VegetableTemp	(degC, Average)
DoorOpenAlarm	("Door Id", Timeout)
PowerFaultAlarm	(0 1)
StatusInterval	(s)

Features are named collection of sensors/actuators



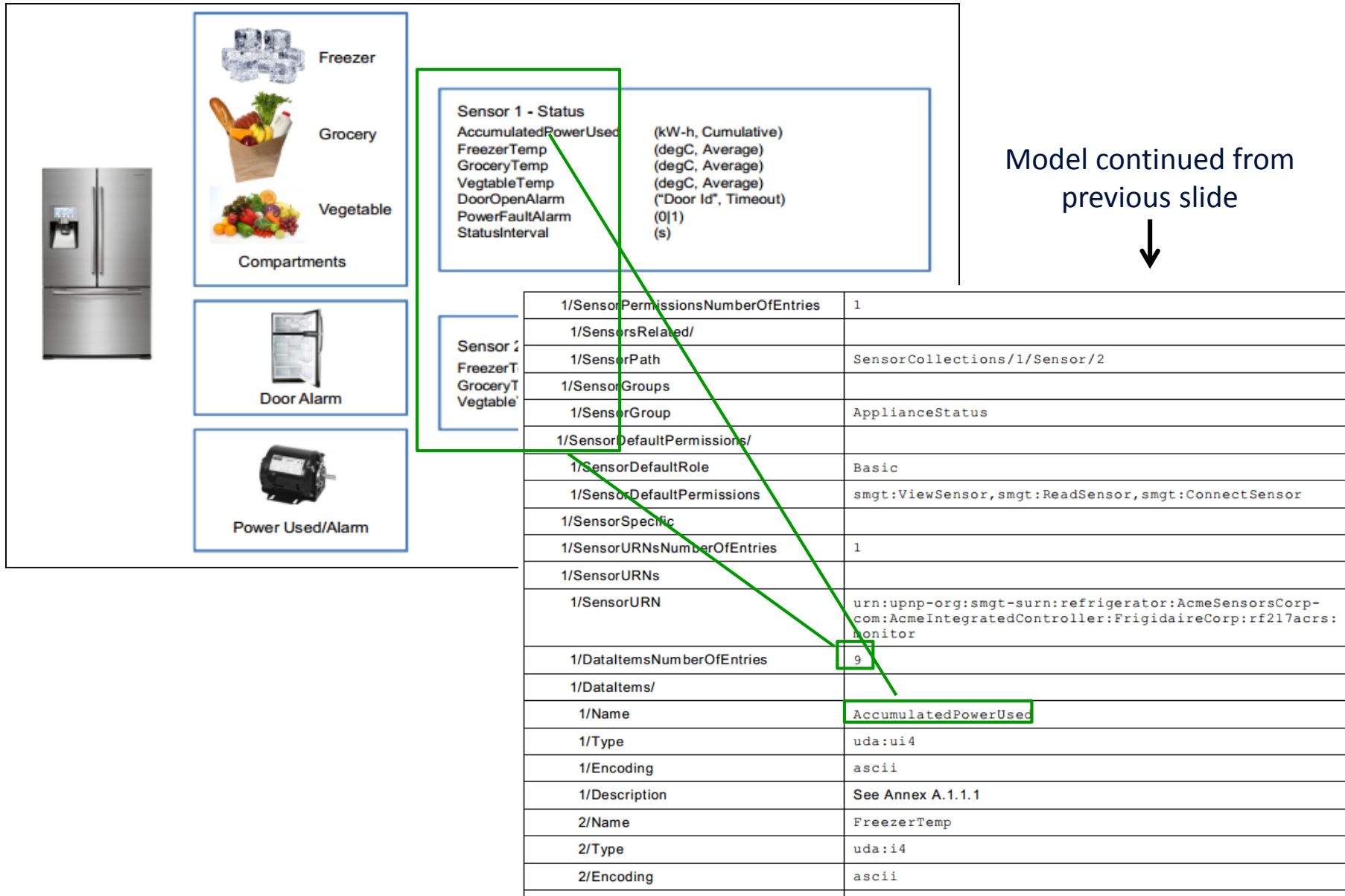
Sensor 2 - Control	
FreezerTempSetting	(degC - Current, LowLimit, HighLimit)
GroceryTempSetting	(degC - Current, LowLimit, HighLimit)
VegetableTempSetting	(degC - Current, LowLimit, HighLimit)



Refrigerator is a modelled device – can be generic or specific

Parameters	Value
/UPnP/SensorMgt	
SensorCollectionsNumberOfEntries	1
SensorCollections/	
1/CollectionID	Collection0001
1/CollectionType	urn:upnp-org:smgt-sct:refrigerator:AcmeSensorsCorp-com:AcmeIntegratedController:FrigidaireCorp:rf217acrs
1/CollectionFriendlyName	"Your Refrigerator"
1/CollectionInformation	"Vendor Refrigerator Model RF217ACRS"
1/CollectionUniqueIdentifier	"123456789"
1/CollectionSpecific	
1/SensorsNumberOfEntries	2
1/Sensors/	
1/SensorID	Sensor0001
1/SensorType	urn:upnp-org:smgt-st:refrigerator:AcmeSensorsCorp-com:AcmeIntegratedController:FrigidaireCorp:rf217acrs:monitor
1/SensorUpdateRequest	0
1/SensorPollingInterval	0
1/SensorReportChangeOnly	0
1/SensorsRelatedNumberOfEntries	1
1/SensorGroupsNumberOfEntries	1

DataModel Refrigerator (Cont)

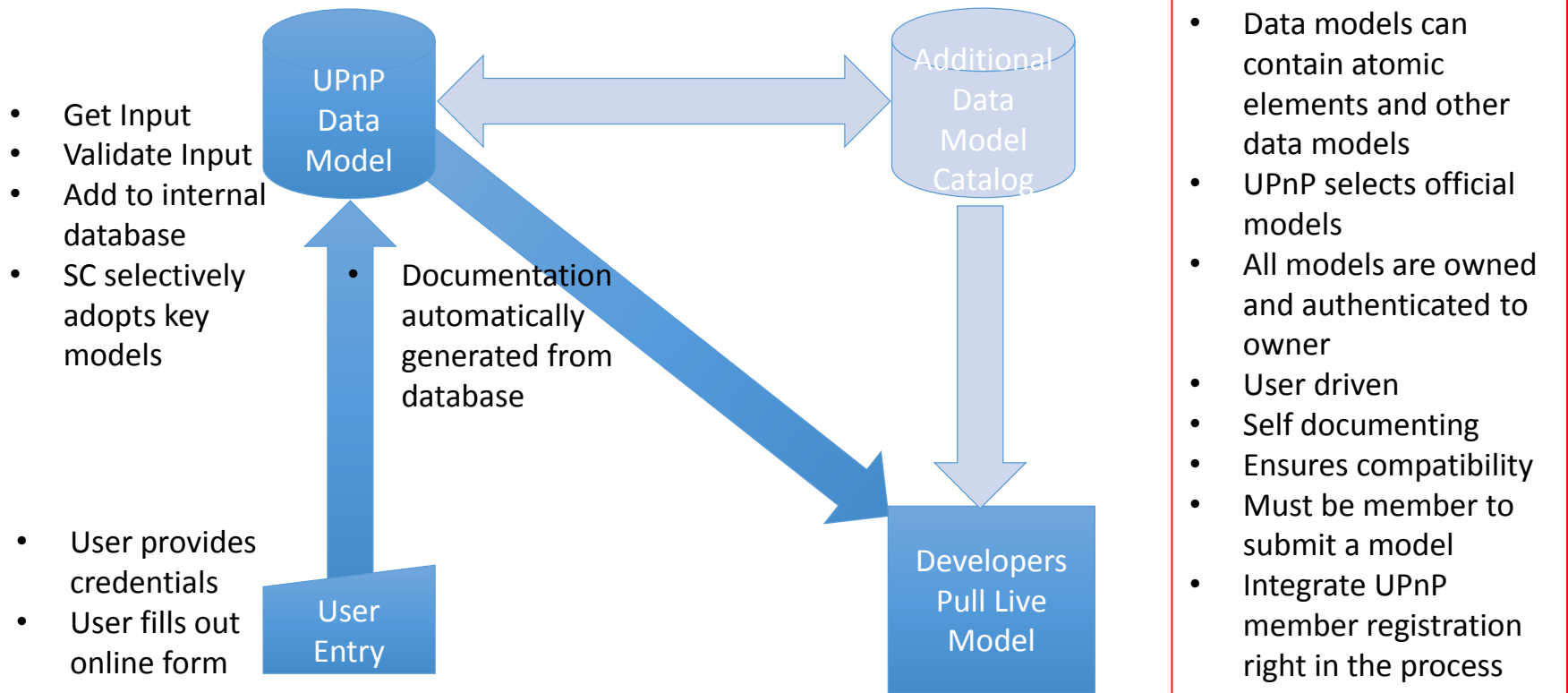


- Extend list of Common Device Identifiers
 - Support more devices!
- Extend list of Data Items
 - Support more types of actuators/sensors
- Extend list of locations
- Incorporate scripting engine

- Member companies – vendor specific models
- Some popular home devices and bridges –
 - HUE, StriiimLight, WeMo, ..
- Other SDOs
 - ongoing evaluation based on IPR and accessibility
- Short list of Generic Models and Features
 - UPnP IoT Data Model Task Force

Sustainable Data Model Strategy

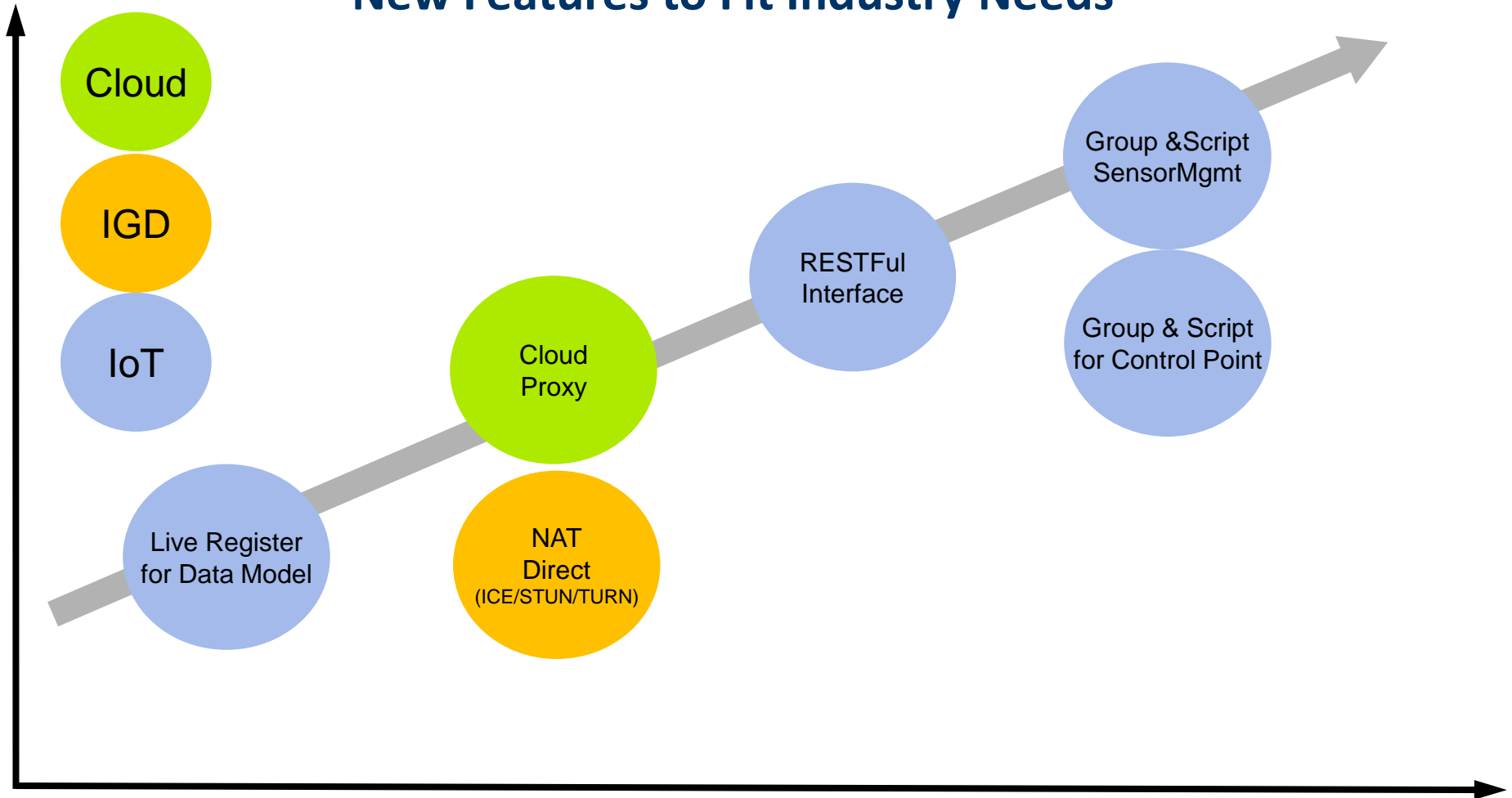
- UPnP has been connecting things for a dozen years with **seamless service discovery and control**



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

New Features to Fit Industry Needs



Thank you

Questions?

Contact Us

- Scott Lofgren, Intel
 - President & Chairman
 - scott.o.lofgren@intel.com
- Clarke Stevens, CableLabs
 - Technical Committee Chair, IoT Task Force Chair
 - c.stevens@cablelabs.com
- Aja Murray, UPnP Forum
 - Executive Director
 - upnpadmin@forum.upnp.org
- Follow us on Twitter [@UPnP Forum](https://twitter.com/UPnP_Forum) or join the Forum's Facebook community at <http://www.facebook.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).

- Website: www.upnp.org
- UPnP Forum Invites Orgs to use UPnP+ Certification
 - http://upnp.org/news/documents/UPnP_UPnPPlusCertificationLaunch_Nov2014.pdf
- Overview: UPnP+ Initiative
 - <http://upnp.org/latestupdates/upnpplus/>
- Presentation: UPnP Internet of Things Overview
 - http://upnp.org/resources/documents/UPnP_IoT_Overview_Dec2014.pdf
- Presentation: UPnP: The Discovery & Service Layer for IoT
 - http://upnp.org/resources/documents/UPnP_Internet_of_Things_OverviewPresentation_2015.pdf
- 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



For the interconnected lifestyle