

UPnP

Internet of Things

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- Scope
- Architecture
 - Local components description
 - Sensor Management Bridge
 - Bridging types
 - Bridge component descriptions
 - Cloud components description
 - UPnP 2.X for IoT
- SensorManagement Overview
 - Structure, Use Case Example (Aggregation)
- Sensor Management Data Modelling
 - Modelling Approach, Example (refrigerator)

UPnP IoT solves:

- Aggregating devices sensor and actuator data in a local network
- Observing and controlling those devices from anywhere agnostic to any platform
- Sharing information on a predefined granularity basis across networks with anyone
- Deciding what, when and with whom to share lies with the owner of the device
- Securing all communication

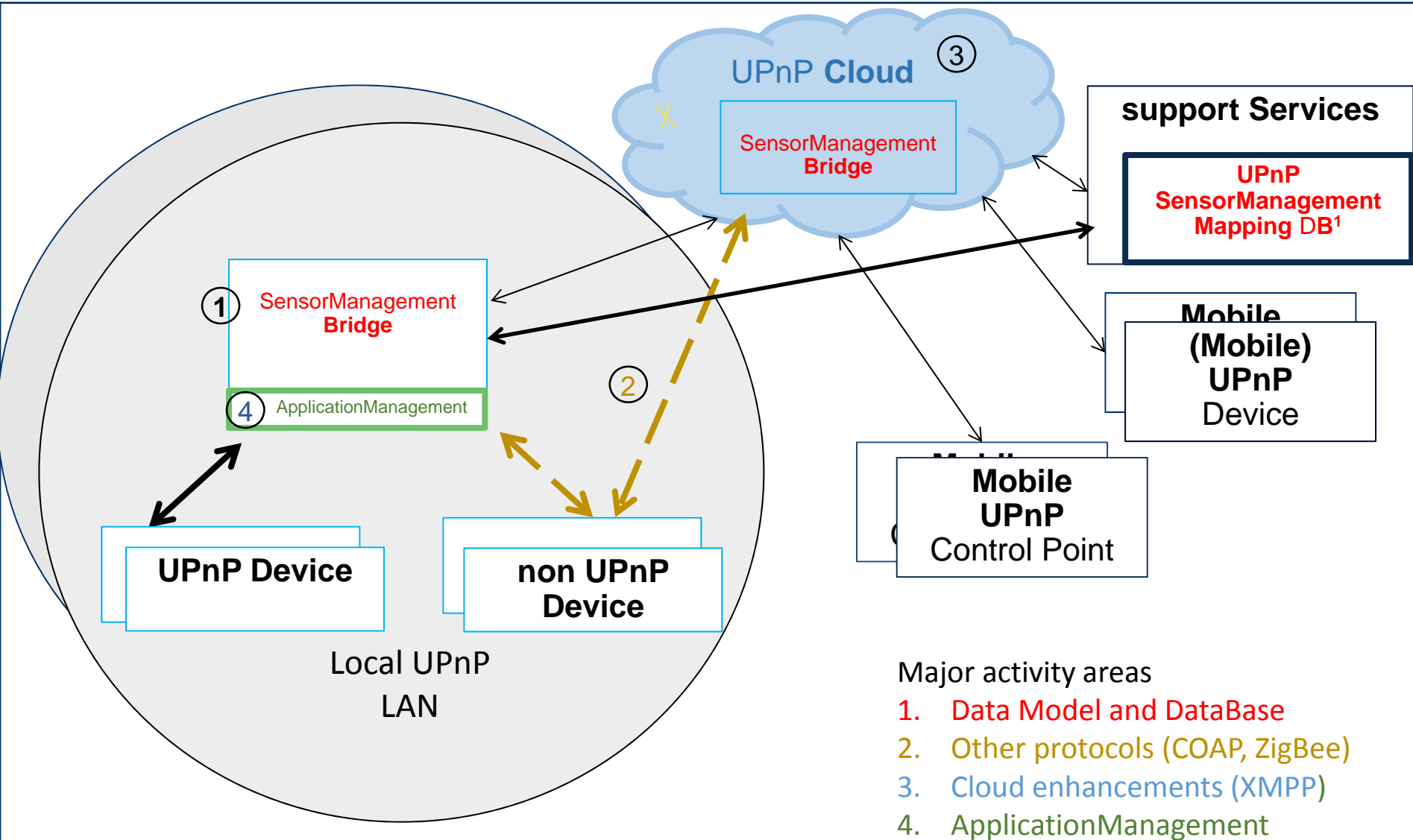
Using UPnP infrastructure

Existing Open Standards

- Billions of deployed devices.
 - Smart TVs, Gateways, Mobile Devices, Game Consoles, PCs
- Existing Device Control Protocols for home automation
 - HVAC, light, security camera, ...
 - Sensor, Device, and Energy Management

New Open Standards

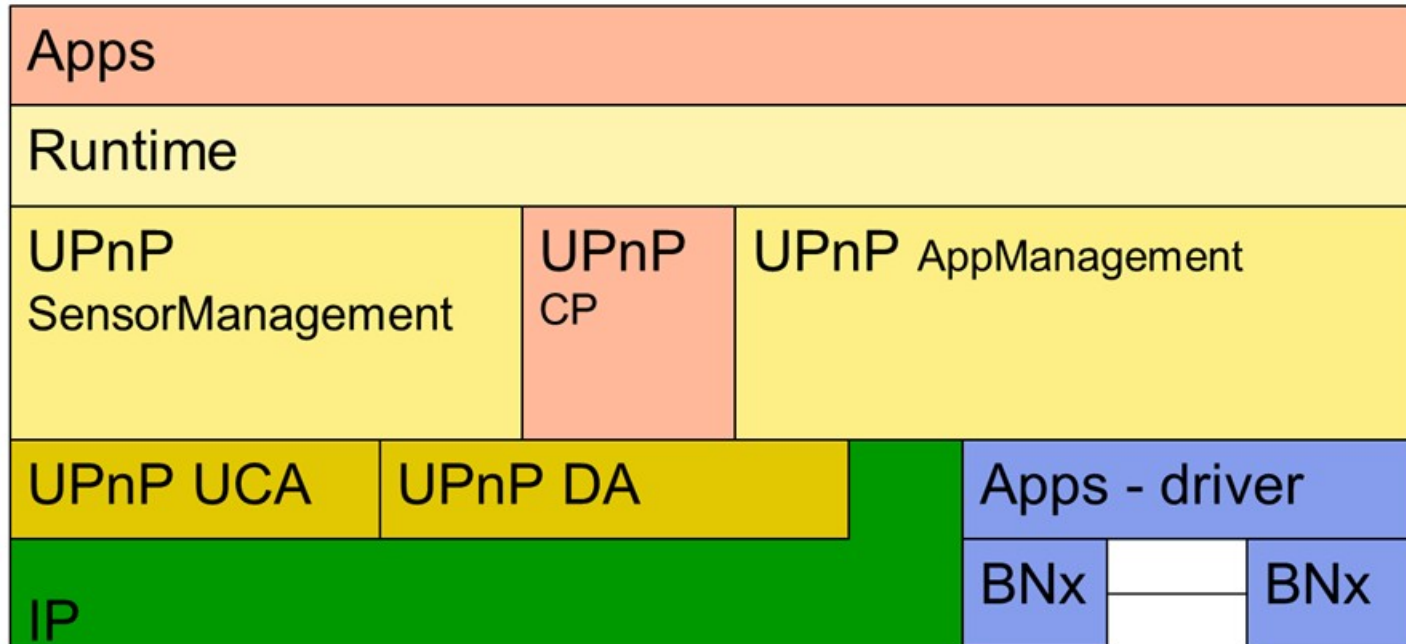
- UPnP Device Architecture 2.0 including
 - UPnP Cloud based on RFC 6120, 6121 [XMPP]
 - IPv6 support
 - ApplicationManagement



- Multiple local networks are connected to the cloud by means of UPnP Cloud architecture
 - This can include cloud services
- Individual UPnP devices and control points can be connected to the cloud with presence, state, and events shared securely with other local networks
- Ecosystem is easily extended using simple and flexible Data Models
- Data Models can be stored and interacted with via the SensorManagement Database (Service)

Bridging between UPnP and non UPnP devices includes

- Devices sensors/actuators supporting IP
 - For example, HTTP, COAP, REST, XMPP, MQTT
- Devices sensors/actuators on non-IP networks
 - For example, sensor hardware bridging between IP and non-IP networks (ZigBee, Z-Wave, ANT+, Bluetooth, etc)
- Runtime conversion Apps
 - ApplicationManagement (DIAL-like) for conversion



Applications

UPnP DCPs

UPnP infrastructure

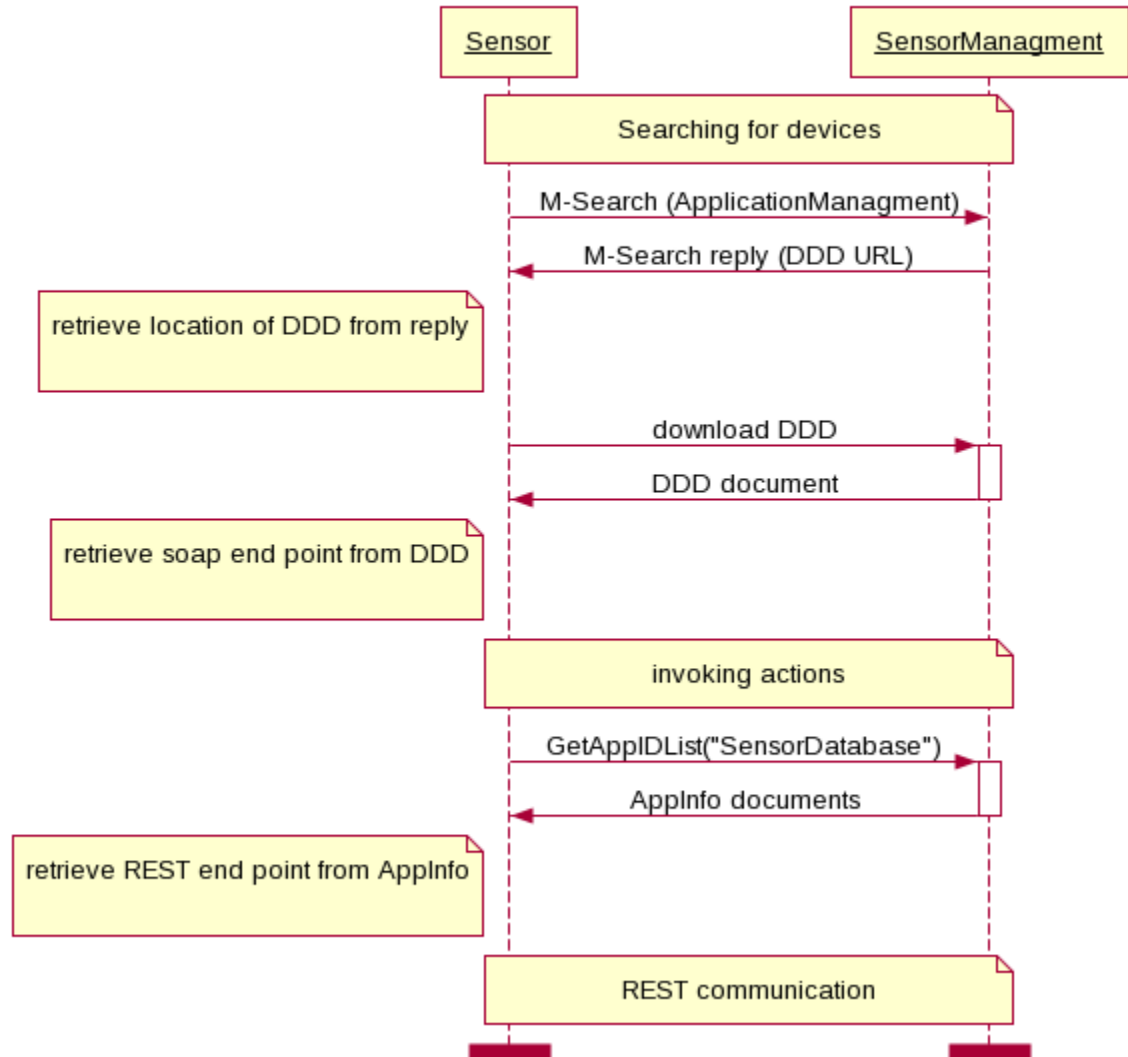
Bridged network infrastructure

SensorManagement supports a RESTful Interface which can be exposed via ApplicationManagement

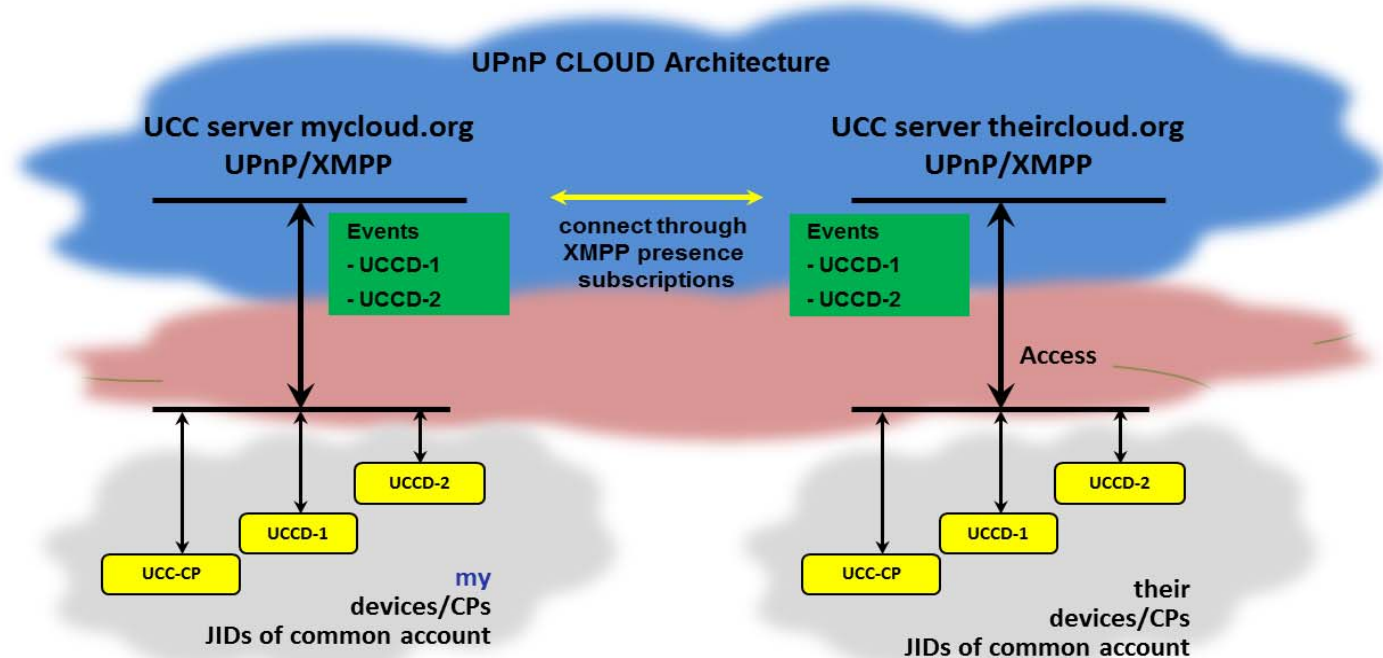
Flow is described in diagram.

Only HTTP and SSDP needed for sensor interface.

ApplicationManagement for Bridging Sensors

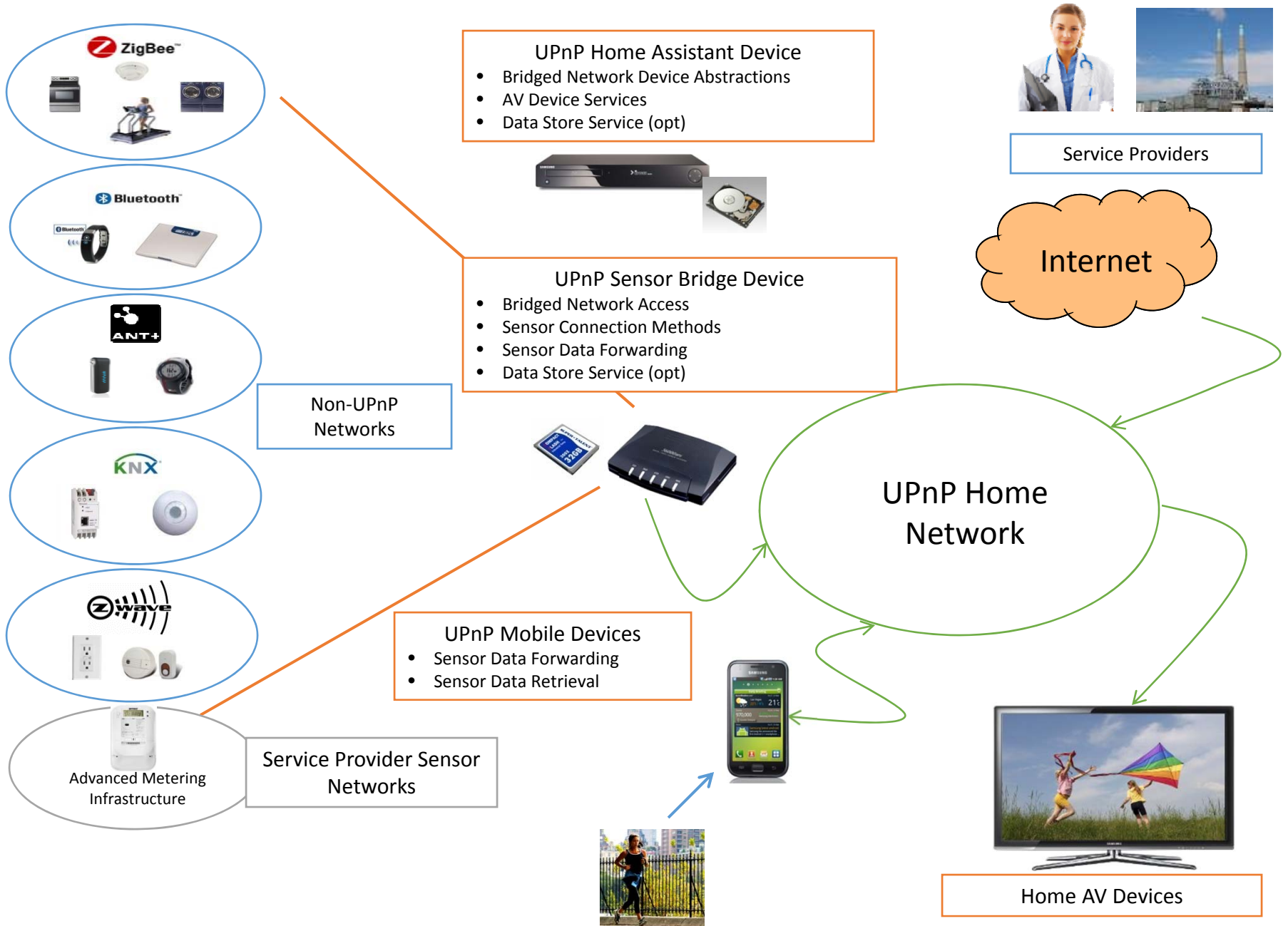


- UPnP Cloud connects UPnP Devices (UCCD) and Control Points (UCC-CP) as XMPP clients via an XMPP server.



- UPnP 2.0 release imminent
- UPnP 2.X version in development.
- UPnP IoT is adding new protocols and architectural elements
 - In particular, existing APIs are being mapped to REST+JSON
 - SensorManagement is already RESTful
 - CoAP is under consideration as one of the protocols for resource constrained devices.

UPnP Sensor Network Infrastructure



ConfigurationManagement (with specific Sensor DataModel)

This service enables UPnP clients to access sensors and/or actuators without needing a detailed knowledge of the target sensor or actuator or its connectivity to the UPnP network. *Sensors* and *Actuators* are instead treated as generic data sources or sinks.

The UPnP SensorManagement Sensor DataModel service provides a set of uniform Sensor Properties as defined by Annex A, "SensorManagement General Data Model". These properties assist UPnP clients to identify sensors they may be capable of supporting. In addition to uniform Sensor properties described by the General Sensor Data Model, this specification also can reference additional sensor properties which are defined by the Sensor's parent ecosystem.

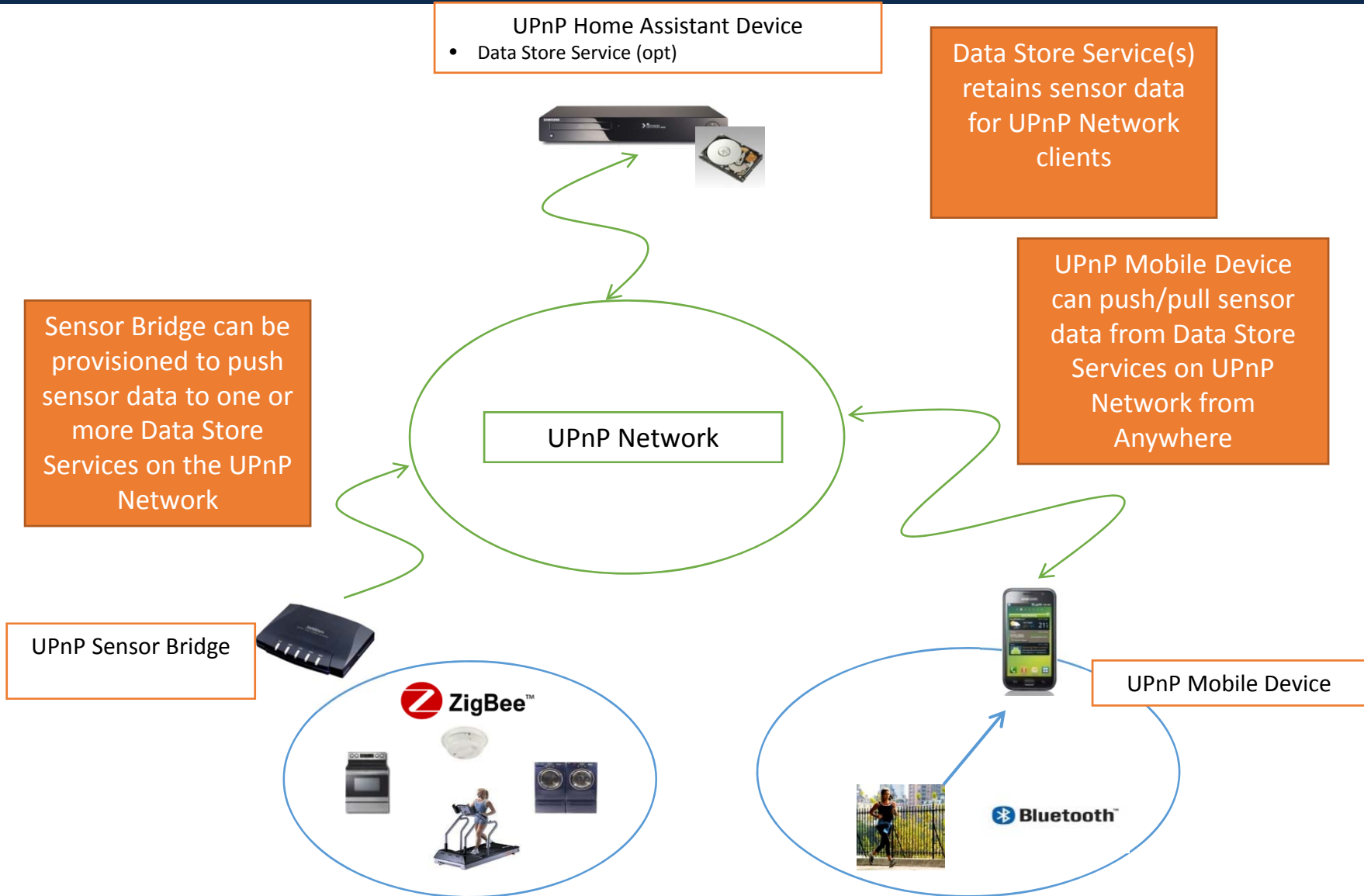
TransportGeneric Service

The SensorTransportGeneric service enables UPnP clients to obtain sensor data without needing to have detailed understanding the operation of a target sensor or the sensor's access network protocols. This service abstracts these notions treating the sensor as a generic data source which defines output record formats. Both HTTP transport and a SOAP-

DataStore Service

The DataStore service provides the ability to acquire and persistently store information for later access. This service allows UPnP devices such as mobile phones and sensors to make information available for subsequent retrieval. This increases the flexibility of the UPnP ecosystem by eliminating requirements to have an immediate nexus between information sources and sinks on the UPnP network. The [DataStore](#) service additionally allows UPnP devices with limited or temporary storage capabilities to persist information for subsequent retrieval. The [DataStore](#) service constructs are intended to be modelled after and compatible with well-established database models.

Typical UPnP Sensor Use Case



- 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 keep interoperability
 - Just have to use standard SensorURNs
- SensorTypes and SensorURNs are like “interfaces”

Naming conventions

- Sensor URNs (DataItems)
 - List of UPnP defined sensors/actuators (features).
 - Generic list that every device can use
 - Units are defined
- List of standard modelled devices
 - Containing:
 - Mandatory SensorURN (features)
 - Optional SensorURN (features)
 - Vendor defined extensions
- Where a sensor is located

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

DataModel Refrigerator



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)

Sensor 2 - Control

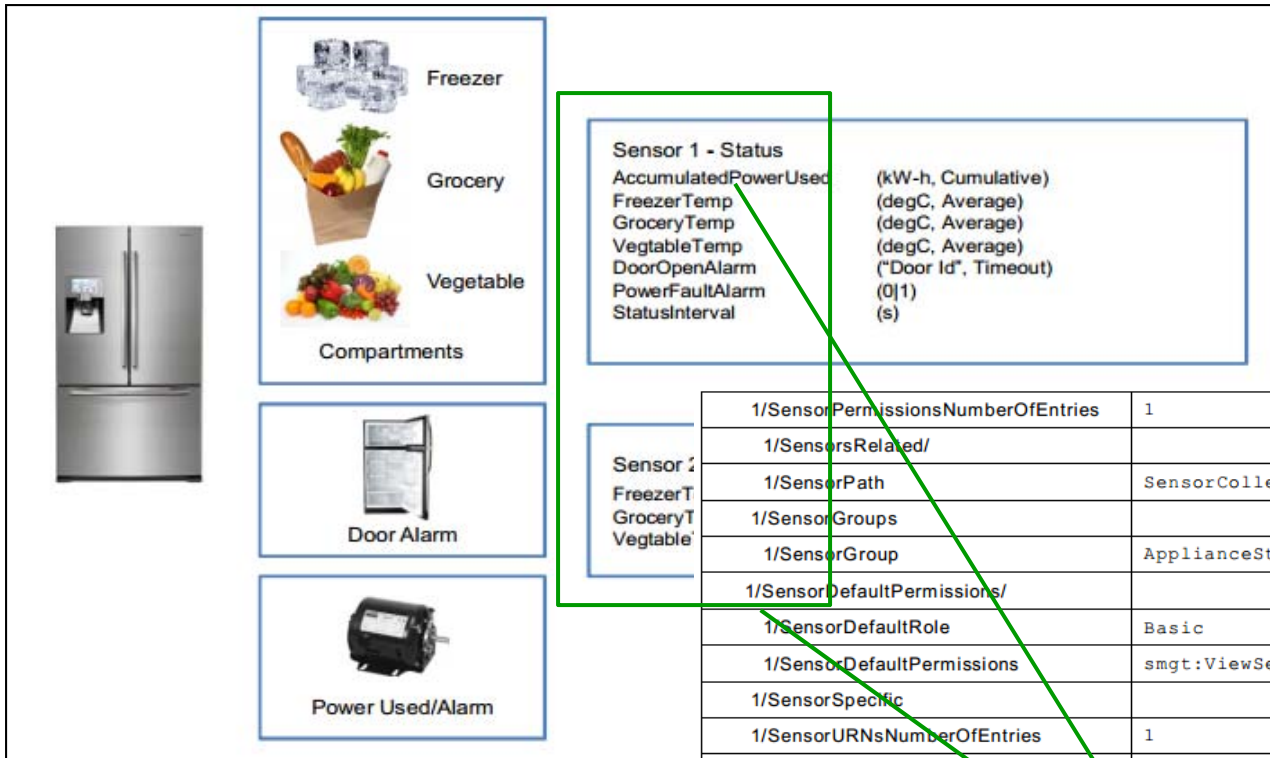
FreezerTempSetting	(degC - Current, LowLimit, HighLimit)
GroceryTempSetting	(degC - Current, LowLimit, HighLimit)
VegetableTempSetting	(degC - Current, LowLimit, HighLimit)

Features are named collection of sensors/actuators

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

Refrigerator is a modelled device – can be generic or specific

DataModel Refrigerator (Cont)



Model continued from previous slide



1/SensorPermissionsNumberOfEntries	1
1/SensorsRelated/	
1/SensorPath	SensorCollections/1/Sensor/2
1/SensorGroups	
1/SensorGroup	ApplianceStatus
1/SensorDefaultPermissions/	
1/SensorDefaultRole	Basic
1/SensorDefaultPermissions	smgt:ViewSensor, smgt:ReadSensor, smgt:ConnectSensor
1/SensorSpecific	
1/SensorURNsNumberOfEntries	1
1/SensorURNs	
1/SensorURN	urn:upnp-org:smgt-surn:refrigerator:AcmeSensorsCorp-com:AcmeIntegratedController:FrigidaireCorp:rf217acrs:Monitor
1/DataItemsNumberOfEntries	9
1/DataItems/	
1/Name	AccumulatedPowerUsed
1/Type	uda:ui4
1/Encoding	ascii
1/Description	See Annex A.1.1.1
2/Name	FreezerTemp
2/Type	uda:i4
2/Encoding	ascii



For the interconnected lifestyle