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IoT & OIC

Consideration of IoT standard and OIC introduction

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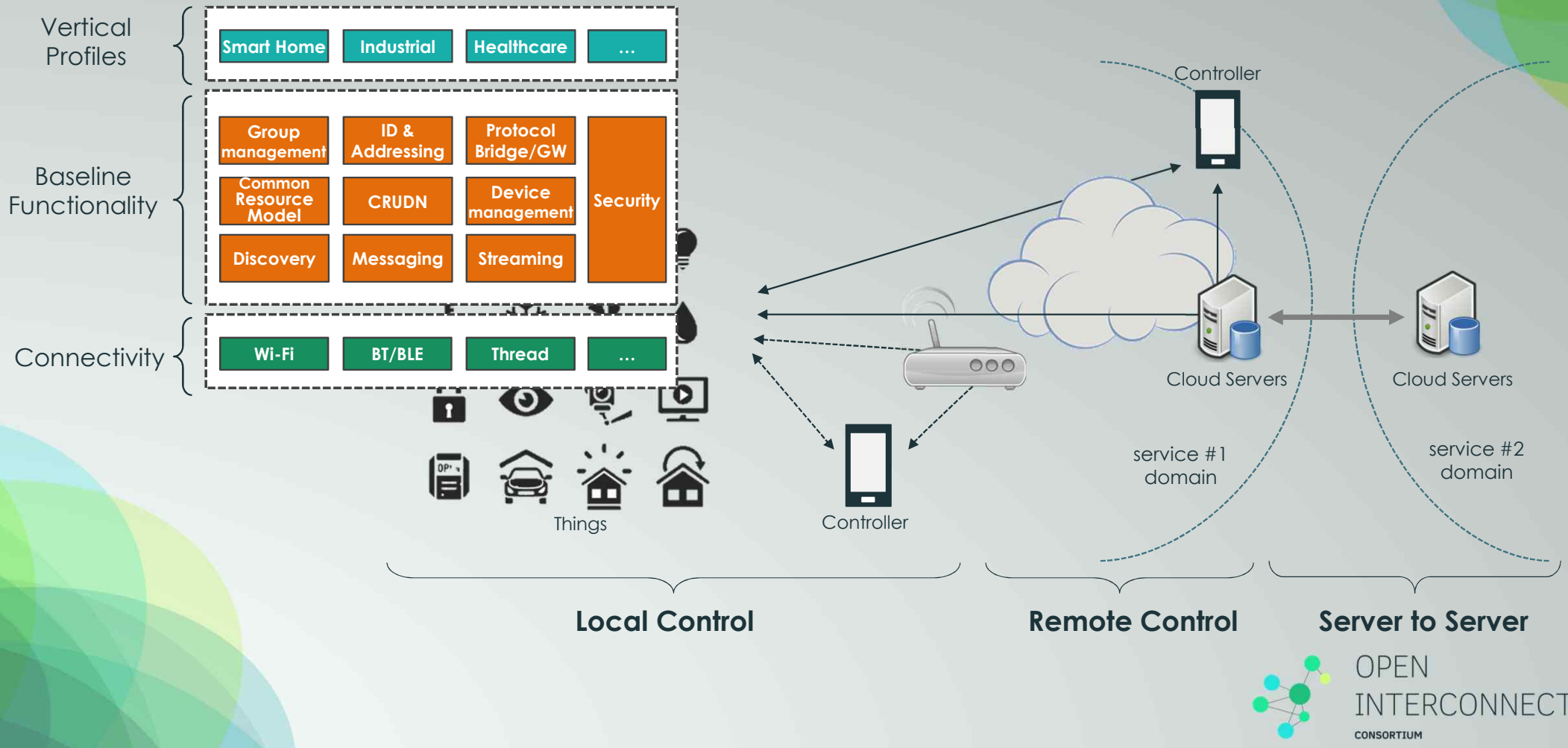
Internet of Things Standard Consideration

Scope of IoT



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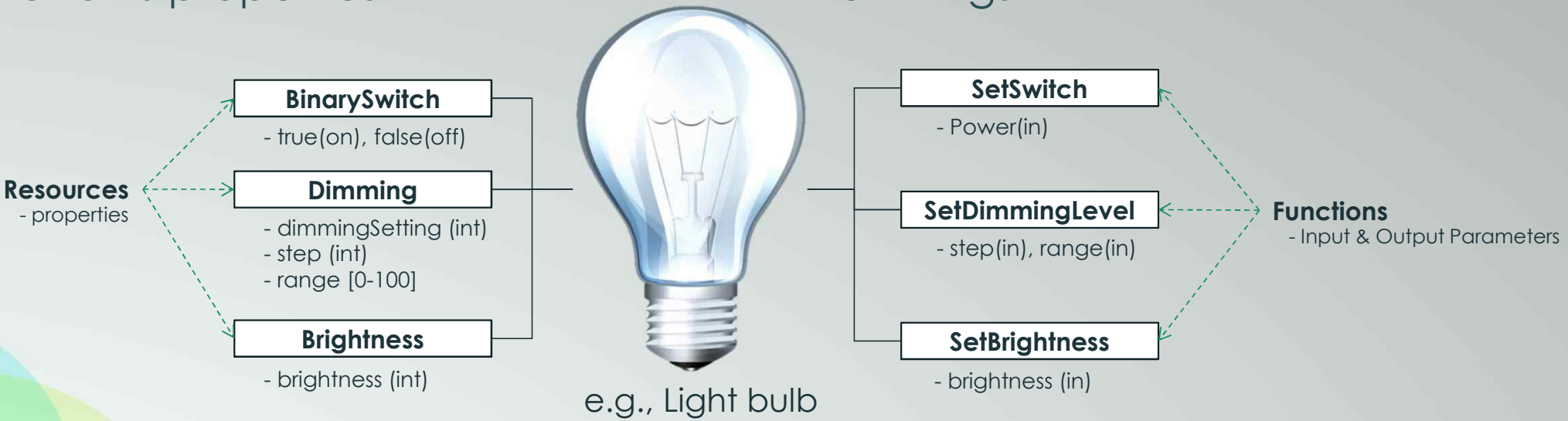
Definition of various Things

- By defining resources of things and its properties
- By defining functions/operations of things



- (no Verbs) + Objects
  *Fixed set of verbs (CRUDN) from transport layer will be used
- Resource model in ReSTful Architecture (e.g., W3C, CSEP, etc.)

- (Verbs + Objects)
- RPC model using DBus

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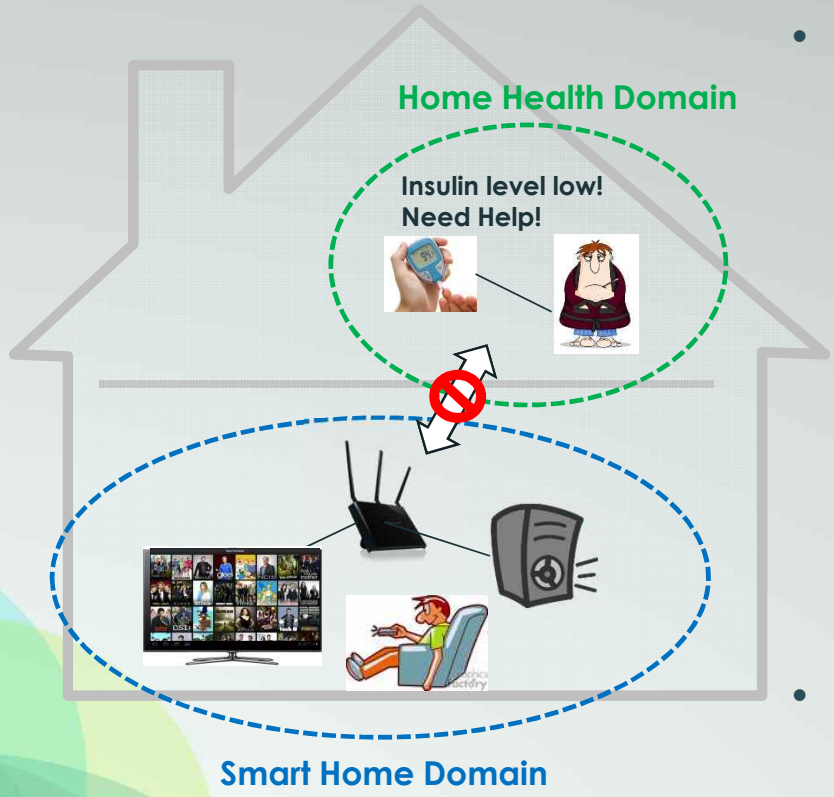
Support of Constrained Things

*RAM <10KB, Flash <100KB (RFC 7228)

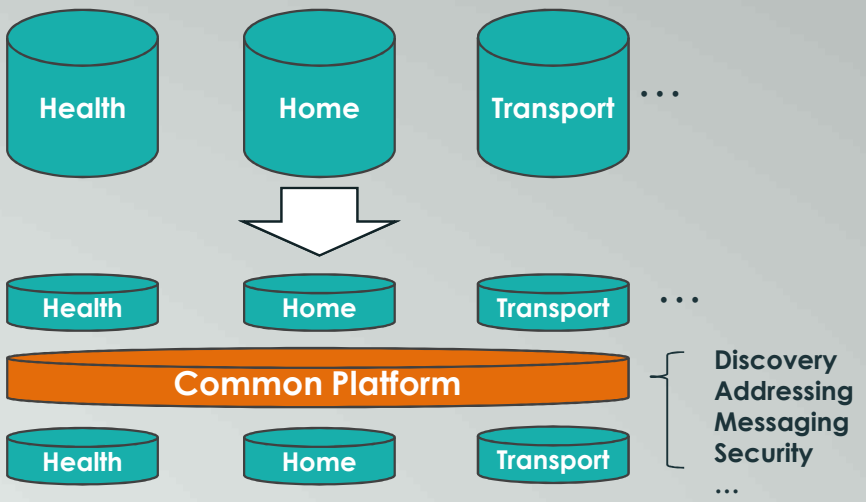
- Less overhead/ Less Traffic
  - Compact header
  - Binary protocol
  - Compressed encoding of payload

- Low Complexity
  - Simple Resource Model
    > Short URI (Late Binding w/ resource type defined)
    > Broad and Shallow Hierarchy

Support of Multiple Verticals



- Legacy vertical services usually designed as silos
  → No common way to communicate among them



- A common platform provides a foundation for vertical services to collaborate and interwork by providing common services and data models

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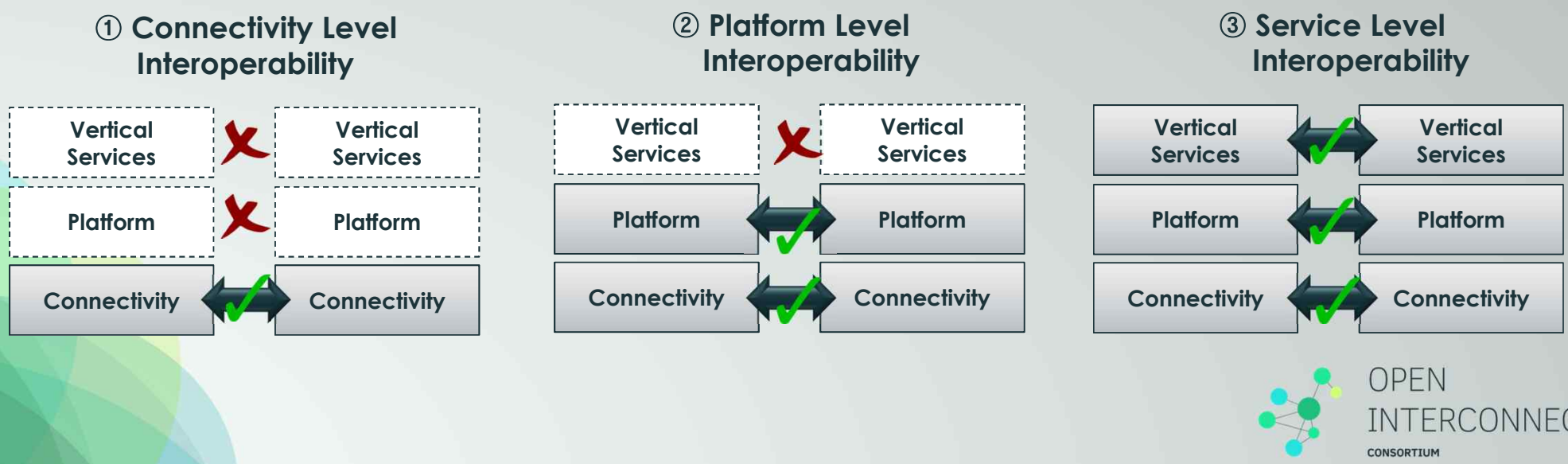
Interoperability

- **Full interoperability** from the connectivity layer up to the service layer is the only way to truly guarantee a satisfactory UX
- Interoperability at the Connectivity and/or Platform layer only provides partial interoperability which can ultimately lead to fragmentation



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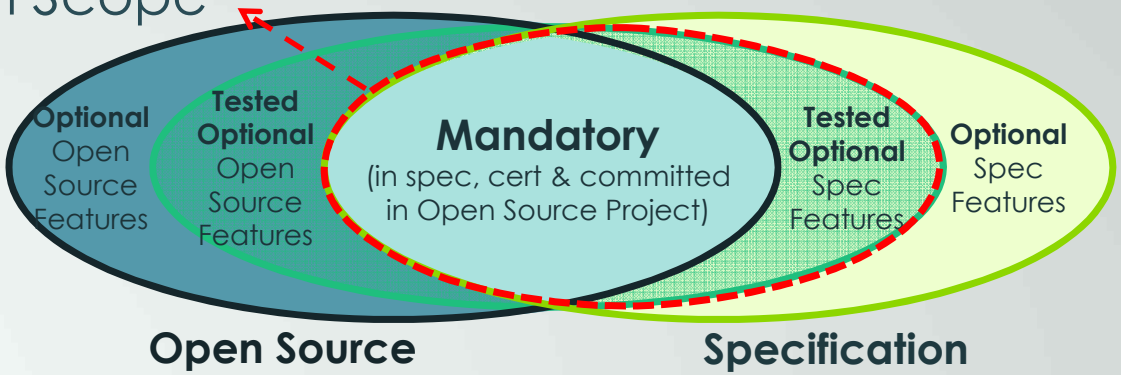
Interoperability & Certification

- Conformance test - Each device proves conformance to specifications
- Interoperability test - Each device proves interoperability with other devices

- Certification Scope



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Licensing

- For IPR Policy : RAND-Z > RAND >> no IPR policy
- For Open Source : Apache 2.0 > ISC

- Due to the common nature of IoT connecting everything over the Internet, it's most critical for manufacturers to avoid a licensing risk
  - Everything connected could be at potential risk

- Offering manufacturer-friendly Licensing and IPR Policy enables growth of market by attracting both start-ups and large enterprises

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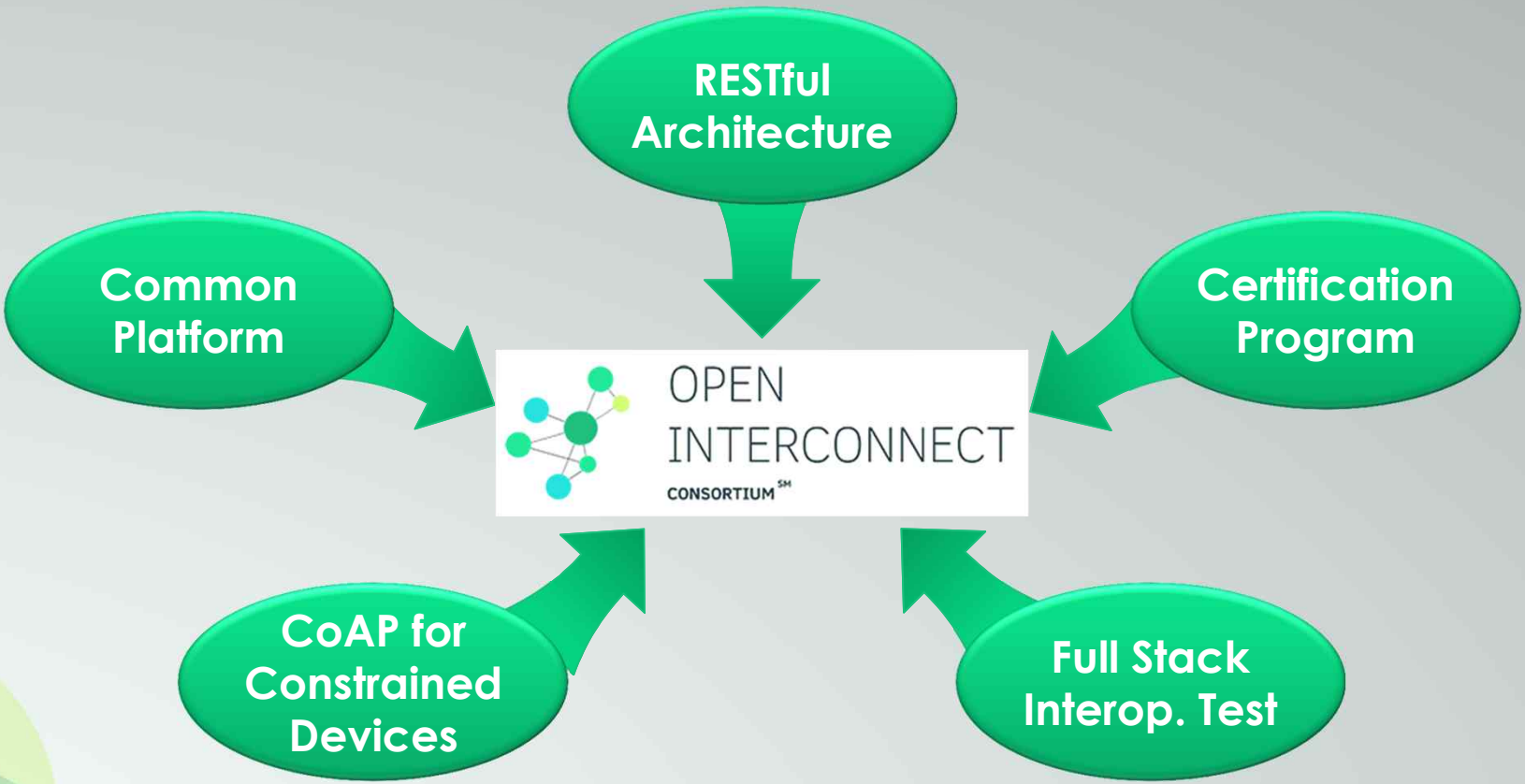
Introduction of Open Interconnect Consortium

Open Interconnect Consortium, Inc.

Introduction to OIC – Optimized for IoT



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OIC Key Concepts (1/2)

- **Free IPR License** (Code: Apache 2.0 & Spec: RAND-Z)
  - License covers both code, standards and related IPR
  - License applies to members and affiliates of members
- **Dedicated and optimized protocols for IoT** (e.g. CoAP)
  - Specific considerations for constrained devices
  - Fully compliant towards RESTful architecture
  - Built-in discovery and subscription mechanisms
- **Standards and Open Source to allow flexibility creating solutions**
  - Able to address all types of devices, form-factors, companies and markets with the widest possibility of options
  - Open Source is just one implementation to solve a problem

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OIC Key Concepts (2/2)

- **Full stack definition for maximum interoperability**
  - Connectivity, Platform and Vertical Services defined
  - License applies to members and affiliates of members
- **Certification and Logo program**
  - Guarantees all devices work together
  - Consistent user awareness for interoperability

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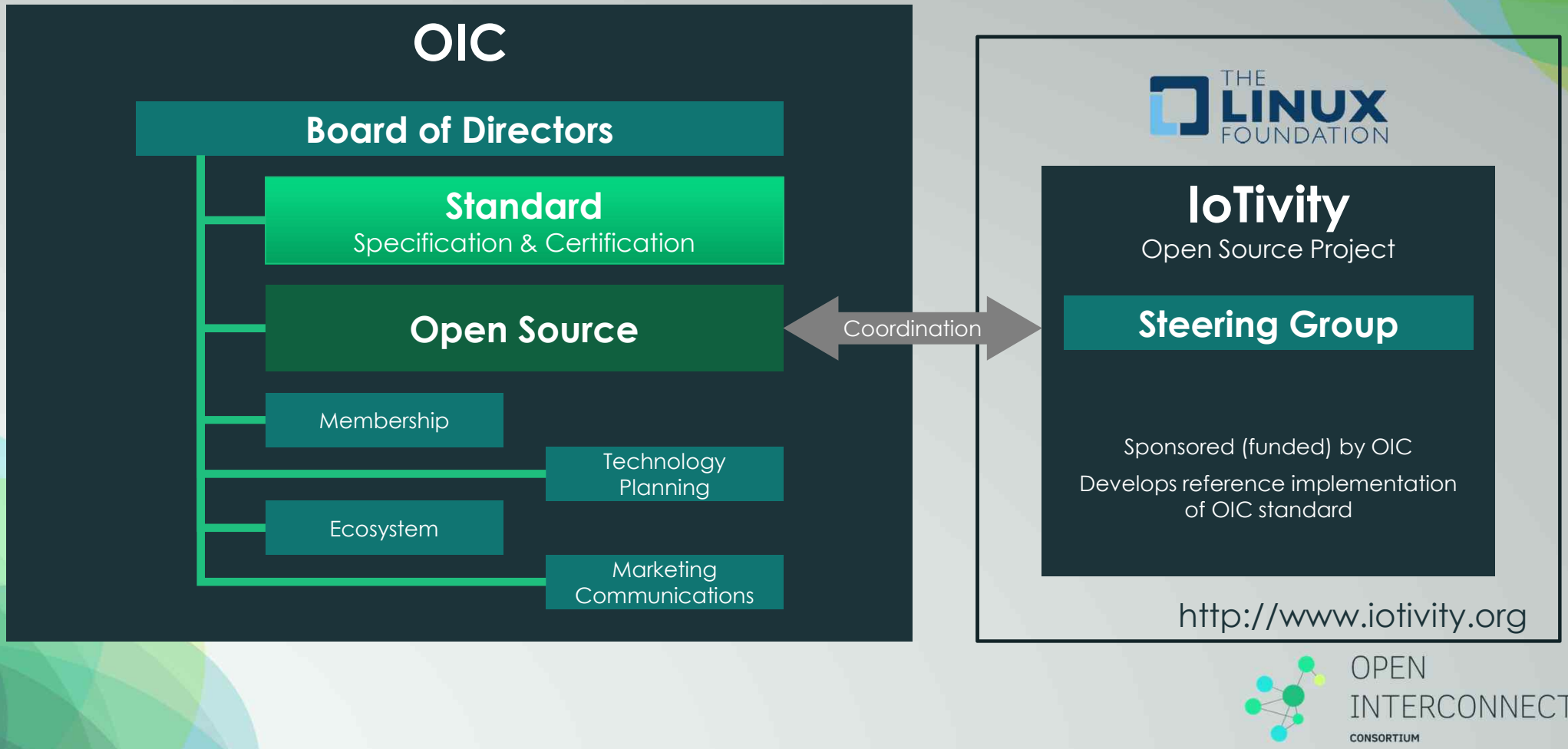
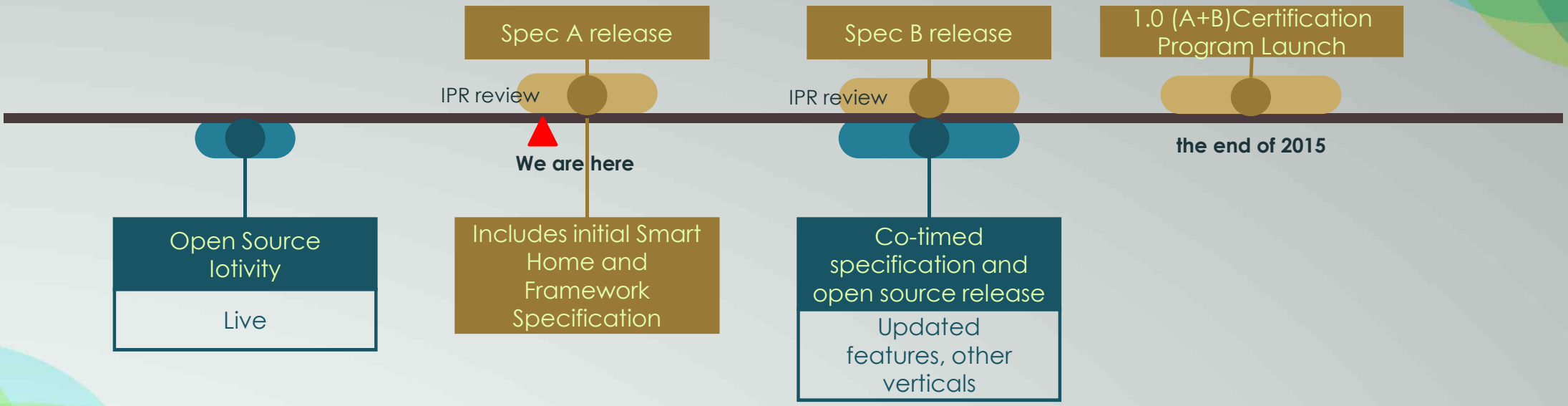
OIC Structure



OIC Timeline



OIC 1.0 targeted Smart Home, but will include more vertical such as Industrial, Healthcare etc

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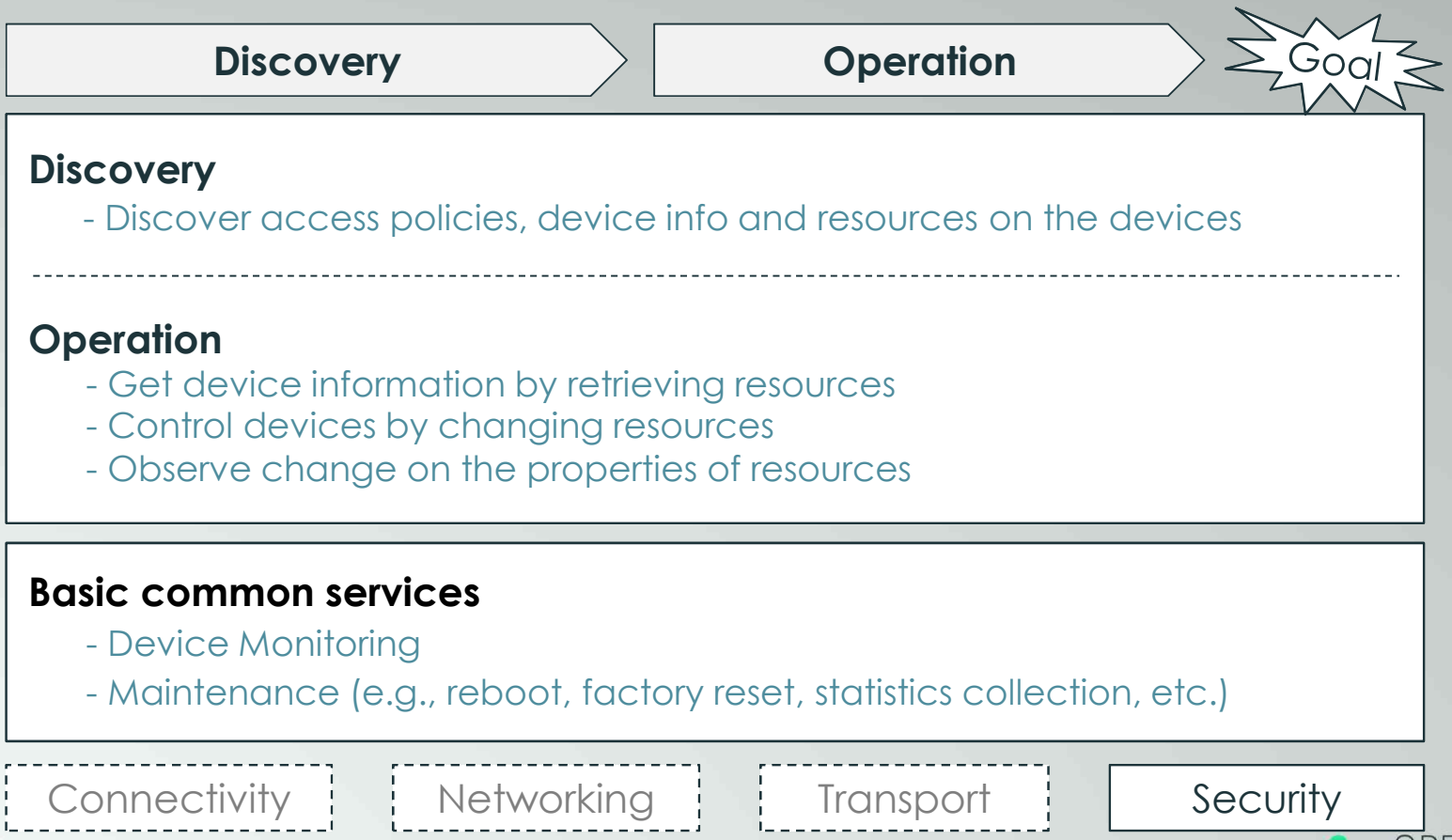
OIC Spec A Basic Operation



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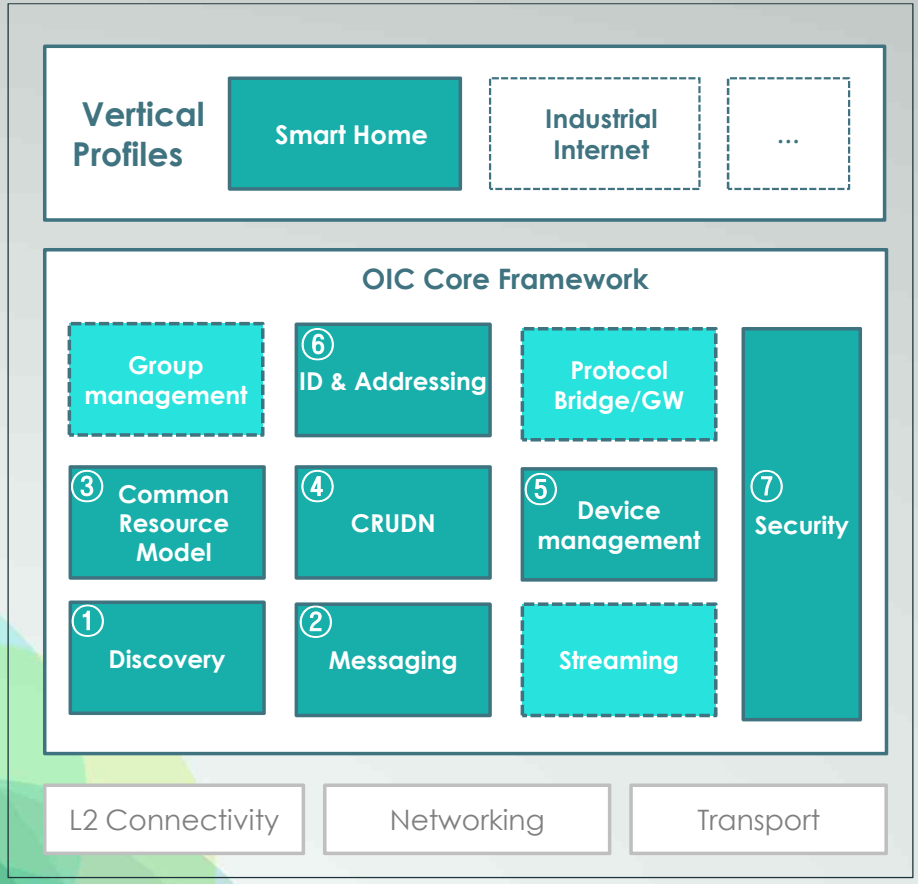
OIC Spec A Features – Core Framework Spec



① **Discovery:** Common method for device discovery (IETF CoRE)

② **Messaging:** Constrained device support as default (IETF CoAP) as well as protocol translation via intermediaries

③ **Common Resource Model:** Real world entities defined as data models (resources)\

④ **CRUDN:** Simple Request/Response mechanism with Create, Retrieve, Update, Delete and Notify commands

⑤ **Device Management:** Network connection settings and remote monitoring/reset/reboot functions

⑥ **ID & Addressing:** OIC IDs and addressing for OIC entities (Devices, Clients, Servers, Resources)

⑦ **Security:** Basic security for network, access control based on resources, key management etc

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OIC Architecture

- OIC adopted RESTful Architecture
- Current OIC Architecture defines 3 logical roles that devices can take
  - OIC Server : A logical entity that exposes hosted resources
  - OIC Client : A logical entity that accesses resources on an OIC Server
  - OIC Intermediary : A logical entity bridging messages between an OIC Server and Client

Model 1

Model 2

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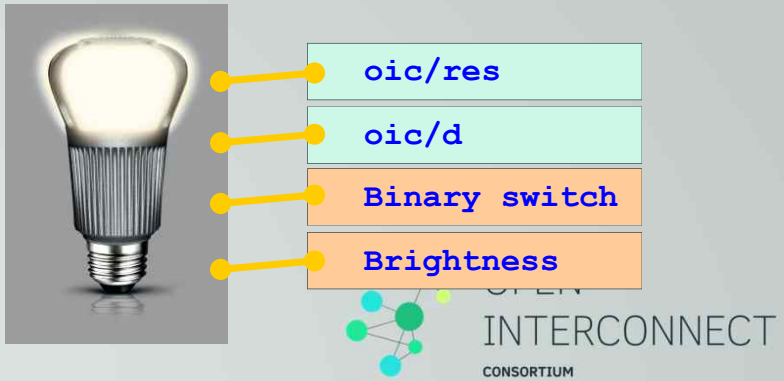
Device example: light device (oic.d.light)

- Example overview
  - Smart light device with i) binary switch & ii) brightness resource
- Device type: Light device (oic.d.light)
- Associated resources
  - Core resources: ① oic/res, ② oic/d
  - Device specific resources: ③ Binary switch (oic.r.switch.binary),
  - Other optional resources can be exposed, in this example ④ Brightness resource (oic.r.light.brightness)

Example: Smart light device with 4 resources

Device Title	Device Type	Associated Resource Type	M/O
Light	oic.d.light	oic/res (oic.wk.core)	M
		oic/d (oic.d.light)	M
		Binary switch (oic.r.swtich.binary)	M
		Brightness (oic.r.light.brightness)	O



Smart Home Device Type

Device Type	Minimum Resource Set
Air Conditioner	Binary Switch, Temperature
Air Purifier	Binary Switch
Blind	Open Level
Dishwasher	Binary Switch, Mode
Door	Open Level
Clothes Dryer	Binary Switch, Mode
Clothes Washer	Binary Switch, Mode
Fan	Binary Switch
Garage Door	Door
Light	Binary Switch
Oven	Binary Switch, Temperature (2)
Printer	Binary Switch, Operational State

Device Type	Minimum Resource Set
Refrigerator	Binary Switch, Refrigeration, Temperature (2)
Robot Cleaner	Binary Switch, Mode
Smart Plug	Binary Switch
Switch	Binary Switch
Thermostat	Temperature (2)

Exposure of an OIC Device Type is Mandatory.
If an OIC Server hosts an OIC known device then it shall follow all normative requirements in the Device Specification applicable to that Device.

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Smart Home Resource Type

Resource Types	Spec A
Air Flow	X
Air Flow Control	X
Battery	X
Binary switch	X
Brightness	X
Colour Chroma	X
Colour RGB	X
Dimming	X
Door	X
Energy Consumption	X
Energy Usage	X
Humidity	X
Icemaker	X
Lock	X

Resource Types	Spec A
Lock Code	X
Mode	X
Open Level	X
Operational State	X
Ramp Time	X
Refrigeration	X
Temperature	X
Time Period	X

Exposure of the minimum set of resource types for a hosted device type is mandatory.
If an OIC Server hosts an OIC known resource then it shall follow all normative requirements in the Resource Specification applicable to that Resource.

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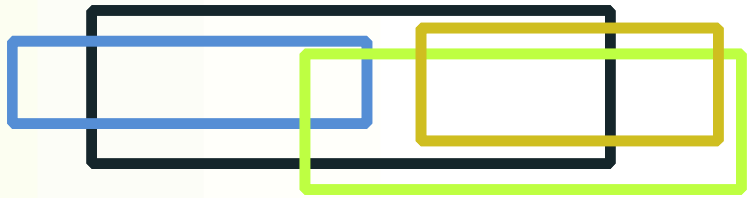
Security Objectives

- Crossing domain boundaries



- Ad-hoc introductions

- Ensuring access

- Establishing ownership

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OIC Spec A Security Summary

- OIC key management supports end-to-end device protection
- Resource layer ACLs allow intended interactions while preventing unintended interactions
- Secure device ownership helps prevent attacks when devices are added to the network

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Thank you!

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