



OPEN
INTERCONNECT
CONSORTIUM

Open Interconnect Consortium

Martin Hsu/徐茂容

Intel Open Source Technology Center

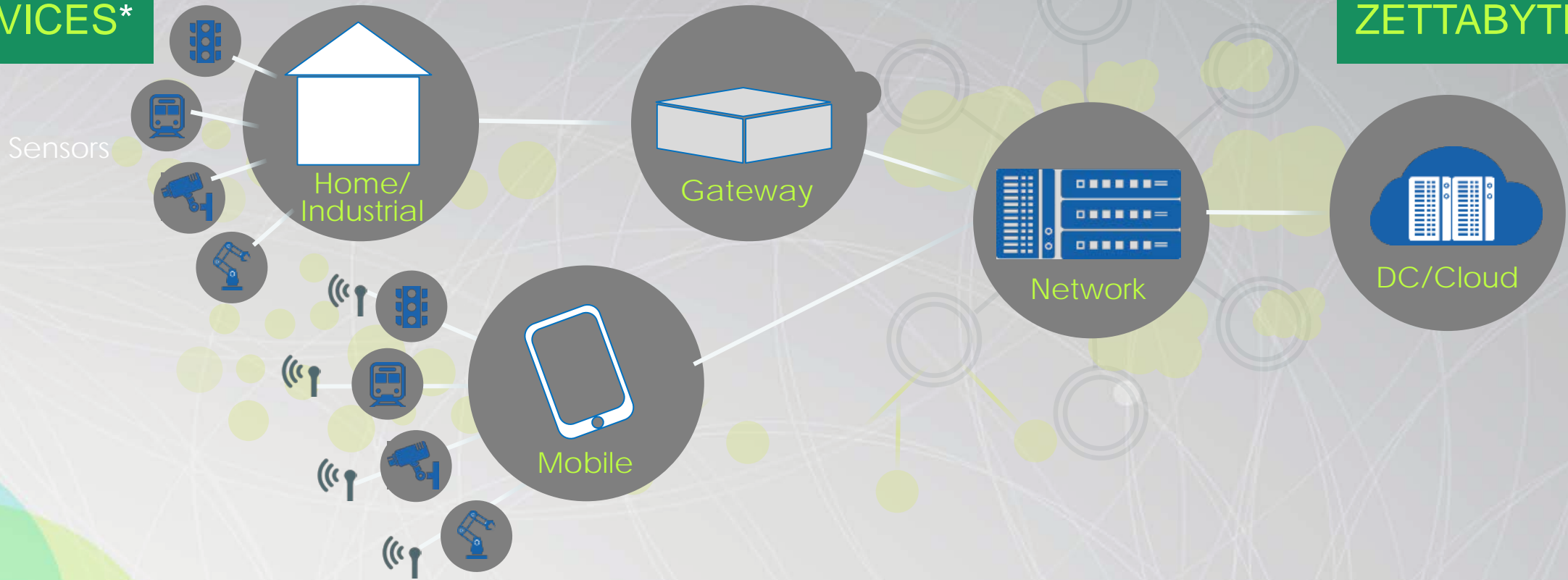
• Content

- IoT Opportunities and Challenges
- Open Interconnect Consortium Vision
- Goals & Strategy
- Open Interconnect Consortium
 - Members & Structure
 - Standards – Compliance – Marketing
 - Open Source Project
 - Roadmap
- Technology

The Internet of Things is... Intelligence Everywhere

50B
DEVICES*

44
ZETTABYTES**



COST OF SENSORS
PAST 10 YEARS **2X** ↓

COST OF BANDWIDTH
PAST 10 YEARS **40X** ↓

COST OF PROCESSING
PAST 10 YEARS **60X** ↓

OPEN
INTERCONNECT
CONSORTIUM

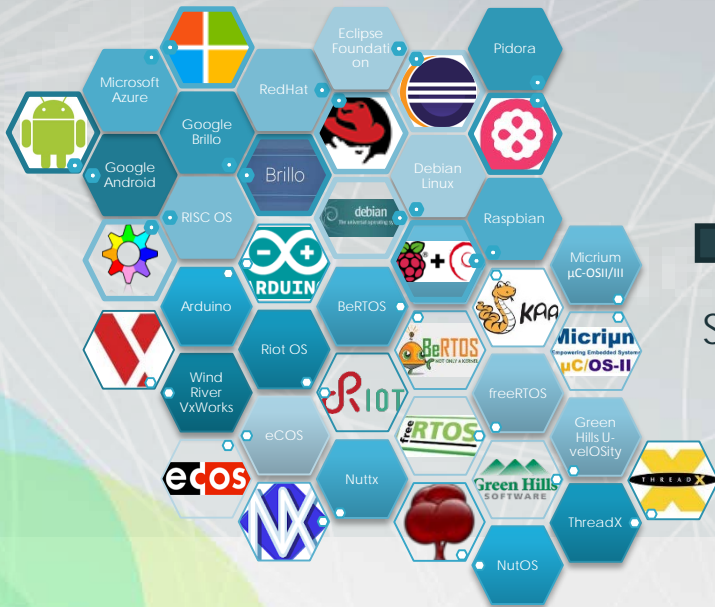
* IDC

** IMC/EDC: The Digital Universe of Opportunities

*** Goldman Sachs

Fragmentation Solutions today

OIC makes it all work together ...



Software

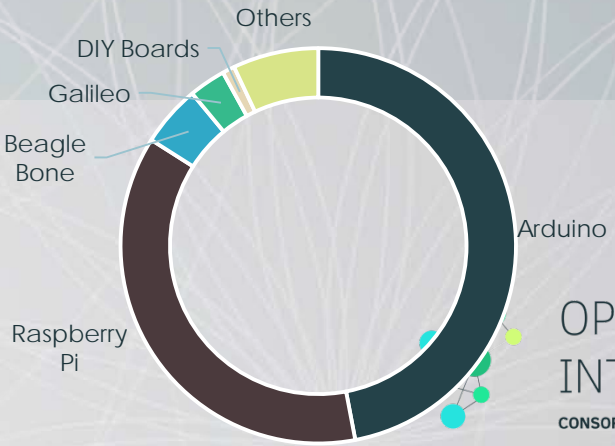


Vertical

| | |
|------------------------------|-----------------------------------|
| Wearables | Accessories with screen |
| | Accessories w/o screen |
| | Clothing/ shoes |
| Smart home | Lighting system |
| | Home automation |
| | Smart metering |
| | Home surveillance |
| Medical electronics | Hospital patient/asset management |
| | Personal health monitoring |
| Connected cars | Entertainment system |
| | Field monitoring |
| Industrial automation | Preventive maintenance |
| | Supply chain monitoring |
| | Public surveillance |
| Smart cities | Traffic control |

Platforms

2013 Maker Boards Market Share, by Unit



OPEN INTERCONNECT CONSORTIUM

- Open Interconnect Vision

- Enable IoT

- Secure and reliable device discovery and connectivity across multiple OSs, platforms, and technologies

- Enable scale

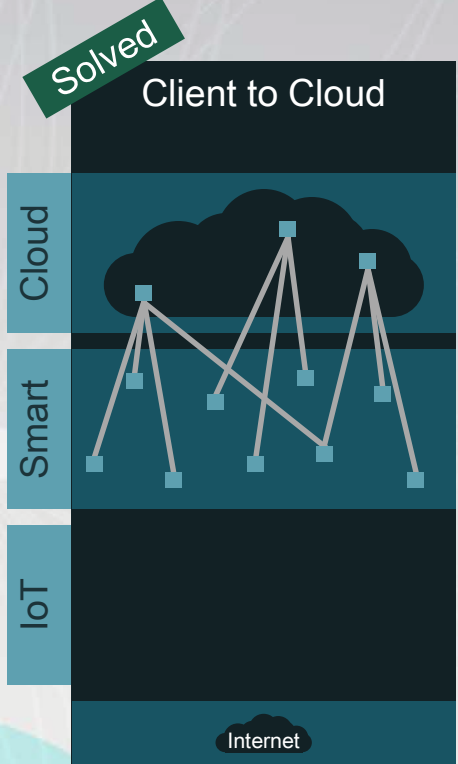
- Industry consolidation around a common interoperable approach, across all vertical markets

Organization Goals and Strategy

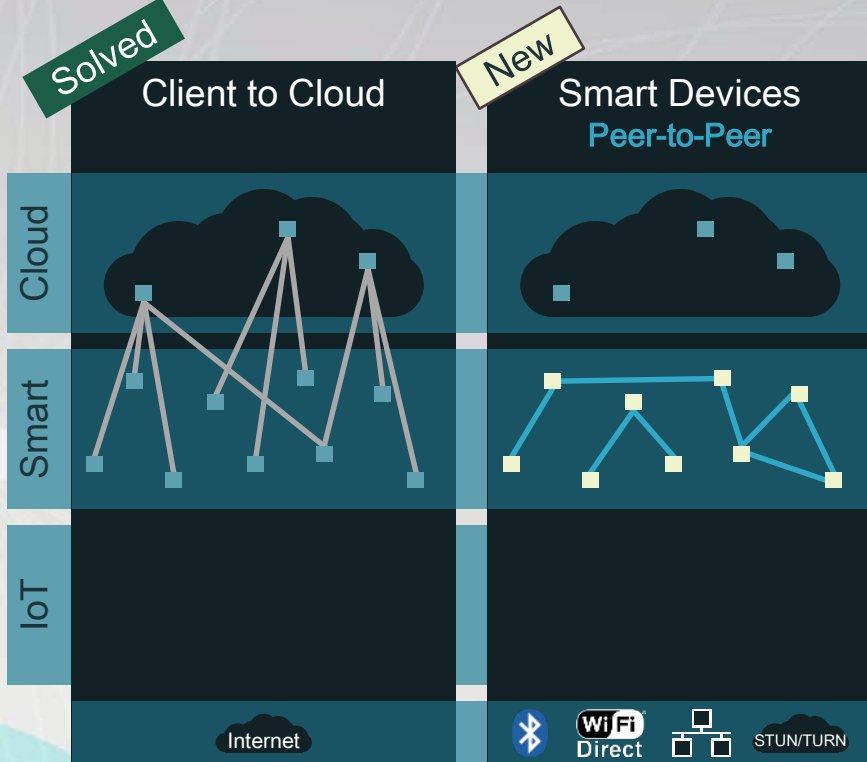
Why Open Interconnect Consortium?

- Current IoT connectivity difficulties...
 - *Technical issues*
 - *Intellectual property rights issues*
 - *Organizational/structural issues*
- Open Interconnect Consortium (OIC) is being formed by...
 - *IoT industry leaders*
 - *A connectivity framework*
 - *Across vertical markets*
 - *Standards development*
 - *Open source*
 - *Royalty free IPR*
 - *An inclusive approach to technologies*

• New Modes of Communication



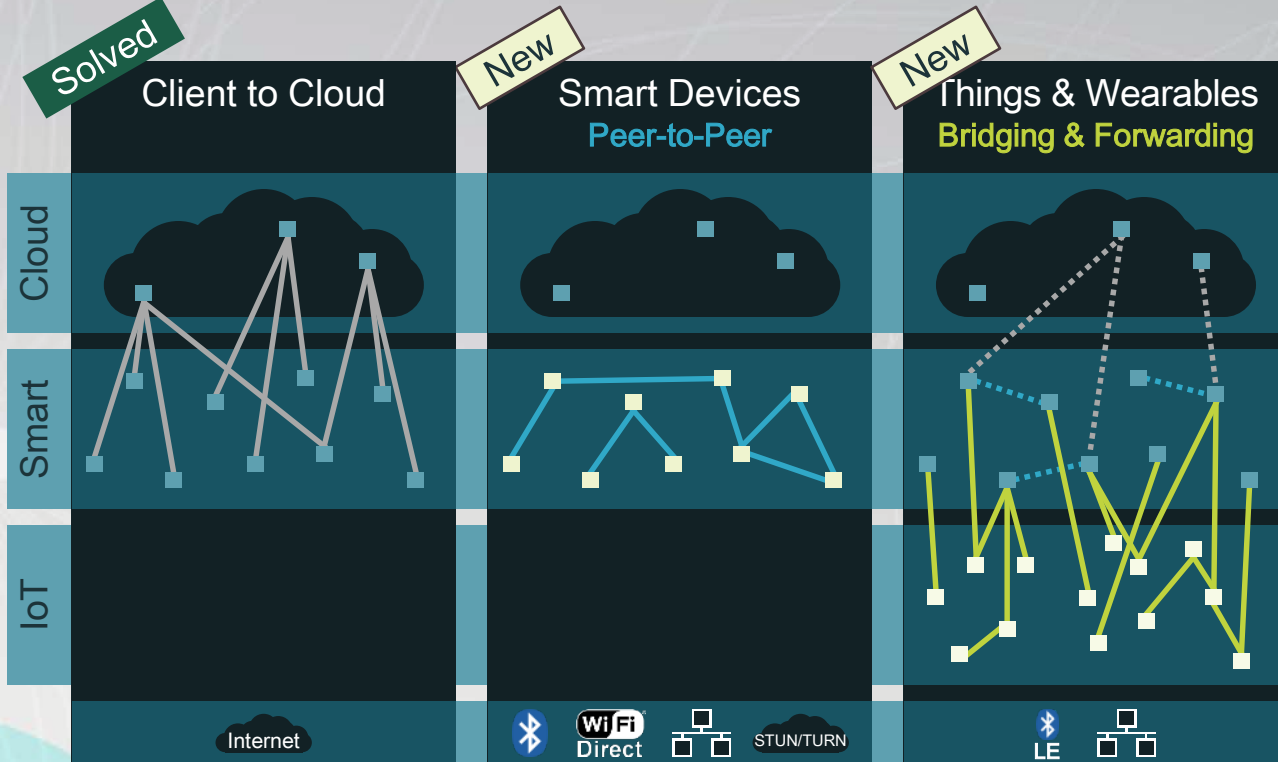
New Modes of Communication



= Local Network / Same Subnet (Wi-Fi, Ethernet, etc...)



New Modes of Communication

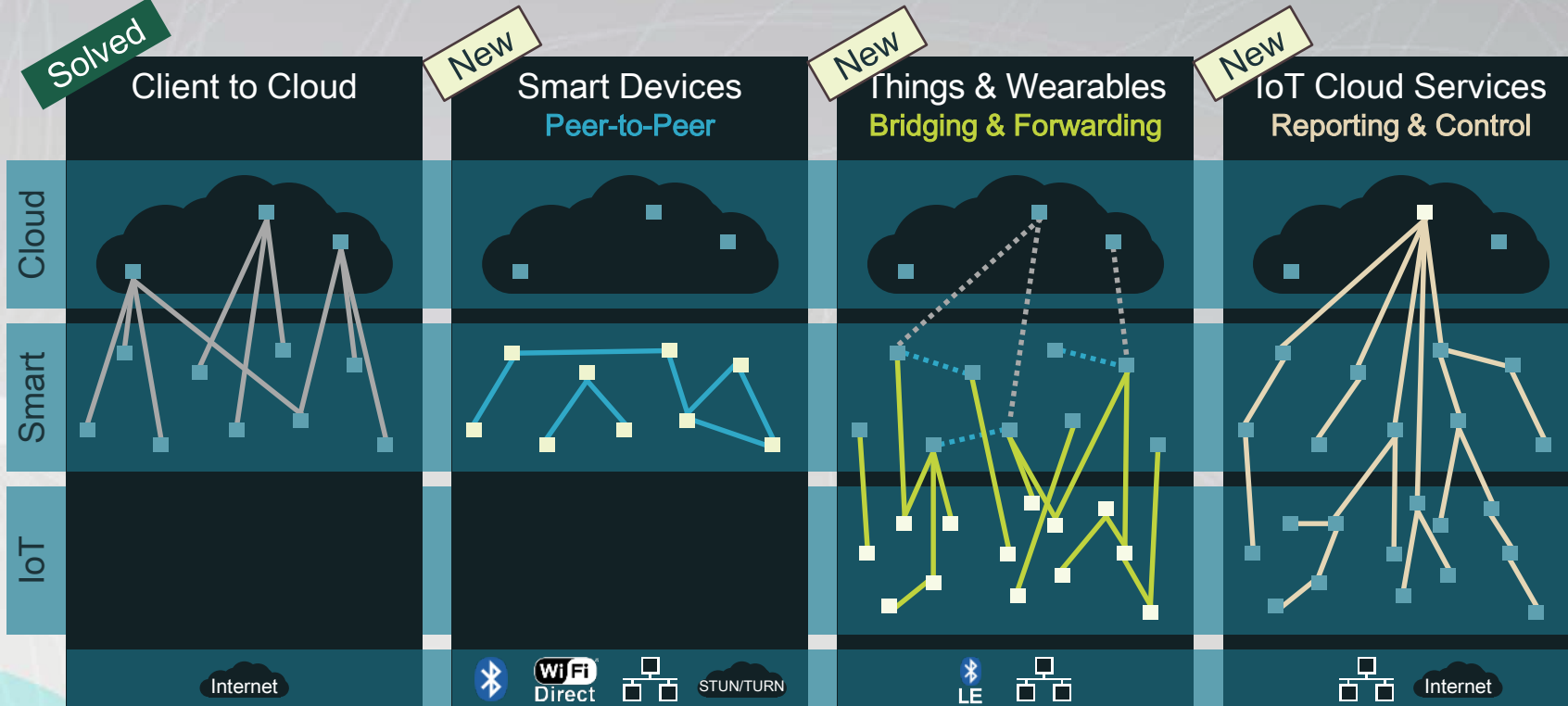


= Local Network / Same Subnet (Wi-Fi, Ethernet, etc...)



OPEN
INTERCONNECT
CONSORTIUM

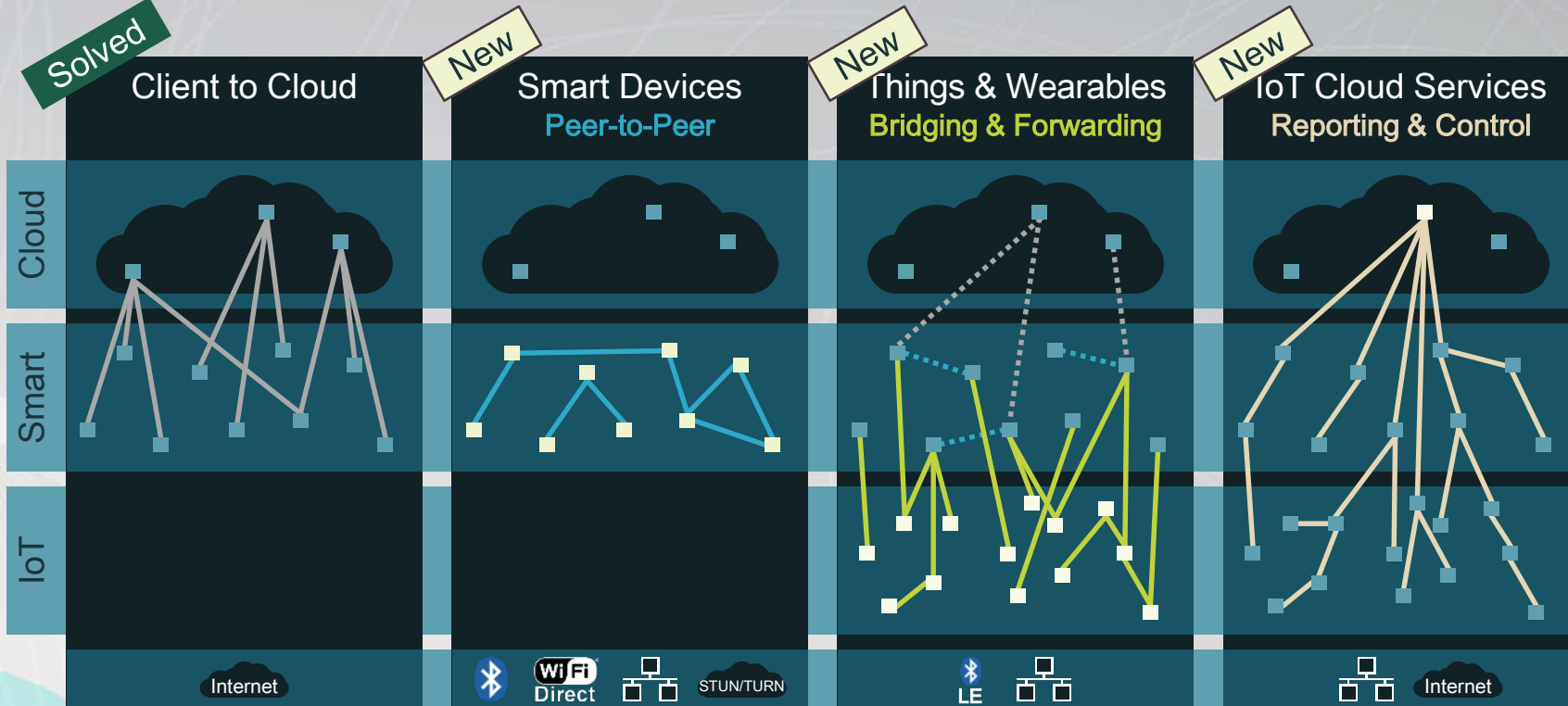
New Modes of Communication



= Local Network / Same Subnet (Wi-Fi, Ethernet, etc...)



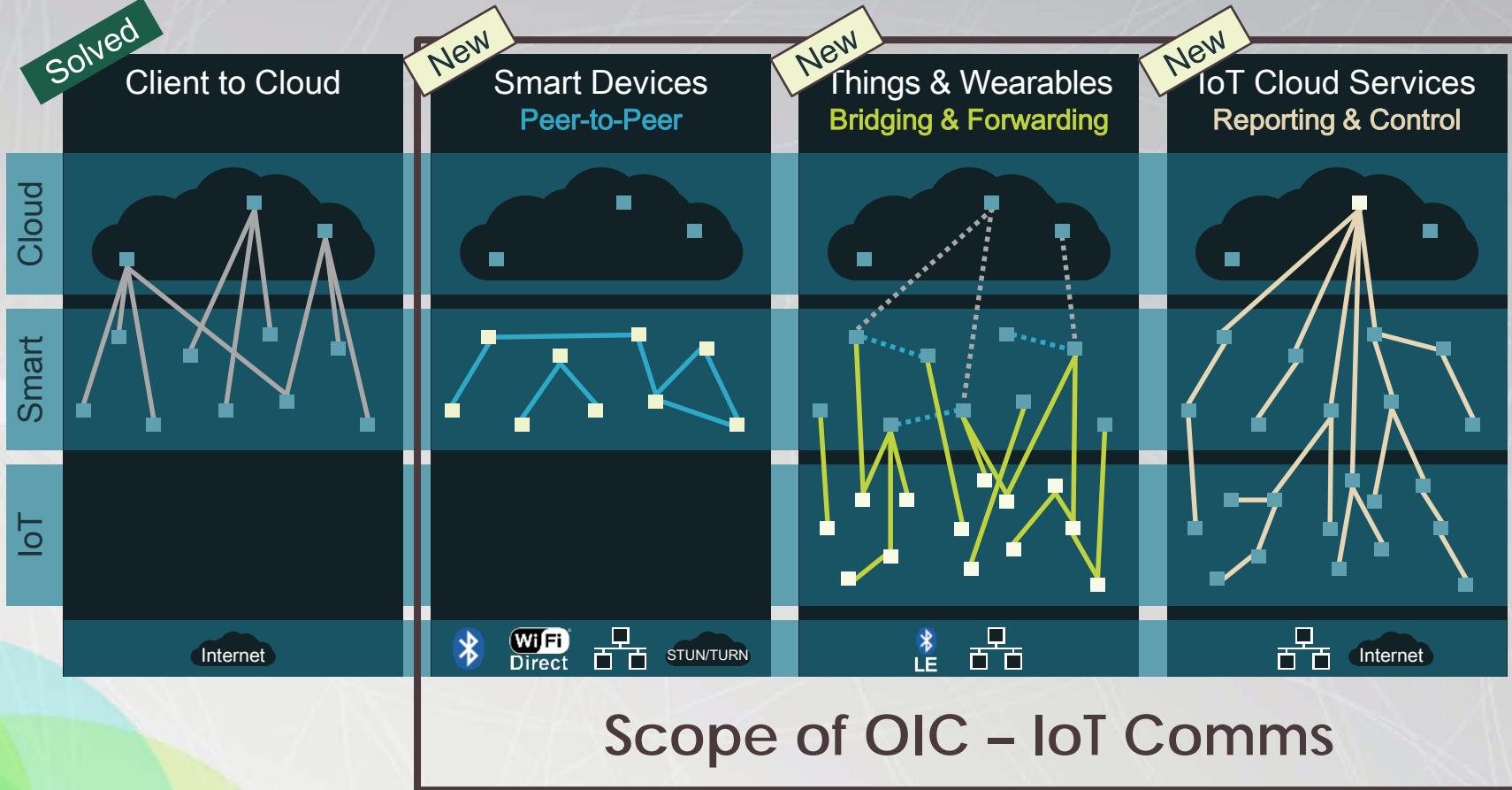
New Modes of Communication



We need a way to make IoT device connectivity as *easy for developers* and manufacturers as connecting a client to a server in the cloud.

 = Local Network / Same Subnet (Wi-Fi, Ethernet, etc...)

New Modes of Communication



We need a way to make IoT device connectivity as *easy for developers* and manufacturers as connecting a client to a server in the cloud.

OIC is addressing the challenge of IoT connectivity

 = Local Network / Same Subnet (Wi-Fi, Ethernet, etc...)

OIC Goals

- Single solution covering interoperability across multiple vertical markets (Consumer, Enterprise, Industrial, Automotive, Health, etc...), OSs, platforms, modes of communication, transports and use cases
 - *Common communications protocols for discovery and connectivity across multiple peer-to-peer transports*
 - *Common approaches for security and identity*
 - *Common service-level protocols, object models & developer APIs*
- Promotes interoperability vs. closed solutions
- Promotes innovation and allows differentiation
- Connecting from smart devices to the smallest connected things

“ OIC is a standard & open source project that delivers “just-works” interconnectivity for developers, manufacturers and end users.”



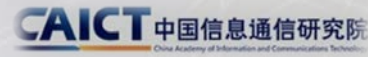
About the Open Interconnect Consortium

Members

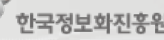
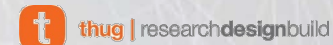
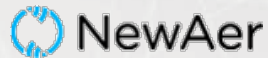
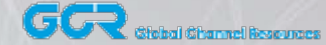
Diamond



Platinum

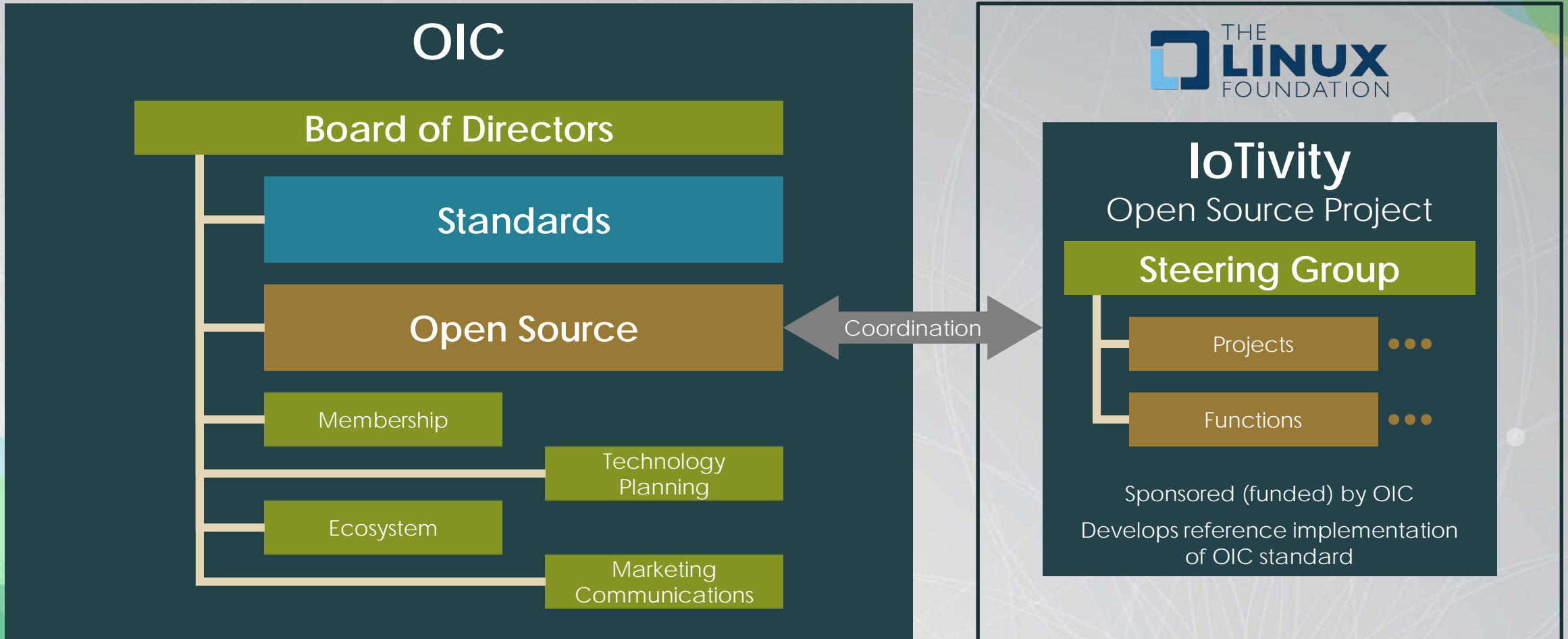


Gold



OPEN INTERCONNECT CONSORTIUM

High Level OIC Governance Structure



OIC Organisational Structure

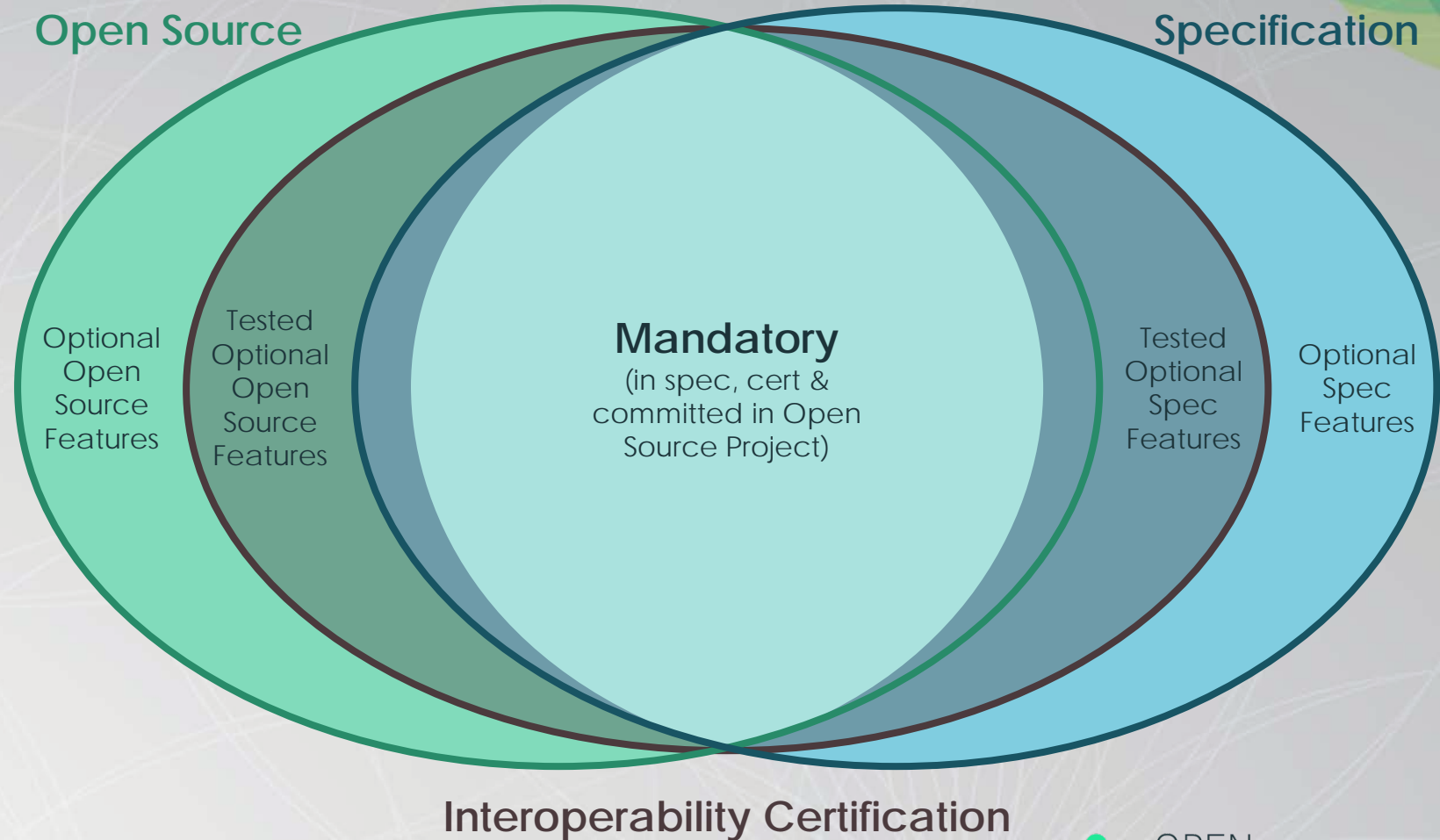


• OIC Intellectual Property Rights Policy

- OIC is a royalty free organisation
- Open source project (IoTivity) – Apache 2.0
 - Copyright & patent coverage for submitted code
- Standard – RANDZ
 - Cross licensing of “necessary” patent claims covering “Compliant Portions” of a member company’s certified products

Compliance Testing & Certification

- Mandatory feature:
 - Defined in the specification,
 - Released in open source, and
 - Mandatory in the Interoperability certification program.
- All other features are optional
 - Note: some features that are in both the specification and open source may be still be optional

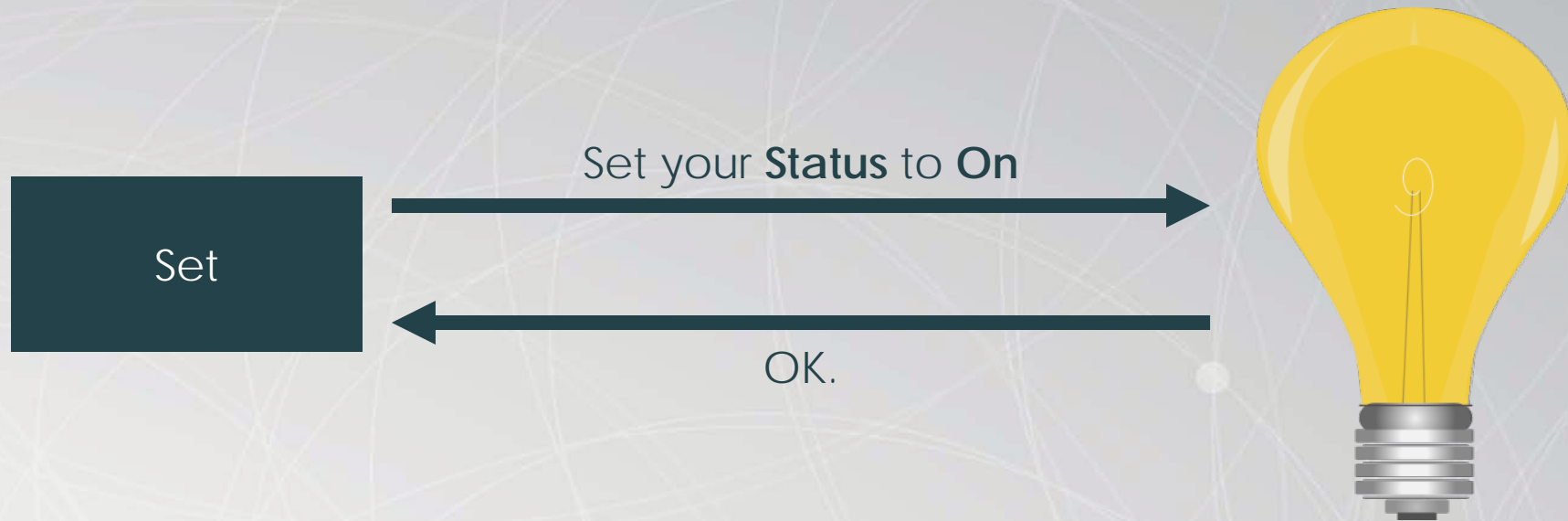


Technical Overview

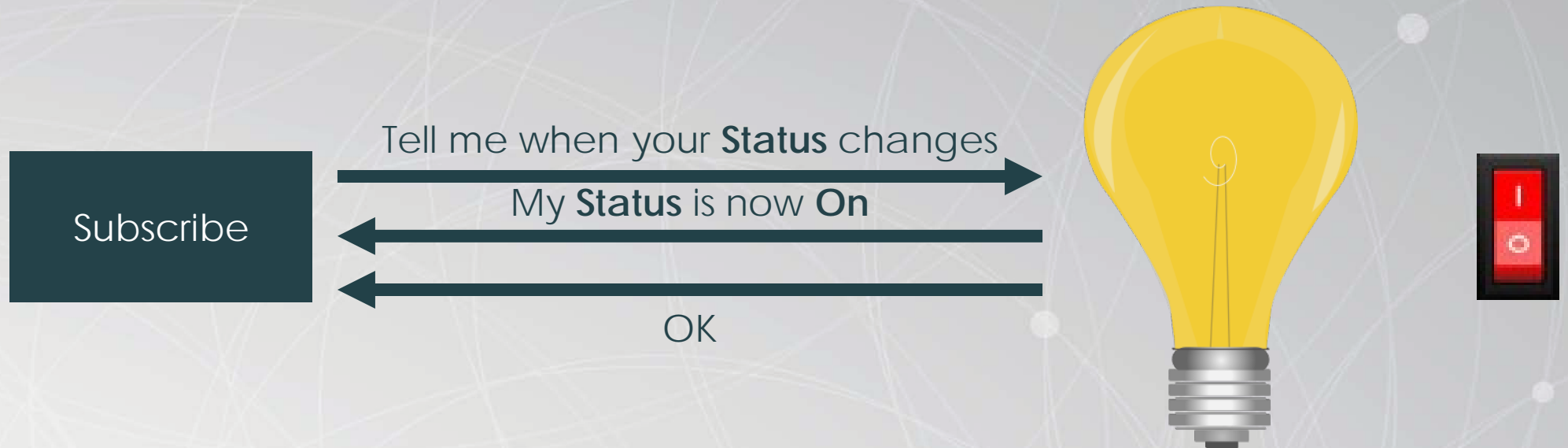
- Interacting with Attributes – Messaging



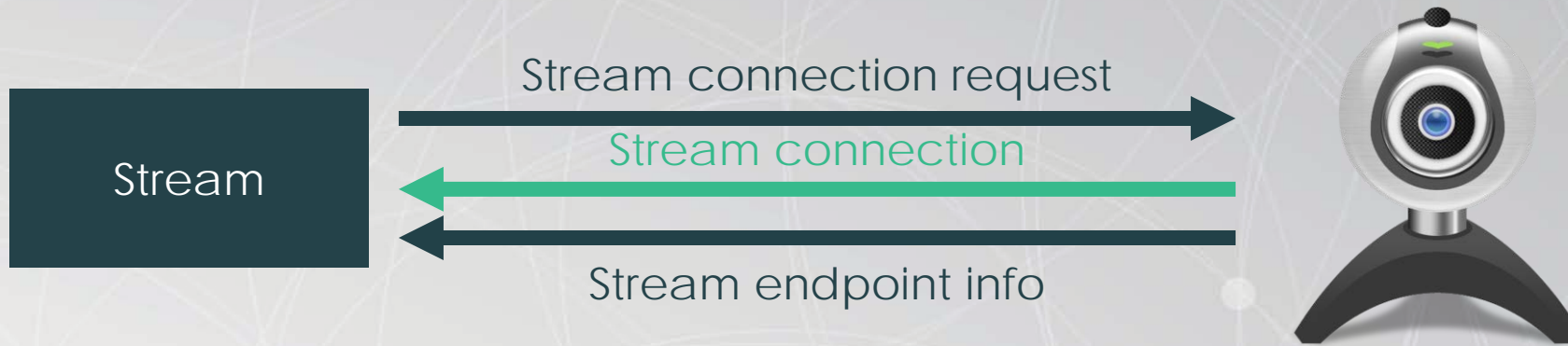
- Interacting with Attributes – Messaging



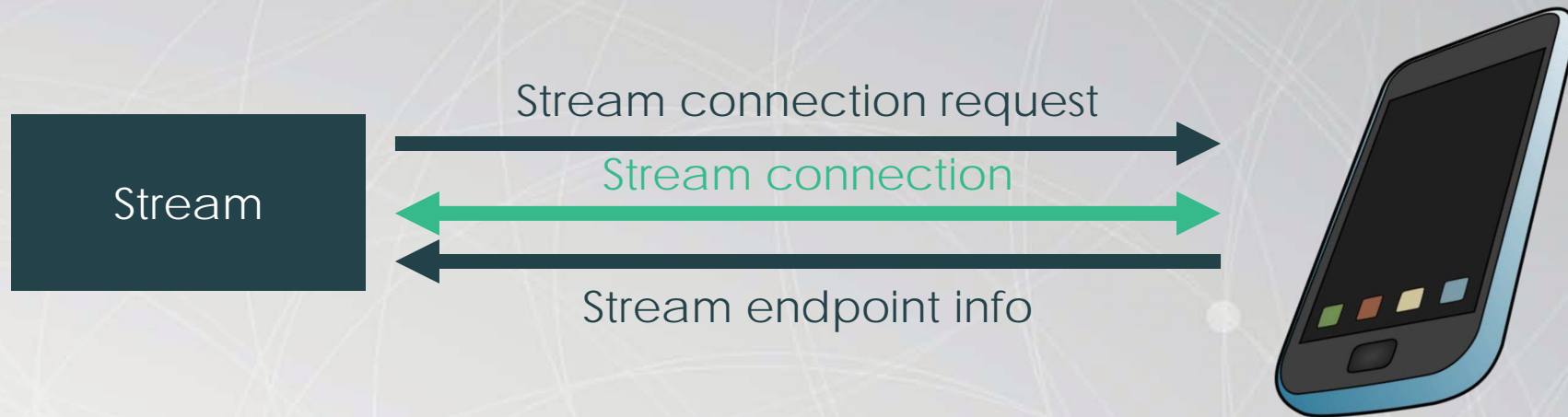
Interacting with Attributes – Messaging



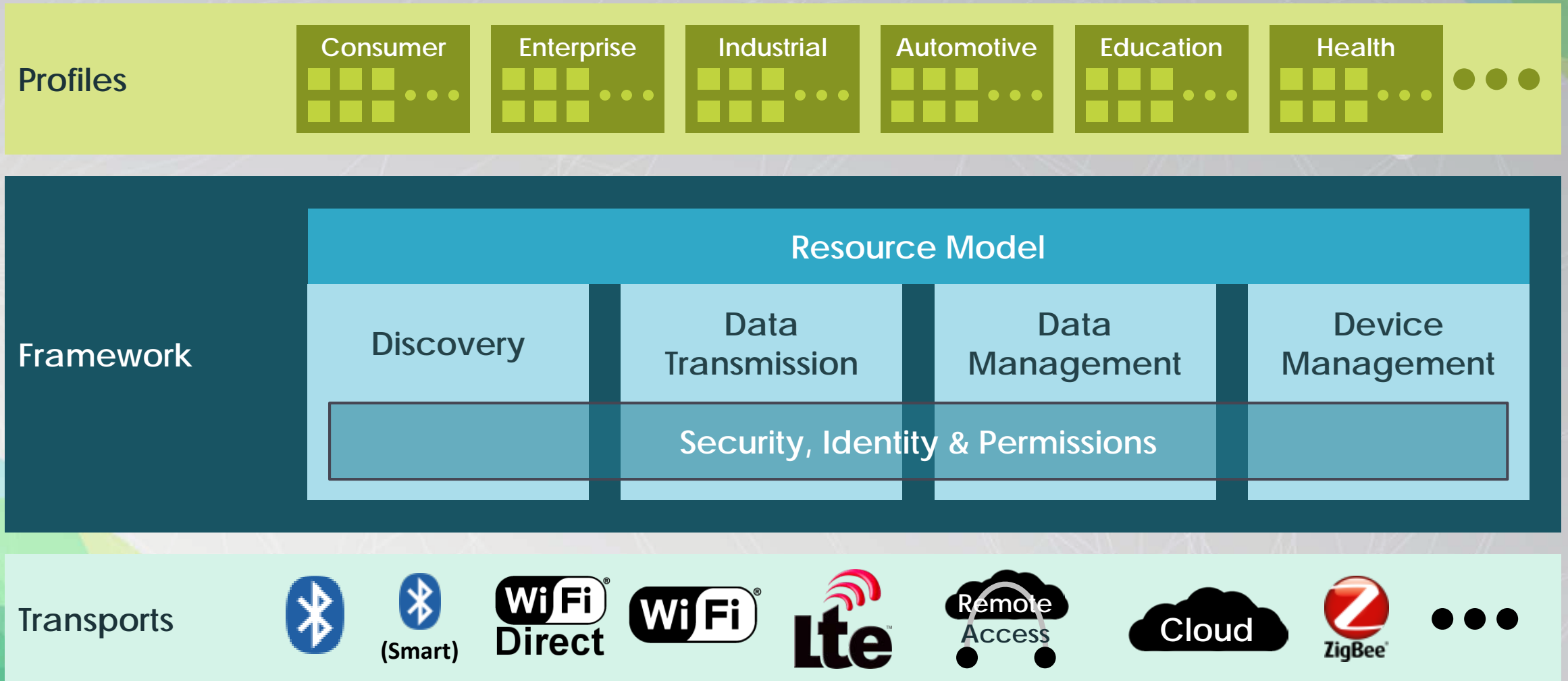
- Unidirectional Streaming



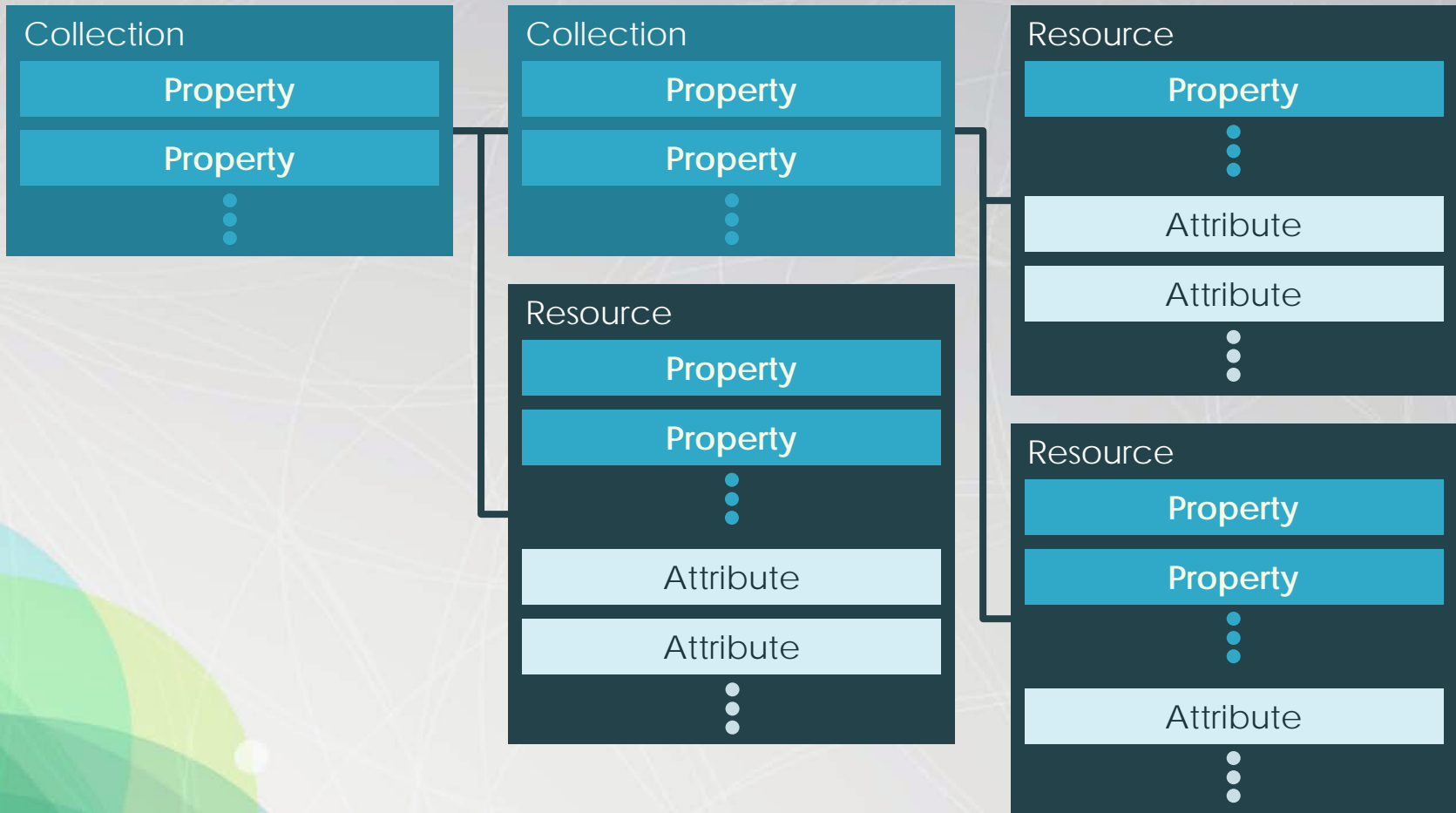
- Bidirectional Streaming



Conceptual Framework



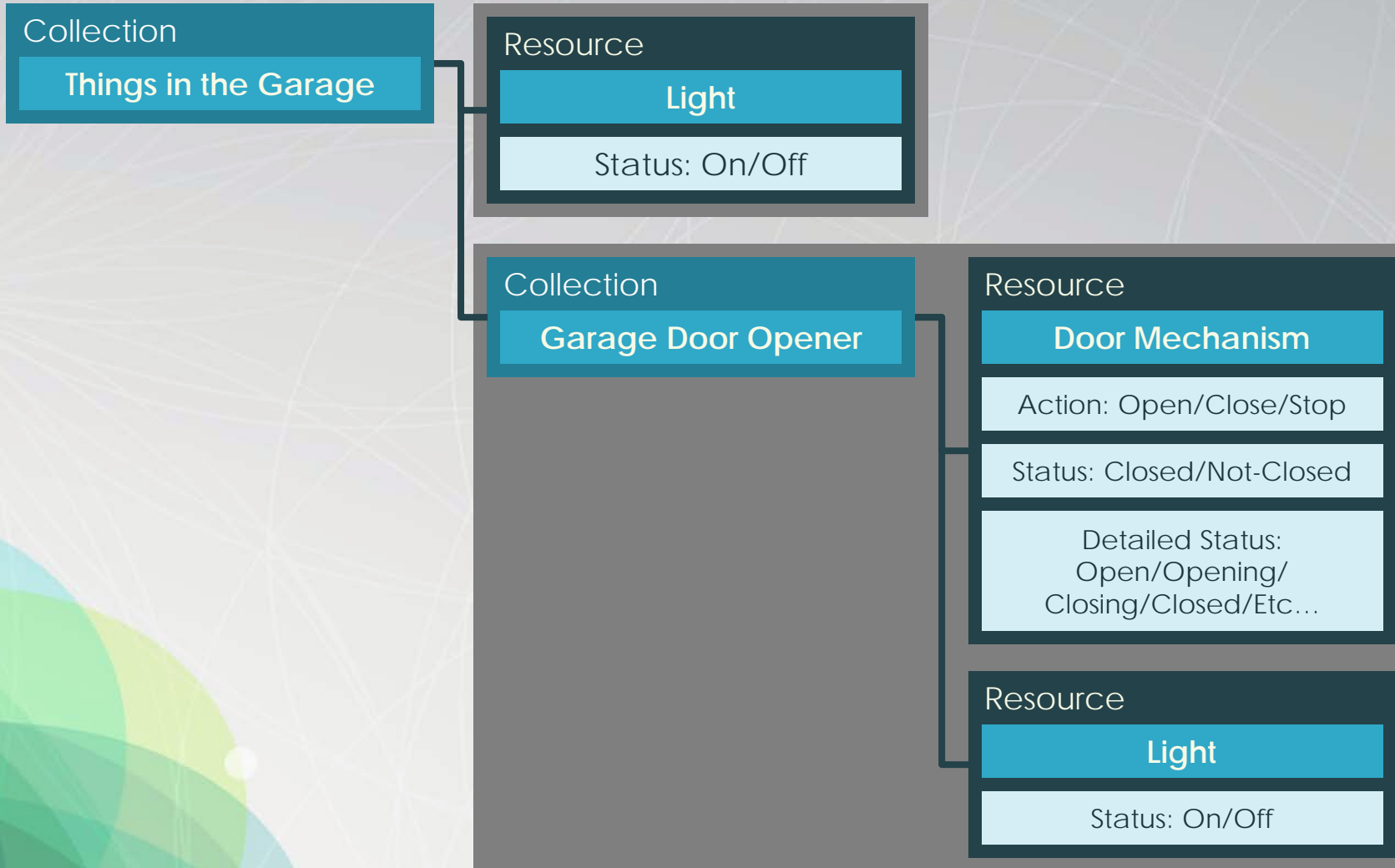
Resources and Structures



- ### Property
- Resource Type
 - Resource Interface
 - Discoverability
 - Resource version
 - Access Control List
 - Observable
 - Etc...

- ### Attribute
- On-off state
 - Brightness
 - Temperature
 - Location
 - Friendly name
 - Sensor version
 - Etc...

Grouping Devices



• How You Can Use OIC Technology...

- Use the code from [IoTivity.org](https://iotivity.org)
 - Open to any individual or company
 - Code is available at [IoTivity.org](https://iotivity.org) under the Apache v2.0 license
- Join as a member
 - Certify spec compliant apps and devices
 - Use OIC branding
 - Benefit from patent cross-licensing protection
 - Go to www.openinterconnect.org for membership agreement, etc...

• How You Can Participate in the OIC...

- Contribute code to [IoTivity.org](https://iotivity.org)
 - Open to any individual or member company
- Participate in standards development
 - Open to Gold and above member companies and Individual members
- Vote on standards development; lead Work and Task Groups
 - Open to Platinum and above member companies

SmartHome IoTivity Demo

Smart Home Components:

- **SmartHome GW:** Intel MinnowBoard MAX as both OIC client and server
- **Control Panel:** OIC client
- **Smart Devices:** OIC servers

Uses open-source IoTivity code to:

- **Get STATUS** from IoT “Things” including sensors
- **Take ACTIONS** on IoT “Things”

OIC-enabled smart devices:

- **LED:** Intel Edison
- **Fan:** Arduino
- **Smoke Detector:** Arduino
- **Motion Sensor:** Arduino





OPEN
INTERCONNECT
CONSORTIUM

Thank you !!

• OIC Membership and Participation

- OIC is a non-profit entity governed by bylaws
 - Board of Directors has fiduciary responsibility (financial, legal, etc...)
 - Sets up working groups to accomplish OIC goals
 - Work/task group structure below BoD defined in “Operational Guidelines”, not bylaws
- IoTivity.org hosted by the Linux Foundation
 - Independent governance and infrastructure, sponsored (funded) by OIC
 - Charter to provide reference implementation of OIC standard (but not limited to ‘only’ a reference implementation)

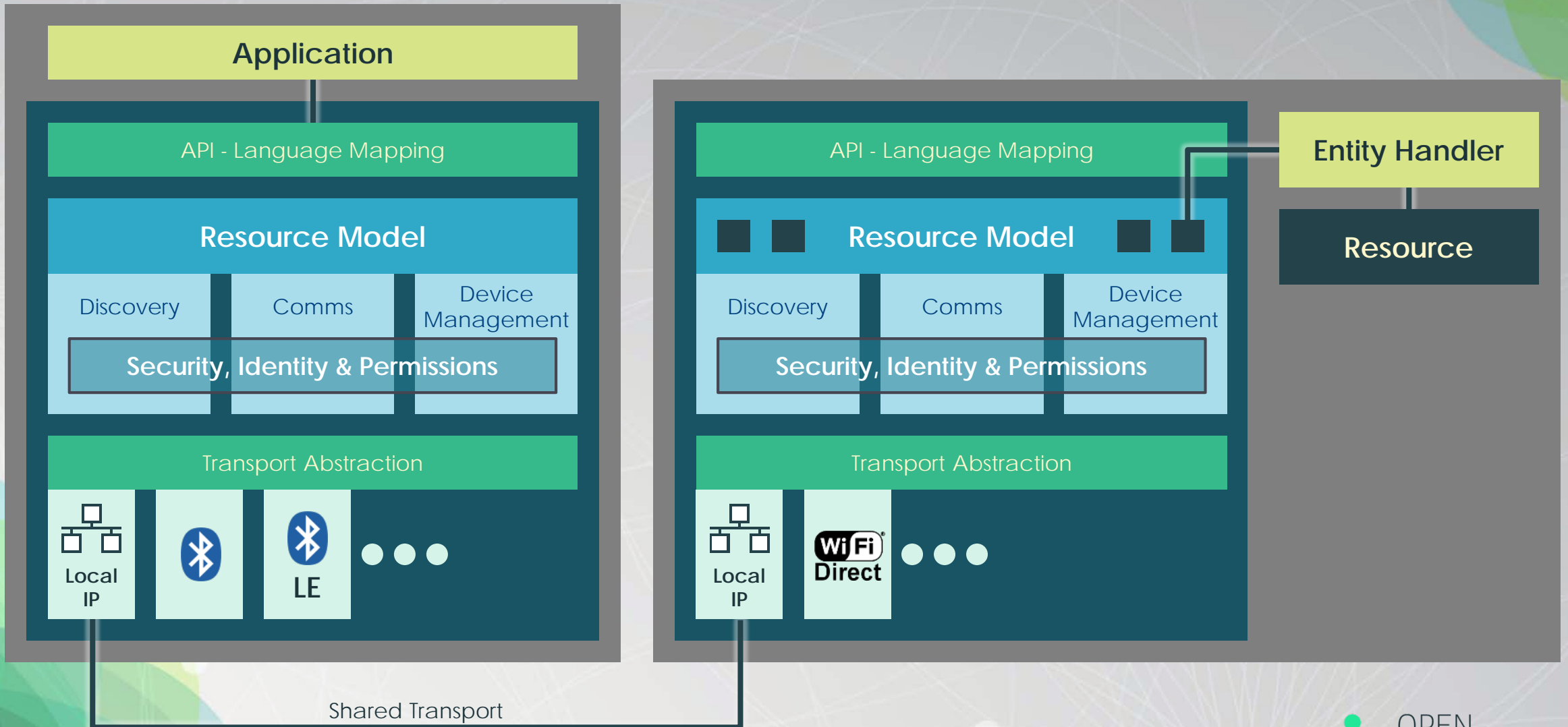
Board of Directors

- Each Diamond member appoints one director to the board
 - Diamond members also appoint 1 Alternate, on joining
- 2/3rd board majority of current Diamond member appointed directors required to accept new Diamond members
- Every 2 years, starting 2 years after founding...
 - Diamond and Platinum Members vote to elect 2 additional (Platinum) Directors for 2-year term from list of candidates nominated by Platinum Members
- Board of Directors may set up working groups
 - Work group rules or flexibility concerning membership, participation, voting, leadership and the ability to set up Task Groups is determined by the BoD at time of formation

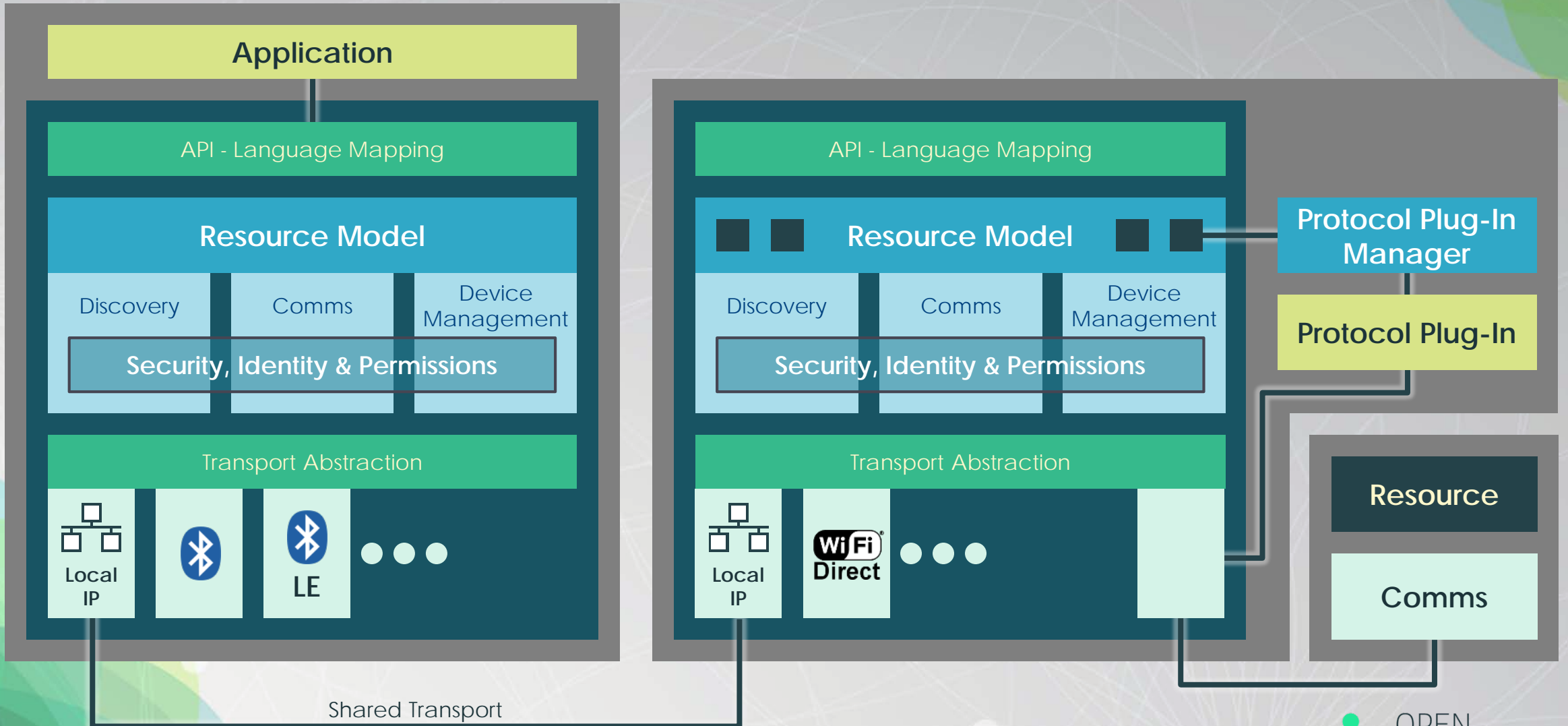
OIC Approach

- Unique combination of standards & open source implementation
- Specification, certification & branding to deliver reliable interoperability
 - Connectivity framework that abstracts complexity
 - Easy to use for developers
 - Open specification that anyone can implement
 - IP protection & branding for certified devices (via compliance testing)
 - Service-level interoperability
- Open Source implementation to enable application developers and device manufacturers
 - Android, iOS, Windows, Linux, Tizen, VX Works, Contiki, single threaded RTOSs and more...
 - Many active contributors across the entire code base

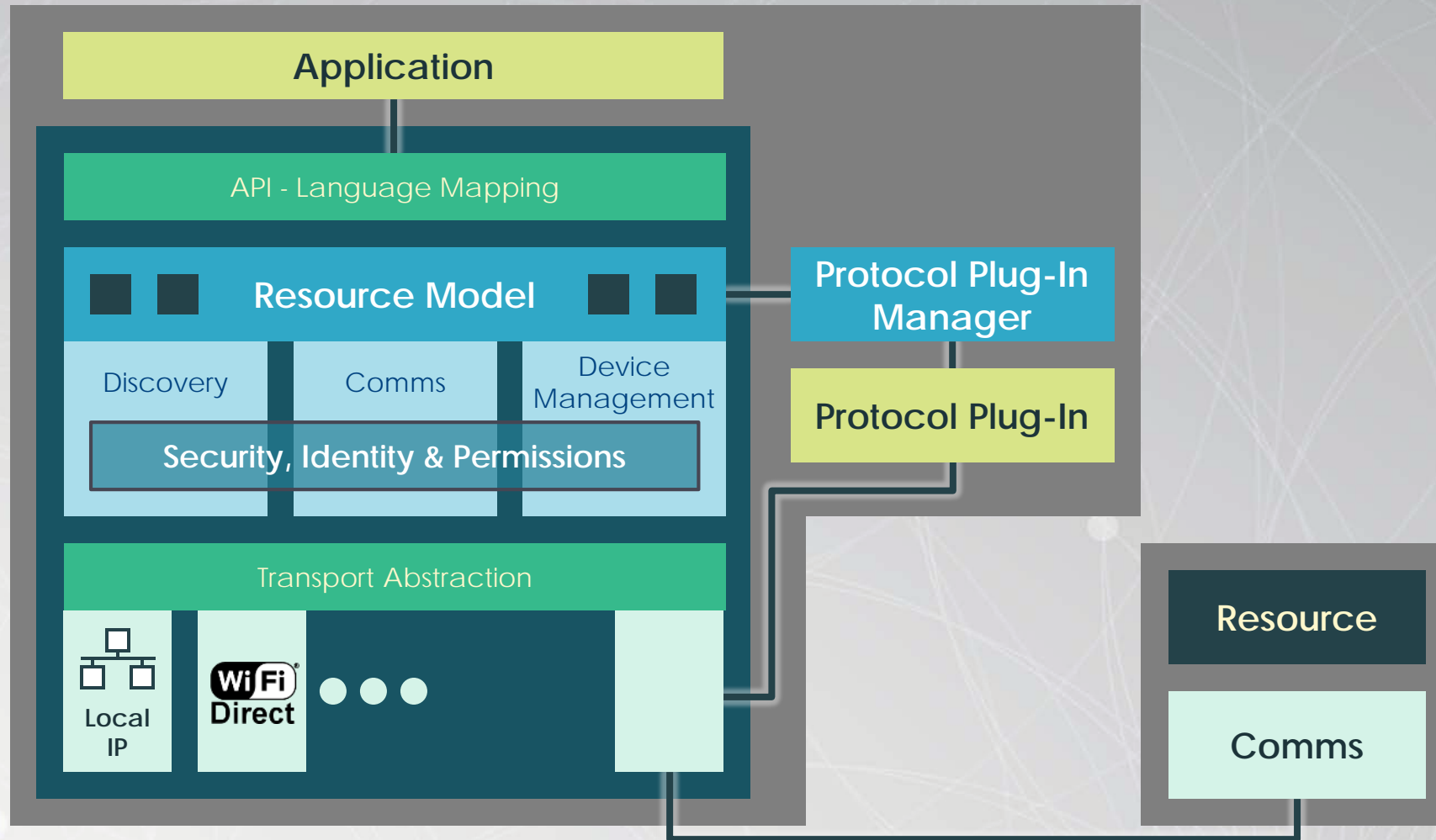
Accessing OIC Resources



Accessing Non-OIC Resources



Protocol Plug-ins: Adding Immediate Capabilities



Light Resource Examples

| Resource |
|----------------|
| Light |
| Status: On/Off |

| Resource |
|----------------|
| Light |
| Status: On/Off |
| Dimming: 0-100 |

| Resource |
|----------------|
| Light |
| Status: On/Off |
| Dimming: 0-100 |
| Hue: RGB |
| Hue: HSL |
| Colour Temp: K |



Garage Door Opener Resource Example

