IEEE IoT Standardisation and surrounding context

Raffaele Giaffreda

Smart IoT Research Head

ICTP Workshop on Internet of Things, Trieste, 26 Mar 2015

CREATE-NET

Outline

- Brief intro to CREATE-NET and RIoT
- IoT standardisation – a complex landscape
- IEEE P2413 – a market-driven std effort
- How to leverage from IoT standards – a real usecase from an EU Innovation Action

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CREATE-NET basic facts

- Research Center located in Trento (Italy) founded in 2003
- Expertise in the networking and IoT domains, mobile sensing and socio-technical systems
- Technology transfer orientation (application areas in the domains of smart infrastructures, future media, sustainable mobility and health and well-being)
- Very active on the EU collaborative projects landscape
  - BIONETS, MONARCA, SUPERHUB, iCore, XiFi PPP
- Collaboration with industry and local SMEs
- Innovation and startups
  - U-Hopper, EXRADE, Intellincs

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Smart IoT (RIoT) Research Area

- Coordinator of EU FP7 iCore (until end of Oct.2014)
  - IoT empowered by cognitive technologies, 13mEur 3yrs project
  - WP leaders for demonstration and pilots
- Research expertise in the domain of cognitive technologies and machine learning in IoT
  - Smart asset management trial with Trilogis at S.ta Chiara Hospital – Trento
  - Smart Home collaboration with BOSCH
- Virtualisation of objects, protocols for IoT wireless communication and data exchange, IoT semantic interoperability
- Stochastic & global optimization (WSN comm protocols)
- IoT lab and exploitation of results (Embedded devices: DIY, hacking & integration of whatever has at least one screw)

iCore
Empowering IoT through Cognitive Technologies

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Where do we stand?

2001

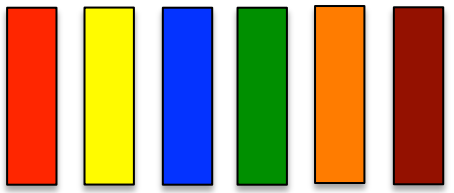
Bluetooth standard as an example

2014

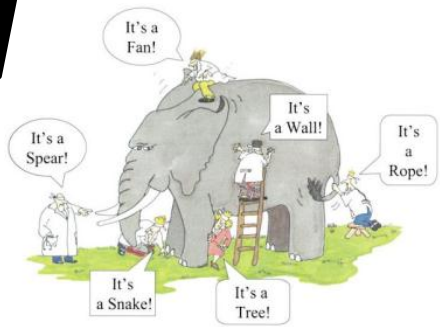
Bose SoundLink Mini ***Bluetooth*** Speaker

It just works: pair it once, the rest is handled automatically

Many vertical silos requiring a lot of human intervention to be setup



IoT



It just DOESN'T work across application domains

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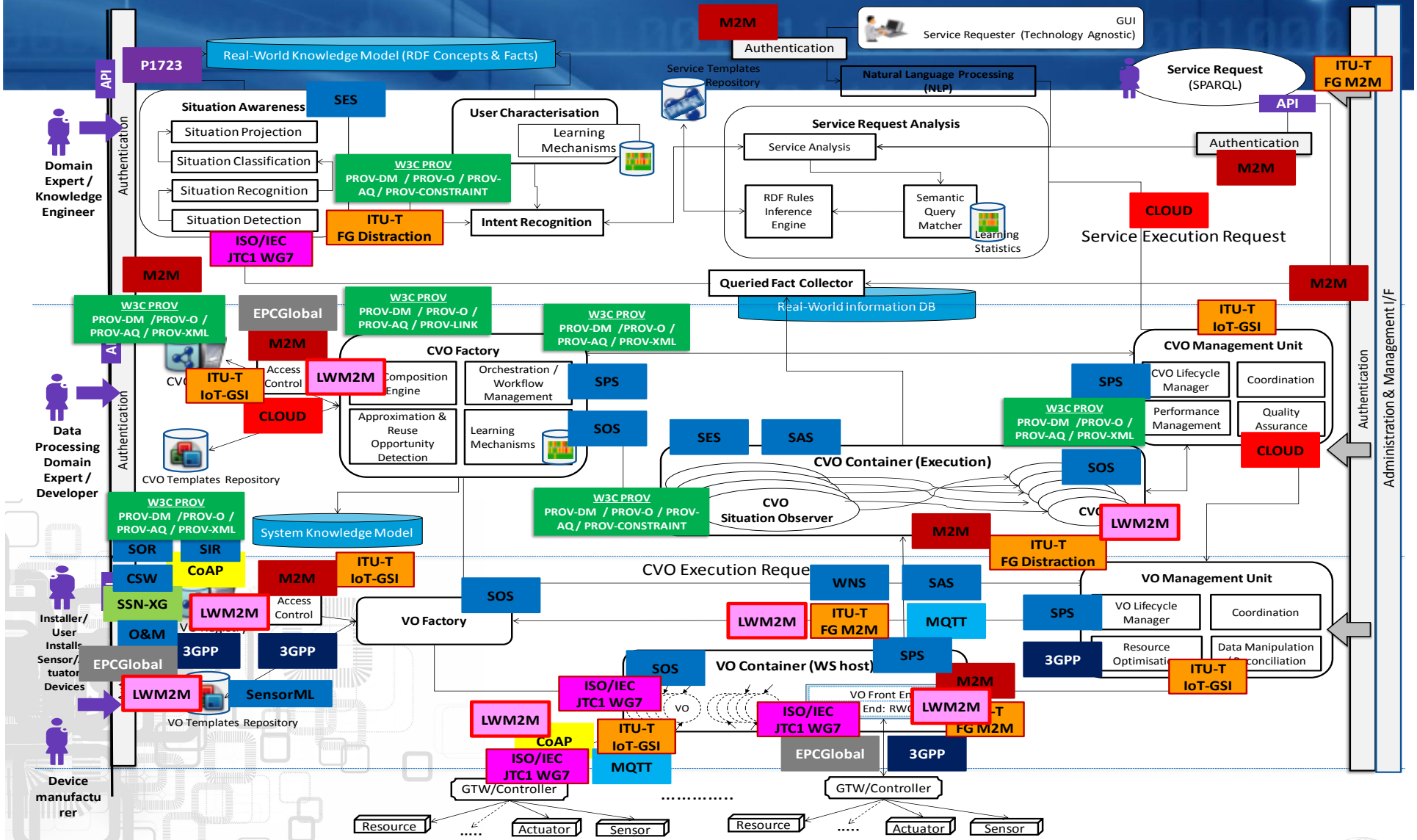
Standardisation in IoT: a (very) complex landscape



courtesy of Panagiotis Vlacheas and Vera Stavroulaki (Piraeus University)

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The IoT business landscape: why so many standards?

- Which market segment am I looking at?
- Where in the value chain?
  - What is the product? And where will it be used?
  - (horizontal “any” smart-home app vs. vertical “MySmartApp”)
- Who to sell to?
  - Consumers vs. industrial
  - More or less stringent standards
- What speed to market can I afford?
  - Standardisation takes some time to achieve, can I afford waiting before selling?
- How big is the core market segment?
- The influence of regional policies

For any combination of answers you will most likely find the a standard exists

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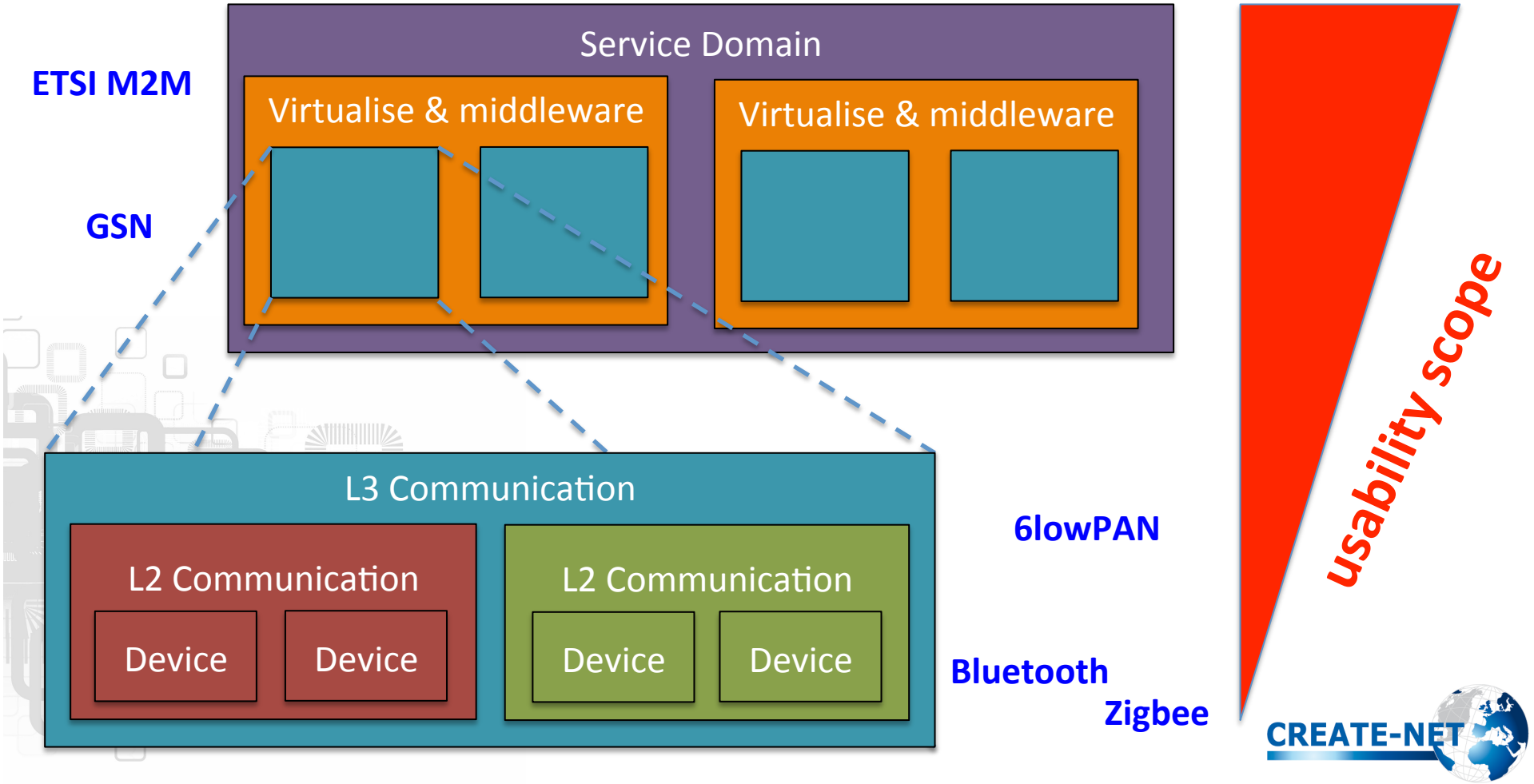
Why is standardisation needed

- Understanding the contextual background



Why is standardisation needed

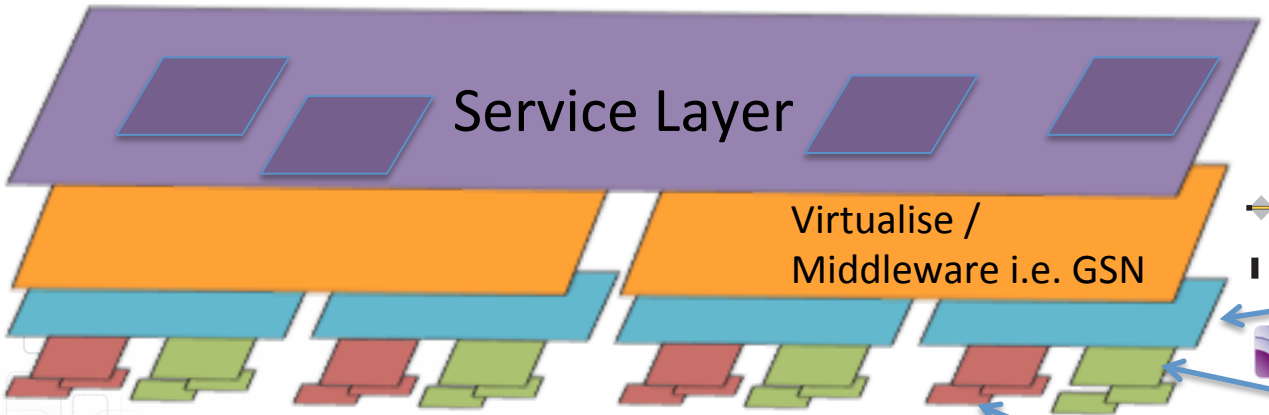
Telcos

Application providers

Why to communicate??

Technology viewpoint

SW



I E T F

L3 Comm (IP) GW

MQTT.ORG

L2 Comm (MAC) GW

Device (PHY)

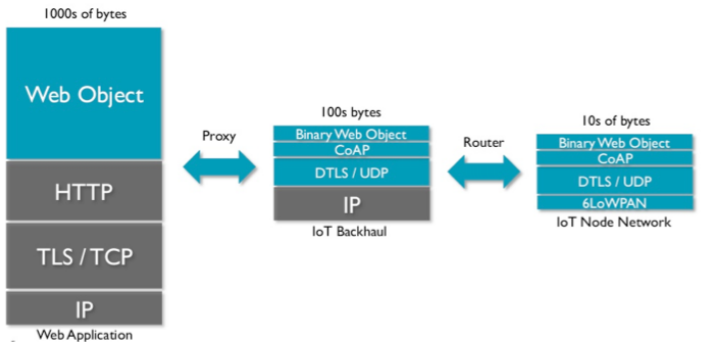
ZigBee

Wi Fi

HW

How to communicate??

Hardware manufacturers



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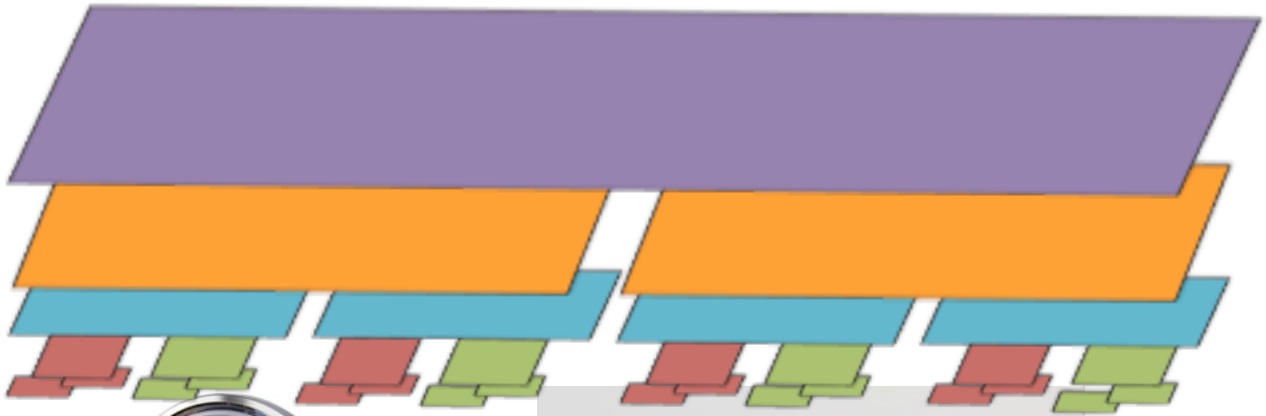
Why different standards exist

Per application domain

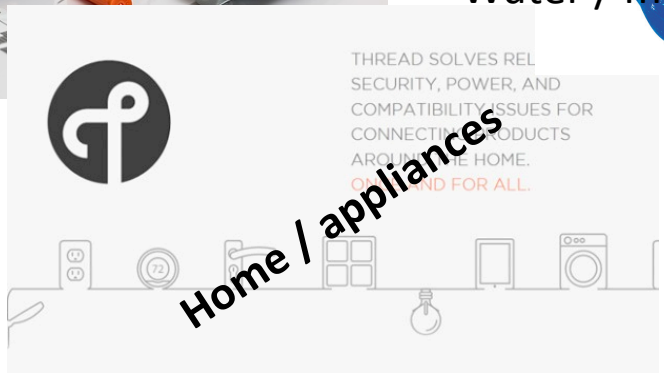


Energy / meters

Health / wearables

Water / meters

Transport / cars



Home / appliances

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Why different standards exist

ALLSEEN ALLIANCE

oma Open Mobile Alliance

Open Source

W3C®

Cellular

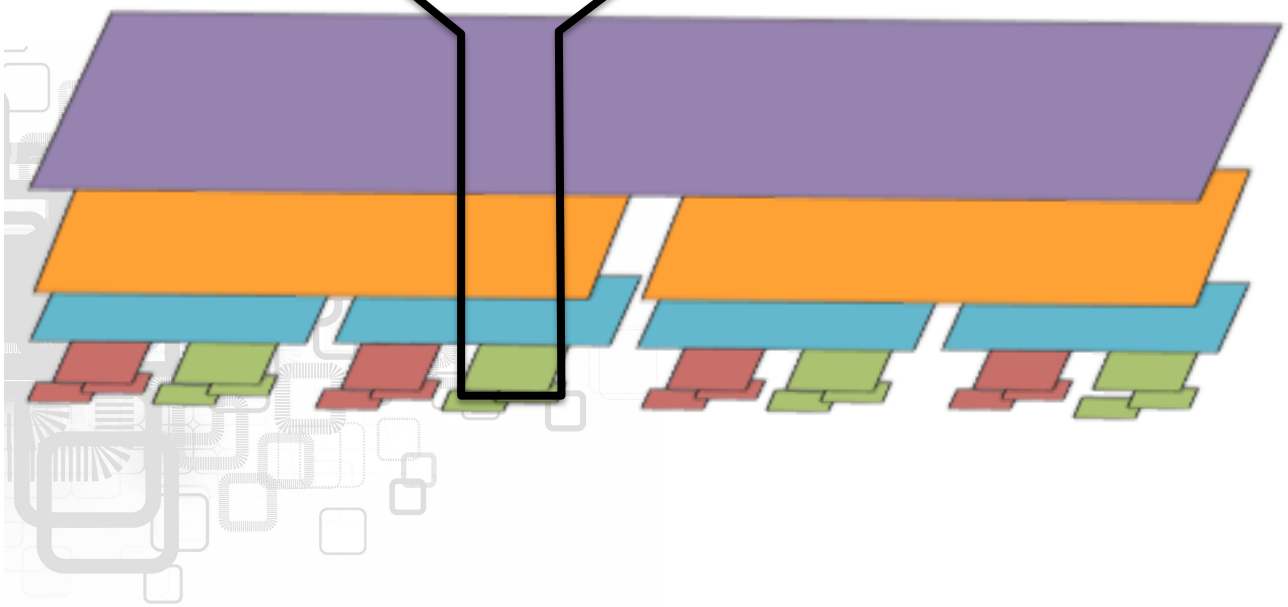
OASIS

Telcos

OGC® Making location count.

one M2M

Geopolitics!



Per industry sector / stakeholder groups

Widely supported, attempt to cut a slice across the stack and propose comprehensive standards…

OGC: OK for geo-spatial services BUT, not good for interacting with objects

STD overlaps examples:
MQTT, messaging in OneM2M
OMA-DM and OneM2M-DM

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Some do better than others…

- “let’s work together, interface to each other”
- “governance fights within same std bodies”
- “let’s just do it”

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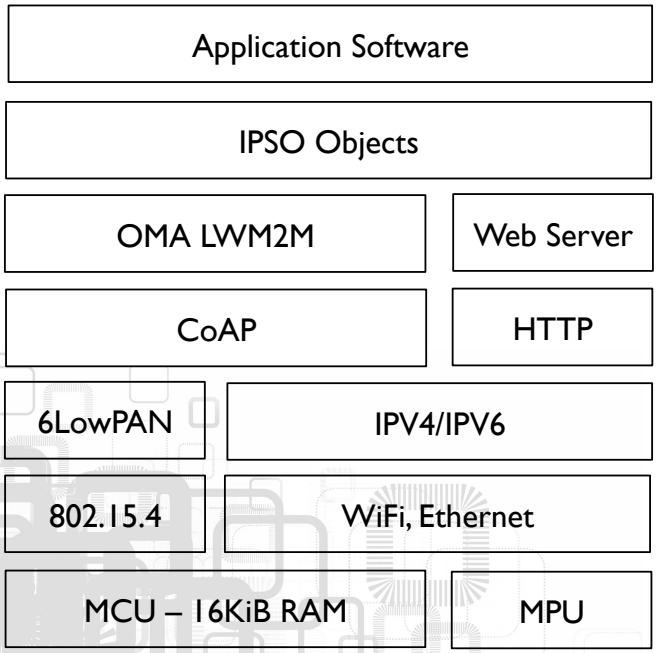
Web to the Edge
Internet Standards for IoT

These guys "just do it!"



Application

Data Models

API & Services

App Protocol

Routing

HW Network

Hardware

- **IETF**
  - IPv6 and 6LoWPAN networking
  - Routing algorithms (e.g. RPL)
  - Web of Things (REST for IoT, CoAP, Resource Directory etc.)
  - Security (DTLS, TLS, Cipher suites)
- **OMA / IPSO Alliance**
  - OMA Lightweight M2M Enabler Standard (CoAP)
  - IPSO Web Objects
- **OneM2M**
  - Ongoing work on M2M system standardization (CoAP, HTTP binding)
- **ZigBee & WiSun**
  - ZigBee IP - An open-standard 6LoWPAN stack for Home Area Networks
  - ZigBee IP NAN – 6LoWPAN stack for Sub-GHz large area applications
  - WiSun - Sub-GHz 802.15.4g/e and 6LoWPAN consortium

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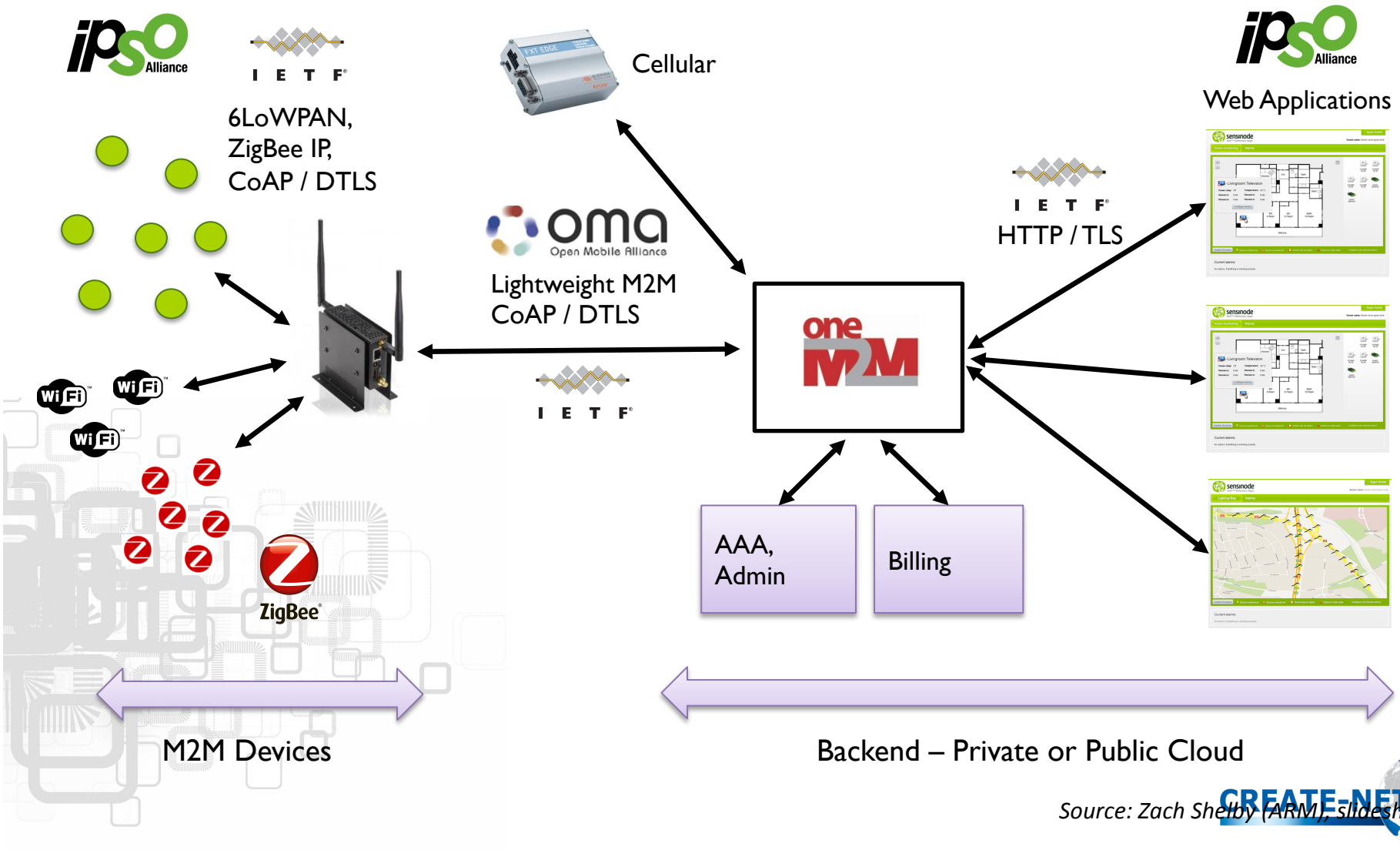
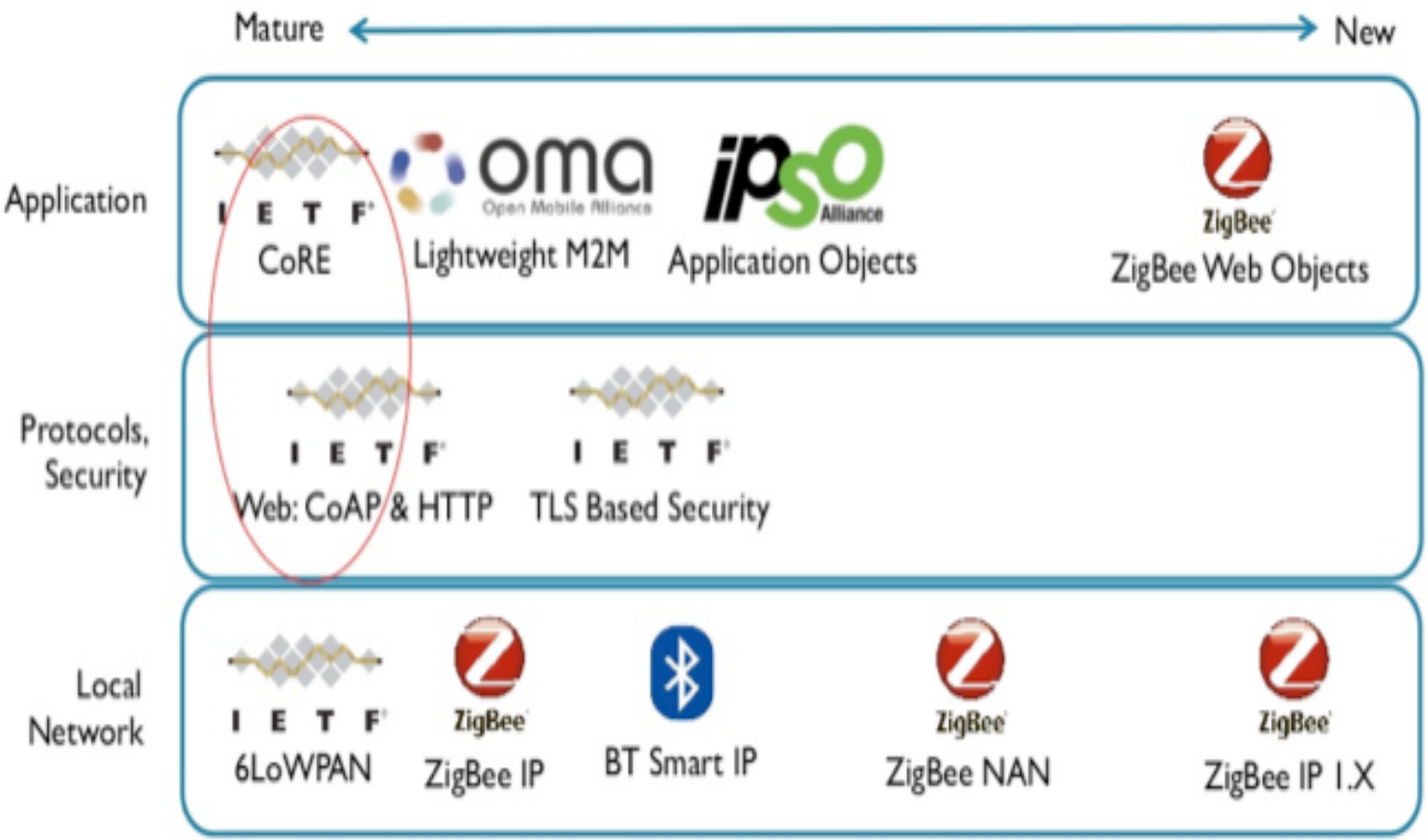
How to Build a Web of Things?



Source: Zach Shelby (ARM), slideshare


Mature
New
Application
IETF
CoRE
oma
Open Mobile Alliance
Lightweight M2M
ipso
Alliance
Application Objects
ZigBee
ZigBee Web Objects
Protocols, Security
IETF
Web: CoAP & HTTP
IETF
TLS Based Security
Local Network
IETF
6LoWPAN
ZigBee
ZigBee IP
BT Smart IP
ZigBee
ZigBee NAN
ZigBee
ZigBee IP 1.X

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IEEE Standard Association – IoT focus

- Initial starting point to find out more:

http://standards.ieee.org/innovate/iot/index.html

Just to give you an idea…

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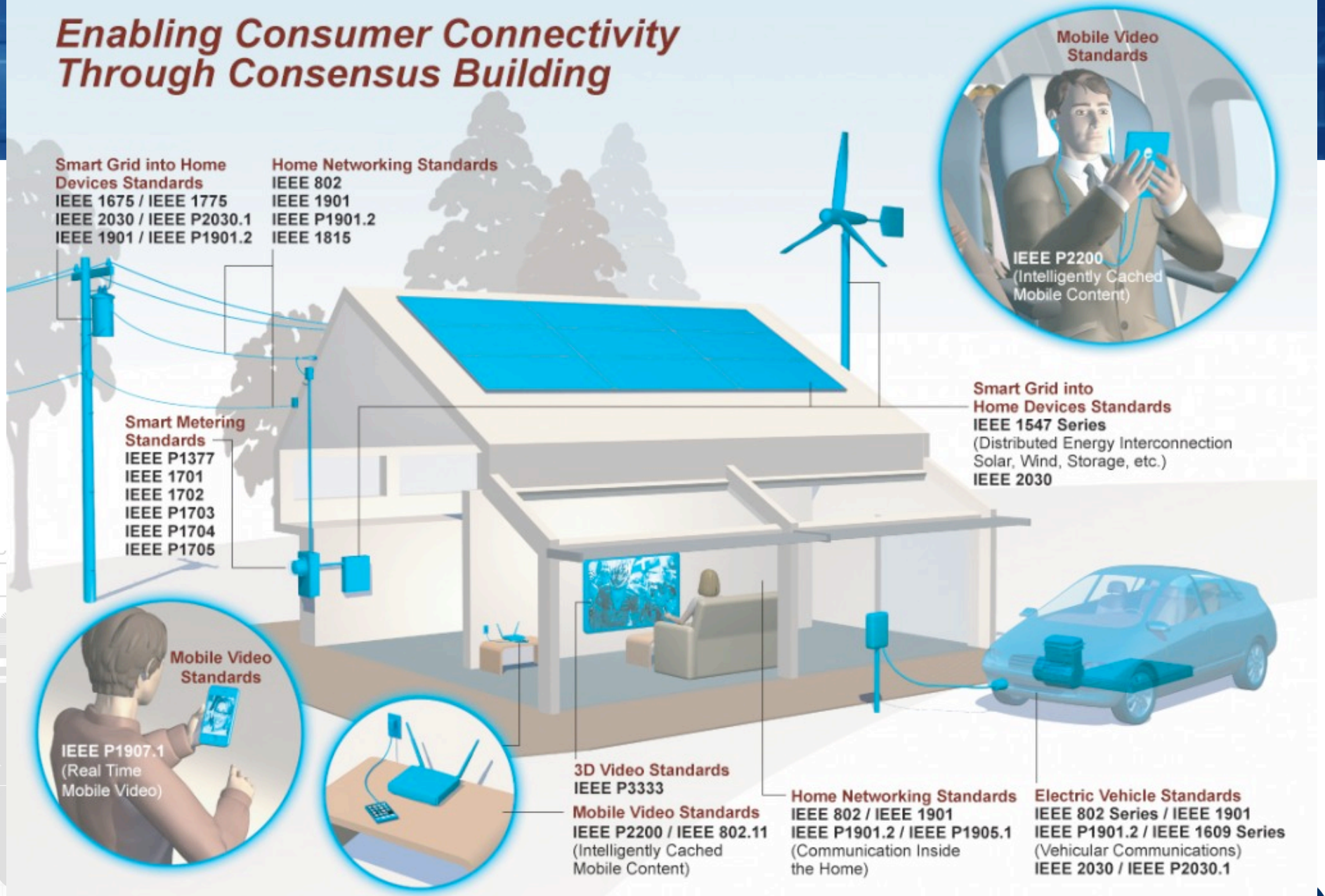
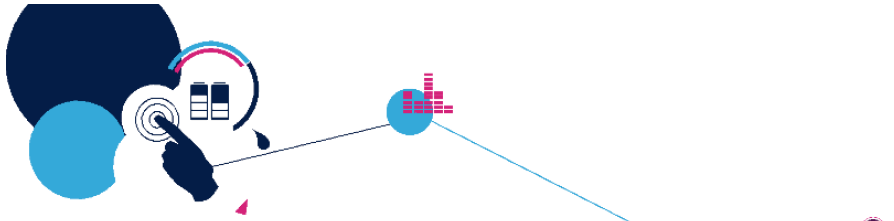
Enabling Consumer Connectivity Through Consensus Building



Special thanks to Oleg Logvinov (IEEE P2413 Chair)



A Market Driven Architecture: The Standard for an Architectural Framework for the IoT

Oleg Logvinov

Director, Special Assignments
Industrial and Power Conversion Division
STMicroelectronics

Chair of the IEEE P2413 Working Group, IEEE-SA

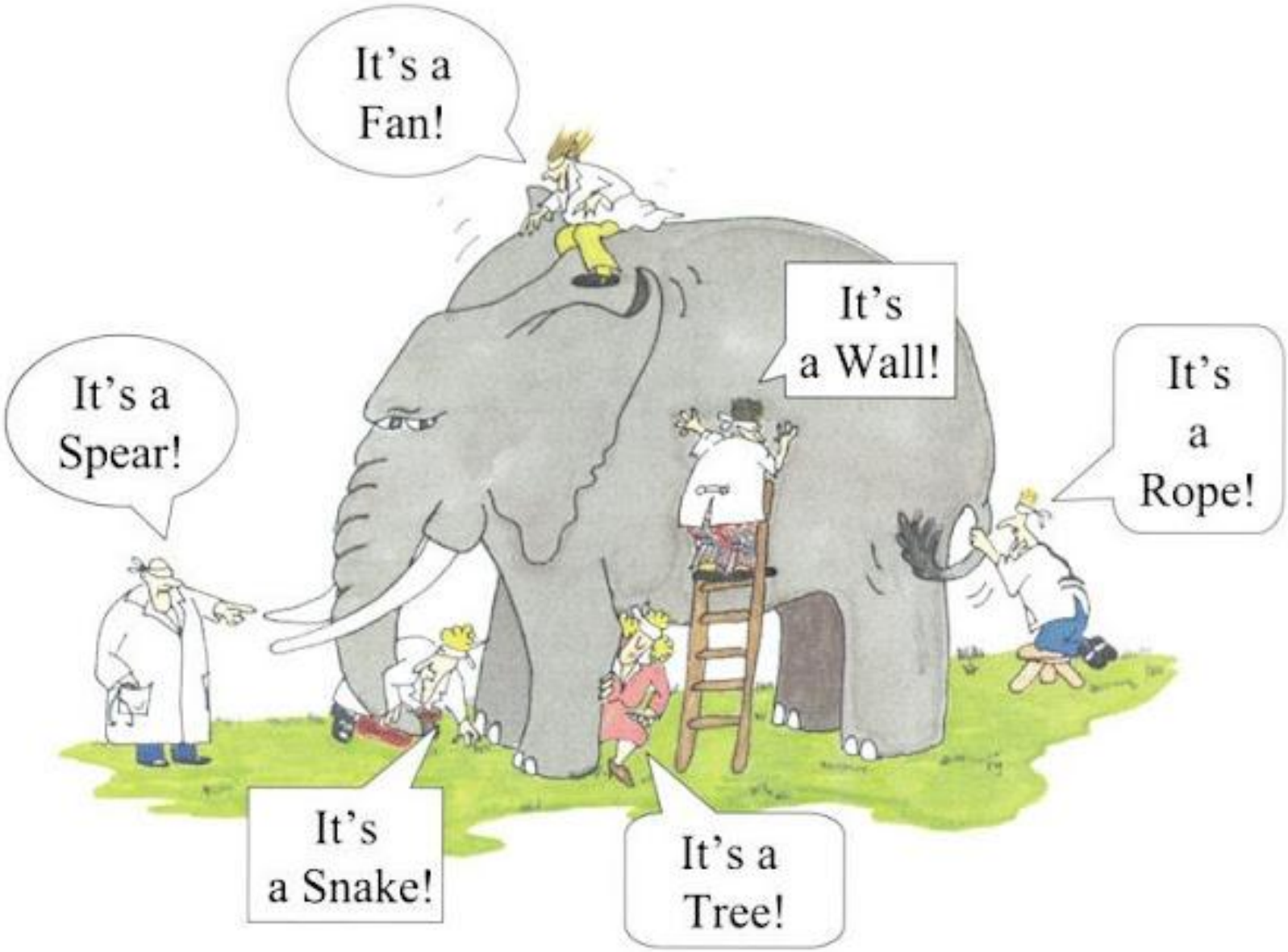
Email: oleg.logvinov@st.com

January 11, 2015

life.augmented

http://grouper.ieee.org/groups/2413/Intro-to-IEEE-P2413.pdf

CREATE-NET


It's a Fan!
It's a Spear!
It's a Wall!
It's a Rope!
It's a Snake!
It's a Tree!

IEEE P2413 in a nutshell

- This standard defines an **architectural framework** for the Internet of Things (IoT), including:
  - descriptions of various IoT domains
  - definitions of IoT domain abstractions
  - identification of **commonalities between different IoT domains**.
- The architectural framework for IoT provides
  - a **reference model that defines relationships among various IoT verticals** (e.g., transportation, healthcare, etc.) and common architecture elements.
  - a **reference architecture that**
    - **builds upon the reference model**.
    - definition of **basic architectural building blocks** and their ability to be integrated into multi-tiered systems
- **blueprint for data abstraction** and the quality "quadruple" trust that includes protection, security, privacy, and safety.
- The reference architecture also addresses how to document and, if strived for, mitigate architecture divergence.
- This standard leverages existing applicable standards and identifies planned or ongoing projects with a similar or overlapping scope.

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The Birth of the IEEE P2413

- P2413 is an outgrowth of a multi-year series of IoT Standards workshops and roundtables to understand requirements by vested stakeholders in the evolving IoT environment.
- P2413 was initiated through the guidance of the IEEE-SA's Industry Strategic IoT Team with a focus to **integrate market needs** with the **developing IoT technology landscape**.
- The IEEE-SA Corporate Advisory Group (representing 200+ industry members) provides sponsorship for P2413 to maintain a **balanced focus on industry / market / technology** and standards eco-system requirements within the development framework.

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IEEE P2413 Purpose and Motivation

- The Internet of Things (IoT) is a key enabler for many emerging and future “smart” applications and technology shifts in various technology markets. This ranges from the Connected Consumer to Smart Home & Buildings, E-Health, Smart Grids, Next Generation Manufacturing and Smart Cities. It is therefore predicted to become one of the most significant drivers of growth in these markets.
- Most **current standardization activities are confined to very specific domains and stakeholder groups**. They therefore represent islands of disjointed and often redundant development. The architectural framework defined in this standard will promote cross-domain interaction, aid system interoperability and functional compatibility, and further fuel the growth of the IoT market.

Siloed “App islands” (up to now)

Seek Interoperability (today)

Thriving IoT and associated applications (tomorrow)

IEEE-SA Internet of Things

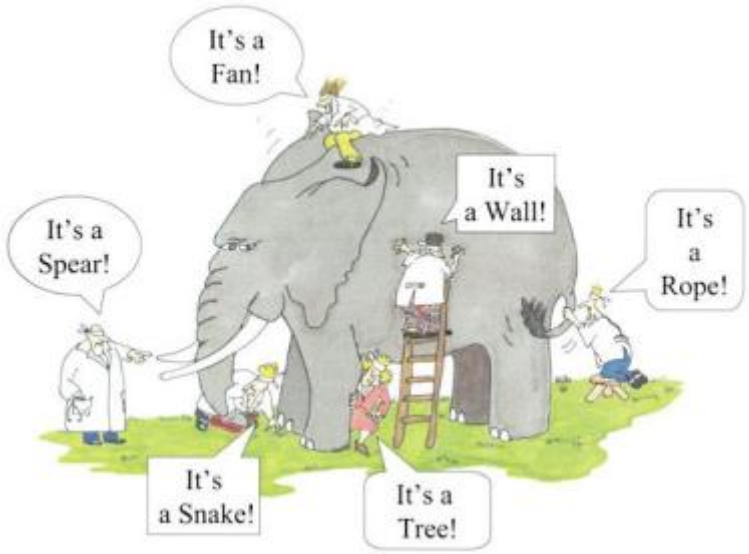
IEEE Internet of Things

Worldwide IoT Workshops

- 2012: Beijing, China and Milan, Italy
- 2013: Shenzhen, China and Mountain View, CA, USA
- 2014: IEEE IoT World Forum, Seoul, Korea (6-8 Mar)
- 2014: 18-19 September in Mountain View, California

Hosting IoT industry roundtables and webinars

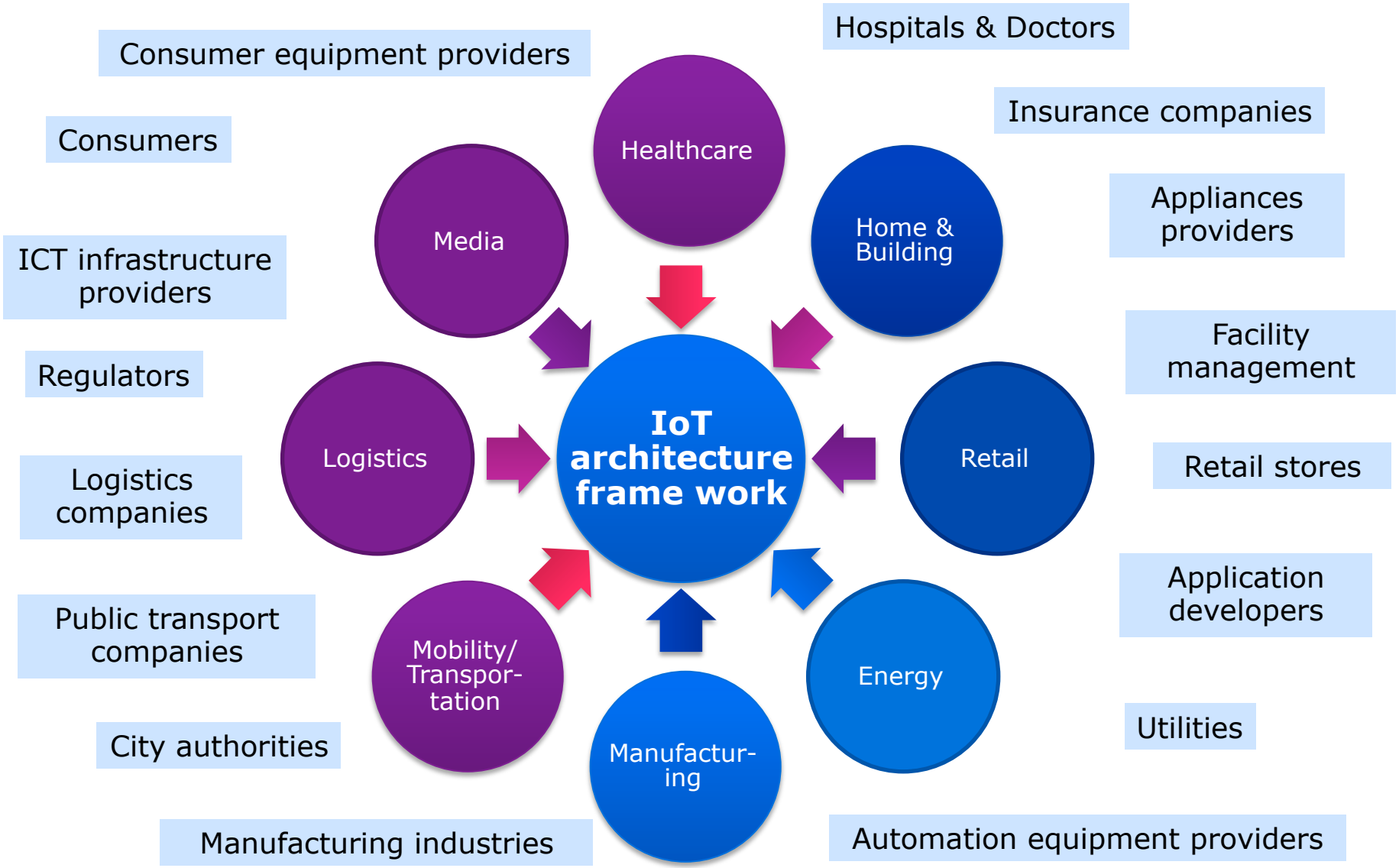
- 2012: Milan Roundtable
- 2013: Roundtables in Korea and USA
- 2014: Webinars introducing IEEE P2413
- 2014: Industry roundtables in US, Europe, and Asia



IEEE Standards Drive OT and IT Convergence

802.11 (wifi axs)
1901 broadband over power lines (BPL).
2030 Smart Grid Interoperability
1888 Ubiquitous Green Community Control Network Protocol (data-level)
1451 set of smart transducer interface standards
(ISO) 11073 health device communication standards
1547 interconnection of distributed generation resources into the power grid in the US

IoT Application Domains & Stakeholders*



IEEE P2413 "Standard for an Architectural Framework for the IoT" Goals

- **Accelerate the growth of the IoT Market** by enabling cross-domain interaction and platform unification through increased system compatibility, interoperability and functional exchangeability
- **Define an IoT architecture framework** that covers the architectural needs of the various IoT Application Domains
- Increase the transparency of system architectures to support system **benchmarking, safety, and security assessments**
- **Reduce industry fragmentation** and create a critical mass of multi-stakeholder activities around the world
- Leverage the existing body of work

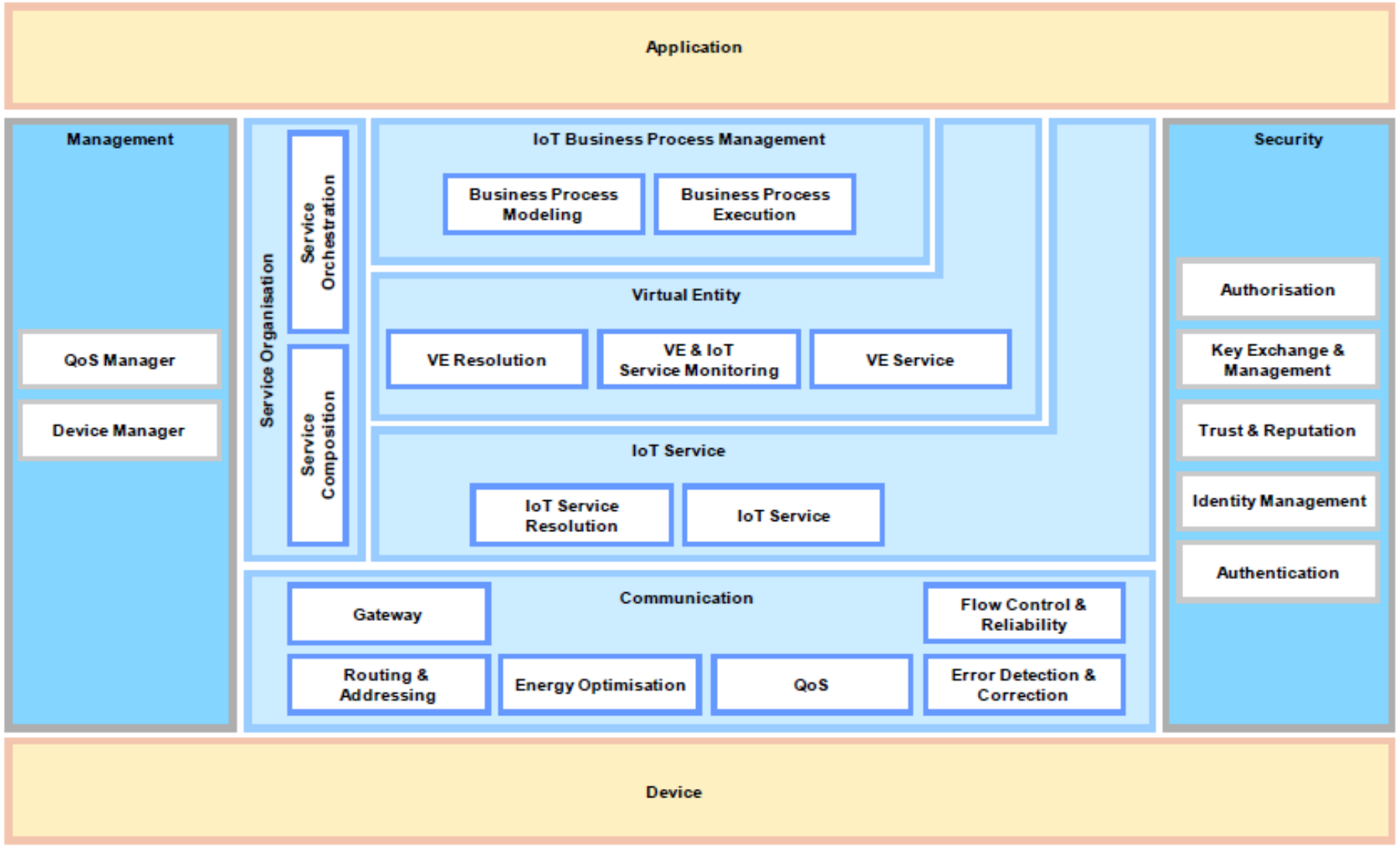
IEEE P2413 Scope

- This standard defines an Architectural Framework for the IoT, including:
  - Descriptions of various IoT domains
  - Definitions of IoT domain abstractions
  - Identification of commonalities between different IoT domains
- The Architectural Framework for IoT provides:
  - Reference model that defines relationships among various IoT domains (e.g., transportation, healthcare, etc.) and common architecture elements
  - Reference architecture that:
    - builds upon the reference model
    - defines basic architectural building blocks and their ability to be integrated into multi-tiered systems
    - addresses how to document and mitigate architecture divergence.
  - Blueprint for data abstraction and the quality "quadruple" trust that includes protection, security, privacy, and safety.

IoT-A Architecture Reference Model

- Minimum set of “functionality groups”
  - application
  - IoT service
  - communication
  - device

IoT-A functional model



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P2413 Methodology

- Identify **commonalities within verticals** and potentially among certain verticals
- Address **relationships** among security requirements, energy efficiency during data transmission (communication), service requirements, application aware routing (including security requirements), versus underlying network technologies.
- **Link features and components in existing standards** to a top-down view of relevant IoT aspects, features and components, embodied in an IoT architectural framework.
- Identify design choices for IoT .
- Match requirements within a specific domain structures to relevant design choices.
- Develop **domain profile structures**, and liaise with vertical standards groups to evaluate areas such as data models.
- **Bridge and leverage standardization landscape**, identifying relevant features and functionalities in other standardization related activities.

IEEE P2413 External interactions

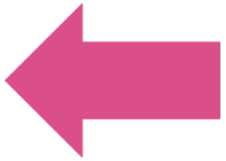
- For a **unified IoT Architectural Framework** it is essential to interact with standardization activities for IoT-based vertical applications to
  - Cover the various applications, their requirements and specific IoT functionalities in the IoT Architectural Framework
  - Ensure that the framework can be referenced by these standardization activities
- Besides interactions with standardization activities within IEEE, P2413 will strive to establish **liaisons with other standardization bodies**.
- An initial set of liaisons include IEEE 802.24, IEC SG8, and oneM2M

IEEE P2413 Membership

Alcatel-Lucent
Broadcom Corporation
Cisco Systems
dZhON Pty. Ltd.
Emerson
General Electric
Hitachi, Ltd.
Honeywell International
Huawei Technologies
Infocomm Development Authority (IDA)
Institute for Information Industry (III)
Marvell Semiconductor, Inc.
Oracle
Qualcomm Inc.
Rockwell Automation
Schneider Electric
Siemens AG
STMicroelectronics
Toshiba Corporation
Wuxi Sensing Net Industrialization Research Institute
Yokogawa Electric Corporation
ZigBee Alliance

IEEE P2413 Working Group Meetings

- First WG Meeting:
  - 10-11 July 2014, Munich, Germany
  - Hosted by Siemens
- Second WG Meeting:
  - 16-17 September 2014, Santa Clara, CA USA
  - Hosted by STMicroelectronics
- Third WG Meeting:
  - Teleconference, 28 October 2014
- Fourth WG Meeting:
  - Teleconference, December 2014
- Fifth WG Meeting:
  - 22-23 January, Taipei, Taiwan
  - Hosted by Institute for Information Industry
- **Sixth WG Meeting:**
  - **27-28 April, Grenoble, France**
  - **Hosted by Schneider Electric**
- Seventh WG Meeting:
  - August, USA (TBD)



P2413 – Conclusions

- P2413 recognizes the evolving transformational integration and **convergence across technology and application domains**.

- P2413's goal is to provide an **extensible integrated architectural framework** that will continue to evolve and unify the standards creation effort.

- P2413 will continue to **deepen industry engagement** by leveraging global IoT workshops, webinars, roundtables and other tools of the IEEE IoT Initiative.

- P2413 is an **open community and all are welcome to participate** and to share perspectives on addressing and preparing for the inter-connected world of 2020.

IEEE IoT Initiative (http://iot.ieee.org/)

Main IEEE IoT Conference

(Milan 14-16 Dec 2015 – Call for Papers is out!)

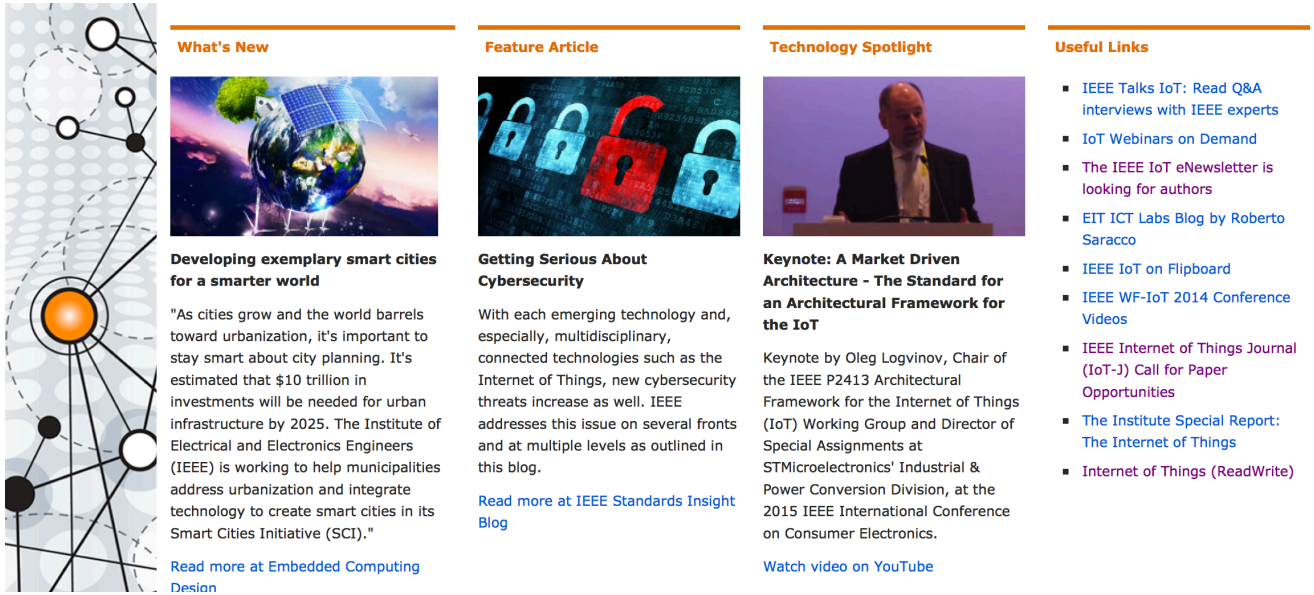
Portal

Journal

Newsletter

Magazine

http://iot.ieee.org/newsletter.html



What's New

Developing exemplary smart cities for a smarter world

"As cities grow and the world barrels toward urbanization, it's important to stay smart about city planning. It's estimated that $10 trillion in investments will be needed for urban infrastructure by 2025. The Institute of Electrical and Electronics Engineers (IEEE) is working to help municipalities address urbanization and integrate technology to create smart cities in its Smart Cities Initiative (SCI)."

Read more at Embedded Computing Design

Feature Article

Getting Serious About Cybersecurity

With each emerging technology and, especially, multidisciplinary, connected technologies such as the Internet of Things, new cybersecurity threats increase as well. IEEE addresses this issue on several fronts and at multiple levels as outlined in this blog.

Read more at IEEE Standards Insight Blog

Technology Spotlight

Keynote: A Market Driven Architecture - The Standard for an Architectural Framework for the IoT

Keynote by Oleg Logvinov, Chair of the IEEE P2413 Architectural Framework for the Internet of Things (IoT) Working Group and Director of Special Assignments at STMicroelectronics' Industrial & Power Conversion Division, at the 2015 IEEE International Conference on Consumer Electronics.

Watch video on YouTube

Useful Links

- IEEE Talks IoT: Read Q&A interviews with IEEE experts
- IoT Webinars on Demand
- The IEEE IoT eNewsletter is looking for authors
- EIT ICT Labs Blog by Roberto Saracco
- IEEE IoT on Flipboard
- IEEE WF-IoT 2014 Conference Videos
- IEEE Internet of Things Journal (IoT-J) Call for Paper Opportunities
- The Institute Special Report: The Internet of Things
- Internet of Things (ReadWrite)

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Use of IoT standards in the context of an EU Innovation Action

- Contextual background: UNCAP (Ubiquitous Interoperable Care for Aging People)
- OGC vs. ETSI M2M

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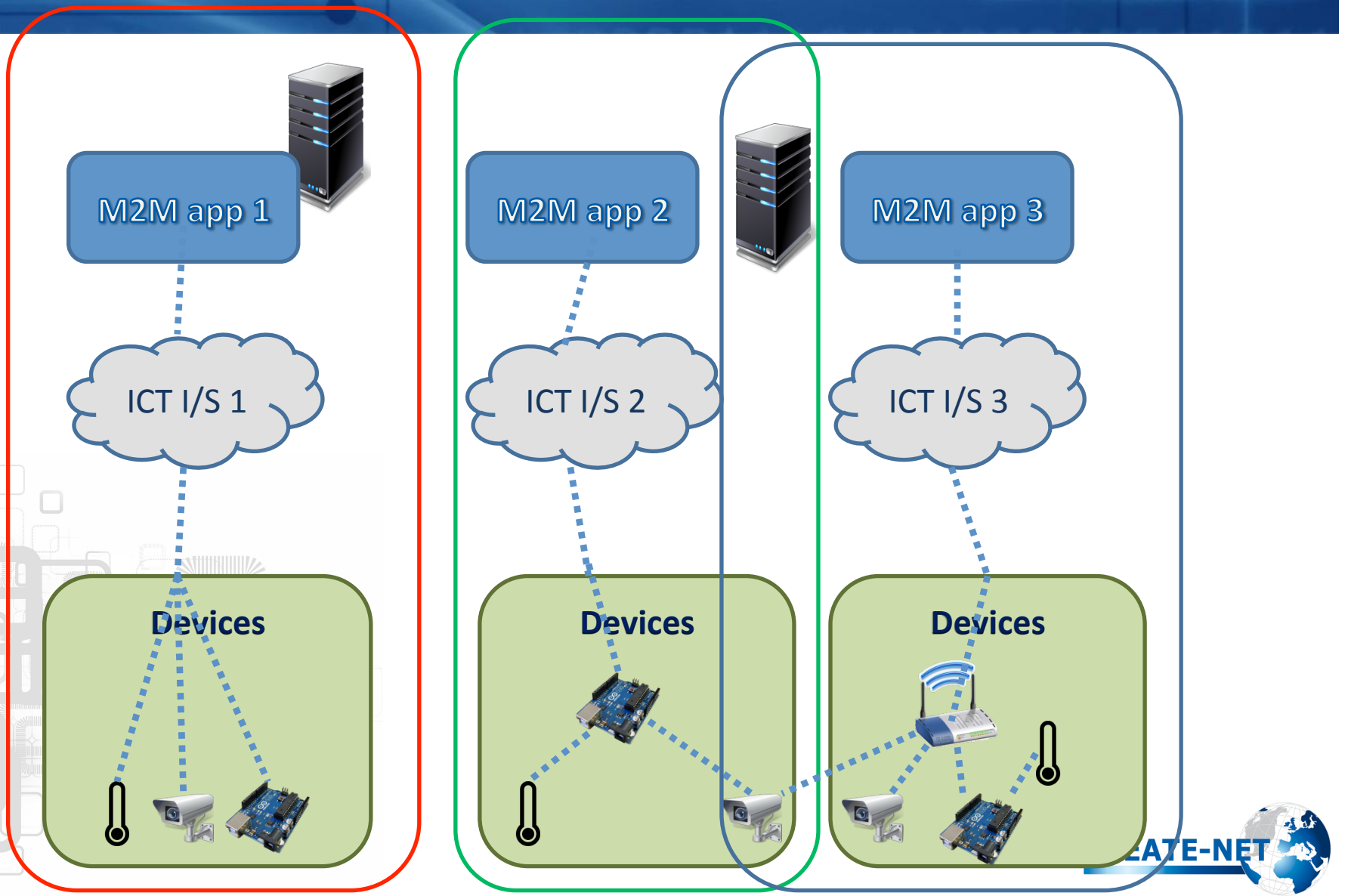
What we have


M2M app 1
M2M app 2
M2M app 3
ICT I/S 1
ICT I/S 2
ICT I/S 3
Devices
Devices
Devices

ETSI M2M “vision”

M2M app 1

M2M app 2

M2M app 3

Application infrastructure

Core Network infrastructure

Access network Infrastructure (xDSL, 3G, Wifi,etc)

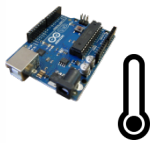
Device

Device

Device

Device

Device



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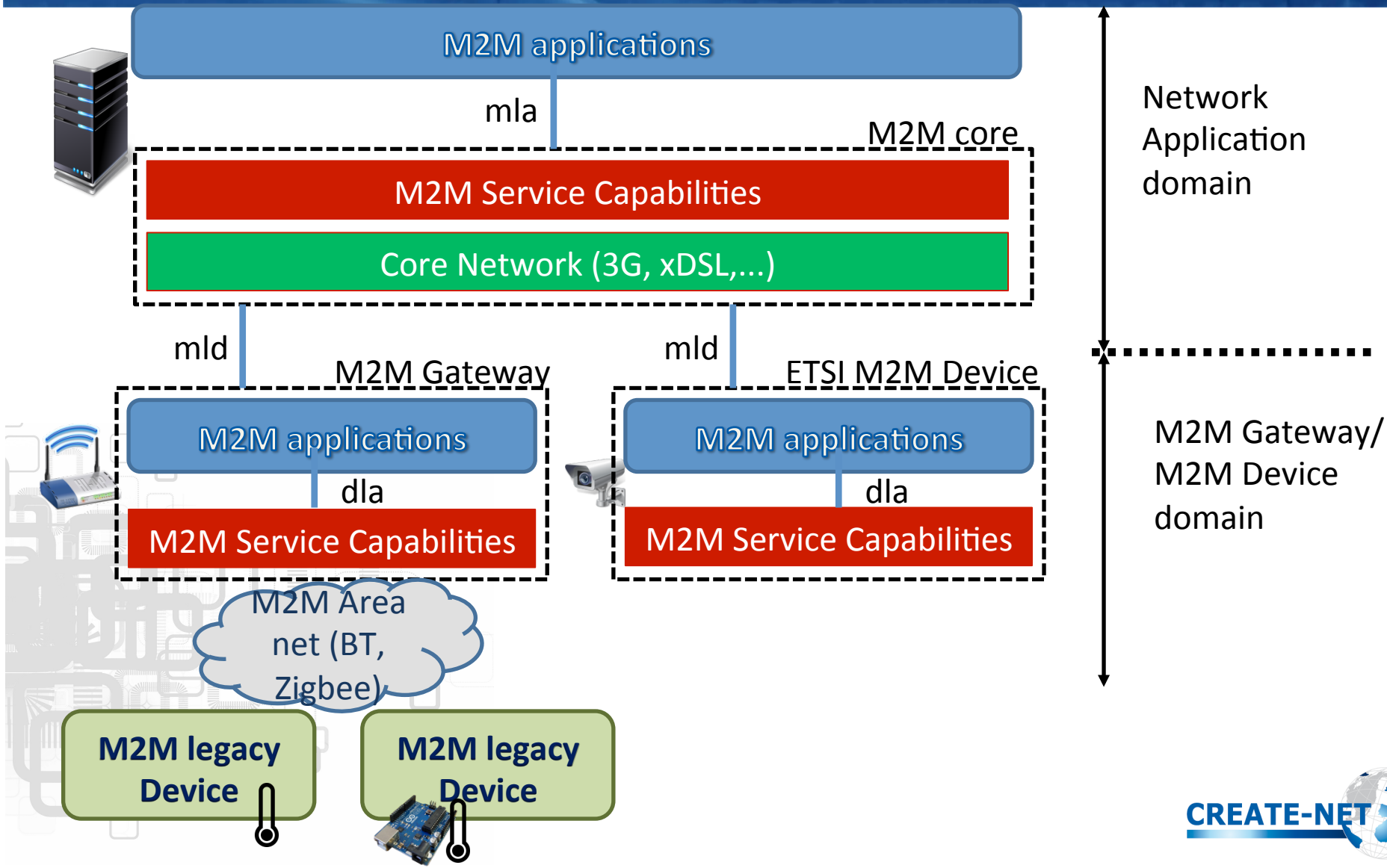
ETSI M2M high level architecture



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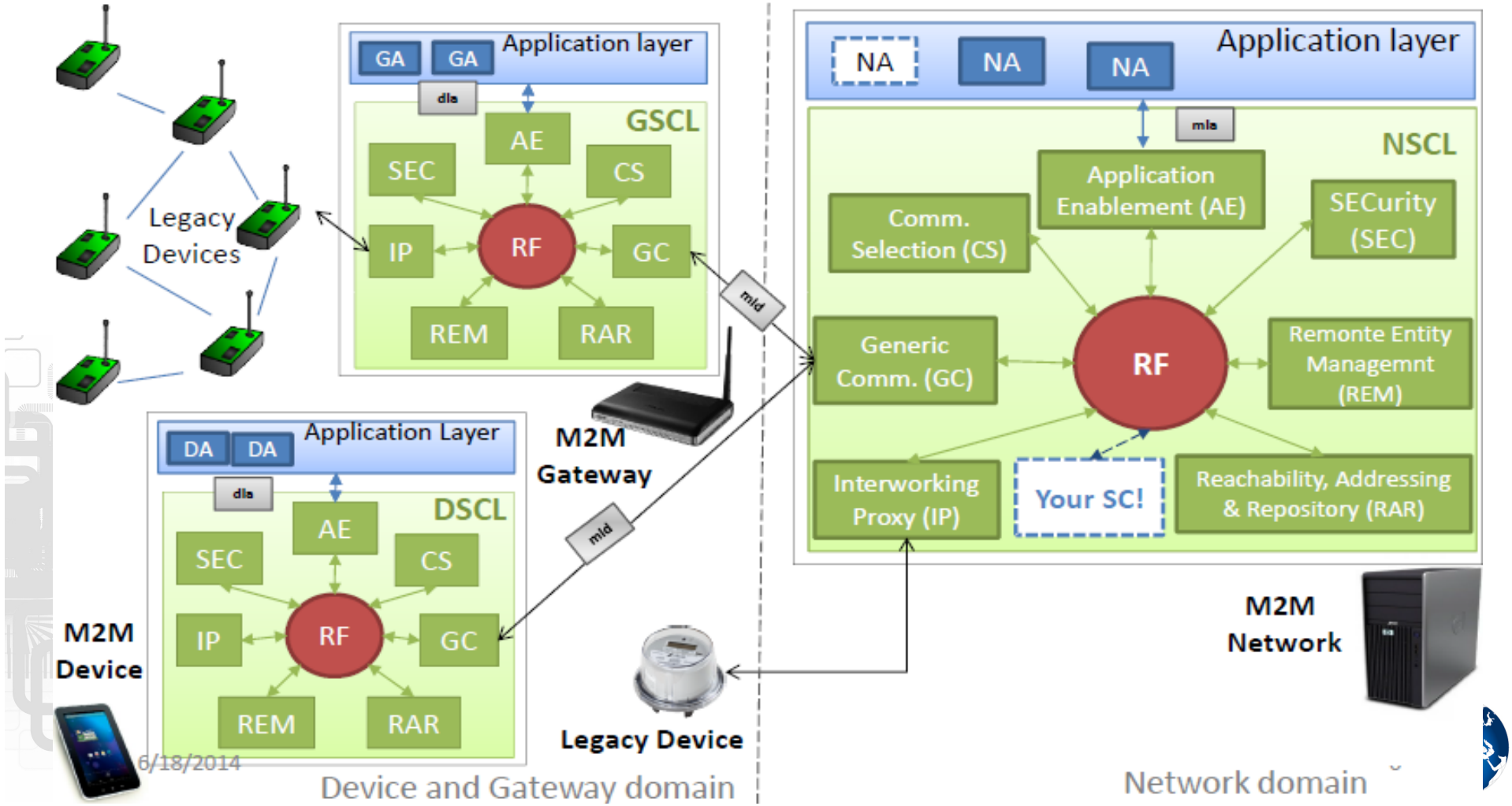
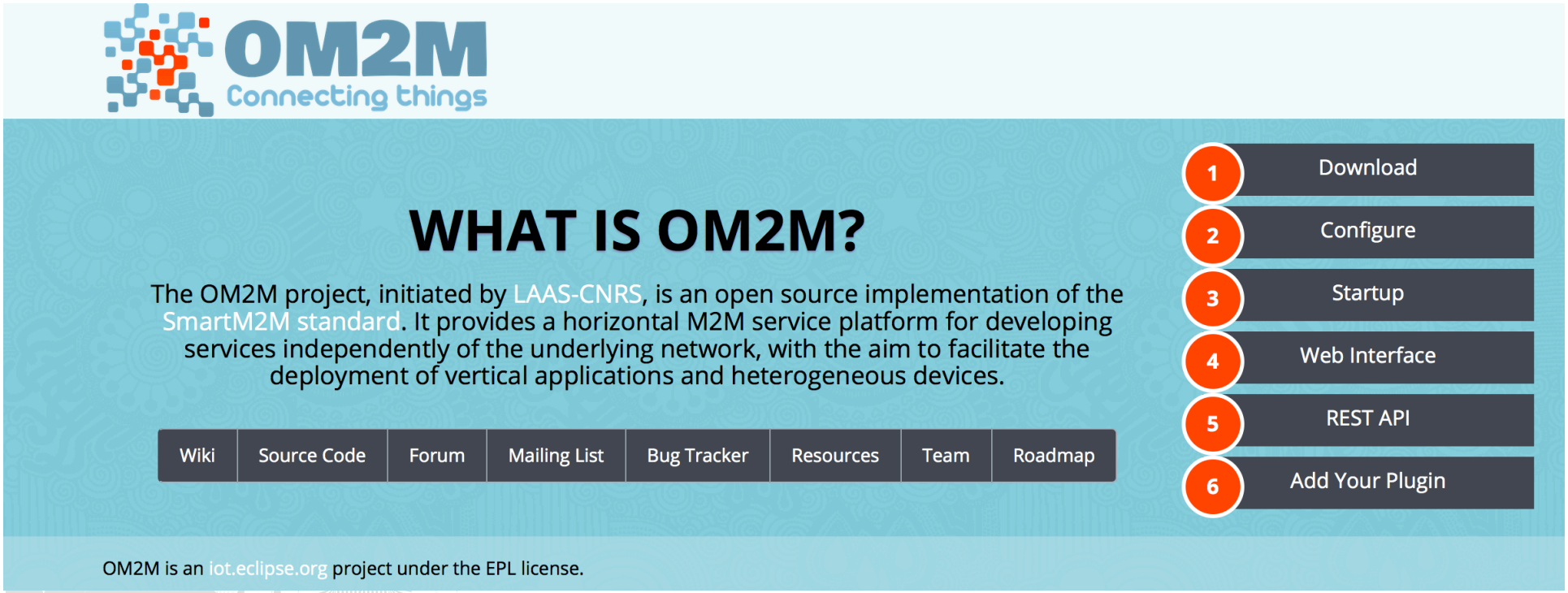
ETSI M2M Standardization

ETSI M2M provides a Service Capability Layer (SCL) that includes a set of common services for M2M interoperability



Existing software to leverage on…



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OM2M unique features

Standardized Platform

OM2M implements the ETSI M2M standard. It provides a horizontal Service Capability Layer (SCL) that can be deployed in an M2M network, a gateway, or a device. Each SCL provides Application Enablement, Generic Communication, Reachability, Addressing and Repository, Interworking proxy, Entity Management, etc.

RESTful API

OM2M exposes a RESTful API providing primitive procedures for machines authentication, resources discovery, applications registration, containers management, synchronous and asynchronous communications, access rights authorization, groups organisation, and re-targeting.

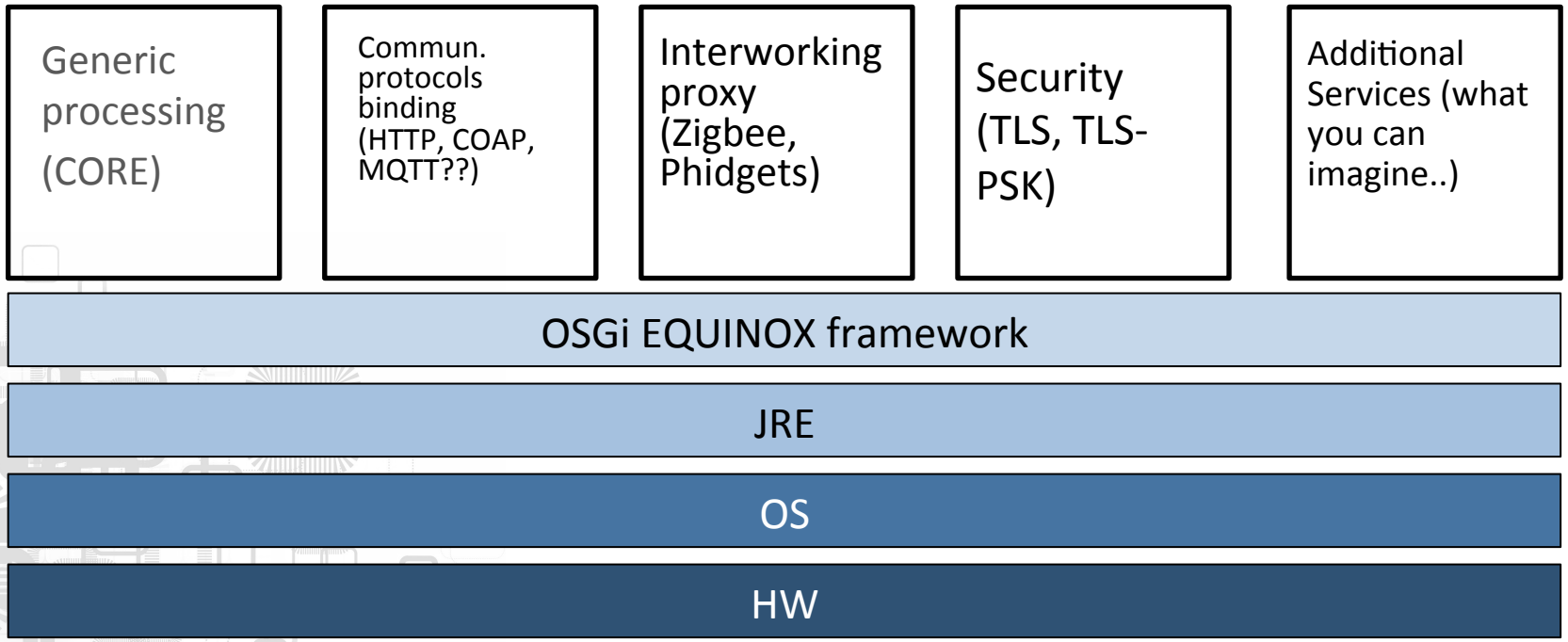
Modularity & Extensibility

OM2M is a Java implementation running on top of an OSGi Equinox runtime, making it highly extensible via plugins. It is built as an Eclipse product using Maven and Tycho. Each plugin offers specific functionalities, and can be remotely installed, started, stopped, updated, and uninstalled without requiring a reboot.

CREATE-NET

OM2M architecture

implements a RESTful API (everything is a document: URI + CRUD methods)
it comes already with several features (SCL discovery, registration, access-right&group mngmt, app registration, subscription mngmt, etc!)



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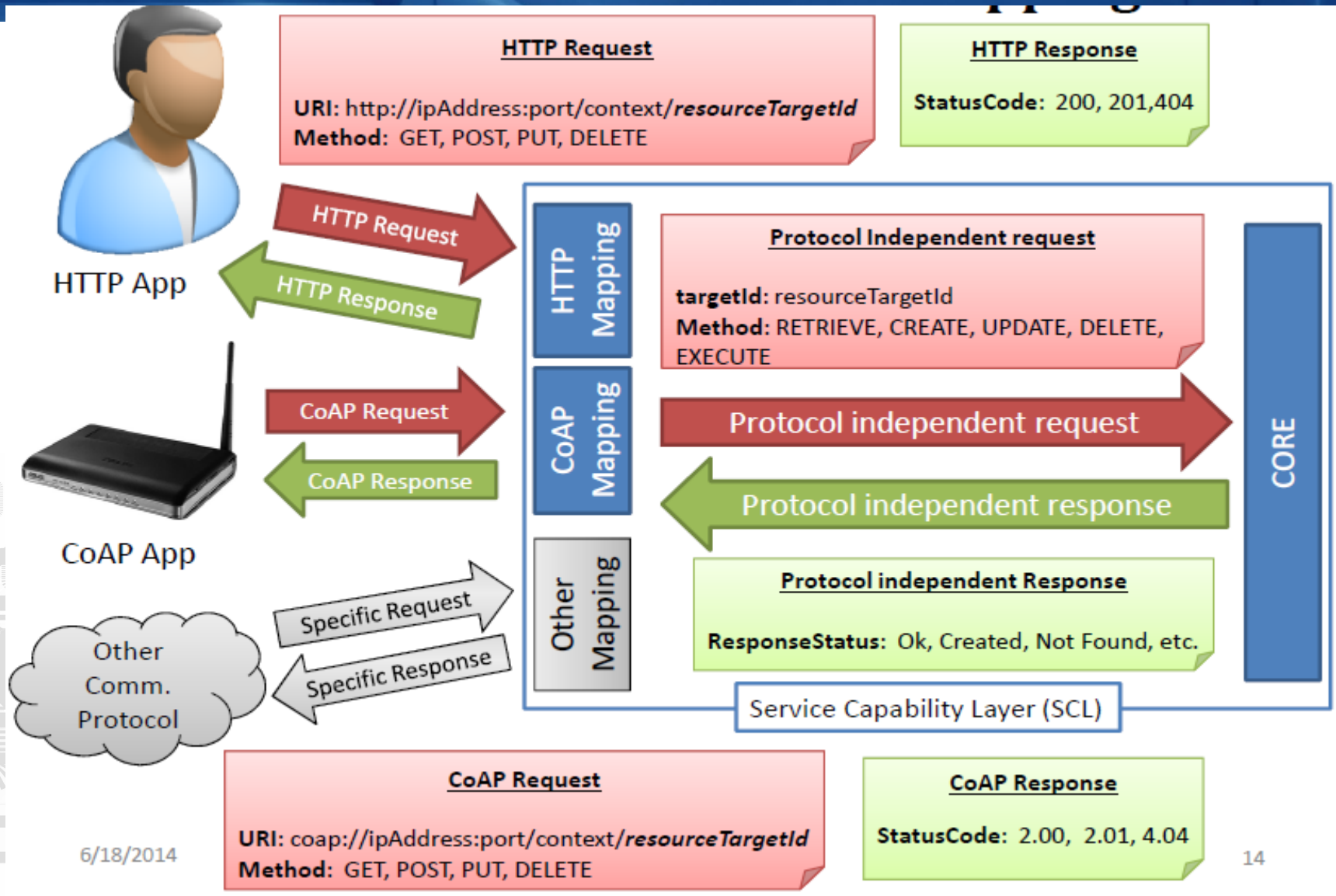
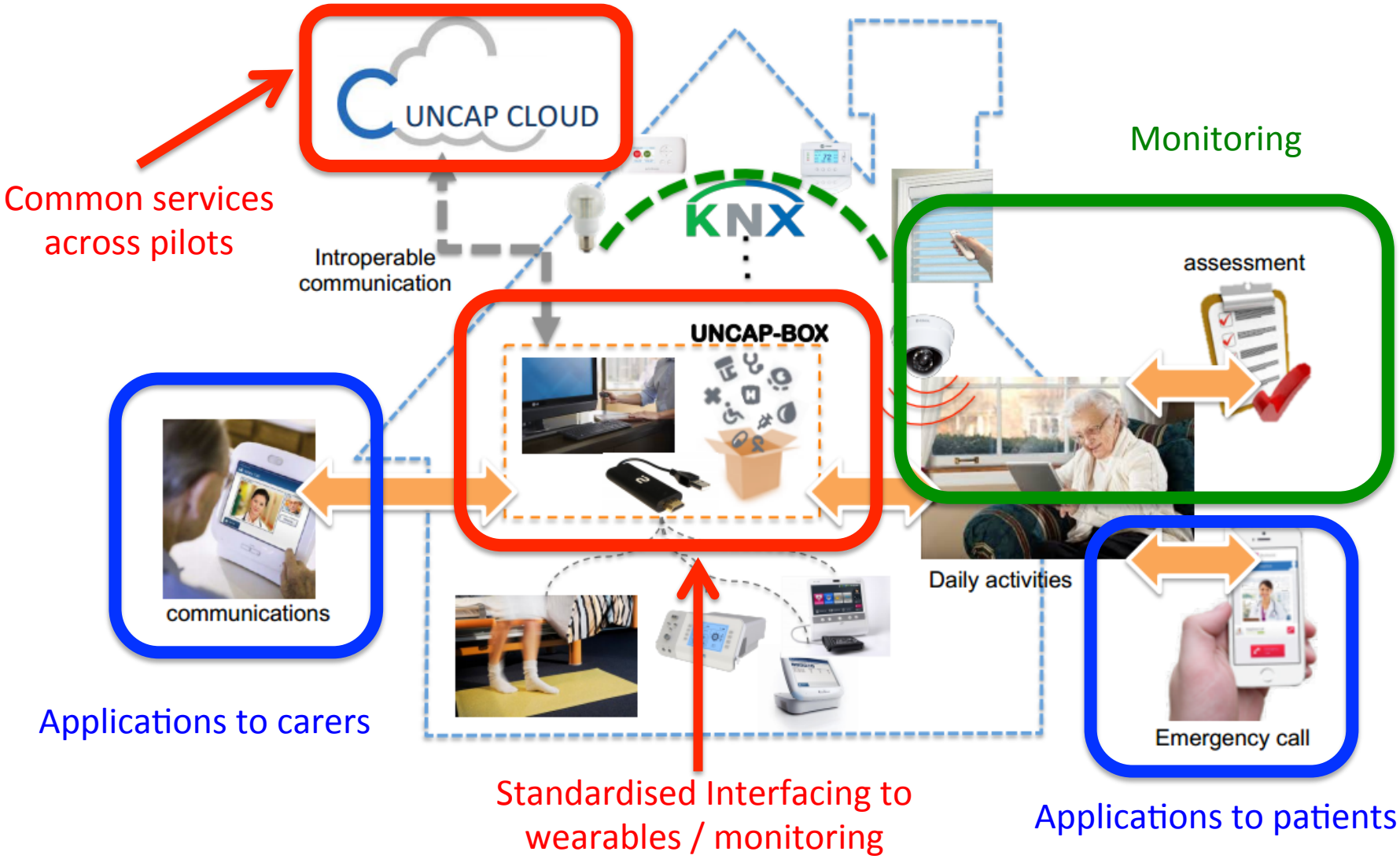
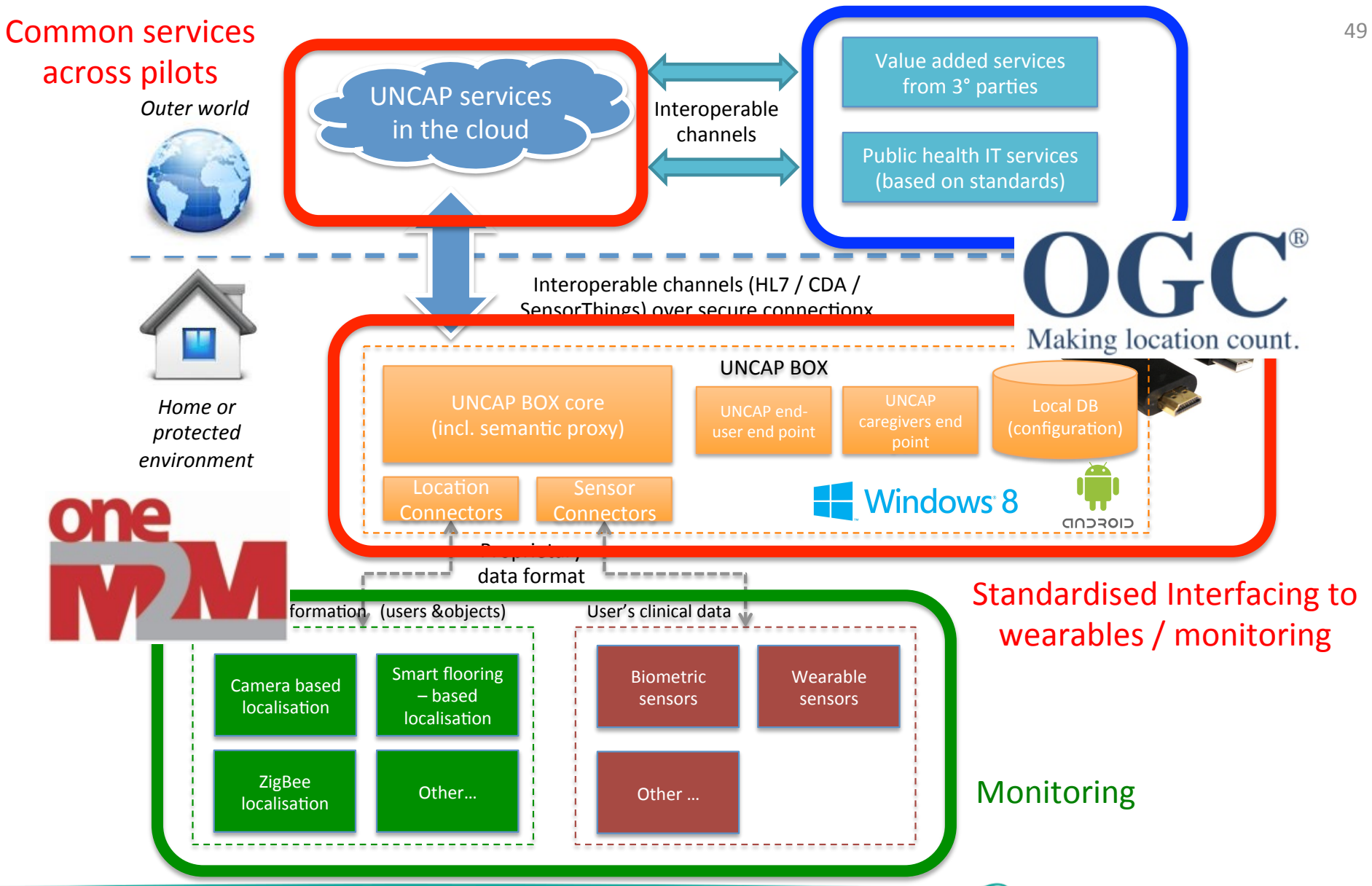
Communication protocol mapping



Overall Approach



Overall architecture



Conclusions

- Very complex world
- Need to be pragmatic
- Field implementation and trials
- Select and use what works for you
- Time and mass market uptake will decide on “the facto” standards

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Thank you!

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