

IEEE Internet of Things Initiative and

IEEE P2413: Standard for an Architectural Framework for the Internet of Things

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THE IMPACT OF IOT

BILLIONS OF DEVICES

- More than 50 billion in 2020
- Heterogeneous architectures
- Big Data and broadband communications

Source: Intel



MANY APPLICATION DOMAINS

- Consumers (i.e., wearable, home automation, wellness)
- Commercial (i.e., retail, building, logistics)
- Industrial (i.e., manufacturing, energy, transportation)
- Public Sector (i.e., Smart Cities and regions, public safety, security, healthcare)

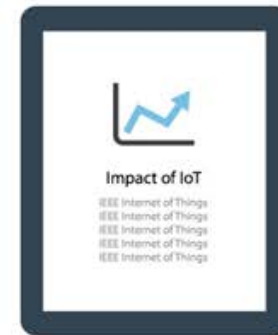
Source: Beecham



DIFFERENT BUSINESS APPROACHES

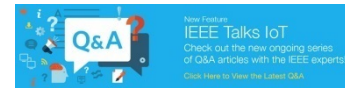
- Intelligent services
- Open ecosystems
- Different value chains
- Many different business models
- New actors (e.g., Makers)

Source: Freescale



IEEE Internet of Things Initiative

- Third issue of IoT eNewsletter published on 13 January
- New by-lined articles placed
 - CSO Magazine – 1/30 - Five Myths (Debunked) about Security & Privacy for Internet of Things; Greg Shannon
 - Medical Design Tech Magazine – 1/8 - Expanding Wellness Monitoring and Care with e-Health; Bill Ash and Kathryn Bennett
- 2015 World Forum on IEEE Internet of Things (WF-IoT); University of Milan; 14-16 December 2015
 - Secured Vinton Cerf, Chief Internet Evangelist for Google as keynote speaker
- IoT Journal – 2014 Summary
 - 6 issues/51 papers/599 pages
 - 47,434 usage (downloads) in 2014 according to IEEE Xplore; papers repeatedly among the Top 100 downloads in IEEE Xplore



Internet of Things Journal, IEEE

Participating IEEE Societies:



Focus on 2015

Conferences

- Organize and support the follow-on to the IEEE WF-IoT 2014 conference
 - ComSoc and Computer Society will be the lead sponsors and organizers
 - Signal Processing, Reliability, Consumer Electronics, Sensors Council, CEDA and VTS have confirmed their intent to be financial co-sponsors
- Participate/support 8-10 IEEE and non-IEEE IoT-focused and IoT-related conferences

Publications

- Continue to publish and promote the IoT eNewsletter
- Launch process to establish an IoT Magazine

Applications/Use Cases

- Identify and publish applications/use cases demonstrating innovative services
- Develop a library of reference designs

Content/Community Development

- Social Media
 - Grow membership, visibility and influence through channels including Twitter, LinkedIn, and Flipboard
- Conduct Webinars, Ask Me Anythings (AMAs), Google Hangouts
- Compose and place By-lined articles/columns, press interviews, etc.
- Create and refresh the portal content; interviews, Q&As, videos, articles

Education

- Develop series of eLearning modules on IoT, leveraging presentations from conferences and course lectures within a university setting
- Develop a series of MOOCs (Massive Open Online Courses)

IEEE IoT Brings People Together

IEEE IoT Workshops

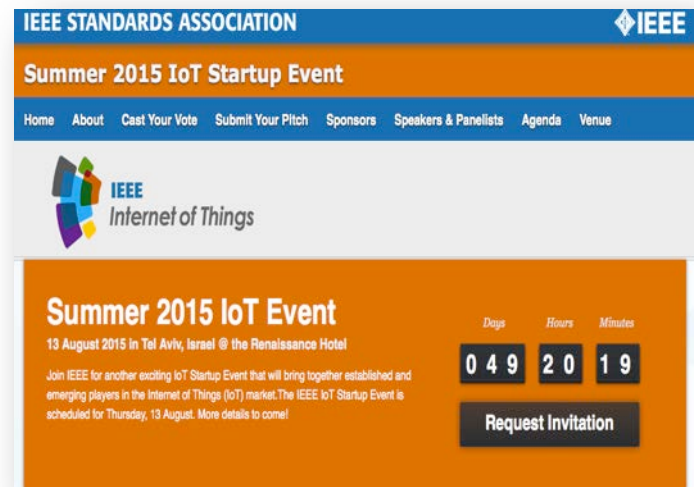
Gathering of global IoT experts, leaders, and other participants to explore new technologies, IEEE standards, applications, and future business models

- September 2014, Silicon Valley
- April 2013, Shenzhen, China
- November 2013, Silicon Valley
- November 2012, Milan, Italy

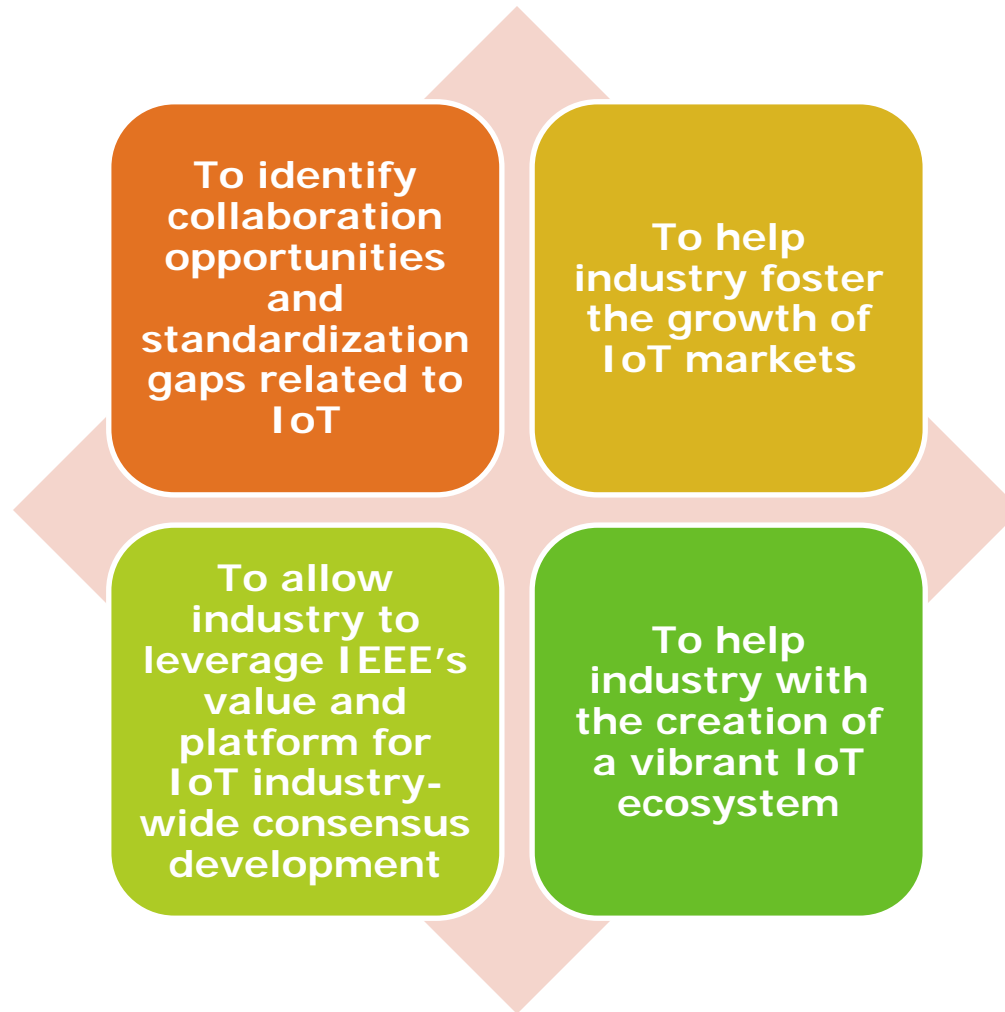
IEEE IoT Soiree & Startup Events

Bringing together established and emerging players in IoT. Fostering IoT innovation. A catalyst for expansion and growth of the IoT ecosystem

- Startup "Hot Seat": Startup companies introduce themselves to potential partners and investors
- Past
 - January 2015, Co-located with Consumer Electronics Show, Las Vegas, NV, USA
 - May 2015, San Jose, CA, USA
- Summer 2015 IoT StartUp Event
 - Aug 13, 2015, Tel Aviv, Israel



IEEE-SA IoT: Goals



IEEE-SA IoT: sample standards

- Sensor networks
 - ISO adopted IEEE 1451 series
- RFID
 - IEEE 1902.1-2009, IEEE Standard for Long Wavelength Wireless Network Protocol
 - IEEE 802.15.4f-2012, Active RFID physical layer
- M2M
 - IEEE 802.16P, Air Interface for Broadband Wireless Access Systems Amendment: Enhancements to Support Machine-to-Machine Applications
 - IEEE 802.16.1b, Air Interface for Broadband Wireless Access Systems - Enhancements to Support Machine-to-Machine Applications
 - Related standards: 802.11 (Wifi®), 802.15.1 (Bluetooth®) and 802.15.4 (Zigbee®)
- IEEE 1888-2011, IEEE Standard for Ubiquitous Green Community Control Network Protocol and subsidiary projects
 - P1888.1, Control and Management
 - P1888.2, Heterogeneous Networks Convergence and Scalability
 - P1888.3, Security
 - P1888.4, Green Smart Home and Residential Quarter Control Network Protocol

IEEE-SA IoT: In Action

Comprehensive Engagement of a Broad Range of Stakeholders

IoT Events

- Fostering Collaboration
- Additional Input

IEEE P2413: Standard for an Architectural Framework for the IoT

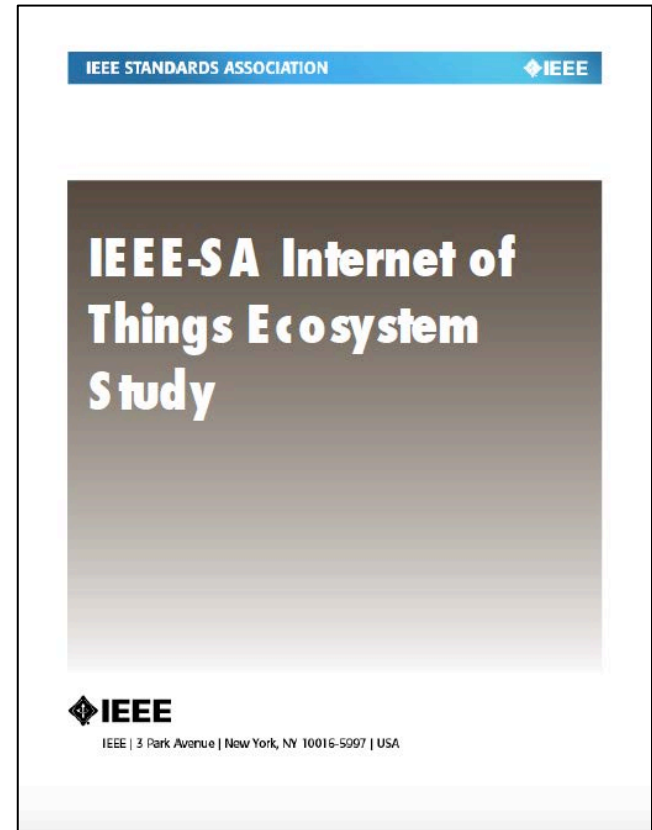
- Collaboration with other SDOs/Alliances
- Collaboration with Societies

Workshops and Roundtables

- Input from industry
- Ecosystem Study
- Foundation for P2413

IEEE-SA IoT Ecosystem Study

- Roundtable Discussions were held worldwide (Europe, Asia, and USA) throughout 2012-2014
- As part of the IEEE IoT Initiative, the IEEE-SA developed an IoT Ecosystem Study, based on input from the Roundtable Discussions
 - Many thanks to the Supporting Organizations who hosted the Roundtable Discussions!
 - IEEE ComSoc
 - IEEE USA
 - Institute for Information Industry (III)
 - SEMI
 - STMicroelectronics
 - Tatung
- The IoT Ecosystem Study is available at <http://standards.ieee.org/innovate/iot/study.html>



IEEE P2413: Standard for an Architectural Framework for the Internet of Things (IoT)

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.



The Birth of 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.

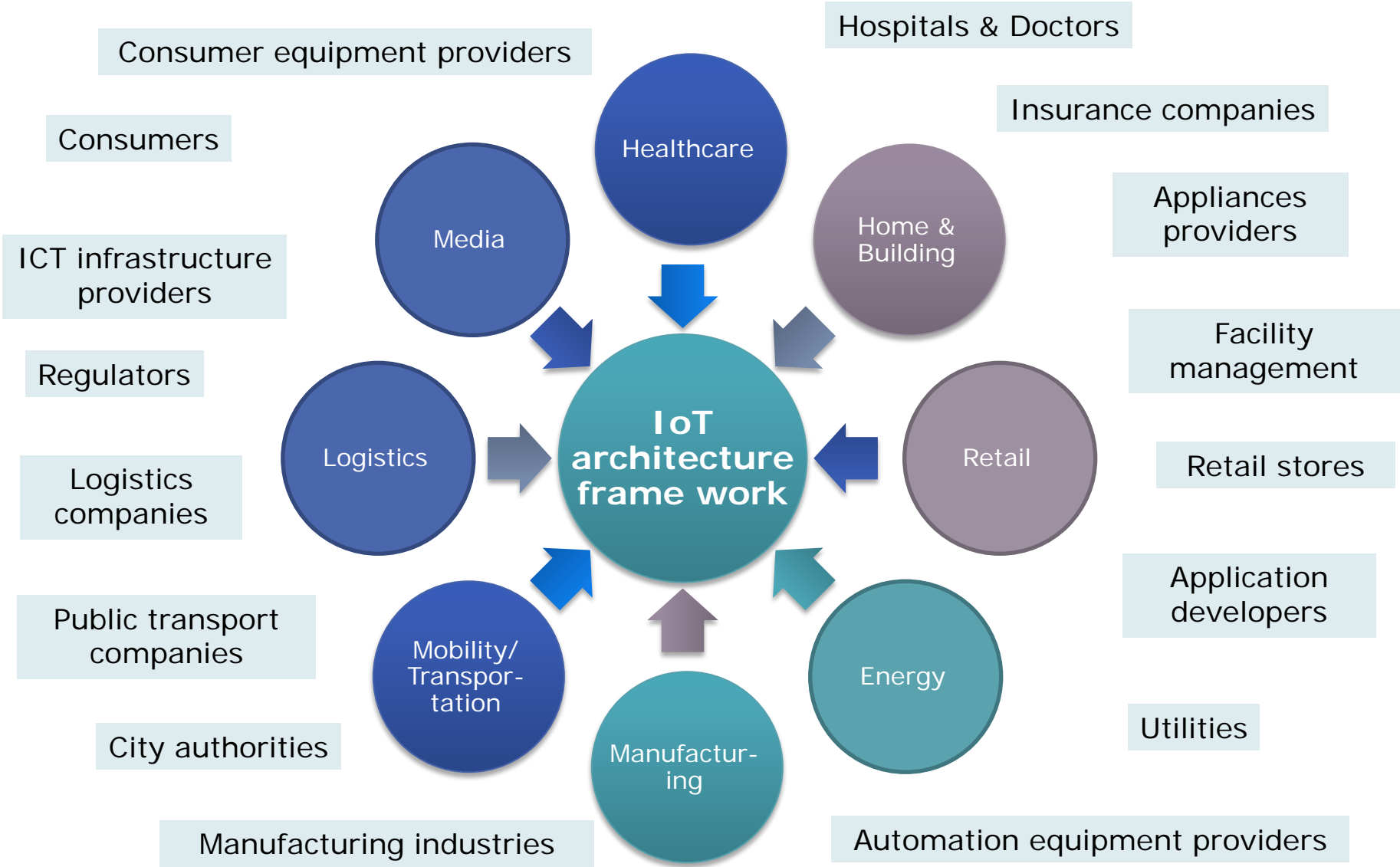
IEEE P2413 Goals

- 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

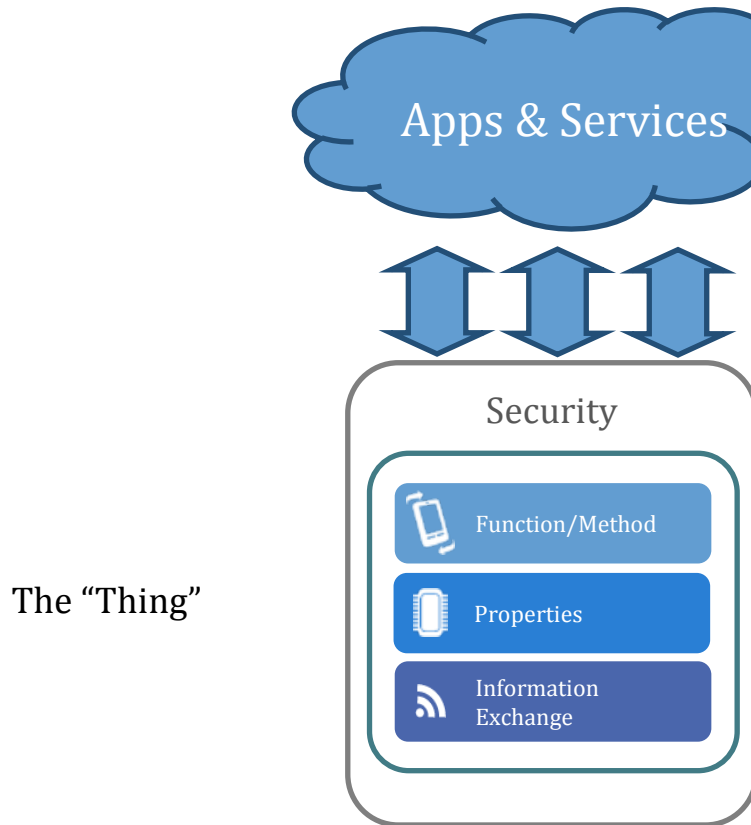
- This standard defines an Architectural Framework for the IoT, including descriptions of various IoT domains, definitions of IoT domain abstractions, and identification of commonalities between different IoT domains.
- The Architectural Framework for IoT provides:
 - reference model that defines relationships 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 Application Domains & Stakeholders*



IEEE P2413 Definitions

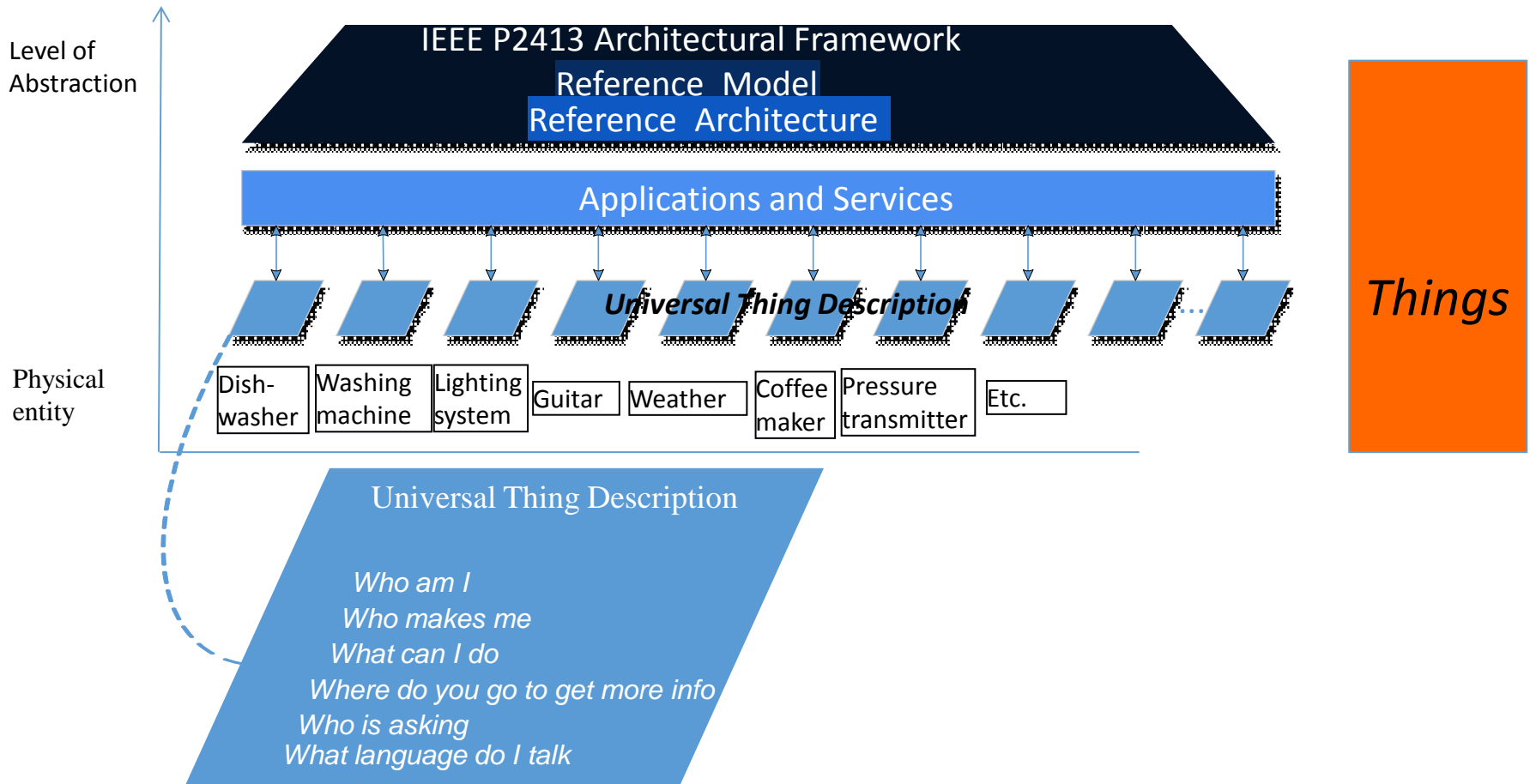
- The Group accepted the definition of the “Thing”:



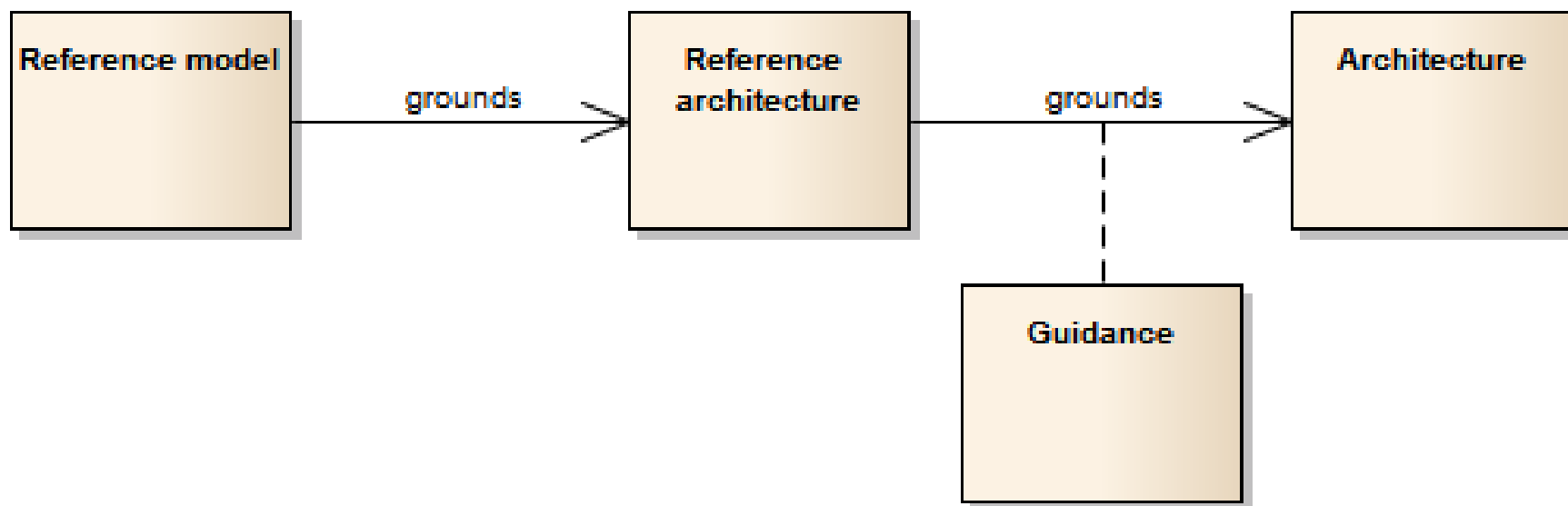
Notes:

- Things, Apps, and Services can be integrated into what would be abstracted as a “Thing”
- Information exchange could be “horizontal” (subscribe/publish as an example) or vertical, or both
- Properties could be real or virtual

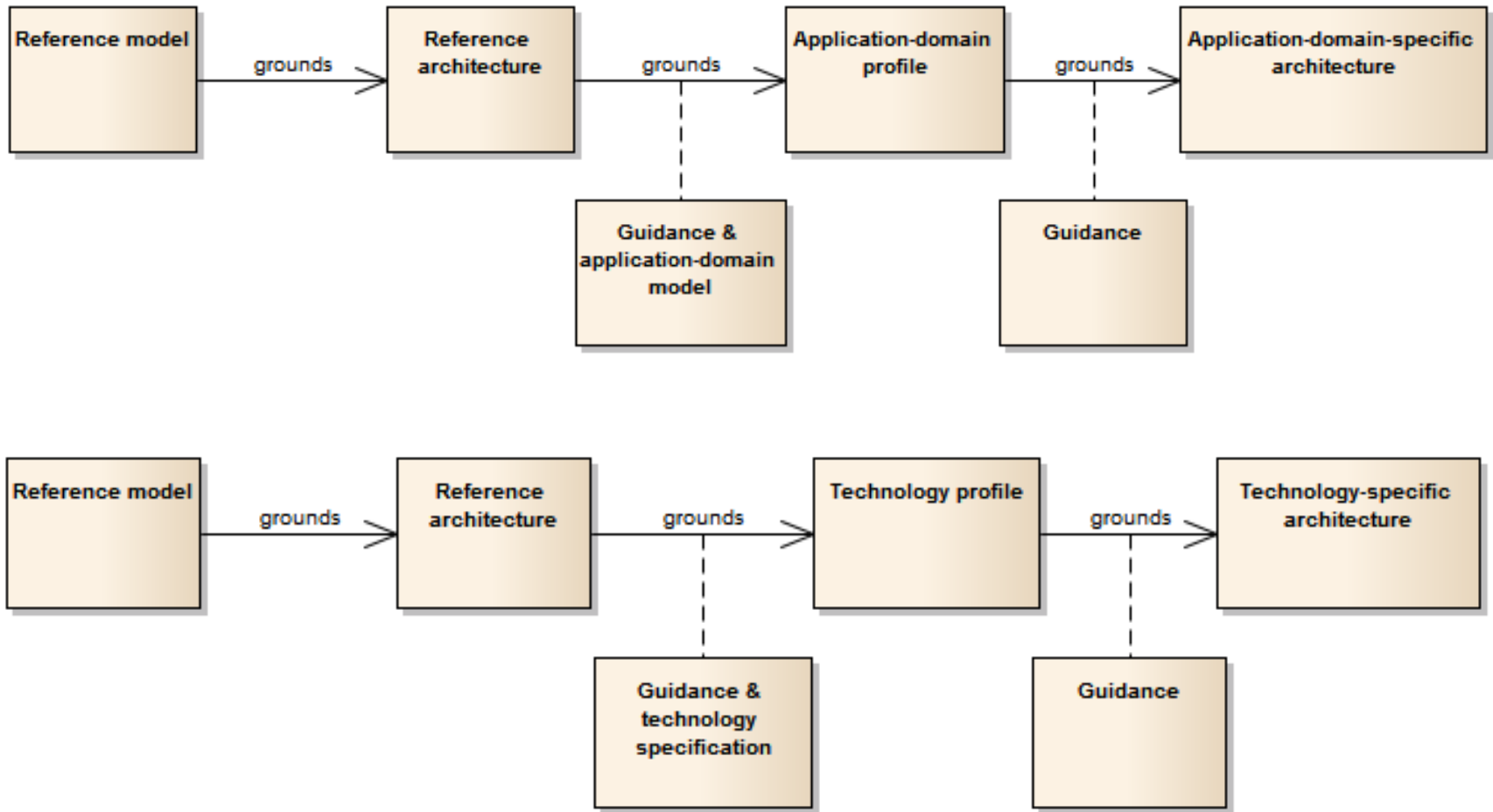
IEEE P2413 Levels of abstractions



IEEE P2413 Structure



IEEE P2413 Potential Profiles



Networking and Communication in P2413

- **Context:** The development of networking and communication technologies is outside of the scope of P2413, but understanding the approaches to the integration of such technologies into the architectural framework and understanding the requirements in this context are the goals.
- Application Aware Communication
 - Identify communications requirements based upon information flow, frequency, allowed latency, required safety, energy efficiency requirements, etc. driven from the application's view
- Network and Channel Aware Communication
 - Identify and advertise network capabilities to provide awareness of available transport options such as message confirmation, scheduled vs. real time delivery, path/media/channel selection, sporadic network connections etc. towards the applications.
- Topologies and Hierarchy

P2413 IoT Compliance SWG Directions

- **Context:** Compliance has many value adding touch points in IoT architecture and reference model. Among others, it ensures Human and Environmental safety, Interoperability between systems, adherence with Quadruple trust and alignment with regulatory and policy guidelines.
- **Features targeted:** Discovery of industry and cross industry compliance requirements, configurability of compliance elements such as, Rules type and Compliance scoring, keep provision for noncompliance prediction for the future.
- **Approach:** Work with standards bodies (e.g., ISO, IEC, IEEE) and regulatory bodies (e.g., EPA, BSEE, FDA), Compliance organization (e.g., ICA, ICPA).
- **Outcome:**
 - Cross industry requirements of compliance
 - Compliance Elements for the P2413 proposed architecture and reference model
 - High level guideline how to enable IoT driven compliance in modern IT systems

P2413 Quadruple Trust SWG

- Quadruple Trust includes : Protection, Security, Privacy and Safety. This is essential and shall be addressed in IoT Architecture Standard.
- Key principle “security in depth”
- The Quadruple Trust SWG will gather and document specific architecture needs and requirements to emphasize on IoT specific topics. Threat Analysis approach for IoT entities and their interactions.
- Key contributions into P2413 IoT architecture
 - Threat model for IoT framework.
 - Quadruple Trust Model for IoT architecture.
 - Assessment and filtering IoT architecture requirements based on the Threat Model

IEEE P2413 Membership

1. Cisco Systems
2. dZhON Pty. Ltd.
3. Emerson
4. EPRI
5. General Electric
6. Hitachi, Ltd.
7. Honeywell International
8. Huawei Technologies
9. Infocomm Development Authority (IDA)
10. Intel
11. Institute for Information Industry (III)
12. Kaspersky Lab
13. NIST
14. Qualcomm Inc.
15. Renesas
16. Rockwell Automation
17. Schneider Electric
18. Senslytics
19. Siemens AG
20. SIGFOX
21. STMicroelectronics
22. Toshiba Corporation
23. Wipro
24. Yokogawa Electric Corporation
25. ZTE

IEEE P2413 Working Group Meetings

- First WG Meeting: 10-11 July 2014, Hosted by Siemens in Munich, Germany
- 2nd WG Meeting: 16-17 September 2014, Hosted by STMicroelectronics in Santa Clara, CA USA
- 3rd WG Meeting: Teleconference, 28 October 2014
- 4th WG Meeting: Teleconference, 17 December 2014
- 5th WG Meeting: 22-23 January 2015 in Taipei, Hosted by Institute for Information Industry (III).
- 6th WG Meeting: 27-28 April 2015 in Grenoble, Hosted by Schneider Electric
- 7th WG Meeting: 27-30 July 2015, Hollywood Beach, Florida USA
- 8th WG Meeting: 3-6 November 2015, Singapore

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.

Thank you!

Join the IEEE P2413 Working Group
<http://grouper.ieee.org/groups/2413/>

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Backup slides