



IEEE 5G Summit Lisbon

Protocols and Standardization Activities for 5G

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Periklis Chatzimisios
CSSN Research Lab,
Alexander TEI of Thessaloniki, Greece



**Department of
Informatics**



Contents

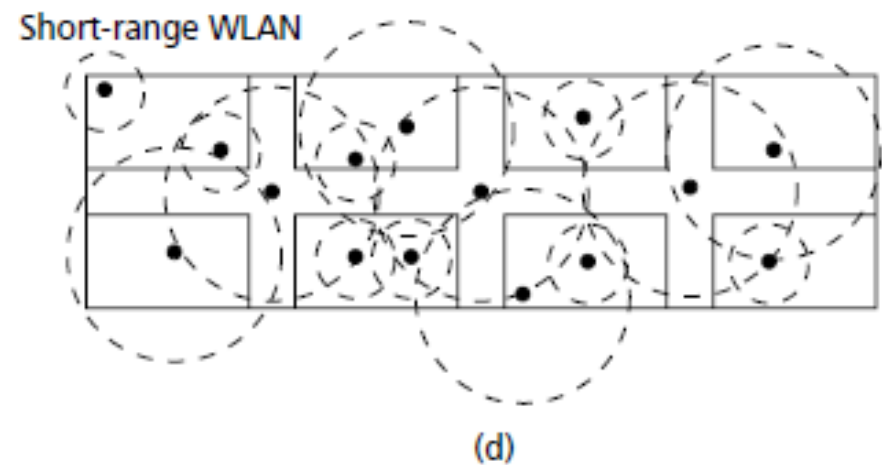
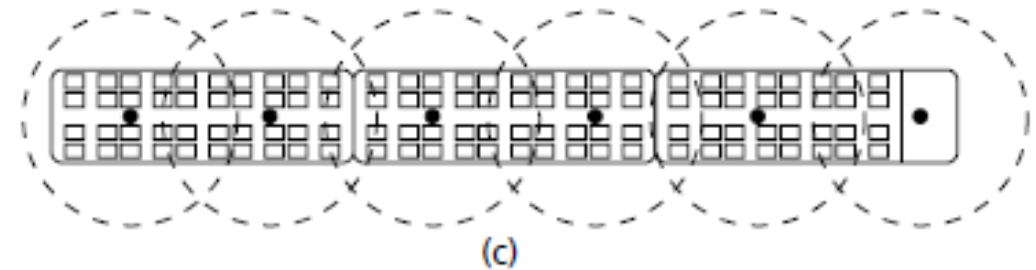
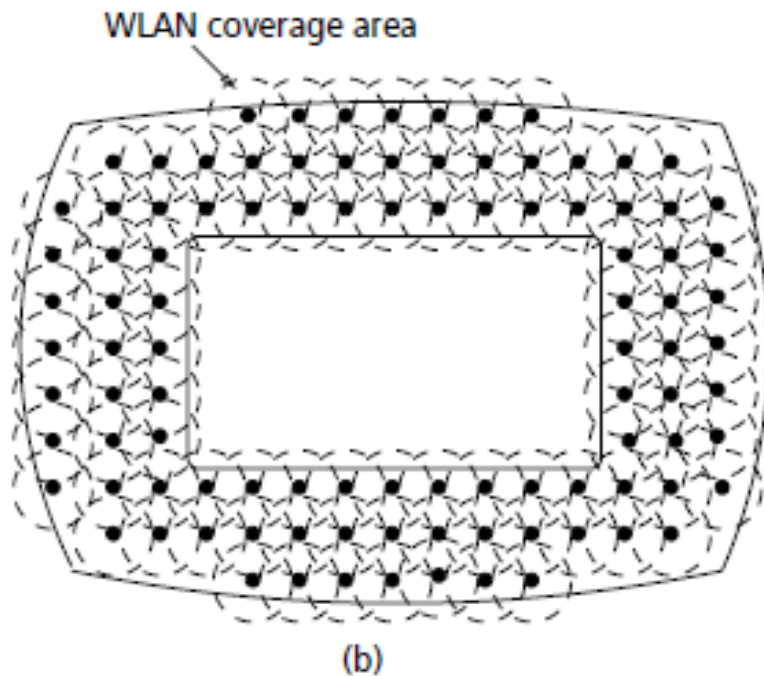
- **IEEE 802.11 towards 5G**
- **On-going Standardization activities**
 - **Tactile Internet & Big Data**
- **Editorial activities**
- **Standards Education**
- **Standardization: An academic perspective**
- **Have you planned where to be in July 2017?**

The current situation

- Scenarios could be residential environments with a large number of connected users (apartment buildings, residential complexes), offices and other gathering places such as stadiums and concert halls.



Very dense networks



- Large number of access points and associated STAs deployed in geographical limited region.



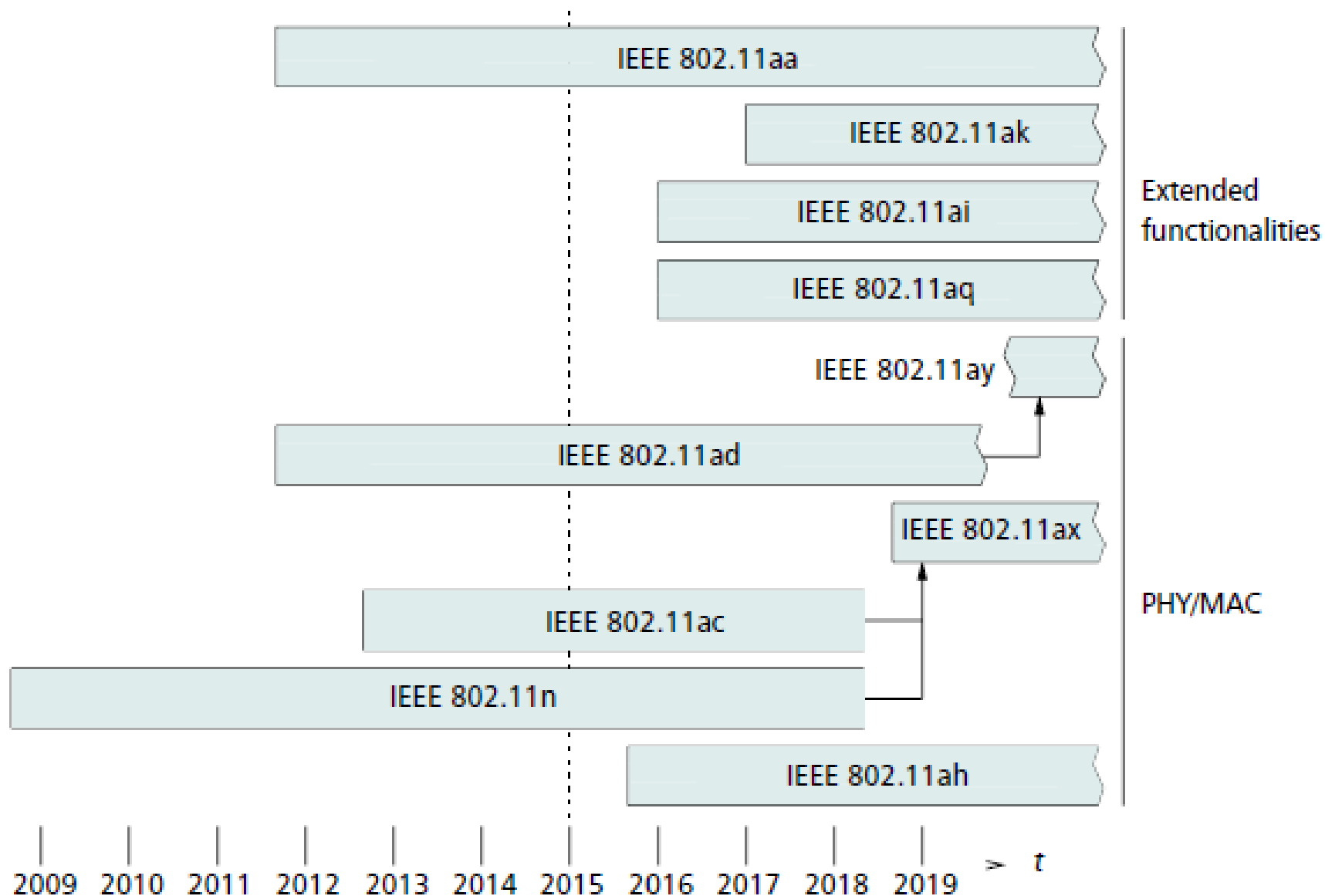
Very dense networks (2)

- Main challenge → a protocol that will maintain the throughput at high levels, allowing for multiple simultaneous transmissions
- A new research Task Group was set up in 2014, the HEWG (High Efficiency Working Group), aiming to create which the IEEE 802.11ax amendment for very dense WLAN environments
- Targets include to reduce conflicts (hidden/exposed nodes) and achieve dynamic use of the spectrum

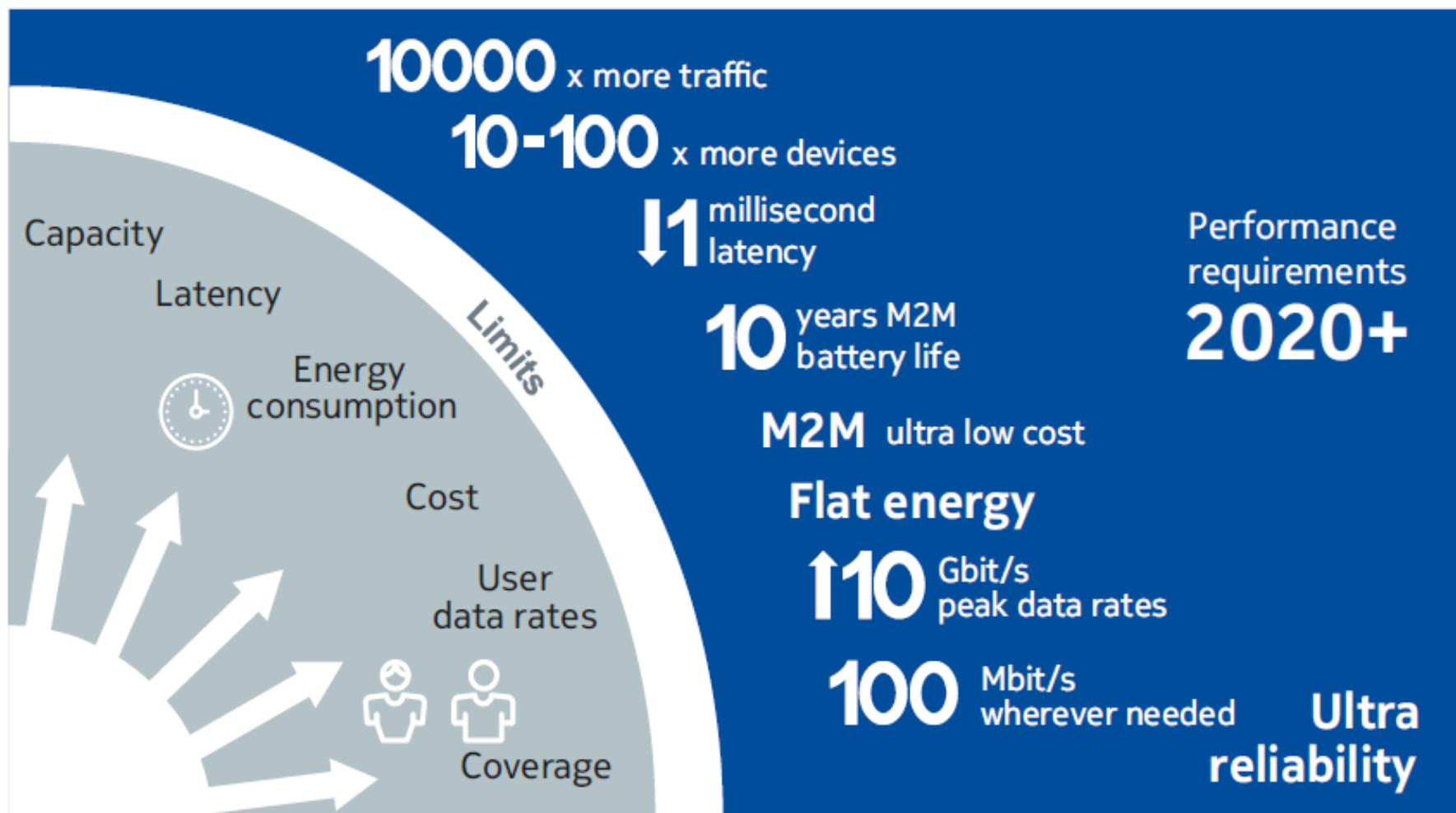


Very dense networks (3)

- A new research Task Group was set up in 2014, the HEWG (High Efficiency Working Group), aiming to create which the **IEEE 802.11ax** amendment for very dense WLAN environments
- Targets to:
 - Targeting at least 4x improvement in the per-STA throughput compared to 802.11n and 802.11ac
 - Improved efficiency through spatial reuse and enhanced power save techniques



5G requirements and IEEE 802.11ax





Requirements / targets of IEEE 802.11ax (1)

- **Throughput:** At least 4x improvement in the per-STA throughput compared to 802.11n and 802.11ac (the system as a whole / each individual node)
- **Latency:** Meet QoS requirements in high dense deployment scenario
- **Spectrum efficiency:** Facilitate increased efficiency through spatial reuse and manage interference between neighboring Overlapping BSS (OBSS) which operate on the ISM bands



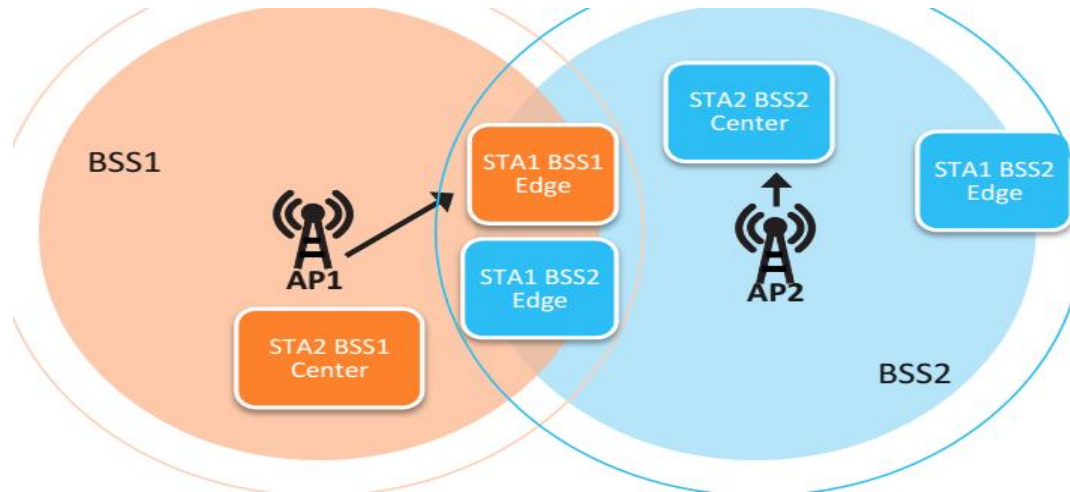
Requirements / targets of IEEE 802.11ax (2)

- **Efficient use of resources:** Minimizing the exchange of management and control packets, revisiting the structure of the packets, improving channel access and retransmission mechanisms
- **Energy efficiency:** Enhanced power save techniques (most devices will be mobile)
- **Backwards compatibility:** Coexistence with legacy devices such that run IEEE 802.11ac/n/g/b/a



Proposed solutions

- **Efficient Retransmissions**
- **Dynamic Adaptation of the Transmit Power and CCA Levels** (working on this!)
- **Dynamic Channel Bonding**
- **Massive MIMO**



AP



BSS center



BSS edge

Group 1: center

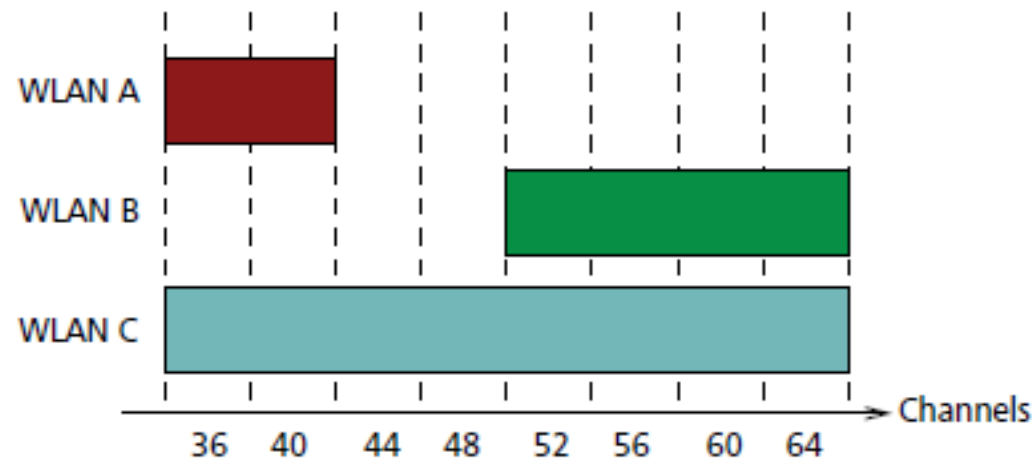
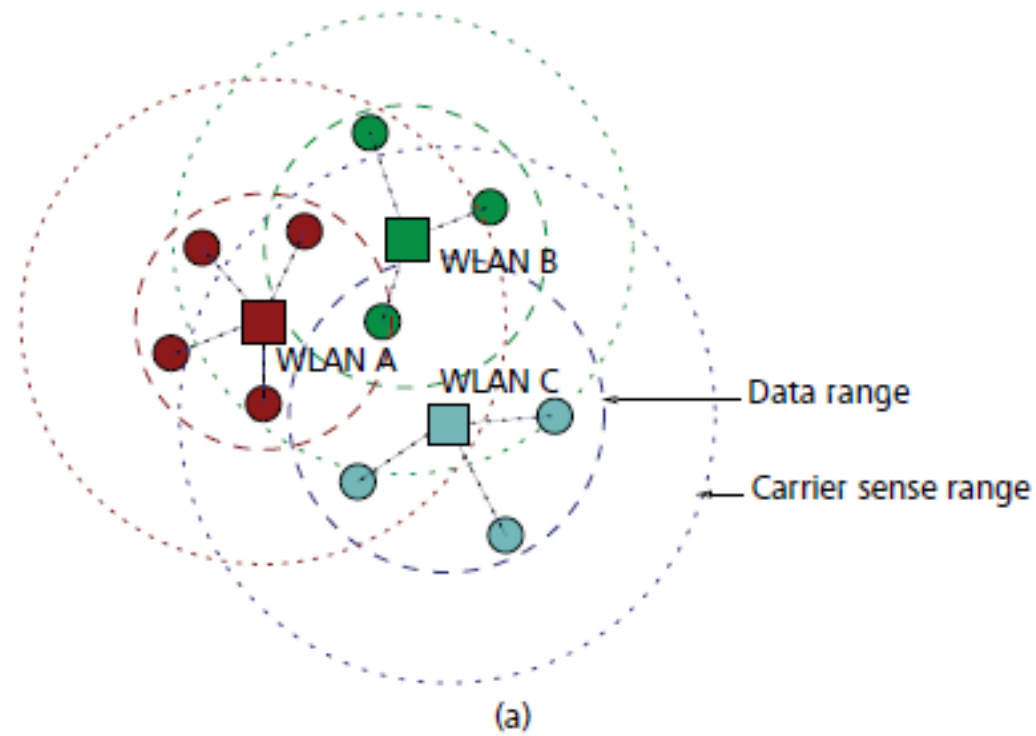
Group 2: edge

Group 3: edge

Timeslot	10	11	12	13	14	15	16	17	18	19	110	111	112
Group 1	10	11	12	13	14	15	16	17	18	19	110	111	112
Group 2	10		12		14		16		18		110		112
Group 3		11		13		15		17		19		111	

Full Orthogonality

Coordination of grouping STAs



On-going Standardization activities: Tactile Internet

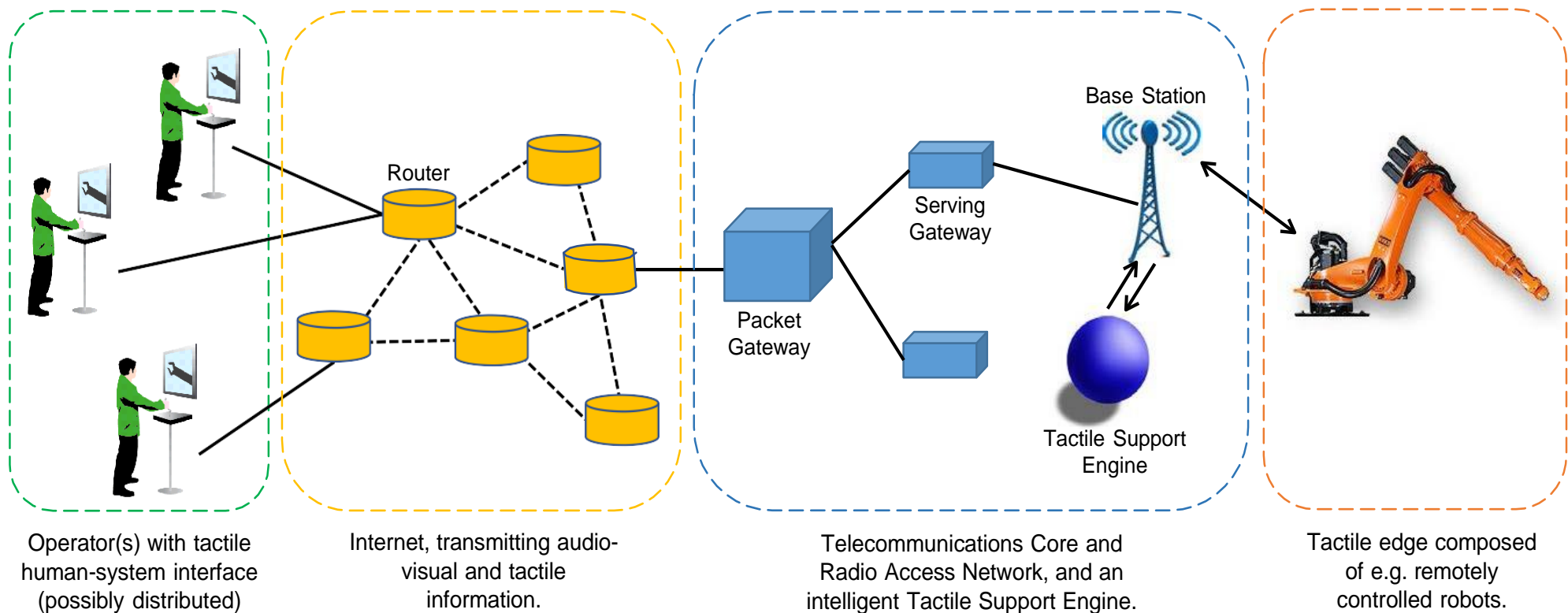


Tactile Internet (2)

- Enabling technology for the remote control of virtual and real objects—in real-time and from any location—involving the conveyance of touch-related information over the Internet
- Visionary usage scenarios
- Challenging technical characteristics (e.g., ultra-low latency, ultra-high reliability)



Tactile Internet (3)



Source: Mischa Dohler, Keyonte in NGMAST 2015



Tactile Internet standardization

- **IEEE 1918.1 Working Group**

<http://grouper.ieee.org/groups/1918/1/public.html>

Kick-off meeting: May 27-28, 2016 (IEEE ICC 2016, in KL)

Online Meetings

- **IEEE Tactile Internet Emerging Technologies Subcommittee**

<http://ti.committees.comsoc.org/>

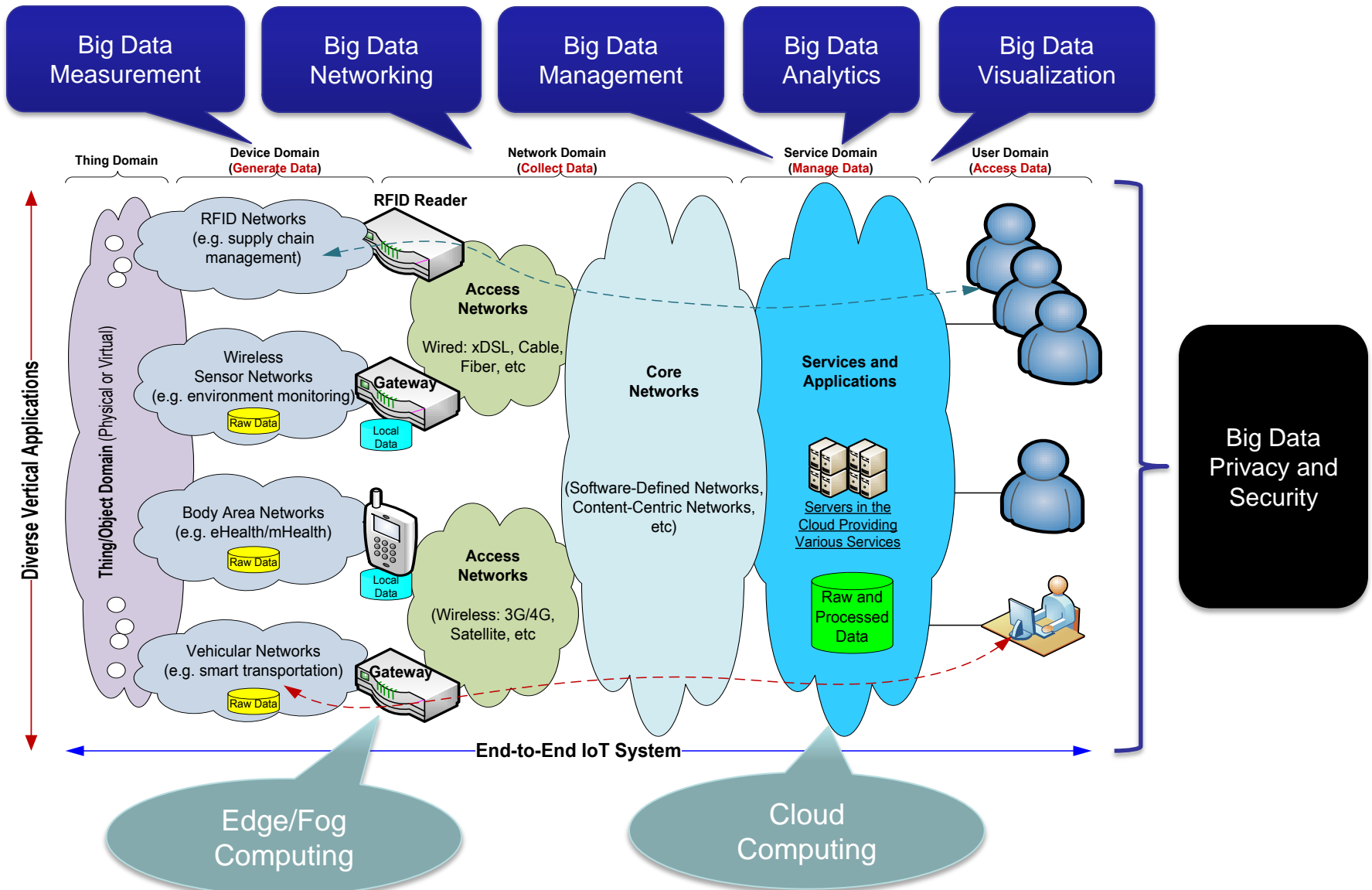


IEEE Big Data Initiative (BDI)

- BDI through the Big Data Standards Committee (BDSC) is working for defining BD standards
 - **WG0** – Definitions & Standards Workshop Organizing Committee
 - **WG1** – Use Cases and Requirements
 - **WG2** – Architecture
 - **WG3** – Infrastructure
 - **WG4** – Networking
 - **WG5** – Management
 - **WG6** – Analytics
 - **WG7** – Security and Privacy (Medical focus first?)
 - **WG8** – Sensors and other Devices



Big Data standardization





Useful links

- ▶ IEEE Big Data Initiative (BDI)
<http://bigdata.ieee.org>
- ▶ IEEE IoT and SDN initiatives
<http://iot.ieee.org>
<http://sdn.ieee.org>
- ▶ IEEE Emerging Technical Subcommittee on Big Data (TSCBD)
http://cms.comsoc.org/eprise/main/SiteGen/TC_BDPAN/Content/Home.html
- ▶ IEEE Standards Association
<http://theinstitute.ieee.org/benefits/standards/standards-that-support-big-data>



Editorial activities

- IEEE Communication Magazine

Feature Topic on “5G Radio Access Network Architecture and Technologies” (published Nov. 2016)

Special Issue on “Education and Training: Telecommunication Standards Education” (deadline: December 2016)

Special Issue on “Education & Training: Scholarship of Teaching and Supervision” (deadline: May 2017)



IEEE Communication Standards Magazine Standards-related Feature Topics*

Proposed Topics (more topics are welcome):

- **Topic:** Standardization activities on Tactile Internet
- **Topic:** Communication Standards for Smart Cities
- **Topic:** QoS and QoE standardization activities
- **Topic:** Cloud Standardization activities
- **Topic:** Standards for Big Data Networking/
Communications



IEEE Communication Standards Magazine Standards-related Feature Topics*

Proposed Topics (more topics are welcome):

- **Topic:** Standardization activities on 5G
- **Topic:** Standardization activities and Advances on IEEE 802.11 protocols
- **Topic:** MAC Protocols for Wireless Communications
- **Topic:** Low-power Wireless Standards
- **Topic:** Standards for Software Defined Internet of Things



Standards Education

- IEEE ComSoc Educational Services Board in cooperation with the IEEE ComSoc Communications Standardization Programs Development Board will offer:
 - Technical Sessions/Track on Education & Training at ICC/GLOBECOM that could include Tutorials on specific standards and more generic/introductory on topics like **“Why do we need Standards”** and **“What is the standardization process”**
- Integration of Standards Education into Academic Curricula



IEEE Standards Education e-Magazine (e-Zine)

<http://www.standardsuniversity.org/e-magazine>

The screenshot shows the top portion of the IEEE Standards University website. At the top left is the IEEE logo with the text "IEEE STANDARDS UNIVERSITY" and the tagline "Innovation · Compatibility · Success". To the right is a search icon and another IEEE logo. Below this is a navigation bar with links for "Courses", "Game", "Videos", "E-Magazine", "Workshops", "Library", and "Grants". There are also two yellow buttons labeled "NEWS" and "FIND A STANDARD". The main content area features a large image of a man in a white shirt and dark pants rappelling down a rope against a cityscape background. Overlaid on the image is the text "November 2016 | Volume 6, Issue 4 | Smart City Standards |" and the main title "Making Sense of the Smart City Standardization Landscape".

IEEE
STANDARDS UNIVERSITY Innovation · Compatibility · Success

Q IEEE

Courses Game Videos **E-Magazine** Workshops Library Grants

NEWS FIND A STANDARD

November 2016 | Volume 6, Issue 4 | Smart City Standards |

Making Sense of the Smart City Standardization Landscape



IEEE Standards Education eZine: Call for contributions

Themes for 2017 are:

- **1st Quarter:** Ethics
- **2nd Quarter:** Standards in Consumer Electronic Devices
- **3rd Quarter:** Compliance and Certification
- **4th Quarter:** Green ICT

Articles should be no more than 2,000 words



Standardization: An academic perspective

Standardization and academia: Do they go together?

Current situation:

- **Involvement:** Not many academics participate in standardization activities and groups
- **Cooperate with industry:** YES, partially
- **Funding:** Uncertain or not all
- **Greece:** The Hellenic Body for Standardization (ELOT) (many of us don't know its existence!)



Proposals (just some first thoughts)

- **Involvement:** Involve both well-established and young researchers/academics
- **Cooperate with industry:** Industry and academia should really come together and benefit from each other!
- **Funding:** Provide traveling support to academics (IEEE) + fund PhD/Postdocs to work with standards
- **Awards:** Recognition of **(a)** good practice, ideas and collaboration between industry-academia on standardization **(b)** best practice of incorporating standards into the classroom and curricula (standards education program!)



(5G) Standardization

An Excellent Career Path for Engineers

The best career you never heard of



Question:

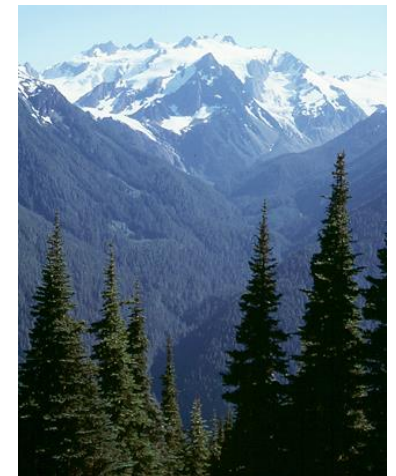
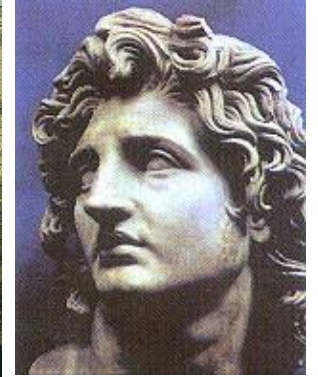
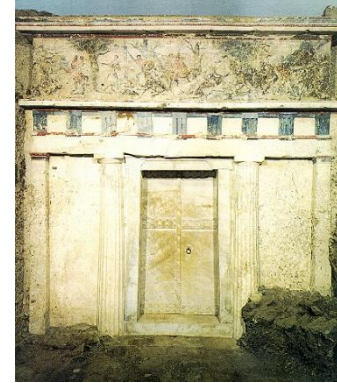
Have you planned where to be in July 2017?

Let's look at an excellent proposal!



IEEE 5G Summit
July 10, 2017
Thessaloniki, Greece

<http://www.5gsummit.org/greece>



Thank you for your attention !

Discussion !

