



The 5G Mobile and Wireless Communications system

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ETSI Future Mobile Summit
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Content

- » Introduction & about METIS
- » 5G scenarios (Selected)
- » Examples of 5G Technology Components




Introduction: Major 5G Activities

- » METIS  (Nov. 2012)
 - » The first stage of the 5G EU “missile”
- » China -  (5G) Promotion group” (Feb. 2013)
 - » Program 863
- » Korea -  (June 2013)
 - » Ambitious plan
- » Japan - 2020 and Beyond AdHoc (Oct. 2013)
 - » ARIB established new AdHoc working group called “2020 and Beyond AdHoc”



Introduction: ITU-R

- » Two documents by  International Telecommunication Union to pave the way for 5G
- » IMT.VISION (Deadline July 2015)
 - » Title: “Framework and overall objectives of the future development of IMT for 2020 and beyond”
 - » Objective: Defining the framework and overall objectives of IMT for 2020 and beyond to drive the future developments for IMT
- » IMT.FUTURE TECHNOLOGY TRENDS (Deadline Oct. 2014)
 - » To provide a view of future IMT technology aspects 2015-2020 and beyond and to provide information on trends of future IMT technology aspects



METIS Objectives

- ❑ **Lay** the foundation for
- ❑ **Ensure** a global forum for
- ❑ **Build** an early global consensus for

⇒ **5G** mobile & wireless communications



**Exploratory
research**

**Pre-
standardization
activities**

**Standardization
activities**

**Commercializa-
tion**

2012

2013

2014

2015

2016

2017

2018

2019

2020



WRC'12

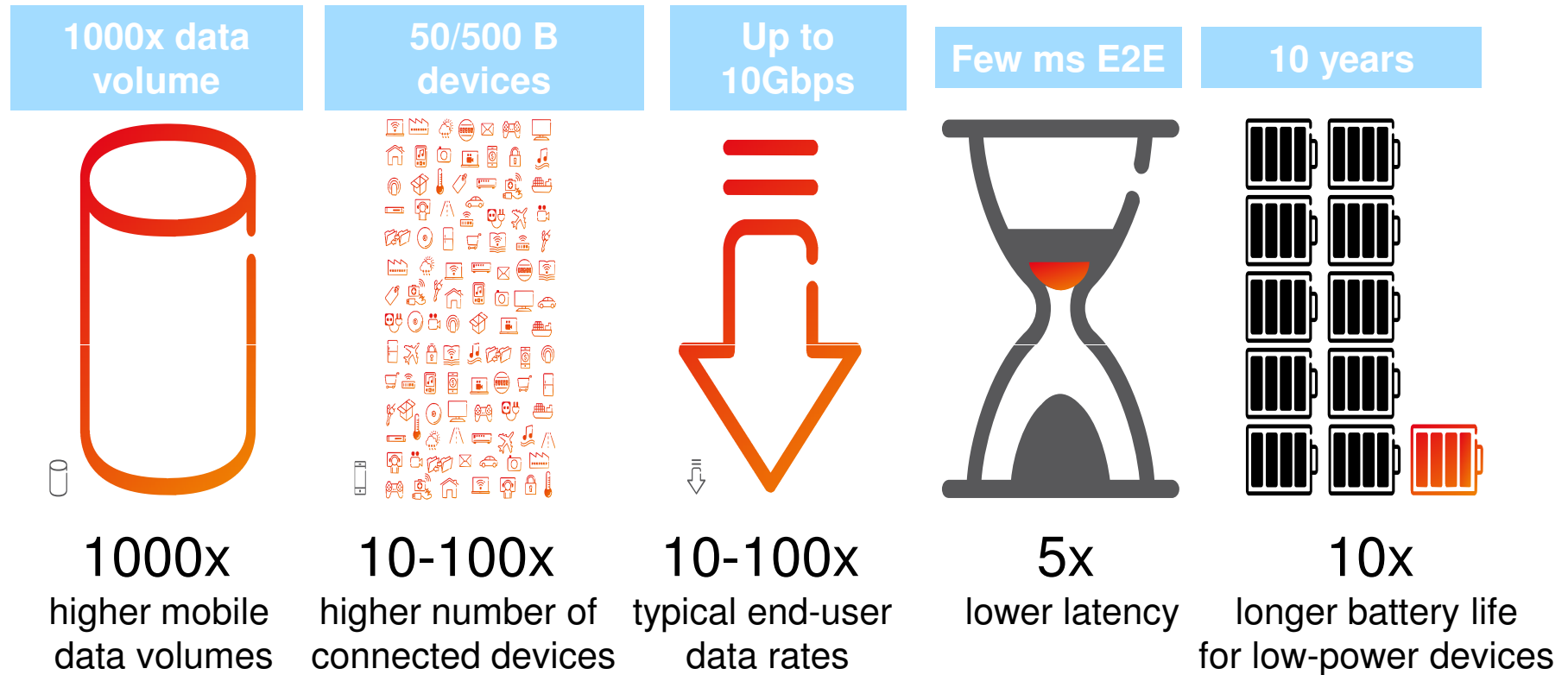
WRC'15

WRC'18/19

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METIS Technical Objectives



METIS 5G Scenarios

Amazingly fast

Great Service in a crowd

Best experience follows you

Super real-time and reliable connections

Ubiquitous things communicating

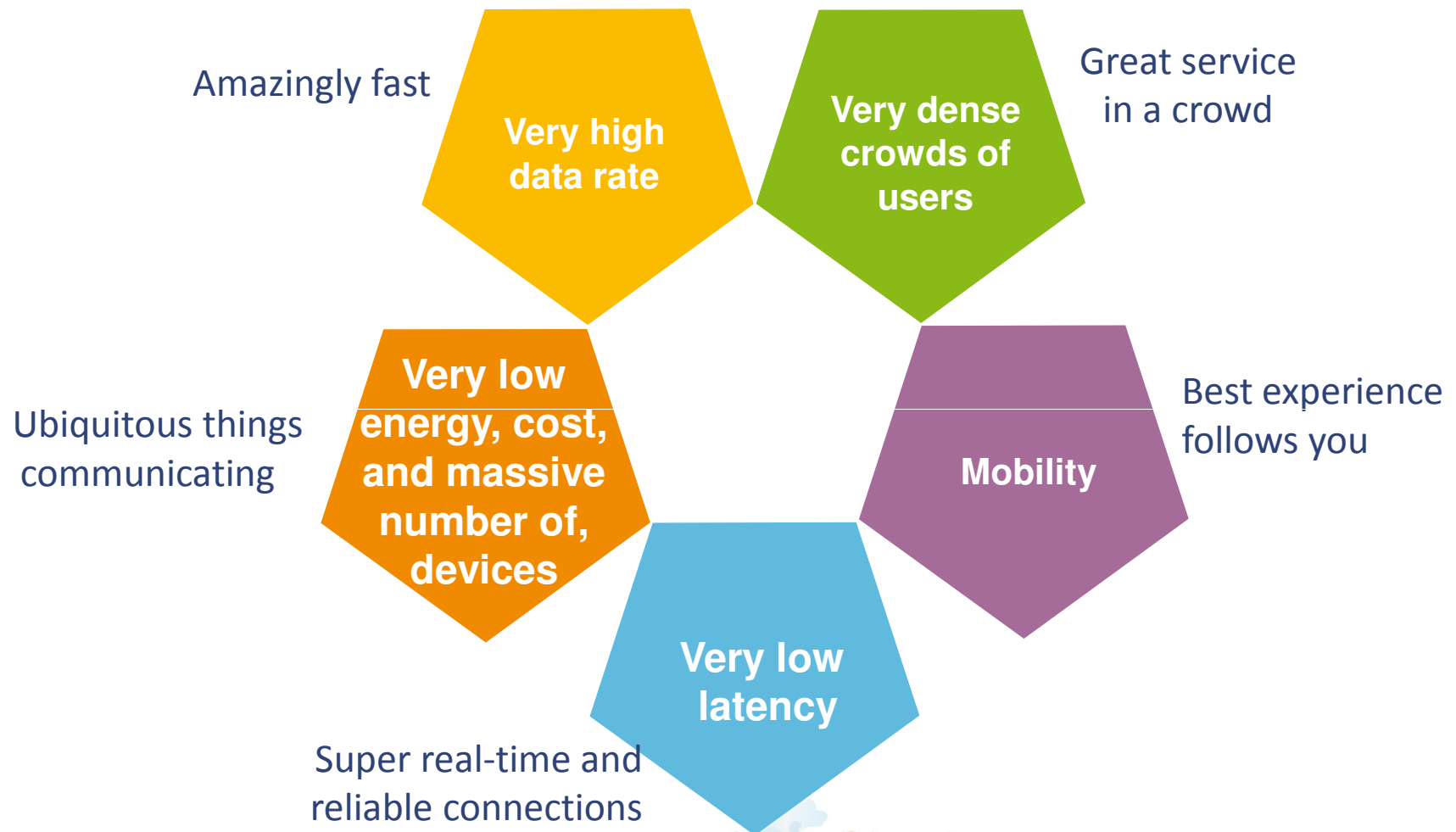


Selected METIS 5G Scenarios

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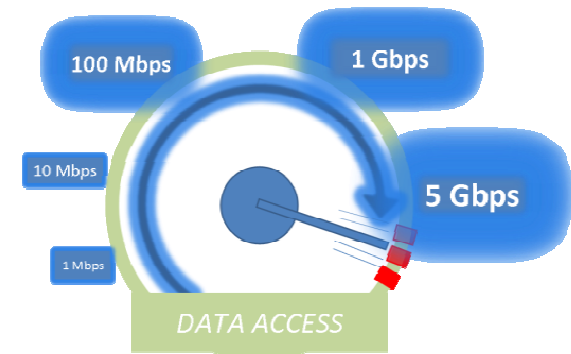


Five Challenges & Scenarios



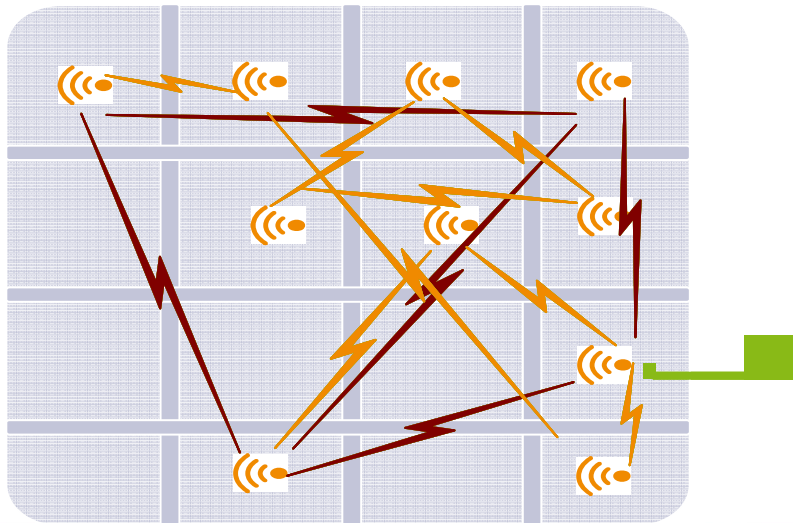
Scenario: *Amazingly fast*

- » Work and infotainment unhindered by delays
- » Amazing end-user experience provided by very high data-rates



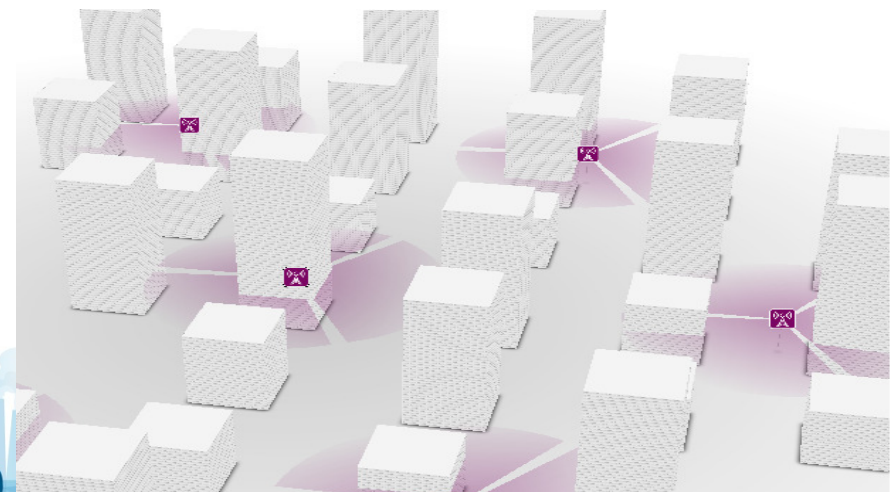
Virtual reality office

Giga bit at application layer



Dense urban information society

- Ubiquitous dense urban coverage
- Large and dynamic user crowds



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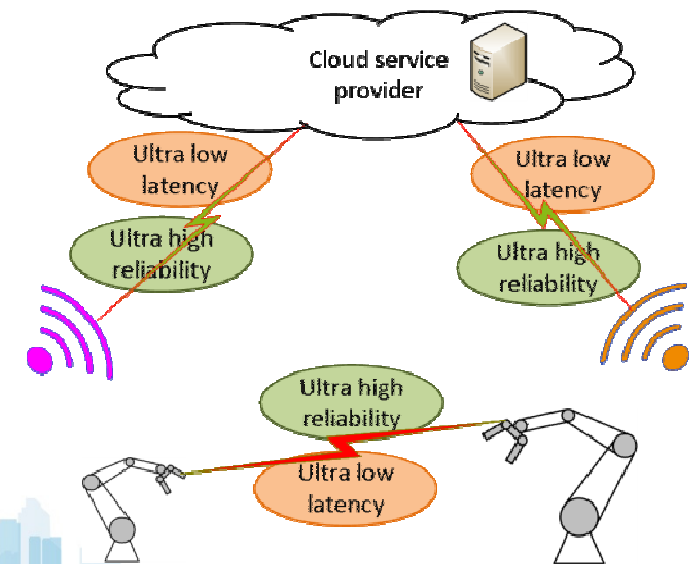
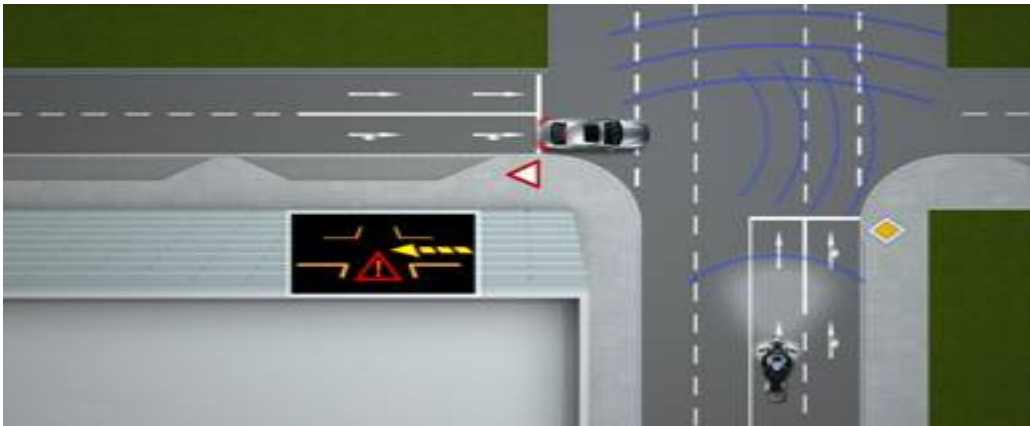
Scenario:

Super real-time and reliable connections

- » Low E2E latency delay and reliable communication enabling critical machine-type applications
- » Empowering industries to embrace new technologies in their processes

Traffic efficiency and safety

- More efficient use of road infrastructure
- Reduce risk for traffic incidents

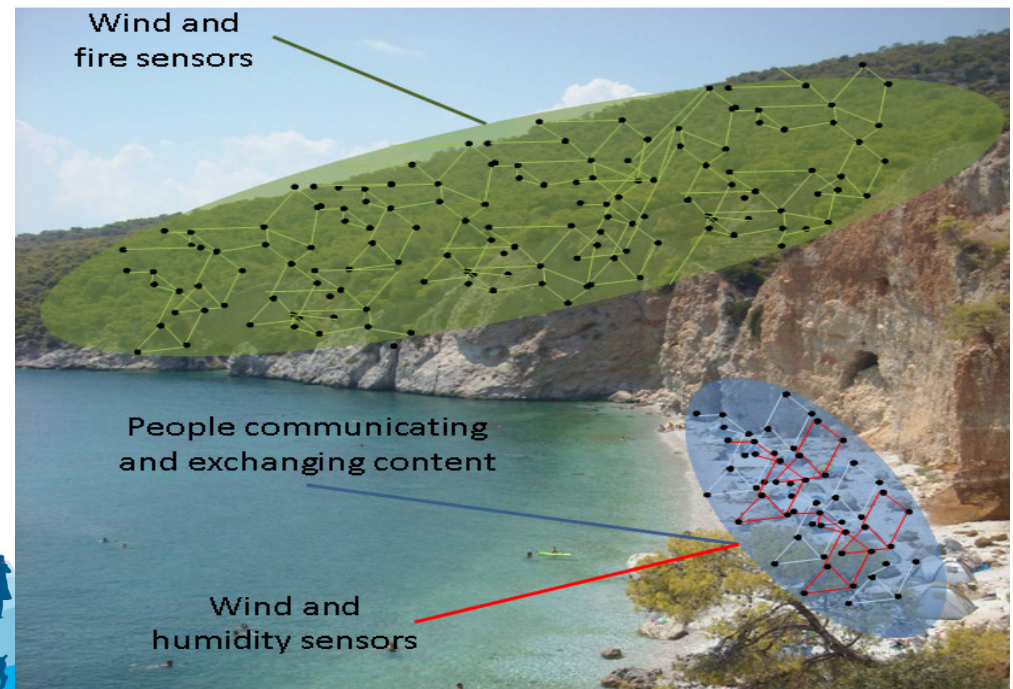


Scenario: *Ubiquitous things communicating*

- » Very large number of small, simple, and inexpensive devices
- » Requirement for long battery lifetime, scalability, and adaptability
 - » Inexpensive = small battery, simple device

Massive deployment of sensors and actuators

- Handle a massive number of devices
- Very low cost devices with long battery lifetime
- Provide protocol scalability and coverage



ROAD TO 5G Technology Components

Examples

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Massive MIMO: CSI Error

Example of contribution:

30 Gbps simulation using 11 GHz band
measured 24x24 MIMO channel

Transmission scheme	24x24 MIMO-OFDM eigenmode
Signal bandwidth	400 MHz
Subcarrier spacing	195 kHz
Maximum bit rate	35.3 Gbps (64QAM, 3/4)

Investigation points:

- › Performance analysis of massive MIMO in higher frequency bands
- › Impact of CSI error and hardware impairments

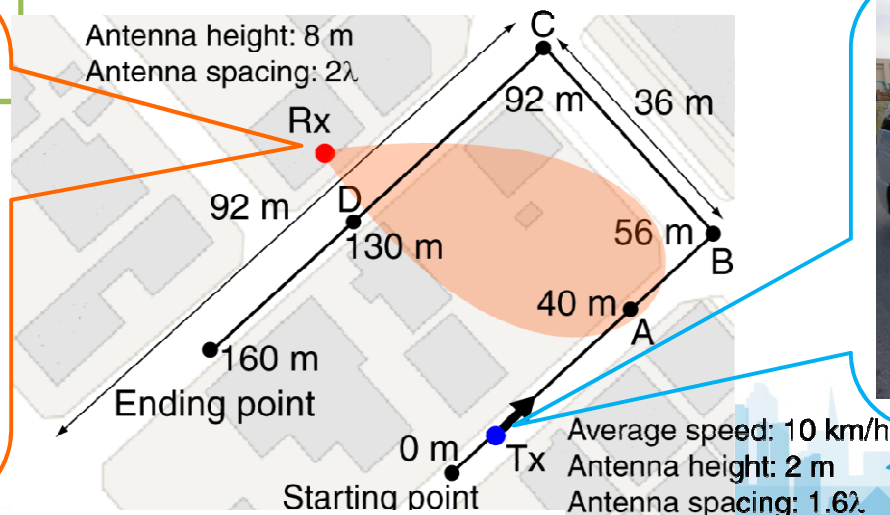
Measurement Environment/Data

12-element array with
dual polarization

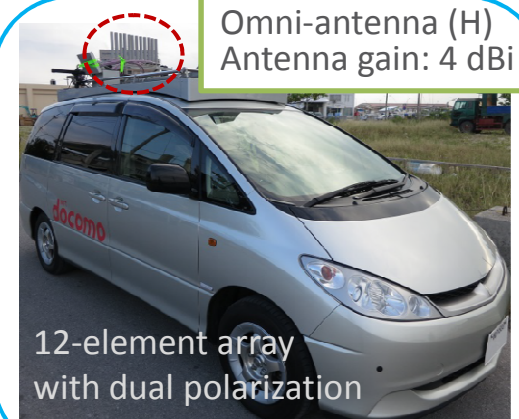


Sector antenna
3 dB beamwidth.
Antenna gain: 15 dBi

Antenna height: 8 m
Antenna spacing: 2λ



Omni-antenna (H)
Antenna gain: 4 dBi



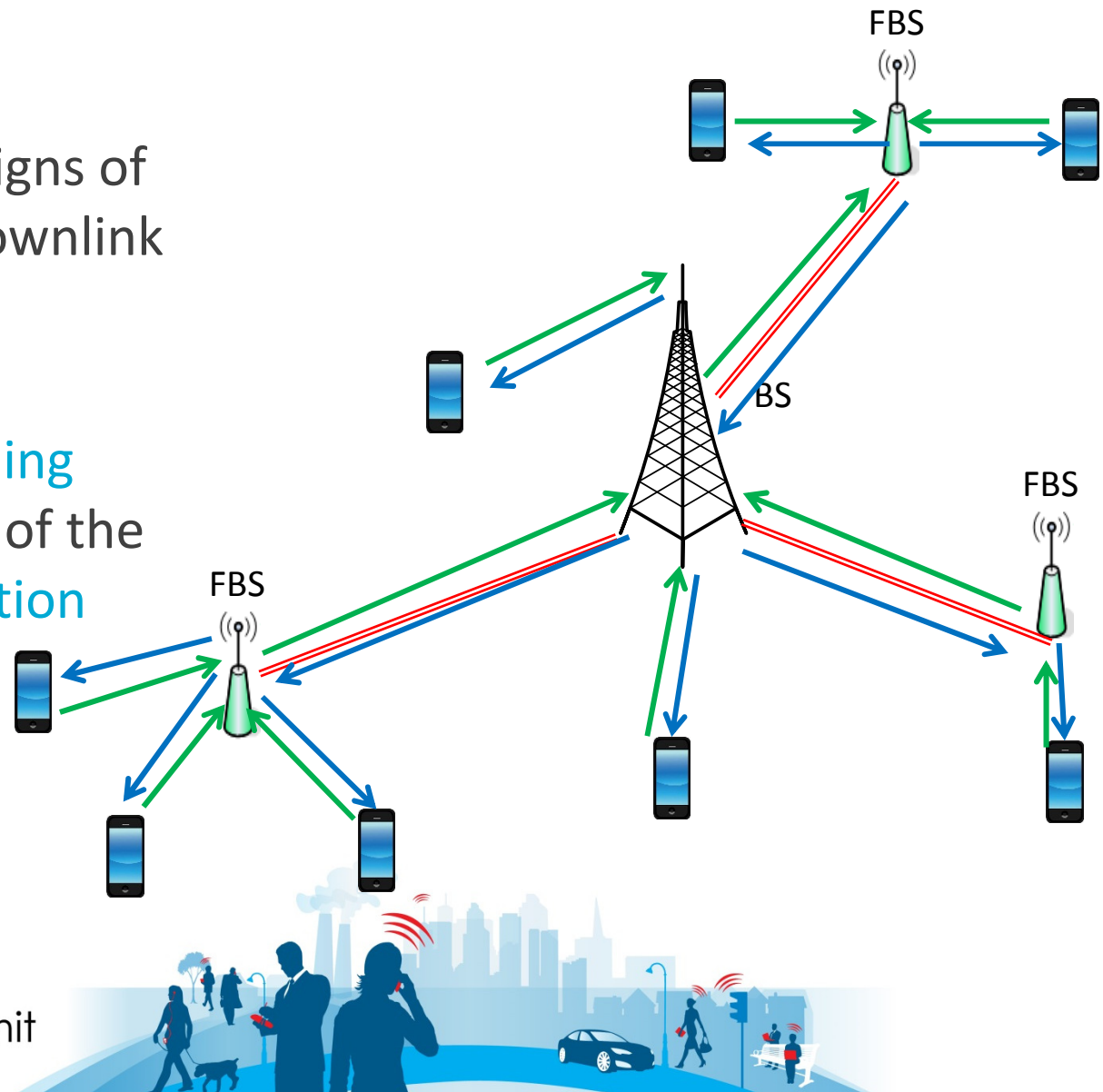
12-element array
with dual polarization

Average speed: 10 km/h
Antenna height: 2 m
Antenna spacing: 1.6λ

* This channel measurement was conducted in Ishigaki City
in partnership with Tokyo Inst. of Tech. in Japanese national project

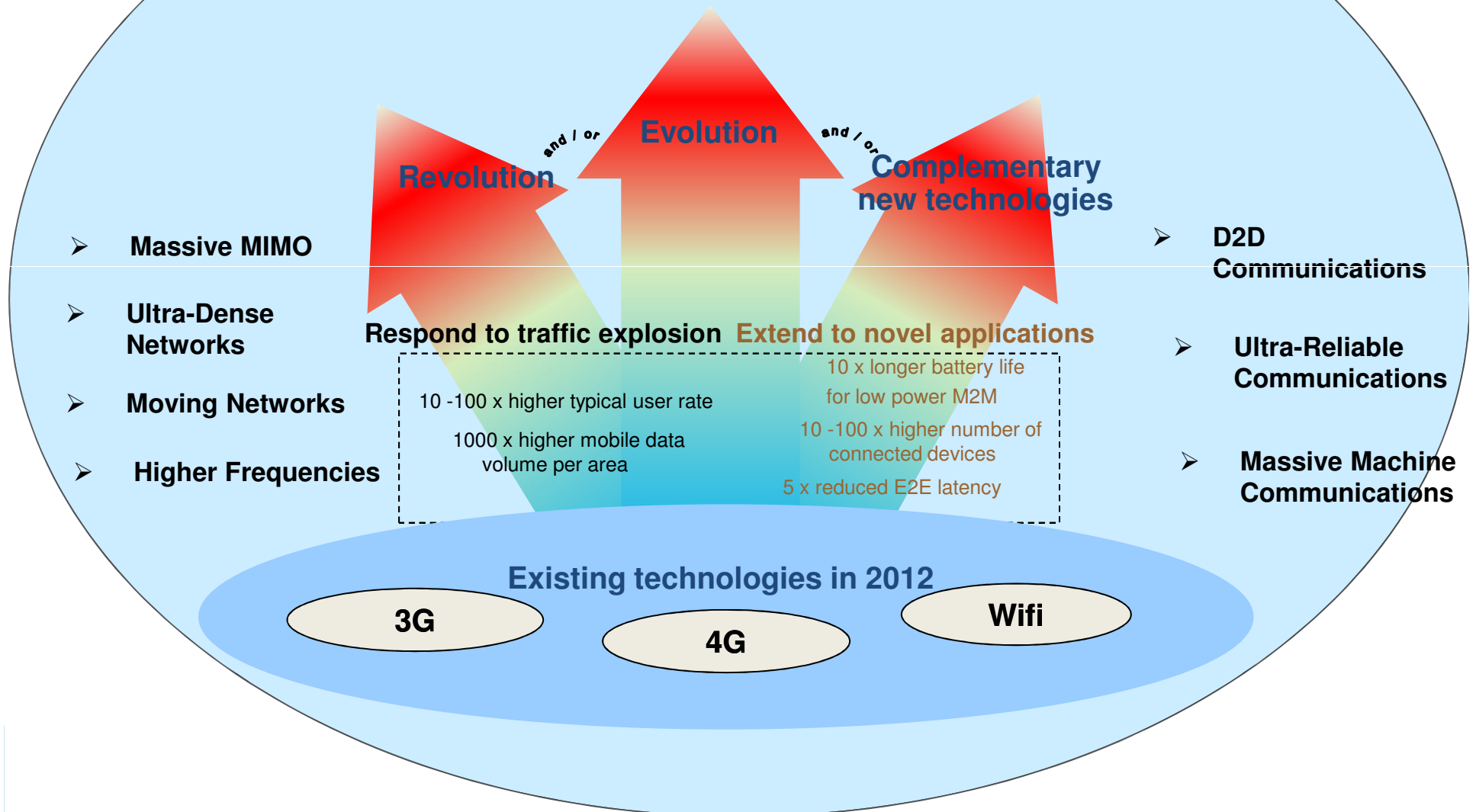
Beyond Uplink & Downlink: two-way comm.

- » Traditionally, the designs of the uplink and the downlink are decoupled
- » The ideas related to **wireless network coding** suggest optimization of the **two-way communication** problem instead of decoupling



5G Future

Integration
of access technologies
into one seamless experience



Useful Links

- » A. Osseiran et al, The foundation of the Mobile and Wireless Communications System for 2020 and beyond Challenges, Enablers and Technology Solutions, VTC Spring 2013, June 2-5, 2013, <https://www.metis2020.com/documents/publications/>
- » **Deliverable D1.1**, “Scenarios, requirements and KPIs for 5G mobile and wireless system”, June 2013
- » **Deliverable D2.1**, “Requirements and general design principles for new air interface”, Sept. 2013
- » **Deliverable D3.1**, “Positioning of multi-node/multi-antenna transmission technologies”, Aug. 2013
- » **Deliverable D5.1**, “Intermediate description of the spectrum needs and usage principles”, Sep. 2013,
- » **Deliverable D4.1**, “Summary on preliminary trade-off investigations and first set of potential network-level solutions”, Nov. 2013
- » **Deliverable D6.1**, “Simulation guidelines”, Nov. 2013

All deliverables can be downloaded from
<https://www.metis2020.com/documents/deliverables/>

