

20ème Journée Interactions Ondes-Personnes
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The 5G Mobile and Wireless Communications system

Dr. Afif Osseiran, Ericsson
METIS Project Coordinator



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- › Introduction
- › 5G Challenges & Scenarios
- › Selected 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 003
- › Korea -  (June 2013)
 - Ambitious plan
- › Japan - 2020 and Beyond AdHoc (Oct. 2013)
 - ARIB established new AdHoc working group called “2020 and Beyond AdHoc”



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

Commercialization

2012

2013

2014

2015

2016

2017

2018

2019

2020



WRC'12

WRC'15

WRC'18/19





Challenges & Scenarios

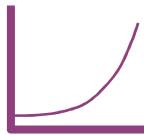
Challenges



Avalanche of Traffic Volume

Further expansion of mobile broadband

Additional traffic due to communicating machines



“1000x in ten years”

Massive growth in Connected Devices “Communicating machines”



“50 billion devices in 2020”

Large diversity of Use cases & Requirements

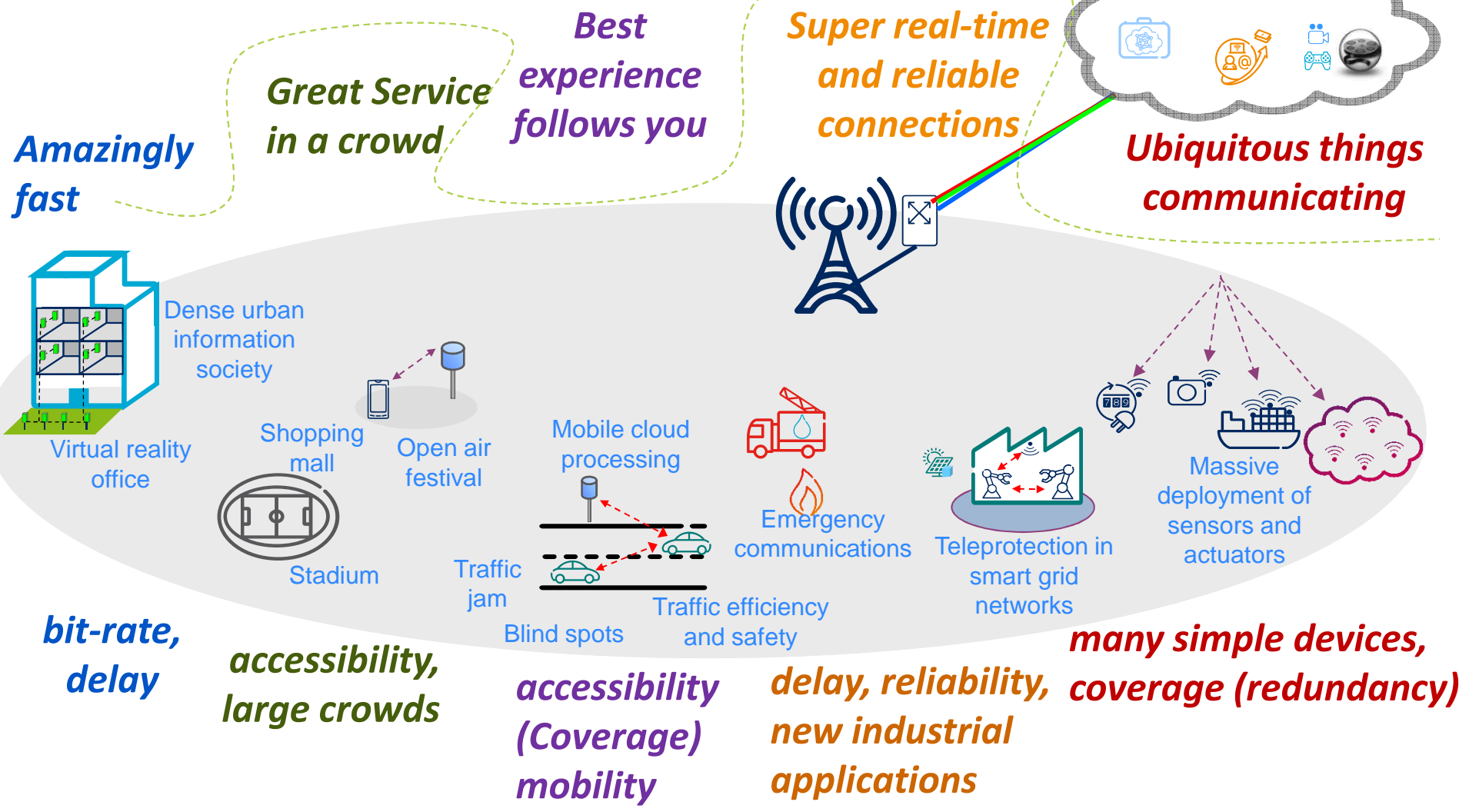
Device-to-Device Communications

Car-to-Car Comm.

New requirements and characteristics due to communicating machines

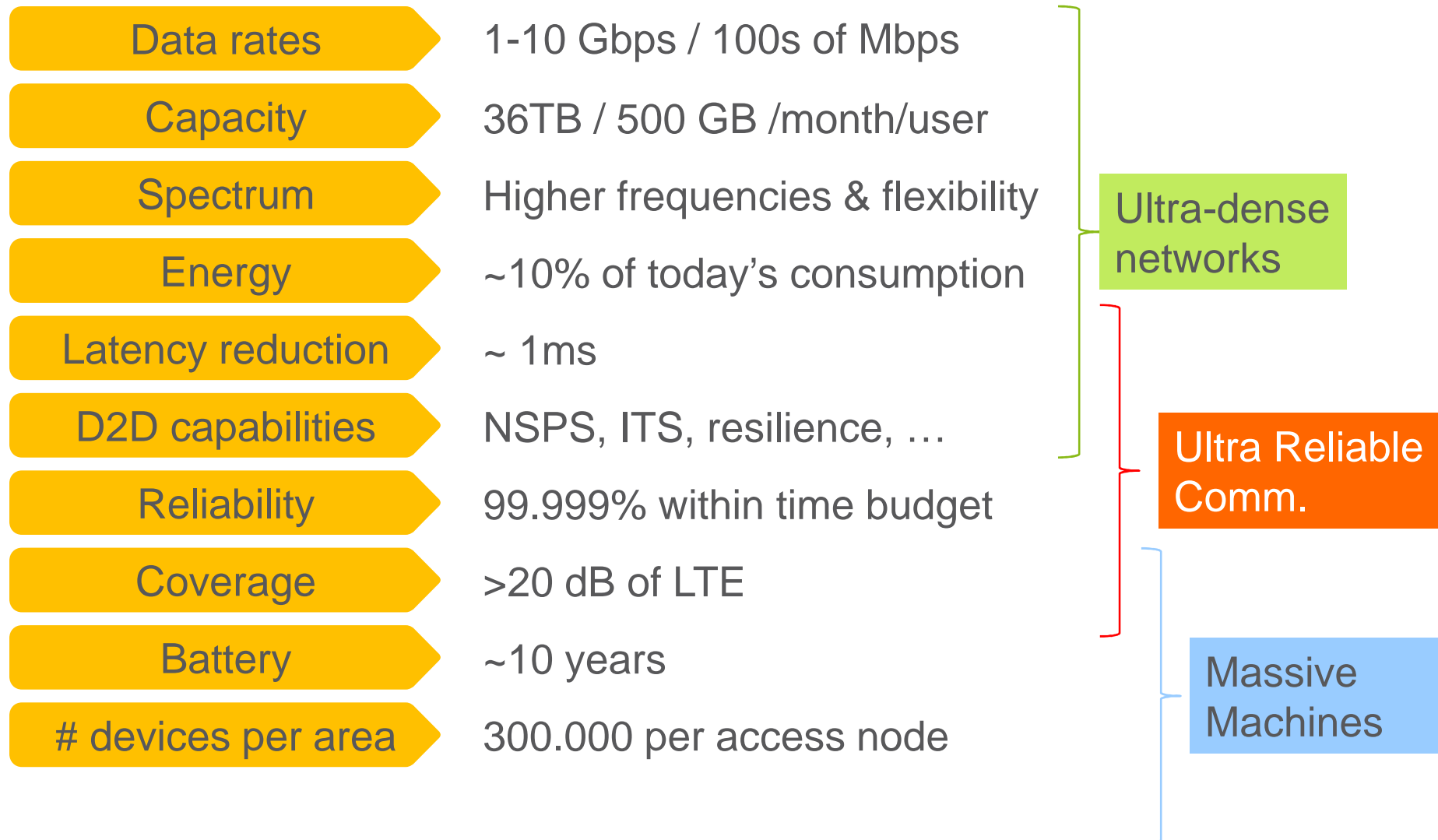


METIS 5G Scenarios





5G Requirements





5G Technology Components

Examples



What METIS says about EMF?

- › All radio solutions derived within the METIS project will be assessed with respect to their EMF exposure to be compliant with relevant recommendations, standards and regulations
- › Products and solutions emitting radio-frequency EMF need to be designed and tested to comply with relevant recommendations, standards and regulations on human exposure to EMF

Massive MIMO: CSI Error

Example of contribution:

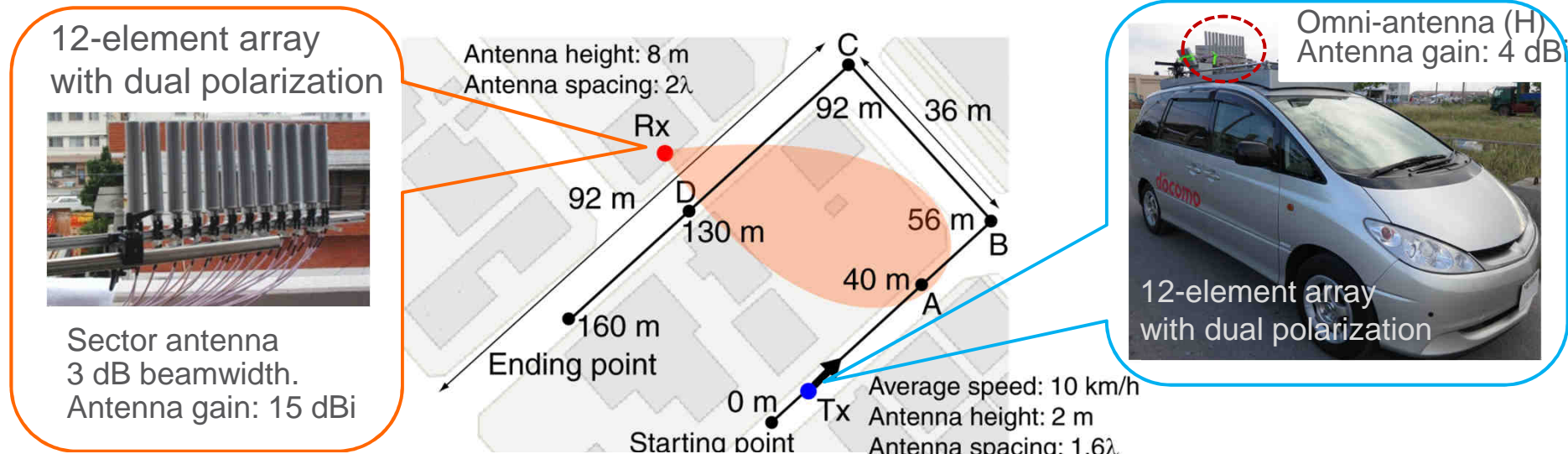
30 Gbps simulation using 11 GHz band
measured 24x24 MIMO channel

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

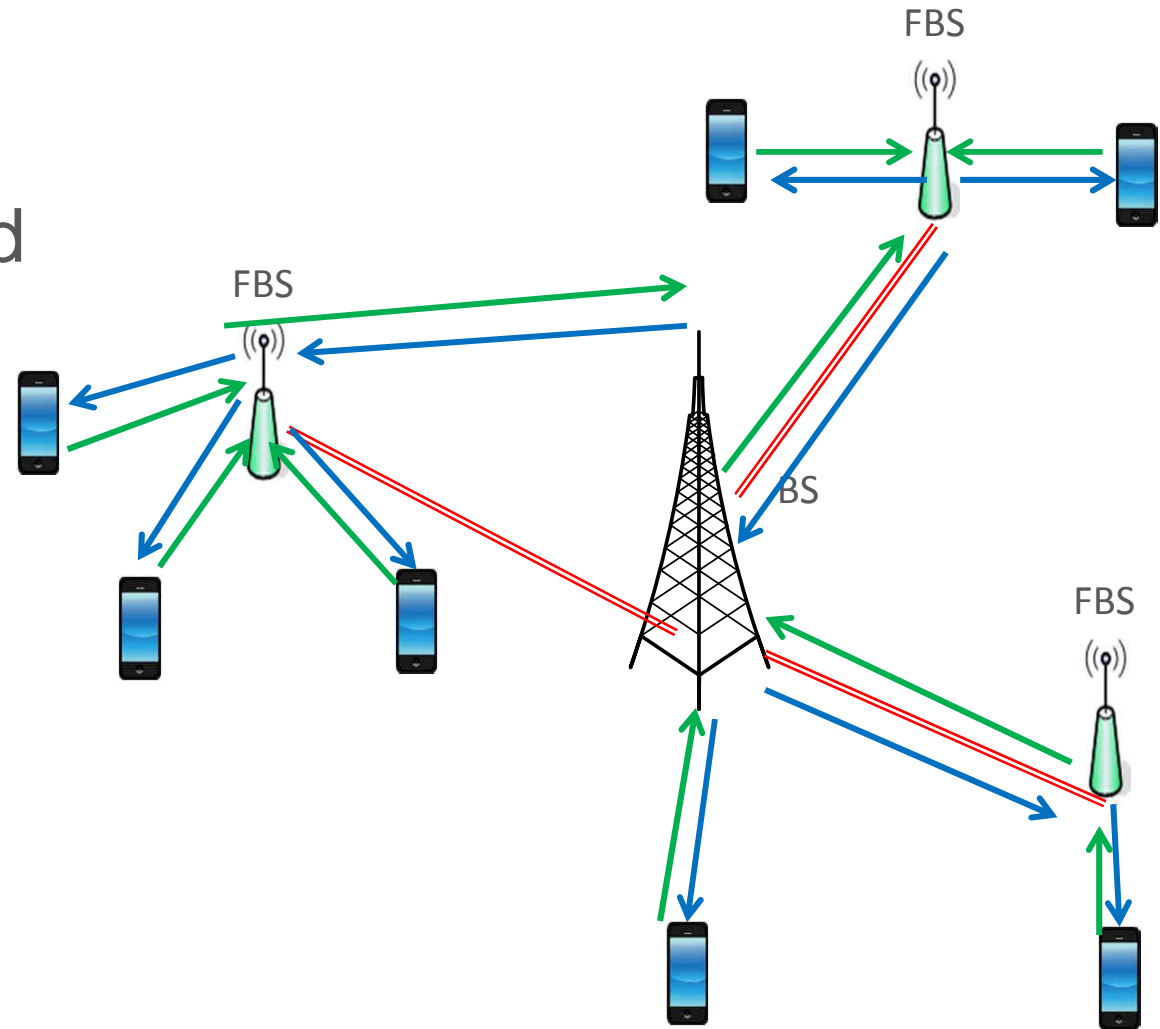
Measurement Environment/Data



* 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 design of the UL and the DL is decoupled
- › Wireless network coding allows optimization of the two-way communication instead of decoupling





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/>

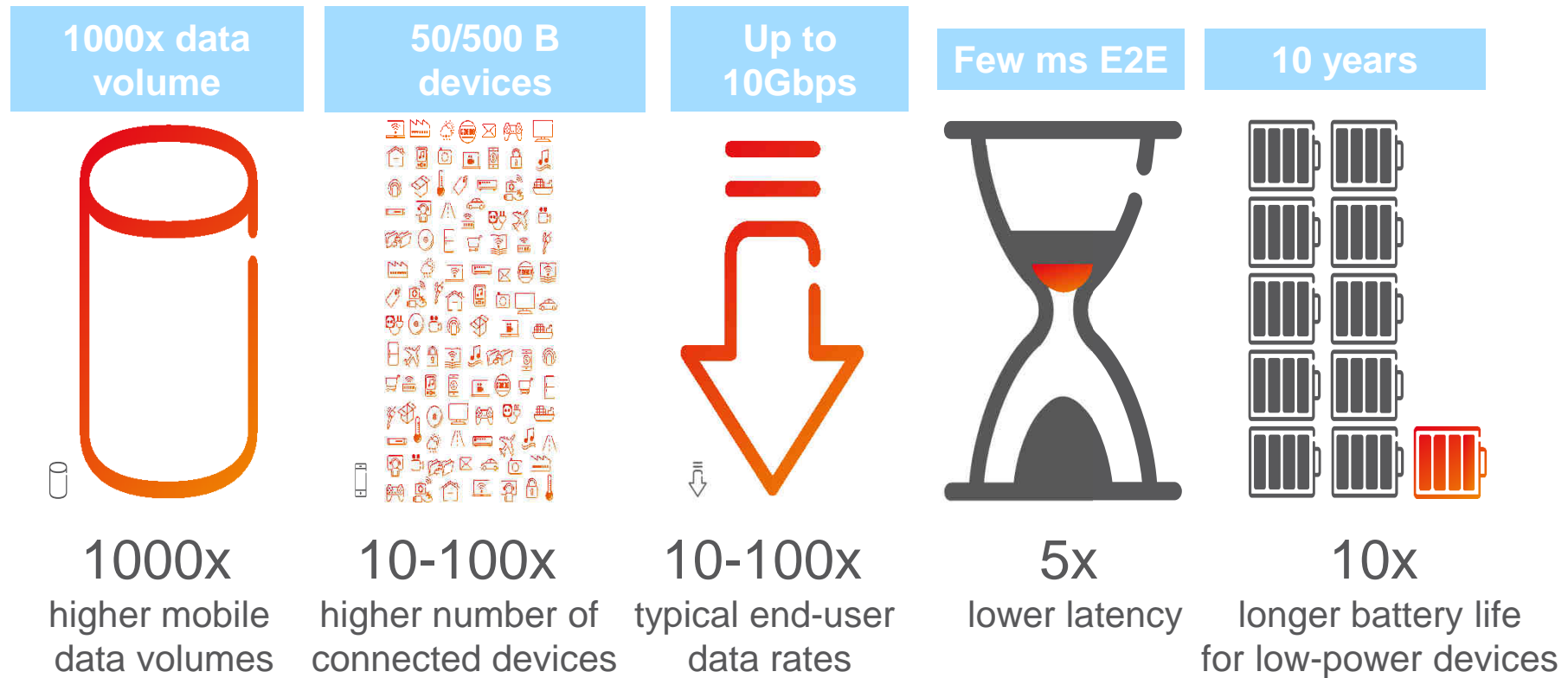


Thank You / Merci



Back up Slides

METIS Technical Objectives



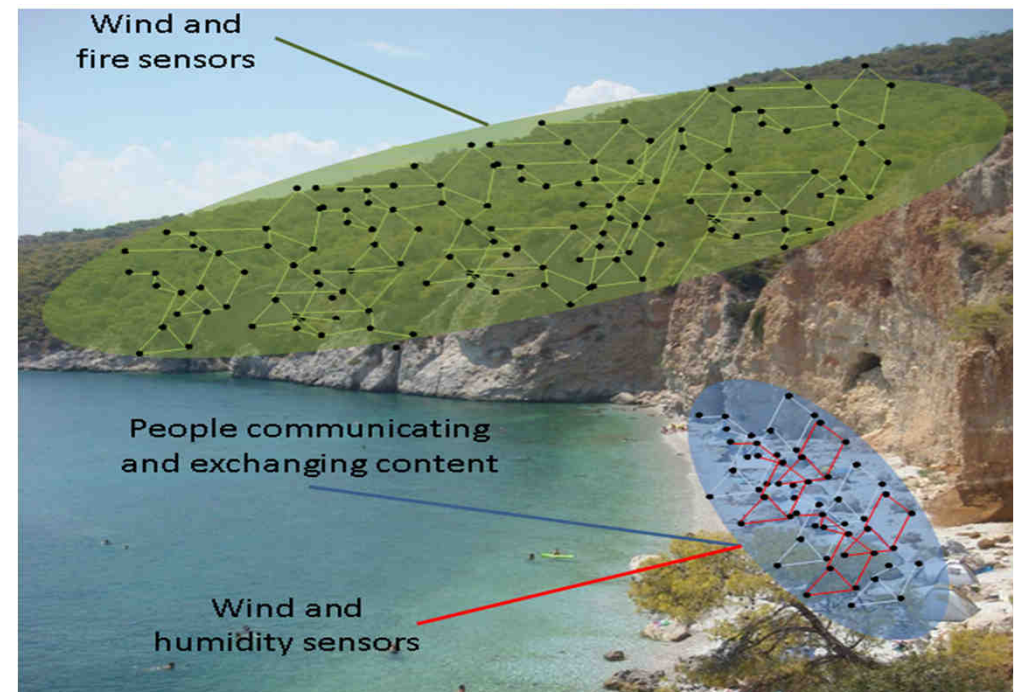
Scenario: *Ubiquitous things communicating*



- › 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



Scenario: *Works in a crowd* - TC3 & TC4



› TC3: Shopping mall

A large shopping mall with its high density of customers and shops staffs

- **Traffic volume:** 1.0 Gbyte/subscriber/hour
- **User data rate:** 300/60 Mbps in DL/UL with 95% availability



› TC4: Stadium

An event in a stadium that gather a lot of people interested in watching and exchanging high quality video contents

- **Traffic volume:** 9 Gbyte/subscriber/hour
- **User data rate:** 20 Mbps with 95% availability

HT: Device-to-Device (D2D) Communication

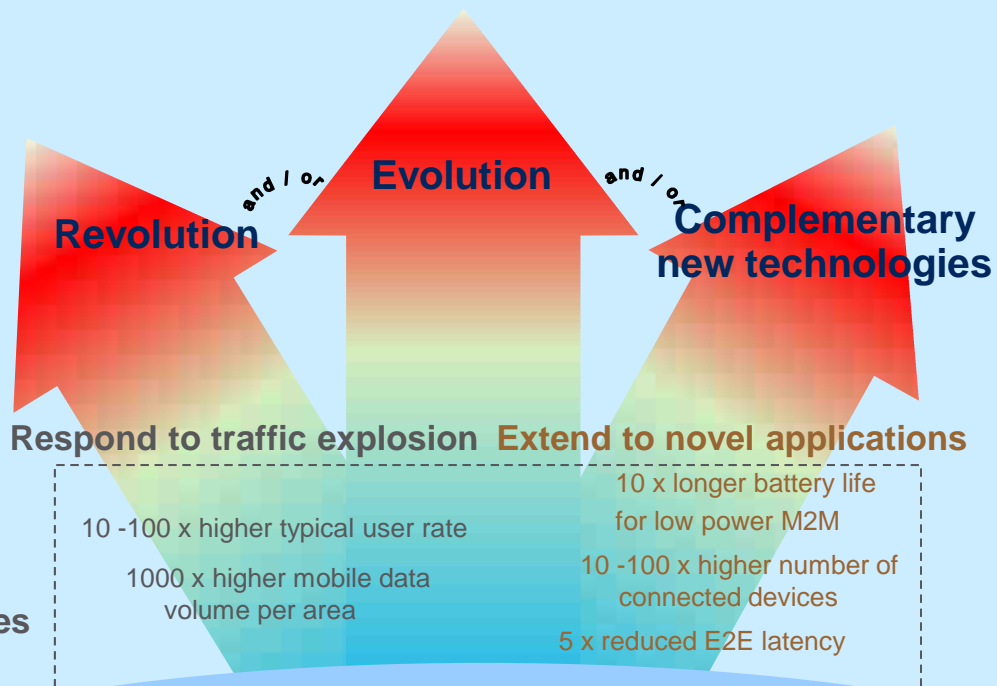


- › **Description:** Controlled by the network, direct D2D communication allows direct communication between mobile devices and exchange data packets between devices locally
- › **Objective:** Integrate direct D2D operation modes as a part of the overall METIS systems
- › **Motivation**
 - End user benefits: Reduced power consumption; Increased throughput; Discovery of geographically close activities;
 - Operator benefits: Increased spectrum efficiency; Extended coverage; Growing number of devices to be connected in the future; Internet of Things



5G Future

Integration
of access technologies
into one seamless experience



- Massive MIMO
- Ultra-Dense Networks
- Moving Networks
- Higher Frequencies

- D2D Communications
- Ultra-Reliable Communications
- Massive Machine Communications

Existing technologies in 2012

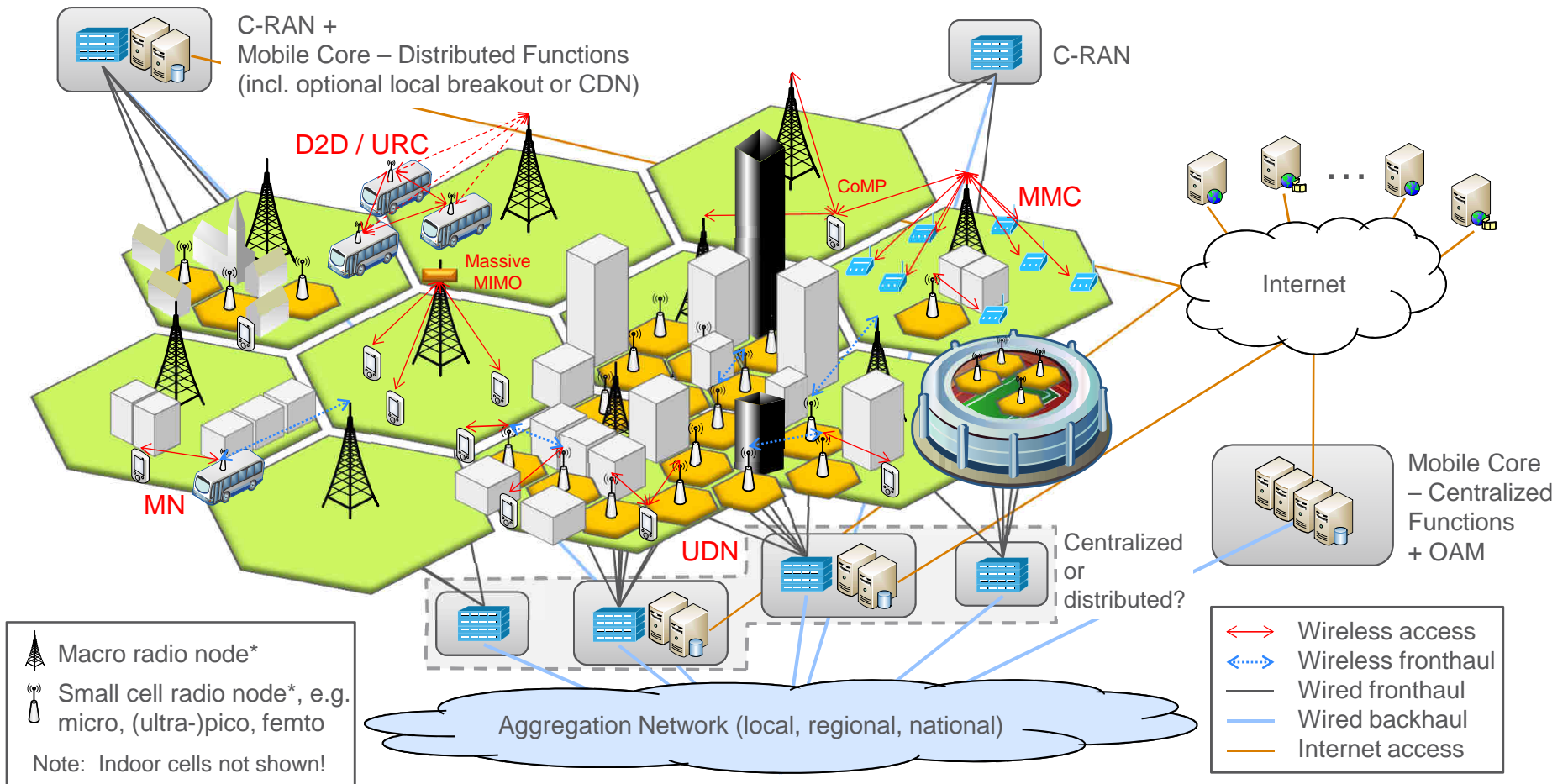
3G

4G

Wifi

5G Architecture

- » Amazingly Fast scenario
 - » high data rates & network capacities
- » UDN
 - » ISD about 10 m
 - » 1>= radio nodes per room
- » Local break out
- » Accelerated content delivery
- » Distributed mobile core functions



* Only Remote Radio Units (RRUs) assumed.