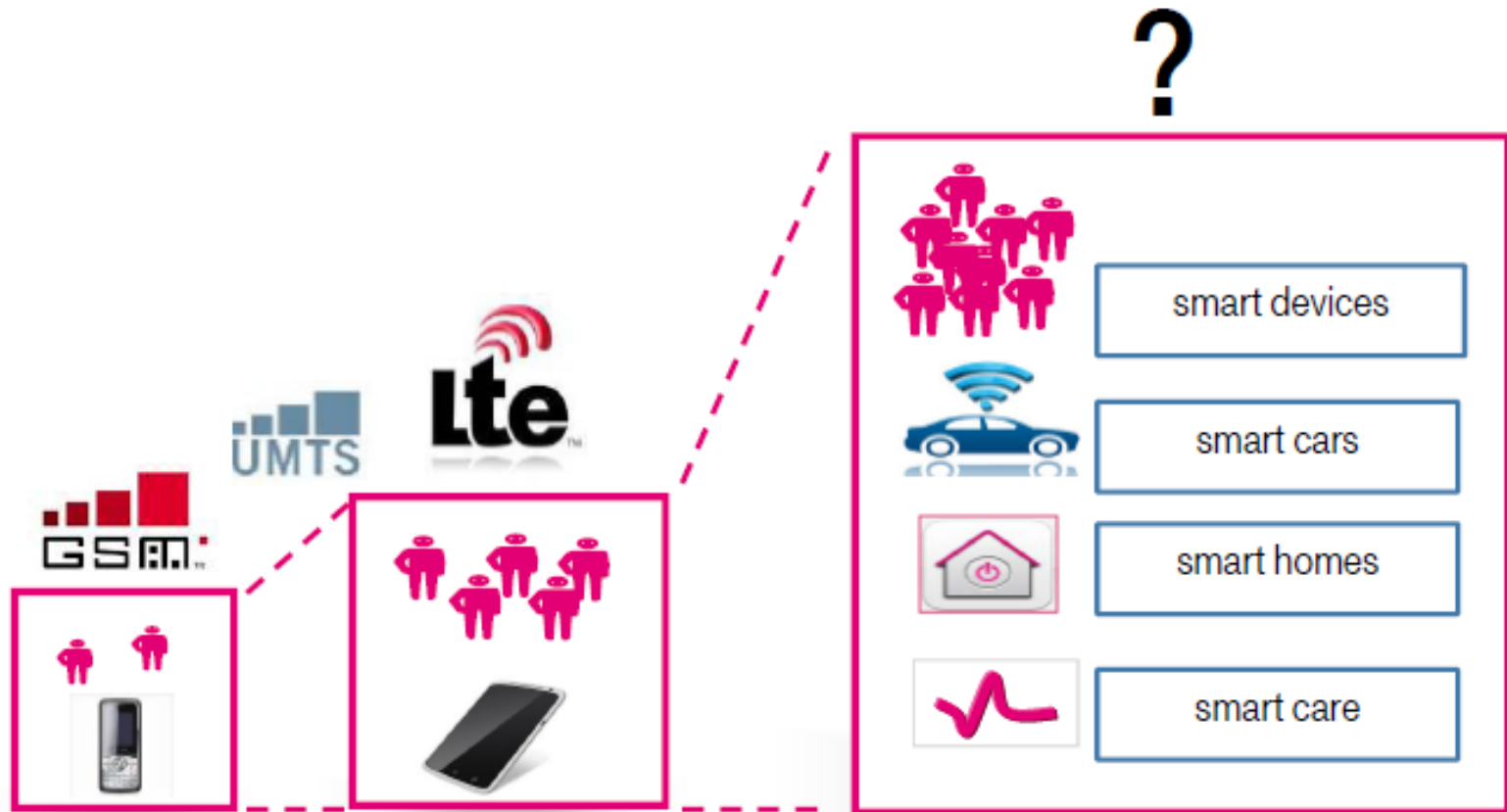# 5G – ENABLING A SMART(ER) WORLD THE METIS APPROACH

Jakob Belschner, Hans J. Einsiedler, Gerd Zimmermann / T-Labs
Dec 4th, 2014

LIFE IS FOR SHARING.

THE MOBILE (R)EVOLUTION

from PHONES to SMARTPHONES to SMART-THINGS

What is 5G?

What is 5G?
➔ Only a new air interface?

What is 5G?

➔ **Only a new air interface?**

➔ **It is a paradigm change!**

What is 5G?

➔ **Only a new air interface?**

➔ **It is a paradigm change!**

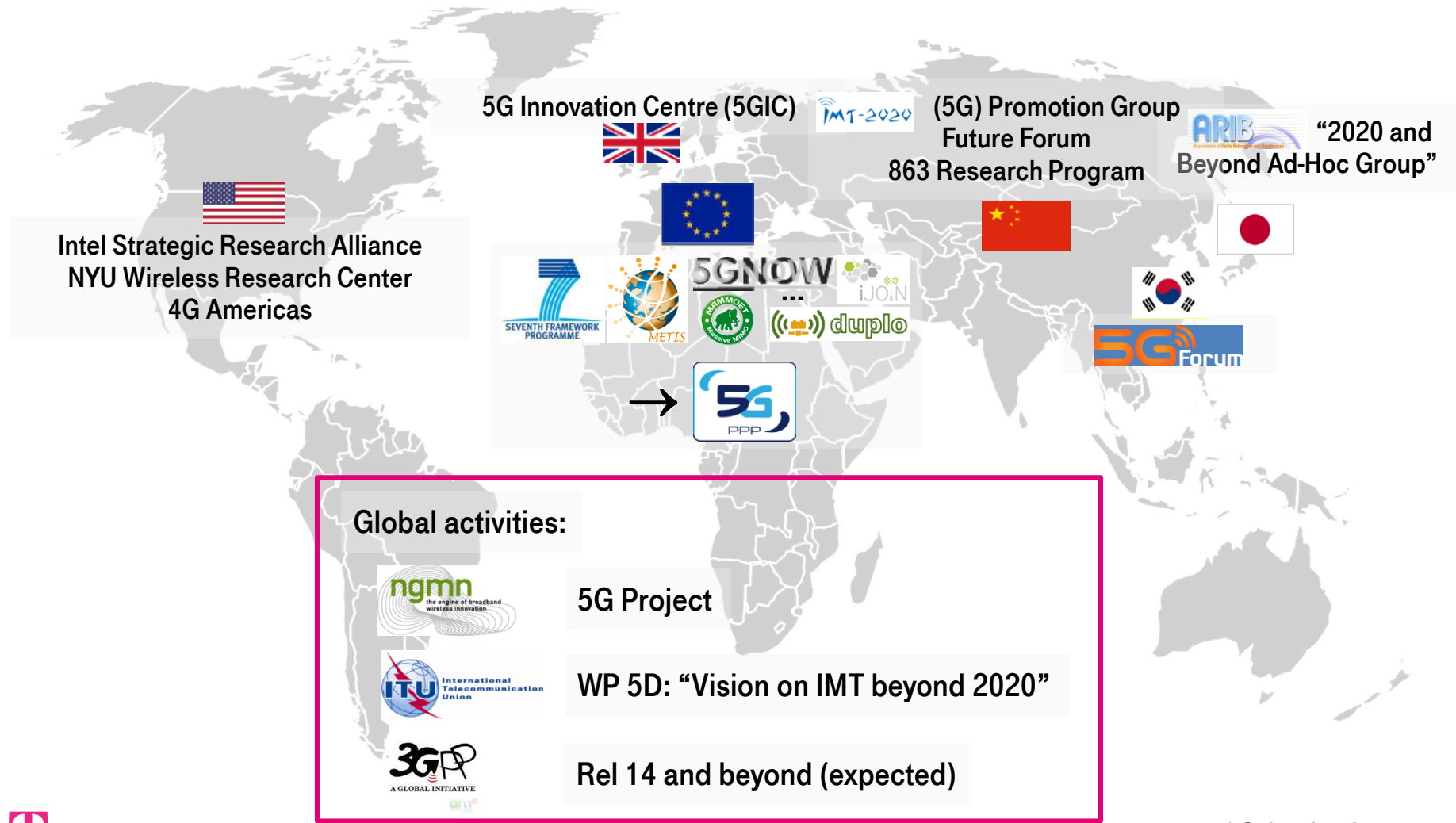   ➔ **Flexible network system concepts and architectures**

    ➔ **Flexible access network technologies**

    ➔ **New types of network service providers**

    ➔ **Driven by context information as well as use case and application areas**

5G SUBJECT TO R&I IN SEVERAL INITIATIVES*
IN EUROPE START END OF 2012 WITHIN EU FP7 CALL 8

5G Innovation Centre (5GIC)

IMT-2020

(5G) Promotion Group
Future Forum
863 Research Program

ARIB

"2020 and Beyond Ad-Hoc Group"

Intel Strategic Research Alliance
NYU Wireless Research Center
4G Americas

SEVENTH FRAMEWORK PROGRAMME

METIS

5GNOW

MAMMOET Massive MIMO

duplo

iJOIN

...

5G Forum

→ 5G PPP

Global activities:
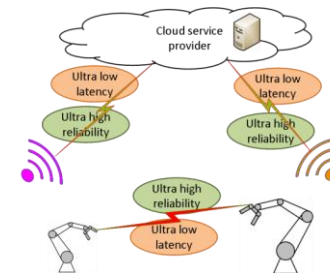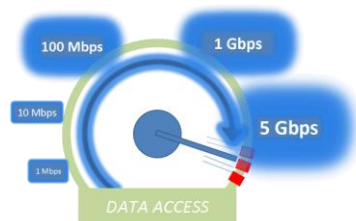
ngmn
the engine of broadband
wireless innovation

5G Project

ITU International Telecommunication Union

WP 5D: "Vision on IMT beyond 2020"

3GPP
A GLOBAL INITIATIVE

Rel 14 and beyond (expected)

* Only subset!

METIS 5G VISION FOR 2020 AND BEYOND
SCENARIOS FOR 5G

"Amazingly fast"

(ultra high data rate, low latency)

"Ubiquitous things communicating"

(huge number of devices, very low energy & cost, coverage, redundancy)

"Super real-time & reliable connections"

(strict latency & reliability, new industrial applications, tactile internet)

5 relevant scenarios for 5G
(examples, non-exhaustive)

"Great service in a crowd"

(very dense crowds of users, accessibility)

"Best experience follows you"

(mobility, coverage, accessibility)
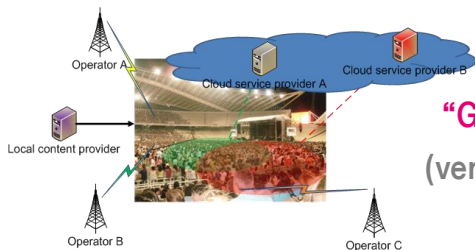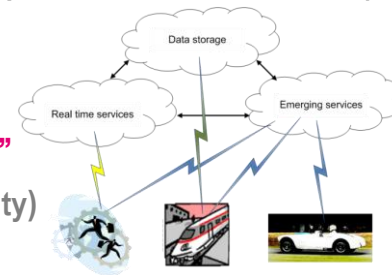
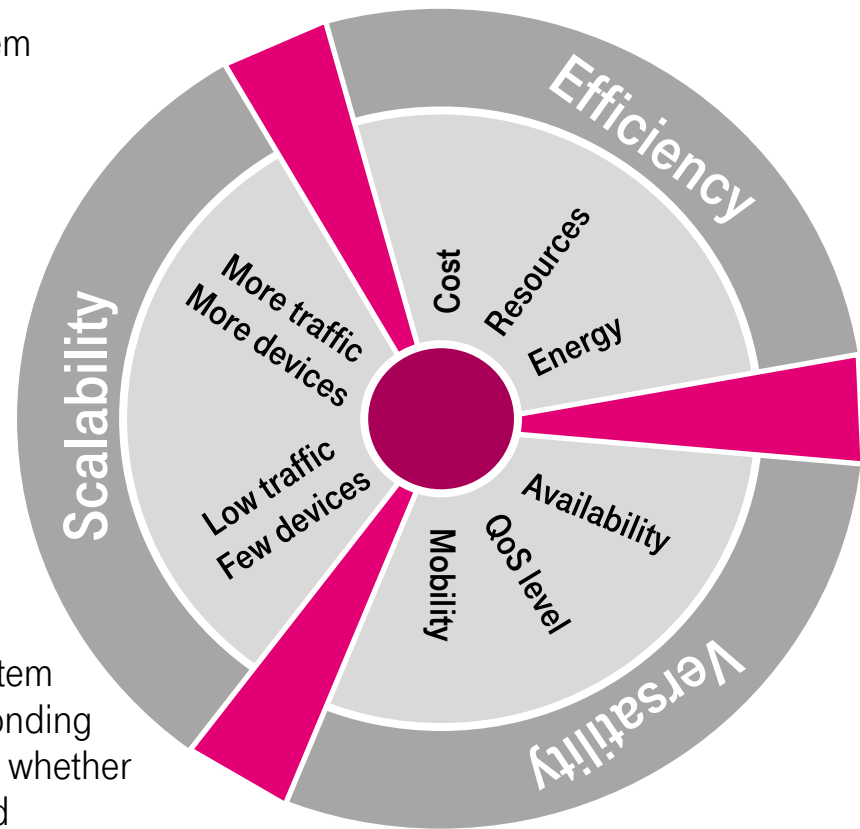**5G is much more than just more speed ...**

KEY ASPECTS FOR 5G
EFFICIENCY, VERSATILITY, SCALABILITY

Key aspects of the future 5G system

- A 5G system has to ...
  - be significantly **more efficient** than today's system in terms of
    - cost,
    - energy and
    - resource utilization,

    in order to allow for a constant growth in capacity at acceptable overall cost and energy dissipation,
  - be **more versatile** to support a significantly wider range of requirements (e.g. availability, reliability, mobility, quality-of-service) and use cases, and
  - provide **better scalability** in the way that the system is cost, energy and resource efficient while responding to a wider diversity of requirements regardless of whether a large or low amount of traffic is to be supported

EXPECTED USER BENEFITS FROM 5G
ENHANCE EXISTING AND ENABLE NEW SERVICES

Enhance existing services

Higher performance (data rates, latency, availability, quality and reliability, ...) for a large variety of mobile applications, services, devices, and environments, e.g.:

- Remote healthcare, remote education, ...
- Smart city, smart shopping mall, smart stadium, ...
- Cloud-based services
- Collaborative Augmented Reality
- Multiplayer real-time cloud gaming
- Cooperative traffic systems
- ...

Enable new services

New ways of how to interact with the world, e.g.

- Real-time 3D videos & holograms
- Internet of everything
- Human-machine real time assistance
- Tactile smart grid and robot control
- Vehicle-to-X
- Remote driving; autonomous vehicles
- Crowd services
- ...

5G

EXPECTED OPERATOR BENEFITS FROM 5G
NEW SERVICES ENABLED BY HIGHLY FLEXIBLE AND EFFICIENT NETWORKS; REDUCED TIME-TO-MARKET

Improved Network Performance and Flexibility
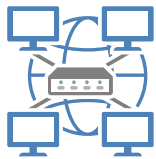
Improved Capacity & Coverage	High Speed Mobility	Low Latency	High Peak & Cell Edge Data Rates
Programmability & Scalability	Massive Device Connectivity	Embedded Security	Service Awareness

Higher Cost Efficiency

Reduced CAPEX & OPEX	Energy-efficient, Sustainable Infrastructure	Simplified NW Management & Operation

Enlarged Business Potential

New Operator Business Models	Reduced Service Time-to-Market	New Revenue Opportunities
Effective Support of Vertical Use Cases	Strong Differentiation to OTTs	Consistent User Experience Anywhere

MANYFOLD 5G TECHNOLOGY INNOVATION AREAS
MOST SOPHISTICATED TECHNOLOGY COMPONENTS

Enhanced interference &
multi-RAT/layer/spectrum
coordination

Enhanced/
Massive MIMO

Ultra-dense radio networks with
multi-hop wireless backhaul
Nomadic/mobile radio relay nodes

**5G Innovation
Areas addressed
by METIS***

Flexible air interface
(waveform, duplexing,
framing, MAC)

Cloudification/virtualization of
RAN & Core (NFV)
Separation of U-/C-Plane (SDN)

Device-to-device
communication
(incl. IoT and V2X)

Extension to new spectrum bands
Radio channel & propagation models
Spectrum access/sharing toolbox

Context awareness for
interference & mobility management,
content adaptation and service delivery

* Only extract!

Source: METIS

SYSTEM CONCEPT DERIVED BY METIS
MAIN COMMUNICATION/SERVICE TYPES IDENTIFIED

- **Extreme/Enhanced Mobile Broadband (xMBB)**
  - High data rates
  - Reliable provisioning of moderate data rates everywhere
  - Moderately low latencies
  - Wide spectrum range
    - from present IMT frequencies up to mmW bands
  - Wide deployment range
    - from macro cell layer down to extreme UDNs

- **Massive Machine-Type Communications (M-MTC)**
  - Scalable connectivity
  - Wide area coverage
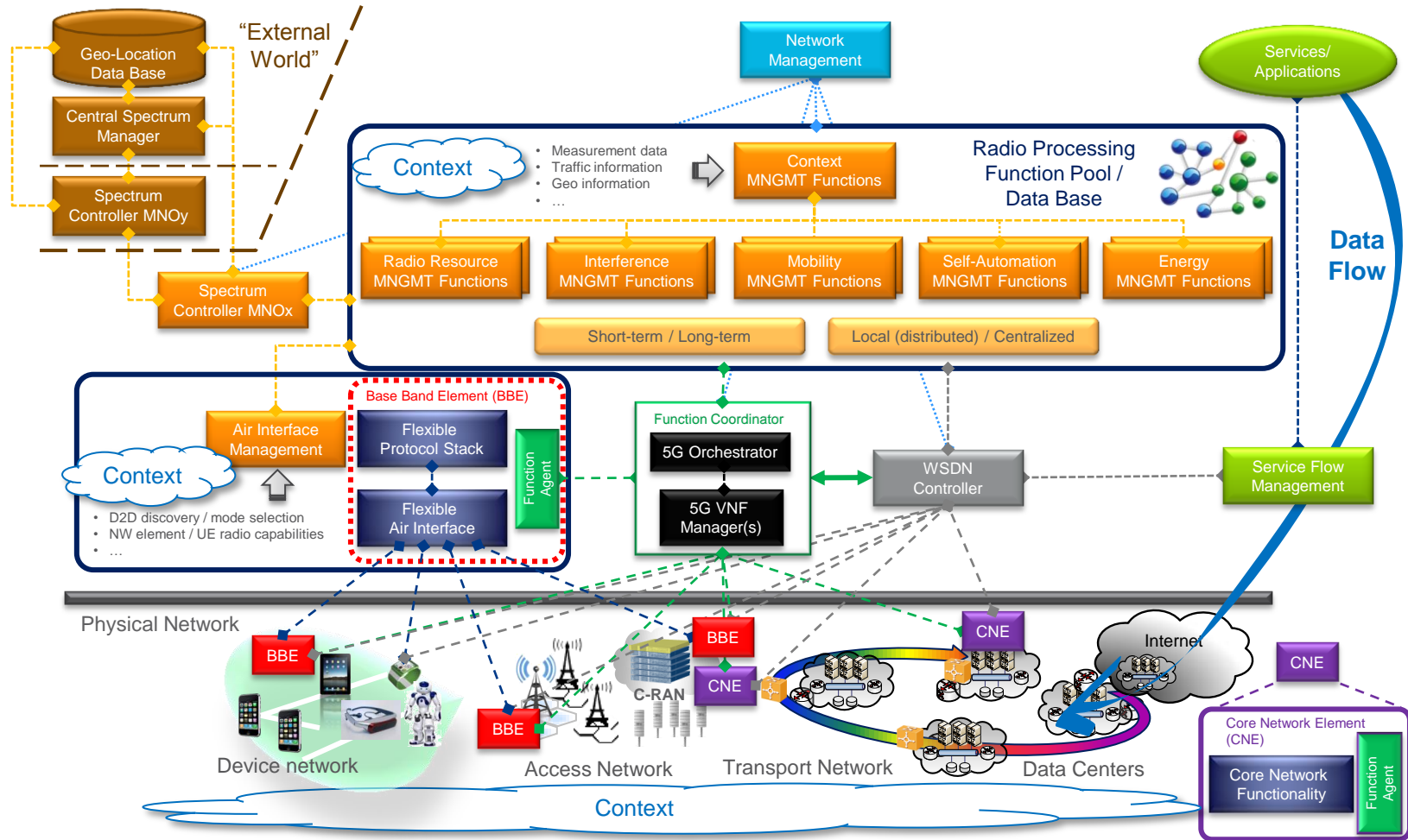 - Deep indoor penetration
  - Low cost and complexity

- **Ultra-reliable/Mission-critical MTC (U-MTC)**
  - Ultra-reliable
  - Low-latency
  - E.g., V2X communication and industrial control

Source: METIS

13
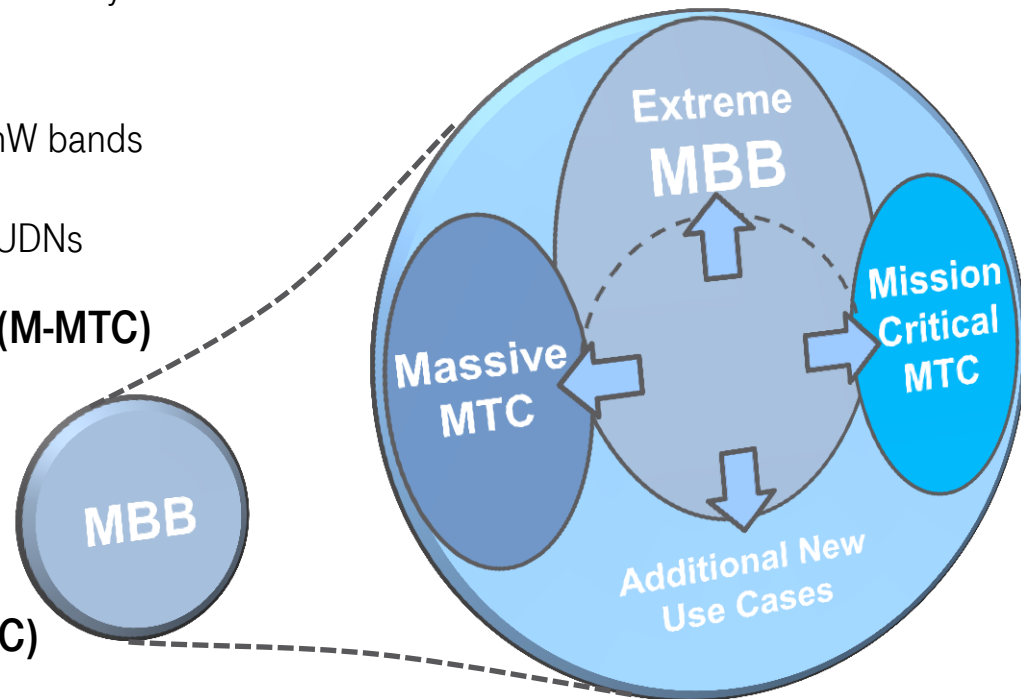
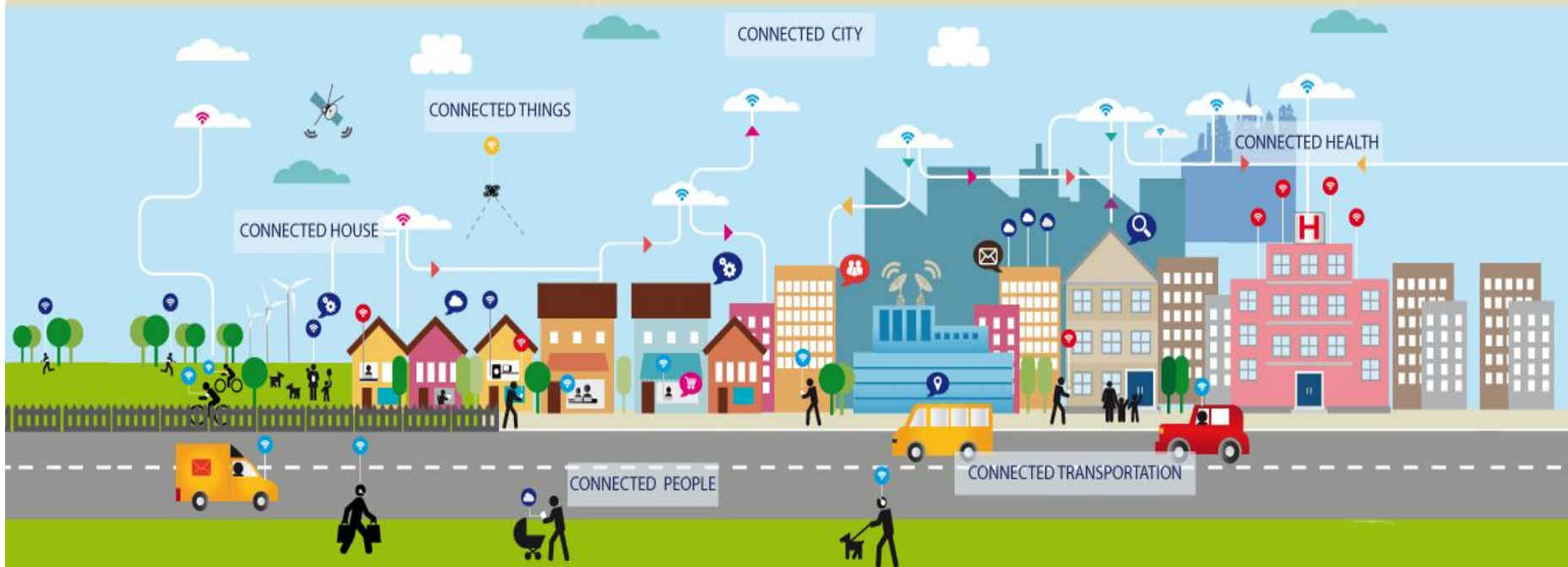# THE METIS ARCHITECTURE
LOGICAL VIEW

Source: METIS

OUTLOOK – THE 5G PPP* VISION
UBIQUITOUS HIGH-SPEED CONNECTIVITY AND SEAMLESS SERVICE DELIVERY IN ANY CONTEXT

The 5G Infrastructure Public-Private Partnership

CONNECTED CITY

CONNECTED THINGS

CONNECTED HOUSE

CONNECTED HEALTH

CONNECTED PEOPLE

CONNECTED TRANSPORTATION

5G PPP = 5G Infrastructure Public Private Partnership – a large EU program for 5G with HORIZON 2020
(http://5g-ppp.eu/)

THANK YOU!