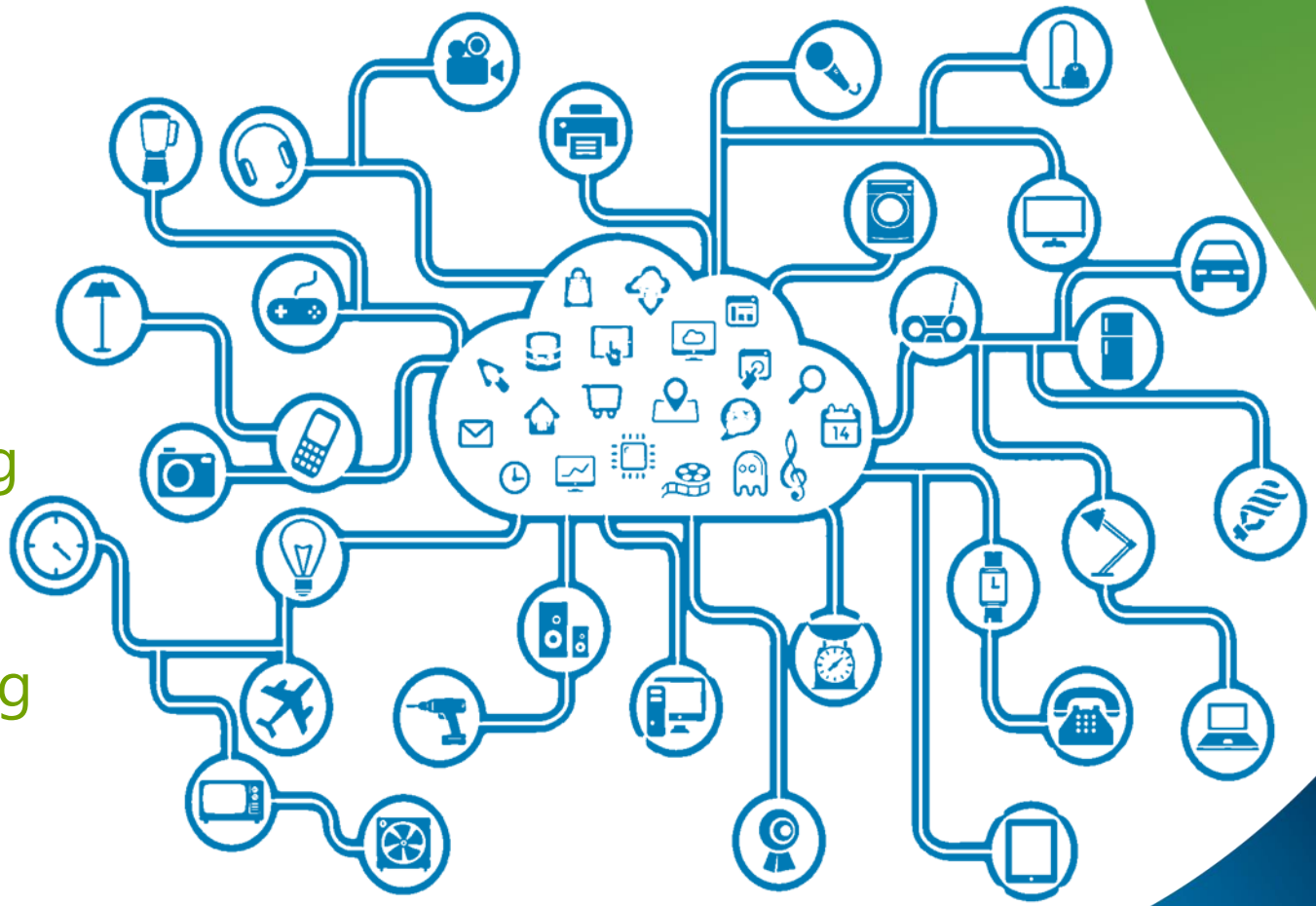
Athens, October 2018

COSMOTE
our world is you

5G & IoT

Accelerating Digital & Transforming Life



George Onopas,
OTE Group, Director Access Networks DevOps, Fixed & Mobile

OTE
GROUP OF COMPANIES

5G & IoT - Accelerating Digital & Transforming Life

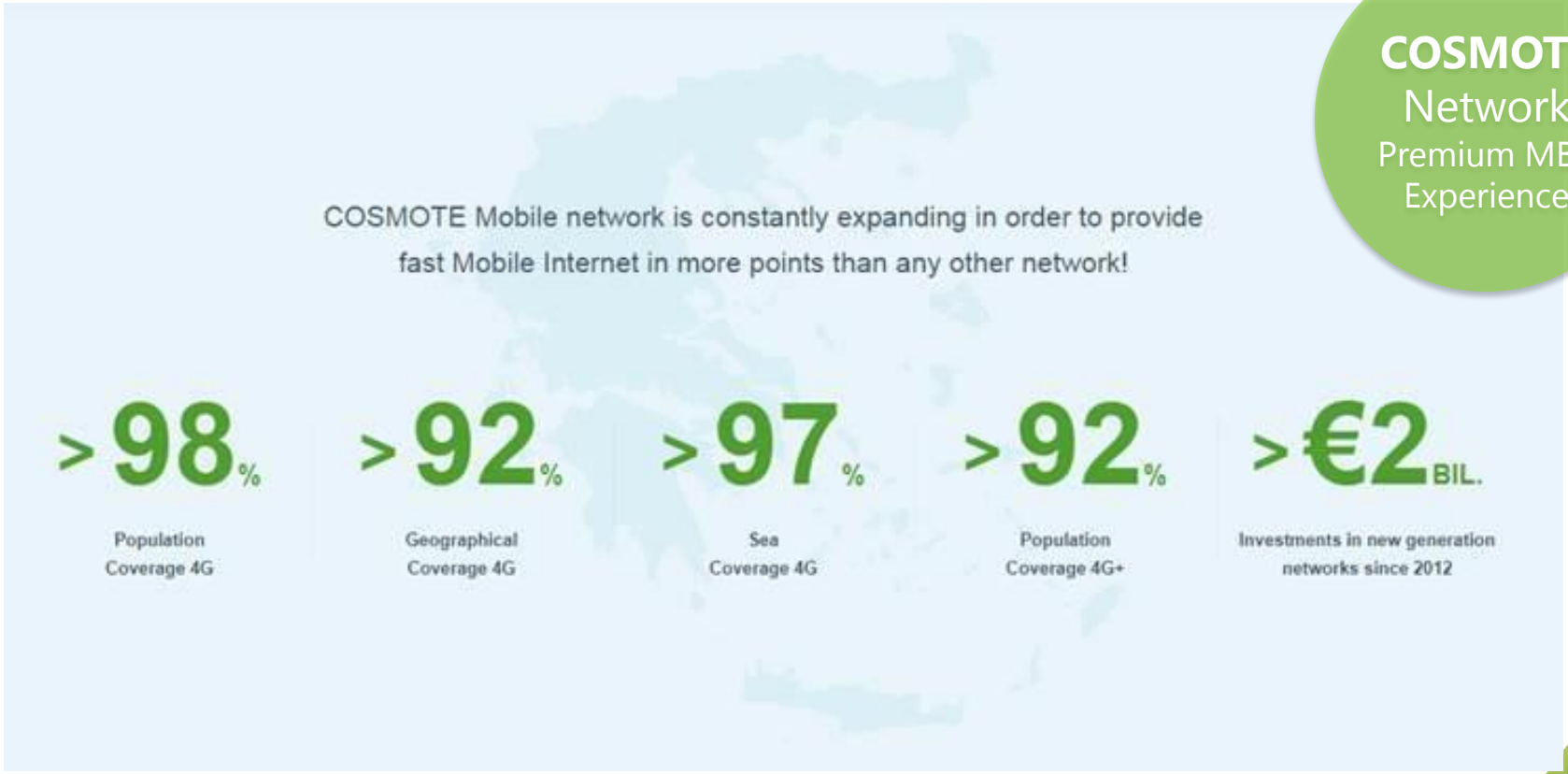
Agenda

- COSMOTE Network Mobile Broadband Facts
- Global Mobile Broadband Facts
- 5G Evolution
- 5G Basic Requirements
- 5G Air Interface
- 5G Architecture
- Licensing & EMF challenges for 5G
- IoT market outlook
- IoT industry re-shaping
- Cellular IoT
- IoT new operating models
- IoT hot apps
- Conclusions

COSMOTE Network Mobile Broadband Facts

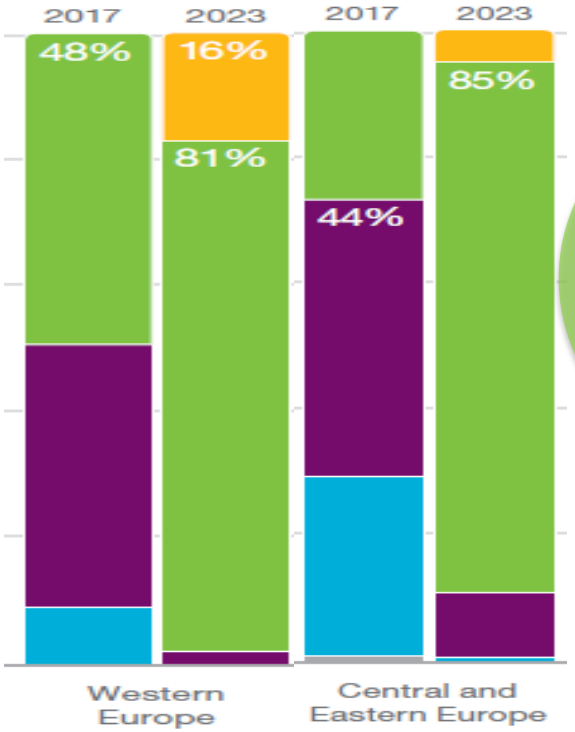
With the highest coverage of MBB Services

COSMOTE
Network
Premium MBB
Experience



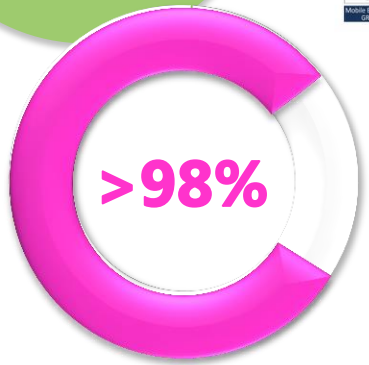
COSMOTE Network Mobile Broadband Facts

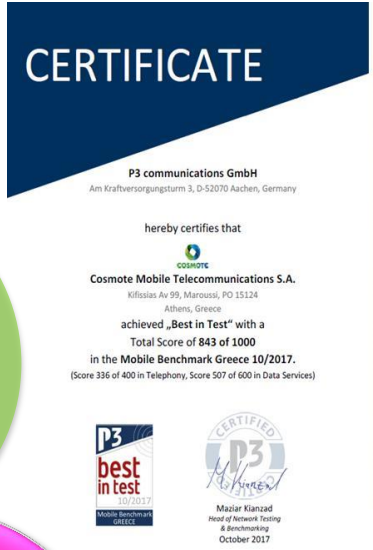
Ready for 2023 MBB Challenge



source: ERICSSON mobility report - November 2017

COSMOTE 4G is already reaching area KPIs for **2023!**





COSMOTE Best MBB Network (OOKLA & P3)

Global Mobile Broadband Facts

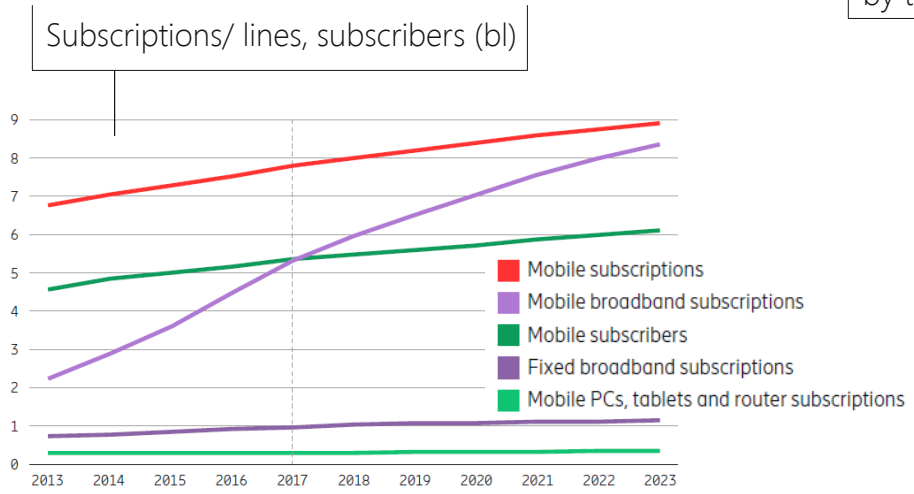
Subscribers and Technology Outlook

By **2023** there will be:

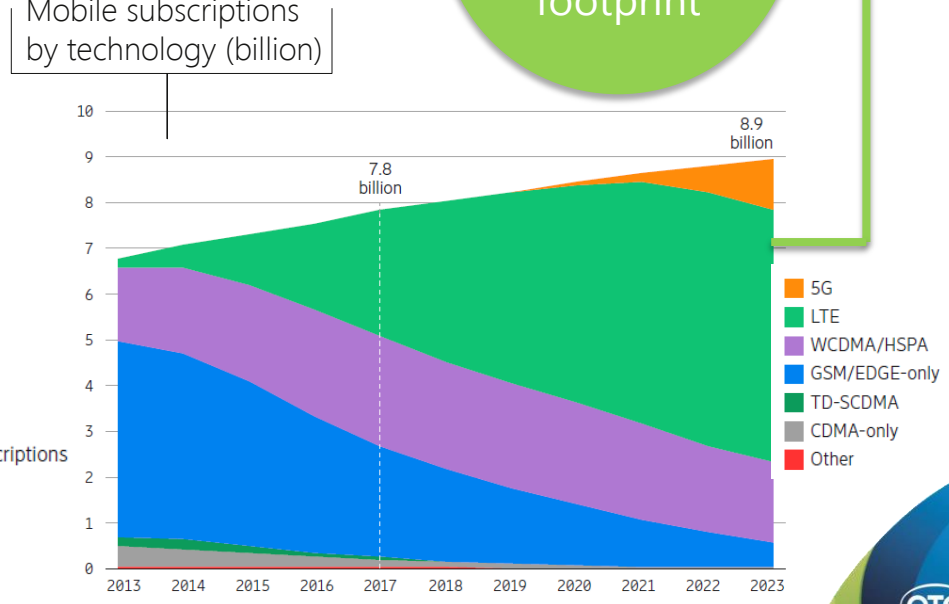
- **8.9 billion** mobile subscriptions,
- **8.3 billion** MBB subscriptions
- **7.2 billion** smartphone subscriptions

Super-fast **LTE** adoption

>60% LTE Subscriptions footprint



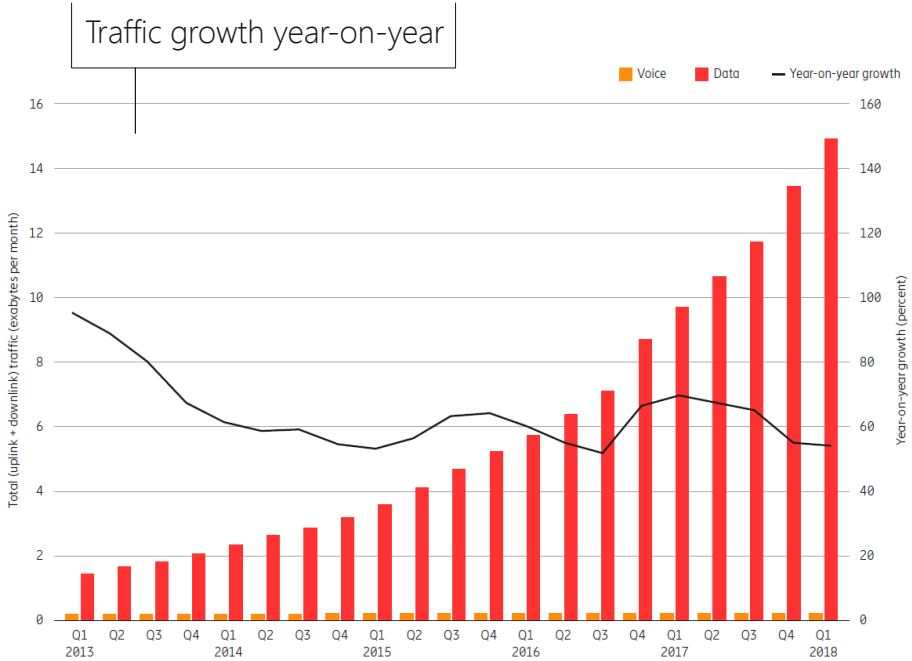
source: ERICSSON mobility report - November 2017



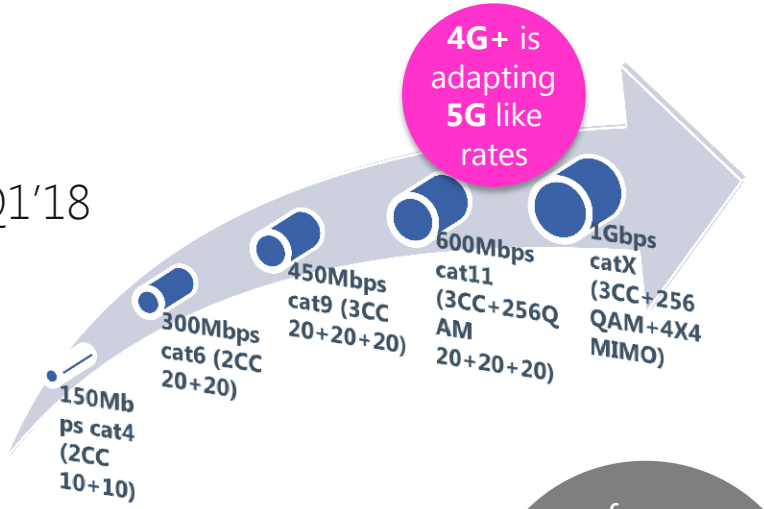
Global Mobile Broadband Facts

Mobile Traffic Outlook & Data Rates Evolution

54% mobile data traffic growth from Q1'17 to Q1'18



source: ERICSSON mobility report - November 2017



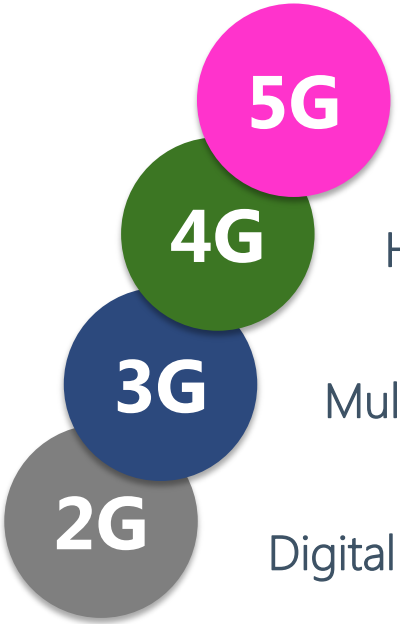
In 2021, video will account for ~**73%** MBB

FYE2023 ~**20%** of MBB traffic will be from **5G networks**

from 2018-2023, a **8x** growth is expected in smartphone traffic

5G Evolution

or revolution?



Business Enabler

Virtual networks & Gigabit networked society

New business models

New revenue streams

Energy efficiency

Capacity & reliability

security

5G Basic Requirements

evolving by revolving

(new) requirements:

- 1-10Gbps connections to end points
- 1 millisecond end-to-end round trip delay
- 1000x bandwidth per unit area
- 10-100x number of connected devices
- ~99.99% availability
- ~100% coverage
- 90% reduction in network energy usage
- ~10 years battery life for low power M2M devices

5G

The hyper-connected vision:

5G, mobile operators would create a blend of pre-existing technologies covering 2G, 3G, 4G, Wi-fi to allow higher coverage and availability, with greater connectivity enabling Machine-to-Machine (M2M) services and the Internet of Things (IoT). This vision include a new radio technology to enable low power, low throughput field devices with long duty cycles of ten years or more.

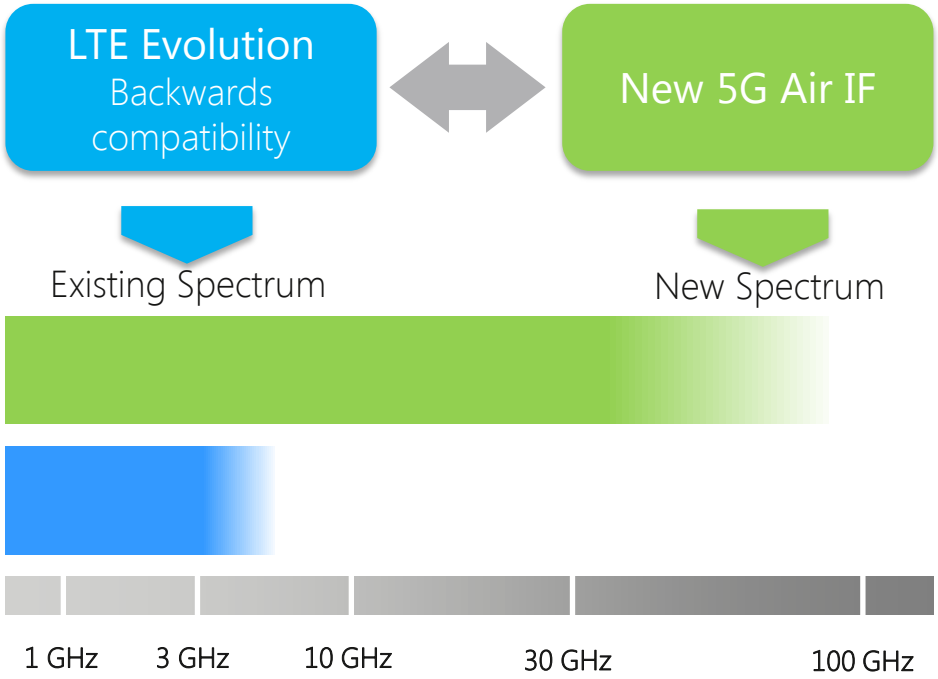
Next Generation Technology vision:

This is more of the traditional 'generation-defining' view, with specific targets for data rates and latency being identified, such that new radio interfaces can be assessed against such criteria. This in turn makes for a clear demarcation between a technology that meets the criteria for 5G, and another which does not.

source: NGMN

5G Air Interface

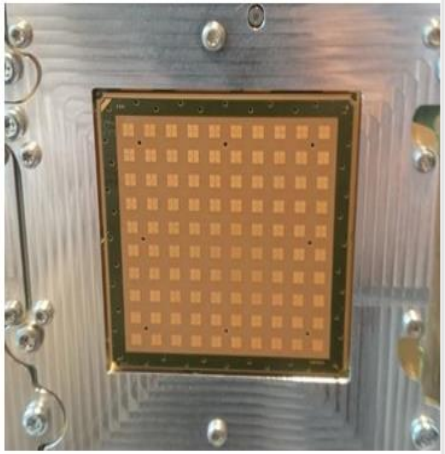
Massive channels, massive MIMO



- Evolution of existing technology adding new RAN technology
- LTE+ and New Air Interface combined allows rapid switching based on radio conditions
- New Air Interface initially applied at new spectrum (up to millimeter waves) with super channels, massive MIMO & beam forming
- Gradual migration of New Air Interface into existing spectrum

EMF challenges for 5G

- Massive MIMO and beamforming
  - More complex EMF compliance assessments
  - Potentially higher EIRP and larger EMF compliance boundaries (exclusion zones) than for conventional antennas
  - Site design of increasing importance



- Frequency bands above 10 GHz
  - Test methodology and standards available but need to be further refined and accepted by regulators
  - EMF limits more conservative in the nearfield which leads to larger compliance distances for small cell base stations and which may affect maximum UE power

Licensing challenges for 5G

(Small Cell Implementation in Cities)

Typical Micro Layer

- Common Transport
- Modem or MW
- Indoor Equipment Deployment
- Feeder/Combiner Usage

Vault site

Small Cell

Street furniture sites

Challenges for 5G

LICENSING

Quick, simple, hassle – free network deployment is critical. Therefore:

- Network implementation must be supported with fast and simple site permission process promoting the deployment of Macro and Small Cells.

EMF

- EMF limits to align with ICNIRP (EU recommended levels) in order to introduce new technologies (5G)
- Introduction of the realistic maximum transmitted power to EMF calculation models. Based on reasonable assumptions, the realistic maximum transmitted power was found to be around of 25% of the theoretical maximum power which translates to a reduction in EMF compliance boundary with a factor of about 2.
- Massive MIMO spread the beams to different directions and has a result of antenna Gain reduction.

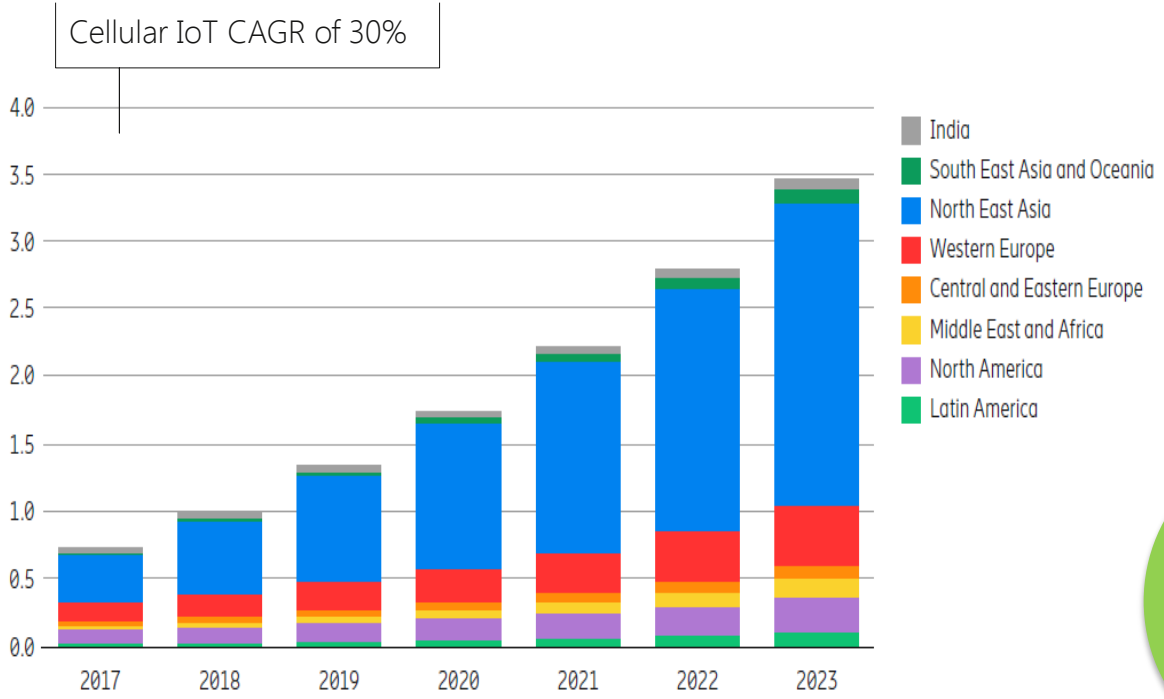
Street Furniture sites, vault sites! Need to educate both the Authorities and the public.

EMF compliance for 5G networks is a challenge considering

i) Existing networks (2G, 3G, 4G)
ii) New MIMO antennas,
iii) Existing Standard for EMF calculations
iv) Stricter EMF limits in Greece

IoT market outlook

3.5 billion cellular IoT @ 2023



source: ERICSSON mobility report - November 2017

Cellular IoT connections expected to go x5 by 2023

Half of connected devices by 2023 will be IoT-related

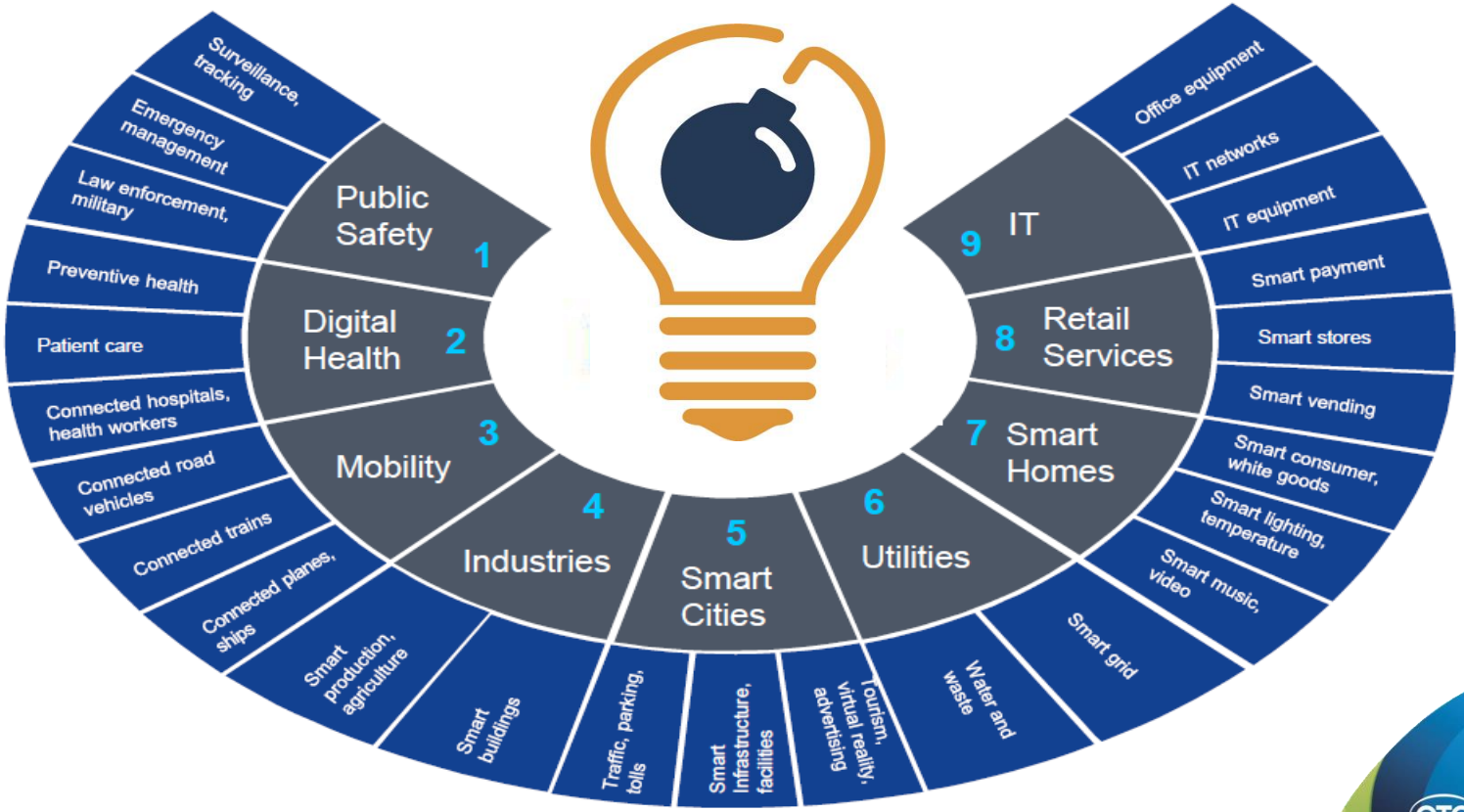
Cosmote included in the twenty networks commercially deployed by Eo2017

Cellular Networks main market is on Wide-Area IoT

IoT industry re-shaping

Transformational impact in all industries, value chains & entire business configurations

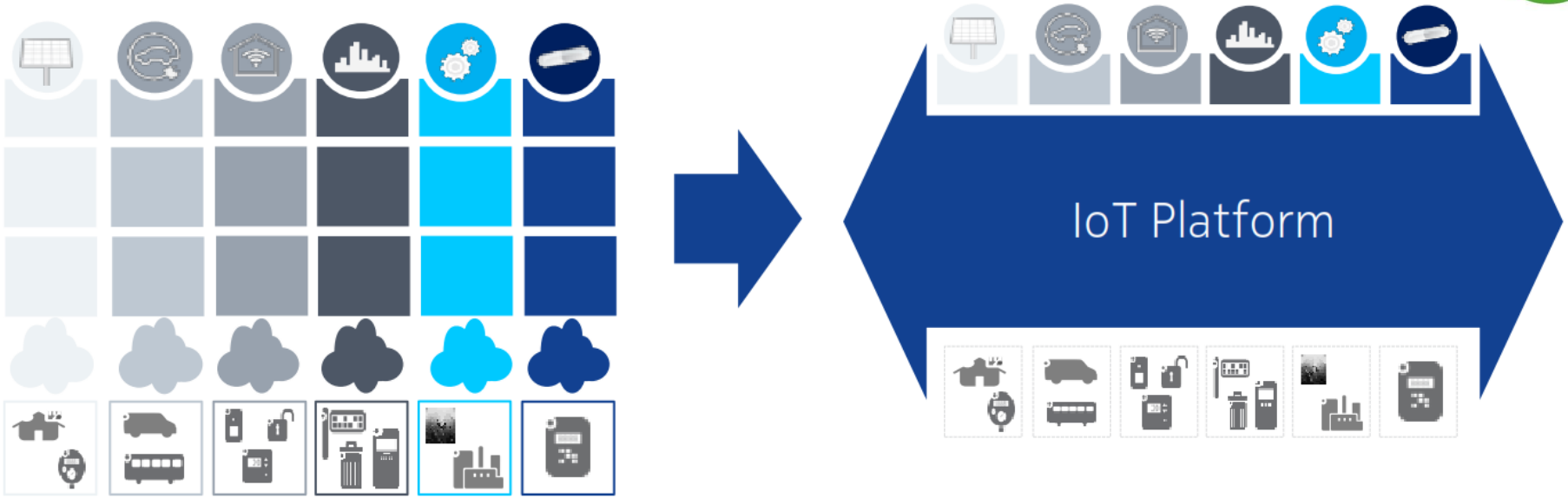
IoT transforms:
- business models
- value chains
- business config's



source: Nokia

Cellular IoT

Standardized horizontal approach to enable mass adoption



Vertical Point Solutions are expensive

- High Cost for integration
- Multiplication of effort in all service life cycle
- Underutilized resources

Horizontal approach drives down cost

- Streamline Operations & Reduce Costs
- Mix and Match devices and Applications
- Open horizons for new services

Cellular IoT

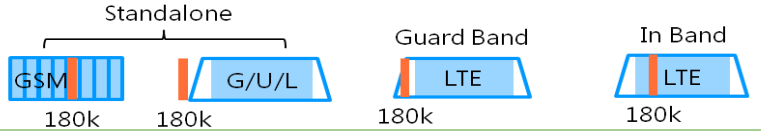
Do we need to wait for 5G?

- **NB-IoT**, is a new narrowband radio technology to address the requirements of the Internet of Things (IoT)
- The new technology will provide improved indoor coverage, support of massive number of low throughput devices, low delay sensitivity, ultra-low device cost, low device power consumption and optimized network architecture
- The technology can be deployed "in-band", utilizing resource blocks within a normal LTE carrier, or in the unused resource blocks within a LTE carrier's guard-band, or "standalone" for deployments in dedicated spectrum.
- R13 3GPP Standard

- NB-IoT is based on LTE Technology
- but it suitable for the re-farming even of GSM channels
- It is compatible with existing RAN

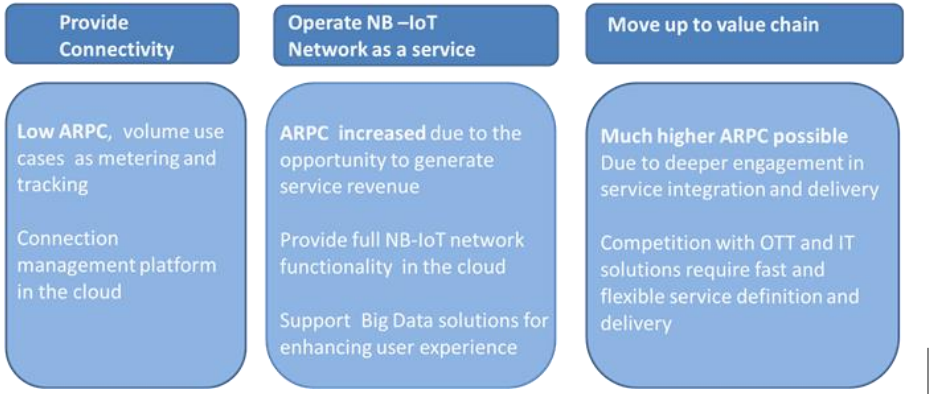
	NB-IOT
Deployment	In-band & Guard-band LTE, standalone
Coverage*	164 dB for standalone, FFS others
Downlink	OFDMA, 15 KHz tone spacing, TBCC, 1 Rx
Uplink	Single tone, 15 KHz and 3.75 KHz spacing SC-FDMA, 15 KHz tone spacing, Turbo code
Bandwidth	180 KHz
Peak rate (DL/UL)	DL: ~250 kbps UL: ~250 for multi-tone, ~20 kbps for single tone
Duplexing	HD (type B), FDD
Power saving	PSM, ext. I-DRX, C-DRX
Power class	23 dBm, others TBD

Mass market IoT can take off using LTE infrastructure with R13 SW/HW

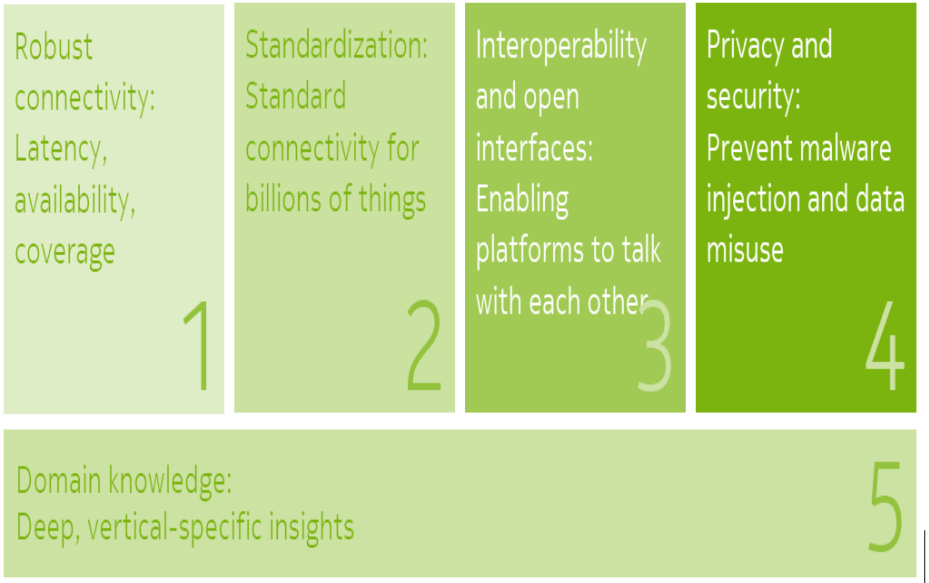


IoT new operating models

IoT may become the absolute business disrupter even for telecom industry



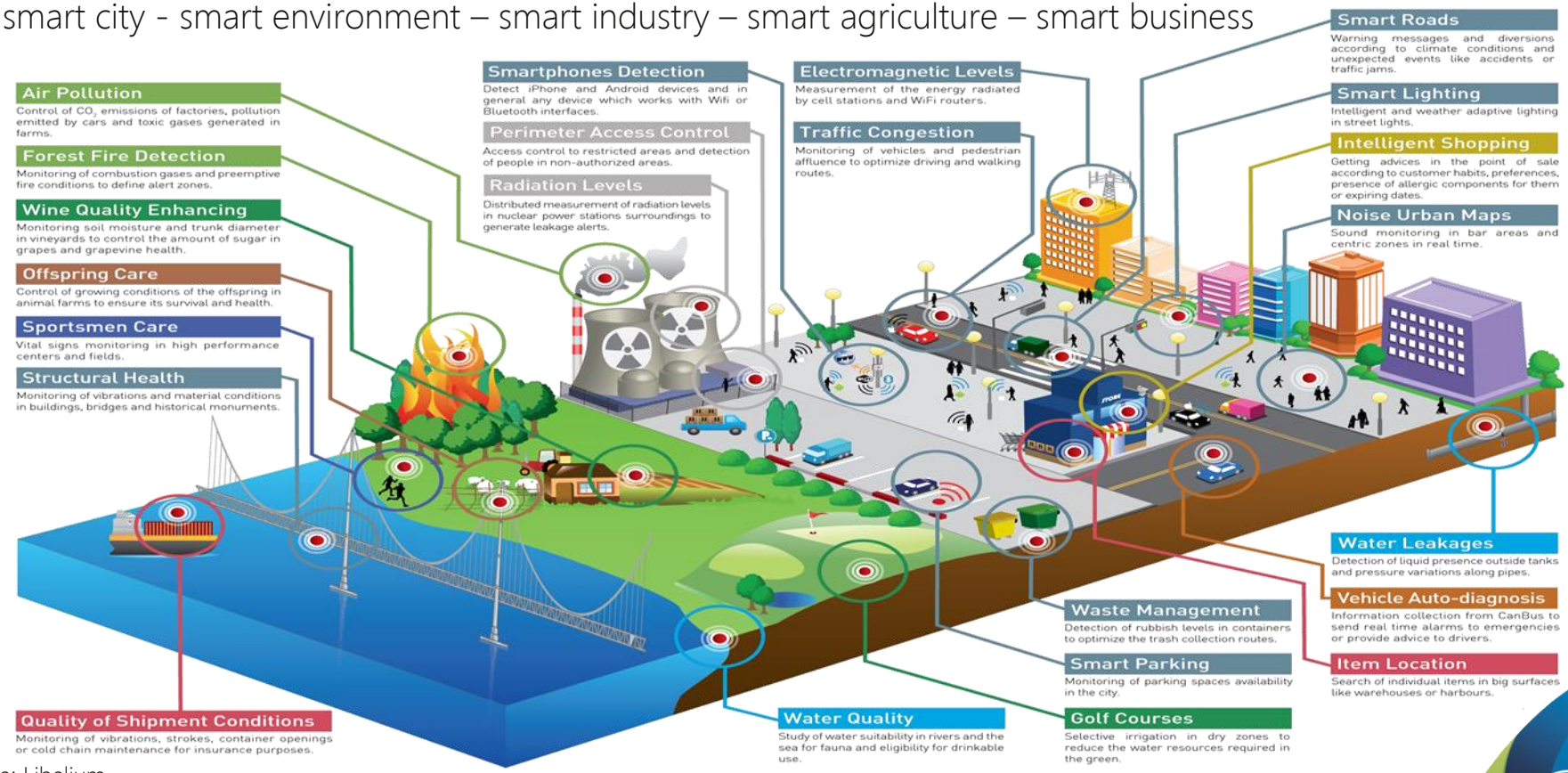
New Operating models and strategies transforming the telecommunication sector



To fully capitalize the IoT opportunity, new challenges have to be addressed

IoT hot apps

smart city - smart environment – smart industry – smart agriculture – smart business

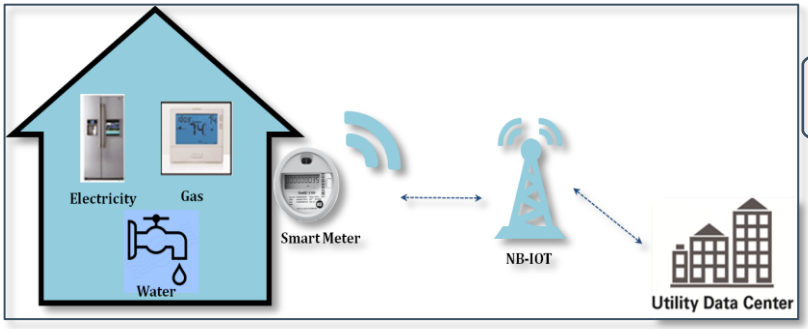


source: Libelium

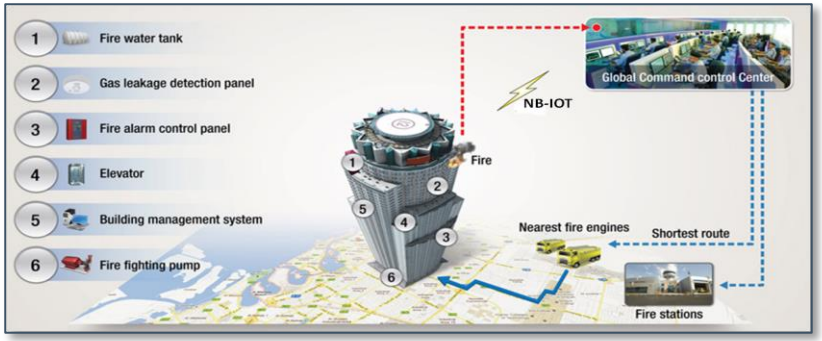
IoT hot apps - Public

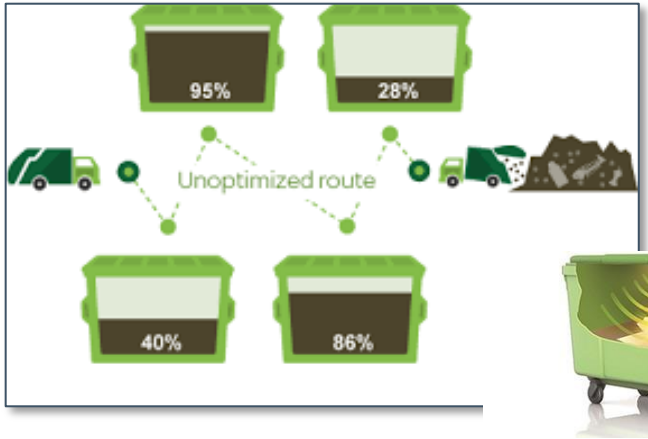
Typical applications & use cases

Alarms & Event Detectors (safety)



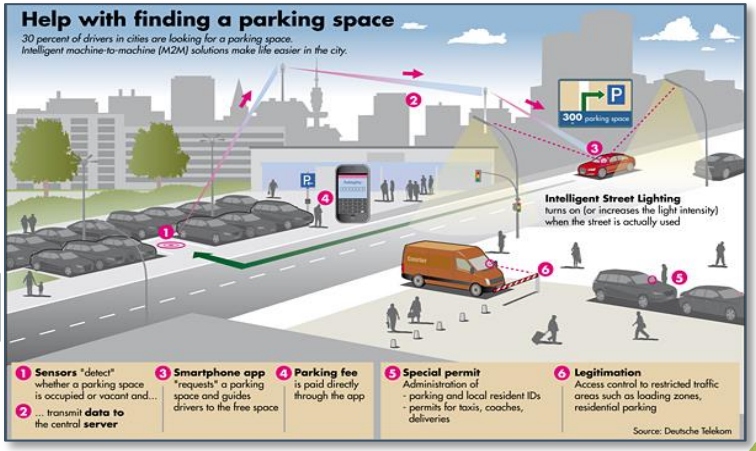
Smart metering





Smart waste management

Smart parking

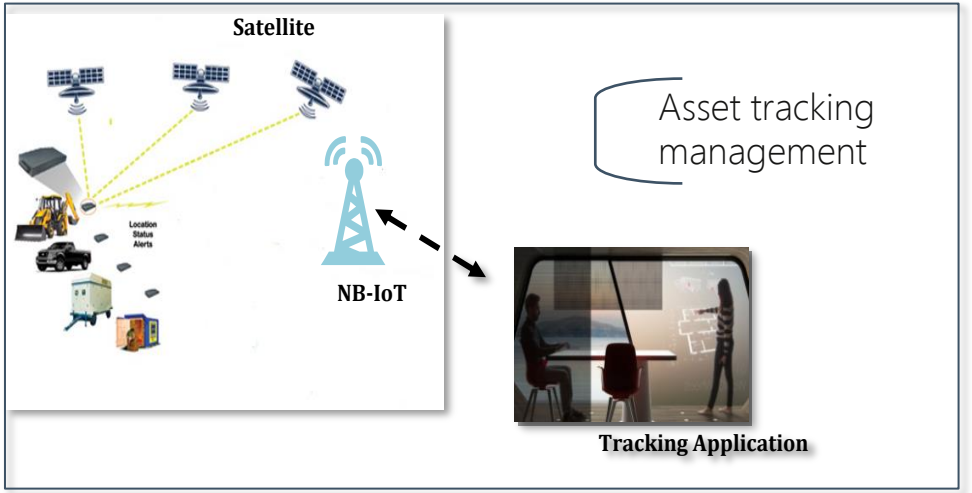


source: Huawei, DT

IoT hot apps - Industry

Typical applications & use cases

Logistics tracking



Asset tracking management

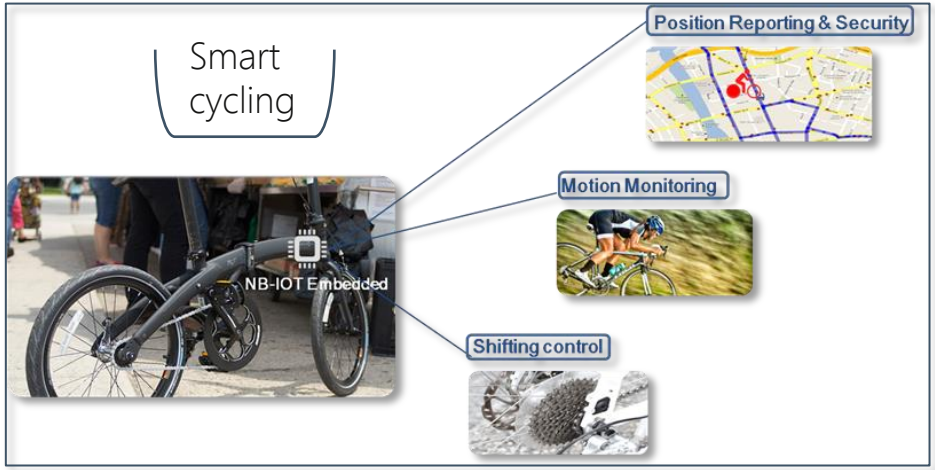
Smart agriculture

source: Huawei

IoT hot apps - Personal

Typical applications & use cases

wearables



Kids monitoring

source: Huawei

Conclusions

Key messages

- Starting as a mobile evolution, 5G will become a revolutionary enabler
- 5G will enable new functionality for people, societies, business & industries
- 5G will facilitate the deployment of huge numbers ,applications of M2M and IoTs
- By imposing new hard technical requirements, 5G will eventually drive to new network structures & architectures (centralized functions together with decentralized, virtual networks, real time processing, etc)
- Network implementation must be supported with fast and simple site permission process promoting the deployment of Macro and Small Cells. EMF limits to align with ICNIRP (EU recommended levels) in order to introduce new technologies (5G)
- But as long as 5G standardization progresses, 4G makes the necessary convergence steps, preparing the smooth adaptation of the new ecosystems:
    - Preparing the Gigabit Society > 1Gbps will be available with LTE advanced technology (trials FE2016)
    - Initiating the IoT market by launching the new NB-IoT standard

The new era is starting just now!

Thank You!