

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 Mobile network is constantly expanding in order to provide fast Mobile Internet in more points than any other network!

> **98%**

Population
Coverage 4G

> **92%**

Geographical
Coverage 4G

> **97%**

Sea
Coverage 4G

> **92%**

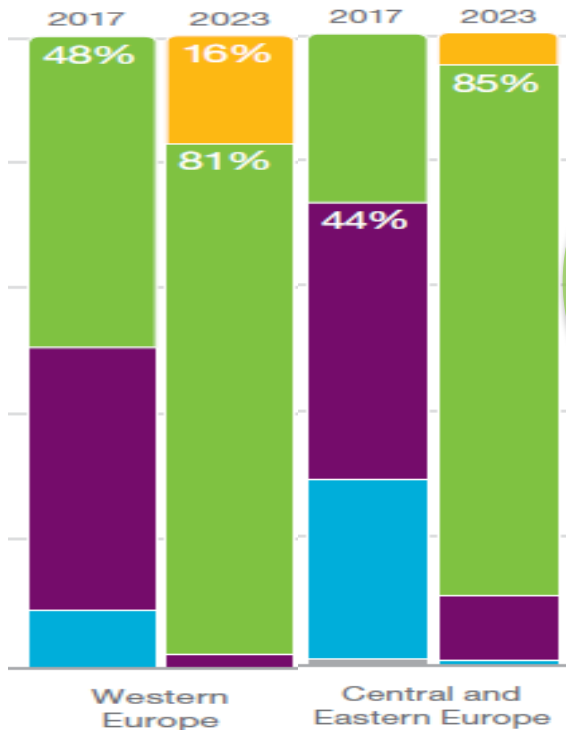
Population
Coverage 4G+

> **€2** BIL.

Investments in new generation
networks since 2012

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!

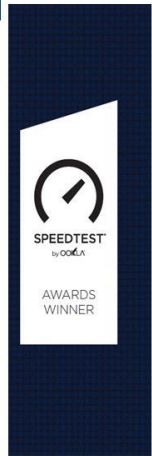


P3 communications GmbH
Am Kraftversorgungsturm 3, D-52070 Aachen, Germany

hereby certifies that

cosmote
Cosmote Mobile Telecommunications S.A.
Kifissias Av 99, Marousi, PO 15124
Athens, Greece

achieved „Best in Test“ with a
Total Score of 843 of 1000
in the **Mobile Benchmark Greece 10/2017.**
(Score 336 of 400 in Telephony, Score 507 of 600 in Data Services)



Greece's Fastest Mobile Network

COSMOTE

IS HEREBY NAMED THE 2017 AWARD WINNER FOR FASTEST CARRIER BY OOKLA IN RECOGNITION OF PROVIDING THE FASTEST SPEEDS FOR THE Q2-Q3 AWARD PERIOD.

Given on
October 13th
2017

AWARDED BY

Doug Suttles
CEO

COSMOTE
Best MBB
Network
(OOKLA & P3)

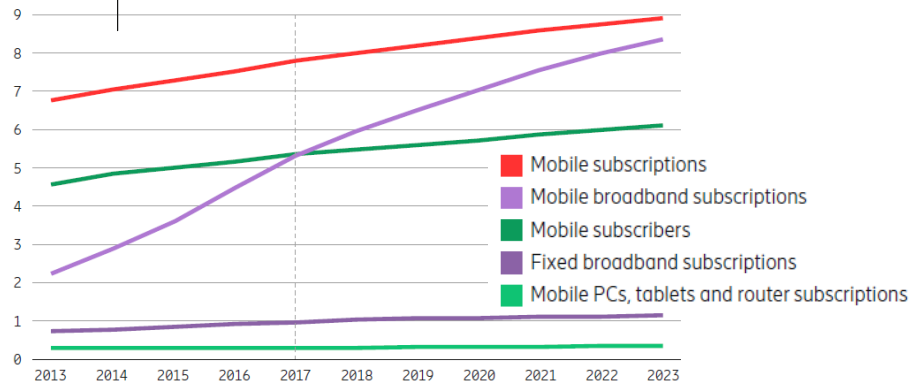
Global Mobile Broadband Facts

Subscribers and Technology Outlook

By 2023 there will be:

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

Subscriptions/ lines, subscribers (bl)

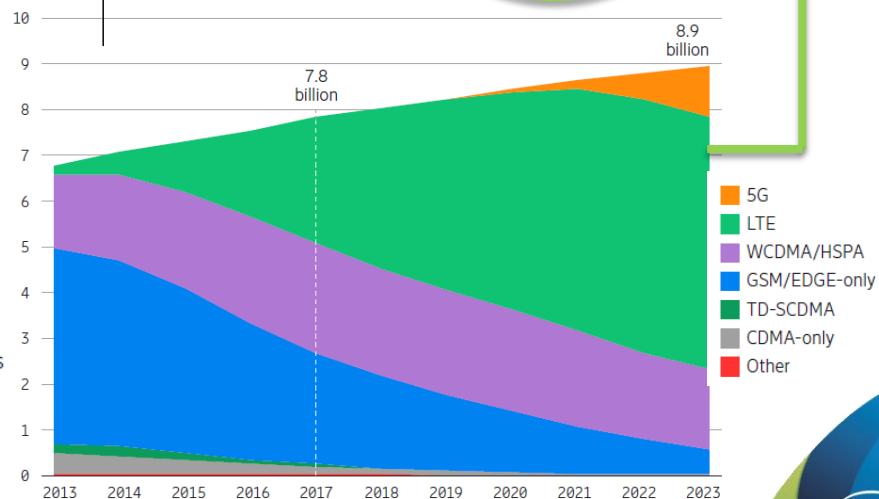


source: ERICSSON mobility report - November 2017

Super-fast LTE adoption

>60%
LTE
Subscriptions
footprint

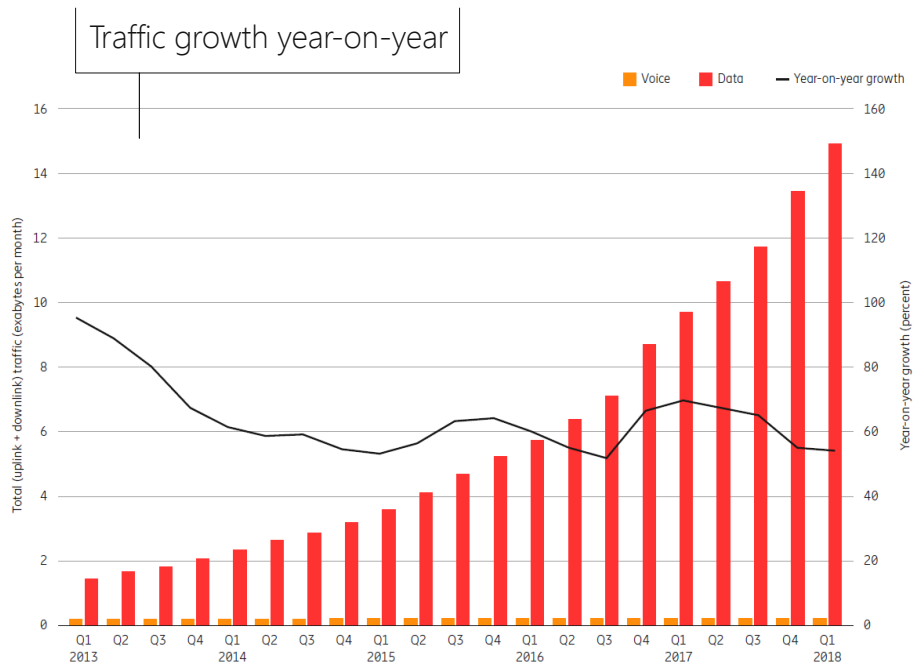
Mobile subscriptions by technology (billion)



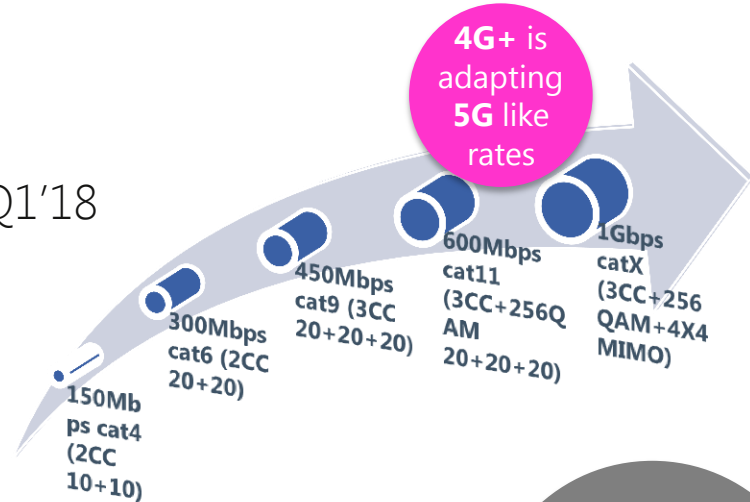
Global Mobile Broadband Facts

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

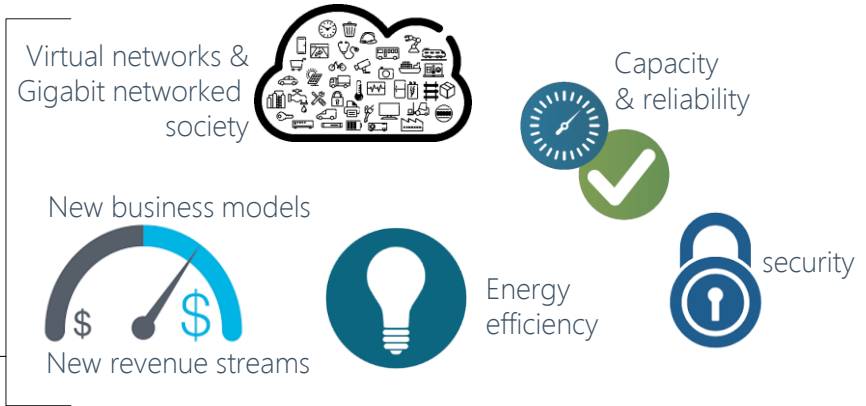
FYE2023 ~20% of MBB traffic will be from 5G networks

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



5G Evolution

or revolution?



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:

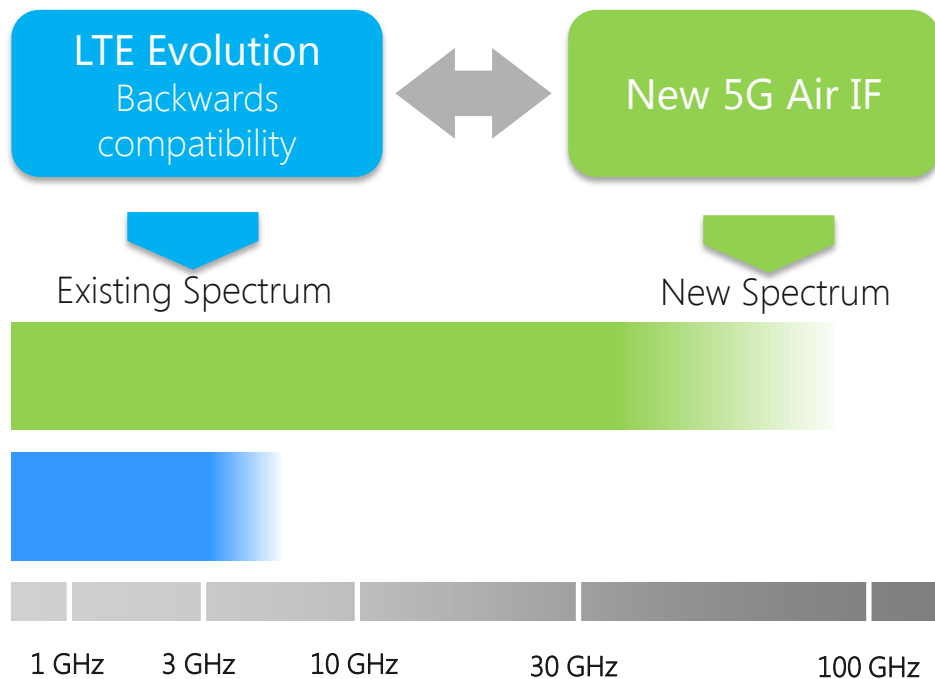
5G, mobile operators would create a blend of pre-existing technologies covering 2G, 3G, 4G, Wi-fi to allow higher coverage and availability, with greater connectivity enabling Machine-to-Machine (M2M) services and the Internet of Things (IoT). This vision include a new radio technology to enable low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

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

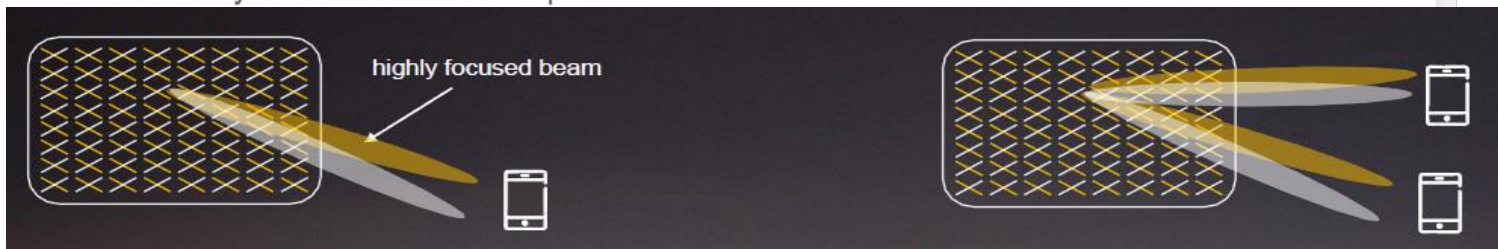
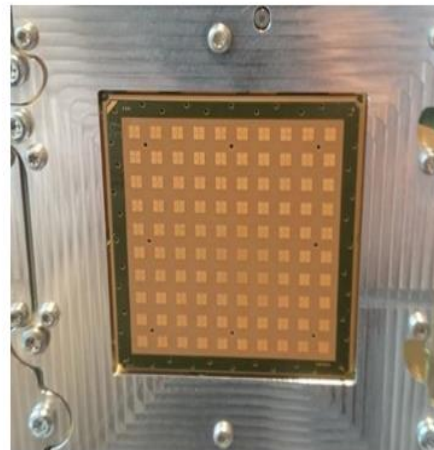
EMF challenges for 5G

› 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)

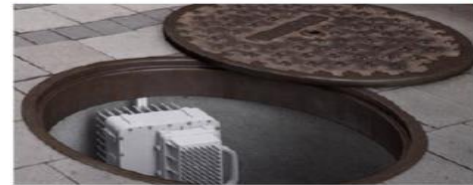


Typical Micro Layer

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



Street furniture sites



Vault site

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.

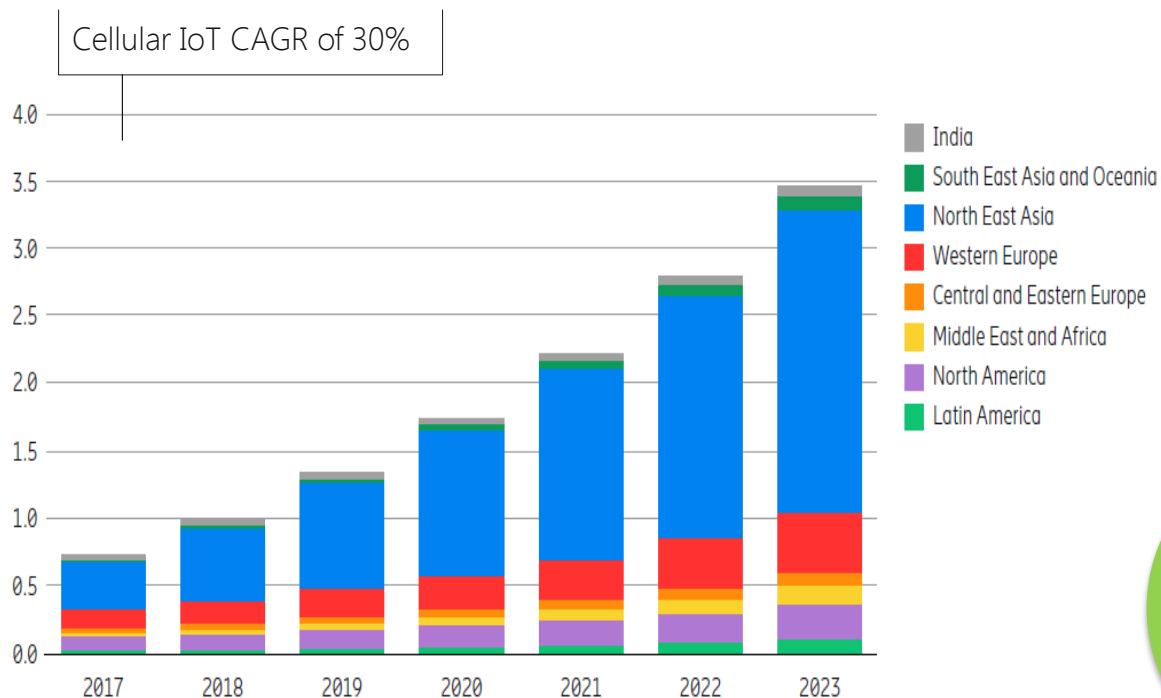
Street Furniture sites, vault sites! Need to educate both the Authorities and the public.

EMF compliance for 5G networks is a challenge considering

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

IoT market outlook

3.5 billion cellular IoT @ 2023



source: ERICSSON mobility report - November 2017

Half of connected devices by 2023 will be IoT-related

Cellular IoT connections expected to go x5 by 2023

Cosmote included in the twenty networks commercially deployed by Eo2017

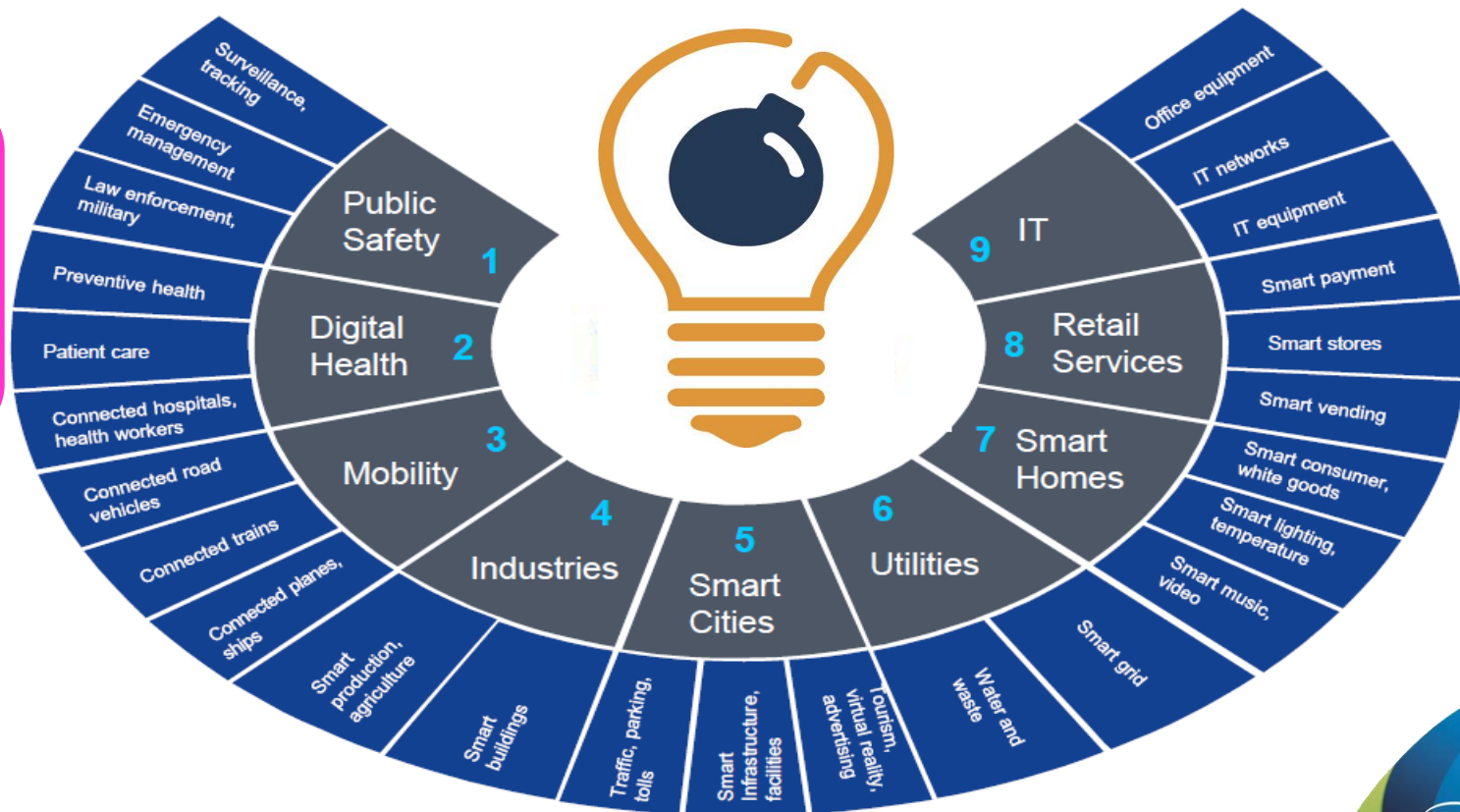
Cellular Networks main market is on Wide-Area IoT

IoT industry re-shaping

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

IoT transforms:

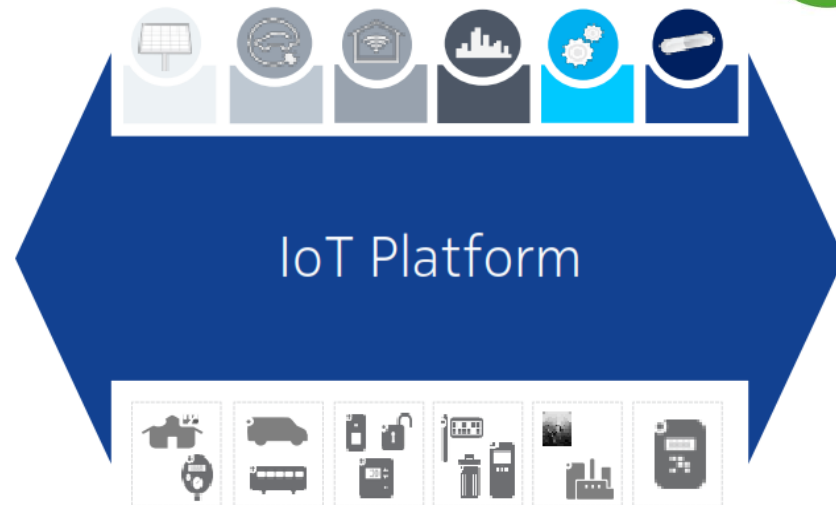
- business models
- value chains
- business config's



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?



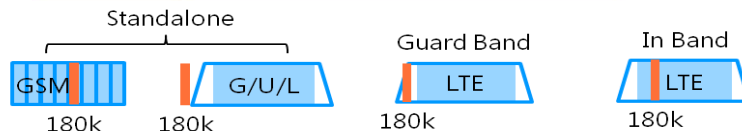
- **NB-IoT**, is a new narrowband radio technology to address the requirements of the Internet of Things (IoT)
- The new technology will provide improved indoor coverage, support of massive number of low throughput devices, low delay sensitivity, ultra-low device cost, low device power consumption and 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

Provide Connectivity

Low ARPC, volume use cases as metering and tracking

Connection management platform in the cloud

Operate NB-IoT Network as a service

ARPC increased due to the opportunity to generate service revenue

Provide full NB-IoT network functionality in the cloud

Support Big Data solutions for enhancing user experience

Move up to value chain

Much higher ARPC possible
Due to deeper engagement in service integration and delivery

Competition with OTT and IT solutions require fast and flexible service definition and delivery

New Operating models and strategies transforming the telecommunication sector

Robust connectivity:
Latency, availability, coverage

1

Standardization:
Standard connectivity for billions of things

2

Interoperability and open interfaces:
Enabling platforms to talk with each other

3

Privacy and security:
Prevent malware injection and data misuse

4

Domain knowledge:
Deep, vertical-specific insights

5

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

Air Pollution

Control of CO₂ emissions of factories, pollution emitted by cars and toxic gases generated in farms.

Forest Fire Detection

Monitoring of combustion gases and preemptive fire conditions to define alert zones.

Wine Quality Enhancing

Monitoring soil moisture and trunk diameter in vineyards to control the amount of sugar in grapes and grapevine health.

Offspring Care

Control of growing conditions of the offspring in animal farms to ensure its survival and health.

Sportsmen Care

Vital signs monitoring in high performance centers and fields.

Structural Health

Monitoring of vibrations and material conditions in buildings, bridges and historical monuments.

Quality of Shipment Conditions

Monitoring of vibrations, strokes, container openings or cold chain maintenance for insurance purposes.

Smartphones Detection

Detect iPhone and Android devices and in general any device which works with Wifi or Bluetooth interfaces.

Perimeter Access Control

Access control to restricted areas and detection of people in non-authorized areas.

Radiation Levels

Distributed measurement of radiation levels in nuclear power stations surroundings to generate leakage alerts.

Electromagnetic Levels

Measurement of the energy radiated by cell stations and WiFi routers.

Traffic Congestion

Monitoring of vehicles and pedestrian affluence to optimize driving and walking routes.

Smart Roads

Warning messages and diversions according to climate conditions and unexpected events like accidents or traffic jams.

Smart Lighting

Intelligent and weather adaptive lighting in street lights.

Intelligent Shopping

Getting advices in the point of sale according to customer habits, preferences, presence of allergic components for them or expiring dates.

Noise Urban Maps

Sound monitoring in bar areas and centric zones in real time.

Water Leakages

Detection of liquid presence outside tanks and pressure variations along pipes.

Vehicle Auto-diagnosis

Information collection from CanBus to send real time alarms to emergencies or provide advice to drivers.

Item Location

Search of individual items in big surfaces like warehouses or harbours.

Waste Management

Detection of rubbish levels in containers to optimize the trash collection routes.

Smart Parking

Monitoring of parking spaces availability in the city.

Golf Courses

Selective irrigation in dry zones to reduce the water resources required in the green.

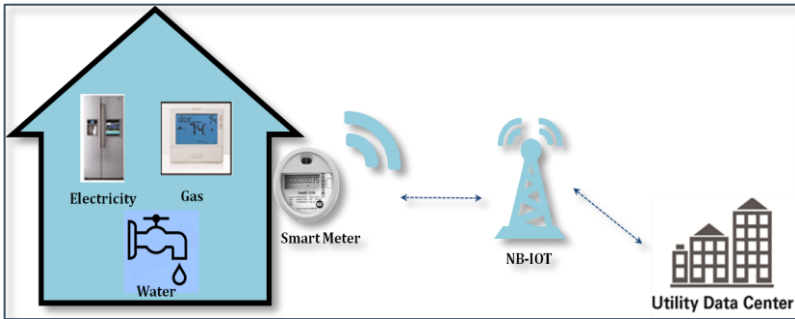
Water Quality

Study of water suitability in rivers and the sea for fauna and eligibility for drinkable use.

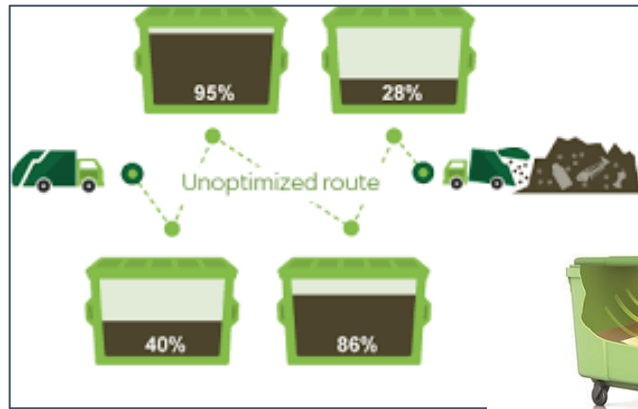
source: Libelium

IoT hot apps - Public

Typical applications & use cases



Smart
metering

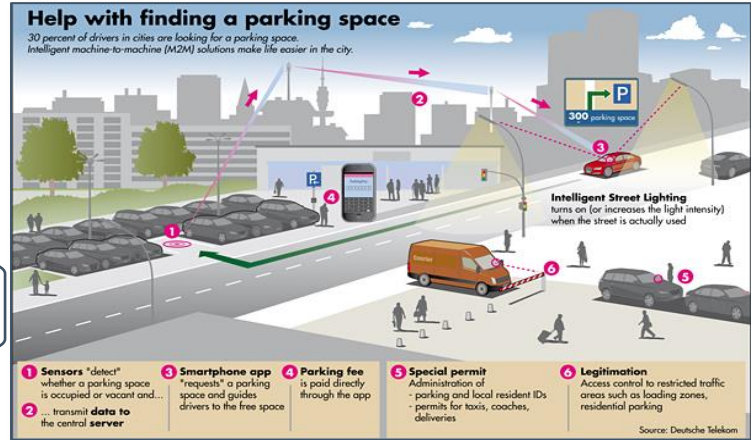


Smart
waste
management



Smart
parking

Alarms & Event Detectors (safety)



source: Huawei, DT

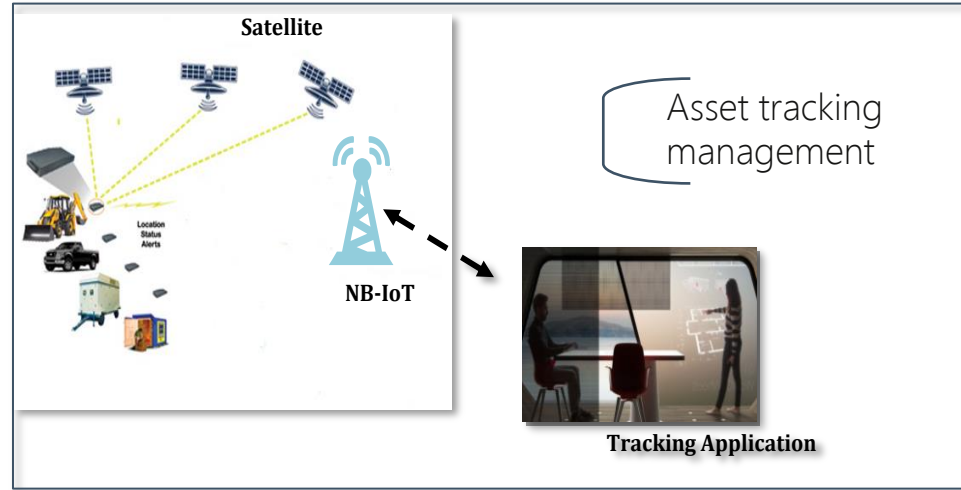
IoT hot apps - Industry

Typical applications & use cases



Logistics tracking

Smart agriculture



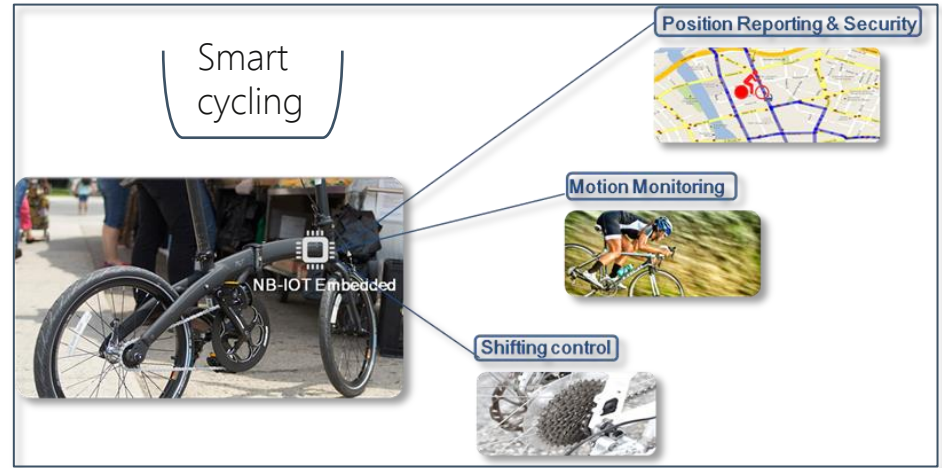
source: Huawei

IoT hot apps - Personal

Typical applications & use cases



wearables



Kids monitoring



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!