



5G OPPORTUNITIES & CHALLENGES

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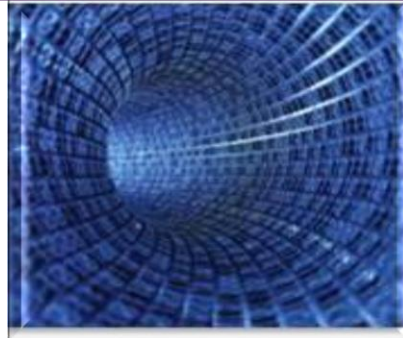
OUR MARKET IS UNDERGOING FUNDAMENTAL CHANGE

Digitization
is everywhere



The rise of digitization changes the way we live our lives – impacting how we communicate, are entertained, shop, work, play...

Customers
are ever-more
bandwidth hungry



Customers demand ubiquitous, high-speed connectivity enabling secure access to digital services from any device, anywhere

A new breed of **competition**
has emerged



New entrants in the markets bring communication services, digital content platforms, apps and virtualized ICT solutions with increasing speed

Technology
revolution changes the
game



Moving towards software-defined, virtualized future and co-creation in global ecosystems will change the business in our industry



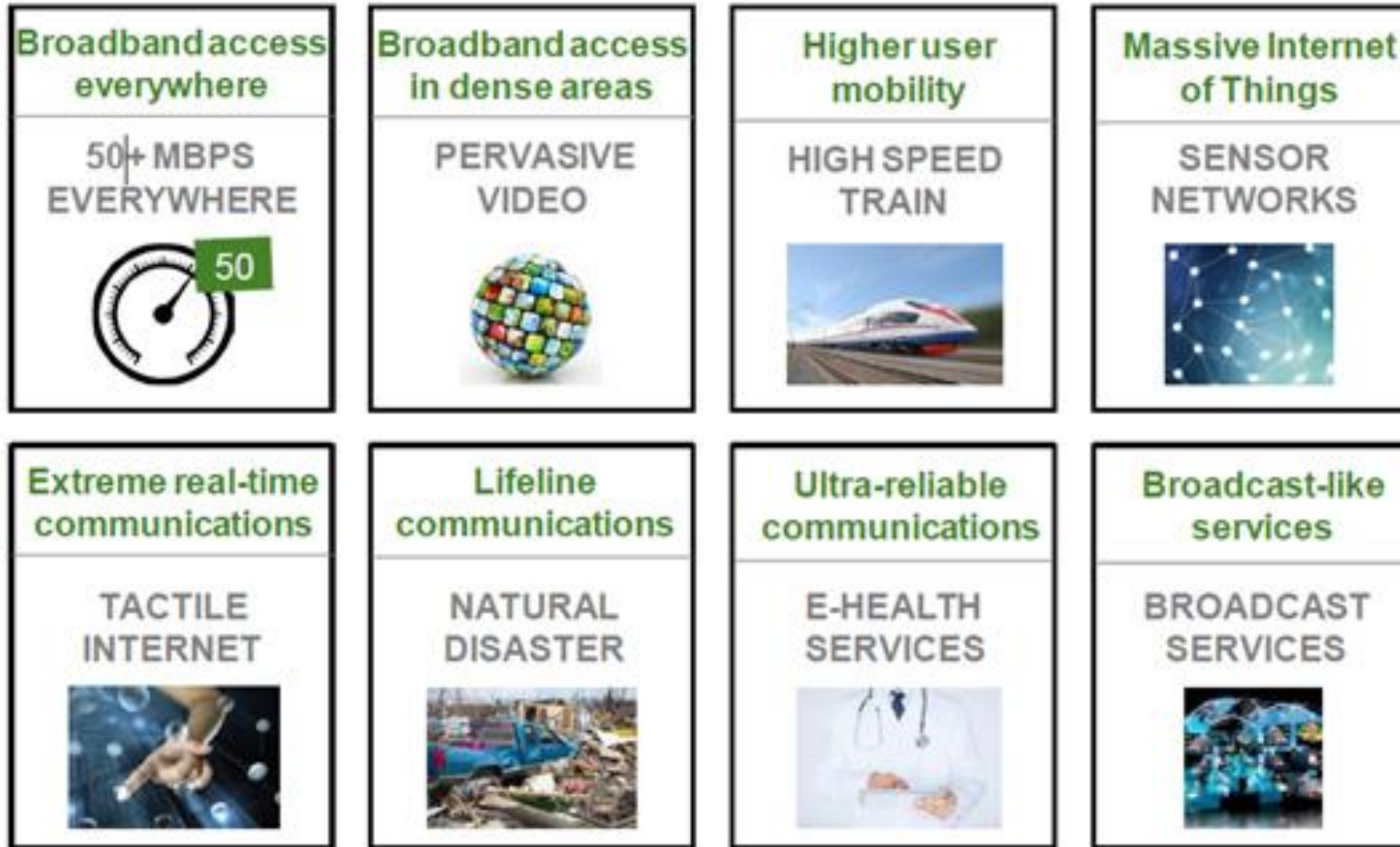
5G IS NEW & DIFFERENT



USAGE	Voice	Voice&Data	Mobile broadband	Multi purpose
DRIVER	Technology	Technology	Technology	Customer needs & Innovation
ECOSYSTEM	No	Limited	Getting there	BIG!
TAKE-OFF	Devices	Devices & apps	Devices & apps	IoT and tons of other things
SYSTEM DESIGN	For specific services	For specific services	For specific services	Dynamic to support a wide range of services.



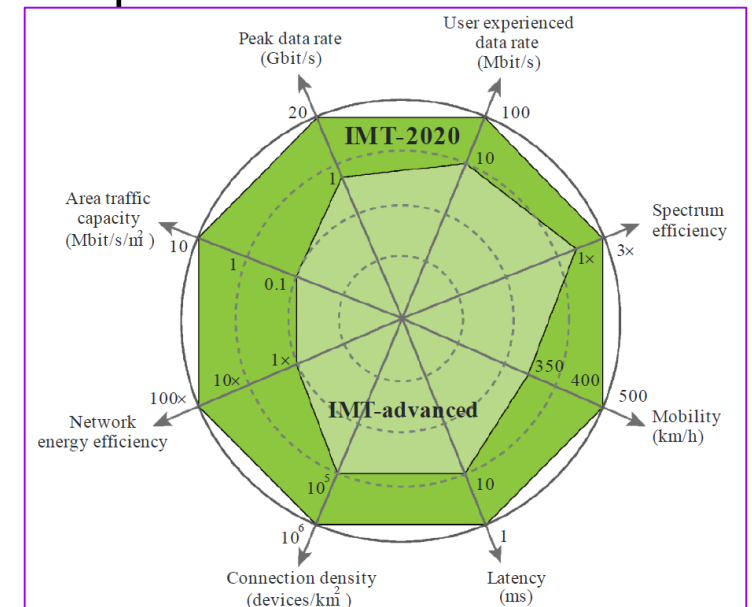
5G USE CASES



5G COMPARED TO 4G – MUCH MORE THAN A NEW RADIO TECHNOLOGY

- Design based on Virtualisation
- Architecture that supports Fixed-Mobile Convergence
- Architecture that supports Automation of Business and Operational processes
- Network Slicing – Defined SLA's for each use case
- Support for Multi-Access

*These are to some extent true also for LTE evolution –
But 5G is designed for these from Day 1!*



Comparison between 4G and 5G with respect to the eight key performance indicators (Arcep)



5G TECHNOLOGY KEY COMPONENTS

5G Specific

- New spectrum bands
 - 3.5 and 3.7 GHz the two most important
 - 700 MHz will be needed for LTE
 - 26, 28 GHz 2nd priority
 - Also unlicensed spectrum of interest
- New Radio Access Network
 - Partly based on LTE technology
 - Massive MIMO
 - TDD (and FDD)
 - Cloud-RAN Architecture

Needed with or without 5G

- Telco Cloud
 - NFV/SDN
 - New OSS for real time predictive management
 - Orchestration and automated operations
 - New processes
- Modernised Core Network
 - CUPS Architecture
 - Dual Connectivity
- Modernised Transport Network
 - Automation
 - Support of high data rates and low latency



5G STANDARDS PLAN



5G CHARACTERISTICS

	4G	GAP	5G
THROUGHPUT	100 Mbit/s	10-100x	1-10 Gbit/s
LATENCY E2E	20 ms	20x	1 ms
CONNECTION DENSITY	10 000/km ²	100x	1000 000/km ²
ARCHITECTURE	Defined Nodes	Flexibility	Virtualised Functions
ENERGY EFFICIENCY	“Decent”	100-1000x	Reduced power consumption despite huge traffic growth



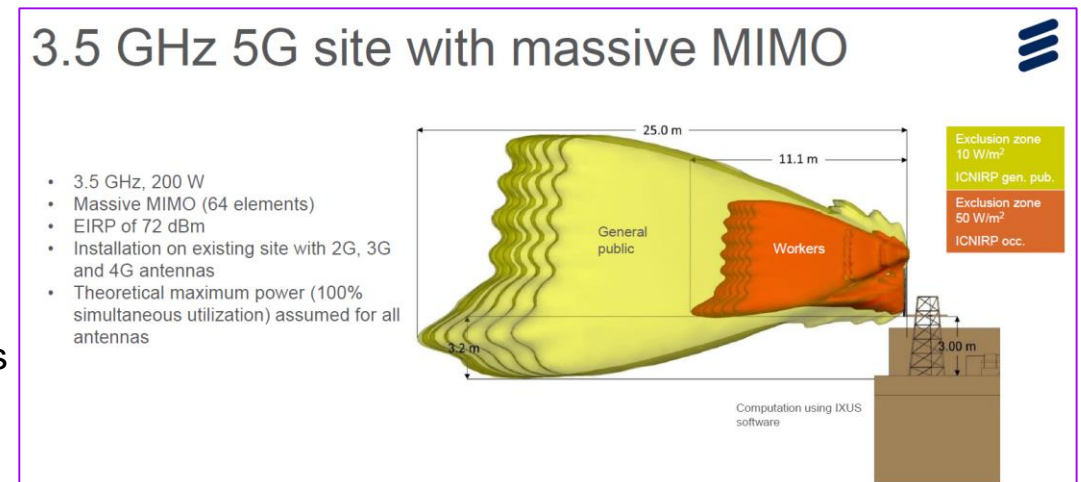
5G CHALLENGES: SPECTRUM

- EU approved frequency spectrum for 5G 700MHz, 3,4-3,8 and 26GHz („5G for Europe: An Action Plan)
- Existing 5G spectrum situation in Lithuania
 - 700MHz allocated to TV until 2022. Possible reallocate TV channels to free up 700MHz for IMT. Existing spectrum utilization is low
 - 3400-3600MHz allocated to WiMAX until 2022. Spectrum needs to be converted from FDD to TDD. Existing spectrum utilization is low
 - 3600-3800MHz allocated until 2028. Spectrum needs to be converted from FDD to TDD. Existing spectrum utilization is low
 - 26GHz few narrowband allocations (good for WiMAX or LTE) already, possible to convert to 5G band
- Spectrum situation in other countries:
 - 700MHz: 2017 Finland, Sweden - 2018, Estonia - 2018, Denmark 2020
 - 3400-3800MHz: Finland and Sweden 2020
- Proposals:
 - 700MHz – review possibilities to optimize existing TV 700MHz spectrum and review 4G/ 5G impact on TV services. Target 700MHz free up date 2020.
 - 3400-3600MHz – review spectrum utilization by existing market players. Create a plan to convert spectrum to 5G readiness.
 - 3600-3800MHz – review possibilities to free up spectrum before 2028.
 - 26GHz / 28GHz – prepare plan for 5G spectrum licenses.



5G CHALLENGES: EMF

- EMF requirement in Lithuania is lowest in EU (1/10 ICNIRP norm, standard in EU)
- 5G technology will use more spectrum, massive MIMO and Beam forming technologies, 2-4 times higher transmitters power, this leads to 10 – 20 times EIRP increase.
- Massive arrival of microsites (x10 more current) seems is not doable with current EMF code.
- Potentially it could stop 5G rollout in Lithuania, because existing ICNIRP didn't correctly calculate higher frequency bands and 5G technology is more complex than existing 2G/3G/4G technologies.
- Proposals
 - Update existing Lithuania EMF requirements according ICNIRP recommendation
 - Update EMF calculation methodology according coming 5G evaluation standards
 - To update and simplify EMF maintenance code according other countries best practices



5G CHALLENGES: OTHER

- Existing E.164 numbering plan was designed based on number of inhabitants for fixed and mobile communications
- Massive IoT deployment will drive additional demand for both E.164 (MSISDN) and E.212 (IMSI).
- According studies will be up to 20 IoT devices per one subscriber by 2030.
- Proposals
 - Create group from industry and regulator to evaluate demand of local numbering plans
- Network Neutrality conflict with 5G traffic prioritisation – necessary for critical services and the “Network Slicing Concept”



5G IS COMING ...