Introduction into 5G Regulation

Detecon International,
Amman, 15.01. 2019

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5G is not just a new RAN standard. It provides new capabilities to support the Digital Economy in combination with other advanced technologies.


Low Latency

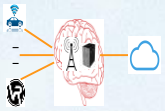

Augmented Reality


Virtual Reality


Network Slicing


Drones


Precise positioning


EDGE Computing


Tactile Internet


V2x


M2M

Network Slicing

New concept for Smart City, Big Players … with high flexibility and scalability

Precise Positioning

High Interest for Car-2-X communications, Drones, Transport or tracking services

Low Latency

AR/VR, drone producers, car industries are relying on latency.

- Logistics
- Manufacturing
- Automotive
- Energy
- Healthcare
- Agriculture
- …

5G standardization is ongoing and first parts have been completed in 2018, key differences in comparison to 4G can be identified.

Selected Features	LTE	5G
① Ultra low latency	10ms to 100ms RTT for User Plane (depending on the area)	1ms RTT for User Plane (applicable in Dense Urban areas)
② Ultra high data rate	100 Mbps in DL - Average 1200 Mbps in DL - Peak	800 Mbps in DL - Average >10 Gbps in DL – Peak … RAN efficiency + large spectrum resource
③ Massive connectivity	2,000 end user devices per km^2	>200,000 end user devices per km^2
④ Ultra high Mobility	Support up to 350 km/h	Support up to 1000 km/h
⑤ Ultra low energy consumption	90% more in network energy usage to 5G (including today NB-IoT)	Up to ten year battery life for low power, machine-type devices

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5G is one of several coexisting access technologies for IoT that is falling under the jurisdiction of Telecom NRAs.

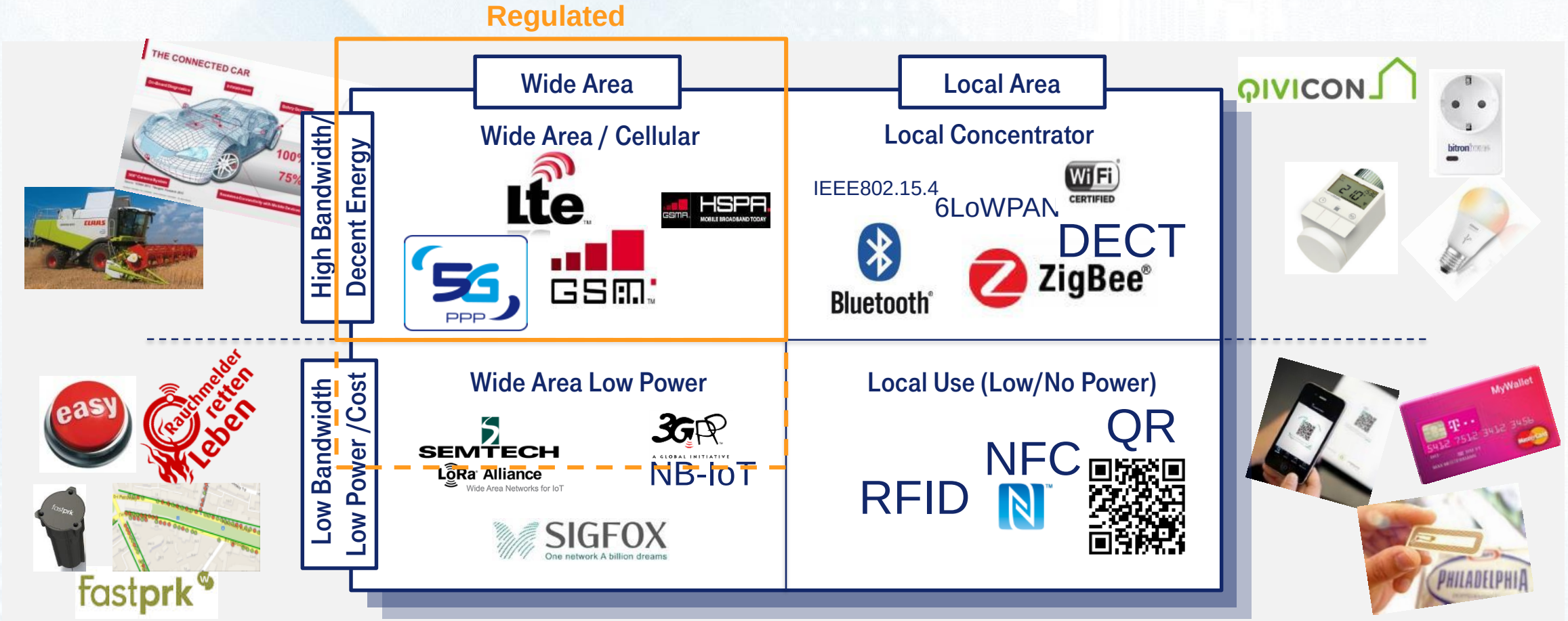

Table of Content

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In a future Industry4.0 environment NRAs increasingly have to co-operate with other Sector Regulators and should initiate ICT related general laws.

Other Vertical Regulatory Authorities | **Telecom National Regulatory Authority** | **“Horizontal” National Legislation**

Co-operation → Initiatives

ICT Ecosystems — enables → Telecom Sector

- Data privacy and security
- Cybersecurity
- Consumer protection (B2C and B2B), including e-commerce and audiovisual media
- Contract law (e.g. M2M contracts, digital signature, liabilities of intermediaries)
- Competition law
- Taxation (double taxation, tax avoidance)
- Intellectual Property Rights / Copyrights
- Education and inclusion in ICT
- ….

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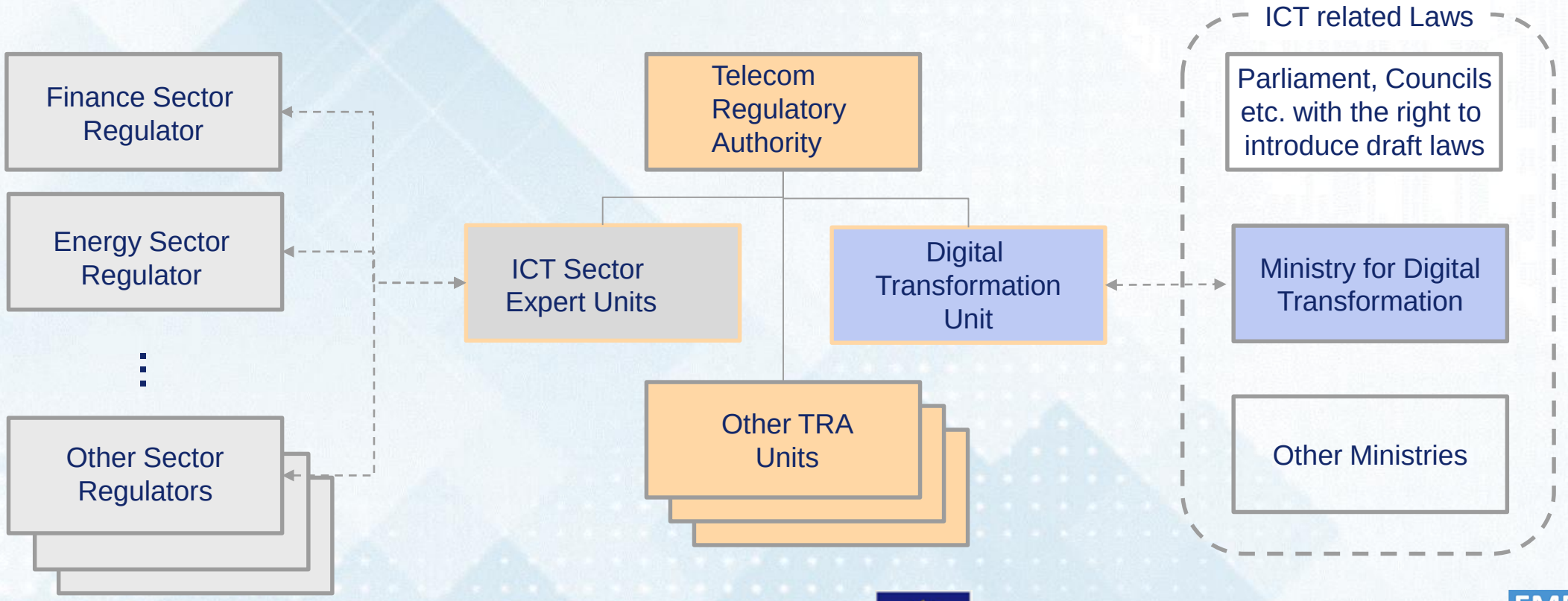
The structure of an NRA should be adapted by creating a horizontal “Digital Transformation Unit” and vertically responsible “Sector Units”.

Organizational Improvements to adapt to Digital Transformation



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Within the future Automotive ecosystem major Telco regulation challenges are only part of the whole picture, but necessary enablers.

Example: Traffic Sectors

Best practice sector regulation in Germany

- (2017) **Traffic Infrastructure Regulation:**
  Several roads opened for testing autonomous driving, in particular motorways in Bavaria and a city route in Berlin. Further to come in other Federal States
- (2017) Automotive Sector: >52% of world wide **patents** about autonomous driving handed in by German Industry

Example: BNetzA (German NRA)

Best practice Telco regulation in Germany

- **Spectrum:** (2015) 270MHz of spectrum in the 700, 900, 1500 and 1800MHz bands have been re-farmed / auctioned.
- **Identifiers: (**2016) permanent extraterritorial use of national numbers for M2M use allowed.
- **Roaming:** (2017) EC decision to abolish international roaming fees within EU
- **Carrier Selection eSIMS:** no decision

Example: Government

Best practice legal development Germany

- 2017: **Ethical** Commission releasing a report with 20 recommendations on **guidelines** for autonomous driving including rules, if an accident cannot be avoided.
- 2017: Minister for Traffic and Transport introduced a change of the **general traffic law** including possibility for automated / autonomous driving
- Many liability issues still unsolved, in particular for artificial intelligence software producers.

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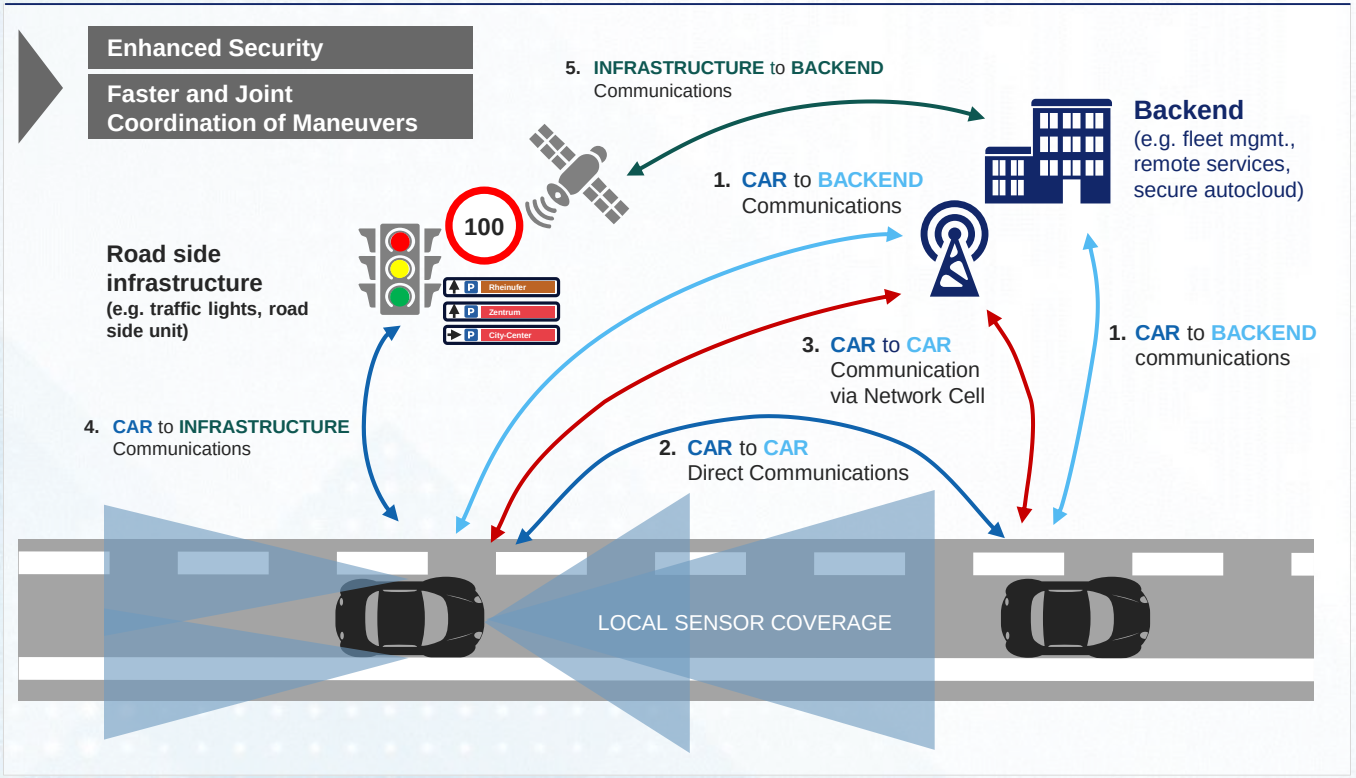
Autonomous cars can drive without communication, but security and economic advantages are significantly enhanced with 5G connectivity.

Key Automotive requirements

Regulatory Tasks

- Global and local mobile broadband area coverage
- Availability
  - High level of Reliability
  - Pro-active information
  - Fall-back solutions to alternative communications
- Global Standards, harmonized frequencies
- Multilevel source of communication and information

Car to X communication overview



There is an exploding number of flying objects where drones are currently not manageable with the existing air-control systems.

Unmanned Arial Systems (UAS) will have potential to revolutionize airspace and rise to a challenge.

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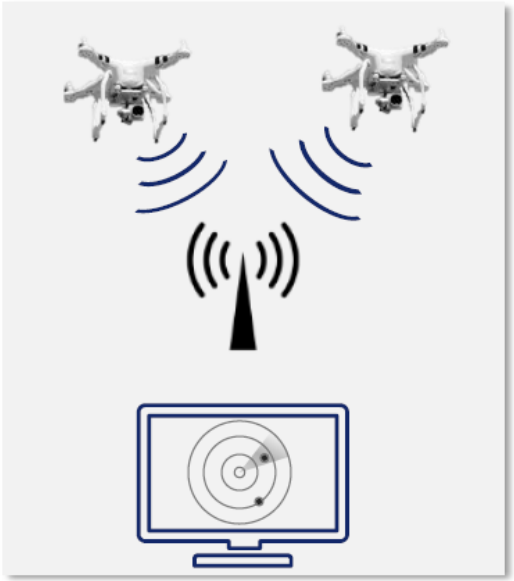
There are basically three challenges that have to be improved in future drone usage and services.

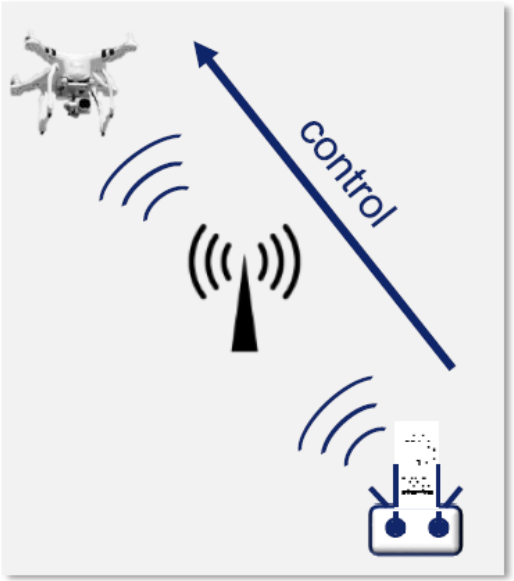
① Air Traffic Management

Make drones visible on the radar



② Remote Operations

Make drones fly beyond visual line of sight



③ Real-time Data Transfer

Real-time transfer & analytics of pictures, videos and sensor data

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Telco networks are the only realistic solution to the problem of full flight path connectivity for BVLOS control of lower altitude drones.

Identity management

- SIM registration solves a similar problem aviation authorities face
- The **drone** can be identified by the International Mobile Equipment Identity Number (IMEI)
- The SIM's International Mobile Subscriber Identify Number (IMSI) can be used to identify the **operator.**

Flight planning /authorization

- A Digital planning process with integration to airspace authorities can be implemented by Telco's.
- Standardized and via Smartphone apps
- Telco's have a **client** contract and can identify them

Object tracking/ control

- Ubiquitous network required
- Transceiver on drone
- Location based systems
- Telco's can deal with scale
- Can only track what is registered e.g. Skyzone

Trust/ accountability

- Air traffic controllers would rather deal with a Telco's than individuals for reasons of reputation, trust and ability to pay fines.
- Telco's are hence brokers

GSMA Regulatory Positions on drones

- Where required drones should be equipped with SIM cards and a communications modem
- Regulators should ensure no undue barriers in relation to the use of existing mobile spectrum for drone connectivity.
- A standardized format for uploading restricted airspace and/or designated special zones to drones is recommended
- Minimum cybersecurity requirements are available on drones

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Telco NRAs have to co-operate with Aviation regulators, grouped into International/ Regional/ National and Federal regulators.

International cooperation

International Civil Aviation Authorities (ICAO)

UN Organization → 195 members
(Head office Montreal)

Cross border

European Aviation Safety Agency (EASA)

28 Nations
(Head Office Köln)

National

Federal Ministry for Traffic and Digital Infrastructure

24 authorities on regional level

Federal

…

Some key drone regulations

- First regulations expected 2023 by Remote Pilot Aircraft System Panel (RPASP)

- Amendment of the basic regulation in 2018 responsible for admission and regulation of UAS > 250g
- EASA Opinion No 01/2018 „Introduction of a regulatory framework for the operation of unmanned aircraft systems in the ‘open’ and ‘specific’ categories” of 6th February 2018

- Air Traffic Act, Aviation Security Act
- Regulation on operation of “Unmanned Aircrafts” of 30th Mar 2017

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Table of Content

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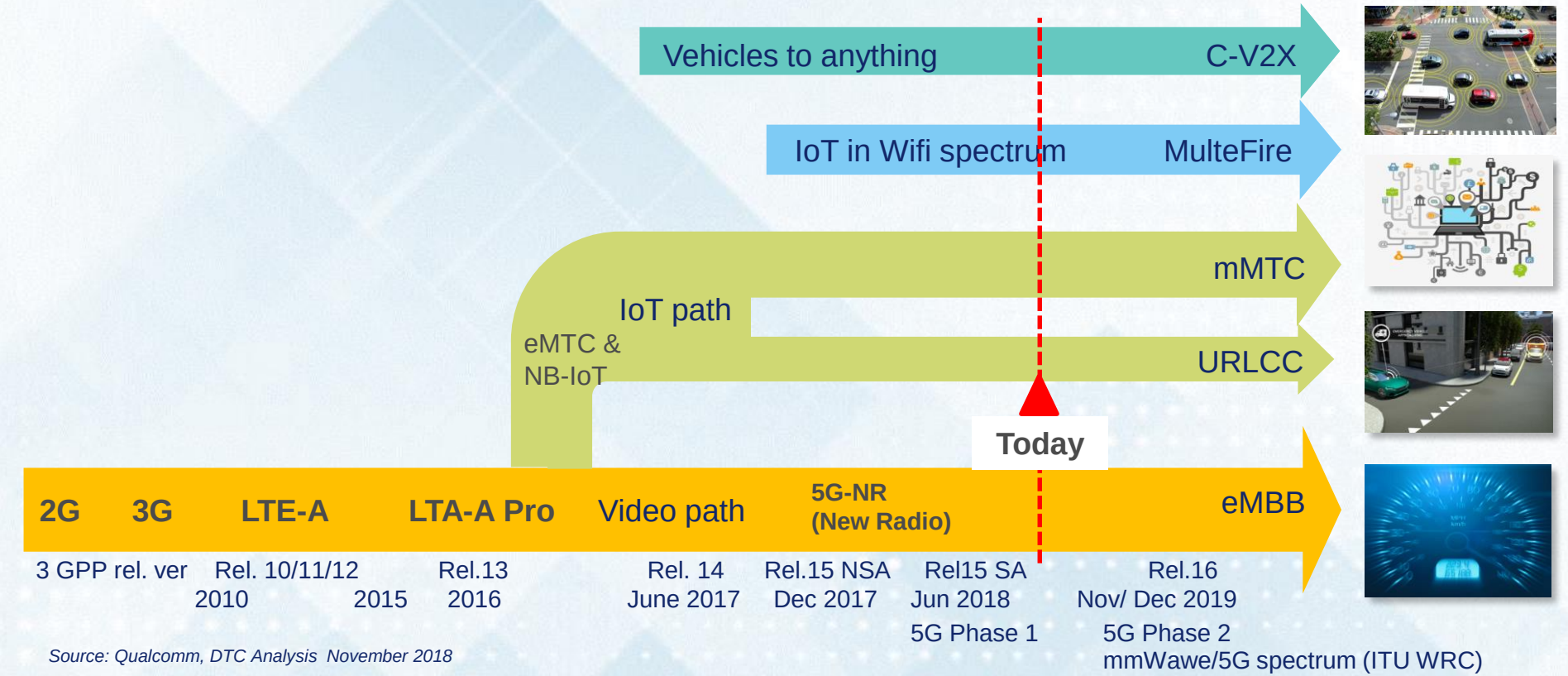
5G Standards are effectively split into two paths: one trying to address IoT and the other Massive Broadband.

Technical Standards Roadmap



Vehicle to Anything

Massive IoT
(billions of connected devices)

Critical Communications
(low/managed Latency, reliability)

Enhanced Mobile Broadband
(up to tens of Gbps)

Source: Qualcomm, DTC Analysis November 2018

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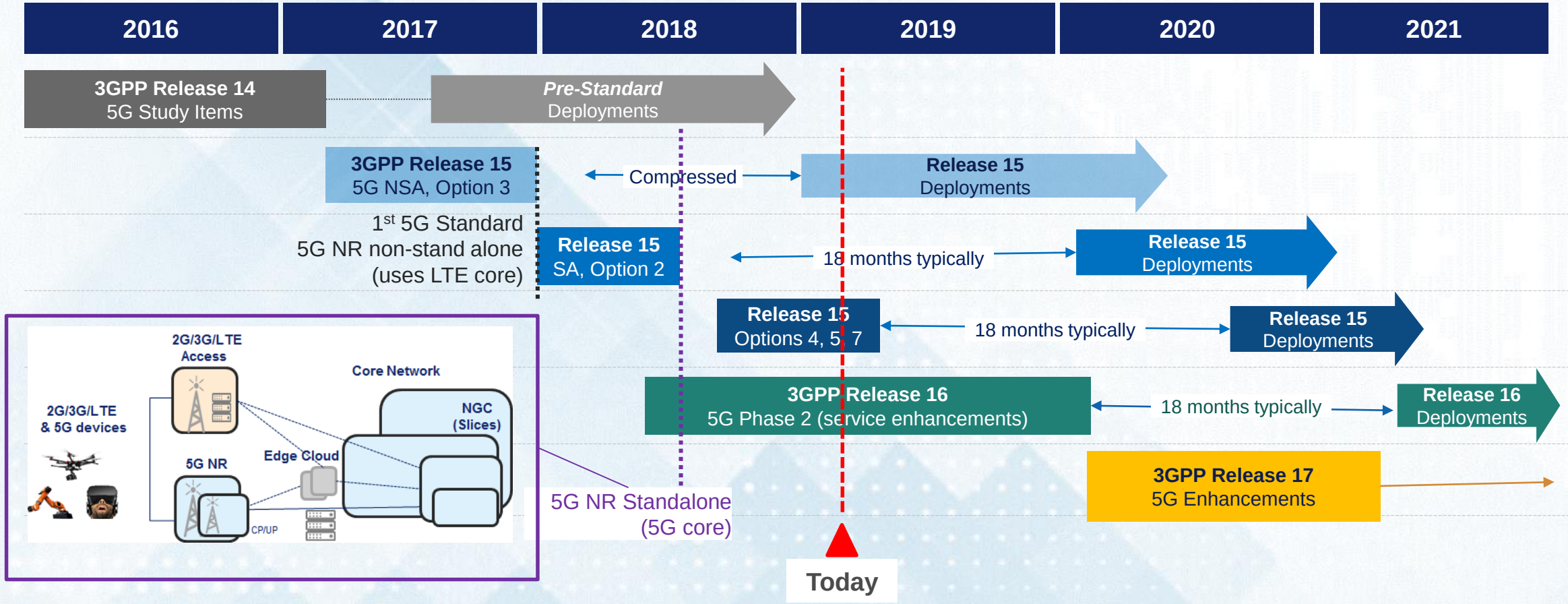
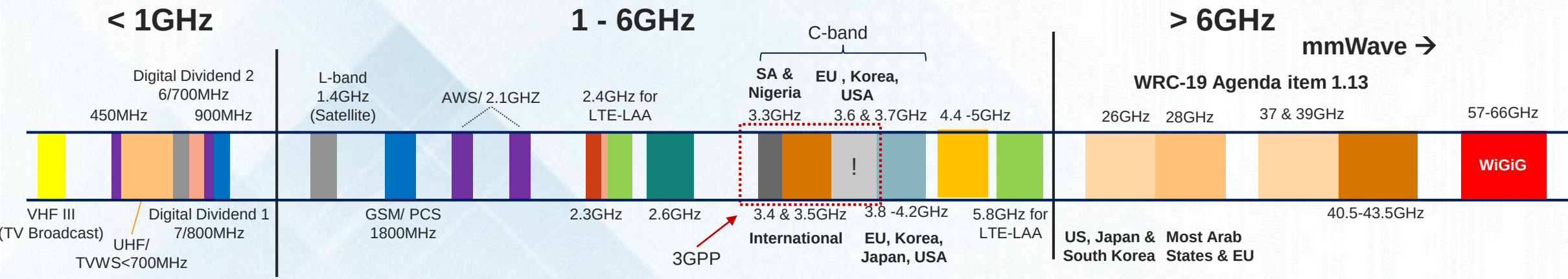
The 3GPP delivered the 1st 5G standard (NSA) in December 2017, with the Stand-alone version "full 5G" in June 2018. Enhancements to follow.



ITU-R's World Radio Conferences are bringing more and more mobile spectrum to market, however all barely usable for area coverage.



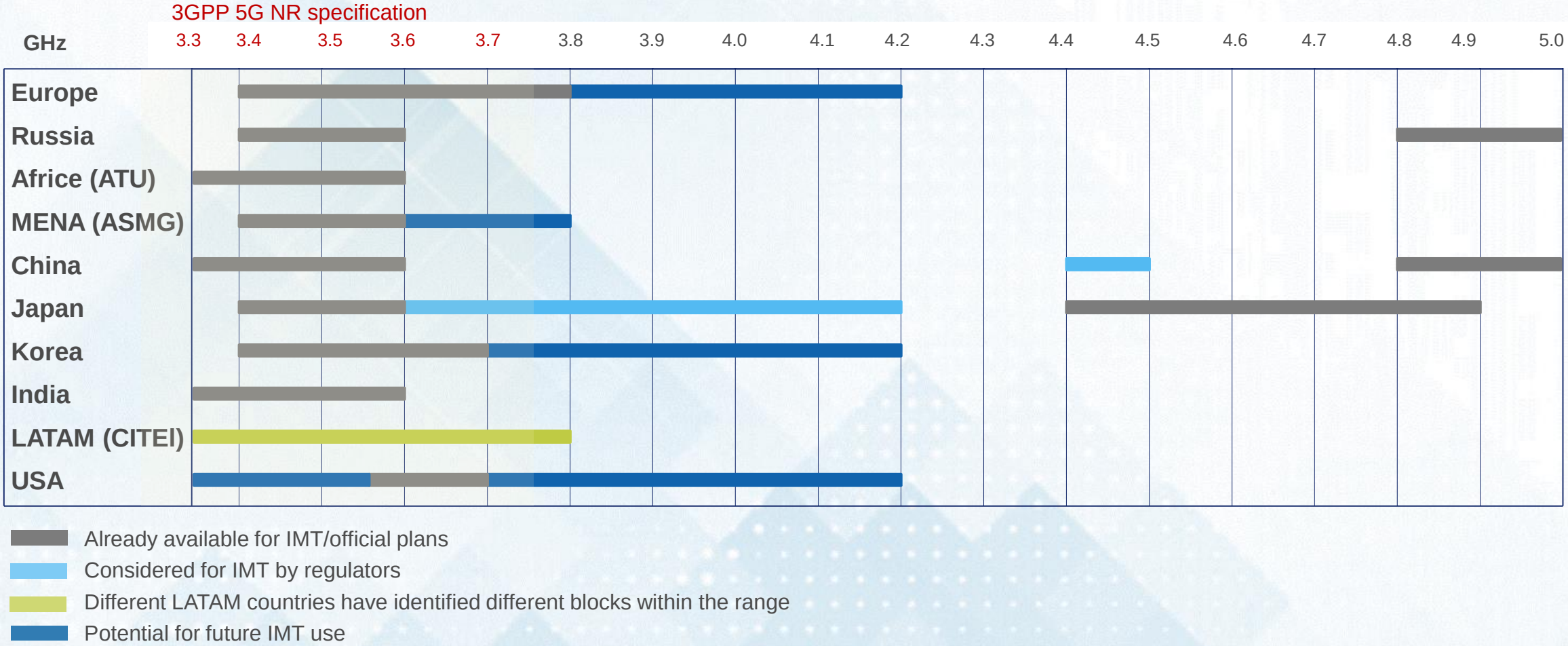
WRC- 15 agreed on two new globally harmonised bands and moved 700 MHz from a regional band (Americas, Asia Pacific) to a global one:

- Three global bands: L-band (1427-1518 MHz), C-band (3.4-3.6 GHz) and 700 MHz
- Regional bands: sub-700 MHz (470-694/8 MHz), Extended C-band (3.3-3.4 GHz)

WRC-19 Agenda Item 1.1.3 will consider the 24 – 86GHz bands
Agenda Item 9.1.2 discuses the use of BSS and coordination with 1452-1492MHz

WRC-23 Agenda Item will re-consider a mobile broadband identification in the sub-700 MHz band (470-694/8 MHz) Europe, the Arab States and Africa

The 3.3 -3.8GHz part of the C-Band is globally the first band to be used for 5G, with little variations between regions.



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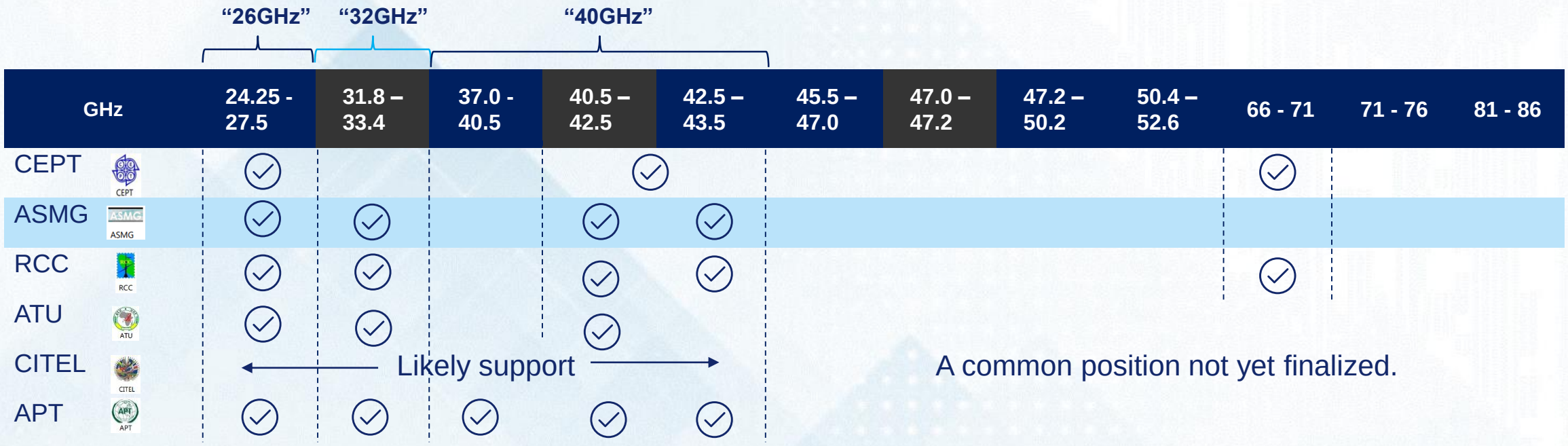
For future 5G usage 26GHz, 32GHz, 40GHz and 66-71GHz likely to receive support at WRC-19 finishing 22 Nov 2019.



"to consider identification of frequency bands for the future development of International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution 238"

Agenda Item 1.13

Seven spectrum ranges in the 24.25 to 86GHz range were selected

Existing mobile allocation | May require allocation to mobile | ☑ Preliminary position

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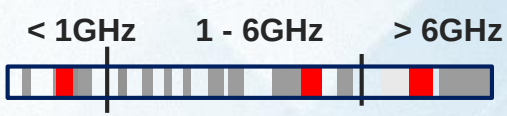
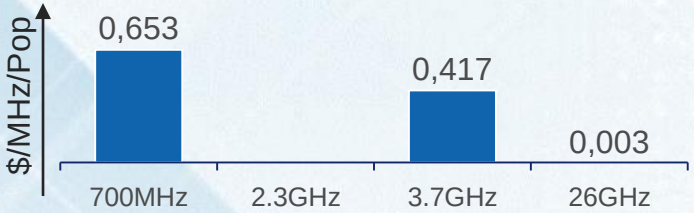
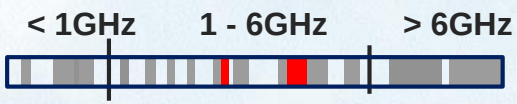
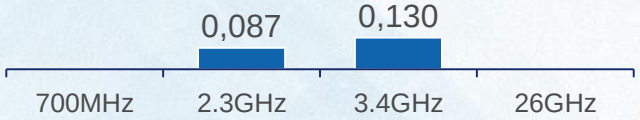
3 Auctions done in 2018 and 89 auctions are planned between 2019 and 2021. High price trends in <6GHz bands, and very low in mmWave.



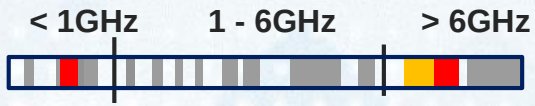


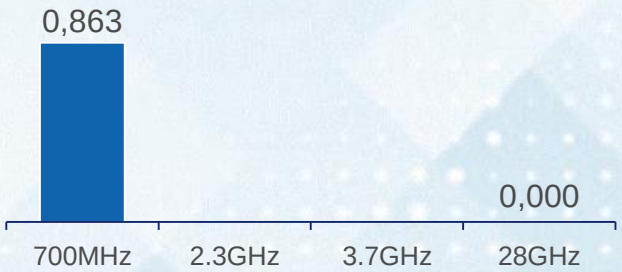
- Italy's 5G auction completed in Oct 2018
- **US$ 7,453bn** (€ 6.55bn)
- US$ 4,95bn (66%) for 200MHz in **3.7GHz** – highest prices
- US$ 2,32bn (31%) for 60MHz in **700MHz**
- US$ 186m (3%) for 1,000MHz in **2.6GHz**





- The UK's First 5G auction completed in April 2018
- **US$ 1,3bn** (15%) for 40MHz in **2.3GHz**
- USUS$ 1,3bn (85%) for 150MHz in **3.4GHz**
- The 3.4GHz band is not available on most current devices
- **700MHz** and **3.6-3.8GHz** band in 2H19 or later





- Began in Nov 2018
- Bids for **28GHz** stand at **US$458.7** for 2x425MHz after 34 rounds
- The regional licences covers only 23% of the population
- Verizon bought StraightPath (28GHz) in 2018 for US$3.1bn
- **24GHz** (7x100MHz) to follow soon
- 600MHz (70MHz) fetched US$19.8bn in Feb 2017

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Massive MIMO – advanced beamforming with multi-user MIMO – is a must in 5G in order to allow the use of mm waves. EMF limits can be exceeded.

Motivation

- In 5G the use of mm waves is under discussion, bands currently used for MW and WiFi systems
- The path loss is proportional to f^2 →Going from the 2.6 GHz band to the 28 GHz band, the path loss increases by a factor > 100

User-specific beamforming is the only solution

- Considerable number of individually steerable antenna elements
- Highly directive beams reduce interference
- Beamforming is the enabler for Multi-User MIMO

Beamforming (illustration)

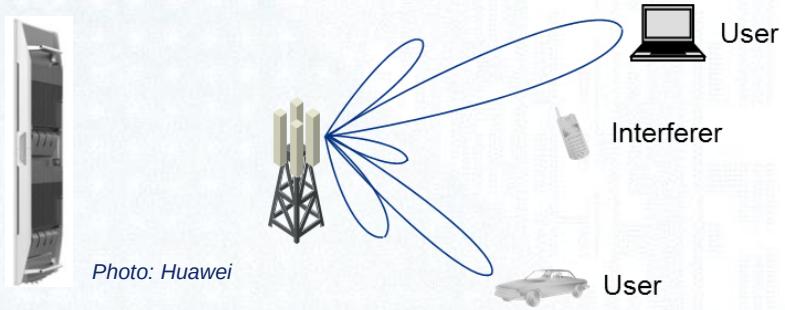

Photo: Huawei

Challenges

- **EMF limits can be exceeded** due to the highly directed beams, thus affecting amount of spectrum to be used per antenna and the output power
- **In particular when several operators would like to share a site**
- Small cells can help with regards to EMF limits however will demand a lot of fiber connectivity
- Antenna dimensions can have an **impact on possibility of placement on site** (especially in sharing case)

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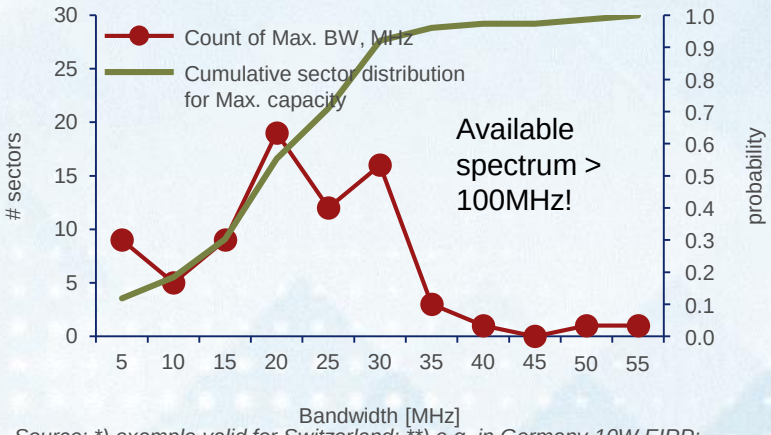
The impact of EMF* on a shared 5G network is significant. Stringent EMF rules in some EU countries may limit mMIMO, especially in a sharing case.

Current EMF limitations

- EMF limitations typically limit the maximum spectrum to be used on sites
- The spectrum headroom distribution will be estimated based for the cost analysis of the shared network deployment assuming 3 V/m per antenna (rad. element)

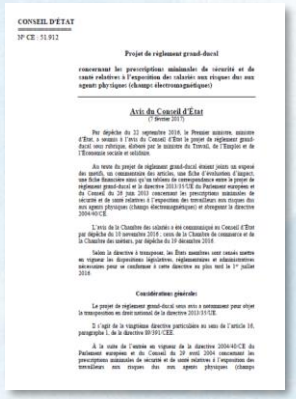
Example: # of sectors with bandwidth headroom due to EMF restrictions*



*Source: *) example valid for Switzerland; **) e.g. in Germany 10W EIRP;*

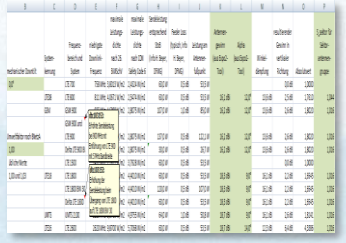
Target EMF limitations *(under discussion)*

- Operators are currently checking and preparing with arguments for the plausible EMF limits that will still enable a practical deployment of 5G massive MIMO nodes


CONSEIL D'ÉTAT

Projet de règlement grand-ducal

Avis du Conseil d'État



EMF = electromagnetic field

Small Cells

- Small Cells often fall below any EMF limitation requirements**
- The feasibility of small cells as one measure for keeping EMF limitations while addressing the traffic demand

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Roll-out of new 5G networks are facing the same general competition policy considerations as always, but with a slightly different focus.

Market failure and justification of regulation in Telecommunications

- **Externalities in Telco networks**: Broadband coverage increases GDP but not necessarily the Telco operator profit.
- **Natural Monopoly**: In particular in low density areas high fixed costs of telco infrastructure lead to a situation, where demand at market prices allow only one operator to be profitable, in some areas even no one.
- **Bottleneck Resources**: Spectrum is a non renewable resource restricting the number of possible RAN operators to a small oligopoly.
- **Social and political objectives**: For reass beyond pure economic rationale like availability of emergeonncy services, freedom of information, participation in e-government services, privacy, education, etc. governments might wish to have a telco offering also in unprofitable segments.
- **5G applications:** Some important applications for 5G like autonomous driving will only work if a high area coverage can be guaranteed.

Options to foster Telco Invest

- Profit gap financing in unprofitable regions
- **Mandatory infrastructure sharing (passive, active, roaming)**
- National public broadband network
- **Wholesale-only open access network with PPP contract**

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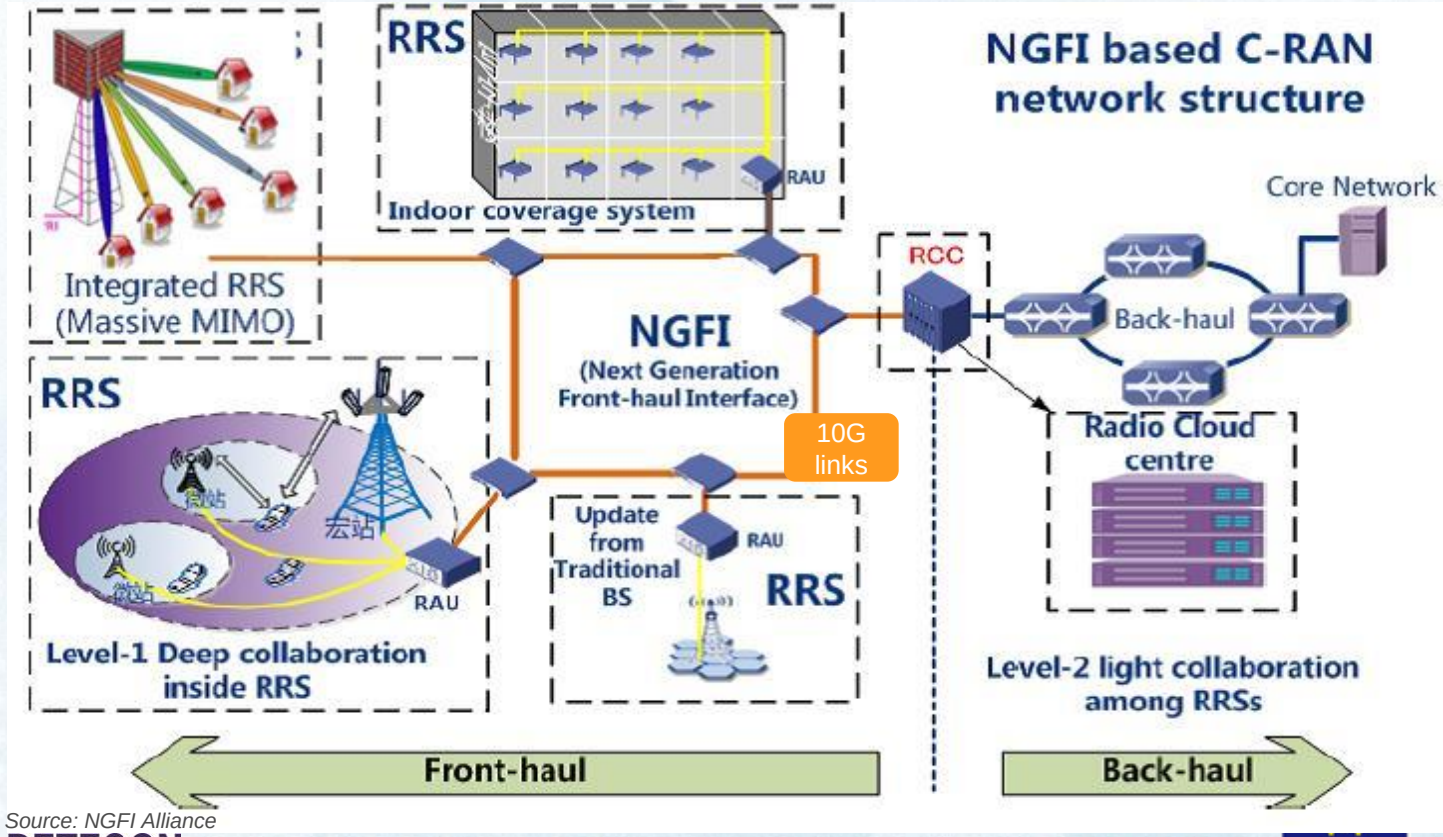
The new functional split in 5G of the baseband processing and the radio units will demand fronthaul as well as backhaul sharing.

C-RAN Radio Network Architecture Based on NGFI



Source: NGFI Alliance

Comments

- In 5G it is expected to have a functional (protocol) split of the traditional radio base station architecture
  - **Different deployment scenarios, in particular in network sharing context (fronthaul sharing)**
  - Massive MIMO combined with significant amount of spectrum will require high capacity links (10G and up)
  - Fiber connectivity becomes mandatory since copper and MW links have their limits ~ 1Gbps
  - Mobile-only operators most likely will not be able to finance a “backhaul” infrastructure, which is basically an FTTB network in all high-density settlements.
  - **Mandatory network sharing may be a regulatory instrument to prevent an even stronger concentration of MNOs.**

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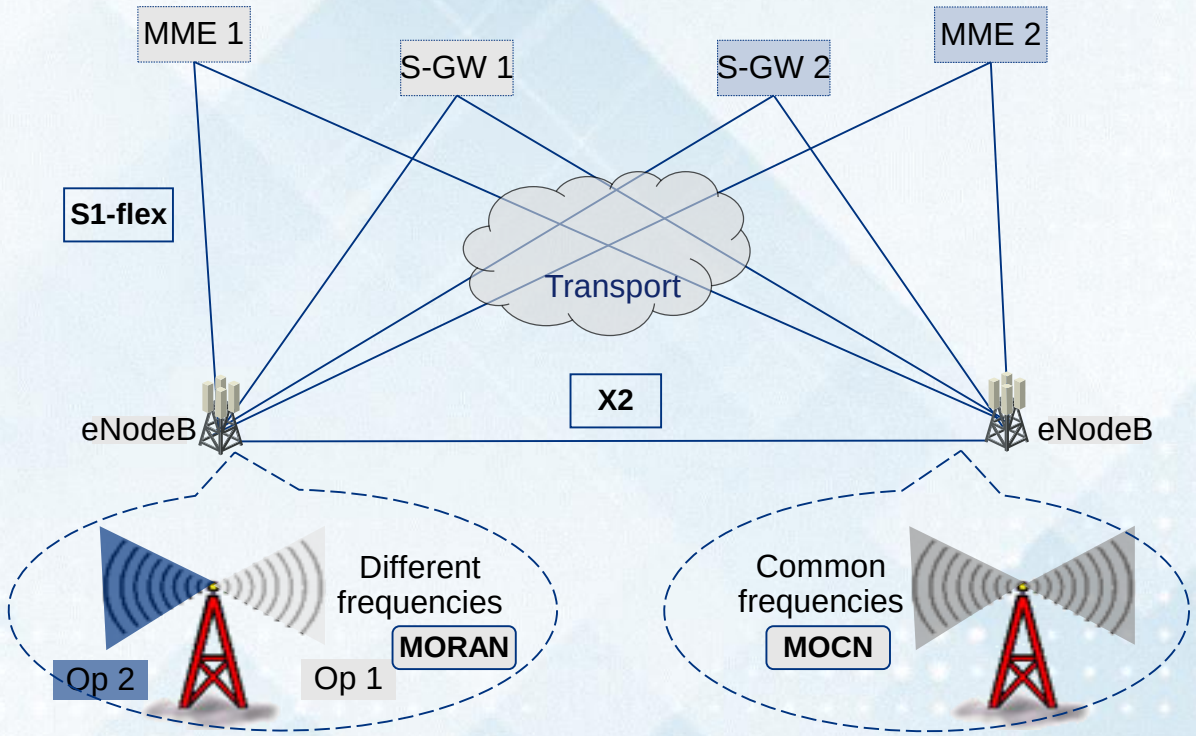
4G and 5G networks will have simplified network sharing capabilities, where Multi Operator Core Network reduces competitive differentiation.

Active RAN sharing with different or common spectrum



Comments

- Thanks to S1-flex interface it is possible to connect one eNodeB to several packet core nodes (GW,MME) and vice versa
- More radio resource management functions are managed in the eNodeB which makes it less dependent on core network thus facilitating sharing
- The eNodeB can broadcast multiple PLMN-IDs in the radio interface (Multi Operator Core Network - MOCN)
- Transport network can be shared or separate
- 3GPP Rel. 13 adds additional enhancements to sharing to enable a fair use of resources (spectrum, equipment) and better QoS per operator
- **However, common use of spectrum is not allowed in many member countries**

Integrated streetlights with mini cell towers is a promising trends, however could enable de facto monopolization of a street by a single carrier.

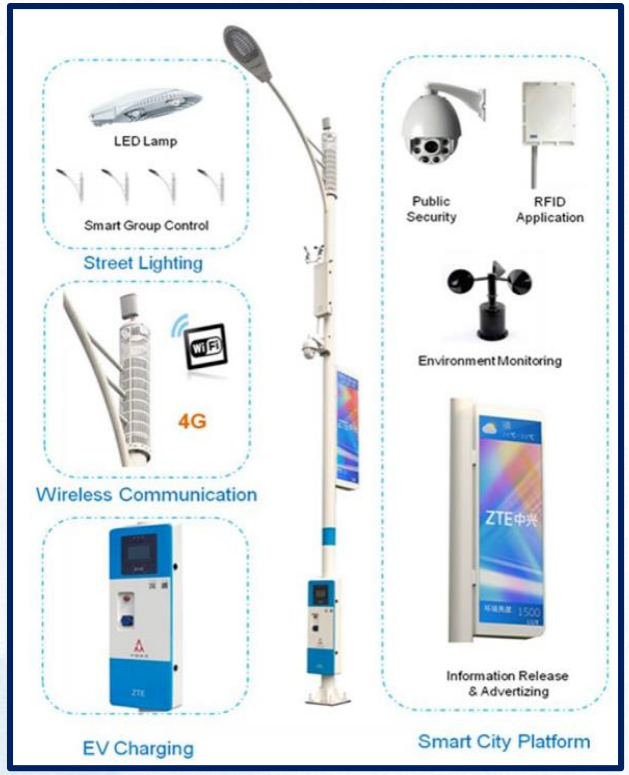
Philips Smartpole Street Lighting
Los Angeles

Source: ZDNet

Ericsson Streetlight Zero Site
Santander

Source: Ericsson

ZTE BluePillar Streetlamp



Source: ZTE

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eSIM and SoftSIM become increasingly relevant in a 5G world. Regulation must balance security vs. anti-competitive SIM locking.

Multi IMSI (15 digit) SIM

- Sim can change IMSI, e.g. if crossing borders
- A low cost roaming solution

Embedded SIM (eSIM)/ OTA/ eUICC

- Remote provisioning of a SIM/ remote changing of operator
- Multiple operator profiles possible
- GSMA standard, aimed at M2M/IoT

SoftSIM

- No SIM “hardware”, SIM data is stored in secured memory on device
- Device vendors on pole position
- Antagonistic to SIM vendors who are driving eSIM.

- IMDA launched a consultation on eSIM in 2018 suggesting adaptation of GSMA standard and ISO 27001 to protect against cyber attacks. Matters of SIM locking also discussed. Final position not yet gazette.

- In April 2018 the Department of Justice initiated an anti-trust investigation against AT&T and Verizon for trying to establish standards that would allow them to lock a device to their network even if it had eSIM technology,

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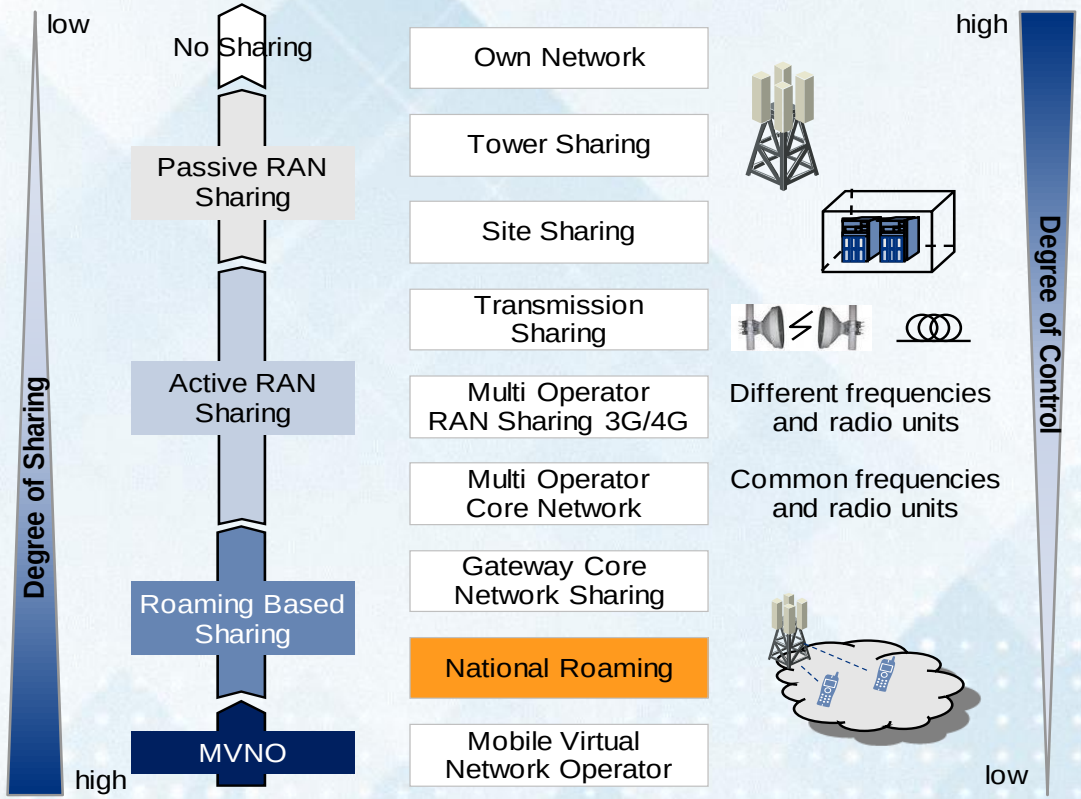
Long-term national roaming obligations are discussed in the context of 5G introduction to improve coverage experience of customers.

National Roaming realizes high sharing economies but reduces differentiation



Regulatory considerations

- National roaming is typically implemented upon commercial agreements for a short term by a new entrant in order to achieve nationwide coverage.
- In the 5G context it is also discussed to oblige MNOs to national roaming with all other networks to reduce “white-spots”.
- For example in Germany this is meant as a long-term obligation to be realized by a change in the telecommunications law.
- From a competition policy point of view it has to be considered, whether such an obligation leads to higher coverage (as lower overall CAPEX is required), or the contrary because operators cannot differentiate by network coverage and quality anymore.

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Network sharing can be realized by a wholesale-only operator who sells the mobile network capacity to all other parties.

Technical economies of scale and optimal use of Spectrum

The basic idea of a wireless **W**holesale-only **O**pen **A**ccess **O**perator (WOAN) is

- to prevent the slicing of the scarce available spectrum bands suitable for nationwide coverage to all retail MNOs and giving it to one new operator,
- with the opportunity to realize high data rates,
- realize all economies of scale of a shared network for low CAPEX roll-out, and
- realize high coverage in under-served areas.

Regulatory considerations

- Important 5G applications require a high area coverage, even beyond economic feasibility for private MNOs
- In the German political arena the idea of a 5G PPP wireless infrastructure company is discussed with the objective to realize coverage of under-serviced areas
- A model could be Mexico, which licensed (2016) a private consortium “Altan” to become a 4G WOAN with 92,5% population coverage by 2023.
- A number of regulatory questions arise:
  - Will technical efficiency of a WOAN be outweigh by monopolistic inefficiency?
  - Business case for a WOAN?
  - Tacit collusion and vertical market power?

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Table of Content

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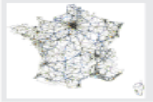
Many spectrum auctions are obliging bidders to follow a roll-out plan with targets for high population, but also road and railroad coverage.

Best Practice Example France: 700MHz Coverage Targets

Obligation	17 January 2022	17 January 2027	T_1 + 15 years (late 2030)
Metropolitan population		98%	99,6%
 Main roads			100%
 Population in each metropolitan department		90%	95%
 Population in the « priority rollout zone » (18% of population, 63% of territory)	50%	92%	97,7%
 Main location of each of the 3300 villages included in the mobile coverage extension national program		100%	
 Regional rail roads : nationwide coverage	60%	80%	90%
 Regional rail roads : coverage in each region		60%	80%

Comments

- In November 2015 France organized a combinatorial clock auction for the 700MHz spectrum, well suited for coverage
- After 11 rounds the spectrum was successfully sold to 4 operator
- The bidding met ARCEP's revenue target, resulting in payments of €2.8 billion (US$3 billion). The result is equivalent to €0.72 per MHz-pop
- The coverage targets stretched over a long period of 15 years and were not too extensive for rural areas and railroad coverage did not hit profitability of the operator's business cases.

- **Currently also similar high population and area coverage targets are demanded for 5G spectrum (3.4-3.8GHz), e.g. in Germany. This may endanger the business cases for 5G spectrum.**

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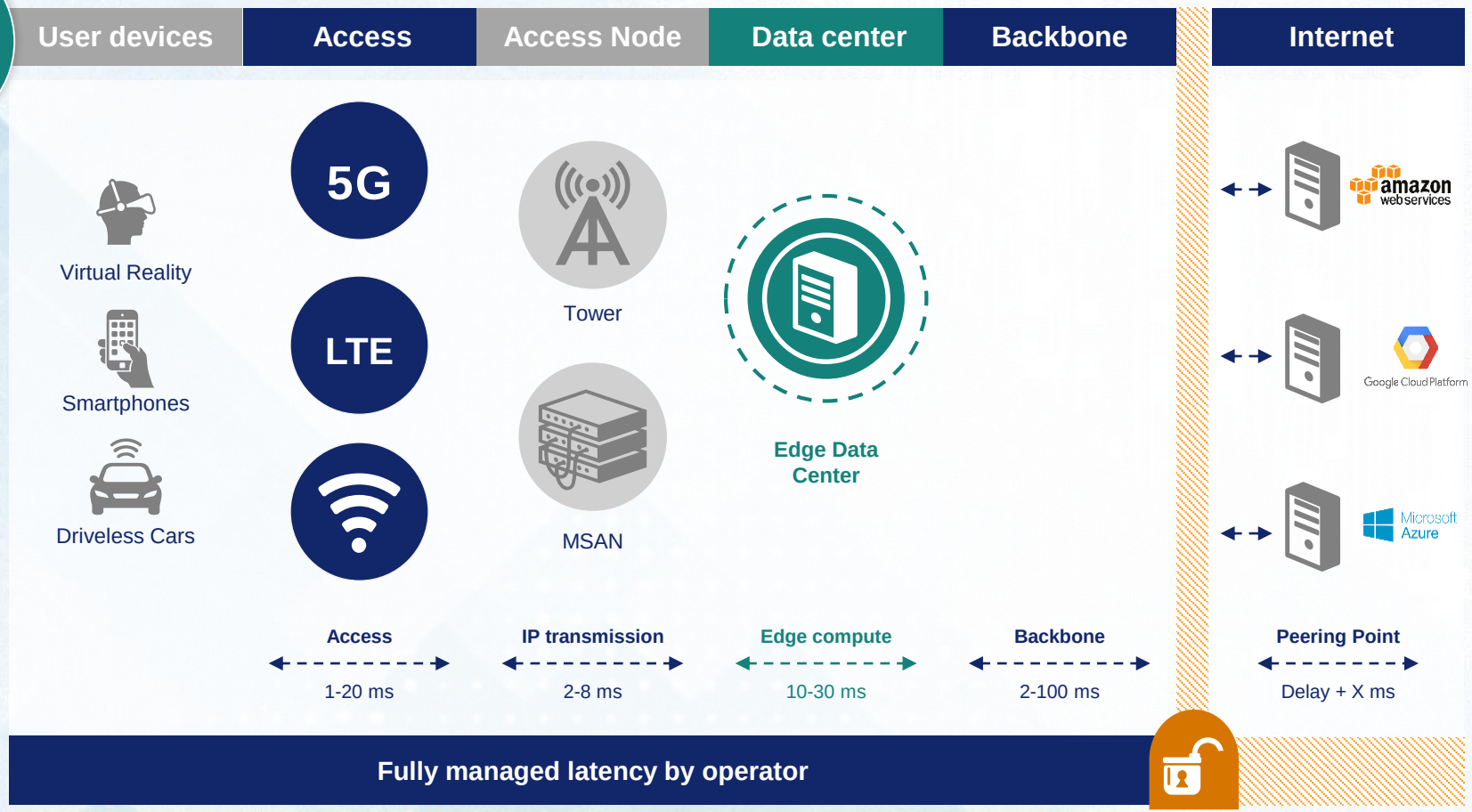
Edge Computing cuts out a small piece of the cloud (cloudlet) and places it into the Node B. Latency is reduced as required for many 5G applications.

Low Latency

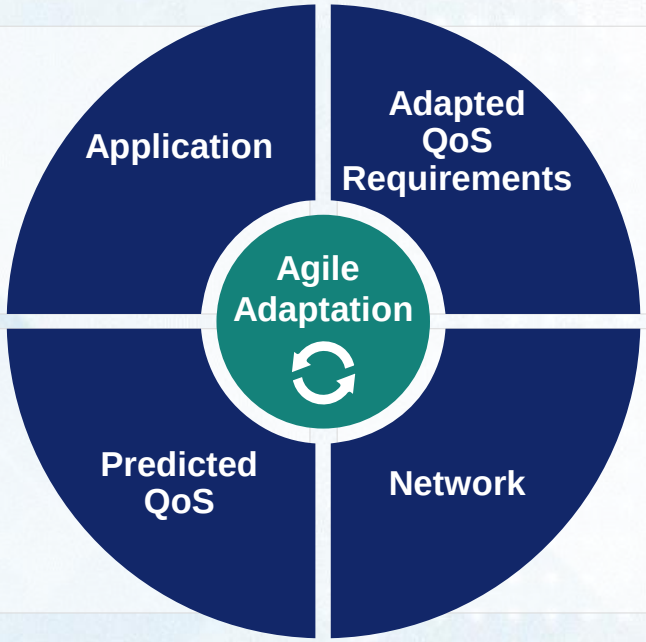
In Edge Computing the data processing is performed at the edge of the network, therefore moving closer to the user device:

- The objective is to enable low-latency sensitive applications and services by providing an environment to execute tasks in close proximity to the user
- Integration of Edge data centers providing computing and storage under full control of the operator
- A USP for operators having a huge advantage against OTT Players



Predictive QoS and agile Quality-of-Service Adaptation (AQoSA) is an important enabler e.g. for advanced Connected-Vehicle Applications.

- Provides initial requirements
- Adjust the application settings to recent and predicted QoS



- Informs the network about initial and updated requirements

Under development in standardization

- Update the IoT device/UE on current and predicted QoS

- Monitors QoS
- Adapts network parameterization or configuration based on conditions and requirements

P-QoS allows an application to actively react on changes in the connection quality. This relates to automotive use cases which are safety relevant or mission critical and have to rely on information received over a radio channel. AQoSA provides the advanced closed loop between application (IoT backend) and the network. The concept requires two new interfaces: application and network interfaces.

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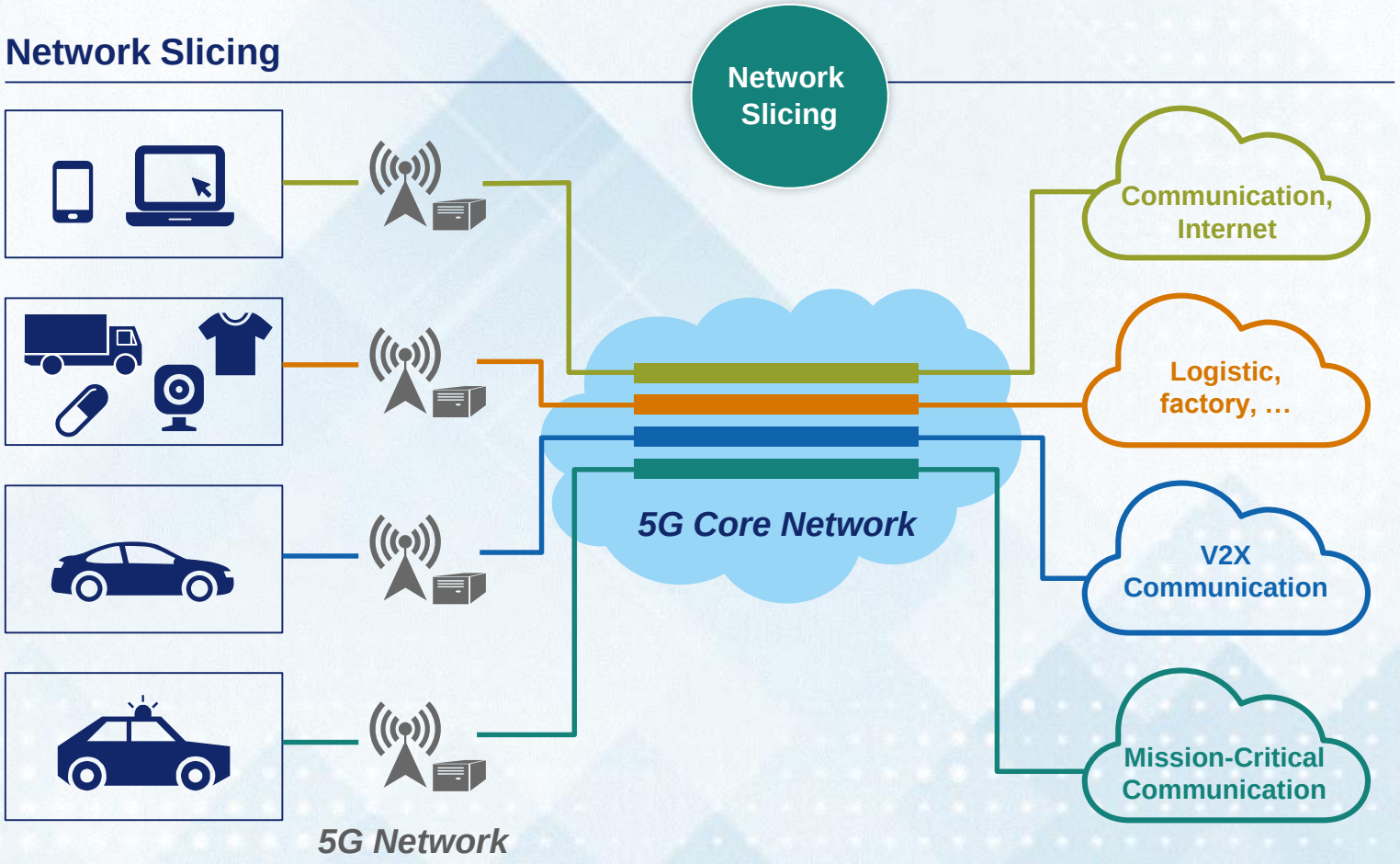
5G network slicing allows to establish a multitude of logical networks in a single physical network, with specific QoS bundles (latency, speed, …).

Network Slicing



Slicing Principles

- Networks are realized as SW layer on top of a common infrastructure
- Functionality will adapt Qos combinations to specific use cases (latency, data rate, mobility speed, connectivity, reliability, security,…)
- Resources can be dedicated or shared (radio, servers…)
- Per slice dedicated network management
- New business models required (e.g. integration into customer environment or customer provided functionality)

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Network Slicing, a QoS approach to highly customized networks is a regulatory net neutrality issue and a liability issue.

Regulatory Issues

Net Neutrality

- Is a network slice a “Special Service” in the sense of the Net Neutrality regulation? (If yes it could limit the power of OTTs, which most likely cannot offer vertical solutions on a best-effort internet basis but have to buy network slices)

Liability

- Guaranteed low latency, predictive QoS etc. offered by Telcos may result in heavy damages if SLAs cannot be met. Who in the value chain will finally be liable for such damages?

5G Network

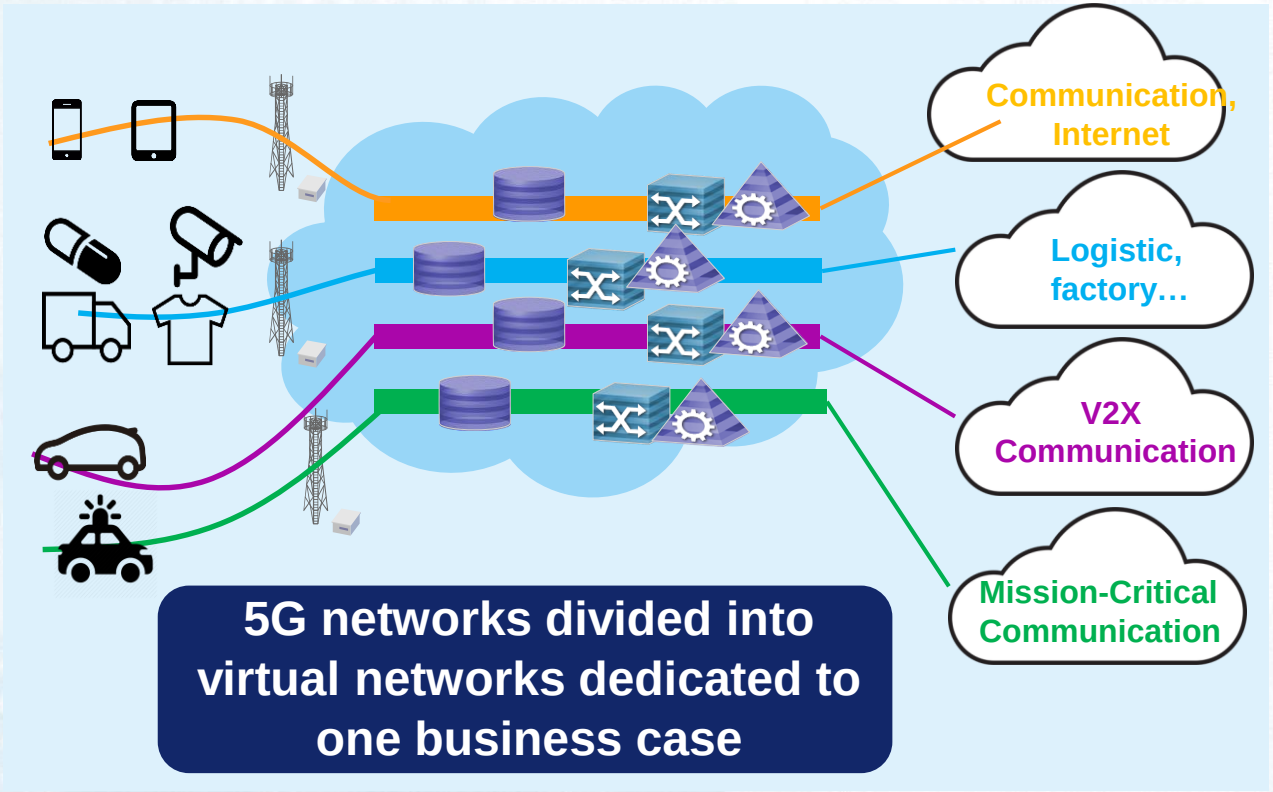

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Table of Content

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5G IoT poses a number of inter-related regulatory questions on roaming, numbering, and SIM locking …

- Is permeant roaming permitted (by the visited country)?
- Is the extra-territorial use of numbering resources permitted by the donor country?
- How are roaming fees regulates?
  Specifically how can one abolish roaming fees and have permanent roaming?
- Should M2M roaming have its own regulation (and how can networks differentiate)
- How does SIM locking affect competitive dynamics?

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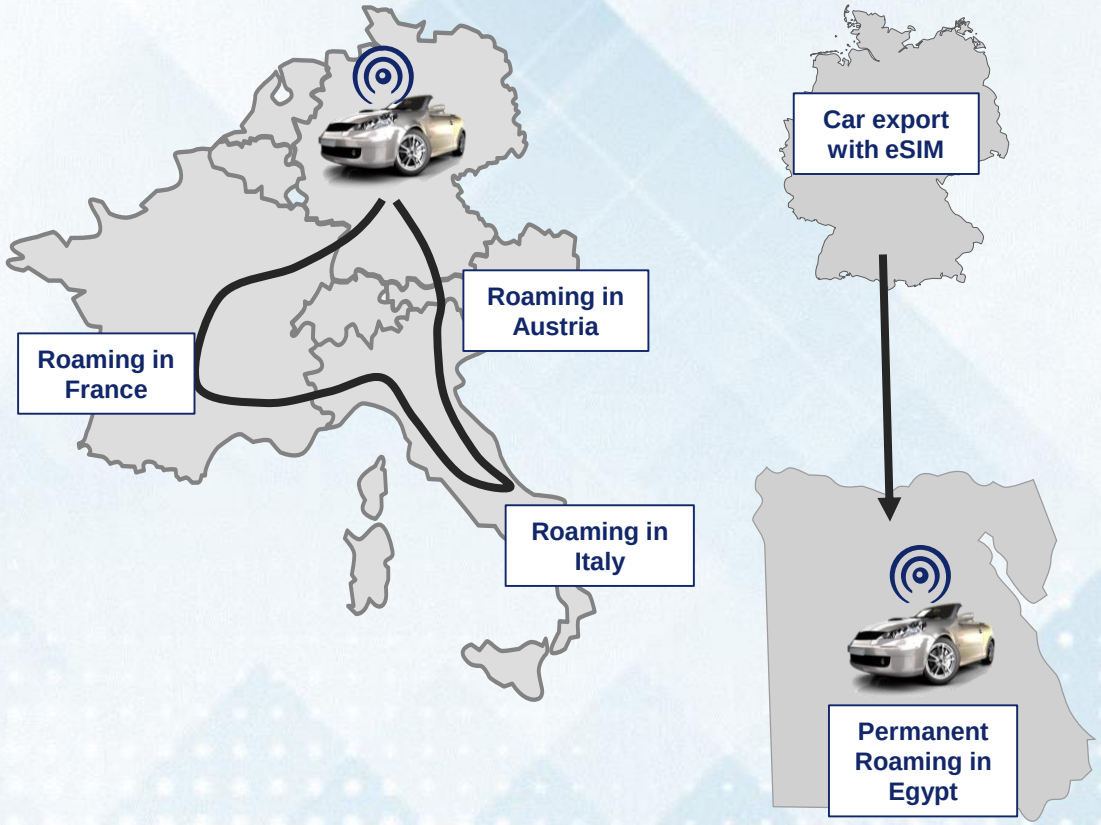
Roaming costs, permanent roaming and big-data hosting are a threat to Internet of Things only solvable on an international level.

Connected Car services as an example for the need of roaming agreements



Roaming represents a cost factor for autonomous driving services that should not be neglected

- Connected cars depend on international roaming
- A connected car, traveling from one country to the other would require roaming in every country (narrow- and broadband)
- Exported cars with eSIMs operated by a producer country Telco will permanently roam in the import country.

International solutions are needed

- EU and BEREC as an enabler
- Bilateral roaming agreements and MVNO licensing are a first step as interim answer only.
- Permanent roaming and dedicated M2M roaming tariffs are a necessary way forward

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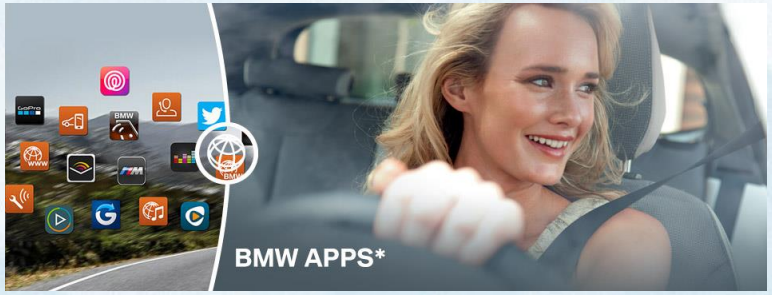
If permanent roaming is prohibited, or universal SIMS's are not used, an MVNO for M2M may be required e.g. Deutsche Telekom in Brazil

The context:

- Telekom Group signed a contract with BWM Group to deliver managed connectivity for BMW's Connected Drive
- Roaming-SIM solution
- Geographical Service Scope: 55 countries
- Onboard equipment assembled in Germany and distributed to BMW factories.
- Centralized connectivity management
- Centralized IT Backend
- Centralized Service Management
- Services: Voice, SMS and Data
- Network Technologies: 2G, 3G and 4G
- SIM Technologies: eSIM, Remote Provisioning



The challenge:

- Permanent Roaming not allowed in Brazil.
- Brazilian regulations are very restrictive with respect to business models for telecommunication services.

The opportunity:

- T-Systems do Brasil is a fully-owned subsidiary of the Deutsche Telekom Group and a leading provider of IT Solutions for the Brazilian automotive industry, with more than 2.000 employees.
- T-Systems became a national MVNO in Brazil
- **However, this solution is not possible in many MENA countries due to restrictive MVNO licensing regulation.**

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Roaming is playing an important role for the globalization of many services. But even the EU "roam like at home" prices are prohibitive for IoT.

Permanent Roaming

The connected device is sold outside the country of production but uses a SIM card IMSI of the country of production e.g. cars, e-readers, wearable devices.

Periodic Roaming

- Roam like at home
- Fair use policy

EU criteria for period roaming

- More time at home than abroad (4m)
- Request for clarity

If you continue roaming more than you are at home, your operator may start applying a small charge to your roaming consumption. This will be capped at

- 3.2 cents / min per voice call
- 1 cent per SMS.
- A maximum data surcharge €/GB as per graph on right

EU roaming regulations do not expressly set whether connectivity services for connected devices are subject to its provisions

"NRAs are encouraged to investigate solutions regarding IoT and M2M services in order to promote measures to apply permanent roaming services, and the application of specific prices and conditions for IoT/M2M traffic".

International mobile roaming strategic guidelines, ITU 2017

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There are three major threats concerning roaming for 5G applications.

Costs	▪ Traditional roaming in MENA and the GCC countries incurs high charges which may immediately kill any IoT business case. ▪ In many countries with an open licensing system creating a local MVNO is cheaper than using MNOs for roaming.

Connectivity	▪ When implementing local content in a global vehicle two challenges are obvious:
	  ▪ Complex IP addressing
	  ▪ High latency
	▪ There is virtually no operator that is really offering global coverage, but some offer roaming with more than 170 countries.

Security	▪ Legal Interception: While in roaming domestic authorities will experience difficulties to intercept in country calls due to foreign jurisdiction of the SIM M(V)NO ▪ Data Security: In many countries big data need to be hosted locally and may not leave the country.

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Table of Content

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An issue arises when one correlates people to devices, and then tracks the device, *a fortiori* with accurate location based services.

Public Interest

The may be public interest debates for tracking people, or informing the location of people which over-rides the right to privacy:

- Law enforcement/ anti-terrorism
- Mentally disabled
- Hospital patients
- Emergency/ Disaster assurance

Asset tracking

- Tracking assets is not covered by general data protection rules (GDPR) i.e. grey area
- Europe is considering an ePrivacy Regulation, which deals with location risks.
- The thinking is that consent must be informed. There is an onus on the device manufacturer to inform the user of how their information will be used, and then remain within those parameters.

Digital maps

"Privacy has already been a consideration for our products and services for a long time. Therefore, the concepts of privacy by design and privacy by default are not new. However, the formal aspects of data protection impact assessments are new requirements that have to be integrated into the product development process"

Philip Fabinger, global privacy counsel for HERE Technologies (owned by Audi, Daimler and BMW)

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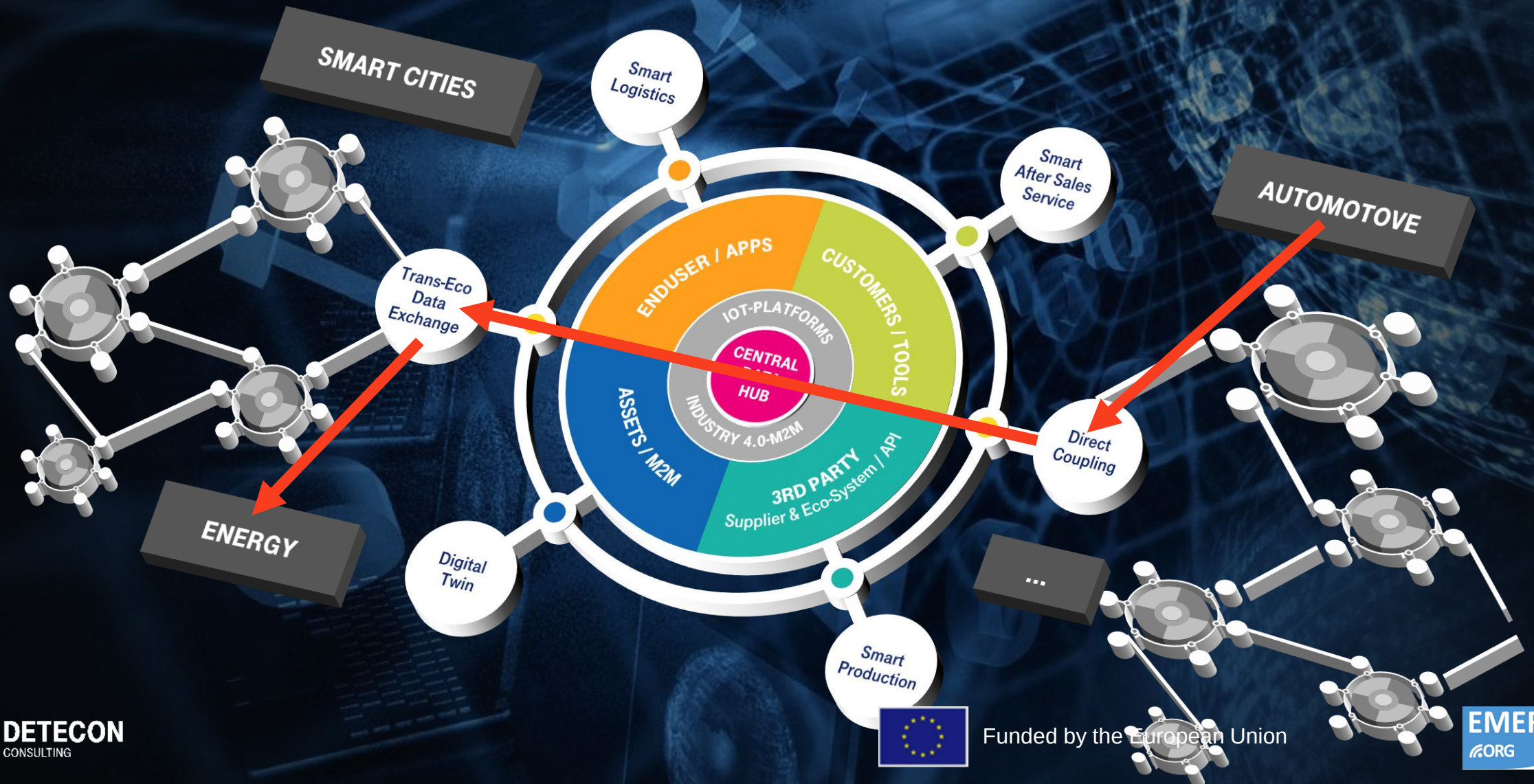
Data hubs may be a new business for Telcos to become a “data aggregator” cross industry eco-systems. Where are the privacy limits?



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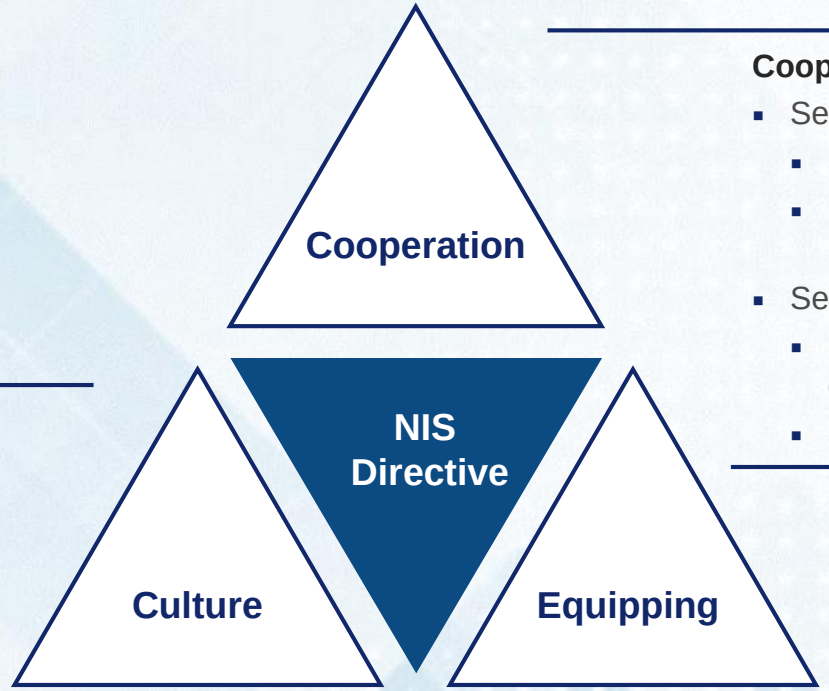
The EU Network & Information Security (NIS) Directive is the first EU-wide legislation on cyber security, transposed into National Laws by May ’18.

EUROPEAN COMMISSION



Cooperation among all the Member States:

- Setting up a cooperation group
  - Support and facilitate strategic cooperation
  - Exchange of information among Member States
- Set a **CSIRT*** Network
  - Promote swift and effective operational cooperation on specific cybersecurity incidents
  - Sharing information about risks

Culture of security across sectors:

- Take appropriate security measures
- Notify serious incidents to the relevant national authority
- Comply with the security and notification requirements under the new Directive.

Member States to be appropriately **equipped**:

- Computer Security Incident Response Team (CSIRT)
- Competent national NIS authority

* Computer Security Incident Response Team

Applies to Digital service providers based outside of the EU, but offering services within the EU.

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Besides regulation of verticals there are eight general areas of regulatory concern and intervention in the 5G (and IoT) area which need to be solved.

Interoperability
- Global technical standards
- Regional technical standards
- High concentration of vendor industry
- EMF emissions
- …

Spectrum
- licensed or unlicensed spectrum
- Volume and price of spectrum
- Re-farming, trading, sharing
- License obligations
- …

Identifiers
- Scarcity of numbers
- IP addresses
- Permanent extraterritorial use of national numbers
- Cost of identifiers
- …

Competition Policy
- RAN sharing and spectrum sharing
- eSIM locking
- National roaming
- …

Quality of Service
- Coverage
- Data rates
- Latency
- Liability of Telcos not complying with QoS minimum rules
- …

Roaming
- Roaming vs. MVNO
- Permanent roaming and fair usage policy
- Pricing
- Commercial agreements vs. roaming obligations
- …

Privacy
- GDPR individual rights
- Collectors, processors, distributors,…
- Personal privacy vs. data analytics in public interest
- Extraterritorial transmission and storage of personal data

Security and Safety
- Automated production, decision making and profiling
- Hacking
- Cyber war and viruses
- Legal interception
- …

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