



Kapsch CarrierCom

# ***5G - The Future of Communication***

*November 2018*

# 3GPP Cellular Communication Evolution

A 10 years cycle



1990

2000

2010

2020

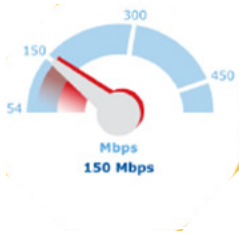


**GSM-R**



# 5G vs LTE

What's new?



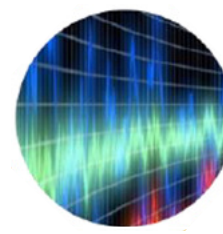
**Data Rate**



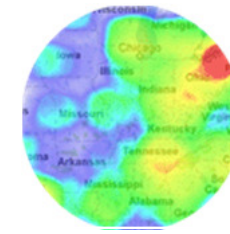
**Latency**



**Mobility**



**Spectrum Efficiency**



**Connection Density**



**Energy Efficiency**

	<p>Avg &gt; 100 Mbps Peak &gt; 20.000 Mbps</p>	<p>~1 ms</p>	<p>&gt; 500 km/h</p>	<p>300% Increase</p>	<p>&gt; 10<sup>6</sup> / km<sup>2</sup></p>	<p>x100</p>
	<p>Avg ~25 Mbps Peak 150 Mbps</p>	<p>Typically ~50 ms</p>	<p>Functional up to 350 km/h</p>	<p>DL: 0,1- 6,1 b/s/Hz UL: 0,1-4,3 b/s/Hz</p>	<p>Typically ~2.000 active users / km<sup>2</sup></p>	<p>Moderate</p>

# Translating the new KPIs

What is this good for?



**Increased radio flexibility & Multi-access architecture**



**Optimized communication latency**



**Application-centric Quality of Service architecture**



**Network Slicing & Virtualization**



**Addressing Cybersecurity demands**



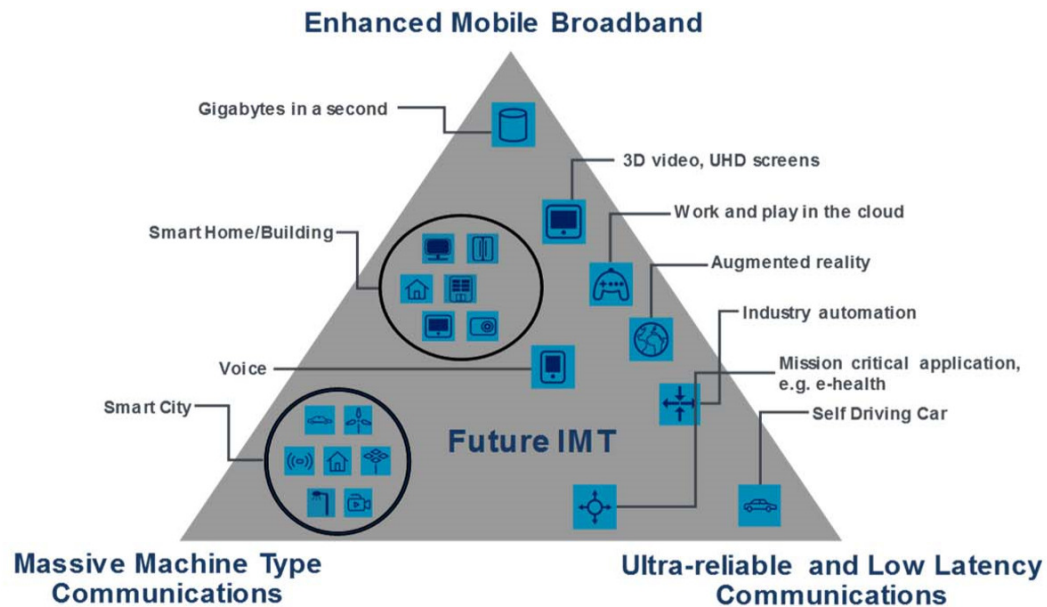
**Requirements from Verticals in standardization**

**kapsch** >>>  
challenging limits



# Aspects for Verticals

How all this comes together



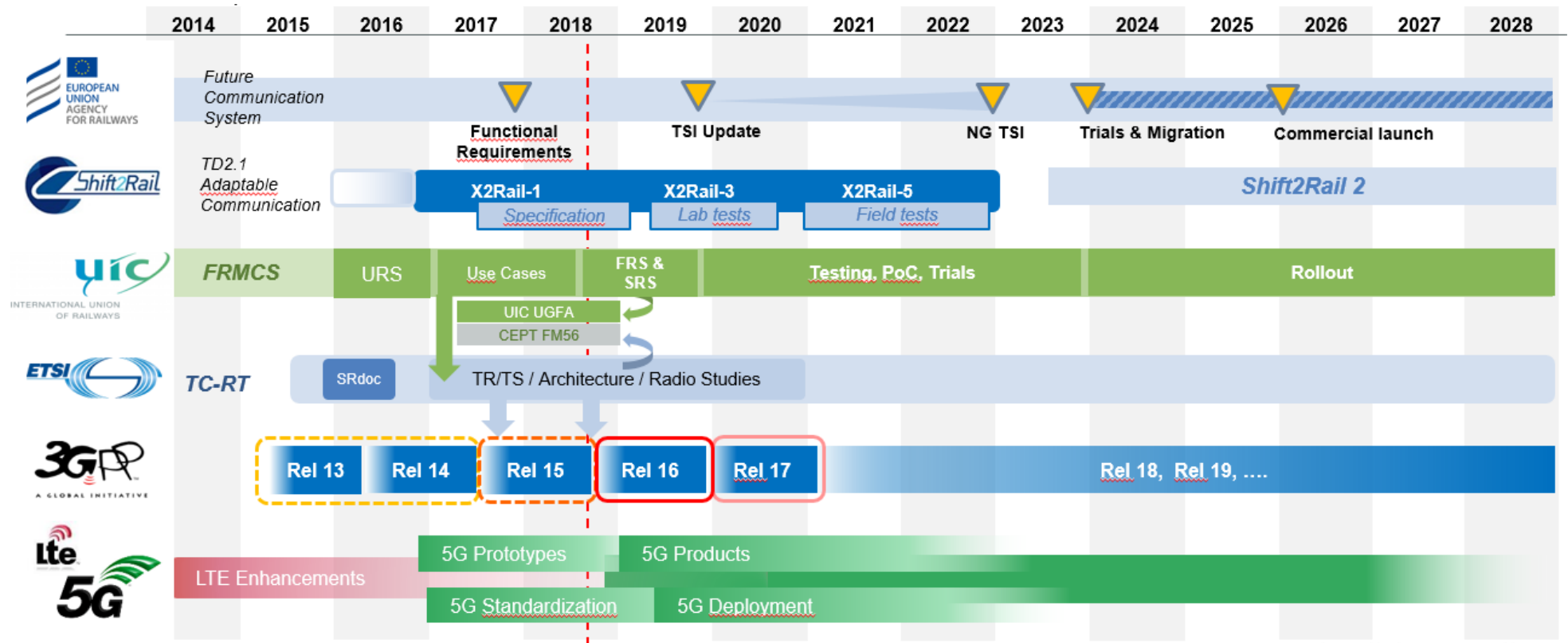
Source: ITU 5G Usage scenarios

## ! Derived benefits for Railways

- 1 Massive MIMO
- 2 Beam forming
- 3 Scalable numerology and TTI
- 4 Common & flexible framework

# Why 5G makes sense for FRMCS

Match from requirements and timeline

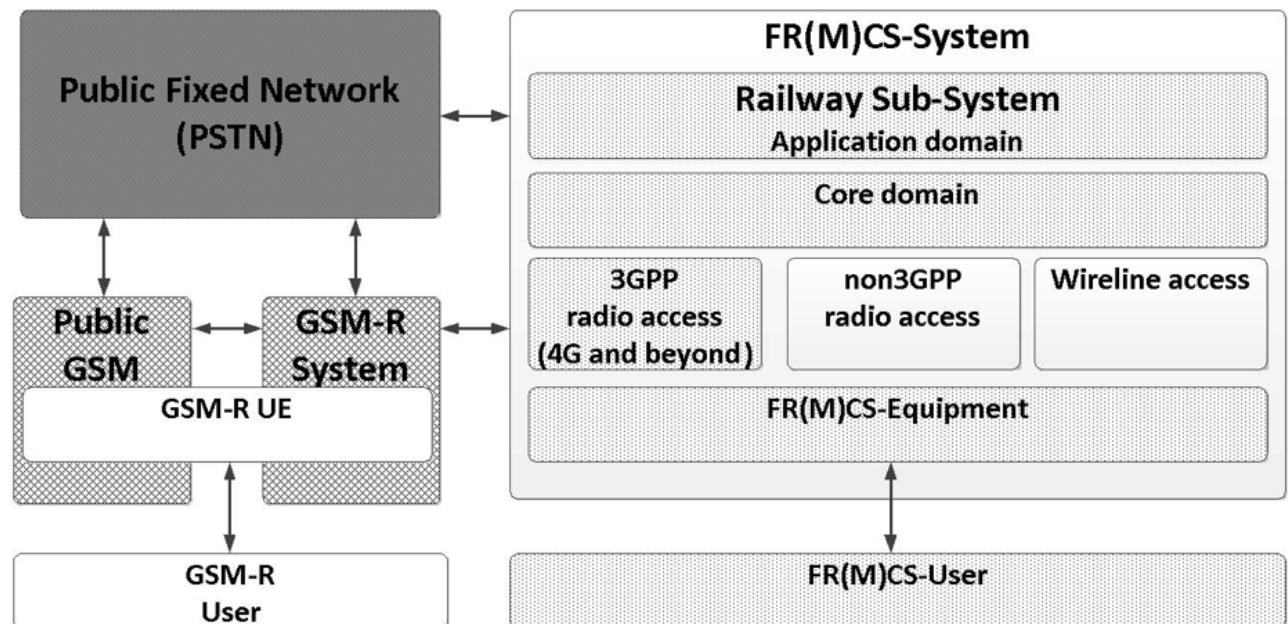


\*) Technical Specifications for Interoperability (TSI)

# FRMCS Architecture

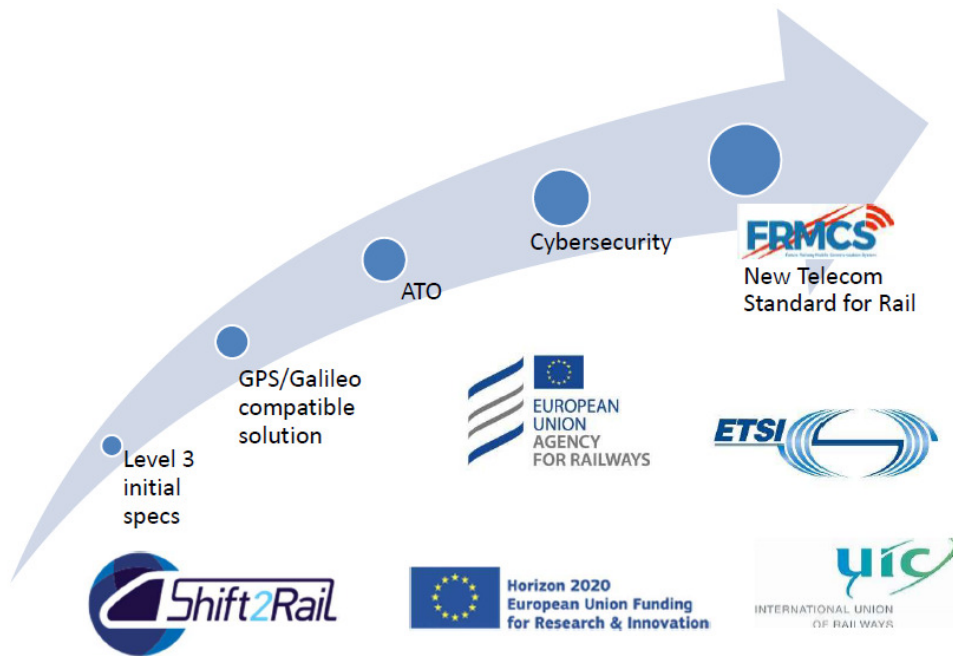
## Relevant remarks

- > 5G does not specify a methodology for voice or group calls
- > Therefore, MCX comes into play
- > MCX however is access agnostic
- > Same applies for FRMCS – the concept is bearer independent
- > Consequently, Railways would be enabled to start with LTE as well
- > While voice will be a demand in the future as well, UIC sees more...



# European Game Changers in Railways

FRMCS will be more than a replacement of GSM-R due to obsolescence



- > FRMCS will be an essential Game Changer for the Digitalization in Railways
- > With an IP-based wireless data network research projects become real, be it predictive maintenance, advanced traffic management and autonomous train operation, train position and train integrity and many more...

But...

- ! GSM-R is not dead, and
- ? What is the value of the fastest car without the race track?

Source: UIC, UNIFE and UNISIG presentations

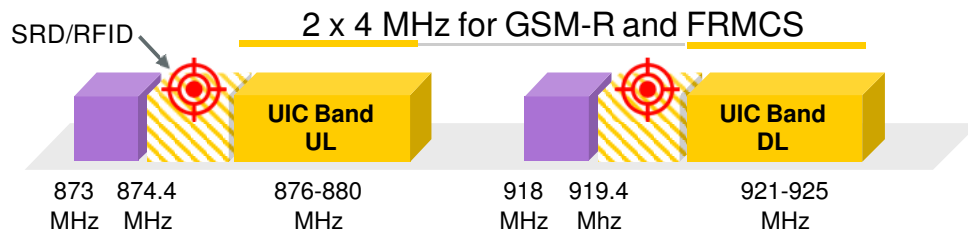


# Radio Spectrum for Railway Communication

A dedicated network will also be in the future essential for mission-critical infrastructure applications

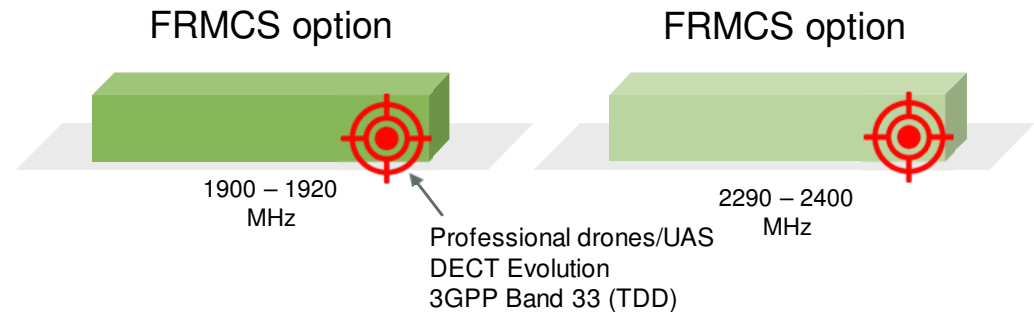
RSCOM #64 on July 11<sup>th</sup>, 2018 adopted the “squeeze option”

2 x 1.6 MHz currently preserved for railways, but not guaranteed !



## Article 3(4)

Member States shall refrain from introducing new uses in the 874.4-876MHz and 919.4-921 MHz sub-bands until such time as harmonized conditions for their use are possibly adopted under Decision No 676/2002/EC.



## Next steps in CEPT (FM56 / PT1 / SE7)

- > Assess FRMCS spectrum needs
- > FRMCS Feasibility studies for 900Mhz, 1900-1920Mhz and potentially 2290-2400Mhz ranges
- > Analyse and define harmonised technical conditions between spectrum neighbours to minimize interferences

# Please remember

## Conclusions



**5G is the next step towards a more powerful wireless communication network**



**For the first time, demands of verticals are baselined in standardization**



**Railway communication in Europe will be based on FRMCS and 5G**



**FRMCS will enable Digitalization in Railways beyond pure communication**



***Thank you.***

***Jochen Nowotny***

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