

# kontron

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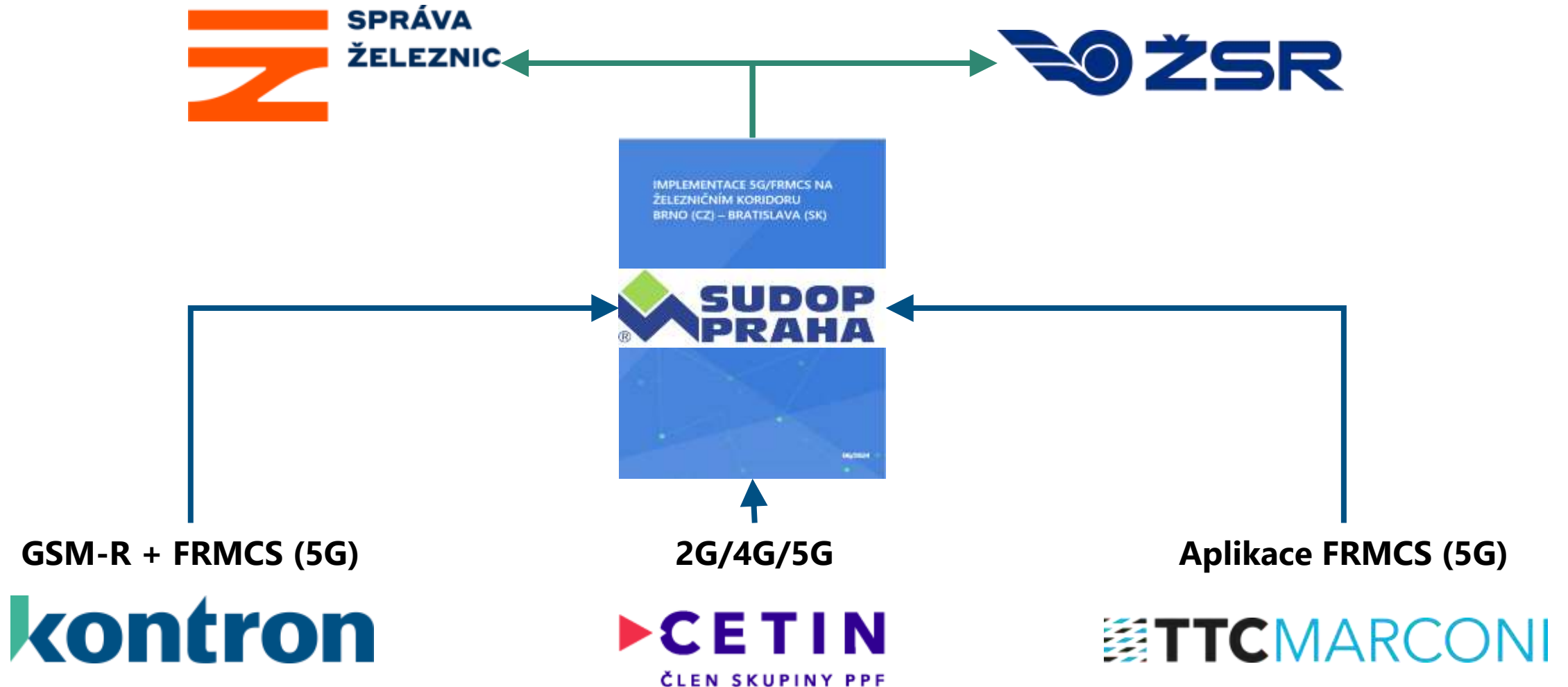
## Studie implementace 5G/FRMCS na železničním koridoru Brno (CZ) – Bratislava (SK)

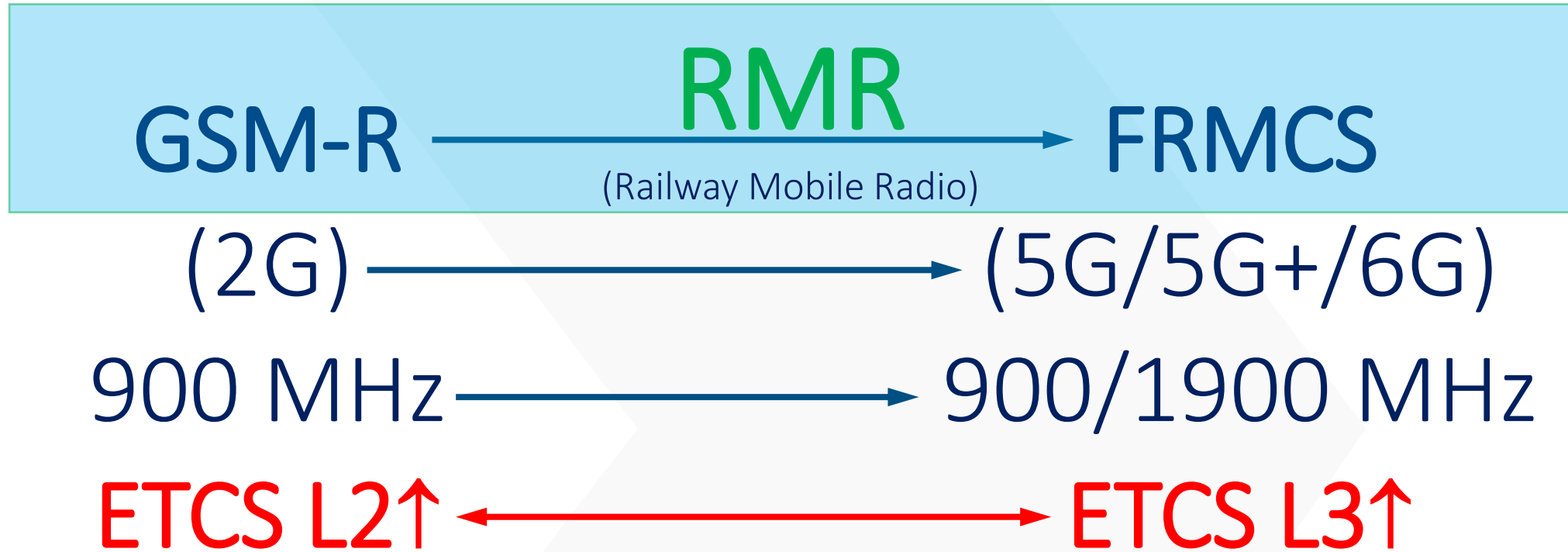
Ing. Petr Vítek



# Zpracovatelé studie

Studie implementace 5G/FRMCS na železničním koridoru Brno (CZ) – Bratislava (SK)





# Pokrytí koridorů

## 2G – pokrytí tratě

The screenshot displays the VPortal interface for simulating 2G mobile network coverage. The main map shows a green line representing the railway corridor across Central Europe, including parts of Germany, Poland, Czechia, and Slovakia. Major cities like Prague, Brno, and Ostrava are visible. The left sidebar contains filters for operator (O2, T-Mobile, Vodafone, Nordic), technology (5G, 4G, 2G), and frequency bands. The 2G - Vše filter is selected, showing frequency bands 900 and 1800 MHz. The 'Simulace pokrytí' (Coverage simulation) and 'Měření' (Measurement) options are also visible.

**VPortal** GSM, LTE, 5G CZ

ÚVOD MOBILNÍ SLUŽBY PEVNÉ SLUŽBY ROZHLASOVÉ SLUŽBY TELEVIZNÍ SLUŽBY ROZVOJOVÁ KRITÉRIA

Nastavení Hledání Info Mapa Data Popis

**O<sub>2</sub> 2G**

Operátor, Technologie, Pásmo

O2 T-MOBILE VODAFONE NORDIC

Technologie, Pásmo

5G - Vše	700	1800	2100	3400-3800
4G - Vše	700	800	900	1800
	2100	2600	3400-3800	
2G - Vše	900	1800		

Simulace pokrytí Měření

100 km

MAPY.CZ © Seznam.cz a.s. a další

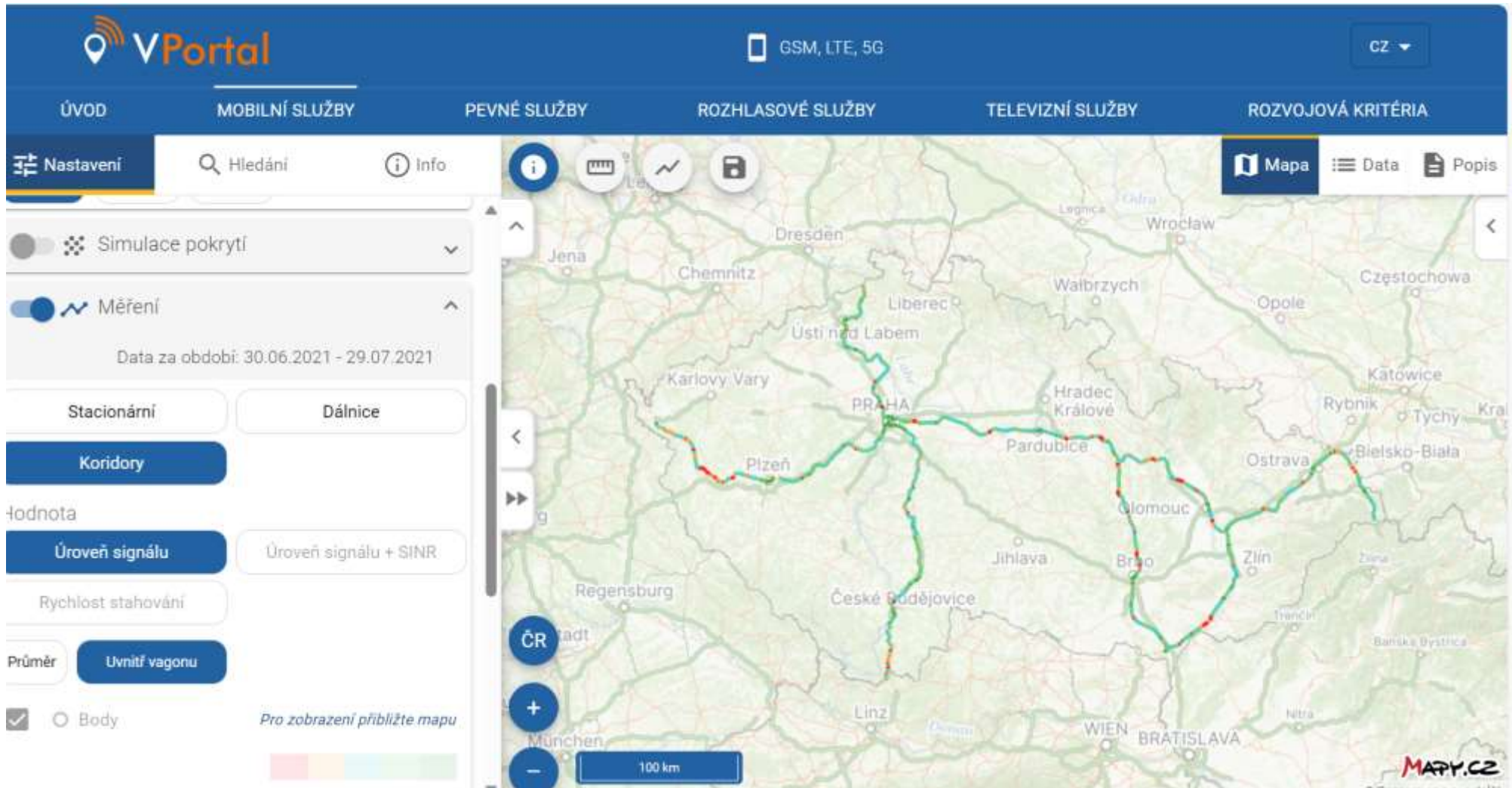
# Pokrytí koridorů

## 4G – pokrytí tratě

The screenshot displays the VPortal interface for simulating 4G coverage. The top navigation bar includes 'ÚVOD', 'MOBILNÍ SLUŽBY', 'PEVNÉ SLUŽBY', 'ROZHLASOVÉ SLUŽBY', 'TELEVIZNÍ SLUŽBY', and 'ROZVOJOVÁ KRITÉRIA'. The 'MOBILNÍ SLUŽBY' section is active, showing '4G' coverage simulation. The left sidebar contains settings for 'Operátor, Technologie, Pásmo' (Operator, Technology, Band) and 'Simulace pokrytí' (Coverage simulation). The main area features a map of Central Europe with a green route line. The route starts near Plzeň, passes through Prague (PRÁHA), and extends eastwards through Pardubice, Olomouc, and Zlín towards Ostrava. The map includes various city names and a 100 km scale bar. The bottom right corner of the map area has the 'MAPY.CZ' logo.

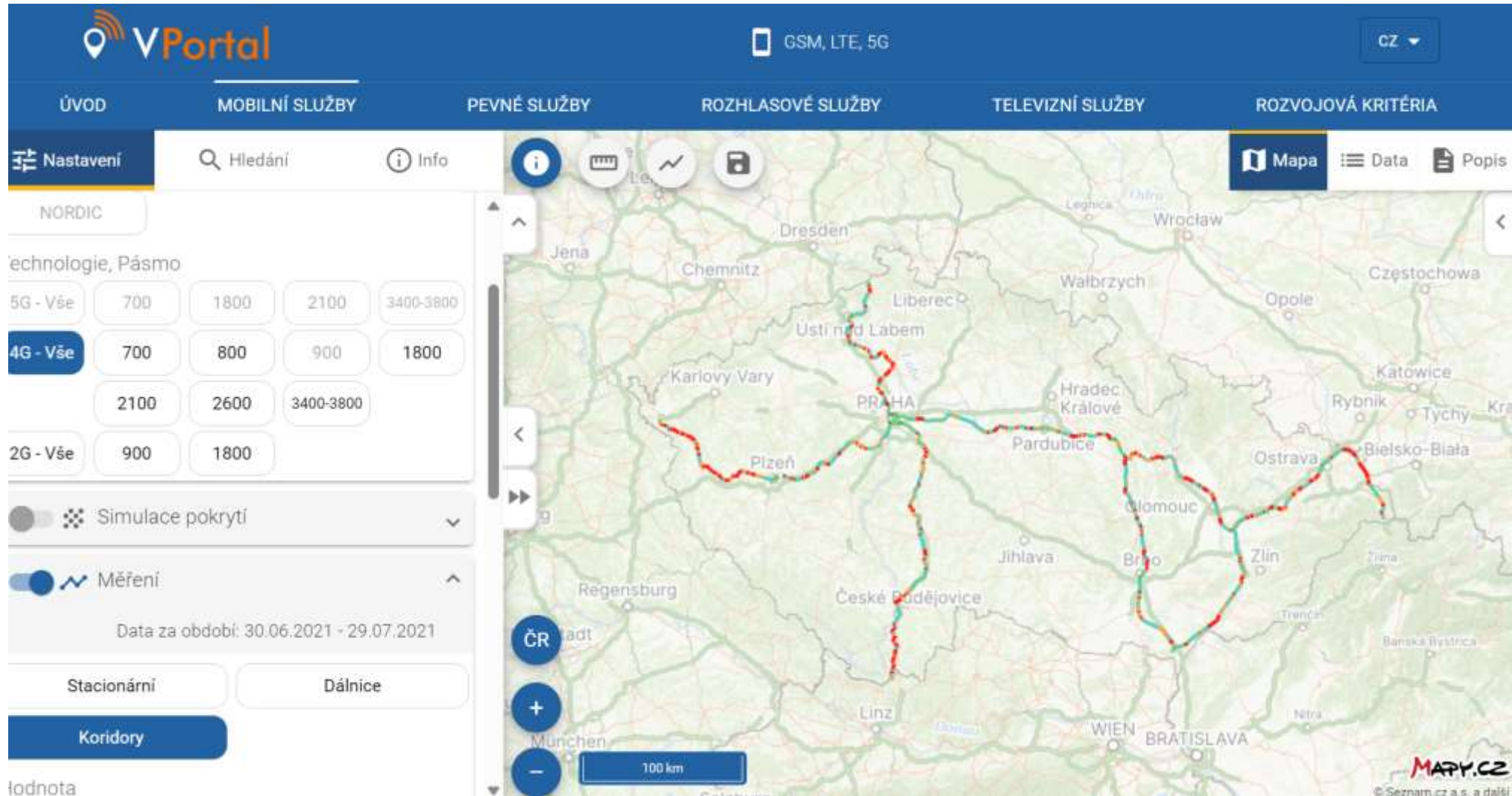
# Pokrytí koridorů

2G – pokrytí uvnitř vlaku



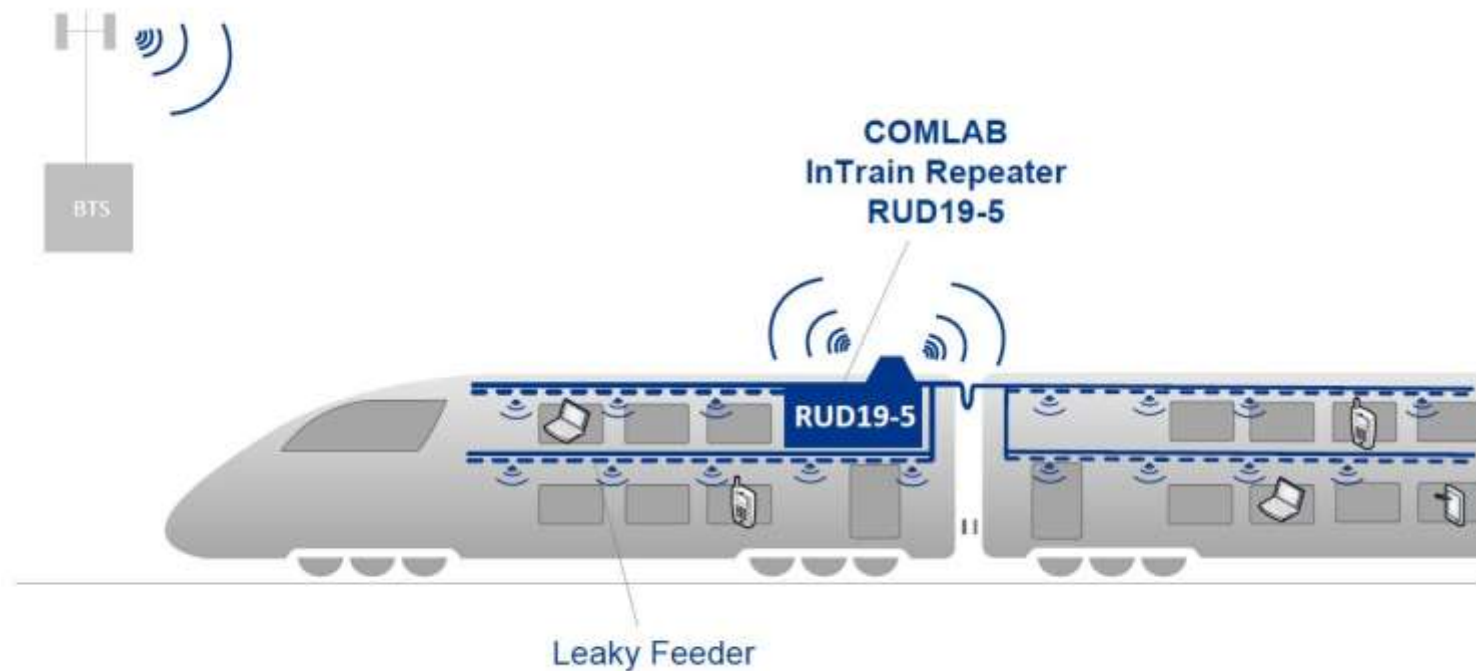
# Pokrytí koridorů

## 4G – pokrytí uvnitř vlaku



# RUD19-5 Intrain Repeater

## Systemový koncept





**UIC**  
UNION INTERNATIONALE DES CHEMINS DE FER  
INTERNATIONAL UNION OF RAILWAYS

## LTE / SAE - The Future Railway Mobile Radio System?

### Long-Term Visions on Railway Mobile Radio Technologies

#### Technical Report

DS System Owner	UIC
Editor-Client Master	Dan Mandoc
<a href="mailto:mandoc@uic.org">mandoc@uic.org</a>	<a href="mailto:mandoc@uic.org">mandoc@uic.org</a>
Version:	1.0
Status:	Final
Date:	23.10.2009

Paris, October 2009

UIC

PAGE 1/79

#### Vision 1:

• A Future Railway Mobile Radio System should be characterized by an excellent QoS and should be able to support real-time applications (e.g. ETCS).

- Why?
  - At least existing QoS requirements, met by GSM-R, have to be fulfilled. Real-time applications, like ETCS, are also characterized by "strong" QoS requirements.

#### Vision 2:

• A Future Railway Mobile Radio System should be able to co-exist with other mobile radio systems in the same area and in the same frequency range (interference free).

- Why?
  - Technical, operational and regulatory simplifications justify this vision.

#### Vision 3:

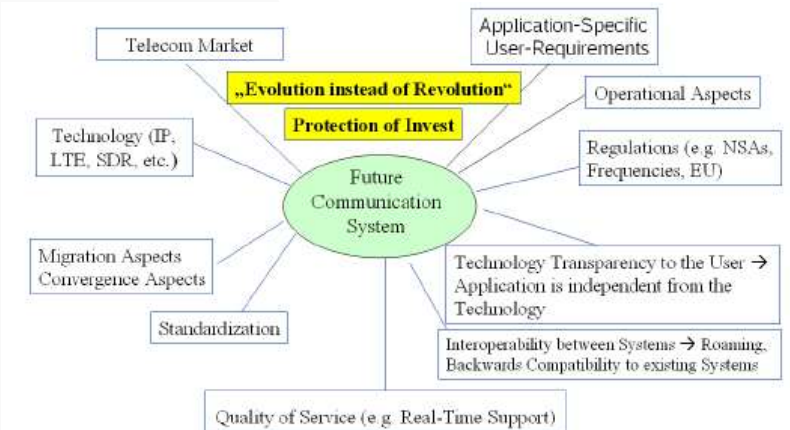
• A changed EURORADIO protocol stack should be independent of the mobile radio technology.

- Why?
  - This vision refers to the EURORADIO protocol stack (and not directly to the mobile radio system!) which is implemented between the application ETCS and the Railway mobile radio system. Today the protocol stack is adapted to the CS service. ETCS based on GPRS, a possible midterm option, requires a change of the EURORADIO protocol stack into the direction of PS-technology. From user's point of view is not acceptable that the EURORADIO protocol stack is to change again in the case of the usage of a long-term mobile radio technology.

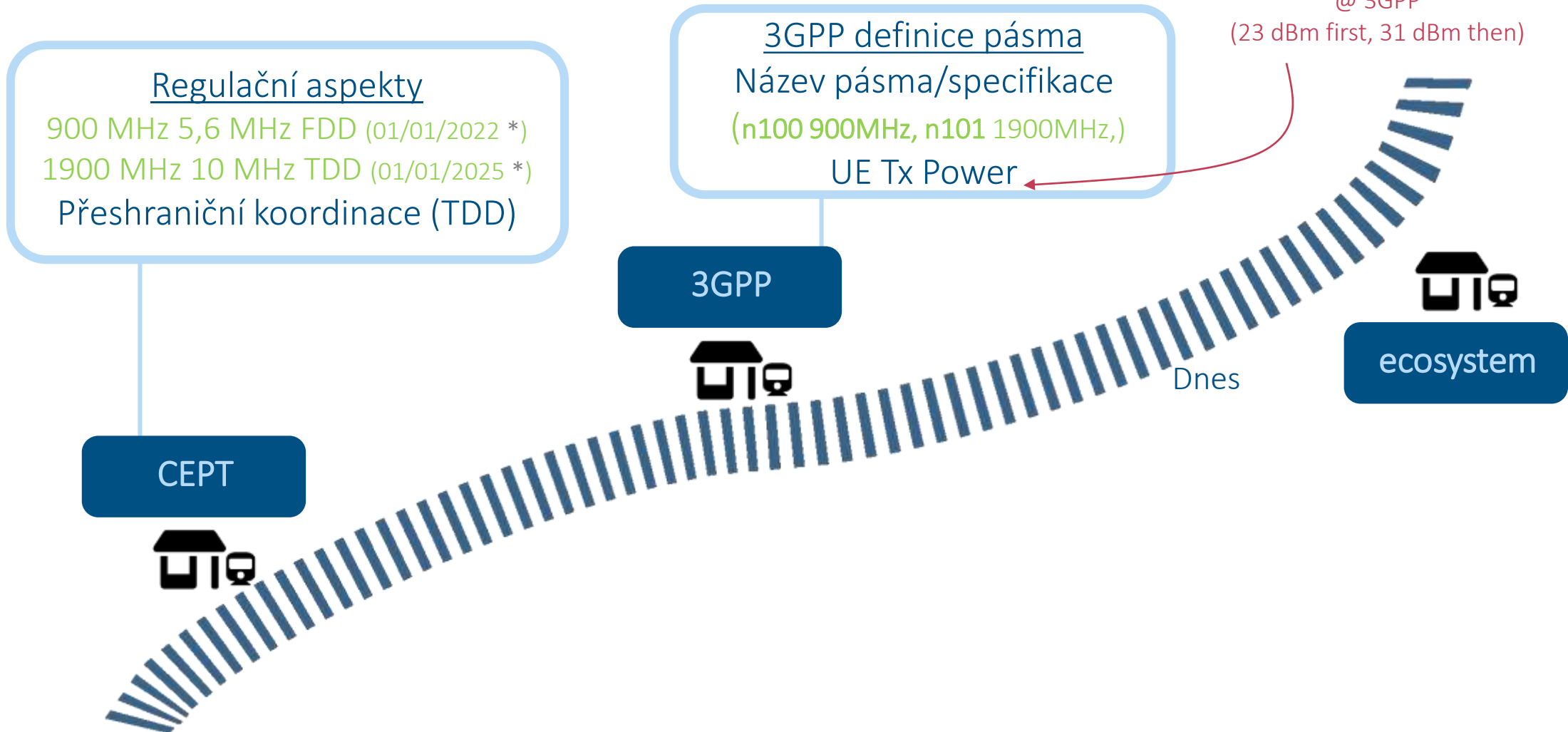
#### Vision 5:

• A Future Railway Mobile Radio System should interwork with different mobile radio technologies [2G (like GSM-R), 3G, LTE, Worldwide Interoperability for Microwave Access (WiMAX) (IEEE 802.16), Wireless Local Area Network (WLAN) (IEEE 802.11),...].

- Why?
  - The interworking enables backwards compatibility and the support of future mobile radio technologies.
  - The interworking supports a migration to a future Railway mobile radio system. In this way it is conceivable to start the implementation of a new mobile radio technology only in some selected „regions“ of the network operator's operating area while new Mobile Stations, supporting the older (legacy) and already the new mobile radio technology could work in the older and in the new networks.
  - The interworking enables flexibility regarding roll-out of a future network, usage of different radio access technologies in a system as well as the introduction of new applications created only for a specific mobile radio technology.
  - Intermodal traffic systems: Logistical, operational and customer needs justify this vision. For example global freight transports use today already different transport carriers (e.g. trains, trucks, container ships and planes). Supporting all the different traffic systems' applications a Future Railway Mobile Radio System (incl. its Mobile Stations) should interwork with mobile radio systems implemented e.g. in harbors and at airports (for example WLAN or WIMAX) if the Railway track is connected to such infrastructure locations.



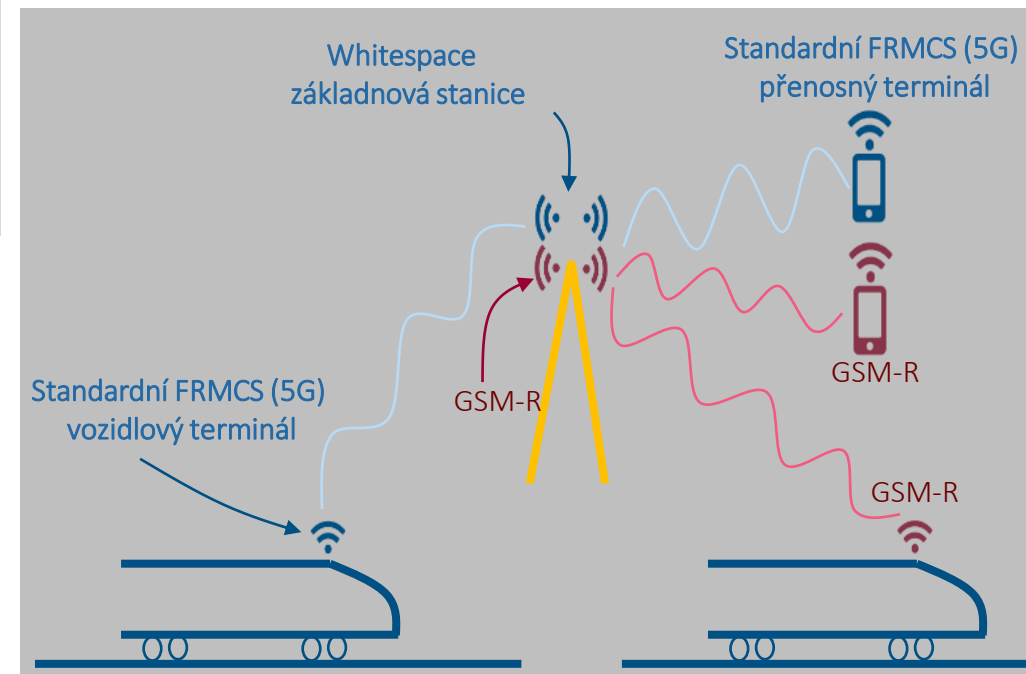
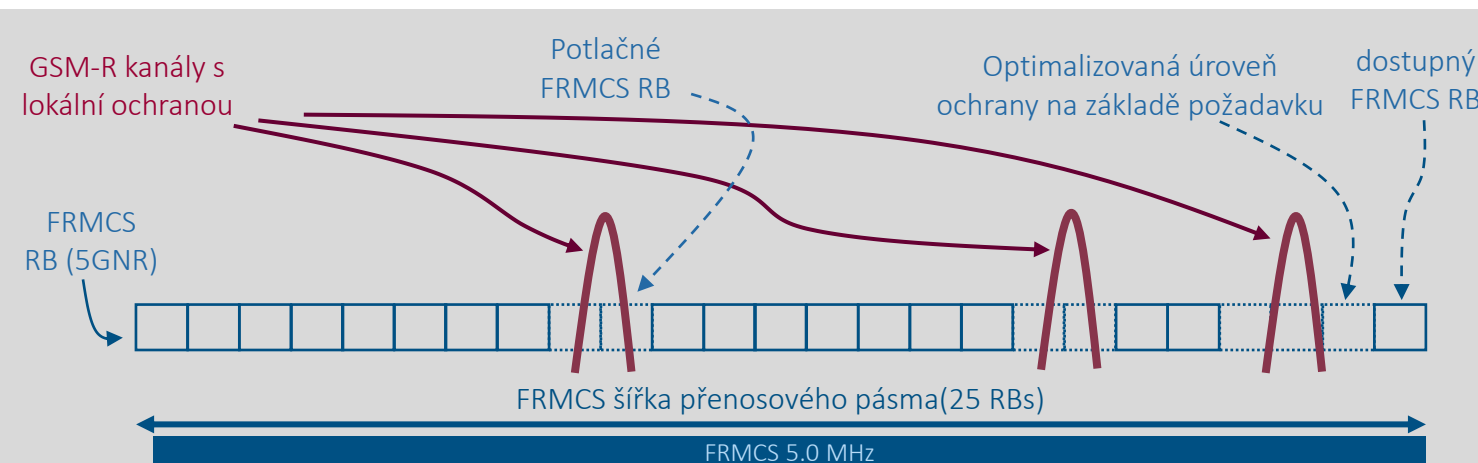
# FRMCS - standartizace



(\*) COMMISSION IMPLEMENTING DECISION (EU) 2021/1730 of 28 September 2021 on the harmonised use of the paired frequency bands 874,4-880,0 MHz and 919,4-925,0 MHz and of the unpaired frequency band 1 900-1 910 MHz for Railway Mobile Radio [https://eur-lex.europa.eu/eli/dec\\_impl/2021/1730/oj](https://eur-lex.europa.eu/eli/dec_impl/2021/1730/oj)

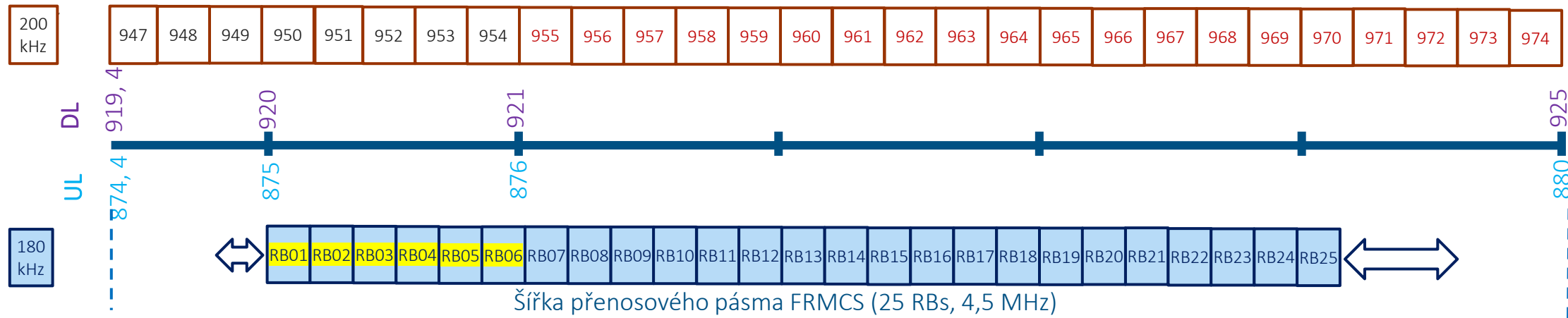
# Whitespace princip – pásmo 900 MHz

## 5G NR překrytí GSM-R pásma a ochrání GSM-R



# Whitespace princip

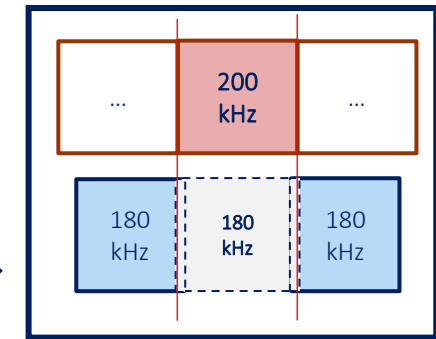
## 5GNR Radio Blocks (RBs) zakrytí GSM-R frekvence



Všeobecně je na GSM-R frekvenci vynecháno až 2 RBs 5GNR.



Je také možné zarovnat na subnosné v rámci RB.  
→ Maximální počet prázdných míst 2 RB na frekvenci GSM-R.



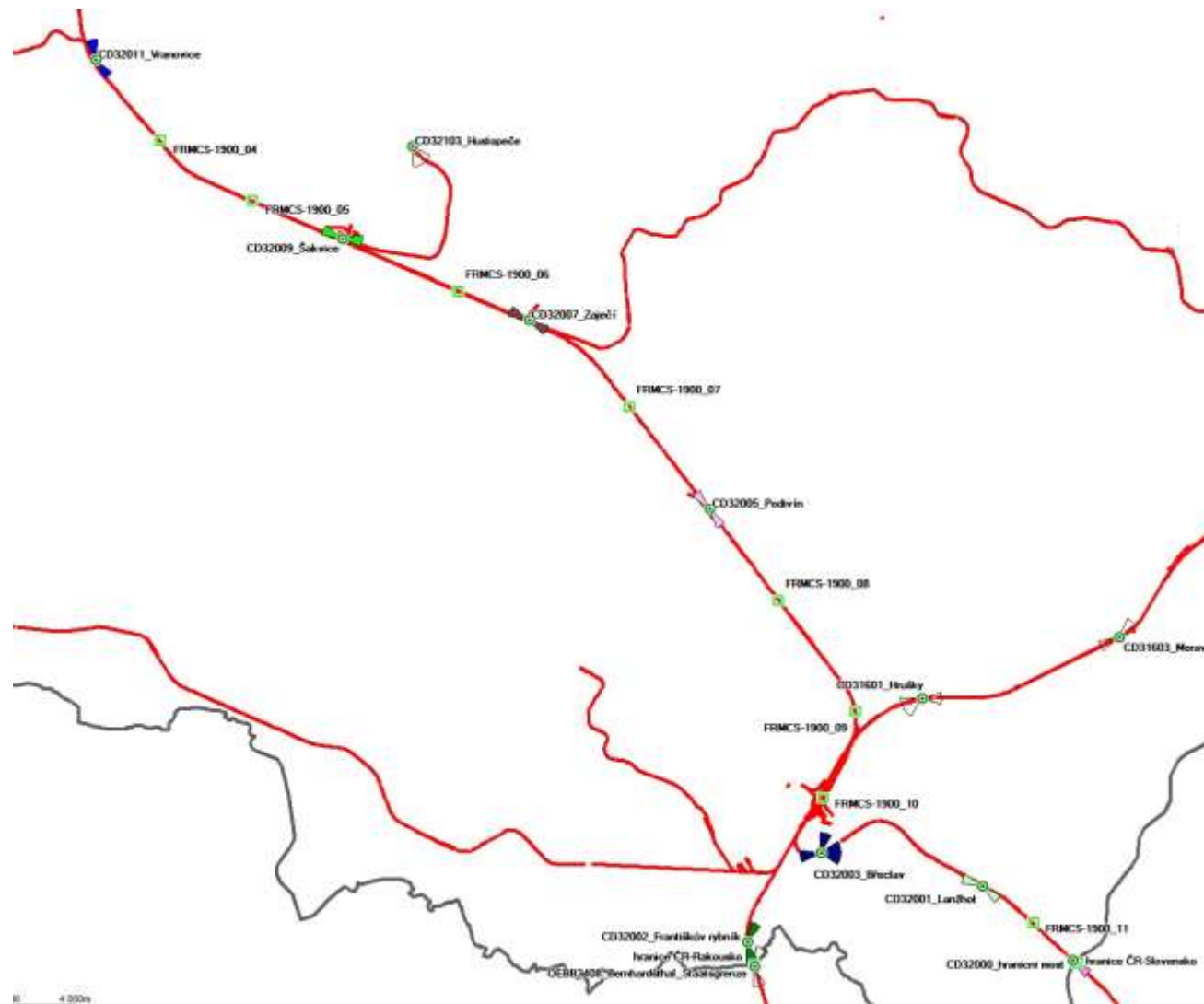
Stavíme mosty mezi generacemi

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# FRMCS – 1900 MHz

Brno – hranice CZ/SK – Bratislava (příklad)



- V současné době se stále ve stavbách SŽ požadují analogové rádiové systémy ve frekvenčním pásmu 160/450 MHz. Pro dopravce je důležitá jednotnost systému, aby bylo možné používat jeden systém na celé síti.
- Georedundantní centrální části GSM-R jsou vybudované pro celou ČR – to zajišťuje stejnou bezpečnost a spolehlivost pro všechny tratě na celé infrastrukturu ČR.
- Pro nasazení na vedlejších tratích stačí pouze rozšiřovat síť základnových stanic BTS.
- Je tedy možné jednoduše, kvalitně a investičně výhodně rozšiřovat pokrytí na všech dalších tratích s ohledem na evoluci k FRMCS (5G).
- GSM-R doporučený plynulý přechod na FRMCS.
  - Využití hybridního provozu GSM-R + FRMCS v pásmu 900 MHz
  - Finální stav 1900 MHz - možné využít budovanou infrastrukturu SŽ i pro veřejné operátory

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## Děkuji za Vaší pozornost

Ing. Petr Vítek  
CEO

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[www.kontron.com/ktrdn](http://www.kontron.com/ktrdn)

