



UIC Conference 2013

# GSM-R: Borderless Communication

Boris Gombač, UIC FG, Slovenske železnice, Slovenia  
Chiel Spaans, UIC NMG, ProRail, The Netherlands  
Dirk Brucks, UIC ENIR, DB Netz AG, Germany

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# Content



- **The role of GSM-R in international train operation**
- **Roaming and interconnection**
- **Border Lines**
- **Network Management**
- **Future developments**

# The International Scope of GSM-R

## Support of Railway Safety voice communication

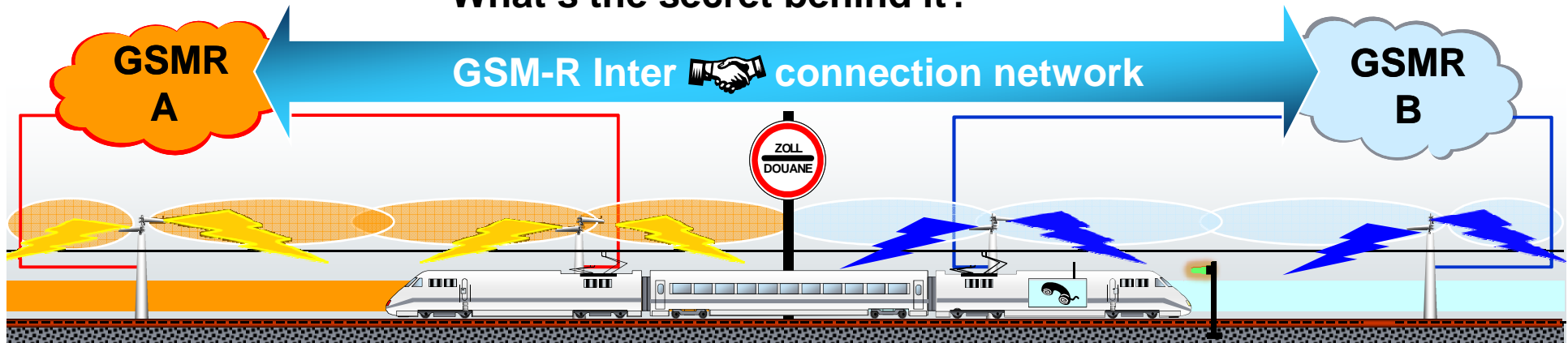
- Driver – Controller
- Railway Emergency Calls
- Shunting communication

## Support of ETCS Level 2 data communication

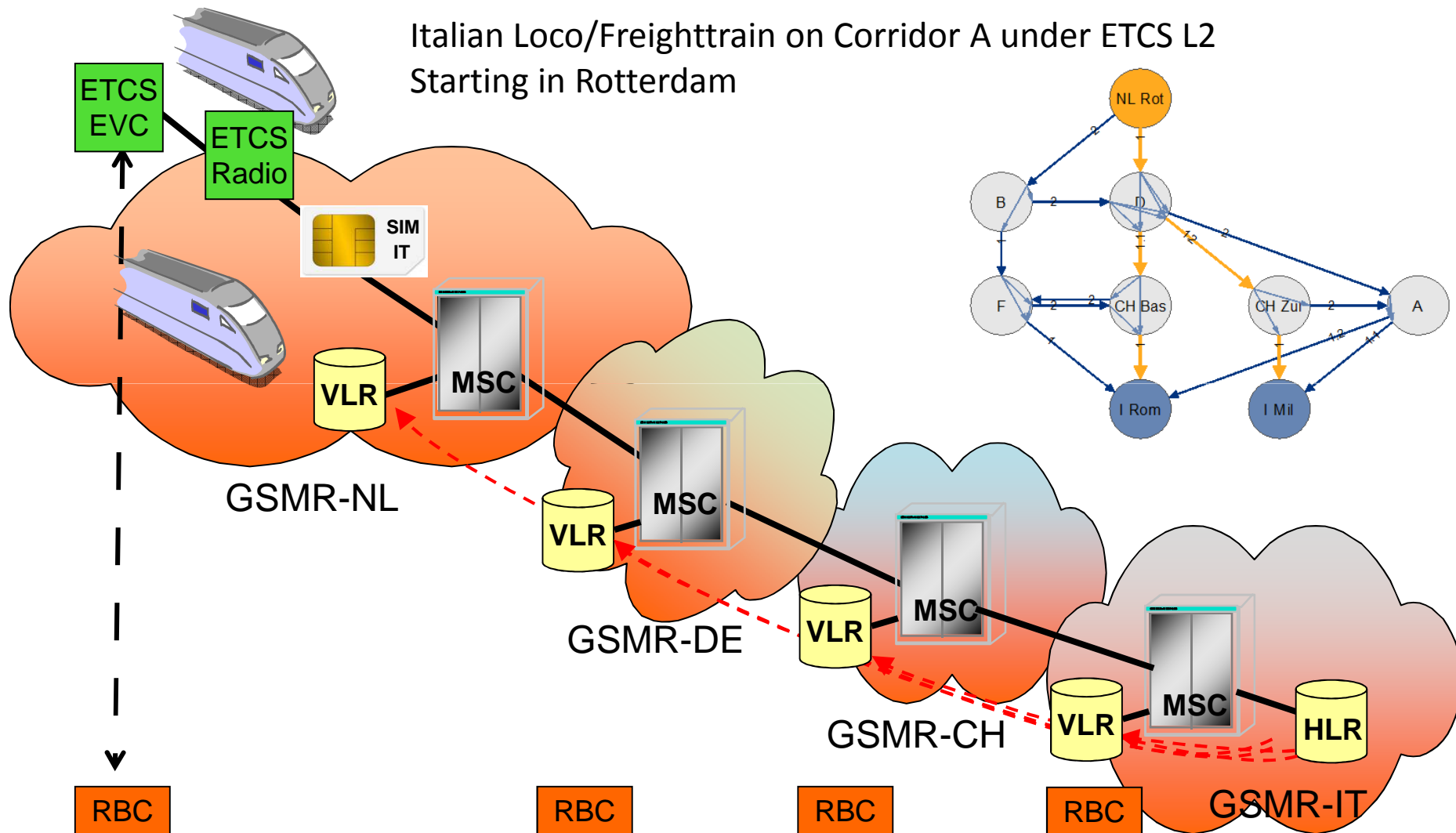
- Train (EVC) – Trackside (RBC) communication

It's just normal that this works always for all trains, not only national trains, but also for visitors from abroad.

What's the secret behind it?



# Example of interoperability



# GSM-R Interoperability

## Definition:

- **GSM-R Interoperability is: network independent behavior of standardized onboard Voice and ETCS Data applications**

## So what's needed:

- *GSM-R network* interconnection and roaming: Infrastructure Managers are suppliers of GSM-R communication services, providing at least mandatory EIRENE functionalities to **all users**, *independent of their country of origin*
- *Users*: Trains (with EIRENE compliant cabradio and ETCS modem) and handhelds, with GSM-R SIM cards
- **This is only possible when GSM-R SIM cards are accepted in all GSM-R networks**
- **Roaming is prerequisite for Interoperability**

# Interconnection versus Roaming

## Interconnection



- **Physical connection links** (2 Mbit/s lines) between national GSM-R networks, (forming our international GSM-R overlay network )
- Providing **Europe-wide interconnection** of *all* GSM-R networks with redundant routing paths for SS7 signaling and user data
- Bi-lateral **Interconnection Agreements** between Network Operators
- Multi-lateral **Transit Routing Agreement**, signed by everyone (!)
- **Needed for Roaming and border-crossing calls**, but also for fixed GSM-R communication, e.g. dispatcher-dispatcher communication on borderlines

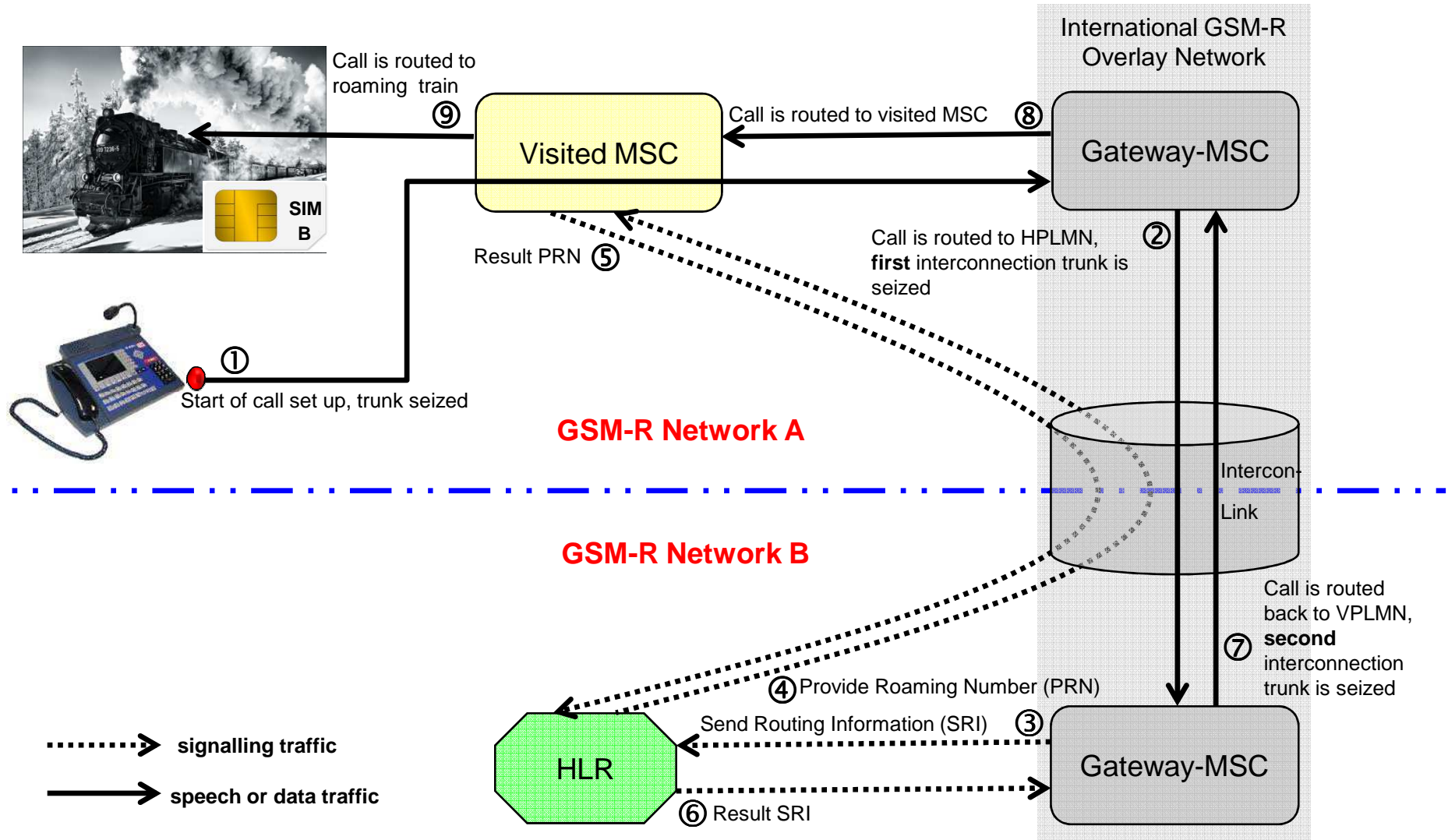
## Roaming



- Technical provisions and configurations in Networks in order to offer **communication services to GSM-R radio's abroad** (= SIM card from other Network Operators)
- Bi-lateral **Roaming Agreements** between Network Operators

# How does roaming work?

## Call routing principle for international mobile terminated call (MTC)

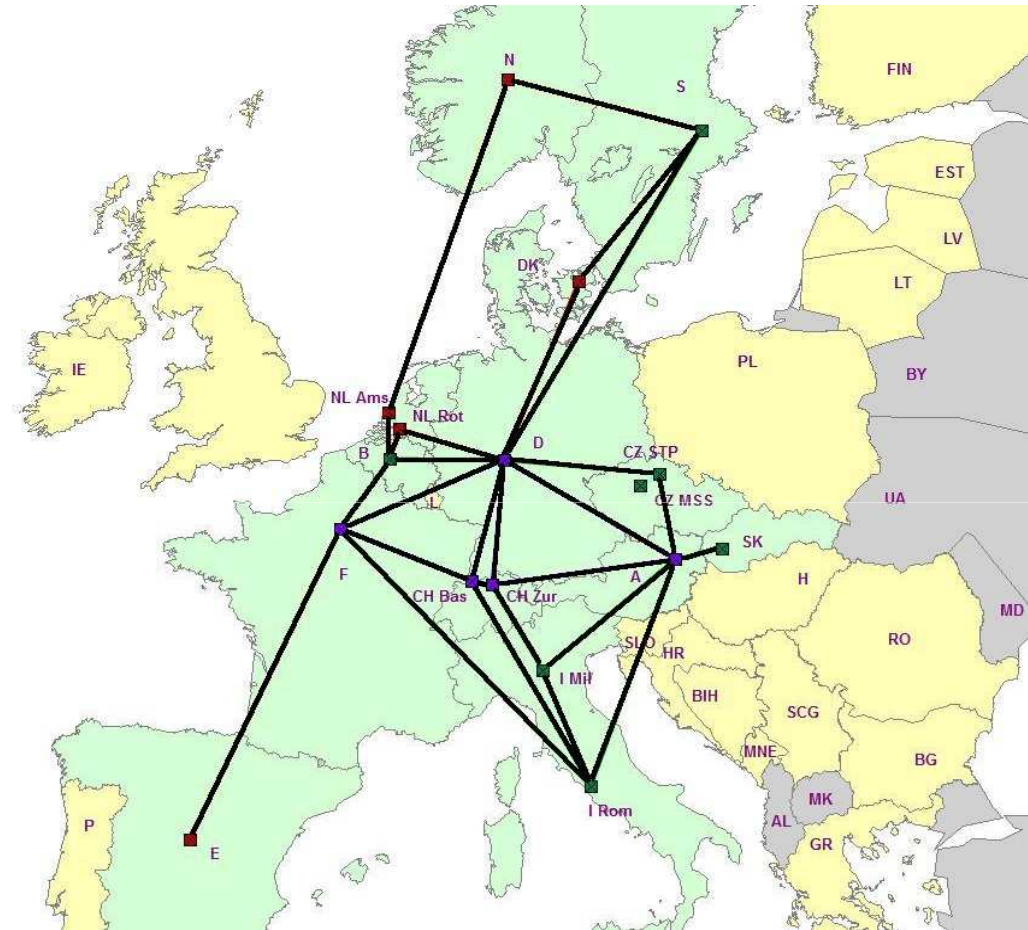


# The GSM-R Interconnection Network

## Overview

### ENIR GSM-R Overlay Network

- 13 railways interconnected  
A, B, CH, CZ, D, DK, E, F,  
I, N, NL, S, SK,
- 28 physical international GSM-R  
Interconnections
- Non-hierarchical network  
structure
- Fault tolerant routing schema for  
SS7 signaling and user data
- Update: once a year
- Latest design, activation with  
Routing Data Set (RDS) #9  
at 22<sup>nd</sup> of Sept 2013



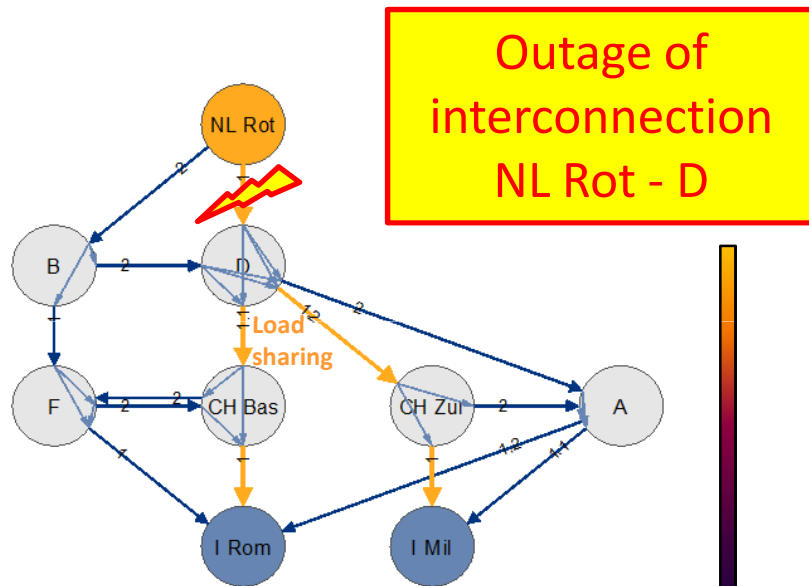
**=> This network should be treated as a common international GSM-R network, needed to support our roaming facilities and cross-border calls !**



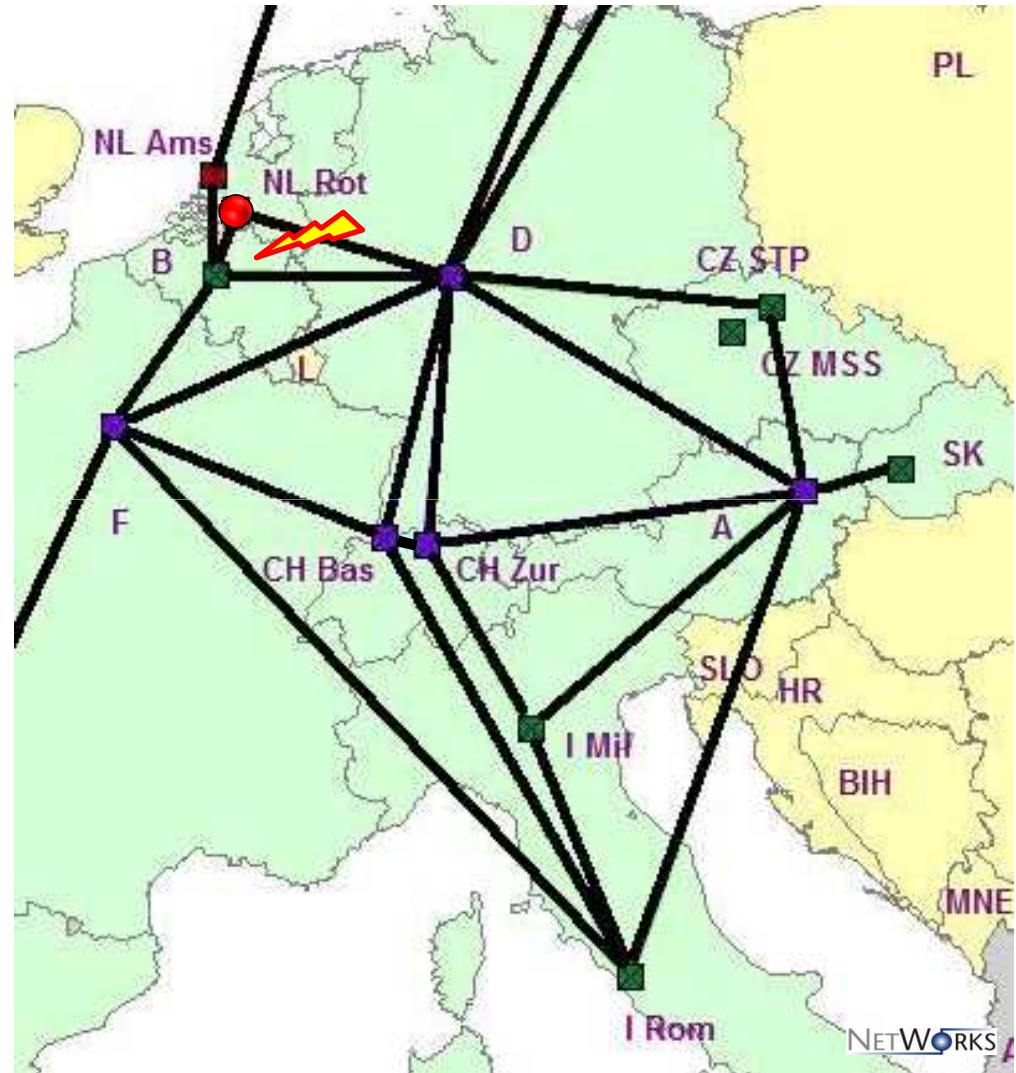
# The GSM-R Interconnection Network

Used fault tolerant routing schema

Example: End to end routing paths for calls from NL Rotterdam to Italy



=> Alternate routing path will be used:  
NL Rot – B – F – I Rom



# GSM-R Roaming

Country	Infrastructure Manager Name	Country Abreviation	A	B	CH	CZ	D	DK	E	F	I	N	NL	S	SK
Austria	ÖBB	A	Operational	Expected	Operational	Operational	Operational				Operational		Operational		2013
Belgium	SNCB	B	Expected	Operational	Operational	Expected	Operational			Operational	Expected		Operational		
Switzerland	SBB + BLS	CH	Operational	Operational	Operational		Operational			Operational	Operational		Operational		
Czech Republ.	SZDC	CZ	Operational	Expected		Operational							Operational		2013
Germany	DB Netz	D	Operational	Operational	Operational	Operational	Operational	2013		Operational	Operational	Operational	Operational	Operational	
Denmark	Banedanmark	DK					2013	Operational						2013	
Spain	ADIF	E							Operational	Operational					
France	RFF	F		Operational	Operational		Operational		Operational	Operational	Operational		Operational		
Italy	RFI	I	Operational	Expected	Operational		Operational			Operational	Operational		Operational		
Norway	JBV	N					Operational					Operational	Operational	Operational	
Netherlands	ProRail	NL	Operational	Operational	Operational	Operational	Operational			Operational	Operational	Operational	Operational	Operational	
Sweden	Trafikverket	S					Operational	2013				Operational		Operational	
Slovak Republ.	ZSR	SK	2013			2013									Operational

Operational

Ready for operation

Expected

Source: NMG doc. N-9004

# What if Roaming fails

## Outage of MSC CZ (2010)

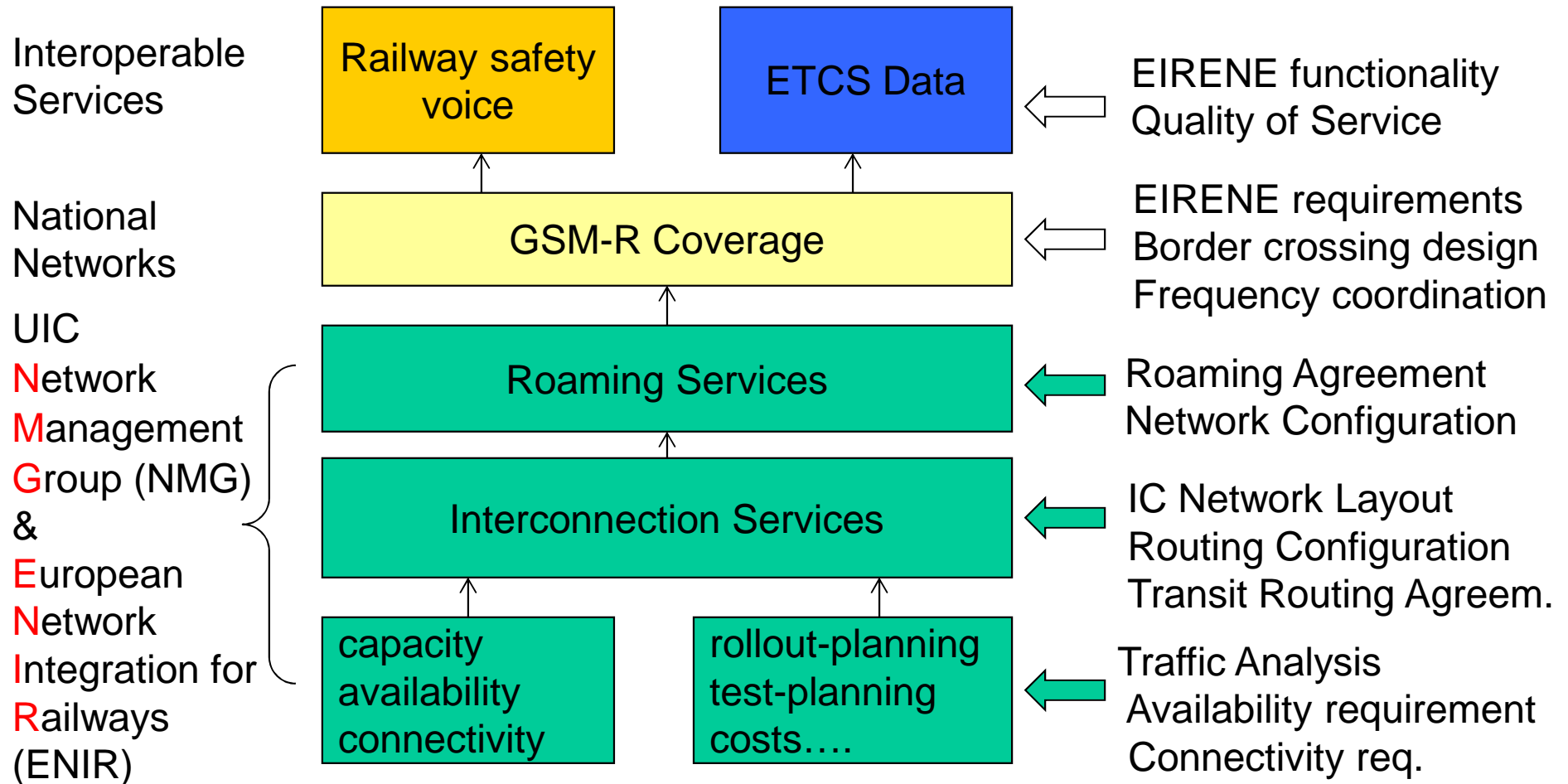
- Due to flooding
- Several days unavailable
- Consequence: no roaming possible in Germany
  - International traffic D - CZ affected during at least 2 days
  - Loco's with CZ SIM cards to be changed at borders
  - Massive delays



## Outage of MSC NL (2009)

- Due to planned work/upgrade activities
- 20 minutes unavailable
- Consequence: no roaming in D, F, BE, CH
  - Only 5 trains affected
  - Scheduled on 31/12/2009 at 23.00 !

# Dependencies



# Future – Network Expansion

## Expansion of GSM-R Europe

- New networks added to the interconnection network, e.g.
  - Slovenia
  - Denmark
  - Portugal
  - Luxemburg
  - UK
  - Eastern Europe, Russia?
- New Roaming agreements
  - “Every SIM card supported in every country”
  - GPRS roaming



# Future - Move to layered network structure

## Challenge

### Current network structure does not fit future requirements

- In many countries single Core (MSC/IN/etc) will be replaced by geo-redundant Core solutions -> almost double of network nodes
- Planned expansions by adding new countries to the interconnection network

### Impact on interconnection network:

- Configuration Management for routing becomes too complex to handle
- Requested reliability and availability can't be guaranteed
- **Decrease of availability and risk of circular routing -> Roaming Outages!**



**Current: Non-hierarchical** (layered)  
international GSM-R overlay network  
-> **Routing gets too complex due to  
needed expansions of the network!**

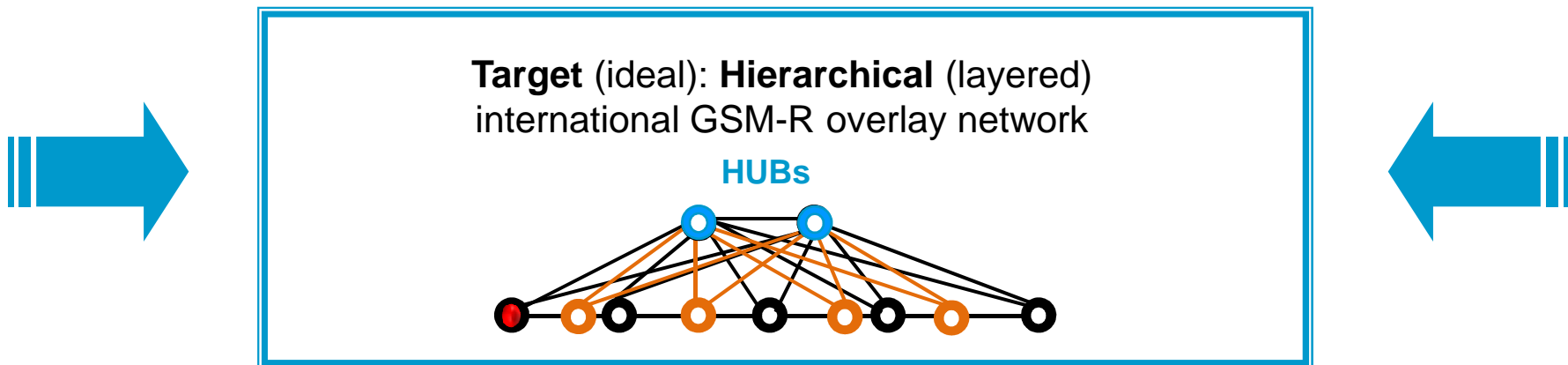


# Future - Move to layered network structure

## Solution

### Layered approach

- Moving from a non-hierarchical network architecture to a hierarchical (layered) network architecture for SS7 signaling and traffic routing.
- Installing HUB functions in GSM-R interconnection network in order to connect multiple MSC networks
- Optimize the interconnection network regarding routing straight forward via HUBs and multiple routing paths , load balancing, increase of availability, flexible expansions, etcetera



# Summary

## Roaming and Interconnection is essential for Interoperability

- All operational GSM-R networks are interconnected by a well designed and managed interconnection network
- Roaming is active where needed (and more)
- Border crossing emergency calls are ready to implement
- Every international GSM-R service is covered by Roaming Agreements, Operation and Maintenance Agreements, Transit Routing Agreements, leading to an extremely high availability
- UIC coordinates by means of
  - > NMG for legal matters
  - > ENIR for technical issues





End of presentation

**NMG / ENIR - connecting networks**

Thank you for your attention

Boris Gombač, [boris.gombac@slo-zeleznice.si](mailto:boris.gombac@slo-zeleznice.si), UIC FG, Slovenia  
Chiel Spaans, [chiel.spaans@prorail.nl](mailto:chiel.spaans@prorail.nl), UIC NMG, The Netherlands  
Dirk Brucks, [dirk.brucks@deutschebahn.com](mailto:dirk.brucks@deutschebahn.com), UIC ENIR, Germany

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