



UIC ERTMS Conference 2004, Rome

GSM-R as a Global Standard

**Presentation by
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Indian Railways**



India



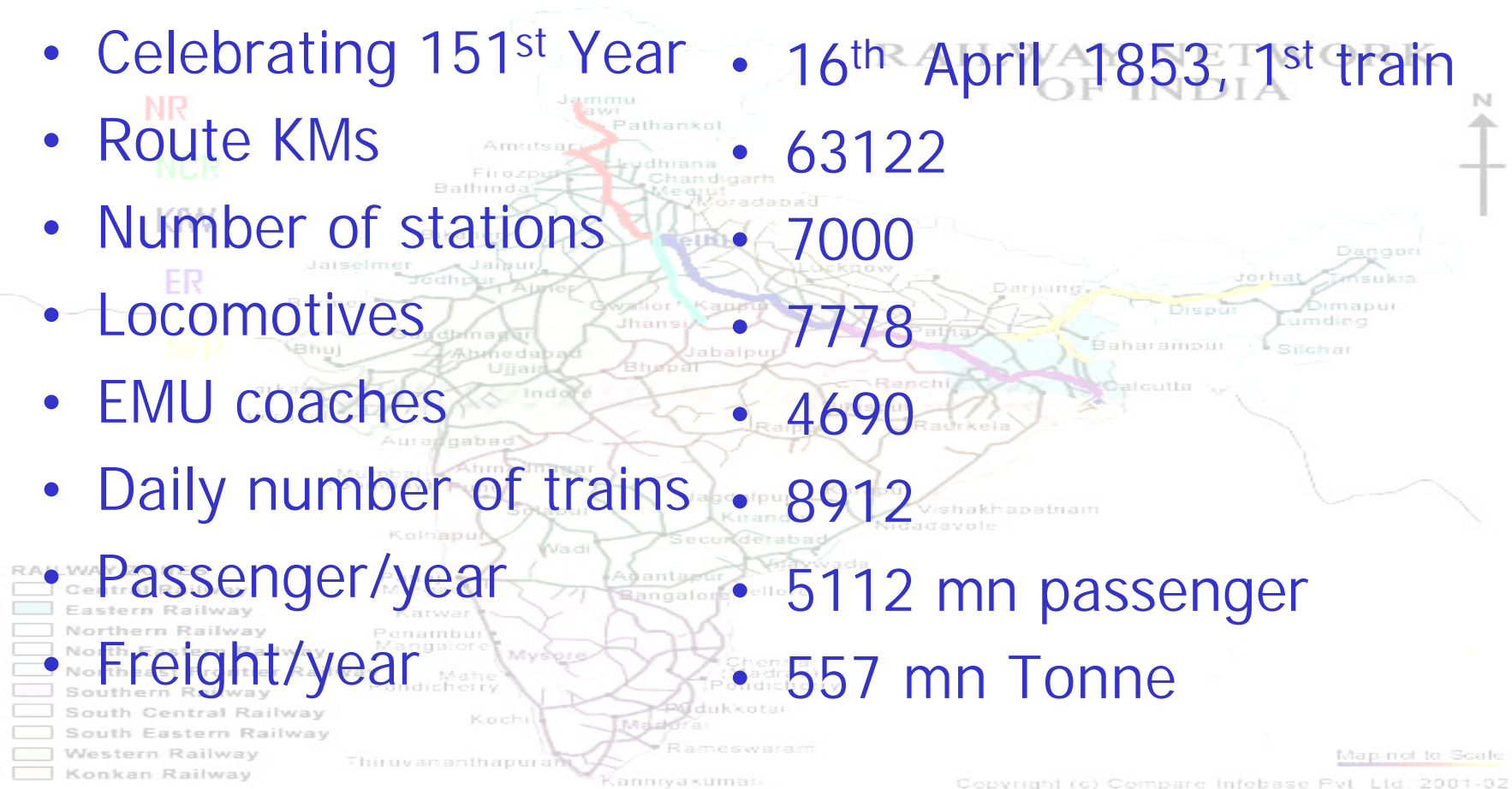
- 
- A map of India titled "INDIA STATES & UNION TERRITORIES 1991". The map shows the geographical boundaries of India, with various states and union territories labeled. The map is color-coded by state/territory. The title "INDIA" is at the top center, followed by "STATES & UNION TERRITORIES 1991". Below the title, it says "BOUNDARIES : INTERNATIONAL - - - - - STATE/UT. - - - - -". At the bottom, it says "CAPITAL OF INDIA - - - - -". The map shows the following states and union territories: Jammu & Kashmir, Punjab, Haryana, Rajasthan, Gujarat, Madhya Pradesh, Uttar Pradesh, Bihar, West Bengal, Orissa, Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Pondicherry, Arunachal Pradesh, Nagaland, Assam, Manipur, Mizoram, Tripura, Meghalaya, and Goa. It also shows neighboring countries: Pakistan, China, Nepal, Bhutan, Bangladesh, and Myanmar (Burma). The Arabian Sea is to the west, and the Bay of Bengal is to the east. The Indian Ocean is at the bottom. The map also shows the Lakshadweep islands in the Arabian Sea.
- World largest democracy
 - 1.2 billion population
 - Economy liberalised from 1990
 - Economy growth more than 6%
 - Heavy demand for better infrastructure
 - Rail transport growth : 5 % in freight & 3.5 % in passenger
 - Availability of professionals & skilled manpower
 - A global source for IT & other high technologies



Indian Railways (IR)

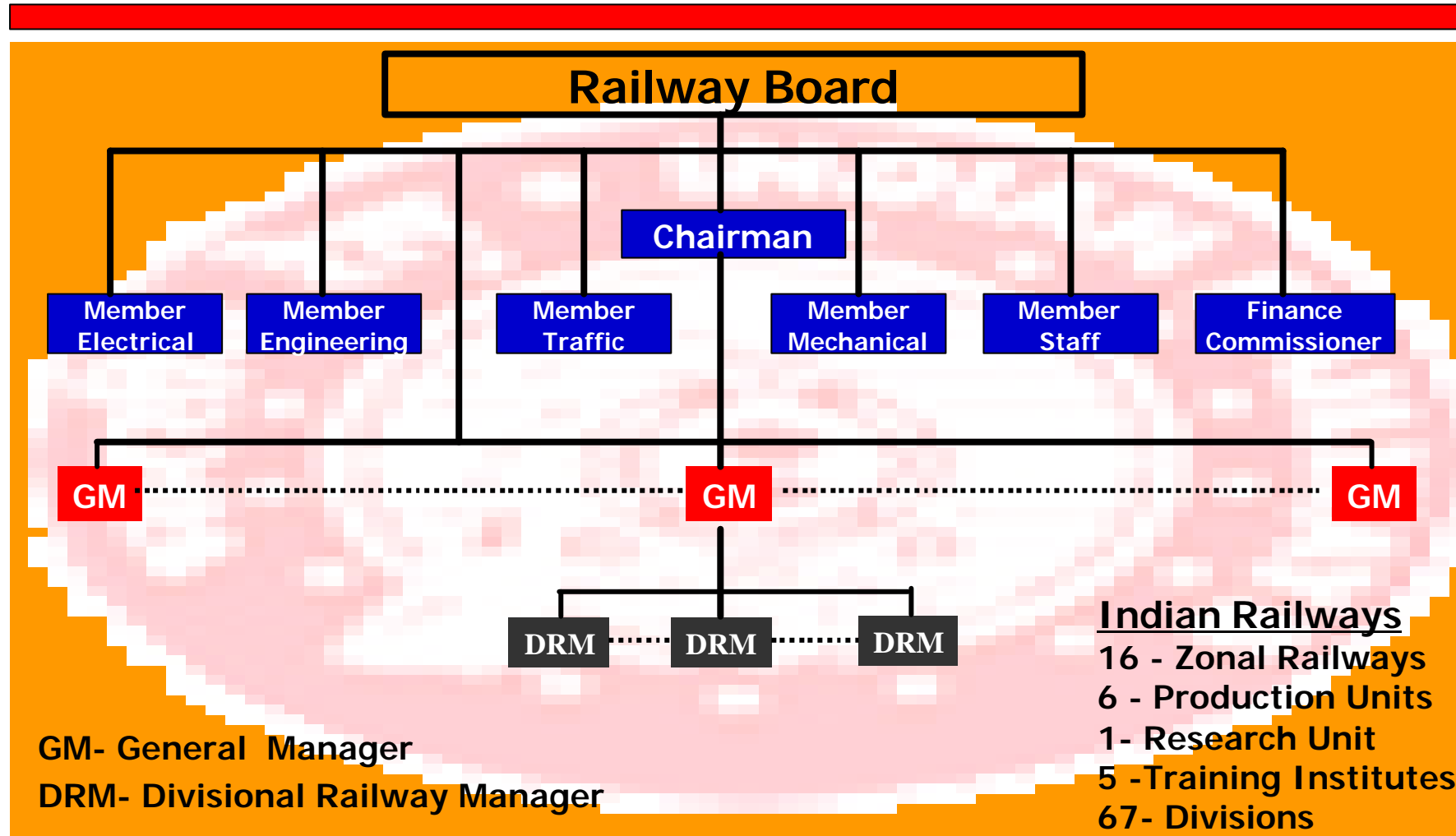


- Celebrating 151st Year
 - Route KMs
 - Number of stations
 - Locomotives
 - EMU coaches
 - Daily number of trains
 - Passenger/year
 - Freight/year
- 16th April 1853, 1st train
 - 63122
 - 7000
 - 7778
 - 4690
 - 8912
 - 5112 mn passenger
 - 557 mn Tonne





Organisation Structure





IR's Signal & Telecommunication



- | | |
|---|---|
| <ul style="list-style-type: none">• Interlocked stations<ul style="list-style-type: none">– Multi aspects Colour light<ul style="list-style-type: none">• Relay Interlocking• Electronic Interlocking (SSI)– Mechanical• Digital Microwave• Control communication 18 GHz• Qaud cable• OFC | <ul style="list-style-type: none">• 5692<ul style="list-style-type: none">– 3508<ul style="list-style-type: none">• 2951 (768 work in progress)• 45 (209 work in progress)– 2184• 6352 RKm• 989 RKm• 17000 RKm• 24500 RKm |
|---|---|

Largest pool of Signals & telecommunication professionals and skilled manpower providing human resource services to leading world railways & contractors



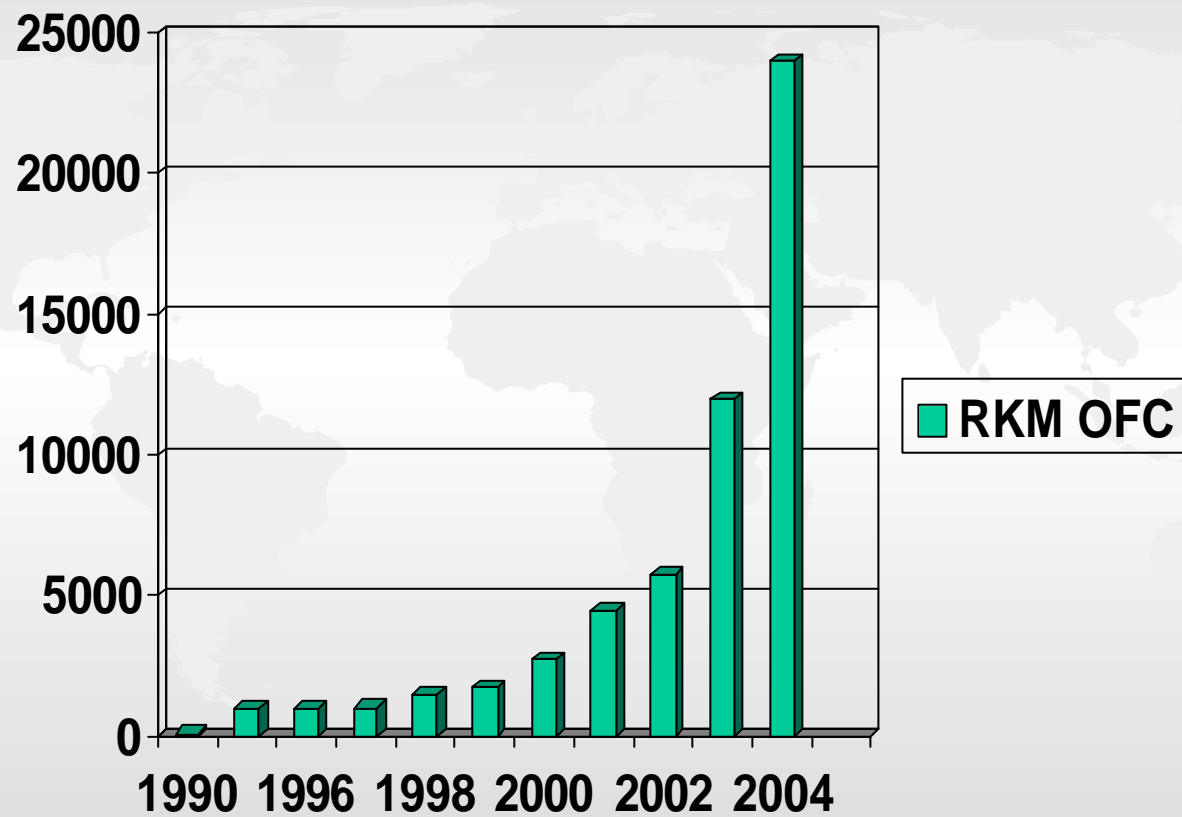
Communication Requirements of IR & System adopted by IR

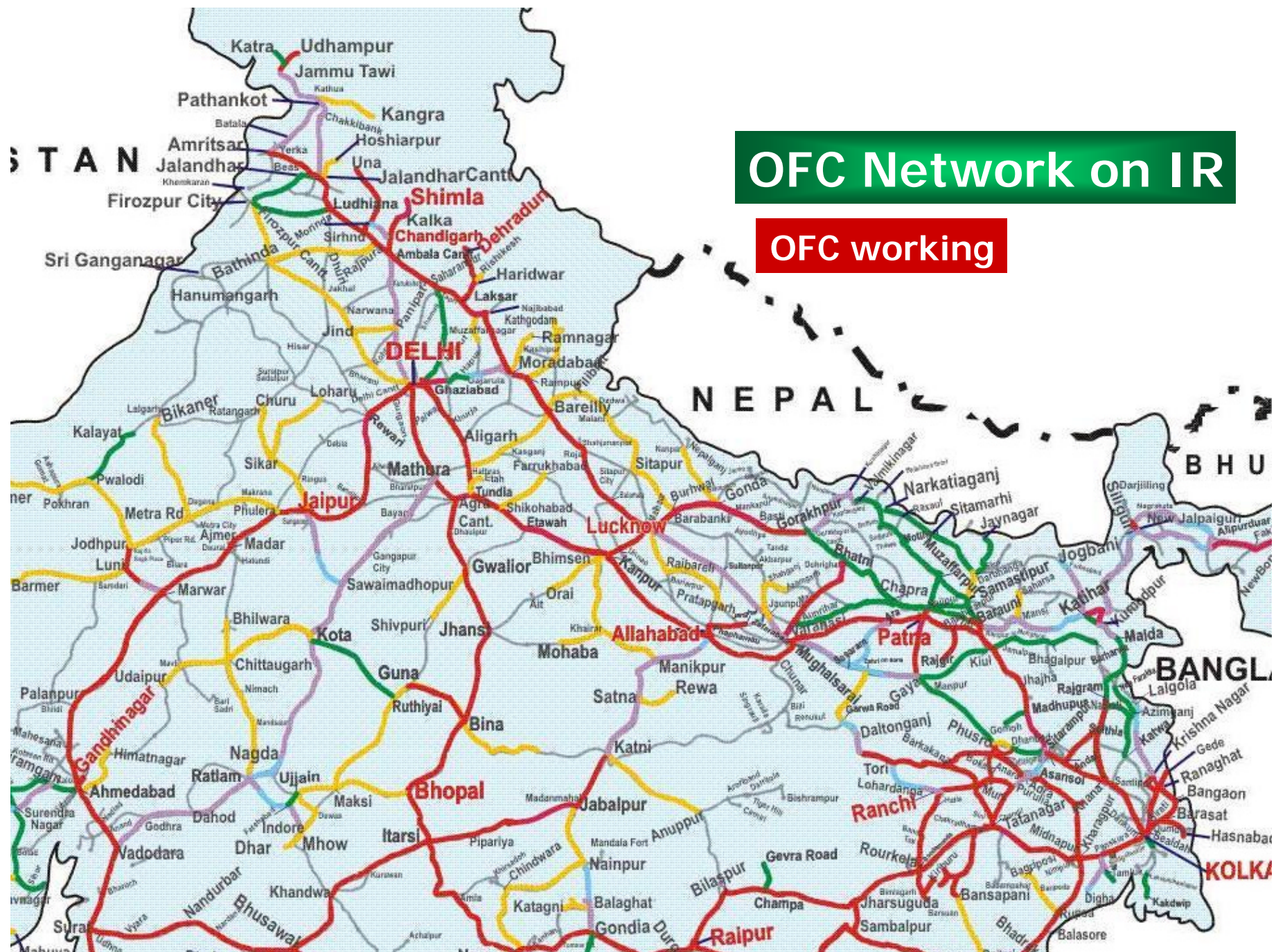


- **Control Communication**
 - Omnibus communication between Control office and Stations (Overhead, quad cable, OFC, MW)
- **Long haul administrative circuits**
 - for Railway Board, GM office, DRM office, major stations, production units & Major repair units (MW and OFC)
- **Switching Networks**
 - Digital Exchanges
- **Data Networks**
 - for Railnet, Freight Operation & Information System, Passenger Reservation System, National Train Enquiry System (Servers, routers, hubs , etc)



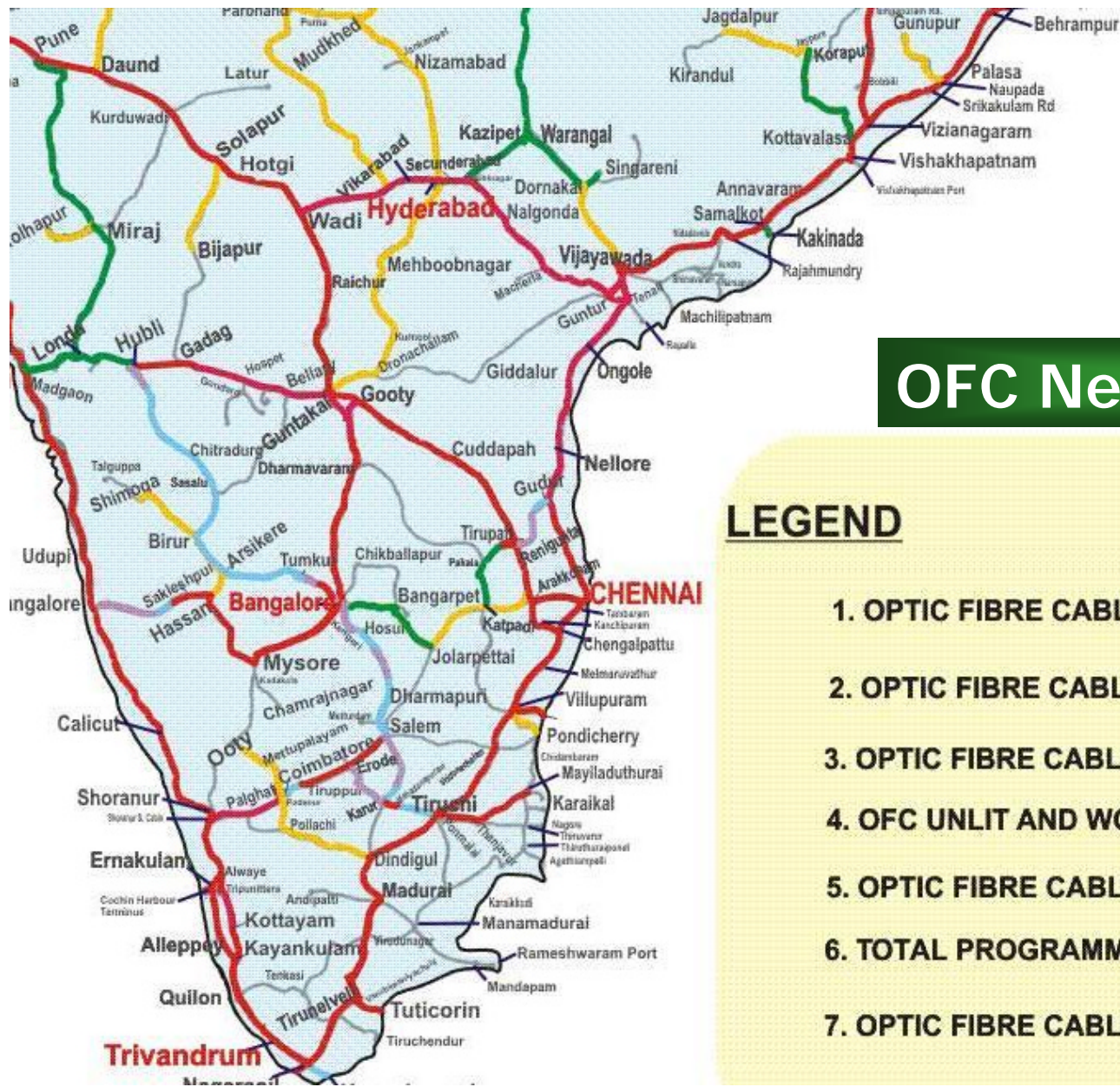
Growth of OFC on IR





OFC Network on IR

OFC working



OFC Network on IR

LEGEND

1. OPTIC FIBRE CABLE COMMISSIONED

RKm

20552

2. OPTIC FIBRE CABLE UNLIT

2156

3. OPTIC FIBRE CABLE WORK IN PROGRESS

2548

4. OFC UNLIT AND WORK IN PROGRESS

6787

5. OPTIC FIBRE CABLE PROPOSED

6. TOTAL PROGRAMMED

7. OPTIC FIBRE CABLE FUTURE WORKS

10538



Mobile Train Radio Communication (MTRC)



- Train crew to ground communication (Simplex) provided since 1950 in Europe, Japan and US.
- IR started MTRC in 1985
 - Analog, Duplex, Multi channel MTRC provided on 1686 route Kms of IR in 314-322 MHz band
 - From 1999 - Walkie-talkie, Simplex communication , gradually provided to train crew of all the trains to communicate with station and between train crews.
 - Large number of staff speak on same channel
 - Speech quality problem at speed
 - Range is limited, continuous communication not possible



GSM as a Global Standard



- GSM is de facto global standard
 - Standardization
 - Economies of scale
 - Global Roaming
 - Reliable
- Evolution to mobile data services
 - GPRS
 - EDGE
 - UMTS



Evolution of GSM-R



- 1992 - feasibility study by UIC to create a new radio standard for railway operation
- 1993 – GSM adopted as basis for the system
- 1994 – ETSI standardized ASCI features
- 1995 – CEPT mediated in frequency allocation in 900 MHz. MORANE consortium formed consisting of EC, UIC and Industry to develop prototype for EIRENE
- 1996 –Railway specific features standardized



GSM-R



- GSM-R services standardized within GSM standard issued by ETSI (European Telecommunication Standard Institute)
GSM-R = GSM + Advanced Speech Call Items (ASCI)
- **ASCI**
 - ✓ eMLPP (Enhanced Multi Level Precedence & Pre-emption)
 - ✓ Voice Broadcast Calls
 - ✓ Voice Group Calls
- **Railway specific applications**
 - ✓ FA (Functional Addressing), PFN (Presentation of Functional Number), LDA (Location Dependent Addressing), AM (Access Matrix)
- **Quality of Services requirements**



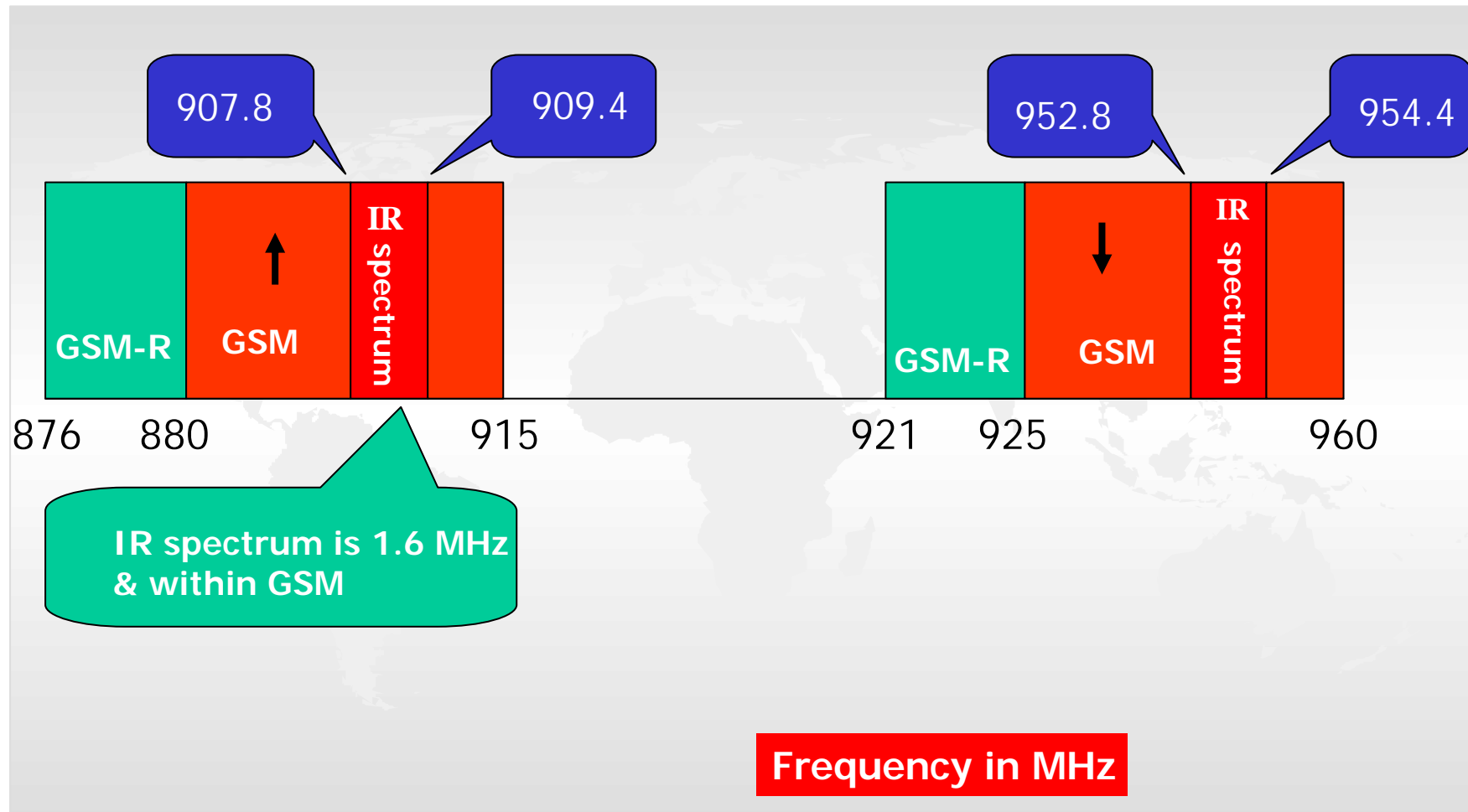
Railway Safety Review Committee (RSRC)



- A reliable Train Radio Communication facility between driver , guard, station, level crossing gates and approaching train should be provided in 3 years on high density, high speed and suburban routes and in next 3 years on important routes. Once optical fibre backbone is in place communication facility should be extended to control office. The system should have built in call over ride , broadcast and SOS facility.
 - High density, high speed & suburban routes on IR is 15225 route KMs long



GSM Spectrum





GSM-R as a Global Standard



- It is based on successful, current, reliable GSM technology deployed world over (Global mobile user base 1.5 bn out of which 1.25 bn GSM (84%)
- Skilled resources to deploy and maintain NW are available
- Future developments in application of GSM can be introduced in GSM-R, since GSM-R is part of the family of the ETSI "2.5G" standard
- Validation of functional specification by MORANE
- Standardized interfaces

GSM- R Projects under implementation on IR

Jammu- Pathankot -Amritsar – Ludhina-Ambala
New Delhi – Palwal **828 kms**

New Delhi- Kanpur-
Mugalsarai- **760 kms**
under KfW Project

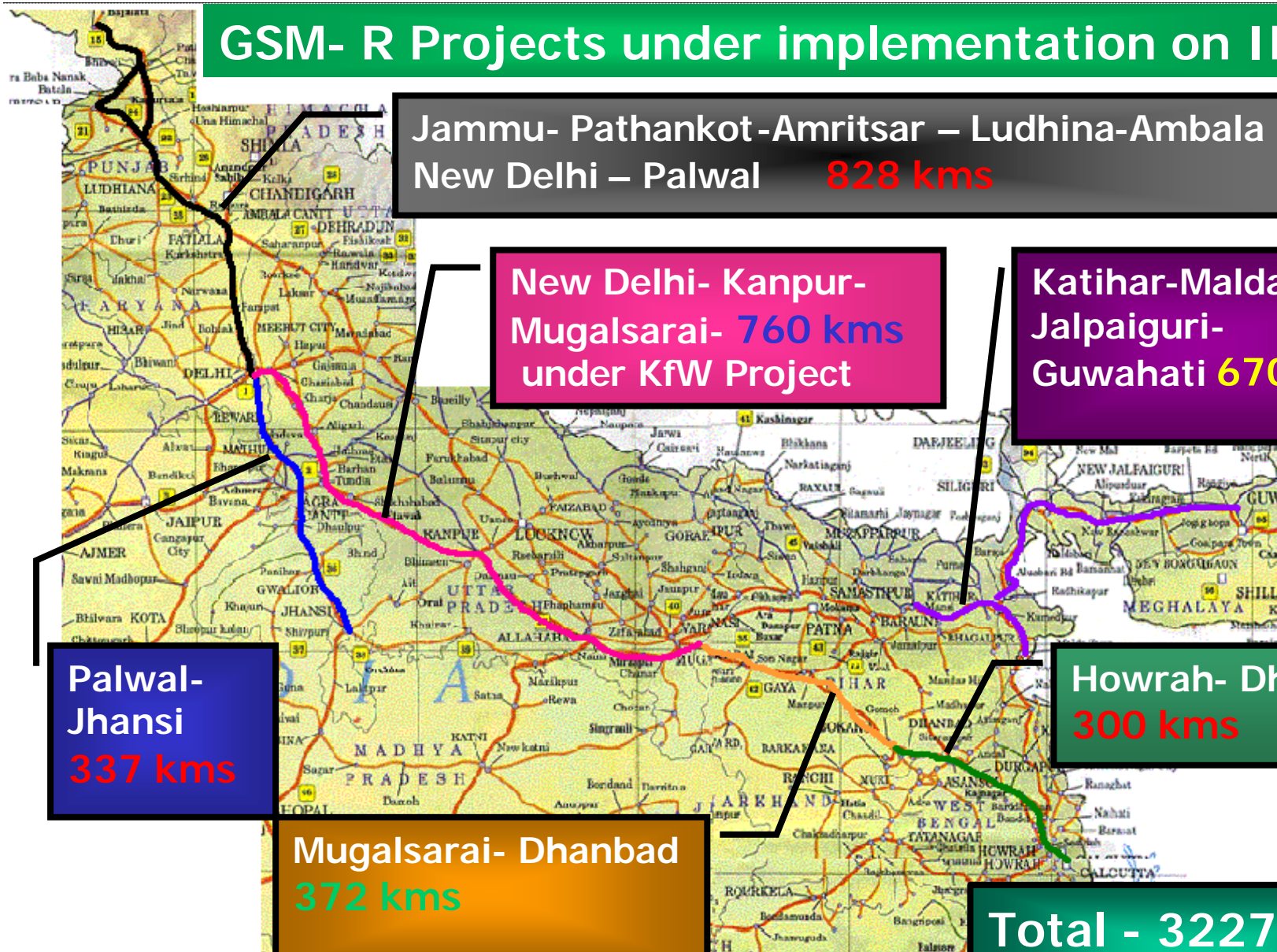
Katihar-Malda -
Jalpaiguri-
Guwahati **670 Kms**

Palwal-
Jhansi
337 kms

Mugalsarai- Dhanbad
372 kms

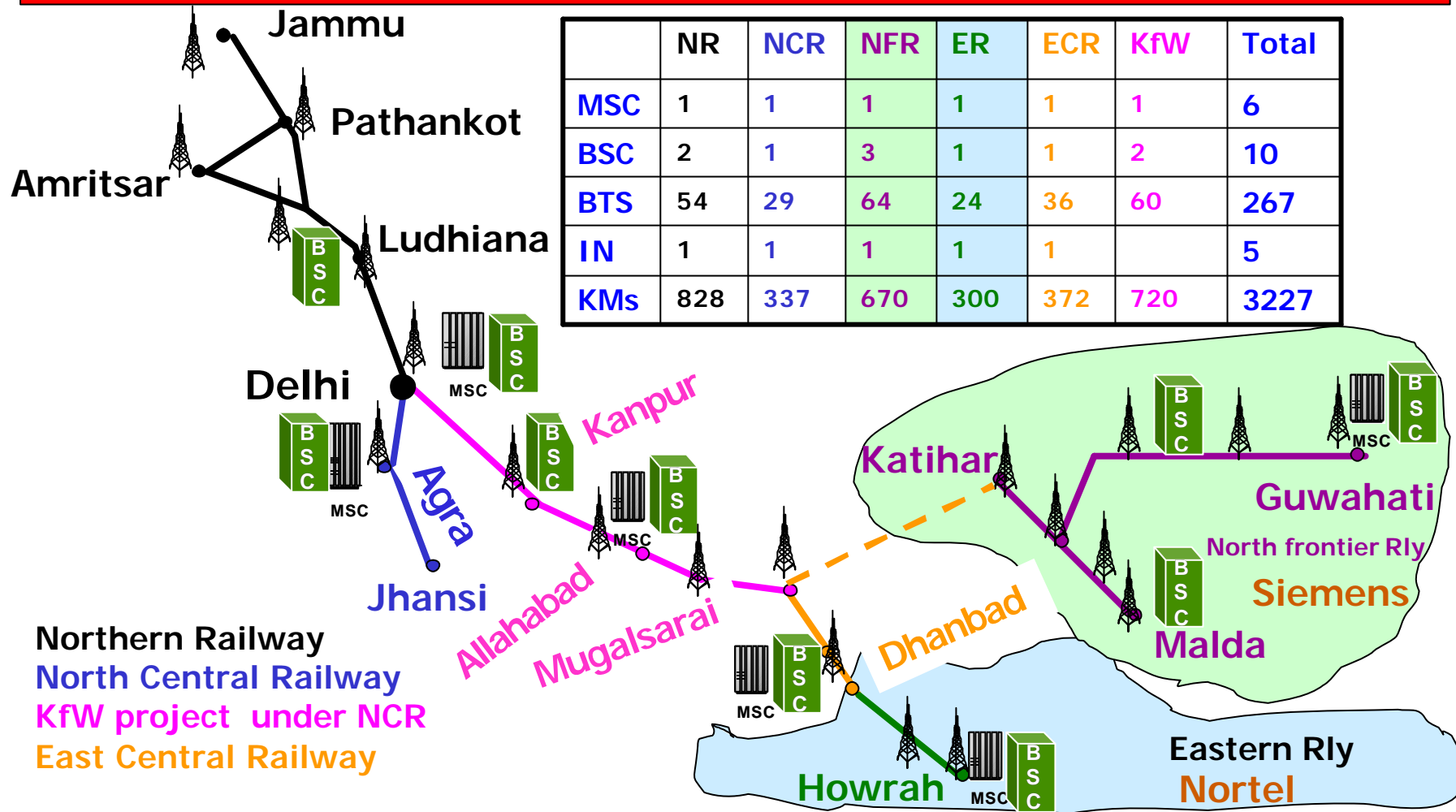
Howrah- Dhanbad
300 kms

Total - 3227 RKm
40 mn Euro



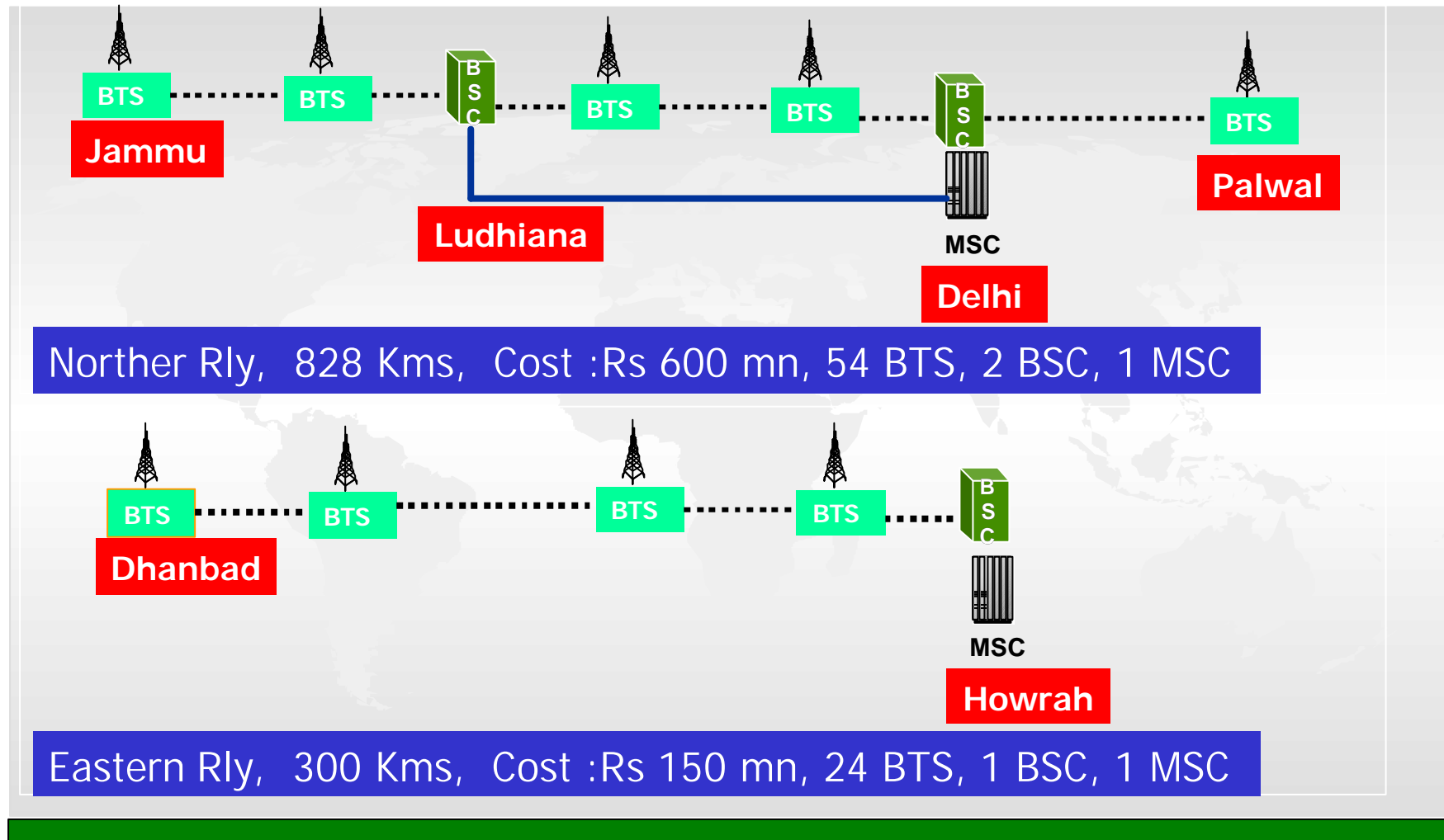


Indian Railways Network Topology



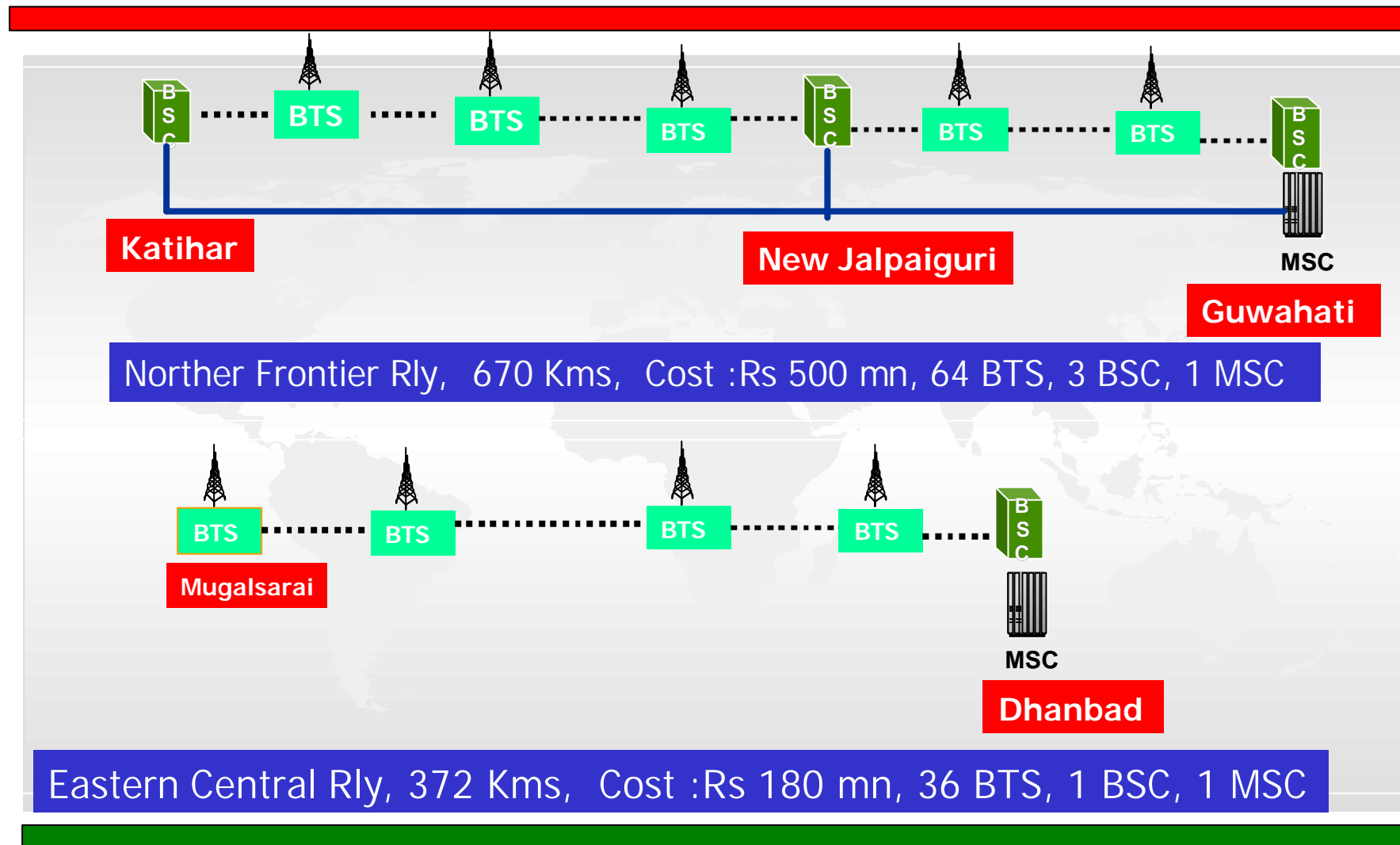


Indian Railways Network Topology





Indian Railways Network Topology

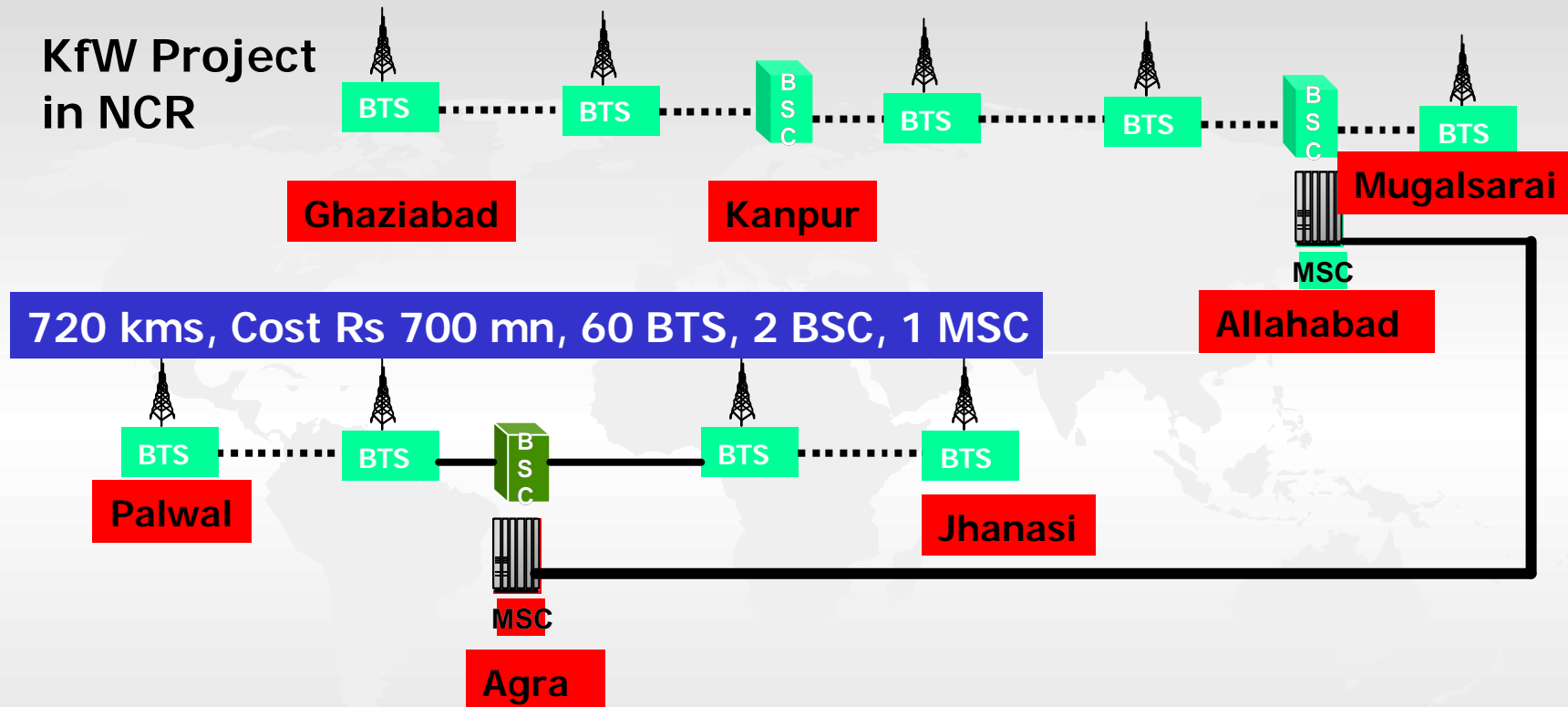




Indian Railways Network Topology



KfW Project
in NCR





Issues for GSM-R to become a global standard



- **Spectrum**

- EU directives for GSM-R spectrum allotment are enforceable in Europe; there is no mandate in other countries.
- There is limitation in allotment of spectrum in GSM/GSM-R Band. IR has only 8 pairs of spot frequencies in GSM Band. UIC has helped IR in obtaining these frequencies. 8 pairs are inadequate in multi direction stations (junctions).



Issues for GSM-R to become a global standard



- **Non ERTMS application**

- GSM-R has been developed as carrier for ETCS
 - Safety validation has been done in Europe. Other Railways can implement ERTMS-2 & 3 without further validation.
- However for non ERTMS application technologies like CDMA & TETRA are alternative solutions.
 - Tetra is working in India, 25 kms on DMRC (Delhi Metro Rail Corporation). On Central Railway, 80 Kms, it is being deployed



Issues for GSM-R to become a global standard



- **Cost**
 - GSM-R is substantially costlier than GSM; both for infrastructure and handsets
- **Limited Vendors**
 - Nortel and Siemens for infrastructure & Sagem and Kapsch for handhelds and limited for CAB radios & dispatcher terminals



Issues for GSM-R to become a global standard



- **Migration to 2.5 G and 3 G**
 - In the age of predominance of data application 2.5 G and 3G are requirements.
 - GPRS (2.5 G) is available in GSM
 - EDGE(Enhanced data rate for Global evolution) capable GSM-R hardware should be available
 - AMR (Adaptive Multi Rate Codec) in GSM-R
 - it's prohibitively expensive to upgrade GSM to 3G (new equipment, software, royalties, and spectrum)



Action plan



- **Action plan to make GSM-R as a global standard**
 - Reduce cost of GSM-R in line with GSM
 - Increase number of vendors
 - Make available GSM-R in other band where availability is better
 - Notify certifying organisation for compliance to EIRENE specification by Vendors to enforce interoperability
 - Bring clarity in migration strategy to 2.5G and 3G



GSM-R projects on IR



- IR have started implementing GSM-R. Contracts for 970 KMs have been awarded and for 2257 KMs in advance stage of finalisation.
- In 2 years IR will implement 2000 KMs of GSM-R Network & 500 KMs every year thereafter provided:
 - Interoperability issues among vendors equipment & real competitions between them becomes available
 - Vendors provide service from India
 - Manufacturing of equipment is started in countries having big network like India & China



ETCS implementation



In Europe

Information upto July 2004 Source : ERTMS web site

	ETCS -1	ETCS -2
Track	1000 KMs	100 KMs
Loco equipment	200	20

In India

Track	250 KMs
Loco	120



ETCS implementation



- IR contracts for ETCS-1 covering 250 KMs are under finalisation.
 - 250 Kms, 120 loco equipment
 - participation is limited; only 2 vendors.
- It appears from press that EU railways are not fully committed for ETCS –2 & 3.
- Until ETCS –2 & 3 are accepted widely GSM-R future may get impaired.



Conclusions



UIC, EIRENE, UNISIG, MORANE groups should address:

- ✓ GSM-R Spectrum
- ✓ Multi Vendor for GSM-R & ERTMS
- ✓ Achieving large installation base of GSM-R & ERTMS in Europe
- ✓ Cost reduction of both GSM-R & ERTMS
- ✓ Migration strategy to 2.5G & 3G
- ✓ Local manufacturing of equipment in countries having big railway network

