

Packet Switched Technology

ETCS under

GSM-R Packet Mode Conditions

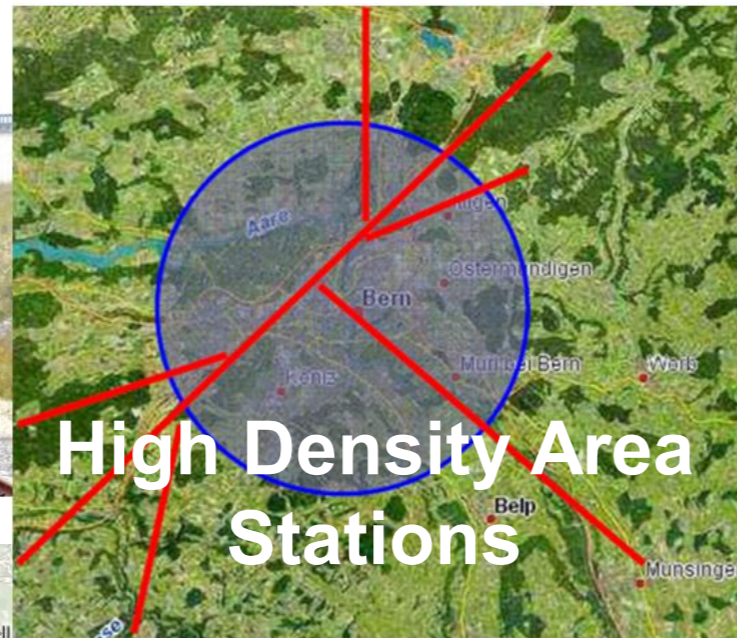


Packet Mode for ETCS

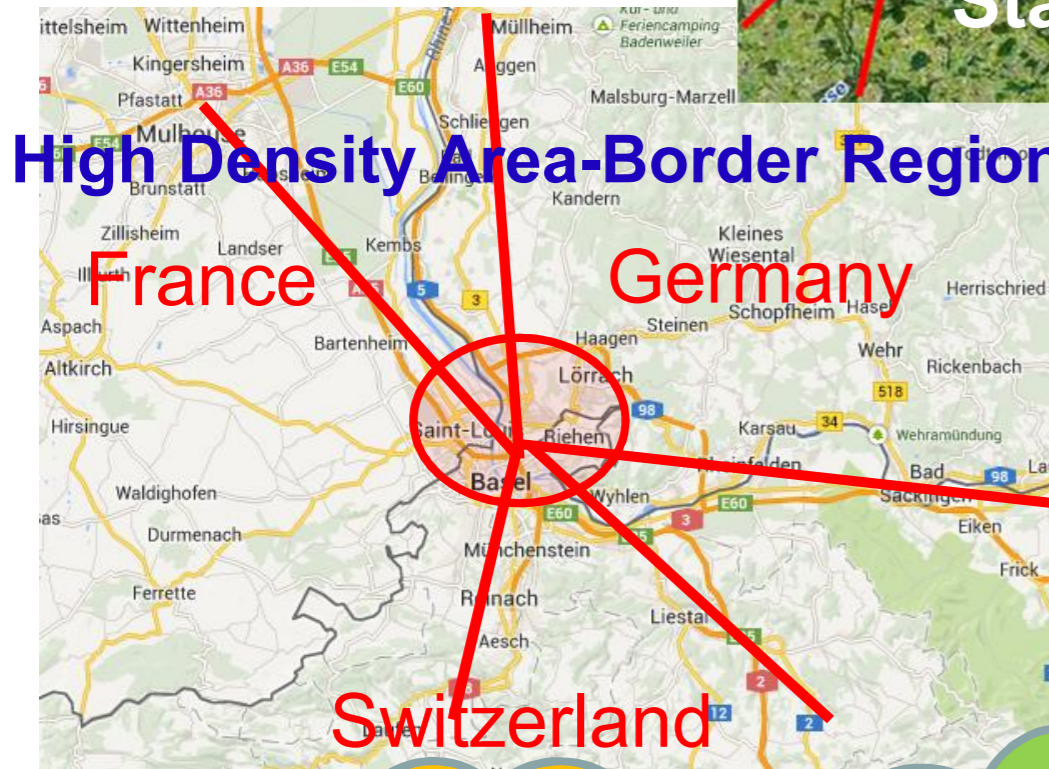
Motivation



Track



High Density Area
Stations

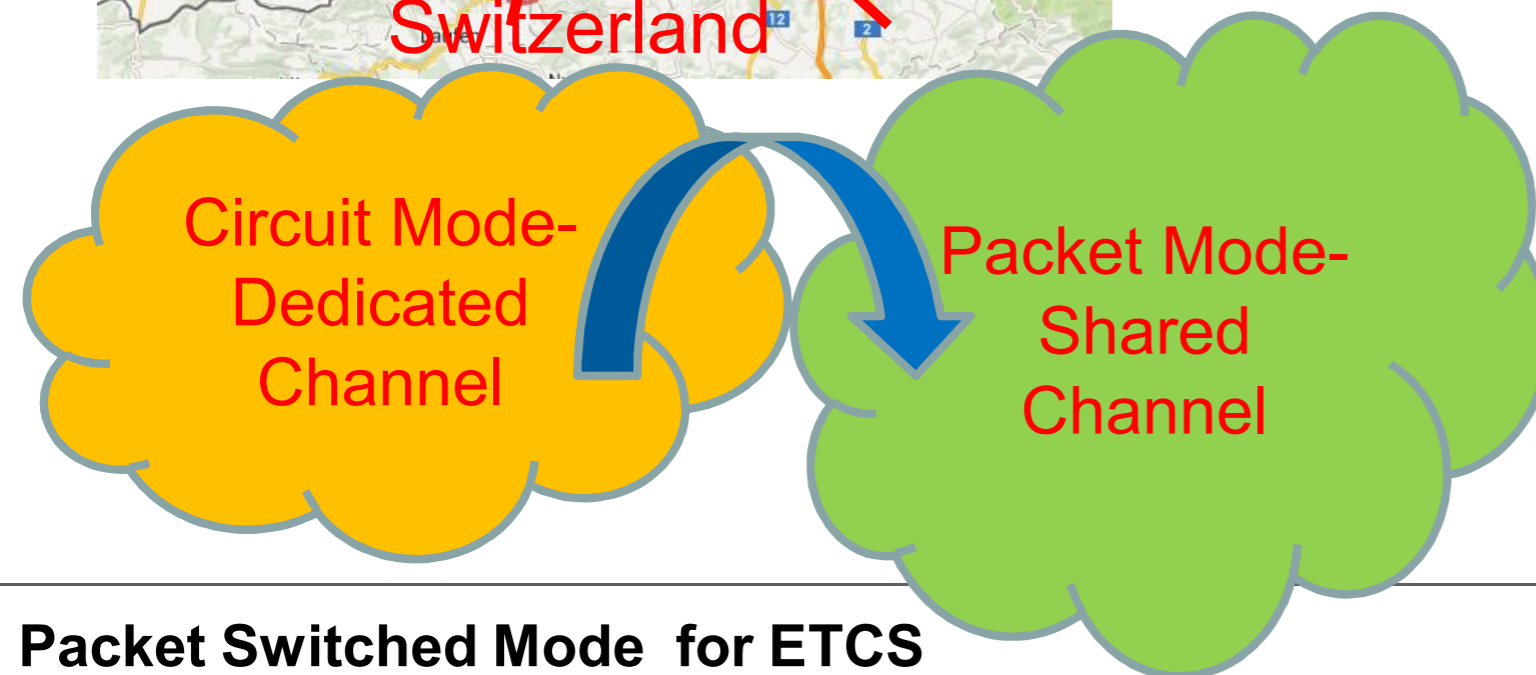


High Density Area-Border Region

France

Germany

Switzerland

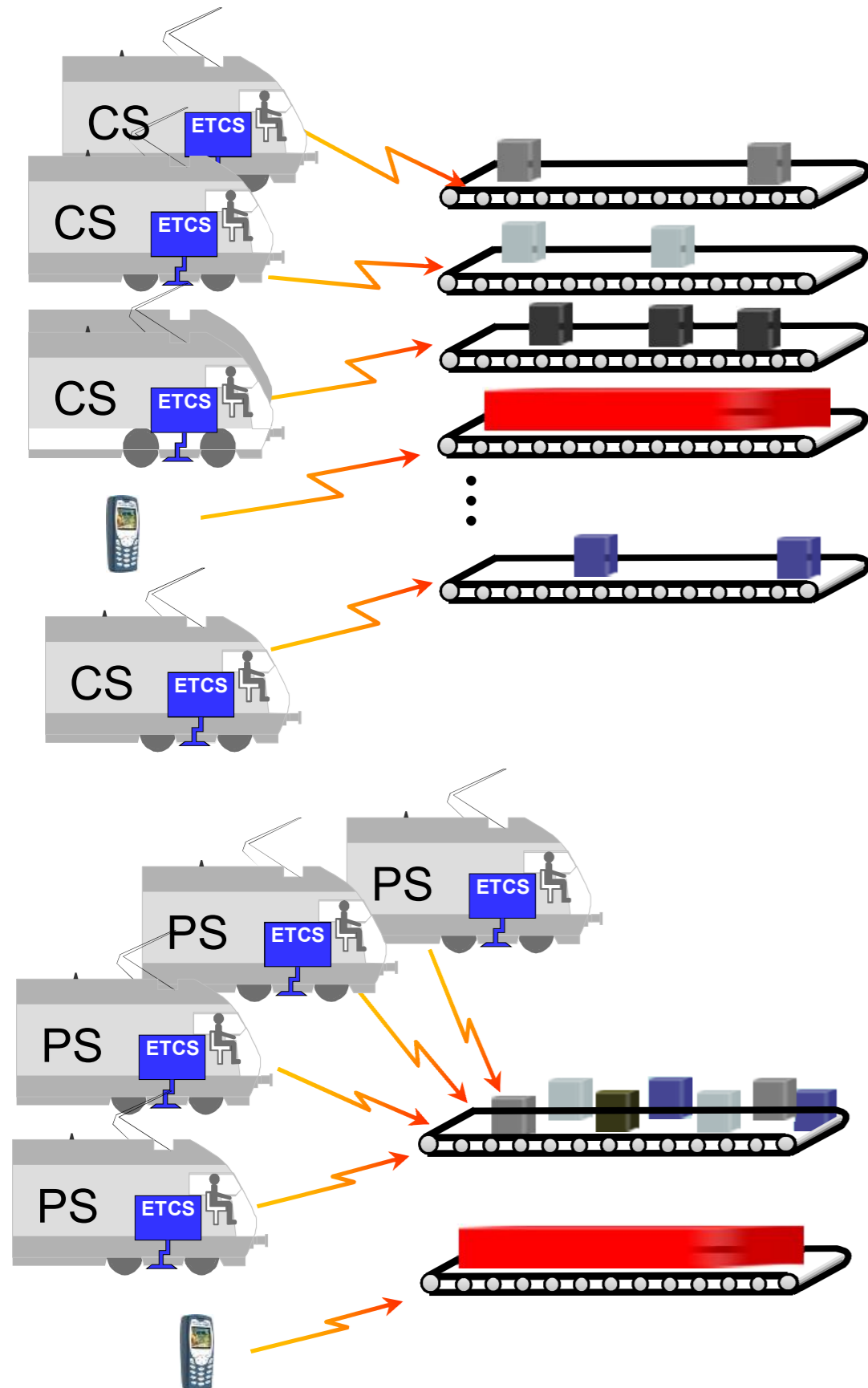


Status GSM-R Air-Int. Capacity

- ETCS data application widely used in low density areas (track)
- What about high density areas like stations?
 - Voice capacity demand increases!
 - ETCS in stations demands additional Circuit Mode channels!
 - Border regions have to share number of frequencies
- Capacity demand conflicts with the limited GSM-R(EIRENE) frequency band resources
- Increase radio channel multiplexing – keep QoS requirements → transition towards packet switched mode

GSM-R ETCS Bearer Service

Circuit(CS) versus Packet (PS)Mode



Circuit Mode

- Dedicated transmission resource per ETCS session
- Average GSM-R traffic channel duty cycle varies between 5% - 20%
- Sufficient transmission robustness (Radio Network design)
- Low air interface transmission capacity utilisation

Packet Mode (GPRS/EGPRS)

- Shared transmission resource(s) between several ETCS sessions
- Bearer Service bandwidth depends on:
 - Line Speed
 - Radio Network design
- Improved protection algorithms against transmission errors
- Multiplexing of several ETCS sessions improves resource utilisation

GSM-R ETCS Bearer Service

Circuit (CS) versus Packet Switched (PS) Mode

Radio Resource Allocation/Release

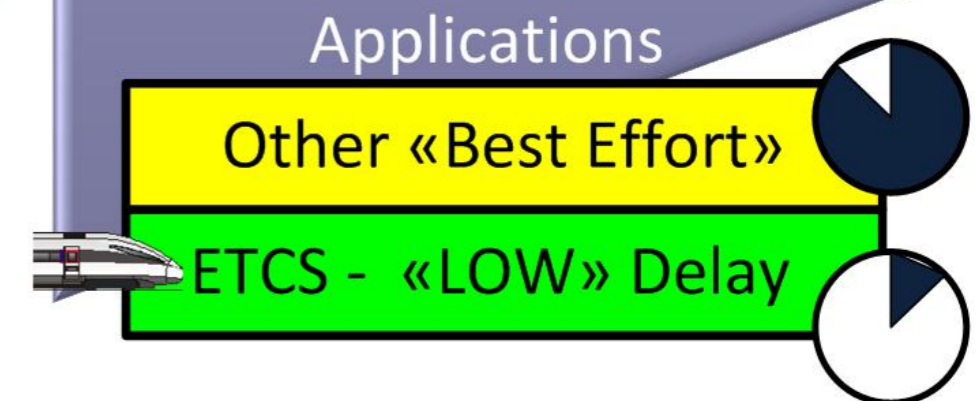
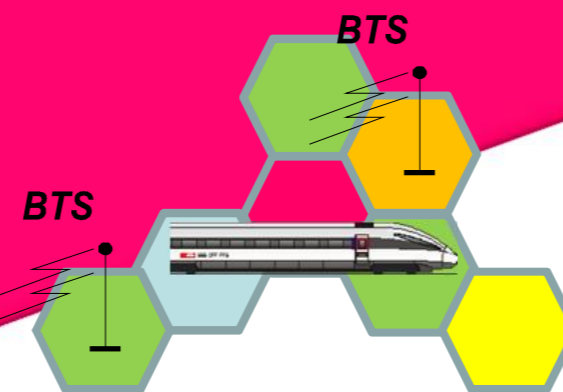
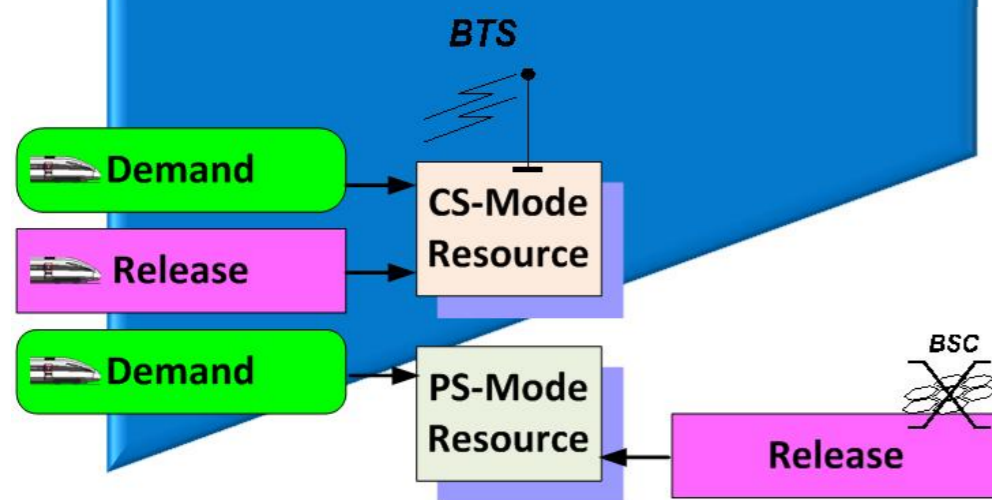
- CS-Mode
 - End User resource demand
 - End User release resource
- PS-Mode
 - End User demand
 - Network release

Mobility

- CS-Mode
 - Handover (Network commanded)
 - dedicated resources in source and target cell
- PS-Mode
 - Cell Change (Reselection)
Mobile self sustaining with/without Network assistance
 - Traffic resources between target cell and origin cell (Planning Task)
 - Handover (Network commanded)
(Neither in Public-GSM nor in GSM-R Network/Mobile available)

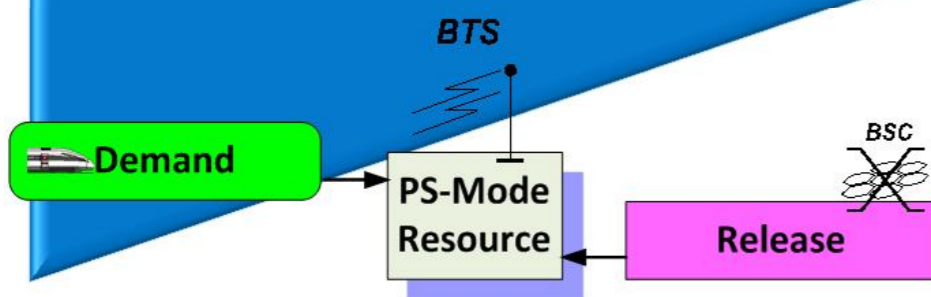
Application - Priority based resource allocation

- CS-Mode
 - Dedicated transmission resource - allocation – ranking by pre-emption!
- PS-Mode
 - ETCS application
 - typical machine to machine interaction (location measurement to get track segment permission)
 - stringent and low delay → real time treatment



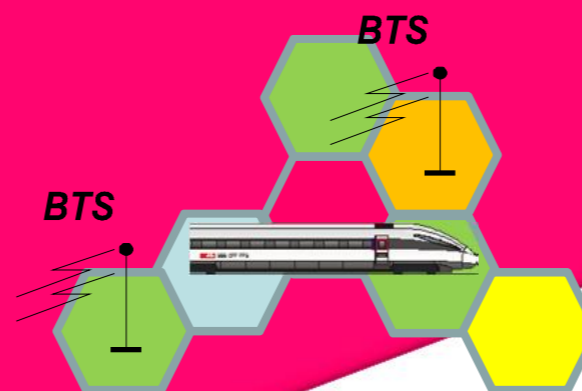
Radio Resource Allocation/Release

- PS-Mode
- Delay transmission resource release by the network
- **Features:**
 - Delayed-DL-TBF (Network)
 - Extended-UL-TBF (Network/Mobile)
- Abbreviations
 - DL-Downlink
 - UL-Uplink
 - TBF- Temporary Block Flow



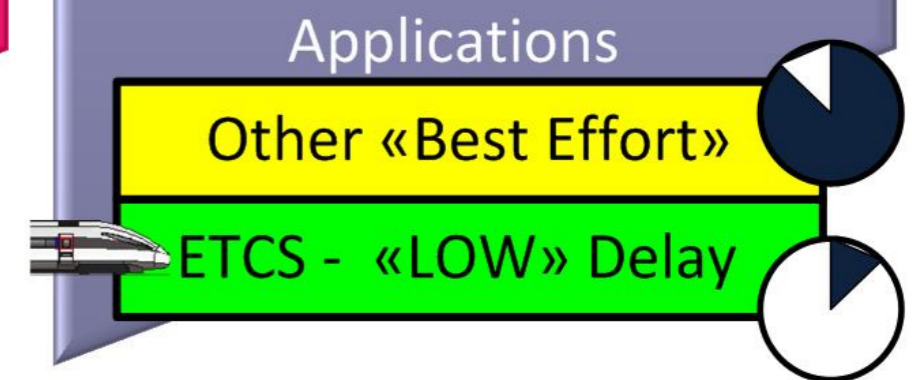
Mobility

- PS-Mode
- Reduce Cell Change (Reselection) time
- **Feature:**
 - Network Assisted Cell Change (Network/Mobile)



Application - Priority based resource allocation

- PS-Mode
- Real Time treatment ETCS application
- **Feature:**
 - Packet Flow Context (Network/Mobile)



GSM-R GPRS/EGPRS

Test Cases(O-3023v0.73)

3GPP Features

- Delayed DL-TBF
- Extended-UL-TBF
- Network Assisted Cell Change
- Packet Flow Context

GSM-R GPRS/EGPRS Bearer Service

Test Case Description

Traffic Model 1- Limit

- Train-RBC every 3seconds 49 octets
- RBC-Train every 6 seconds 319 octets
- Reflects high GSM-R traffic channel utilisation

Traffic Model 2- Typical

- Train-RBC every 6seconds 49 octets
- RBC-Train every 20 seconds 319 octets
- Reflects medium GSM-R traffic channel utilisation

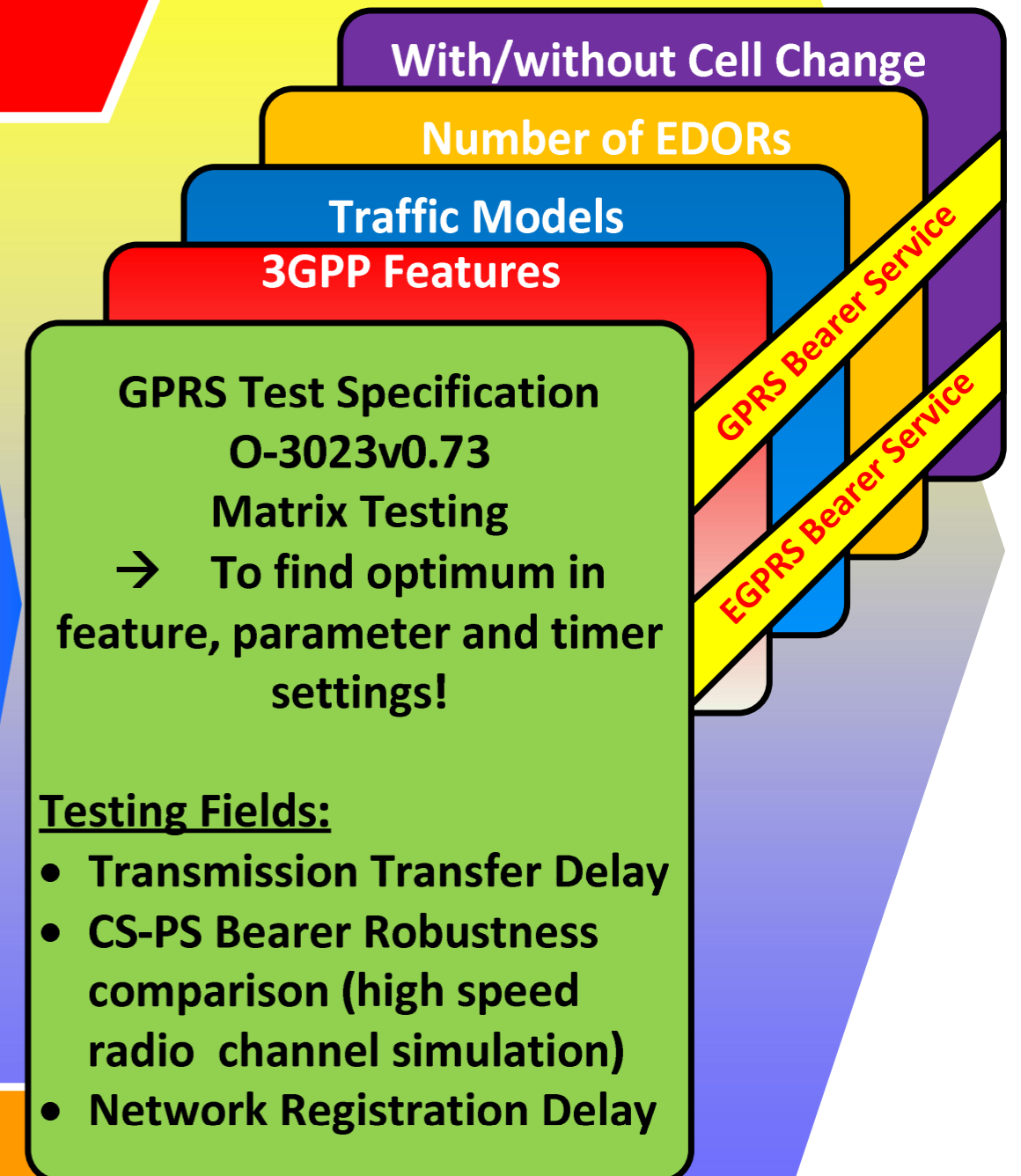
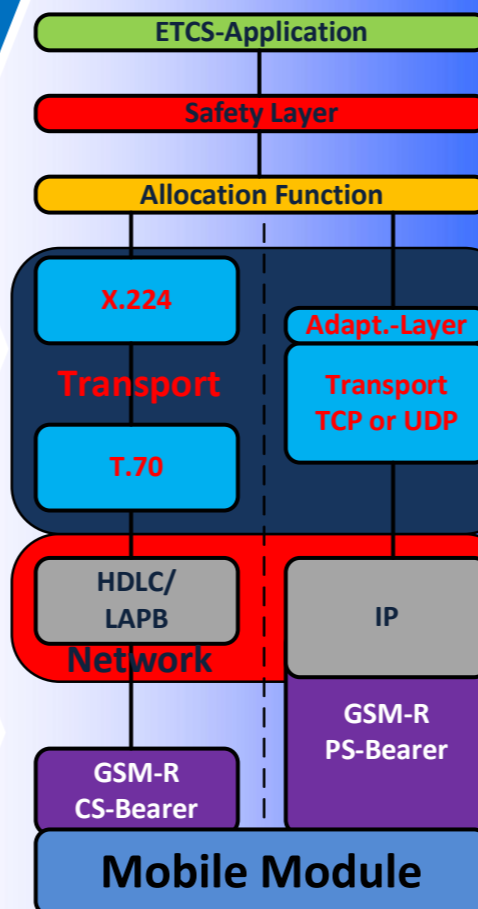
Mixed Traffic – Application dependent bandwidth allocation/reservation

- Traffic Model 1 – Best Effort data stream
- Traffic Model 2 – Best Effort data stream

Number of Mobile Modules

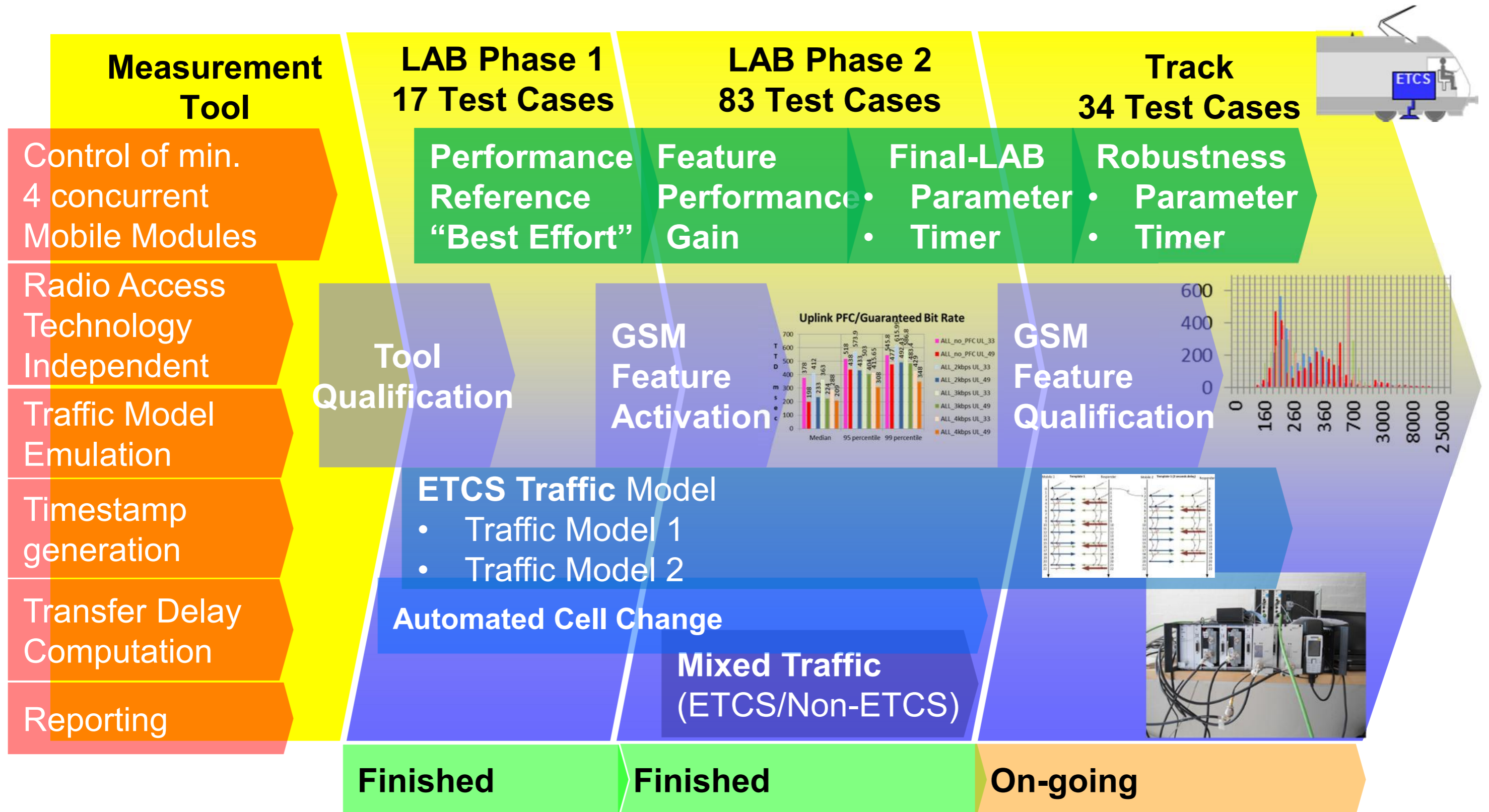
1 or 4 concurrent ETCS sessions

Transport Protocol



GPRS/EGPRS Bearer Service

Optimisation - Testing Procedure

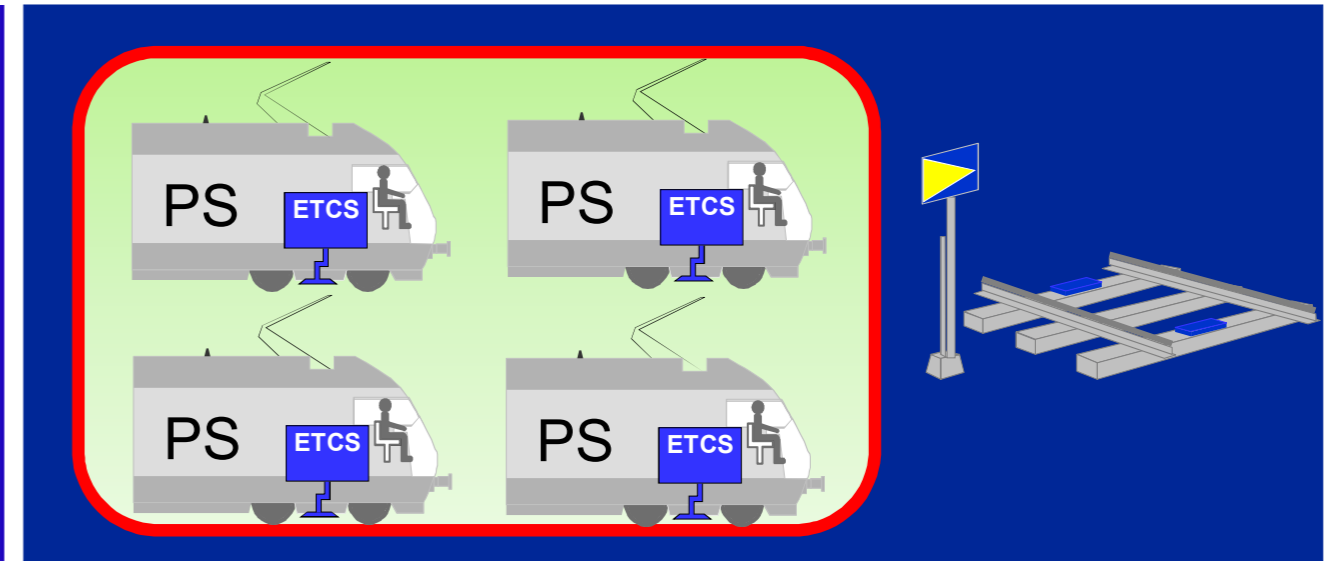


GPRS/EGPRS - ETCS Bearer Service

Test Results

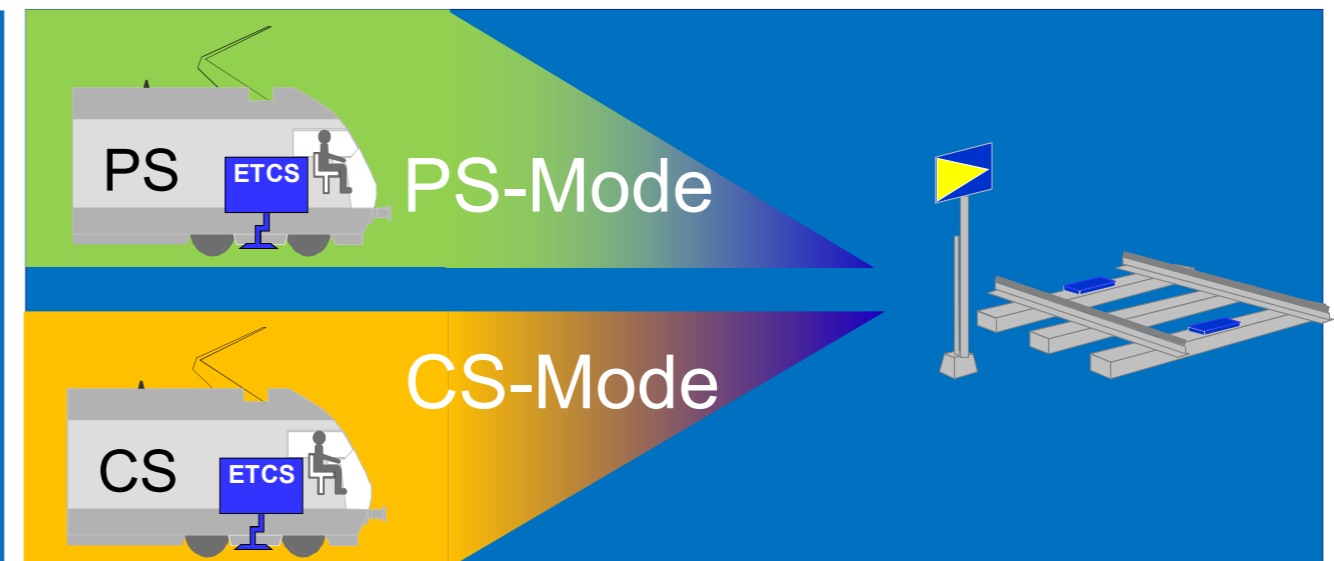
Multiplexing Gain
one GSM-R
Traffic Channel

- 4 concurrent ETCS sessions
- Confirmed by LAB and on-going Track testing



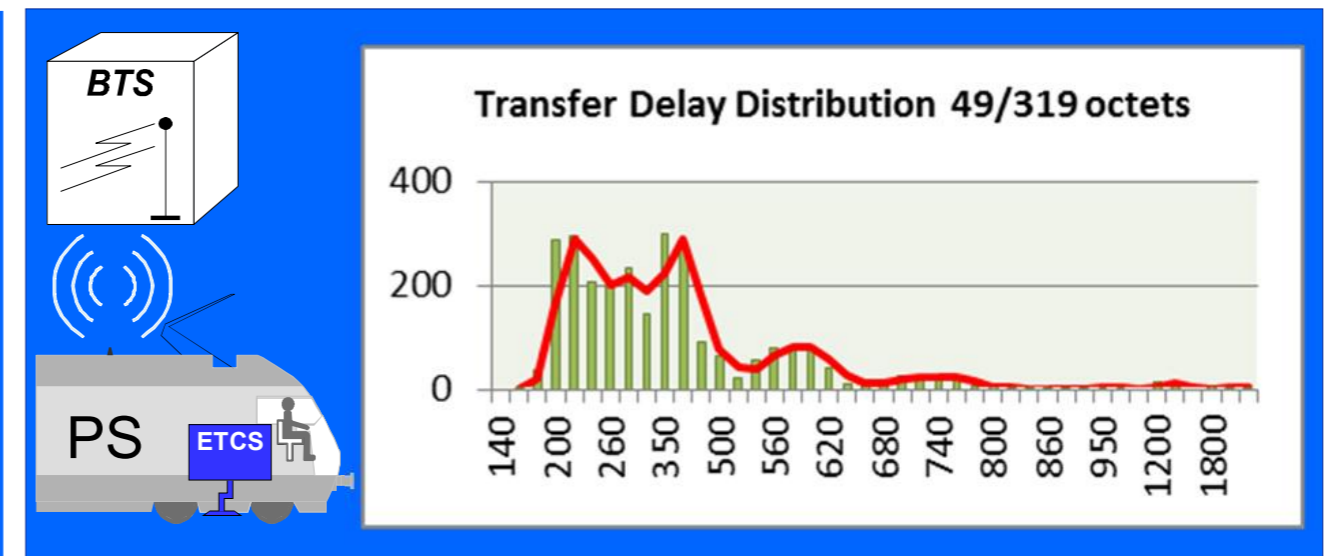
Impact
CS ← → PS Mode

- Circuit and Packet Mode
- Co-existence guaranteed - Matter of GSM-R capacity planning
- Requires one dedicated Packet Mode Traffic Channel!



Transmission
Transfer Delay /
Robustness

- 3GPP GSM features improves transfer delay significantly
- (TTD) equal/better than CS-Mode for ETCS
- Recovery of erroneous packets faster than in CS-mode



GPRS/EGPRS - ETCS Bearer Service



INTERNATIONAL UNION
OF RAILWAYS

unity, solidarity, universality

Conclusions

GPRS/EGPRS
can provide
traffic capacity
improvement!

GPRS/EGPRS
Engineering
Guidelines

No specific
3GPP GSM-R
features are
required!

Can improve
ETCS
transmission
robustness!

Transformation
“Best Effort” →
“QoS
Transmission
System”

(UIC) Measurement-Tool
Independent to Radio Access
Technology --> LTE etc.

Specific GPRS/EGPRS timer and
algorithms adjustments are
necessary!

Can enable (future proof) IP
based communication for ETCS!

Thank You
for the support of all involved parties!



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