Agenda

- Railway White Paper

- World Radio Conference

- Standards

- Examples of Broadband Network for Railways & Utilities
  - Europe
  - Brazil
  - South Korea

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White Paper

- Transport Canada's Advisory Council on Railway Safety (ACRS) established the Train Control Working Group. It was given the mandate to study existing and developmental fail-safe train control systems—also known as Enhanced Train Control (ETC).

- Although no specific technology or combination of technologies have yet to be determined, a common factor among all technologies reviewed by the Working Group was the need for a reliable wireless communication infrastructure to support ETC.

- Railways must seek spectrum in a band that is compatible, as much as possible, with existing network infrastructures. The propagation characteristics of the spectrum must also be compatible with railway operations. There are currently two "available" bands that meet those requirements: 600 MHz and 700 MHz.

- The RAC should initiate discussions with potential partners outside the railway industry. Through a LTE capability known as "network slicing", which allows multiple logical networks to be created on top of a common shared physical infrastructure7, networks can be shared seamlessly amongst different services and competing entities (such as CN and CP). Furthermore, ISED looks favorably at initiatives that can both maximize the utilisation of radio spectrum and the sharing of infrastructures, especially antenna towers. The RAC should seek the support of both TC and ISED on the issue of partnership.
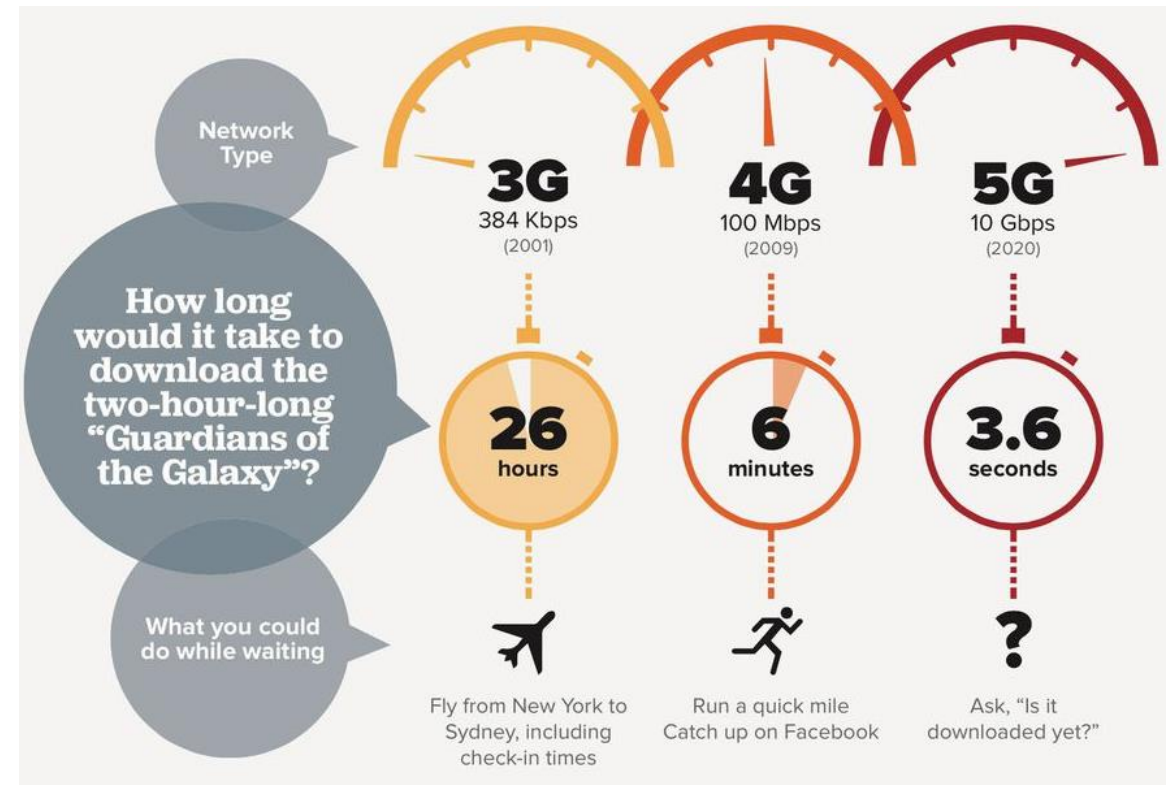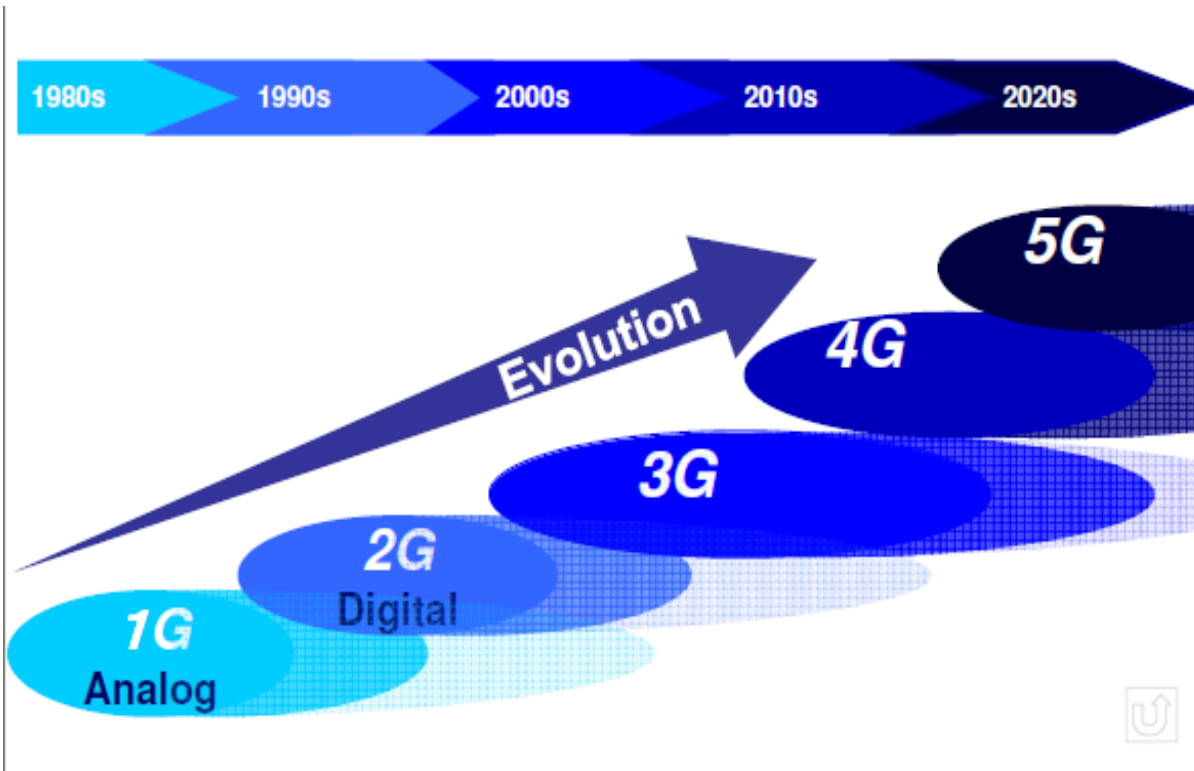
Technology Progression

Vision Beyond 2020

Usage Scenarios of IMT-2020
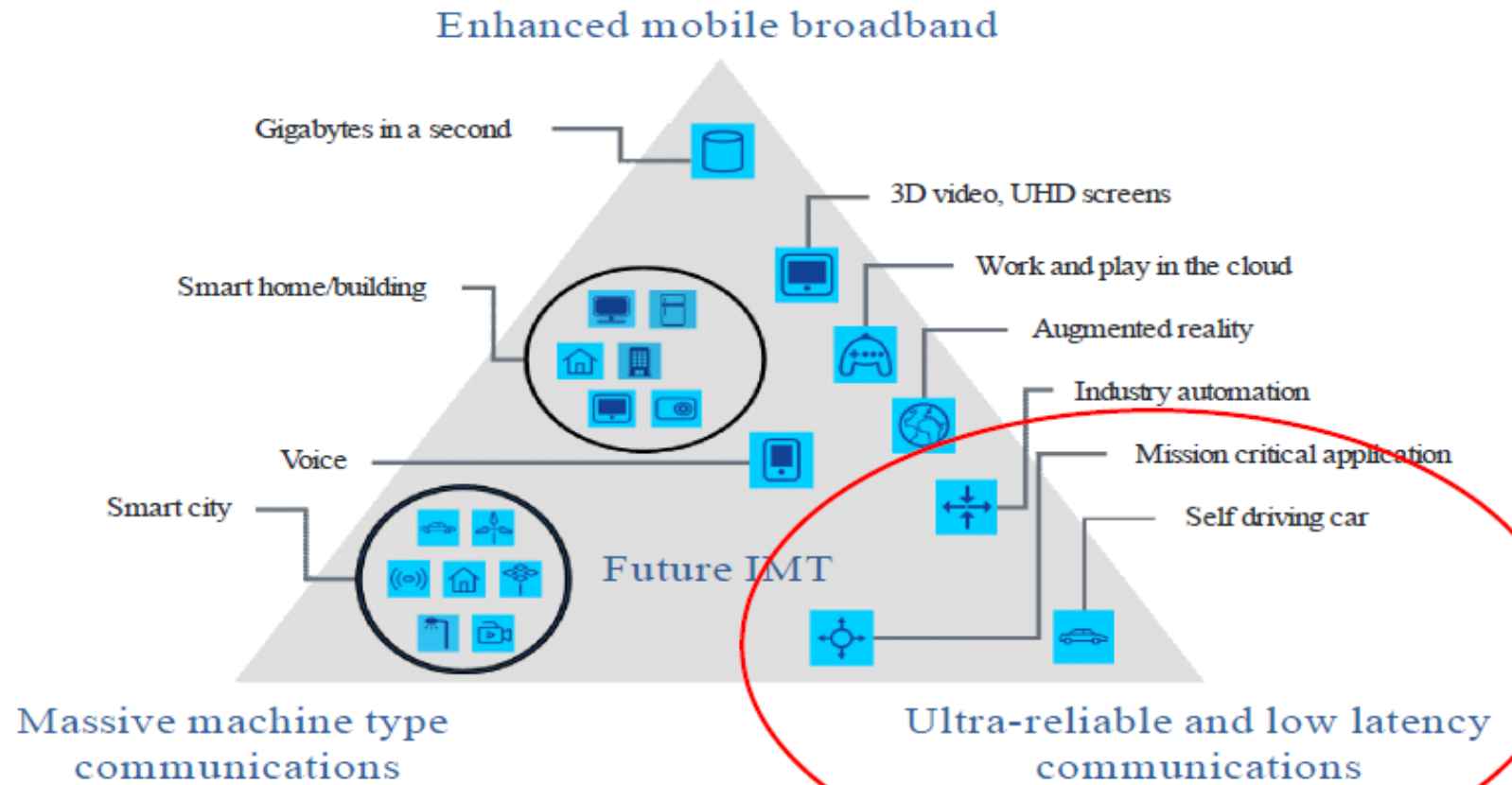
Enhanced mobile broadband

Gigabytes in a second

3D video, UHD screens

Smart home/building

Work and play in the cloud

Augmented reality

Industry automation

Voice

Mission critical application

Smart city

Self driving car

Future IMT

Massive machine type communications

Ultra-reliable and low latency communications
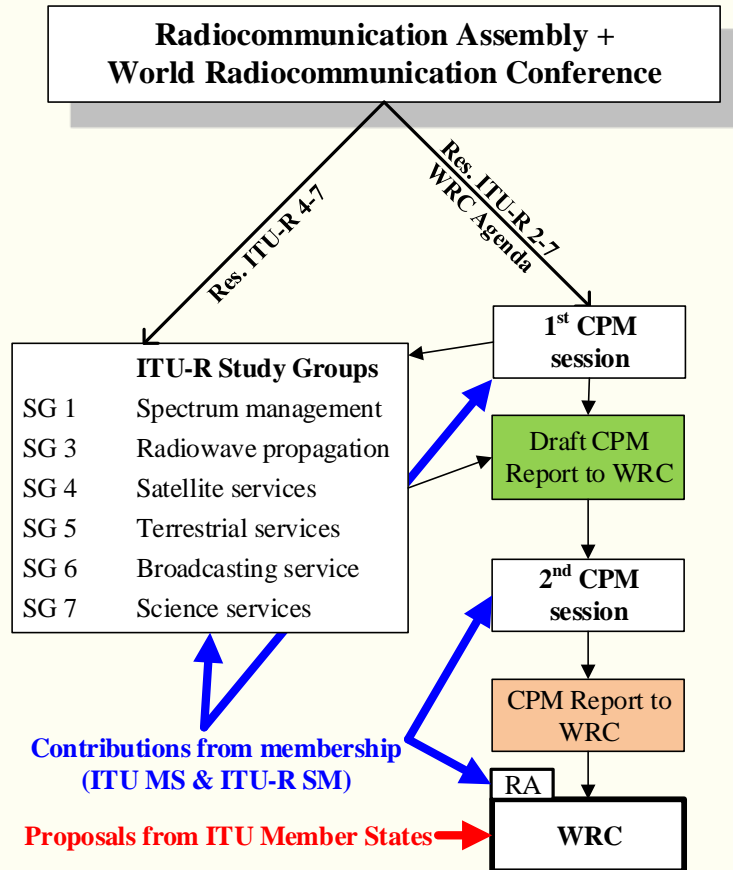
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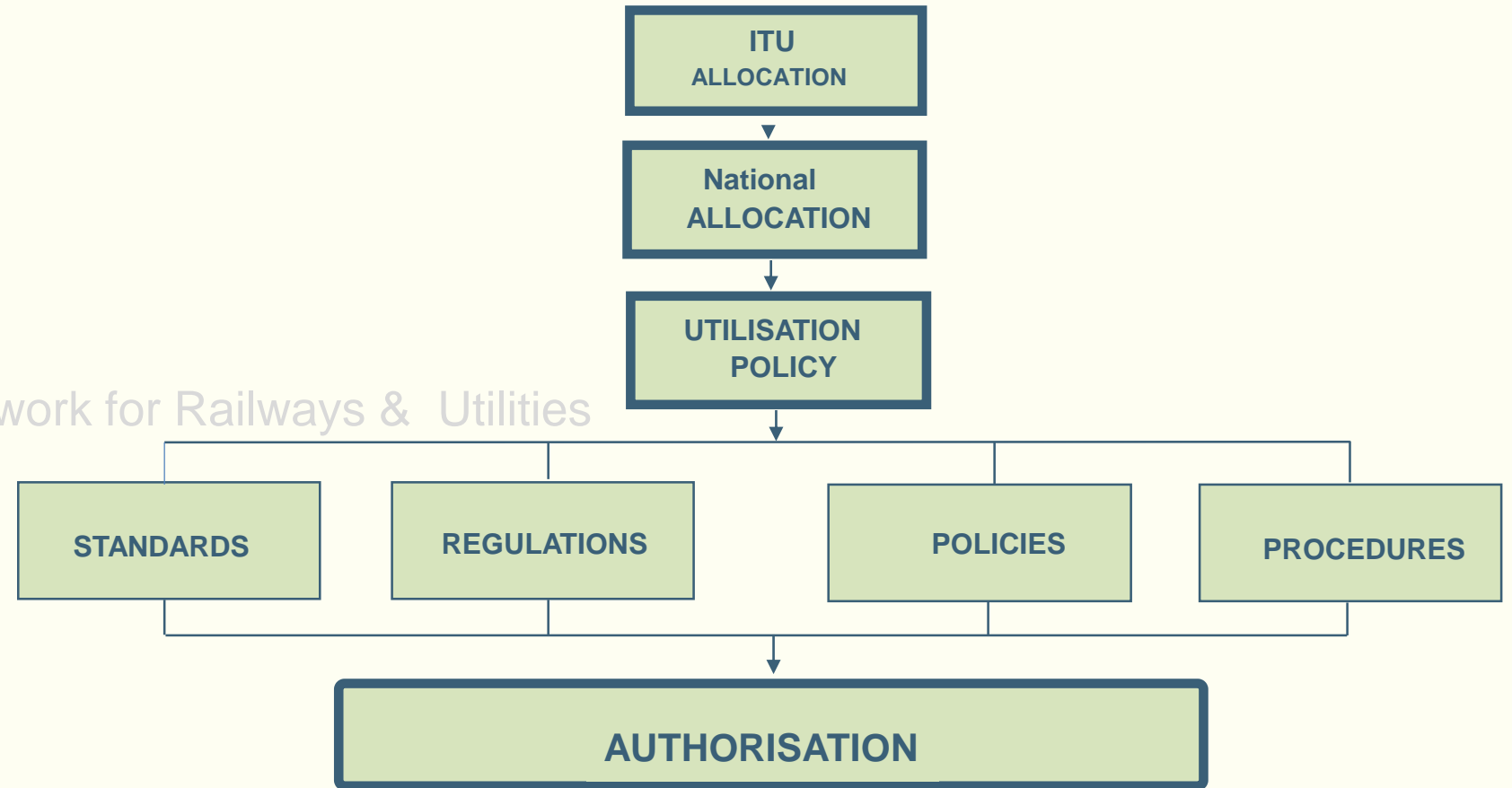
World Radio Conference

Organization of the ITU-R conference preparatory work

- World radiocommunication conferences (WRC) are held every three to four years. WRC reviews, and, if necessary, revises the Radio Regulations, the international treaty governing the use of the radio-frequency spectrum and the satellite orbits
- Last WRC was in 2015
- Countries submit proposal for next WRC
- China/Japan proposed item on railways
- Studies are carried out by Working parties over four years
- Over 2500 delegates attend WRC from 193 countries
- Lasts for 28 days
- On last day a report is produced which binding treaty, each country has to abide by it

WRC AI 1.11 - Railways

- Resolution **236 (WRC-15)** invites WRC-19, based on the results of ITU-R studies, to take necessary actions, as appropriate, to facilitate global or regional harmonized frequency bands, to the extent possible, for the implementation of railway radiocommunication systems between train and trackside (RSTT), within existing mobile service allocations.

    - 1.11   to take necessary actions, as appropriate, to facilitate global or regional harmonized frequency bands to support railway radiocommunication systems between train and trackside within existing mobile service allocations, in accordance with Resolution **236 (WRC-15)**;

- RAC has participated in Canadian Preparation for this conference since 2017

Proposal for WRC to Consider

- To address agenda item 1.11, ITU-R (WP5A) has undertaken studies towards the development of two ITU-R Reports and one Recommendation
- Three methods have been proposed to satisfy this agenda item:
  - Method A: No change to the RR except suppression of Resolution **236 (WRC-15)**;
  - Method B: Add a new Resolution **[A111-METHOD B] (WRC-19)** specifying frequency ranges for RSTT and referencing the most recent version of Recommendation ITU-R M.[RSTT_FRQ] and consequently suppress the Resolution **236 (WRC-15)**;
  - Method C: Add a new Resolution **[B111-METHOD C] (WRC-19)** without specifying frequency ranges for RSTT, while referencing the most recent version of Recommendation ITU-R M.[RSTT_FRQ] and consequently suppress the Resolution **236 (WRC-15)**.

Likely Outcome

- Americas – support no change
- Europe – support no change
- Russian Block – support no change
- Africa – Some form of Resolution
- Middle East - Some form Resolution
- Asia/Pacific – Split

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Demise of GSM-R

GSM-R is being phased out from 2020 onwards:

- The system life-cycle is coming to an end, with vendor support uncertain beyond 2025/2030
- Severe interference with LTE out of band emissions
- UIC wants to have a successor technology in place by 2020 for trials and by 2022 for deployment
- UIC has already published a user requirement specification in their paper "Future Railway Mobile Communication System "

realwireless
independent wireless experts

5G and the IoT –
keeping both on track in 2016

about | services | sectors | practices | resources | events

Posted on **September 28, 2016** by **John Okas**   ← Previous   Next →

Demise of GSM-R highlights the need for radical rethinking of wireless communications in the rail industry

The International Railway Union has recently called for a **replacement for the GSM-R network** to be developed as a matter of urgency.

GSM-R is the modified version of GSM, which was developed for the specific needs of the rail industry's operational needs. However, as the TelecomTV article above points out, the technology has had a notoriously volatile history and is now past its prime.

GSM-R was originally developed in the 1990s to deliver a specific set of functionality for the rail industry, but it was decided that it would use spectrum outside of the main GSM frequencies.

This decision meant that GSM-R required completely bespoke equipment, which in turn significantly raised the cost of deployment and has created commercial challenges ever since for the rail industry. As the International Railway Union itself said: "The use of … GSM-R has proven expensive for the railways, both in terms of capital and operational expenditure."

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TETRA
TERRESTRIAL **T**RUNKED **RA**DIO

The Standard

Developed by ETSI

Open digital standard in Europe

Adopted worldwide

Used by various verticals/segments

A Success

TETRA Association represents more than 150 organizations worldwide

More than 100 companies are involved in the development of applications

Over 110 countries have adopted TETRA

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Future Railway Mobile Communication System

User Requirements Specification

Source: FRMCS Functional Working Group
Date: 29th of March 2016
Reference: FU-7100
Version: 2.0
No of pages: Cover + 96 pages

- UIC is moving towards next generation wireless communication technologies for rail operations to replace GSM-R
  - UIC has recently published a set of technology independent user requirements for the FRMCS (Future Railway Mobile Communication System)
  - **UIC and TCCA are cooperating** to define the next generation broadband communications for railway operations
  - The aim is to use standard technologies like 5G, and not a specialized system like GSM-R

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LTE Release 12 onwards supports Mission Critical Train communications

3GPP Release	Main Radio Features
Rel-99	WCDMA FDD & TDD
Rel-4	TD-SCDMA
Rel-5	HSDPA
Rel-6	HSUPA
Rel-7	HSPA+, EDGE evolution
Rel-8	LTE
Rel-9	LTE enhance
Rel-10	LTE-A air interface
Rel-11	HSPA+ and LTE-A enhancements
Rel-12	HSPA+ and LTE-A enhancements

LTE for mission-critical users

http://www.tandcca.com/Library/Documents/CCBGMissionCriticalMobileBroadbandwhitepaper2013.pdf

• Group comms system enablers for LTE (3GPP GCSE_LTE), proximity-based services (3GPP ProSe)
• Frequency bands

Standards Aligned to 3GPP Release 12

• 3GPP: GCSE Phase 1
• 3GPP: ProSe Phase 1
• OMA: PCPS* v1.0
• ETSI TCCE: CCA** Stage 1
    * Push-to-Communicate for Public Safety
    ** Critical Communications Architecture

Standards Aligned to 3GPP Release 13

• 3GPP: MCPTT Phase 1
• 3GPP: Isolated Operations (IOPS - Stage 1)
• 3GPP: GCSE Phase 2
• 3GPP: ProSe Phase 2
• ETSI TCCE: CCA Stage 2 (Stage 3 TBD)

3GPP Release 14 & 15 Standards

• Isolated Operations (IOPS - Stage 2 &3)
• Later phases of GCSE, ProSe, MCPTT
• MC Multi-Media
• End-to-End Security (including User Identity)
• PS Broadband Consoles
• 5G, Spectrum (Unlicensed, Sensing, Dynamic, etc.)

GSM-R Replacement for ETSC (European Train Control System)

International Railway Union (UIC) calling for a GSM-R replacement:
- Published user requirements in *"Future Railway Mobile Communication System (FRMCS)"* white paper (Mar 2016, http://www.uic.org/IMG/pdf/frmcs_user-requirements.pdf)
- Expecting complete GSM-R obsolescence by 2030
- Calling for successor technology in place by 2020 for trials, and by 2022 for deployment

Standards for Mission Critical features are still evolving…for Railways

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Europe Today

- Today 876 - 880 MHz / 921 - 925 MHz harmonised for GSM-R
  - 2x4 MHz for GSM-R only

- No spectrum harmonisation of 873 - 876 MHz / 918 - 921 MHz
  - Only on a national basis
  - 3 countries so far: Germany, Switzerland and Liechtenstein (rights of use)
    + planned in Belgium

Europe Studies

- CEPT tasks
  - FRMCS spectrum needs (only for critical applications)
  - Feasibility of the 900 MHz range while ensuring parallel operation with GSM-R during the migration
  - Feasibility of the 1900-1920 MHz band (and further bands if relevant)
  - Feasibility to use commercial mobile networks
  - Develop harmonised technical conditions

- Target date: November 2020

Europe Future…

To FRMCS and beyond! - A possible ending

Core band: 874.4 - 880 MHz / 919.4 - 925 MHz FDD
   Both GSM-R and FRMCS, including guard-band towards SRD

Complementary band: probably 1900 - 1910 MHz TDD
   Or 10 MHz in 2290-2400 MHz TDD as a tuning range
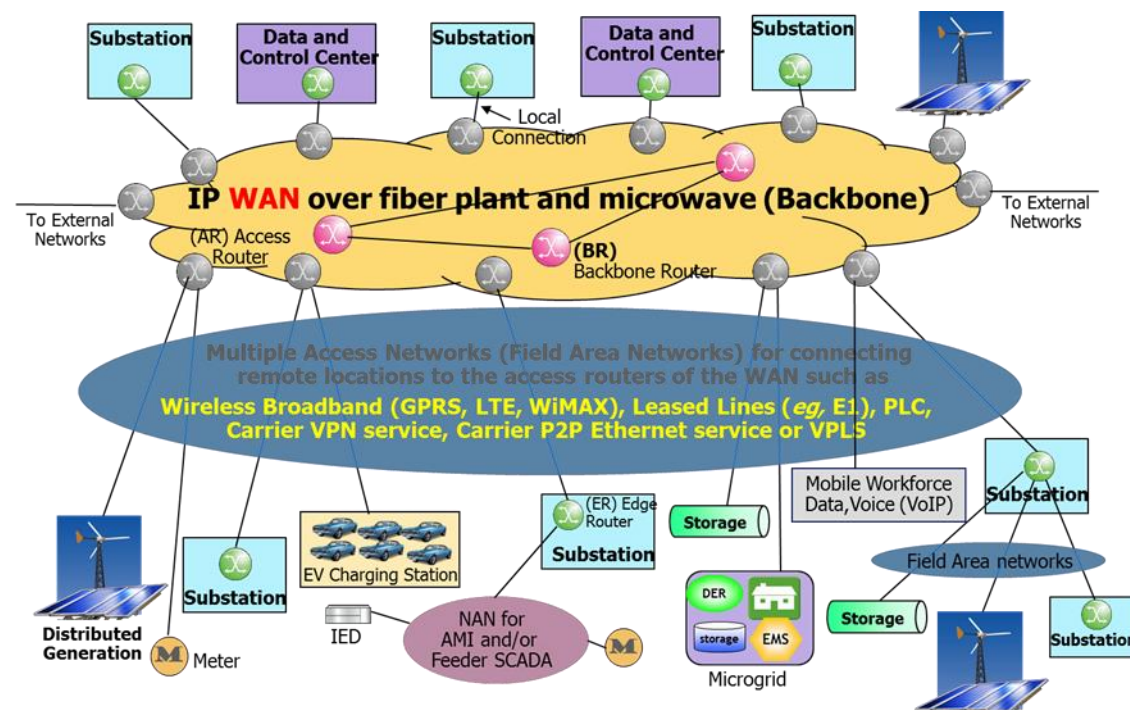   FRMCS only

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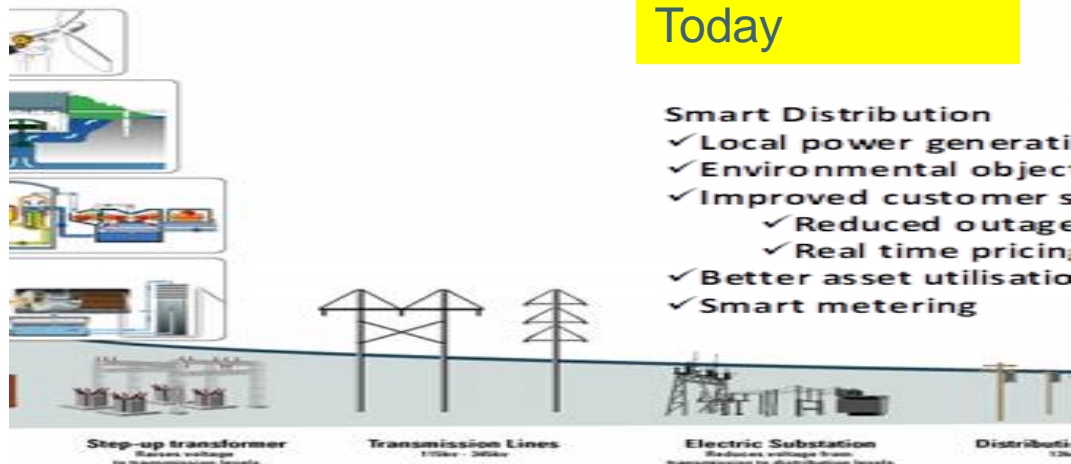
Today

Smart Distribution
✓ Local power generati
✓ Environmental objec
✓ Improved customer s
   ✓ Reduced outage
   ✓ Real time pricin
✓ Better asset utilisatio
✓ Smart metering
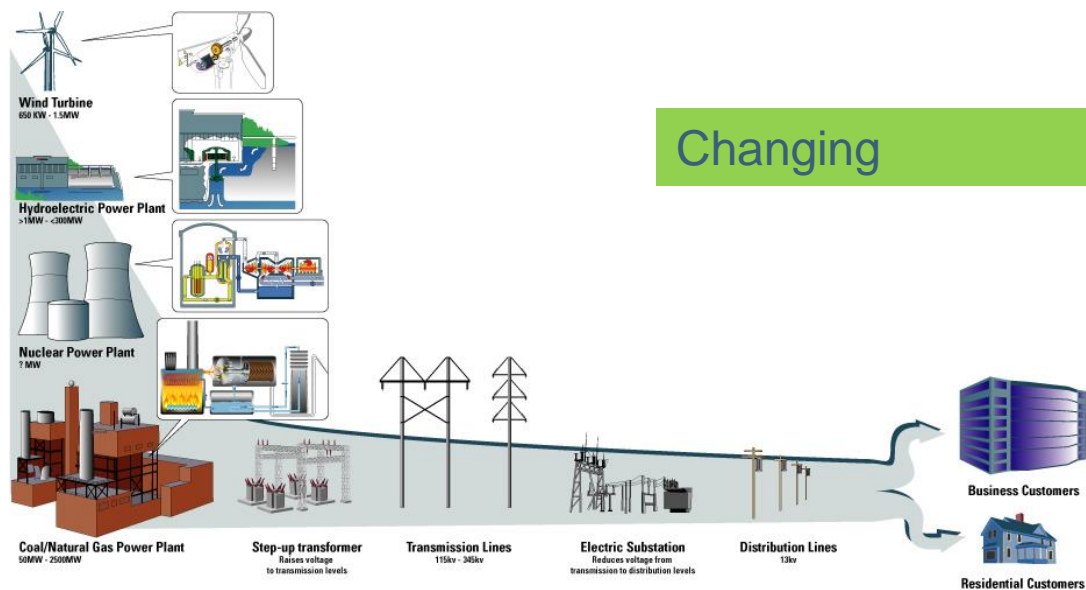
Changing

Future

Canadian utilities have been granted access to 30 MHz of spectrum in the band 1800-1830 MHz for intelligent electricity networks

Extract from ITU – WP5A Report

Annex 9 to
Document 5A/976-E
16 November 2018

Brazil – Private LTE Network

- First private LTE deployment in Brazil for grid automation, allowing fast power restoration in the event of an outage and improving power delivery in parts of the State of Sao Paulo

- The LTE network will link smart meters and other equipment to track power usage and enable more than 75,000 customers to shift consumption patterns to save money

- The 4G LTE network will be deployed in 3.5 GHz

- The network will provide business-critical connectivity for grid equipment, smart meters, substations and distributed energy generation sources throughout the service area,

+ Establishment of Integrated Public Network (2014)

South Korea

CONFUSION

Different Radio Communication System

Need for Public Safety Network

Ministry of Science and ICT

Integrated Public Network

• Sewol Ferry Disaster (2014)
• Daegu Subway Fire (2003)
…

• LTE-R (LTE-Railway)
• PS-LTE (Public Safety LTE)
• LTE-M (LTE-Maritime)

+ Frequency Allocation of 700 MHz Band (UL 718-728 MHz, DL 773-783 MHz)

| 698 | 710 | 718 | 728 | 748 | 753 | 771 | 773 | 783 | 803 | 806 |

Broad-casting 2CH (12MHz) | Guard (8MHz) | Integrated Public Network↑ (10MHz) | Telecommunication↑ (20 MHz) | Remote MIC | Guard | Broadcasting : 3CH (18MHz) | Guard | Integrated Public Network↓ (10MHz) | Telecommunication↓ (20 MHz) | Guard

740   752

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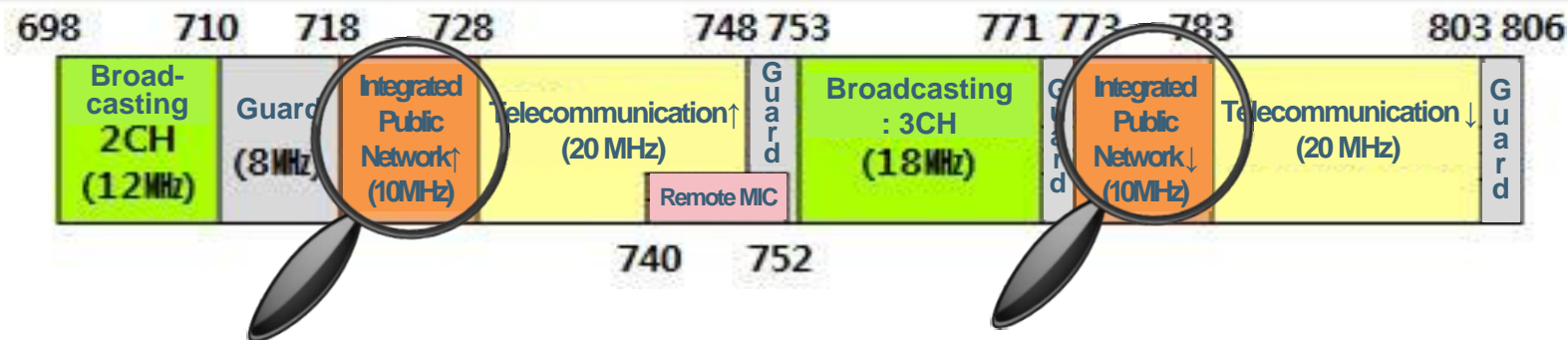
+ Future Intelligent Railway Services (Examples)

Railway Safety

- Monitoring infrastructure status
  - Railway asset management
- Image information
  - Cab and coach CCTV real time transmission
- Train control
  - GIS location-based Central Traffic Control

Maintenance Enhancement

- Wire-wireless integration
  - wired & wireless integrated system
    : (Inside) WIFI ↔ (Outdoor) LTE-R
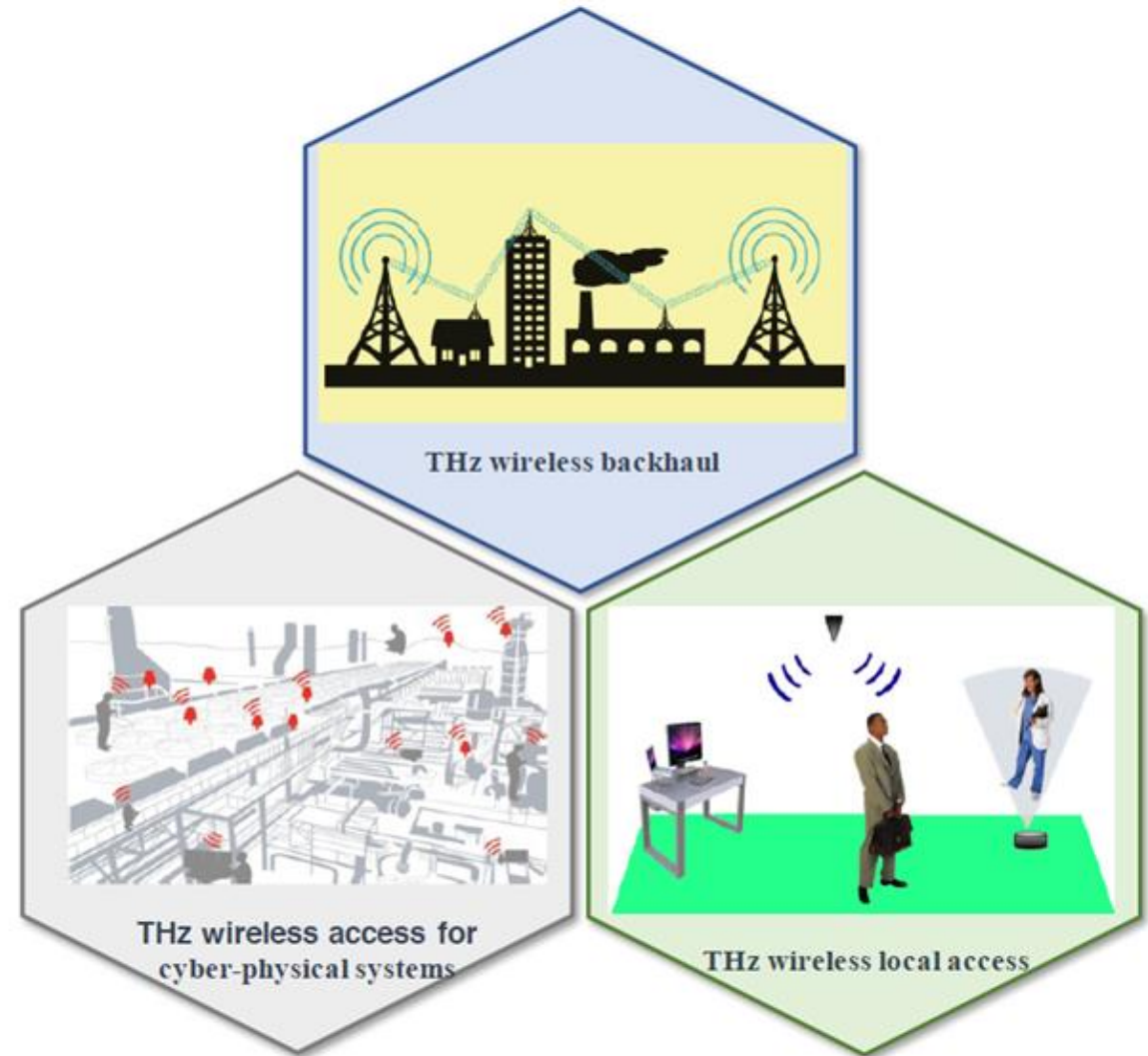- Maintenance technical support
  - Emergency recovery support including image transmission

Customer Service

- Logistics information
  - Provide real-time logistics information(Cargo information)

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Future 6G?

- Inherently support a large dynamic range of novel usage scenarios that combine extreme data rates with agility, reliability, zero response time and AI

- Cost-efficient and flexible provision of high-speed data connections guaranteed, zeroing the 'digital divide'

- Extend the fibre optic systems QoE and performance reliability to wireless

THz wireless backhaul

THz wireless access for cyber-physical systems

THz wireless local access

Courtesy of Wireless World Future Forum (www.wwrf.ch)

Last Thoughts

- Need for creating Eco System for User Equipment (UE)
- Work through WP5A & CITEL to harmonize spectrum band
  - USA first
  - South & Central America
- Synergy with Utilities
- Spectrum Possible Partners
  - Public Safety
  - Public Mobile Service Providers – New Entrant
  - Ancillary Terrestrial Component (ATC)
    - Terrestrial network of [cell-phone towers](#) to supplement a [Mobile Satellite Service](#) (MSS)
  - Network Slicing

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