Webinar session

Connectivity beyond limits in mobility cross-border scenarios with 5G

Agenda

- Introduction by Christian Micas, Senior Policy Officer, DG Connect, European Commission
- 5GMED presentation by José Luque Lopez, project coordinator at Cellnex
- Technical Challenges by Francisco Vazquez Gallego, technical manager at I2CAT
- Use case results by use case owners
- Synergies with 5G Blueprint and 5GRail
- Q/A

EC Perspective on 5G corridors From large-scale cross-border trials to pan-European deployment

5GMED 2nd Demos Webinar

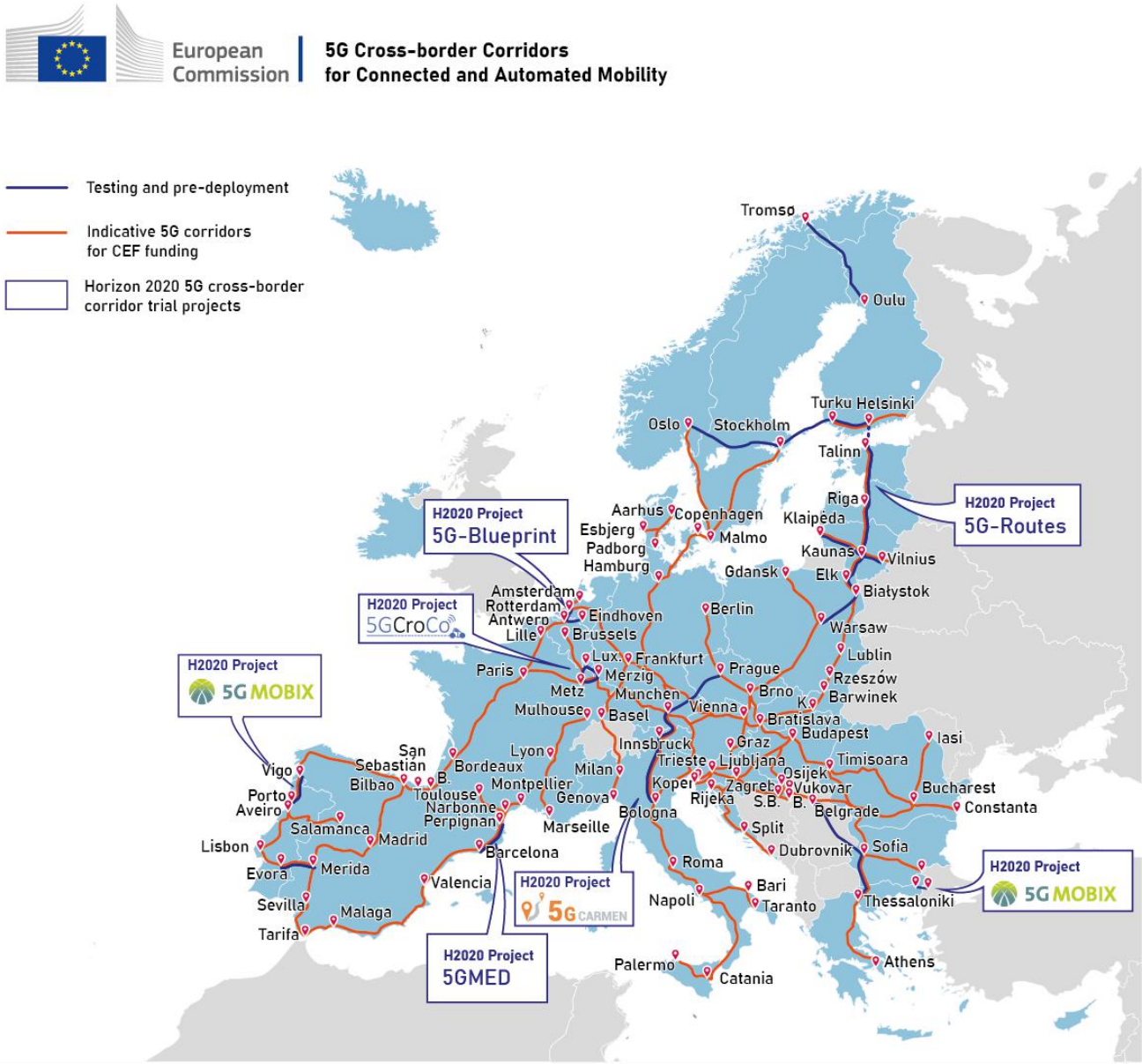
8 November 2023

Christian Micas

Senior Policy Officer
European Commission
DG CNECT E1

5G Corridors: driving the EU Green and Digital Transition

- 2018-2023: from large-scale 5G cross-border trials (5G-PPP) to pan-European Deployment (CEF Digital)
- Multi-country project (MCP) Vision: Pan-EU 5G corridors for Connected and Automated Mobility
- Private investment with public funding of cross-border and "challenge" areas
- CEF Digital
  - Objective: 26.000km transport paths along TEN-T 49 intra-EU borders: Investment required: ~EUR 5,4 bn
  - Planned EC funding ~€1B for 5G Corridors
  - First Call: projects launched in 2023
  - Second Call: closed, evaluation results in Q4 2023
  - Third Call: 17 October 2023 to 20 February 2024
- Smart Networks and Services Joint Undertaking formally tasked to coordinate Strategic Deployment Agendas(Road & Rail)



5G Corridor Projects: CEF Digital Call 1 2022

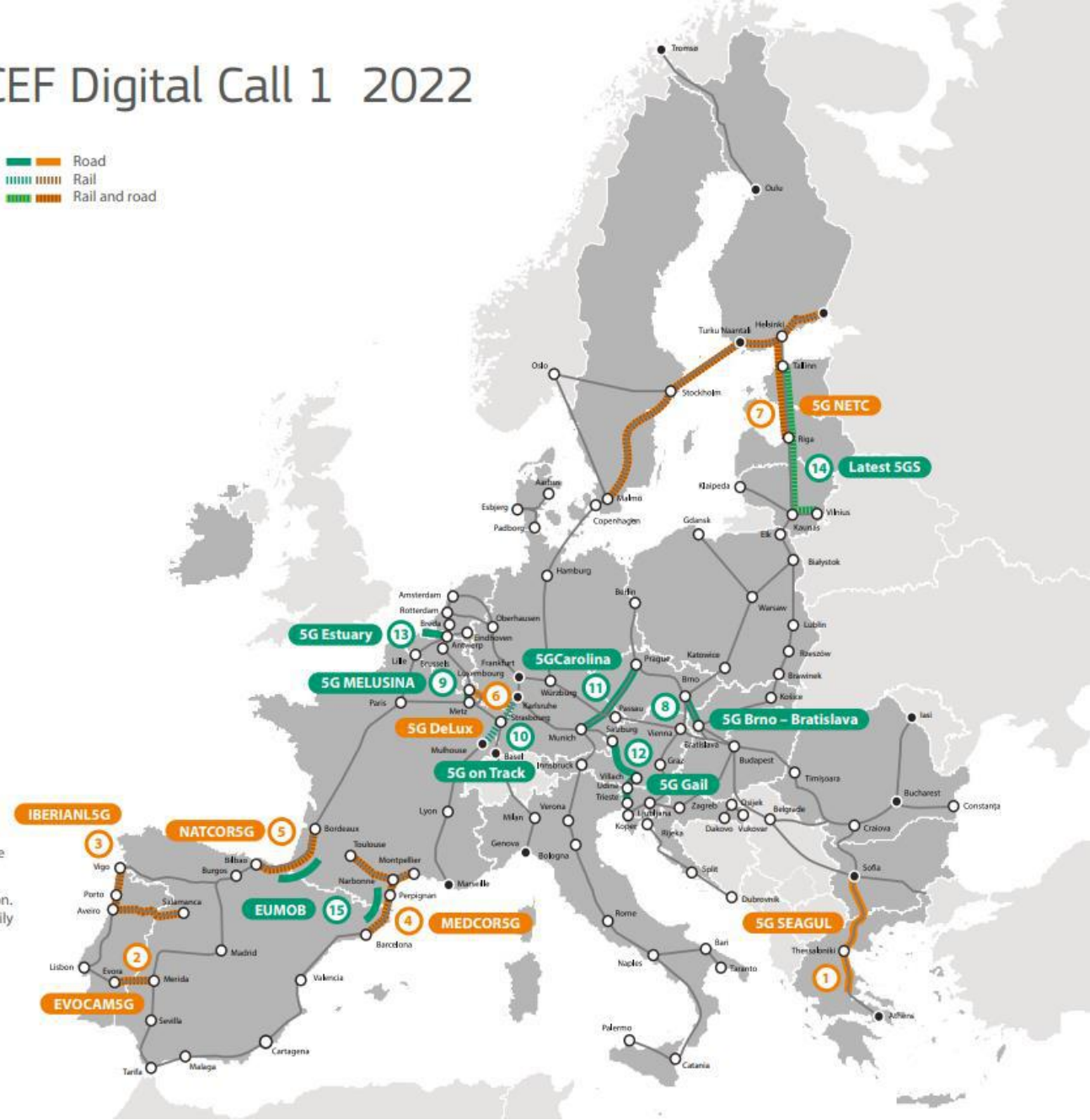
WORKS

1. **5G SEAGUL**
   Sofia (BG) to Velestino (EL)
   ~ 475 km
2. **EVOCAM5G**
   Evora (PT) to Merida (ES)
   ~ 155 km
3. **IBERIANL5G**
   Vigo (ES) to Aveiro (PT)
   to Salamanca (ES)
   ~ 600 km
4. **MEDCOR5G**
   Barcelona (ES) to Montpellier (FR)
   ~ 550 km
5. **NATCOR5G**
   Bilbao (ES) to Bordeaux (FR)
   ~ 515 km
6. **5G DeLux**
   Frisange (LU) to Güdingen (DE)
   ~ 100 km
7. **5G NETC**
   Malmö (SE) to Helsinki (FI)
   to Riga (LV)
   ~ 2000 km

STUDIES

8. **5G Brno – Bratislava**
   Brno (CZ) to Bratislava (SK)
   ~ 140 km
9. **5G MELUSINA**
   Luxembourg (LU) to Metz (FR)
   ~ 70 km
10. **5G on Track**
    Mulhouse (FR) to Karlsruhe (DE)
    ~ 200 km
11. **5GCarolina**
    Prague (CZ) to Munich (DE)
    ~ 70 km
12. **5G Gail**
    Udine (IT) to Salzburg (AT)
    ~ 200 km
13. **5G Estuary**
    Antwerp (BE) to Vlissingen (NL)
    ~ 260 km
14. **Latest 5GS**
    Tallin (EE) to Vilnius (LT)
    ~ 670 km
15. **EUMOB**
    Bordeaux (FR) to Bilbao (ES)
    Perpignan (FR) to Barcelona (ES)
    ~ 500 km

Road
Rail
Rail and road



Road and rail network based on the list of 5G corridors and cross-border backbone connections identified in Part V of the Annex of CEF Regulation (EU) 2021/1153.

The GUIDE project is a Coordination Support Action funded by the European Union. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or HADEA. Neither the European Union nor the granting authority can be held responsible for them.

Co-funded by the European Union

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5G Corridors Planning

CEF Digital 5G corridor deployment calendar & planning												
Year		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	EU Budget
Early Wave	Call 1	Call Q4-Q1		Studies								
		Call Q4-Q1		**Deployment (CEF/RRF)**								42 MM €
	Call 2		Call Q4-Q1		Studies							
			Call Q4-Q1		**Deployment (CEF/RRF)**							28 MM €
1st big Wave (Call 3)				Call Q4-Q1		Studies						
				Call Q4-Q1		**Deployment (CEF/RRF)**						100 MM €
2nd big Wave (TBC)						Call Q1-Q2	Studies					
						Call Q1-Q2	**Deployment (tbc)**					
Last Wave (TBC)												TBC

5G corridor CEF Budget: 170 MM € for 2021-23

- Call 1 Studies and Projects launched in 2023 (8 studies & 7 works)
- Call 2 Studies & Projects will launch in 2024: grant agreements currently under way
- Call 3 : 17/10/23-20/02/2024, EU budget 100 MM € (50% co-financing)

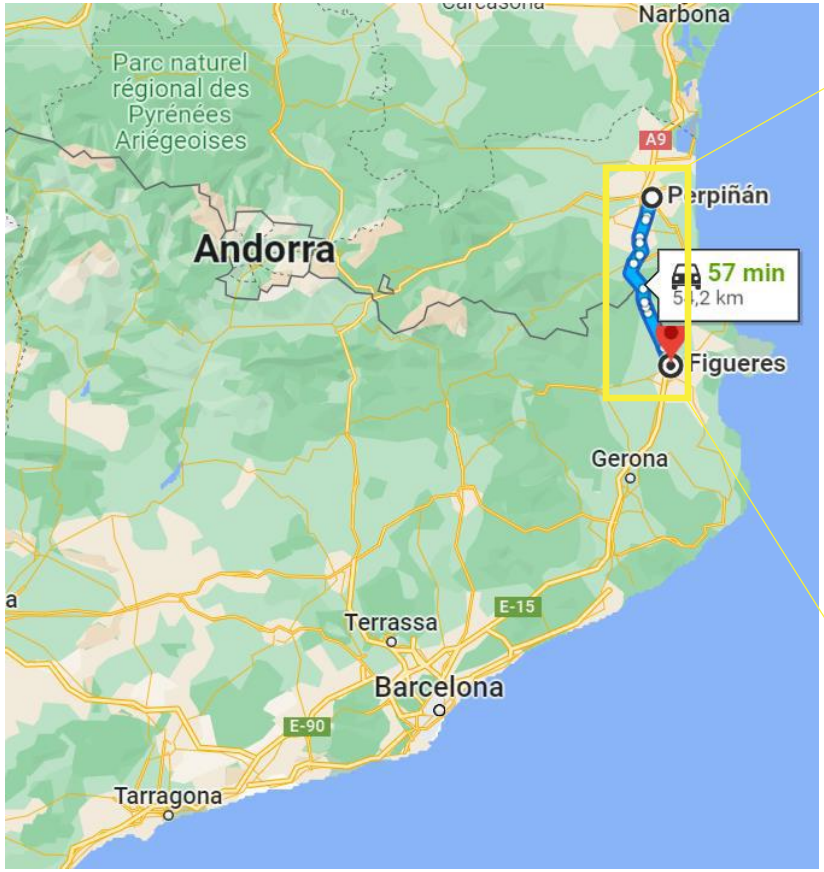
European Commission

5GMED Promoted Webinar

Connectivity beyond limits in mobility cross-border scenarios with 5G

José López Luque
5GMED Project Coordinator

Cross-border Corridor



- 50 km of Mediterranean corridor between Spain and France
- Highway E-15 for CCAM use cases
- High-speed rail track Train based use cases
- Highway and rail track very close → shared 5G network infrastructure
- 8 km rail track inside cross-border tunnel (Le Perthus)

Project overview

5GMED demonstrates advanced Cooperative Connected and Automated Mobility (**CCAM)** and Enhanced Railway Mobile Communications along the “Figueres – Perpignan” cross-border corridor between Spain and France.

Enabled by a multi-stakeholder compute and network infrastructure deployed by MNOs, neutral hosts, and road and rail operators, based on **5G.**

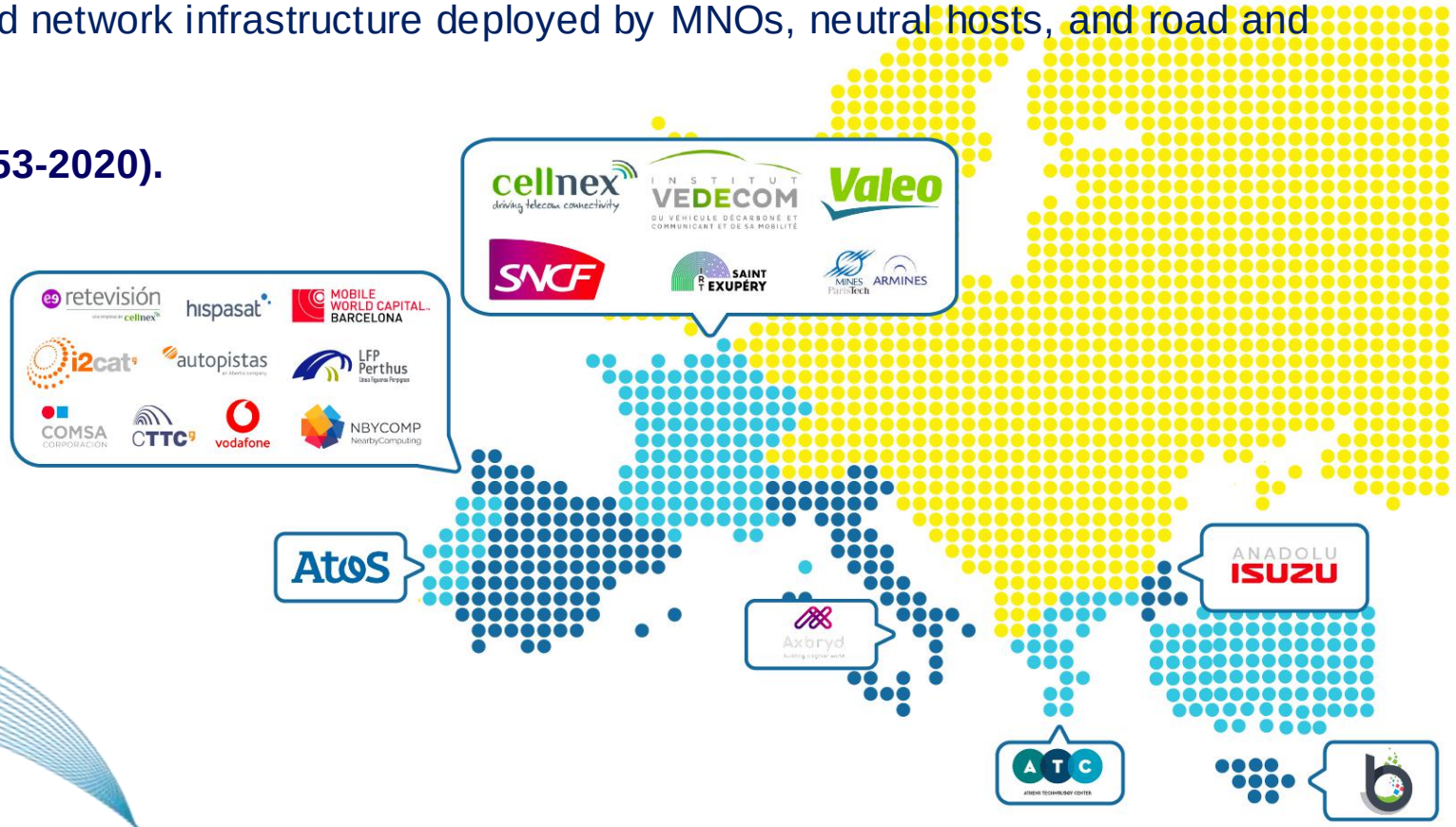
EU funded Innovation action (H2020-ICT-53-2020).

Total project budget: 15.717.821 €

Project Duration: 01/09/200 – 31/08/24

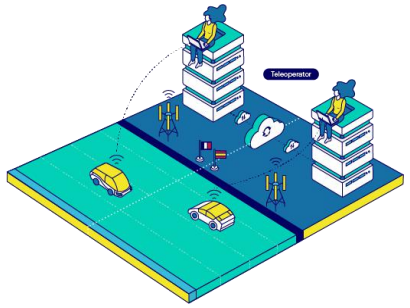
The consortium coordinated by Cellnex Telecom includes 21 partners from 7 countries:

- Telecom Sector
- Transport and Mobility Sector
- Solution providers
- Consulting services providers
- Research institutions
- Outreach boosting organization



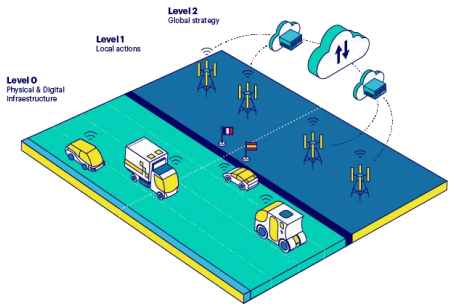
Overview. Four Use Cases

UC1: Remote Driving



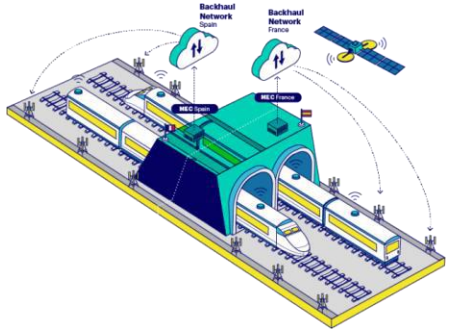
Automated driving on highways can be performed in full safety, even when a critical event occurs on the Automated Driving System (ADS) preventing the normal system operation beyond the homologated Operation Design Domain (ODD)

UC2: Road infrastructure digitalization



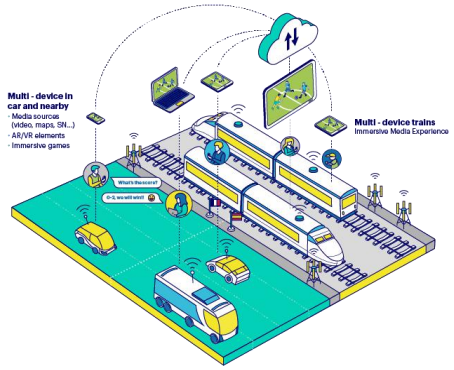
- Intelligent traffic management of the CAV
- Uninterrupted, safe, and efficient mobility for mixed conventional and automated traffic.
- Road infrastructure closer to support levels for AD
- Guide groups of vehicles for traffic optimisation.

UC3: Enhanced railways connectivity for cross border



- Transition of a commercial train between Spain and France,
- Advanced applications in cross-border situations.
- On-board seamless service continuity with multiple media types, service QoS requirements, handover between service orchestrators, and edge network transitions.

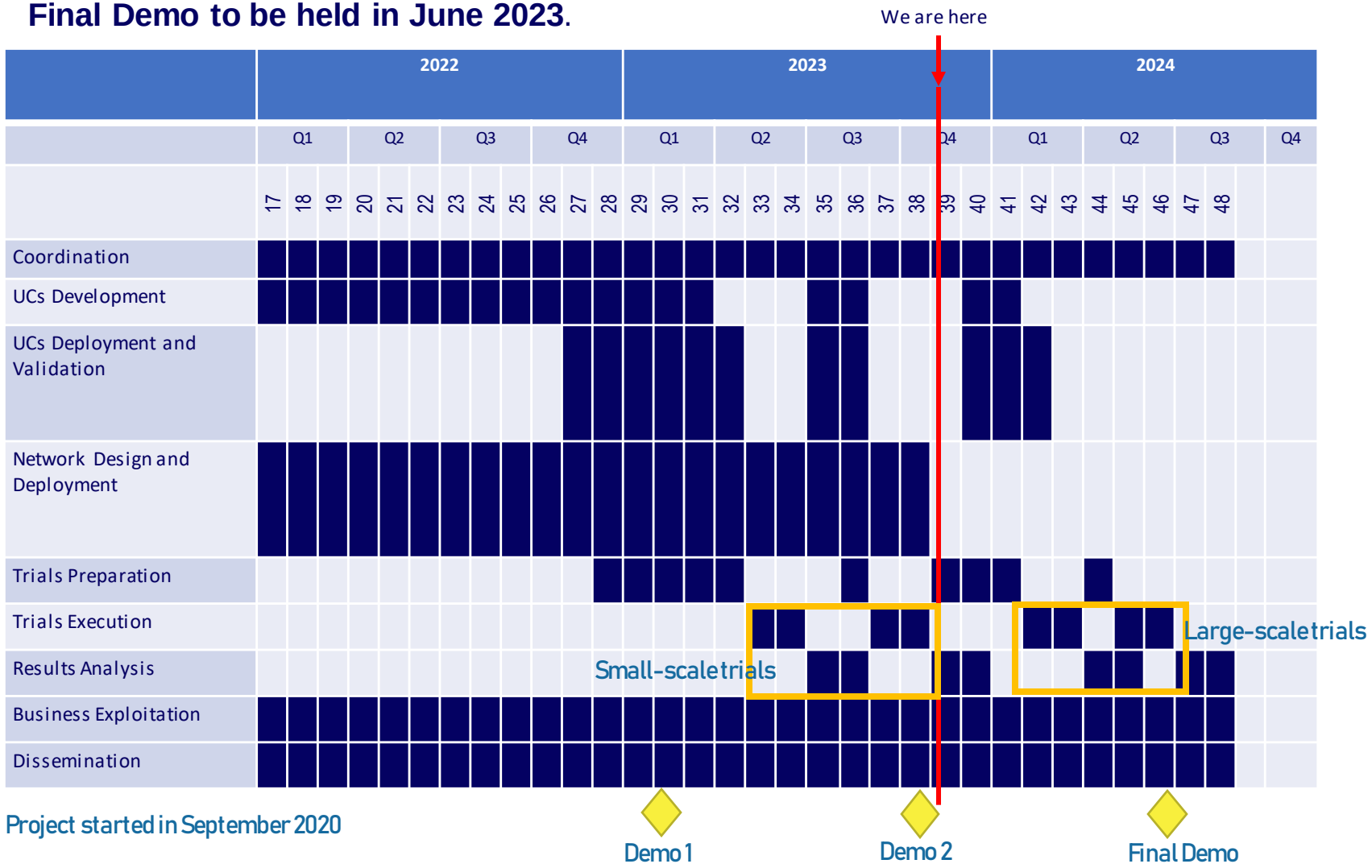
UC4: Follow-ME Infotainment



- Virtual reality applications and enriched 3D map models providing autonomous car drivers more information regarding the surroundings and road conditions.
- On-board media server needs to offer a seamless service continuity (handover between service orchestrators, and edge network transitions)

Project Status

- 5GMED Network deployed. Testing ongoing with the network in focus, as presented on the Project 2nd Demo in October 2023.
- **Final Demo to be held in June 2023**.



Webinar Session

Connectivity beyond limits in mobility cross-border scenarios with 5G

Francisco Vázquez Gallego, PhD
Technical Manager, i2CAT Foundation (Barcelona)
November 8th, 2023

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 951947

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- Technical Objectives
- Technical Challenges
- Achievements

Technical Objectives

- Main goal
  - Evaluate the capabilities of 5G technologies (3GPP Rel.16) to meet the requirements of Connected and Automated Mobility (CAM) services in cross-border scenarios

1. Design a cross-border 5G network architecture to facilitate seamless service continuity across national borders

2. Deploy two 5G SA networks (based on 5GMED network architecture) along the Mediterranean cross-border corridor between Figueres (Spain) and Perpignan (France)

3. Develop and deploy 4 use cases on the cross-border corridor
   - 3 vehicular use cases (highway E-15)
   - 1 railway use case (high-speed train TGV)

4. Conduct trials to evaluate the impact of 5G roaming on the KPIs of the use cases

Technical Challenges

- Guarantee service continuity when connected vehicles & trains drive across national borders

- Existing Home Routed Roaming (HRR) mechanism
  - Introduces **long interruption time** (1-2 minutes): unfeasible for seamless service continuity
    → We need **roaming optimization techniques** to minimize interruption times

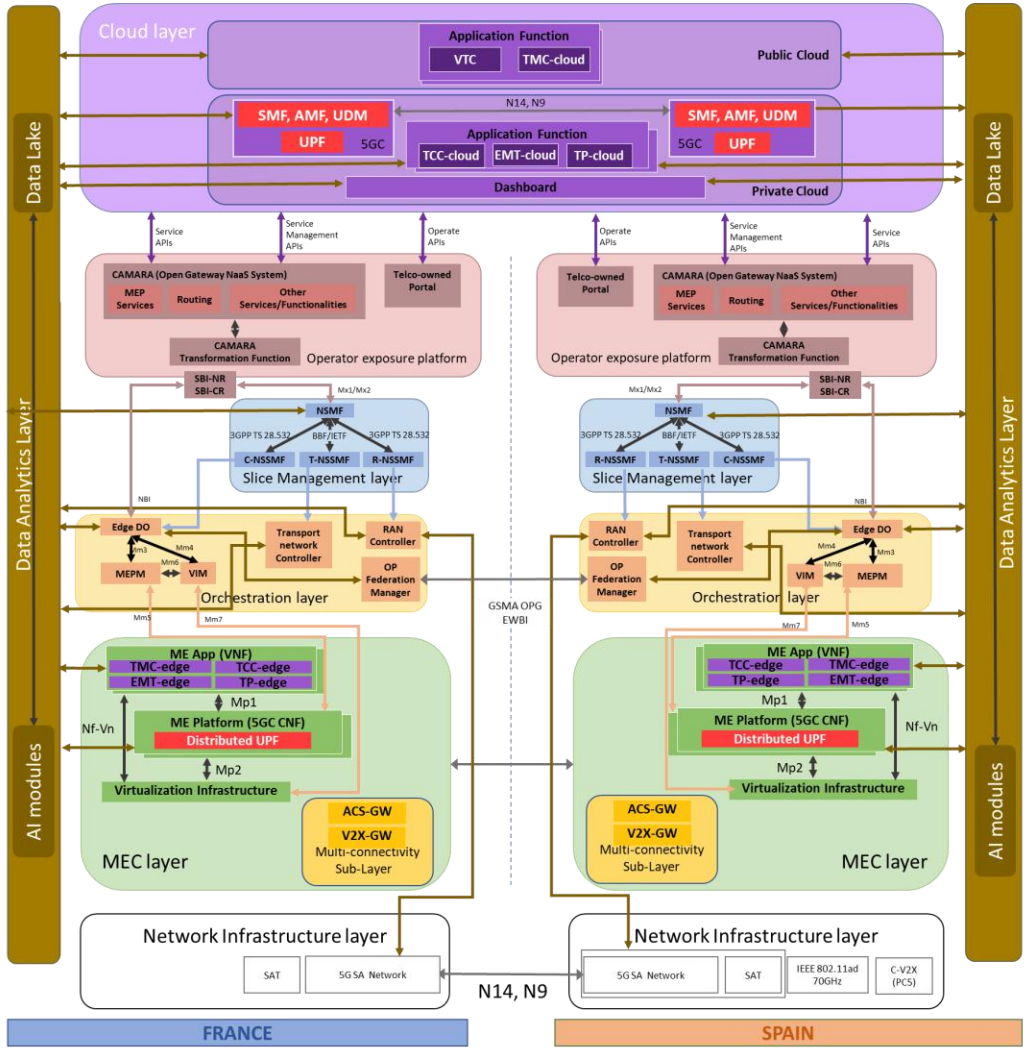
  - Induces **high latency when UE is in a visited network** (because user data are routed to home UPF)
    → We need **Local Break-Out (LBO) roaming** to minimize latency

- Each Mobile Network Operator (MNO) uses an orchestrator to manage its own services, network slices, and computing resources
  - To ensure that the required services/slices/computing resources will be ready when UE crosses the border → We need **cross-border interactions between orchestrators of different MNOs**

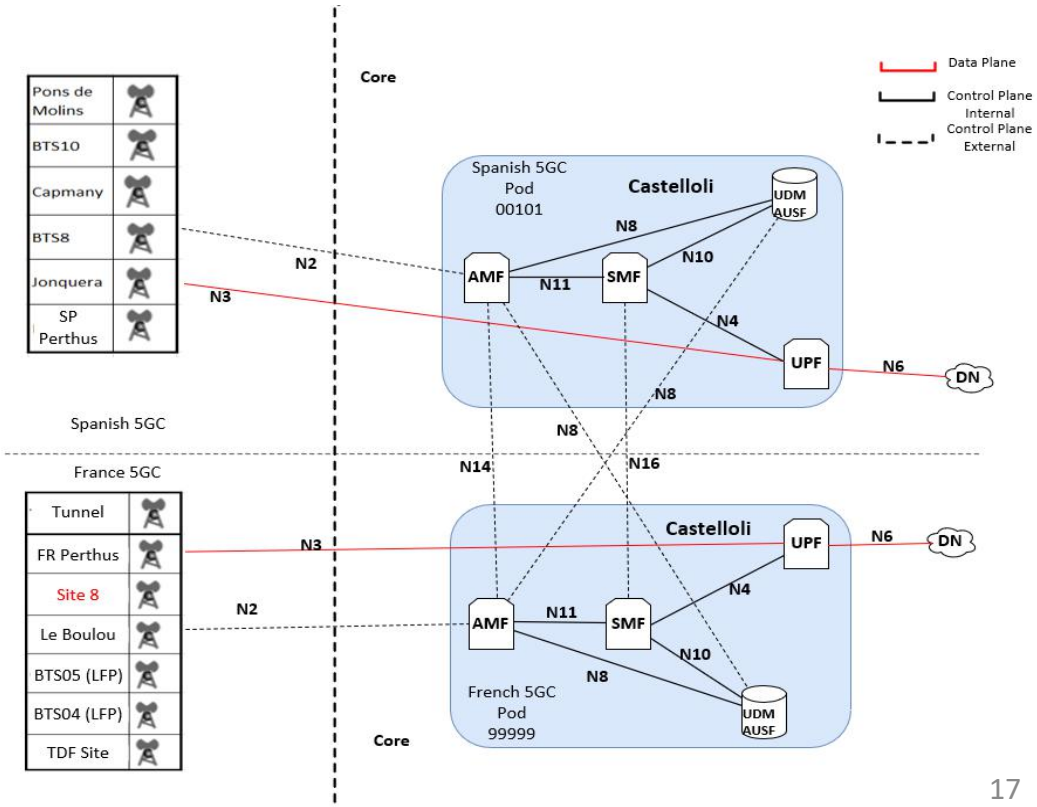
- Irregular orography and dense vegetation in cross-border area
  → We consider complementary radio technologies to cover 5G gaps (C-V2X/PC5 on highway, 70 GHz and satellite on rail track)

- Technical Objectives
- Technical Challenges
- **Achievements**

5GMED cross-border 5G network architecture



- HRR+LBO roaming with optimization techniques
  - N14 interface between AMFs of both MNOs
  - Radio handover between gNodeBs in the border
- Cross-border orchestration
  - Federation of orchestrators based on East/Westbound Interface of Operator platform by GSMA

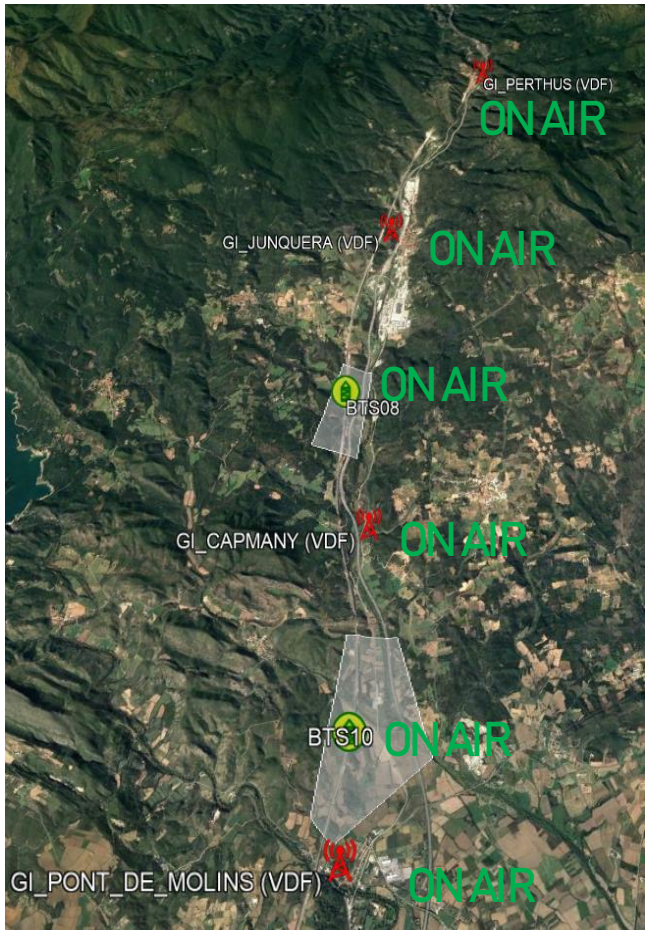


5G Network Deployment in Cross-border Corridor

- Two 5G SA networks deployed
  - 2 different 5G cores (Druid)
  - 11 gNodeBs (Ericsson, Nokia)

- Irregular and complex orography
  - Railway Tunnel in Perthus
  - Complex transport network → Multi-hop microwave links and fiber links
  - Difficult radio overlapping between cells in border

SPAIN



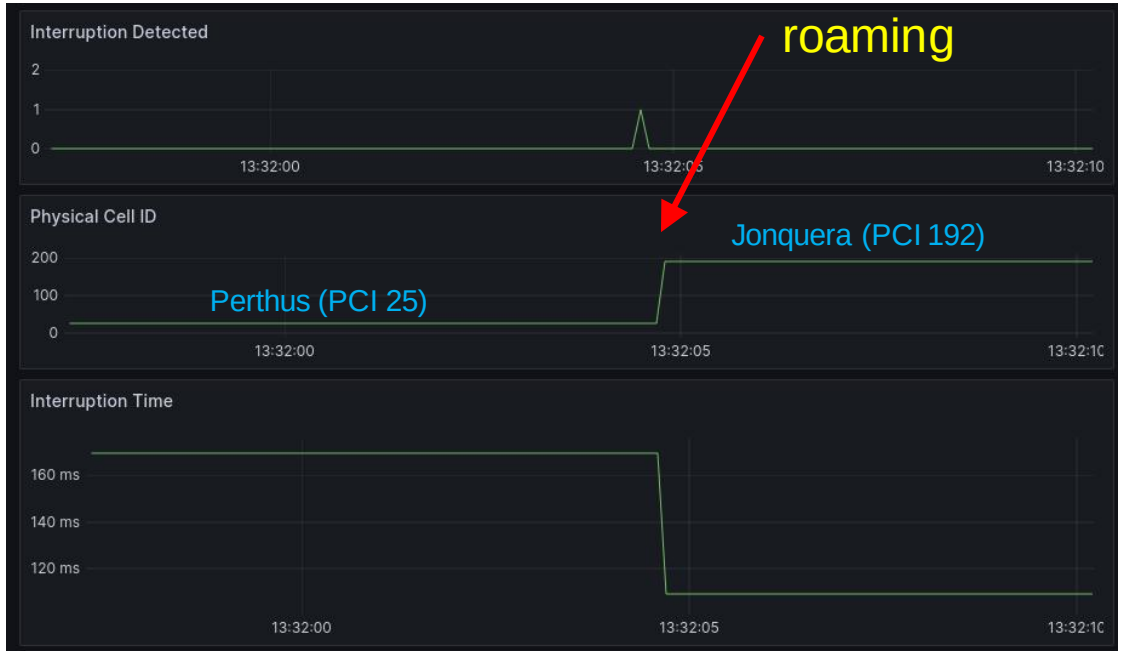
FRANCE

Roaming Interruption Time

- HRR with **equivalent PLMN, N14 interface, and radio handover*** between cross-border gNodeBs
  - ePLMN eliminates the need for blind attachments attempts of UE
  - N14 interface between AMFs of both MNOs
    - Reduces registration time: the AMF of visited network gets the UE context from the source AMF
    - Reduces user plane re-establishment time: the visited network is informed of used UPF and UE IP address

- Experiments conducted at Bellegarde Forte in Spain-France border
- Optimal conditions for inter-PLMN handover: good cell overlapping, walking tests

- Interruption times measured
  - **90 to 170 ms**



* Network Reselection Improvements recommended by 5GAA

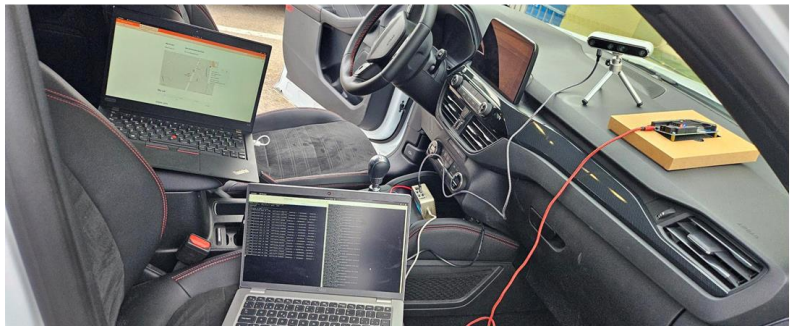
Demo of Remote Driving Use Case

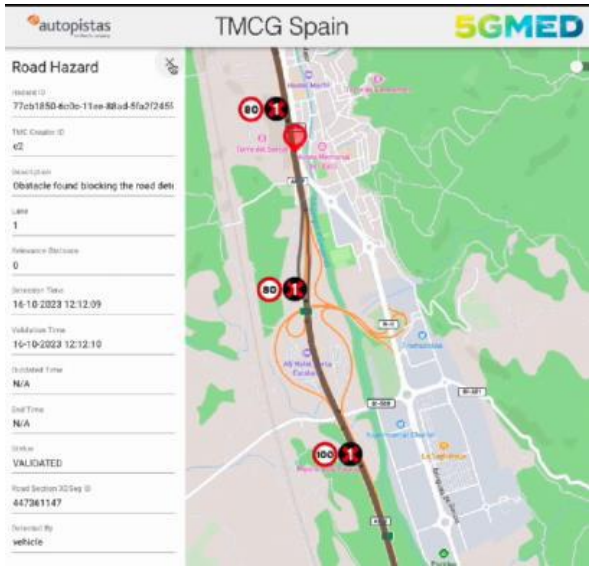
- Teleoperation of connected autonomous vehicle that finds a complex traffic situation in the highway
- Vehicle sends video images + sensors data to Remote Station, and remote driver sends commands to vehicle

Remote driving up to 70 km/h for 2 km on AP7 highway!!!

Demo of Road Infrastructure Digitalization Use Case

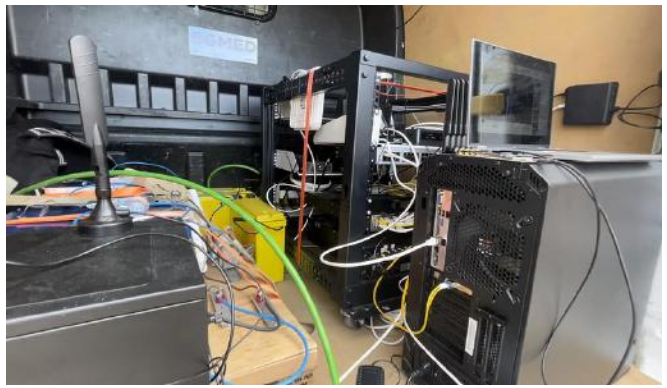
- Vehicle equipped with smart-sensor detects hazards and sends data to the Edge
- Traffic Management Center generates/disseminates warnings & traffic recommendations





Demo of Railways Use Case

- Monitoring of 1000s of sensors on-board the train
- Detection of obstacles on rail track using LiDAR
- Provide high-performance wireless connectivity to passengers (Wi-Fi AP, 5G Small-Cell)

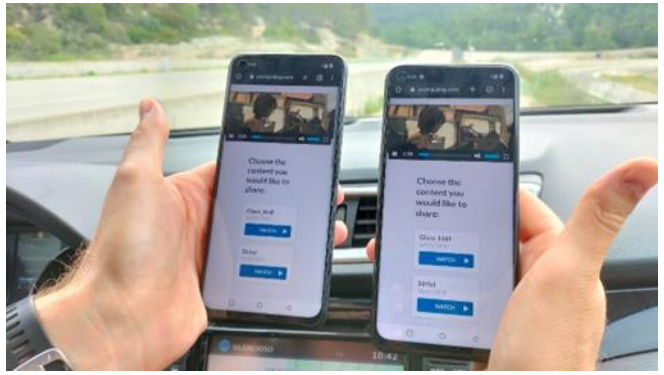


4 services demonstrated on-board…

- A 5G connected van on the highway
- A maintenance train with satellite and 70 GHz radio access technologies

Demo of Follow-Me Infotainment Use Case

- Distribution of high-quality media content to passengers
- Media services deployed on MEC and follow the movements of users to minimize latency (service migration controlled by cross-border/MNO orchestrators)



Demo of 2 types of media contents distributed over 5G:

- Synchronized video-streaming to several users
- Virtual Reality video

Use case 1
Teleoperation

Webinar 08/11/2023

Kévin NGUYEN

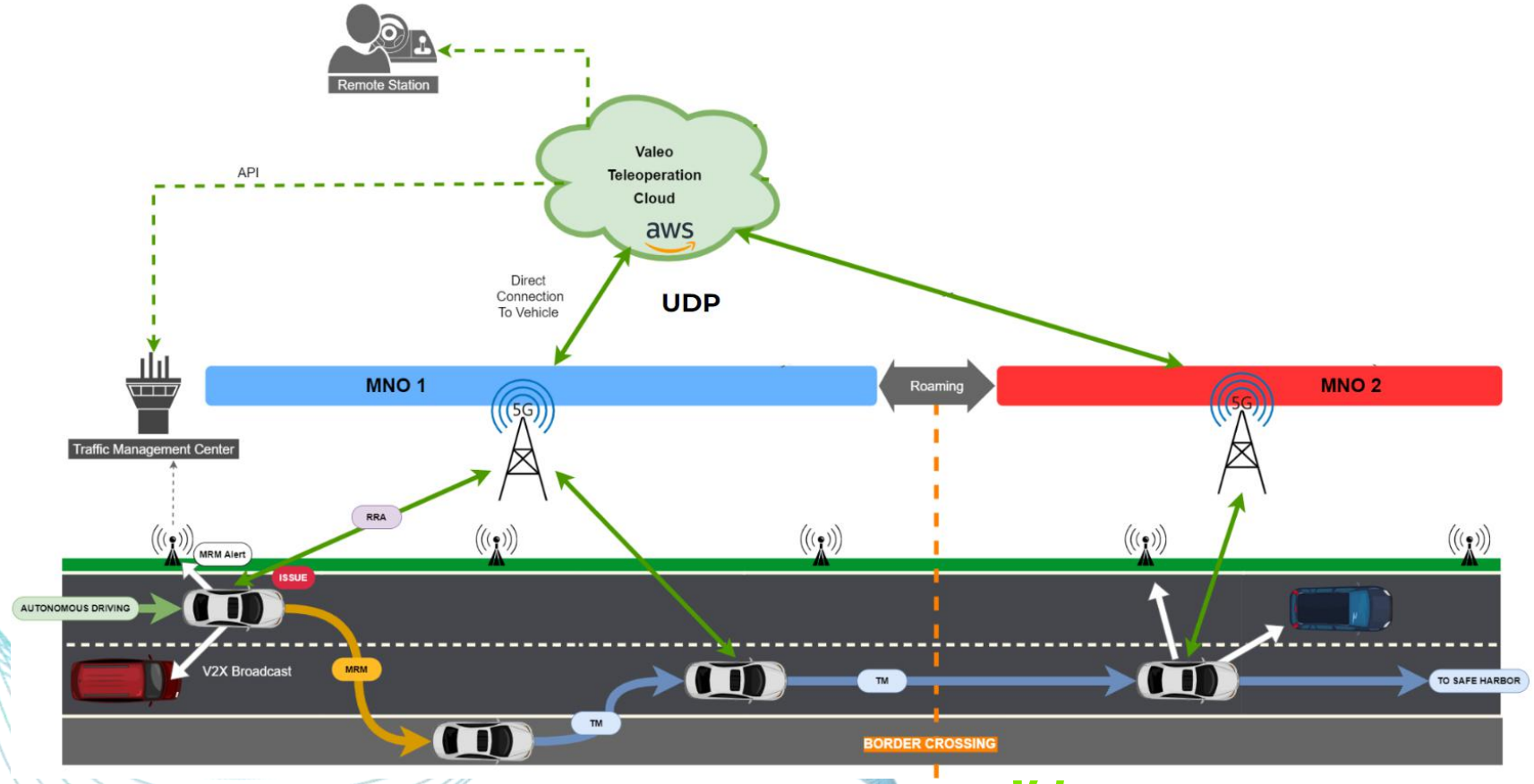
Agenda

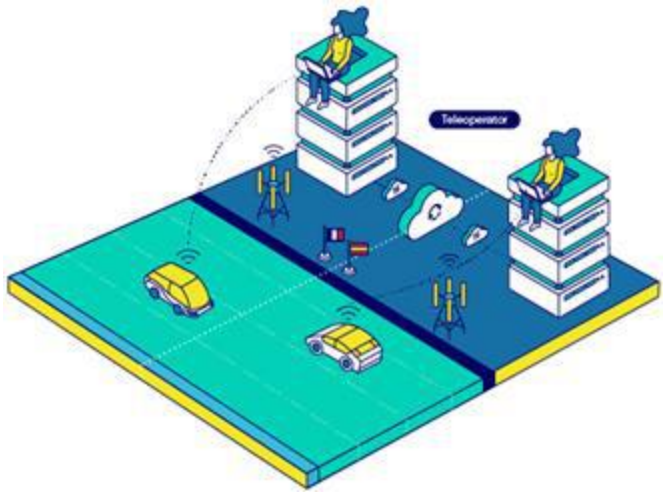
- UC1 Overview
- Cross-border challenges
- Next steps

Use Case 1 - Introduction

The assistance of an automated vehicle in getting outside its operating design domain.

Using the 5G cellular network, a teleoperator can control the car from a remote location and ensure the dynamic driving with full safety. This means that 5GMED will add a new reliable mode to autonomous fallback procedure.





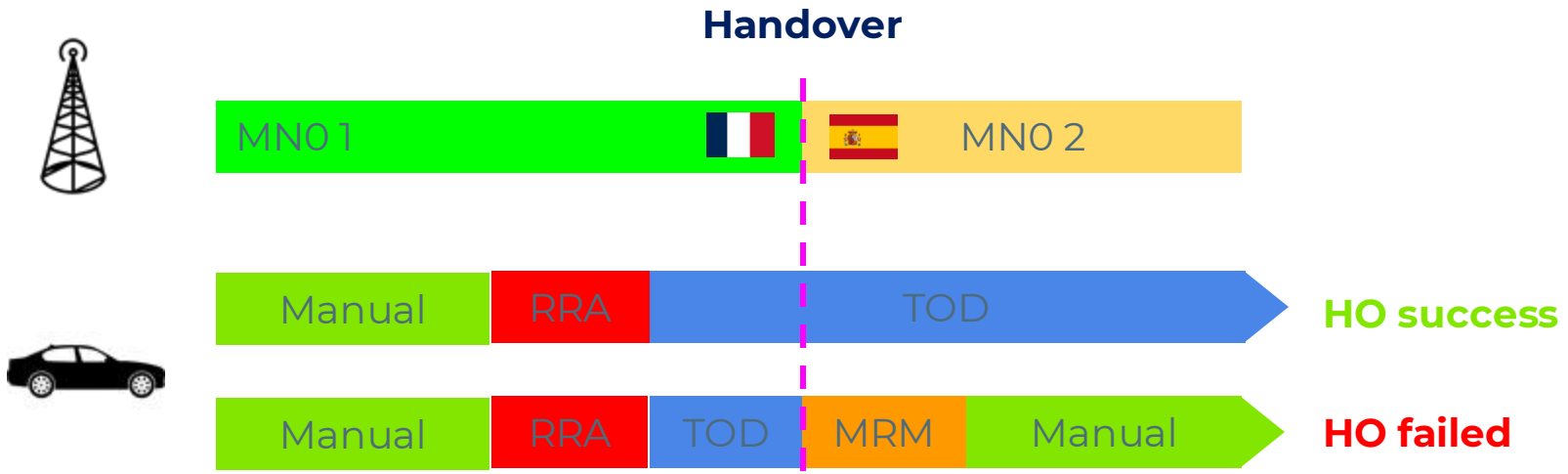
Use Case 1 - Remote Station & Vehicle

Main view

KPI view

Teleoperated vehicle

Use Case 1 – Cross border



Acronyms
MRM = Minimum Risk Manoeuver
RRA = Request for Remote Assistance
ToD = Teleoperation Driving

HO = HandOver
MNO = Mobile Network Operator

VTC = Valeo Teleoperation Cloud

ToD mitigation strategies

- Adjusting remote driving speed according to the latency
- VTC ToD connection monitoring

ToD Network requirements

- Maximum latency allowed to operate — 200 ms (at 90 kph)
- Minimum bandwidth requested for ToD — 2 MBit/s

Use Case 1 – Next steps

- Improve end-to-end latency, average 80 ms
- 100% successful handover, below 100 ms of interruption time
- Increase the teleoperation speed on highways, reach 100 kph
- Manage the authorizations and large scale trial test procedure
- Add new features to ensure the teleoperation safety at high speed

SMART TECHNOLOGY
FOR SMARTER MOBILITY

UC2 Road Infrastructure Digitalization

David Porcuna (AAE)

5GMED Webinar Session
November 8th, 2023

Index

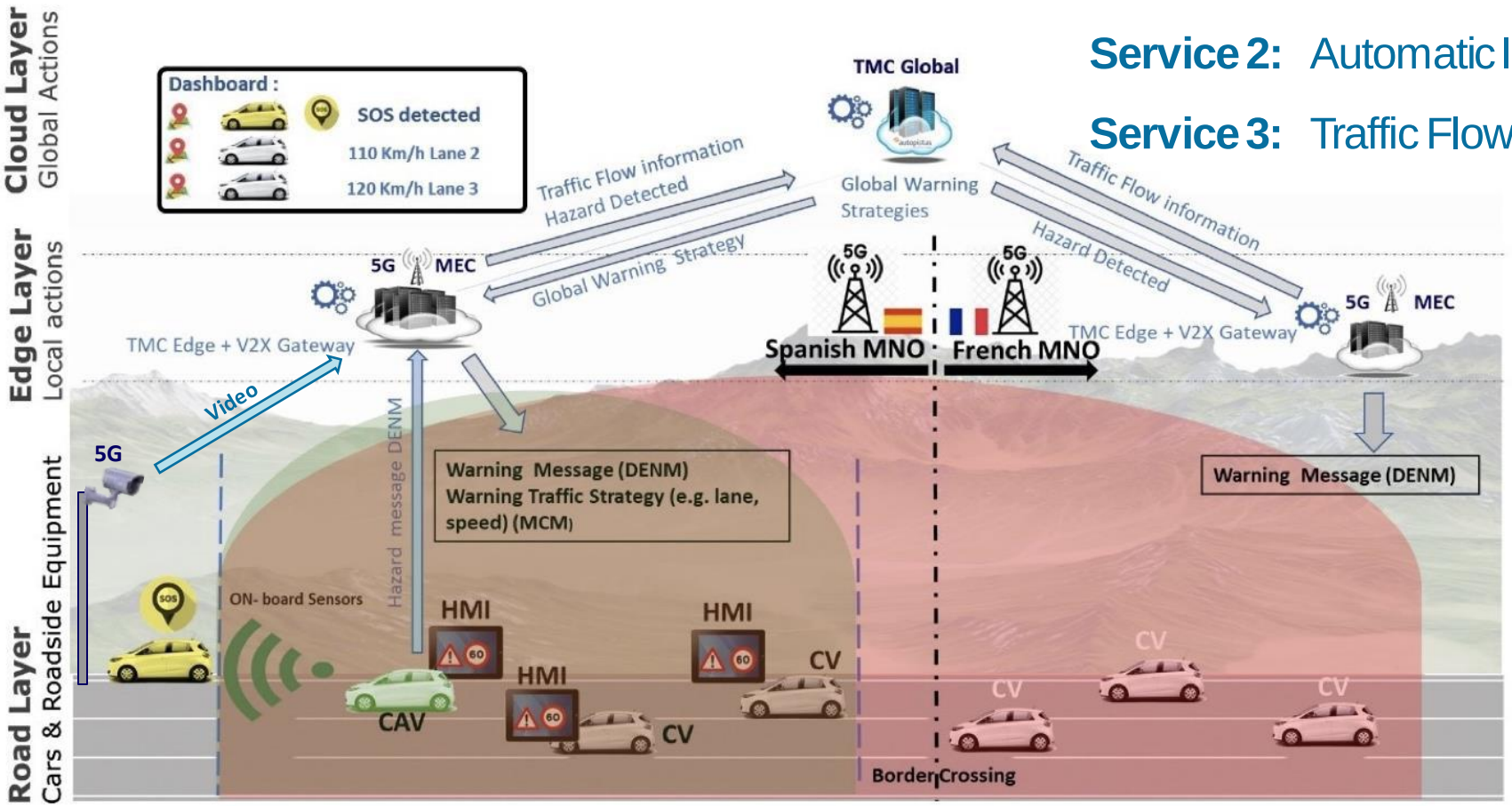
- UC2 Road Infrastructure Digitalization
- Cross-border challenges
- UC2 Demo days
- What comes next?

UC2 - Road Infrastructure Digitalization

Service 1: Relay of Emergency Messages **(REM)**

Service 2: Automatic Incident Detection **(AID)**

Service 3: Traffic Flow Regulation **(TFR)**



UC2 diagram

Cross-border challenges

- **Main challenges**
  - How to cope with **service interruption** when crossing the border ?
    - Loss of hazard information
    - Loss of traffic strategies information
  - How to ensure **service continuity** and **overall performance** when crossing the border ?

- **5GMED solutions**
  - Fast service **reconnection** based on enhanced 5G Roaming
  - **Interoperable cross-border traffic management** communication based on per-country service components (V2XGW, TMC Edge/Global)
  - **Dissemination** of hazards & traffic strategies information to all connected TCUs, even under roaming conditions, and based on several fast retransmissions (UDP over 5G)

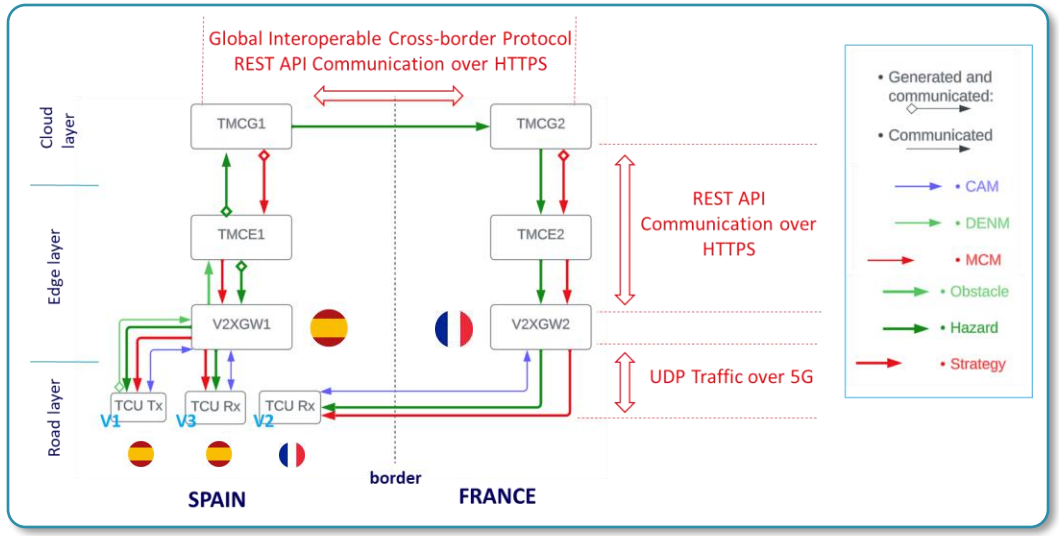
UC2 Demo days

Demo 1 - Functional demonstration

- Statical demo – Service 1: Relay of Emergency Messages **(REM)**
- Location: La Jonquera service area

- Vehicles:
  - V1: Obstacle detection camera
    CTTC TCU – Spanish SIM card — Tx
  - V2: CTTC TCU – French SIM card — Rx
  - V3: VEDE TCU – Spanish SIM card — Rx

- **Demonstrated**:
  - Detection of an obstacle & hazard dissemination
  - HRR of the visitor vehicle (French SIM card)

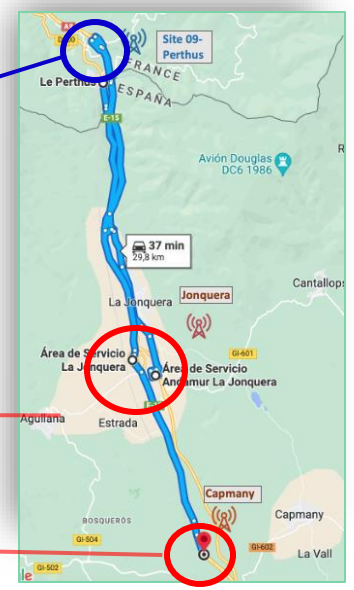


Data path for Service 1 messages

UC2 Demo days

Demo 2 - Performance demonstration

- Dynamic demo – Relay of Emergency Messages **(REM)**
- Trip:
  - La Jonquera
  - Le Perthus
  - Capmany
- Vehicles:
  - V1: CTTC TCU – Spanish SIM cards Tx
  - V3: CTTC TCU – Spanish SIM cards Rx
  - V2: CTTC TCU – French SIM card Rx
- Demonstrated:
  - HRR and handover at the cross border
  - Vehicle Dashboard
  - Grafana Dashboard



Hazard End-to-end Latency

Hazard Notification Reliability

Mobility Interruption Time

Physical Cell ID

Grafana dashboard

What comes next?

- Use of roaming optimization techniques
- Fine tuning of sychronization
- Improve message processing time on TCUs
- Deployment of roadside video cameras for Service 2 & 3

Use Case 3
Enhanced railways connectivity for cross-border

Webinar – 8th Nov 2023

Juan Agustí (CMS)

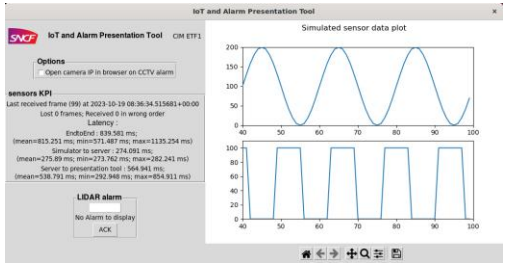
Index

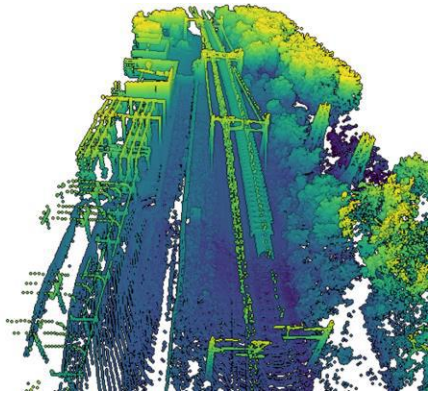
- UC3 Overview
- Cross-border Challenges
- Next Steps

UC3 Services

Three main aspects

1. The development of performance railway services
2. The development of the “Gigabit Train concept” to support passenger’s services
3. Seamless services (with similar QoS what you can get at home or at work): orography, cross-border, tunnels





UC3 Services

1. Performance Services — 2 services
   - Massive IoT (idioma 4000 sensors)
   - Obstacle detection using LiDAR (10 rotation per second in dual-return mode)
2. Passengers’ Services — 2 services
   - High-performance Internet Access (Wi-Fi 6)
   - In-train MNO services (proof of concept)

Train to track connectivity

To enforce seamless experience:

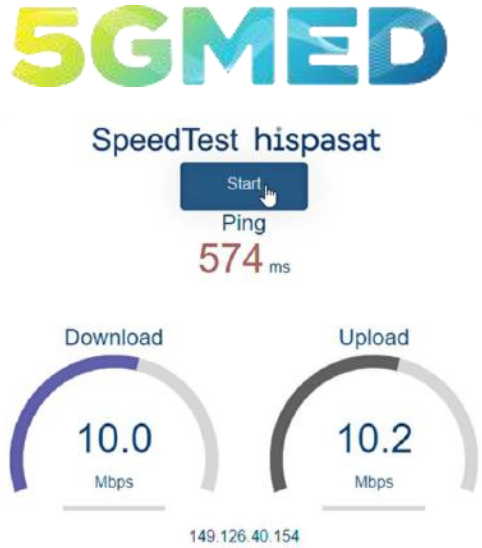
- Three different Radio Access Technologies:
  - 5G SA (Spain/France –including Le Perthus tunnel-)
  - 802.11ad 70 GHz (Spain –Gigabit train concept-)
  - Satellite (France/Spain)
- ACS-GW units: selecting access technology according to predefined policies (e.g.: service type, train position)

Showcased in two trains:

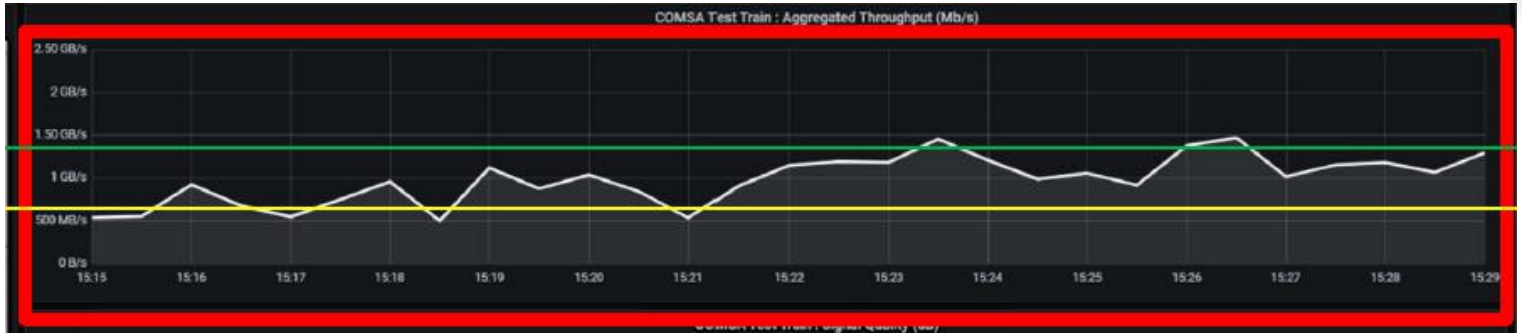
- LFP Maintenance Train (max. speed 90km/h) - May 2023
- SNCF TGV (max. speed 300 km/h) – July 2024

Access Network Technologies

Deployed



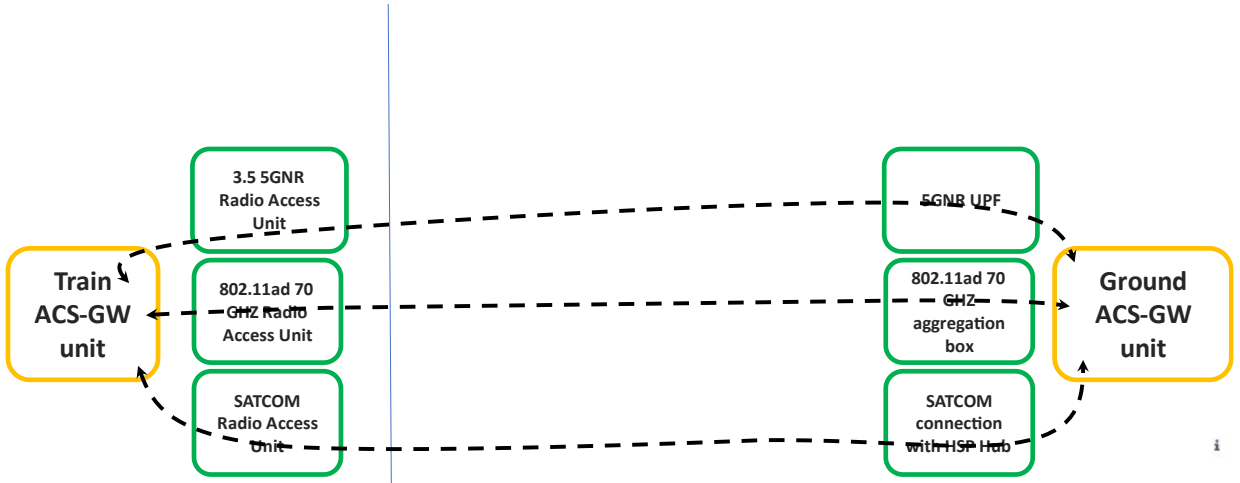
- 5G Network info correlated with service KPIs
- Use of the 5G SA combined with highway



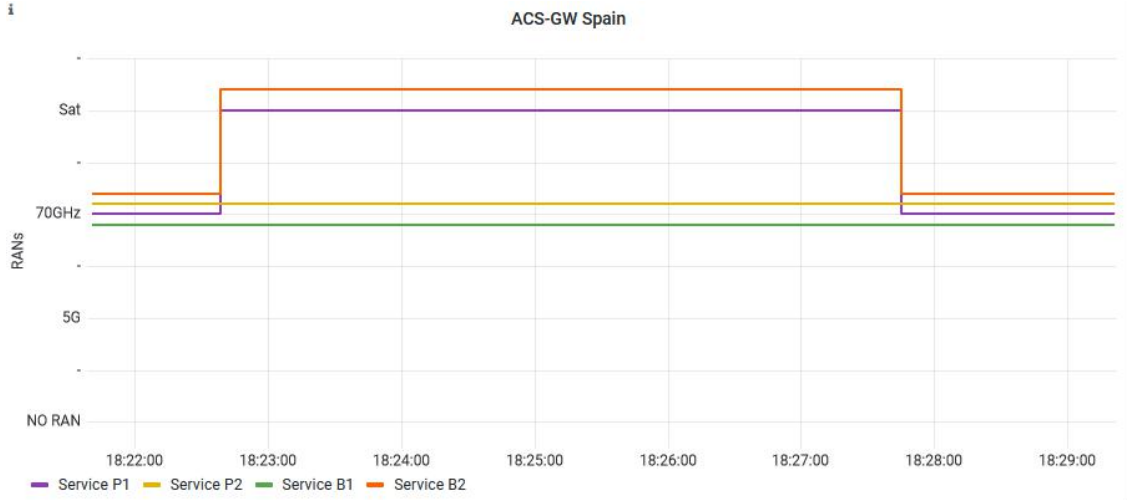
- Minimum/Average/Peak data throughput across circulation: 500Mbs/850Mbs/1.5Gpbs
- Maximum latency recorded (round- trip delay): 20ms
- Dual radio link association observed for 98.7% of circulation run (100% single association) between LFP base and tunnel

- Satellite: H30W-6
- Frequency: Ka-band
- freqUL: 28,363 GHz
- freqDL: 20,063 GHz
- Circular polarization: RHCP/LHCP
- Availability along corridor: 99,5%

Adaptative Communication Gateway



Service Flow	ACS-GW forwarding priority		
	3.5GHz 5GNR	IEEE 802.11ad 70 GHz	Satellite
P1	2	3	1
P2	1	2	-
B1	2	1	-
B2	2	3	1



Cross-border challenges

1. Roaming: All services should be able to tolerate the additional latency and interruption time that will be induced by the roaming at the border in the range defined by their respective KPI's (ready)
2. Vertical handover specifically at the cross-border (ready)
3. Different ACS-GW ground unit in France/Spain (deployed/not fully ready)
4. Different P2 VM in France/Spain Edge (deployed/not fully ready)
5. Different B1 Traffic servers in France/Spain (deployed/not fully ready)
6. Change B2 frequencies used by the train small cell based on detection of border crossing (ready)

Next steps

- Complete the validation of pending cross-border challenges (aligned with LBO roaming)
- Track performance characterization (based on network and service KPIs), programming automatic handovers between radio access technologies depending on train position.
- Service KPIs analysis
- TGV tests (including train components deployment, tunning, validation and testing)

Use Case 4
Follow-ME Infotainment

Webinar – 8th Nov 2023

Rodrigo Peces (ATOS)

Index

- UC4 Services Overview
- Cross-border Challenges
- Next Steps

UC4 Services

Two main aspects

1. The development of the media infotainment applications
2. The implementation of the Edge-to-Edge service migration on the MEC network

UC4 Services

1. Enjoy Media Together (EMT) Service
   - 2 functionalities
     - Video streaming
     - Video conferencing and Messaging service
2. Tour Planning (TP) Service
   - 3 functionalities
     - High resolution media
     - 360º high resolution media
     - Immersive media

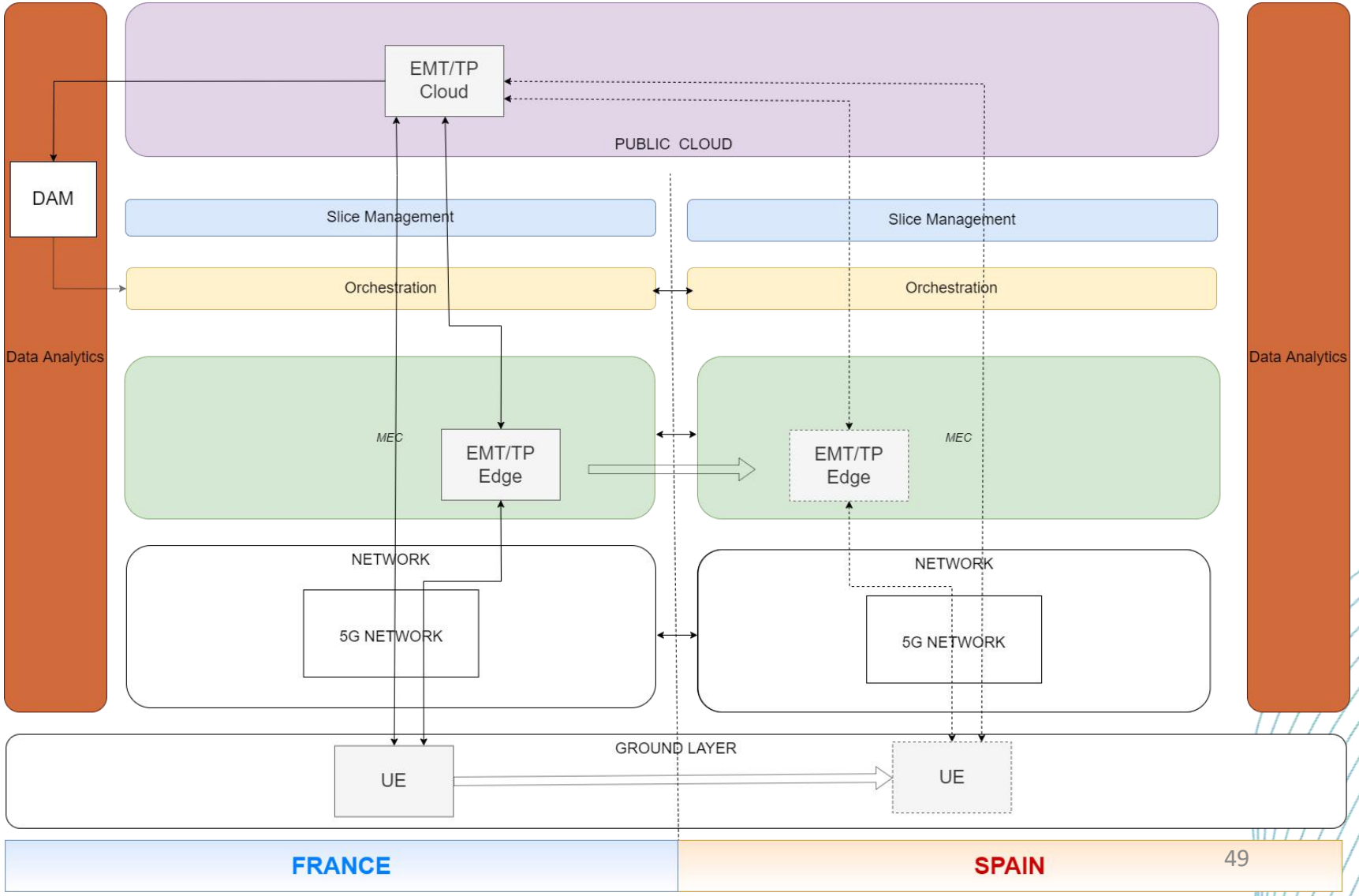
Mapping media services in network architecture

Service layers:

- Client Layer
- Edge Layer
  - Hosts the EMT/TP Edge Server.
- Cloud Layer
  - Provides metrics to the Data Analytics Module.

MNO-MNO Communication

- Edge Federation.



Cross-border Challenges

- Session service continuity beyond pure connectivity.
- Network performance in terms of service continuity, throughput and reliability.
- Local traffic re-routing to optimise Edge.
- Edge federation: Edge resources management and orchestration and Service migration.
- Two operators coordinate the use of edge resources through their orchestration platforms.

Next Steps

- Integration of components to attain an automatic federated deployment.
- More testing is required:
  - Mobile devices.
  - SIM Cards.
  - Other Network configurations.

5G seamless roaming for teleoperated driving and sailing

5G-Blueprint approach

Dr. Nina Slamnik-Kriještorac
Senior researcher, Principal investigator

IDLab, imec research group at Ghent University and University of Antwerp

Outline

- Quick overview of 5G-Blueprint project
- Use cases
- 5G seamless roaming
- Summary & Lessons learned

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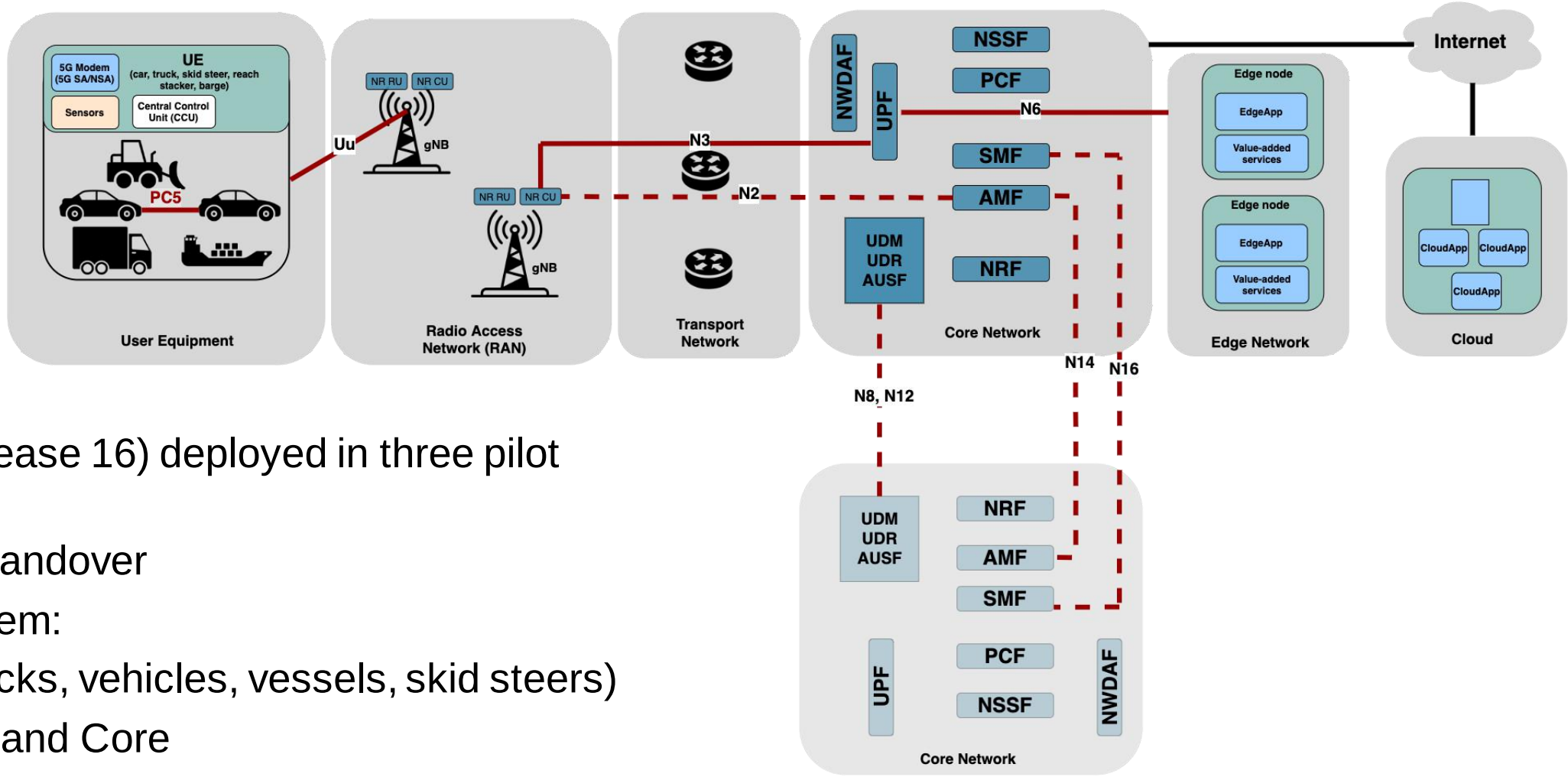
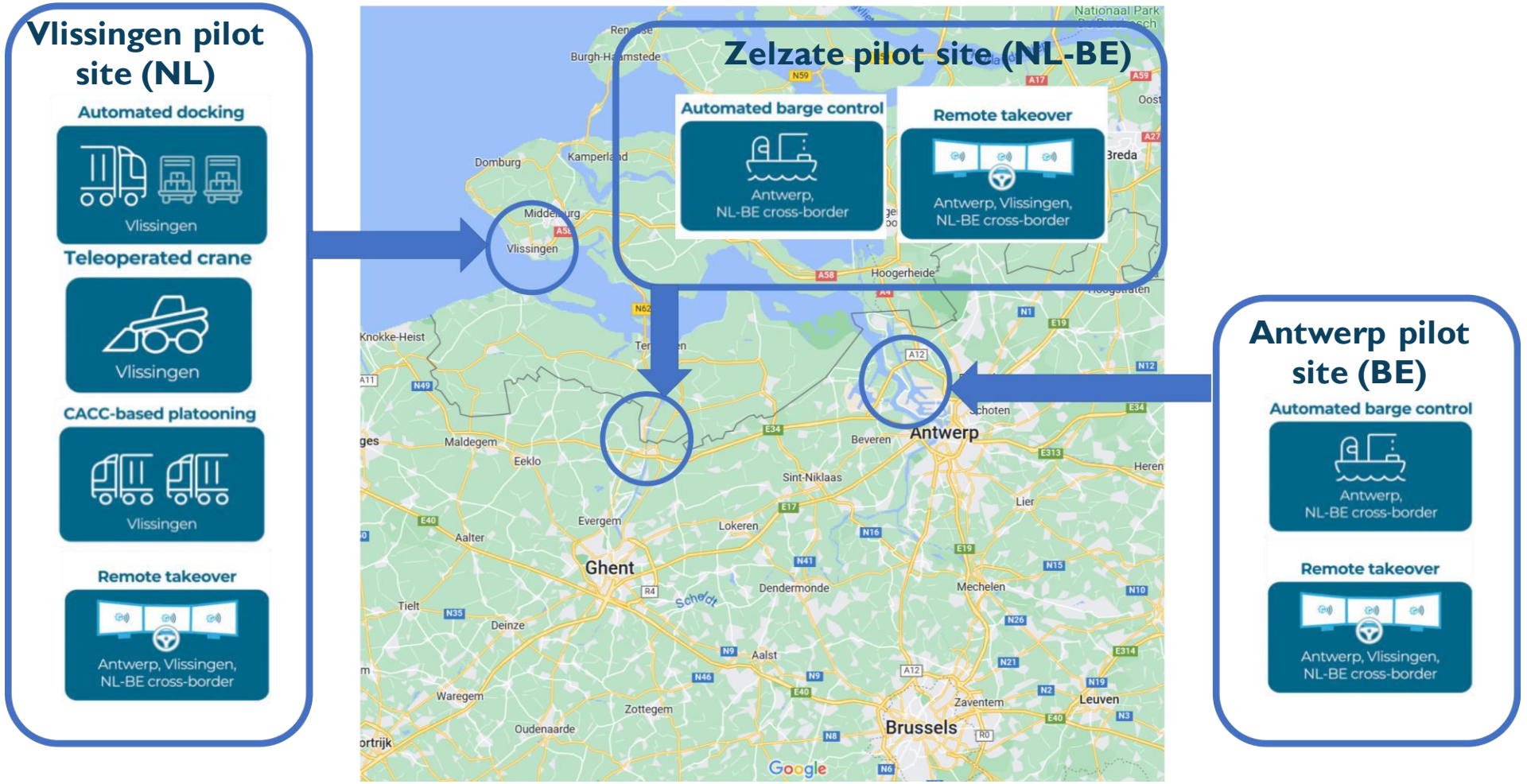
5G-Blueprint combines (cross-border) 5G SA with teleoperated driving and sailing



- 5G SA (Release 16) deployed in three pilot sites
- Seamless handover
- 5G ecosystem:
  - UE (trucks, vehicles, vessels, skid steers)
  - 5G NR and Core
  - Data network (Enabling functions and Use case components)

Use cases are mapped to national and cross-border pilot sites



Outline

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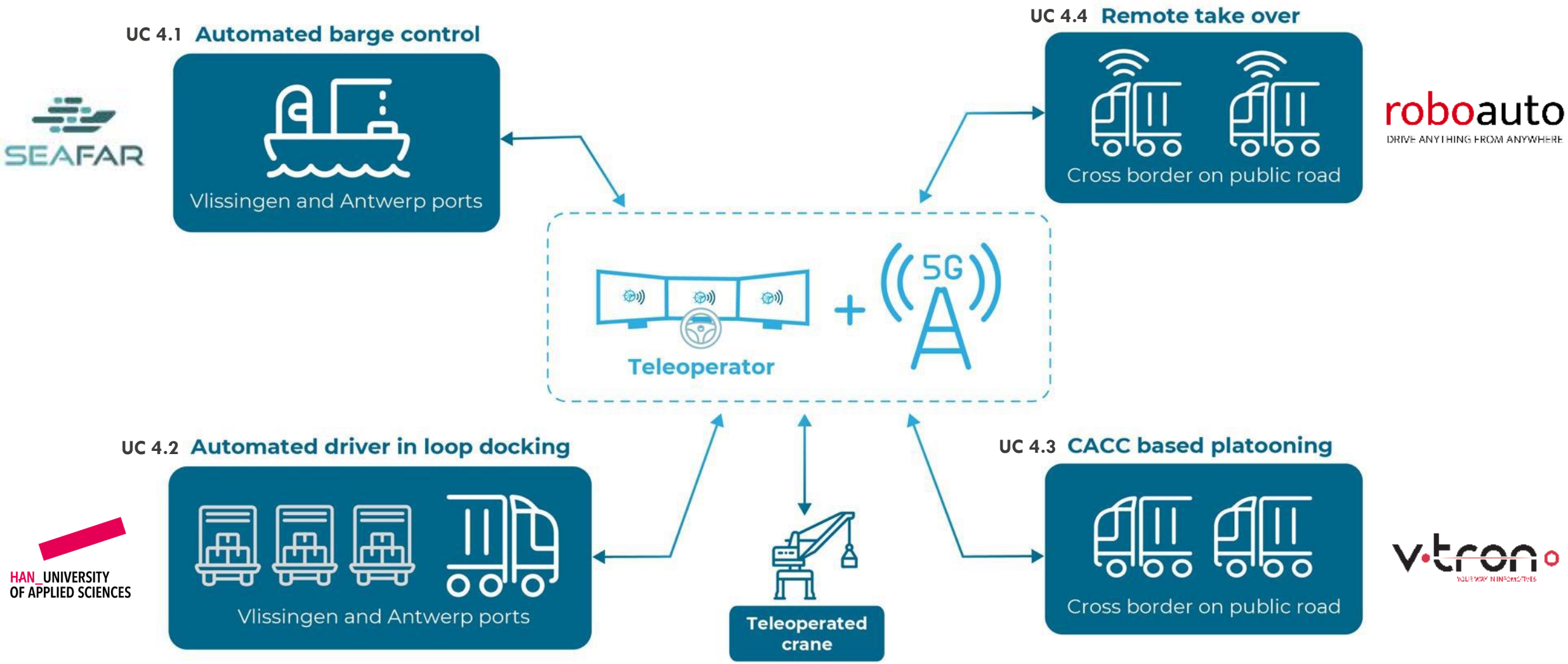
Use cases are tested in real-life environments such as busy ports and public roads



Shadow mode testing of remote barge control is essential for testing 5G SA capabilities before proceeding with actual teleoperation

Shore control Center

Control and Monitor

5G

vessel

-Sensors' data
-Sensors Processor

Seafar Cloud

Telenet Backbone

Teleoperated Docking scaled from simulations to pilot with trucks

Teleoperator view

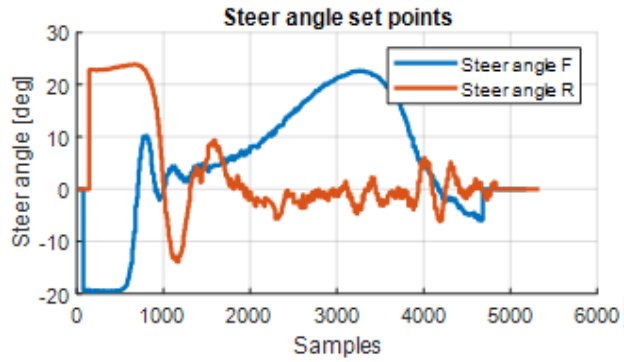
Cabin

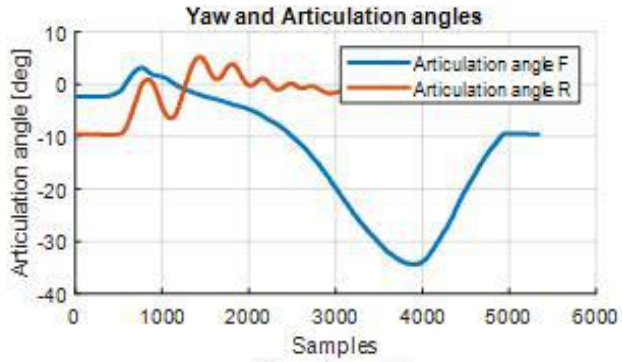
Average tracking error 0.16m, target values less than 0.5m

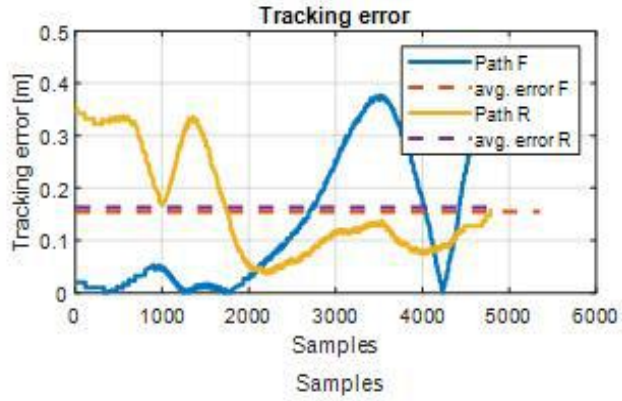
An example test run at MSP Onions

Final docking state error:

- A = 3.6cm, required < 10cm
- B = 8.4cm, required < 10cm
- C = 0.4deg, required < 2deg







Overall robustness of the teleoperation system improved, full takeover of DAF truck achieved

Steering accuracy: Mean absolute error 4.83deg (<6deg)

Braking accuracy: Mean absolute error 0.72% (<4%)

Steering accuracy: Mean absolute error 2.41deg (<3deg)

Braking accuracy: Mean absolute error 0.51% (<4%)

Overall robustness of the teleoperation system improved

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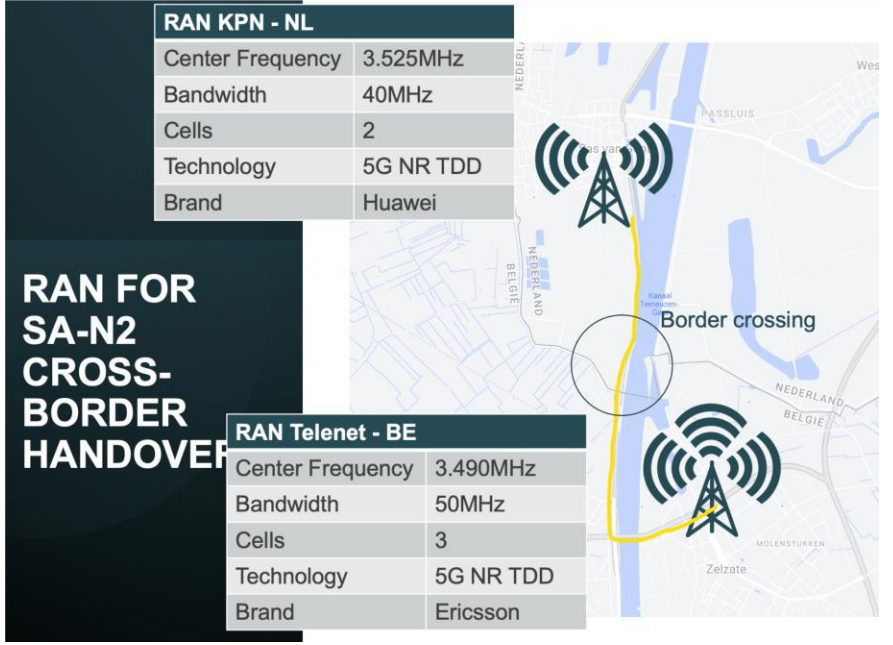
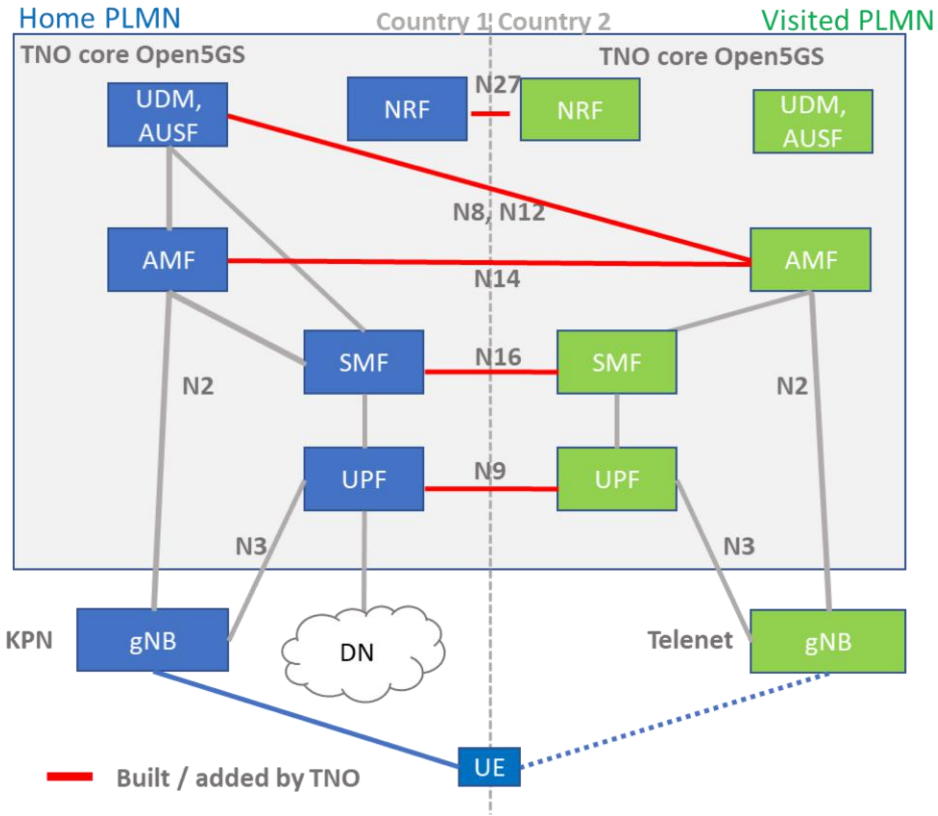
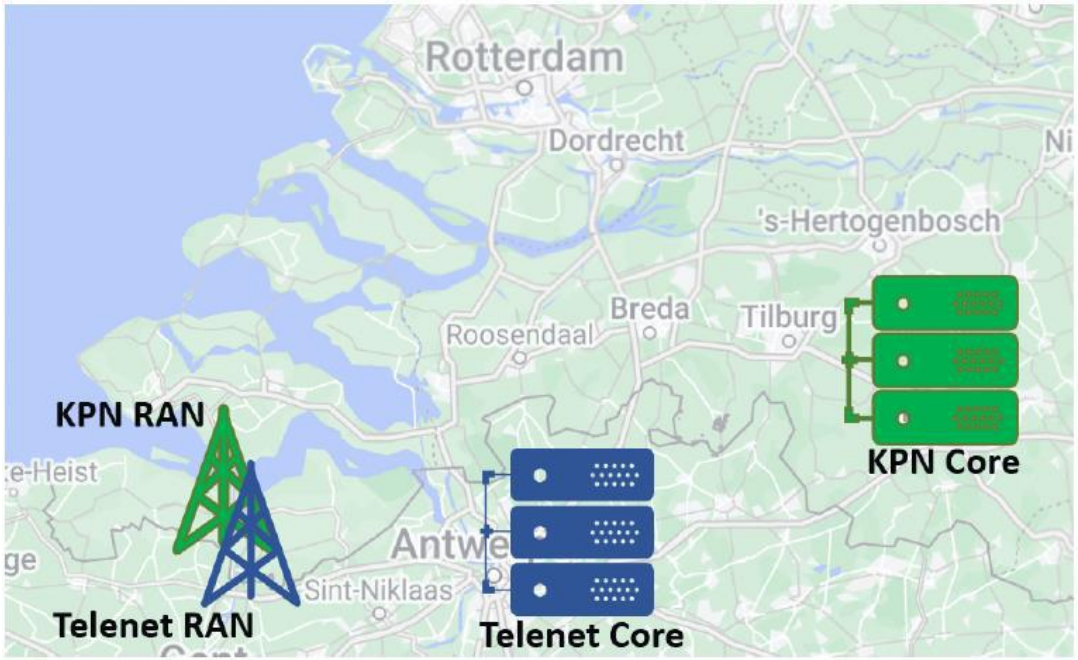
Seamless roaming crucial for safe cross-border teleoperation

- 5G SA seamless roaming working and deployed at cross-border site
- Network evaluation done at BE and NL sites
- Successful seamless roaming demos

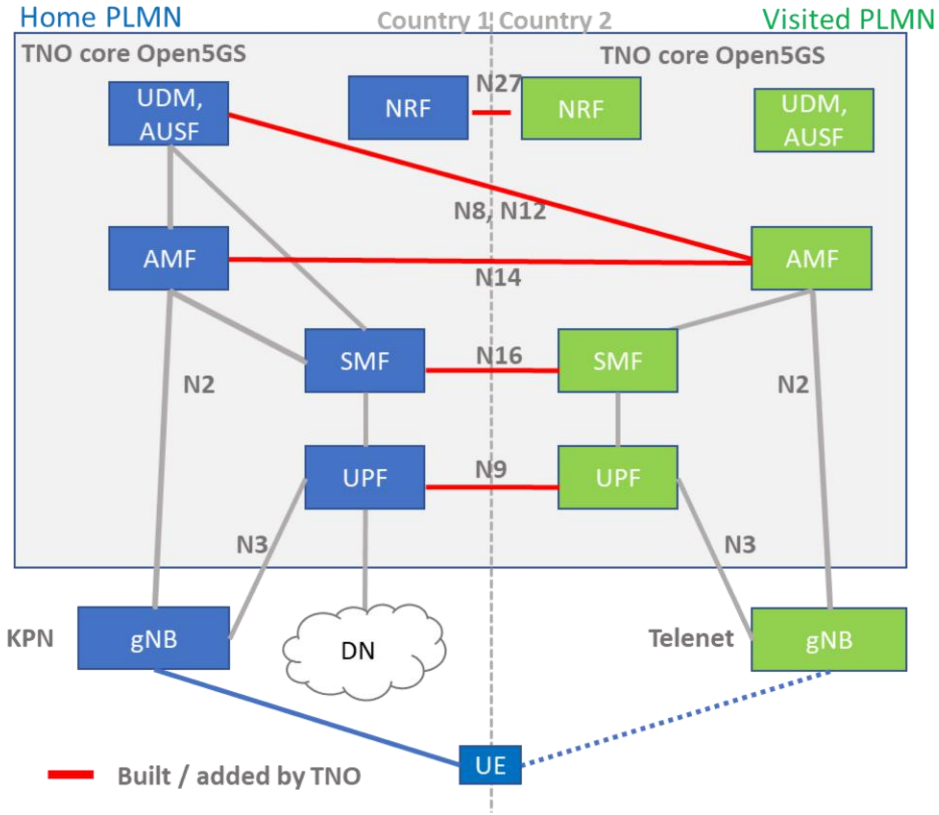






Home Routing & N14-based routing with novel optimization to reduce downtime are needed

- UE's PDU session data exchanged between home and visited networks via N14 interface
- Both visited and home networks are configured as equivalent PLMNs (E-PLMN)
- Roaming behaves similarly to a normal handover procedure
- No new PDU re-establishment at visited network needed



Roaming procedures can be optimized by combining Home routed SA principles with N14-based roaming

N14 vs N2

Seamless cross-border N14 handover performs similar to the N2 handover, the main difference is that it depends on the latency between the cores

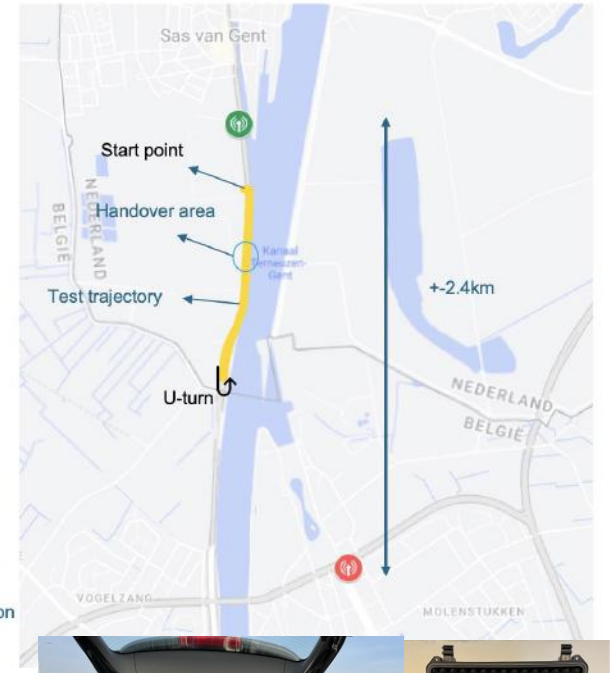
Lab results

- N2 handover: 100-120ms
- N14 handover: 100-150ms

- Uplink throughput: 32.4 Mbps
- Downlink throughput: 145 Mbps

Field results

- N14 handover: ~100ms
- Latency between the two cores: ~7ms → small impact compared to the other latency components



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Summary

Teleoperation of vehicles and barges

- Autodocking successfully tested with the full-scale trucks over 5G SA
- Teleoperation of vehicles (Toyota vehicles and DAF trucks) and barges successfully tested over 5G SA in the national sites (BE, NL)
- Network testing demonstrated that its performance enables **safe teleoperation across borders**
- Testing campaigns with teleoperation of vehicles and barges ongoing in the cross-border setup

Seamless roaming

- 5G-Blueprint solution one of the first practical implementations for seamless roaming in 5G SA
- Solution combines Home routed SA roaming with the N14 interface
- Service interruption time significantly reduced → sufficient for teleoperation (<150ms)

Lessons learned

Teleoperation of vehicles

- Human factors need to be considered for teleoperation: varying driver experiences, resolutions and frame rate effects, fatigue
- Handover-caused interruption times sufficient for cross-border teleoperation

Seamless roaming

- Standardization potential:
  - New procedure to enable Home-Routed Seamless roaming in 5G SA → **merges** N14 handover with Home-Routed Roaming
  - Seamless roaming with inter-PLMN handover in **both** directions → procedure for V-PLMN to H-PLMN direction is also missing in standards.

- Handover decisions currently based on signal strength, exploring other criteria (allowed IMSI, service availability, contractual relations)
- Vast amount of configuration parameters → to be automated

Join us at the final event

Date: November 21st 2023

Location: Industrial Museum Zeeland, Sas van Gent, The Netherlands

The event is free of charge, but registration is mandatory, due to limited seats

5GRAIL – first FRMCS demonstrator

Connectivity beyond limits in mobility cross-border scenarios with 5G

8th November 2023

Dan Mandoc, Head of FRMCS | FIRSE - UIC

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 951725.

FRMCS is the 5G GSM-R successor and the Railways Digitalization enabler

- The Future railways Mobile Communications system (FRMCS) is Railways answer to GSM-R obsolescence. GSM-R, working well, and installed on more than 130.000 km of track in Europe, is becoming obsolete, with an end of support around 2035.
- FRMCS, which is a 3GPP 5G Stand Alone system, will also enable trains digitalisation. FRMCS has dedicated frequencies bans allocated via ECC (20) 02 in 900 and 1900 MHz bands.
- FRMCS is now included on the CCS TSI, and will be operational in 2027.

- 5GRail has built first FRMCS prototypes, for the On-Board equipment, and also for the applications: Voice communications, ETCS, ATO, TCMS, Video, PIS
- 5GRail has a consortium of 18 partners – Railways, suppliers, two Universities, UIC and UNIFE.
- 5GRail consist of eight work packages which aim to :
- Agree the test scenarios, including BX
- Build test cases
- Build On-Board FRMCS and Applications prototypes, against FRMCS available specifications
- Test these in two Labs, histed by Kontron in Montigny, France, and Nokia, in Budapest, Hungary, including BX scenarios
- Test them then in Field, in two test tracks, in France and Germany, in real trains.
- Study Rails and Roads coexistence
- Feed back to FRMCS specification process

5GRail

ALSTOM · mobility by nature · France
CAF Spain
DB NETZE Germany
DTU Denmark
Infraestruturas de Portugal Portugal
kontron S&T Group Germany
NOKIA Finland
ÖBB INFRA Austria
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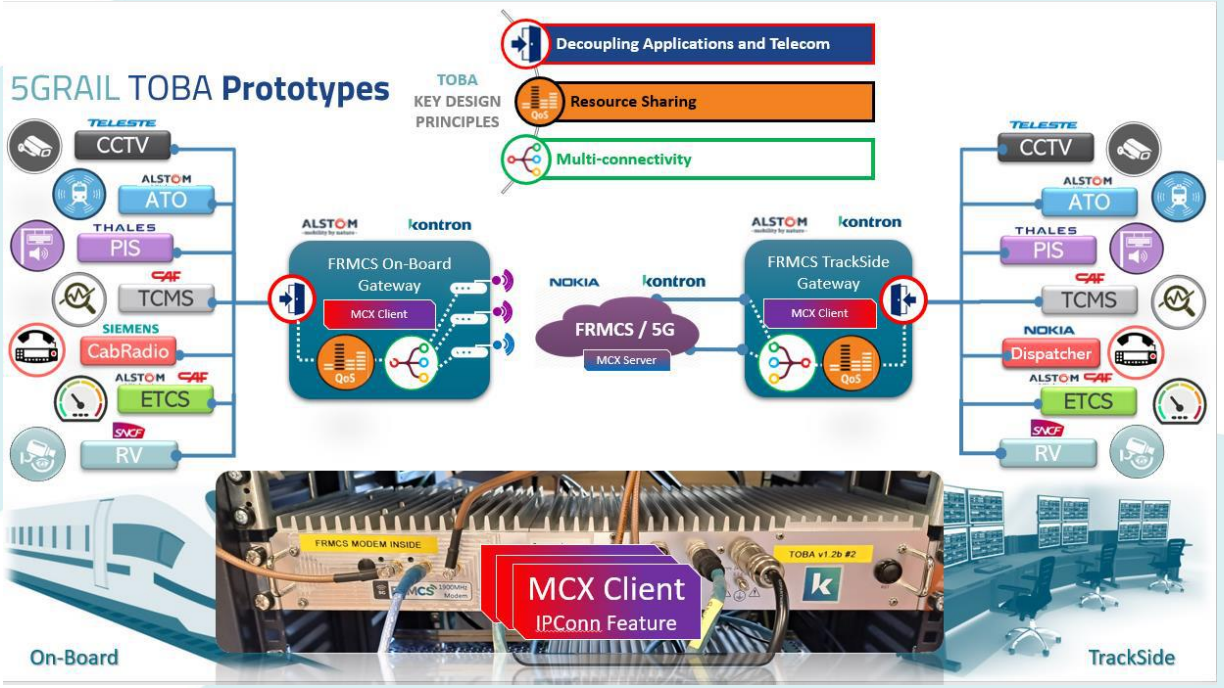
100 YEARS ANNIVERSARY UIC INTERNATIONAL UNION OF RAILWAYS

5GRAIL is an EU funded project. This project has received funding from the European Union's Horizon 2020 research and innovation program, under grant agreement No 951725.

5GRail reached its target

- To date, the testing is finalized:
- The prototypes have been built. I wish to remind that FRMCS is a 5G SA Mission Critical System, where especially the Mission Critical BX is very challenging
- The prototypes have been tested in the two labs
- Field test have been finalized, with valuable results.
- We have tested two BX scenarios:
  - 2UEs – which is a scenario that FRMCS will utilize until 2027-8
  - Partly an Inter-PLMN Handover over AMF, where two out of three steps were demonstrated.
- We are now finalizing the Tests campaign reports, and preparing the Project Final Conference.
- We aim to finalize the project in tome, as planned.



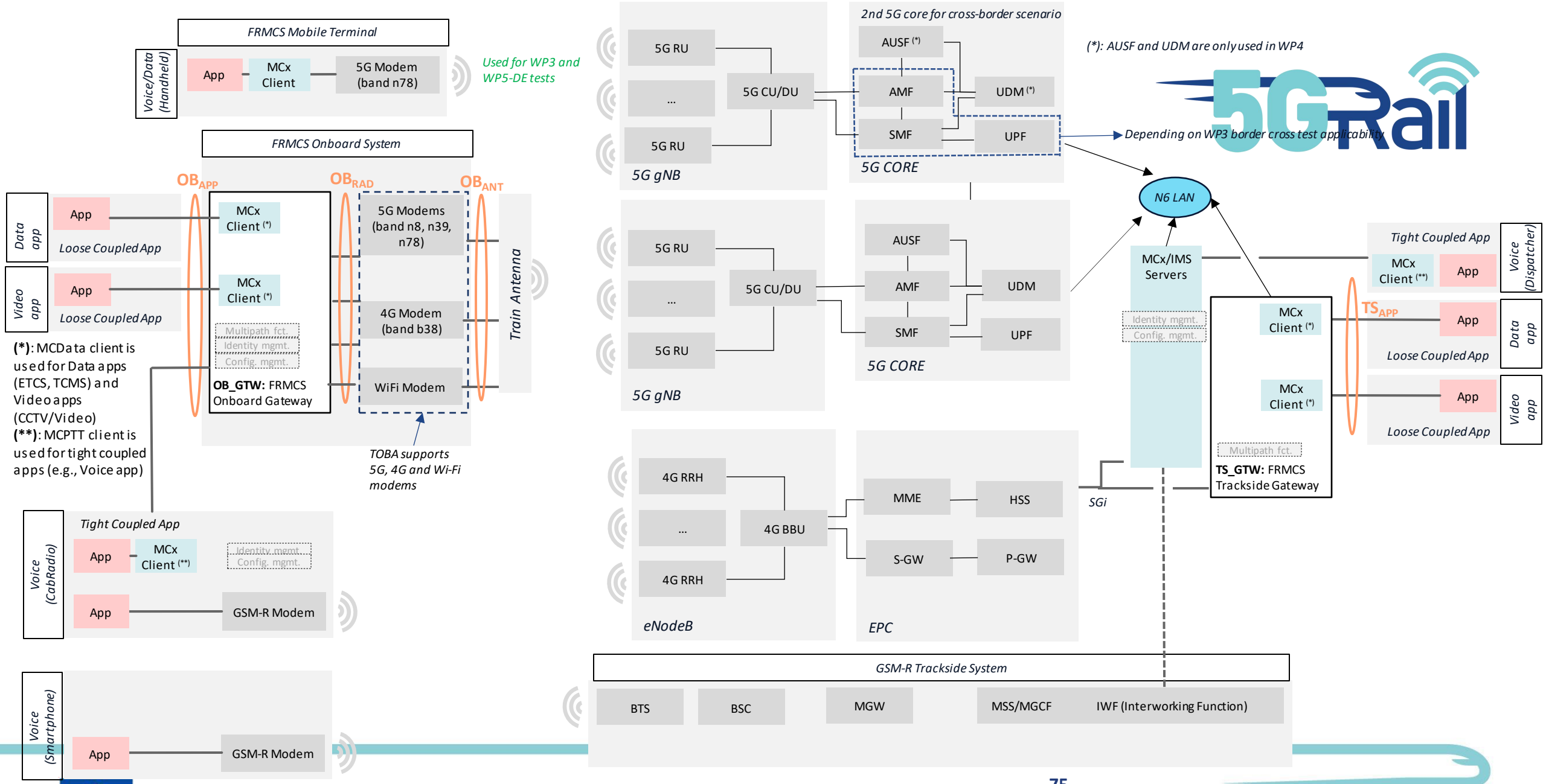
5G Rail received innovation recognition from the EC, for following items:

- FRMCS tailor-made 5G Module (1900 – 1910 MHz TDD)
- 5G FRMCS – GSM-R interworking
- Cyber Security architecture for the MC over 5G ATO application

Our demo at German Testbed was succesful !

We invite you to our final conference, planned for the 7th of December 2023!

https://5grail.eu/2023/07/03/experimental-trials-for-the-future-railway-mobile-communication-system-in-5grail-project-registrations-open-for-5grail-final-conference-on-07-12-2023/



Grant agreement No 951725

5GRail Generic e2e Test Architecture

5GRail Demo Team

5GRail

Thank you for your kind attention

5GMED

Q/A

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 951947

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