

FROM R&I TOWARDS ACTUAL DEPLOYMENT

UPDATE ON 5G TRIALS AND PILOTS FOR CONNECTED AND AUTOMATED MOBILITY

A perspective from the 5G-PPP and SNS JU Ecosystem

June 2023



V2X USE CASES

What follows is a brief description of the different use cases being studied, analysed, and tested across the various projects. Detailed description of the use cases and particular implementations of these use cases, the so-called user stories, can be found at the websites of the respective projects.



Tele-operated Driving (ToD): is defined as remote control of an automated vehicle through a mobile radio network. ToD is meant to complement automated driving by bringing the tele-operator, located in the Vehicle Control Centre (VCoC), into the control loop in situations where an automated vehicle cannot handle on its own.

High Definition (HD) maps: being considered one of the corner stones of an autonomous car, the generation and distribution of these maps allow integrating information such as lane markings, barriers and other information which can be used by the automated driving functions. The HD maps can also be used as the base upon which more dynamic information can be stored, e.g., road works and accidents.

Anticipated Cooperative Collision Avoidance (ACCA): this use case relates to the possibility to anticipate certain road hazards to reduce the probability of collisions, particularly in situations when these hazards are out of the field of view of the vehicles' sensors. It allows to build a situational awareness of the road in quasi real-time manner, and to notify nearby vehicles about collision risks.

www.5gcroco.com



Automated driver-in-loop docking functionality: Within this use case, 5G-Blueprint explores a driver assistant system for docking articulated vehicles within warehouses and distribution centres, as a well as enabling a mobile harbour crane with teleoperation functionality, so that it can be operated from a remote-control centre by a teleoperator. Communicating optimal driving paths to the tractor and manoeuvring the crane in safety-critical situations will be highly time-critical.

Cooperative Adaptive Cruise Control based platooning: Platooning of trucks has been a widely discussed topic in logistics for a while now. However, this use case revolves around the fundamental strategy of platooning by relying of 5G, while the driver is removed from the cabin of the truck and placed in a remote location from where they can control the vehicle. The system is aimed at being partly automated wherein the lead vehicle can be driven by a driver in the cabin or a teleoperator and the following vehicle(s) can be automated.

Remote takeover operations: Remote takeover defines the process in which a remote operator takes control of a distant vehicle. To enable remote takeover, it is necessary to monitor and adjust the vehicles to steer and drive remotely from the control centre. Remote takeover operations are integration tests verifying the function of all major components (vehicle, remote station, teleoperation centre) of the teleoperation solution.

Automated Barge Control: the channel navigation of the barges will be teleoperated along with partial automation. Cross-border passing will be given a priority whereas channel navigation, port entry, and exit efficiency will be enhanced by reducing crew requirements for barge navigation.

www.5g-blueprint.eu



5GMETA

Crowd-sourced dataset generation and ML model update through connected vehicles: the 5GMETA platform is used to provide new relevant vehicle sensor data to a third party for refining a CCAM machine learning (ML) model.

Instead of storing locally or streaming the entire sensor data, the vehicle selects the data that makes the ML model perform below an established threshold and it sends them to the 5GMETA platform. Then, the third party, which is subscribed to this dataflow, receives the data through the 5GMETA platform. The data are anonymized in the 5GMETA MEC, blurring faces and car plates, offloading from this task to the vehicle.

Dynamic route planning & parking support: 5GMETA pipelines the required information to accurately and dynamically predict the departure time and the optimal path to reach a destination in a target arrival time and to quickly find a free parking lot. The data delivered by the platform generate revenues from the added value to the users of dynamic route planning and parking support services that are re-scheduled in real-time to avoid any incident meaning a late arrival.

Driving safety & Awareness: The 5GMETA platform helps drivers to correct their behaviour and assist in bringing the vehicle to safety mode before a dangerous event can occur. It is a solution for safely stopping the remotely assisted vehicle in the closest available parking lot detected. The video camera stream can be processed at the infrastructure to quickly detect available parking lots, required for the success of the rescue manoeuvre.

www.5gmeta-project.eu

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USE CASE	TELE-OPERATED DRIVING	HD MAPPING	ANTICIPATED COOPERATIVE COLLISION AVOIDANCE	VEHICLE PLATOONING	ADVANCED DRIVING
KEY 5G KPI	RELIABILITY	DATA RATE	DELAY, LOCALIZATION ACCURACY	RELIABILITY / E2E LATENCY	E2E LATENCY
5GCroCo	✓	✓	✓		
5G-CARMEN			✓		
5G-MOBIX	✓	✓	✓	✓	✓
5G-ROUTES			✓	✓	✓
5G-Blueprint	✓			✓	✓
5GMED	✓		✓		
VITAL-5G		✓	✓		
5G-IANA	✓		✓		
5GMETA					

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USE CASE	EXTENDED SENSORS	COOP. & AUTOMATED MANOEUVRING	BACK SITUATION AWARENESS	VEHICLE SENSORS AND STATE SHARING	VIDEO STREAMING
KEY 5G KPI	E2E LATENCY	LATENCY	COVERAGE, RELIABILITY	LOCALIZATION ACCURACY	LATENCY, DATA RATE
5GCroCo				✓	
5G-CARMEN		✓	✓	✓	✓
5G-MOBIX	✓				
5G-ROUTES	✓	✓		✓	✓
5G-Blueprint				✓	
5GMED					
VITAL-5G	✓			✓	✓
5G-IANA		✓	✓	✓	✓
5GMETA				✓	✓

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USE CASE	GREEN DRIVING	ROAD INFRASTRUCTURE DIGITALIZATION	FOLLOW-ME INFOTAINMENT	DISTRIBUTED PERCEPTION	VEHICLE QoS SUPPORT	IOT CONNECTIVITY
KEY 5G KPI	SERVICE CONTINUITY	RELIABILITY	DATA RATE, CONTINUITY	DATA RATE, LOW LATENCY	DATA RATE, RELIABILITY	RELIABILITY, LATENCY
5GCroCo						
5G-CARMEN	✓					
5G-MOBIX					✓	
5G-ROUTES						✓
5G-Blueprint				✓		
5GMED		✓	✓			
VITAL-5G						
5G-IANA					✓	
5GMETA		✓				

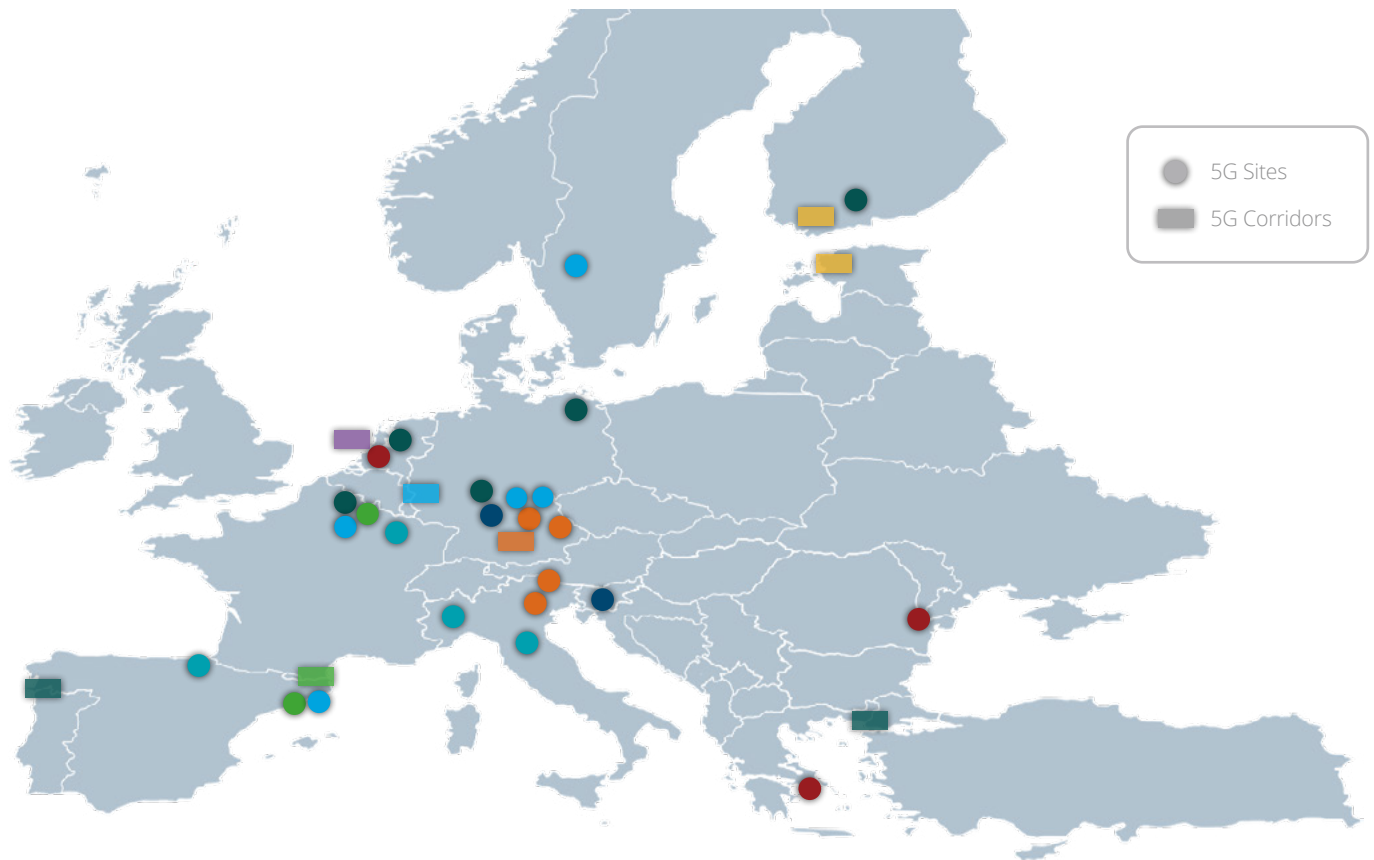
TESTED 5G TECHNOLOGIES

	RELEASE TESTED	5G DEPLOYMENT		TECHNICAL FEATURES					
		NSA	SA	5G NR	MEC	SERVICE DIFFERENTIATION	pQoS	AI	PC5
5GCroCo	15	✓		✓	✓	✓	✓		
5G-CARMEN	15	✓		✓	✓		✓		✓
5G-MOBIX	15/16	✓	✓	✓	✓	✓			✓
5G-ROUTES	16/17	✓	✓	✓	✓	✓			
5G-Blueprint	16/17	✓	✓	✓	✓	✓		✓	✓
5GMED	16		✓	✓	✓	✓	✓	✓	✓
VITAL-5G	15/16		✓	✓	✓	✓			
5G-IANA	15/16		✓	✓	✓	✓	✓	✓	
5GMETA	15/16	✓	✓	✓	✓	✓	✓		

TERMINOLOGY

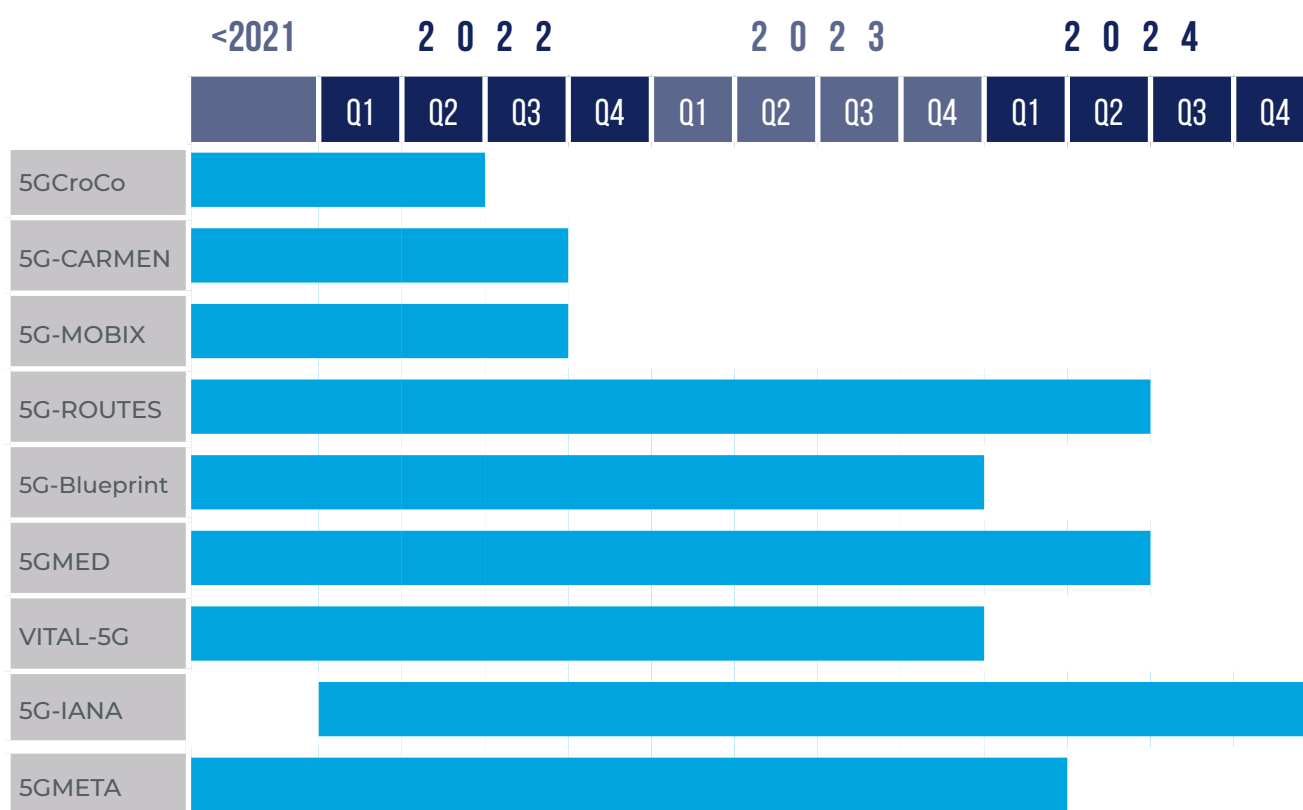
- **NSA:** Non-standalone;
- **SA:** Standalone;
- **5G NR:** 5G New Radio;
- **MEC:** Mobile Edge Computing;
- **Net. Slicing:** Network Slicing;
- **pQoS:** predictive Quality of Service;
- **AI:** Artificial Intelligence;
- **PC5:** interface to allow direction communication between devices in a 5G network.

CARTOGRAPHY



5G-MOBIX	• Vigo - Porto (Spain-Portugal Corridor) • Kipoi - Ipsala (Greece-Turkey Corridor) Hard borders • Berlin and Stuttgart (German) • Espoo (Finland) • Paris (France) • Eindhoven-Helmond (Netherland) • China Test Site: Jinan • South Korea Test Site: Yeonggwang	5GCroCo	• Corridor France-Germany-Luxembourg • Barcelona (Spain) • Monthl�ry (France) • Munich (Germany) • A9 5G-ConnectedMobility Testbed (Germany) • AstaZero (Sweden)
5GMED	• Corridor E-15 Figueres – Perpignan • Castellol� Track (Spain) • TEQMO Centre, Paris (France)	5G-Blueprint	• 5G cross-border in waterways and high-ways between Belgium and The Netherlands
5G-CARMEN	• Corridor Germany-Austria-Italy • Trento (Italy) • Munich (Germany) • Brenner Pass (Italy-Austria) • Kufstein (Austria-Germany)	5G-ROUTES	• 5G cross-border Via Baltica-North corridor: • Latvia - Estonia - Finland
5G-IANA	• Ulm (Germany) • Ljubljana (Slovenia)	VITAL-5G	• Port of Galati (Romania) • Port of Antwerp (Belgium) • Port warehouse/logistics hub of Athens (Greece)
		5G-META	• San Sebastian (Spain) • Satory (France) • Turin (Italy) • Modena (Italy)

TIMELINE



Please note that some projects had started before January 2021 and have experienced delayed periods due to Covid19 pandemic.

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