5GHEART.ORG

INTRODUCTION TO 5G-HEART TRANSPORT VERTICAL TRIALS

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5G HEALTH AQUACULTURE AND TRANSPORT VALIDATION TRIALS

Agenda

- Overview of 5G-HEART
- 5G-HEART Transportation Vertical Trials
- Conclusion

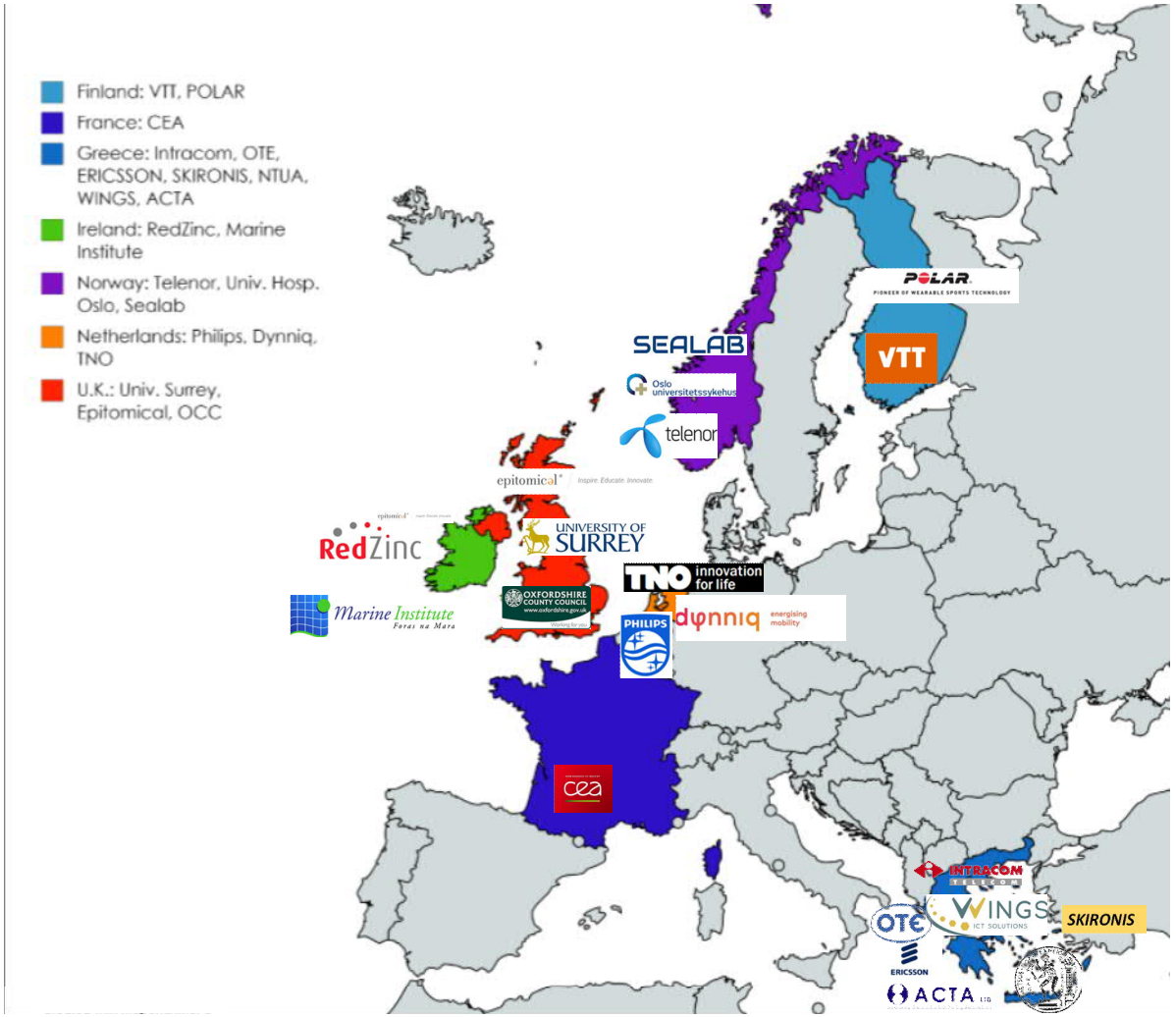
Overview of 5G-HEART

Introduction to 5G-HEART

- Project call: ICT-19-2019: Advanced 5G validation trials across multiple vertical industries
- Project number: 5G-HEART (Grant agreement no. 857034)
- Action type: RIA
- The consortium budget : 14.3 MEur from EC
- Project duration: 42 months (June 2019 – Nov 2022)
- Project team: 22 partners
- Project website: 5gheart.org

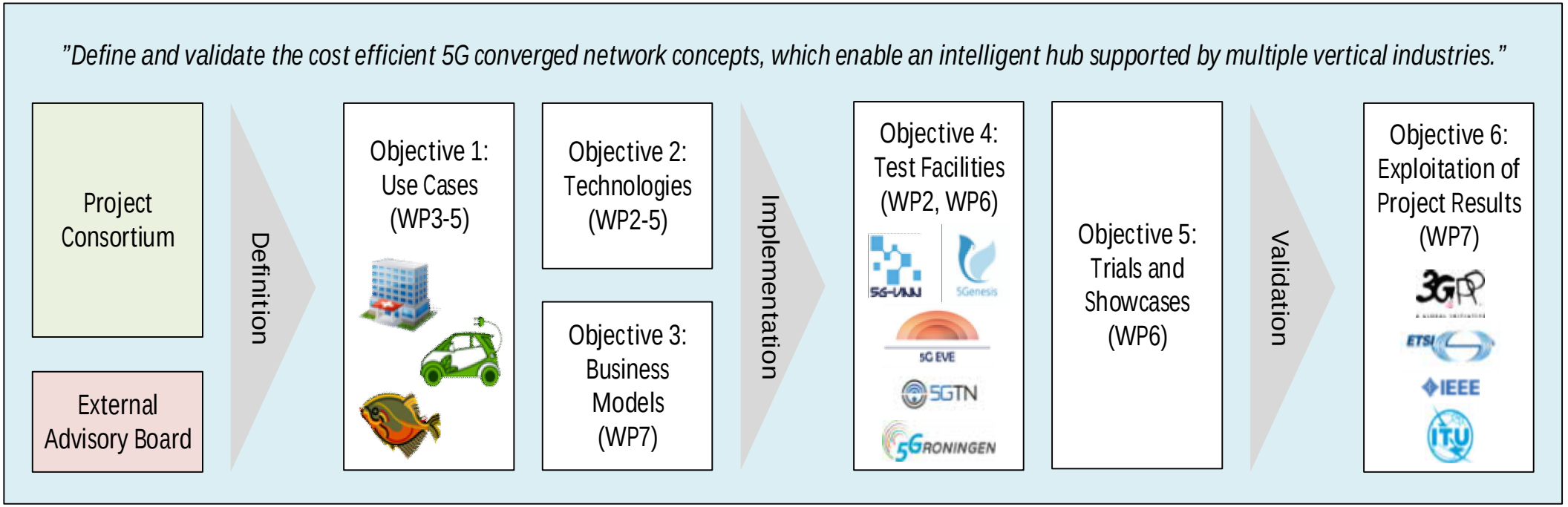
5G-HEART partners

Partner Type	Partner	From
Research	VTT	FI
	Marine Institute	IE
	OUS	NO
	TNO	NL
	UOS	UK
	NTUA	EL
	CEA	FR
LE	Telenor	NO
	Intracom	EL
	OTE	EL
	Ericsson	EL
	Philips	NL
	Dynniq	NL
	Polar	FI
SME	Skironis	EL
	SEALAB	NO
	WINGS	EL
	RedZinc	IE
	ACTA	EL
	Epitomical	UK
Other	OCC	UK

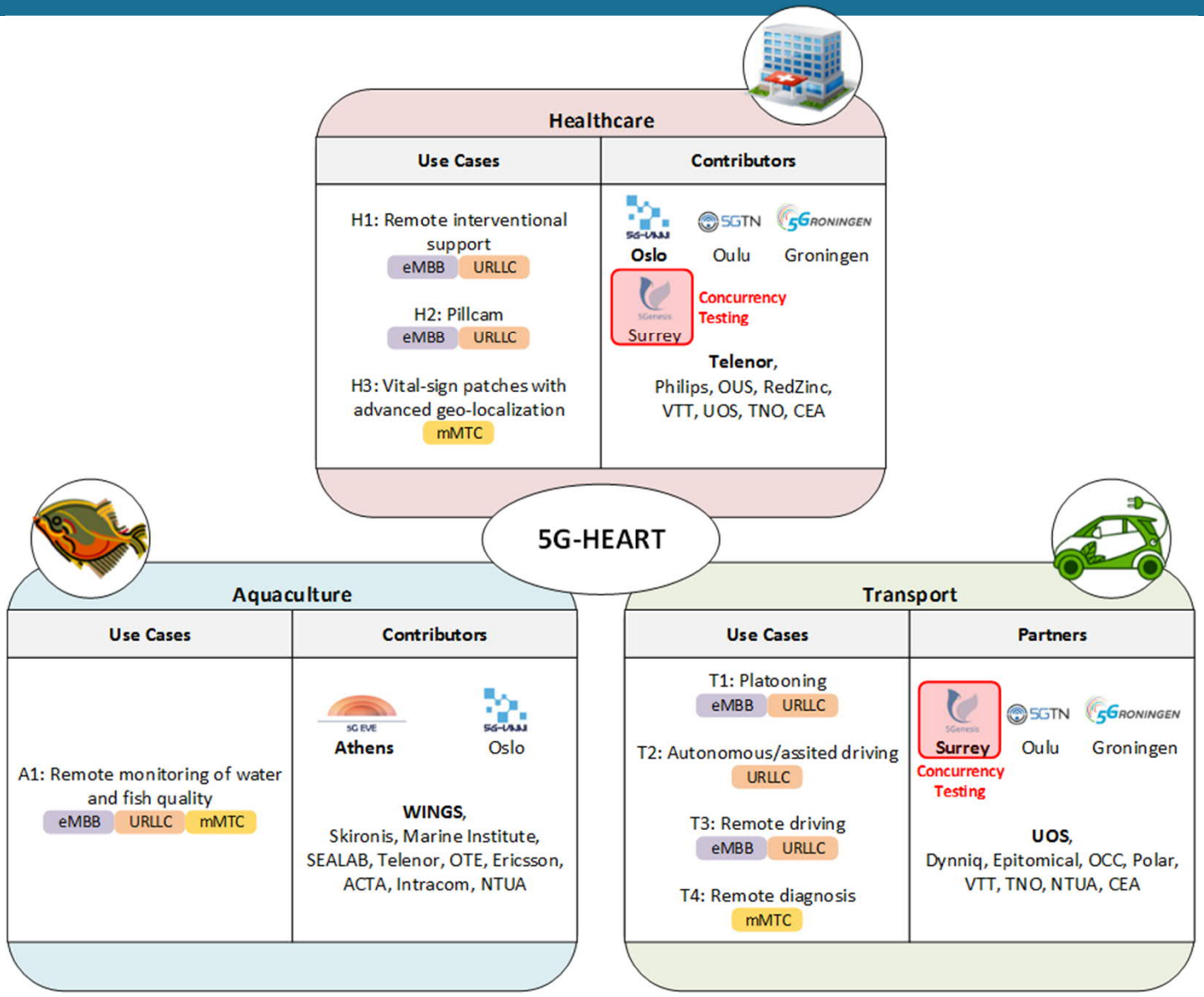


Objectives to 5G-HEART

- The overall objective of the 5G-HEART is to define and validate the cost efficient 5G converged network concepts, which enable an intelligent hub supported by multiple vertical industries.



5G-HEART Ecosystem



5G HEART

5G-HEART facilities

Pilot site	Oslo-Kongsberg-Trondheim, NO	Surrey, UK	Athens, GR	Oulu, FI	Groningen, NL
Verticals	Healthcare Aquaculture	Transport Healthcare	Aquaculture	Healthcare Transport	Healthcare Transport
Test facility	ICT-17 5G-VINNI	ICT-17 5Genesis	ICT-17 5G-EVE	National 5GTN	National 5Groningen
5G-HEART use cases	H1, H2, H3, A1	T1, T2, T3, T4, H3	A1	H1, T2	H1, T2
Use case categories	eMBB URLLC mMTC	eMBB URLLC¨ mMTC	eMBB URLLC mMTC	eMBB URLLC	eMBB URLLC
Involved partners	Telenor	UOS	OTE Ericsson WINGS	VTT	TNO

Healthcare vertical

Use case H1: Remote interventional support

The use of advanced, rich media communications in the context of remote monitoring, education and robotics in patient diagnostics and treatment.

H1A: Educational surgery, H1B: Remote Ultrasound examination,

H1C: Paramedic support, H1D: Critical health event

Locations: Norway, Finland, Netherlands

Use case H2: The Pillcam

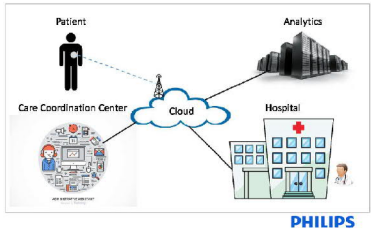
Colon capsule may be an alternative to colonoscopy, for early detection of Colon cancer with high mortality.

Location: Norway

Use case H3: Vital-sign patches with advanced geo-location

Direct-to-Cloud, disposable, vital-sign patches to enable continuous monitoring of ambulatory patients, anytime and anywhere

Locations: France, Norway



5G HEART

Transport vertical

Use case T1: Platooning

T1S1&T1S2: High Bandwidth in-vehicle Virtual Reality (VR) Streaming or See-through for Platooning.

T1S3 - Dynamic Channel Management for Traffic Progression

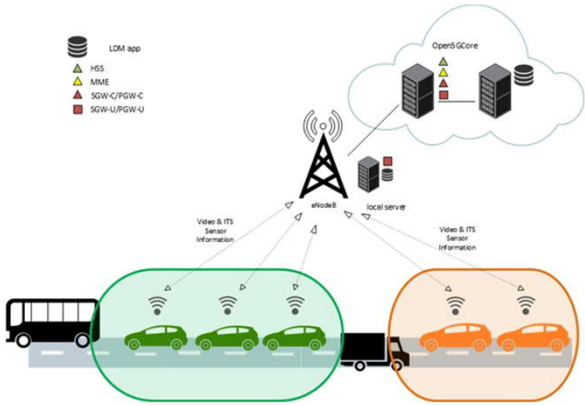
Location: UK

Use case T2: Autonomous Assisted driving

T2S1 - Network Assisted Collision Warning & Cooperative Collision Avoidance (CoCA)

T2S2 - Smart Junctions, T2S3 - QoS for Advanced Driving

Location: UK, Netherlands, Finland



Use case T3: Support for Remote driving

T3S1 – Tele-operated Support (TeSo)

Location: UK

Use case T4: Vehicle Data Services

T4S1 - Vehicle Prognostics, T4S2 – OTA (over-the-air) Updates , T4S3 - Smart Traffic Corridors

T4S4 - Location Based Advertising, T4S5 - End to End (E2E) Slicing, T4S6 - Vehicle Sourced HD Mapping, T4S7 - Environmental Services

Location: UK

VTT 5G Automated Driving: https://youtu.be/QZI7RRs5QCk

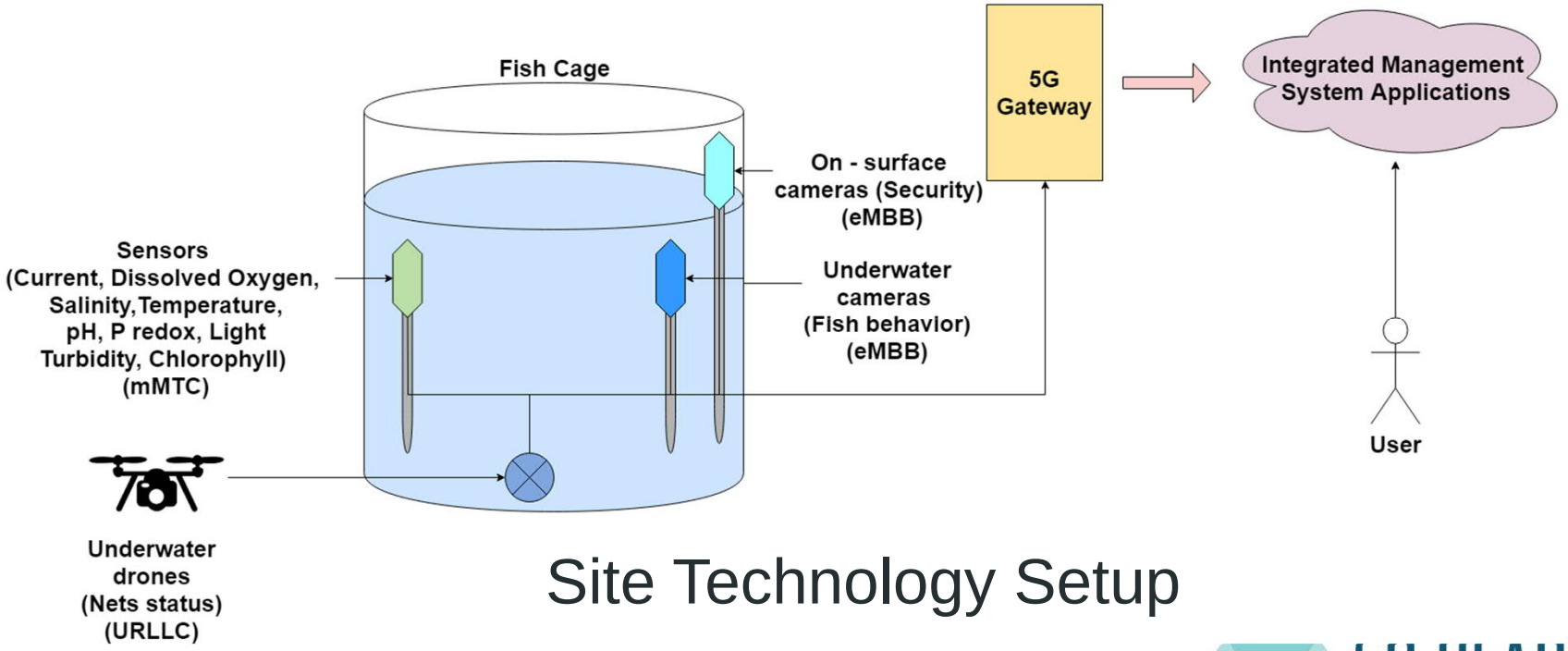
Aquaculture vertical

Use case A1: Aquaculture monitoring and managment

Development of autonomous data acquisition and communication systems for advanced aquaculture management

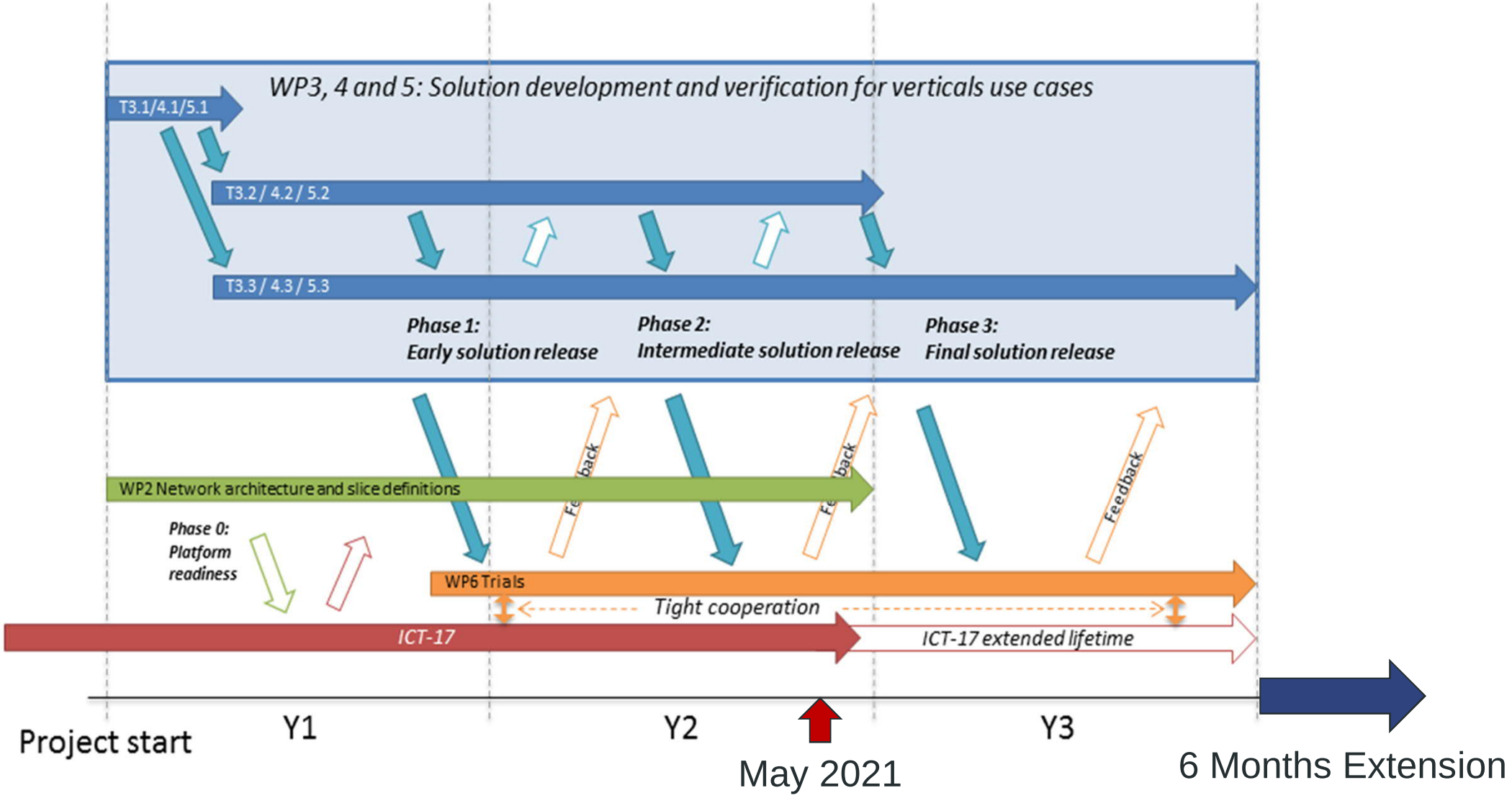
Covering off-shore production systems efficiently

Location: Greece and Norway (https://bluethink-go-demo.sealab.no/)



Site Technology Setup

Timeline of vertical trials



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5G-HEART Transportation Vertical Trials

Transport use cases: T1 Platooning

- Vehicles move like a train with virtual strings.
- Reduces the distance between vehicles, overall fuel consumption and number of needed drivers.
  - ✓ T1S1&T1S2: High bandwidth in-vehicle situational awareness and see-through for platooning.
  - ✓ T1S3: Dynamic channel management for traffic progression.
  - ✓ Trial facility: 5GENESIS (Surrey)
  - ✓ **eMBB and URLLC requirements.**

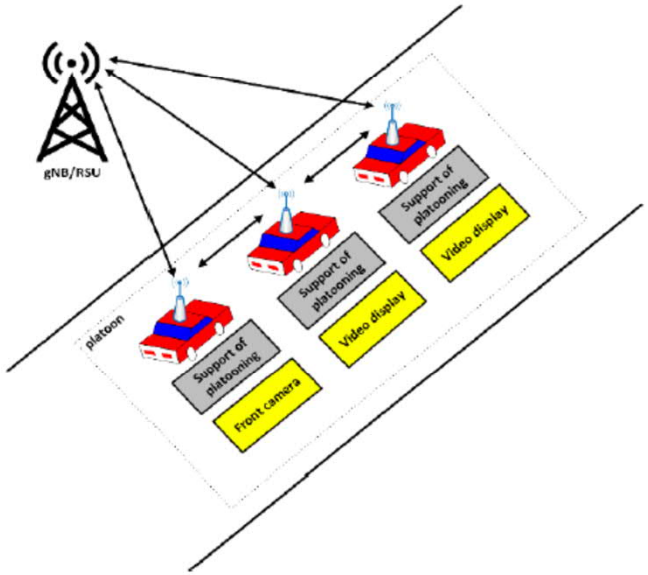


Figure 1 See-through for platooning

Transport use cases: T2 autonomous/assisted driving

- Combine sensor data and communication capabilities to support advanced driving modes.
  - ✓ T2S1&T2S2: Smart junctions and network assisted & cooperative collision avoidance (CoCA).
  - ✓ T2S3: QoS for advanced driving.
  - ✓ T2S4: Human tachograph.
  - ✓ Trial facilities: 5GTN (Oulu), 5GRONINGEN (Groningen) and 5GENESIS (Surrey).
  - ✓ **URLLC requirement**.

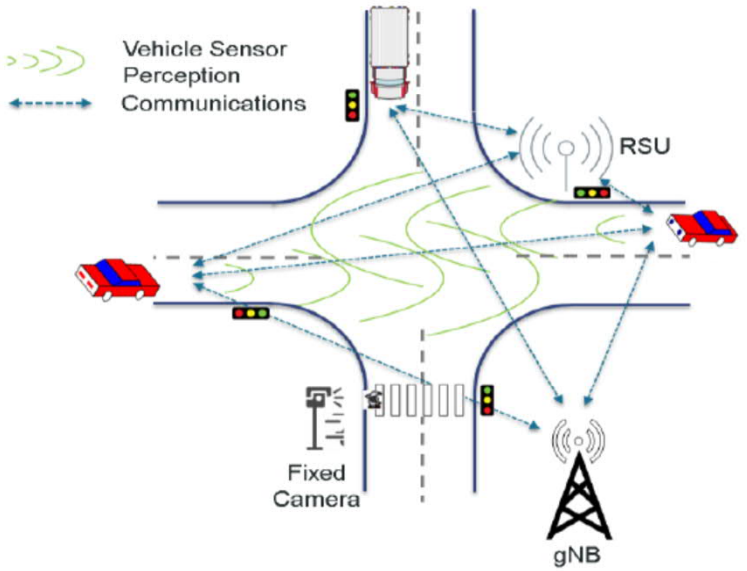


Figure 2 Network-assisted collision warning

Transport use cases: T3 support for remote driving

- Remote driving is a concept in which a vehicle is controlled remotely by either a human operator or cloud computing.
  - ✓ Efficient road construction, control of multiple autonomous vehicles from a single human operator (e.g., snow plowing).
  - ✓ Cost-efficient step towards purely automated driving.
  - ✓ Trial facility: 5GENESIS (Surrey)
  - ✓ **eMBB and URLLC requirements.**

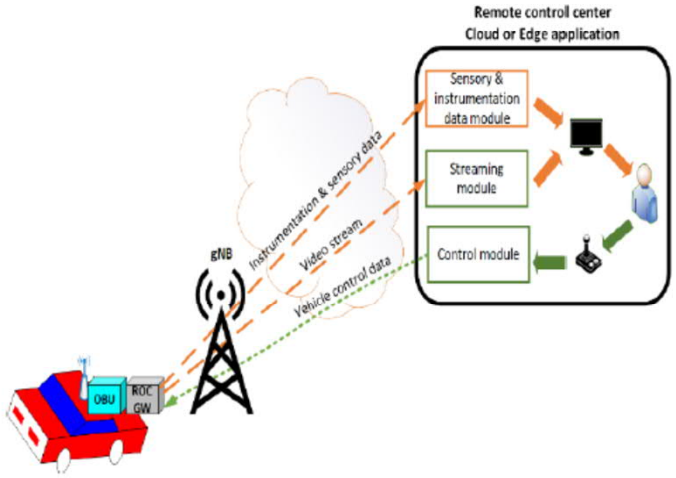


Figure 3 Remote Driving

Transport use cases: T4 Vehicle data services

- The network collects actionable information from the vehicles and road users to provide various services.
  - ✓ T4S1: Vehicle prognostics.
  - ✓ T4S2: Over-The-Air (OTA) updates
  - ✓ T4S3: Smart traffic corridors
  - ✓ T4S4: Location based advertising
  - ✓ T4S5: End-to-End (E2E) slicing
  - ✓ T4S6: Vehicle sourced HD mapping
  - ✓ T4S7: Environmental services
  - ✓ Locations: 5GENESIS (Surrey) and 5GTN (Oulu).
  - ✓ **mMTC requirement.**

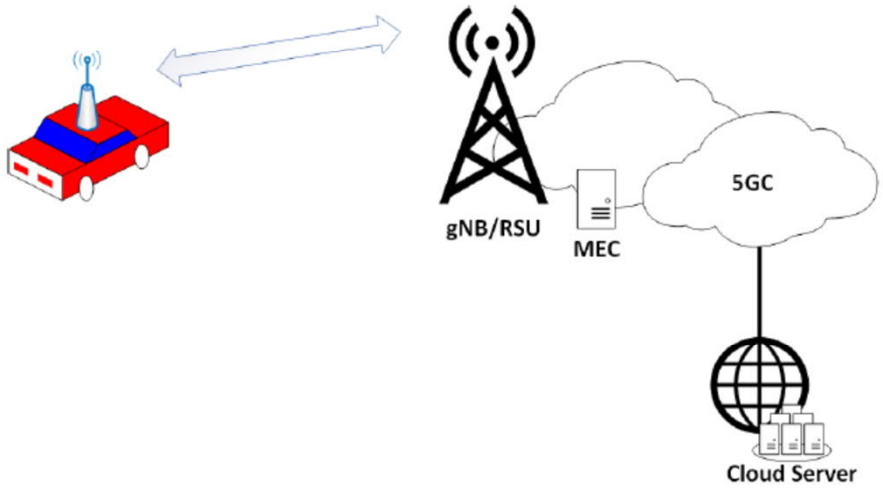


Figure 4 Indicative architecture for vehicle data services

Conclusion and interim results

- As one of ICT-19 projects, 5G-HEART was introduced. Various 5G transport vertical trials have been explained.

- The interim results will be released in the project website (5gheart.org) in a couple of months.

THANK YOU
FOR YOUR ATTENTION

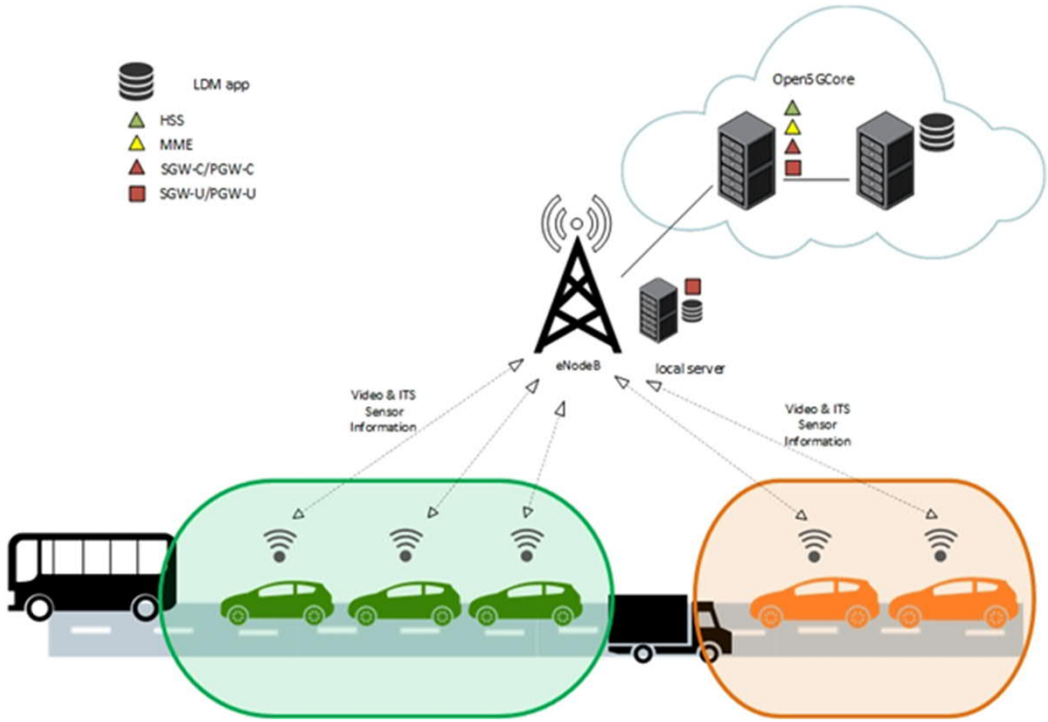
5GHEART.ORG

This project received funding from the European Union's Horizon2020 research and innovation programme under grant agreement No 857034

Backup slides: 5G-HEART Transportation Vertical Trials

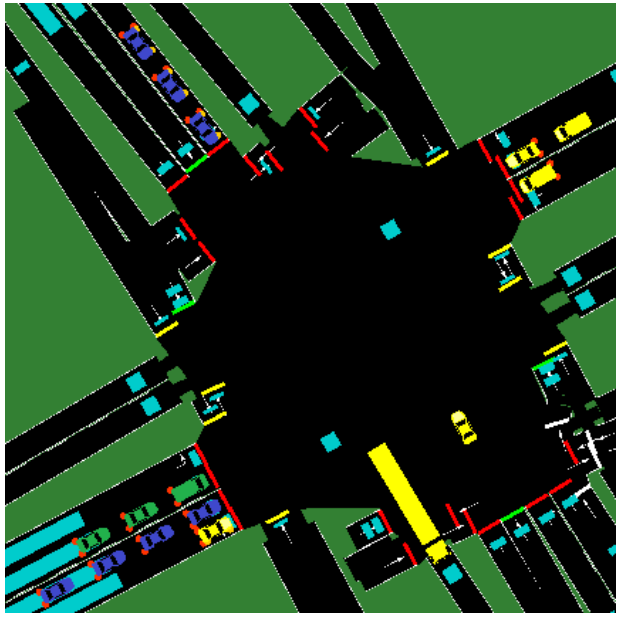
T1S1&S2 High bandwidth in-vehicle VR streaming or See-through for platooning

- This scenario involves support for high bandwidth in-vehicle video streaming serving virtual / augmented reality (VR/AR) applications of see-through for platooning scenarios.



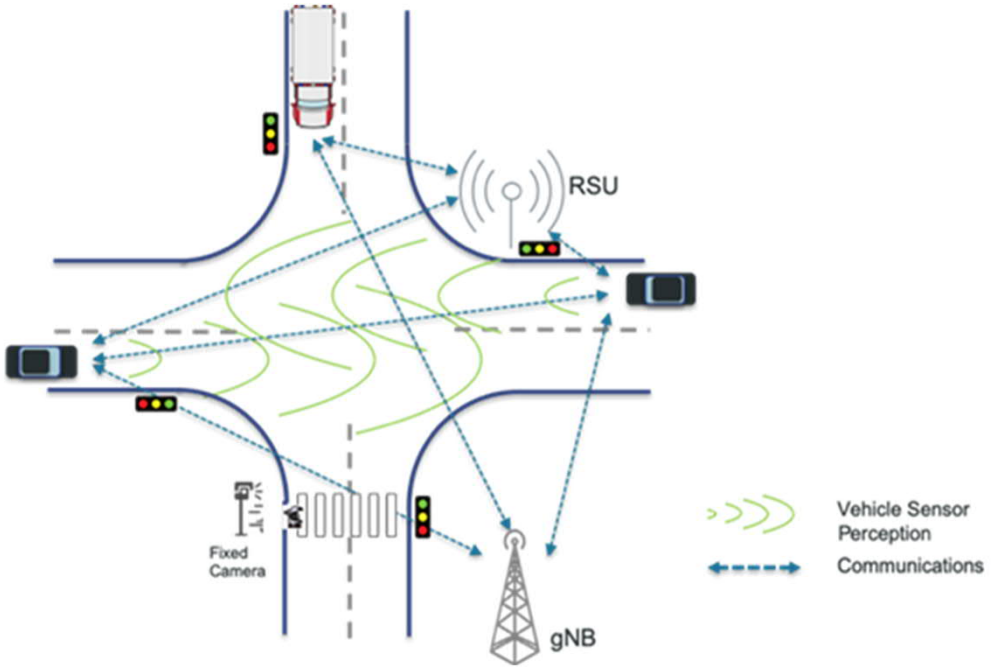
T1S3 Dynamic channel management for traffic progression

- This scenario proposes to optimize the assignment of radio channels to the vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) links used by the platoons operating in a given area. A centralised architecture is considered, where a V2X application analyses the speed, location and destination of the platoons before assigning the best radio channels to each of them.



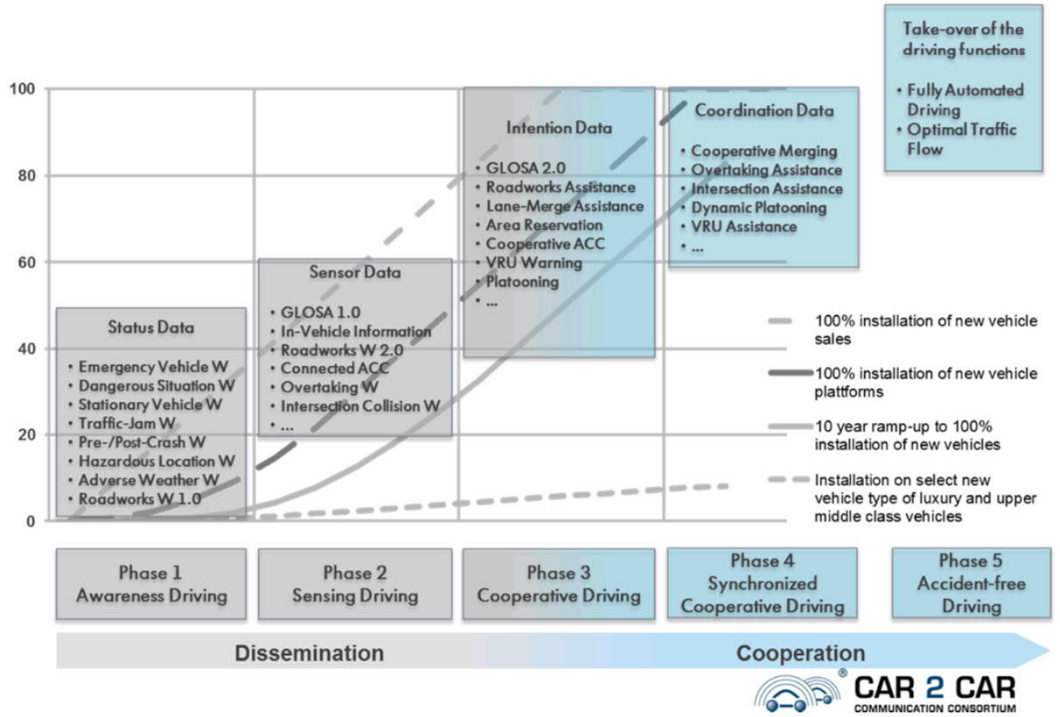
T2S1&T2S2 Smart Junctions and Network assisted & Cooperative Collision Avoidance (CoCa)

- A high percentage of all traffic accidents occur at intersections, where there is a high density of vehicles and vulnerable road users (e.g. cyclists and pedestrians).
- The “Intersection Safety Information Provisioning” scenario as described within 3GPP (i.e. Smart Junctions) provides network assisted safety information towards vehicles to prevent traffic accidents and assist cooperative automated driving functions when the vehicles pass through an intersection.



T2S3 QoS for advanced driving

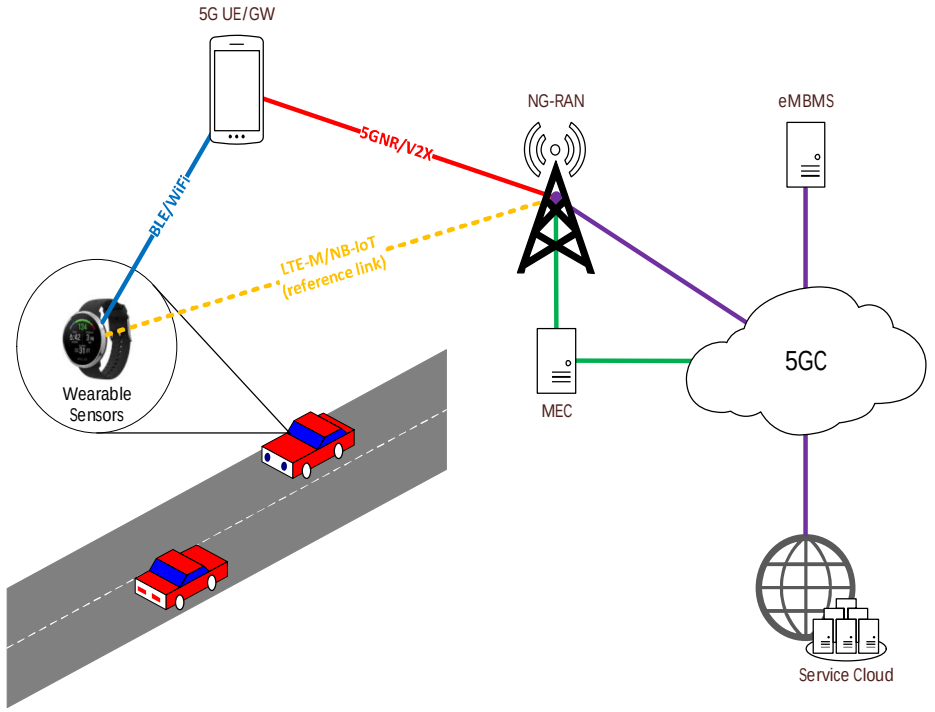
- This scenario is focused on the provisioning of QoS for Advanced Driving. This involves the dynamic selection of the appropriate driving mode based on the context at-hand.
- The driving mode is mainly reflected by the level of automation (LoA), which reflects the functional aspects of the technology and affects the system performance requirements.



[Source] Car-2-Car Communication Consortium. (2015). https://www.car-2-car.org/

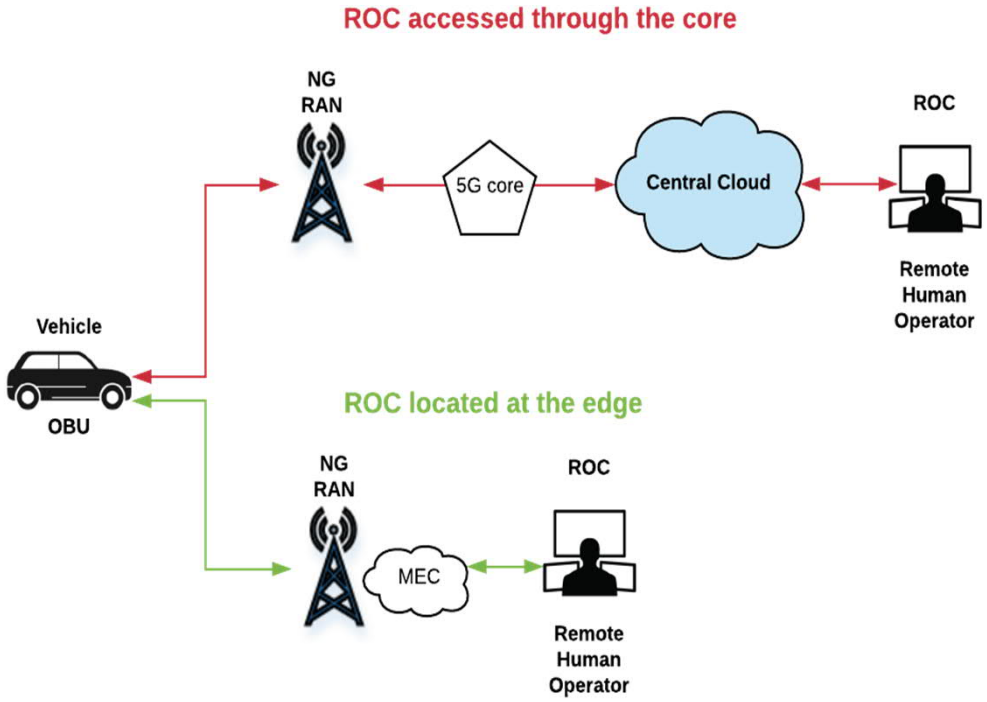
T2S4 Human tachograph

- This scenario focuses on a wearables-based Human tachograph, which provides a direct measurement/assessment method and technology to assess the driver's physiological status.



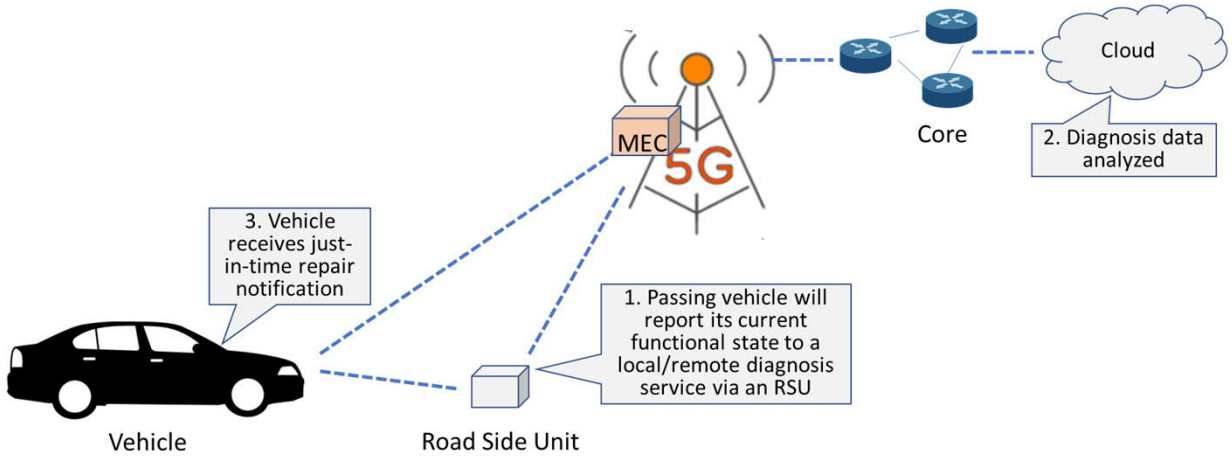
T3S1 Tele-operated Support (TeSo)

- Remote driving is a concept in which a vehicle is controlled remotely by either a human operator or a Cloud computing software.
- While autonomous driving needs a lot of sensors and sophisticated algorithms, remote driving with human operators can be realized using less of them.



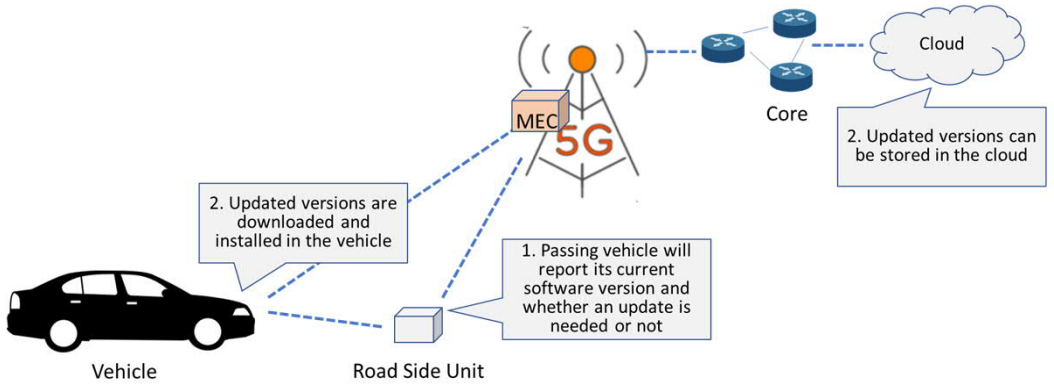
T4S1 Vehicle prognostics

- A road side unit (RSU) application, having the capability to access the Internet will enable any passing vehicle to report its current functional state to a local/remote diagnosis service and to receive “Just in time repair notification”.
- A Vehicle Service application linked to local Repair Centres needs to obtain and analyse data from the vehicle periodically. Based on the analysis result, it will notify to the vehicle owner showing what's going on with the vehicle



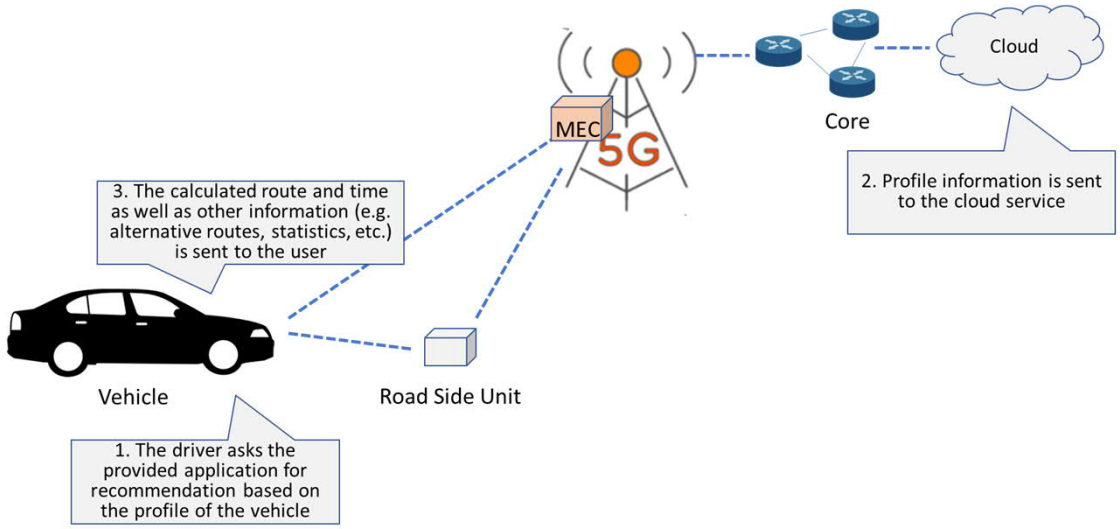
T4S2 Over-The-Air (OTA) updates

- Engine Control Unit (ECU) is a generic term for a hardware module with corresponding software in a car that controls some electronic functions within the vehicle system. This could be anything from the steering wheel to the brakes and with automated driving this becomes a key part of the vehicle that will possibly need regular software updates.
- Over-the-air updates can provide significant cost-savings, as the vehicles will not need to be recalled by a manufacturer or service centre.



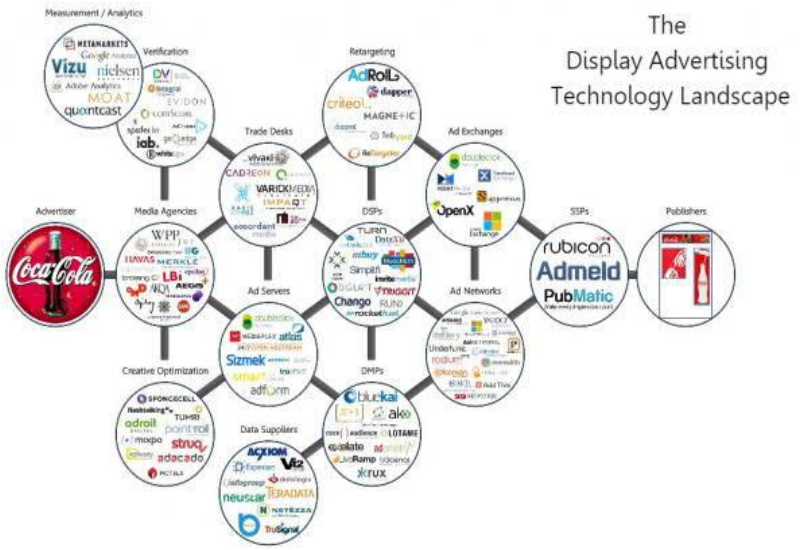
T4S3 Smart traffic corridors

- This scenario looks at how historical and real-time data from vehicles can be used to intelligently control the routes that a vehicle is recommended or mandated to take in any given journey.



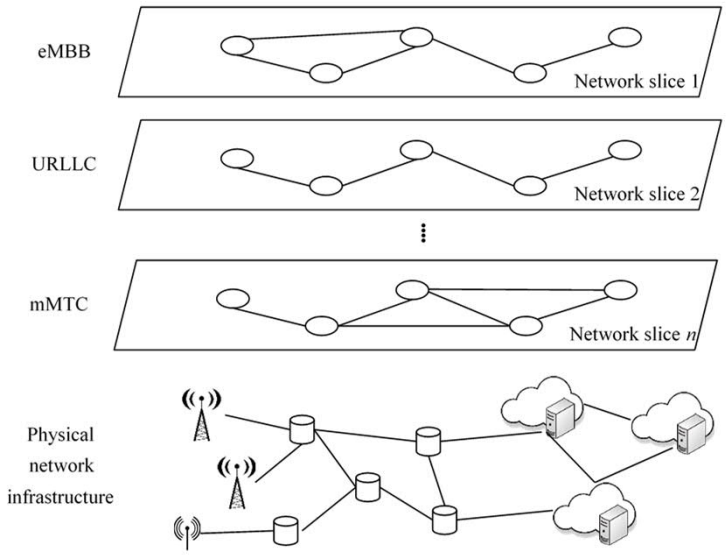
T4S4 Location based advertising

- With vehicle and passenger information readily available, location-based servers can be implemented to stream content (upon request, if required) as well as local advertising or traffic guidance to vehicles and road users.
- This becomes especially useful in car-sharing models where vehicles are not owned and the origin and destination of each journey may vary depending on the passengers.



T4S5 End to end (E2E) Slicing

- Virtual links between vehicles, infrastructure and remote services can be beneficial in enabling differing Quality of Service (QoS) per application.
- For example, certain vehicle data may be critical to vehicle operation and safety. E2E Slicing allows a single link to be segregated and QoS parameters be applied, controlling parameters such as bandwidth and latency based on the individual service or application.



T4S6 Vehicle sourced HD mapping

- Autonomous vehicles do not only require on-board sensors to perceive the world around them, but also high-definition maps to aid their decision making. HD maps of roads and infrastructure will take years to capture and consolidate. There is the added issue of dynamic changes to these maps over time.

T4S7 Environmental services

- Local, Regional and National weather offices source their data through satellite earth observation maps and local weather stations. These are generally used for weather forecasts.
- Vehicles may provide a rich and real time source of weather and environmental information through existing on-board sensors.