

H2020-ICT-2018-2

5G-CARMEN Connected and Automated Road Mobility in the European union

Preparandosi al 5G: scenari applicativi per la guida connessa e assistita nel
corridoio Monaco-Bologna

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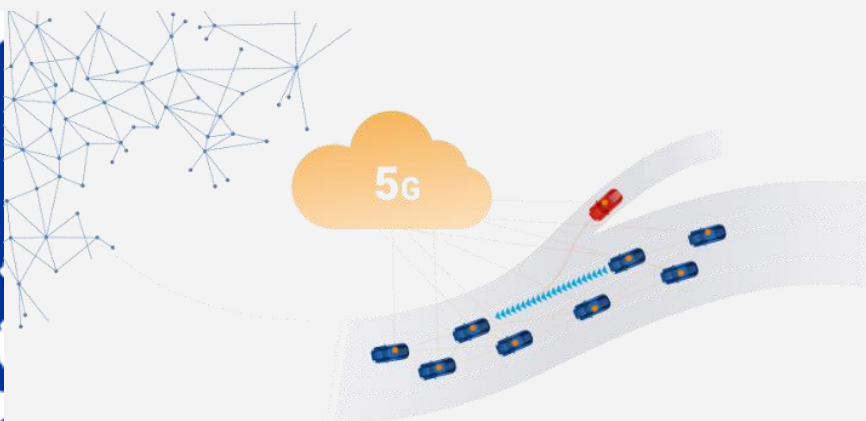
FCA-CRF

Workshop: Il 5G per l'Autonomous Driving, 30/10/2020

5G CARMEN Challenges

- 5G CARMEN selected a variety of use cases to estimate the extent to which the 5G cellular network and direct communication C-V2X PC5 can play a crucial role in vehicle connected services and functions.
- For vehicle automation (L2/L3/L4), the use cases are evaluating which operational design domains & scenarios can be extended (e.g. in adverse weather) thanks to data exchanged via 5G.
- For vehicle services, the use cases are evaluating essential 5G KPIs (e.g. Quality of Service) to pave the road for future implementation.

Use Cases addressing the challenges



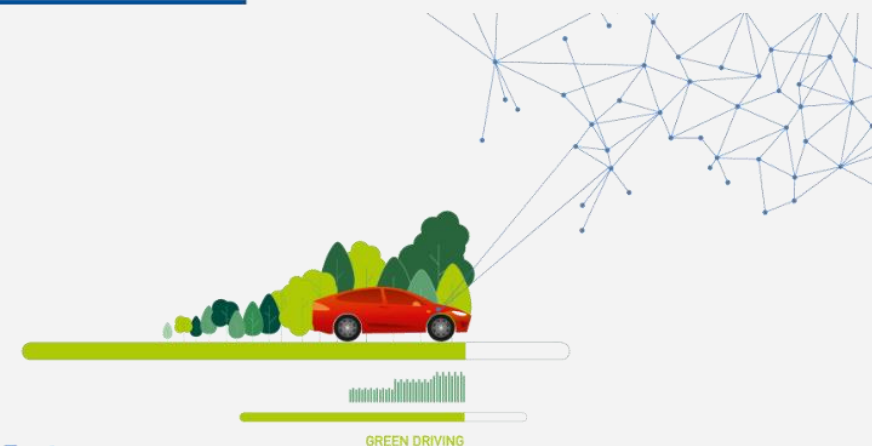
1 Cooperative Manoeuvring



2 Situation Awareness



3 Video Streaming



4 Green Driving

Technical Challenges

- 5G connected vehicles dealing with CROSS BORDER issues should
 - Deal at best with situation to ensure service continuity (network/infrastructure problem)
 - Be resilient to communication and localization interruptions (vehicle problem)
- 5G connected vehicles dealing with L2-L3-L4 vehicle automation, given 5G potential but also its current limitations (e.g. cross border) should
 - Define quality metrics for the received C-V2X data
 - Implement C-V2X data quality control
 - Use C-V2X data and quality control information to support AD
 - High quality, redundant C-V2X information: potentially a key enabler of HAD
 - Non-redundant C-V2X information: auxiliary support to AD
 - Sporadic C-V2X availability; warning only

Goal of WP5 pilot Planning and Execution

- Set-up 5G-CARMEN proofs of concept: vehicles, roadside systems, MEC components, back-end within the **Corridor Munich-Bologna**
- Verify components and system functionality, following a **Use Case-driven approach**
- **Evaluate use cases based on KPI**, to answer open research questions and hypotheses, focussing on **cross-border challenges**
- Demonstration of the **value of 5G in Connected Cooperative and Automated Mobility**, also in view of Highly Automated Driving

5G-CARMEN pilot overview

Use Cases

- Vehicle Sensor and State Sharing
- Back Situation Awareness
- Cooperative Lane Merge
- Green Driving
- Video Streaming

Local Pilots

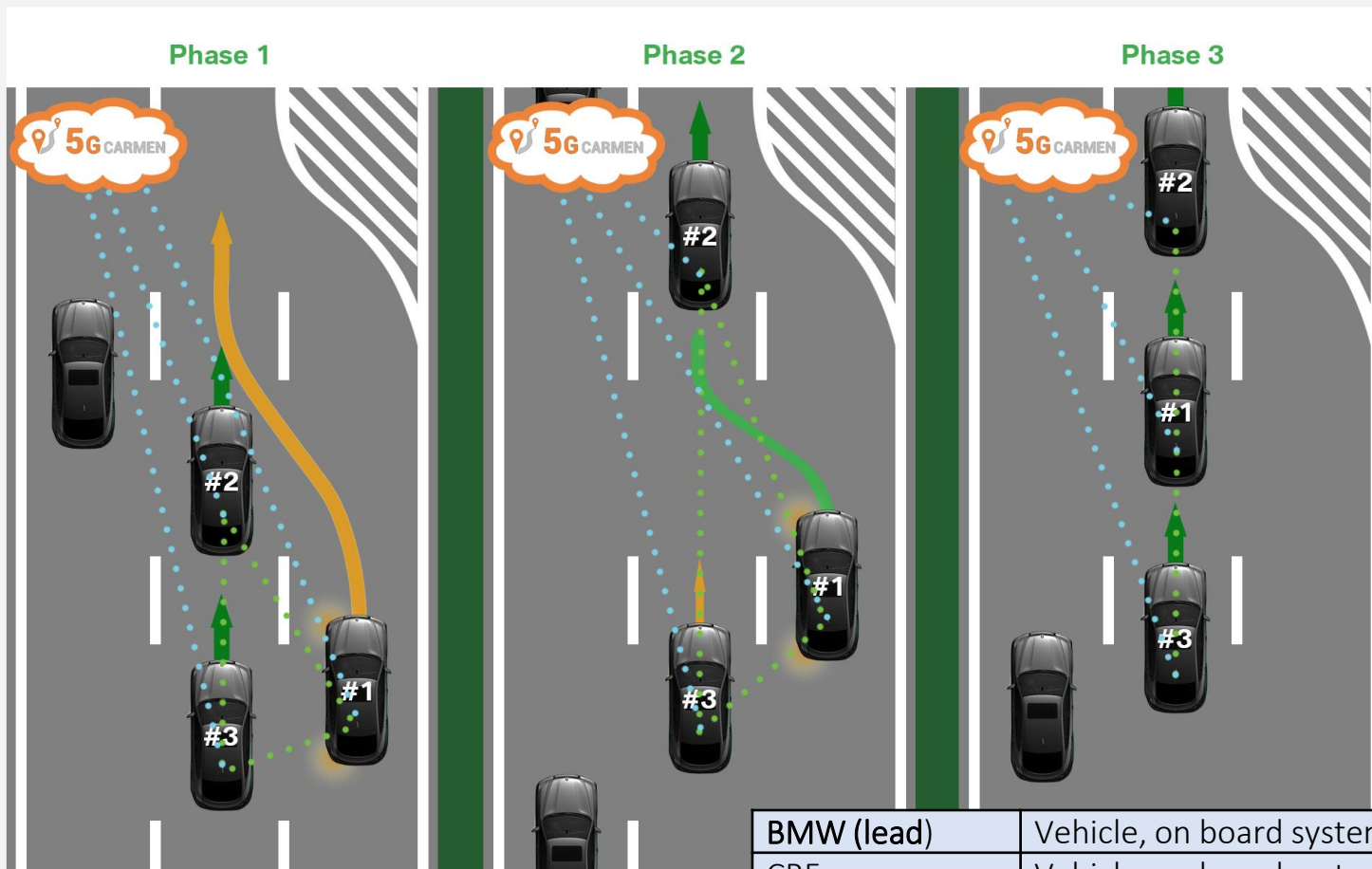
- Trento
- Munich
- Modena

Cross Border Pilots

- Kufstein (Germany-Austria)
- Brennerpass (Austria-Italy)



Cooperative Lane Merge



Vehicles in proximity coordinate to achieve a sufficiently large gap for Lane Merge

BMW (lead)	Vehicle, on board system and on board application
CRF	Vehicle, on board system and on board application
QCGER	PC5 OBU and 5G modem
DTAG	Precise Positioning, MEC in Germany
NOKIA	MEC and Geoservice; cross border sync
FBK	Supervisor on MEC

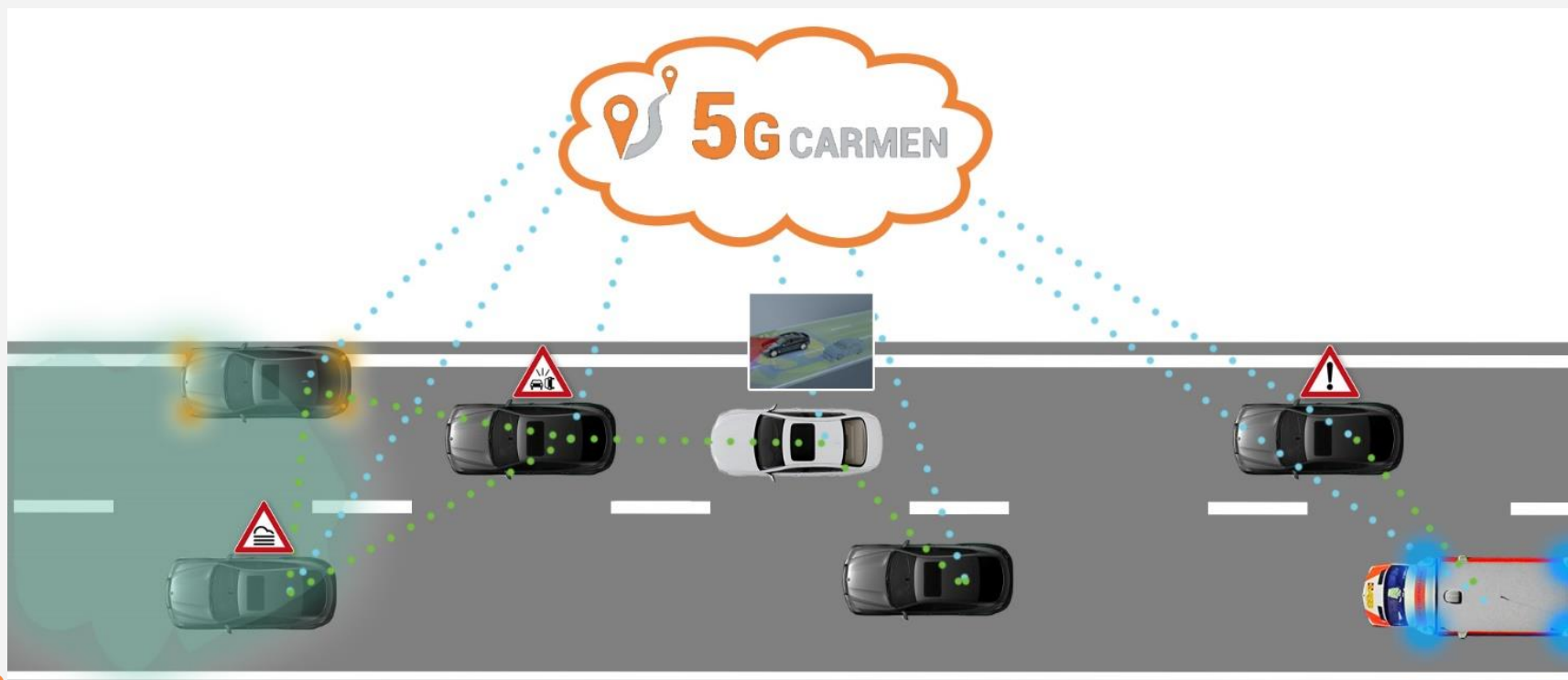
Vehicle Sensors and State Sharing

CRF (lead)	Vehicles, on board system and on board application
BMW	Additional supporting vehicle (PC5)
QCGER	PC5 and Uu OBU's
A22	C-ITS Server, Roadside Sensors, PC5 roadside unit
TIM	AMQP broker, cross border sync through AMQP, MEC server (from NOKIA)
SWARCO	AMQP broker; cross-border sync through AMQP

V2X “Day1” hazard warning applications.

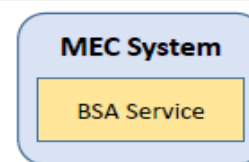
Information shared among vehicles, for

- Preventive safety
- Driving Assistance
- Automated Driving



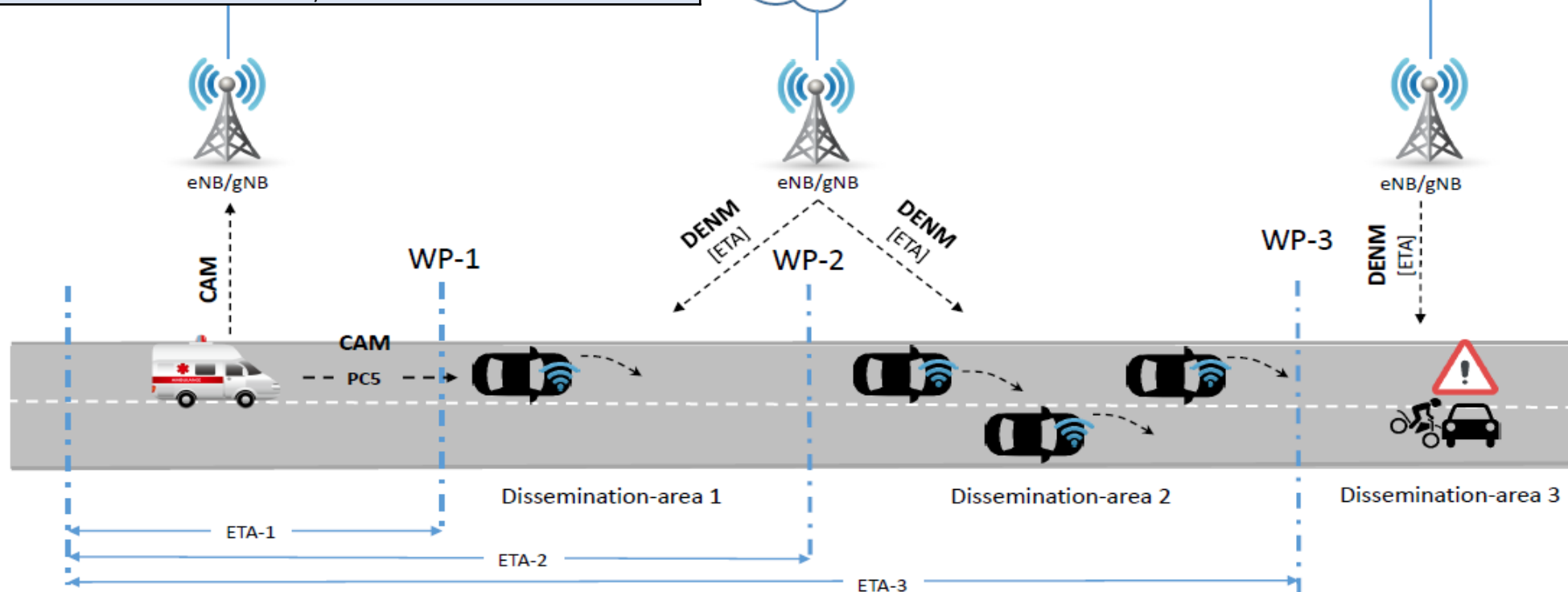
Back Situation Awareness

CRF	Vehicles, on board system and on board application
BMW	Vehicles, on board system and on board application
QCGER	PC5 OBU and 5G modem
NEC (leader)	BSAF service on MEC; cross-border sync
IMEC	BSAF service support
CNIT	On board C-V2X BSAF application on CRF car
DTAG	MEC in Germany
NOKIA	Geoservice on MEC in Germany



Warning and information about the time of arrival of emergency vehicles

(ETA = Estimated Time of Arrival)



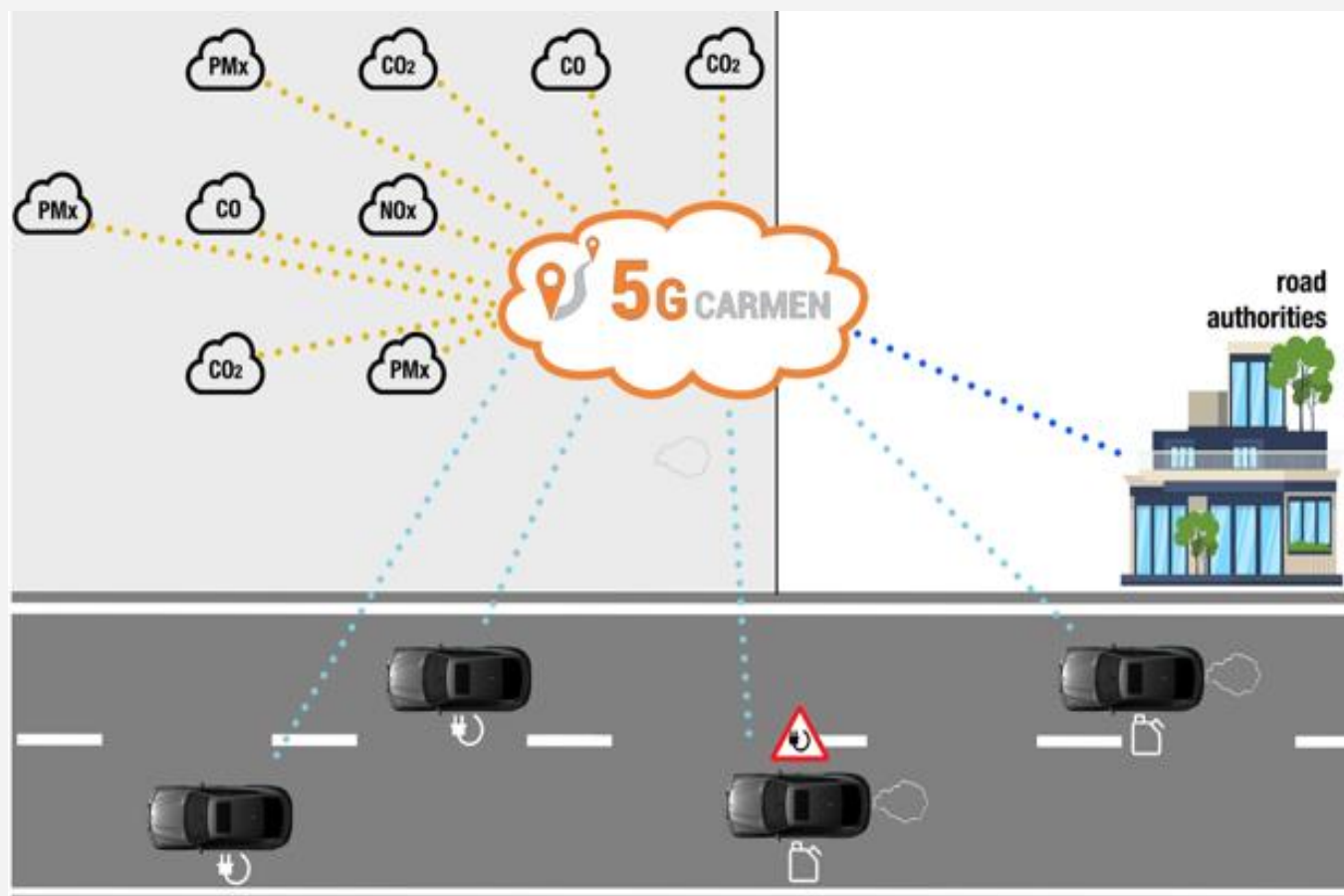
Green Driving

Electric Mode	BMW	Vehicles, on board system and on board application
	WINGS (lead)	Back end data analytics; air quality measurements
	SWM	Back-end electric mobility strategy service, air quality measurements
	NOKIA	Geoservice on MEC in Germany
	DTAG	MEC in Germany hosting the application

Dynamic Speed Advisory	CRF (lead)	Vehicles, on board system and on board application
	A22	Dynamic speed advisory, Italy
	SWARCO	Back-end dynamic speed advisory strategy service, Austria, AMQP broker. Cross border sync with AMQP, air quality measurements
	WINGS	Back end data analytics; air quality measurements (in Austria)
	TIM	AMQP broker, cross border sync through AMQP, MEC server (from NOKIA)

Based on air quality, sends information about

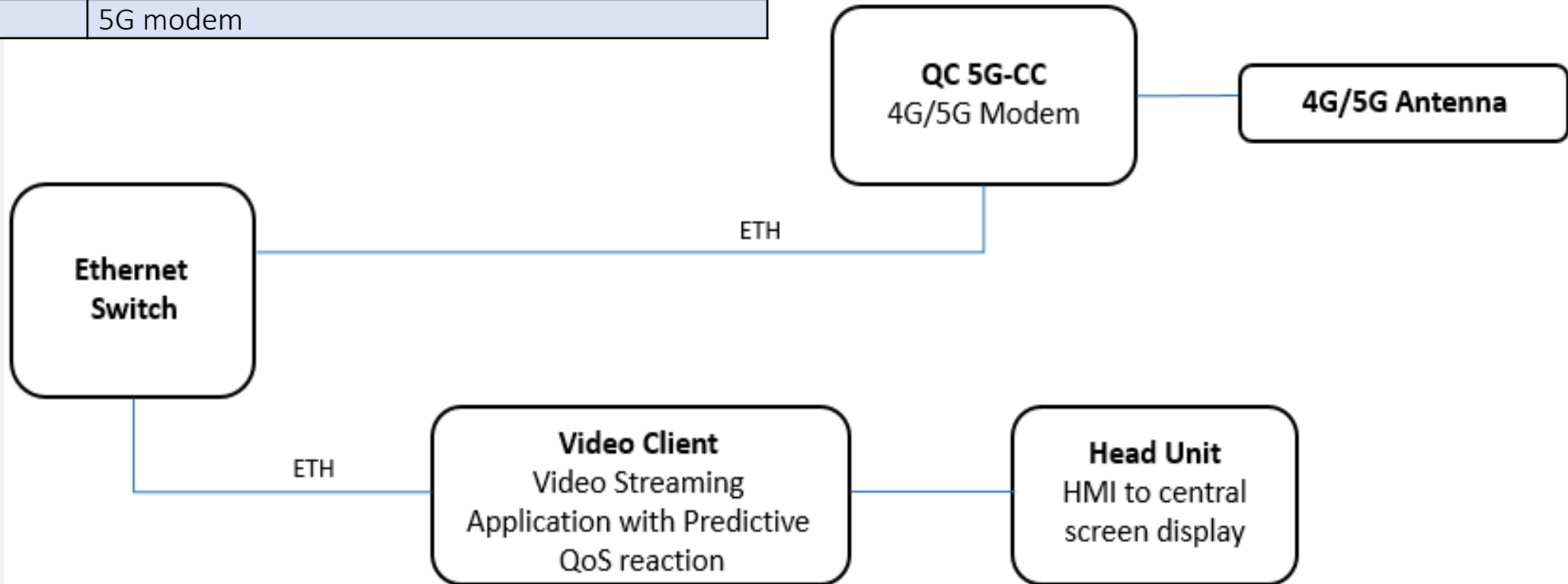
- zones where only vehicles in electric mode are allowed
- suggested speed



Video Streaming

BMW (lead)	Vehicle; on board unit; streaming service
DTAG	Predictive QoS
QGER	5G modem

Video streaming of multimedia content for infotainment, with predictive Quality of Service



Status and plan

Use Cases currently tested (Q4 2020)

- Vehicle Sensors and State Sharing in Italy
- Green Driving in Germany, Austria and Italy
- Back Situation Awareness and Cooperative Lane Merge (focus on V2V communication)

Use Cases piloted next (Q1 – Q2 2021)

- Back Situation Awareness (full Use Case)
- Cooperative Lane Merge (full Use Case)
- Video Streaming

Outlook (after Q2 2021)

- Testing, evaluation and demonstration of all Use Cases in cross-border scenarios

Thank You

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