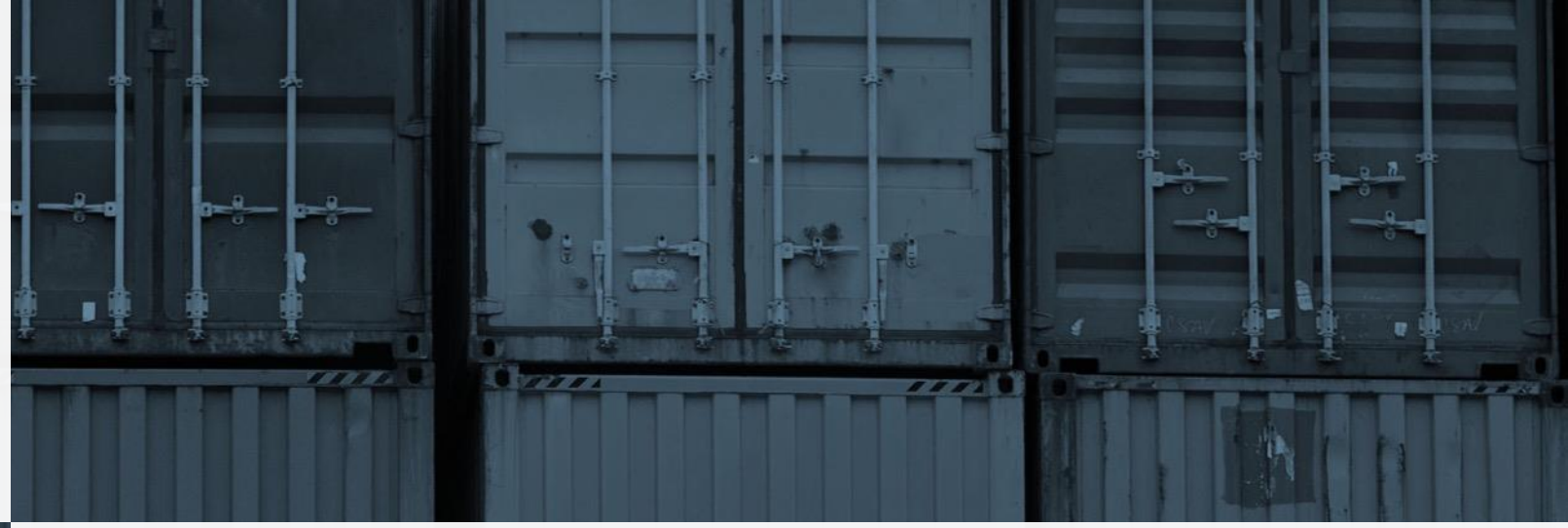


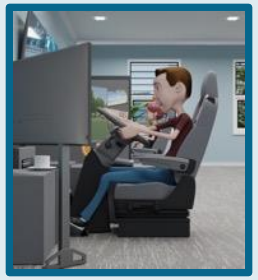
INTRODUCTION TO 5G-BLUEPRINT

Wim Vandenberghe, I&W

KPN event "The role of 5G", April 5th 2022, Helmond

5G-BLUEPRINT IN A NUTSHELL

TELEOPERATED TRANSPORT



TECHNOLOGY – 5G NETWORK & ENABLING FUNCTIONS

Fast **Reliable** **Secure** **Guaranteed** **Cross-border**

C H A L L E N G E S

ECONOMICS

- Reduction of waiting time
- Reduction labour shortage
- Economic growth
- Safer driving
- Facilitator automated mobility
- Complex business model

GOVERNANCE

- MNO SLA's
- ToD service SLA's
- Legislation
- Certification
- Liability
- Data sharing and GDPR

5G-BLUEPRINT ULTIMATE GOALGOAL OF THE PROJECT

5G-Blueprint designs and validates **technical architecture, business,** and **governance model** for uninterrupted cross-border teleoperated transport based on 5G connectivity.

TECHNOLOGICAL

BUSINESS

REGULATORY

OBJECTIVES

TECHNOLOGICAL

- Design and implement a **5G network for CAM services**
- Develop and implement the **prototype of a TO system**
- Implement and deploy enabling functions **guaranteeing safety** and increasing value
- Validate the **end-to-end TO transport** solution supported by 5G in real-life cross-border scenarios

BUSINESS

- 5G TO transport **market analysis**
- **Commercial possibilities**
- Positions the **possible role** of TO transport based on 5G **in CAM**
- TO transport based on 5G connectivity **market adoption**

REGULATORY

- Identify regulatory issues
- Recommended actions

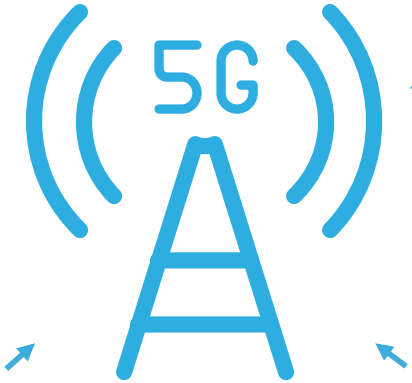
USE CASES

UC1: Automated barge control

Vlissingen and Antwerp ports

UC4: Remote take over

Cross border on public road



UC2: Automated driver in loop docking

Vlissingen and Antwerp ports

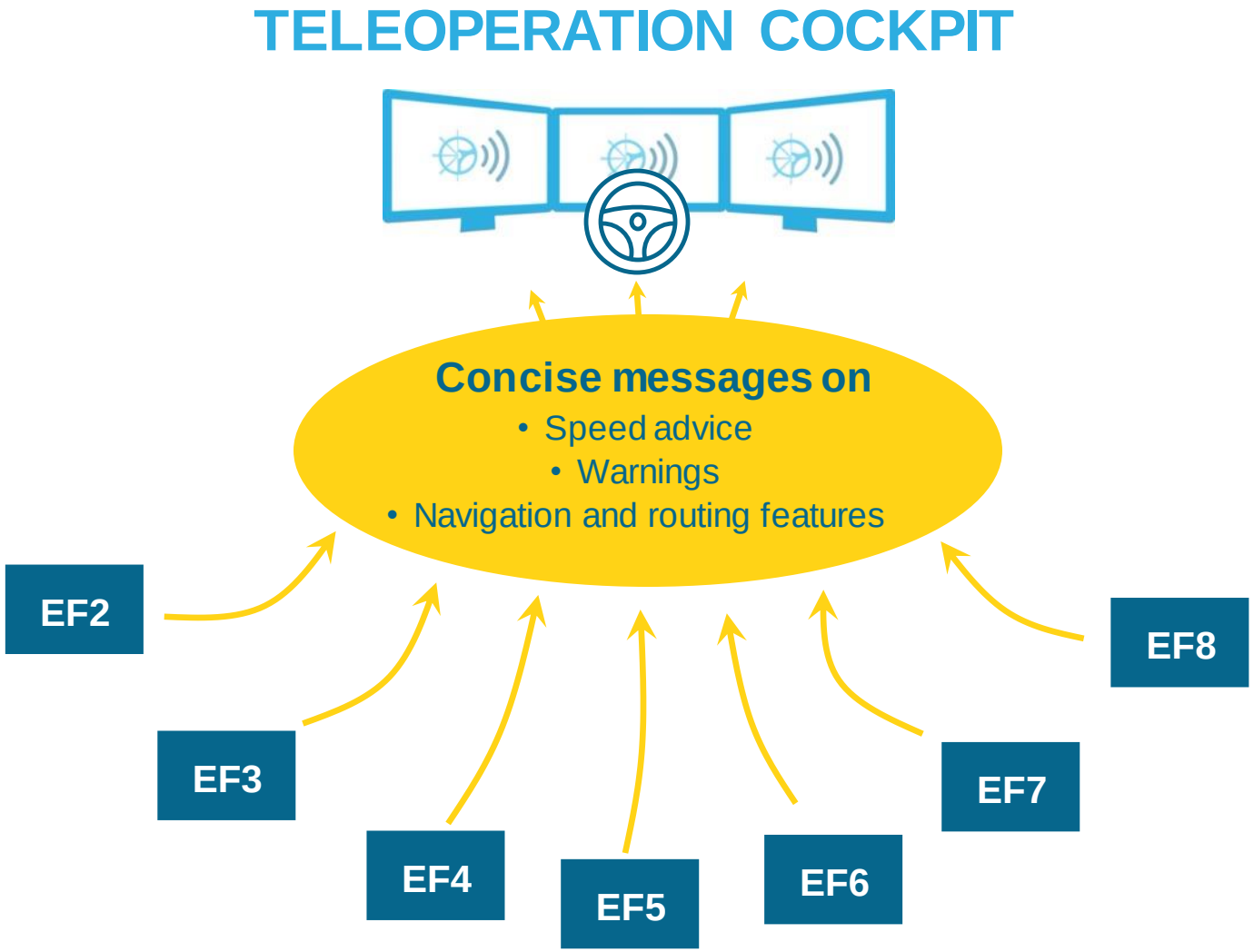
Teleoperated crane

UC3: CACC based platooning

Cross border on public road

ENABLING FUNCTIONS

EF1	Enhanced awareness dashboard
EF2	Vulnerable Road User (VRU) interaction
EF3	Timeslot reservation at intersections
EF4	Distributed perception
EF5	Active collision avoidance
EF6	Container ID recognition
EF7	ETA sharing
EF8	Scene Analytics



PILOT AREA

NORTH SEA PORT-ANTWERP-ROTTERDAM TRANSPORT CORRIDOR

VLISSINGEN SITE

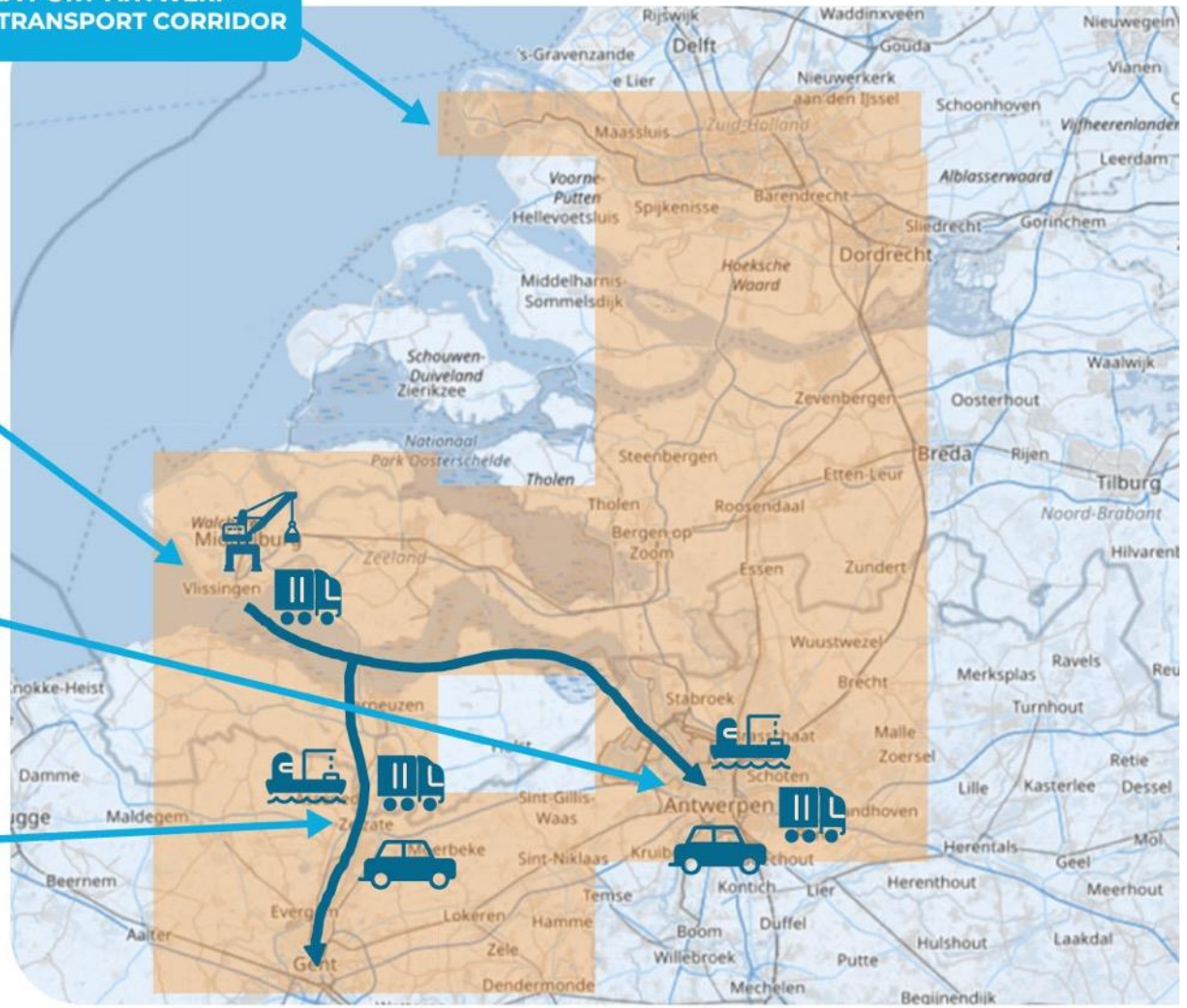
- Teleoperation
- Gracefully degrading safety fallback
- Teleoperation station for operator
- Cameras at terminal
- Docking service
- Logistics chain optimization

PORT OF ANTWERP SITE

- Teleoperation
- Gracefully degrading safety fallback
- Teleoperation station for operator
- Cameras at terminal
- Cooperative Adaptive Cruise Control (CACC)
- Logistics chain optimization

ZELZATE CROSS-BORDER SITE

- Teleoperation
- Gracefully degrading safety fallback
- Teleoperation station for operator
- Cooperative Adaptive Cruise Control (CACC)



PROPOSED SCENARIO DISTRIBUTION ACROSS SITES

Use-case	Vlissingen	Zelzate	Antwerp
UC1 Automated Barge Control		**Cross-border** *passive* 7 • Navigating canal with obstacle (bridge) at the border location	**"Hard" conditions** 4 7 • Navigating busy port
UC2 Automated driver-in-loop docking	**Full use case** 2 4 5 6 7 • Truck docking • Crane operation		*no test/demo only deployment* 1 2 4 5 7
UC3 CACC based Platooning	**Milk run** • Between terminal and MSP factory (same trajectory as UC4) 1 2 3 4 5 7	***Cross-border (tentative)*** • *PC5 Mode 3 or UU CACC handover (tentative)* 1 2 3 4 5 7	**Full use case** • Platooning on different road types • Co-existence with ITS-G5 signals
UC4 Remote Takeover Operation	**Terminal traffic & basic milk runs** • Confined area (terminal) • Short route over 50 km/h public roads and with limited traffic between terminal and MSP factory 1 3 4 5 7	**Cross-border, high speed, urban** • Crossing the border on 50 km/h public road, 90 km/h in Flanders • Urban environment with presence of iTLCs 1 2 3 4 5 7	**Milk runs** • Short route over 50 km/h public roads, including 2 parallel locks, between terminal and Transport Roosens 1 5 2 7 8 4

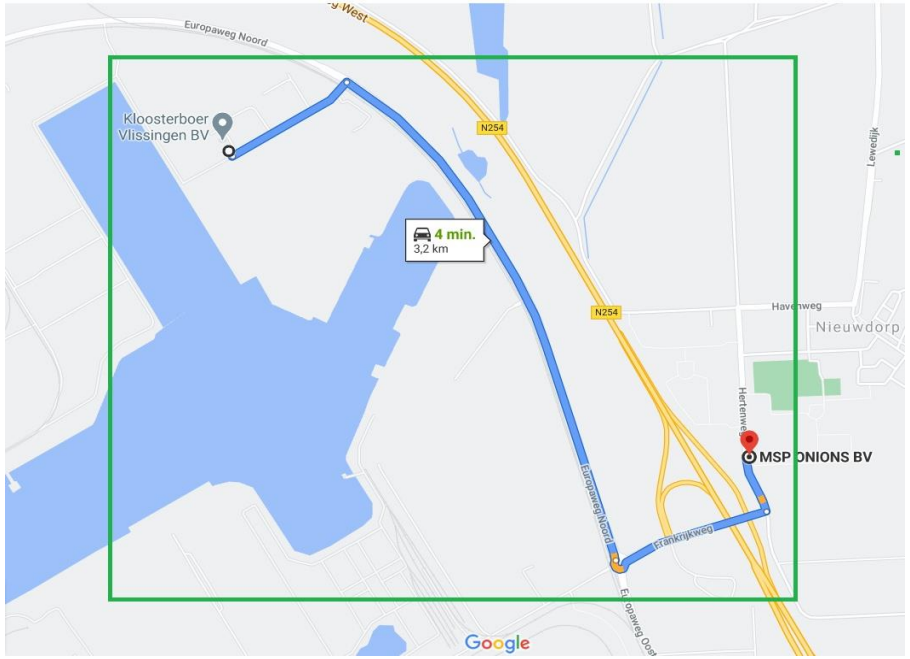
Enabling functions:

1 Enhanced awareness HMI
2 VRU interaction
3 Time slot reservation intersection
4 Distributed perception
5 Active collision avoidance
6 Container ID recognition
7 ETA sharing
8 Logistics chain optimization

VLISSINGEN SITE DETAILS

https://www.google.be/maps/@51.4581162,3.6968918,13.75z

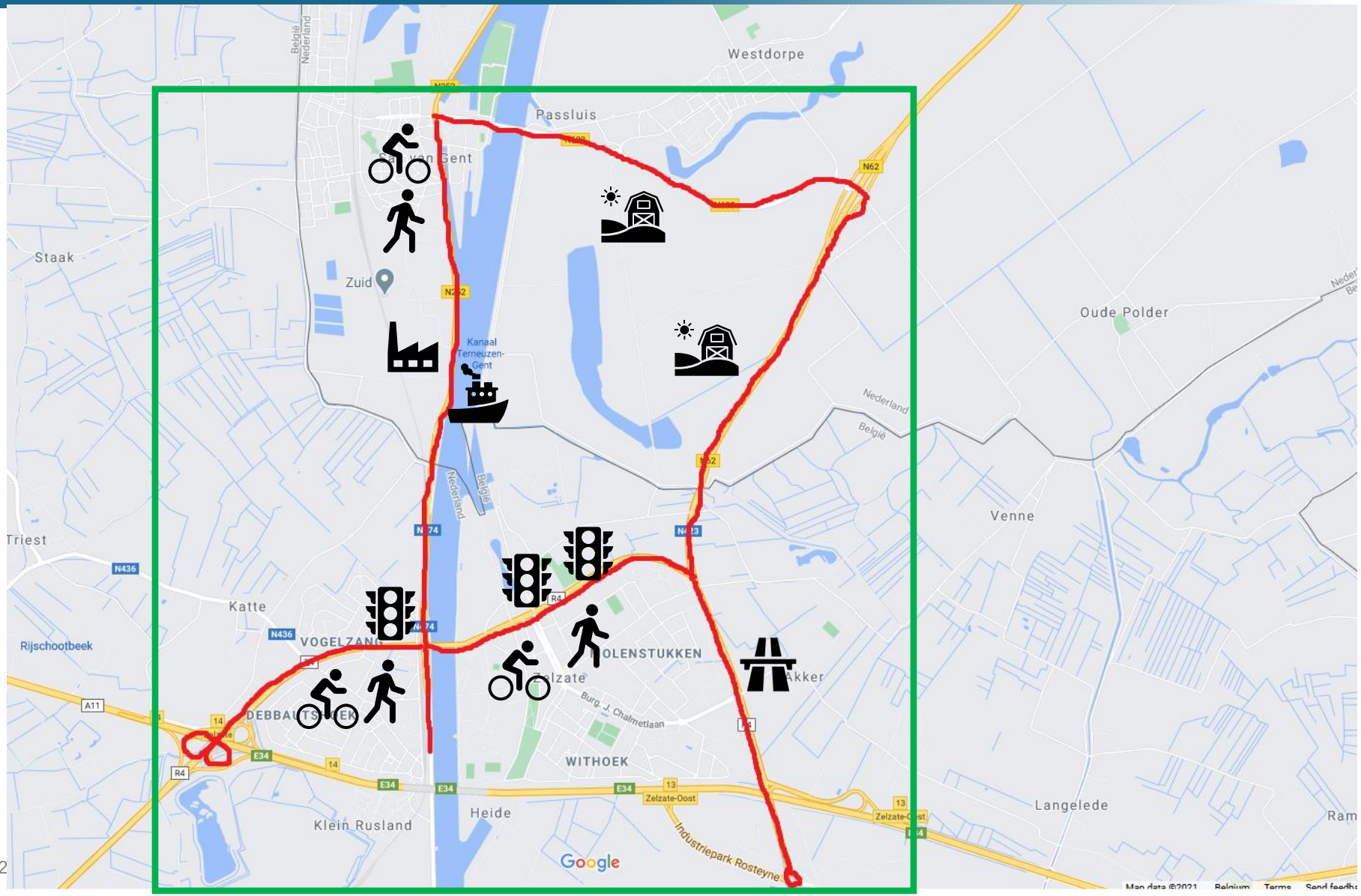
VLISSINGEN DETAILS



ZELZATE SITE DETAILS

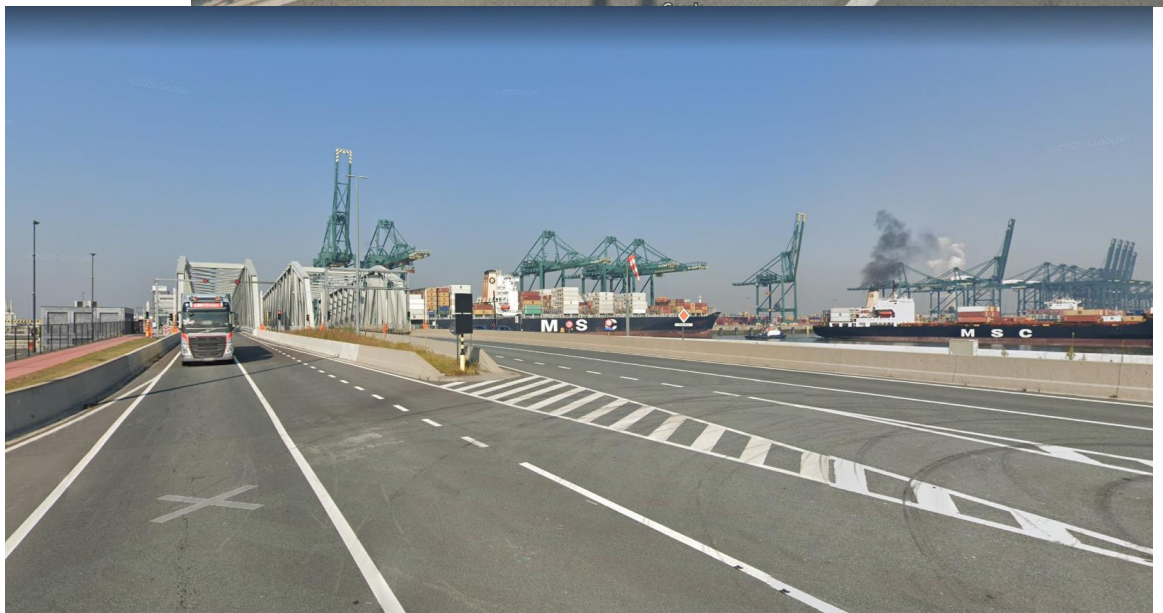
https://www.google.be/maps/@51.207446,3.8004474,15.25z

ZELZATE DETAILS

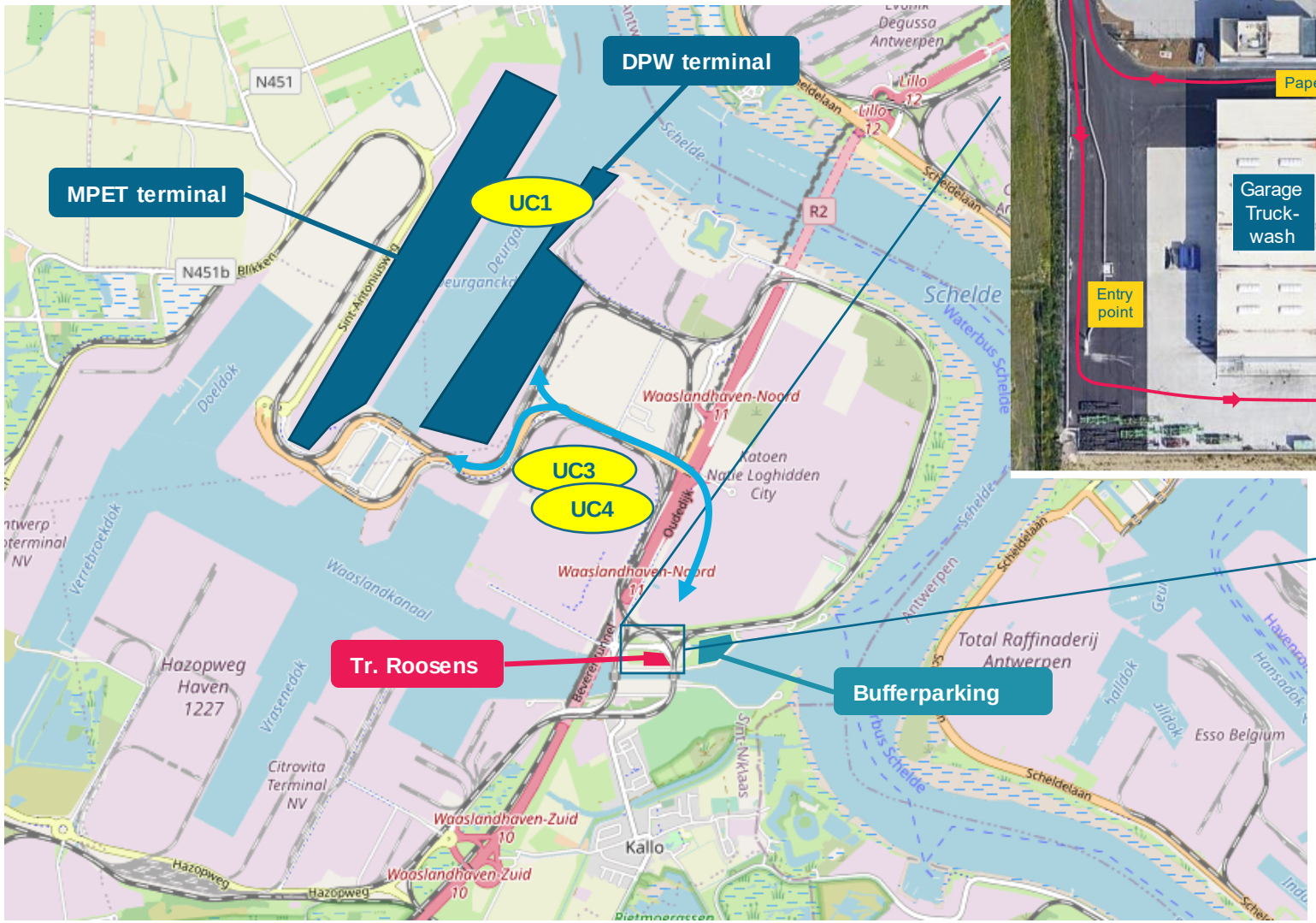


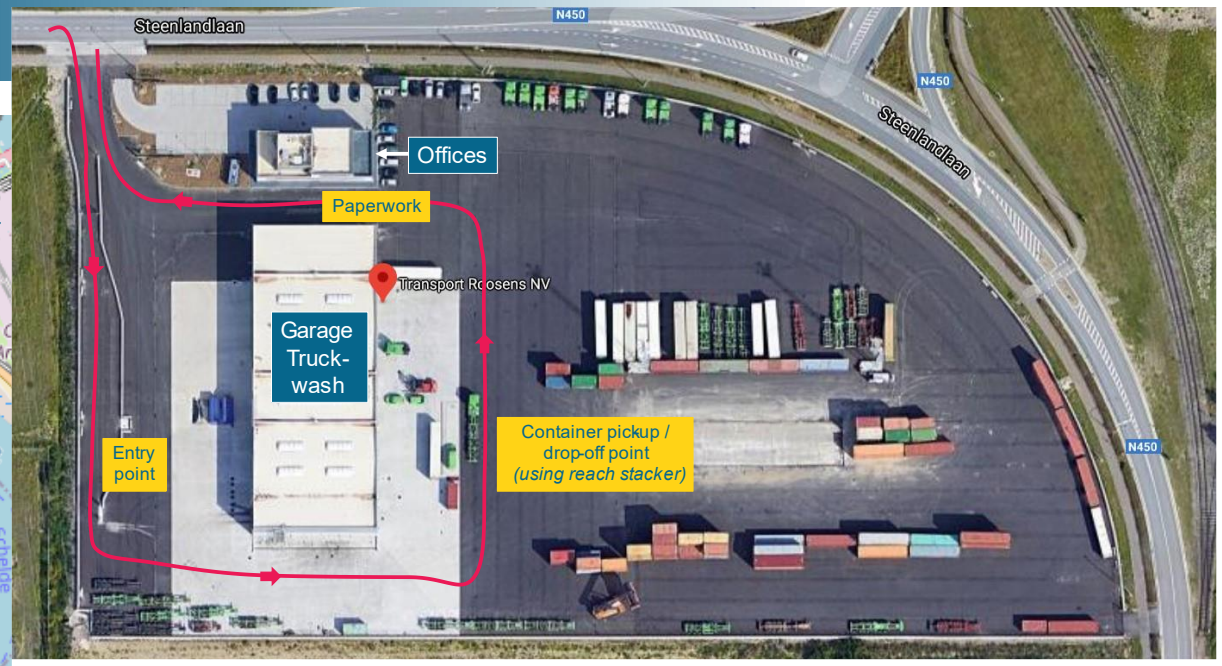
ANTWERP SITE DETAILS

https://www.google.be/maps/@51.2894393,4.2511426,13.5z

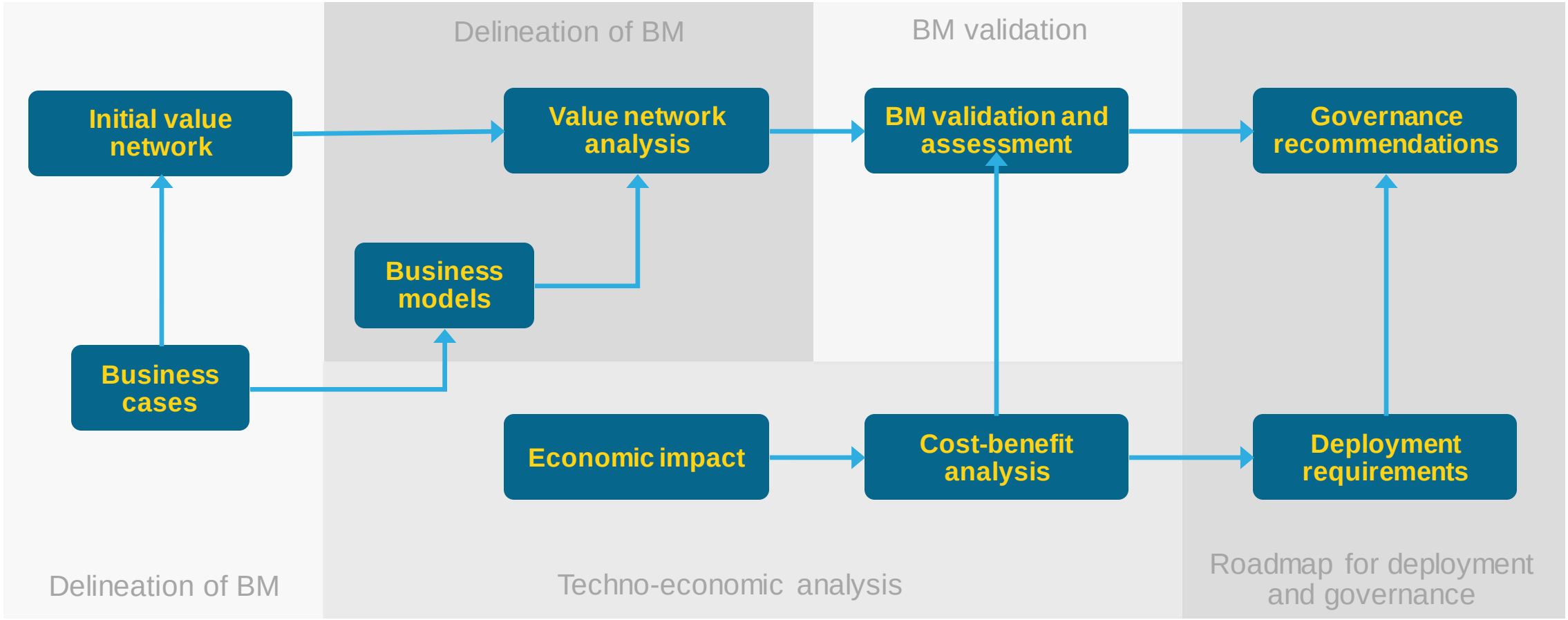


ANTWERP DETAILS





CAM GOVERNANCE AND BUSINESS MODELS



CONSORTIUM AS A WHOLE

5G BLUEPRINT

Network operators

kpn

eurofiber

Vehicle OEMs

TOYOTA

Teleoperation OEMs

v-tron

roboauto

MWLC
More work less carbon

SEAFAR

Logistics

Transport

Kloosterboer

VERBRUGGE INTERNATIONAL n.v.

TR Transport Roosens

Ports

Port of Antwerp

North Sea Port

Software

[sentors]

room 40

NxtPort

Connected Mobility sector

BEMOBILE
a revolution in traffic

swarco
The Better Way. Every Day.

locatienet

Research institutes

imec

HAN_UNIVERSITY OF APPLIED SCIENCES

UNIVERSITY OF APPLIED SCIENCES

Business accelerator

MARTEL innovate

Impuls Zeeland

Governments

Ministry of Infrastructure and Water Management

Flanders
State of the Art

CONSORTIUM ADVISORY BOARD

Regional government

Provincie Zeeland

STAD ANTWERPEN

Agentschap Telecom
Ministerie van Economische Zaken en Klimaat

Vehicle OEMs

FORD OTOSAN

DAF

Logistics sector

TLN

Port of Amsterdam International

ICBO
INTERNATIONAL CONTAINER BARGE OPERATORS

Port of Rotterdam

FACTS & FIGURES

Project Acronym: 5G-Blueprint

Project Name: Next generation connectivity for enhanced, safe & efficient transport & logistics

Funded Under: H2020-ICT-2018-20

Topic: ICT-53-2020: 5G PPP *(5G for Connected and Automated Mobility)*

Call for proposal: H2020-ICT-2019-3

Starting Date: 01/09/2020

Duration: 36 Months

Total cost: EUR 13,9 M

EU contribution: EUR 10 M

Project Coordinator: Dr Wim Vandenberghe, *Ministerie van Infrastructuur en Waterstaat*

Technical Coordinator: Prof. Johann Márquez-Barja, *Interuniversitair Micro-Electronica Centrum*

CONCLUSION

- 5G-Blueprint is
  - Tackling challenging teleoperation-related use cases
  - Exploring the capabilities of 5G regarding not only eMBB but also URLLC requirements at the same time
  - Investigates the feasibility of teleoperation over 5G in the context of transport and logistics from a technical, business and governance perspective
  - Aiming to deliver the roadmap to enable future deployments in Europe
  - Performing its first pilot activities in June 2022, so stay tuned!

BACK UP SLIDES

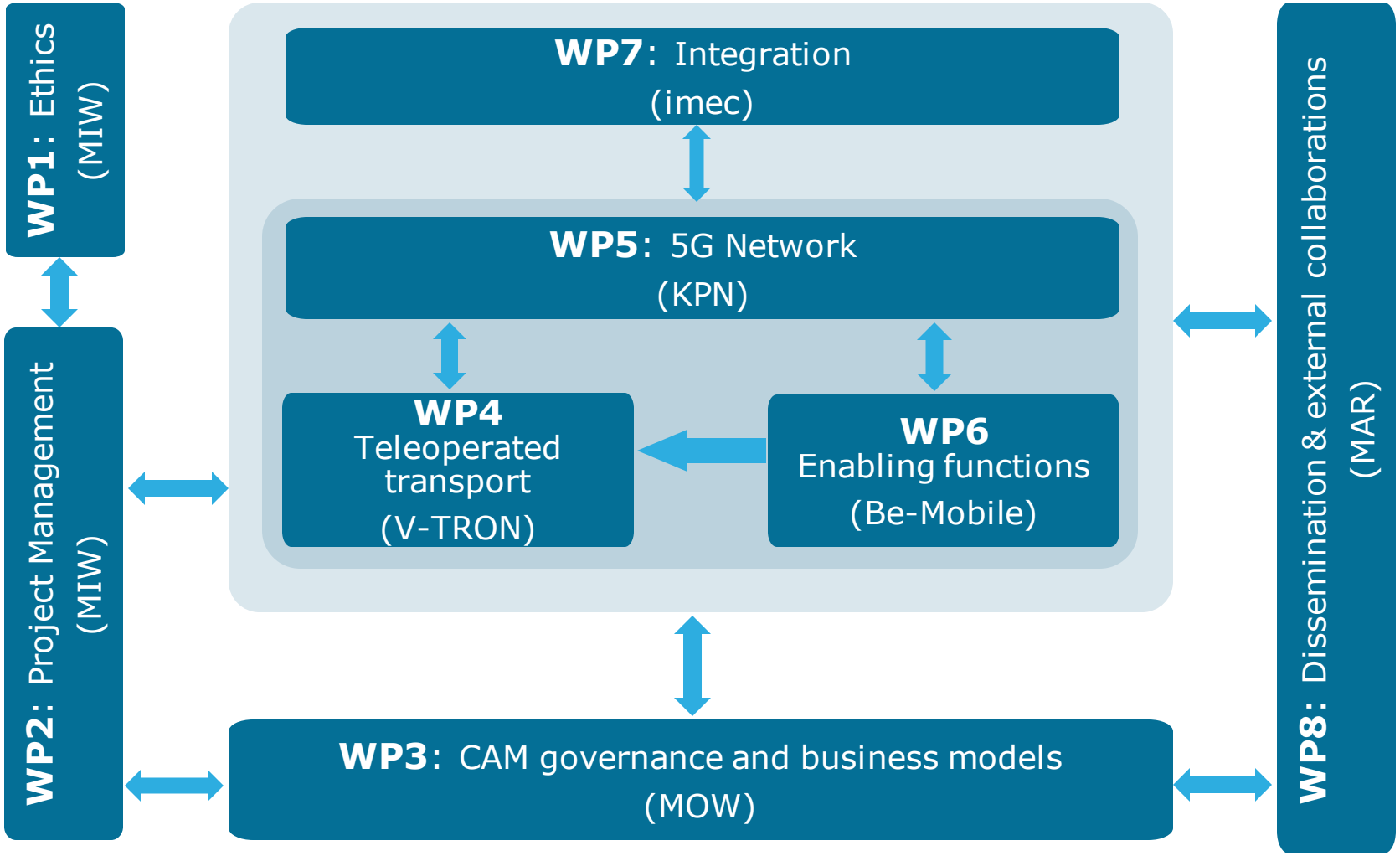
MAIN ACTIVITIES, MILESTONES, DELIVERABLES

		Year 1												Year 2												Year 3											
		2020				2021								2022												2023											
		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
		PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	PM11	PM12	PM13	PM14	PM15	PM16	PM17	PM18	PM19	PM20	PM21	PM22	PM23	PM24	PM25	PM26	PM27	PM28	PM29	PM30	PM31	PM32	PM33	PM34	PM35	PM36
WP1	Ethics																																				
T1.1	Ethics requirements						D1.1 D1.2																														
WP2	Project management	MS01 MS02																	PPR1																		PPR2
T2.1	Project coordination and			D2.1																																	
T2.2	Technical management																																				
T2.3	Quality assurance and risk						D2.2												D2.3																		D2.4
WP3	Governance and business models	MS03																															MS03				MS04
T3.1	Description of business cases									D3.1																											
T3.2	Delineation of business models																		D3.2																		
T3.3	Techno-economic analysis																										D3.3										
T3.4	Business model validation																																D3.4				
T3.5	Roadmap for deployment and																																				D3.5
WP4	Teleoperated transport																																	MS05			MS06
T4.1	Defining use case requirements																																				
T4.2	System integration for U.C. 2.1																																				
T4.3	U.C. 2.3 Lab testing																																				
T4.4	Vision based localization system																																				
T4.5	Development of driver-in-loop																																				
T4.6	CACC enabled car and container																																				
T4.7	Integration of teleoperable crane for																														D4.3						
T4.8	Teleoperation capability integration																																				
T4.9	System evaluation																														D4.1 D4.2						
T4.10	Use case demonstrations																																				
WP5	5G Network												MS07						MS08		MS09						MS10				MS11						MS12
T5.1	Definition of the network												D5.1																								
T5.2	Planning, implementation and																						D5.2														
T5.3	Governance between MNOs at																														D5.3						D5.8
T5.4	Test plan and evaluation of the 5G																														D5.4						
T5.5	Hybrid 5G C-V2X communication																																				D5.5-D5.6
T5.6	Study on the use of public/private															D5.7																					
WP6	Enabling functions																																	MS13			
T6.1	Description of enabling functions			D6.1																																	
T6.2	Architecture						D6.2			D6.3																											
T6.3	Function development																																				
T6.4	Front end development																																				
T6.5	Deployment and operation																																				
T6.6	Evaluation																																				D6.4
WP7	Integration												MS14												MS15						MS16						MS17
T7.1	Requirements and Architecture												D7.1																		D7.3						
T7.2	System Integration of Teleoperated																								D7.2												
T7.3	Development of Minimum Viable 5G-																																				
T7.4	Final Evaluation and Demonstration																																				D7.4
WP8	Dissemination & external	MS18											MS19												MS24												MS21
T8.1	Dissemination and communication		D8.2	D8.1						D8.5									D8.3																		D8.4-D8.6
T8.2	Joint events and community building																																				
T8.3	Standardisation																																				
T8.4	Project exploitation																																				

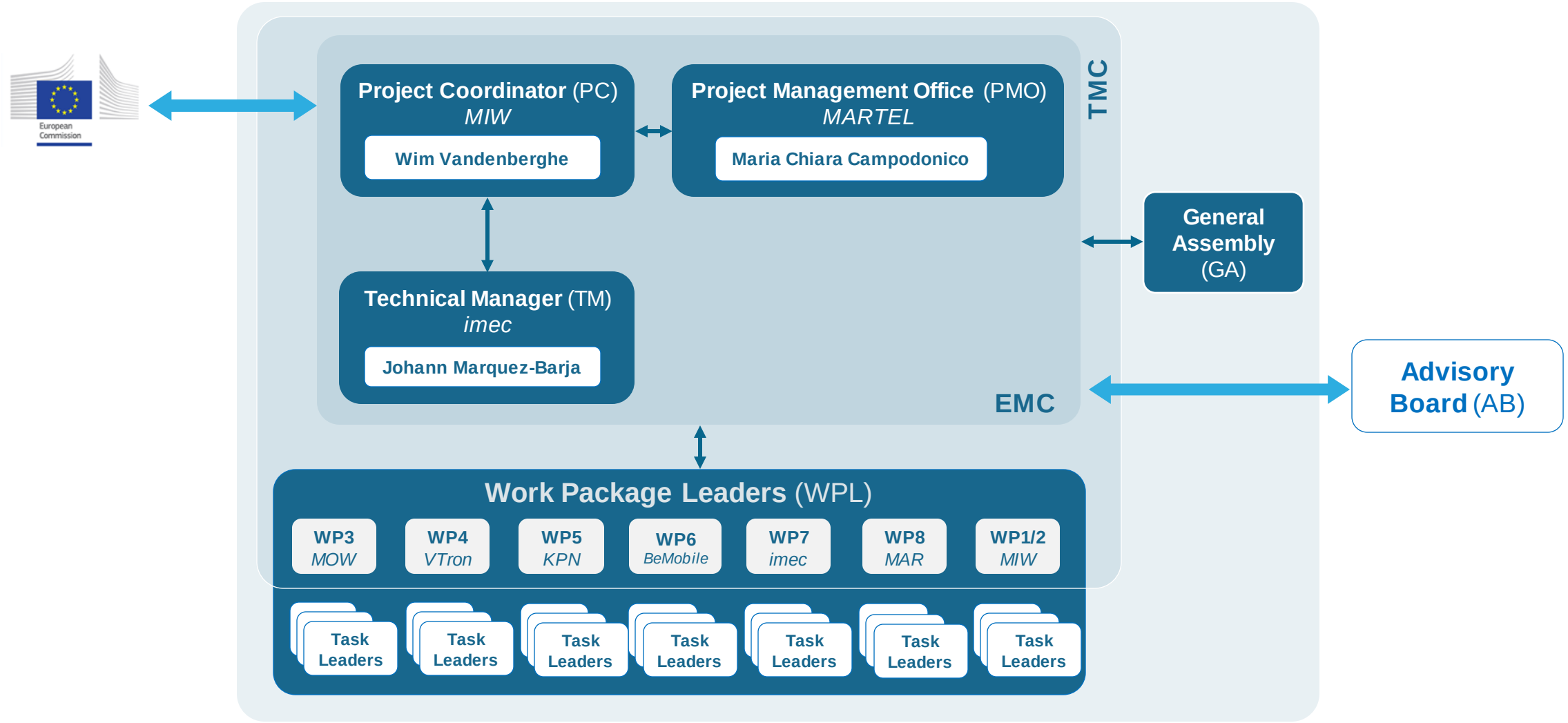
WP duration | Task duration | Dx.x Deliverable | MSX Milestone | PPRx Project periodic report

Starting Date: 01/09/2020 **Duration**: 36 Months

WP STRUCTURE

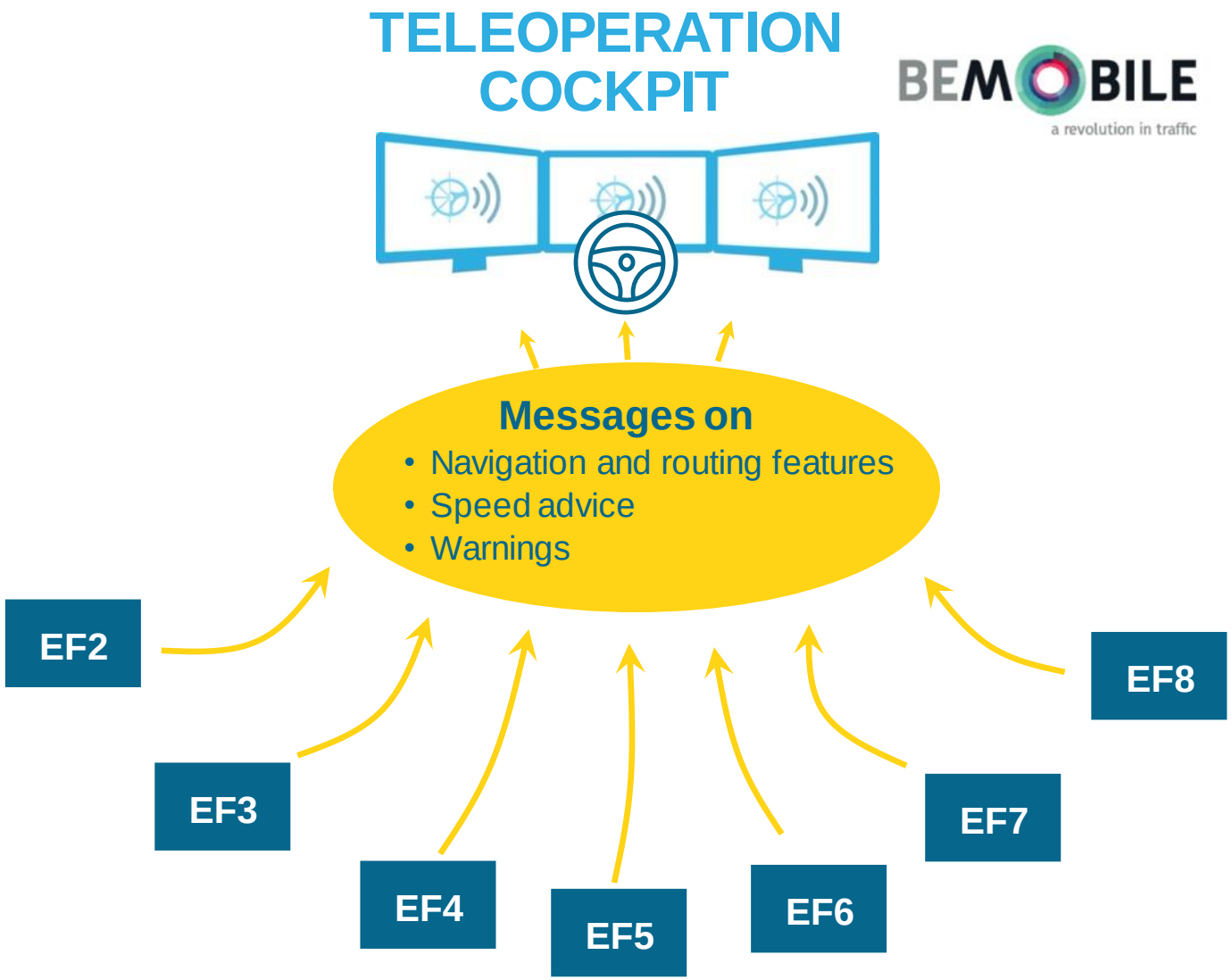


GOVERNANCE



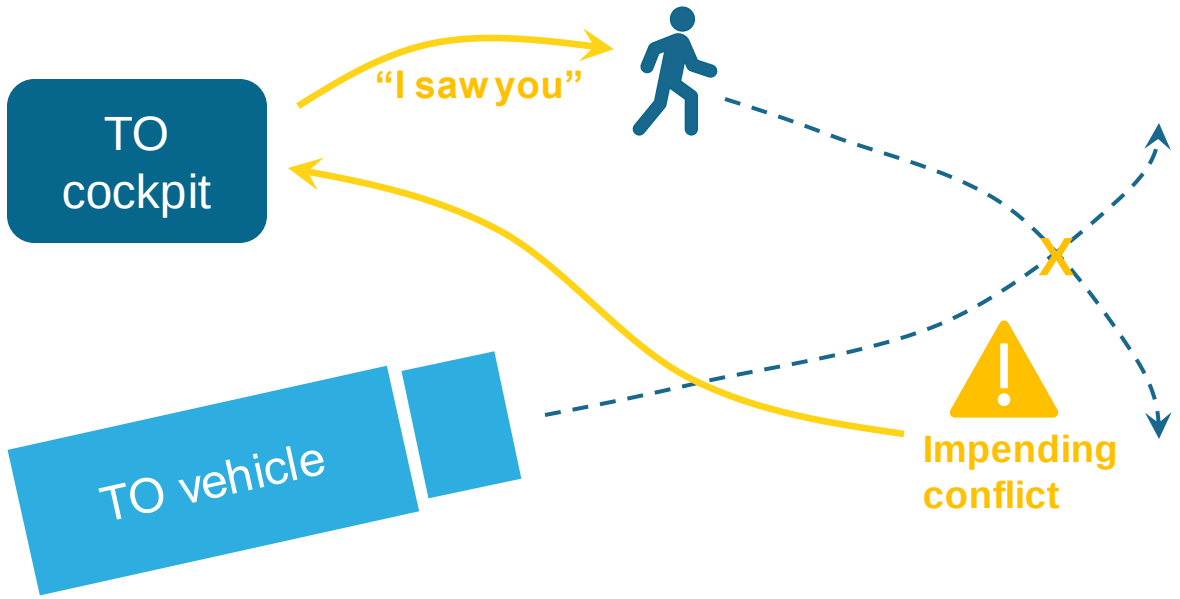
ENABLING FUNCTIONS

EF1	Enhanced awareness dashboard
EF2	Vulnerable Road User (VRU) interaction
EF3	Timeslot reservation at intersections
EF4	Distributed perception
EF5	Active collision avoidance
EF6	Container ID recognition
EF7	ETA sharing
EF8	Logistics chain optimization



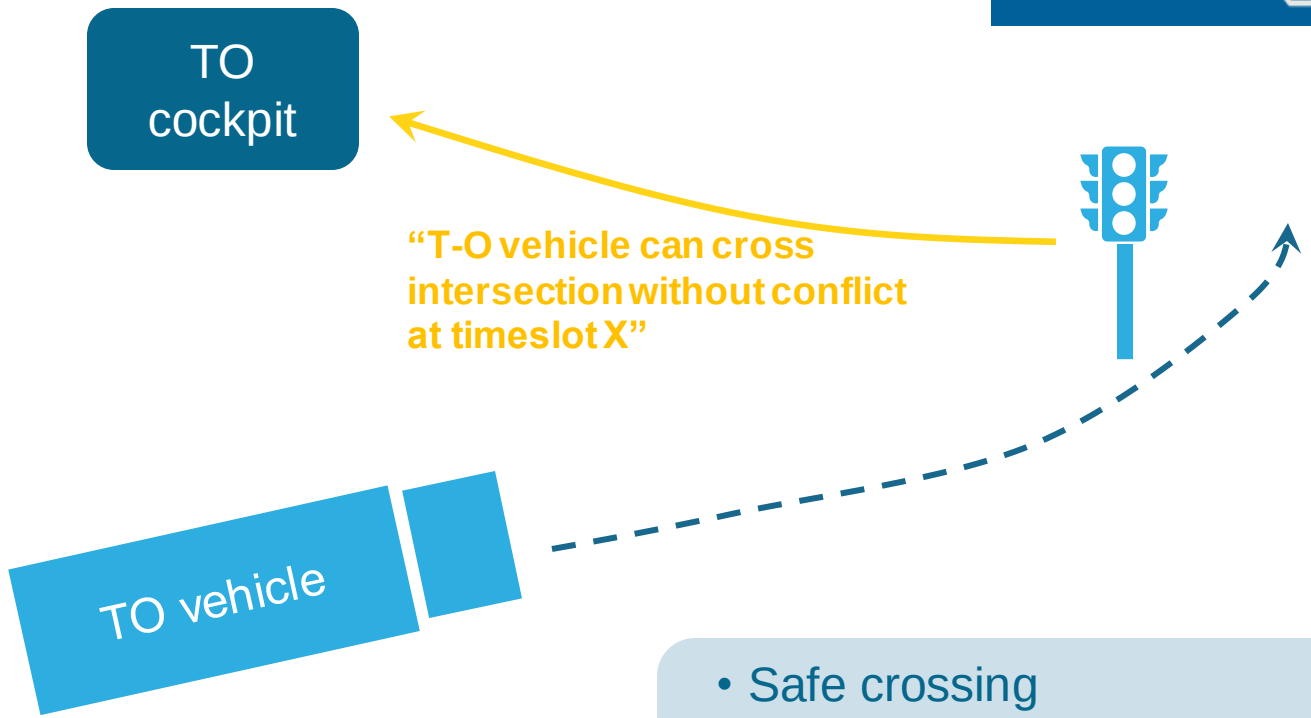
ENABLING FUNCTIONS

EF1	Enhanced awareness dashboard
EF2	Vulnerable Road User (VRU) interaction
EF3	Timeslot reservation at intersections
EF4	Distributed perception
EF5	Active collision avoidance
EF6	Container ID recognition
EF7	ETA sharing
EF8	Logistics chain optimization



ENABLING FUNCTIONS

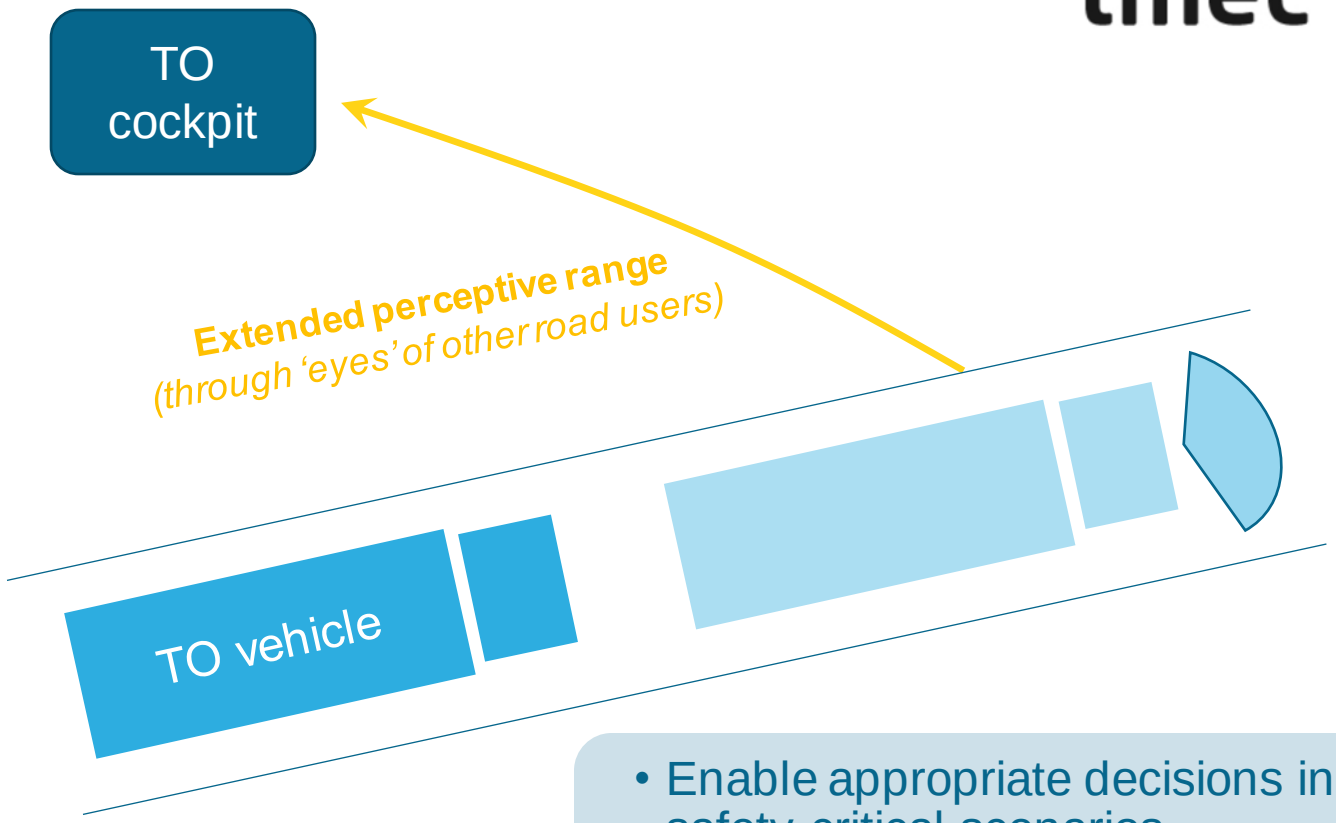
EF1	Enhanced awareness dashboard
EF2	Vulnerable Road User (VRU) interaction
EF3	Timeslot reservation at intersections
EF4	Distributed perception
EF5	Active collision avoidance
EF6	Container ID recognition
EF7	ETA sharing
EF8	Logistics chain optimization



- Safe crossing
- Reduced need for sudden deceleration/acceleration

ENABLING FUNCTIONS

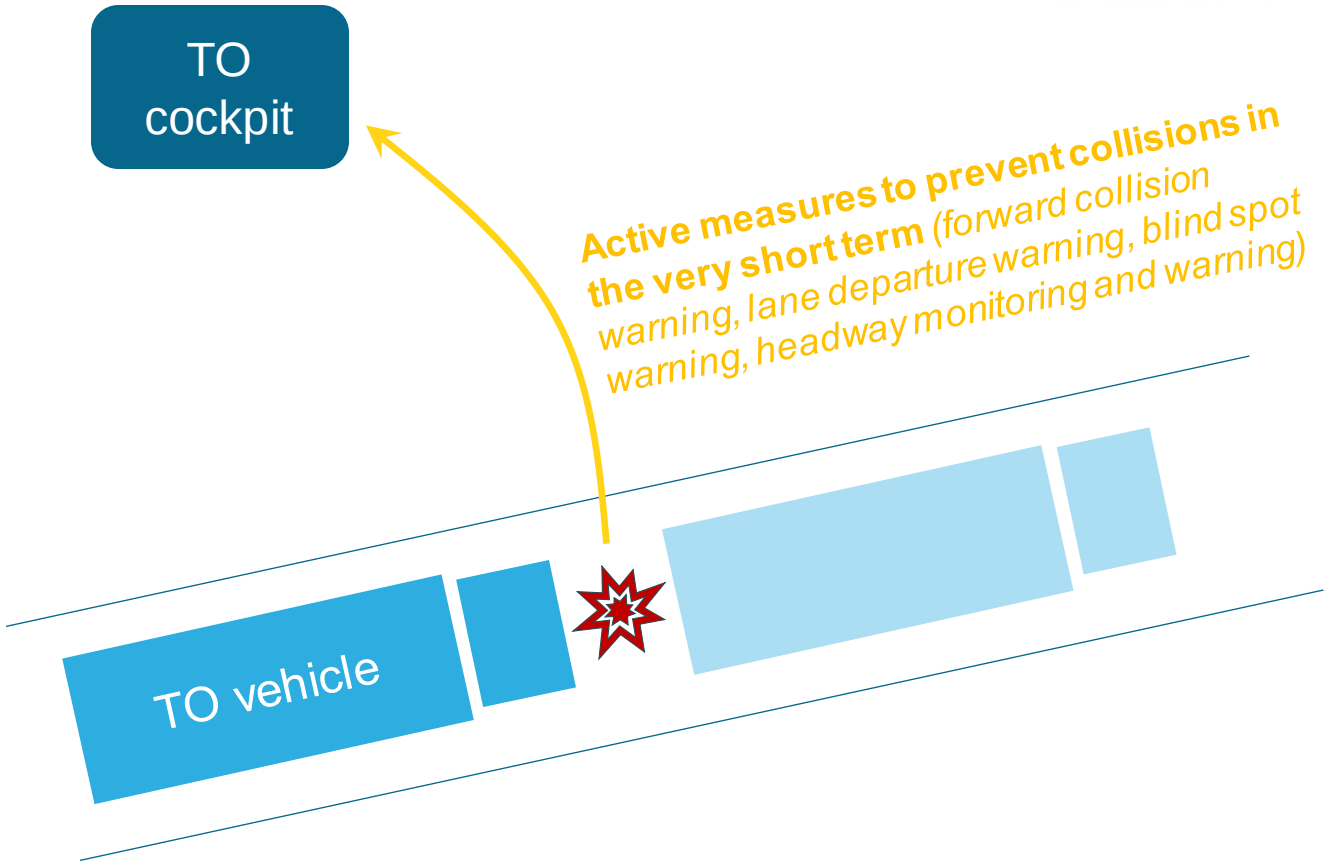
EF1	Enhanced awareness dashboard
EF2	Vulnerable Road User (VRU) interaction
EF3	Timeslot reservation at intersections
EF4	Distributed perception
EF5	Active collision avoidance
EF6	Container ID recognition
EF7	ETA sharing
EF8	Logistics chain optimization



- Enable appropriate decisions in safety-critical scenarios
- Graceful degradation

ENABLING FUNCTIONS

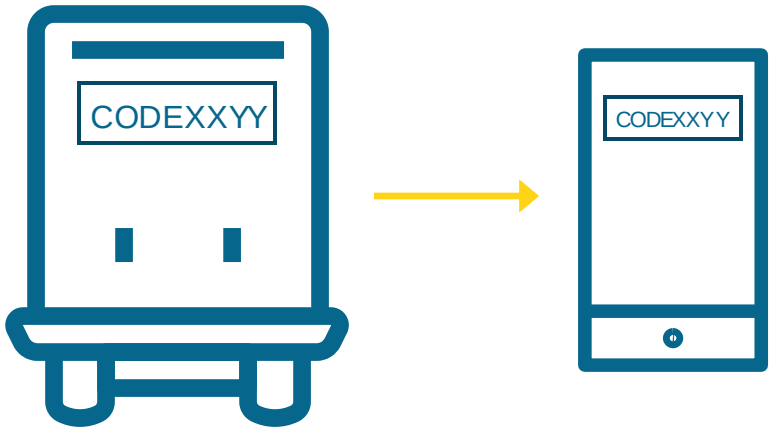
EF1	Enhanced awareness dashboard
EF2	Vulnerable Road User (VRU) interaction
EF3	Timeslot reservation at intersections
EF4	Distributed perception
EF5	Active collision avoidance
EF6	Container ID recognition
EF7	ETA sharing
EF8	Logistics chain optimization



ENABLING FUNCTIONS

EF1	Enhanced awareness dashboard
EF2	Vulnerable Road User (VRU) interaction
EF3	Timeslot reservation at intersections
EF4	Distributed perception
EF5	Active collision avoidance
EF6	Container ID recognition
EF7	ETA sharing
EF8	Logistics chain optimization

[sentors]



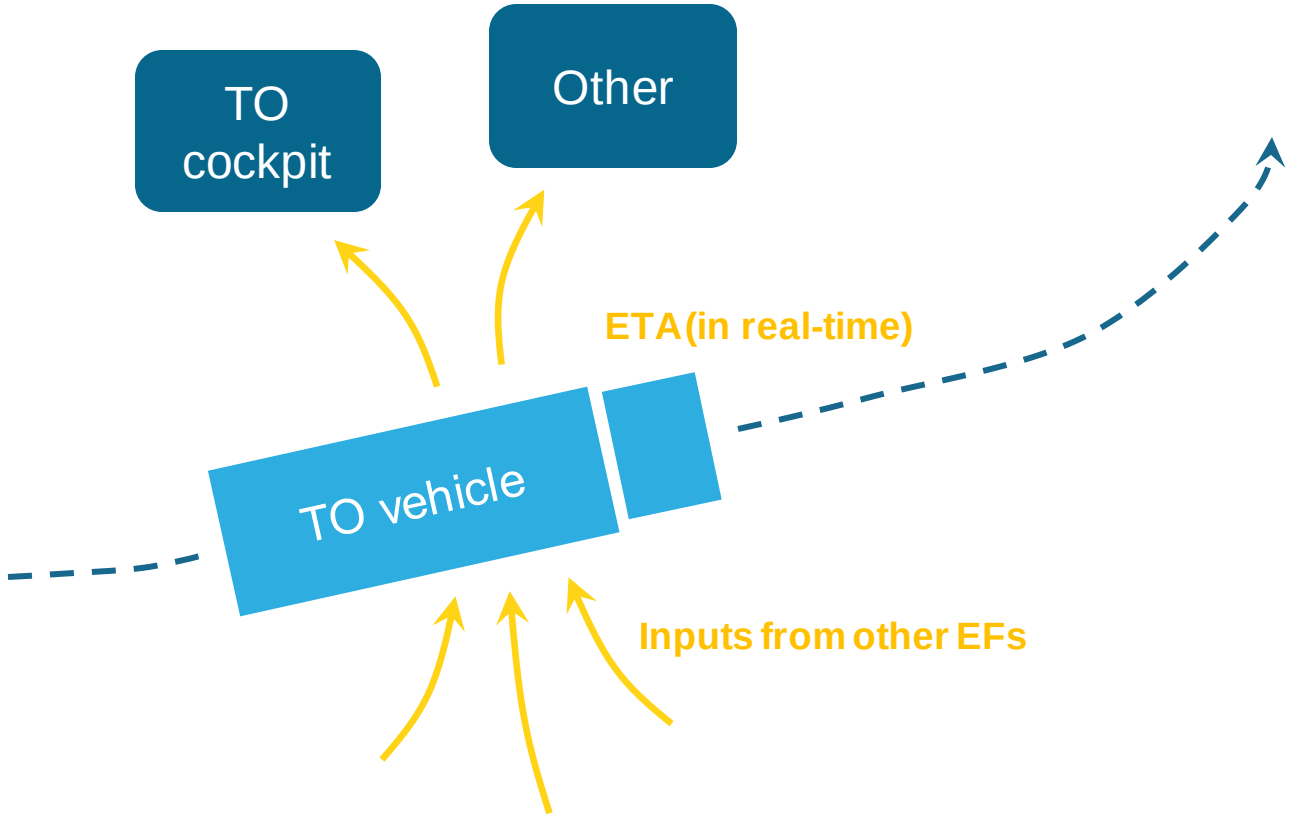
Plug&Play, Deploy Anywhere system on 5G network

Potential use-cases:

- Exit/entry detection in ports
- Detection of dangerous goods transport
- Truck platoon order monitoring

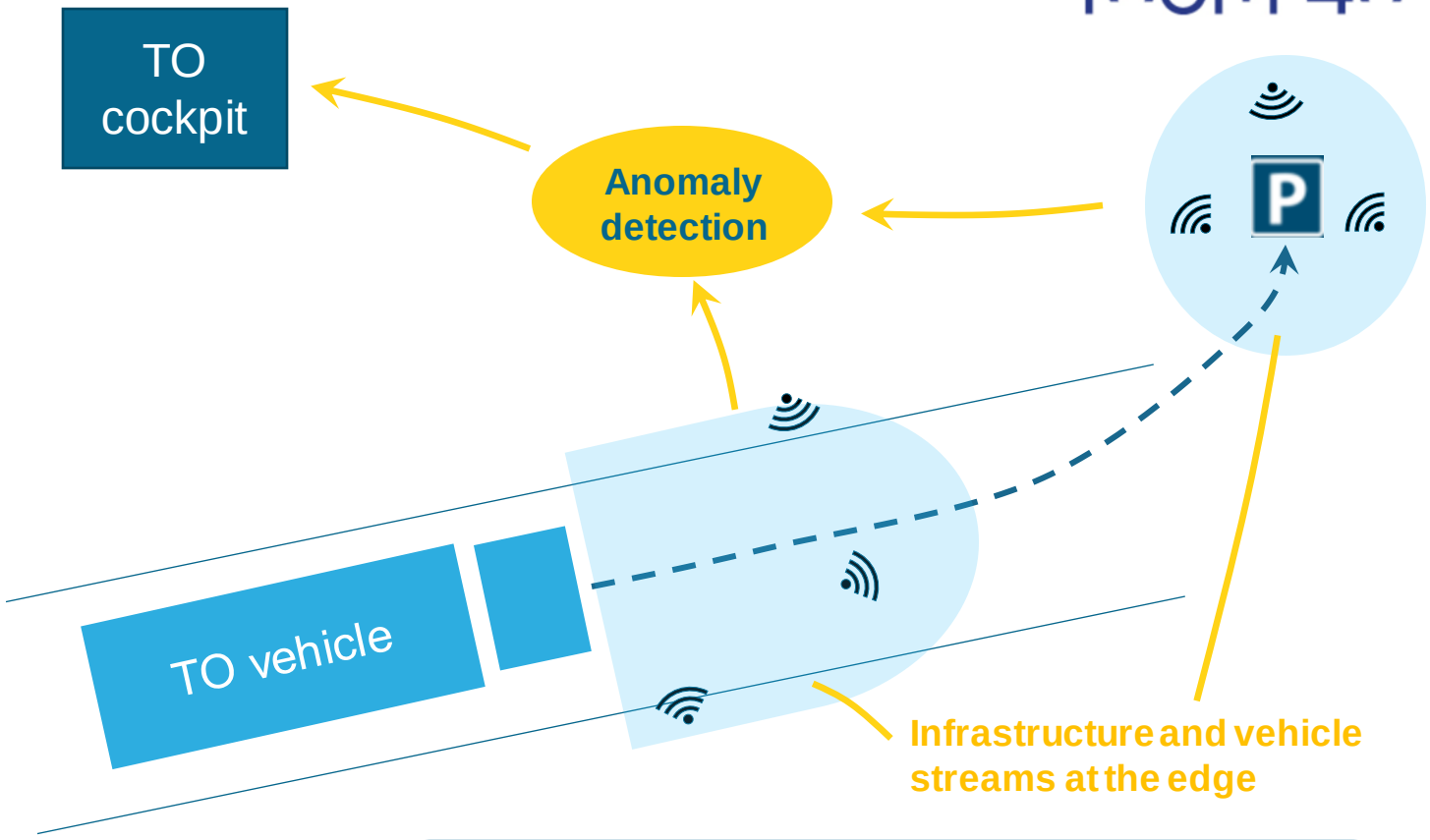
ENABLING FUNCTIONS

EF1	Enhanced awareness dashboard
EF2	Vulnerable Road User (VRU) interaction
EF3	Timeslot reservation at intersections
EF4	Distributed perception
EF5	Active collision avoidance
EF6	Container ID recognition
EF7	ETA sharing
EF8	Logistics chain optimization



ENABLING FUNCTIONS

EF1	Enhanced awareness dashboard
EF2	Vulnerable Road User (VRU) interaction
EF3	Timeslot reservation at intersections
EF4	Distributed perception
EF5	Active collision avoidance
EF6	Container ID recognition
EF7	ETA sharing
EF8	Logistics chain optimization



- Detection of unforeseen events
- Assessment of parking availability

5G BLUEPRINT

THANK YOU FOR YOUR ATTENTION

5GBlueprint.eu

THIS PROJECT IS PART OF THE 5G PUBLIC AND PRIVATE PARTNERSHIP

5G PPP WWW.5G-PPP.EU

5GBlueprint project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 952189