5G-BLUEPRINT PROJECT

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5G PPP Webinar: 5G for Cooperative, Connected and Automated Mobility (CCAM)
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EUROPEAN CONTEXT

Long term Vision and priorities

STRATEGIC RELEVANCE OF CONNECTED AND AUTOMATED MOBILITY

SAFETY
(No road accidents)

EFFICIENCY
(Reduced Pollution)

INNOVATION & GROWTH
(Global Competitiveness)

INTEROPERABILITY
(Technological Neutrality)

5G Coverage in Pan-European Corridors
5G-BLUEPRINT IN A NUTSHELL

TELE-OPERATED TRANSPORT

TECHNOLOGY – 5G NETWORK & ENABLING FUNCTIONS

Fast          Reliable           Secure           Guaranteed        Cross-border

CHALLENGES

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 designs and validates a technical architecture, business and governance model for uninterrupted cross-border Tele-Operated transport based on 5G connectivity.
OBJECTIVES

TECHNOLOGICAL

• Design and implement a 5G network for CAM services
• Tailor and implement the prototype of a T-O system
• Implement and deploy enabling functions guaranteeing safety or increasing value
• Validation of the end-to-end T-O transport solution supported by 5G in real-life, cross-border scenarios

BUSINESS

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

REGULATORY

• Identify regulatory issues and identify recommended actions
USE CASES

**UC1:** Automated barge control
- Vlissingen and Antwerp port

**UC2:** Automated driver in loop docking
- Vlissingen and Antwerp port

**UC3:** CACC based platooning
- Cross border on public road

**UC4:** Remote take over
- Cross border on public road

Tele-Operated crane
USE CASES

- **UC1**: Automated barge control
- **UC2**: Automated driver in loop docking
- **UC3**: CACC based platooning
- **UC4**: Remote take over

Diagram:
- Tele-Operator
- Input to barge
- Visual feedback to Tele-Operator
- Automated barge control
USE CASES

UC1: Automated barge control
UC2: Automated driver in loop docking
UC3: CACC based platooning
UC4: Remote take over

CACC based platooning
Input to crane
Path following error determination
Mathematical model-based feedback
Sensor to localize vehicle
Visual feedback to Tele-Operator
Docking gates
Container placed in truck
Automated driver in loop docking
Visual feedback to Tele-Operator
Like a crane
USE CASES

UC1 Automated barge control
UC2 Automated driver in loop docking
UC3 CACC based platooning
UC4 Remote take over

V2V Communication
CACC based platooning

Input to vehicle

Visual feedback to Tele-Operator

Tele-Operator
USE CASES

UC1 Automated barge control
UC2 Automated driver in loop docking
UC3 CACC based platooning
UC4 Remote take over

Remote take over operation

Input to vehicle

Visual feedback to Tele-Operator

Tele-Operator
## ENABLING FUNCTIONS

<table>
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<tr>
<th>EF1</th>
<th>Enhanced awareness dashboard</th>
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<tr>
<td>EF2</td>
<td>Vulnerable Road User (VRU) interaction</td>
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<td>EF3</td>
<td>Timeslot reservation at intersections</td>
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<td>EF4</td>
<td>Distributed perception</td>
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<td>EF5</td>
<td>Active collision avoidance</td>
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<td>EF6</td>
<td>Container ID recognition</td>
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<td>EF7</td>
<td>ETA sharing</td>
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<td>EF8</td>
<td>Logistics chain optimization</td>
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### TELE-OPERATION COCKPIT

Concise messages on:
- Speed advice
- Warnings
- Navigation and routing features
PILOT AREA

VLISSINGEN SITE
- Tele-Operation
- Gracefully degrading safety fallback
- Tele-Operation station for operator
- Cameras at terminal
- Docking service
- Logistics chain optimization

ZELZATE CROSS-BORDER SITE
- Tele-Operation
- Gracefully degrading safety fallback
- Cooperative Adaptive Cruise Control (CACC)

PORT OF ANTWERP SITE
- Tele-Operation
- Gracefully degrading safety fallback
- Tele-Operation station for operator
- Cameras at terminal
- Docking service
- Logistics chain optimization

NORTH SEA PORT-ANTWERP-ROTTERDAM TRANSPORT CORRIDOR
CAM GOVERNANCE AND BUSINESS MODELS

- Initial value network
- Value network analysis
- BM validation and assessment
- Governance recommendations
- Delineation of BM
- BM validation
- Business cases
- Economic impact
- Cost-benefit analysis
- Deployment requirements
- Techno-economic analysis
- Roadmap for deployment and governance
5G-BLUEPRINT CHALLENGES

Technical challenges

5G Network requirement
- Low latency
- High throughput
- High availability at cross-borders
- Security and Reliability
- Radio RF - Spectrum

Safe direct control T-O
- Vehicle safety fallback at ASIL
- Security on all levels
- Sufficient situational awareness operator
- Safe operator handover during active ToD session
- Applicability on public road

Autonomous mobility
- Automated docking
- CACC
- CCAS
5G-BLUEPRINT CHALLENGES

- Stakeholders needs
- Most satisfactory business case
- Regulatory frameworks for T-O on public road
- Stakeholder service-level agreements
- Liability agreements
- Political Acceptance

Business & regulation challenges
FACTS & FIGURES

Project Acronym: 5G-Blueprint
Project Name: Next generation connectivity for enhanced, safe & efficient transport & logistics

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Type of action: Innovation action (IA)
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Project Coordinator: Dr Wim Vandenberghe, Ministerie van Infrastructuur en Waterstaat
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THANK YOU FOR YOUR ATTENTION

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