C-ROADS
Antwerp-Helmond

CEF C-Roads ISA Webinar

24/09/2024

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Agenda

1. Introduction
2. The C-Roads Antwerp-Helmond project
3. ISA explanation
4. ISA project development
5. ISA & C-ITS
   a) Standards and messages
   b) Roadworks Warning
   c) Tunnel Height Warning
6. Lessons learned
7. Q & A

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Introduction to the C-Roads Antwerp-Helmond project

Laura Khammash – Tractebel Engineering

September 2024

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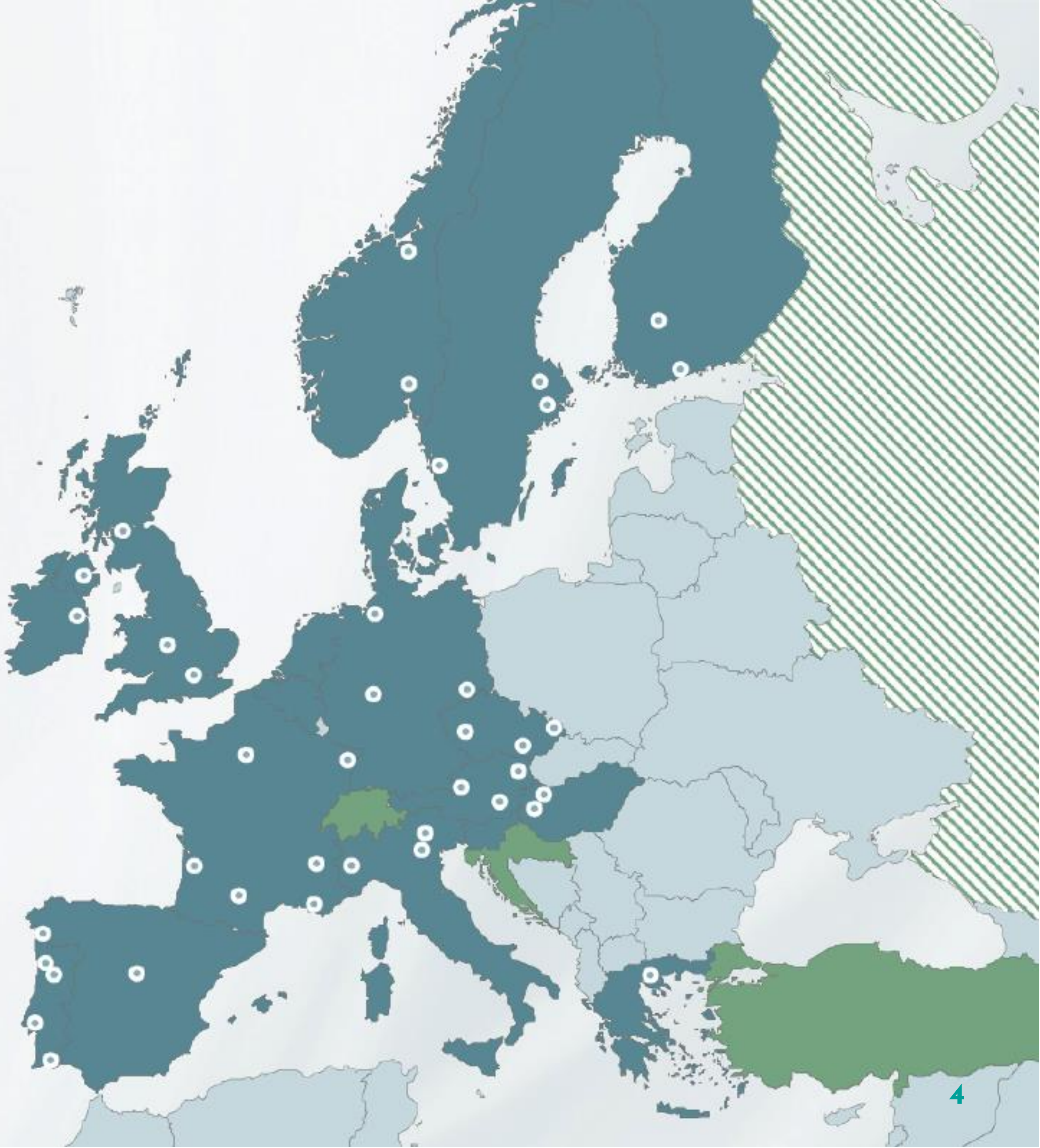
The C-Roads Platform

- **50 European cities**
  Start with C-ITS roll out in urban areas

- **Short-range C-ITS**
  20,000 km European roads equipped with C-ITS

- **Long-range C-ITS**
  100,000 km European roads covered by C-ITS services



Goal of the C-Roads Platform

- Linking all C-ITS deployments
- Develop, share, and publish common technical specifications
- Planning intensive cross-testing to verify interoperability
- Develop system tests based on the common communication profiles, focusing on hybrid communication mix, which is a combination of ETSI ITS-G5 and operational cellular networks

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C-Roads Antwerp (BE) - Helmond (NL)

- November 2022 – October 2024
- Our consortium consists of the following 9 partners:

TRACTEBEL engie

v-tron YOUR WAY IN INFOMOTIVES

STAD ANTWERPEN

TRANSPORT & MOBILITY LEUVEN

BE MOBILE a revolution in traffic

HOGESCHOOL PXL

lantis

Gemeente Helmond

YUNEX TRAFFIC

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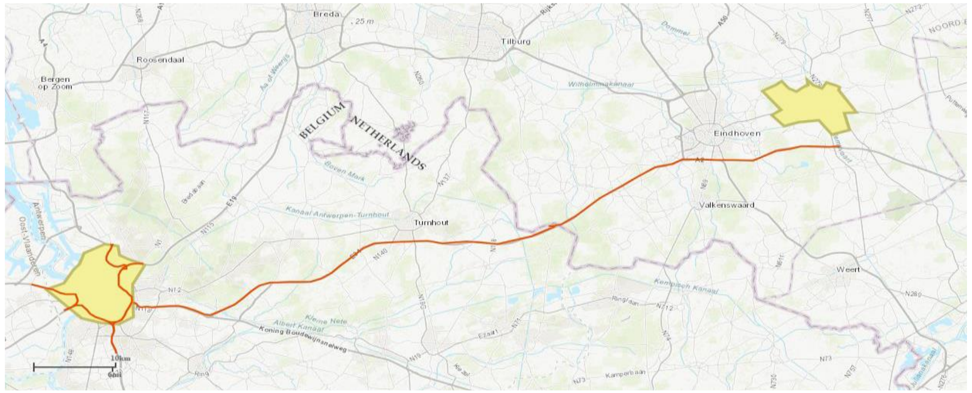
The project set-up

- Two cities involved:

Antwerp



Helmond

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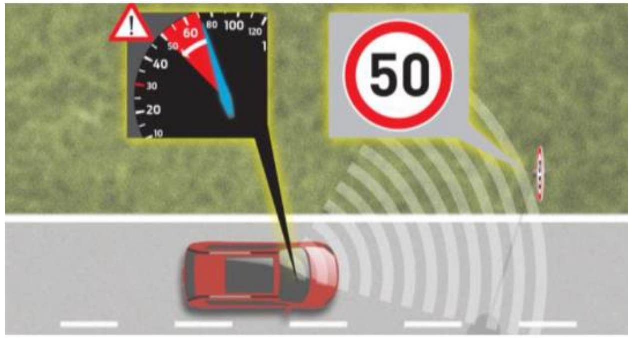
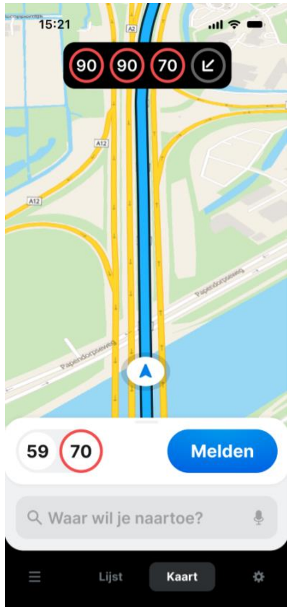
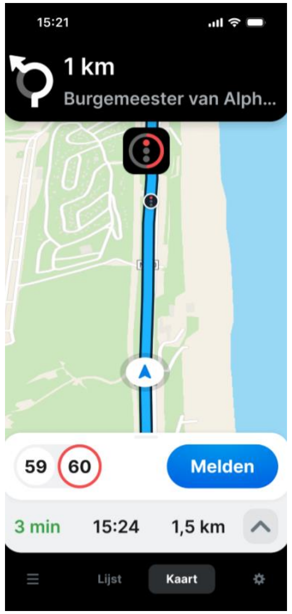
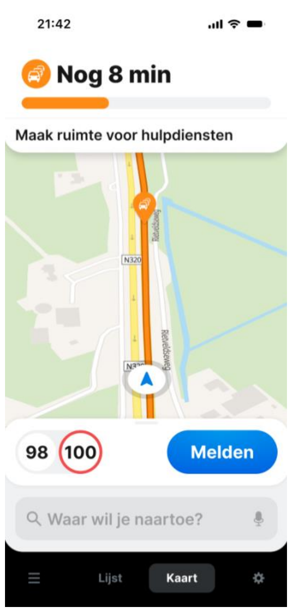
Pilots

- **C-ITS & ADAS** (Advanced Driving Assistance Systems)
  - Intelligent Speed Assistance: ISA-system
  - Real-time traffic information: On Board Unit or APP: Flitsmeister, Truckmeister









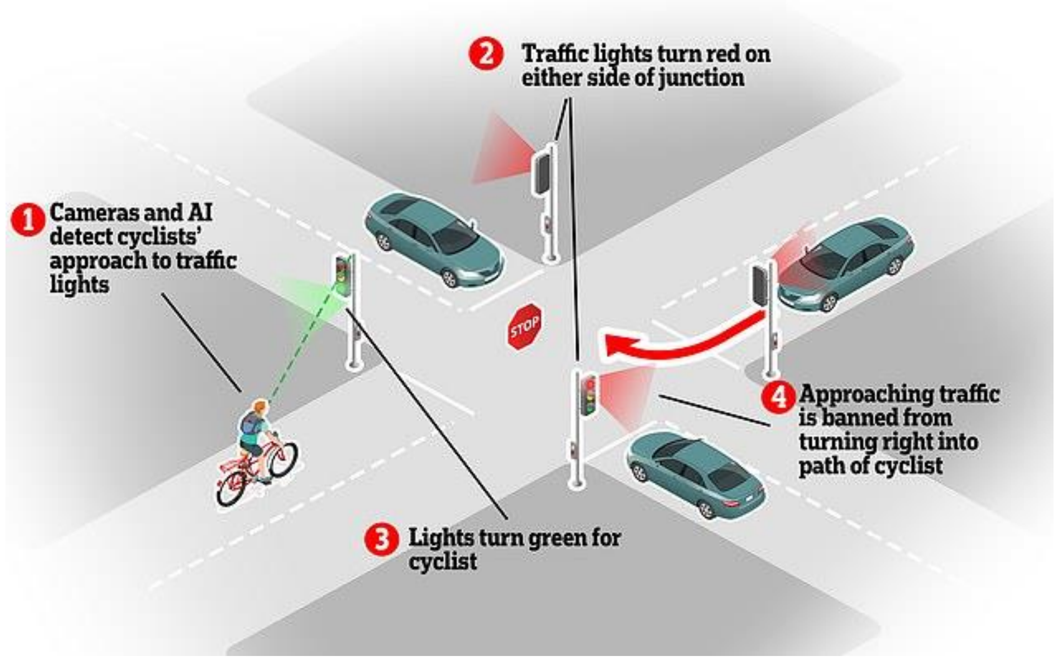
Pilots

- **C-ITS & UVAR** (Urban Vehicle Access Regulation)
  - Access restrictions for trucks
  - Cut-through traffic
  - Temporary speed restrictions near school areas
  - Tunnel height warnings
  - Speed restrictions for active mobility users (slow-speed zones)

Pilots

- **C-ITS & (urban) mobility services**
  - Truck buffering
  - P&R information
  - Traffic light priority for trucks and bicycles

SWAY



The project goals

- Deployment of **combined Day-1 and Day-1.5 C-ITS services** in Antwerp and Helmond
- Cross-border and **interoperability testing** of the services between Antwerp and Helmond
- **Evaluation** of the different services on:
  - Functional aspects
  - Impact assessment
  - User acceptance
- Development of **scalability and implementation strategies** for the different services.

Project timing

- November 2022: Start project
- Spring 2024: Start pilots in Antwerp and Helmond
- Summer 2024: End of pilots
- September 2024: Evaluation results
- October 2024: Finalisation project

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Webinars

- September 24th: Intelligent Speed Assistance
- October 1st: Traffic Light Prioritization

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ISA Explanation

Niels Kneppers – V-Tron

September 2024

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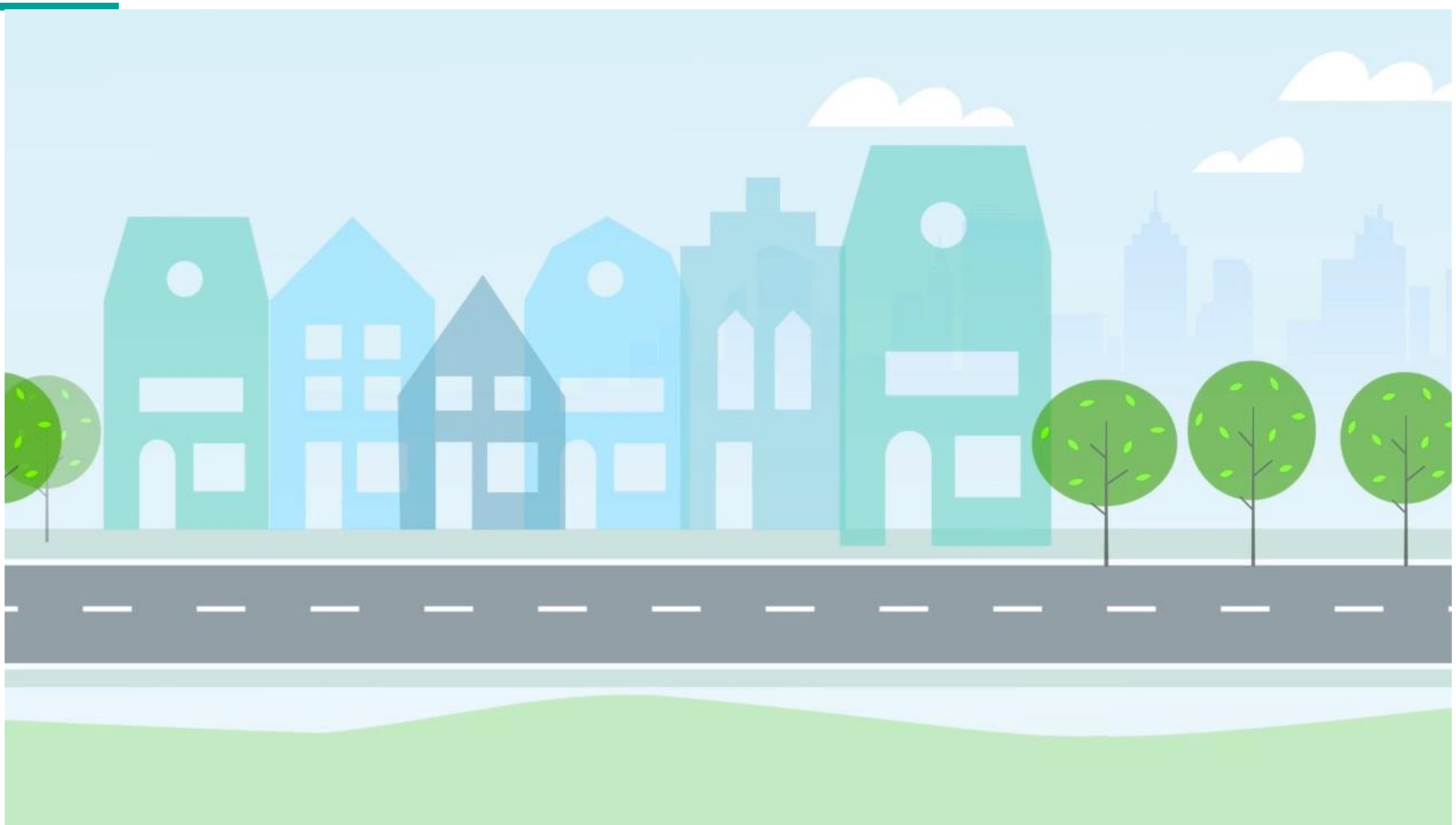
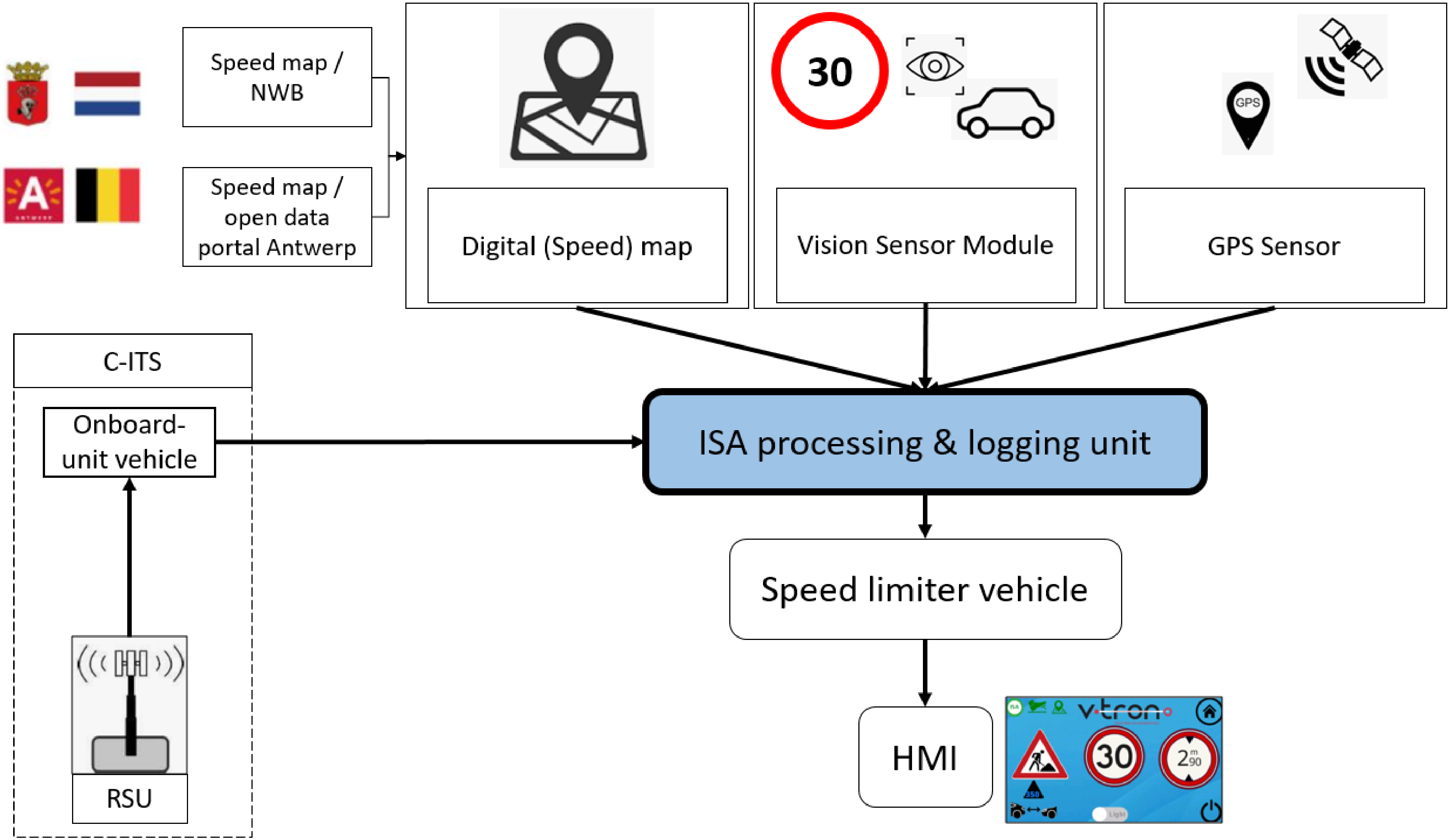
ISA video



ISA explanation



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ISA Project development

Niels Kneppers – V-Tron

September 2024

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ISA project development

- Updated digital maps
- Improved HMI
- Improved logging
- ISA Feedback-Loop

ISA Data back-end Helmond

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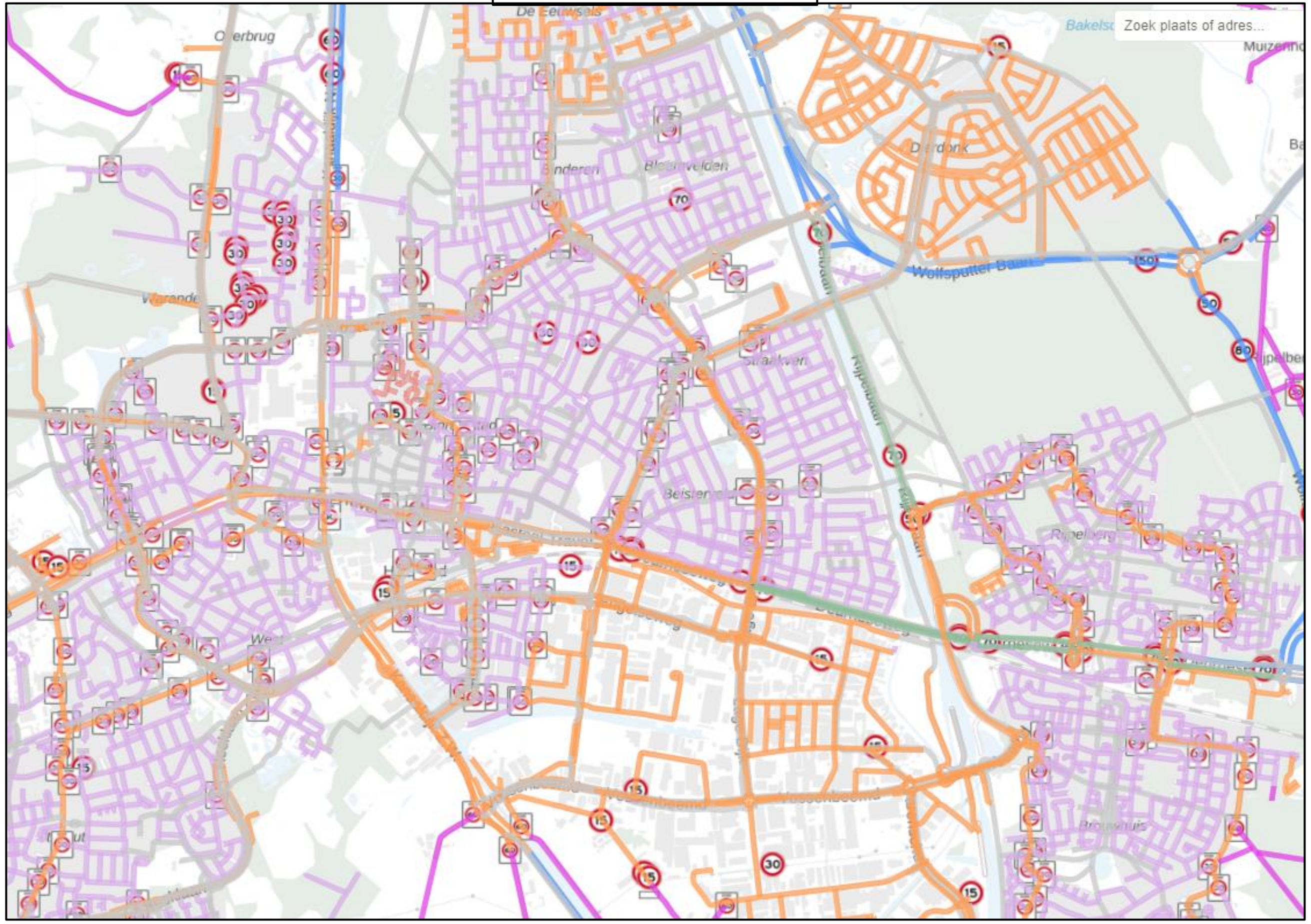
Data from National Road Database (NWB)

- Updated frequently, but having discrepancies with reality
- NWB – George shows the current state of the map and speed limits in the Netherlands
- V-Tron continuously retrieves the latest version of NWB map, ensuring best possible driving experience
- To improve map quality, ISA-feedback-loop is introduced (later this presentation)

NWB - George



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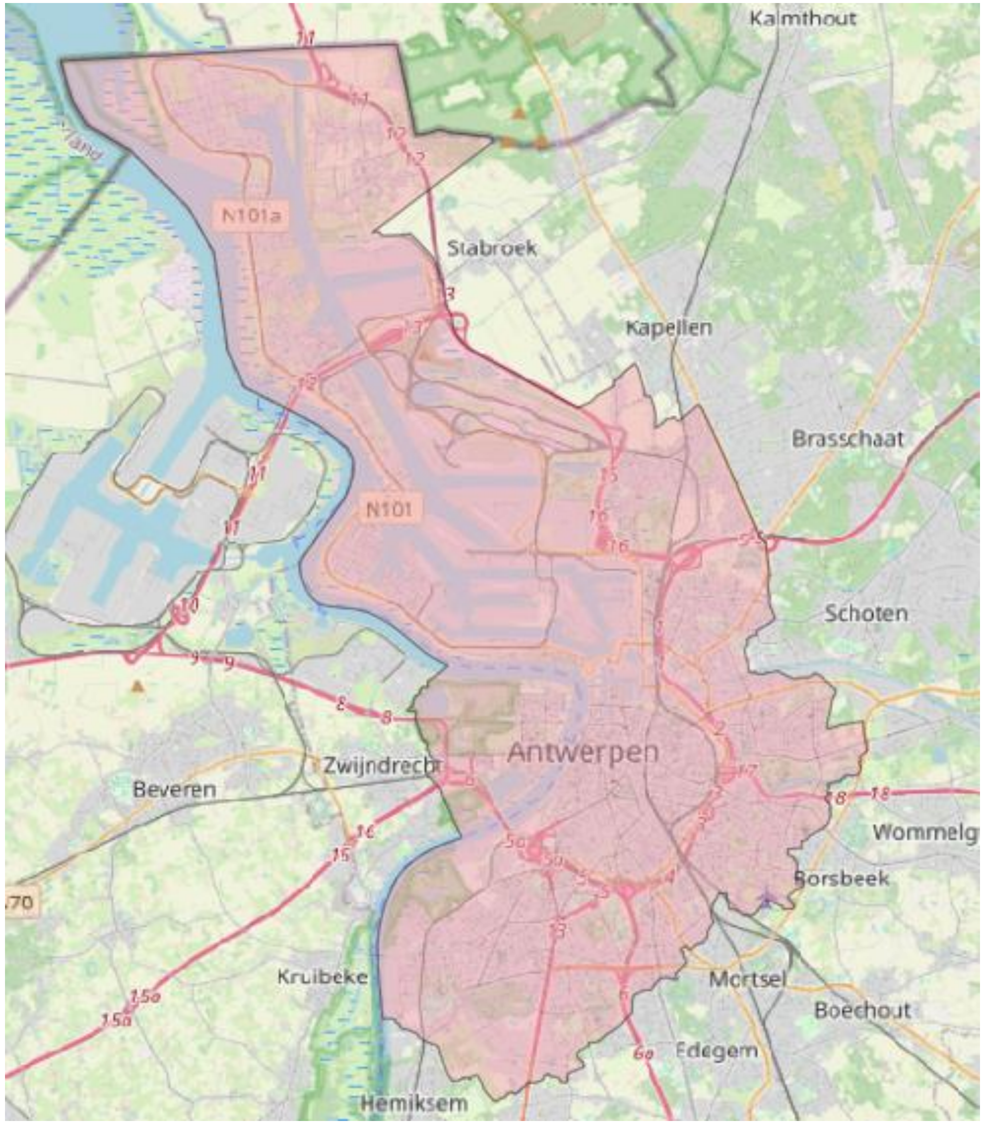
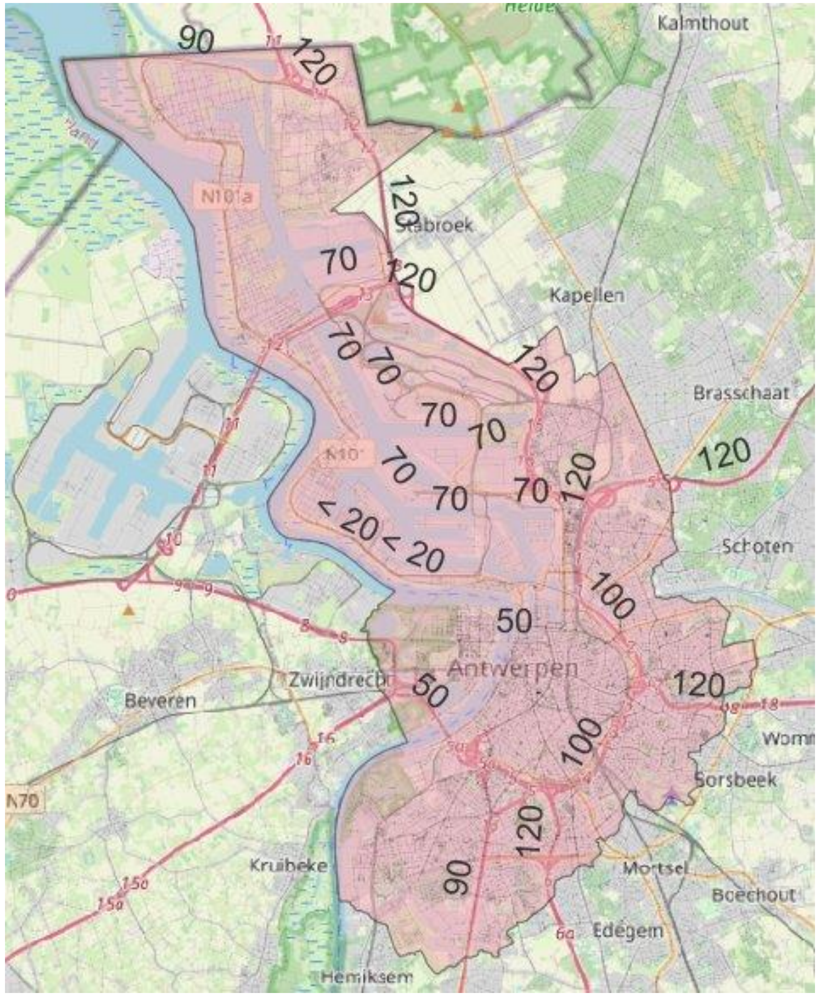
Data back-end Antwerp

- Initial focus on 'open data' from Flanders
  - Desktop research revealed the data was of poor quality
  - Decision was made to use data from City of Antwerp itself – combined set 'best of both'
- Extensive data processing, simulation, and physical testing have ensured coverage in the city of Antwerp and the main road network
  - Enabled cross-border functionality



Data back-end Antwerp

- Data used from Antwerp road authority combined with open data of Flander for the main roads
- V-Tron conducted extensive tests with Antwerp's data, but concluded there were <u>too many errors and new issues with the ISA system</u>, making it unsuitable for deployment in a large number of private vehicles as pilot
- Retro-fitting vehicle-fleets or private vehicles was an issue
- Multiple (new) issues were identified in Antwerp near tunnels and viaducts. These findings will lead V-Tron to further develop the system, its algorithms and logging



Improved HMI

V-Tron developed a new HMI for the ISA system

- Enables combination of C-ITS UC and ISA
- Improved visibility for the driver
- Sound warnings
- Textual warnings / instructions
- Icons show which functionalities are active
- Switching off ISA system **and** controller via screen

Improved logging

- Enhanced ISA logging enables more targeted improvements and allows for the assessment of the current implementation's effectiveness

```
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12,8,2024,3,34,46,51.204435,4.411605,4,2.12,30,30.0,A01-30,30,0.0,0,C,41.54
```

The ISA log file contains:

- ✓ Date
- ✓ Month
- ✓ Year
- ✓ Hour
- ✓ Minutes
- ✓ Seconds
- ✓ Latitude
- ✓ Longitude
- ✓ Number of satellites connected
- ✓ **Horizontal Dilution of Precision (HDOP)**
- ✓ Digital map speed limit
- ✓ Traffic Sign Recognition (TSR) speed limit
- ✓ **TSR speed limit type sign**
- ✓ **Previous speed limit**
- ✓ **Digital map alternative speed limit**
- ✓ Override (yes=1 / no=0)
- ✓ Current speed based on digital map (D), camera-based (C), or none
- ✓ **Current GPS speed of the vehicle**

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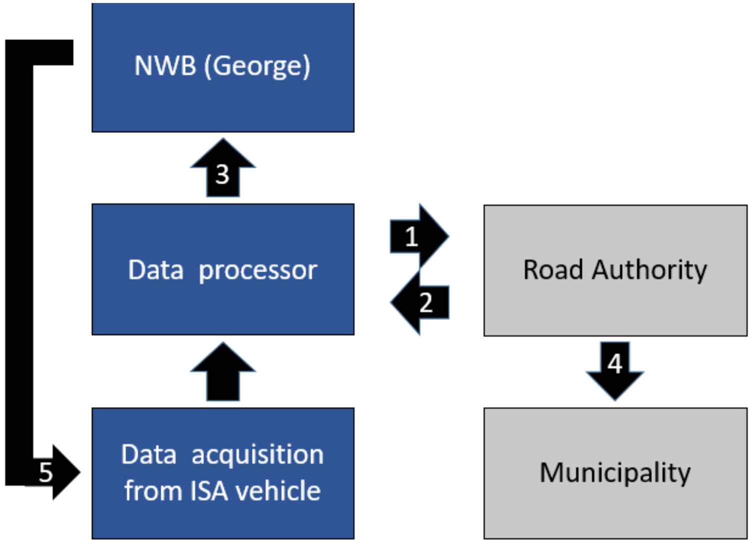
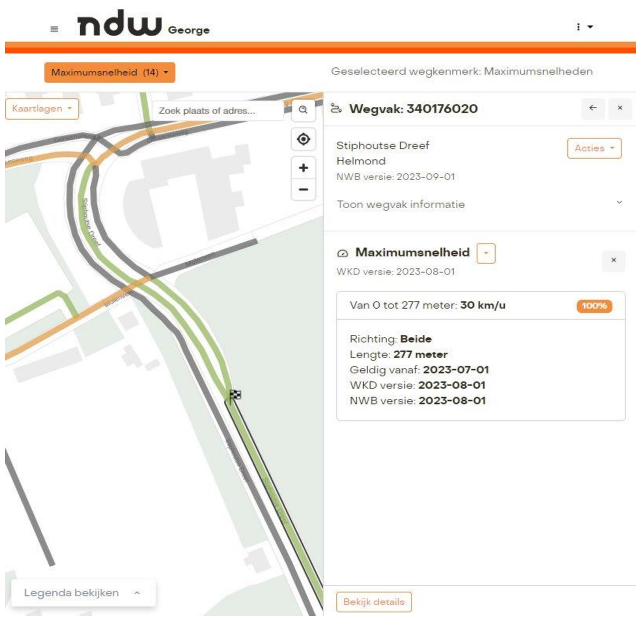
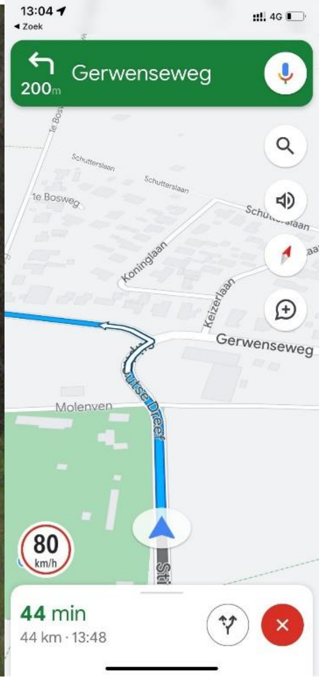
ISA feedback-loop

- Discrepancies in speed data exist between sources such as NDW (Netherlands), Google Maps, and actual road signs.
- Improvements are necessary to ensure accurate speed information.
- V-Tron developed and tested a feedback loop to address these discrepancies together with Helmond
- Discrepancies are logged and reported to road authorities.
- Road authorities can then update the speed information.
- NDW receives correct speed data, ensuring accurate information is displayed to drivers.



1. Detected deviation with processing advice
   a) Road segment file update proposal
   b) Traffic sign file update proposal
   c) Speed limit update proposal
   d) Physical signage adjustment proposal
2. Decision made
3. Change request (options a,b,c from road authority)
4. Follow-up action to adjust physical signage
5. Vehicles use the latest NWB update





ISA Feedback-loop

- In order to learn valuable lessons in Antwerp regarding ISA and improve the data:
  - Non-limiting ISA system is installed in Antwerp-Tax Taxi
  - Scanned traffic signs and info about the ISA 'map' status in Antwerp
  - **Traffic signs are scanned and events are logged** in Antwerp, which are currently analyzed for further improvement of the MAP
  - Antwerp's 'ISA feedback-loop'

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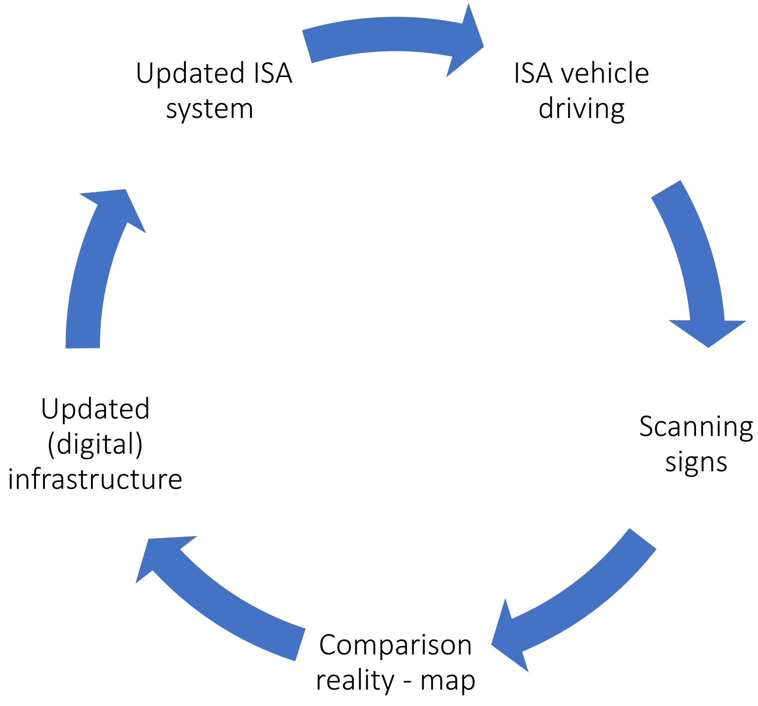
ISA Feedback-loop

- By equipping ISA systems in vehicles such as taxis, a significant number of kilometers are driven in the city (Antwerp) without requiring additional resources. This has several benefits:
  - Users can see progress based on their own data in their own city.
  - ISA developments can be accelerated, allowing OEMs to benefit from more accurate data.
  - It leads to higher acceptance rates.
  - It contributes to safer roads in the city.



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ISA & C-ITS

Johan Hellemans – Yunex Traffic

September 2024

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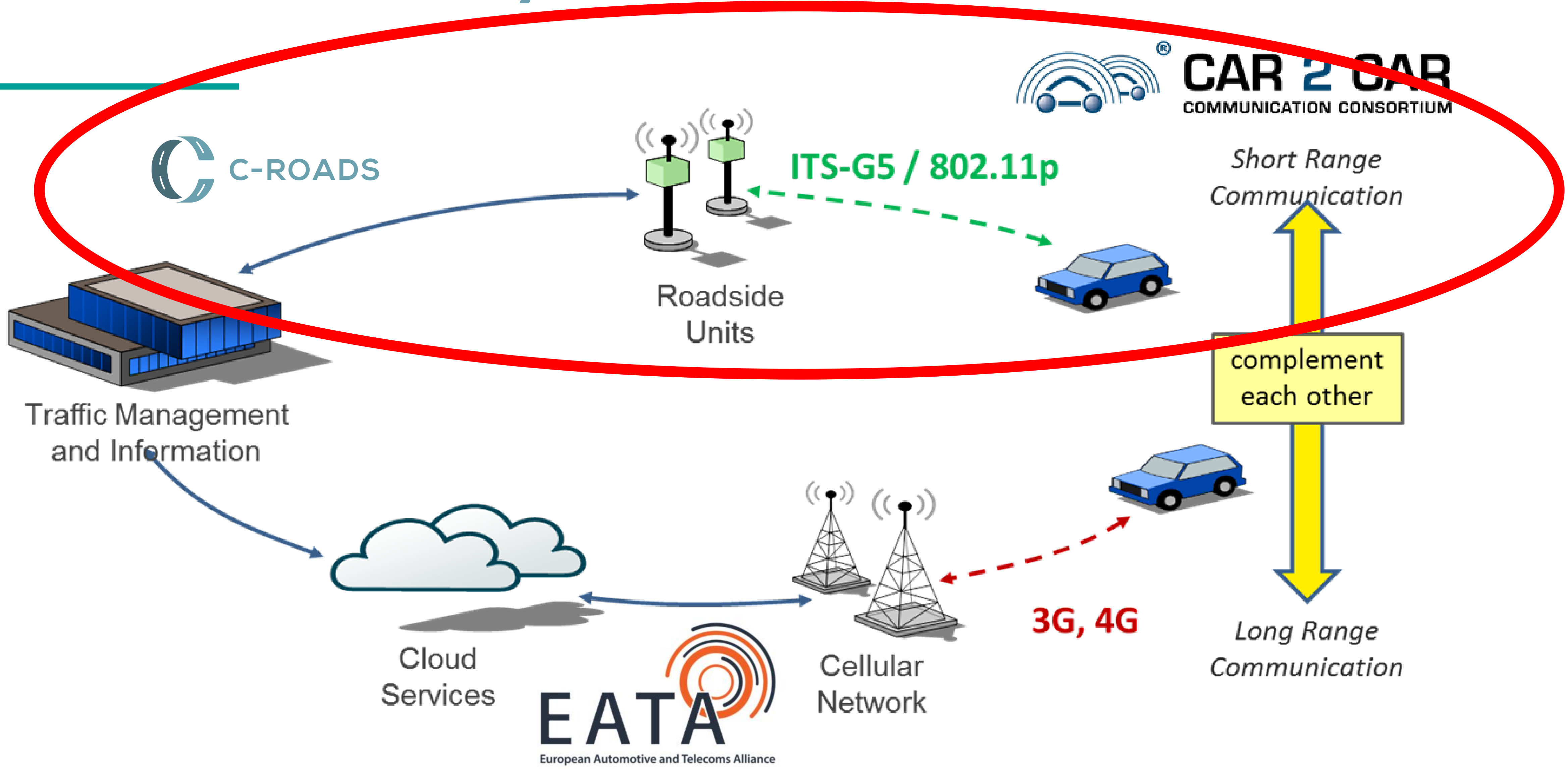
Yunex Traffic

Yunex Traffic Belgium provides Intelligent Traffic Solutions in the form of infrastructure and services. Typical examples in Belgium:

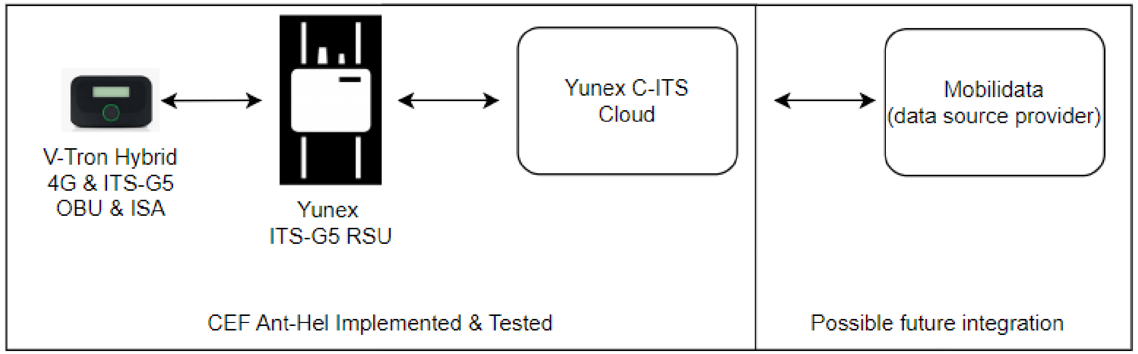
- Traffic Light Controllers and Traffic Management Centrals including C-ITS V2X short range & long range full stack solutions.
- Parking Guidance Systems
- Tunnel and waterways Infrastructure & Monitoring

C-ITS based on hybrid communication



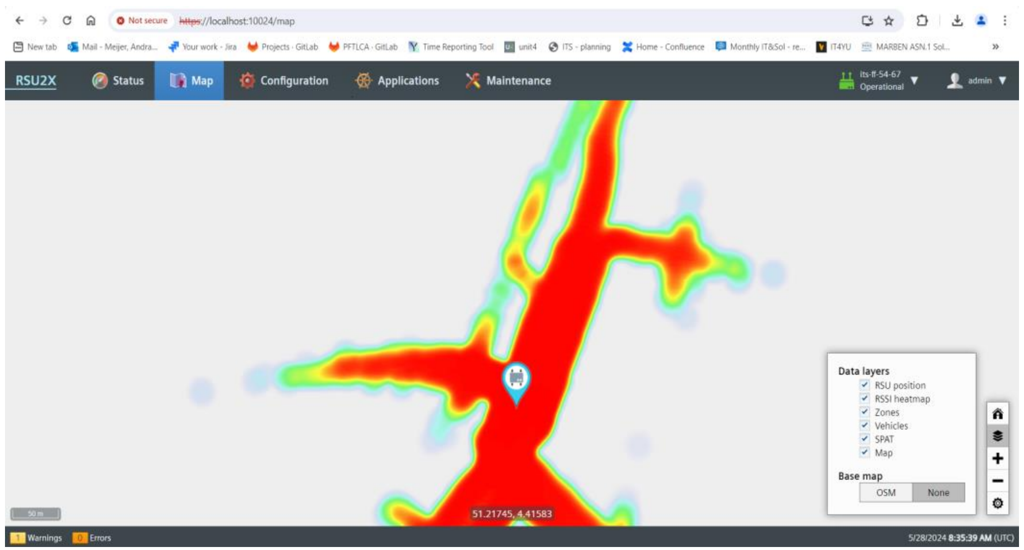
Yunex Traffic

Short Range Yunex RSU



We added connectivy for Yunex Short Range RSUs to our Open Yunex C-ITS Cloud to allow flexible interfacing with external data source providers and C-ITS platforms like Mobilidata:

- Flexible generation of ETSI IVIM & DENM messages
- Enhanced logging



Yunex Traffic

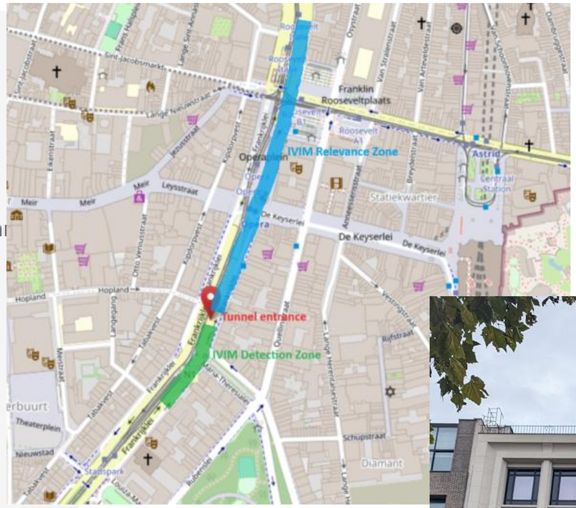
Tunnel Height Warning Antwerp:

- ETSI IVIM
- Detection Zone & Relevance Zone

Road Works Warning Helmond:

- ETSI DENM

"Ivims": [
{
"StationId": 1,
"CountryCode": "BE",
"ProviderIdentifier": 32,
"IviIdentificationNumber": 143,
"DateTimeFormat": "dd-MM-yyyy HH:m
"ValidFrom": "01-01-2024 00:00:00",
"ValidTo": "01-07-2024 00:00:00",
"Latitude": 512162330,
"Longitude": 44143590,
"SemiMajorConfidence": 4095,
"SemiMinorConfidence": 4095,
"SemiMajorOrientation": 3601,
"AltitudeValue": 800001,
"Direction": 0,
"IviType": 1,
"RelevanceZoneId": 1,
"DetectionZoneId": 2,
"Relevance": [
{
"DeltaLatitude": 23190,
"DeltaLongitude": 13960
},
{
"DeltaLatitude": 24690,
"DeltaLongitude": 9410
},
{
"DeltaLatitude": 2080,
"DeltaLongitude": -380
}
],
"Detection": [
{
"DeltaLatitude": -3280,
"DeltaLongitude": -1890
},



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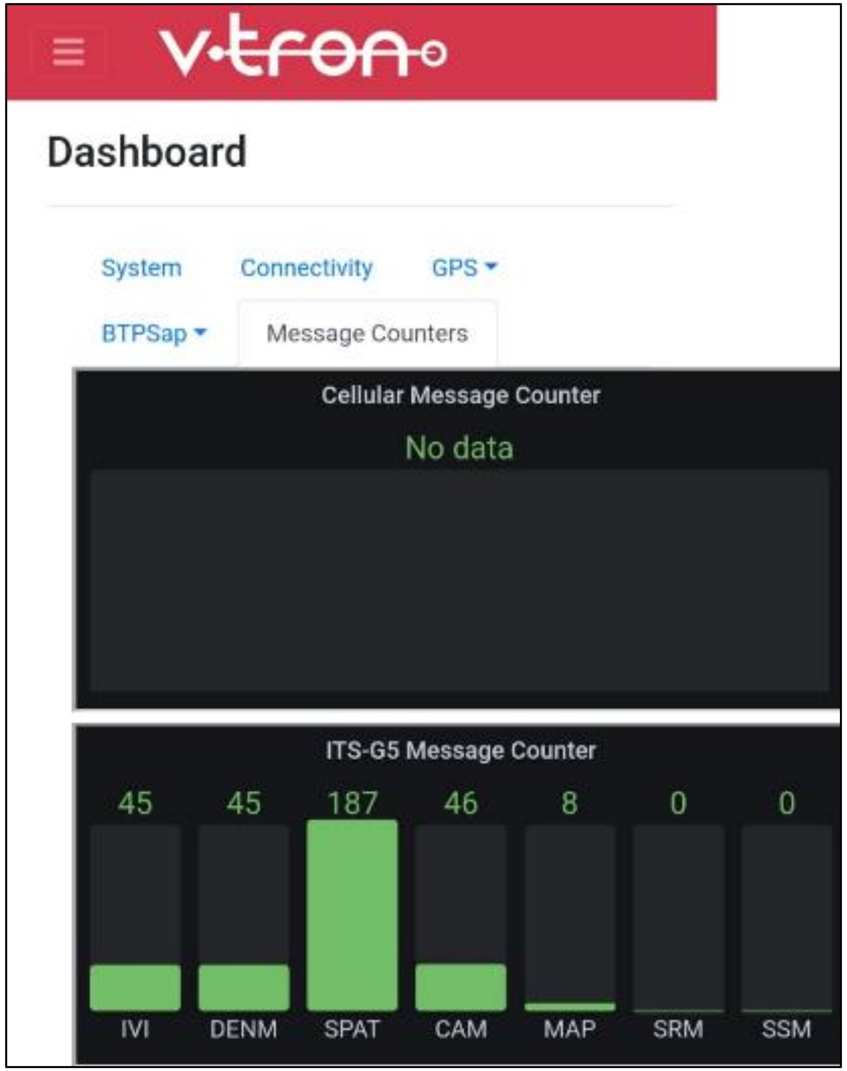
V-Tron OBU

- The **V-tron Hybrid Onboard Unit** is used, which is a C-ITS test platform easily installed in vehicles via a 12V connection.
- The Onboard Unit (OBU) is capable of receiving standardized (ETSI) messages both via:
  - **short-range** (ITS-G5)
  - **long-range** (cellular channels, e.g., 4G/5G)
- Messages include **CAM, DENM, IVI, SPAT,** and **MAP,** enabling various services.
- V-Tron has its **own backend** that can connect to various (long-range & short range) services and receive direct messages from the road-side unit operator, such as Yunex in this project.
- The Onboard Unit itself receives these 'raw' messages and converts them into simplified messages specifically for the **ISA system and its HMI.**
- This will also be demonstrated in practice today.



C-ITS & ADAS combination

- **C-ITS and ADAS**
  - Link ISA (ADAS) and C-ITS Day-1 services
    - Research on what usecases could be implemented with the ISA system
    - Focus on actualities and importance in Antwerp and Helmond

C-ITS and ADAS combination

All existing DENM and IVI messages can be implemented as warning with ISA system:

DENM
- Accident Notification
- Road Blockages and Obstacles
- Adverse Road Conditions
- Traffic Incidents
- Traffic Light Irregularities
- Emergency Situations and Evacuations
- Traffic Signs and Road Markings
- Lane Restrictions
- Etc

IVI
- Traffic Information
- Navigation Assistance
- Weather Alerts
- Roadwork Updates
- Parking Information
- Fuel Station Locations
- Safety Warnings
- Points of Interest (POI)
- Etc.

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Combined C-ITS and ISA services

- During the project, the C-ITS and ISA services have been combined
  - Improved HMI for the driver shows speed limit, and info from all possible IVIM and DENM messages

  - During the project demonstrated with
    - Roadworks Warning (Helmond & Antwerp)
    - Tunnelheight Warning (Antwerp)

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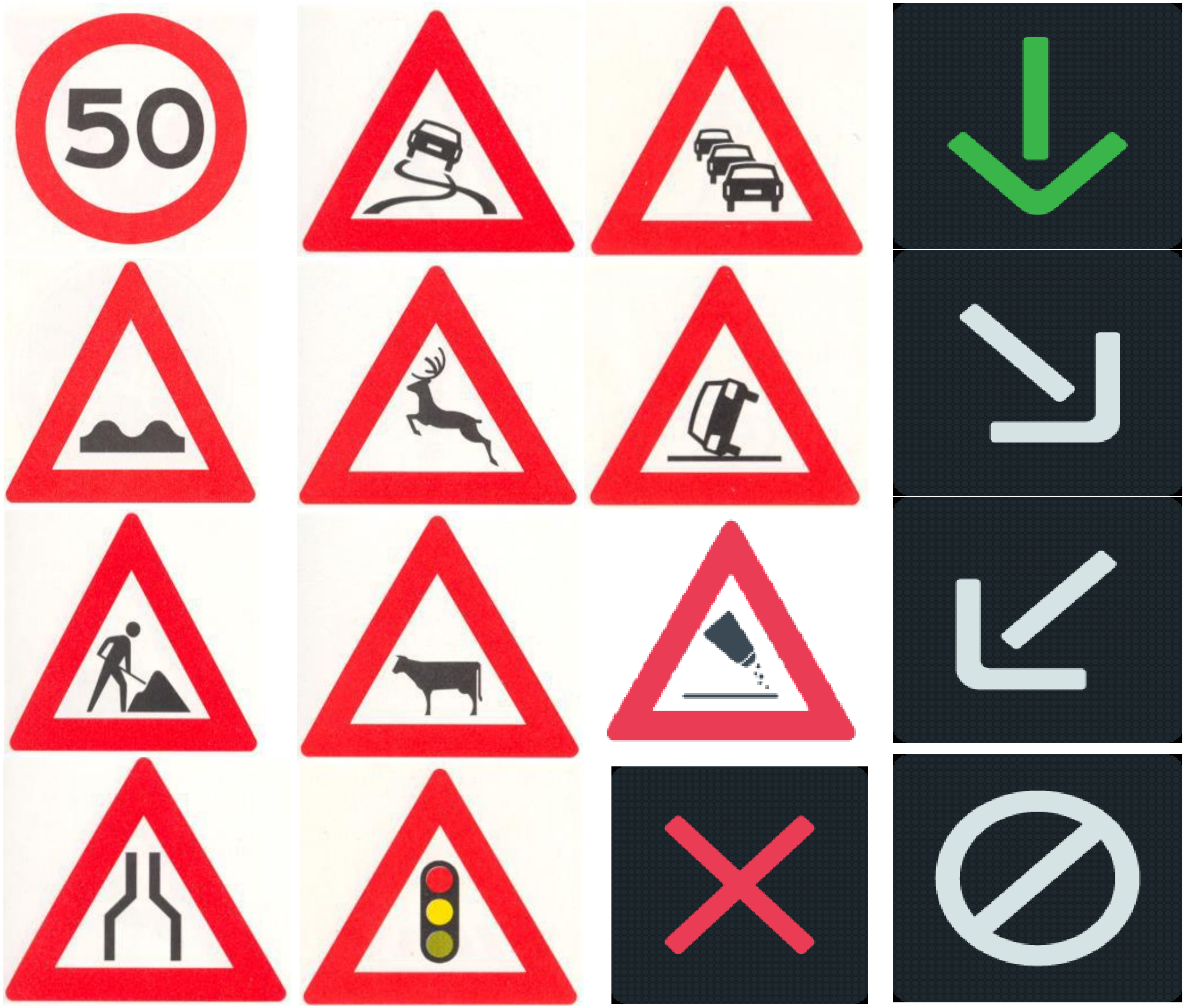
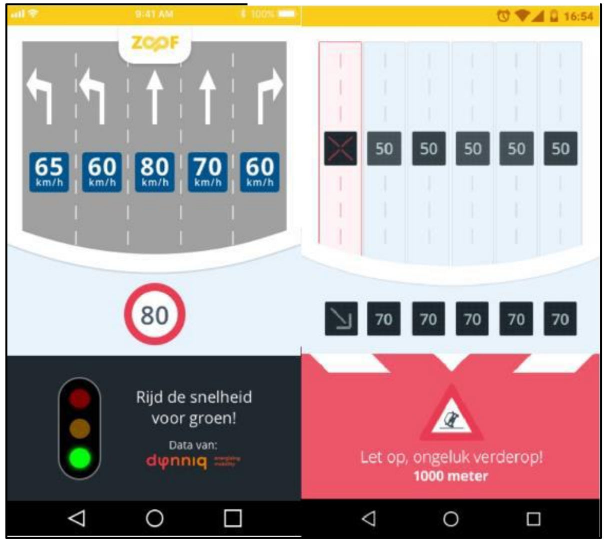
Combined C-ITS and ISA services

- Two usecases are demonstrated as combination of C-ITS and ISA services
  - Tunnel Height Warning
  - Roadworks Warning
- All combinations are possible with following messages:
  - **IVIM**
  - **DENM**



Combination of C-ITS and ISA services

- Combination of ISA and GLOSA information (Green light optimal speed advice)
  - Integration of the **SPAT** and **MAP** messages enable a combination of services
    - Urban services
    - Possibly reducing vehicle speed automatically in the future
  - *(Note: conceptual, not piloted)*



ISA - Roadworks Warning

YOUR WAY IN INFOMOTIVES

Suitable for all DENM messages!


```
{
  "events": {
    "updated": "2024-05-28T11:14:22.428000Z",
    "timestamp": 1716894862428,
    "gpspositionage": 1428,
    "receivedcount": 2,
    "receivedrate": 0.4,
    "event": [
      {
        "identifier": "1_2",
        "timestamp": 643986859762,
        "latitude": 51.216233,
        "longitude": 4.414359,
        "causecode": 3,
        "subcausecode": 4,
        "priority": 80,
        "trafficsign": "Road works",
        "servicecategory": "dangerWarning",
        "servicecategorycode": 11,
        "roadsigncode": 348,
        "extratext": [
          {
            "text": "Wegwerkzaamheden"
          }
        ]
      }
    ]
  }
}
```

ISA - Roadworks Warning

ISA - Tunnel Height Warning

Suitable for all IVI messages!


```
{
  "laneinfo": {
    "updated": "2024-05-28T08:15:44.923000Z",
    "timestamp": 1716884144923,
    "gpspositionage": 923,
    "receivedcount": 0,
    "receivedrate": 0.0,
    "info": [
      {
        "identifier": "BE_32_143",
        "timestamp": 1716891282140,
        "latitude": 51.216233,
        "longitude": 4.414359,
        "roadsign": [
          {
            "lane": 1,
            "trafficsign": "Maximum vehicle height",
            "servicecategory": "regulatory",
            "servicecategorycode": 12,
            "roadsigncode": 511,
            "maxvehicleheight": 2.9
          },
          {
            "lane": 2,
            "trafficsign": "Maximum vehicle height",
            "servicecategory": "regulatory",
            "servicecategorycode": 12,
            "roadsigncode": 511,
            "maxvehicleheight": 2.9
          },
          {
            "lane": 3,
            "trafficsign": "Maximum vehicle height",
            "servicecategory": "regulatory",
            "servicecategorycode": 12,
            "roadsigncode": 511,
            "maxvehicleheight": 2.9
          },
          {
            "lane": 4,
            "trafficsign": "Maximum vehicle height",
            "servicecategory": "regulatory",
            "servicecategorycode": 12,
            "roadsigncode": 511,
            "maxvehicleheight": 2.9
          }
        ]
      }
    ]
  }
}
```


v·tron
YOUR WAY IN INFOMOTIVES

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ISA - Tunnel Height Warning

Demonstrated in Antwerp

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Antwerp-Helmond

Lessons Learned

September 2024

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Lessons Learned

- Ensure that the centralised digital map is accurate: prioritise data accuracy and continuous map updates
  - establish clear data qualitiy standards and guidelines
  - implement automated data validation and verifications (feedback loop)
  - enable real-time updates to digital maps
  - encourage collaboration among data providers
- Improvements and optimizations to ISA are required in the following areas:
  - tunnels and bridges with layered signage,
  - the end of speed limit restrictions at dynamic traffic signs (green arrow),
  - expanding ISA to include sound signals, and stop commands.
- Facilitate seamless collaboration and trust establishment

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Q & A

September 2024

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Given that ISA has been mandatory in new vehicles since 2024, how have you experienced this technology in your own driving or as a passenger?

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