5G in SHOW - Tampere Site

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SITOWISE

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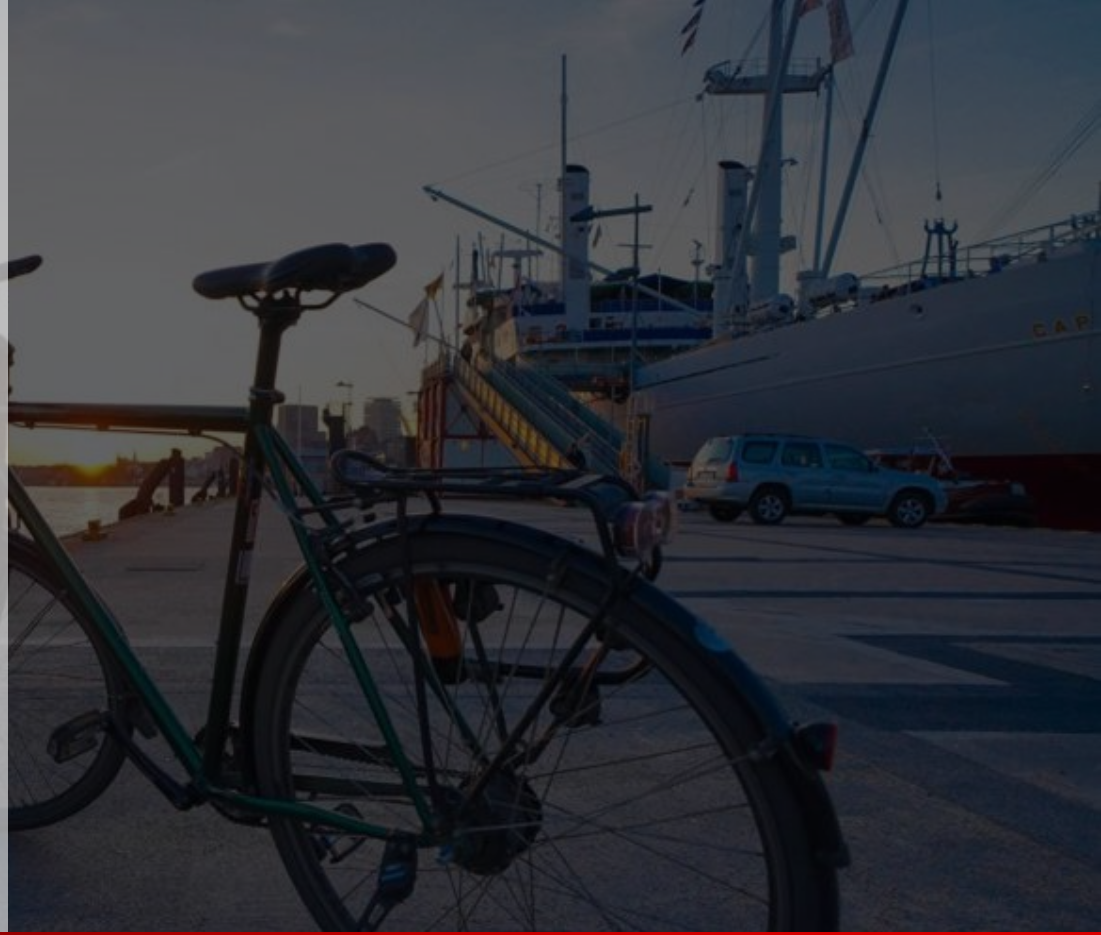

SHOW

SHared automation Operating models for Worldwide adoption

aims to support the deployment of shared, connected and electrified automated vehicles in urban transport, to advance sustainable urban mobility.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agree

SHOW WILL

Develop technical solutions, business models & priority scenarios for impact assessment

Deploy shared, connected, electrified fleets of AVs in public transport, Demand Responsive Transport (DRT), Mobility as a Service (MaaS) and Logistics as a Service (LaaS)

Conduct real-life urban demonstrations taking place in 20 cities in Europe for 24 months, with real service seamless operation in each pilot site lasting at least 12 months

SHOW will deploy more than 70 SAE L4/L5 AVs for both passenger and cargo transport in dedicated lanes and mixed traffic, connected to a wide range of supporting infrastructure (5G, G5, IoT) and operating under traffic speeds ranging from 18 to over 50km/h.

SHOW DEMOS

5 Mega sites

Sweden, Germany, France, Austria, Spain

6 Satellite sites

Finland, Denmark, the Netherlands, Italy, Greece, Czech Republic

3 Follower sites

Belgium, Geneva, Thessaloniki

(and at least 10 more are targeted throughout project)

SHOW IN BRIEF

We are on M22!

January 2020 – January 2024 (48 months)

69 partners from 13 EU-countries

Twinning actions with 11 global organisations

€30 million

SHOW PARTICIPANTS

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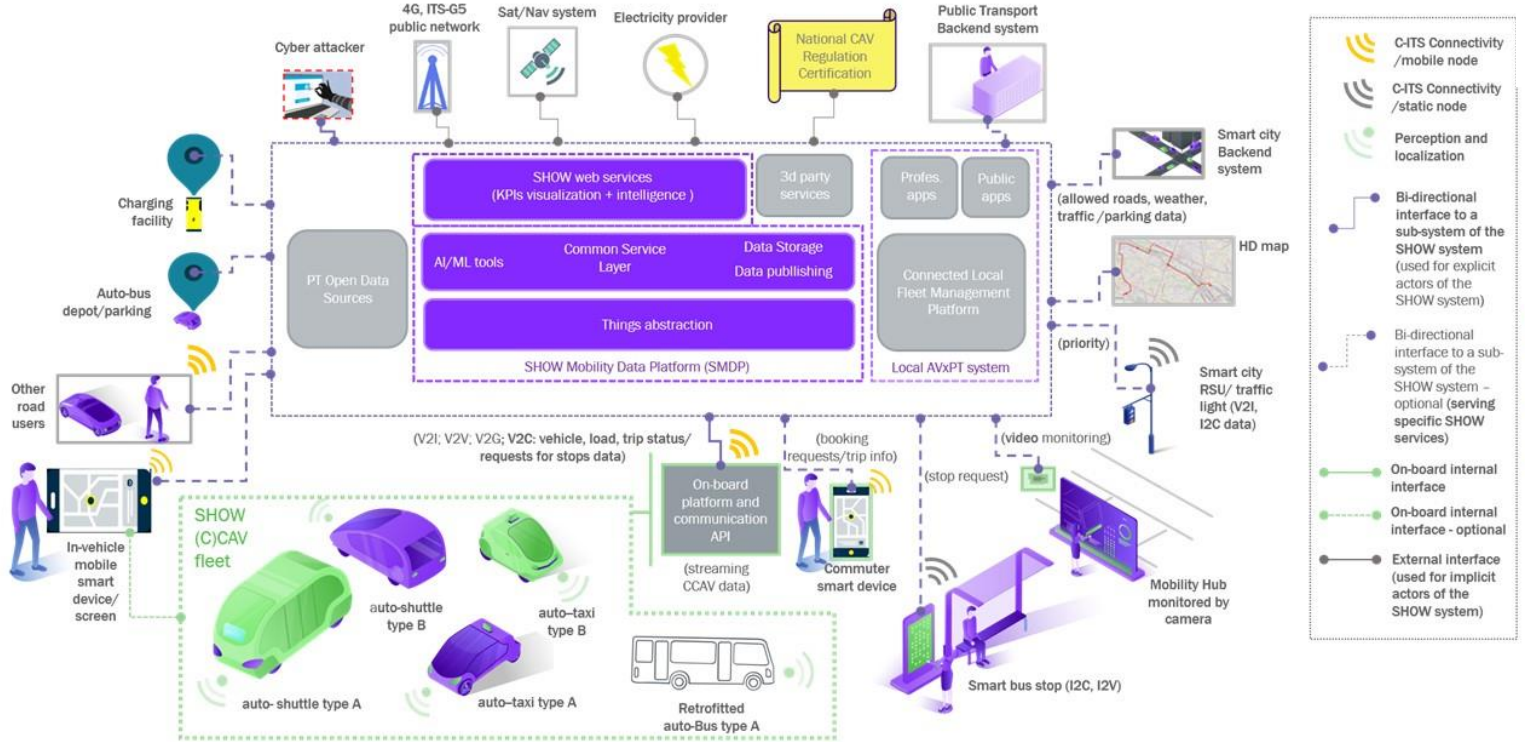
DIGITAL & COMM. INFRA

- Digital & Communication in SHOW is HYBRID, across sites AND within the same site
- 4G, 5G, ITS-G5, Wifi, …
  - distributed but also centrally monitored system respecting and relying on the most mature technologies in place…
  - to accommodate a multifaceted architecture (and its variations) & number of use cases ranging from platooning to teleoperation with shared CCAV of up to 50km/h of SAE Level 4/4+
- Coupled physical infrastructure equally varying: RSUs, 4G/5G base stations, Traffic Lights Controllers, Variable Message Signs, GNSS augmentation RTK stations, Sensors (on-board, infra), web services fed by sensors and other surveillance systems (real-time weather data, …), Fleet Management Centres (dynamically interfacing CAV), Traffic Management Centres wishing to interface with Fleet Management Centres among other, Centralised Data Collection Platform & Dashboard collecting, processing and visualizing static and dynamic fed data.

CONCEPTUAL VIEW

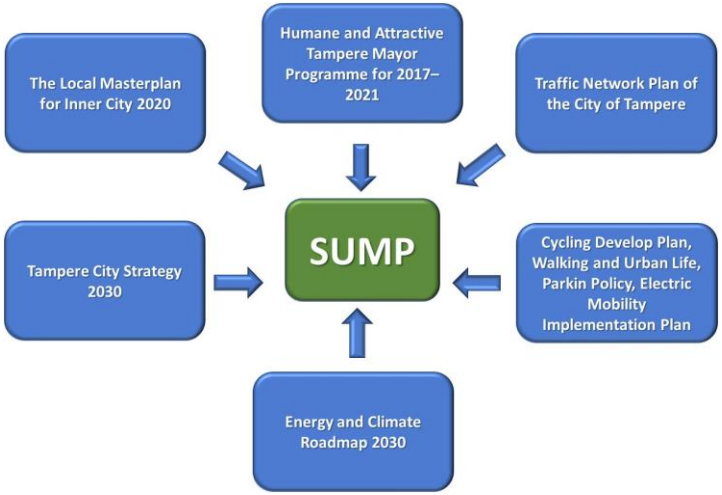


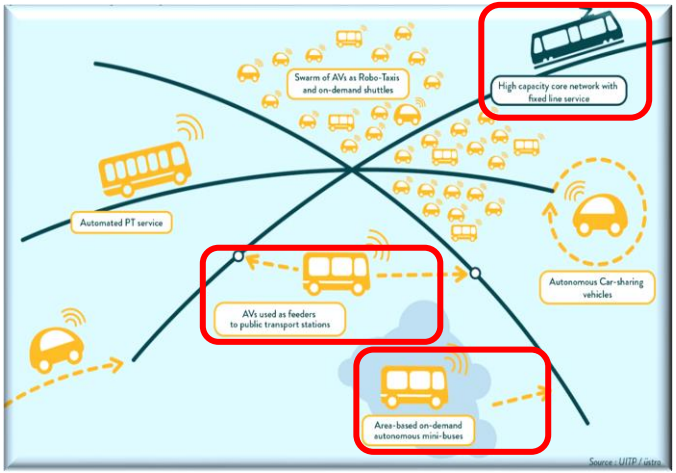
ARCHITECTURE VARIATIONS

- *CCAVs data ingestion cloud platform privately owned*
- *Multiple data ingestion cloud platforms*
- *Multiple data ingestion cloud platforms plus shared data ingestion platform for open real-time data publication*

SCOPE IN TAMPERE

- Automated feeder transport is based on the strategy and objectives of the City of Tampere.
- Tampere Mayor Programme 2018-2021 states: ”The objective is to create a public transport system, where train, tram, bus and city bike services support each other. The aim is to have autonomous buses gradually operating in feeder services in Tampere by 2021”.





INTEGRATED PUBLIC TRANSPORT

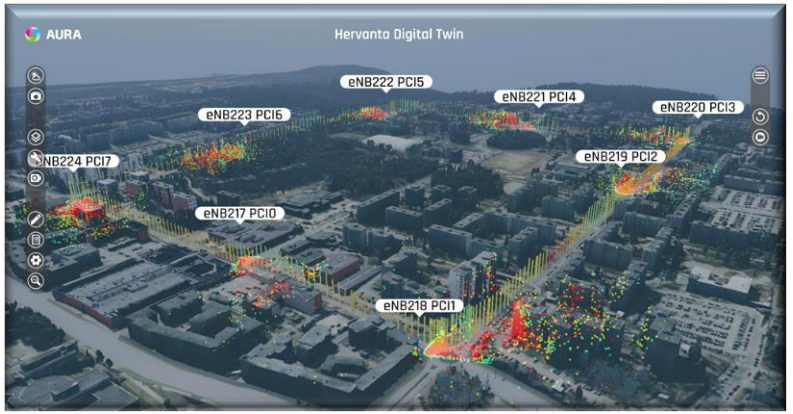
- Tampere wants to promote low-carbon, energy-efficient transport.
- The backbone of public transportation system is 20 km long tramway.
- Autonomous feeder transport service piloting will be carried during the SHOW-project.
- Several national activities are carried out in parallel.
- Seamless automated feeder transport in Hervanta suburb to start in the beginning of 2022.
- Testing/pre-demo to start in the autumn 2021.
- First fix-route services, later also DRT services.
- Two level 4 Toyota Proaces from Sensible 4 in ans one electric Auvetech shuttle bus from VTT Hervanta residential area – secured and ready for operation.
- Three more buses are targeted.
- There are plans to deploy feeder services in several areas in Tampere.

DEVELOPMENT – OEM VIEWS

- 2021-22 Autonomous driving in urban and suburban environments 0-40 km/h (last/first mile application) with safety driver.
- Q2/2022 Last/first mile application ready for fully autonomous driving in closed areas without mixed traffic.
- 2023 Fully autonomous (no safety-driver), driving on own lanes in open areas.
- 2024 Last-mile ODD, simple routes, shared lanes, public roads.
- 2025 True last-mile, autonomous, operations in commercial setting with complicated routes, on-demand, urban/suburban settings.
- 2026 trunk lines and highway operation 0-80 km/h.

5G IN HERVANTA SUBURB 1/2

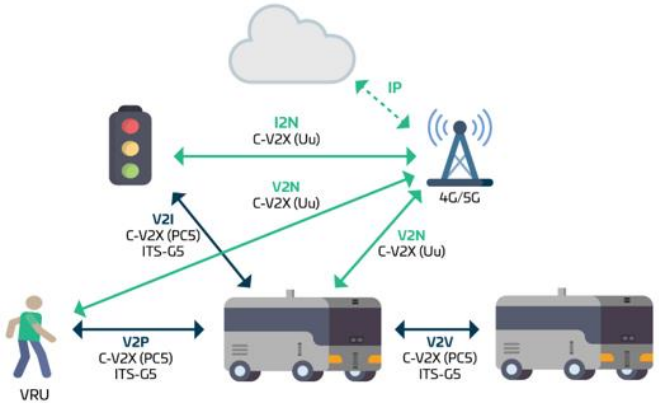
- In Finland national legislation allows remote manouvres.
- Cyber secure remote monitoring & control targeted - real-time communications needed.
- Remote monitoring & control will benefit from capacity, realiability & low latency of 5G.
- 5G base stations need also fiber optic connection.
- Use of 5G in automated transport is studied in SHOW and several other projects in Finland.
- Private 5G-test network (enhanced 4G/LTE) and ITS G5 units are available in Tampere/Hervanta.
- Test network has MEC (Mobile Edge Computing) & low latency and there are plans to update the test network (lack frequencies available, though).
- Public 5G networks are available in Tampere and offer bigger bitrate, but latencies are longer.



See also https://www.youtube.com/watch?v=G8Nj2-BmUtI

5G IN HERVANTA SUBURB 2/2

- Short range communications C-V2X (PC5) vs. 5G (5G-Drive project by VTT):
  - Packet error rate highly increases when communication range (~700 m) is reached for C-V2X (PC5)
  - Latency variation in cellular network is higher compared to C-V2X (PC-5)
  - Obstacles (i.e. non line-of-sight) decrease network performance especially in 5,9 GHz bands.
  - GLOSA/SPAT messages are useful for automated driving when approaching intersection area.
- Challenges/motivation for further work:
  - Automated driving requires “hidden knowledge” concerning intersection driving intentions.
  - The available automotive sensors cannot see everything.
  - Interaction between manually driven cars and automated ones.
  - Interaction between VRUs and automated vehicles.



DEVELOPMENT PATH

- Sitowise has prepared an Autonomous Bus Development Path report for the Cities of Turku and Espoo.
- In addition to the Cities, all the major stakeholders (national transport authorities, ITS Finland, regional transport operators etc.) are in the Advisory Group of the initiative.
- The report was published in August 2021. The role of 5G and ITS-G5in automated transport are strongly present in the work.
- Summary report will most likely to be published in English.

THANK YOU ALL

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