5G Test Network Finland - infrastructure and ecosystem for 5G evolution technology and application development

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5G Test Network Finland Targets

MISSION

5G Test Network Finland is open and evolving innovation ecosystem supporting **5G evolution and Beyond 5G technology research and validation**, **vertical industry product development** and pioneer company experiments.

VISION

5G evolution and B5G R&D and **utilization of AI and novel cyber security** concepts are ramping up and offer excellent business opportunities to both telecom and vertical industries

REQUIREMENTS

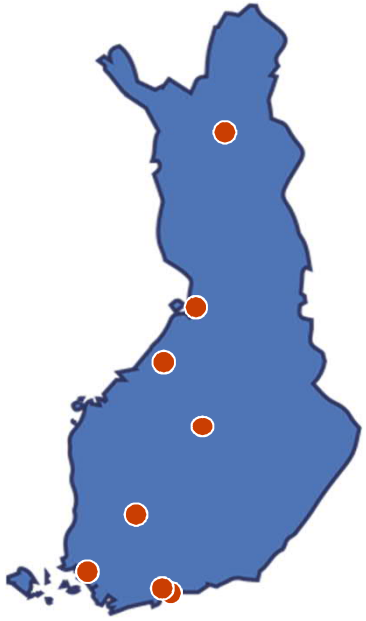
SOLUTIONS FOR VERTICALS

- Smart Industries
- Smart Cities and Living
- Smart Mobility
- Smart Health and Wellbeing

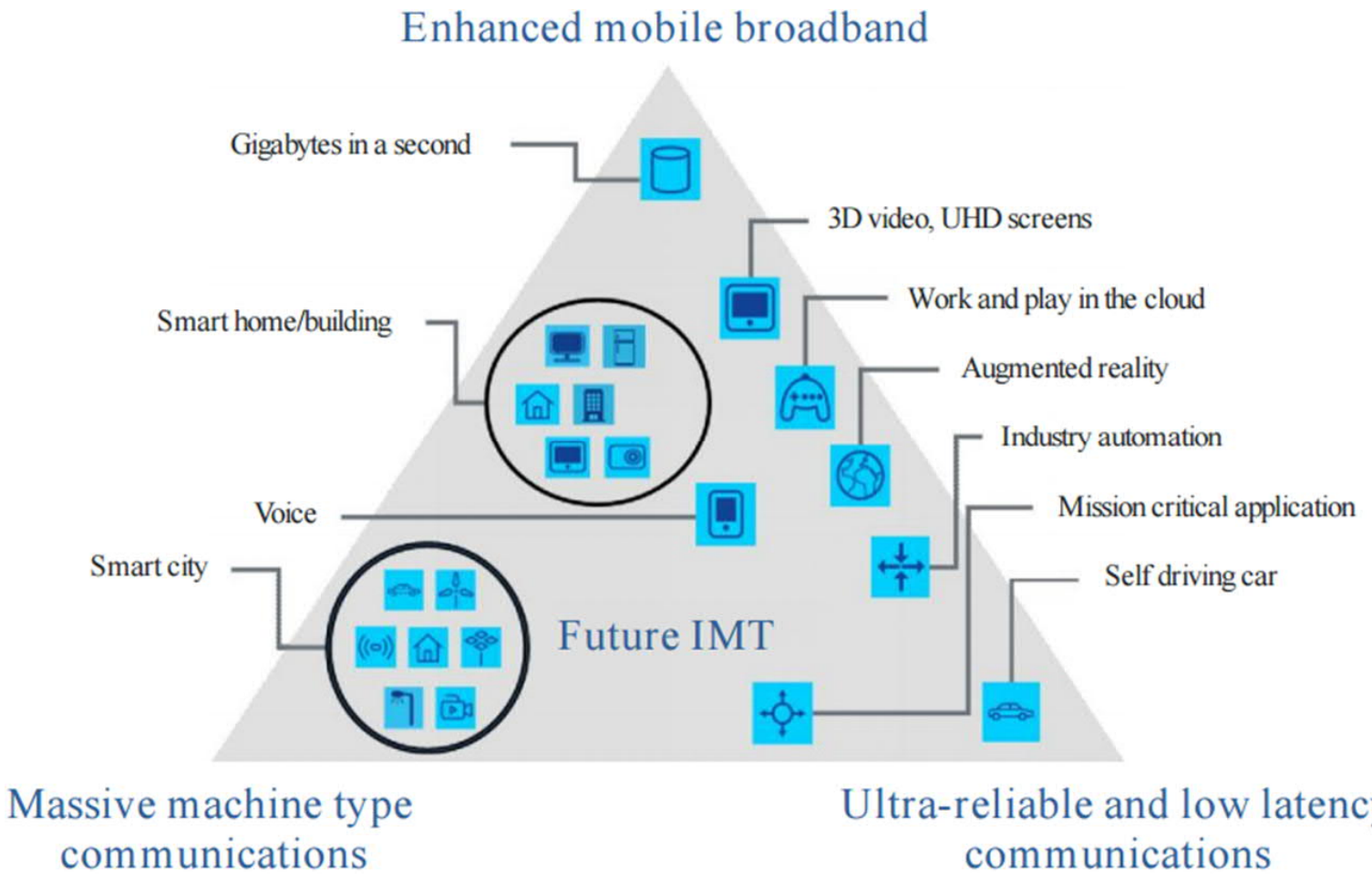
PLATFORM R&D

- Beyond 5G Network and Radio enablers
- Artificial Intelligence
- Service security privacy and data management
- Development and integration of test network

TECHNOLOGIES & PLATFORM



Why we need 5G Test Network Finland ?



5G features:

- Unlimited Broadband experience
- Instant Action
- Things Connected
- Ultra Reliability
- Slicing
- Virtualization
- Energy saving

Source: 5GPPP

General Targets

- regeneration
  - 3GPP **Rel16->, 5G and beyond** communication concepts, towards 6G
  - **utilization of AI** in radio resource and network management and vertical use case implementation, novel **cyber security** concepts
  - **vertical use cases** utilizing 5G and beyond, AI and cyber security concepts
- interdisciplinary approach
  - co-operation between **telecom and vertical** (automation, energy, health, safety, media, automotive, buildings, …) area technology and **business model** experts
- differences compared to existing research;
  - Strong support to **verticals**
  - **Integration** of Beyond 5G research, vertical use case design, utilization of AI, cyber security concepts and large area research infrastructure implementation
- differences compared to pre-commercial test environments;
  - more **future looking**, non-commercial (still under standardization and research, utilization of AI, novel cyber security) technologies, flexibility, wide set of tools and co-operation possibilities with wide eco-system

Ecosystem founding members

Network manufacturers

Operators

Technology and R&D service providers

Testing systems and tools manufactures

Verticals/ applications developers

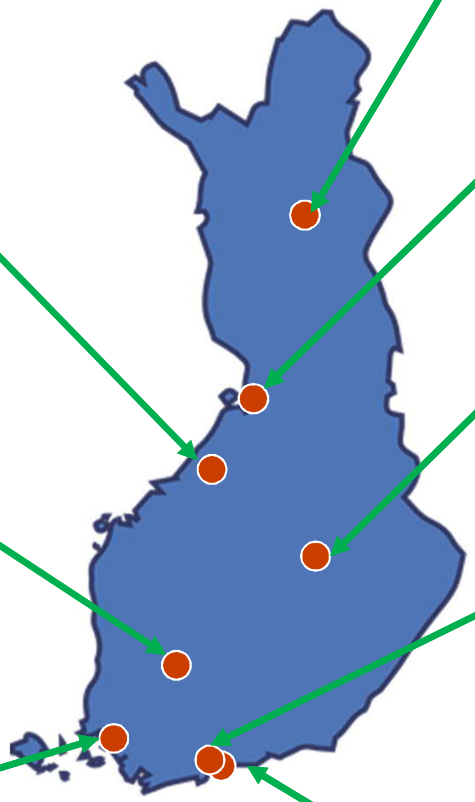
Public organizations

Research organisations

Current core test platform with state-of-the-art technologies

- From LTE evolution to 5G radio access
- Provides access for the IoT network (NB-IoT, LTE-M, LoRa) to test your devices and applications
- New frequencies and spectrum sharing
- MEC's to bring services close to users access
- Network slicing
- C-RAN, SDN and NFV technologies
- eMBMS enables efficient broadcasting to mobile users
- Core network in a cloud environment
- Cloud systems for applications
- Connection between test sites in Finland and worldwide
- Monitoring of selected KPIs from network elements and interfaces for your use case

Sites



Sodankylä

Oulu
VTT &University of Oulu

Ylivieska
Centria University of Applied Science

Kuopio
Savonia University of Applied S

Tampere
Tampere University
Wirepas

Espoo
Aalto University
Nokia
TietoEVRY
VTT

18.2.2021

Turku
Turku University of Applied Science

Helsinki
University of Helsinki

Technologies and frequencies

Mainly LTE and 5G-NSA capability but also some 5G-SA capability

LTE-FDD, LTE-TDD, NB-IoT / LTE-M, 5G NR (TDD)

Frequencies in use: **LTE** B1/2100MHz, B3/1800MHz, B7/2700MHz, B28/700MHz, B38/2600MHz (TDD), B40/2300MHz (TDD), B42/3500MHz (TDD) & **5G** NR n78/3500MHz, n258/26GHz, n257/28GHz

Others: Wi-Fi, LoRa, IoT mesh, Ka-band satellite

Network in numbers

Several 10s of network numbers (PLMN)

Several core instances both EPC and 5GCore

10s of base station sites

Several 10s of base stations and cells

>100 radios around different sites

- **>10** 5G NR macros and **>20** LTE macros (and **>10** mmWave 5G NR more coming)
- **>20** 5G NR and **>40** LTE pico radios indoors

>100 000 m^2 outdoors and >10 000 m^2 indoors coverage

Coverage

Tampere: Hervanta campus, Korkeakoulunkatu street areas

Ylivieska: Centria campus area, Vierimaantie

Espoo: Aalto campus and VTT buildings, Maarintie, Otakaari, Tietotie, and Tekniikantie areas in Otaniemi, Nokia Karaportti campus

Oulu: Oulu university campus and VTT office in Kaitoväylä and Linnanmaa area

Turku: TUAS campus in Joukahaisenkatu in Kupittaa

Helsinki: Helsinki university campus in Kumpula

Sodankylä: Air field together with vehicle winter testing area

End-user devices

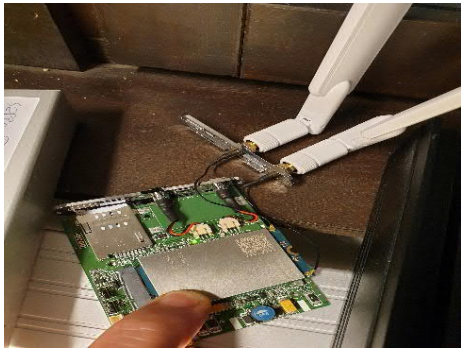
What to keep in mind when selecting devices for test network:

- Support for frequency combinations, NSA – SA operation, operator locking
- Nice to have features: band locking, signal strength monitoring

Yet to find the ultimate test device!

Quectel (NSA and SA), Sierra Wireless (NSA), MediaTek, TeleWell 5G modem, …

Different phones



Platform R&D focus

- ***Radio Technology enablers****:* positioning and tracking, RAN support fo UAV's, multi-RAT mobility and connectivity, mmw massive MIMO, uRLLC platform, radio enablers for dense 5G networks

- ***Network Technology enablers:*** Edge computing, Network slicing, Industrial Internet, Massive scale autonomous IoT network, 5GNTN

- ***Artificial Intelligence:*** network management and self healing, mobility and radio beam management, uRLLC and E2E reliability, Media & Entertainment, AI integration to verticals

- ***Service security privacy and data management:*** AI applications in Security, Trust and blockchain, DoS vulnerabilities and defencies, Roaming security, Cyber-Security interface for verticals

- **Development and integration of test network:** Platform experiments manager and cross platform orchestrator

5G for smart manufacturing – industry X technology vision

AI enabled cognitive, resilient and adaptable manufacturing with automatic decision making and forecasting

Digital twins and simulation models for the evaluation of industrial assets at all factory levels and over system or product life-cycles

Digital data platforms for integrating factory systems, sensors, supply network, and customers, smart contracts, data analytics

Human centred manufacturing, human in the loop (automation, data), multimodal interaction, human-cobot collaboration, employee skills and wellness

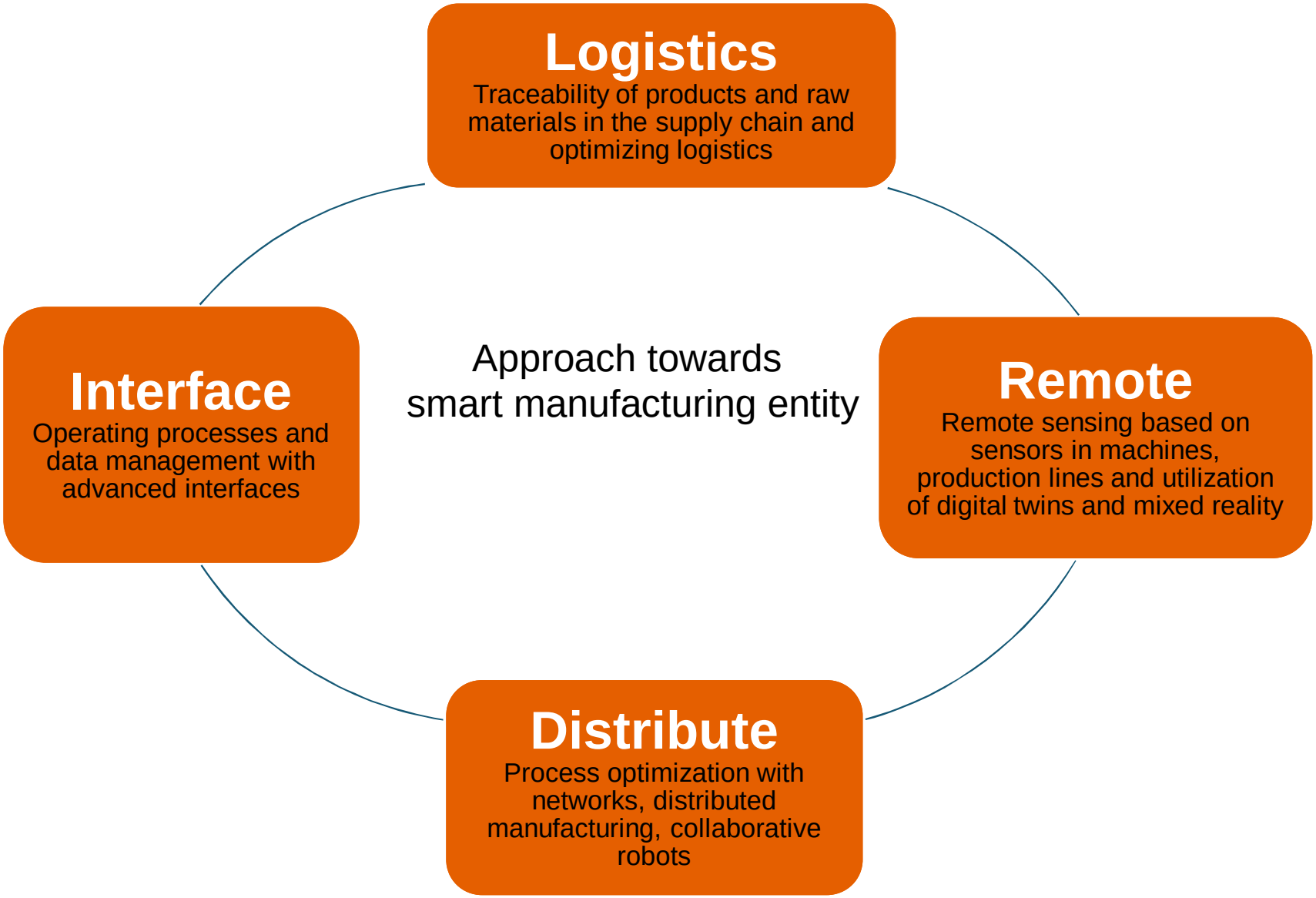
Sustainable manufacturing in a circular economy in a sense of energy and resource consumption and impact in the environment

Advanced automation that is data driven, predictive, human/mobile robot resourcing, cobotics, next generation MES

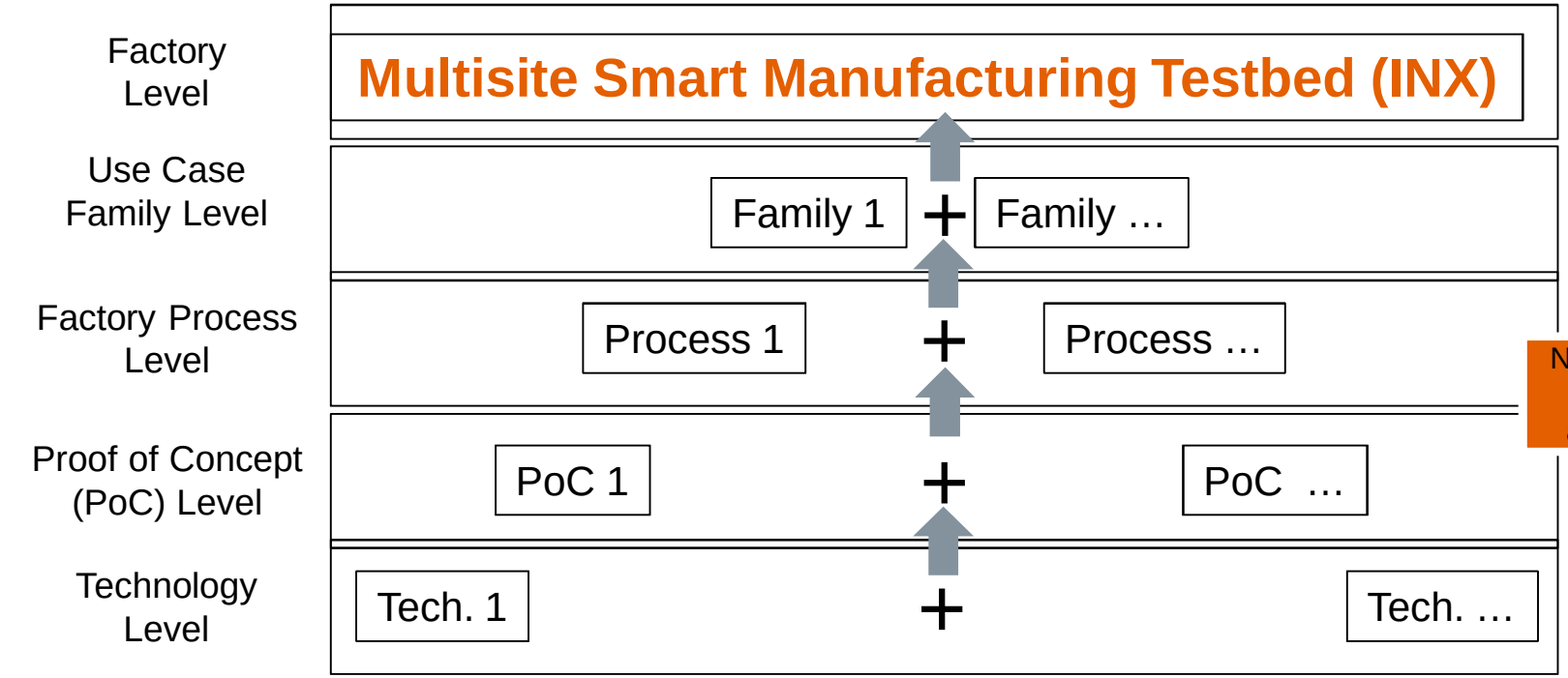
5G wireless operation, control and management of production assets and material flows, positioning, private networking, ultralow latency and extreme reliability

Source: Marko Jurvanasuu et all

5G for smart manufacturing – supported use case families



5G for smart manufacturing - integration 5G with other ICT and manufacturing technologies



USE CASE FAMILIES

Interface, Distribute, Logistics Remote

Next generation collaborative assembly cell

Supply chain transparency through IDS connectors

Virtualization of mobile manipulator control

etc…

5G for smart manufacturing PoC example - Virtualization of mobile manipulator control

Due to e.g. weight and energy constraints computational power on mobile manipulators is limited.

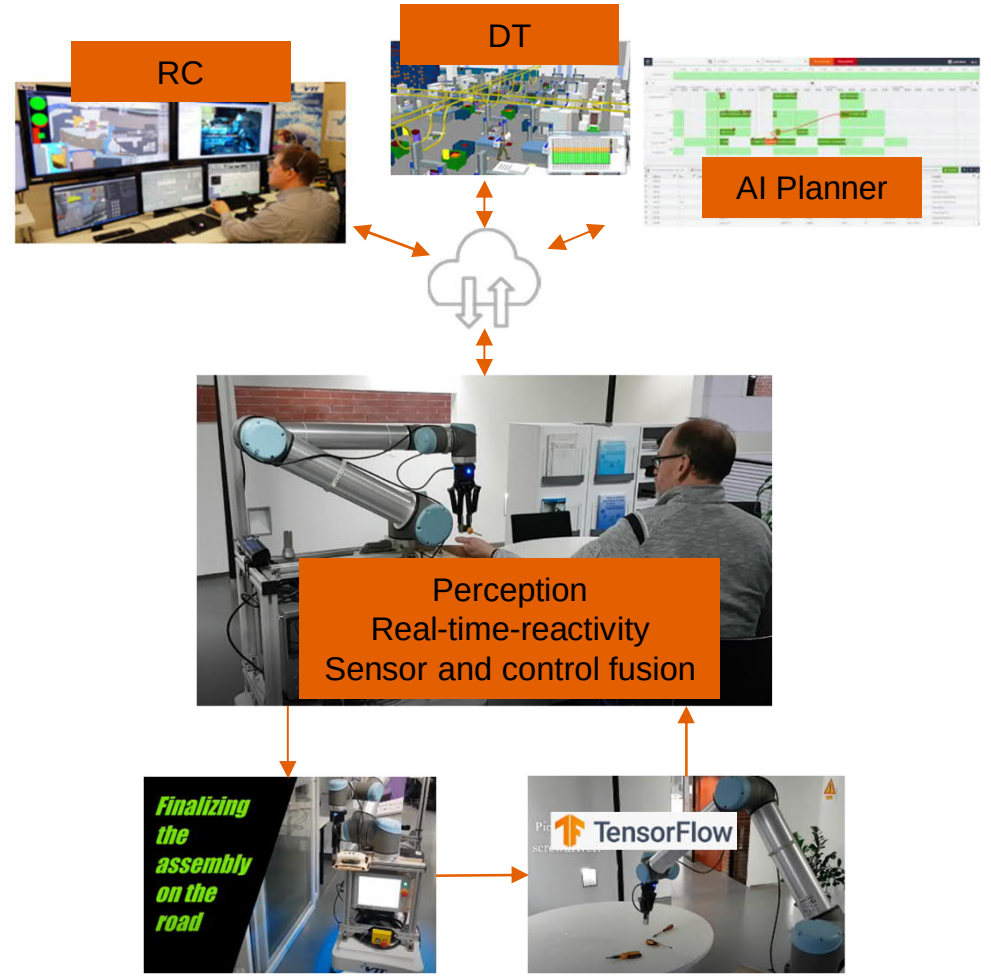
5G edge (MEC) can provide scalable computational power with bounded communication latency.

Control software can be moved from on-board computer to the edge starting with non-real time functionalities e.g. vision and mapping and continuing with rt functionalities e.g. force control by utlizing 5G URLLC features

In the testbed the mobile manipulator is serving fixed assets such as industrial robots, 3D printer and injection moulding machine providing flexible routing for manufacturing.

5G for smart manufacturing PoC example – next generation collaborative assembly cell

- Collaborative robots are sensing their environment, changes in it and humans in the operating area and react to unscheduled changes.
- Mobile+cobot combo fetching components
- Assembly cell technology fusion: cobot, mobile robot, sensors, AI control software. Possibility to connect to remote control (5G), AI Planner and digital twin



Solutions for verticals - trials

- **Smart Industry**
  - 5G enabled solution for smart grid protection,
  - Automation in a harbor and factories; remote control, control of autonomous vehicles, machine-to-human interaction, cooperational platform for intelligent port environment (Digital-Twin)

- **Smart Cities and Living**
  - 5G light pole infrastructure with integrated 5G mmW radios, sensors, cameras, information displays and other devices
  - Remote inspection of facilities with drones
  - Multi-point metering system to monitor of energy consumption of buildings' cooling and air conditioning systems,
  - Monitor and control of electric vehicle charging
  - Environmental monitoring, air pollution status
  - Live video feed from drone and drone control over rapidly deployable non-public cellular network (localized single cell "bubble")
  - Use of drones to enable immersive video services for firefighting scenarios
  - Support search and capture and emergency response in rural areas

Solutions for verticals - trials

- **Smart Mobility**
  - MEC based low delay connectivity solution for autonomous vehicles
  - Green light optimal speed advisory
  - Intelligent Intersections
  - Road safety services
  - Cooperative & connected automated mobility on X-border corridors

- **Smart Health and Wellbeing**
  - Sensing care for long-term health and wellbeing
  - Real-time cellular IoT monitoring for sport wearables
  - AR/VR streaming from operation room to students and remote doctors
  - Robotics in patient treatment

Benefits to partners

- Promotion of members as early technology adopters with validation expertise in nation wide test platform
- Early visibility to 5G evolution and corresponding 5GTNF test network features
- Information about vertical industry/applications communication technology needs
- Possibilities to participate common R&D projects utilizing 5GTNF test network
- Access to state-of-art 5G infrastructure for own R&D and 5G expert support to test network operation/configuration and management and technology validations and application trials
- Participation to new 5G evolution and solutions related R&D projects (EU, BF) preparation
- Participation to the planning of 5GTNF test network investment roadmap and guidance of 5GTNF development
- Networking with leading 5G experts
  - support to holistic development of 5G strategy
  - latest information about 5G evolution and application status and roadmap
- Participation to wide R&D ecosystem focusing on technologies and innovations related to 5G evolution and solutions for vertical industries

5G TNF

- **Ecosystem Services:**
  - Access to state-of-art 5G infrastructure with expert support to:
    - test network operation/configuration and management
    - technology validations and application trials
  - Expert services for 5G evolution R&D and different type application and system design with 5G infrastructure
  - Participation to wide R&D ecosystem focusing on
    - technologies and innovations related to 5G evolution and beyond network and radio enablers, cyber security, utilization of AI and business models
    - 5G and AI enabled solutions for vertical industries; smart industry, smart cities and living, smart mobility and smart health and wellbeing
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