5G HEART

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5GHEART.ORG

5G-HEART HEALTHCARE VERTICAL TRIALS

Per Hj Lehne

Telenor

Workshop: Tele-Health Solutions Powered by 5G

22 October 2021, online

5G HEALTH AQUACULTURE AND TRANSPORT VALIDATION TRIALS

What is 5G-HEART?

- **"5G Health Aquaculture and Transport Validation Trials"**

- Phase 3 project of the 5G Public-Private Partnership (5G PPP) of the EU Horizon 2020 Framework Programme

- Runs from June 2019-November 2022

- The overall objective of the 5G-HEART is to define and validate the cost efficient 5G converged network concepts, which enable an intelligent hub supported by multiple vertical industries

- 22 partners, includes major vertical players, research/academic institutions and SMEs

5gheart.org

Which problem to solve?

Challenges: Teaching, Insufficient access to healthcare, Sub-optimal patient care delivery, Insufficient training, Decision support, Cost of stay in care facility, Expensive screening methods

Our healthcare use cases are defined from real clinical scenarios, where obvious pain points are identified

Outline

Overview, facilities and locations

Healthcare use cases

Summary

Three major use cases for e-health which will challenge the performance and availability of 5G services

Vision: 'hospitals without walls'

Use case H1: Remote interventional support

Using remote assisted or controlled ultrasound, advanced video and augmented reality in different clinical situations
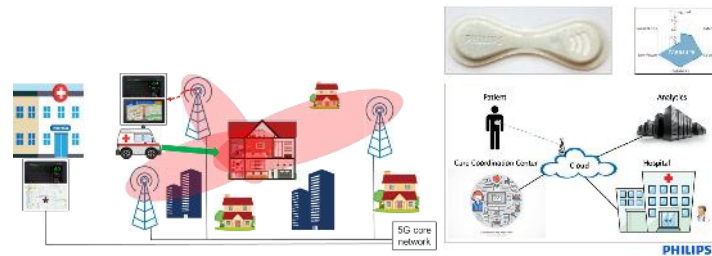

Use case H2: Automatic pill camera anomaly detection

Colon wireless capsule endoscopy with automatic polyp detection for early detection of colon cancer with high mortality
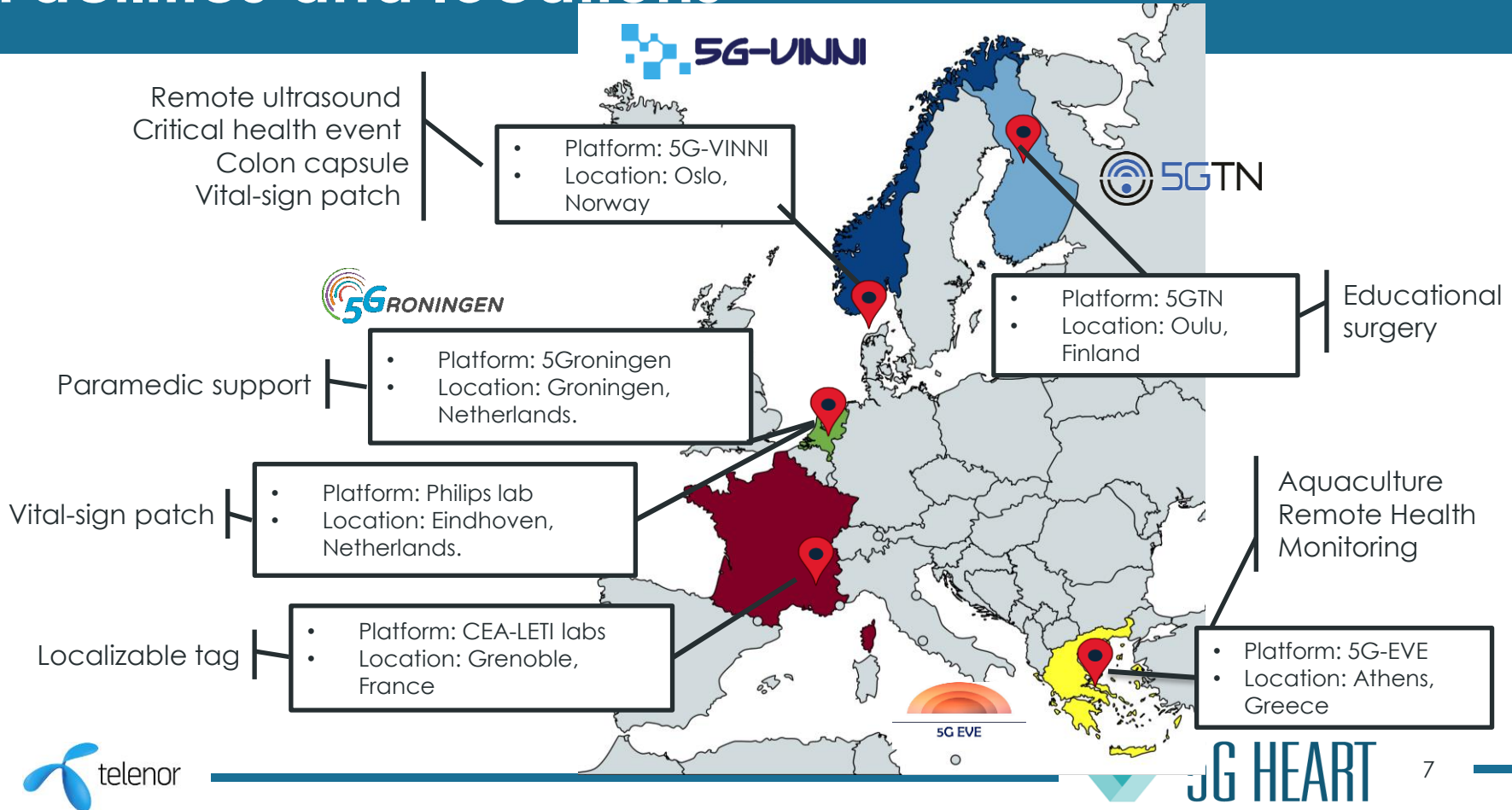

Use case H3: Vital-sign patches with advanced geo-location

Prototyping single-use vital-sign patch and accurate geo-location technology using current and future versions of NB-IoT and/or LTE-M. Real-time health condition monitoring of workers in remote locations.


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Facilities and locations

Remote ultrasound
Critical health event
Colon capsule
Vital-sign patch

- Platform: 5G-VINNI
- Location: Oslo, Norway

- Platform: 5GTN
- Location: Oulu, Finland

Educational surgery

Paramedic support

- Platform: 5Groningen
- Location: Groningen, Netherlands.

Vital-sign patch

- Platform: Philips lab
- Location: Eindhoven, Netherlands.

Aquaculture
Remote Health
Monitoring

Localizable tag

- Platform: CEA-LETI labs
- Location: Grenoble, France

- Platform: 5G-EVE
- Location: Athens, Greece

Healthcare use cases in 5G-HEART

Use case: Educational Surgery

Using a video streaming platform which provides a near-real-time feed from an operational facility towards a classroom for educational purposes.
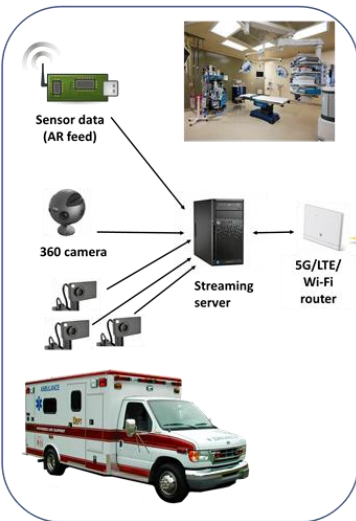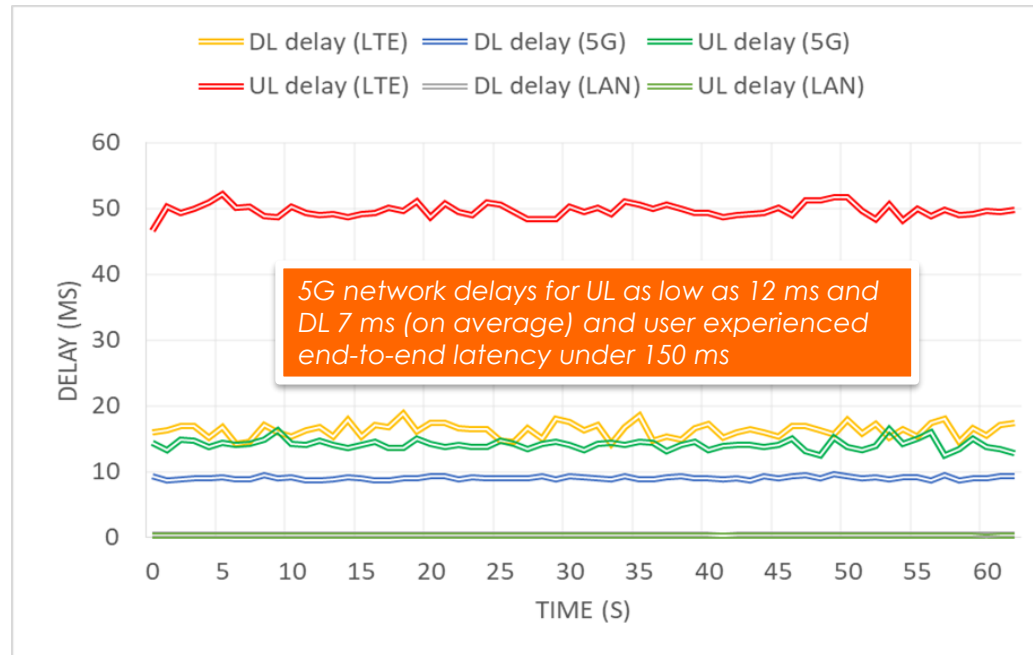

M. Uitto and A. Heikkinen, "Evaluation of Live Video Streaming Performance for Low Latency Use Cases in 5G," 2021 Joint European Conference on Networks and Communications & 6G Summit (EuCNC/6G Summit), 2021, pp. 431-436, doi: 10.1109/EuCNC/6GSummit51104.2021.9482605.
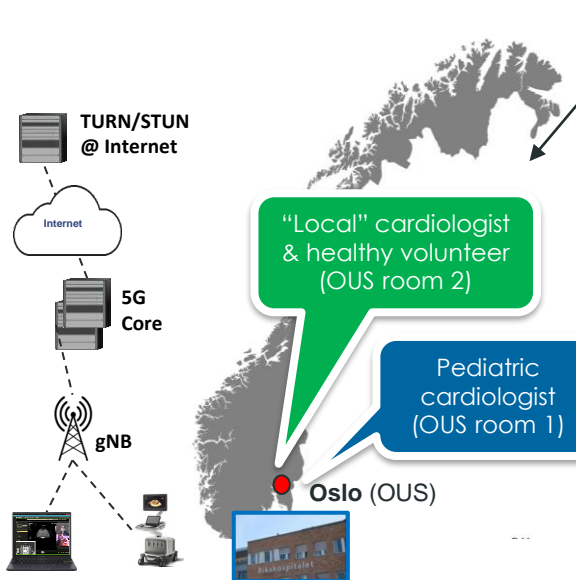
Use case: Tele-guided ultrasound examination

Tele-sonography will enable an expert to guide a remote doctor or paramedic in performing ultrasound exams and ultrasound-guided intervention
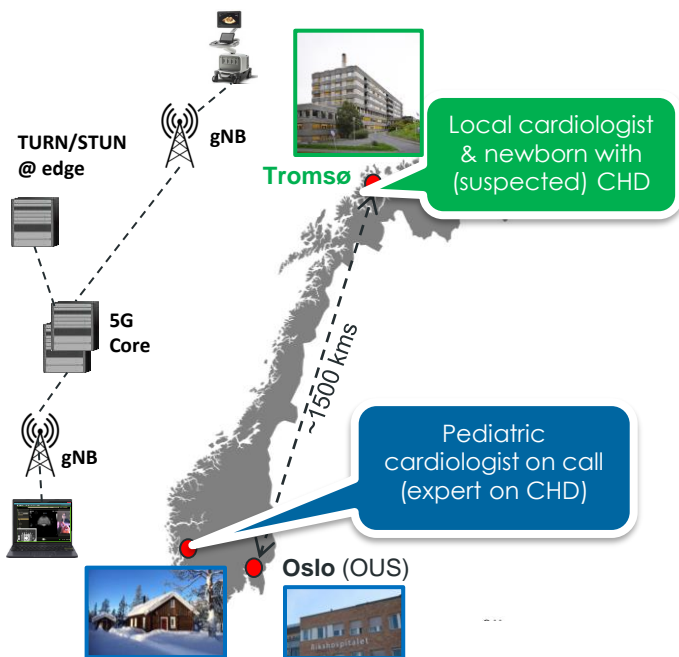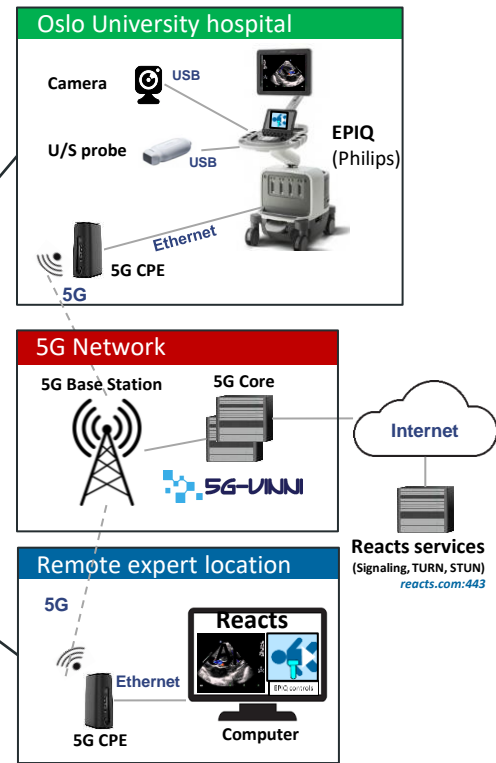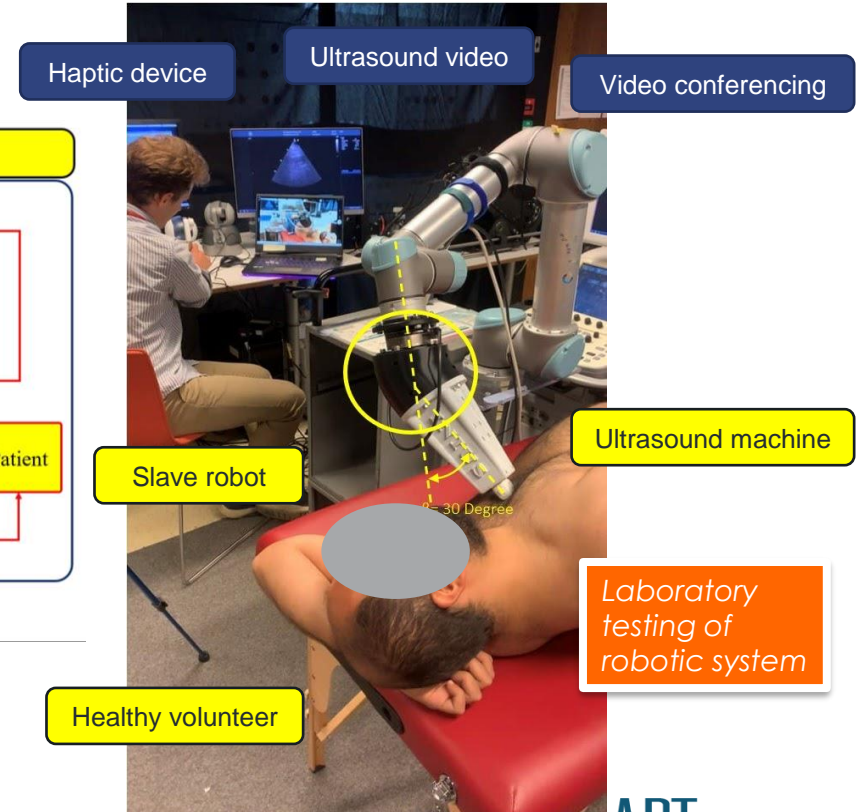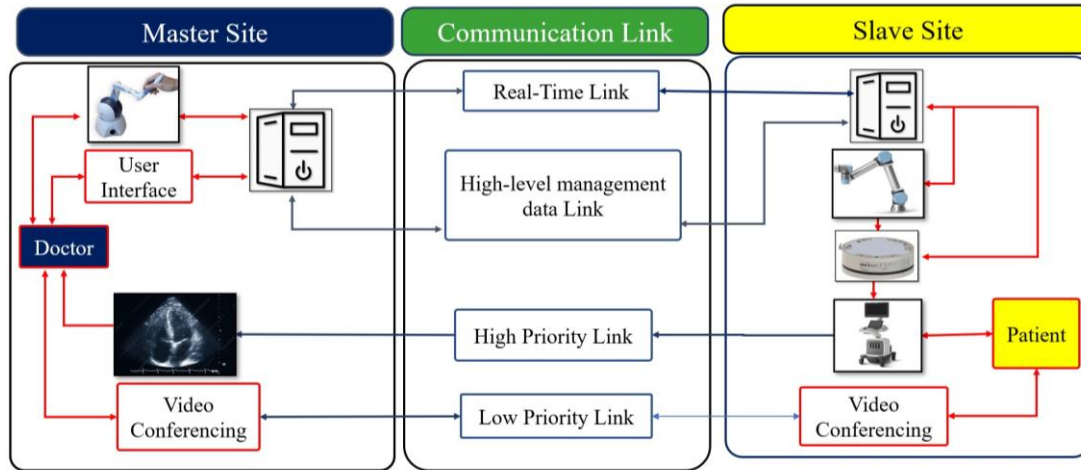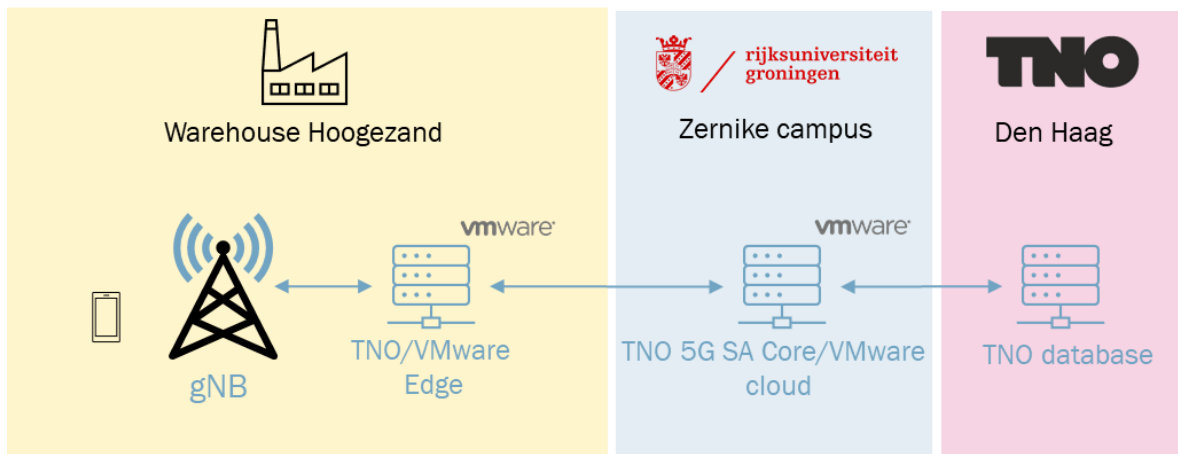
Use case: Robotic ultrasound examination over 5G network

The remote expert will be remotely controlling a robot arm, with haptic feedback, manipulating the ultrasound probe touching the patient
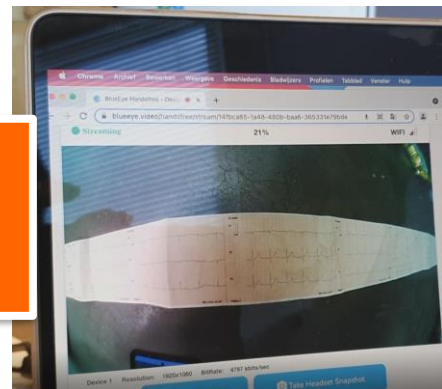

Master Site | Communication Link | Slave Site

- User Interface
- Doctor
- Video Conferencing
- Real-Time Link
- High-level management data Link
- High Priority Link
- Low Priority Link
- Patient
- Video Conferencing

Haptic device | Ultrasound video | Video conferencing

Slave robot | Ultrasound machine

Healthy volunteer

θ = 30 Degree

Laboratory testing of robotic system

Presentation available on 5G-HEART YouTube channel: https://youtu.be/AjfFgZJi-A0

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Use case: Paramedic Support / Critical Events

Using 5G to connect a healthcare professional responding to medical emergencies supported by a medical expert located at a hospital or medical facility

Warehouse Hoogezand

rijksuniversiteit groningen

Zernike campus

TNO

Den Haag

vmware

gNB

TNO/VMware Edge

vmware

TNO 5G SA Core/VMware cloud

TNO database

Testing ECG readability through the video application

Presentation available *on 5G-HEART YouTube channel:* https://youtu.be/D4_TfHYqXRc

Ambulancezorg Groningen — *samen beter*

5G-VINNI

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TNO innovation for life

5GRONINGEN

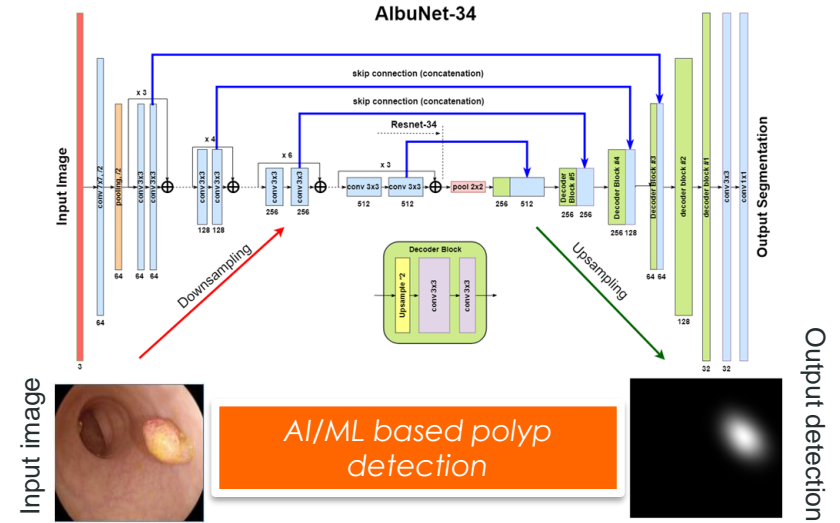RedZinc

Oslo University Hospital

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Use case: Automatic pill camera anomaly detection
Testing real-time transmission with feedback control of a colon capsule to improve diagnosis

Capsule and backscatter design
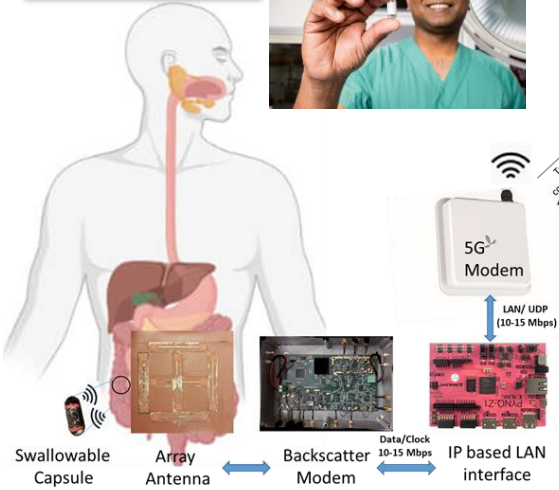
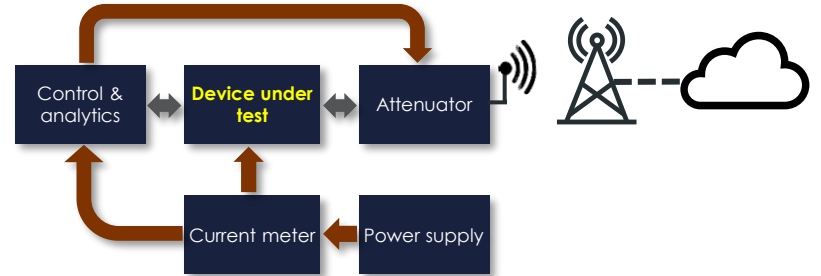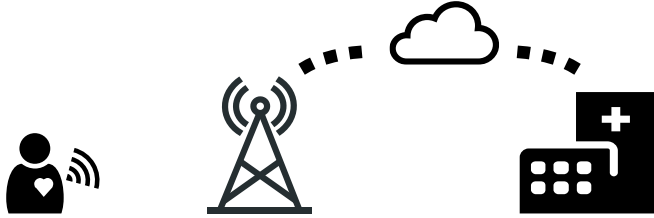Application architecture and connection via 5G

AI/ML based polyp detection
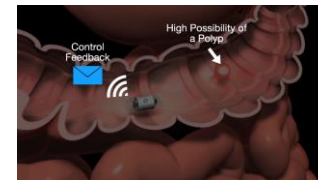
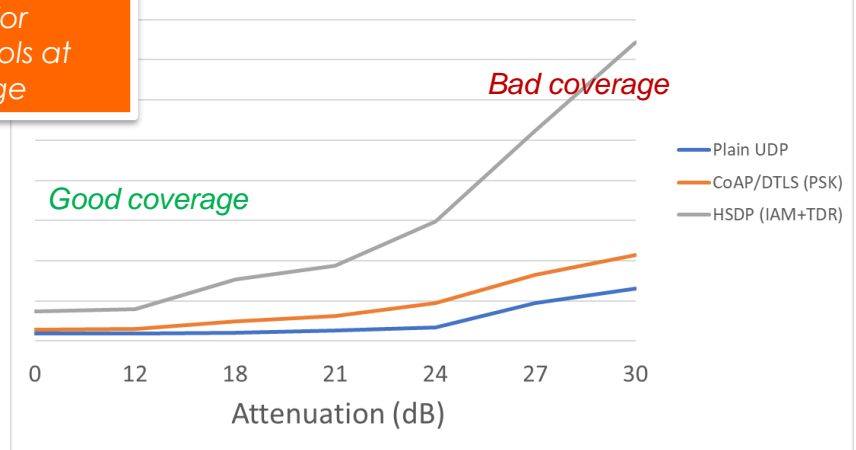Feedback loop

Use case: Vital-sign patch prototype

Developing a prototype single-use vital-sign patch equipped with NB-IoT and/or LTE-M, to assess the technology's suitability for single-use, direct-to-cloud vital-sign patches

To antenna (outside box)

USB Hub

Adaura attenuator

Nordic nrf9160 Evaluation Kit

OTII power supply

**Current and energy measurements for different protocols at varying coverage**

Control & analytics — Device under test — Attenuator — Current meter — Power supply

Energy consumption per upload (preliminary)

Bad coverage

Good coverage

- Plain UDP
- CoAP/DTLS (PSK)
- HSDP (IAM+TDR)

Attenuation (dB)
0 12 18 21 24 27 30

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Use case: Localizable Tag

Developing accurate geo-location technology that could be applied to disposable vital-sign patches using (future versions of) narrow-band 3GPP mMTC technologies

*Multi-Frequency Phase Difference of Arrival (MF-PDoA)*
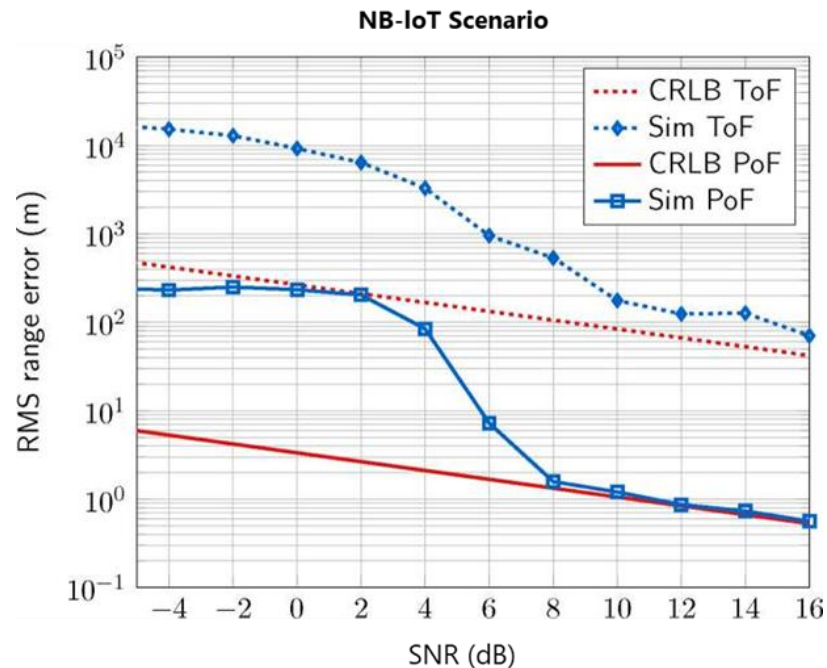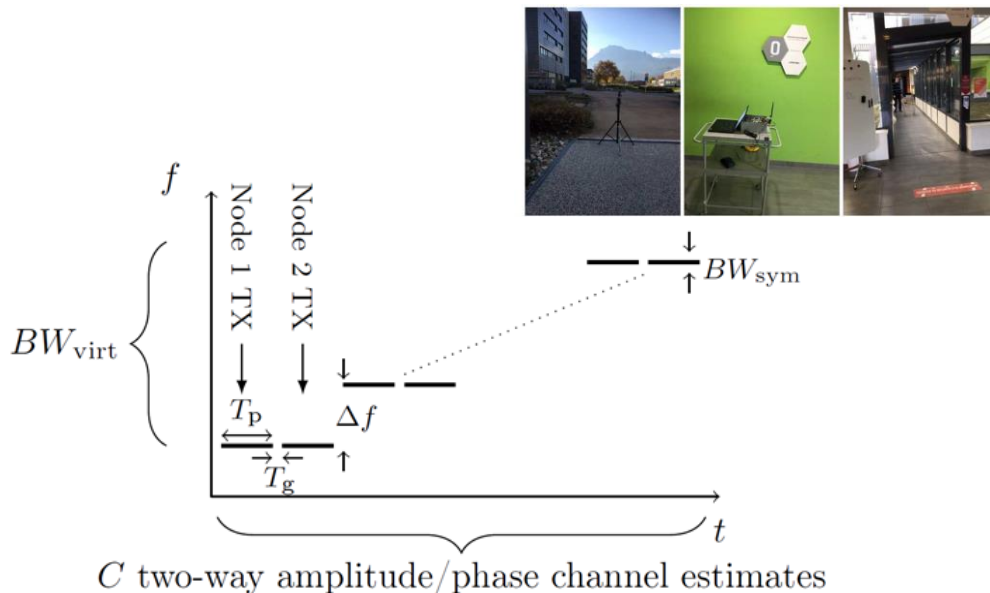
F. Wolf, V. Berg, F. Dehmas, V. Mannoni and S. De Rivaz, "Multi-Frequency Phase Difference of Arrival for Precise Localization in Narrowband LPWA Networks," *ICC 2021 - IEEE International Conference on Communications*, 2021, pp. 1-6, doi: 10.1109/ICC42927.2021.9500389.

Use case: Aquaculture Remote Health Monitoring

Providing real-time monitoring and constant situational awareness of the health status and environment of workers or vulnerable people in remote locations, such as aquaculture sites
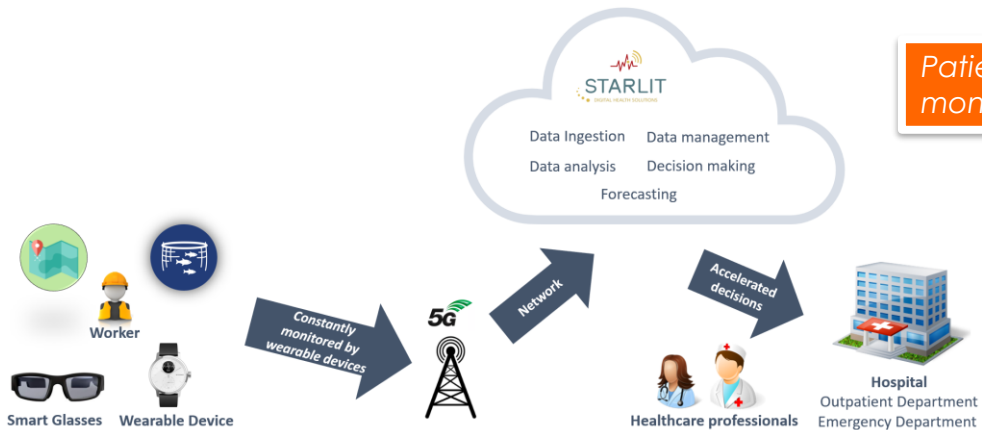
Patient location monitoring (geofencing)
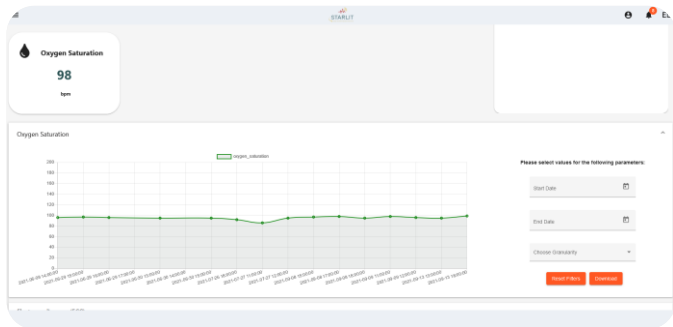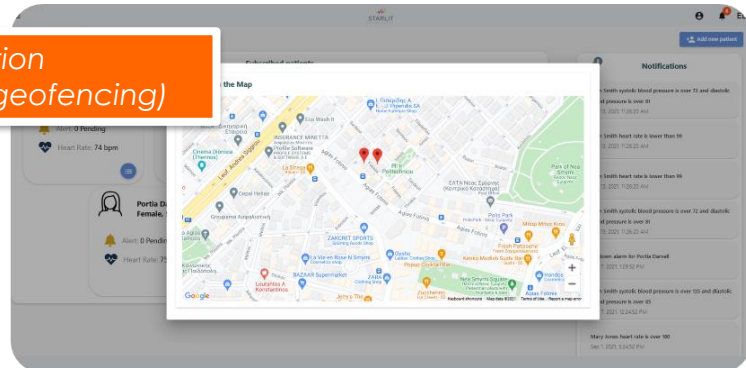
ECG, heart rate and oxygen saturation monitoring

Summary

The 5G-HEART project is addressing the '**Hospital without walls**' vision

By involving the healthcare sector professionals **we address real needs**

More information on 5G-HEART website: https://5gheart.org/

THANK YOU
FOR YOUR ATTENTION

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