Applying 5G and Edge Processing in Smart Manufacturing

Next Generation Collaborative Assembly Cell

Jari Montonen, Jukka Koskinen, Sami Ruponen

VTT Technical Research Centre of Finland Ltd.

5G Test Network Finland results seminar

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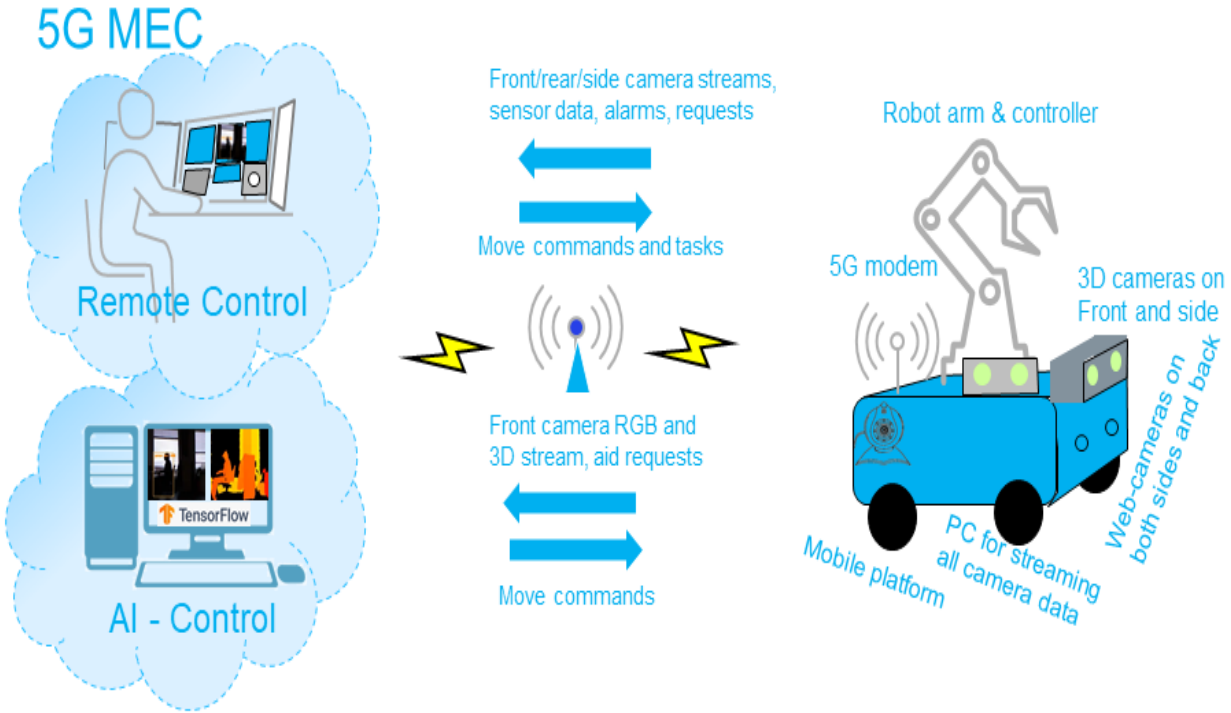
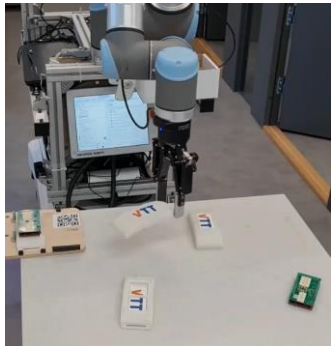
Concept of the next generation assembly cell



UR10 - robot arm

MiR100 - mobile robot



Concept of the next generation assembly cell

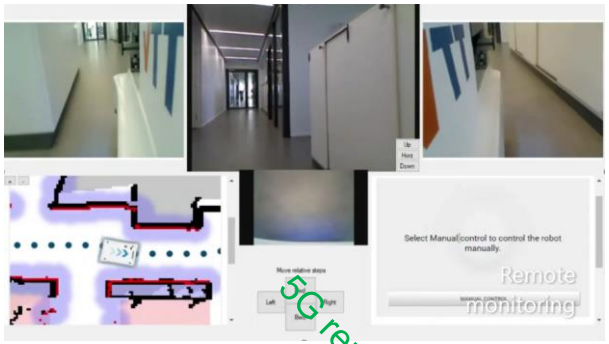
The platform autonomously fulfills variable tasks within the facilities

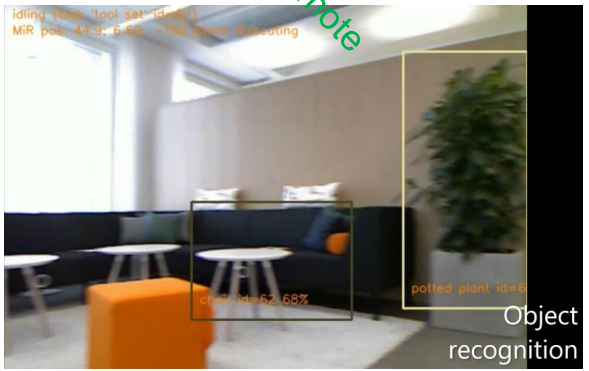
- Assembly
- Fetch/deliver
- Monitor
- Etc.

The platform is equipped with cameras and sensors for cognitive capabilities i.e. obstacle detection, object recognition and speech recognition.

Local

5G remote

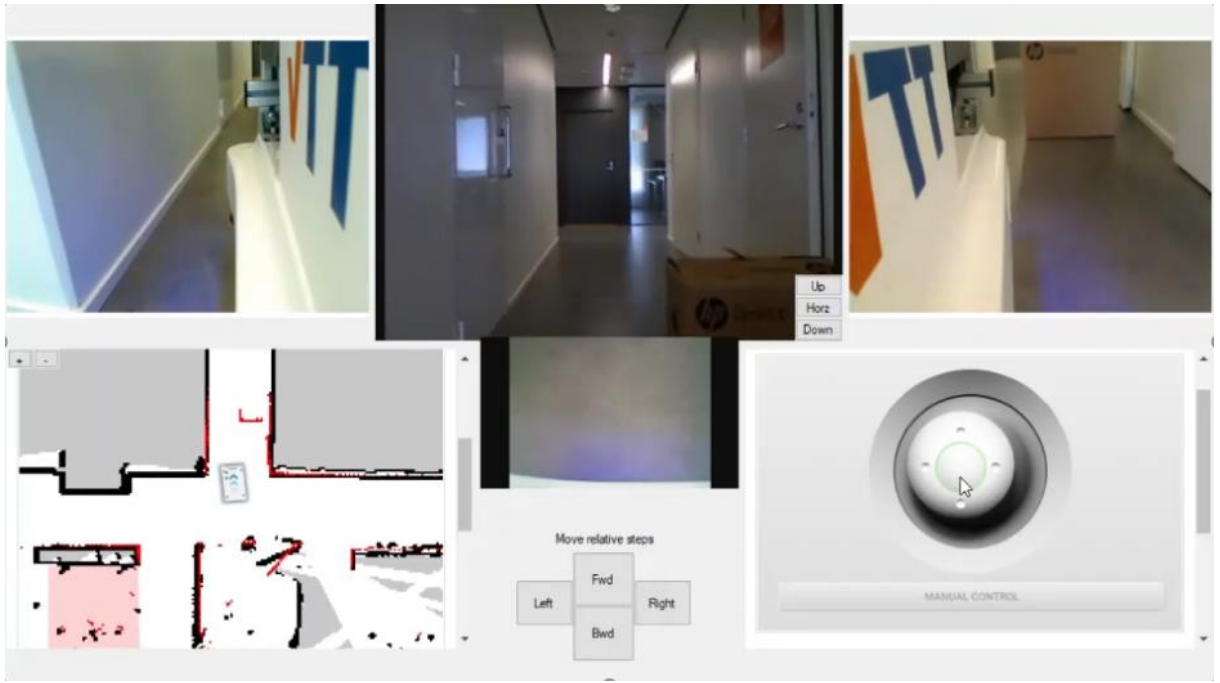




Scenario 1: Remote cockpit (5G)

Use case:
Remotely monitor and assist the mobile robot platform.

- Remote cockpit displays the videostreams along with map, sensor and control-information from the platform
- In case the robot is unable to navigate autonomously to its destination, an alert is raised
- The remote operator assists in navigation to overcome the problematic situation



Bandwith and latency requirements: 60 Mbps / RTT < 30 ms
4 * 640x480 30 fps mjpeg-streams + map & sensor data

Scenario 2: AI powered remote control (5G MEC)

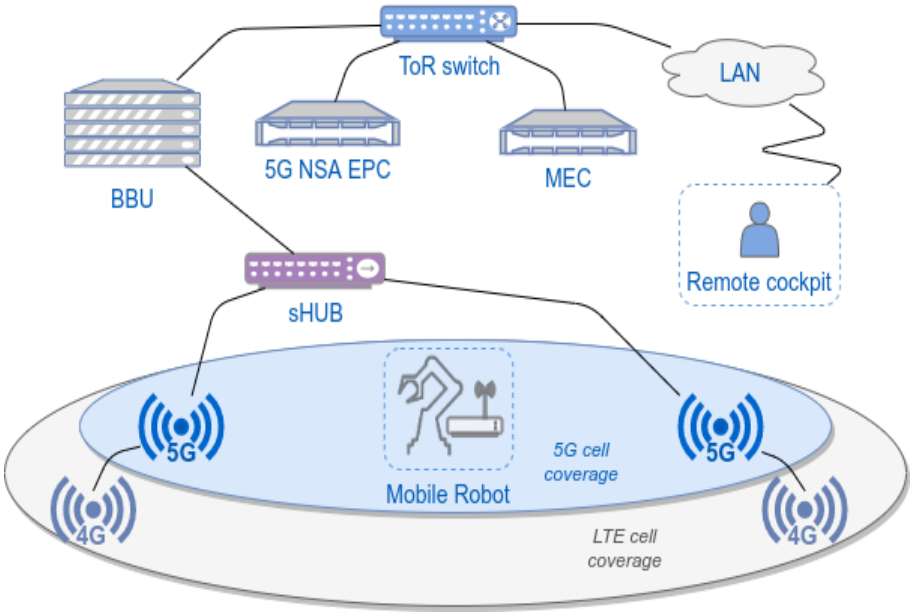
Use case:
Heavy computation done in the edge to maximize onboard battery life.

- The AI-control (5G MEC) receives a video stream from the platform and respective 3D data of the view.
- The platform is requested to drive to a dynamic target, i.e. an operator.
- AI-control requests the platform to ‘look around’ until the operator is located, analyses the position from the 3D-data and then drives the mobile platforms to the operator.
- Objects (tables, chairs, persons etc.) are identified utilizing a Convolutional Neural Network (CNN)

Bandwith and latency requirements: 30 Mbps
640x480 30 fps mjpeg-stream + 640x480 10 fps 3D-depth data

Conclusions

- The first experiences were made with 5G NSA setup optimized for broadband downlink use cases.
- Current commercial 5G is capable for remote operation for low speed mobile platform using limited image resolutions and frame rates
- With the edge processing and the private network setup we were able to realize **a proof of concept for collaborative robots.**
- With future enhancement for 5G connectivity solution, it is foreseen that technology will boost industrial cases further.



More information:
J. Montonen, J. Koskinen, J. Mäkelä, S. Ruponen, T. Heikkilä and M. Hentula, "Applying 5G and Edge Processing in Smart Manufacturing," 2021 IFIP Networking Conference (IFIP Networking), 2021, art. 9472851.

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Jari Montonen, Jukka Koskinen, Sami Ruponen

firstname.lastname@vtt.fi

@VTTFinland

www.vtt.fi