5G-SMART
5G for Smart Manufacturing

Krister Landernäs TM, ABB AB

Networld 2020 Workshop

Overall scope and key challenges

□ **Scope**

- Demonstrate, evaluate and validate 5G capabilities at three 5G-enabled industry field trials across Europe
- Explore how to integrate 5G in the manufacturing eco system and identify enhance 5G for smart manufacturing

□ **Key challenges**

- Seamless integration of 5G into manufacturing systems
- Smart manufacturing contains a plethora of use cases with very different requirements
- Factory setting impose dynamic and challenging radio environment

5G for Smart Manufacturing

WP1: Integrate 5G in the manufacturing ecosystem

WP2,3,4: Demonstrate, evaluate and validate 5G capabilities at three 5G-enabled industry field trials across Europe

WP5: Enhance 5G for smart manufacturing

Factory 5G deployment:

- ❑ Business models
- ❑ Business impact analysis
- ❑ New manufacturing use cases
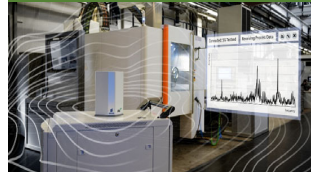- ❑ Evaluation of smart factory deployment options

Ericsson smart factory Kista

5G for enhanced industrial robotics applications

IPT Fraunhofer shop floor Aachen

5G for enhanced industrial manufacturing processes

Bosch factory Reutlingen

5G for enhanced semiconductor factory automation

Study and propose:

- ❑ New 5G features for, e.g., time-sync and TSN/industrial LAN integration
- ❑ Factory 5G network architectures
- ❑ Improved inter-cloud coordination
- ❑ Industrial centric framework for network management and configuration

WP6 – Communication and dissemination

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5G for Smart Manufacturing

WP1: Integrate 5G in the manufacturing ecosystem

WP2,3,4: Demonstrate, evaluate and validate 5G capabilities at three 5G-enabled industry field trials across Europe

WP5: Enhance 5G for smart manufacturing

WP6 – Communication and dissemination

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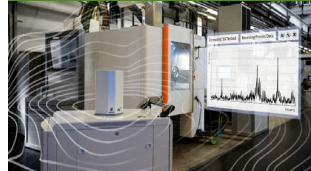
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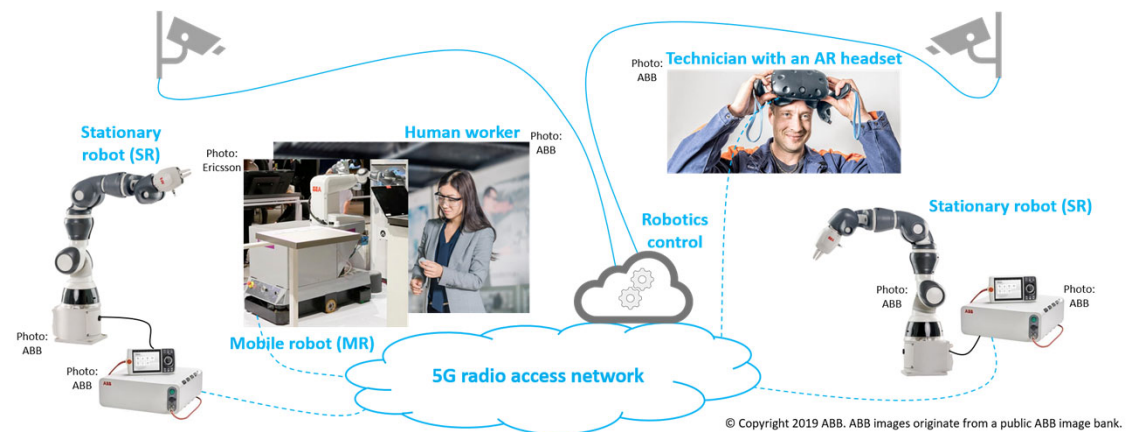❑ Industrial centric framework for network management and configuration

The Kista trial site: WP2 overview

Ericsson smart factory use cases

❑ 5G-connected robots and remotely supported collaboration of connected robots

❑ Machine vision assisted real-time human robot interaction over 5G

❑ 5G-aided visualization of the factory floor

❑ Description:
- A mobile robot takes an object from one stationary robot and delivers it to another stationary robot. Human-robot interaction with a human worker moving on the factory floor. Visualization of factory floor information via AR.

❑ Challenges:
- Major control and support functionalities are moved to the edge cloud: robot motion planning, mobile robot localization, map building, human position tracking, status information storing
- Seamless integration of 5G

The Kista trial site: WP2 overview

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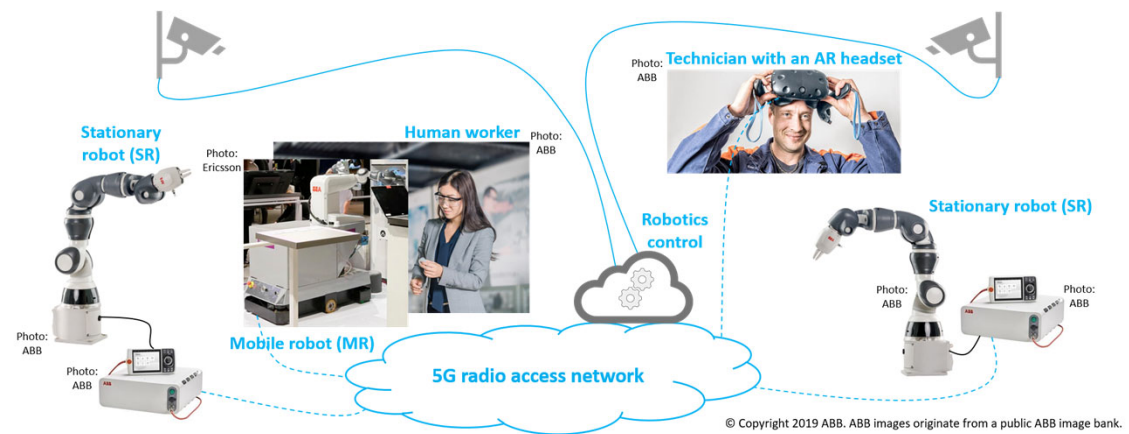- ☐ 5G-aided visualization of the factory floor

☐ Three main activities

- ▪ Design testbed (Finalized)
- ▪ Implement testbed (Ongoing, both at ABB and ERI factory Kista)
- ▪ Validate testbed (Starting up)

Activity A2.1: design testbed for 5G-enhanced industrial robotics

Ericsson smart factory use cases

- ❑ 5G-connected robots and remotely supported collaboration of connected robots

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- ❑ 5G-aided visualization of the factory floor

- ❑ **Progress**
  - ▪ Activity successfully completed as per the original work plan
  - ▪ Design of the 5G testbed produced, covering both robotics systems and network infrastructure

- ❑ **Results**
  - ▪ Specification of common functional architecture from the robotics perspective
  - ▪ Identification of key hardware and software to realize the 5G testbed
  - ▪ Functional design of robotics-related software to be prototyped
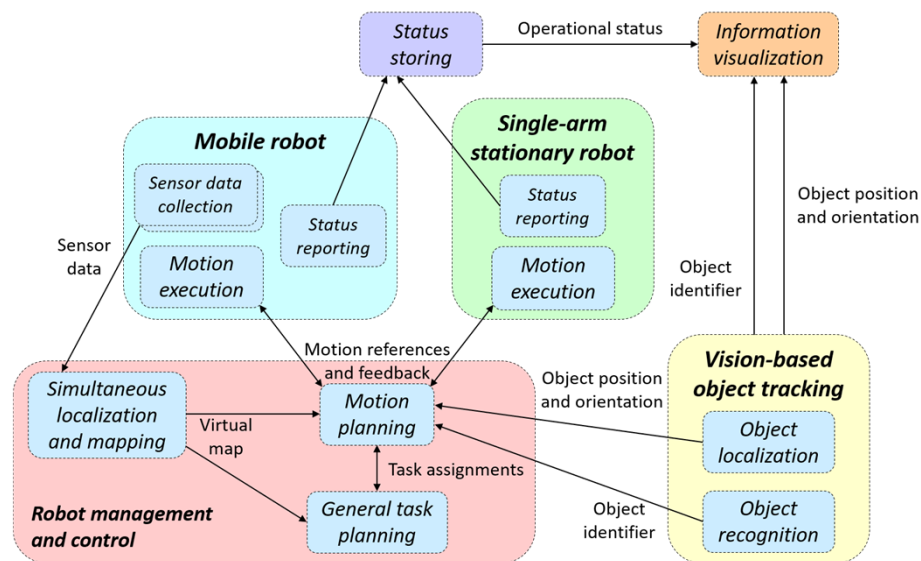 - ▪ 5G testbed deployment and inter-connectivity plan

- ❑ **Findings**
  - ▪ A close collaboration between OT and ICT partners required to specify use case requirements onto 5G infrastructure

Functional architecture for the 5G testbed design

❑ Main functional components and their roles in the 5G testbed

❑ High-level interaction among them

Activity A2.2: implement the testbed for 5G-enhanced industrial robotics

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- ❑ 5G-aided visualization of the factory floor

- ❑ **Progress**
  - ▪ Activity running (until May 2021 per the original work plan)
  - ▪ To deploy and configure hardware equipment, design and implement prototype software, and build the 5G testbed

- ❑ **Results**
  - ▪ 5G network at the Kista trial site deployed
  - ▪ Hardware equipment acquired
  - ▪ Lab infrastructure at ABB premises set up for the use case development
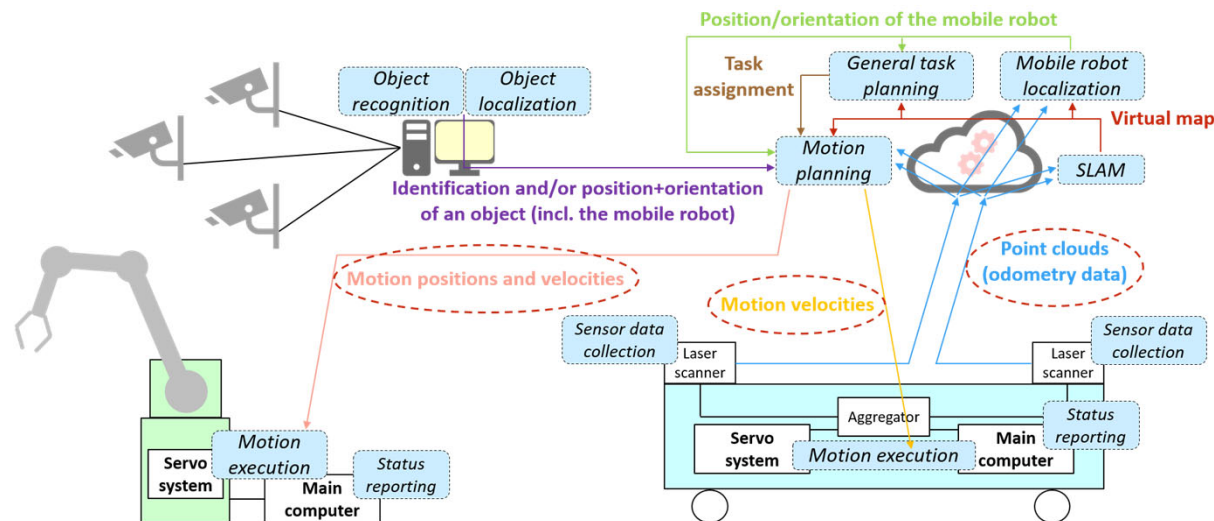 - ▪ Several intermediate results in the development achieved

- ❑ **Findings**
  - ▪ Suitable 5G UE availability limited in 2020
  - ▪ Cross-domain expertise needed to setup robotics use case

Hardware and software to realize the WP2 use cases

❑ Mapping key functional components to the identified robotics equipment
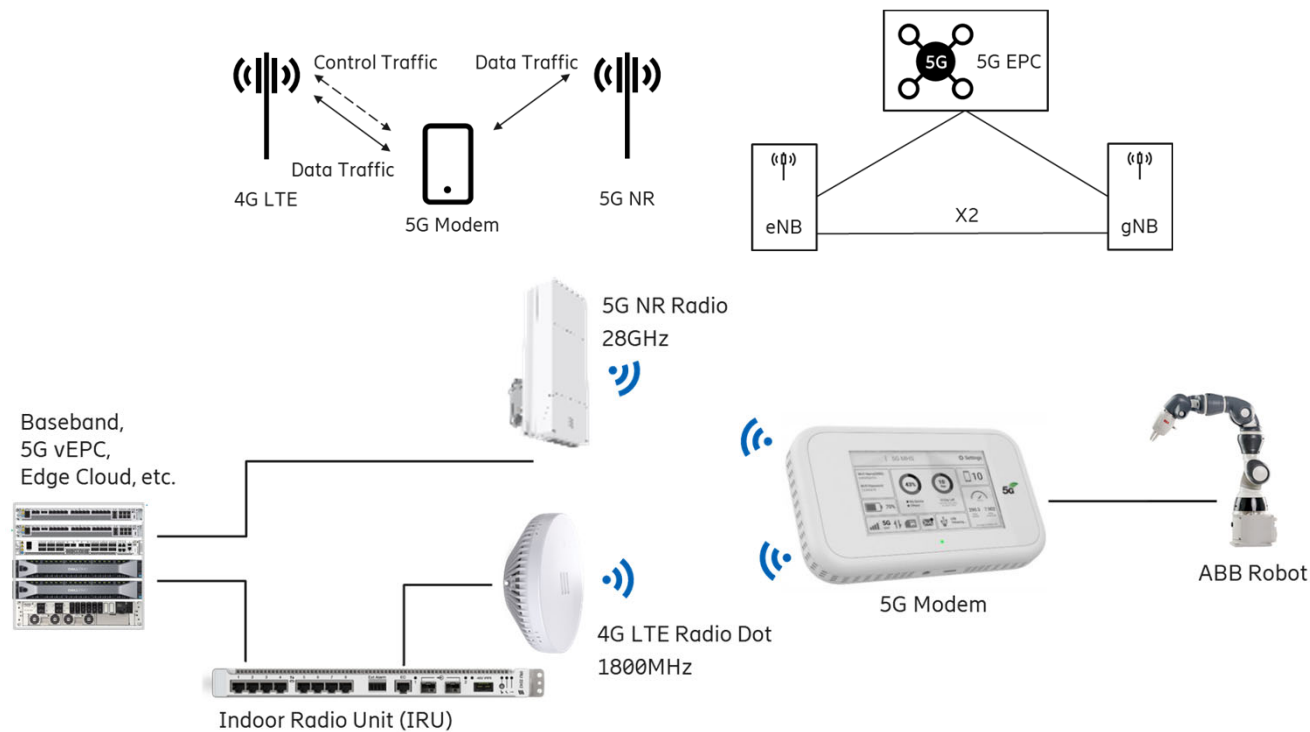
Acquired equipment for the use cases development

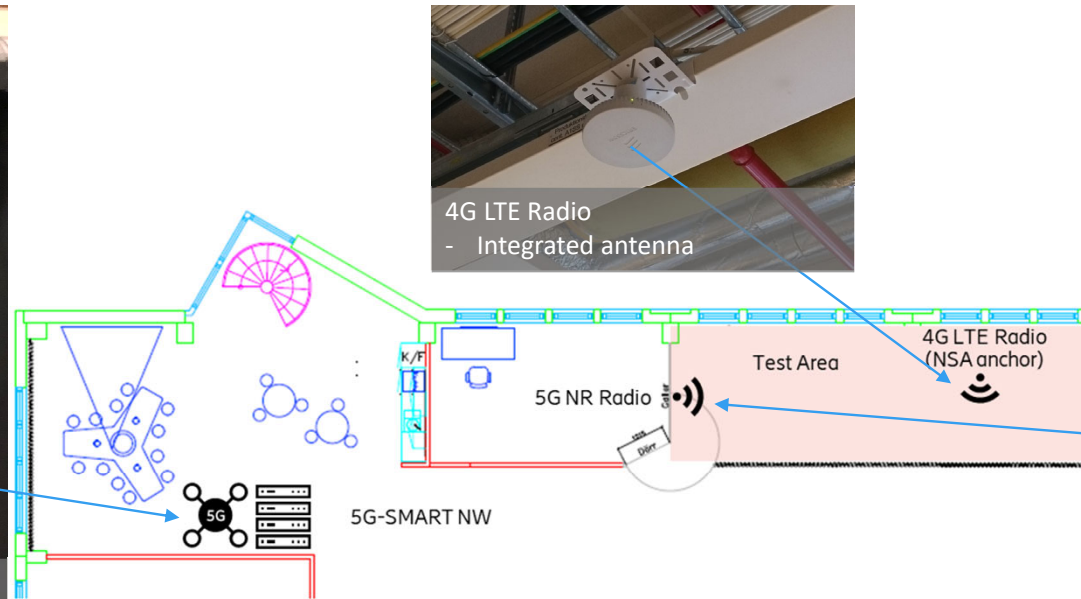| Equipment item	Status	Comment
Single-arm stationary robot	**Available**	*2x ABB YuMi© units, installed and configured*
Mobile robot	**Available**	*In-house research platform, deployed and configured*
Video camera system	**Available**	*E.g. 2x 3D cameras to assist "pick-and-place" operation*
AR headset	**Available**	*2x MS HoloLens 2 units, used for prototyping*
5G network	**Available**	*Ericsson 5G NSA system, installed and configured*
Edge cloud server	**Available**	*A workstation currently used*

Trial Site: 5G network architecture and design

❑ 5G non-standalone (NSA), high-band solution

5G Network solution

☐ Installed and tested at the Kista trial site

4G LTE Radio
- Integrated antenna

5G-SMART NW

Test Area

5G NR Radio

4G LTE Radio
(NSA anchor)

5G Private Network cabinet
- Switch
- IRU (Indoor Radio Unit) + BBU (Baseband Unit)
- vEPC (core network)
- Application server (multiple functions)

5G NR Radio
- Integrated antenna
- Integrated baseband
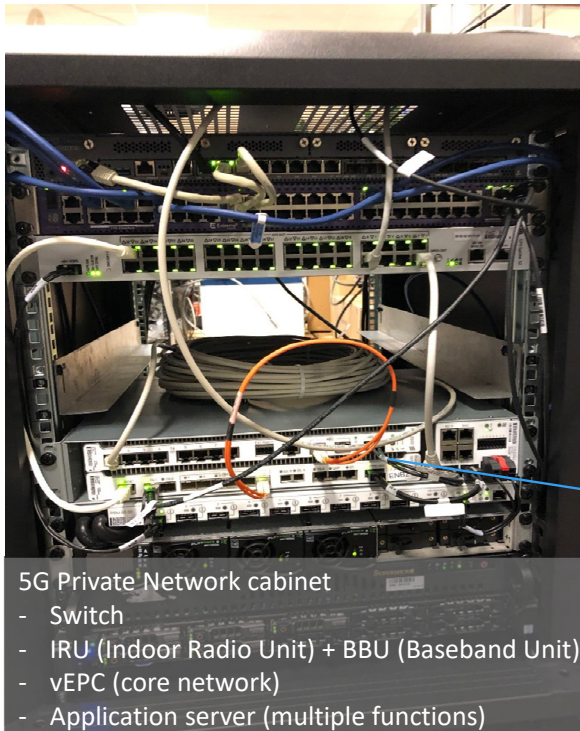
Activity A2.3: validate 5G for the industrial robotics scenarios

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- ☐ Machine vision assisted real-time human robot interaction over 5G

- ☐ 5G-aided visualization of the factory floor

☐ **Progress**
- Activity running (until November 2021 per the original work plan)
- To carry out 5G evaluation in the testbed for selected validation scenarios and analyze performance

☐ **Results**
- Work ongoing on modeling a validation methodology

☐ **Findings**
- To be evaluated in 2021

Next steps

❑ Integrate testbed and use cases at the Kista trial site

❑ Perform evaluation tests on the 5G testbed in Kista

❑ Identify gaps and propose enhancements (both 5G and robotics applications)

Thank you

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If you need further information, please contact the coordinator:
Dr. Leefke Grosjean, ERICSSON
E-Mail: coordination@5gsmart.eu
or visit: www.5gsmart.eu

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