PRESS RELEASE

5G technology for more reliable real-time communication between machines, plants and cloud systems thanks to Time Sensitive Networking

Being able to reliably and safely control and regulate highly dynamic production systems still appears to be a challenge for many companies. Edge and cloud systems are gaining in importance, but even today there is still a lack of appropriate equipment and infrastructure to permanently integrate existing machines and plants into digital IT landscapes in accordance with the necessary industrial requirements.
To this end, the Fraunhofer Institute for Production Technology IPT in Aachen, together with partners from mechanical engineering, network technology and robotics, is now developing an end-to-end real-time-capable communication infrastructure based on 5G mobile technology and the Time Sensitive Networking (TSN).

For a fast and reliable data exchange in the 5G production network, the Aachen research partners rely on a set of standards in the "5G-Comet" project, which are collectively known as Time Sensitive Network (TSN): These enable data transmission with very low latencies and high availability and were developed by the Time-Sensitive Networking Task Group, a working group of the Institute of Electrical and Electronics Engineers (IEEE). The partners in the 5G-Comet project now want to combine the TSN standards, which were originally developed for wired networks, with 5G mobile technology in an overall system with real-time capability. The goal is to have highly available, reliable and secure communication of all components and modules: from sensors and actuators at field level via 5G networks and Ethernet connections to the Fraunhofer Edge Cloud (FEC).

The Fraunhofer Edge Cloud acts as the control center for all connected systems in the 5G production network: the data of all components in the network converge here. The high storage and computing capacities of the cloud, the fast data transfer between 5G and Ethernet, and the reliable interfaces then make it possible for the numerous individual processes within the network to be cloud-based rather than locally controlled. In this way, especially programmed virtual applications can be used to adaptively coordinate real process chains.

To ensure that this works reliably, the Aachen research partners are now also combining the TSN standard for Ethernet with 5G so that the entire production network has a uniform communications infrastructure. The standardized interfaces between the mobile and the wired network should thus have a positive effect on the reliability of data transmission.

Editorial
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First applications being tested

The Aachen research partners are testing initial application scenarios for real-time control of robot-assisted laser machining and assembly processes:

In the laser processing application, a robot with a special tool provides complex three-dimensional surfaces with textures, engravings or markings. Determining the exact position of the robot and the laser tool during operation and precisely controlling both components requires high computing capacities. The end-to-end TSN network with low-latency data transmission up to the factory cloud ensures that all required individual systems can react to each other quickly and without delays. The wireless connection of the tool sensor technology with 5G and the outsourced control in the Factory Cloud also allow modular and flexible use of the tool.

Assembly systems with cooperating robots that work together on an assembly task represent another application scenario: Whereas the controllers of cooperating robots were previously connected directly to each other through hardware, the necessary computing processes can be outsourced to the factory cloud in the future. All calculations of the robot paths can be carried out there and the results fed back to the robot system. The inclusion of TSN-capable network components provides consistent and reliable synchronization and connection of the individual systems.

5G Industry Campus Europe as test environment for the 5G Comet research project

Europe's largest 5G research infrastructure, the 5G Industry Campus Europe, went online in May 2020. A total of seven subprojects are investigating various application scenarios ranging from 5G sensor technology for monitoring and controlling highly complex manufacturing processes to mobile robotics and logistics to cross-site production chains. In addition, the Aachen scientists are testing the use of modern edge cloud systems for the rapid processing of data in order to exploit the potential of 5G in networked, adaptive production.

The 5G-Industry Campus Europe also offers a fully equipped test environment for the use cases of the 5G-Comet research project: "The 5G infrastructure with the one square kilometer outdoor and several indoor networks offers perfect conditions for testing and trialling time-critical use cases that place high demands on reliability, availability and latency. Communication between the respective individual systems and the factory cloud can be extensively tested in this already existing environment," says Niels König from Fraunhofer IPT.

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Project consortium

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- ISEK Lehr und Forschungsgebiet Informationstheorie und Systematischer Entwurf von Kommunikationssysteme, Aachen
- Laboratory for Machine Tools and Production Engineering (WZL) of RWTH Aachen University
- Meastream GmbH, Eschweiler
- Utimaco GmbH, Aachen
- Mitsubishi Electric Europe B.V., Ratingen
- Fraunhofer Institute for Production Technology IPT, Aachen
- SMS Group GmbH, Düsseldorf
- German Edge Cloud GmbH & Co KG, Eschborn
- Ericsson GmbH, Herzogenrath
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