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INDUSTRY 4.0

THE NET FOR THE NET

SETTING UP AND OPTIMIZING CAMPUS NETWORKS

Translation of the German InnoVisions article

The development of 5G networks in Germany will initially focus strongly on capacity expansion as well as broadband coverage. Companies also need new infrastructure and know-how to build local, company-internal 5G networks. The Open5GCore software enables the control of a so-called campus network and at the same time offers a high degree of flexibility in design. It is therefore also predestined for portable, temporary mobile networks, such as those that should be available in the event of a disaster.

Hello Prof. Magedanz, the construction and optimization of so-called campus networks is a complicated topic.

That depends on the perspective. The re-entry of a manned space capsule into the Earth's atmosphere is also a complicated topic – for example if you talk about all the physical laws and calculations that have to be taken into account. In the end, however, it is crucial to reach the earth alive. So we can try to focus as clearly as possible on 5G and campus networks: The decisive factor is the benefit for the companies.

You and your team at the Fraunhofer Institute for Open Communication Systems FOKUS are working on optimizing the use of these campus networks...

...or make it possible in the first place. However, in order to understand our work and the benefits it brings, I have to provide a few explanations: A campus network, i.e. a regionally limited communication network, is set up by means of antennas, end devices, local data, applications and a connection to the company's own network and, if required, to the Internet. It, therefore, represents an environment in which 5G can be used. At the center of this ensemble is a core network. This core network is crucial because it is here that authentication, mobility management and the control of dedicated communication links between end devices and

"Open5GCore allows the dynamic configuration of 5G communication infrastructures."

services take place. It is thus the heart of a communication network, because the control programs for communication work here. These control programs, however, have been continuously expanded and enriched with additional functions in the course of technical adaptations and new requirements with a view to the most diverse 5G applications.

This is not only true for the software, but also for hardware components.

That's another crucial point. Originally, the improvement of individual hardware components always necessitated additional adaptation of the control software. The complexity on-site in the campus networks is, therefore, increasing in all areas. We wanted to get away from this and have therefore been developing "software-based networks" for years. This is where software and the usually very specialized hardware are decoupled. For this, we use the so-called virtualization technology.

The term is closely related to cloud technologies as we know them from "Software as a Service".

That's correct. We use local data centers, so-called edge computing nodes, which house company data and application software. The virtualized software for the core network is also stored here. In this way, we can support the development or further development of smaller networks or even more extensive corporate networks.

The software that makes this feasible is called Open5GCore and was developed at Fraunhofer FOKUS. Put very simply, Open5GCore offers a comprehensive program package that can be used to flexibly and in a scalable manner control the different hardware components of a campus network, depending on the situation.

Open5GCore allows the dynamic configuration of 5G communication infrastructures. It is, therefore, possible to individually adapt a campus network on the software side to specifications and expectations. It can be used to implement application-specific local 5G networks. Companies, as well as public institutions around the globe, are currently using it. We have been issuing licenses for this for a good two years now. Version 4 is currently available.

Why is this dynamic configuration so important?

Because campus networks will have very different tasks in the future and will be correspondingly set up differently: Think of the different end devices to be integrated, such as sensors, production machines, robots, unmanned vehicles, computers, tablets or AR/VR glasses, the bandwidth required in each case as well as the priority of low-latency transmission for machine and vehicle control. There are still many factors that play a role in campus networks and that have received little attention from traditional 5G providers. This is because the focus is usually on the area-wide construction of networks for supporting many end users rather than the question of whether conventional networks are flexible enough to be easily and dynamically adapted to individual industry needs. Besides, customers would never get the source code from Huawei, Ericsson or Nokia to make their customizations.

Where and how is Open5GCore concretely in use? Are there any application examples?

Sure, a rather fundamental example is our 5G Playground. This is a kind of showcase or reference testbed for 5G hardware and software, where we show different configurations of a network infrastructure for different application areas. For example, when it comes to a portable mobile campus network that requires an interconnection to satellites to connect a robot or even a 360 degree camera. Another example is the programming of manufacturing machines, for which our Industrial IoT group has gained global expert status. Of course, manufacturing robots also play a central role here. And these require a real-time communication connection such as 5G to be controlled in a decentralized way in the context of Industry 4.0. Together with our partners, we presented a corresponding setup at the Hannover Messe. Among other things, together with the German Edge Cloud (GEC), we were able to show at the Rittal booth how an industrial robot can be controlled via a local wireless 5G network running Open5GCore. The low latency setup enabled real-time control.

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Prof. Dr. Thomas Magedanz, director of the business unit Software-based Networks at Fraunhofer FOKUS

This means that Open5GCore serves two development directions: on the one hand portable and on the other hand stationary, local networks, as they are typical for production plants.
These are indeed two very different applications. The establishment of a campus network in an industrial environment is currently one of the focal points of our work. But portable networks are also becoming increasingly important: just think of the possibilities that such a network offers in the event of calamities, for example. For the fire brigade or the Federal Agency for Technical Relief (THW), for example, such networks are an important support for communicating even where there are radio gaps. Above all, however, they can be used to allow the emergency forces to communicate with each other on-site using multimedia services and to control machines, robots, and drones in real-time.

How does this work in practice?
For example, we can install a local 5G cell on a fire-fighting vehicle, which is then not only connected to the rest of the world via satellite but also links the various emergency forces together in a stable network. Because our software flexibly controls this network for the various communication applications. Shortly, the core network could probably consist of just a small box, connected to the radio antennas on one side and the connection network on the other. This can be a traditional fiber-optic connection or a satellite connection. Thanks to its low latency and very high bandwidth, this "handy core network" then enables connections to be established that can handle a wide variety of communications securely and with the required quality of service. We are currently working on this.

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What are currently the greatest obstacles to the further development of these core networks?
It's the end user devices! Currently, there are simply not enough commercial end devices and base stations available that use a 5G based on the "Standalone Architecture". What is meant is a 5G architecture that works based on the latest Internet protocols. This is because telecommunications providers are currently still using an old 5G that uses a network infrastructure that must also support 4G. From a researcher's point of view, a lot of unnecessary dead weight is carried along. The future 5G network will be fully programmable and expandable. Thanks to machine learning and artificial intelligence, it will then be able to adapt automatically to the needs on-site.

(aku/ English translation by Fraunhofer FOKUS)