



**Fraunhofer**  
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FRAUNHOFER INSTITUTE FOR OPEN COMMUNICATION SYSTEMS FOKUS

**COMPETENCE CENTER  
NEXT GENERATION  
NETWORK INFRASTRUCTURES**



# BUILDING BLOCKS FOR THE COMMUNICATION OF THE FUTURE

In the future, communications networks will become increasingly heterogeneous. Seamless communication is ensured by NGNI's software toolkits, which can be combined from individual building blocks.

Just imagine that your country's national team has made it to the World Cup final and everyone is sitting at home glued to their TV screens. In the city of the future, the TV signal will be transmitted to stationary and mobile devices via Next Generation Networks (NGNs) which enable multiple forms of information exchange. Network load is already high because of the numerous viewers when, on top of that, a severe storm hits the capital. This puts the communication networks to the limits: emergency calls are received over the NGN via IP telephony, power grid operators have to transmit telemetric signals to switch off damaged overhead power lines, and the operational centers of the police, fire and disaster management services must exchange information about the damages. Enabling all this information to be transmitted through a single network, and giving priority to the most important communications in the case of bottlenecks, is an essential element of research and development at Fraunhofer FOKUS's Next Generation Network Infrastructures (NGNI) Competence Center.

## PLATFORM-INDEPENDENT SMART COMMUNICATION

What the researchers mean by communication is essentially interaction between humans and machines, or from machine to machine. In technical terms, it makes no difference who wishes to communicate with whom or for what purpose. The Future Seamless Communications Playground (FUSECO PG) is a highly modular reference testbed developed by the NGNI team that abstracts from a concrete application domain by providing communication services for generic human-to-human and machine-to-machine interaction. The related OpenXXX software toolkits which constitute the testbed offer developers a customizable platform for prototyping all desired forms of communication without them having to deal with the concrete technical details of the network environment. Information is automatically transmitted in a form appropriate to the recipient, via suitable transmission channels and with proper encryption and prioritization. The high degree of abstraction achieved by state of the art software programming interfaces facilitates the use of and the mutual exchange of

information between a wide range of humans and devices, in turn enabling flexible and efficient Smart City Communications on top of multiple heterogeneous network infrastructures.

## SEAMLESS INTEGRATION OF ALL CURRENT AND EMERGING STANDARDS

The NGNI software toolkits, such as OpenIMS (IP Multimedia Subsystem), OpenMTC (Machine Type Communication) and OpenEPC (Evolved Packet Core), represent industry acknowledged reference implementations of international communication standards. They are modular and lightweight in design and can be easily deployed in emerging cloud infrastructures. The OpenEPC toolkit allows fast, seamless networking of all communication partners according to the "always best connected" paradigm. It enables dynamic alternations between different communications protocols and standards in order to ensure swift and reliable connections in mobile communication using WLAN, 2G/ 3G/ LTE and the future 5G standard. The communication protocols can also be used

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simultaneously, according to specific application requirements. The compatibility of the existing fixed network with mobile communication technologies is ensured as well. This makes it possible – if, for example, a storm like the one mentioned above causes damage to the DSL transmitting wire – to ensure that important eHealth data is transmitted using existing alternative mobile communication technologies.



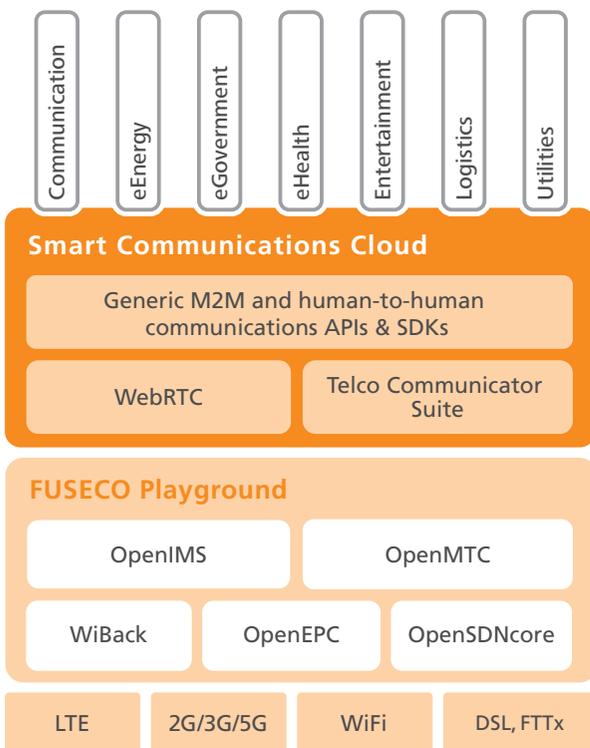
**86%**

is the annual growth rate  
of machine-to-machine  
communication until 2016.  
Scalability, and reliability  
are major factors here



Upcoming 5G standard will be designed to further reduce latencies in mobile data transmission. This becomes very important for the remote control of vehicles, for example

The FUSECO Playground software toolkits can be combined with other already existing solutions to create a wide variety of R&D testbeds. NGNI is committed to making its expertise and the required toolkits locally available to its partners during every stage of developing equipment, software and services. "We've learned that it makes much more sense to work with customers on their premises. The toolkits make our laboratory ultra portable – you might even say we offer 'labs to go'." explains Thomas Magedanz, head of the NGNI Competence Center.



*Using the NGNI FUSECO Playground, services and technologies for seamless communication can be tested close to reality*

#### Target groups:

- telecommunications companies
- manufacturers
- integrators
- operators
- service providers
- manufacturers of I&C equipment
- infrastructure companies
- electricity providers
- logistics companies
- hospitals
- operators of special-purpose networks
- Smart City application and service providers
- universities and research institutions

#### Technologies:

- FUSECO Playground
- OpenIMS Core, OpenEPC, OpenMTC, OpenSDN Core, Open5G Core
- Voice over LTE, Rich Communication Services (RCS)
- DSL, WLAN, 2G/ 3G/ LTE/ 5G

#### Services:

- technology coaching
- requirements analysis
- concept reviews
- migration planning
- performance and interoperability testing
- prototype development
- proof-of-concept implementation
- quality of service warranty
- provision of licensable software
- provision of technology testbeds (lab as a service)
- network and service platforms (lab to go)



*Prof. Dr. Thomas Magedanz, head of the NGNI Competence Center, develops communication infrastructures, which are operated worldwide*

In cooperation with partners that operate broadband communication networks in Europe, Asia, Africa and America NGNI is constantly refining its toolkits and playgrounds in order to meet the needs of the market and is actively helping to shape new industry trends. The introduction of the OpenSDN Core toolkit, for example, adds cloud computing capabilities to the FUSECO Playground in line with the concept of Software Defined Networking (SDN) and Network Function Virtualization (NFV). It allows network operators to convert their existing hardware-specific telecommunications infrastructure into a software-based infrastructure running on commodity hardware. This does not only allow the infrastructure to be operated much more cost-efficiently, as the infrastructure can be scaled up and down dynamically according to the actual usage. Another benefit for the network operators is to start new business opportunities quicker with much lower investments and risks.

NGNI offers services ranging from consulting on potential implementations to requirements analysis and technology coaching to prototype development and proof-of-concept implementation as well as interoperability and performance testing. NGNI conducts projects with universities and industrial partners that are engaged in the development of forward-looking solutions in the following areas: eHealth, eEnergy and Utilities and eGovernment communications networks. NGNI's OpenEPC toolkit, for example, is a control and monitoring platform for mobile broadband communications that enables potential implementations of Voice over LTE (VoLTE) to be practically tested on the ground, working together with mobile network operators.

## **BOUNDLESS OPPORTUNITIES IN THE SMART CITY**

### **Prof. Dr. Thomas Magedanz**

Prof. Dr. Thomas Magedanz, born in 1962 in Berlin, studied computer science at the TU Berlin where he obtained his PhD in 1993. Since 2002 he has been head of the Next Generation Network Infrastructures (NGNI) Competence Center at the Fraunhofer Institute FOKUS, and since 2004 he is also head of the Next Generation Networks chair at the TU Berlin. The teaching and supervision of MSc and PhD students focuses mainly on the research and development of platforms for the provision of multimedia services in fixed and mobile networks, Next Generation Networks and the Future Internet. This work ideally complements the research being done at FOKUS, given that Prof. Magedanz is training the engineers of the future who will control the complex ICT infrastructures of Smart Cities.

Besides its routine work with customers, NGNI is also active in standardization bodies, helping to prepare communication networks for the challenges of the future. In this area, NGNI pursues the idea of establishing the future 5G standard as a new distributed and highly efficient network architecture in which all transmission channels provide – seamlessly and with minimum latency – the basis for new applications in line with the concept of a responsive internet. Such a network facilitates Smart City applications, which usually rely on the intelligent, secure and efficient exchange of information among all communication partners. Examples are not only vehicles communicating with traffic lights, but also weather stations communicating with trains to enable them to adapt their speed to current wind forces. Such forms of communication, which must be fail-safe and go beyond the needs of private users, can be offered as value-added services in professional networks, in particular using the FUSECO Playground.



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