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5G: A View from Switzerland

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Switzerland projects a rural, pastoral image with beautiful countryside and mountains, but it is also a highly industrialised country that is recognised for its precision manufacturing and innovative services. It is the industrialised side of Switzerland that is vitally interested in 5G, the most advanced generation of mobile communication. Currently the country faces social, political and legal challenges that make the 5G roll-out both difficult and costly

In October 2018 the highest level of government in Switzerland, the Bundesrat, acknowledged that a solid, efficient and reliable IT network infrastructure is the backbone of a successfully functioning economy and society. New digital technologies promise huge improvements in education, vehicle safety, manufacturing, financial transactions, and inter-personal communication.

For Switzerland to take advantage of these improvements it needs more wireless capacity. Switzerland has strict regulations regarding non-ionising radiation - in fact, Switzerland's field-strength limits are ten times more restrictive than those in the European Union. These non-ionising radiation limits are exhausted in most urban locations, meaning that 5G cannot be added on top of the already installed services at these locations. Furthermore, with its dynamic, "smart" antennas, 5G challenges the regulatory framework that governs static antennas.

"Smart" antennas have many names that often stress different characteristics: massive MIMO (massive Multiple Input Multiple Output), switched-beam antennas, dynamic phased-array antennas, or adaptive antenna arrays. We can no longer afford to blanket a large area with communication energy. One key characteristic of 5G is that smart antennas permit transmitted energy to be focussed on a small area where there is an active user. The dynamic aspects of these antennas even allow the system to follow an active user in motion. In addition, the antenna can simultaneously serve multiple users. Such beam-steering implies that non-active, potential users would receive little radiation, in contrast to the current static antennas that cover large areas with communication energy.

Given the importance of 5G to wireless communication in Switzerland, the Swiss Research Foundation for Electricity and Mobile Communication organised a conference in December, 2018, focusing on smart antennas. Professor Jürg Leuthold from the Swiss Federal Institute of Technology in Zurich summarised the technical fundamentals of 5G, stressing the capabilities of smart antennas.

A talk by Hugo Lehman from Swisscom, Switzerland's largest communication service provider, discussed the difficulties faced by providers in installing the new technology: to stay within radiation limits per cell site, additional cell sites are needed. For the general public, this is a contradiction; more cell sites to protect against non-ionizing radiation.

The problem is exacerbated in 5G due to the dynamic control of the antenna beam. Worst-case radiation summation leads to an overestimation of the average peak radiation by factor of 5-10. This calls for either a change of the current practice of assessing maximum exposure, or an increase in allowed radiated power, or both. Lehmann also reported that preliminary 5G systems are running in six cities in Switzerland to test equipment and coverage. These experimental systems operate under the existing, maximum average transmitted power regulation, even though propagation at 5G's higher frequencies face increased atmospheric attenuation.

Switzerland's federal government organisation BAFU (Federal Office for the Environment) implements national laws and ordinances relating to environmental protection. Within BAFU is a section devoted to non-ionising radiation.

Urs Walker from BAFU discussed the political dilemmas faced by the Office: First, the Telecommunications Act and the Environmental Protection Act follow goals that are not easy to harmonise in the field of radiation protection. Second, customers of mobile services and citizens living close to base stations generally have opposing interests. Third, the Swiss Parliament is in disagreement on the issue: the two houses of Parliament are divided: one house was in favour of allowing an increase in the radiated power - by only a few votes; the other was in favour of preserving the present regulation - also by only a few votes.

5G smart antennas deliver energy where it is needed rather than blanketing a large area. Illustration courtesy of Romain Bonjour, IEF, ETH Zurich.

BAFU is currently investigating the political options as to how to proceed. These options should address: (i) current and future network capacities, including bottlenecks and topologies, (ii) current and future exposure levels of the population in relation to potential roll-out scenarios of 5G networks, and (iii) the current state of evidence on potential health impacts of cell phone radiation from both handsets and base-stations. The report, prepared by a group of experts, should be available in mid-2019 and is eagerly awaited.

The last presentation was given by Andy Fitze from the consultancy Swiss Cognitive. He explored the necessity of 5G for taking advantage of recent developments in blockchain technology, big data, data analytics and artificial intelligence widely accessible to the Swiss economy. His talk was clearly focused on innovation and economic opportunities, not on health risks. The most important risk he identified was missing out on the current development of the digitalisation of society.

An overview and charts from the presentations is available on the web page below, written mostly in German.

Link:
https://kwz.me/hcb

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Paving the Way for Local and Industrial 5G Networks and Testbeds

by Marius Corici, Marc Emmelmann, Manfred Hauswirth, Thomas Magedanz (Fraunhofer FOKUS, TU Berlin)

Local 5G networks are a major area of 5G innovation and offer vital insights into practical 5G deployment. Local 5G networks can give us important information because in these environments 5G technologies must be tightly integrated with different access network technologies and with the end-to-end software stacks of different vertical application domains, such as manufacturing and energy. To achieve this in an efficient and economical way, the Open5GCore.net software toolkit of Fraunhofer FOKUS provides the first 3GPP Release 15 5G core network implementation facilitating the rapid deployment of local 5G use-case-oriented testbeds. We have also developed the FOKUS "5G Playground", a reference live deployment, with multiple customised network slices based on the Open5GCore and use case applications. The "5G Playground" has served as a blueprint for many other 5G testbeds deployed across Europe and around the world in the context of 5GPPP.

After many years of international research and standardisation [1] the 5th Generation of Mobile Communications (5G) is on the verge of being deployed. The first 5G network deployments will start this year after the first 5G frequency auctions. Like previous generations of mobile communication systems, 5G will evolve functionally over time by means of new 3GPP releases and from practical experience obtained during the deployments of previous releases. However, the 5G system architecture is probably the most complex one so far, representing a radical change from previous generations due to its incorporation of various technology innovations, such as software-defined networks (SDN), network function virtualization (NFV), and edge computing, which make 5G a distributed, dynamically programmable software platform. Another reason for the complexity of 5G is its multi-access network support, including the novel 5G New Radio (NR) system, which adds a lot of flexibility, but also complexity to interworking in the migration to 5G. In addition, concepts like network slicing and local networking enable completely new levels of network customisation and new business models within different vertical domains. This means that the scope, the degree and the dimensions of flexibility are quite different from previous versions.

Thus, current 5G technology is still in its infancy and still requires a wide range of validation and optimisation by means of proof-of concepts and real-world trials in different application contexts in order to be fully applicable and gain acceptance in the different vertical domains. In this context the notions of campus networks and local/regional networks are gaining strong momentum. In contrast to public trials focussing on enhanced multimedia broadband use cases, requiring significant infrastructure investments with unpredictable returns, 5G deployments in a local context will be more affordable and can focus on very specific industrial requirements in the field of ultra-reliable, low-latency communication for complex business processes, such as automation in manufacturing. Also, business model exploration is going to happen in this area, as new deployment and operation models may evolve. In these local network environments, scalability and interoperability become key issues because local networks vary in size. Their access network and backhaul technologies, and their applications also vary, often demanding dedicated networks or different network slices. These emerging considerations have moved to the centre of discussions in the latest German plans for local/regional 5G spectrum assignments in the 3,7-3,8 GHz frequency range.

This is the environment for the Open5GCore, a scalable 5G core network; highly customisable to different application needs (mMTC vs. eMMB) for building 5G testbeds, developed by Fraunhofer FOKUS. Fraunhofer FOKUS has a long track record of building reference software toolkits for testbeds since 3G.

Open5GCore provides a solution for most of the requirements currently under discussion as it adequately reflects the 3GPP Release 15 for the core network functionality and its integration with 5G New Radio along with legacy off-the-shelf LTE-based access and non-3GPP accesses. As such, Open5GCore enables