An Enterprise Contemplation For A 5g Complex Architecture

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ABSTRACT:

This article offers a shape imaginative and prescient to address the demanding situations placed on 5G mobile networks. A two-layer structure is proposed, consisting of a radio network and a community cloud, integrating numerous enablers collectively with small cells, large MIMO, control/customer aircraft break up, NFV, and SDN. Three most important requirements are incorporated: relatively-dense small cell deployments on certified and unlicensed spectrum, underneath control/individual plane break up shape, to deal with ability and records price worrying situations; NFV and SDN to provide bendy community deployment and operation; and clever use of community statistics to facilitate most dependable use of network property for QoE provisioning and planning. An initial evidence of concept assessment is supplied to illustrate the functionality of the notion. Finally, one among a type issues that ought to be addressed to apprehend a whole 5G shape vision are cited.

INTRODUCTION

Despite the advances made in the design and evolution of fourth generation cellular networks, new requirements imposed by emerging communication needs necessitate a fifth generation (5G) mobile network. New use cases such as high-resolution video streaming, tactile Internet, road safety, remote monitoring, and real-time control place new requirements related to throughput, end-to-end (E2E) latency, reliability,1 and robustness2 on the network. In addition, services are envisioned to provide intermittent or always-on hyper connectivity for machine-type communications (MTC), covering diverse services such as connected cars, connected homes, moving robots, and sensors that must be supported in an efficient and scalable manner. Furthermore, several emerging trends such as wearable devices, full immersive experience (3D), and augmented reality are influencing the behavior of human end users and directly affecting the requirements placed on the network. At the same time, ultra-dense small cell deployments and new technologies such as massive multiple-input multiple-output (mMIMO), software defined networking (SDN), and network function virtualization (NFV) provides an impetus to rethink the fundamental design principles toward 5G. This article proposes a novel 5G mobile network architecture that accommodates the evolution of communication types, end-user behavior, and technology. The article first highlights trends in end-user behavior and technology to motivate the challenges of 5G networks. Some potential enablers are identified, and design principles for a 5G network are highlighted. This is followed by the articulation of a 5G mobile network architecture together with details of some fundamental technology enablers and design choices, and a discussion of issues that must be addressed to realize the proposed architecture and an overall 5G network. The article wraps up with proof of concept evaluations and conclusions

OVERVIEW:

It is well known that mobile data consumption is exploding, driven by increased penetration of smart devices (smart phones and tablets), better hardware (e.g., better screens), better user interface design, compelling services (e.g., video streaming), and the desire for anywhere, anytime high-speed connectivity. What is perhaps not widely mentioned is that more than 70 percent of this data consumption occurs indoors in homes, offices, malls, train stations, and other public places [1]. Furthermore, even though mobile data traffic is increasing at a brisk pace, signaling traffic is increasing 50 percent faster than data traffic More end users are using multiple devices with different capabilities to access a mix of best effort services (e.g., instant messaging and email) and services with quality of experience (QoE) expectations (e.g., voice and video streaming). Over-the-top (OTT) players provide services and apps, some of which compete directly with core operator services (e.g., voice, SMS, and MMS). Connectivity is increasingly evaluated by end users in terms of how well their apps work as expected, regardless of time or location (in a crowd or on a highway), and they tend to be unforgiving toward the mobile operator when these expectations are not met. Moreover, the battery life of devices and a seamless experience across multiple devices (or a device ecosystem)have also become important issues for many end users. The Internet of Things (IoT), which adds “anything” as an additional dimension to connectivity (in addition to anywhere and anytime), is also becoming a reality. Smart wearable devices (e.g., bracelets, watches, glasses), smart home appliances (e.g., televisions, fridges, thermostats), sensors, autonomous cars, and cognitive mobile objects (e.g., robots, drones) promise a hyper connected smart world that could usher in many interesting opportunities in many sectors of life such as healthcare, agriculture, transportation, manufacturing, logistics, safety, education, and many more. Even though operators currently rely on existing networks (especially widely deployed 2G/3G networks and fixed line networks) to support current IoT needs, many of the envisaged applications impose requirements, such as, very low latency and high reliability, that are not easily supported by current networks. To cope with such evolving demands, operators are continuously investing to enhance network capability and optimize its usage. Operators are deploying more localized capacity, in the form of small cells (e.g., pico and femto cells and remote radio units, RRUs, that are connected to centralized baseband units by optical fiber) to improve capacity. In addition, traffic offloading to fixed networks through local area technologies such as Wi-Fi in unlicensed frequency bands has become widespread. To optimize network usage for better QoE in a fair manner, mobile networks are also integrating more functionality such as deep packet inspection (DPI), caching, and transcoding. All these improvements come at significant capital and operating costs, however. With the increasing complexity and associated costs, several concepts and technologies that have proved useful to the information technology (IT) sector are becoming relevant to cellular networks as well. For instance, an industry specification group (ISG) set up under the auspices of the European Telecommunications Standards Institute (ETSI ISG NFV) is currently working to define the requirements and architecture for the virtualization of network functions and address identified technical challenges. Similarly, the Open Networking Foundation approved a Wireless and Mobile Working Group in November 2013 to identify use cases in the wireless and mobile domain that can benefit from SDN based on Open Flow.

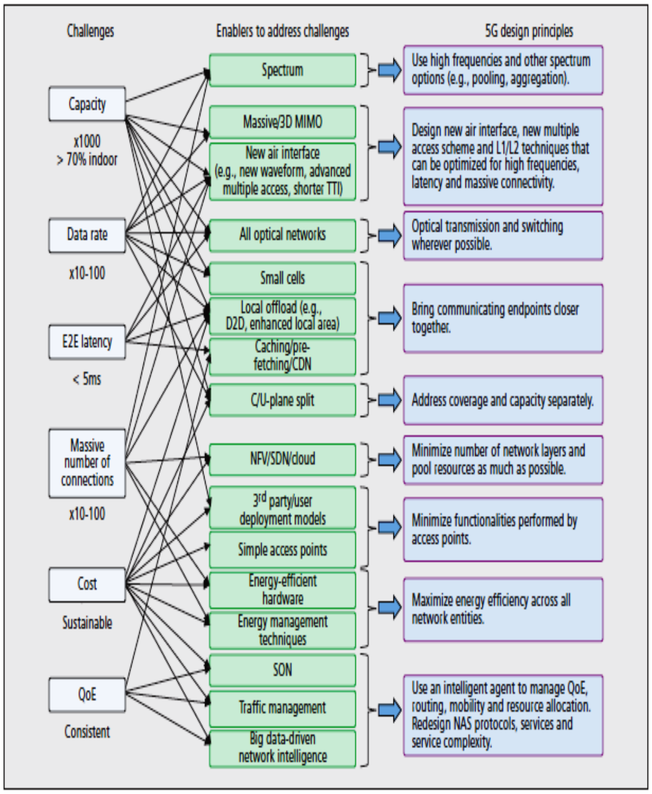


Fig. 5G challenges, potential enablers, and design principles.

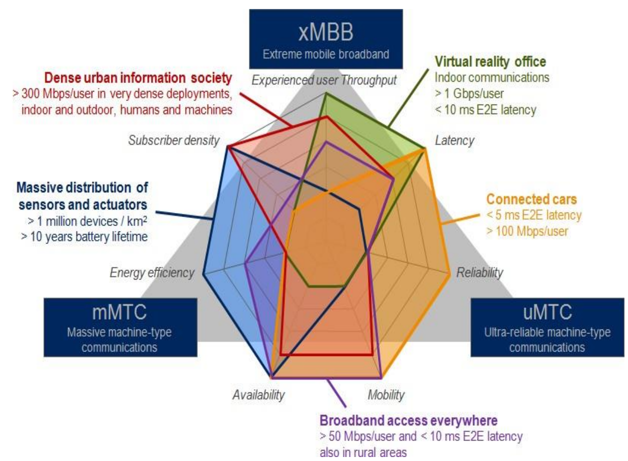
KEY 5G RAN DESIGN REQUIREMENTS

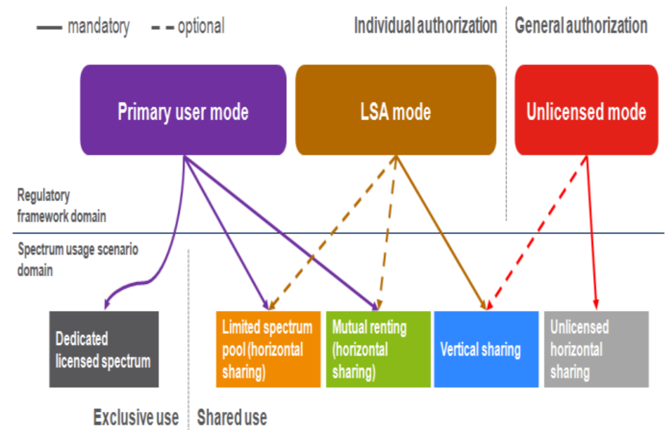
Due to the diverse and extreme requirements of the mentioned main 5G service types, it is clear that the 5G RAN must be designed to operate in a wide range of spectrum bands with diverse characteristics, such as channel bandwidths and propagation conditions [1]. It must further be able to scale to extremes in terms of throughput, number of devices, connections etc., which is likely only possible if it can handle the so-called user plane (UP), related to the transmission of actual application payload, and control plane (CP), related to control functionality and signaling, individually. To provide scalability also in the context of various possible deployments and an evolving application landscape, it is essential that the overall 5G network (both RAN and CN) is software-configurable, meaning that, e.g., the logical and physical entities to be traversed by CP and UP packets are configurable. A key aspect described more in Section 3 is that the 5G RAN should offer the option to integrate Long- Term Evolution Advanced (LTE-A) evolution and novel 5G radio technology on RAN level, though integration need not always take place on this level. The 5G RAN should further support more sophisticated mechanisms for traffic differentiation than legacy systems in order to fulfill diverse and more stringent Quality of Service (QoS) requirements, and it should facilitate the Network Slicing vision from NGMN [2], enabling to operate multiple independent logical networks for different business cases on a shared physical infrastructure (see also Section 4). Another required feature distinctive from legacy systems is the native and efficient support of communication forms like multi-connectivity (e.g. concurrent communications of a device with multiple network nodes) and network-controlled device-to-device (D2D) communication, including point-to-point, multi-cast and broadcast communication.

The 5G RAN should further support a wide range of physical deployments, from distributed base stations to centralized cloud-RAN deployments or distributed edge clouds. Different types of backhaul shall also be supported with graceful performance degradation associated to the backhaul quality in terms of delay and capicity. Also self-backhauling is seen as an important feature, where also devices may act as base stations and self-establish wireless backhaul links to suitable donor base stations

AIR INTERFACE LANDSCAPE AND INTEGRATION INTO ONE 5G AIR INTERFACE

In order to handle simultaneously the extreme requirements of 5G services and use cases, an overall 5G AI is envisioned, as shown in Figure 1, which is composed of new 5G AIVs as well as evolved legacy technologies like LTE-A. This overall 5G AI is expected to operate on a wide range of spectrum bands, where frequencies below 6 GHz are likely most suitable to support, e.g., mMTC services where coverage is most important, while spectrum above 6 GHzis essential to provide the massive capacity demanded by xMBB applications. Three authorization schemes or mixtures thereof are expected to coexist for the spectrum used by 5G: Primary user mode, Licensed Shared Access (LSA) mode and Unlicensed mode. For example, the License Assisted Access (LAA) approach already considered for LTE-A is a combination of “dedicated licensed spectrum” for primary users aggregated with unlicensed spectrum bands [1]. An exclusive use of spectrum should remain the main and preferred solution, while a shared use of spectrum may be a complement to increase spectrum availability.





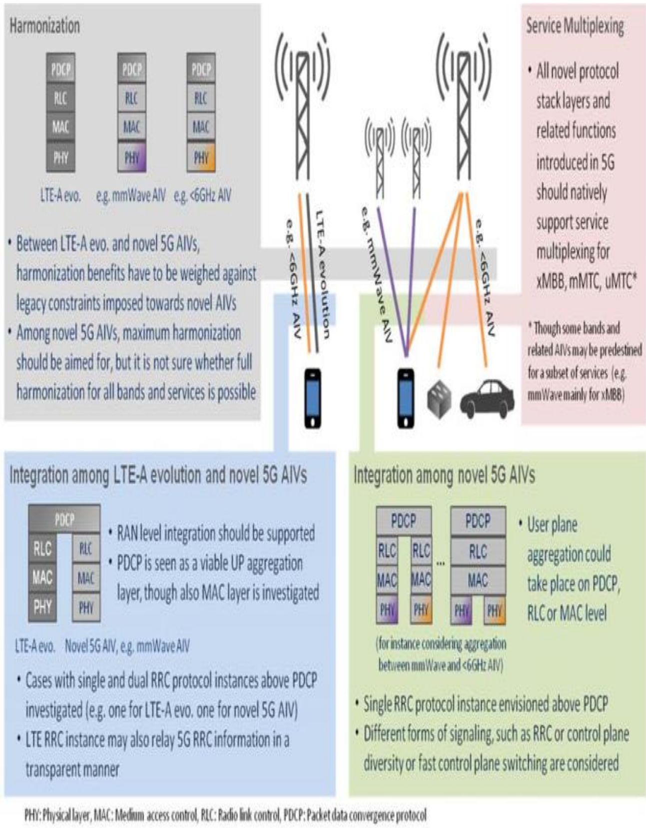


Fig. Overall 5G AI envisioned, and key considerations on AIV integration in 5G.

LTE-A and its evolution is likely to play a pivotal role and serve as coverage layer and potentially also as anchor layer particularly in early 5G deployments when novel 5G AIVs will not yet be able to provide the same coverage as LTE-A. Novel 5G AIVs may operate in conjunction with LTE-A or stand-alone, and may, for instance, be designed for specific frequency ranges, services, or cell types etc. For example, an AIV tailored toward slower carrier frequencies, large cell sizes and high velocity will likely have a physical layer (PHY) designed to be most robust towards delay spread and Doppler spread, whereas an AIV tailored towards mmWave frequencies and short-distance communication with limited mobility may rather require robustness towards other impairments such as phase noise. Further, in order to support applications requiring very low latencies and/or very high data rates, some new 5G AIVs are expected to use shorter transmission time intervals (TTIs) and a wider bandwidth compared to LTE-A. The exact waveform(s) to be used for novel AIVs are still under investigation, but it appears clear that key properties will be a flexible and scalable numerology enabling user- and service-specific adaptations, flexible sub-band configurations, improved spectral efficiency, support for flexible time division duplex (TDD) and reduced out-of-band (OOB) emissions. Two approaches that are currently being compared are to have either a single waveform type parameterized to support all services and bands, or a co-existence of different waveforms such as variants of orthogonal frequency division multiplex (OFDM) and filter-bank multi-carrier (FBMC)

SYSTEM MODEL:

In alignment with the NGMN vision [2], it is expected that the majority of CN and Service-Layer functions are deployed in 5G as virtual network functions (VNFs), thus running in virtual machines on standard servers, potentially on cloud computing infrastructures, i.e. data centers. The design of these functions will to some extent explore software-defined networking (SDN) principles such as a split of UP and CP, and allow for their flexible deployment in different sites in operators' networks depending on requirements related to latency, available transport, processing and storage capacity etc. Moreover, different services or network slices may utilize different CN and Service-Layer VNFs deployed at different network sites. An important assumption, also considered by the 3rd Generation Partnership Project (3GPP) [5], is a logical split between RAN, CN and Service Layer functions. This is seen as beneficial because it:

• Allows for an independent evolution of RAN and CN functionality to speed up the introduction of new technology;

• Enables to make some CN functions access-independent (e.g. common UP processing);

• Facilitates mobility since some CN functions can be kept when UEs move to a new RAN node; • Allows cross-layer optimizations when the functions are co-located;

• Facilitates multi- vendor CN / RAN interoperability. The exact logical split between RAN and CN has not been defined yet. While the evolved packet system (EPS) provides a natural baseline for the split [6], enhancements are being investigated such as RAN-based paging for dense deployments and a new connected state optimized for inactivity periods, both resembling a shift of functions from CN to RAN

In order to address future architecture requirements, a novel CN/RAN interface denoted S1* is envisioned which supports:

• E2E Network Slicing (where each slice may have its own set of CN functions);

• New 5G services with diverging requirements (where CN functions can be optimized for a specific service);

• Enhanced multi-RAT integration with common CN functions where some could be designed to be independent of the access technology;

• Potentially new UP/CP splits in the 5G CN;

• A new connected state, optimized for battery savings but enabling a fast transition to active.

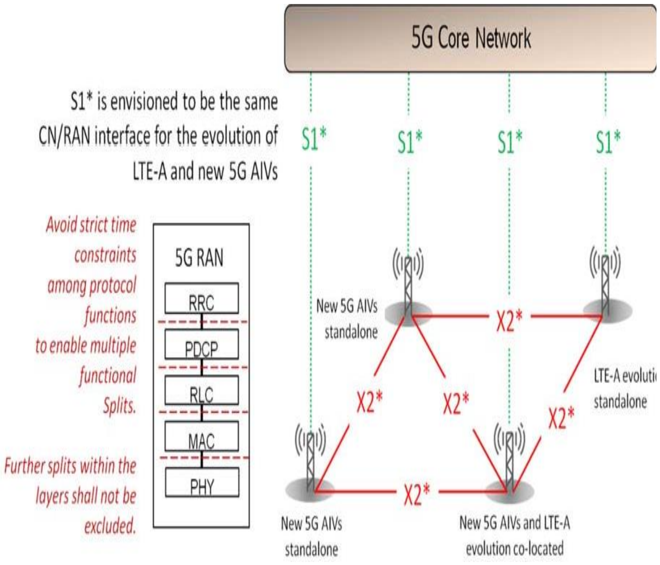
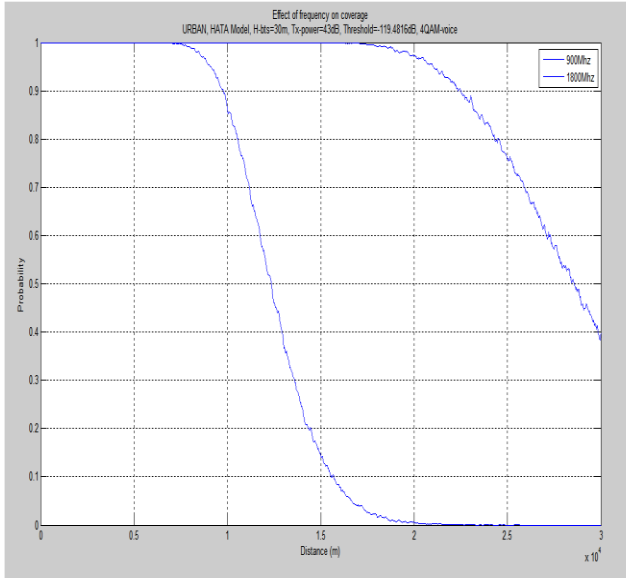
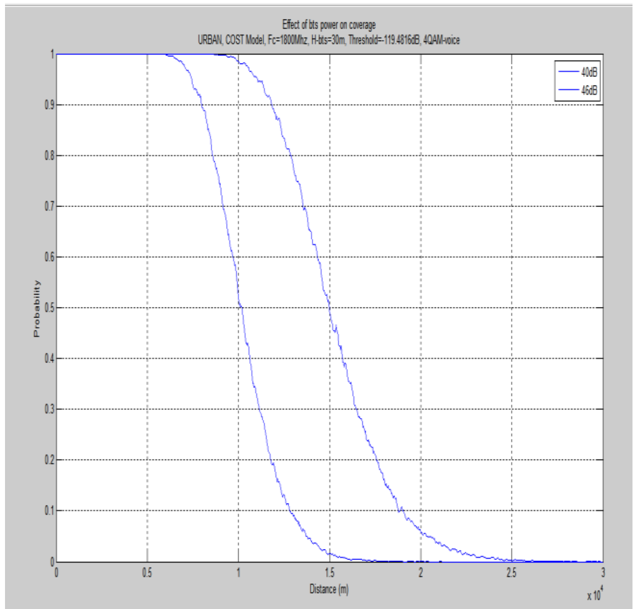


Fig : Considered 5G network interfaces.

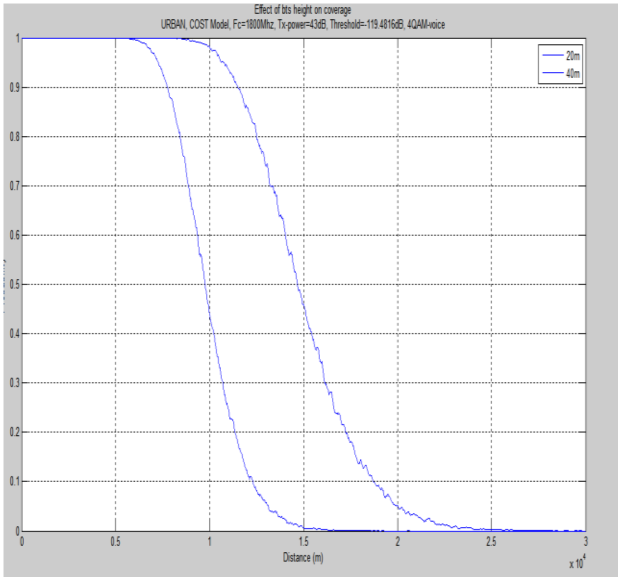


Effect of Frequency on coverage

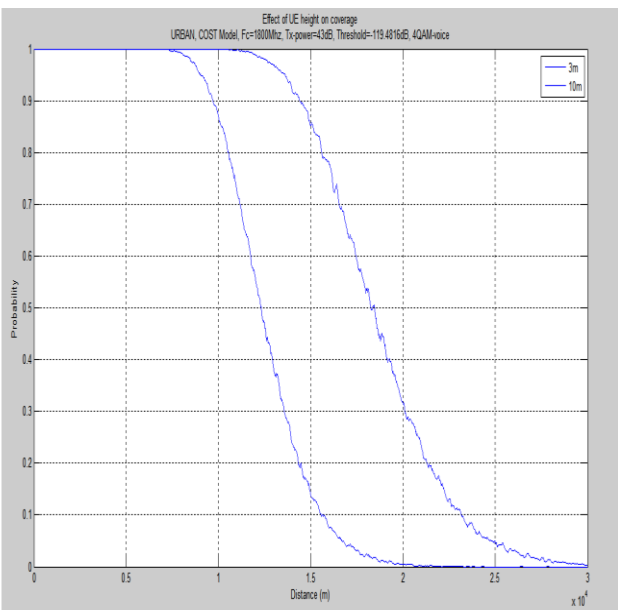
SIMULATION RESULTS:



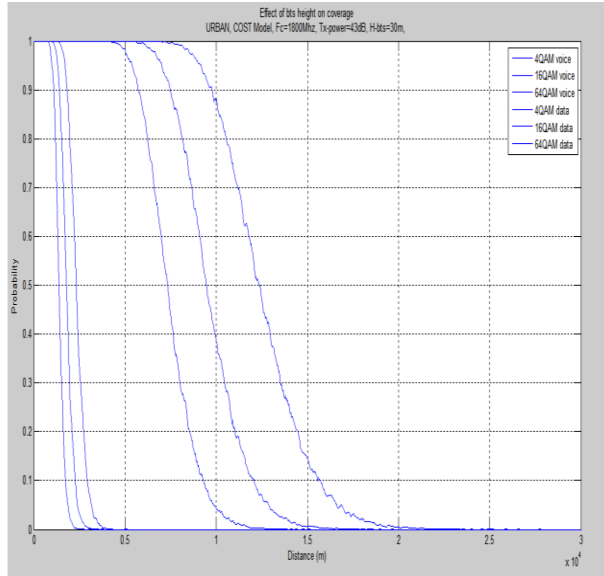
Effect of bits power on coverage



Effect of bits height on coverage



Effect of UE height on coverage



Effect of bits heights on coverage

CONCLUSION

This paper has provided a view of the current considerations on the overall 5G RAN architecture and related key functional aspects. It has listed a set of paradigm changes expected to be introduced in 5G, for instance related to a beam-enabled lean design or the introduction of a novel UE state, as well as a set of specific functionality proposals that will be a basis for standardization in 3GPP. It has to be noted that the topics covered in this paper are still under research and subject to finalization in the next months.

REFERENCES

[1] ICT-671680 METIS-II, Deliverable 1.1, "Refined scenarios and requirements, consolidated test cases, and qualitative techno-economic assessment", January 2016.

[2] Next Generation Mobile Networks (NGMN) Alliance, "NGMN 5G White paper", February 2015.

[3] International Telecommunication Union – Radio (ITU-R) Working Party WP 5D: Draft New Recommendation "IMT Vision - Framework and overall objectives of the future development of IMT for 2020 and beyond", Doc. R12-SG05-C-0199 (approved by Study Group SG5), June 2015.

[4] M. Tesanovic, M. Schellmann, P. Weitkemper, D. Calabuig, O. Aydin, C. Kilinc and V. Venkatasubramanian, "Towards a flexible harmonised 5G air interface with multi-service, multi- connectivity support ", ETSI Workshop on Future Radio Technologies: Air Interfaces, January 2016.

[5] 3GPP S2-153651, "Study on Architecture for Next Generation System", October 2015.

[6] 3GPP TS 36.300, "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2", November 2015.

[7] ICT-317669 METIS, Deliverable 6.4, "Final report on architecture", January 2015.

[8] 3GPP TR 25.912, "Feasibility study for evolved Universal Terrestrial Radio Access (UTRA) and Universal Terrestrial Radio Access Network (UTRAN), Release 13", December 2015.

[9] D. Szczesny, A. Showk, S. Hessel, A. Bilgic, U. Hildebrand, and V. Frascolla, "Performance analysis of LTE protocol processing on an ARM based mobile platform", International Symposium on System-on-Chip (SOC), October 2009.

[10] I. Da Silva, G. Mildh et al., "On the impact of network slicing on 5G radio access networks", IEEE International Conference on Communications (ICC), 5G RAN Design Workshop, May 2016, submitted for publication.

[11] F. Athley, S. Tombaz, E. Semaan, C. Tisdav and A. Furuskär, "Providing Extreme Mobile Broadband using higher frequency bands, beamforming and Carrier Aggregation", IEEE Global Conference on Communications (Globecom), December 2015.

[12] P. Frenger, M. Olsoon, E. Eriksson, "A Clean Slate Radio Network Designed for Maximum Energy Performance", IEEE International Symposium on Personal, Indoor

and Mobile Radio Communications (PIMRC), September 2015.

[13] ÖmerBulakci, Athul Prasad, JakobBelschner; Marten Ericson, IngolfKarls, HarisCelik, Milos Tesanovic, Roberto Fantini, Luis Miguel Campoy, Emmanouil Pateromichelakis, Fernando Sanchez Moya, Gerd Zimmermann and Icaro da Silva "Agile Resource Management for 5G - A METIS-II Perspective," IEEE Conference on Standards for Communications and Networking (CSCN), October 2015.

[14] 3GPP TR 23.720, Technical Specification Group Services and Systems Aspects, "Architecture enhancements for Cellular Internet of Things (Release 13)", November 2015.

[15] I. Da silva, G. Mildh, M. Säily and S. Hailu, "A novel state model for 5G radio access networks", IEEE International Conference on Communications (ICC), 5G RAN Design Workshop, May 2016, submitted for publication.