

## Editorial

# Slicing in Modern Cellular Networks

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One of the basic assumptions of the 5G network architecture is network slicing. It has the advantage of enabling, as a result of creation of logical networks (slices), simultaneous optimization of hardware and radio resources and provide network communication capability that is service-oriented. The ability to create virtual networks, dedicated to different users or services, allows for efficient dimensioning and management of allocated resources.

In this special issue of the “Slicing in Modern Cellular Networks”, five high-quality papers are selected for publication whose authors consider typical challenges related to slicing in cellular networks, such as:

- (i) resource management algorithms in logical 5G networks,
- (ii) virtualization of 5G network components,
- (iii) Cloud Radio Access Network (C-RAN),
- (iv) hybrid architectures of 5G with other wireless technologies (e.g., SDN/NFV, satellite networks),
- (v) analysis and modeling of 5G multiservice logical networks.

One of the articles is devoted to resource management algorithms in logical 5G networks. The article, entitled “Waveform Flexibility for Network Slicing,” is written by Ł. Kułacz et al. The authors propose heuristic algorithms for waveform selection and frequency assignment in order to optimize the use of the spectrum and provider’s infrastructure. The authors consider the possibility of cognitively adjusting the shape of the waveform to the requirements associated with various

network slices jointly with the selection and allocation of the appropriate frequency bands to each slice. It is worthwhile to emphasize that in the proposed algorithms the assumed slice-specific Quality of Service (QoS) parameters are guaranteed. The proposal is verified and evaluated by simulation experiments conducted for four case studies covering several network deployment scenarios with a number of slices characterized by different QoS requirements.

Another article discusses virtualization of 5G network components. In the article “A Service-Oriented Approach for Radio Resource Management in Virtual RANs,” B. Rouzbhani et al. propose a centralized cooperative mechanism of Radio Resource Management for Virtual Radio Access Networks based on aggregation and virtualization of all the available radio resources from different Radio Access Technologies (RATs). The presented virtual platform is responsible for service orchestration among Virtual Network Operators, enabling a definition of various services and policies, separately from vendors and underlying RATs. The virtual platform has the advantage of maximizing the virtual capacity utilization from different RATs in order to satisfy the specific QoS requirements for each service. The performance of the proposed model is discussed based on a simulation study. The results confirm that the model can capture the demanded capacity in keeping with the concept of proportional fairness.

L. M. P. Larsen et al. in one of the articles consider cloud RAN. The authors, in their article entitled “Fronthaul for Cloud-RAN Enabling Network Slicing in 5G Mobile Networks,” present the Cloud Radio Access Network (C-RAN) architecture as a promising element which enables the introduction of virtualization and network slicing. In

particular, the authors pay special attention to the fronthaul network which links a distributed and a centralized unit of C-RAN. Proper deployment of a fronthaul network requires careful consideration of the trade-off between fronthaul bitrate, flexibility and complexity of the local equipment close to the user. In the numerical part of the article, the authors present the fronthaul range in relation to processing delay for exemplary LTE and Ethernet scenarios.

Another article is related to hybrid architectures of 5G with other wireless technologies. It is entitled as “A Biological Model for Resource Allocation and User Dynamics in Virtualized HetNet,” is written by L. Ma et al.. The article investigates the dynamic-aware virtual radio resource allocation based on utility and fairness. The authors also propose a virtual radio resource management framework in which the radio resources of different physical networks are virtualized and form a common virtual resource pool. The virtual pool can be then used by mobile virtual network operators (MVNOs) to provide service to users. In the article, the authors propose a virtual radio resource allocation algorithm based on a biological model. In this model, the virtual resource allocation problem is formulated as a population competing problem, where users in the system are considered as the predators in nature environment, and virtual resources are prey to be hunted down by users. The algorithm is based on the Lotka-Volterra model, in which the authors introduced aggregated utility function and are considering together fairness and utility of the system. The authors also present the results of simulation experiments to verify that the proposed virtual resource allocation algorithm achieves a better trade-off between the total utility and fairness than the existing algorithm. It is worth emphasizing that the algorithm can also be utilized to analyze the population dynamics of system.

Finally an article proposes new solutions for analysis and modeling of 5G multiservice logical networks. M. Głabowski et al. in their article entitled “Modelling of Multiservice Networks with Separated Resources and Overflow of Adaptive Traffic” propose a new method of determining traffic characteristics of multiservice overflow systems that carry adaptive traffic. The authors assume that adaptive traffic is subjected to the threshold compression mechanism in both primary and secondary resources that can be physical resources as well as virtual resources (e.g., slices). The model was elaborated on the basis of a generalization of Hayward’s concept and its application to model systems with adaptive traffic with threshold compression. The presented method allows grade of service parameters (blocking probability, carried traffic, and network load) to be analytically determined and therefore can be used for optimal dimensioning of slices in modern mobile systems. The obtained calculation results are compared with the results of simulation experiments for a number of selected structures of overflow systems that service adaptive traffic, confirming the accuracy of the proposed analytical model.

We do hope that the selected articles will spark many discussions among the readers contributing to new research concepts and efficient implementation of slicing in cellular networks. We would like to thank everyone who contributed

to this special issue, the authors for the interesting submissions, the reviewers for timely feedback, and the staff from the Editorial Office for their invaluable assistance.

### **Conflicts of Interest**

The authors declare that they have no conflicts of interest.

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