MODELLING TRAFFIC CONTROL MECHANISM IN MOBILE NETWORKS

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Since the first attempts to develop systems with the voice connection in the 2G mobile network - GSM (Global System for Mobile Communications) in 1991, the indisputable success of cellular networks has not been questioned. Modern cellular networks enable their users to have access to the internet as well as to multimedia services. First 4G networks are being currently set up that are entirely based on IP (Internet Protocol) technologies.

The problems that emerge in designing of modern cellular networks, and, in particular, mobile networks that service multi-service traffic, i.e. 3G networks and, in the near future, 4G networks that would guarantee an acceptable level of the quality of service of calls, clearly indicate the need for developing effective and efficient methods for their optimization, dimensioning and traffic load evaluation. The process of dimensioning of mobile networks makes it possible to determine the appropriate capacities of the system that ensure -- with the pre-defined load of the system --the assumed level of GoS (Grade of Service) and QoS (Quality of Service). At the stage of dimensioning of the system, it is also necessary to take into consideration mutual dependencies between call service processes in the core network and the access network, as well as in individual elements of the access network, such as the UMTS system (Universal Mobile Telecommunication System), the WCDMA radio interface (Wideband Code Division Multiple Access) and the Iub interface.

Radio interfaces and other interfaces of the access network in 2G, 3G and 4G systems are crucial in establishing the traffic effectiveness of the network. Due to the low capacity of the radio interface, additionally limited by the influence of interference from neighbouring calls and the capacity and the organization (resources) of combined "non-radio" interfaces, network operators are to make use of a number of traffic management mechanisms that make it possible to increase the effectiveness of the systems. These mechanisms include the threshold and non-threshold compression, partial limitation of resources for preselected service classes and overflow of part of traffic caused by privileged traffic, priorities for preselected services or groups of subscribers, optimum allocation of connections in a group of cells, overflow mechanism in neighbouring cells and cells that belong to other networks of a given operator that cover a given area (e.g., from cells of a 3G network to cells of a 2G network), multicast service availability (also know as "multicast" connections) at the so-called technological level (the subscriber does not know that the connection that is being just executed is a multicast connection, e.g. as a result of a transfer of connections between cells), and the availability of servicing multicast connections at the service level (an executed connection is defined as a multicast connection within the context of a given service, e.g., conference connections).

The construction of appropriate models of cellular systems that would include both servicing a mixture of traffic with different properties and different GoS requirements, and also traffic management mechanisms in appropriate interfaces of the access network, undoubtedly influences the development of traffic theory within the domain of multi-service systems, while in the practical dimension it makes it possible to evaluate properly the traffic load in cellular networks and their efficient dimensioning and optimization.

In the key-note speech addresses the issues of analytical modelling of interfaces in the radio access network. In the first part of presentation the way of representation of multi-service traffic in multi-rate switching networks, with a particular attention given to the method of the so-called bandwidth discretization are presented. It next part the basics of modelling of interfaces of the radio access network with built-in traffic management mechanisms will be discussed. Than the most important traffic management mechanisms used in radio access networks will be shown. Finally, problems stemming from the introduction of the LTE (Long Term Evolution) technology and Advanced LTE technology to cellular networks are presented and discussed.

Prof. Maciej Stasiak received MSc and PhD degrees in telecommunication from the Institute of Communications Engineering, Moscow, Russia, in 1979 and 1984, respectively. In 1996 he received DSc degree (habilitation) from Poznan University of Technology in telecommunication. In 2006 he was nominated as full professor. Between 1983-92 he worked in Polish industry as a designer of electronic and microprocessor systems. In 1992, he joined the Institute of Electronics and Telecommunications Poznan University of Technology. He is currently a head of the Chair of Communications and Computer Networks at the Faculty of Electronics and Telecommunications at Poznan University of Technology.

Prof. Maciej Stasiak is the author or co-author of 5 books and more than 200 scientific papers, which have been published in scientific journals and presented at national and international conferences. He is engaged in research and teaching in the area of performance analysis and modeling of multi-service networks and switching systems, in particular, resource allocation, call admission control, quality of service, multi-rate systems and queuing systems. He was a supervisor of 6 PhD dissertations and about 50 MSc projects. Prof. Maciej Stasiak is a Member of Communications Society, Institute of Electrical and Electronics Engineering, a Member of Communications Society, Institute of Electronics, Information and Communication Engineers, and a Member of Association for Computing Machinery.

Prof. Maciej Stasiak has been involved in many national and international projects dealing with network and resources optimization. Since 2004 he has been actively carrying out research on modeling and dimensioning cellular networks 2/3/4G. The relevant research results obtained so far have been implemented in software used by cellular operators to handle tasks such as the analysis of the capacity and optimization of the 2/3G/4G network (he is co-author of book: Modeling and Dimensioning of Mobile Networks: From GSM to LTE, From GSM to LTE published by Wiley).