

6G Technology Challenges from devices to wireless systems

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Abstract: Evolution of wireless communications systems has provided ever increasing data rates for wireless communications systems over the years, and Edholm's law predicts data rates exceeding 1Tbps in ten year time. Such a target is also one of the key drivers on the way towards 6G communications and sensing. However, scaling up the performance of future systems to the requested bandwidths is not straightforward and many aspects related to technologies indicate challenges that must be taken seriously. Those include availability and properties of carrier frequencies to achieve the capacity, radio propagation and hardware technologies from antennas to transistors that are needed for such systems. Speed of transistors, interconnects, etc. will limit the capabilities on one side. On the other hand, scaling of antennas towards higher carrier frequencies and their impact to RF transceivers have different constraints on the potential solutions. Future wireless systems should take these aspects carefully into account, and on the other hand, technologies that would pave the way towards improved communications and sensing capabilities with reasonable power consumption will be core elements for 6G.

This tutorial addresses many of the aspects that need to be considered when implementing radio systems for anticipated 6G requirements. Principles of wireless communications systems will be analyzed against link capacity and range, and based on those challenges related to RF transceivers with circuit and device aspects will be explored. Wireless communication system are already complex and complexity will even increase once technology boundaries are approached. The tutorial will provide insights on the challenges related to technologies at different hierarchies and considerations on the tradeoffs to be tackled related to the next generation of communications.

Bio: Aarno Pärssinen (S'95-M'01-SM'11) received the M.Sc. and Doctor of Science degrees in electrical engineering from the Helsinki University of Technology, Finland, in 1995, and 2000, respectively. From 1994 to 2000 he was with Electronic Circuit Design Laboratory, Helsinki University of Technology, Finland, working on direct conversion receivers and subsampling mixers for wireless communications. In 1996, he was a Research Visitor at the University of California at Santa Barbara. From 2000 to 2011 he was with Nokia Research Center, Helsinki, Finland. During 2009-2011 he served as a member of Nokia CEO Technology Council. From 2011 to 2013, he was at Renesas Mobile Corporation, Helsinki, Finland working as a Distinguished Researcher and RF Research Manager. From October 2013 to September 2014 he was an Associate Technical Director at Broadcom, Helsinki, Finland. Since September 2014 he has been with University of Oulu, Centre for Wireless Communications, Oulu, Finland where he is currently a Professor. He leads Devices and Circuits research area in 6G flagship program financed by Academy of Finland. His research interests include wireless systems and transceiver architectures for wireless communications with special emphasis on the RF and analog integrated circuit and system design.

Aarno Pärssinen has authored and co-authored one book, two book chapters, more than 150 international journal and conference papers and holds several patents. He is also one of the original contributors to Bluetooth low energy extension, now called as BT LE. He served as a member of the technical program committee of Int. Solid-State Circuits Conference in 2007-2017, where he was the chair of European regional committee in 2012-13, and the chair of the wireless sub-committee in 2014-2017.