Tutorial T-1: 5G Evolution and Candidate Technologies

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Tutorial Overview

Technologies for future cellular wireless networks and devices are expected to meet the needs of an increasingly diverse set of devices and services anticipated beyond 2020, which we will refer to as "5G". From a user perspective, 5G research should dramatically transform our wireless service experience by offering a disruptive increase in service rate, by enabling a uniform service experience anytime anywhere, and by providing a high level of service quality. Experts vary in opinion on vision and requirements for 5G, which range from 10-100x peak rate, 1000x network capacity, 10x energy efficiency, or 10-30x lower latency. The objective of this tutorial is to give an overview of 5G requirements and enabling technology potentials.

We will discuss i) applications and usages for future 5G communications, ii) a set of key metrics for these usages and their corresponding target requirements, and iii) potential network architectures and enabling technologies to meet 5G requirements. It is expected that some of the new technologies comprising 5G will be evolutionary, covering gaps and enhancements from 4G systems, while some of the technologies will disruptive covering fundamentally new waveforms, duplexing methods and new spectrum. We will also provide an overview of 5G activities around the world to understand the vision and research direction of various teams as they tackle the challenging problems of capacity (rate and massive number of devices), ultra-low latency, power efficiency, etc. that wireless networks are expected to face by year 2020.

A detailed breakdown of the tutorial is as follows:

Part 1: Brief Introduction to the evolution of 2G, 3G and 4G
This part will briefly cover the requirements, enabling technologies and capabilities of 2G, 3G and 4G to build the foundation for the rest of the tutorial.

Part II: Introduction to 5G
This part will cover the following aspects: What is 5G? What is the difference from 4G? What is the user application and perspective for 5G? What are the 5G Requirements? What are the potential enhancements to 4G and new disruptive 5G technologies? What are the latest 5G Activities all around the world?

Part III: Candidate Technologies
This part will cover evolutionary and revolutionary candidate technologies for 5G. The evolutionary Technologies include: (a) Small cell enhancements, (b) Relays enhancements, (c) Multi-Radio coordination and integration technology, (d) Interference coordination technologies, (e) M2M communications for Internet of Things, (f) D2D communications, and (g) Energy efficiency. The revolutionary technologies include: (a) New physical layer waveforms, (b) mmWave technologies, (c) Massive MIMO technologies, (d) Simultaneous transmit and Receive, (e) Cloud-based radio access techniques.

Presenter Biography

Rath Vannithamby received his BS, MS, and PhD degrees in EE from the University of Toronto. He leads a team responsible for 5G research in Intel Labs. Previously, he was a researcher at Ericsson. He is a Senior Member of IEEE. He is an IEEE Communications Society Distinguished Lecturer for 2014-2015. He has published over 50 scientific articles and has over 150 patents granted/pending. He is a co-editor of a couple of books "Towards 5G: Applications, Requirements and Candidate Technologies" by John Wiley and Sons, and "Design and Deployment of Small Cell Networks" by Cambridge Press to be published. He has also authored chapters of 3 books on 4G Technologies.

Dr. Vannithamby has given keynote speeches in IEEE APWiMob'14, IEEE ISTT'14, and IEEE GC'10 BWA workshop. He is currently an associate editor for two journals: (i) Journal of IEEE Communications Surveys and Tutorials, and (ii) IEEE Internet of Things Journal. He was a lead-chair for workshops on "5G Technologies" and "M2M Communications" in IEEE ICC 2014. He was a Guest Editor for EURASIP JWCN SI on RRM for 3G+ Systems. He was a TPC track-chair for PIMRC'11. He has also served on TPC for IEEE ICC, GC, VTC, WCNC, and PIMRC. His research interests are in the area of 5G, M2M and IoT, energy efficiency, QoS for mobile internet applications, cross-layer techniques.