IEEE

International Network Generations Roadmap

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Systems Optimization

IEEE Future NETWORKS

An IEEE 5G and Beyond Technology Roadmap

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This edition of the INGR is dedicated to the memory of Earl McCune Jr., who left us tragically and too soon on 27 May 2020. Earl was a microwave/RF guru, brilliant technologist, major industry/IEEE contributor, global visionary, keen skeptic, and all around fantastic human being. He was a major contributor to the INGR's early work on energy efficiency, millimeter-wave, and hardware. He worked for a technologically advanced yet more energy efficient world, and the contents of the INGR are a tribute to that vision. Rest in peace, Earl!

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ABSTRACT

Fifth generation (5G) networks represent the first step from evolutionary to revolutionary networks. Use cases driving this transition for 5G networks focus on the need to support heterogeneous traffic such as enhanced Mobile Broad Band (eMBB), massive Machine-Type Communications (mMTC), and Ultra-Reliable Low-Latency Communications (URLLC). On the software and control side, 5G and beyond networks are expected to support SDN and NFV technologies and will leverage the merging of communication and computing through the "wireless edge". With the deployment of novel applications and the expected increase in their usage and demand, the scope of innovation within future networks will be governed by: (a) limitations and boundaries of available resources; (b) limitations of the adaptability of legacy solutions (scalability and flexibility); (c) limitations of available decision making entities (network slice orchestrators and SDN-controllers will not be enough); and (d) lack of intelligent management and control solutions for multi-variate optimization.

Technologies are available for efficient use and self-adaptive optimization of resources using enablers such as AI-powered autonomic control loops. With ever increasing complexity expected for beyond-5G networks, there is a necessity for novel design, planning and operations paradigms. There is a need for assessment of legacy tools versus new Artificial Intelligence solutions for applicability to systems optimization, and a need for introduction of novel methods to model and study the behavior of highly complex systems developed for the realization of 5G and beyond networks. The goal of this working group (WG) is to assess complexity challenges for the 5G era and beyond, explore novel design, planning and operations techniques for networks and services, and explore intelligence sciences to create the roadmap of the IEEE Future Networks Initiative (FNI) Systems Optimization WG.

Key words:

Systems Optimization, Traffic Variance, Control Variance, Service Variance, Confluence, Dependency, Complex Systems, Self-Organizing Networks, Self-X, Autonomics, Autonomic Management & Control (AMC), Emergence.