We are witnessing the transition into the fifth generation (5G) cellular mobile systems. Is there any need for beyond 5G? A significant change in recent wireless networks is that much more data are collected from various sources, including channels, locations, radio access options, and network states. The availability of this large amount and various types of data can potentially transform the current knowledge-driven mobile network into a more powerful data-driven cognitive and learning-assisted mobile network.

In this talk, we discuss how machine learning algorithms can address the performance issues of high-capacity ultra-dense small cells in an environment with dynamical traffic patterns and time-varying channel conditions. First, we introduce a bi-adaptive self-organizing network (Bi-SON) to exploit the power of data-driven resource management in ultra-dense small cells (UDSC). On top of the Bi-SON framework, we propose a polynomial regression supervised learning, and an affinity propagation unsupervised learning algorithm to improve energy efficiency and reduce interference of the operator deployed and the plug-and-play small cells, respectively. Finally, we discuss the opportunities and challenges of reinforcement learning and deep reinforcement learning (DRL) in more decentralized, ad-hoc, and autonomous modern networks, such as Internet of things (IoT), vehicle-to-vehicle networks, and unmanned aerial vehicle (UAV) networks.

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