Challenges and prospects in 5G

5G Infographic shows the exponential increase in demands of capacity and efficiency of mobile and wireless devices. 5G address not only capacity constraints but also existing challenges such as network reliability, coverage, energy efficiency, and latency which exist with current communication systems.

Massive MIMO, a candidate for 5G technology, promises significant gains in wireless data rates and link reliability by using large numbers of antennas. If the promise of massive MIMO holds true, 5G networks of the future will be faster and accommodate more users with better reliability and increased energy efficiency. With so many antenna elements, massive MIMO has several system challenges not encountered in today's networks. For example, today's advanced data networks based on LTE or LTE-Advanced require pilot overhead proportional to the number of antennas. Massive MIMO manages overhead for a large number of antennas using time division duplexing (TDD) between uplink and downlink assuming channel reciprocity. Channel reciprocity allows channel state information obtained from uplink pilots to be used in the downlink pre-coder.

Advancements in prototyping and availability of cost-effective CMOS technology have strengthened the viability of mmWave 5G cellular systems. In the coming years, there will be a significant amount of research to support going from theory to practical and commercially-viable mmWave cellular networks. To address OFDM deficiencies, researchers are investigating alternative methods categorized as 5G Waveforms including generalized frequency division multiplexing, filter bank multi-carrier, and universal filter multi-carrier. Researchers speculate that using one of these approaches over OFDM may improve network capacity by 30 percent or more while improving the battery life for all mobile devices.

Today's communications infrastructure is unable to keep pace with demand as individuals and businesses alike are increasingly connecting more devices and transferring more data than ever. Beyond the need for greater bandwidth, new design constraints including security, coexistence, and power consumption are emerging.

To prototype new designs, communications designers have standardized on software-defined radio (SDR) platforms, as these hardware devices offer tremendous flexibility. Unfortunately, programming the processor and FPGA on modern SDRs demands different specializations and different tools.

NI (National Instruments) is playing a key role in providing tools and technology for prototyping

and defining this new frontier for wireless communications. NI’s unique hardware and software platform enables researchers to innovate faster by providing a path from theoretical research to rapid prototyping. Understanding the need of such a tool, NI has taken a lead by coming up with a comprehensive environment which offers a more efficient, integrated approach to prototyping new designs with SDR hardware. With his tool called LabVIEW Communications, researchers can choose between a variety of approaches for defining algorithms on the processor and on the FPGA.