Move over 4G. The next-generation of wireless — 5G — is coming. But first, there is research to be done. UC San Diego is taking a leading role in preparing for the 5G age.

Engineers creating 5G technologies need to be in closer communication with one another and with the developers of future 5G applications. Two recent forums organized by the UC San Diego Center for Wireless Communications addressed these issues. The more recent event brought together experts from academia, industry and government to share insights, best practices and research questions pertaining to wireless systems and applications.

“This is a very unique forum because it gives us an opportunity to have conversations between people who are innovating in applications and people who are innovating in 5G technologies,” said Sujit Dey, the director of the Center for Wireless Communications and a professor in the Department of Electrical and Computer Engineering.

Speakers discussed advances in wireless technology that will soon make it possible to download gigabytes of data in a second from our phones, allowing us to watch 3-D video or work and play in the cloud from our devices. 5G will also lead to improvements in augmented reality, industry automation, wearable devices, mission-critical applications including e-health apps, and self-driving cars.

Some of the biggest players in wireless applications and technologies — including more than 100 representatives from UC San Diego, Qualcomm, Nokia, Ericsson, Amazon, Yahoo!, Intel, Samsung, Mitsubishi Electric, Keysight Technologies, Symantec, SiBEAM, Kaiser Permanente and the City of San Diego — attended the two-day forum.

UC San Diego research teams are working on making some of these visions a reality. Electrical and computer engineering professor Gabriel Rebeiz, a leader in phased array technology research, has developed hardware for a new generation of automotive radar systems that Toyota is building into its new autonomous cars. These systems capture high-resolution images of areas approximately 100 meters around a moving car, which is useful for keeping safe distances from other objects.

Rebeiz recently collaborated with TowerJazz on a silicon wafer-scale phased array chip for 5G high-performance wireless communication systems. This array is the first of its kind: it has 256 high-efficiency antenna elements all integrated on the same chip; operates in the 56–65 GHz frequency range; and aims for high-speed communication, defined as greater than a 10-gigabits-per-second peak data rate.

Higher-performance and higher-speed systems for 5G will also require changes in the circuitry of silicon chips found in smartphones and other computing devices. The conventional analog circuitry in today’s systems won’t cut it, noted electrical and computer engineering professor Ian Galton. He explained that technology for 5G will need new analog circuit blocks that are more digital-like and that use extensive digital calibration. Galton’s lab built such a chip that achieves state-of-the-art analog to digital converter (ADC) performance and is much smaller in area than the closest competing ADC.

Achieving high performance in next-generation devices and connections also comes with costs. According to Dey, the mobile networks will leave behind a much larger carbon footprint than wired networks.

“The overall consensus is about 50 to 60 percent of the energy is being consumed by base stations,” said Dey. In addition, video and other demanding applications are draining mobile device batteries faster than ever. Dey is leading an effort to save power consumed by the base stations by switching off the antennas from time to time and sometimes leaving them idle. This strategy can also be applied to batteries. Systems can draw power from them in bursts — rather than continuously draining them.

“A challenge with using renewable energy like solar and wind is its intermittent nature,” explained Dey. “By matching the energy consumption of the base station with the solar or wind energy generation, we can reduce grid power usage.”

MORE INFORMATION ABOUT THE 5G FORUM AT: 5g.ucsd.edu