



## 5G, What's the Deal?

–Jim McCoy, Senior Director, Edge Technology Solutions, Black Box Corporation

Simply, 5G is the fifth generation of cellular wireless/mobile technology. The more interesting question is how did we get to our current state with 4G and how will we move to 5G? The answer to both questions is evolution.

Each generation of mobile technology has included a core network, a radio access network (RAN), and end-user devices. Looking back we see that only the first generation (1G) was built from nothing – a clean sheet of paper. Every subsequent generation (2G, 3G and 4G) has been incrementally built on top of the preceding generation (i.e. evolution). This is the only logical approach given the financial burden of deploying an entirely new network prior to generating any cash flow from it. No generation change has resulted in an immediate hard cutover. Instead, a portion of the current generation RAN is taken out of service in order to make room for the initial deployment of the new RAN – with the new RAN operating with the existing core network. After a sufficient number of end-users transition to the new generation, then the core network is upgraded and the remaining RAN is transitioned. Once the transition is complete, that generation is then homogenous and ubiquitous.

### The Three Promises of 5G

Each generation of cellular technology has increased service provider capacity and increased end-user speed. 5G will continue this evolution but promises large scale improvements. Specifically 5G promises to 1) deliver speeds in excess of 1 Gbps, 2) deliver ultra-low latency <1 mSec, and 3) deliver effective IoT to a massive number of devices. While the three promises of 5G are interrelated, they rely on independent evolutionary paths.

For example, data speeds in excess of 1 Gbps require more spectrum than is available for use by any single service provider at conventional sub-3 GHz frequencies. The answer is the use of millimeter wave (mmWave) frequencies (28 GHz, 39 GHz) with hundreds of MHz of bandwidth. Ultra-low latency involves moving core application “compute and storage” resources closer to the end-users and making them virtual functions. Massive IoT requires 5G to simultaneously support both narrowband, low power, devices and enhanced broadband user devices.

### mmWave Mobility Rollouts

Major US carriers, such as AT&T and Verizon, have begun mmWave mobility rollouts, using their 4G core networks, in major urban city centers. This is not the first time that service providers have used

these frequencies. In the late 1990s, the FCC authorized fixed point-to-multipoint (Local Multipoint Distribution System [LMDS]) use of 28 GHz and 39 GHz frequencies. The industry quickly realized that mmWave had very poor penetration through weather (rain), windows, walls, vegetation, etc.

The same physics limit today's attempts to use mmWave for mobility. Early adopters report high speeds when walking in the urban centers, but not when inside a taxi or after entering a shop. Similarly, high speeds are reported when in high density areas of arenas/stadiums/convention centers but not throughout the facility. mmWave mobility can/will provide very high speeds to very small targeted areas, thus the very dense deployments. But it will remain limited to point-to-multipoint deployments in suburbs—and may never see deployment in low density rural areas.

In a fully connected world, IoT will include traditional low data rate machine-to-machine remote monitoring and will expand to include high data rate, low-latency, real-time control applications. The broadband emphasis of 3G and 4G temporarily left traditional IoT in the hands of legacy narrowband 2G – until it was turned off by the service providers. Recent narrowband LTE has addressed this shortcoming but it causes RF channel planning inefficiencies for service providers. The 5G New Radio (NR) standards with virtual channel slicing and virtual network slicing will enable narrowband and broadband to simultaneously coexist within a single RF channel.

### The 5G Evolutionary Time line

Each of the three major components of 5G can, and undoubtedly will, proceed with its own evolutionary time line. Although service providers started with mmWave, expect them to reevaluate their deployment plans in the near future. Notwithstanding, expect 5G NR technology to make its way into the existing frequency bands over the coming two or three years. Similarly, do not expect immediate replacements of core networks just to achieve <1 mSec latency. Do expect ongoing upgrades built on virtual network functions moving towards ultra-low latency. Massive IoT may not be functional until a fully native 5G network is operational in parallel with the legacy 4G network—maybe in five years.

Remember that after about seven years of deployment, 4G LTE has just now reached maturity and is far from obsolete. You should expect 5G to follow a similar time line. We are at the beginning of a seven-plus-year evolution.