5G online course covers the big picture

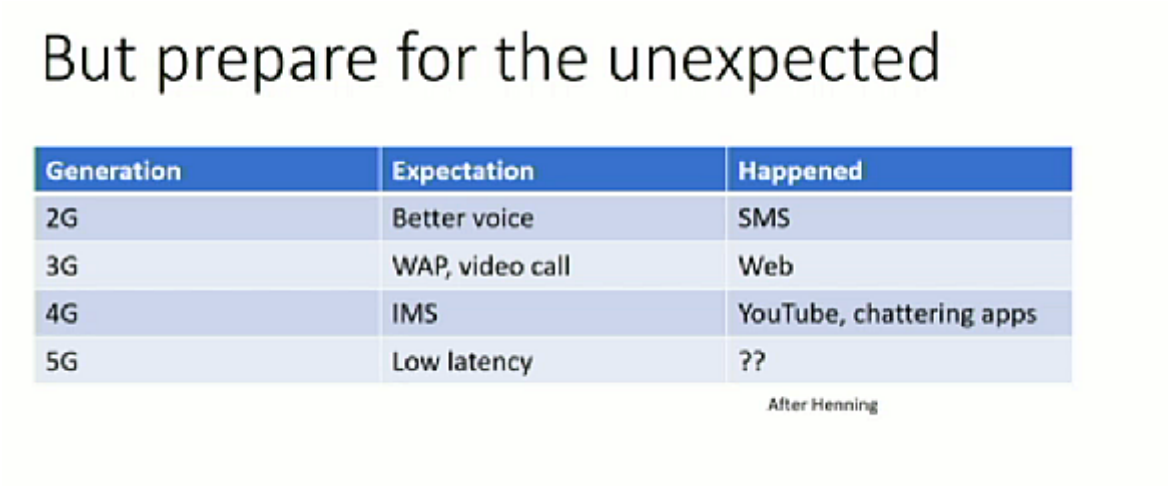
Martin Rowe - May 19, 2017

Hardly a day passes that I don't hear about 5G. Mostly, I hear about the radio technologies that are in the works: Massive MIMO (multiple input, multiple output), beamforming, carrier aggregation, and the like. Even if you're not working on anything 5G right now, there's a good chance you'll need to know what it entails before long.

To that end, the IEEE Communications Society (ComSoc) produced a half-day course, "The Road to 5G and SON Evolution," on May 17 (SON stands for "self-organizing networks"). The instructor was Javan Erfanian, IEEE Communications Society Distinguished Lecturer.

In this 3½-hour course, Erfanian explained that although 5G will incorporate new technologies, it depends heavily of LTE, LTE-Advanced, and LTE-Advanced Pro to get there. The first half of the course covered the "big picture." That is what I'll call the upper network layers, which are all software. The second half pushed into the physical layer and how it will join with the upper layers.

Erfanian described how 5G networks will need to be more flexible than today's networks because there's more to delivering wireless high-speed data than just streaming video. Technologies such as artificial intelligence, autonomous vehicles, IoT (of course), and "anything as a service" will bring about applications we haven't conceived yet, just as 2G, 3G, and 4G did.



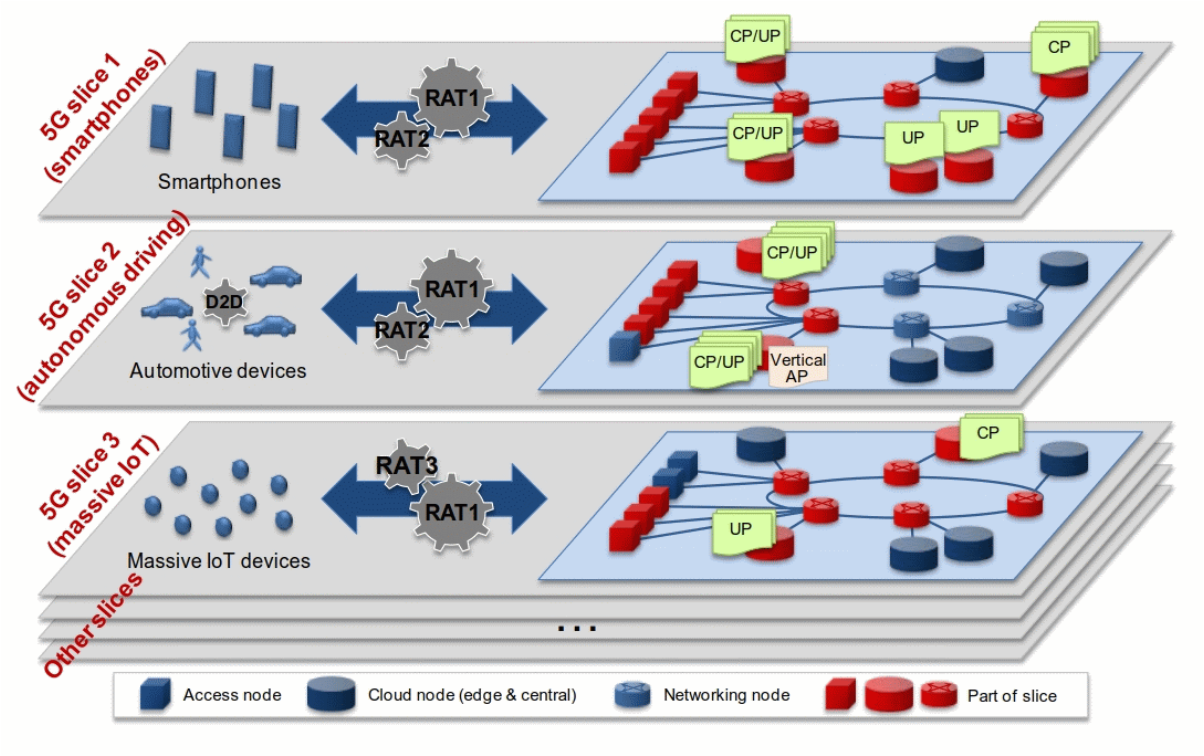
User needs will vary all over the place. IoT devices, which might send only small sets of data, but with tens or even hundreds of billions of connected devices, will compete with streaming video and audio for network capacity. Plus, some services will need low latency (think video) while others will need extreme reliability (think public safety).

On top of that, networks must perform well in cities and in sparsely populated areas. That's where load balancing comes in. SON will need to manage loads and adjust to changing conditions. For example, base stations will need the intelligence to move subscribers to different cells, taking

advantage of underutilized capacity and not necessarily try to connect to the nearest base station when another is available.

"Load balancing can help reduce the need for always more capacity," said Erfanian. "There's a great deal of potential for automation of things that aren't automated today. It's not only about replacing people, but providing information for people to act on. This will lead to new jobs and a demand for new areas of expertise."

Other network features such as automatic neighbor relations (ANR) and virtualization need to be managed, but how? That's where Erfanian introduced the concept of centralized versus decentralized network management. From a software perspective, the wireless network will morph from one where a centralized network will handle traffic to one where numerous virtual networks will handle traffic flow. Erfanian referred to each virtual network as a "slice" where one slice might handle IoT devices, another manages connected cars, and another manages services such as streaming, cloud services, and browsing. The idea here is to configure networks based on business cases rather than on simple network traffic as we have today.



5G networks could divide into "slices," each serving a different use case. **Source:** NGMN Alliance

Erfanian discussed several network use cases, including

- broadband access in dense and rural areas
- massive IoT, not just the few million devices in use today
- extreme real-time communications
- ultra-reliable communication (traffic control coordinated robots, public safety, etc.)
- broadcast-like services

Moving on down the stack, Erfanian discussed architectures for centralized versus distributed network management. He suggested that networks will likely use a hybrid of the two, depending on use cases. Moving into the physical layer, Erfanian projected that cell-management functions would move away from being embedded in hardware and up into the network itself. That, he argued, would

make network hardware more of a commodity than it is today. Doing so would make the network more adaptable and scalable.

Massive MIMO could also improve throughput by letting base stations configure RF signals to maximize power for individual users. "Interference is front and center," he said. There's plenty of work being done in this area, particularly at test beds in research labs, industry, and universities.

The combination of an application and business-model-based network—from both a software and hardware perspective—will result in new network architectures that are more versatile than those in use today. Not only will network software become more reconfigurable, but hardware will be able to more readily adapt to new radios, both above and below 6 GHz. But, this doesn't mean that 5G will replace everything in use all at once. Indeed, as "LTE-Advanced Pro: The bridge to 5G" shows, LTE networks will continue to evolve because the market won't sit back and wait for the expected performance jump that 5G promises.

"The Road to 5G" was certainly worth taking four hours of my day. Click here to request notification the next time the course will be offered.

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