

Toward the 5G Era



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The first research theme given to me on entering NTT DOCOMO was “4G.” At that time, there was no 3G system much less i-mode—in fact, we were at the stage in which digital cell phones with maximum data transmission speeds of 9,600 bps were just starting to appear. While we knew that 4G would be coming something in the near future, we had no idea what it would entail, what its aim was, and what problems could arise, so we were essentially groping about in the dark. However, since 100BASE-T Ethernet was already the norm in fixed-line communications at that time, we thought that 4G despite being a wireless system would surely have transmission speeds of around 100 Mbps as well. So with this in mind but still unsure as to what problems could arise with what kind of wireless transmission system, I began research with my superior while searching for some direction. Looking back at that period, I was not as pressed for time as I am now, so I was able to do my research while taking a variety of detours. This was a good experience, and I learned the value of an approach that considers things from various angles.

At the time of 3G commercialization, the 4G study team took on more members and the breadth of research extended not only to the physical layer but to upper layers as well. Furthermore, to bring 4G to the world, it was not simply a matter of increasing speed and expanding capacity, the universal problems in communications. We also had to explain the concept of 4G, that is, we had to answer the question “What exactly is 4G?” Then, when replying “It’s QoS!” hinting at the next big trend, we would be asked “What do you mean by QoS?” or “Please explain in concrete terms.” but we would be stuck for an answer. From then on, we included QoS in our research and began to study what form it would take in 4G, but at that time, voice was still positioned at the core of mobile communications. On the other hand, data communications using TCP/IP in fixed-line communications was becoming mainstream, so the expectation was that data communications would someday also become important in mobile communications. In voice communications, controlling quality requires the shortening of latency when establishing a connec-

tion and while a call is in progress, and in data communications, it requires the shortening of end-to-end latency assuming TCP. With this in mind, we simplified QoS in 4G as a matter of “controlling latency” and proposed at standardization meetings that latency be significantly reduced. Though not necessarily precise, I believe that addressing the problem first in conceptual terms in this way was how we were later able to reduce it to more concrete, physical indicators.

We are now at the dawn of the 5G era. Achieving higher speeds and greater capacities will always be an important item as long as traffic volumes continue to increase, so we can expect it to be a core issue in 5G. As for latency, the plan for 4G was to reduce it from several hundred milliseconds to several tens of milliseconds taking into account the applications that people would be using, so given the requirements of future devices in fields such as machine type communication, we can expect that a further reduction to several milliseconds will be needed. In short, reducing latency even further will be another core issue of 5G. It is also thought that many and varied terminal connections (massive connectivity) targeting IoT devices that first attracted attention in 4G will likewise be a core issue in 5G.

The 4G era enabled users to take full advantage of all the features that smartphones had to offer thanks to significant improvements in transmission speeds, picture quality, and latency that were insufficient for smartphone use in 3G. Now, in 5G, we can foresee the need for features that will enable users to navigate the world in a more intuitive, reflexive, or even unconscious manner much like human reaction via the spinal cord. In addition, we can expect the connection of all sorts of devices to the network to contribute to the creation of new industries through inter-industry collaboration and to the formulation of solutions to pressing social problems such as regional revitalization and labor shortages. At NTT DOCOMO, we have had experience with people-to-people connections since the 1G era, so the problems associated with such connections are relatively easy to understand, but we have yet to have sufficient experience with connecting things via mobile communications. I would therefore like to enter this new stage in communications by observing phenomena closely and identifying problems as quickly as possible.

Moreover, to swiftly and flexibly deal with a variety of new use cases, it is important that we construct an environment (ecosystem) in which equipment can be freely selected according to the rollout scenario. Starting with 4G, NTT DOCOMO has been providing interoperability between different vendors by standardizing the interface to radio access network equipment, and with 5G, we expect even more vendors to be adopting a common interface as a means of dealing with new use cases. NTT DOCOMO is a founding member of the O-RAN Alliance and a leader in interoperability initiatives that aim to facilitate cooperation with other operators and achieve open and interoperable interfaces on a global scale.

Going forward, I see NTT DOCOMO R&D as a pioneer opening up the 5G era by identifying new problems and taking the initiative to find their solutions.