Cloud Radio: Leading the Future of LTE

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Challenges of the Mobile Broadband Era

Back in 2010, the number of mobile broadband users worldwide soared to 940 million, more than the number of fixed broadband users. The next decade will see a tenfold increase in mobile broadband users and more than 500-fold growth in mobile data consumption.

LTE is a next-generation mainstream mobile broadband technology that is being commercialized at an unprecedented pace. According to the report “Evolution to LTE,” by the Global mobile Suppliers Association (GSA), as of October 2013, 222 operators worldwide had commercially launched LTE services. Currently, 474 operators worldwide are investing in LTE networks. LTE will not only improve network speed but also revolutionize people’s lifestyles. However, telecom operators face two challenges in the LTE era: high requirements on bearer networks and complex interference.

In terms of bearer network requirements, the throughput of a 4G network is much higher than that of a 3G network; therefore, a 4G network requires much more wireless bandwidth (more than 50 Mbps uplink and 100 Mbps downlink). This is more than 10 times that of 3G networks. Mobile bearer networks must be upgraded or transformed before LTE networks can be constructed. The 3rd Generation Partnership Project (3GPP) protocol is based on ideal transmission; that is, when bandwidth and latency fully meet coordinated multi point (CoMP) transmission requirements. However, in actual networks, only dedicated fibers can meet these requirements. If coordination technologies defined in the LTE Advanced standard are used, investment in a bearer network may be too costly for the operator. Transmission is currently the biggest bottleneck in LTE deployment.

In terms of complex interference, LTE networks provide high-speed internet access, so both signal coverage and network capacity need to be considered when addressing this problem. LTE is deployed in high spectrum bands, so sites are dense in order to ensure signal quality. This causes greater interference. Compared with GSM and WCDMA, OFDMA-based LTE does not have an inter-cell interference-suppression mechanism. The 3GPP standard provides some coordination solutions for suppressing inter-cell interference and improving network performance; however, the requirements these

solutions place on transmission networks are too high, and they cannot be applied under current bearer conditions.

Furthermore, co-frequency networking and hierarchical heterogeneous network deployment make interference in LTE networks more complex. Network performance, especially cell-edge performance, relies heavily on the level of inter-cell interference suppression. With the rapid increase in the number of 4G users, interference in LTE networks may become more severe, but telecom operators are not fully aware of this. In the future, more than half of the performance problems in LTE networks could be caused by severe interference, not poor coverage.

Bearing capacity can be improved by transforming and upgrading transmission networks and increasing investment in networks. Solving the interference problem requires an advanced, all-round technical solution that greatly improves the performance of commercial LTE networks. With commercial use of LTE networks and number allocation, interference may be much more severe than expected, and standard inter-cell interference suppression technology or evolved technology may not be solely relied on to deal with the problem.

How are these two challenges to be addressed in the LTE era? Is there solution that significantly improves network performance using the legacy bearer networks so that minimal extra investment is needed?

ZTE's Innovative Solution Cloud Radio

Based on the legacy mobile bearer network, Cloud Radio solves the interference problem in LTE networks. The solution improves cell-edge performance and enables seamless inter-site coordination using the available bandwidth. This greatly improves access performance.

Cloud Radio uses a two-level scheduling mechanism that comprises a central cloud scheduler and distributed cloud schedulers. The central scheduler collects information (reported by base stations) about interference, load, user distribution, and interference location. The scheduler then determines the optimal resource allocation policy and gives cell-level macro scheduling instructions. Upon receiving these instructions, the base stations start scheduling at the local user level. This is the most efficient way of allocating

resources and coordinating interference. The inter-cell interference problem can be solved almost without increasing the bandwidth of the bearer network.

Cloud Radio improves interference coordination from a macro perspective, and improves user-level coordination from a micro perspective. Cloud Radio supports IP-based data transmission and intelligent coordination. In this mode, the optimal coordination solution is selected according to the conditions of the bearer network. Cloud Radio is no longer limited to one site or BBU pool and is a truly dynamic, seamless method of coordination across sites. Cloud Radio improves radio networks and user experience, significantly reduces the amount of investment needed in a 4G network, and ensures that LTE networks have radio access performance that is as good as that of LTE Advanced.

Cloud Radio allows an LTE access network to be constructed without having to upgrade the bearer network. Wireless coordination can be optimized using available bearer resources. In the initial stage of LTE deployment, operators wish to avoid investing heavily in upgrading their bearer network to achieve a standard level of coordination. With ZTE Cloud Radio, operators can even use the PTN to achieve a level of coordination that is comparable to that when bare fibers are used.

Cloud Radio Deployment in Guangzhou

In February 2013, ZTE introduced its Cloud Radio solution for 4G optimization at Mobile World Congress in Barcelona. Meanwhile, ZTE and China Mobile were jointly conducting a Cloud Radio field test in Guangzhou.

Cloud Radio enables real-time scheduling and allocation of resources according to the actual needs of the network. The field test in Guangzhou showed that Cloud Radio significantly reduces inter-cell interference and improves cell throughput. As the network load increased, and when the network load changed dynamically, Cloud Radio is more useful. Cloud Radio requires only a few megabytes per second of transmission bandwidth. Without being transformed, the legacy transmission network met the requirements of a commercial deployment.

Cloud Radio improves cell-edge user experience by increasing throughput and improving inter-site coordination. This enables users to experience seamless, borderless networks. In the LTE-A era, CoMP is a key technology for improving user experience. The Cloud

Radio network in Guangzhou provides coordinated multipoint joint transmission (CoMP JT), coordinated multipoint coordinated scheduling (CoMP CS), and CoMP JT/CoMP CS self-adaptation. Cloud Radio is deployed in the Tianhe business district of Guangzhou. With an area of 1.5 million square meters, this is the largest business district in China. It is a complex wireless environment with a large number of tall buildings and a dense population. This will be the most common scenario in the future commercialization of Cloud Radio.

The Cloud Radio network makes use of the idle PTN transmission resources of China Mobile Guangzhou, and no hardware resources are added. Data from the live network shows that Cloud Radio improves network performance significantly. In a scenario where users are stationary at cell edges, cell-edge performance is improved by nearly 100% when CoMP CS is used and by more than 100% when CoMP JT is used.

In a scenario where users are on the move, CoMP JT, CoMP CS, and CoMP JT/CoMP CS self-adaptation all eliminate inter-site interference. The probability of throughput less than 2 Mbps drops from 8% to less than 1%. The probability of throughput less than 4 Mbps drops from 20% to 8%.

With the debut of Cloud Radio in Guangzhou, the industry has witnessed the first example of trans-site coordination, coordination based on PTN, and trans-site CoMP CS, CoMP JT and CoMP CS/CoMP JT self-adaptation on a live network. This is the point where LTE commercialization moves into a new stage.

Future mobile broadband networks will be designed to provide superior service experience. They will be ultra-wideband, have zero latency, and provide full coverage. Cloud Radio involves more than 200 patents and more than 20 innovations, and it is considered the most complete, most advanced solution for improving RAN performance. With continuous evolution, Cloud Radio will help operators reduce TCO and open up new business models.