What can wideband RF bring for GSM?

Wideband RF technology had been put into commercial use only in WCDMA and CDMA systems during its earliest stage. The application of this technology to the GSM system will deliver with it a breakthrough in traditional mobile networks, which will greatly assist GSM operators to lower TCO and achieve a low cost for rapid expansion. Moreover, it will offer smooth future evolution potential.

By Feng Baoshun

The necessity

With today’s flourishing global mobile communications development, operators are increasingly aiming to reduce TCO and identify cost-effective methods of expanding mobile networks. This is necessary to cope with the rapidly growing needs of users that, to date, exceeds any previous time.

GSM forms a narrow-band digital communications system, and its present base stations commonly adopt single carrier technology. Specifically, each carrier corresponds to an independent RF channel as illustrated in Fig.1.

If a cell needs to configure multiple carriers (for example, 6 carriers) to meet the capacity requirements, the signals must be combined through a traditional combiner before being sent to the antenna - for the purpose of saving antennas. However, each time when signals are combined, base station power output drops by at least 50%, which of course represents an unwelcome situation in large-capacity networks. Given the combiner’s significant losses, a carrier’s transmission power needs to be increased to meet coverage requirements.

Wideband RF technology will help solve this problem by utilizing MCPA - the multi-carrier power amplifier technology - which represents one of the key means of allowing a module to be configured with multiple wireless carriers according to capacity requirements, helping operators to lower TCO.

The core concept of wideband RF technology involves signal combination on the digital IF module followed by output through the broadband power amplifier, as shown in Fig. 2. Wideband RF technology was first put into commercial use in WCDMA and CDMA systems. However, due to the shift to network convergence, breakthrough progress has been made its...
modify the software configuration in the expansion to an S6/6/6 site. In this case, the number of subscribers may require the site during the initial phase. The increased use of MCPA modules to establish an S4/4/4 configuration allows operators to seamlessly expand. GSM stations can be shared among carriers, and baseband technology can be adopted to enable the seamless sharing of one power amplifier, and baseband technology can be adopted to enable the sharing of one power amplifier and filter combiners. Therefore, the cable distribution of the base station is greatly simplified, and reductions are made in technical requirements for maintenance personnel and the probability of cable misconnection.

**Large capacity and wide coverage**

The typical capacity of a traditional GSM base station is 12 carriers, which can increase to a highly integrated, single with Multi-carrier technology. Moreover, this technology does not require broadband filter combiners, thus decreasing the fault points of equipment and insertion loss. Coverage performance does not in any way decline compared with that of a traditional GSM base station.

Using 6-carrier configuration as an example, multi-carrier technology incurs an insertion loss of only 1dB, compared with 3dB for a filter combiner and 7dB for a broadband combiner in a traditional GSM base station. Coverage performance is increased by the use of multi-carrier technology that allows power resource sharing among different carriers and need-dependent idle channel allocation.

**Lower power consumption and cost**

Multi-carrier technology enhances base station power amplifier efficiency. As each carrier can share power resources, then resources can be dynamically and flexibly allocated according to different carriers’ traffic volumes and power requirements. Savings can be made in ordinary combiners and this substantially decreases both power losses and carrier output power demanded for base station coverage. With the help of multi-carrier technology, power consumption and OPEX of base stations can be reduced substantially. For example, the typical power consumption of a multi-carrier GSM base station under a S12/12/12 configuration can be less than 2,000W, which is an impossible feature for traditional GSM base stations.

**Alluring prospects**

The linearization and efficiency of power amplifiers are two key issues for wideband RF technology, and vendors will continue prioritizing its R&D. Following the successful utilization of MCPA in WCDMA systems, GSM equipment vendors have already begun researching the introduction of multi-carrier technology to GSM systems, and have already incorporated it into their products. At present, dual-mode and multi-mode technologies have been developing rapidly in the global mobile communications market. The inception of multi-carrier technology in GSM systems will lay the foundation for the multi-mode base stations that can share carrier modules.

Furthermore, software defined radio (SDR) will play an important role in multi-mode base station deployment. In the near future, SDR research and production will emerge as key technical goals, the commercialization timeframe for which will be elevated by the introduction of MCPA to GSM systems. Huawei is set to adopt SDR in its products during 2008. SDR permits a set of equipment to simultaneously support a variety of technical systems and software configuration is the only measure required to realize evolution from GSM single-mode to GSM/WCDMA dual-mode or to WCDMA and LTE directly.

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**Three key benefits**

**Smooth expansion and easy maintenance**

Multi-carrier linear power amplification technology can be adopted to enable the power amplification of baseband signals for multiple carriers after the combination on the digital IF module. Carriers can thus share one power amplifier, and base stations can be seamlessly expanded. GSM operators can, for example, use three MCPA modules to establish an S4/4/4 site during the initial phase. The increased number of subscribers may require the expansion to an S6/6/6 site. In this case, engineering personnel only need to modify the software configuration in the equipment room, without interrupting base station services. Meanwhile, they do not have to replace hardware or change cable distribution by re-accessing the site. After MCPA technology is adopted, each cell in a typical configuration needs only one MCPA module, and it is unnecessary to configure the traditional broadband or filter combiners. Therefore, the cable distribution of the base station is greatly simplified, and reductions are made in technical requirements for maintenance personnel and the probability of cable misconnection.

**Large capacity and wide coverage**

The typical capacity of a traditional GSM base station is 12 carriers, which can increase to a highly integrated, single cabinet capacity of 36 carriers if multi-carrier technology is adopted. Moreover, this technology does not require broadband filter combiners, thus decreasing the fault points of equipment and insertion loss. Coverage performance does not in any way decline compared with that of a traditional GSM base station.

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