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CARRIER AGGREGATION Helps Unclog the Wireless Traffic Jam

To accommodate the increasing demand for wireless data, networks across the globe are implementing carrier aggregation.

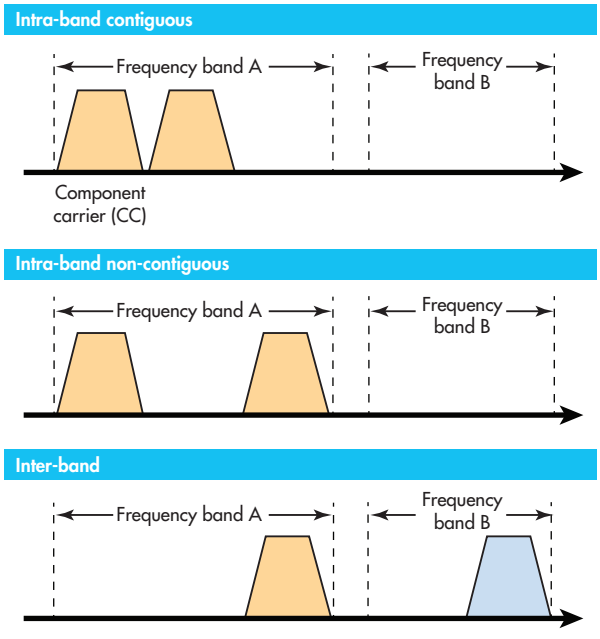
The ever-increasing amount of wireless data traffic in today's technology-driven world is no more evident than in the number of smartphone users worldwide, which has leapt into the billions. And the foreseeable future sees that traffic only becoming more intense. As a consequence, the heat is ratcheting up on mobile network providers to meet the demand.

CARRIER AGGREGATION

To address that challenge, mobile network providers across the globe are adopting and deploying carrier aggregation (CA). CA is a key aspect of LTE-Advanced (LTE-A) because it combines two or more blocks of spectrum, or component carriers (CCs). Adding multiple CCs to create wider channel bandwidths helps achieve the much-needed faster data rates. CA was introduced in 3rd Generation Partnership Program (3GPP) Release 10 in 2011. The first LTE-A network with CA was deployed in South Korea in 2013, and has since been set up in networks across the world.

Each subsequent release since 3GPP Release 10 has changed the parameters for CA for LTE-A. The 3GPP Release 10 allowed the aggregation of as many as five CCs, each with a bandwidth as high as 20 MHz. Thus, combining five 20-MHz CCs would yield a maximum bandwidth of 100 MHz. Release 13 will support as many as 32 CCs.

One company that plays a major role in the CA space is Qorvo (www.qorvo.com). "One of the biggest technical challenges that Qorvo will continue to help smartphone makers overcome in 2016 is carrier aggregation," says Brent Dietz, the firm's director of corporate communications. "Strong global demand for mobile data combined with very limited 4G spectrum has driven the need for CA, which simultaneously combines two or more carrier channels, or bands, for higher data throughput."



1. Network providers can deploy one of three different forms of carrier aggregation.

Dietz further adds, "CA focused on combining two bands for increased downlink (network base station to the smartphone) speeds in 2015. The challenge in 2016 is to combine three carrier bands for even faster downlink as well as uplink (from the smartphone to the base station) speeds, as consumers live stream, upload more content, and move to cloud-based computing."

2. Cobham Wireless's test system supports carrier aggregation with unlicensed frequency bands. *(Courtesy of Cobham Wireless)*

CA VARIETIES

CA can be classified into three types: intra-band contiguous, intra-band non-contiguous, and inter-band *(Fig. 1)*. Intra-band contiguous aggregates multiple adjacent CCs in a single operating band. Intra-band non-contiguous also aggregates multiple CCs in a single operating band. However, the CCs are actually separated rather than adjacent. Inter-band CA aggregates multiple CCs in different operating bands. This is more complex than intra-band CA because the multi-carrier signal cannot be treated like a single signal.

The many challenges associated with CA will likely become more difficult due to the higher-complexity CA deployments expected to arrive over the next few years. Early CC deployments combined only two CCs, while future deployments will combine three, four, five, or even six CCs.

One persistent challenge involves RF filtering, because of the need to prevent interference between CCs. Multiplexers will become crucial components as more CCs are combined. Devices like power amplifiers (PAs) and switches must also be adequately designed to provide the required performance. For example, switches must maintain high isolation to minimize interference from one port to another. And PAs with very high linearity are required for intra-band CA.

"CA poses many RF challenges for smartphone makers," says Dietz. "These challenges include cross-isolation, which means avoiding interference between aggregated bands. Another challenge regards in-band isolation between the transmit and receive frequencies of each band. Minimizing insertion losses to maintain system sensitivity and optimizing power consumption are two additional challenges.

"We plan to help our customers tackle the challenges of CA in 2016 with products like our multiplexers and surface-acoustic-wave (SAW) and bulk-acoustic-wave (BAW) filters," he continues. "Because we see 2016 as a critical year in the rollout of 3-band and uplink CA across the globe, we are focused on delivering products with the performance, size, scale, and speed that customers need to get their newest smartphones to market."

TEST SOLUTIONS

Component suppliers are not alone in the need to deliver CA solutions. CA obviously requires test solutions, which means that test-equipment manufacturers must offer products that can handle the demands of CA.

A number of equipment suppliers offer such solutions. For example, Cobham Wireless's (www.cobhamwireless.com) TM500 network test family *(Fig. 2)* can validate all of LTE-A's main features, include those specified in Release 12 of the 3GPP specification. Furthermore, support was added for CA with unlicensed frequency bands, which represents a major aspect of 3GPP Release 13.

For its part, Rohde & Schwarz (www.rohde-schwarz.com) offers a number of test solutions for LTE-A CA implementations. They include signal generators and signal analyzers for physical-layer testing on base stations, mobile devices, or components. In addition, the company offers base-station emulators for physical-layer and protocol tests for all types of wireless devices and chipsets.

Anritsu (www.anritsu.com) has also entered into the fray, recently making news by announcing that a demonstration featuring the company's MD8430A LTE simulator used 10 simultaneous 100-Mb/s data streams. The company touts this as a breakthrough achievement.

The MD8430A is used to develop LTE-A-compliant chipsets and wireless devices. The scalable LTE network simulator has several models, such as the standard test model (STM) and the enhanced test model (ETM). The MD8430A can verify normal communications procedures. It also supports fault operation tests, which are difficult to perform at connections with live base stations.

To summarize, carrier aggregation is unquestionably a vital technology component that will be counted on to meet the demands of today and tomorrow. With wireless technology being such an integral part of our lives, wireless carriers must look to CA as a means to address the challenges associated with mobile data traffic. Over the next few years, even more sophisticated forms of CA may emerge, which means both components suppliers and test-equipment manufacturers must keep pace by delivering solutions to enable the ever-more complex wireless world. mw