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Microwave Links Offer an Elegant Backhaul Solution

Wireless carriers must increase backhaul capacity while managing capital and maintaining customer satisfaction.

Truly high-speed wireless data is now being brought to smartphone users via HSPA+, LTE, and WiMAX. It's finally making possible what carriers have been promising for years: streaming video, painless web browsing, and fast file uploads and downloads. The consumer never sees (or probably even knows or thinks about) the other half of the network, in which the traffic from each cell site is sent to a central point. There, it's merged with the rest of the global communications matrix. Nevertheless, without this inelegantly named 'backhaul' system, there would be no second "wireless revolution:" the ongoing global connectivity bonanza that's driving communications to a level that's never been possible before.

Considering the massive amounts of data generated by these newly enabled services, the obvious transmission choice for backhaul is optical fiber. But most cell sites aren't near a fiber node. And some may never be close enough to capitalize on the bandwidth that nodes afford. In these and other cases, microwave point-to-point (PtP) links that operate in bands from 3.5 to 86 GHz will be an excellent solution. Their data rates rise from today's 750 Mbits/s per radio to achieve even higher throughput.

Microwave radios have been employed by telephone companies to send voice, video, and data for decades. They remain one of their key assets. The radios also are used in applications as diverse as traffic webcams and radio and TV electronic news gathering (ENG) in the broadcast industry. However, they haven't been used as much for cellular backhaul (at least in the U.S., where T1 lines are typically employed).

The opposite is true in Europe, where PtP links power more than 70% of wireless backhaul and globally account for about 50%. While T1 lines are expensive in the U.S., they're even more expensive elsewhere (or not available), making microwave an appealing choice. However, this scenario is changing fast in the U.S. because T1 lines are ill suited for IP-based packet communications (wireless data). Additionally, their bandwidth simply cannot handle the data onslaught that "4G" services are creating. Add to that the cost and time required to deploy T1 or all-fiber systems, which typically exceed that of microwave radio solutions, and one can quickly grasp how network operators will meet backhaul capacity requirements in the future.

To illustrate the intensity of this data deluge and how much more intense it will soon become, consider Cisco's Visual Networking Index (a respected source of wireless industry statistics). Cisco projects that mobile-data traffic will increase at an annual rate of 92% to yield a 26-fold increase by 2015. It will reach 6.3 exabytes per month that year, which is 6.6 million terabytes (see Figure 1). The company projects that mobile-network connection speeds will rise by a factor of 10 by the end of 2015. Tablets alone, which only recently exploded into the market, will create 248 petabytes of data per month (about the same as last year's total global mobile-data traffic).

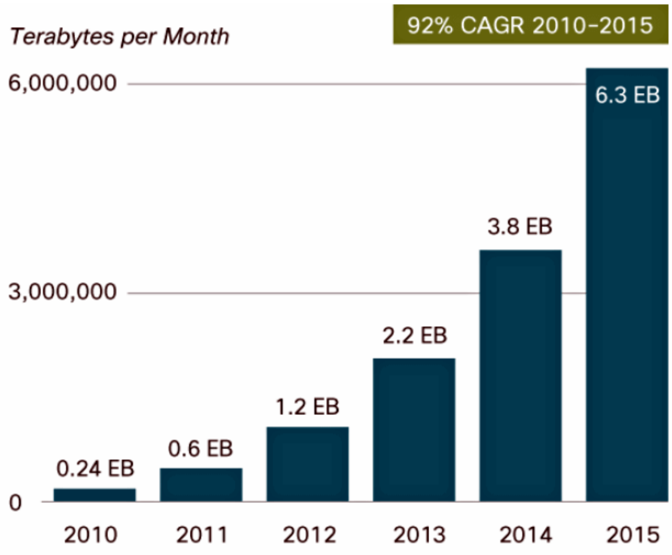

Figure 1: Cisco forecasts mobile-data traffic of 6.3 exabytes per month by 2015. Source: Cisco Visual Networking Index

These are astronomically large amounts of data. Only fiber and microwave PtP links have the intrinsic backhaul capacity to satisfy such gigantic data-transport requirements. In short, fiber will be used where it's available. Where it isn't, microwave PtP links will supply the solution. Where a fiber node can be reached via a single microwave "hop," both technologies will be employed.

The plot thickens, as carriers are adding large numbers of microcells and picocells to complement their traditional macrocells to fill coverage gaps. This trend creates its own backhaul challenge. The potential revenue bonanza it presents has gotten the interest of cable MSOs with their installed base of hybrid fiber coax (HFC). They already generate about $200 million in backhaul revenue and serve more than 11,000 cell sites in the U.S. Another company has developed a system based on IEEE 802.11n (WiFi) operating at 5 GHz. It forms a PtP or meshed PtP using "smart" high-gain antennas and beamforming.

Meanwhile, manufacturers of microwave radios have been honing their products to deliver more compact, cost-effective solutions that deliver higher power and consume as little power as possible. The latter goal is extremely important, as carrier electricity bills are already one of the largest operational costs for most networks. Two of the key elements in achieving these goals can be found in radios' RF amplifiers and RF power transistors.

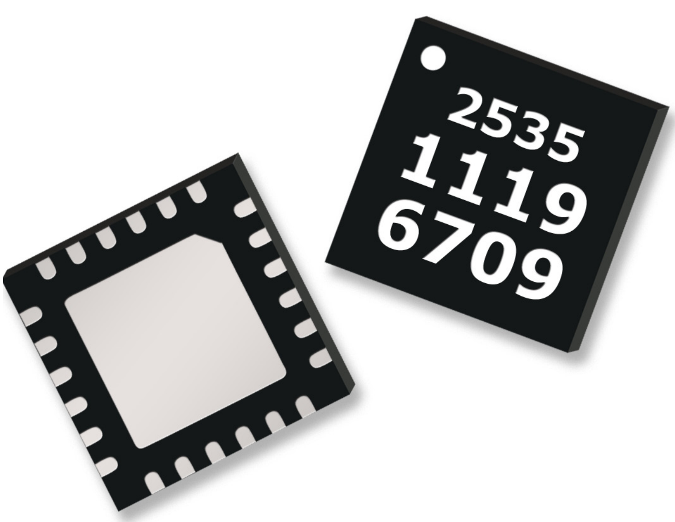

Figure 2: This 2.5-W packaged power amplifier is designed for 10/11-GHz PtP microwave radio.

For example, TriQuint Semiconductor continues to expand its line of packaged RF power devices dedicated to microwave PtP applications. Recently, the company introduced three new RF power amplifiers (PAs) for PtP radio bands at 10, 11, 13, 15, and 23 GHz. They combine high RF power output, linearity, and gain with low power dissipation. The product line complements the company's optical-modulator driver amplifiers for 10, 40, and 100-Gbit/s fiber-optic systems that also are targeted for backhaul applications.

The new TGA2535-SM is a 5 x 5-mm, QFN-packaged PA that operates from 10.0 to 11.7 GHz (see Figure 2). It provides saturated output power of 34 dBm (2.5 W) with a third-order intercept point of 43 dBm and 25 dB of small-signal gain. It operates at a quiescent bias condition of 6 VDC at 1300 mA. Additionally, the TGA2524-SM is housed in a 3 x 3-mm QFN package. It operates from 12 to 16 GHz and delivers 26.5 dBm (500 mW) of saturated power with a third-order intercept point of 37 dBm. It provides small-signal gain of 23 dB at a quiescent bias condition of 5 VDC at 320 mA. Finally, the TGA4533-SM is housed in a 4 x 4-mm QFN. It operates from 21.2 to 23.6 GHz and delivers 32 dBm (1.6 W) of saturated power with a third-order intercept of 41 dBm. It offers small-signal gain of 22 dB and operates with a quiescent bias point of 6 VDC at 900 mA, offering superior linear performance for a packaged 1-W PA.

Increasing data rates—and the growing numbers of smartphones, tablets, and, no doubt, other devices still in the concept stage—require wireless carriers to increase backhaul capacity while managing capital and operating expenditures and maintaining customer satisfaction. While optical fiber will play a key role in the solution, microwave PtP radio will be equally important. RF amplifiers and other product innovations will continue to meet the challenges posed by new generations of PtP microwave radios as they evolve to serve this growing market. More information about TriQuint's PtP devices can be found at www.triquint.com.

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