Wireless Base Stations Benefit from Signal Compression

For deployments by a single operator, wireless repeater systems offer more cost effective fiber transport costs.

By Allan Evans, VP of Marketing, Samplify Systems

ABI Research predicts that revenues for distributed antenna systems and in-building wireless systems will exceed $15B by 2013. These numbers are being driven in large part by mobile operators who use distributed antenna systems and wireless repeater systems as a means of gaining a competitive advantage in terms of area coverage.

Distributed antenna systems, in-building wireless systems, and wireless repeater systems typically connect to a wireless base station, via a pico-cell, via RF. The systems distribute the RF signal to numerous antennas positioned on other base stations throughout the coverage area via fiber-optic, coax, or even CAT-5 cable. These systems can be either completely analog, completely digital, or a hybrid of both.

The digital bit rates required to transport sampled signals can drive up fiber optic transport costs resulting in higher priced base stations. Additionally, achieving the analog performance of a distributed antenna system, with 75 MHz bandwidth with a high-IF sampling radio architecture, requires 14-bit ADCs with sample rates over 180 MHz. The bit rate of a dual-band system requires 6.3 Gb/s (180 Msample/sec/band • 14 bits/sample • 2 bands / 8B/10B). At this data rate, the base station would need to be equipped with more expensive FPGAs and small form-factor pluggable (SFP) fiber-optic transceivers.

For deployments by a single operator, wireless repeater systems offer more cost effective fiber transport costs. A single operator will have at most 20 MHz in a given frequency band, with 12-bit ADCs operating around 60 Msamples/sec. Therefore, a dual band system can fit easily within the bandwidth of 2.5 Gb/s optical networks (60 Msamples/sec/band • 12 bits/sample • 2 bands / 8B/10B = 1.8 Gb/s) and SERDES interfaces available on lower-cost FPGAs.

In both cases, signal-compression technology can reduce the cost of digital transport between base stations. For distributed antenna systems, compressing the data rate by 1.5:1 would reduce the bit rate to less than 4.25 Gb/s, so fiber-optic transceivers that have been commoditized by the storage area networking market can be used. For wireless repeater systems, the same compression ratio of 1.5:1 would reduce the data rate requirements to 1.2 Gb/s enabling base stations to continue to use low-cost CAT-5 twisted pair cabling, eliminating the need for fiber optics altogether for distances less than 100 m.

Moreover, existing signal-compression techniques can deliver truly lossless transmission, so there is no impact to signals sent across the fiber optic link. In fact, in the uplink direction, the signal to noise ratio is quite low allowing near lossless compression methods to be used. With such compression techniques, the losses can be modeled the same as any other noise source as long as the compression distortion level can be controlled and the spectrum of the compression distortion is white.

Additionally, to minimize the impact on latency, when transmitting over fixed-bandwidth fiber optic links, there are compression algorithms that can adapt to maintain output bit rate requirements to reduce the amount of buffering. And, the availability of a low complexity compression algorithm enables them to fit into FPGAs in base stations already in the field.

Signal-compression technology can play a key role in reducing the cost of deploying distributed antenna systems and wireless repeater systems on existing and future base stations. By reducing the acquisition costs of distributed antenna systems and wireless repeater systems, the promise of providing coverage fill-in for data services can be realized.

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