Base Station Technologies and Trends

LTE will bring changes to base station design, from both the hardware and software perspective, giving operators challenges as they prepare for technology trials.

What do you feel is the greatest challenge today in deploying base stations and how can designers address it?

By Frank Ditore, ESL/SystemVue Product Manager, Agilent EEsof EDA

Multi-format, multi-band radios are quickly reaching maturity in the commercial wireless infrastructure market. The cost of air interface infrastructure upgrades, while reasonable compared to other network operation/upgrade costs (site development, maintenance, power), is still considerable when deciding when and how to upgrade a wireless network. With the emergence of 3.9G technologies, like LTE and WiMAX™, there will be a big push over the next five years to upgrade existing commercial wireless infrastructure to support these new technologies while staying backwards compatible with existing 2.5G (GSM/EDGE) and 3G UMTS, and offering a supportable/low cost path to future upgrades.

Many large basestation manufacturers, like Huawei, ZTE and Alcatel-Lucent have turned to software defined radio (SDR) solutions to address some of the challenges mentioned above. Additionally, software defined radio is also being adopted by other infrastructure vendors in the pico-cell and femto-cell markets and is the basis of the newest generation of silicon solutions by companies like Marvell, Altair, NXP, MimoOn, and others. Lastly, FPGA suppliers like Xilinx and Altera have targeted specific SDR solutions to wireless infrastructure based on their newest generation of field reprogrammable devices.

In short, re-configurable radios have hit a maturity point such that almost all new wireless infrastructure will be based, at least in part, on software and firmware.

Much of the emphasis and resulting challenges in the design of these new systems is in the development of Layer1 (PHY) algorithms, for each of the wireless standards that can operate efficiently and accurately on the chosen SDR architecture. Additionally, it is equally a challenge to develop the multi-band RF/IF front end to these systems that offer the required linearity, dynamic range and sensitivity required by each of the supported standards. To this the implications on multi-band

antenna design have to be added. Lastly, ensuring that the complete systems adhere to the demanding performance and interoperability requirements for each of the standards, as a complete baseband/RF/IF system, always poses a challenge, both during design and while testing the conformance of the finished product.

Software definable radio systems for commercial wireless infrastructure (Base Stations included) have reached maturity. While these systems offer flexibility and upgrade paths for service providers, their development poses new challenges to the equipment manufacturers who develop these systems. Ensuring conformance to supported standards and offering high performance is critical to successful deployment.

By Scott N. Schober, President/CEO of Berkeley Varitronics Systems, Inc.

The popular WiFi 802.11b/a/n/g access points (APs)/base stations often suffer from RF interference issues. Interference takes a toll on both the usable range and the data rate since base stations are iso-synchronous and will reduce speed if interference causes lost symbols. Since independent networks are not synchronous, the greatest challenge is avoiding interference from client nodes spatially nearby on the same or close to the frequency of other networks. This is because network clients are "granted unilaterally" transmission opportunity windows which may collide with another network data stream. This interference is somewhat elusive and may come and go throughout the day. Also, the license-free ISM band in 2.4 GHz and 5.8 GHz is widely used for WiFi, but also prone to interference from many other RF sources such as microwave ovens, baby monitors, cordless phones, wireless speakers, even Direct Satellite Service (DSS) RF cable leakage and radiation.

To address interferers, the base station vendors have implemented ‘intelligent' access points (AP) that actually perform a radio frequency (RF) sweep and utilize an algorithm that switches to a different channel/frequency when interference is detected. Base stations that provide this monitoring are expensive but have an advanced architecture utilizing an integrated circuits and control software which may be a preferred choice for enterprise level new WiFi buildout.

For existing WiFi networks, a more cost effective way to optimize a network is to utilize an independent tool such as the Yellowjacket 802.11b/a/n/g Tablet Analyzer. This instrument allows the wireless design engineer to scan and monitor for non-synchronous interferers within the WiFi spectrum. The built-in triggering option aids in finding interferers, thus allowing the engineer to switch to a clear channel. Ultimately, if there is a persistent interferer, an optional direction finding (DF) antenna can be attached to the instrument pinpointing the source of interference and mitigating the problem. With the continual growth of WiFi base stations in the

workplace and home offices and the endless sources of interference appearing daily, the base station manufacturers inevitably need to provide enhanced spectrum monitoring to their base stations and utilize test instruments that can find and remedy the sources of interference.