Tech Exchange: Base Station Design

Q: What are some of the most challenging issues when designing products for remote base station applications?

 **Damian Anzaldo, Communications Segment Manager, Maxim**

Today's remote base stations must be power efficient, smaller in size and deliver excellent radio performance. Power efficiency is important to improve mobile operator total cost of ownership, help reduce CO2 emissions and minimize heat dissipation to address passive cooling requirements. Smaller size is important to meet diverse site installation scenarios and help lower operator CAPEX; and excellent radio performance is needed to deliver exceptional user Quality-of-Experience.

There are two areas where Maxim is focused in developing solutions for remote base stations and each area has its own unique challenges. The two areas are radio signal path and analog baseband. The radio signal path includes RF devices, high-speed data converters and frequency synthesizers. Analog baseband solutions support the radio and digital baseband. Maxim's analog baseband solutions include power management, precision measurement and control, system management and signal integrity with fiber optics for front haul applications.

In the radio the most challenging issues related to RF and high-speed data converters are weighing the tradeoff for wideband, high dynamic performance and circuit partition against total power consumption and the right levels of integration. Next is balancing these tradeoffs with IC process selection to meet performance and price expectations. This becomes more complex as remote base station segmentation now includes macro cells, different classes of small cells and different wireless backhaul technology.

In analog baseband the challenges are more function specific but the underlying trend is miniaturization through integration and high reliability. For example, in power conversion a challenging issue is developing intelligent and high efficiency DC-to-DC converters to address increasing power density. Power density and related improvements in energy conversion efficiency over wide operating conditions are a primary focus and we have a compelling solution with digital point-of-load using the MAX15301.

 **Stephen Turnbull, Marketing Leader for QorIQ Qonverge, Freescale**

The challenge is to meet high levels of integration within the required power and cost budgets. Individually these are not challenging, but the combination of performance, cost and power can be a difficult balance to achieve. Of course, there are also considerations related to software partitioning and how to architect the SoC to meet the power/performance balance while also making the device easy to use. Freescale's approach is to provide smart acceleration combined with high performance DSP and processor cores. This provides optimal power/performance balance while still maintaining flexibility.

Q: What new temperature control techniques have you developed to maintain good performance over a wide range of temperature ranges when developing remote electronics for base stations?

Damian Anzaldo

To address wide operating temperature range, Maxim takes a holistic approach at meeting this challenge. We look at device and system level issues. At the device level Maxim temperature control techniques for RF devices and high-speed data converters include advanced packaging and innovative circuit topologies; but fundamentally you need, and we are fortunate to have, world class analog IC designers and product definers.

In terms of innovative circuit topologies for lowering power while maintaining high dynamic performance in mixers, modulator/demodulators and high-speed data converters; our RF DACs employ a proprietary differential current-steering topology; our high-speed ADCs use a proprietary zero crossing detection topology. Our mixer cores on a SiGe BiCMOS process use a passive topology which delivers high linearity at low power while enabling the high levels of integration.

Production test and bench characterization is an important customer requirement to ensure high-reliability operation over a wide temperature range. Maxim production tests all devices and guarantees operating parameters over the full temperature range.

At the system level, smart system partitioning with innovative architectures help address temperature control challenges. This includes solutions that diverge from conventional designs and operate at much lower total power. For example multi-carrier/multi-band MIMO transmitters that employ direct digital synthesis with the MAX5879 direct RF DAC.

Stephen Turnbull

Freescale uses thermal diodes which allow users to monitor the junction temperature of our devices and use that to prevent thermal runaway and control loadings in software. We also employ a wide range of power management techniques to minimize power and temperature, such as clock gating, voltage islands, waterfall power management and drowsy circuits.

Q: Do you see operators trending towards a "multi-band/multi-standard" architecture that must be scalable to accommodate, picocell, femtocell and macrocell base station development?

Damian Anzaldo
Yes, operators are trending toward a multi-band/multi-standard architecture. This has always been the operator and equipment manufacturer desire and is becoming more important as we move to a Heterogeneous Network (HetNet). But different classes of base station have different performance requirements, operating conditions and cost tolerance. In the short term there will be optimized solutions for groups of equipment like pico and femto cells versus micro and macro cells. In the long term as active antenna and active antenna arrays are more widely adopted, a single multi-standard/multi-band architecture or software defined radio will come closer to realization. We have a good jump start on this challenge with the MAX2550-family of single-chip RF transceivers that address femto cells and the MAX5879 RF DAC which addresses multi-band/multi-standard transmitters in micro and macro cells.

Stephen Turnbull
Absolutely, and this is exactly the strength of Freescale's QorIQ Qonverge family of heterogeneous multicore basestation-on-a-chip SoCs. Qonverge incorporates multiple integrated antenna interfaces, accelerators architected for WCDMA or LTE and a common software architecture spanning from residential solutions (covering a handful of users) to macro solutions (which can handle 3 x 20MHz sector of LTE) . This common, scalable architecture has been popular with our customers, allowing them to migrate from residential to enterprise implementations without significant development costs, or produce macro and metro solutions leveraging pin compatible hardware and providing operators a common software solution