Smart TECHnology World
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Abstract
Smart connected devices enabled by embedded systems will experience spectacular growth during this decade. Market opportunities abound in smart grid, smart appliances, home networks, M2M and industrial, point-of-sale and kiosks, healthcare, transportation and logistics, digital signage, networks and infrastructure, automotive, video surveillance, and sensors. Supporting this unprecedented growth will bring both challenges and opportunities for vendors in every segment of high technology—microprocessors, semiconductor equipment, servers, storage, software, network and systems management, network equipment, carriers, and services.

Embedded Systems
Embedded systems are a big part of our lives, whereas traditional nature of the market has been built-in, hidden from the user, fragmented across industries, and disconnected. How we defined the embedded market over the past three decades is dramatically changing as we move to smart and interconnected systems:

- Micro-controller units migrate to multi-core processor units, system-on-chips (SoCs), and Smart SoCs.
- RTOS is shifting to operating systems and platforms to run millions of applications.
- Consumers expect everything to be intelligent, connected, and transparent.
- Billions of 32-bit microprocessors ship every year.
- The Net Effect: Broadband access and constant connectivity are driving new business and consumer behavior.
- Sensors will get smart enough to do on-chip analytics; the device will recognize you and provide user-specific experiences. With near-field communication (NFC), they are already morphing into mobile wallets.

ARM controls about 80% of the embedded market in units and last year shipped over six billion processors (Figures 1-4). Over 400 million smartphones will be shipped this year with over one million apps already available. The next billion users will come from developing nations. For many of them their first Internet experience will be through a smartphone and not a PC. This doesn't mean the end of the PC; news of its death is highly exaggerated. Tablets for under $100 will be available in BRICS countries, mostly subsidized by carriers. Today, there are over five billion cell phones deployed.
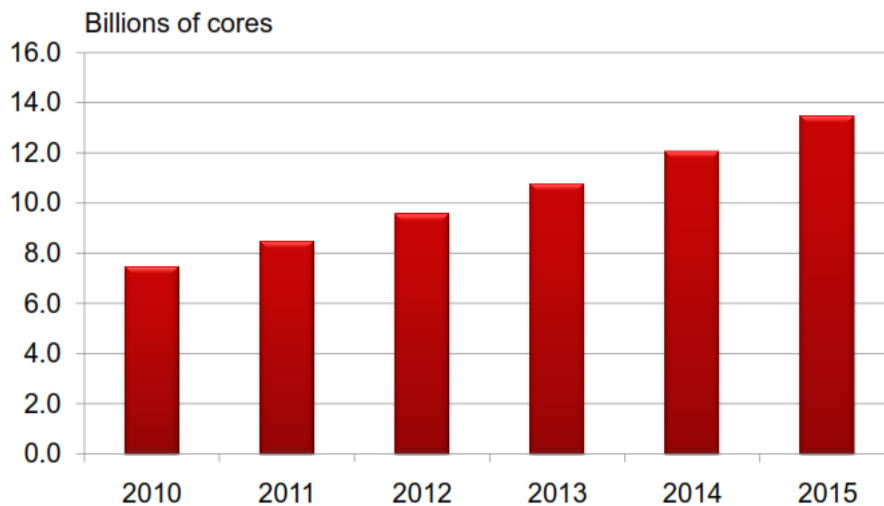

Figure 1. Embedded Processor Cores Unit Forecast, 2010-2015
(includes SoCs, SSoCs, and stand-alone microprocessors with one or more cores)
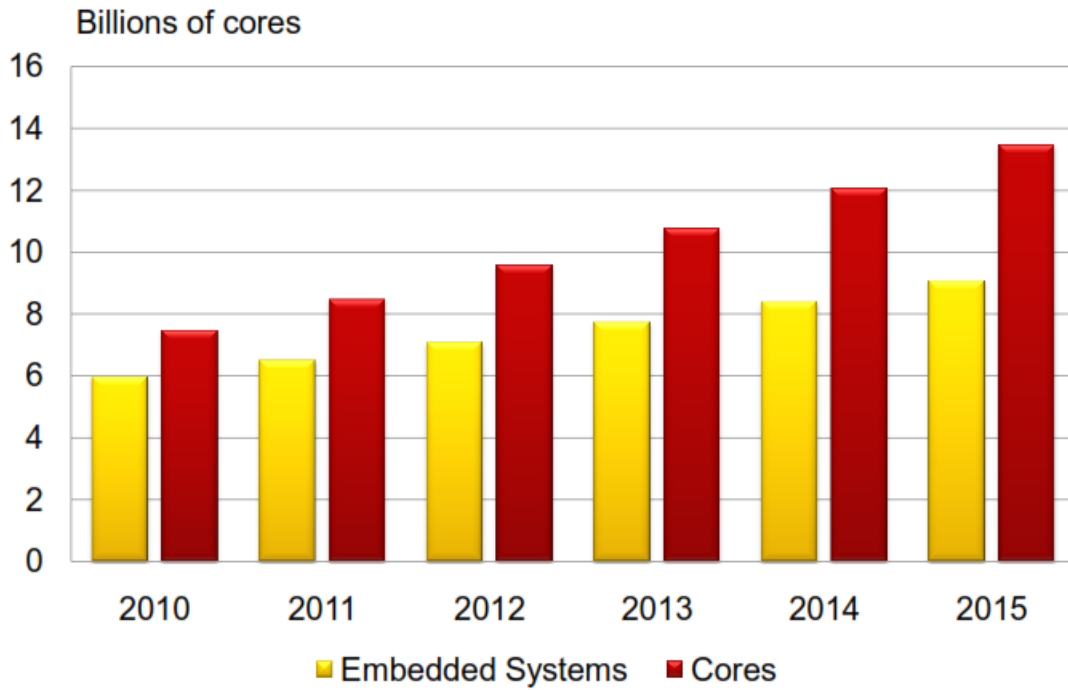
Billions of cores

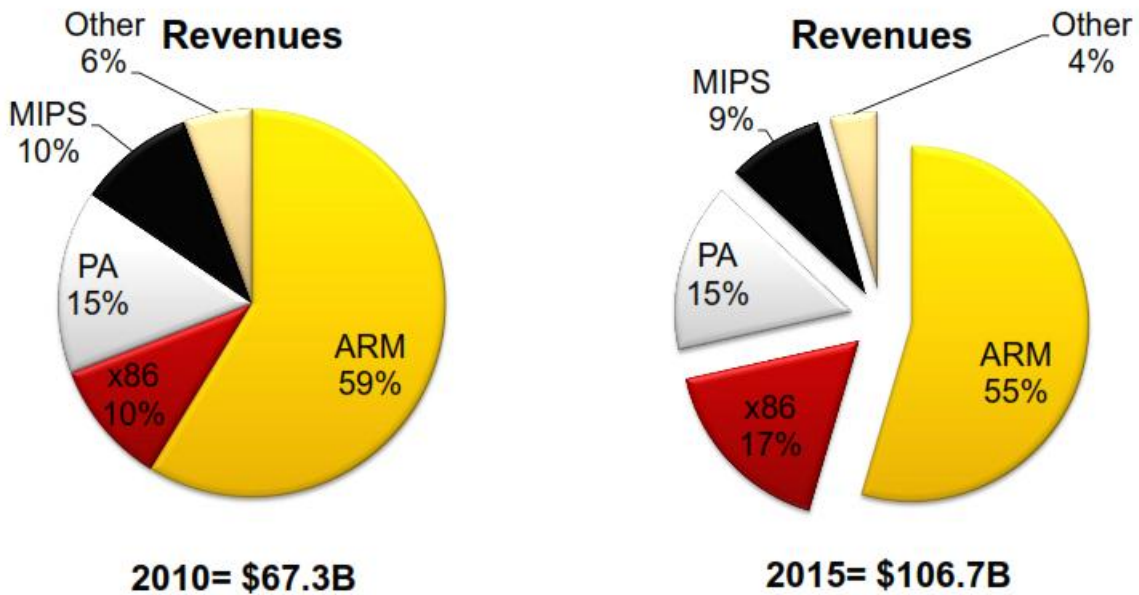Figure 2. Embedded Systems and Processor Cores Unit Forecast, 2010-2015

Figure 3. Embedded Processor Revenue Forecast by Architecture, 2010 to 2015
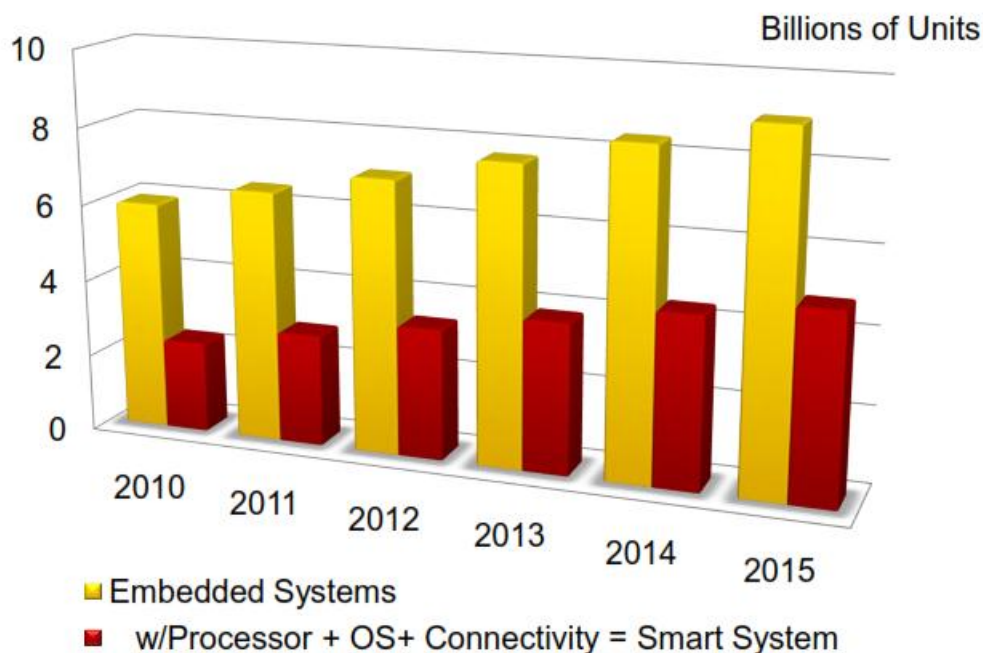
Figure 4. Smart System Unit Forecast, 2010-2015

Today, on an average there are 4.8 devices/person worldwide and 6.6 devices/person in the U. S., and it is all about:

- Integration
- Storage
- Internet
- Touch screen
- Multicore application processors (APs)
- Sensors
- Multiple Radios
- Video playback
- OSes
- Apps

Tomorrow, it will be:

- Multicore AP and multi-mode
- Baseband SoCs
- 100GB+ storage
- Sensors and multiple camera integration
- Intelligent Radios
- Proximity-based peer to peer
- Mobile device as remote control
- Vision-based augmented reality
- Network and cloud-friendly application support

Your consumers will eventually become your competitors. There will be room for OSes other than iOS and Android. There also will be lot of vertical integration, e. g., Apple designing its own chips, devices, software, OS, browser, and many apps, albeit it's a fabless shop with outsourced, contract manufacturing.

The average smartphone today has four radios. Over 600 million NFC chips will be shipped over the next five years. By 2020, there will be 1.9 billion PCs, 2.6 billion mobile phones, over 2 billion CE Devices, and 25 billion embedded devices.

Ton Steenman of Intel said his company wants to go from Intel Inside® to Intel "Every-Ware". Computing surrounds us anywhere you go. Global Entry Program, for instance, lets you avoid long lines at Customs and Immigration. About 30% of traffic in San Francisco is generated by people looking for parking spaces! That's one reason San Francisco has established SFpark to use new technologies and policies to improve parking by helping drivers find parking spaces. Cities will blaze the trail because of their sheer size. Today, about 50% of the world's population is urban, and it is expected to grow to 60% by 2030. We dynamically balance workloads in IT, but doing so for network bandwidth and traffic is more challenging. With its recent acquisition of McAfee, Intel has about 10,000 software people. Digital signage is moving to PC OEMs and is no longer static as it was five years ago.

Reiner Klement of Qualcomm claimed smartphone is the fastest-growing market, exceeding PCs, game consoles, and even car tires! Multi-mode connectivity—2G, 3G, 4G, LTE, Wi-Fi, NFC, Bluetooth—is the future. Pretty soon, your smartphone will become your car key, too, so you can lock it or disable it completely, thus controlling your kids' driving.

Freescale Semiconductor's Lisa T. Su contended embedded is no longer just industrial. What we need is intelligent legacy integration, as we evolved from proprietary mainframes era to x86 PC era to non-proprietary HW/SW/open source Internet of Things era.

Worldwide car sales are expected to reach 61 million this year; that's about 240 million tires, whereas 400 million smartphones are expected to sell this year worldwide. Also, a typical car today has 100 microprocessors and 100 million lines of software code, according to GM. So, today's car has more computing power than an IBM 360!

Market Trends
- Globally, mobile data traffic will **double** every year through 2015.
- Mobile data traffic is growing 4x faster than fixed broadband.
- There will be over 7 billion connected devices by 2015.
- Moving from voice to data to services centric
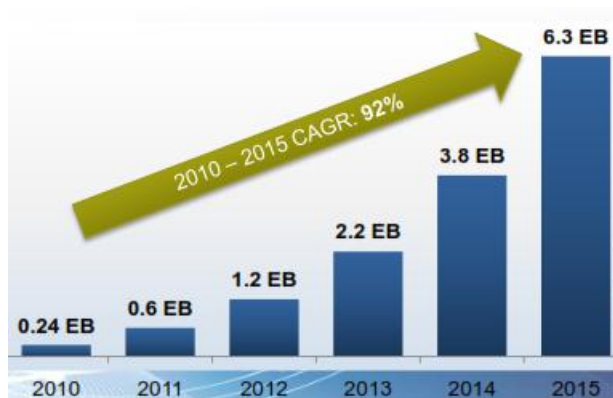- Growth in data traffic will place enormous strain on mobile networks globally.

Figure 5. Mobile Data Traffic (Exabytes per month)

Technology Trends
- Multi-standard support for new equipment and upgrades
  - GSM, UMTS, LTE
- Heterogeneous networks for coverage

o Small (Femto & Pico) and large cells (Metro & Macro)
- Cloud-based RAN architectures

R&D Challenges
- Create a **future-proof portfolio** of products supporting multiple standards, ranging in performance and cell sizes
- Reduce **total cost of ownership** while adding **increased differentiation**

Evolution of the Cellular Network
Size Reduction
Today's basestation equipment must support multiple modulation standards and increasing signal bandwidth with shrinking form factors. The benefits of deploying multimode basestations (Figure 6) include network flexibility and simplified upgrades to LTE, thus opening up the possibility for site sharing, allowing for spectrum re-farming, resulting in reduced OpEx/CapEx.
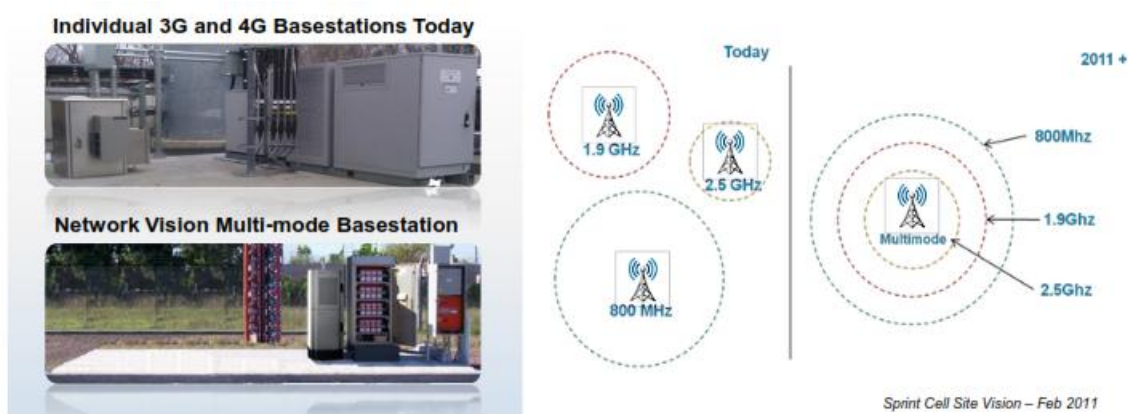

Figure 6. Multimode Basestation

Power Diversity
Active antennas become scalable, platform-agnostic building blocks which can be arrayed in different configurations to work as small cells, directional (smart) antennas or even macro cells, thus resulting in significant reduction in cell site footprint and power consumption.
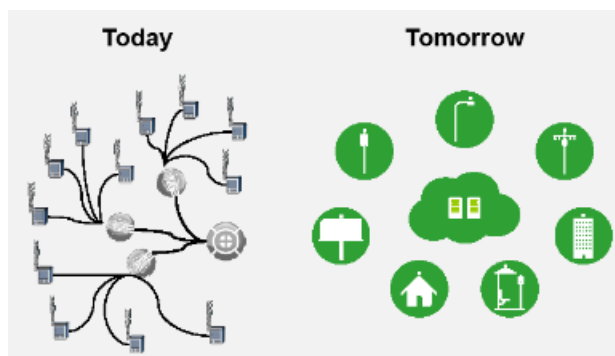

Figure 7. Active Antennas (*ALU lightRadio Concept, February 2011*)

CloudRAN
CloudRANs (Figure 8) are essentially CPUs that perform baseband and higher layer signal processing. The control unit and its distributed antennas are connected in different configurations as needed, potentially reducing CapEx and OpEx by up to 20% and 60%.
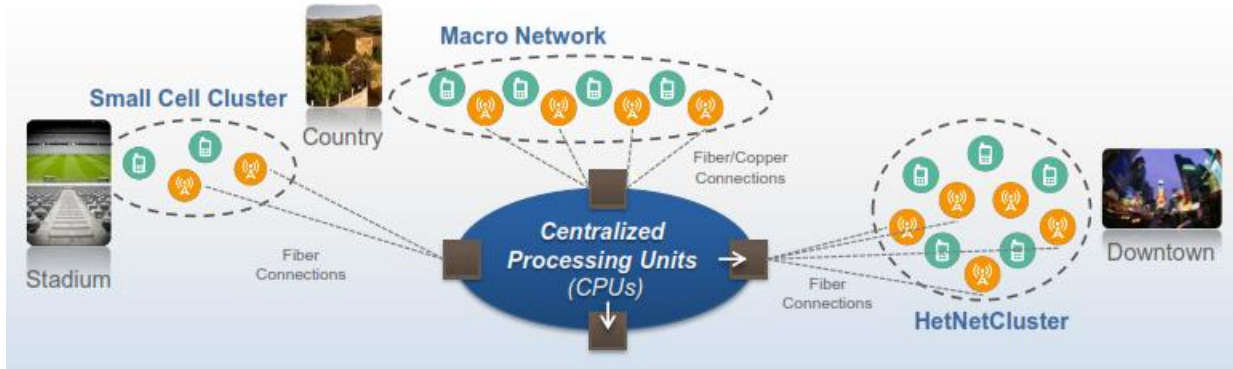
Figure 8. CloudRAN

The explosive growth of tablets, eReaders, and a host of embedded devices will drive increasing intelligent integration (Figure 9). Also, will tablets kill the eReader market? After all, eReader is single-function device, but tablets are four to five times more expensive.
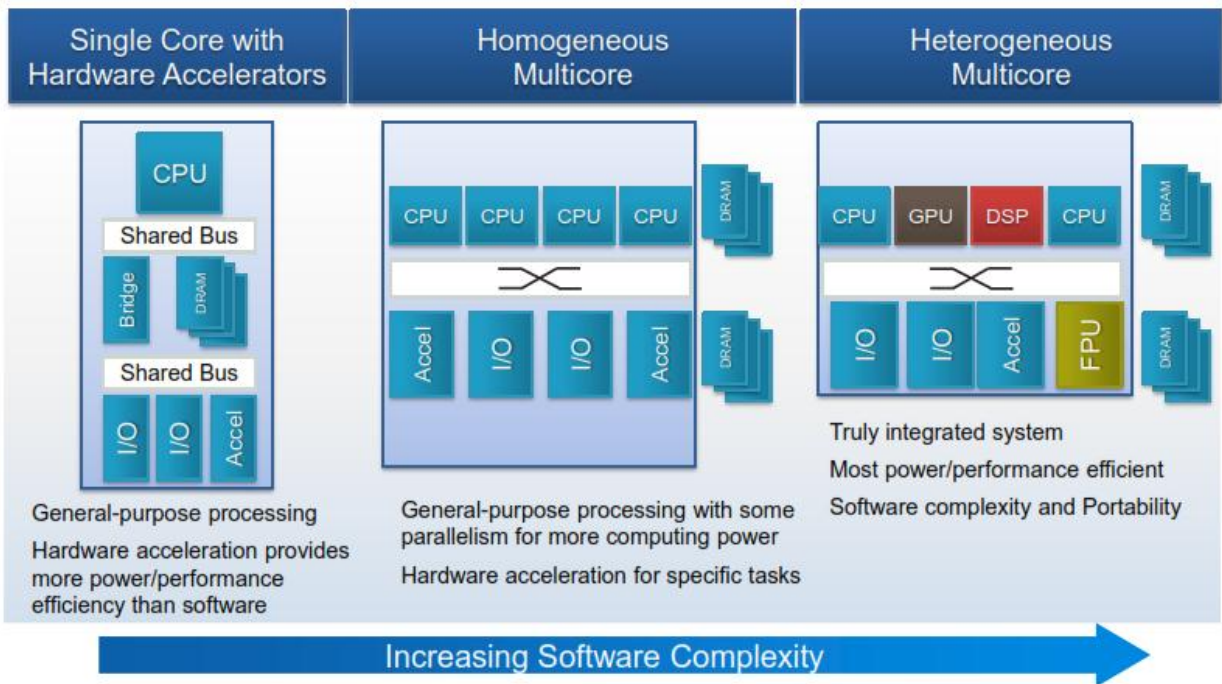

Figure 9. Intelligent Integration Options

Intelligent integration is what enabled Freescale to announce a new family of processors for cell sites at Mobile World Congress in Barcelona in February 2011. The family, called QorIQ Converge, features hybrid technology that collapses the need for various processors usually needed at a cell site. As a result, Freescale's basestation on a chip (Figure 10) will let gear to shrink and be more easily deployed in enterprises, at bus stops, and other buildings.
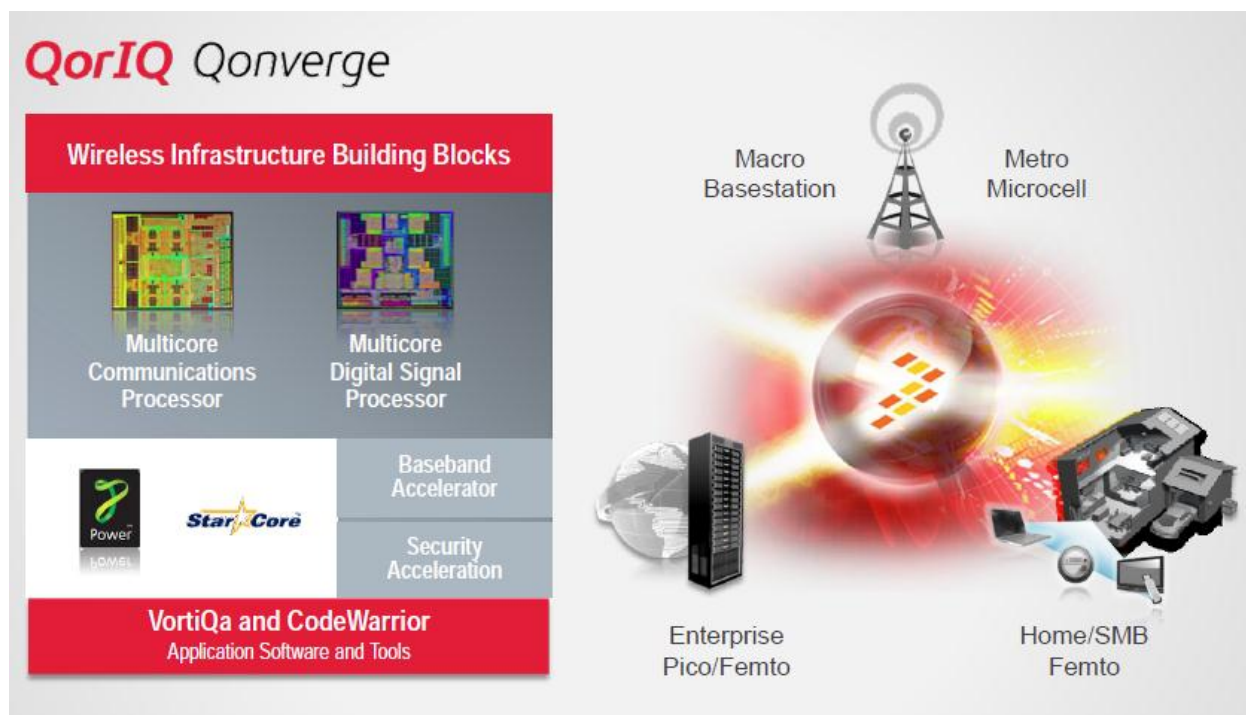
Figure 10. Freescale's Basestation on a Chip

Timothy Johnson of Sprint described the company's vision of TIE-ing [*T*ransportation, *I*nformation, and *E*nergy] together a connected world. Below are some interesting factoids:

- Of the more than 250 million vehicles, trains, and busses in the U.S. (U. S. DoT), only 4% are connected. (Feeney Wireless)
- More than 6% of truck miles are "out of route" – and expanding the carbon footprint. (PACCAR)
- Distracted driving killed 5,500 people in 2009. (USDoT)
- Usage-based insurance, with proper privacy considerations, promotes safer driving behaviors, with lower premiums.
- 885,000 electric cars will be on the road in North America by the year 2015. (IDC Energy Insights)
- If the average family purchased two electric vehicles, the load on the electrical grid would more than triple requiring greater Utility demand forecasting. (GridNet)
- The number of electric vehicle charging stations globally could reach 3 million by 2015. (GE)

Conclusion
The mood at the event was upbeat and most attendees saw bright days ahead for high-tech. We personally fear another bubble is due in the social media space where companies are highly overvalued. Overall, this was a well-organized conference with good content, except for a couple of companies whose presentations sounded more like a sales pitch.