Notices

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Outline

- Small Cells: Motivation and Implications
- Cellular Access Point Evolution
- The FSM9xxx Chipset
- Design Challenges
- Selected Advanced Features
- FSM9xxx Based Access Point
- Power Consumption
- Summary and Closing Remarks
Traditional Cellular Coverage Model + Small Cells → New Cellular Topology

- Data Demand ↑
- Capacity ↑
- Limited Spectrum
- Improved User Experience

Small Cells with Macro Overlay

Neighborhood Femtocells

Ultra Compact Small Cell Access Point

FSM9xxx

- Interference Management
- Low Cost
- Low Power
- Advanced Features

New Requirements for Cellular Access Points
Cellular Access Point Evolution

- POWER
- ADVANCED FEATURES
- COST & SIZE

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The FSM9xxx SoC

Key Stats
- 45 nm
- ~ 1.8 W for realistic full load
- Sampling commercially since April 2011

Key Features
- Small Cell Modem
- Integrated GPS
- Snapdragon™ Application Processor
- Security provisions
- Interference management
The FSM9xxx Architecture

- Memory Controllers
- Peripheral Interfaces
- Crypto Engines
- Hexagon™ Processor
- Snapdragon™ Processor

Interconnect Fabric

- Security Controller
- Small Cell Modems
- Downlink Receiver
- GPS
- Secure Boot Processor

- Digital Front End
- DACs
- ADCs
- DFE
- ADC
- DFE
- ADC
Snapdragon™ Processor

- Qualcomm’s 1st generation CPU, codenamed “Scorpion”
- 1 GHz
- ARMv7 ISA
- ~1.6x DMIPS/MHz w.r.t. ARM11
- Optimized for low power
- Open processor
- Handles L3, OA&M, etc.

Hexagon™ Processor

- Qualcomm’s custom DSP
- 600 MHz
- Multi-threaded
- Closed processor
- Handles L1 hardware control and L2
Design Challenges

- Need to combine base station and mobile functionality
  - Downlink processing for neighbor discovery and self-configuration
- Aggressive power consumption target
  - < 5W for full solution
- Stringent security requirements for residential deployment
  - Requires on-chip trusted execution environment
- Uncompromised modem performance
  - Up to 16 Multi-RAB UMTS users
  - 28 Mb/s downlink throughput
  - 5.7 Mb/s uplink throughput
  - Rx and Tx diversity
- Support for advanced interference management features
  - Additional processing chains for beaconing and uplink measurements
Advanced Signal Processing

Additional processing chains:
1) Downlink beaconing to facilitate system reselection
2) Uplink mobile and interference sensing

Simultaneous small cell service and downlink sniffing:
1) Dynamic interference management
2) Continuous VCTCXO disciplining

Small Cell Modem

Downlink Receiver

DFE

DACs

ADCs

ADC
Security

Interconnect Fabric

Hardware Accelerators for OTA Encryption and IPSec:
1) AES 128/192/256 bits
2) SHA1 to SHA256
3) SNOW 3G
4) Kasumi

Trusted Code:
1) Access to private data
2) Secure external storage in RAM

Secure Region for Trusted Execution Environment

Secure Boot Procedure
The FSM9xxx Chipset

**FSM9xxx Baseband Processor**
- FSM92xx SKUs for UMTS
- FSM98xx SKUs for CDMA2000

**FTR8700 Transceiver**
- 2x2 wideband (25 MHz) chains
- Global UMTS and CDMA2000 bands

**RTR8605 Receiver**
- Downlink receiver
- GPS receiver

**Power Management IC**
- Voltage regulators
- System clocks
FSM9xxx Based AP: Implementation

2.5 in. x 2.5 in., 6-layer Board
Small Cell Access Point Implementation
Power Consumption

Test Configuration:

- 8 user residential femtocell (FSM9208)
- HSDPA + EUL operation
- 1.9 GHz band
- 13 dBm maximum Tx power
- Single Tx/Rx
- GPS and downlink receiver active
- Measurements at room temperature

Total AP Power: 4.8 W
Data demand, capacity limits and economics are driving operators towards small cells

Small cells deployment models create new opportunities and introduce new design challenges

The FSM SoC provides a set of advanced features for improved system performance

This SoC enables a very compact, low power small cell AP design

The FSM9xxx chipset is Qualcomm’s 1st generation small cell solution, focused on 3G

This chipset is part of a portfolio of solutions that will include LTE, integrated Wi-Fi, and small cells evolution
Thank You!