# Wireless SDR Solutions: The Challenge and Promise of Next Generation Handsets

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# Agenda

Motivation for SDR

Market

Technology Requirements

Sandbridge Technologies' Solution

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# The Challenges of an Industry

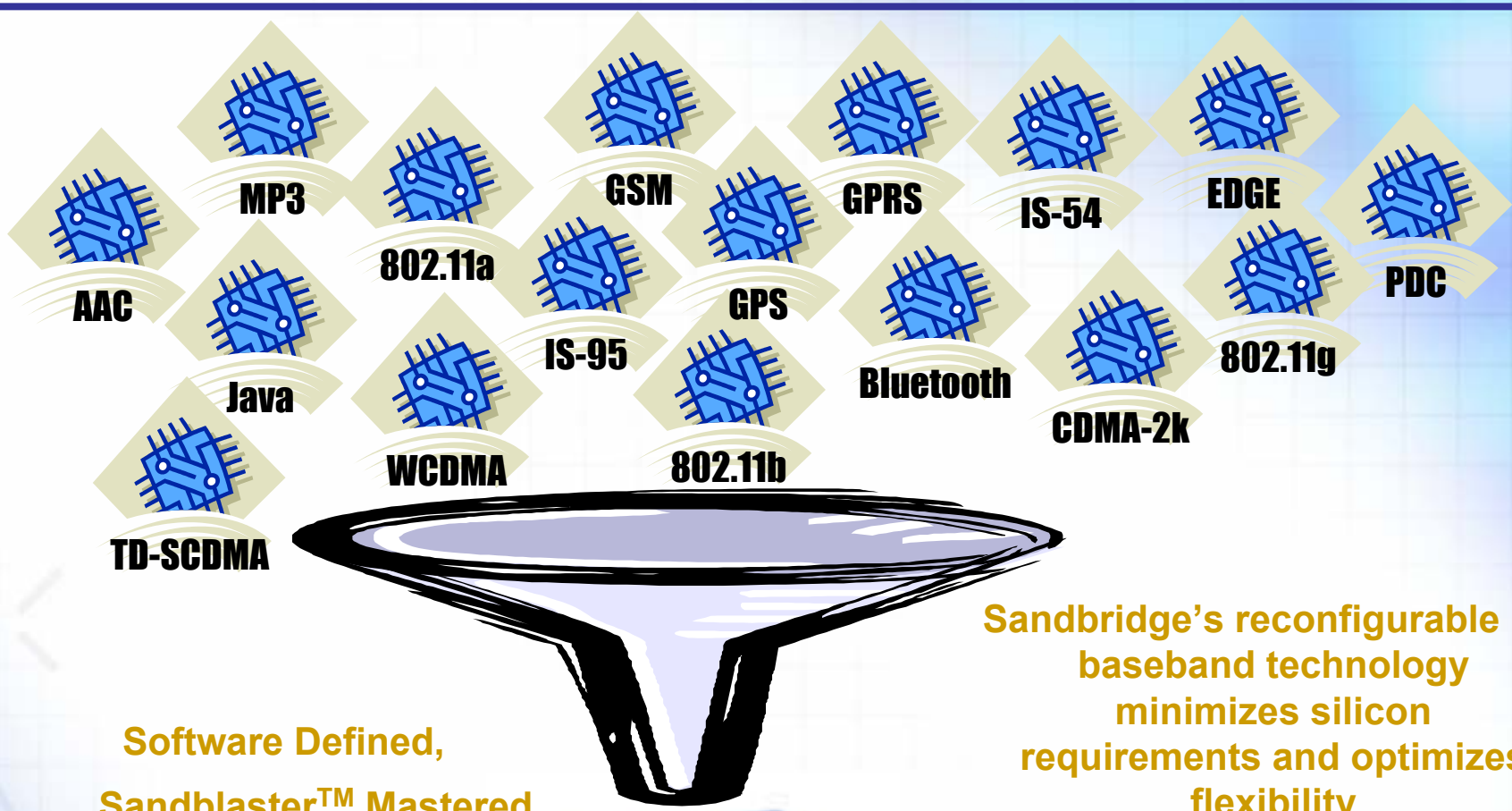
## Cost

- 3G is >10x more complex than 2G
  - but cost should be same, or even less
- Convergence phone 2x complexity
  - WLAN, 2G, and 2.5G integration
  - Traditionally implemented in HW
- Moore's law reduces cost 50% every 18 months
  - 6 years until the wireless multimedia is a real consumer market

## Time-to-market

- GPRS terminals were late
  - OEMs had to wait until bug free SoCs were available
- 3G terminals will be late
  - OEMs have to wait until bug free SoCs with 'reasonable' power consumption are available

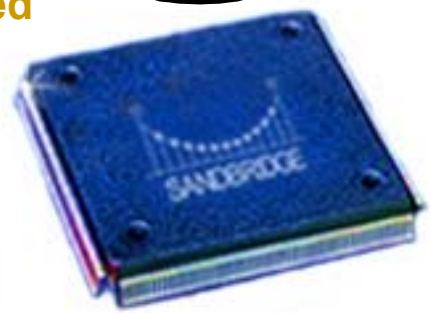
# Multifunction Devices




Software Defined,

Sandblaster™ Mastered

Sandbridge's reconfigurable baseband technology minimizes silicon requirements and optimizes flexibility

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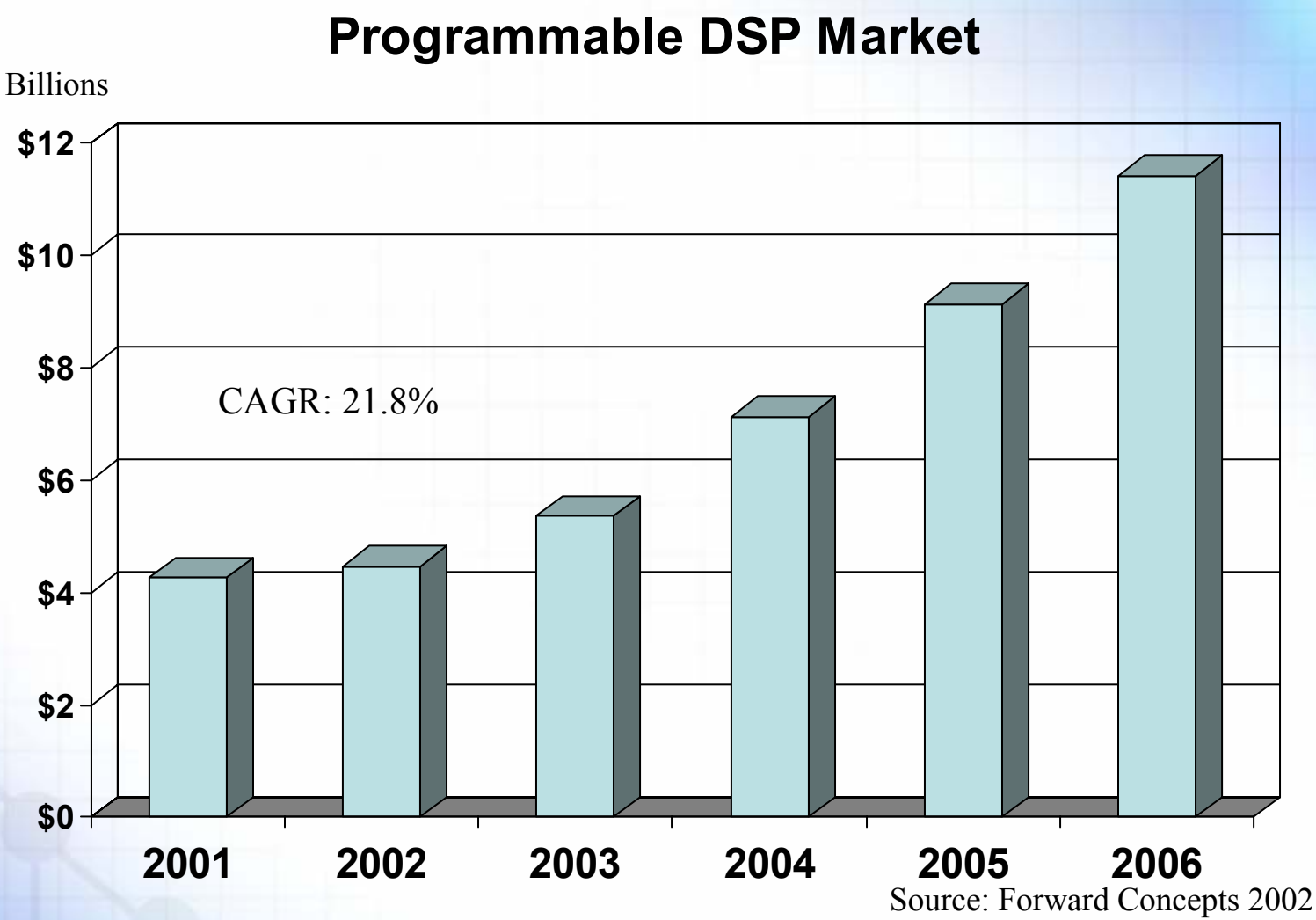
# Programmable DSP Market




Source: Forward Concepts 2002

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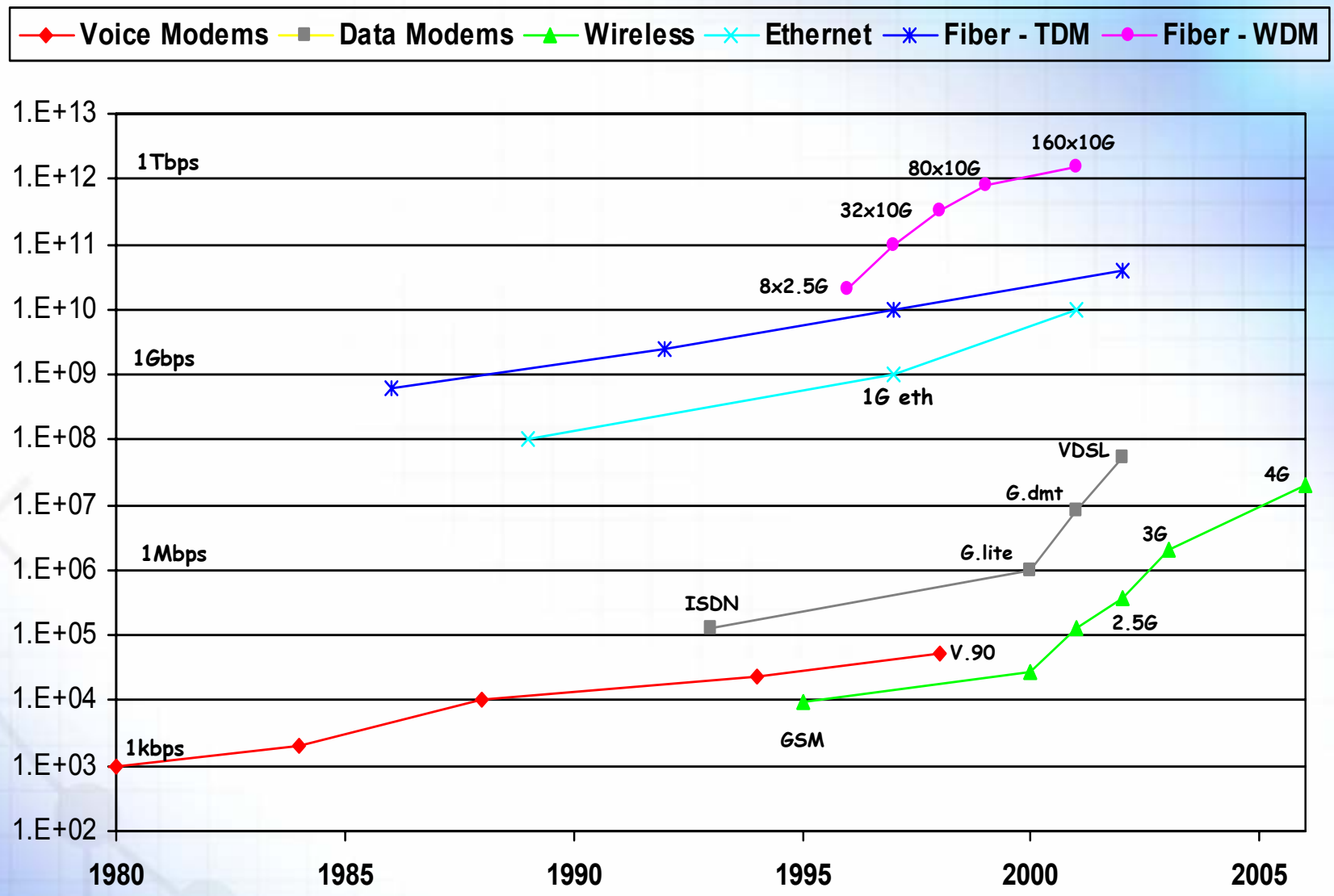
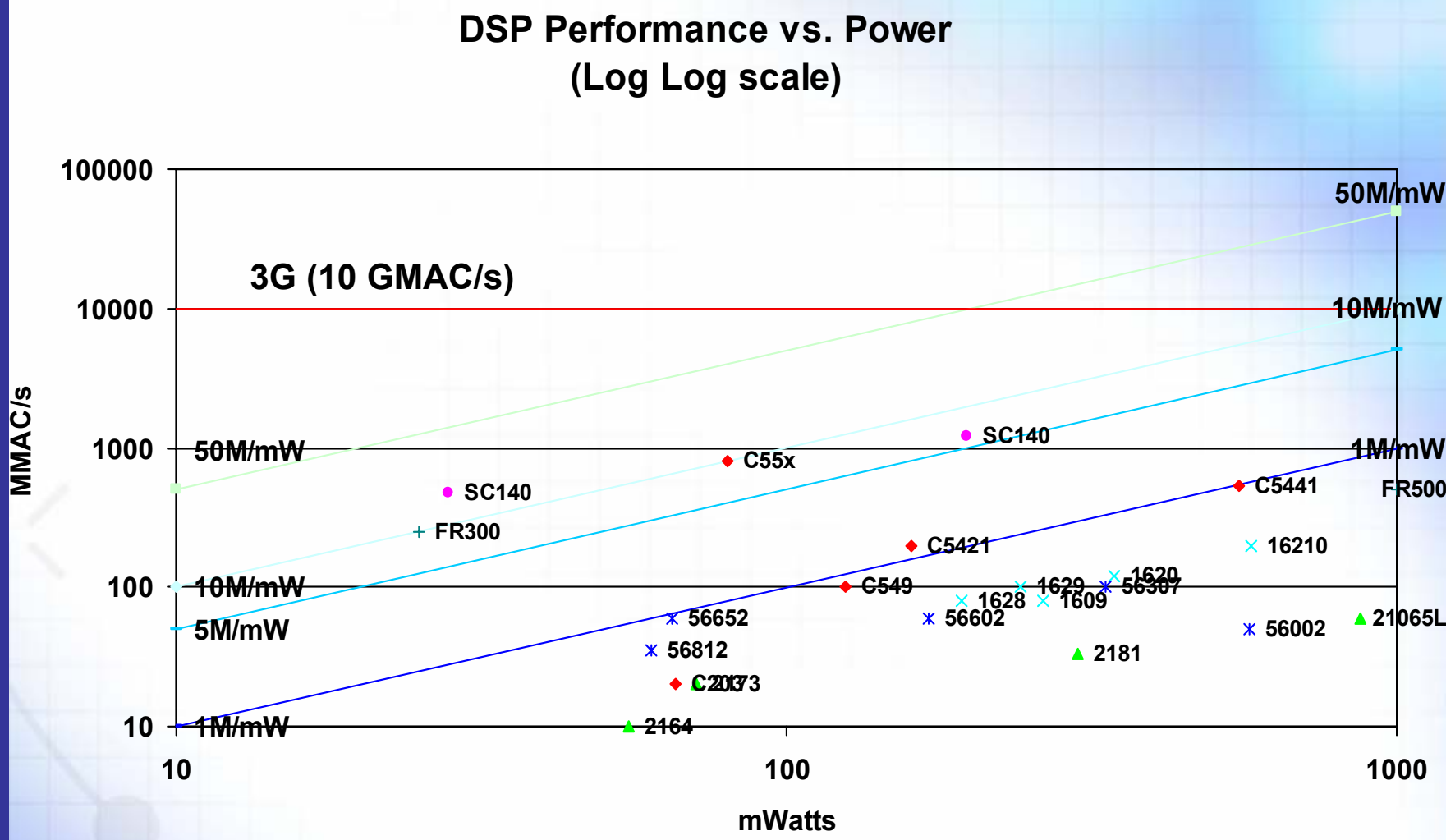
# Datarate Evolution



# DSP Power/Performance



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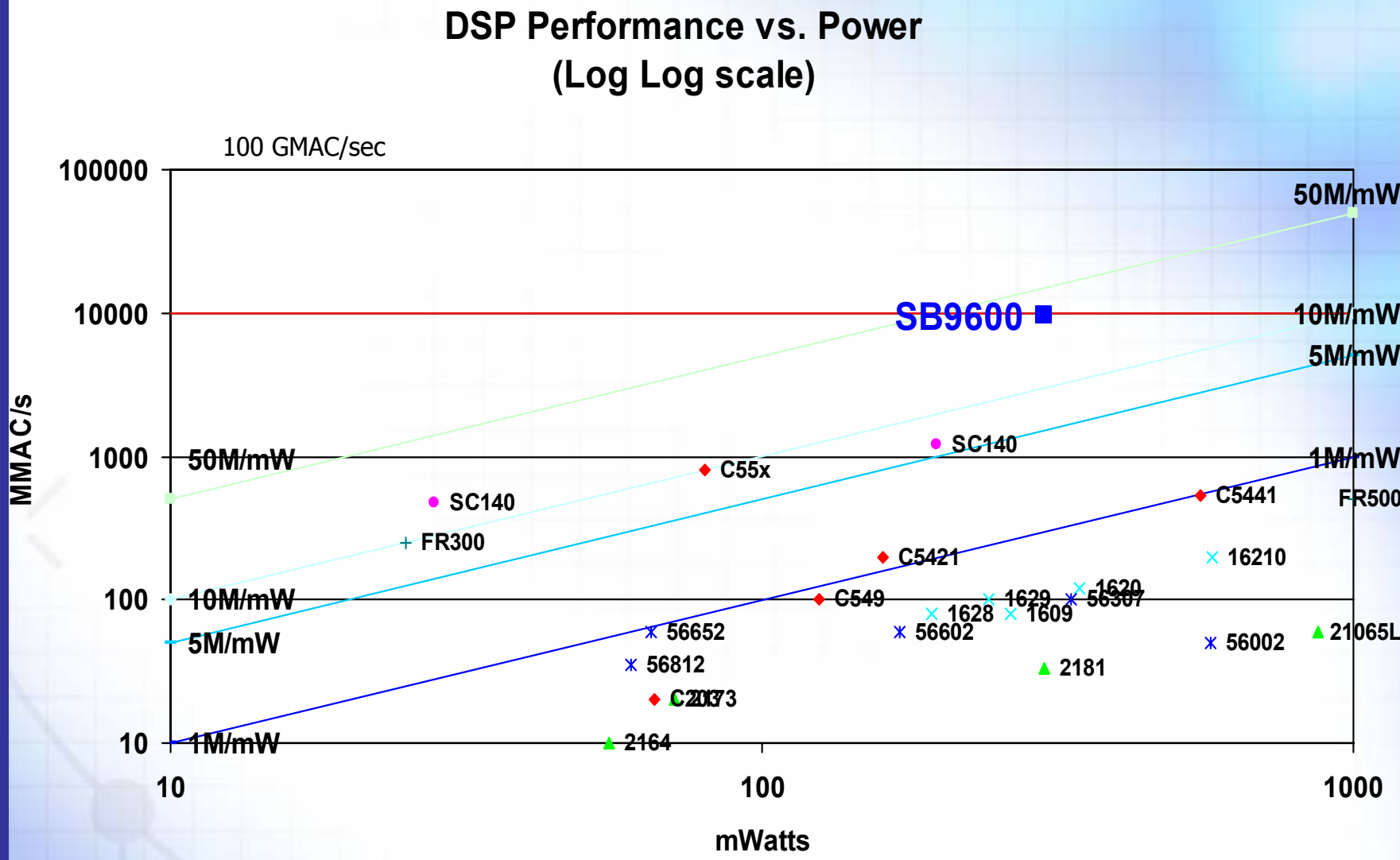
# Competitive Power



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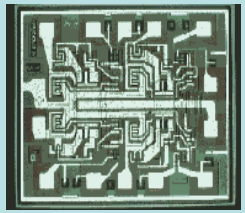
# Sandbridge Approach

## Available now

### SandBlaster™ DSP



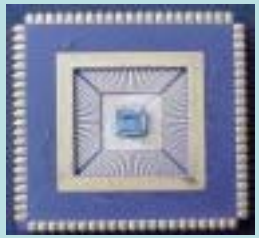
- Programmable
- Ultra-low power
- High-performance
- Multithreaded

### SandBlaster™ Tools

- High productivity C compiler
- 70% time-to-market reduction
- User-friendly Environment

## Q3-03

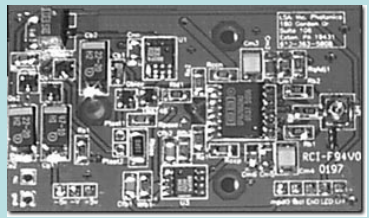
### SB9600 Baseband



- Scalable & Programmable
- Integrated Sandblaster cores
- Up to 2Mbit/sec data rate
- 40,000 RISC MIPS
- 10,000 MMACs
- Low Cost 0.13um CMOS
- Integrated protocol stack

## Q1-04

### Multi-function System Solution



- Low Cost
- Power Efficient
- Ultra-high performance
- Fully tested / validated
- Dedicated Customer Support
- Flexible and upgradeable



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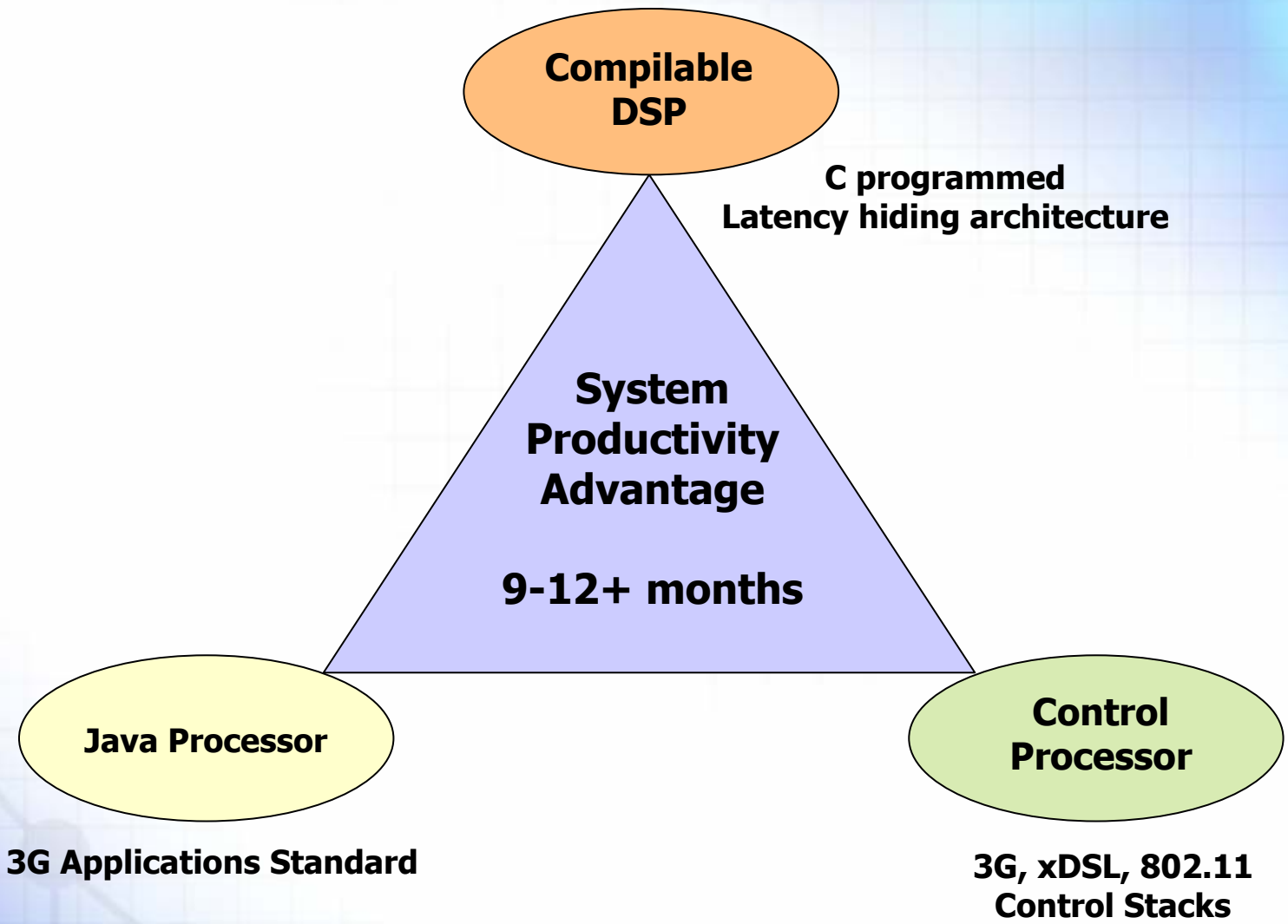
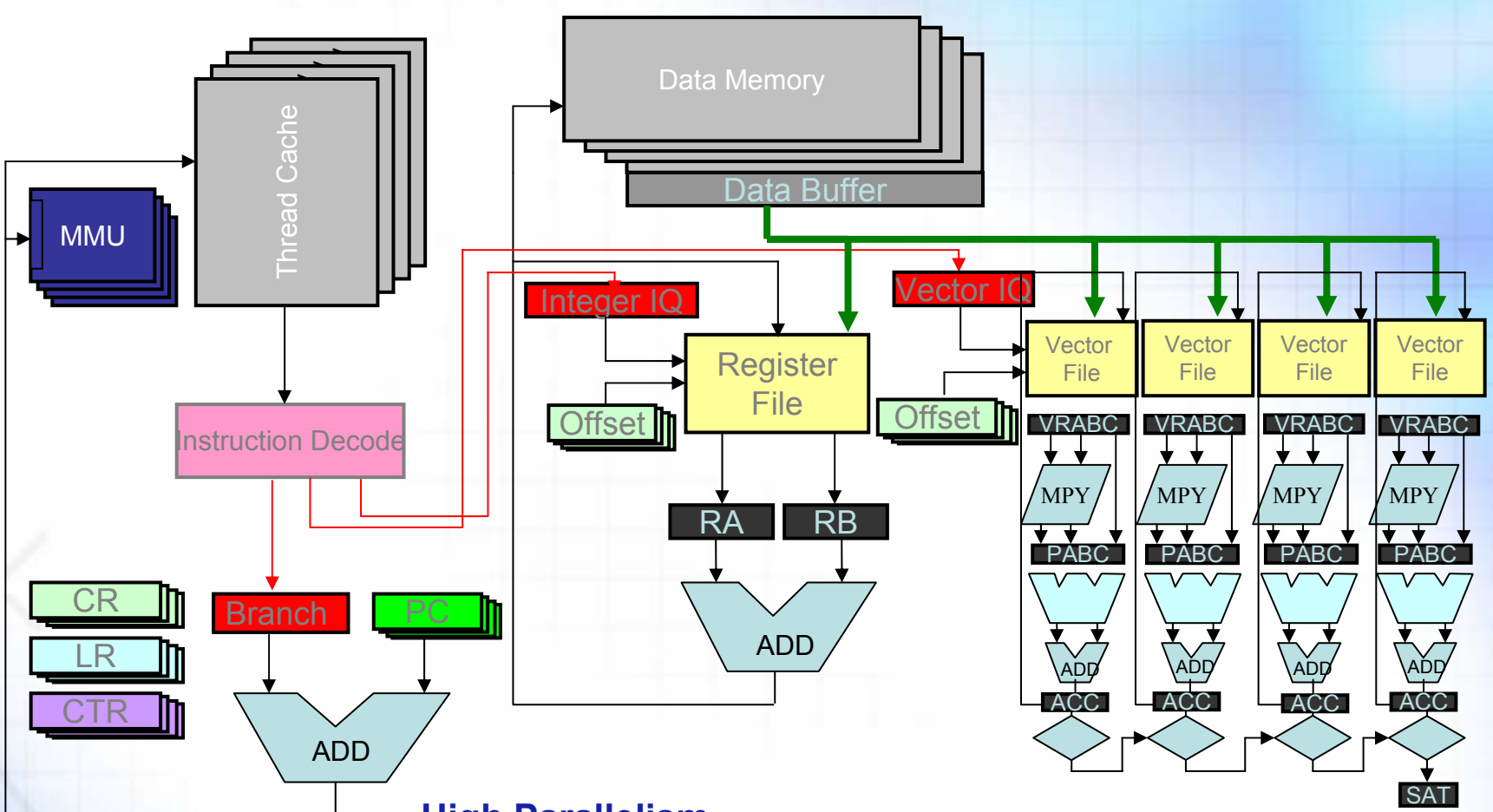
# Sandblaster™ Architecture Performs



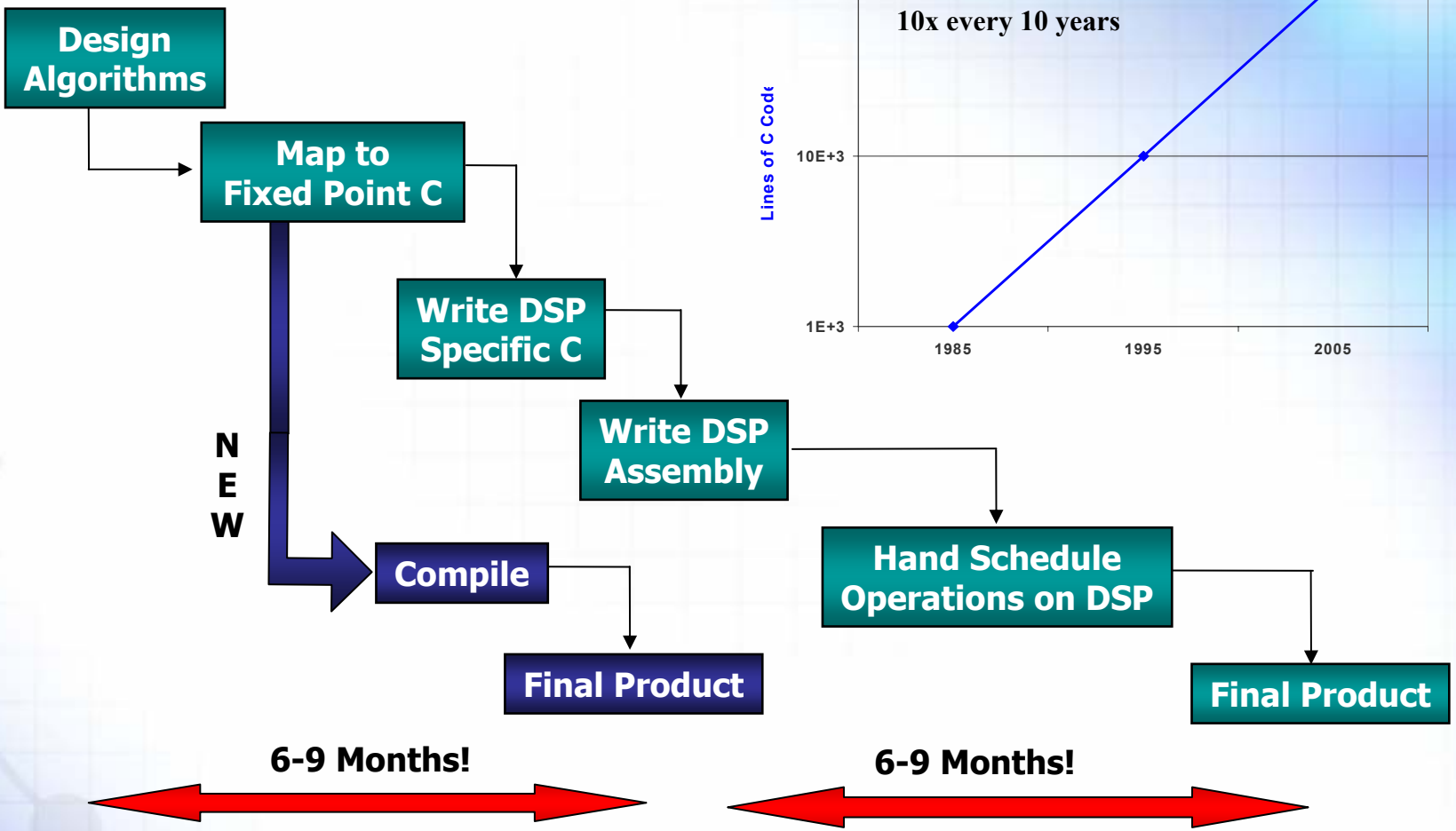
# Multithreaded DSP




## High Parallelism

- Vector / SIMD data parallelism
- Multiple instruction issue
- Thread-level parallelism

# Compiler Productivity







**Sandblaster™ Provides Dramatic Improvement**



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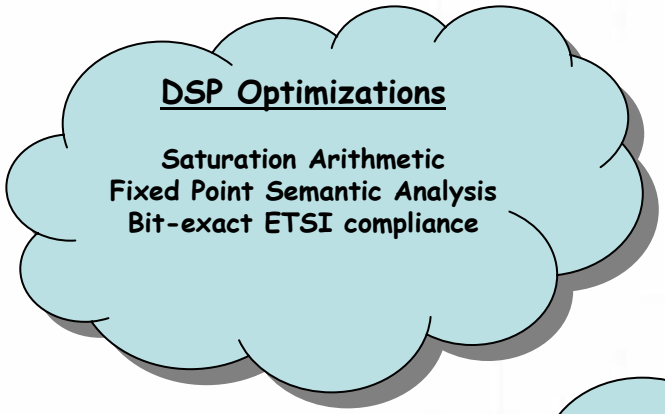
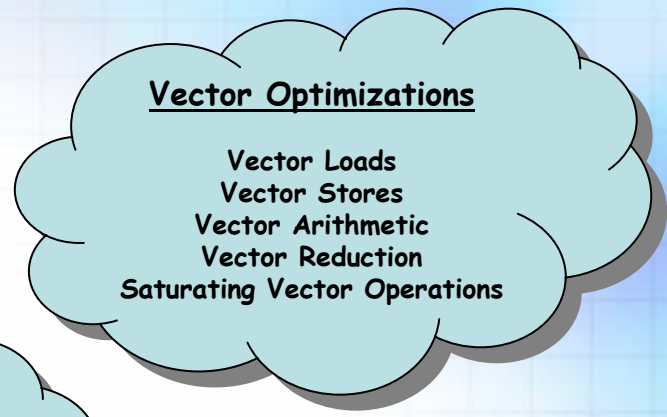
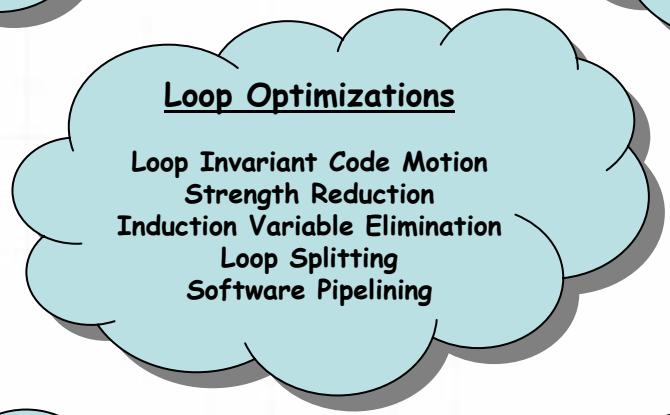
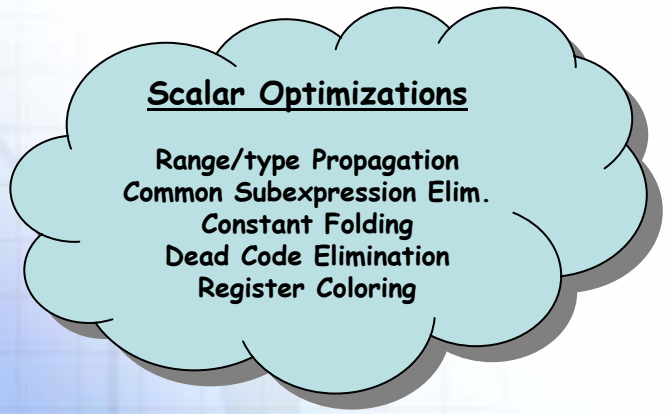
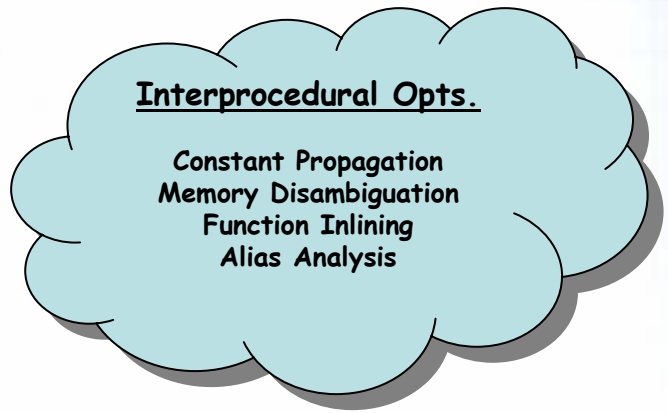
# Compiler Optimizations



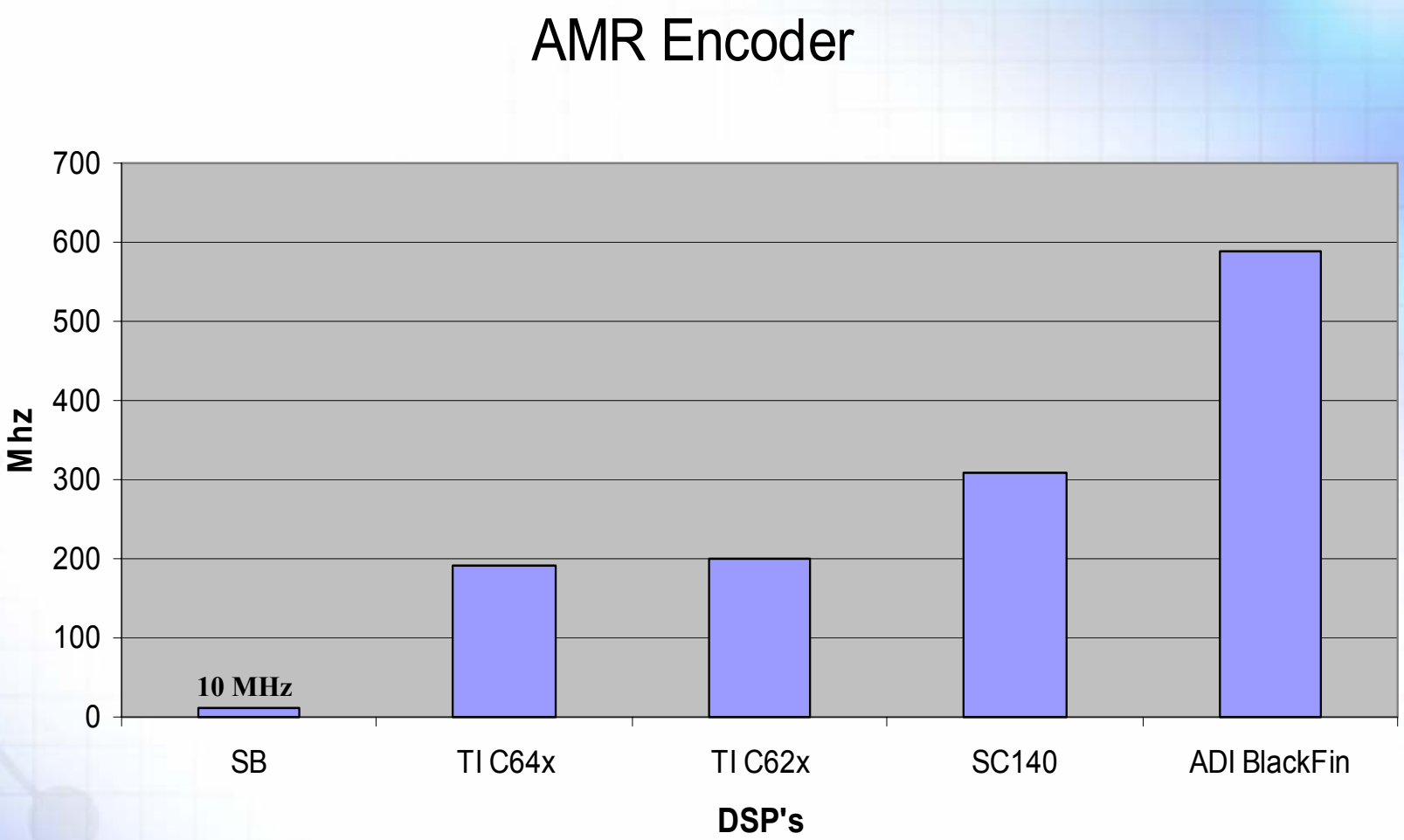



# AMR Out of Box Results



# Simulation Technology

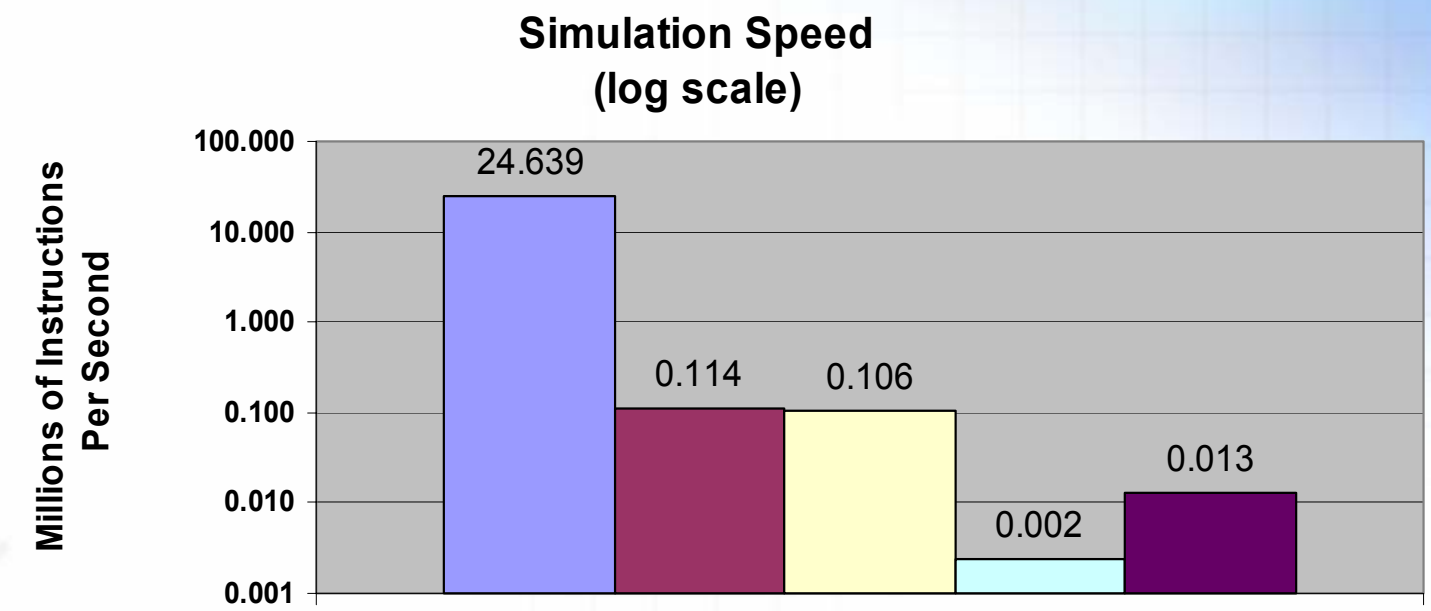
## Compiled Simulator

- 100 MHz on high end x86
- JIT “Flash” compilation
- Multi-threaded supported
- Function level profiler
  - Non-intrusive
- Up to 4 orders of magnitude faster
  - Dramatic development time reduction
  - Significant productivity improvement

## Cycle Accurate Simulator

- Used for Verification against VHDL model
- Provides detailed statistics

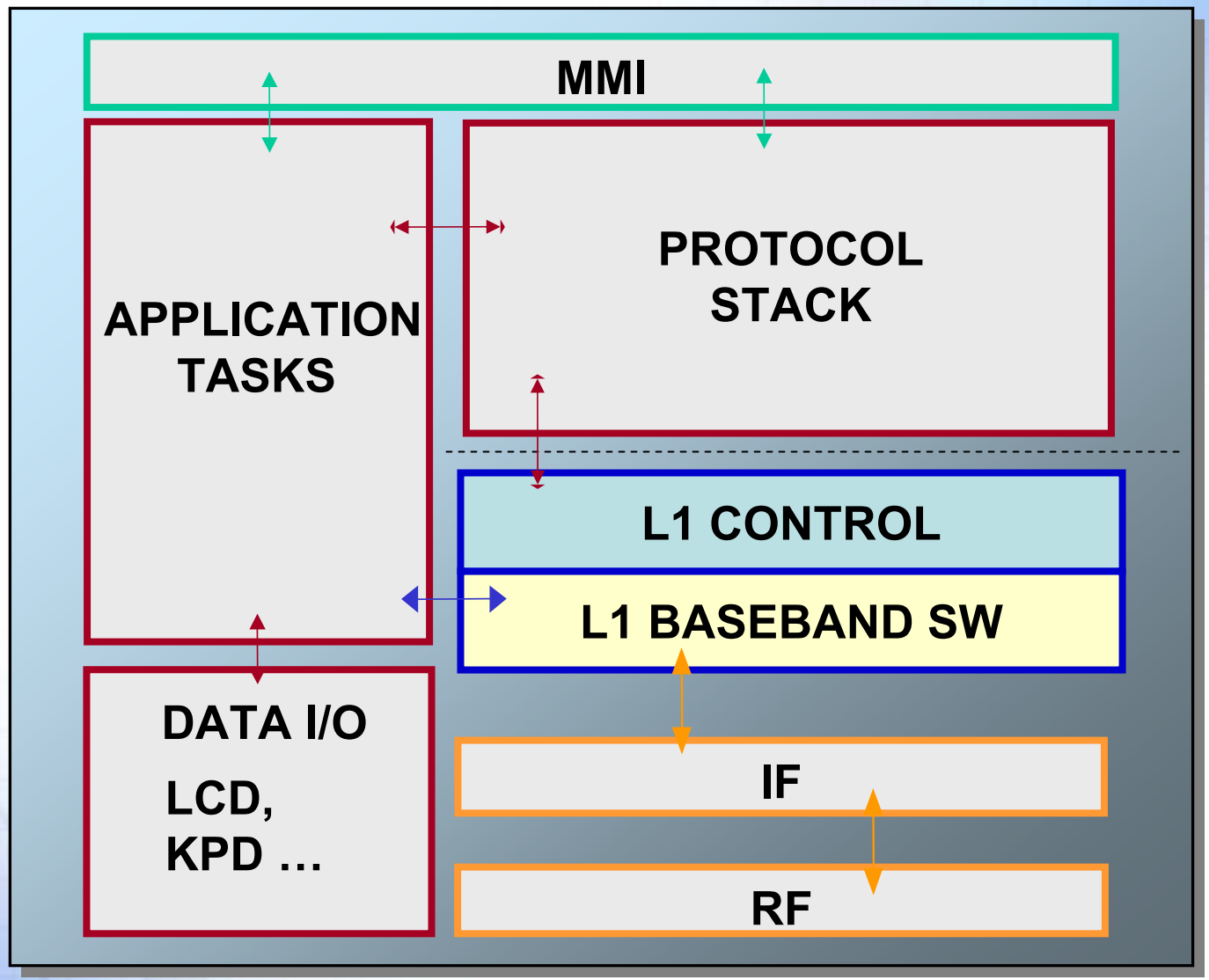
# Functional Simulator Speeds




| | |
|---|---|
| SB | 24.639 |
| TI C64x (Code Composer) | 0.114 |
| TI C62x(Code Composer) | 0.106 |
| SC140(Metrow erks) | 0.002 |
| ADI Blackfin (Visual DSP) | 0.013 |

## Results on 1Ghz laptop

# Integration



# Development Process

## MATLAB physical layer

- End-to-end UTRAN + UE
- Channel models
- Configurable via test-scripts
- BER/FER measurement

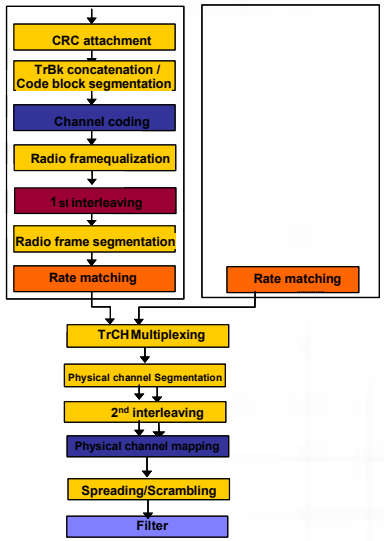
## Simulation level C

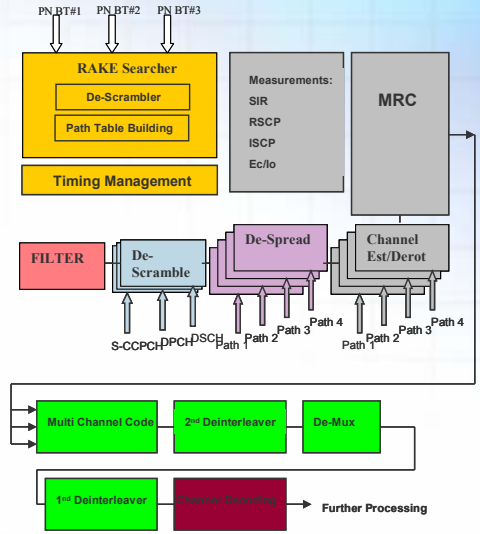
- Fixed point
- UE only
- Fixed configuration
- Performance measurement

## Product level C

- Partitioned for real-time
- Using actual peripherals
- Integrate with L1 control + L2/L3

# Real-time WCDMA Performance




## Real-time chip, bit, and symbol rate processing

- 1 SB9600 chip for 2Mbps Rx concurrently with 768kbps Tx
- <75% utilization for 384kbps Rx / 384kbps Tx

## Includes functions traditionally implemented in H/W

- Turbo Decoder
- Rake Receiver
- Tx/Rx Filters

# SB9600 Features

## Communications Protocols

- GSM / GPRS / WCDMA multimode
- Bluetooth / GPS / 802.11b

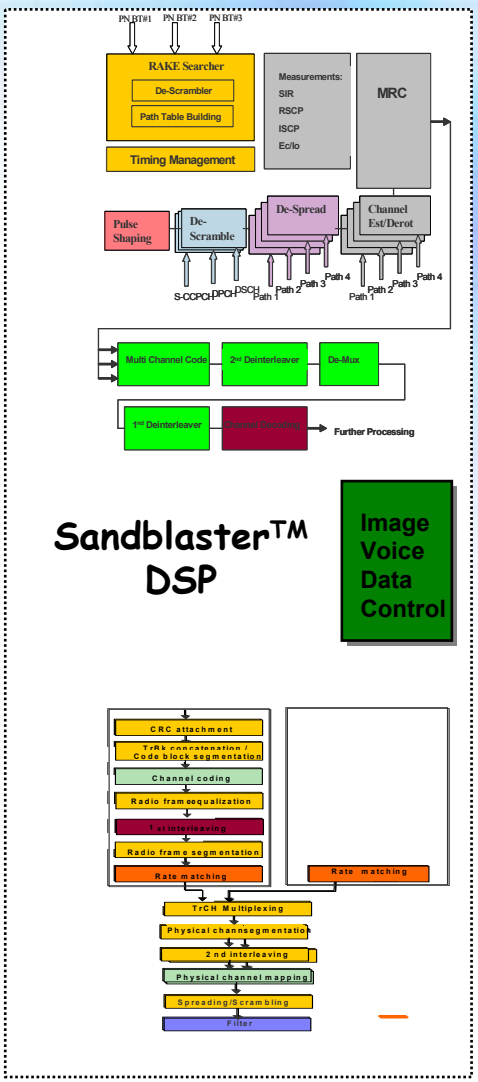
## Audio/Video/Telephony

- MP-3 / AAC / MIDI / WMA / Real
- MPEG-4 (QCIF, 15fps)
- VoIP (H.263, G.723.1)
- Still & Video Camera

## Misc

- MMS / SMS / iMode / WAP
- SIM / USIM
- SMIL / SyncML
- Java

## Reconfigurable on the Fly



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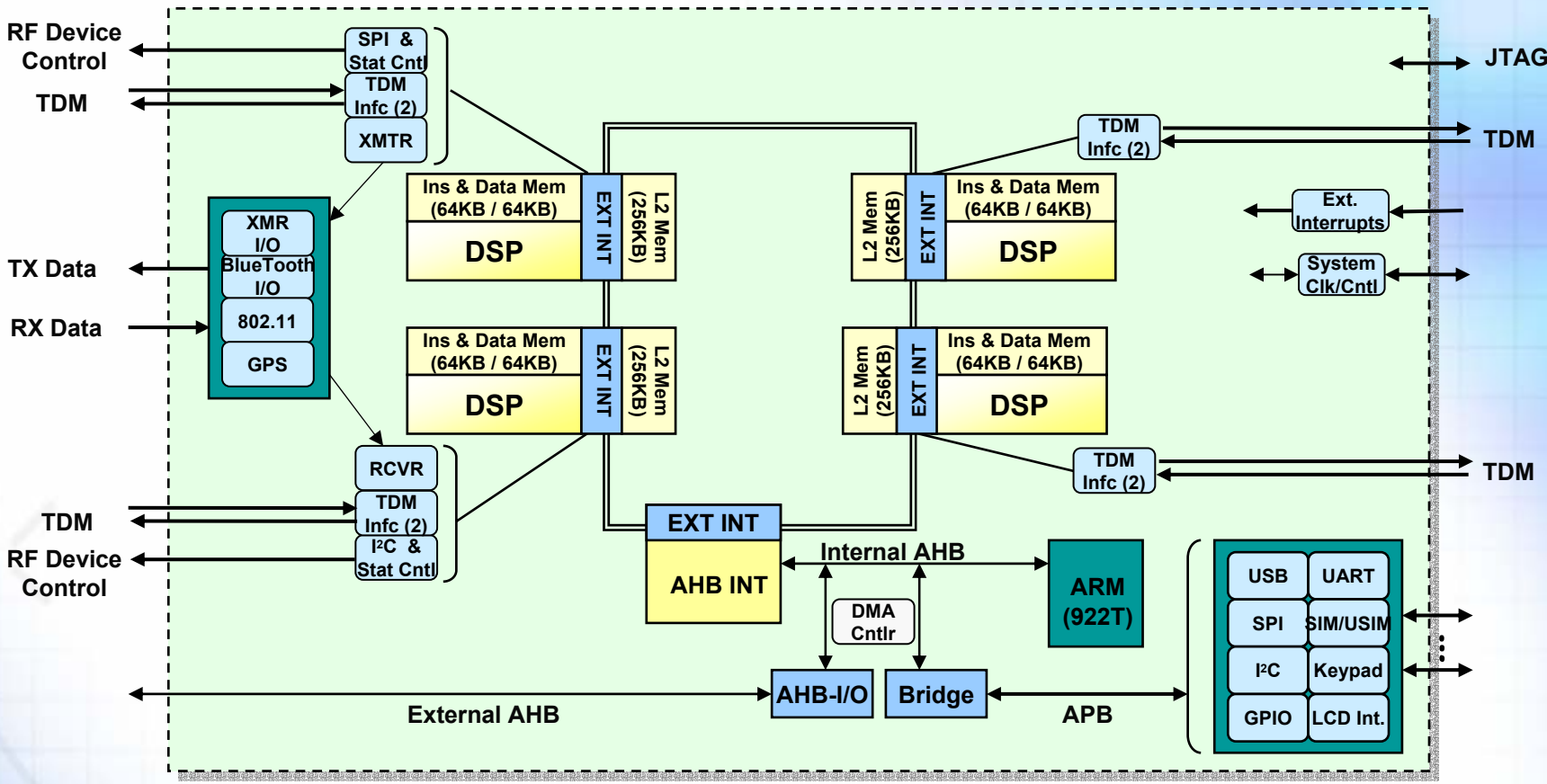
# SB9600 2003 Handset Chip




- 0.13um CMOS, *custom*
- Replicated Sandblaster™ core
- Low Power design

# Summary

## Multithreaded baseband processor

- multi-threaded
- high-performance and low-power

## Sophisticated compiler technology

- automatically generates DSP operations
- near-assembly language performance

## Reconfigurable Communications Protocols

- WCDMA
- GSM, GPRS
- 802.11
- Bluetooth
- GPS

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# Expanding the Dimensions of Wireless Multimedia Technology

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