Intel® PXA27x Processor Family:
An Applications Processor for Phone and PDA applications

N.C. Paver PhD
Architect
Intel Corporation

Hot Chips 16
August 2004

Agenda

• Overview of the Intel® PXA27X processor architecture
• The Intel XScale® Microarchitecture with Intel® Wireless MMX™ technology.
• Wireless Intel Speedstep® technology
• Performance/Power metrics
• Advanced Packaging technology
• Summary
Quick Capture interface
4-bit SD I/O
PWM x 4
USIM Card
Keypad
UART x 3
AC97/S
SSP x 3
I2C

Intel® PXA270 Processor block diagram

Intel® PXA270 Processor

256KB SRAM
XScale® Core
Power and Clock Manager

Intel Communications Group – Cellular and Handheld Group Page 3

Intel Communications Group – Cellular and Handheld Group Page 4
**Intel XScale® Microarchitecture**

Key Features:
- ARM® V5TE Architecture Compliant
- Up to 624 MHz operation
- Scalar, in-order issue architecture
  - Concurrent execution in 3 pipes
  - Out-of-order return
- 7-stage integer pipeline
- Dynamic branch prediction
- 32 KB I Cache & 32KB D Cache
  - 32 Entry I and 32 Entry D TLB
  - Eight entry write buffer
  - Four entry fill buffer
- Supports dynamic voltage and frequency management

---

**Intel® Wireless MMX™ Architecture**

Datapath units include:
- Register file unit
- Execution unit
- Multiply accumulate unit
- Shift/Permute unit.

- Intel® Wireless MMX™ Technology offers a large register space (16x64bit registers)
- Can use register file as a Level 0 Cache.
  - Store all of the filter coefficients in the register file for repeated application
  - For motion search 8x8 reference region can be kept in only 8 registers
Pipeline Organization

The Intel® Wireless MMX™ unit is tightly coupled with Intel XScale® core and also contains three pipelines.

Intel® XScale® Pipeline

Intel® Wireless MMX™ Pipeline

Intel® Wireless MMX™ Technology: Performance

Play a video while listening to an MP3

Up to 50% more performance than Scalar code
Multi-media Interfaces

- Supports up to 4M Pixel image sensors
- Wide Range of Sensors
- Converts packed image data to planar format for SIMD processing
- Low power image preview can utilize HW color conversion

Wireless Intel SpeedStep® Technology

Includes:
- 5 low power modes
- Ability to change Frequency and Voltage dynamically
- Power Manager software provides framework to utilize Intel PXA27x processor low power modes

Intel® PXA27x processor Power Modes

- IDLE Mode:
  - CPU state retained
- Deep IDLE Mode:
  - Human interface devices on
- Standby Mode:
  - CPU state retained
- Sleep Mode:
  - GPIO state retained
- Deep Sleep Mode:
  - Max power savings
  - No state retained

Faster response Time*

Lower Power*

*Faster response time, lower power based on which power mode the processor is in
New Low Power Modes

- Deep Idle
- Standby
- Deep Sleep

Power Consumption mWatts*

15
35
25
20
10
5
0

Balance power with system response time

Processor response time (ms)*

Time (ms)

Exit Time (ms)

100
90
80
70
60
50
40
30
20
10
0

Deep Idle
Standby
Deep Sleep

*Other names and brands may be claimed as the property of others.

Wireless Intel SpeedStep® Power Manager

- Software which enables the use of Wireless Intel SpeedStep Technology
- Power Manager is an add-on software module that is integrated in the OS BSP's
- Supports Palm*, Symbian*, Linux* and Microsoft* OSs
- Intel provides documentation to assist driver modifications required to interface to the software

Includes:

- Profiler Modules – Monitors idle activity, CPU% usage, and provide user input to the Policy Manager so the power policy can be determined
- Policy Manager – Takes input from profilers and determines the system power policy under all types of workloads

Power Policy
Processor and Device States
Operating Frequencies and Voltages

Inputs into the Policy Manager

User preferences

Drivers

Outputs from the Policy Manager

Intel Communications Group – Cellular and Handheld Group Page 11

Intel Communications Group – Cellular and Handheld Group Page 12

Other names and trademarks are properties of their respective owners.
Wireless Intel Speedstep® Technology  
In Action: Video Playback

- Use MHz and voltage change to achieve lower total playback power
- Enabled by Wireless Intel SpeedStep® Power Manager

![Chart showing voltage and MHz changes](chart.png)

Intel® PXA27x Processor Family: SoC to SiP

- Intel® PXA27x processor family includes stacked products:
  - PXA270 discrete processor
  - PXA271, PXA272 & PXA273 stacked products
  - Processor speed and stack contents vary with product
    - MHz, Flash and SDRAM

![Stack package diagram](diagram.png)

*The tape, die and packages shown are samples only provided solely to illustrate Steps in the folded stack packaging process and should not be considered, when processing completed, as discrete components, die or packages.

**When comparing PXA271 to Intel® PXA270 processor and separate discrete of PXA270.**
Summary

- The family of Intel® PXA27x processors provide a highly integrated, low power SoC and SiP solution for wireless and handheld platforms.

- The Intel XScale® microarchitecture with Intel® Wireless MMX™ technology provides a high performance, low power multimedia experience.

- Wireless Intel Speedstep® technology provides advance power management for low power applications.