Moorestown: Intel’s Next Generation Platform for MIDs and Smartphones

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SPCS005
Agenda

- Intel® Atom™ Processor Strategy
- Intel’s Value Proposition
- Moorestown Overview
- Moorestown Technologies
  - Performance
  - Power
  - Size Reduction
- Software
**Vision: 1B “Connected clients” by 2015**

**Core Business**
*Client PCs*

**Strategic Growth Areas**
- CE (Internet)
- Mobile Internet Devices
- Low Cost PCs
- Embedded

**One Architecture Across Multiple Client Platforms**
Intel® Atom Processor: Value Proposition

PERFORMANCE
Run the Internet at Ultra Low Power

INTERNET
Availability with the Latest Technologies

SOFTWARE
Compatibility For the Developer

WIRELESS
Connectivity For Always On
Intel® Atom™ Processor Enables a Spectrum of Devices

- From Intel Roadmap. Based on Smart Phones TAM with >$200 ASP,
- ** Based on Portable Navigation devices TAM,
- *** Based on Portable Video and Gaming TAM,
- **** Based on Tablets, Vertical HHs, and Select Netbooks Data Sources: iSuppli, ABI, IDC, Canalys, Intel analysis

Volume

MID, Portable Media Players, Game Consoles, Navigation Devices

Menlow

MID, Productivity Devices

Mooresstown

> 400 Mu TAM

Medfield

Mainstream Smartphones

High End Smartphones

Lower Power
Opportunity: Next Gen. Mobile Computer

• Pocketable Device
• Always-On Always Connected (AOAC)
  – 3G, WiFi or/and WiMAX
• Long Battery Life for all day use
• Data Oriented, Voice Capable
• Great Media Performance
• 100% Compatible at App level with Linux on PC
• Smartphone form factor, e.g. 3.5+” Display, 150gm

Carry Small, Live Large Experience Device
Major Reductions in Power & Form Factor

2008

Menlow
Board Size 8,500 sq mm
Standby Power 1.6W

2010

Mooresstown
Board Size – Reduced 2x
Standby Power Up to 50x* Forecast

2011

Medfield
Board Size – Reduced
Standby Power - Lower

Power and Form Factor Reductions On Track
Mooresstown Idle Power Is Similar To Smartphone level

*Moorestown Platform Idle power reduction (based on current platform features) compared to Menlow Platform
Drawings are not to scale
Moorestown Platform Goals

- Power: Over 2x Reduction over Menlow
- Motherboard Size: At least 2x Reduction over Menlow
- Break-through: Always On (50x reduction on Idle Power)
- Enable richer functionality (e.g., Always-On Always-Connected, Handheld IO, Solid State Drive)
- Faster Derivatives Products by changing to SoC methodology
- Leverage our process technology for size, power and performance

Dramatic reduction on power, cost, size and maintaining performance, technology, compatibility leadership
Moorestown Platform Overview

**LANGWELL (65nm)**
- 2D / 3D Graphics
- CPU core
- Hardware Video Acceleration
- Display Controller
- Memory Controller

**BRIERTOWN**
- System Controller
- SDIO Ports
- Audio Engine
- MIPI CSI Interface
- USB Controller
- NAND Controller

**MSIC**
- LP DDR

**LINCROFT (45nm)**
- 3G
- WiFi a/b/g/n
- WiMAX
- BT
- GPS

**EVANS PEAK**
Moorestown Platform Re-Partitioning

Re-Partitioning using 45nm SoC process → Higher Performance and Ultra Low Power
Moorestown’s Technologies

• Performance
• Power Reduction
• Size Reduction
Moorestown Performance Technologies

- Intel® Hyper-Threading Technology
- Intel® Burst Performance Technology (Intel® BPT)
- “Bus Turbo Mode”
Intel® Hyper-Threading Technology

Hyper threading Increase in an In-order Machine

![Graph showing performance and power increase with Hyper-Threading Technology]

Intel® Hyper-threading technology provides good Performance/Power efficiency

Source*: Intel Testing. Specint2k and EEMBC run in Single Threaded / Hyper Threaded Mode on Linux. For Performance the score for each binary is calculated based on the runtimes; for Power, the effective capacitance or C-dyn is measured per binary on each of the benchmark while running in ST and HT modes. The difference in C-dyn and thus total power difference is calculated for ST and HT modes. Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance and the performance of Intel products, visit Intel Performance Benchmark Limitations.
Intel® Burst Performance Technology (Intel® BPT)
Additional Performance Headroom

• Takes advantage of Thermal headroom on $T_J$ and $T_{Skin}$ for short duration

• System reduces frequency to Recovery points when $T_{Skin}$ thresholds are exceeded

• Saves consumed CPU and Platform energy (= power x time)
  ▪ Race to idle
  ▪ Saves energy if $t_2/t_1 < p_1/p_2$

Intel® BPT provides on-demand performance and Battery Life Saving without impacting thermal design
Burst Mode in Operation

Burst mode delivers higher performance on demand.
“Bus Turbo Mode”
Further Performance Boost

• Motivation
  – Reduce memory latency and increase bus BW when CPU bursting at higher frequencies

• Implementation
  – HW dynamically increases BUS freq. at pre-set CPU freq.
  – No need to re-lock PLL that provides clock to bus
    ▪ Uses clock divider
  – Re-lock CPU PLL

“Bus Turbo Mode” provides substantially higher bus bandwidth
Moorestown Power Reduction

- Active Power Management – Power & Clock Gating

- Use Low Power and Handheld I/O: SDIO, Display I/F, LP DDR

- Accelerators (e.g., GFX, Video Decode) – serve two purposes:
  - Enable functionality at low power (e.g., HD Video)
  - Reduce CPU C0 time – e.g., Offload: LP Audio Engine, Video
Active Power Management

- Enables long standby battery life needed for Smart Phones
  - Through low idle power

- Enables new usages
  - Always-On, Always-Connected
  - Low Power Playback

- Lowers active scenario power by shutting things off that are not pertinent in that mode
  - Switching off video decode block in web browsing
OS Power Management Overview

• Next generation OS Power Management solution for IA based MID designed to deliver the best possible power and performance for a given usage model on the platform

• Fine grained OS “Guided” Platform Power Management based on understanding of the platform usage modes
  – Driving the CPU to optimal possible C and P states
  – Driving individual platform components to their optimal power states

• Aggressively Manage platform idle and active power states based on platform usage policies by:
  – Fully utilizing all hardware power management functionality (clock and power gating)
  – Fully realizing the potential of platform power island

Enables best performance with minimum power
Mooresstown OS Power Management

OSPM is an event-driven engine to actively manage power modes.
OSPM - The Big Picture

- **Well defined Operating Modes**
  - Standby, Internet Browsing, MP3 Playback, Video Playback, Voice Call, Video Capture, etc.

- **OS-Directed Power Management**
  - OSPM Policy Manager for Mode Control

- **OS-Transparent sub-system control with Firmware & hardware**
  - Idle States: System(Sx), Device(Dx);
  - Micro-controller based PMUs in Lincroft and Langwell provide autonomous PM events control

- **Fine-grain Power Management**
  - Power Islands for Optimum power-down of sub-systems
  - Aggressive Power and Clock gating
  - Integrated Clocks and PMIC VR power down via MSIC
Lincroft SoC: Full ON vs. Power Gated

- Multiple Physical power Partitions
- Distributed power gating
- Active Island power management via SW interface
- Power Manager responsible to sequence powering on and off

Aggressive Distributed Power Gating enables up to 50x reduction in idle power*
Range of Usage Models
At Dramatically Low Platform Power

Standby: Assuming S0i3, 38mW with S0i1

MRST Projection: Workloads were emulated on McCaslin (GreenCanyon CRB-XP-600MHz-DTN-512MB memory-32GBSSD) and cross checked on some data points with Menlow (Crownbeach CRB, SLT-1GHz, 512MB memory, 32GB SSD). CPU, Memory and CS power data was analyzed with C-state, P-state residencies, Memory Bandwidth and power data points were studied and scaled where appropriate to MRST architecture. Assuming Native MIPI display and LPDDR1 memory (32b, 400MTs)
Moorestown Core Size Reduction

McCaslin

- Core Area: Estimates ~4500-5000 mm²
- Screen size: 5.0”+
  Volumetric: 562cc

Menlow

- Core Area: ~4000 mm²
  (40x50mm, double sided)
  Includes: Silverthorne, Poulsbo, IMVP, DDR2, EC, CK540, RTC battery, crystals
- Screen size: 4.8”+
  Volumetric: 266cc

Mooresetown

- Core Area
  2X Size Reduction
- Screen size: 4”+
  Volumetric: 2x reduction
Integrate Jelly Beans to Reduce Size & Power

- Embedded Controller (H8 DF2117VBG20V, 13mm x 13mm, BGA, Power ~120mW) – assume NOR is part EC
- Camera (USB Chip) (ST micro, Sensor + DSP w/USB interface, 7mm x 8mm, Pwr~400mW, 2M Pixel camera) X 2
- USB OTG (Philips ISP1760, 20mm x 14mm, Power ~300mW)
- NAND (SSD) PATA Controller (~4mm x 7mm, Power 50-80mW)
- TPM (6mm x 6mm – 6.1mm x 9.7mm,, Power 85mw)
- Clock chip (8mm x 8mm to 10mm x 10mm, Power 170-350mw)

Capabilities integrated in Langwell and Briertown
Briertown – Mixed Signal Integrated Circuit

- Integrates power delivery, battery charger and jelly beans
  - Audio codecs, intelligent battery charger, touch screen controller, analog and current sensors, LDOs, DC-DC, GPIOs,

- Enables power gating solution – multiple voltages rails to Lincroft and Langwell switched under OS control

- Enables fast ramp with burst mode – delivering performance on demand

- Enables faster transitions in and out of power states that allows more frequent and longer residency in power saving states
MID and Smartphone Software

• Deliver base Moblin OS, drivers, middleware tuned for Mobility, tools, Intel developer eco-system and access to experts

• Enable OEM/ODM software adaptation for apps and services to take advantage of platform capabilities & perf., tuned for power

• Perform power and performance tuning part of development methodology and validation

• Intel provides significant support for Open Source and collaborate in development for Open Source projects

Significant software resources to support software development for MIDs and Smartphones
Base: Moblin and Drivers

- Intel Software Adaptation is based on subset of Moblin
- Moblin is a project under the Linux* Foundation
- Versatile stack that targets multiple form-factors and segments
- Moblin team includes many of THE industry experts

Software adaptation is based on Moblin
Summary

- Drove power performance optimization with Si repartitioning
- Drove innovation to dramatically reduce idle and active power
  - Active power management – power gating at logical units
  - Use of Accelerators and off load engines
  - Use of Handheld IO
  - Fast power ramp – enables longer low power residency
- Shrank platform size with integration on Langwell & Briertown
- Enabled new functionality
  - Always-on, Always-connected, Video Encode, SSD, LP Audio
- Delivering power performance optimized customizable stack

Moorestown enables Intel Architecture compatible
Next Generation Mobile Computer with Voice capability
Additional sources of information on this topic:

**MID Sessions:**
- **MIDQ001** Meet the Experts: Intel’s Next Generation MID and Smartphone Platform
- **MIDS001** Developing Games for Intel-based MIDs and Smartphones
- **MIDS002** Designing a Compelling User Experience for Moblin-based MIDs and Smartphones
- **MIDS003** Open Microphone for Next Generation MID and Smartphone Ecosystem Solutions
- **MIDS004** Deliver Compelling Entertainment on Intel-based MIDs and Smartphones
- **MIDS005** Stay Always Connected: Wireless Technologies and Solutions for Intel-based MIDs and Smartphones
- **MIDS006** Designing Highly Secure Intel-based MID and Smartphone Platforms

**Moblin sessions:**
- **MOBS001** Understanding Moblin and the Key Benefits
- **MOBS002** Moblin Technical Overview
- **MOBS003** Developing Moblin Applications
- **MOBS004** System and Application Performance Tuning for Devices Powered by the Intel® Atom™ Processor

*Come see the Moblin Community in the Technical Showcase*
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The gross margin percentage could vary significantly from expectations based on changes in revenue levels; capacity utilization; start-up costs, including costs associated with the new 32nm process technology; variations in inventory valuation, including variations related to the timing of qualifying products for sale; excess or obsolete inventory; product mix and pricing; manufacturing yields; changes in unit costs; impairments of long-lived assets, including manufacturing, assembly/test and intangible assets; and the timing and execution of the manufacturing ramp and associated costs. Expenses, particularly certain marketing and compensation expenses, as well as restructuring and asset impairment charges, vary depending on the level of demand for Intel's products and the level of revenue and profits. 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