Tunnel Creek: Intel’s First Generation Intel® Atom™ Processor-based System-on-Chip for Embedded

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Pranav Mehta, Senior Principal Engineer & CTO, ECG

Technology Insight SPCS002
Agenda

• Tunnel Creek Architecture Overview
  – Platform Partitioning Flexibility
  – Platform BOM Reduction
  – Performance Density

• Tunnel Creek Application Case Studies
  – Industrial Automation
  – IP Media Phone
  – Electronic Cash Register
  – In-Vehicle Infotainment

• Summary
The Embedded Internet by 2015

Internet 7 X 24
Every Modality of Life

15B Devices

Ubiquitous

Invisible

Many

Researchers

Mainframes

Servers, PC’s

Cell Phones

Embedded
Intel® ATOM™ Processor: FUELING THE BUILD OUT

Digital Blackjack Table
Pachinko Machine
Vending Machine
Carwash Kiosk
Subway Ticket Station
Biometrics Finger Print Reader
Point of Sale
Digital Weight Scale
ATM
Hotel Concierge System
Handheld Barcode Reader
Handheld Wireless Spectrum Tester
Handheld Ultrasound
Hospital Bedside Terminal
Voting Machine
Lottery Machine
Network Security Appliance
VoIP PBX
Test and Measurement Appliance
Education Terminal
Communications Gateway
Programmable Logic Controller
Computer Numeric Controllers
Industrial HMI Panel
Industrial PC
Avionics System
Wearable PC
Connected Soldier Device
Military Soldier Training Device

>2,900 Design Engagements
Enabling the Next 1,000 Embedded Customers

• Customers Need:
  – Reduced Cost on Bill of Materials
  – Increased Control of System Source code
  – Reduced Vendor Complexity
  – Reduced Boot Times
  – Reduced Foot Print
  – >Perf/Watt/Inch
3 Cornerstones of Innovation for Tunnel Creek

Platform Flexibility

Reduced Bill of Materials

Performance Density

Tunnel Creek: Intel® Atom™ Processor-based System-on-Chip for Embedded
3 Cornerstones of Innovation for Tunnel Creek

- Platform Flexibility
- Reduced Bill of Materials
- Performance Density
Re-Partitioning for Flexibility

2008 Menlow Platform

Intel® "CPU"
Processor Core
FSB
SCH
Display Controller
Graphics & Video
Memory Controller
USB
Audio
SDIO
PATA
PCIe*

2010 Queens Bay Platform

Processor Core
PCIE
IOH
SDIO
SATA
PCIe
USB
GbE

Tunnel Creek: Intel® Atom™ Processor-based System-on-Chip for Embedded
Queens Bay Platform = The software, OS, boards & chipset that work with Tunnel Creek
PCIe = PCI Express* Technology
Menlow = platform with Intel® Atom™ processor Z510/530
Launching in Q4, 2010
Queens Bay Platform
Unleashing Innovation for Optimization

Tunnel Creek
Processor Core
Display Controller
Audio
SPI/LPC
Graphics & Video
Memory Controller
PCI Express* 4 x1

Target Segment
- Segment requiring standard, minimal I/O’s e.g. IP Camera
- Customer with existing proprietary ASICs e.g. Print Imaging, PLC
- Segments with diverse I/O requirements e.g. Industrial Automation
- High volume segments with uniform I/O e.g. IVI, Media Phone, Premise Service Gateway

Proprietary ASIC
FPGA
I/O Hub (IOH)

Flexibility -> Scalable and Optimized Solutions

PCIe = PCI Express* Technology
Tunnel Creek: Intel® Atom™ Processor-based System-on-Chip for Embedded
Queens Bay Platform = The software, OS, boards & chipset that work with Tunnel Creek
Queens Bay Platform Choice of IOH

Tunnel Creek: Intel® Atom™ Processor-based System-on-Chip for Embedded
Queens Bay Platform = The software, OS, boards & chipset that work with Tunnel Creek
3 Cornerstones of Innovation for Tunnel Creek

Platform Flexibility

Reduced Bill of Materials

Performance Density
Hardware BOM Benefits of Flexibility

- Intel® Atom™ Processor-based System-on-Chip for Embedded
  - Tunnel Creek: Intel® Atom™ Processor-based System-on-Chip for Embedded
    - e.g., 2008 IVI platform
    - e.g. 2010 IVI platform
## Software BOM: A Spectrum of Options

<table>
<thead>
<tr>
<th>Solution</th>
<th>Custom BIOS</th>
<th>Standard BIOS</th>
<th>Boot Loader Development Kit</th>
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<tbody>
<tr>
<td>Project Name</td>
<td>-</td>
<td>-</td>
<td>Trinity Lake</td>
</tr>
<tr>
<td>Rating</td>
<td>Best</td>
<td>Better</td>
<td>Good</td>
</tr>
<tr>
<td>Features</td>
<td>Advanced Features</td>
<td>All PC features</td>
<td>CPU, Memory, Basic I/O initialization</td>
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<tr>
<td>OS</td>
<td>Off the Shelf OS, Windows * OS, RTOS, Custom OS</td>
<td>Off the Shelf OS, Windows OS</td>
<td>RTOS, Custom OS and Embedded OS</td>
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<tr>
<td>Availability</td>
<td>Ready for Silicon Launch</td>
<td>Ready for Silicon Launch</td>
<td>Likely after Silicon Launch</td>
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<tr>
<td>Completeness</td>
<td>Fine tuning, unique features &amp; boot times</td>
<td>Turnkey Solutions, Reliable schedules</td>
<td>Some Assembly Required</td>
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<tr>
<td>Cost</td>
<td>Highest</td>
<td>Middle</td>
<td>Lowest</td>
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</table>

Trinity Lake: Boot Loader Development Kit for Intel® Atom™ Processor based platforms in Embedded
Software BOM: A Spectrum of Options

Intel is actively enabling the Embedded Eco-System
3 Cornerstones of Innovation for Tunnel Creek

- Platform Flexibility
- Reduced Bill of Materials
- Performance Density
Tunnel Creek
Improved Graphics Performance

3D Mark'06 relative score

- Intel® Atom™ Processor Z5xx
- Tunnel Creek

Menlow-XL package size (CPU: 22x22 + SCH: 37.5x37.5) = 1890mm²
Tunnel Creek+Topcliff package size (CPU: 22x22 + IOH: 23x23) = 1013mm²
46% smaller but 50% better graphics performance
Or 2.7x performance density improvement

Tunnel Creek: Intel® Atom™ Processor-based System-on-Chip for Embedded
Menlow = platform with Intel® Atom™ processor Z510/530
Tunnel Creek
Improved Performance Density
Boot Performance with Splash

• Video BIOS normally scans for panel timings and device priority

• Intel® Embedded Graphics Driver v10.2 supplies Embedded Pre-OS Graphics (EPOG) Driver

• Optimized Pre-OS driver for LVDS splash screen support

• Performance*
  – RESET# to Display < 500 mS

• Available on Intel® Atom™ processors Z5xx series

*Time estimated from CPU RESET vector, beginning of system firmware execution on a customer reference board based on the Intel® Atom™ processor Z5xx series and the Intel® System Controller Hub-based platform.
Tunnel Creek Application Examples
Programmable Logic Controllers
1. Historically hardware centric (ASIC+MCU)
2. Shifting to software centric design on IA
3. Enables software scalability across PLCs
4. Delivers Faster Time to Market
5. Increased performance headroom
The IA Continuum of Computing
For Industrial Automation

One Software Code Base

Intel® Architecture
Tunnel Creek for IP Media Phones

News
Weather
Stock
Music
Photos
Video
Directory
+ 
IP Multimedia communication
Tunnel Creek for IP Media Phone
Lower Cost, Increased Capabilities

Menlow Today

- Scalable Solution
- Low Power
- Dual Independent Video Streams
- HW Accelerated De-Code
- Intel® Hyper-Threading Technology and HW virtualization (Intel® VT-x)
- Security Integrated in HW
- Intel® HD Audio 7 Channel, HW AEC

Queens Bay Adds

- HW Accelerated Encode
- 50% Boost in Graphics Performance
- Reduced BOM
- 45% Reduction in form factor*
- Integration of Acoustic Echo, Line Echo and Noise Cancellation

* Compared to Menlow XL
Tunnel Creek Opportunity for Smart Electronic Cash Registers (ECR)

- $1500: Smart & Adaptable ECR
- $1000: ECR
- $500: ECR

Closed | Architecture Flexibility | Open
Tunnel Creek for Smart Adaptable ECRs

Platform Flexibility:
- Business specific
- Modular apps
- Multi-lingual capability or Localization

Reduced Bill of Materials:
- Integrated Peripherals
- MeeGo* & Trinity Lake Support

Performance Density:
- Internet capable
- Human-Machine Interface
- One-touch Interface

Tunnel Creek: Intel® Atom™ Processor-based System-on-Chip for Embedded
Trinity Lake: Boot Loader Development Kit for Intel® Atom™ Processor based platforms in Embedded
“Today we're thinking and behaving like a consumer-electronics company,”

Derrick Kuzak, Ford Motor Company
VP of Global Product Development

January 2010
Tunnel Creek for IVI

**Performance:**
- Advanced Usage Models
- Multimodal HMI
- ECU Consolidation
- Energy Efficient CPU
- Rich Internet Experience

**Automotive Capable:**
- Extended Temp (-40C - +85C)
- Embedded Lifetime (~7 - 10 yrs)
- Auto Spec
  (Grade 3-AEC-Q100 Rev F)
- Auto OS Support
  (Microsoft, QNX, MeeGo*)
- Lower DPM

**Rich Ecosystem:**
- Hardware and Software
- Compatibility and Re-use
- PC and Consumer
- Electronics Ecosystem

Tunnel Creek: Intel® Atom™ Processor-based System-on-Chip for Embedded
Tunnel Creek for IVI
In-Vehicle Infotainment Compute Module (ICM)

• 230 Pin MXM2 connector

• Defined Pin functions for 230 Pin
  – Includes numerous common automotive functions in addition to common CE functions

• 106mm x 85mm, and 85mm x 85mm versions

• Edge connector tested at Automotive conditions

• Easy migration to next generation
  – Pin functions service both Tunnel Creek + IOH & Next Gen Atom + IOH design migration without carrier board change

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<td>Customer Presentation/technical overview</td>
<td>NOW</td>
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<tr>
<td>Detailed Specifications/Q&amp;R material</td>
<td>March</td>
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<tr>
<td>Millville Development Systems</td>
<td>May</td>
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<td>Sample ICMs</td>
<td>May</td>
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<tr>
<td>ODM sample ICMs</td>
<td>September</td>
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<td>ICM development Kits (Crossville)</td>
<td>Q4 ‘10</td>
</tr>
<tr>
<td>ODM Production</td>
<td>Q4 ‘10 onward</td>
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</table>
Tunnel Creek based ICM Block Diagram

230 pin Finger Edge
ICM scales top to bottom and for multiple generations

Gen 1
Menlow Based ICM

- High End
  3D Navigation
  Multi-display Entertainment

- Mid-range
  Navigation
  Optional Single Display Entertainment

- Entry
  Media Connectivity

Gen 2
Tunnel Creek Based ICM

- High End
  3D Navigation
  Multi-display Entertainment

- Mid-range
  Navigation
  Optional Single Display Entertainment

- Entry
  Media Connectivity

ICM will have different CPU speed, memory and other population/depopulation options
ICM230
Go To Market Options

**ODM Enabling**
Design, Development, tooling, processes to produce ICM for Tier1 Customers

- An ODM fully enabled, and ready to Bid volume automotive business with Tier1’s

**ICM Licensing**
Intel licensing of design, gerbers to enable Tier1’s to choose their manufacturing channel

- Allows Tier 1 to choose and enable their own ODM or manufacturer and/or take advantage of automotive techniques

**ICM Specification**
Pin-out, connector, form factor etc.

- Allows room for Tier1 to choose exact cost points while maintaining pin out compatibility or carrier board interoperability
Summary

Tunnel Creek delivers
1st Generation Intel® Atom™ processor Based SoC for Embedded

Tunnel Creek unlocks a new generation of innovation for Intel Atom processor in Embedded through:

- I/O Flexibility
- Bill of Materials Reduction
- Performance Density

Tunnel Creek SoC architecture poised to enable next 1,000 designs on IA
For Additional Information on Intel in Embedded Computing

Intel Embedded Design Center
http://edc.intel.com
Intel Embedded at IDF 2010:
http://edc.intel.com/Events/IDF2010/

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