# Embedded Market Solutions

Presenter: CP Ong
Title: Technical Marketing Manager/EIA
Intel Infrastructure Processor Division (IPD)
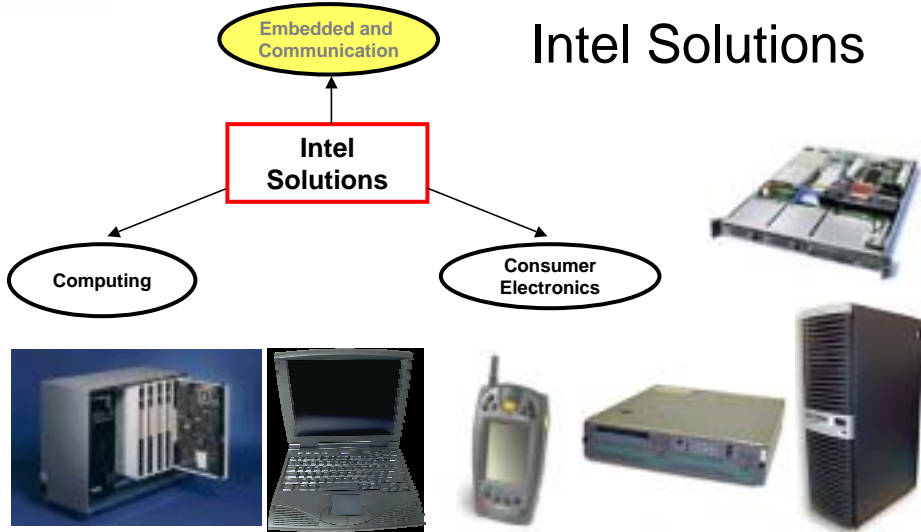
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# Agenda

- Intel in the Embedded and Communication Market
- Intel Processors and Usage Model Examples
- Industry Enabling, Standards and Embedded Software Solutions
  - Technology Transitions
  - Advanced Mezzanine Card
  - PICMG 1.3 Form Factor
  - Embedded Software Building Blocks
  - Intel® Embedded Graphics Drivers
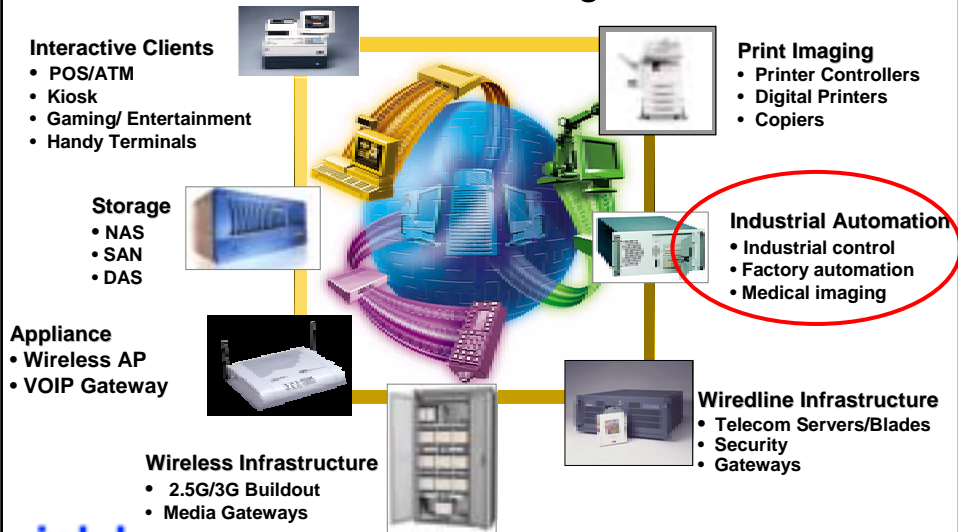- Key Messages

**Intel Offers Solutions for Embedded Market**

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# Intel Solutions

**Embedded and Communication**

**Intel Solutions**

**Computing**

**Consumer Electronics**

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# Embedded Market Segmentation

**Interactive Clients**
- POS/ATM
- Kiosk
- Gaming/ Entertainment
- Handy Terminals

**Print Imaging**
- Printer Controllers
- Digital Printers
- Copiers

**Storage**
- NAS
- SAN
- DAS

**Industrial Automation**
- Industrial control
- Factory automation
- Medical imaging

**Appliance**
- Wireless AP
- VOIP Gateway

**Wiredline Infrastructure**
- Telecom Servers/Blades
- Security
- Gateways

**Wireless Infrastructure**
- 2.5G/3G Buildout
- Media Gateways

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# Sample List of Embedded Applications

- **Industrial Controls & Automation**
  - Industrial PC's
  - Intelligent Remote Controls
  - Machine Vision
  - Building Controls
  - Human Machine Interface
- **Test and Measurement**
  - Ruggedized Laptops
  - Manufacturing Testers
  - Wastewater Utility Monitors
  - Earthquake monitors
  - Fish Finders
  - Electron Microscopes
- **Transportation**
  - Ticketing systems
  - Air Traffic Control systems
  - Toll booth Digital Video Recorders
  - Ticket dispensing
  - Inventory Mgmt

- **Military/Aerospace**
  - Simulation training equipment
  - Ruggedized Hand Held
  - Security Systems
  - GPS
- **Medical**
  - Data Acquisition and analysis
  - CT Scanner
  - Ultrasound Workstations
  - Patient Monitoring
- **Interactive Clients**
  - Point of Sales
  - Voting Machines
  - Gaming
  - RFID Readers
- **Communications**
  - Switches/routers
  - Wired/Wireless Access Points
- **Storage**
  - Storage Array Networks
  - Network Attached Storage

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# Intel Processors in Communications

**Transport & Packet Processing Platforms**  **Application Platforms**

| Metro / Core Switch | Edge / Enterprise Switch | Network Servers | App/ Web Servers |

**Standards Based Building Blocks**

**Intel® Internet Exchange Architecture (IXA)**

**Intel® Architecture (IA)**

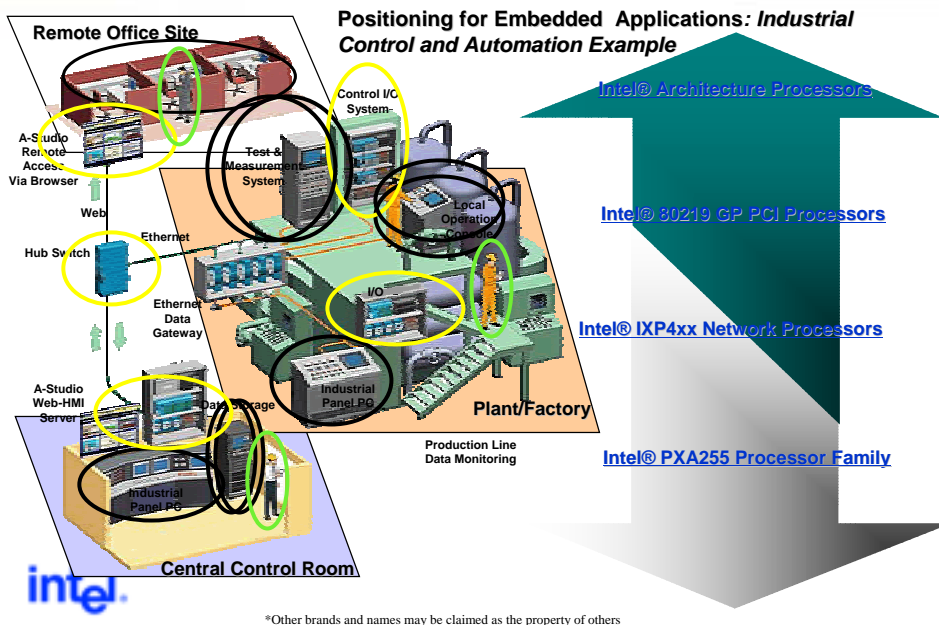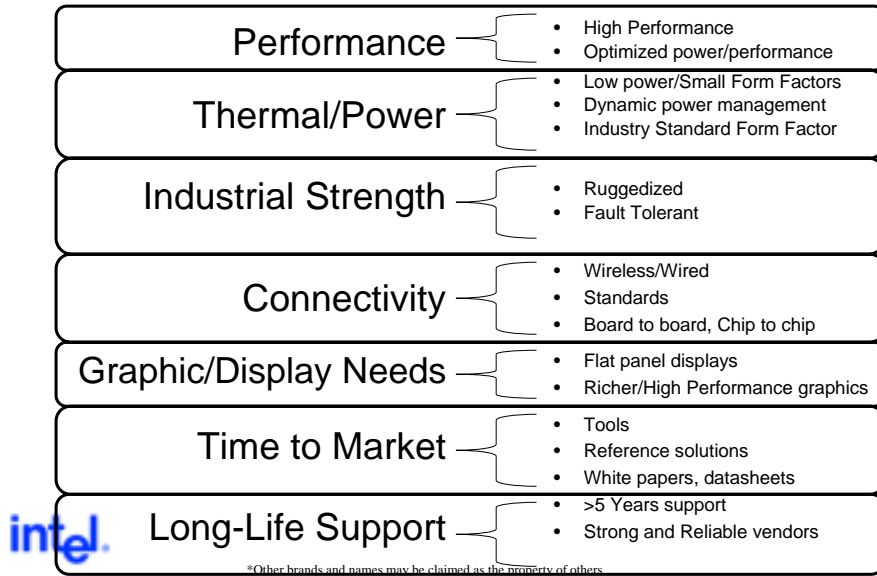**Network processing**   **Control processing**   **Services  Processing**

**Optical Building Blocks**

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## Embedded Market Considerations

**Performance**
- High Performance
- Optimized power/performance

**Thermal/Power**
- Low power/Small Form Factors
- Dynamic power management
- Industry Standard Form Factor

**Industrial Strength**
- Ruggedized
- Fault Tolerant

**Connectivity**
- Wireless/Wired
- Standards
- Board to board, Chip to chip

**Graphic/Display Needs**
- Flat panel displays
- Richer/High Performance graphics

**Time to Market**
- Tools
- Reference solutions
- White papers, datasheets

**Long-Life Support**
- >5 Years support
- Strong and Reliable vendors

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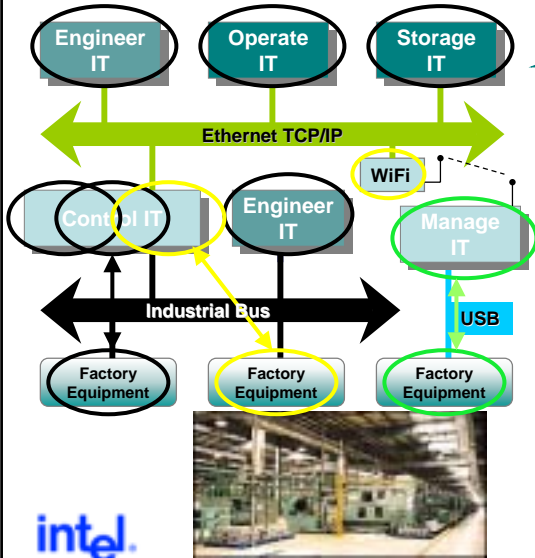
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**Positioning for Embedded Applications: Industrial Control and Automation Example**

Remote Office Site

A-Studio Remote Access Via Browser

Web

Hub Switch

Ethernet

Control I/O System

Test & Measurements System

Local Operation Console

I/O

Ethernet Data Gateway

A-Studio Web-HMI Server

Data Storage

Industrial Panel PC

Plant/Factory

Production Line Data Monitoring

Industrial Panel PC

**Central Control Room**

Intel® Architecture Processors

Intel® 80219 GP PCI Processors

Intel® IXP4xx Network Processors

Intel® PXA255 Processor Family

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**Positioning for Embedded Applications*: Industrial Control and Automation Example*

Engineer IT | Operate IT | Storage IT

Ethernet TCP/IP

WiFi

Control IT | Engineer IT | Manage IT

Industrial Bus

USB

Factory Equipment | Factory Equipment | Factory Equipment

**Intel® Architecture Processors**
**Compute-intensive applications**
- Industrial pcs
- Ruggedized laptops
- Single board computers

**Intel® 80219 GP PCI Processor**
**Storage and CompactPCI* solutions for**
- Intelligent shelf management
- Data acquisition and analysis
- System data storage

**Intel® IXP4xx Network Processors**
**Connects factory bus/equipment to enable**
- Industrial bus to Ethernet communication
- Factory equipment control

**Intel® PXA255 Processor Family**
**Portable handheld devices providing**
- Warehouse inventory
- Portable data acquisition
- Real-time equipment diagnostics

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*Intel XScale® Technology for Embedded:*  Processor Matrix

| PCI Processors | Network Processors | PXA Processor |
|---|---|---|
| • 80219 GP | • IXP420, IXP421, IXP422, IXP425 | • PXA255 |
| • 80331 (IOP331) | | Bulverde** |
| • Chevelon** | • Azusa** | |

*Intel® Architecture for Embedded:*

| High End | Mid-Range | Low Power |
|---|---|---|
| • Intel® Xeon™ | • Intel® Pentium® 4 | • Intel® Pentium® M |
| • Intel® LV Xeon™ | • Intel® Celeron® | • Intel® Celeron® M |
| | • Intel® Celeron® D | |
| **E7501 based today E7520 now** | **845GV based today 915GV now** | **855GME based today 915GM Q1'05** |

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**Product code names are subject to change without notification.
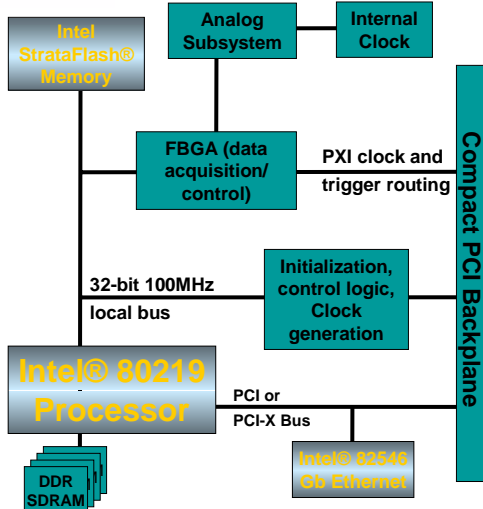*Other brands and names may be claimed as the property of others

# Usage Models
## *Industrial Control and Automation Example*

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## Intel® 80219 Processor in cPCI Data Acquisition

Intel StrataFlash® Memory

Analog Subsystem

Internal Clock

FBGA (data acquisition/ control)

PXI clock and trigger routing

Compact PCI Backplane

32-bit 100MHz local bus

Initialization, control logic, Clock generation

Intel® 80219 Processor

PCI or PCI-X Bus

DDR SDRAM

Intel® 82546 Gb Ethernet

**GP PCI Processor**
- Intel XScale® core
  - 400 or 600 MHz
- 32/64-bit PCI/PCI-X interconnect
- DDR SDRAM Controller w/ECC
  - 200 MHz
- 32-bit local bus (programmable)
  - 33, 66 or 100 MHz
- Optional GbE network connect
  - via PCI bus
- Offloads system host processor
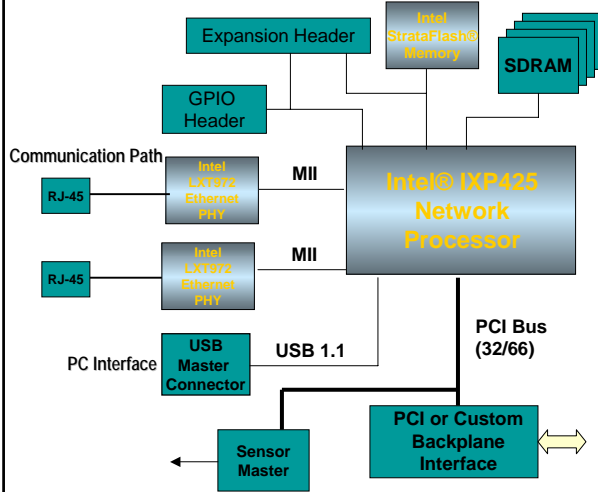- Extended hot temperature (+85°C)

**OS support:**
- ATI* Nucleas*
- GreenHill* Integrity*
- LinuxWork* BlueCat Linux*
- Wasabi* NetBSD*
- Windriver* VxWorks*
- OS support also planned for Win CE*, QNX*

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## Industrial Control Ethernet Line Card
### *Using Intel® IXP425 Network Processor*

Expansion Header

Intel StrataFlash® Memory

SDRAM

GPIO Header

Communication Path

RJ-45 — Intel LXT972 Ethernet PHY — **MII**

Intel® IXP425 Network Processor

RJ-45 — Intel LXT972 Ethernet PHY — **MII**

PC Interface — USB Master Connector — **USB 1.1**

**PCI Bus (32/66)**

Sensor Master

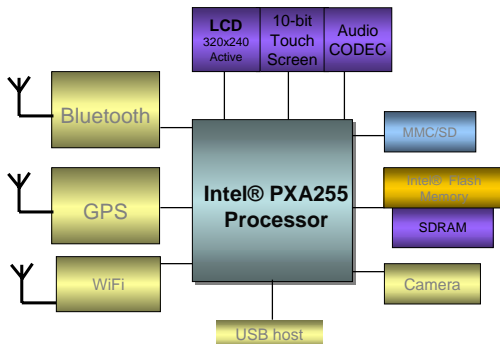PCI or Custom Backplane Interface

**Network Processor**

- **Highly integrated system on chip solution**
  - **Intel XScale® core**
    - **266/400/533 MHz**
  - **Rich Peripherals**
    - *Wire speed* **Ethernet**
    - **Network Processor Engines**
    - **PCI, USB, HSS ports**
    - **Timers, Counters, DMA, UART**
    - **SDRAM controller, GPIO**
    - **Expansion Bus**
    - **Interrupt controller**
- **Extended Temperature**
  - **-40°C to 85°C**
- **1.5W typical**
- **O/S Support**
  - **VxWorks\*, MV Linux\*, WinCE.net\*, QNX\*, ThreadX\*, Nucleus\***

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## Intel® PXA255 Processor Family in an Industrial Handheld Platform

LCD 320x240 Active

10-bit Touch Screen

Audio CODEC

Bluetooth

GPS

WiFi

Intel® PXA255 Processor

MMC/SD

Intel® Flash Memory

SDRAM

Camera

USB host

Processor

- Highly integrated solution for handheld devices
- 300/400MHz Intel Xscale® core
- Extended Temperature, -40°C to 85°C
- <500 mW typical

Wireless Connectivity

- WiFi
- Bluetooth
- GPS

Flexible I/O

- LCD display controller
- USB client, 3 UARTs,AC97 audio, IR ports
- SSP and Network SSP
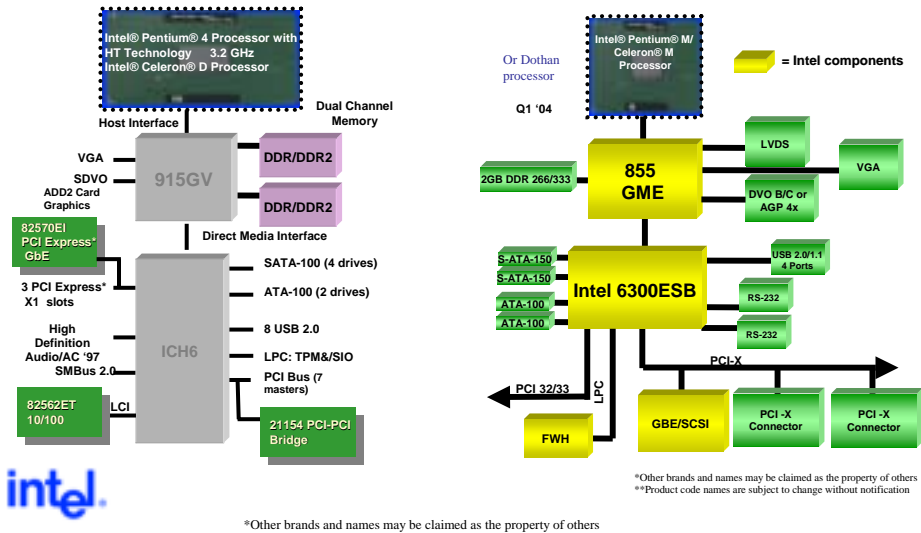- Flash/SDRAM and MMC controllers
- I2C controller

OS Compatibility
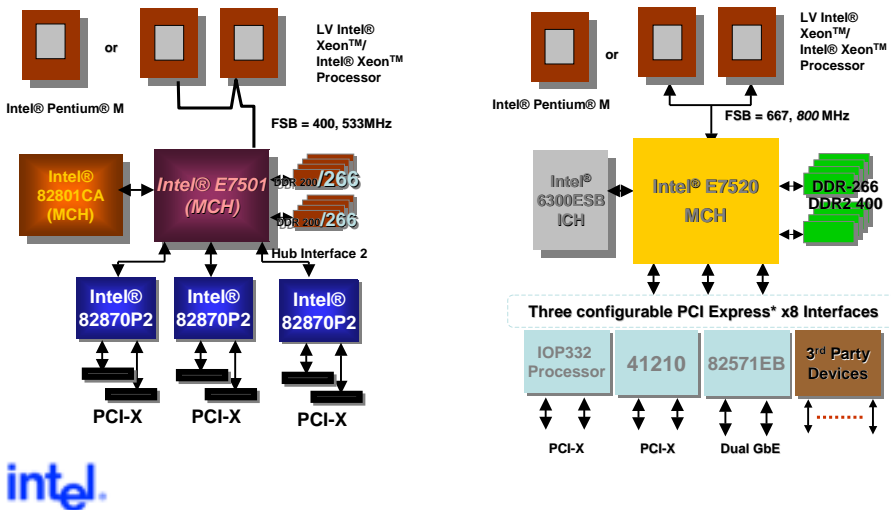
- WindowsCE\*, VxWorks\*, QNX\*, PalmOS\*, Linux\*

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**Scalable Performance for Flexible Industrial PC**

Intel® Pentium® 4 Processor with HT Technology 3.2 GHz
Intel® Celeron® D Processor

Host Interface

Dual Channel Memory

VGA
SDVO
ADD2 Card Graphics

**915GV**

DDR/DDR2
DDR/DDR2

82570EI PCI Express* GbE

Direct Media Interface

3 PCI Express* X1 slots

**ICH6**

SATA-100 (4 drives)
ATA-100 (2 drives)
8 USB 2.0
LPC: TPM&SIO
PCI Bus (7 masters)

High Definition Audio/AC '97
SMBus 2.0

82562ET 10/100

LCI

21154 PCI-PCI Bridge

Or Dothan processor
Q1 '04

Intel® Pentium® M/ Celeron® M Processor

= Intel components

2GB DDR 266/333

**855 GME**

LVDS
VGA
DVO B/C or AGP 4x

S-ATA-150
S-ATA-150
ATA-100
ATA-100

**Intel 6300ESB**

USB 2.0/1.1 4 Ports
RS-232
RS-232

PCI-X

PCI 32/33
LPC

FWH

GBE/SCSI
PCI -X Connector
PCI -X Connector

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**High Performance Platform for High-End Industrial PC**

Intel® Pentium® M

or

LV Intel® Xeon™/ Intel® Xeon™ Processor

FSB = 400, 533MHz

Intel® 82801CA (MCH)

**Intel® E7501 (MCH)**

DDR 200/266
DDR 200/266

Hub Interface 2

Intel® 82870P2
Intel® 82870P2
Intel® 82870P2

PCI-X
PCI-X
PCI-X

Intel® Pentium® M

or

LV Intel® Xeon™/ Intel® Xeon™ Processor

FSB = 667, 800 MHz

Intel® 6300ESB ICH

**Intel® E7520 MCH**

DDR-266
DDR2 400

Three configurable PCI Express* x8 Interfaces

IOP332 Processor
41210
82571EB
3rd Party Devices

PCI-X
PCI-X
Dual GbE

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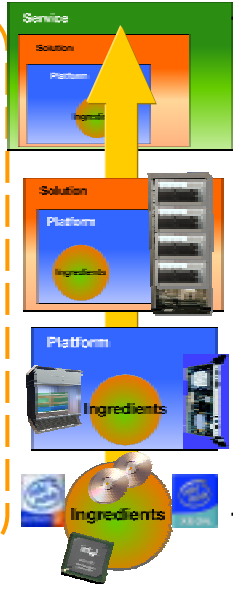
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# Next Generation Platform Features

| Performance ➡ | • Higher Frequencies<br>• Multiple Cores<br>• Dual / multi-ported MCU |
| **Power** ➡ | • Low Power<br>• Small Form Factor |
| **Industrial Strength** ➡ | • Long life support<br>• Hardened Linux |
| **Connectivity** ➡ | • PCI express<br>• Integrated Gb Ethernet controller |
| **Graphic/Display Needs** ➡ | • Next generation graphics<br>• DID, LVDS |
| **Time to Market** ➡ | • Reference designs<br>• Additional white papers |
| **Peripherals** ➡ | • SATA<br>• DDR2 SDRAM<br>• Serial Attached SCSI |

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# Industry Enabling, Standards and Embedded Software Solutions

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**Integration Services & Support**

**Application-ready Platforms**

**Systems & Software Middleware**

**Chassis & Boards Drivers**

**Silicon, Software & Tools**

Service
Solution
Platform
Ingredients

Solution
Platform
Ingredients

Platform
Ingredients

Ingredients

**Intel® Architecture Ecosystem and Intel® Platform Solutions**

**Intel Brings Embedded Faster TTM**

Intel Communications Alliance

A community of communications and embedded developers and solution providers

http://www.intel.com/design/network/ica/index.htm

**Intel cPCI* and AdvancedTCA* boards, SBCs**
**Intel® Embedded Graphics Driver**

**Intel® Compilers**
**Intel® VTune™ Performance Analyzers**

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## Technology Transitions: *All I/O Technologies Becoming Serial*

| | '97 | '98 | '99 | '00 | '01 | '02 | '03 | '04 | '05 |
|---|---|---|---|---|---|---|---|---|---|
| **External Desktop Interconnect** | Parallel Printer Port | | USB | | | USB 2.0 | | | |
| **Graphics** | PCI | AGP x2 | | AGP x4 | | | AGP x8 | | PCI Express* |
| **DT/Entry Server Drive Interconnect** | Parallel ATA | | | | | | Serial ATA | | |
| **Enterprise Server Drive Interconnect** | SCSI | | | Fibre Channel | | | | SAS | |
| **DAS** | SCSI | | | | | | | SAS | |
| **SAN** | | | Fibre Channel | | | | iSCSI | | |
| **Network** | 10/100 Ethernet | | | Gig Ethernet | | | | 10 Gig E | |
| **Datacenter Clusters** | Proprietary | | | | | | IBA | | 10 Gig E |
| **Local I/O** | PCI | | | PCI-X | | | | PCI Express | |

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Parallel
Serial

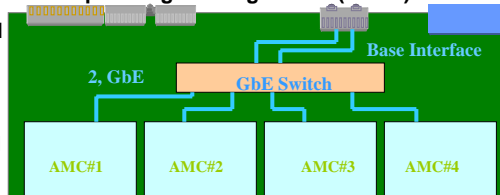*Other brands and names may be claimed as the property of others

# Embedded IA Roadmap (partial)

| | | 1H'04 | 2H'04 |
|---|---|---|---|
| **Performance** | Performance | Intel® Xeon™ Processor *Intel® E7501 chipset* | **Intel® Xeon™ Processor** *Intel® E7520/Intel® 6300ESB* |
| | Mid-Power | LV Intel® Xeon™ Processor *Intel® E7501 chipset* | **LV Intel® Xeon™** Processor *Intel® E7520/Intel® 6300ESB* |
| **Scalable** | Performance | **Intel® Pentium® 4 Processor with HT Technology** *Intel® 875P/Intel® 6300ESB Chipset* **Intel® Pentium® 4 Processor** *Intel® 852GME Chipset* | **Intel® Pentium® 4 Processor** *Intel® 915GV Chipset* |
| **Low Power** | Performance | Intel® Pentium® M Processor *Intel® 855GME / Intel® 6300ESB* | **Intel® Pentium® M Processor** *Intel® 915GM Chipset* |

## PCI Express* – On all Embedded IA Roadmap Segment

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# Advanced Mezzanine Card Summary

- What's an AMC?
  - A next generation mezzanine standard optimized for AdvancedTCA* and high-speed interconnects such as PCI Express* and Advanced Switching*
- What's it good for?
  - Design simplification
  - Reduced board complexity
  - Increased throughput
    - 21 duplex ports @ up to 12.5 Gbits/s each
    - Designed to also enable SPI-4.2
  - Increases high availability with IPMB and Hot Swap
  - Up to four Pentium-M PrAMCs per AdvancedTCA* Carrier
  - Modularity increases system density and improves TTM **(due to less baseboard redesign)**

**IA-PrAMC Mock-ups**

72 mm

~190 mm**
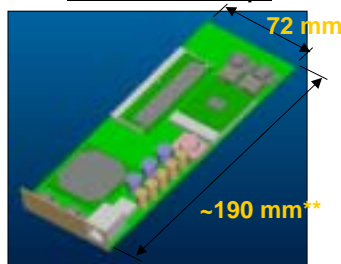
**Example Usage Configuration (ATCA)**

Base Interface

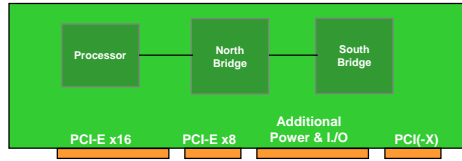2, GbE

GbE Switch

AMC#1   AMC#2   AMC#3   AMC#4

**Scalable performance, > 4500 SpecInt2000**

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# PICMG* 1.3 Specification

**Full-size PICMG 1.3 SBC**



- Form factor: 13.33 inches x 4.976 inches (maintain PICMG 1.2 form factor)
- Full-size PICMG 1.3 SBC should implement connector A, B, C & D
- Half-size PICMG 1.3 SBC should implement connector A & B Only

|  | Scalability | Other information |
|---|---|---|
| Connector A | One channel for 16x (max) PCI-E | At least 1x PCI-E implementation, may support 1x, 4x, 8x, or 16x |
| Connector B | One channel of 4x PCI-E and four channels of 1x PCI-E | At least 1x PCI-E implementation, may support 1x, 4x, 8x |
| Connector C | No PCI-E or PCI(-X) | Power distribution, SATA, USB, Ethernet and Geographic Addressing for IPMB |
| Connector D | One channel of 32-bit PCI(-X) bus. No PCI-E | Arbitration, clock distribution & reset function for all primary PCI(-X) expansion boards |

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# PICMG* 1.3 Passive Backplane
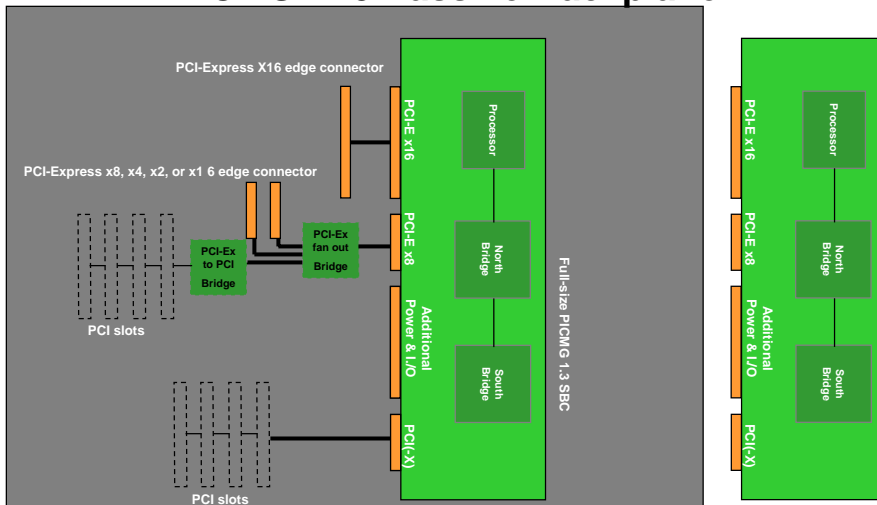


**Please visit www.picmg.com for more information**

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## Embedded Software Building Blocks

- How IPD Handles Drivers:-old days
- DPG/MPG Driver adopt: http://support.intel.com/support/chipsets/index.htm
  - Graphics, IDE, USB, AC97, LAN
  - Direct support for Windows* Drivers
  - Enable Linux* Drivers
  - Third Party support for VxWorks*, QNX*
- Limited Embedded Specific Support

- Going Forward
- Provide Optimized Drivers for Embedded Applications
- Intel® Embedded Graphics Drivers (Shingle Springs)
- Align with Embedded Processors/Chip Sets
- Embedded Specific Support/Modifications
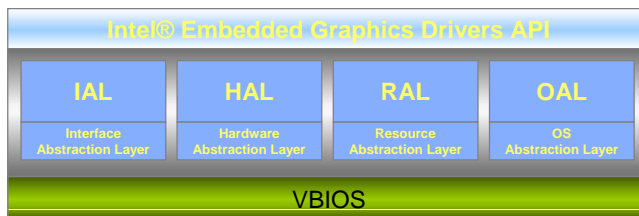
**Dedicated Website
for all EIA Drivers
http://developer.intel.com/
design/intarch/software/dri
ver/index.htm**

**Aligned to support all EIA Roadmap products**

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# Intel® Embedded Graphics Drivers



Intel® Embedded Graphics Drivers API

| IAL | HAL | RAL | OAL |
|---|---|---|---|
| Interface Abstraction Layer | Hardware Abstraction Layer | Resource Abstraction Layer | OS Abstraction Layer |

VBIOS

An embedded graphics customer needs:
- Configurability
- Modularity
- Extensibility
- Portability
- Flexibility

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# Key Messages

- Intel offers solutions for the Embedded market.
  - Processors from <300 mW to >3 GHz
  - Tools for quick TTM
  - Ecosystem solutions from components to services
  - New technologies & Initiatives including PCI Express*, Advanced Switching* and AdvancedTCA*
  - Intel® Embedded Graphics Drivers
- Contact your local representatives and distributors for assistance with your future embedded opportunities

**one generation ahead**
**Silicon. Standards. Solutions.**

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# Contact

- Ong Chuan Poh (EIA Technical Marketing Manager)
  - E-mail: chuan.poh.ong@intel.com
- James Liu (Product Marketing Manager)
  - E-mail: James.Liu@intel.com

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# Embedded Market Solutions

## Thank You!

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