



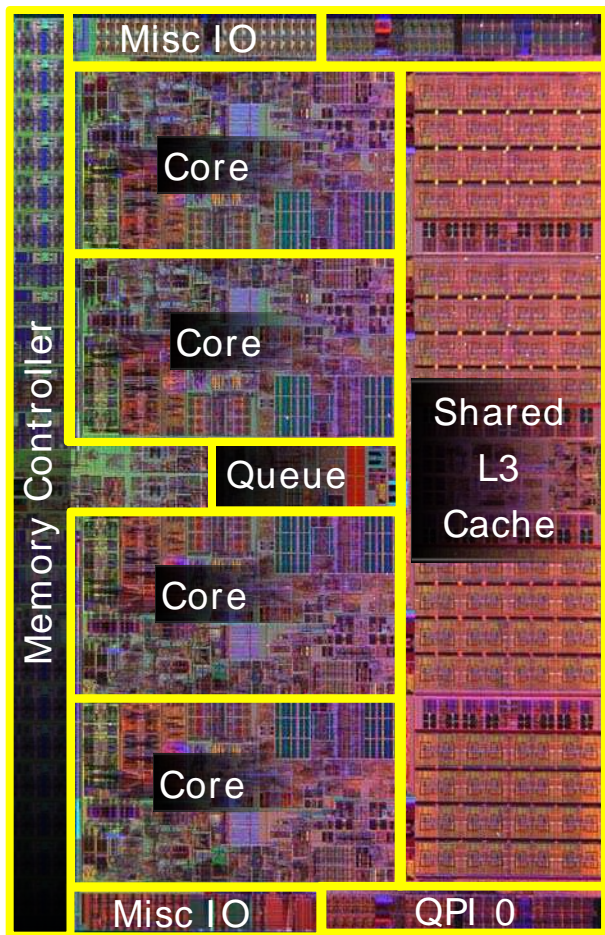
Transitioning the Intel® Next Generation Microarchitectures (Nehalem and Westmere) into the Mainstream

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Intel Corporation
Hot Chips 21
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Agenda

- Next Generation Mainstream CPU's
- New Technologies for Integration for 2009 and beyond

Intel® Core™ i7 Recap



QPI: Intel® QuickPath Interconnect (Intel® QPI)

- **Core microarchitecture**

- Increased parallelism
 - e.g. 33% larger out of order window, handle more cache misses simultaneously
- Enhanced algorithms
 - e.g. faster “unaligned” cache accesses, faster sync primitives, loop streaming detector, macro-fusion
- Better branch prediction
 - e.g. 2nd level branch predictor, renamed RSB
- New Instructions (SSE4)
- Intel® Hyper-Threading Technology

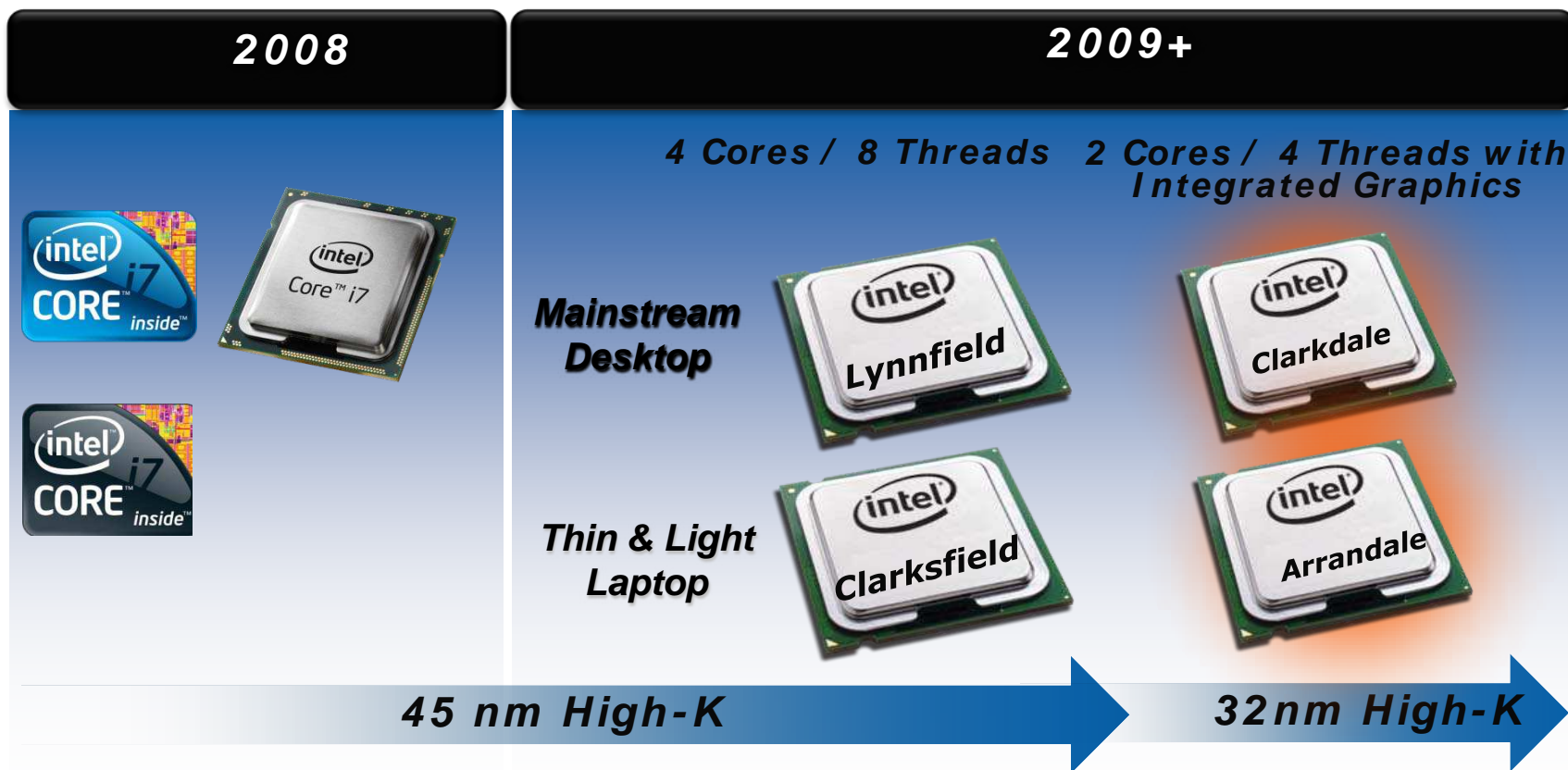
- **Uncore microarchitecture and connectivity**

- Scalable multi-core fabric
- Shared last level Cache
- Integrated memory controller
- Intel® QuickPath Interconnect

- **Power management technologies**

- PCU Microcontroller
- Intel® Turbo Boost Technology
- Integrated power gates

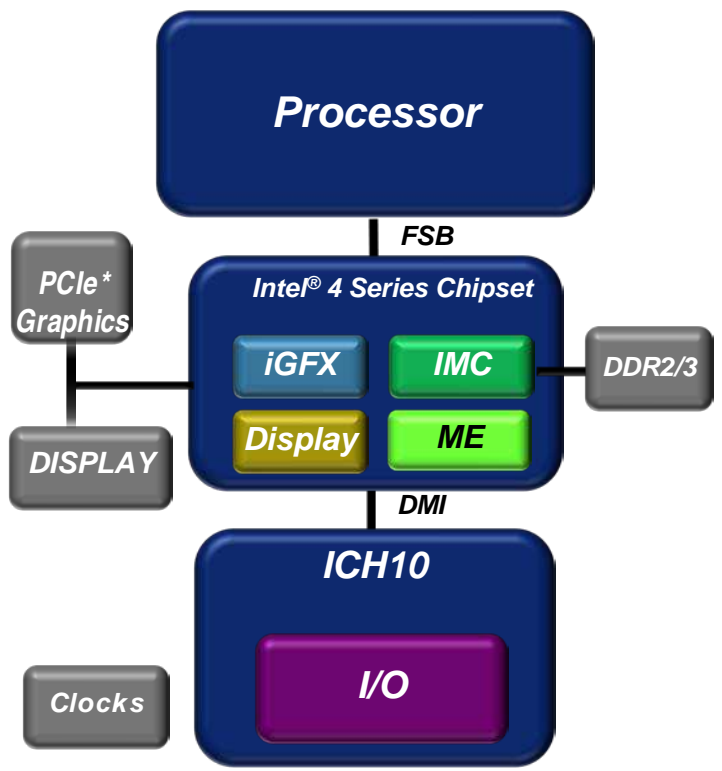
Enabling Nehalem for Every Segment



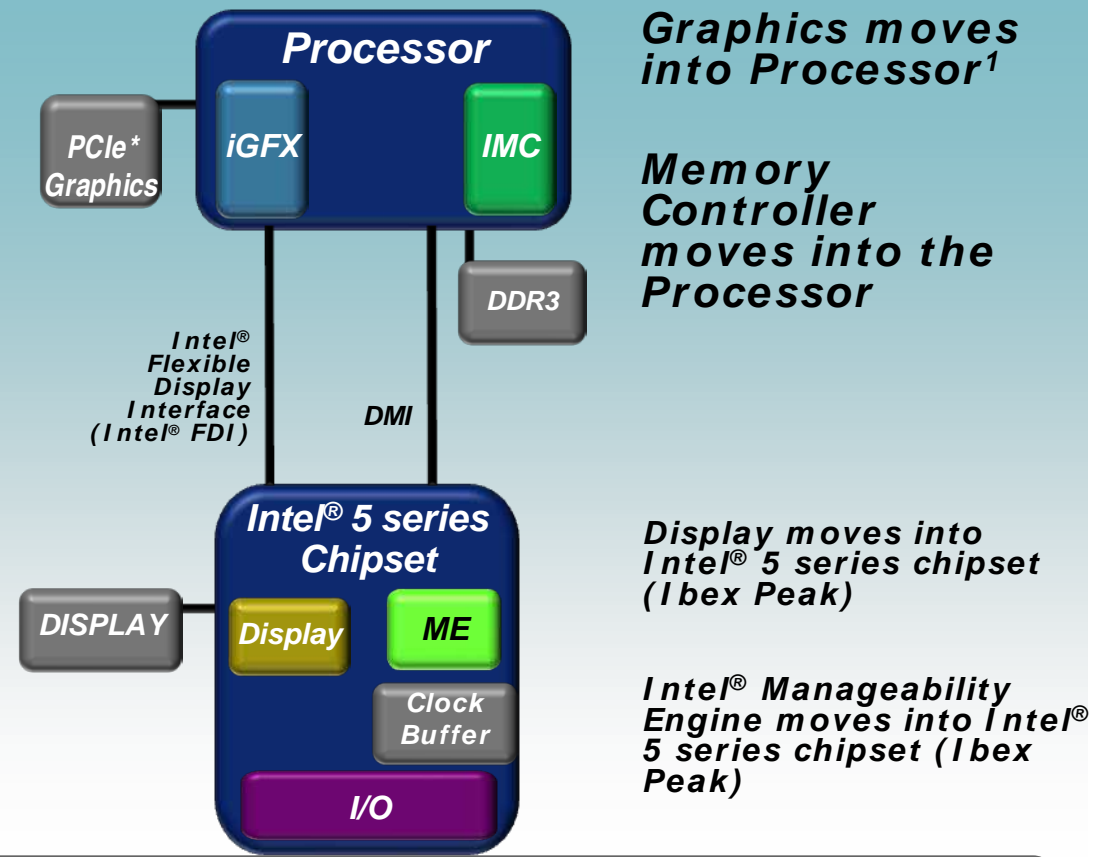
Delivering Outstanding Nehalem Performance to Mainstream Desktops and Laptop Computers

Mainstream Platform Partitioning

Intel® Core™2 Processor based 3-Chip Solution



Nehalem/ Westmere based 2-Chip Solution

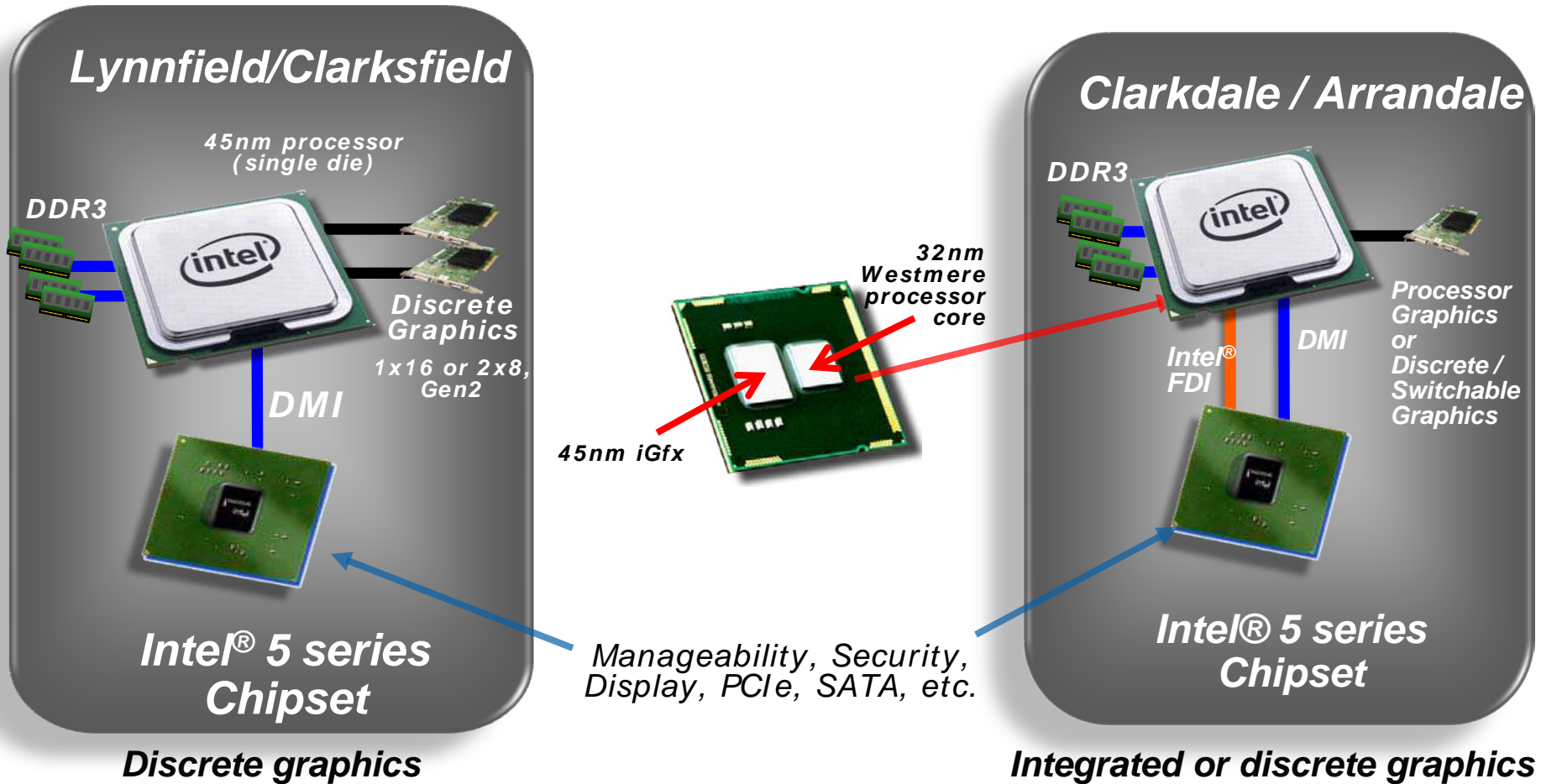


Greater Performance and Lower Power through Integration

- 1. Integrated graphics on Clarkdale/Arrandale
- 5 Intel® Microarchitecture codenamed Nehalem
Westmere: 32nm version of Intel® microarchitecture codename Nehalem



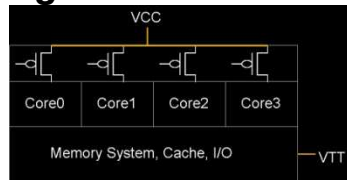
Mainstream Microprocessors



Agenda

- Next Generation Mainstream CPU's
- New Technologies for Integration for 2009 and beyond

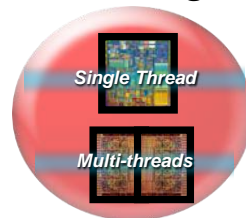
Integrated Power Gates



Intel® Turbo Boost Technology



Intel® Hyper-Threading Technology

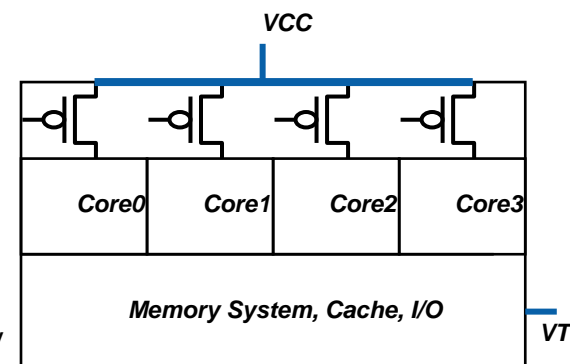


Energy Efficient performance



Integrated Power Gates

- Integrated Power Gates (switches) are critical for integration, turning individual component blocks on/off
 - Zero leakage power, low latency to wake block
 - Key benefits in both idle and active power
- Nehalem turns individual cores on/off
 - Transparent to OS
 - Reduces latency to wake a core
 - Modular/Scalable Clocking
 - Cores, Memory System, I/O can run at independent voltage/frequency
- Extended in 2009 platforms as Integrated Power Gates also used in shared cache and I/O logic to dynamically power down when inactive

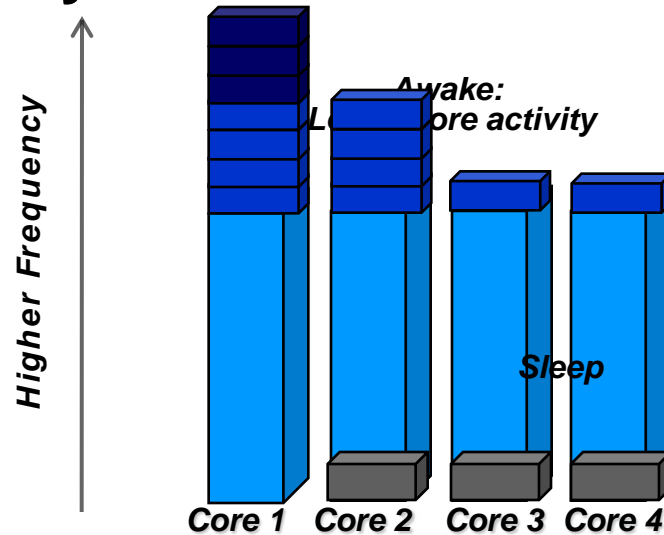


Integrated Power Gates enable Energy Efficient Integration

Intel® Turbo Boost Technology

- Integration splits power allocation among more component blocks
- Intel® Turbo Boost Technology is critical to dynamically manage power allocation and seamlessly maximize performance
 - Higher benefits in smaller form factors

Lynnfield/ Clarkfield

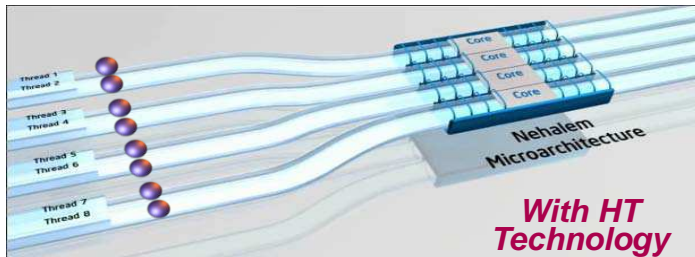


Dynamically Scaled Performance Boost



Intel® Hyper-Threading Technology

- Nehalem is a scalable multi-core architecture
- Hyper-Threading Technology augments benefits
 - Power-efficient way to boost performance in all form factors: higher multi-threaded performance, faster multi-tasking response



	Hyper-Threading		Multi-cores
	Shared or Partitioned	Replicated	Replicated
Register State		X	X
Return Stack		X	X
Reorder Buffer	X		X
Instruction TLB	X		X
Reservation Stations	X		X
Cache (L1, L2)	X		X
Data TLB	X		X
Execution Units	X		X

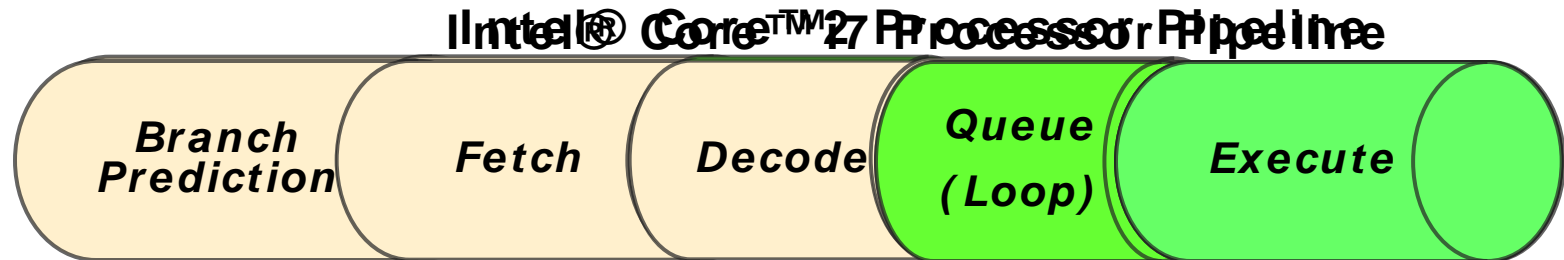
- Next generation Hyper-Threading Technology:
 - Low-latency pipeline architecture
 - Enhanced cache architecture
 - Higher memory bandwidth

**Enables 8-way processing in Quad Core systems,
4-way processing in Small Form Factors**

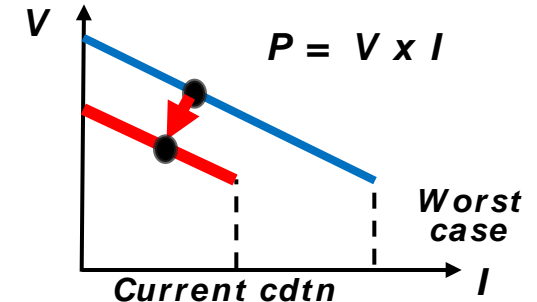


Energy Efficient Performance

- Many innovations in energy efficiency such as loop-streaming detector and dynamic loadline
- As looping is very common to every type of applications, Nehalem loop-streaming detector captures bigger loops and saves more energy



- Dynamic only loadline (PCU)
 - Power = Voltage x Current
 - In prior processors, voltage line is anchored based on worst case
 - Nehalem lowers Voltage based on current conditions: # active cores, temperature, and saves more energy.



Major Innovations in Energy Efficiency



Summary

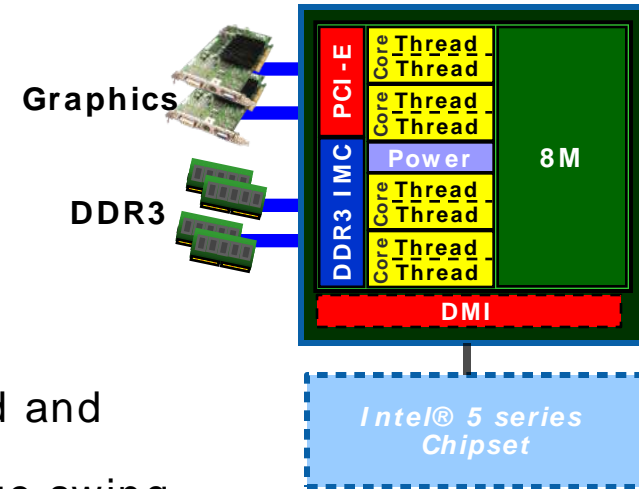
- **Intel maintains pace of innovation and execution**
 - Next generation performance
 - 32nm: Another Process Technology Breakthrough
- **Enabling Nehalem for every segment**
 - Delivering outstanding Nehalem performance to mainstream desktops and laptop computers
- **Redesigning more efficient platforms**
 - Best performance across all segments
 - Low power and better power management
 - Higher levels of integration

Q & A

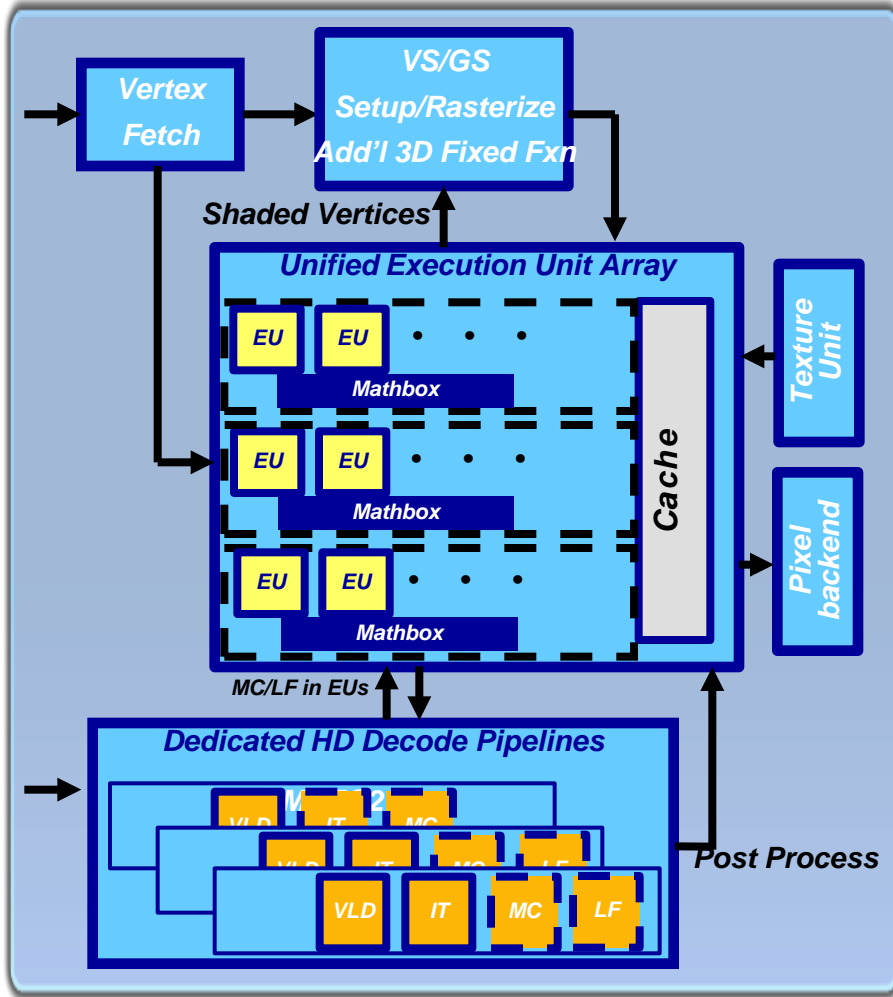
Backup

Lynnfield/ Clarkfield Microarchitecture

- Built on modularity of Intel® Core™ i7
- Further integration to support new mainstream platforms:
 - VTd and IO virtualization support
 - PCI Express* interface
 - x16 PCIe configurable to 2x8
 - 2.5 GT/s (Gen1) and 5 GT/s (Gen2)
 - Flexible interface: lane reversal, dynamic speed and link width changes, peer to peer posted writes
 - Power Optimization: L0s/L1 support, low-voltage swing mode and de-emphasis
 - x4 DMI Interface – Series 5 enhancements
 - Extended power management



Integrated Graphics and Media Architecture (Clarkdale, Arrandale)



- Unified Shader Architecture
 - Evolution of G965 & GM965
 - DX10 & Shader Model 4.0 in HW
 - Full HD Decode, High Quality Video
 - 6 threads/EU
 - Hierarchical Depth Buffer
- Dynamic load balanced
- Multi-functional; multi-threaded
- Enables scalability and flexibility
- Improved Extended Math, larger caches



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