

# Vendor Panel

SOS10 Workshop  
Mar. 9, 2006

**David Barkai, Ph.D.**

**HPC Computational Architect, Intel**



# Getting to 1 PFLOPS by 2009

- Peak PF? – earlier than 2009 ..
- In 2009 we may see sustained 1PF on some apps
- Hardware is the 'easy' part ..
  - Choice of nodes: thin, fat; choice of micro-arch.
  - Scale is challenging, but interconnect feasible
  - Stretch of power, cooling/thermal, floor/density – but doable
- Ecosystem – the bigger challenge
  - Scaling of applications requires software tools foundation
  - Variety of options via COTS and add-ons

Success = at scale beyond Linpack

# A Peak PF System in '07-'08

Consider 20K sockets packaged in 5K nodes

All commodity; Interconnect feasible

Price range and power/cooling with range of a few centers

App will need  $O(100K)$  threads – will the apps be there?

# Elegant Solution vs. Practical Tool

A little provocation: What is all this obsession with efficiency?

If you can have a level X of performance on your app, for \$Y in 6 months, which is 10% of peak

Or

A level of perf 2X for \$Y, in 3 years, at 50% of peak

Which will your users choose?

The small print: the earlier, less efficient, solution allows scaling – even if less efficiently..

In other words – how do we insert “time to scientists” into the cost equation?

# About HPC Market Size

## Trends?, do we care?, Role of HPC users?

### IDC Estimates HPC Market Grew 23 Percent In 2005

IDC's preliminary analysis indicates the high-performance and technical computing (HPTC) market grew about 23 percent in 2005 to reach a record \$9.1 billion in revenue. This is the third consecutive year of 20 percent-plus growth in this market. IDC's analysis is based on actual revenue for the first three quarters of 2005 and preliminary revenue estimates for the fourth quarter.

- IT had an explosive growth the last 10 years (or so)
- Seems that HPC grows faster now
  - (but we don't really care much about that ratio)
- The interesting trend (not yet quantified) is the increasing pace at which new technologies flow from HPC to mainstream Enterprise computing
  - Clusters, Grid, parallel file systems, Open source software, ...

# Who and What is the Competition

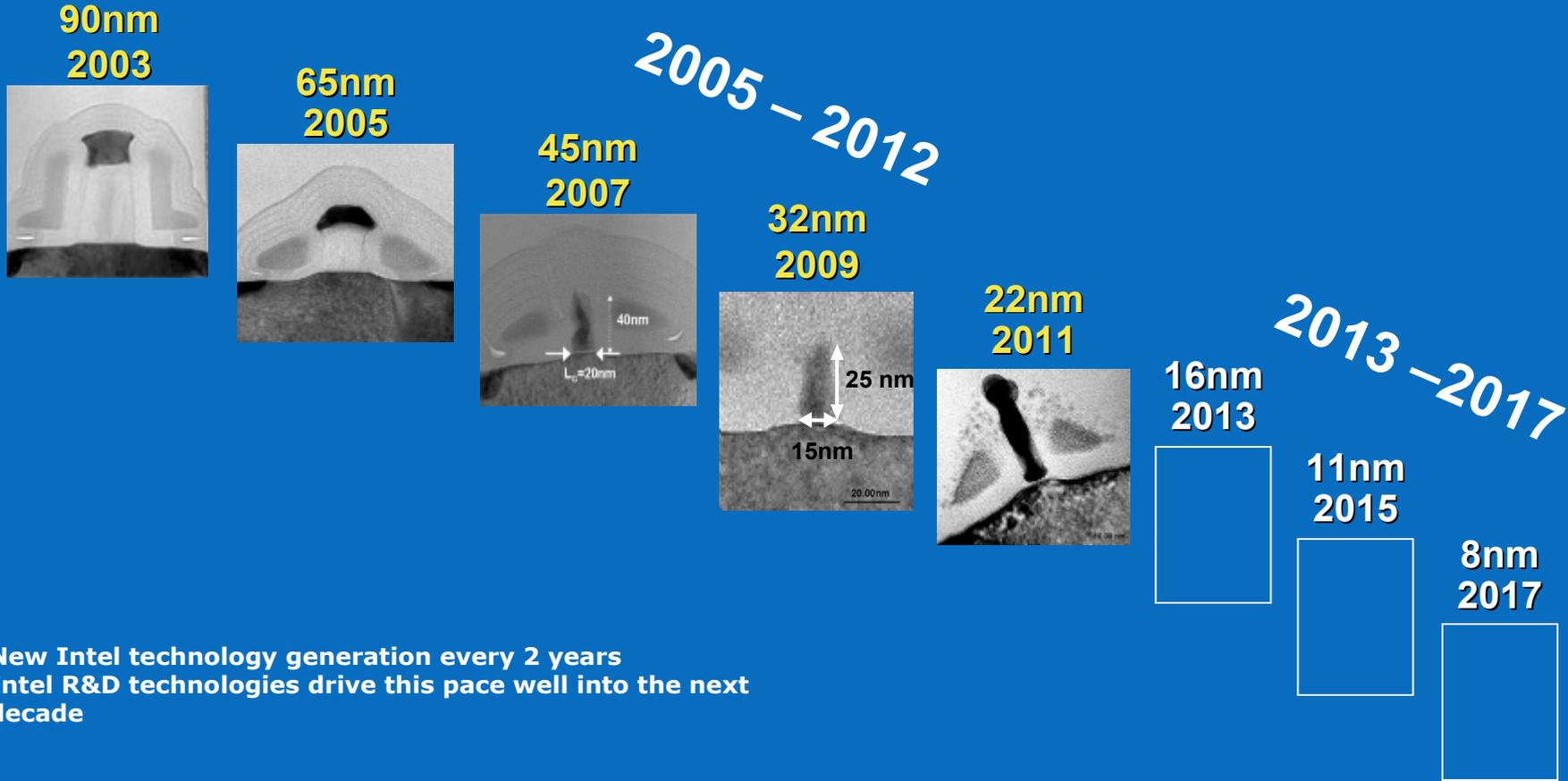
Competition is (mostly) whatever is not open standard commodity

- RISC and Vector – diminishing presence
- The 'real' competition: FPGA's, GPU's, Cell, accelerators
- And .. some competition within the COTS camp ..

Commodity will win out as Volume feeds R&D, feeds fast advances

# Moore's Law – for how long?

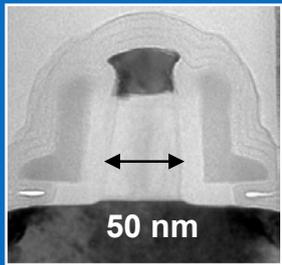
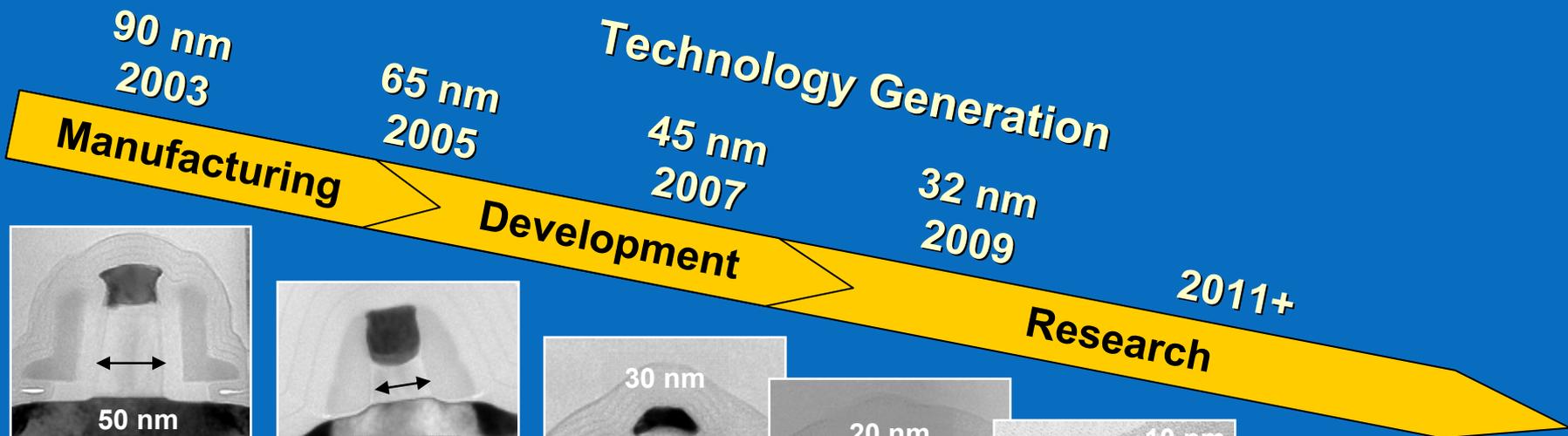
2009? – no problem .. 2020? – we'll see ..



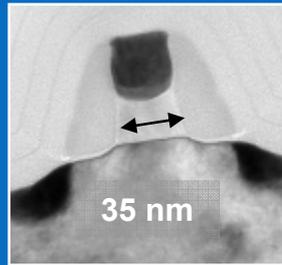
New Intel technology generation every 2 years  
Intel R&D technologies drive this pace well into the next decade



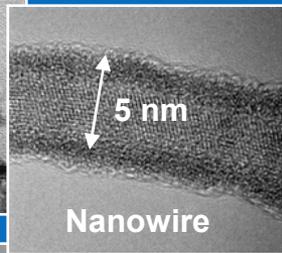
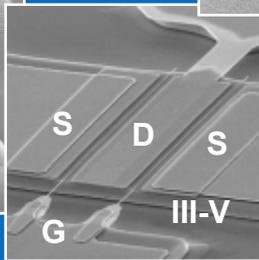
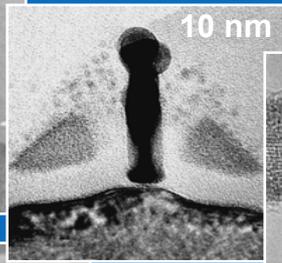
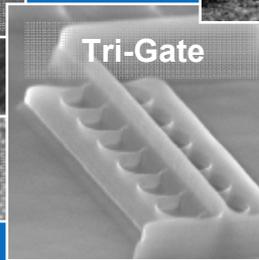
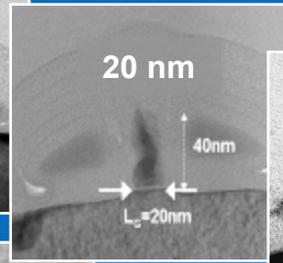
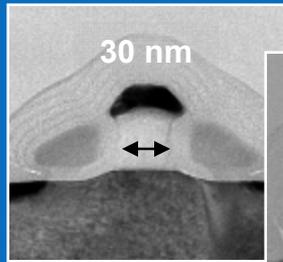
# Innovation-Enabled Technology Pipeline



SiGe S/D  
Strained Silicon



SiGe S/D  
Strained Silicon



Future options subject to change

# Moore's Law –What next?

Keeping the track record of a generation-ahead process technology:  
Jan. 25 – Intel announces 45nm demonstrated; on track for production in 2007

- 193 nm lithography; resolution enhancements techniques (optical proximity, phase shift masks, ..)
- 2x density, +20% switching speed, 30% reduction in transistor switching power
- Sleep transistors
- Strained Silicon (leakage reduced 5x 1<sup>st</sup> gen, another 4x in 2<sup>nd</sup> gen)
- Si-photonics
- High-K/metal gate Dielectric (>100x reduction in leakage)
- Help from advanced compiler opt techniques

# Moore's Law Will Outlive CMOS

-- through innovation

