



# HPEC: the Past as Prolog

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# HPC ~ HPEC

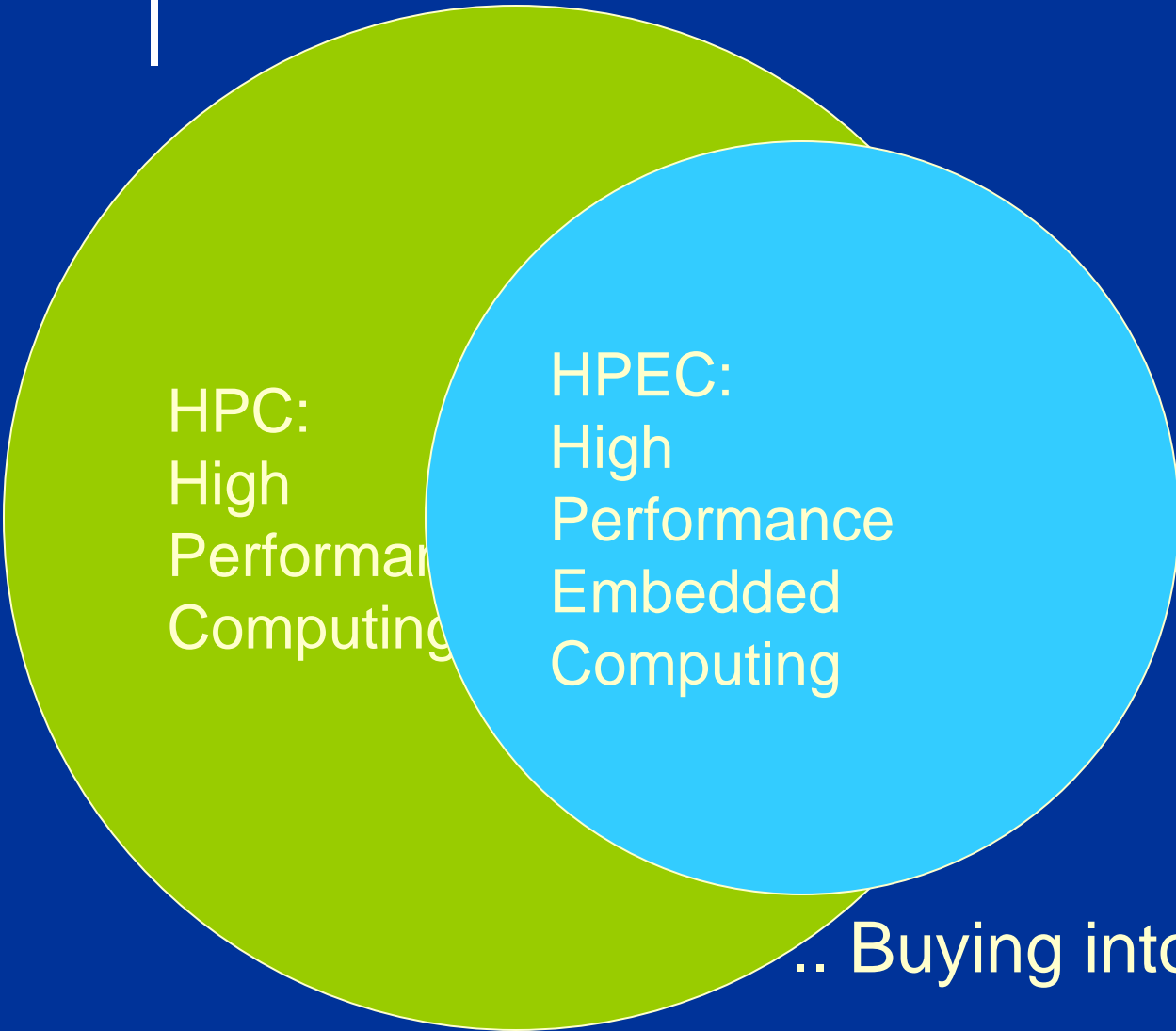


HPC:  
High  
Performance  
Computing

HPEC:  
High  
Performance  
Embedded  
Computing



# HPC ~ HPEC



HPC:  
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.. Buying into complexities



# HPEC: accepting the complexities . . .

- Heterogeneity of hardware
- Greater balance of the solution built in software
  - Size of software increases/explodes
- Genuinely “larger” applications



# HPEC: accepting the complexities . . .

- Costs more; takes longer
- Portability of software across generations of hardware critical
- Software reuse desirable



# HPC: Two paths forward

- 1990's
  - Audacious (single company) hardware development with supporting software
  - General “agnostic” research programs (HPCC)



# Advancing – New Architecture

- Attempt a breakthrough
- Typically, vertically integrated
  - One company performs
  - R&D, manufacturing, software



# Three issues

- Investment level
- Risk
- Picking “winners and losers” vice building mission platforms





# Architecture, different views

"If you were plowing a field,  
which would you rather use?

Two strong oxen or 1024 chickens?"

- Seymour Cray



# Advancing – Research Base

- 1990s High Performance Computing & Communications (HPCC) Program
- Interagency – coordinated investment
- \$1 billion plus per year
- Players: DARPA, NSF, DoE, NASA, NIH, NASA, ...



# Elements of HPCC

- High End Computing & Computation
- Large Scale Networking
- High Confidence Systems
- Human Centered Systems
- Education, Training & Human Resources

DARPA HPCS – follows this path; NSF follows



# Built Ecosystems

- “group of interdependent organisms together with the environment that they inhabit and depend upon”
- Organisms: compute platforms, system software, application software, and the people who know how to exploit them

1 - People

2 - Software

3 - Hardware



# It's the software, the tools

- OS, compilers, schedulers, run-time libraries, debuggers, network protocols, mappers, monitoring software, visualization systems, file systems, .....

"Men ... become the tools of their tools."  
- Henry David Thoreau



# HPEC: Software complexity

“One man’s constant is another man’s variable.”  
- Alan Perlis

“Most problems of computer science can be  
by adding yet one more level of indirection.”  
- Alan Perlis

"In theory, there is no difference between  
theory and practice. But, in practice, there is."  
- Jan L.A. van de Snepscheut

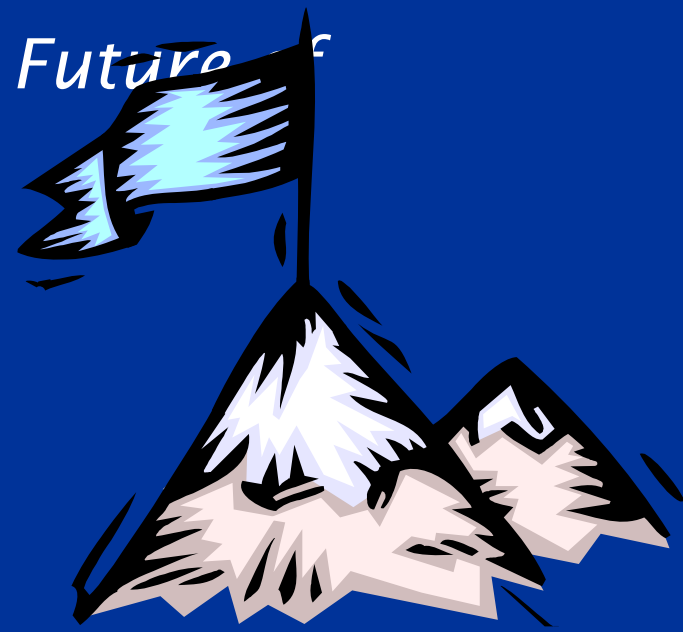


# Impediments to advancement

- Requires 10+ years to mature software standards, tools, algorithm implementations
- Software is incompatible with new hardware architecture
- Multiplicity of tools builders don't coordinate
- ...

# ● ● ● | Revitalization Of HPC

- Repeated calls for a renewed national research effort :
- *CRA Workshop ... Road Map for the Revitalization of High End Computing, 2003*
- Atkins report: “Cyberinfrastructure” 2004
- NRC *Getting up to Speed The Future of Supercomputing, 2005*
- DSB, *Defense Critical Technologies, 2006*







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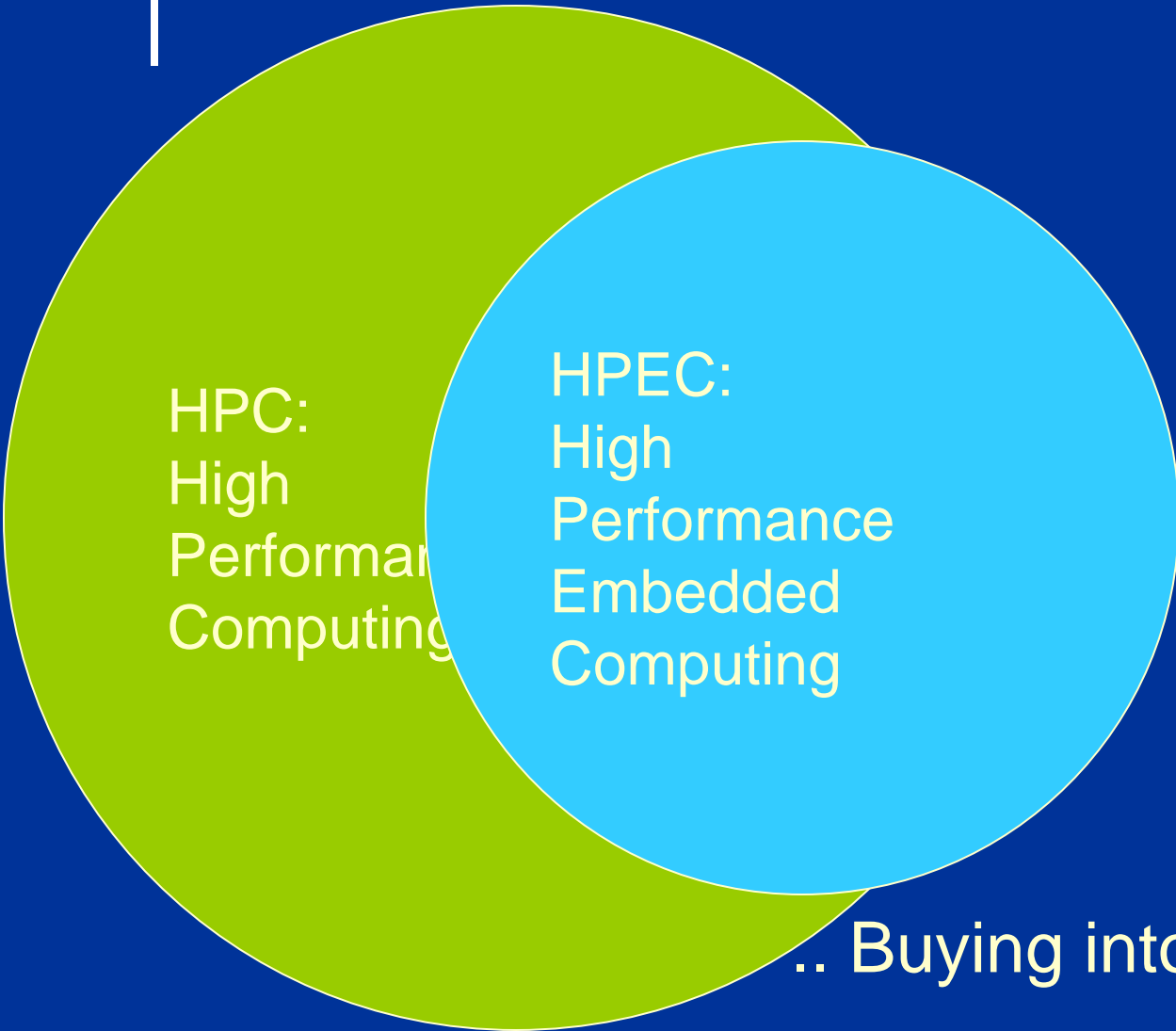


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# Key question for HPEC

- How to manage the HPEC communities so that the technology can advance more rapidly?
  - Coordinate advances among players
  - Develop new technology, new architectures, new components
  - Advance interfaces/standards faster
  - ...



# Quotations

- Barlett's Quotations
- <http://www.cs.virginia.edu/~robins/quotes.html>
- Personal interaction