



## WWW + Grid Computing = Next Generation Web

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## Innovative Computing Laboratory

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- ♦ Numerical Linear Algebra
- ♦ Heterogeneous Distributed Computing
- ♦ Digital Libraries
- ♦ Performance Evaluation

Software and ideas have found there way into many areas  
of Computational Science

Between 40-50 people: At the moment...

20 Researchers: Research Assoc/Post-Doc/Research Prof  
16 Students: Graduate and Undergraduate  
8 Support staff: Secretary, Systems, Artist  
3 Student visitors (2 Danish Tech U, 1 Tokyo Inst Tech)

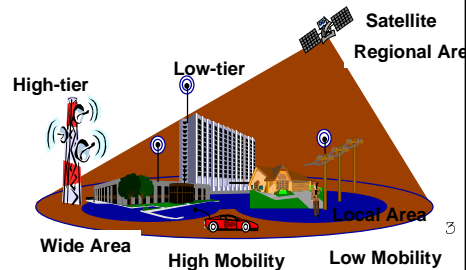
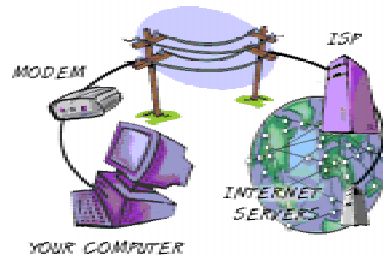
## Remarkable Time We Live In

### ♦ Computers

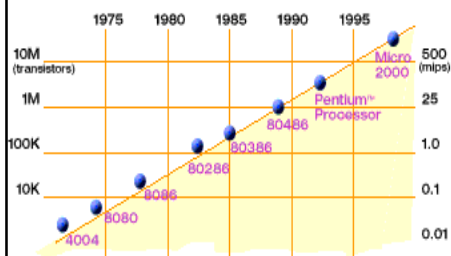
- Handheld devices
- PC's
- Mainframes
- Supercomputers

### ♦ Networks

- Internet
- World Wide Web
- Information Super Highway
- Thousands of networks connected together



## Technology Trends: Microprocessor Capacity



2X transistors/Chip Every 1.5 years  
Called "**Moore's Law**"

Microprocessors have become smaller, denser, and more powerful.  
Not just processors, bandwidth, storage, etc

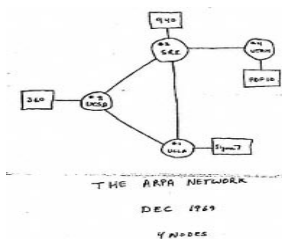


Gordon Moore (co-founder of Intel) predicted in 1965 that the transistor density of semiconductor chips would double roughly every 18 months.

## Internet –

### 4<sup>th</sup> Revolution in Telecommunications

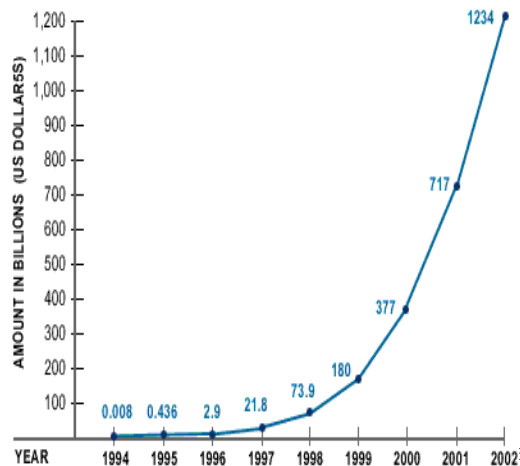
- ♦ Telephone, Radio, Television
- ♦ Growth in Internet outstrips the others
- ♦ Exponential growth since 1985
- ♦ Traffic doubles every 100 days



## The Web Phenomenon

- ♦ 90 - 93 Web invented
- ♦ U of Illinois Mosaic released March 94, ~ 0.1% traffic
- ♦ September 93 ~ 1% traffic w/200 sites
- ♦ June 94 ~ 10% of traffic w/2,000 sites
- ♦ Today 60% of traffic w/2,000,000 sites
- ♦ Every organization, company, school

Internet generated revenue 1996 - 2002



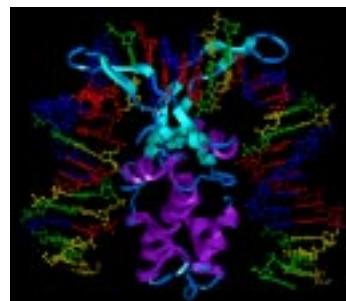
## Computational Science

- ♦ **HPC offers a new way to do science:**
  - **Experiment - Theory - Computation**
- ♦ **Computation used to approximate physical systems - Advantages include:**
  - **Playing with simulation parameters to study emergent trends**
  - **Possible replay of a particular simulation event**
  - **Study systems where no exact theories exist**

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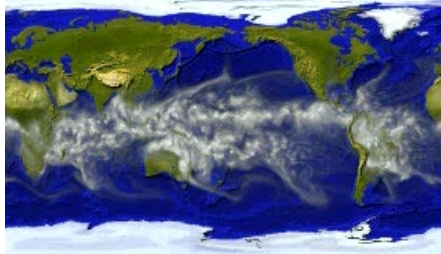
## Why Turn to Simulation?

- ♦ **When the problem is too . . . .**
  - **Complex**
  - **Large / small**
  - **Expensive**
  - **Dangerous**
- ♦ **to do any other way.**

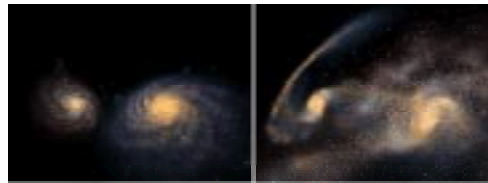
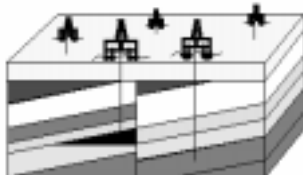


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## Why Turn to Simulation?



- ♦ Climate / Weather Modeling
- ♦ Data intensive problems (data-mining, oil reservoir simulation)
- ♦ Problems with large length and time scales (cosmology)

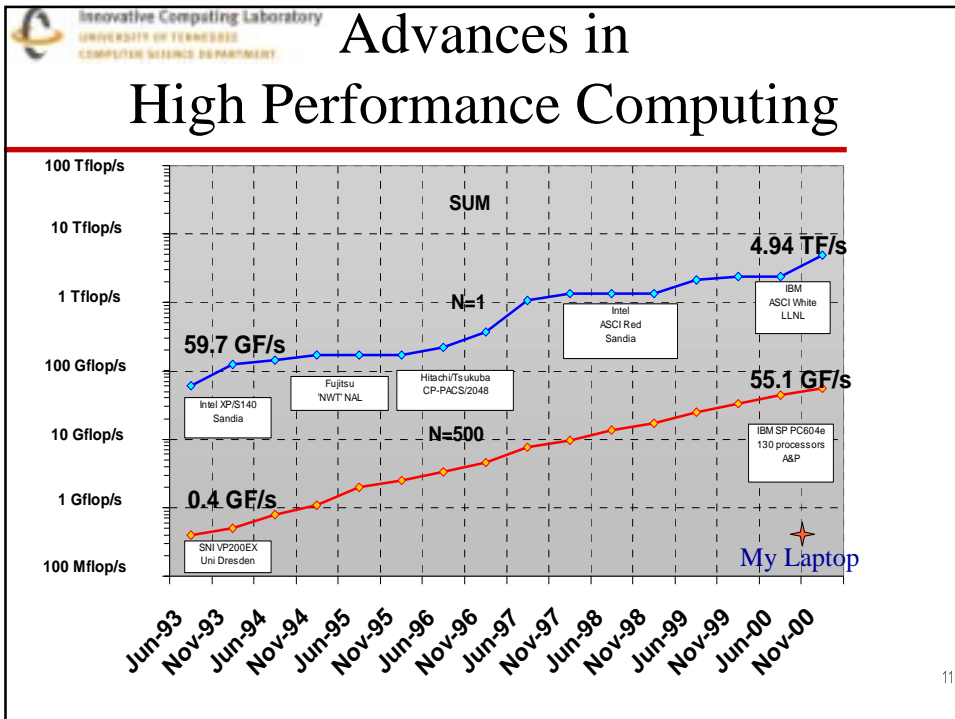


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## Units of High Performance Computing

1 Mflop/s	1 Megaflop/s	$10^6$ Flop/sec
1 Gflop/s	1 Gigaflop/s	$10^9$ Flop/sec
1 Tflop/s	1 Teraflop/s	$10^{12}$ Flop/sec
1 Pflop/s	1 Petaflop/s	$10^{15}$ Flop/sec
<hr/>		
1 MB	1 Megabyte	$10^6$ Bytes
1 GB	1 Gigabyte	$10^9$ Bytes
1 TB	1 Terabyte	$10^{12}$ Bytes
1 PB	1 Petabyte	$10^{15}$ Bytes

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## Other Examples: Sony PlayStation2

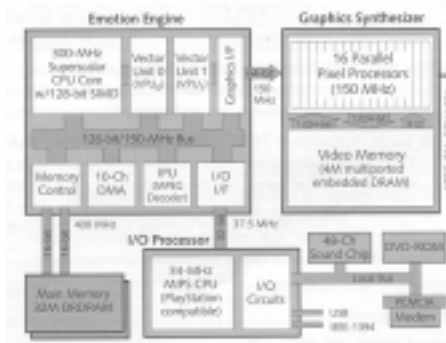


Figure 1: PlayStation 2000 employs an unprecedented level of parallelism to achieve workstation-class 3D performance.



Figure 2: PlayStation 2000 screenshot. (Source: Namco)

- ◆ **Emotion Engine: 6.2 Gflop/s, 75 million polygons per second (Microprocessor Report, 13:5)**
  - **Superscalar MIPS core + vector coprocessor + graphics/DRAM**
  - **Claim: "Toy Story" realism brought to games**
  - **About \$250**

## Sony PlayStation2 Export Limits?

svtech/news/breaking/merc/docs/060772.htm

### Japan limits Playstation2 export, fears military use

TOKYO, April 16 (Reuters) - Japan has slapped export controls on Sony Corp's new, hugely popular Playstation2 video game because the machine is so sophisticated it could be used for military purposes, media said on Sunday.

The hit home game machine, which includes a digital video disc (DVD) player and will eventually offer Internet access, is Sony's most profitable product. The company said it had shipped 1.4 million in the month after the game's March 4 launch.

The console and its eight-megabyte memory card have been designated as "general-purpose products related to conventional weapons" because they contain components that could be used for military devices such as missile guidance systems, Kyodo news agency

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Poo-Chi, the Interactive [Next Page](#), is a new type of friend! Poo-Chi expresses his emotions through his bright expressive eyes, flapping ears and wagging tail. Enjoy hours of playful singing, fun dancing and real puppy sounds. Poo-Chi uses advanced technology to create realistic emotional responses that adapt and change as you play with him. The more you play with Poo-Chi, the happier he becomes — he may even sing a special song for you!

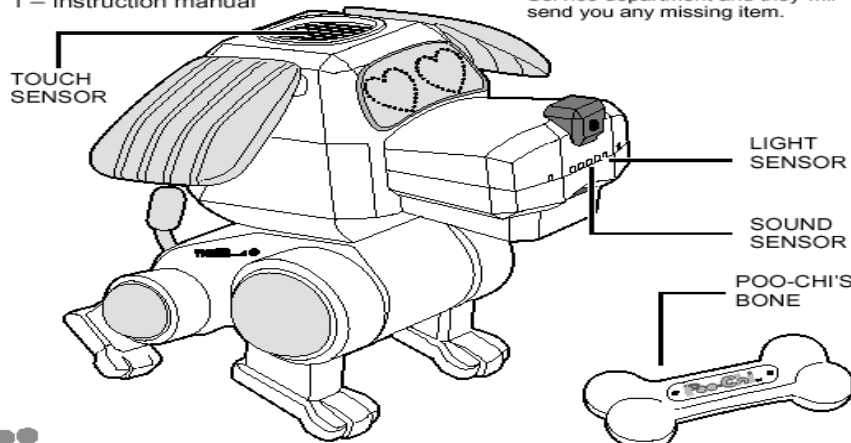


#### CHECKLIST

The following items are included in this package:

- 1 — Poo-Chi, the Interactive Puppy
- 1 — Poo-Chi bone
- 1 — Instruction manual

If anything is missing, please contact the Tiger Electronics' Customer Service department and they will send you any missing item.



**TV/AV**

**Mobile Companions**

**Consumer PCs**

**The Dawn Of The PC-Plus Era,  
Not The Post-PC Era...  
devices aggregate via PCs!!!**

**Communications**

**Automation & Security**

**Household Management**

Innovative Computing Laboratory  
UNIVERSITY OF TENNESSEE  
COMPUTER SCIENCE DEPARTMENT

## Peer to Peer Computing

- ♦ Peer-to-peer is a style of networking in which a group of computers communicate directly with each other.
- ♦ Wireless communication
- ♦ Home computer in the utility room, next to the water heater and furnace.
- ♦ Web tablets
- ♦ Imbedded computers in things all tied together.
  - Books, furniture, milk cartons, etc
- ♦ Smart Appliances
  - Refrigerator, scale, etc

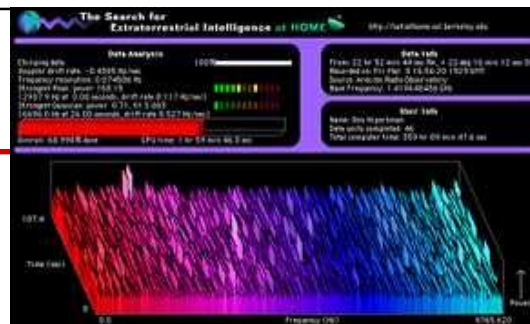


# Internet On Everything



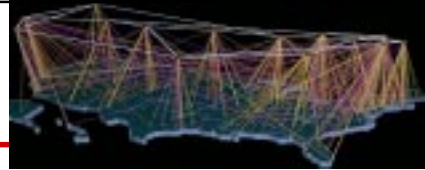
## SETI@home

- ♦ Use thousands of Internet-connected PCs to help in the search for extraterrestrial intelligence.
- ♦ Uses data collected with the Arecibo Radio Telescope, in Puerto Rico
- ♦ When their computer is idle or being wasted this software will download a 300 kilobyte chunk of data for analysis.



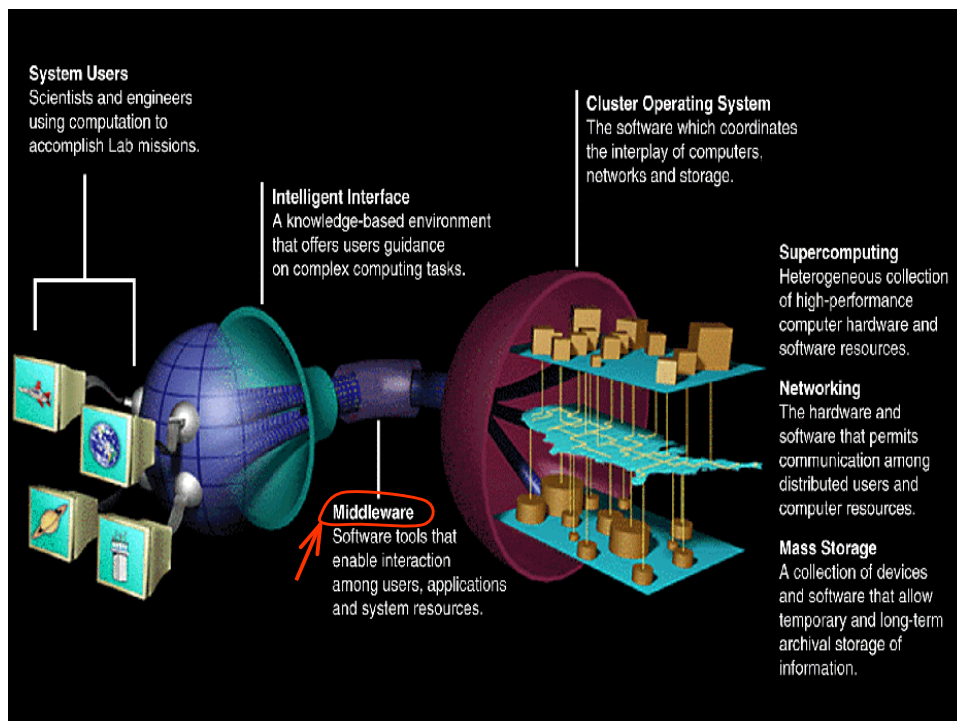
- ♦ The results of this analysis are sent back to the SETI team, combined with the crunched data from the many thousands of other SETI@home participants.

## Next Generation Web



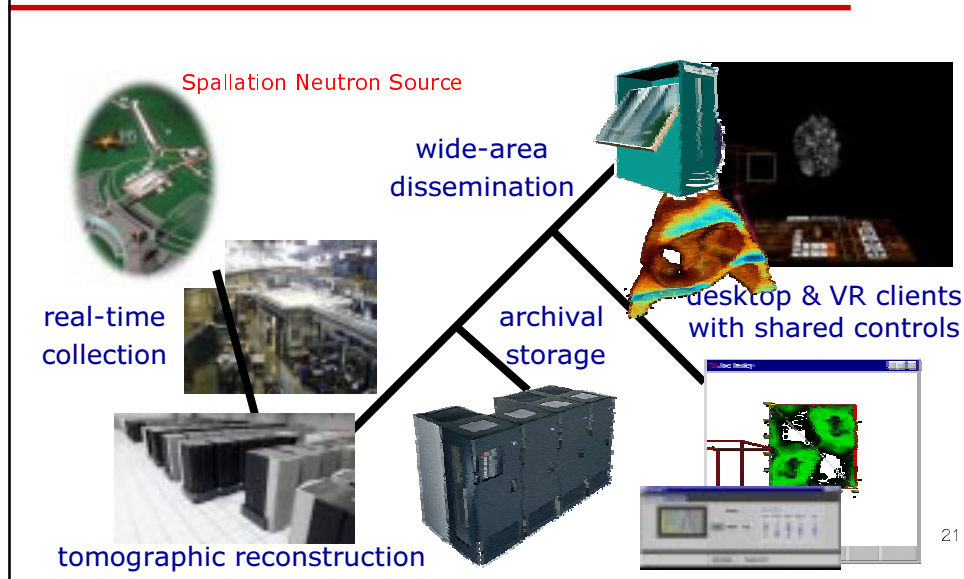
- ◆ To treat CPU cycles and software like commodities.
- ◆ Enable the coordinated use of geographically distributed resources – in the absence of central control and existing trust relationships.
- ◆ Computing power is produced much like utilities such as power and water are produced for consumers.
- ◆ Users will have access to “power” on demand
- ◆ This is one of our efforts at UT.

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## Another Example: Vision for Online Instrumentation



## Computing in 2001 and Beyond



- ♦ Office agents: phone/FAX/comm; files/paper handling - Untethered computing: *fully distributed offices ??*
- ♦ Integration of video, communication, and computing: desktop video publishing, conferencing, & mail
- ♦ We should be able to simulate:
  - Nearly everything we make and their factories
  - Much of the universe from the nucleus to galaxies
- ♦ Performance implies: voice and visual Ease of use.
- ♦ Personal computers in 2001 are today's supercomputers



## Conclusion

- ◆ Exciting time to be in scientific computing
- ◆ Network computing is here
- ◆ The Grid offers tremendous opportunities for collaboration
- ◆ Important for us at UT to be involved in this work that will bring about the next generation web.

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