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Fall 2000

Peer to Peer Computing

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Intel Corporation

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Agenda

- What is Peer to Peer Computing?
- The Three Ages of the Internet
- Current Peer-to-Peer Computing Models
- What are the Implications?
- What is Needed?
- Next steps

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What is Peer to Peer Computing?

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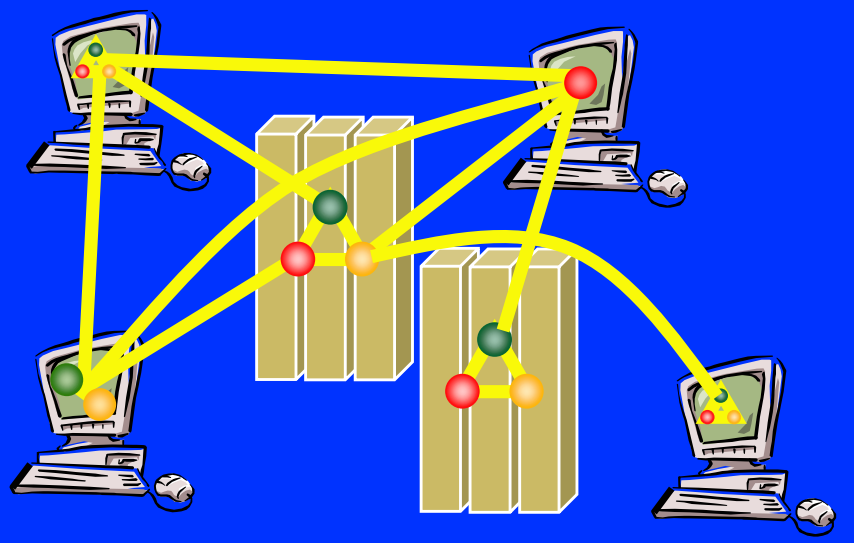
- Pure: Peers have same capability and responsibility. Symmetric communication
- Hybrid: Servers facilitate the interaction between the peers.



Sharing of Computing Resources via Direct Exchange Between Computers

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Intel's View

- New peer-to-peer applications are to the next generation of the Internet as Mosaic was to the second.
- A billion connected computers is naturally organized as millions of smaller virtual webs.
- Peer-to-peer computing is the natural self-organizing complement to the centralized organization of client-server computing.

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A Little History

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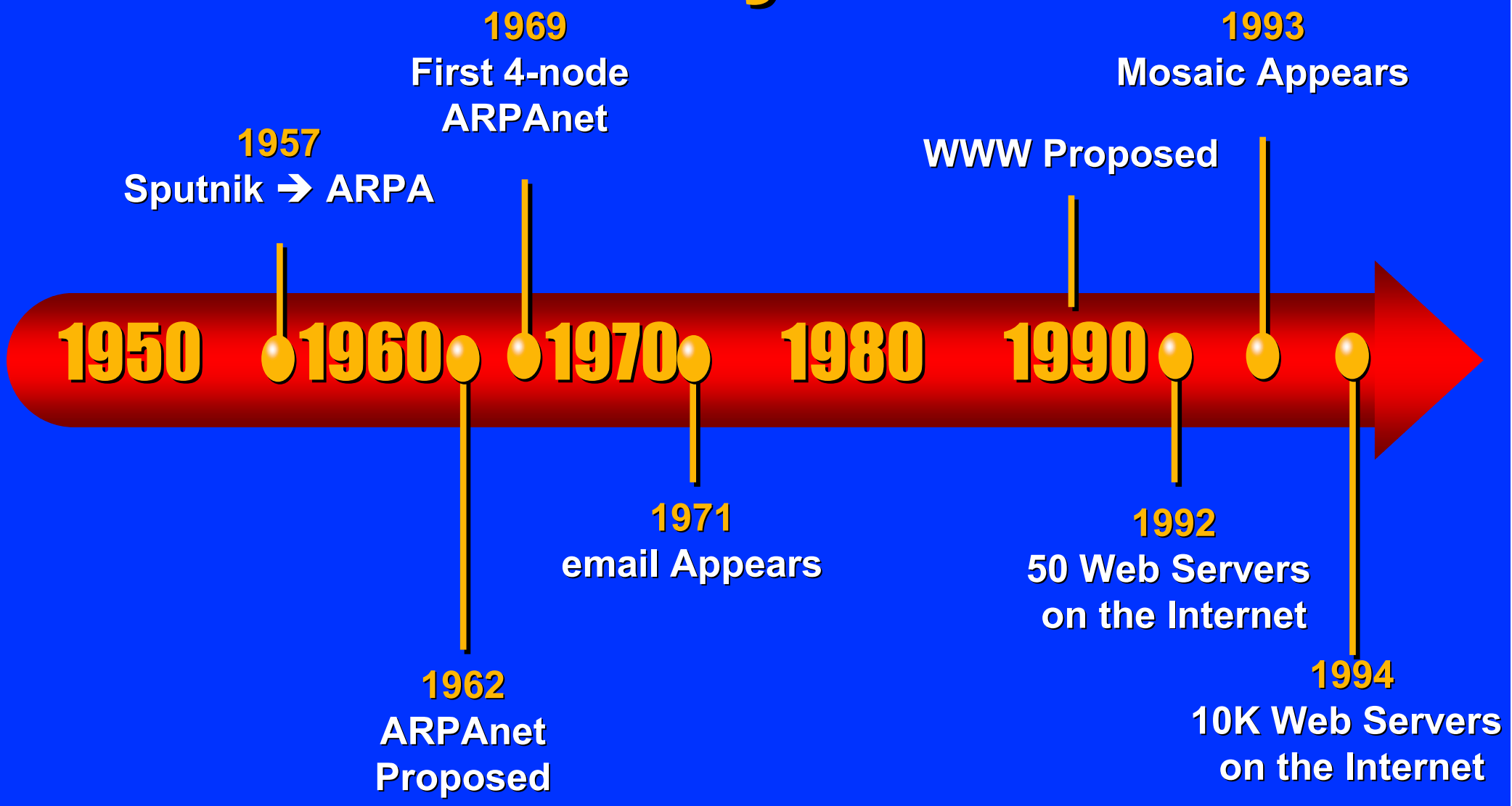

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First Generation:

World Wide Access

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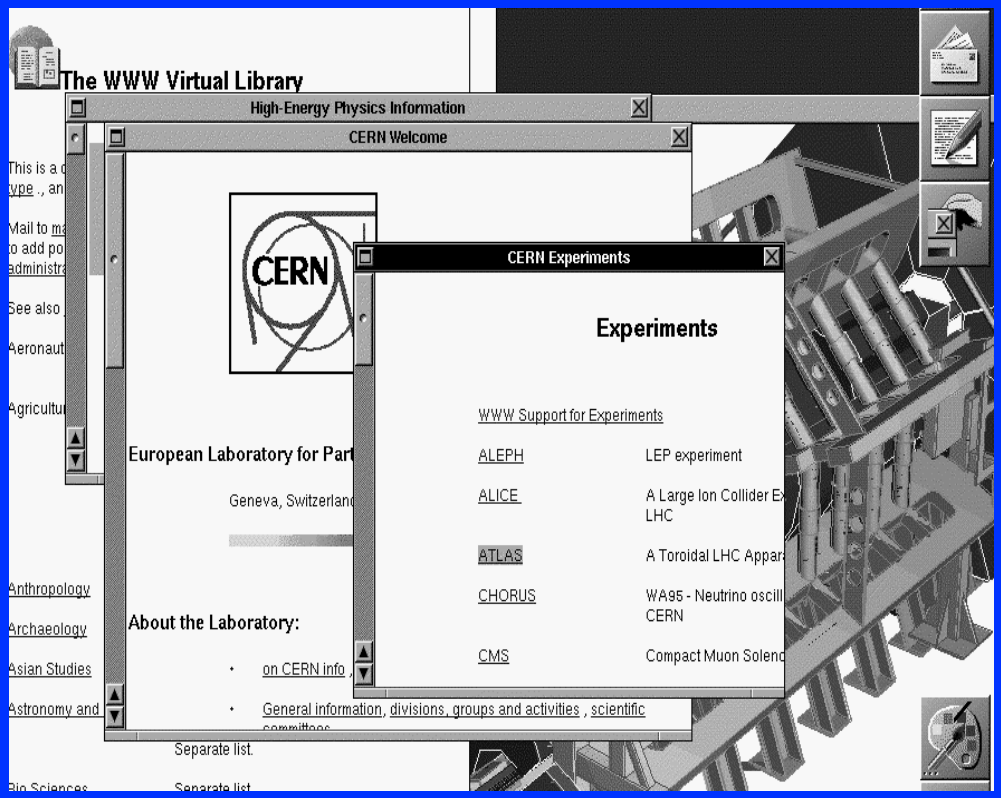

(First Graphical WWW Browser for the NeXTStep OS)

- Access to linked information from within a text document.
- Viewing of context relevant information
- Multiple protocols
  - Telnet
  - FTP
  - Gopher
  - WAIS
  - HTTP

Dynamic access to context sensitive information.

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Second Generation:

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Advent of Mosiac

There are two ages of the Internet - before Mosaic, and after. The combination of Tim Berners-Lee's Web protocols, which provided connectivity, and Marc Andreessen's browser, which provided a great interface, proved explosive. In twenty-four months, the Web has gone from being unknown to absolutely ubiquitous.

A Brief History of Cyberspace
Mark Pesce, ZDNet, October 15, 1995

- Comprehensive graphical browser
- Hid the retrieval process from the user.
- Merged all webs into a WWW.

Mosaic added the infrastructure that enabled the early web to flourish.

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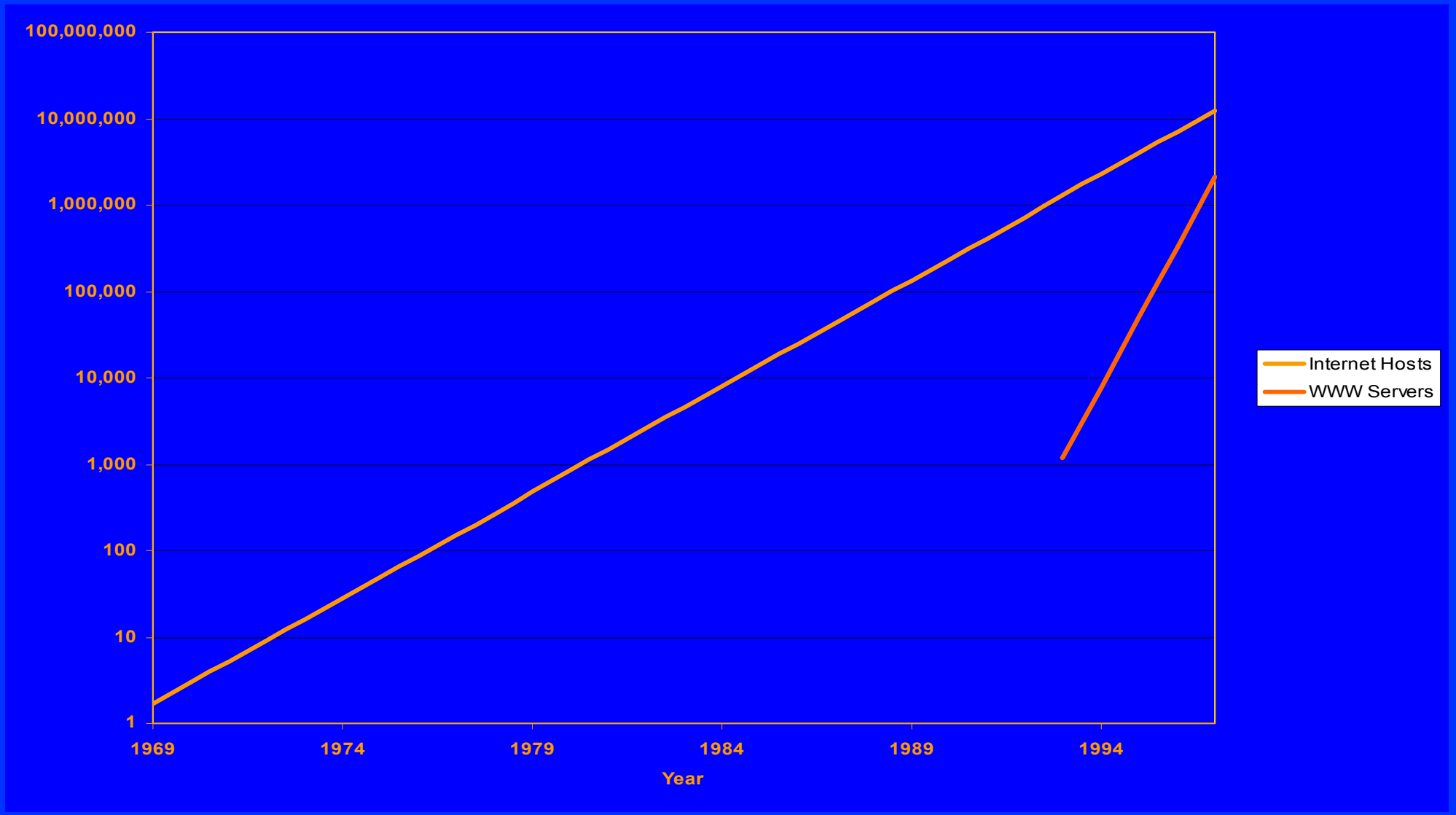
Internet and Web Growth



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Data Source: http://info.isoc.org/guest/zakon/Internet/History/HIT.html

Third Generation:
Peer to Peer Computing

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If a million people use a Web site simultaneously, doesn't that mean that we must have a heavy-duty remote server to keep them all happy? No; we could move the site onto a million desktops and use the internet for coordination. Could Amazon.com be an itinerant horde instead of a fixed Central Command Post? Yes.

David Gelernter, The Second Coming
– A Manifesto

- From zero to fifty COMPANIES in under a year
- Dozens of ideas
- Hundreds of thousands of participants now!

Peer-to-peer computing is leading us into the third generation of the internet!

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Peer-Peer Computing:

Wave as strong as the introduction of Mosaic

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Pre-Mosaic
Web:
- NNTP
- WAIS
- Gopher
- WWW

Trigger
Mosaic

Key Component
Infrastructure
- Ease of Use
- Common Protocols
- Standards
- Scalability

Created the 'e' Revolution

Pre Peer – Peer Web
- Shared Drives
- FTP
- Windows for WG

Trigger
Napster
Gnutella

Key Component
Infrastructure
- Ease of Use
- Common Protocols
- Standards
- Scalability
- Security

The Next Computing Revolution

Infrastructure is the Key success factor.
Intel enables infrastructure.

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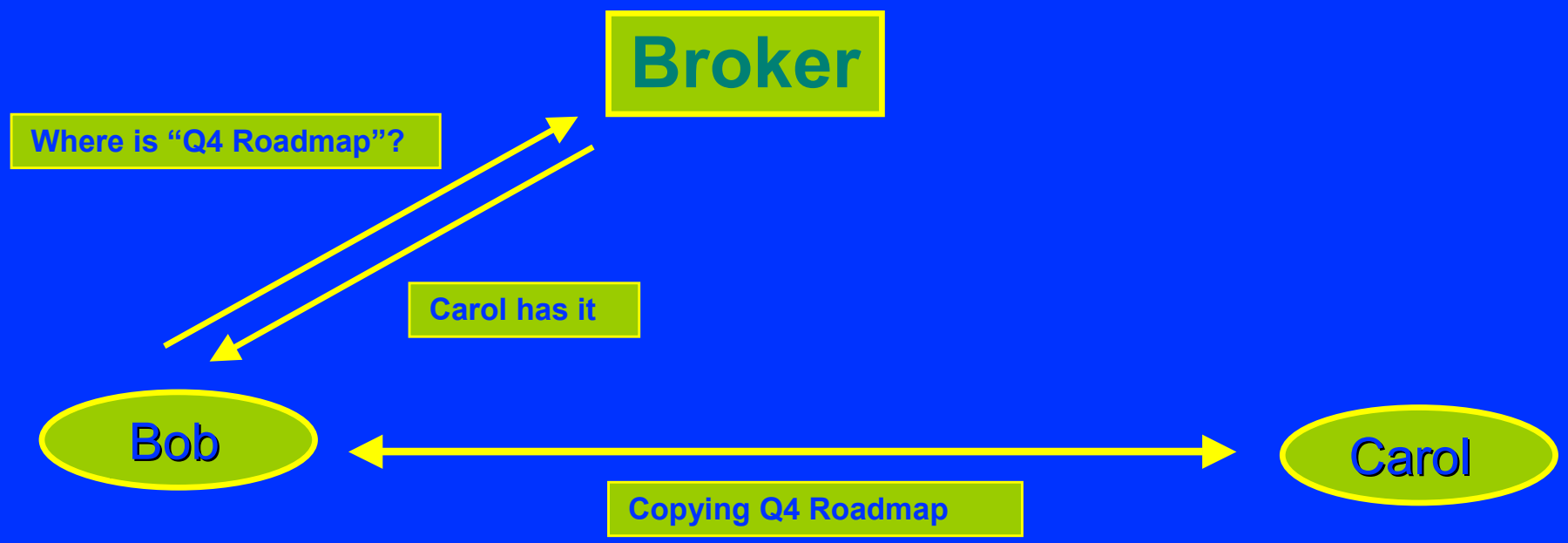
Current Models

- Broker mediated file sharing
  - Users register files with a broker for sharing; use broker to find files to copy



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Current Models

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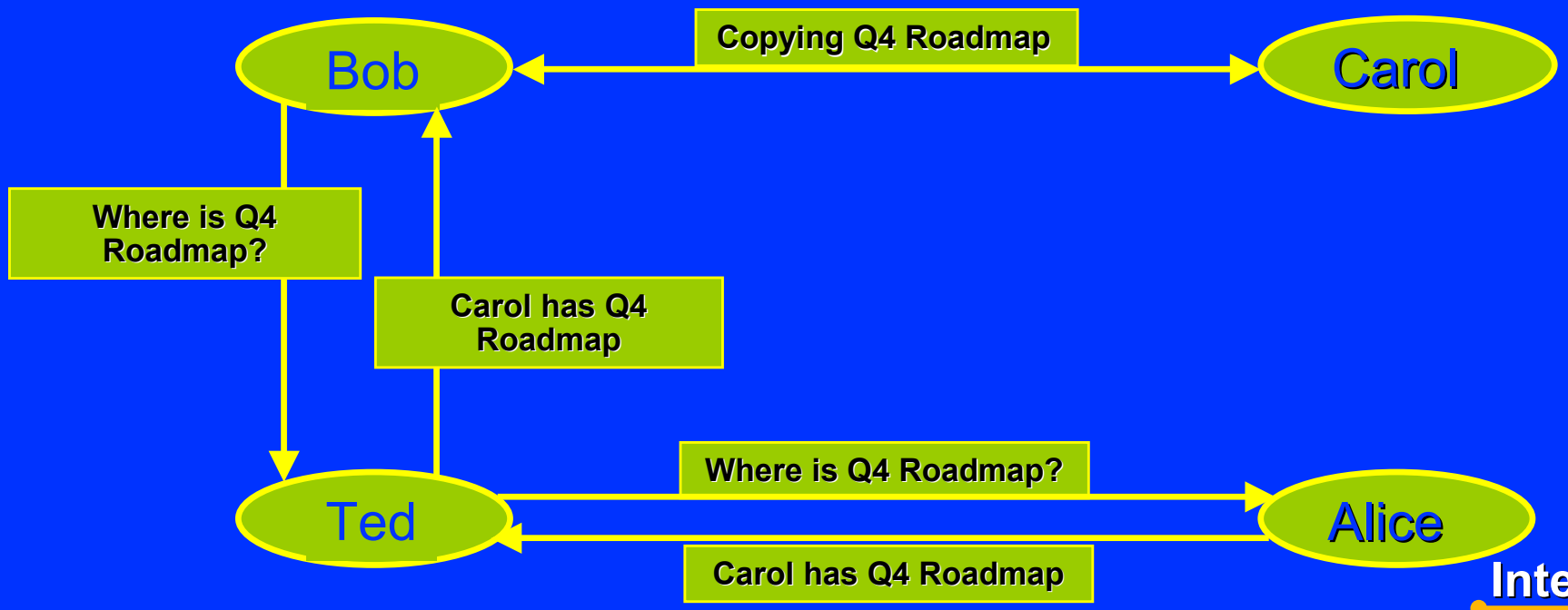
- Peer-to-Peer File Sharing
  - Users register files with network neighbors.
  - Search across the network to find files to copy.
  - Does not require a centralized broker.



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Current Models

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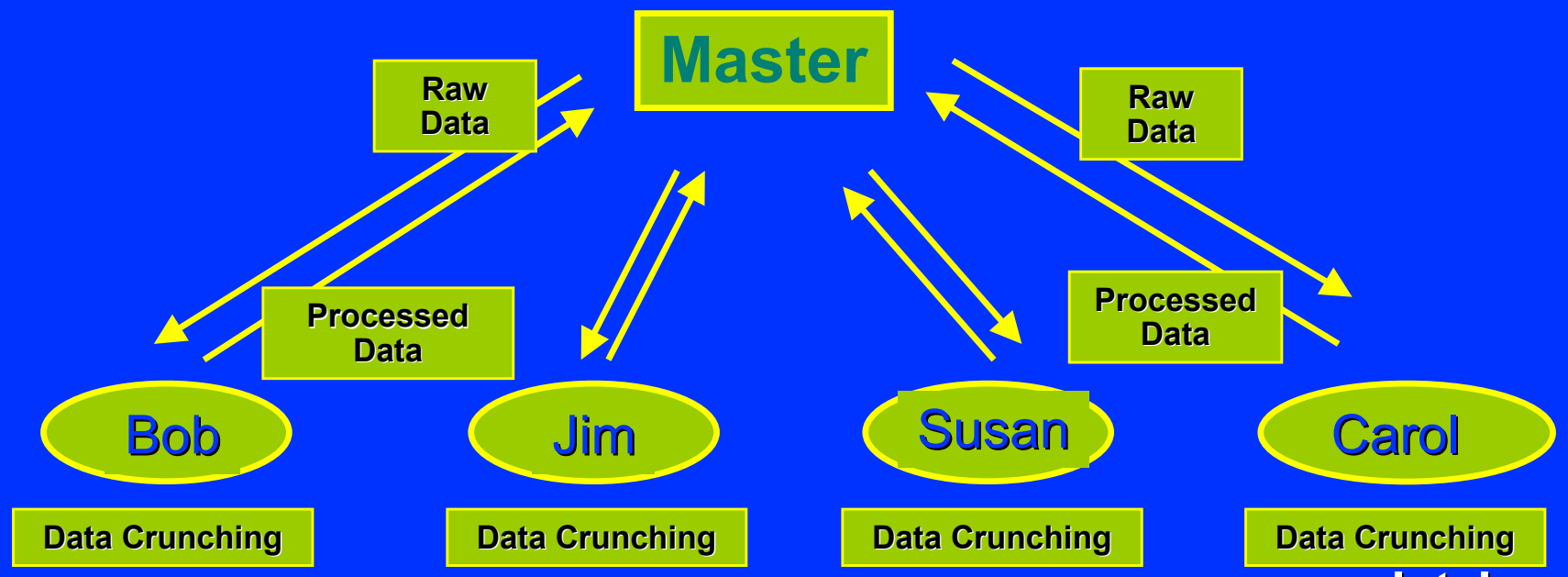
- Cycle Sharing
  - Example: SETI@home scans radio telescope images
  - Chunks of data are sent to client in suspend mode.
  - Data is processed by clients when client is not in use and returned to the master.



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Understanding the Implications

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- Server layer is the layer we rely on in enterprise business.
- Client Layer below is largely untapped as part of the enterprise network infrastructure.
- In a large business client layer might have:
  - 2000 Clients x 10 GB/client = 20 TB spare storage.
  - 2000 Clients x 233 MHz/client x 9 ops/cycle = 4.2 trillion ops/second of spare processing power.

Network of clients in enterprise business is a massive untapped resource for corporate IT.

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Usage Models

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Universal file Sharing
Protected content distribution

Collaboration
Secure file sharing in ad-hoc groups

Distributed Computing
New usage models enabled by 10X reduction in computation cost

Active distributed storage sharing
Reduce need for file servers
Migrate files to area of use

Intelligent Agents
Cooperative search engine.
Computer virus quarantine

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Virtual Private Webs:
A Vision

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- Access should be by content, not address
- Members are peoples, not NICs
- Sharing in a VPW
  - Full network capability, but restricted to VPW
    - Web pages
    - E-mail
    - Messaging
    - File Sharing
  - Directory views shared within the VPW

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Information Technology

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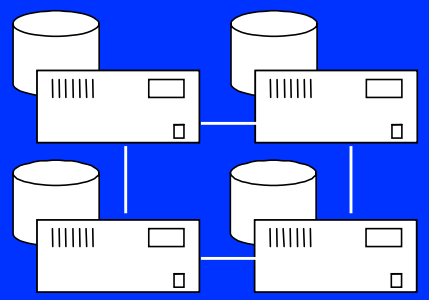
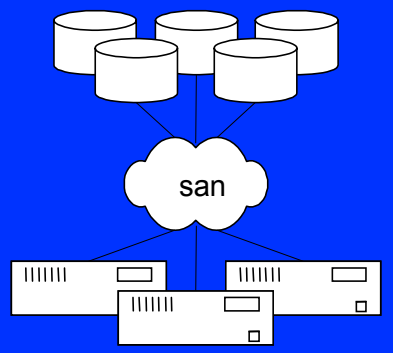
Leverage always on, always connected client side storage to deliver significantly lower cost storage solution

Peer-to-Peer Storage



- Inexpensive Equipment
- Inexpensive Desk Space
- Low Maintenance
- Inexpensive Redundancy

Server Storage



- Expensive Equipment
- Expensive Floor Space
- Expensive Administration
- Expensive Redundancy

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Enterprise Usage Models: Small Group File Sharing

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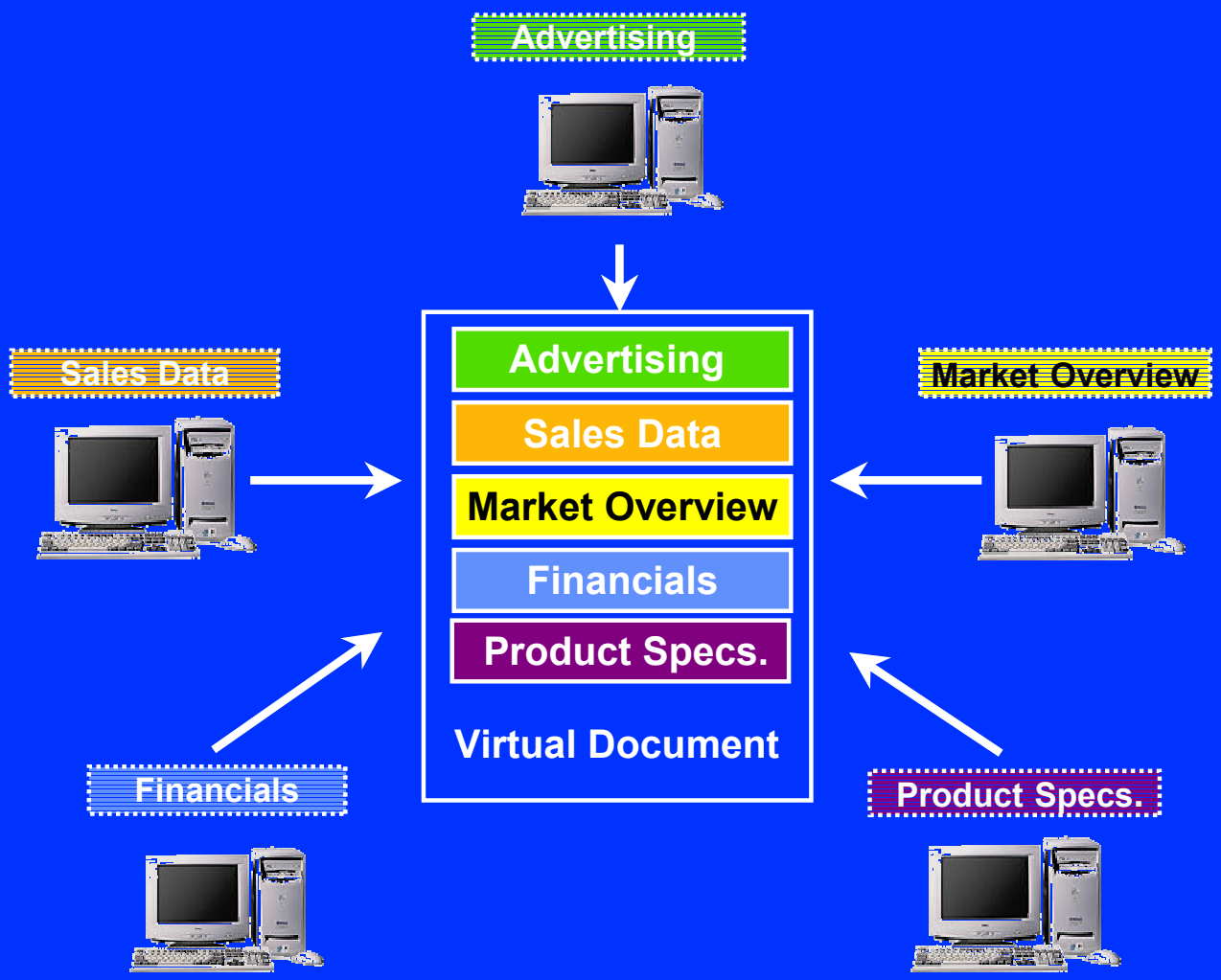

- **Virtual docs created from components residing on clients.**
  - Secure file sharing in small workgroups.
  - Creation of component documents.
- **Component pieces updated on network in real time.**
  - No more outdated docs clogging up the web.
- **OS file sharing is a start, but doesn't work across the Internet.**

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Enterprise Usage Models: Distributed Search Engine

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Rev 1.0 Posted to Server

Rev 1.3 Posted to Server

	t = 1 Rev 1.0	t = 2 Rev 1.1	t = 3 Rev 1.2	t = 4 Rev 1.3
Peer to Peer search returns	Rev 1.0	Rev 1.1	Rev 1.2	Rev 1.3
Server search returns	Rev 1.0	Rev 1.0 (OUTDATED)	Rev 1.0 (OUTDATED)	Rev 1.3

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Enterprise Usage Models:
Peer-to-Peer Virus Protection

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"In March, a coalition of Sandia [Peer-to-Peer] cyberagents successfully protected five network-linked computers over two full working days of concentrated attack by a four-person hacker force called the Red Team, an expert hacker group, also at Sandia, whose purpose is to test the defenses of governmental and corporate computer systems."

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What is Needed?

- Ubiquity
- Standards
  - Interoperability
  - Security
  - Robustness
- Performance
- Community

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What is Needed?
Ubiquity

- Billion connected computers is NOT enough!
- 30 companies today, 300 tomorrow. After that?
- How do we guarantee profusion enhances rather than destroying?

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What is Needed?
Standards

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- How is interoperability achieved?
  - Imposition by dominant player
  - Standards
- No dominant player, so we must have standards

Standards critical for interoperability

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What is Needed?
Security

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- Secure Sharing in Groups
  - Guarantee trust within a secure group
  - Prevent unauthorized access
- Protection against attack
  - Protection against viruses, worm, . . .
  - Protection against man-in-the-middle attacks

Security is crucial for peer-to-peer computing

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What is Needed?
Robustness

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- Control
  - Backup/Restore alternative
  - Guaranteed identity of content
  - Storage & Network Management
- Provision for intermittent connectivity
- Resilience against software and hardware failures

Making a useful whole from unreliable parts

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What is Needed?
Performance

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- What are the performance implications of a billion connected computers?
- 100 million virtual private webs?
- What are the inherent scalability limits?
- What are the performance limits of protocols?

What are the performance implications?

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What is Needed?
Community

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- Diverse Parties of Interest
  - IT departments
  - Enterprise Computer Users
  - Peer-to-peer application developers
  - Open Source Community

Community essential to ubiquity

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Peer-to-Peer Working Group

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First meeting scheduled for September 26, 2000 Santa Clara, CA

Details will appear on web site

http://www.Peer-to-PeerWG.org

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Working Group

- Determine what specifications are needed
- Define the needed specifications
- Distribute reference implementations

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Call To Action

- Fire up your imagination!
- Join the Peer-to-Peer Working Group
  - Peer-to-Peer Application Developers
  - Open Source Developers
  - Information Technology Architects
  - Enterprise Early Adopters

http://www.Peer-to-PeerWG.org

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Reduce need for file servers
Migrate files to area of use

Intelligent Agents
Cooperative search engine.
Computer virus quarantine

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Demonstrations

- Peer-to-Peer File Sharing
  - Demonstration by Intel IT Group
  - File sharing in work groups; rapid update
  - Automatic distribution of training materials
- Secure Gnutella using Trusted Computing Platform
- Distributed Business Computing
- Distributed File Server
- Peer-to-Peer Gaming

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Demonstrations - Setup

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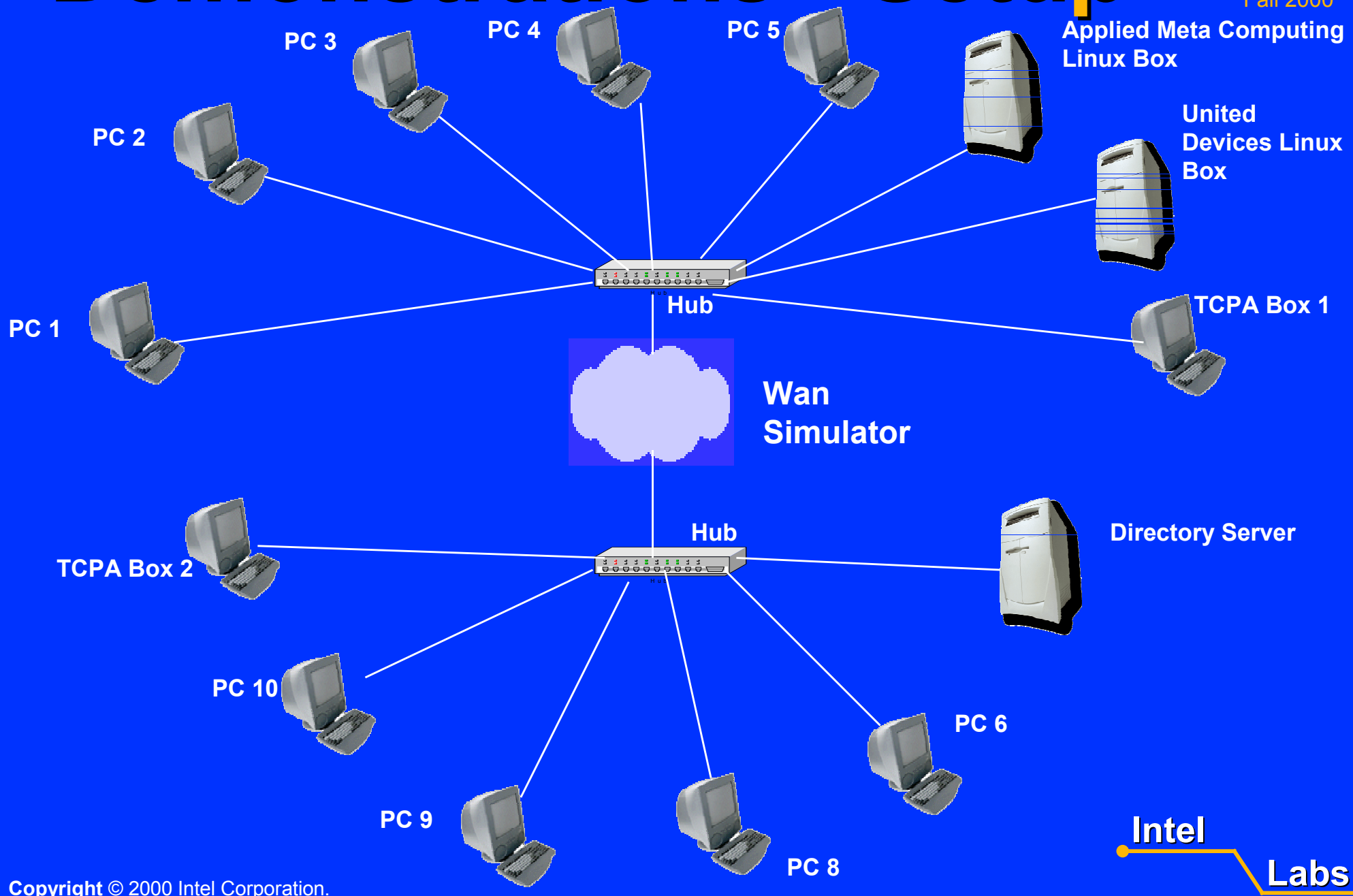

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Collateral

- Peer-to-Peer Working Group web site
  - http://www.Peer-to-PeerWG.net
- Follow up for items in this track
  - Applied Meta Computing: http://www.appliedmeta.com
  - Currid & Company: http://www.currid.com
  - CenterSpan: http://www.CenterSpan.com
  - Hummer Winblad Venture Partners: http://www.humwin.com
  - Legion: http://www.cs.virginia.edu/~legion/
  - SETI@home: http://setiathome.ssl.berkeley.edu/
  - Trusted Computing Platform Alliance: http://www.trustedpc.org
  - United Devices: http://www.uniteddevices.com

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