

Introduction to Distributed Systems

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CS 553: Cloud Computing
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digitalblasphemy.co

Logistics

- Read chapter 1 from textbook
- Read paper on Clouds vs Grids:
 - Cloud computing and grid computing 360-degree compared
 - <https://arxiv.org/pdf/0901.0131.pdf>
- HW1 will be posted today, due on Friday 08/29/24
- NO CLASS on Monday 09/01/25
- Makeup class will be Friday 09/05/25

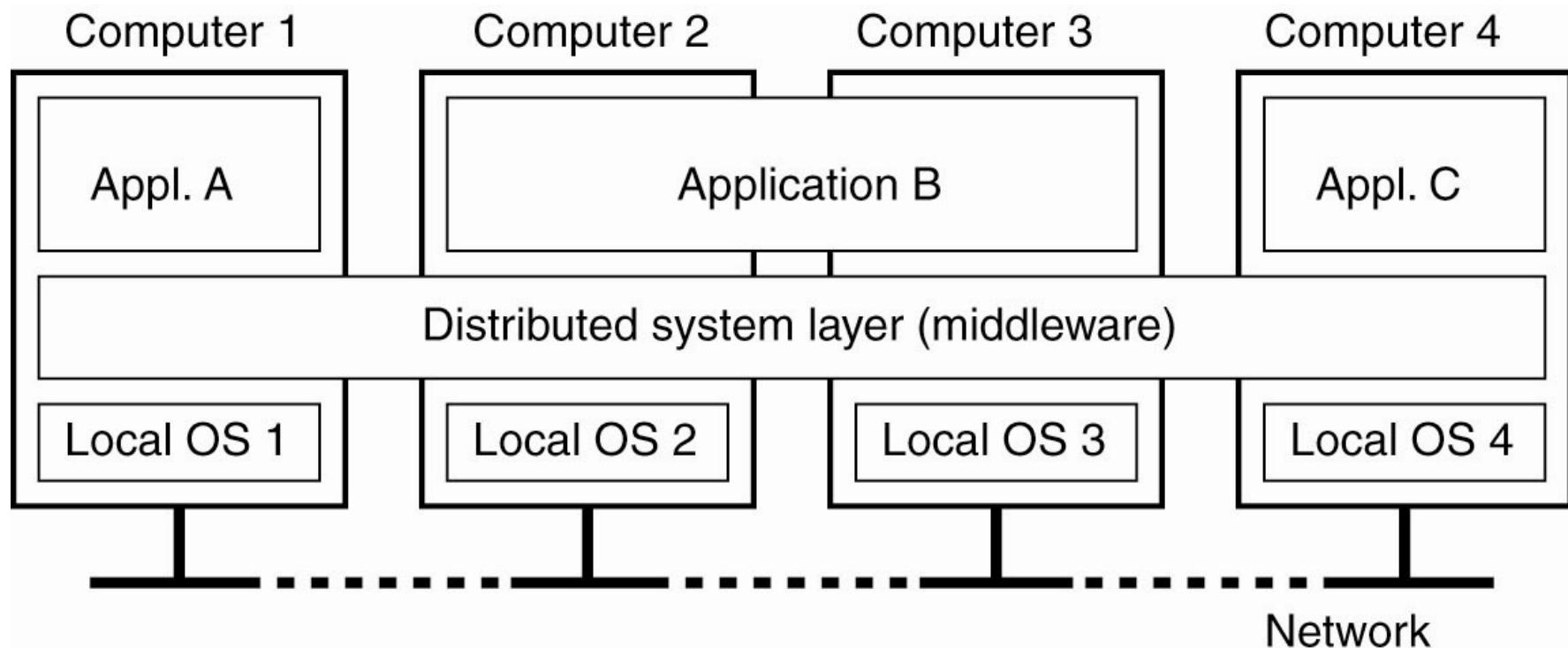
Distributed Systems

- What is a distributed system?

**“A collection of independent computers
that appears to its users as a single
coherent system”**

-A. Tanenbaum

Distributed Systems



A distributed system organized as middleware. The middleware layer extends over multiple machines, and offers each application the same interface.

Distributed vs. Centralized Systems

- Economics
 - Microprocessors have better price/performance than mainframes
- Speed
 - Collective power of large number of systems
- Geographic and responsibility distribution
- Reliability
 - One machine's failure need not bring down the system
- Extensibility
 - Computers and software can be added incrementally

Disadvantages of Distributed Systems

- Software
 - Little software exists compared to PCs
- Networking
 - Still slow and can cause other problems (e.g. when disconnected)
- Security
 - Data may be accessed by unauthorized users

Concurrency

- In a single system several processes are interleaved
- In distributed systems: there are many systems with one or more processors
 - Many users simultaneously invoke commands or applications
 - Many servers processes run concurrently, each responding to different client request

Scalability

- Scale of system
 - Few PCs servers ->dept level systems->local area networks->internetworked systems->wide are network...
 - Ideally, system and application software should not change as systems scales
- Scalability depends on all aspects
 - Hardware
 - Software
 - networks

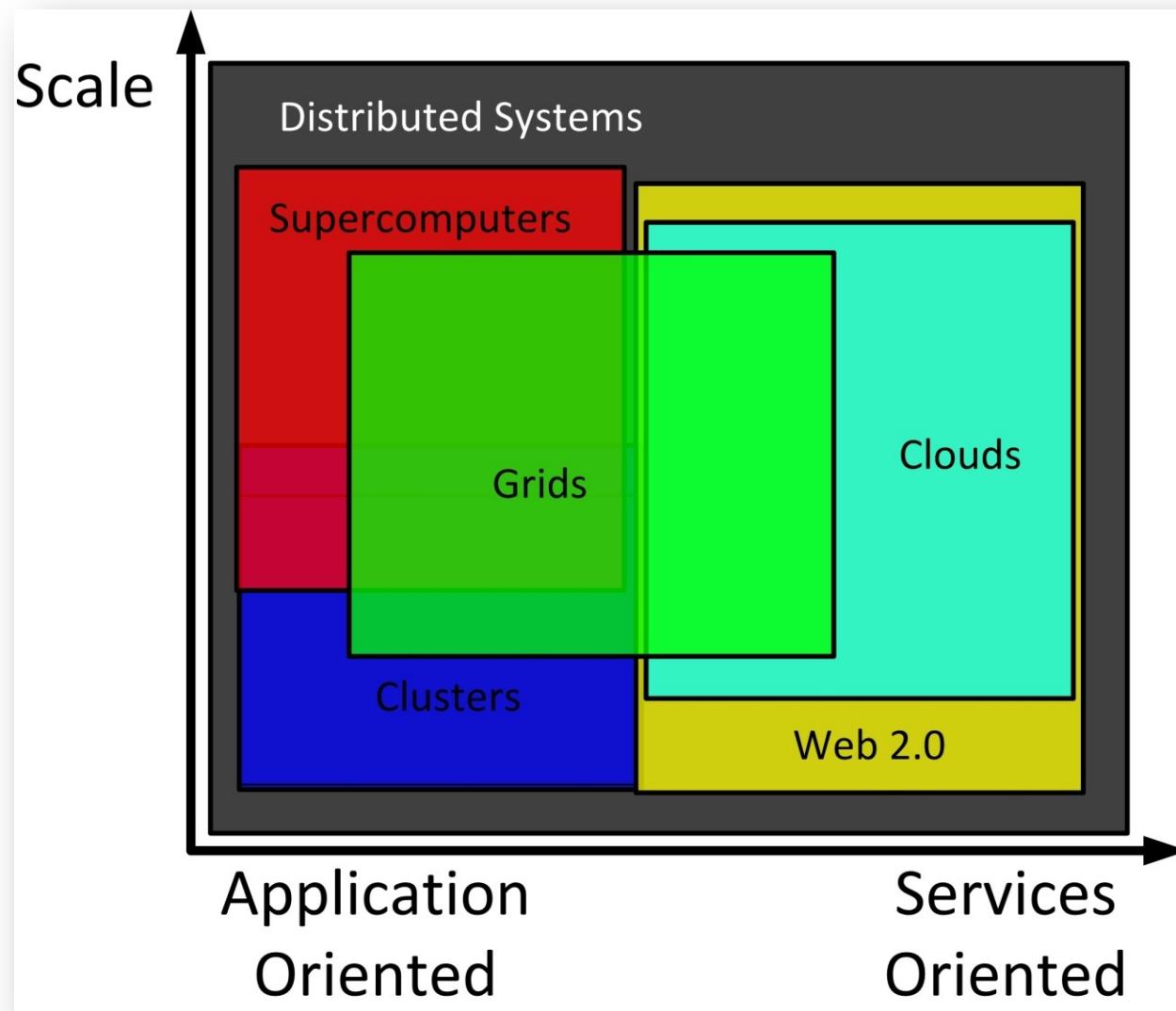
Fault Tolerance

- Definition?
- Two approaches:
 - Hardware redundancy
 - Software recovery
- In distributed systems:
 - Servers can be replicated
 - Databases may be replicated
 - Software recovery involves the design so that state of permanent data can be recovered

Pitfalls When Developing Distributed Systems

- False assumptions made by first time developer:
 - The network is reliable.
 - The network is secure.
 - The network is homogeneous.
 - The topology does not change.
 - Latency is zero.
 - Bandwidth is infinite.
 - Transport cost is zero.
 - There is one administrator.

Distributed Systems: Clusters, Grids, Clouds, and Supercomputers

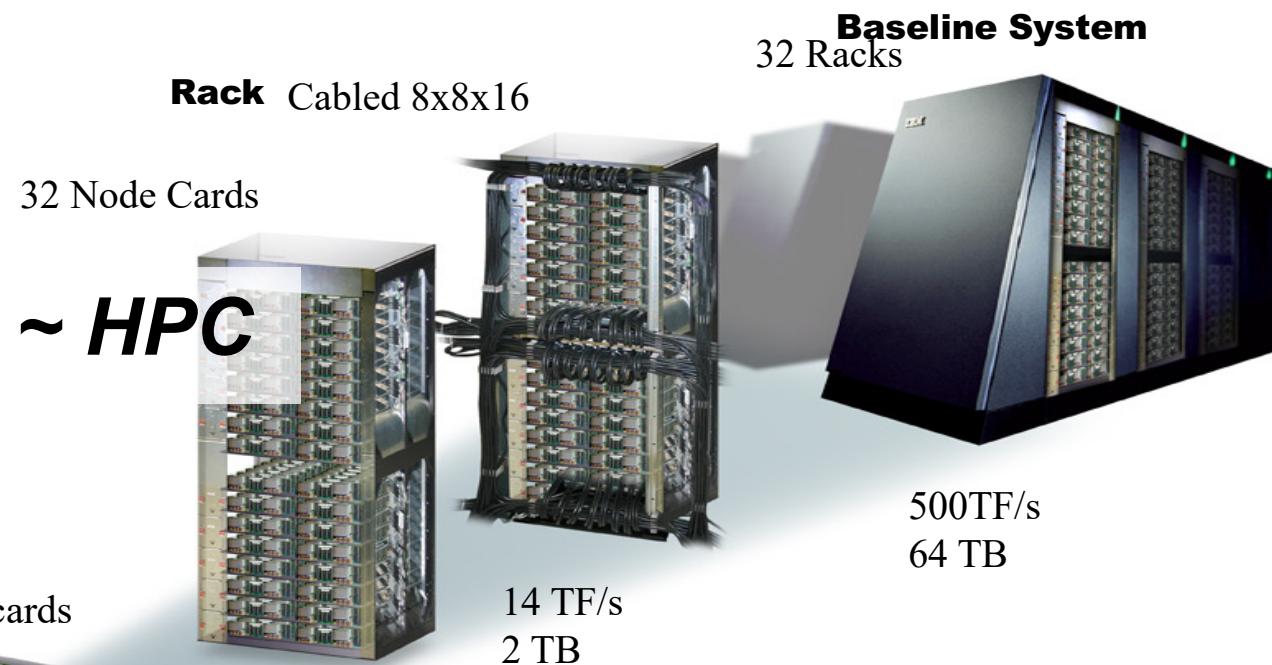


Cluster Computing



Supercomputing

Supercomputing ~ HPC



Compute Card
1 chip, 1x1x1



435 GF/s

64 GB

Chip
4 processors

13.6 GF/s
8 MB EDRAM

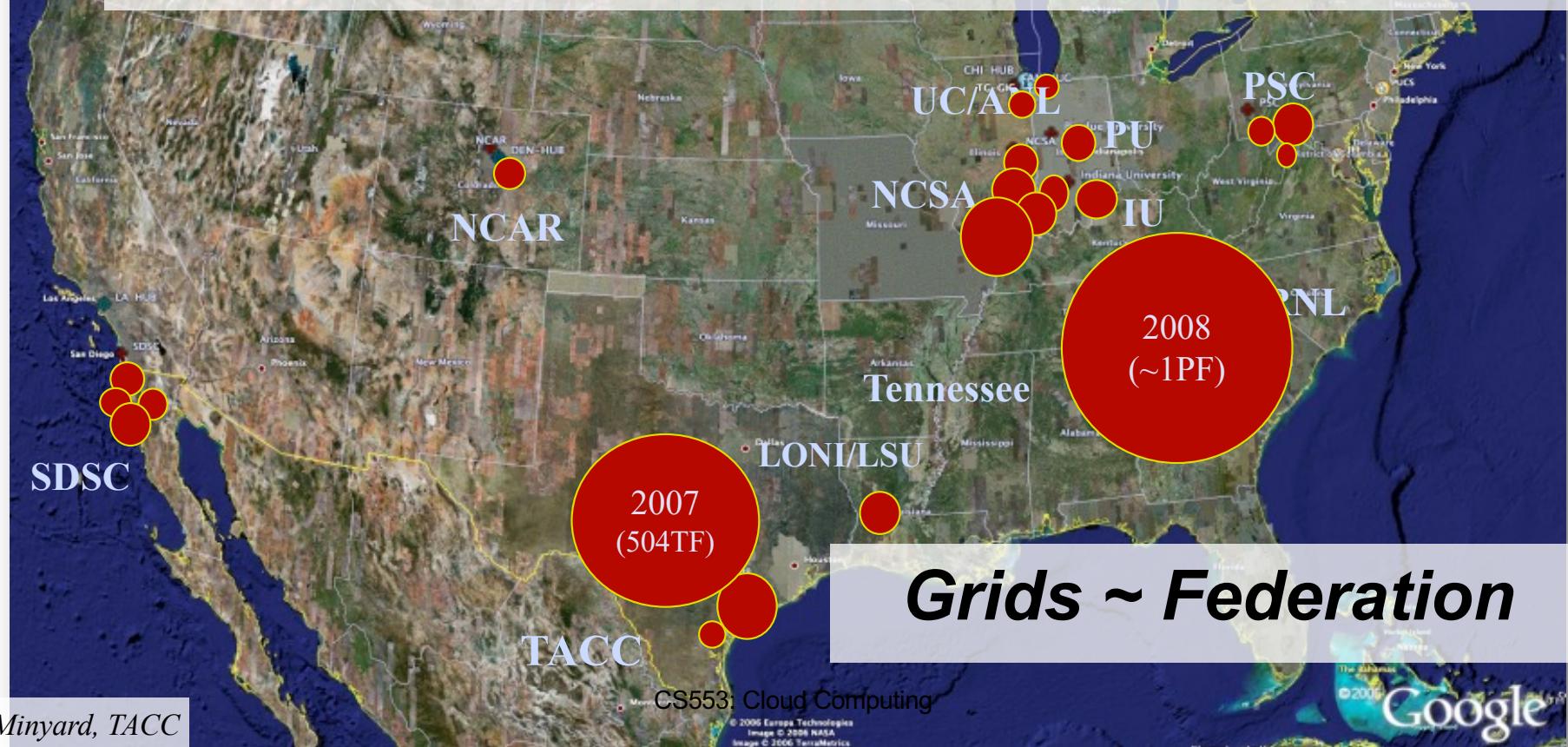
13.6 GF/s
8 MB EDRAM

C9553 Cloud Computing

Highly-tuned computer clusters using commodity processors combined with custom network interconnects and customized operating system

Grid Computing

Grids tend to be composed of multiple clusters, and are typically loosely coupled, heterogeneous, and geographically dispersed

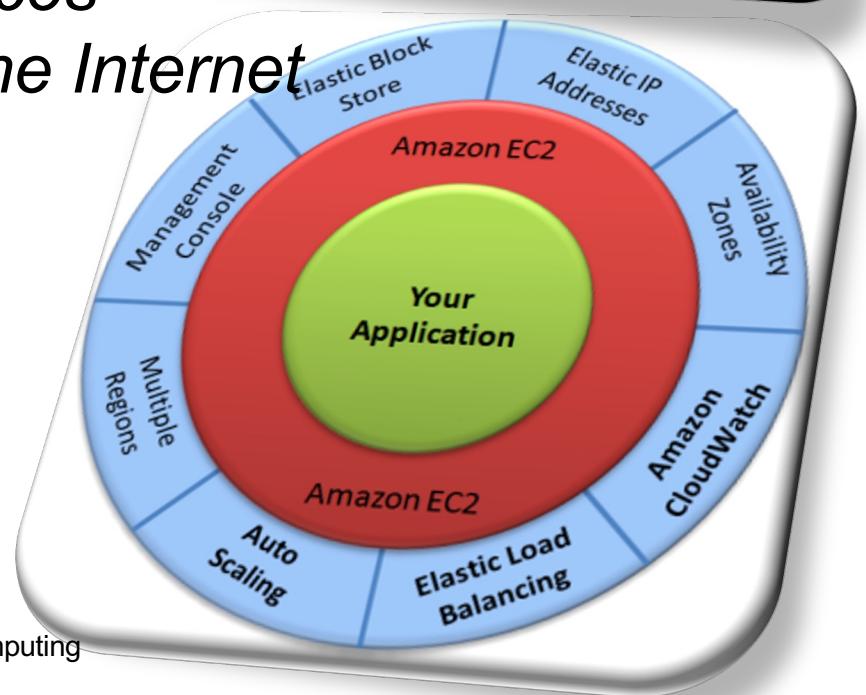


Cloud Computing

- A *large-scale distributed computing paradigm driven by:*
 1. *economies of scale*
 2. *virtualization*
 3. *dynamically-scalable resources*
 4. *delivered on demand over the Internet*



Clouds ~ hosting



Major Clouds

- Industry
 - Google App Engine
 - Amazon AWS
 - Windows Azure
 - Salesforce
- Academia/Government
 - Chameleon
 - CloudLab
- Opensource middleware
 - OpenStack

Questions

