

Distributed Systems CH1 Notes

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1 Characterization of Distributed Systems

1.1 Introduction

Distributed System: A system in which hardware or software components located at networked computers communicate and coordinate their actions only by passing messages. Can be spatially separated by any distance. Why? **To share resources.**

Resources:

Hardware: disk drives, printers etc.

Software: files, databases, data objects etc.

Consequences from the definition:

- *Concurrency:* work can be done simultaneously by different components, sharing resources as necessary.
- *No global clock:* when programs need to cooperate the coordination is done by exchanging messages (no single clock synchronized for all components of the system).
- *Independent failures:* any of the component can fail but still leave the other components running. The failure of a component or unexpected termination of a program is not immediately made known to the other components with which it communicates.

1.2 Examples of Distributed Systems:

- Web Search: need to search and index an enormous amount of data. Google's solution involves very large numbers of networked computers in data centers, a distributed file and storage system, lock service (?) and a programming model that supports the management large parallel and distributed computations.
- Massive Multiplayer Online Games (MMOGs): very large numbers of users interact through the Internet in a persistent world. Some approaches are:
 1. Client/Server: A central server with a single copy of game state distributed to clients. May use cluster of nodes to increase reliability.
 2. Partition the universe to a number of servers (ie: based on geographical location). Easy to extend by adding more servers.
 3. P2P technology (each client contributes resources such as storage and processing to accommodate the game). See Chapters 2 and 10.
- Financial Trading: need to have real-time access to a wide range of data (ie: current share prices, trends, economic/political developments etc). The emphasis is to deliver events such as a drop in a share price reliably and quickly to very large numbers of clients. Client/Server doesn't work! Solution: *distributed event-based systems* (see Chapter 6).

1.3 Trends in Distributed Systems

Changes caused by:

- Pervasiveness of networking technology. For example, the Internet.
- Ubiquitous computing + desire for mobile distributed computing.

Ubiquitous computing: constantly harnessing many small, cheap computational devices in users' physical environments to the point of them not being noticed. Devices are generally fixed to their environments.

Mobile computing: laptop computers, smart phones, GPS, etc. Users can take the device with them.

spontaneous interoperation: allowing visitor devices to quickly communicate with others on the host network.

service discovery: associating visitor devices with suitable local services

- Increasing demand for multimedia services. The system should support storage, transmission and presentation of a range of media types.

discrete media: text messages, pictures

continuous media: audio, videos (has a temporal dimension) -> needs to preserve a throughput such as frames per second & maximum delay/latency.

- The view that distributed system is a utility. Physical resources such as storage and processing can be made available to networked computers. Software services can also be made available.

cloud computing: computing as a utility. A cloud is a set of Internet-based application, storage and computing services for most users' needs. Generally implemented on cluster computers to provide the necessary scale and performance.

cluster computer: a set of interconnected computers that cooperate closely to provide a single, integrated high-performance computing capability.

blade servers: minimal computational elements containing processing & storage capabilities.

1.4 Focus on Resource Sharing