peer-to-peer and agent-based computing

Peer-to-Peer Computing: Introduction

UNIVERSITY of ABERDEEN

Introduction

- Peer-to-peer (P2P):
  - Systems/applications that employ distributed resources to perform a critical function in a decentralised manner

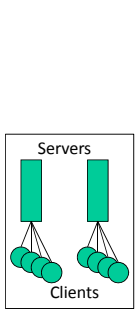
Resources:
- Computing power
- Data (storage space or contents)
- Bandwidth
- Presence (computer, human, resource)

Functions:
- Distributed computing
- Data/content sharing
- Communication/collaboration

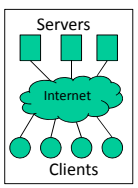
Decentralisation:
- Algorithms
- Data/meta-data
- Both

Introduction (Cont'd)

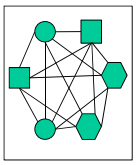
- Evolution of network computing:



Client-Server Silos



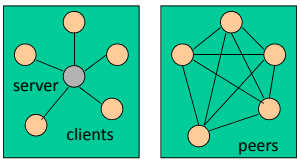
Internet Computing


Peer-to-Peer

Introduction (Cont'd)

- P2P systems
  - May retain centralisation in some parts
  - Typically reside on the edges of Internet
  - Also found in ad-hoc networks
- P2P computing is an alternative to
  - Centralised
  - Client/server

  models of computing



A bit of history

- P2P is a natural evolution:
  - Software engineering trends towards distributed systems
  - Availability of powerful networked computers and inexpensive bandwidth
- P2P is not new (although the term is…)
- Early attempts:
  - USENET (1979) for newsgroups (still in use…)
  - FidoNet (1984) for exchanging message among different BBS systems (still in use…)

Why P2P?

- Cost sharing or reduction
  - Servers bear the brunt of costs in DS
- Improve scalability and reliability
  - More peers can be added at will
  - If a peer fails to deliver, another steps in…
- Resource aggregation and interoperability
  - E.g., distributed file systems
- Increase autonomy
- Promote anonymity and privacy
- Support highly dynamic environments
- Enable ad-hoc communication/collaboration

Some terminology…

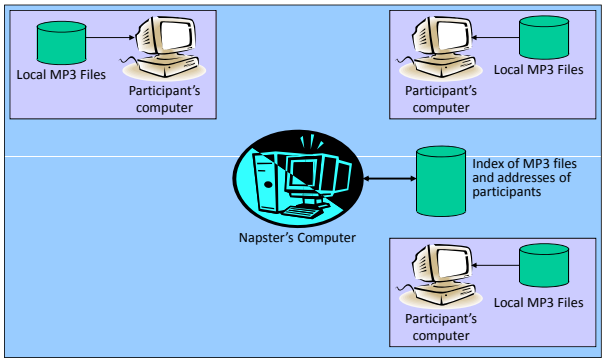
- Client:
  - Computing entity that initiates requests
  - Not able to serve requests
- Server:
  - Computing entity that serves requests
  - Not able to initiate requests
- Peer:
  - Computing entity with similar capabilities as other entities in the system
- P2P Model:
  - Peers share their resources with a limited interaction with a centralised server
  - Peers are simultaneously client and servers

A case study: Napster

- P2P network (`http://www.napster.com`)
- History:
  - Born in 1999 (universities notice first…)
  - Mid 2001: shut down service
  - 2002: all but gone!
- Members can:
  - Connect directly to other member's computers
  - Search hard drives for digital music files

A case study: Napster (Cont'd)

- How it works:



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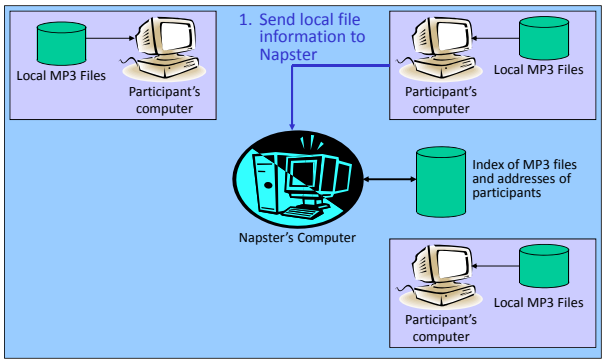

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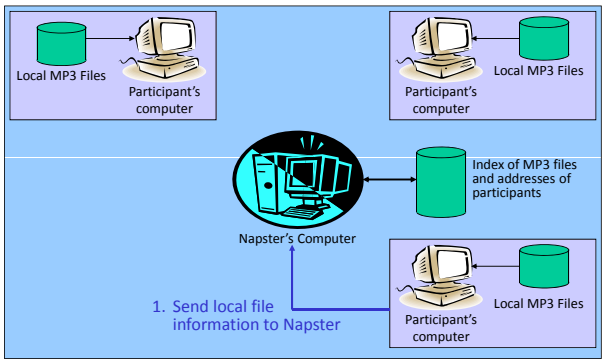

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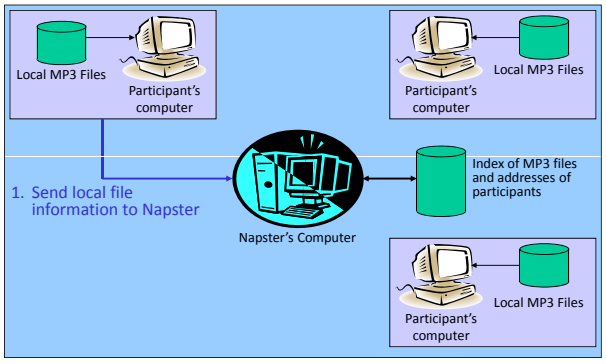

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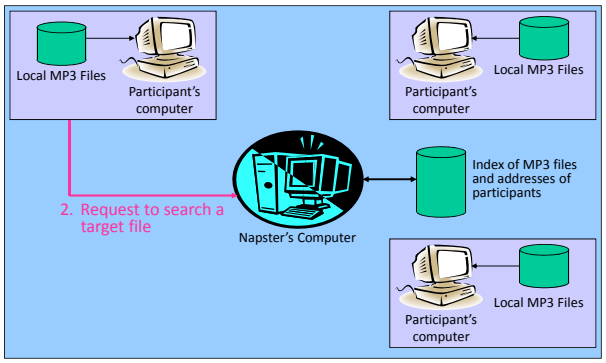

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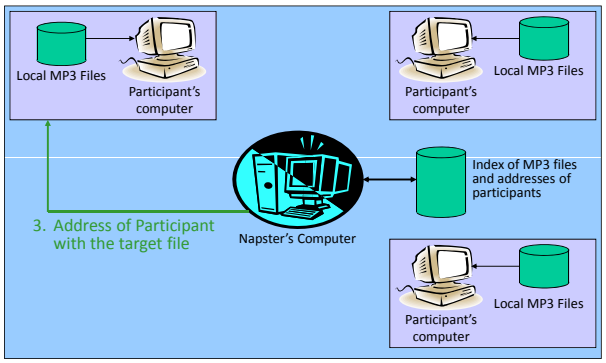

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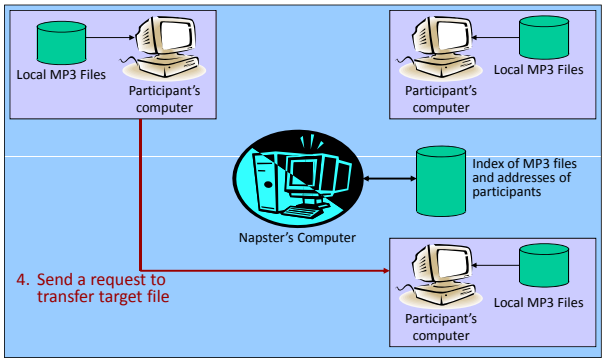

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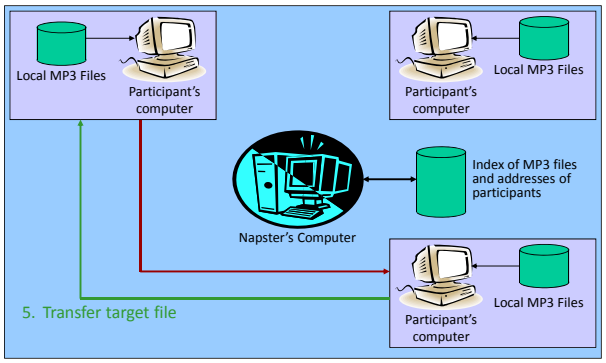

A case study: Napster (Cont'd)

- File download directly between members' computers, bypassing the central computer
- Central computer necessary for initial contact, though.
- Over 36 million people joined Napster
- Limitation: only music files
- Legal issues concerning copyrighted material being freely distributed:
  - Napster never stored any MP3 files!
  - It provided means for people to exchange such files, though…

P2P applications

- Three (3) main classes of P2P applications have emerged:
  - Parallelisable
  - Content and file management
  - Collaborative

P2P parallelisable applications

- Large task is split into subtasks which are performed by peers.
- Principle:
  - Idle time of computers can be used to solve complex problems.
- In some cases, same task is performed by different peers using different parameters
- Examples:
  - SETI@Home (Search for Extra-Terrestrial Intelligence)
  - Intel's Philanthropic Peer-to-Peer Program ("Progress thru Processors")

P2P content & file management

- Storage and retrieval of information on/from peers
- Peers can search for and download files that other peers have made available
- Current systems rely on users to
  - Choose which peer to download file from
  - Retry if download fails
- Examples:
  - Napster (www.napster.com)
  - Gnutella (www.gnutella.com)

P2P collaborative applications

- Allow users to collaborate in real-time
- Do not rely on central servers to collect and relay information
- Examples:
  - Instant messaging (ICQ, AOL, MSN, Yahoo!)
  - Co-authoring tools (Distributed Powerpoint)
  - Massive Multiplayer Online Games (MMOG)

P2P: target environments

- Target environments:
  - Internet, intranets and ad-hoc networks
- Most frequently:
  - Personal computers connected to the Internet
- New trend:
  - P2P for ad-hoc networks of handheld devices

P2P markets

- Three main markets:
  - Consumer
  - Enterprise
  - Public

Consumer:
- Content and file sharing
- Instant messaging
- Games

Enterprise:
- B2B
- Finances
- Entertainment (e.g. VOD)

Public:
- Information sharing
- Education

P2P: an informal architecture

- P2P
  - is not syndicated,
  - hence there is not one unique architecture

P2P: an informal architecture

- One possible architecture is: