Content Search

Unstructured P2P

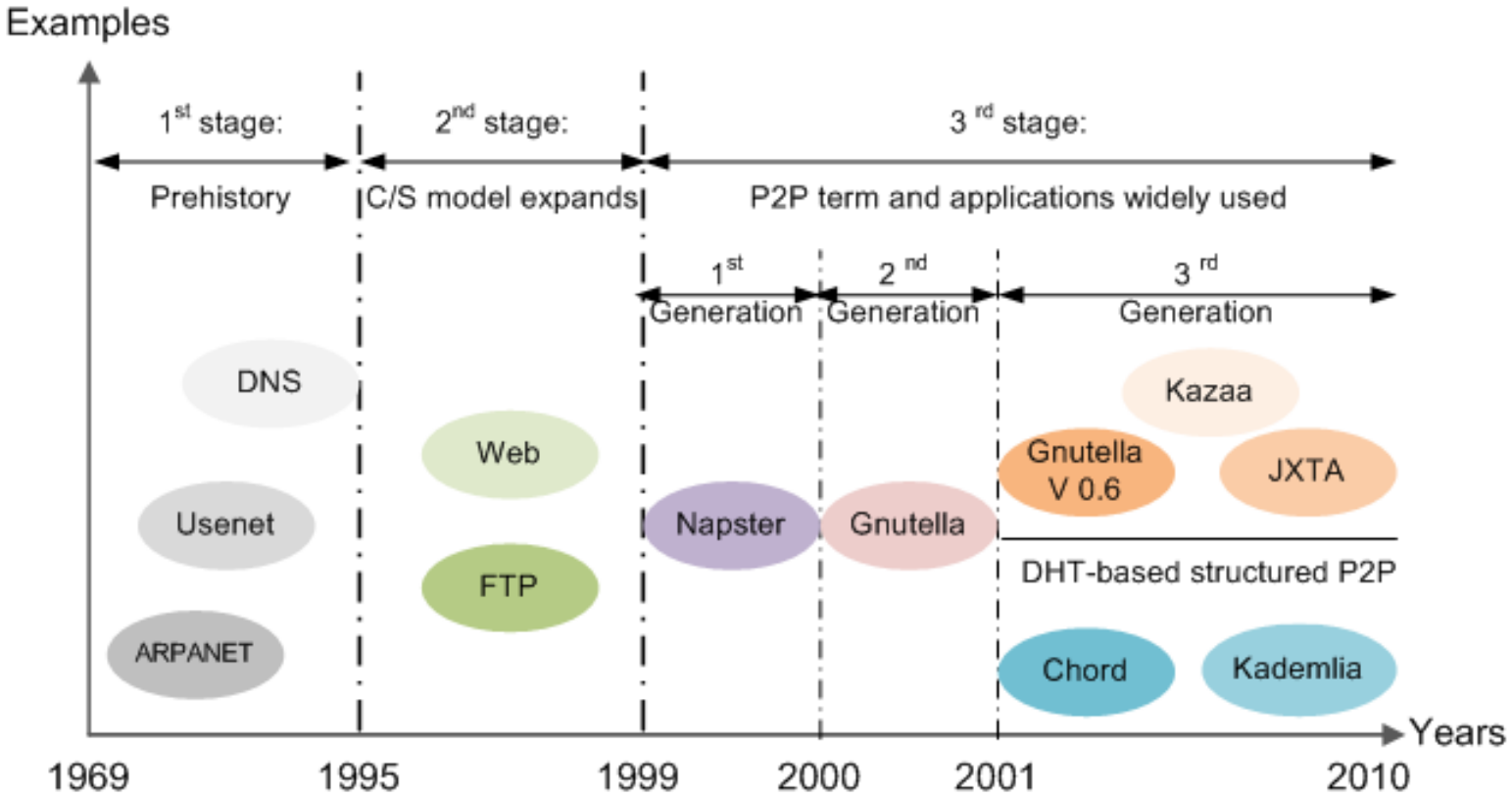
Prof. Jukka K. Nurminen
Data Communications Software (DCS) Lab,
Department of Computer Science and Engineering,
Aalto University

*Partly adapted from original slides provided by Rüdiger Schollmeier and Jörg Eberspächer (Technische Universität München)

Schedule

Tue 13.9.2010 14-16	Introduction to P2P (example P2P systems, concepts)	Content delivery (BitTorrent and CoolStreaming)
Tue 20.9.2010 14-16	Unstructured content search (Napster, Gnutella, Kazaa)	Structured content search (DHT)
Tue 27.9.2010 14-16	Energy-efficiency & Mobile P2P	

History of P2P Networks (Cont.d)

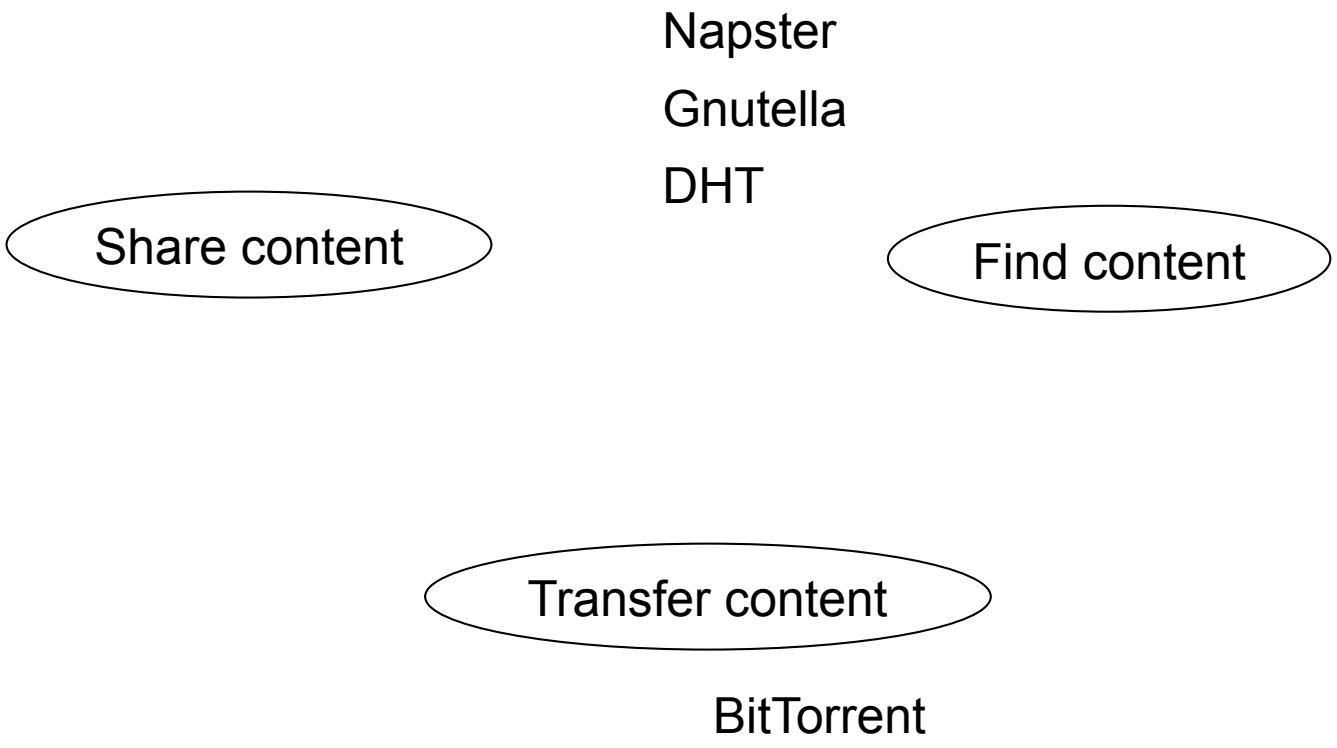


1. (1969–1995) Prehistory: P2P thought burgeoning;

2. (1995–1999) Internet explosion: P2P concept retrogressive;

3. (1999–?) P2P term widely used: P2P-based applications blossom.

Steps of content sharing



X.1 The Architectures of 1st and 2nd Gen. P2P

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2. Server as the higher performance system.
3. Clients as the lower performance system

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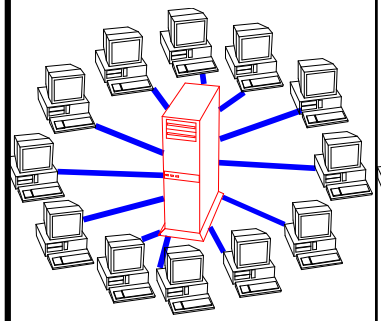
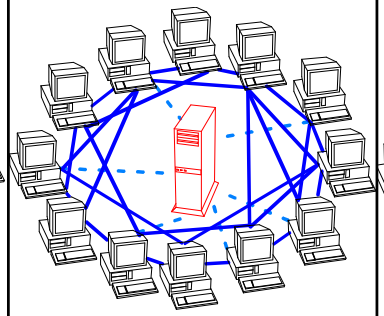
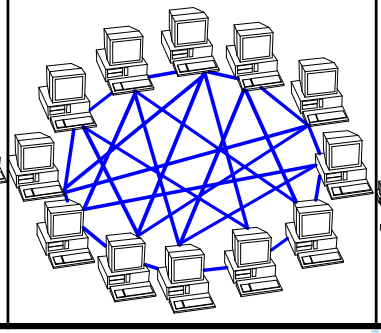
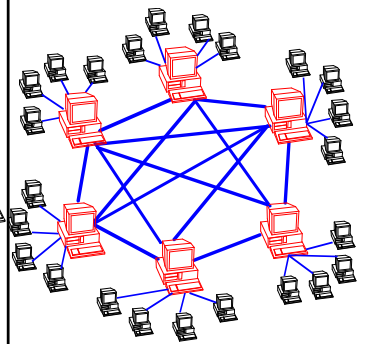
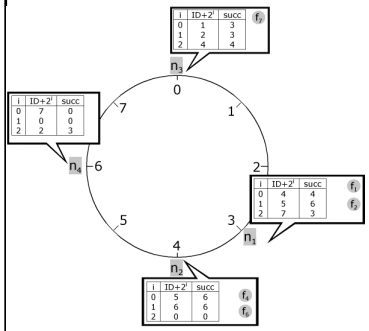
<tr><td>  </td><td>  </td><td>  </td><td>  </td><td>  </td></tr>
</table>

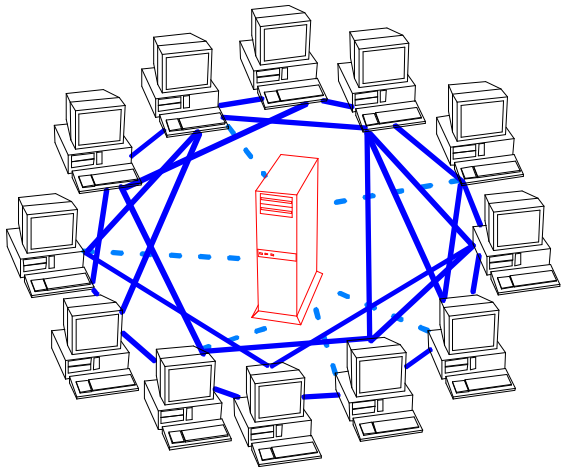
1st Gen. **2nd Gen.**

Further reading

- Ralf Steinmetz, Klaus Wehrle (Eds.): Peer-to-Peer Systems and Applications. Lecture Notes in Computer Science, Volume 3485, Springer, Berlin 2005
- Available (also electrically) at TKK library

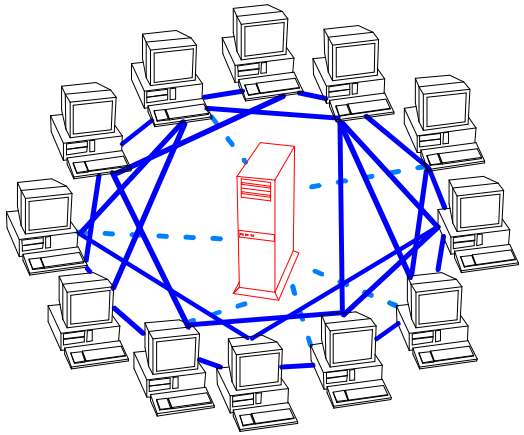
X. Overview

1. Centralized Peer-to-Peer Networks
2. Pure Peer-to-Peer Networks
3. Hybrid Peer-to-Peer Networks



X.2 Definition of centralized P2P

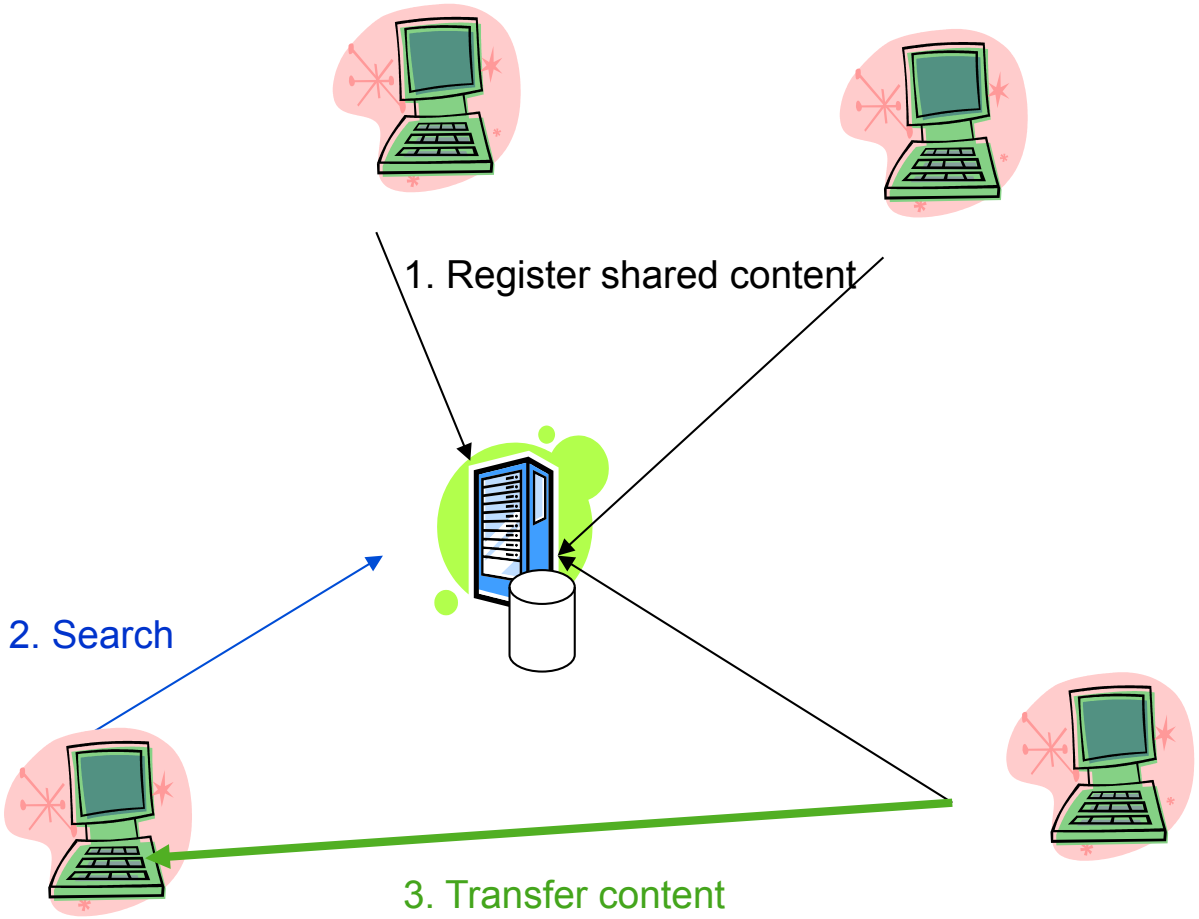
- All peers are connected to central entity
- Peers establish connections between each other on demand to exchange user data (e.g. mp3 compressed data)
- Central entity is necessary to provide the service
- Central entity is some kind of index/group database
- Central entity is lookup/routing table



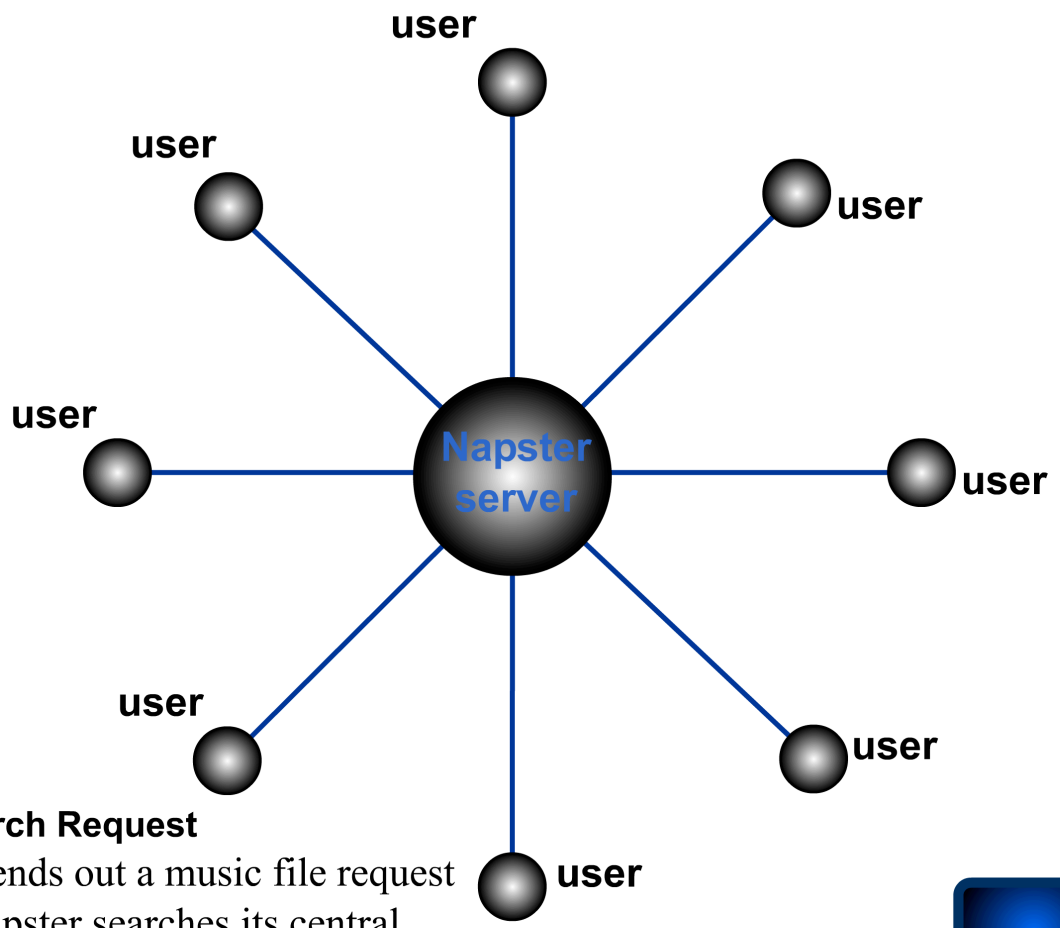
X.2 Example: Napster

- Program for sharing files over the Internet
- A “disruptive” application/technology?
- Brief History:
  - **May 1999**: Shawn Fanning (freshman, Northeastern University) founds Napster Online music service
  - **December 1999**: First Lawsuit
  - **March 2000**: University of Wisconsin reports that 25% of its IP traffic is Napster traffic
  - **December 2000**: estimated 60 million users
  - **February 2001**: US Circuit Court of appeals: napster knew users violating copyright laws
    →Shut down of the service

Napster



X.2 Napster animation



1) Search Request

User sends out a music file request and Napster searches its central data base

X.2 Discussion

- Advantages
  - Simple
  - Efficient, little load for peers => also weak peers (mobiles) able to participate
  - Fast and complete lookup (one hop lookup)
  - Central managing/trust authority
  - Advertising business model
  - Clear legal responsibility

- Disadvantages
  - Single Point of Failure →easily attackable
  - Bottleneck
  - Potential of congestion

- Other applications and application areas
  - BiTorrent
  - VoIP (SIP, H.323)

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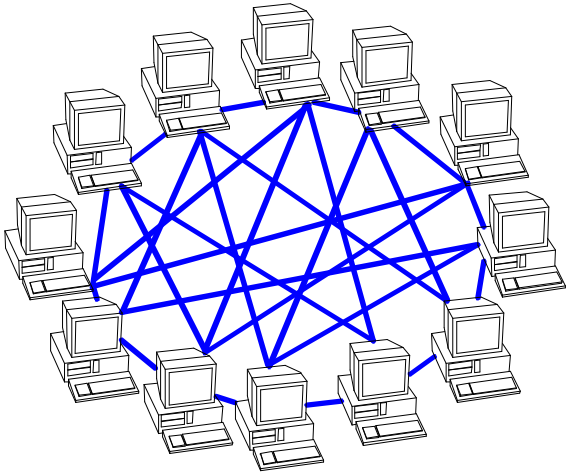
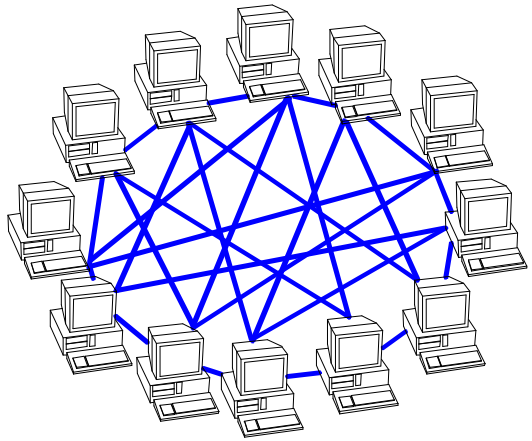


X.3 Definition of Pure P2P

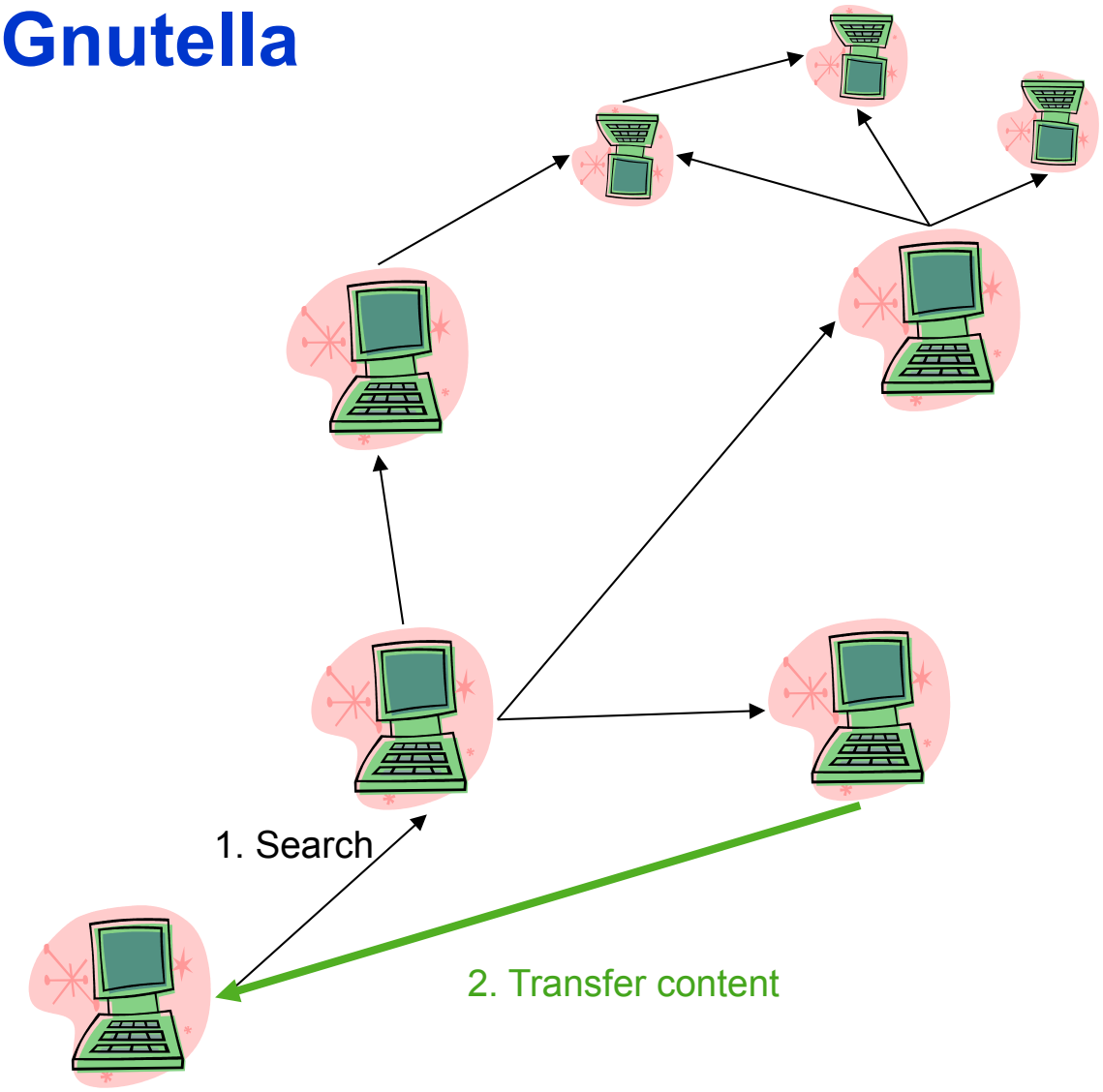
- Any terminal entity can be removed without loss of functionality
- No central entities employed in the overlay
- Peers establish connections between each other randomly
  - To route request and response messages
  - To insert request messages into the overlay



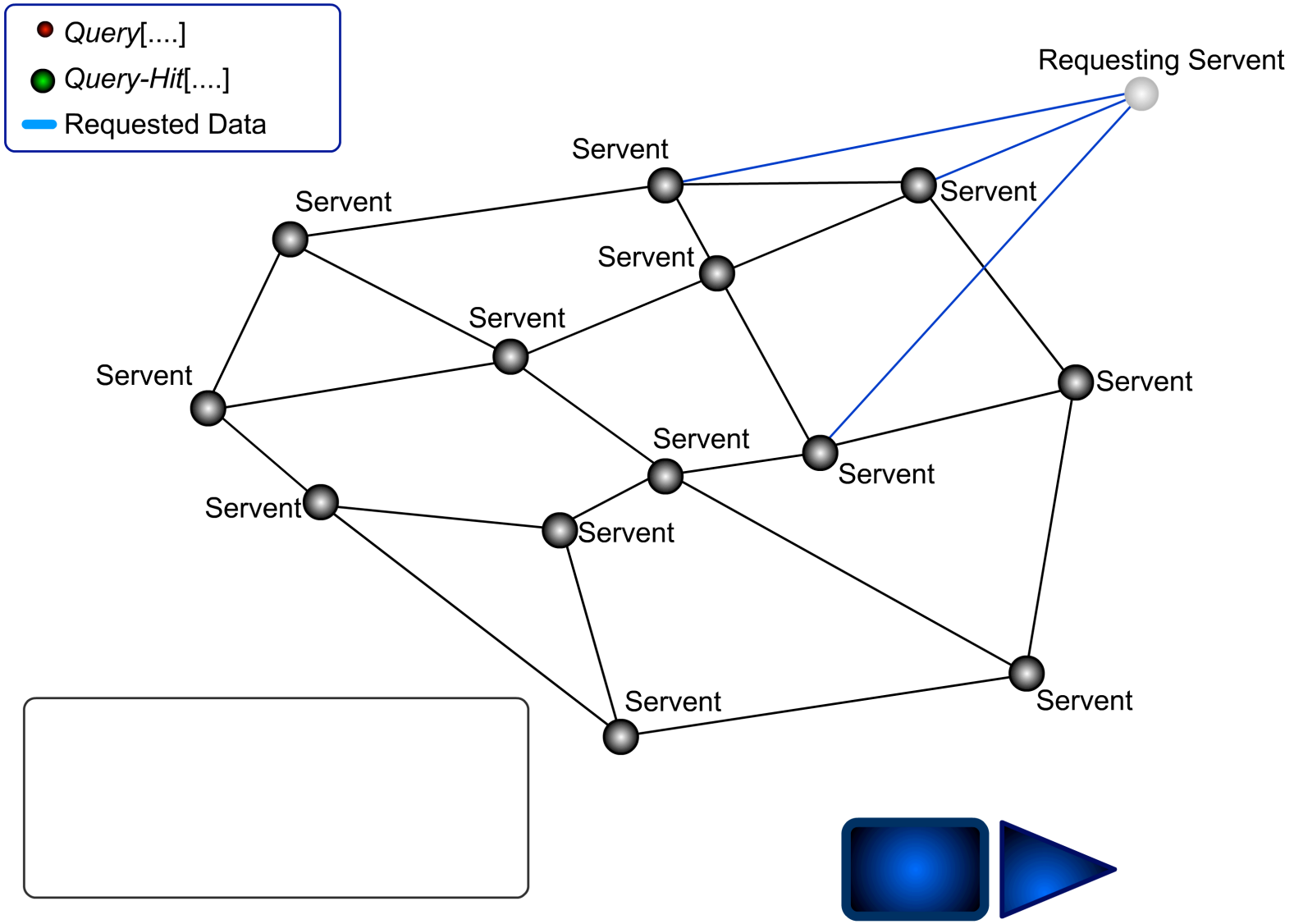
X.3 Example: Gnutella 0.4

- Program for sharing files over the Internet
- Focus: decentralized method of searching for files
- A “disruptive” application/technology?
- Brief History:
  - **March 2000**: open source release by by Justin Frankel and Tom Pepper of Nullsoft, a division of AOL, and almost immediately withdrawn
  - **Spring 2001**: further developments to improve scalability → Gnutella 0.6 (Hybrid P2P)
  - Since then:
    - available in a lot of implementations (Limewire, bearshare,…)
    - Developed further on (privacy, scalability, performance,…)

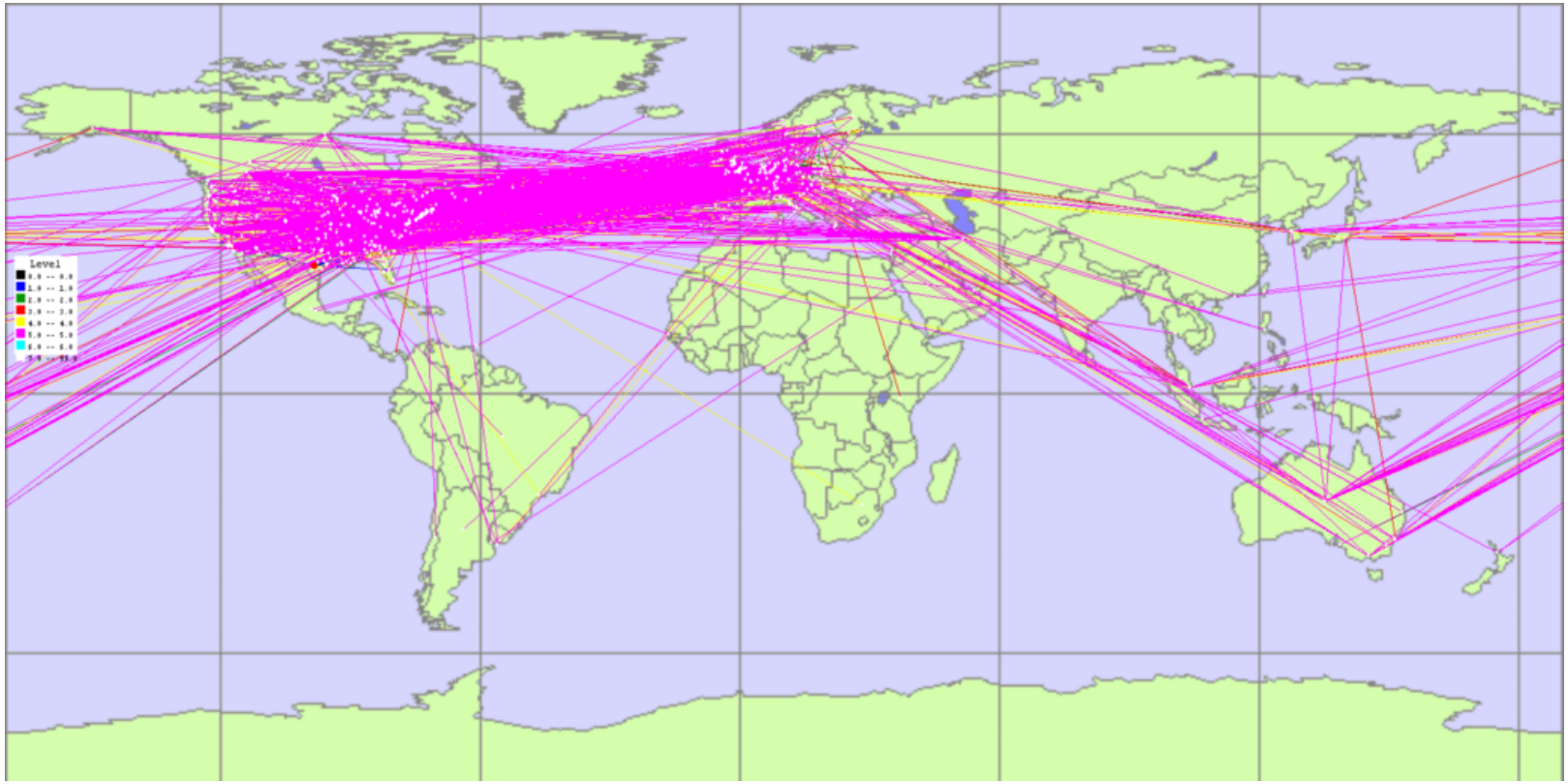
Gnutella



Gnutella Animation



X.3 The Gnutella Network



Measurements taken at
the LKN in May 2002

X.3 Discussion

- Advantages
  - Genuine P2P
  - Fully distributed, no servers
  - No single point of failure
  - Can provide anonymity
- Disadvantages
  - Flooding creates a lot of traffic
  - Unequal distribution of load
  - No responsible party
    - Business model?
    - Legal responsibility?
  - Overlay topology not optimal, as
    - no complete view available,
    - no coordinator
    - Zigzag routes, loops
    - If not adapted to physical structure delay and total network load increases
- Other applications and application areas
  - Freenet
    - Focus on anonymity and privacy
    - Content is transferred in chunks over the signaling network

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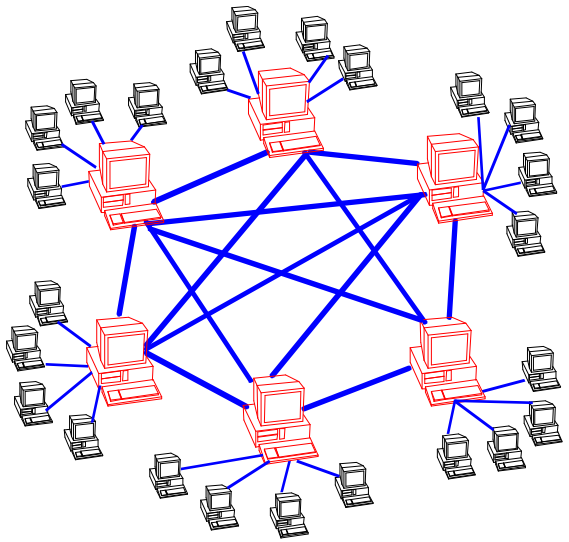
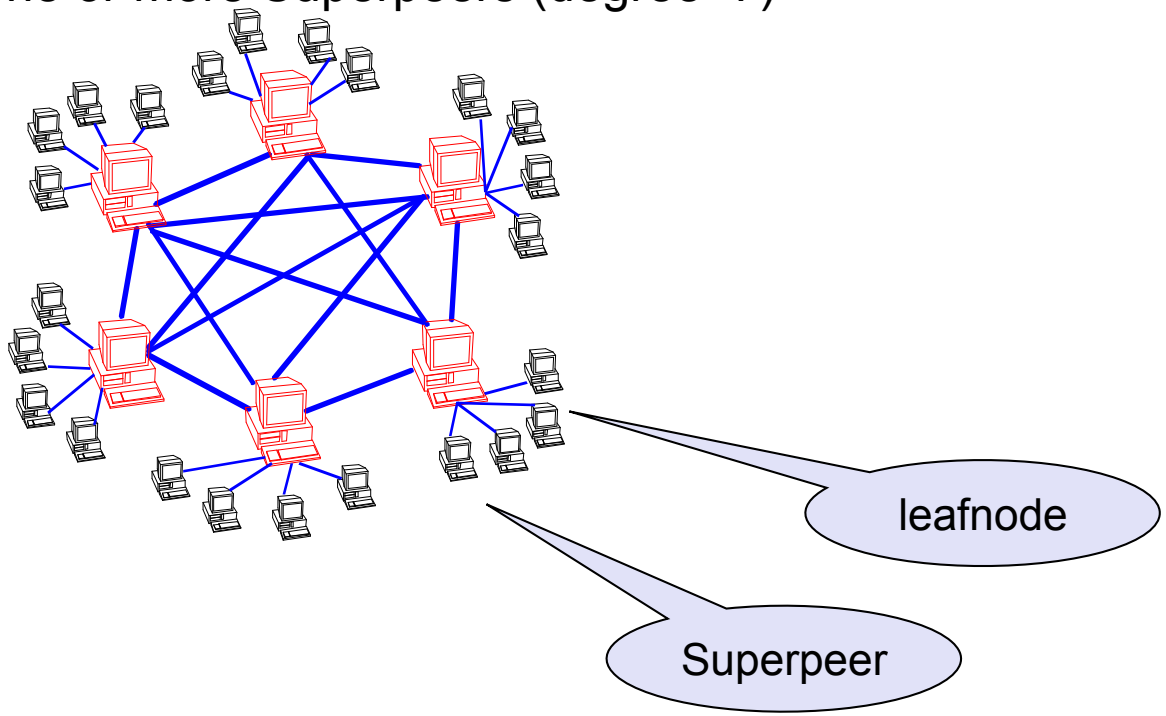
2. Pure Peer-to-Peer Networks
3. Hybrid Peer-to-Peer Networks



X.4 Definition of Hybrid P2P

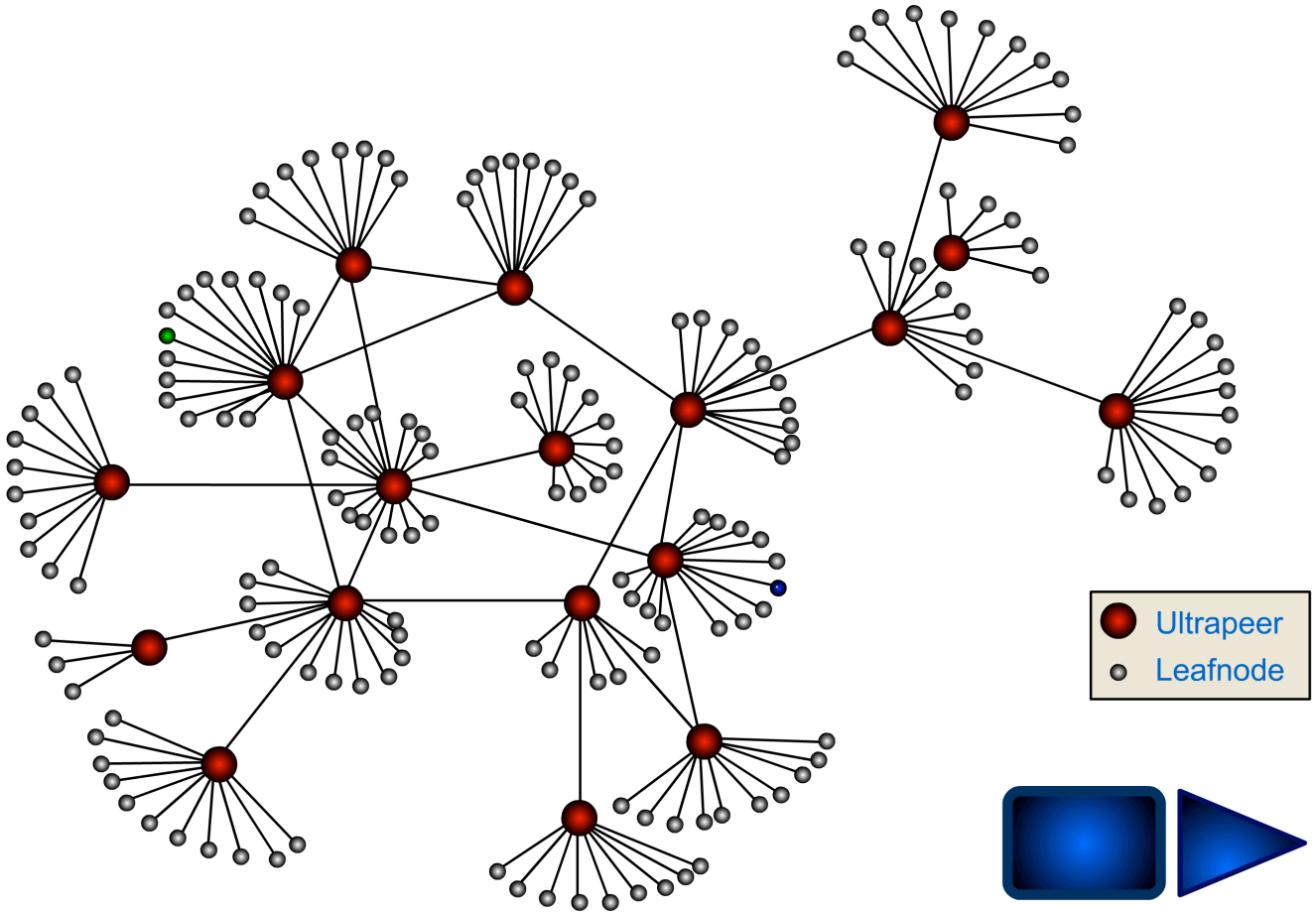
- Main characteristic, compared to pure P2P: Introduction of another dynamic hierarchical layer
- Hub based network
- Reduces the signaling load without reducing the reliability
- Election process to select an assign Superpeers
- Superpeers: high degree (degree>>20, depending on network size)
- Leafnodes: connected to one or more Superpeers (degree<7)



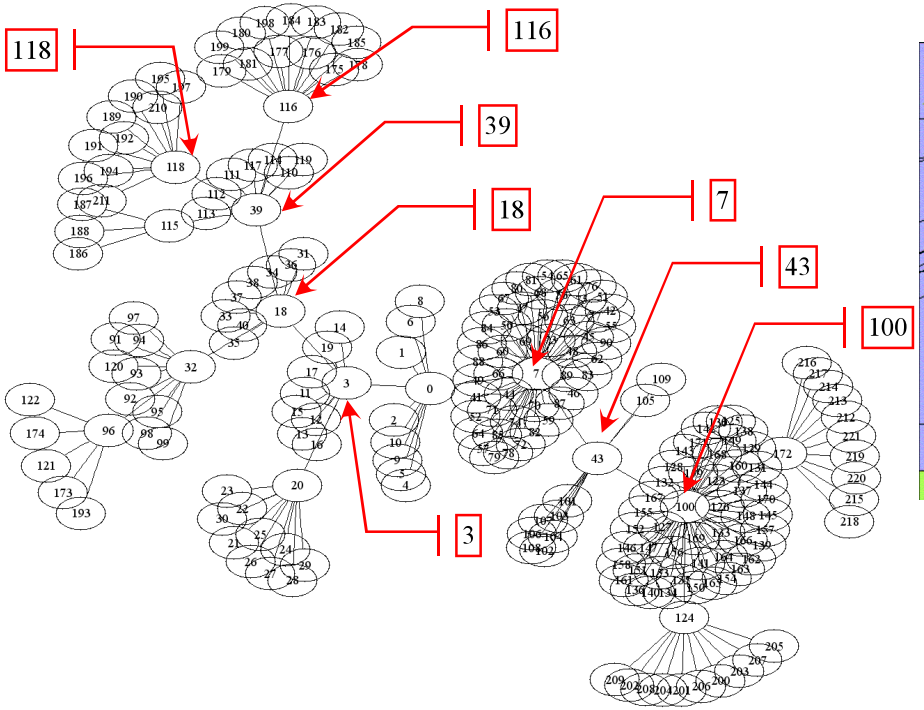
X.4 Example: Gnutella 0.6

- Program for sharing files over the Internet
- Focus:
  - decentralized method of searching for files
  - Higher signaling efficiency than Pure P2P
  - Same reliability (no single point of failure)
- Basis of most file-sharing applications (not BitTorrent)
- Brief History:
  - **Spring 2001**: resulted from Gnutella 0.4 by further developments to improve scalability → Gnutella 0.6 (Hybrid P2P)
  - Since then:
    - available in a lot of implementations (Limewire, bearshare,…)
    - Developed further on (privacy, scalability, performance,…)

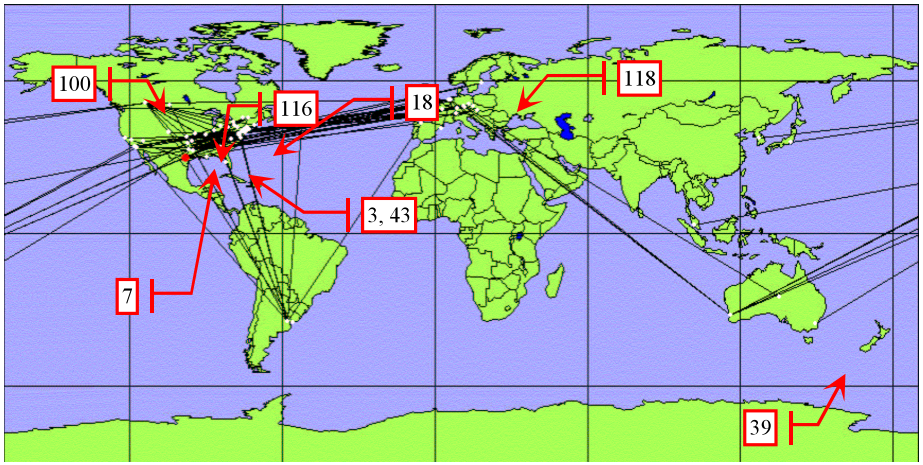
Gnutella 0.6 Animation



X.4 Topology of Hybrid P2P



Abstract network structure of a part of the Gnutella network (222 nodes Geographical view given by Figure on the right, measured on 01.08.2002



Geographical view of a part of the Gnutella network (222 nodes); The numbers depict the node numbers from the abstract view (Figure on the left, measured on 01.08.2002)

- Virtual network not matched to physical network. See path from node 118 to node 18.
- Superpeer (hub) structure clearly visible in abstract view

How Skype works

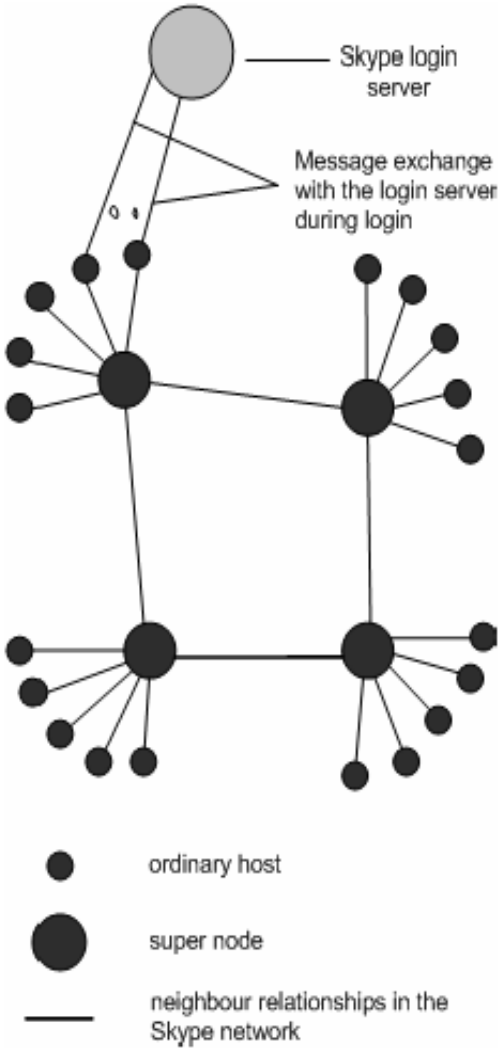


Figure 1. Skype Network. There are three main entities: supernodes, ordinary nodes, and the login server.

Salman A. Baset and Henning Schulzrinne. An analysis of the Skype peer-to-peer Internet Telephony Protocol, Columbia University

X.4 Discussion

- Advantages
  - No single point of failure
  - Can provide anonymity
  - Heterogeneous devices
- Disadvantages
  - Still high signaling traffic, because of decentralization
  - No definitive statement possible if content is not available or not found
  - Overlay topology not optimal, as
    - no complete view available,
    - no coordinator
    - Zigzag routes, loops
    - Can not be adapted to physical network completely because of hub structure
  - Asymmetric load (Superpeers have to bear a significantly higher load)
- Application areas
  - File-sharing (Edonkey, Kazaa/FastTrack, Emule)
  - VoIP (Skype)

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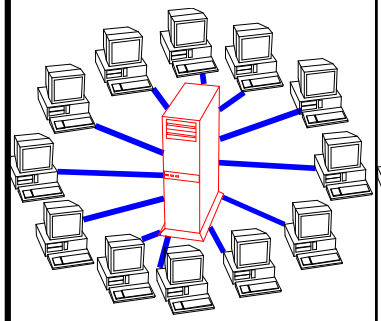
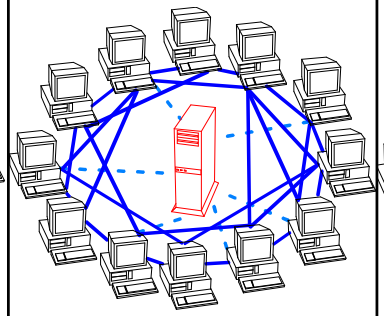
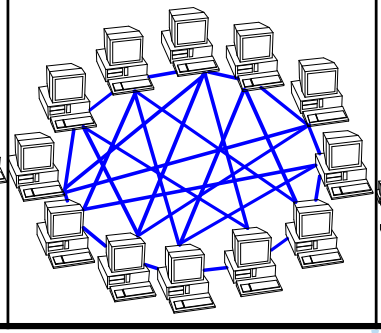
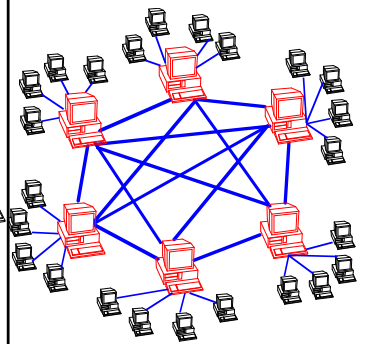
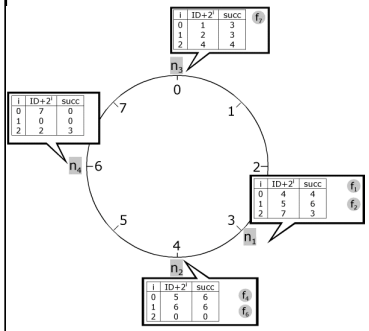
<tr><td>  </td><td>  </td><td>  </td><td>  </td><td>  </td></tr>
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