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Overview of P2P

Prof. Khuller's class - UMD

*ACK: Ross & Rubenstein INFOCOM
2003 tutorial on "P2P Systems"*

***“Scientists discover the
world that exists;
engineers create the world
that never was.”***

— Theodore von Karman

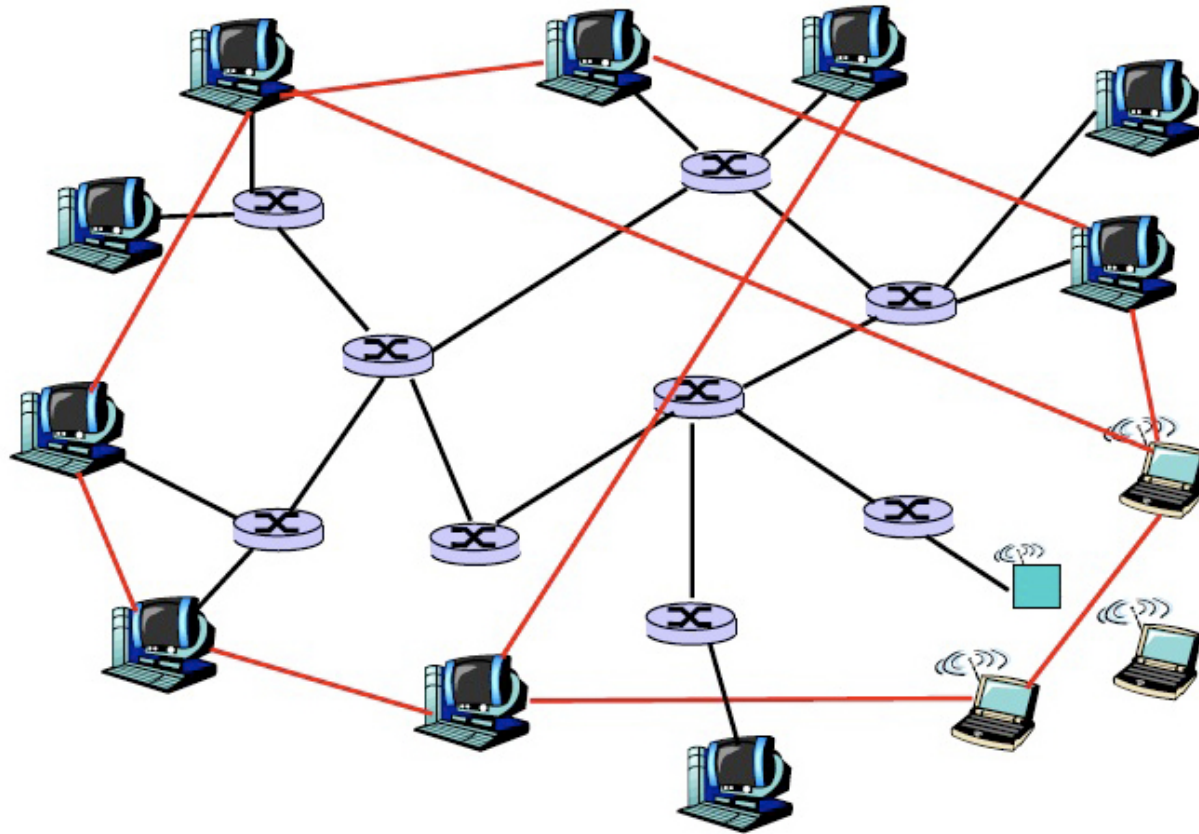
Definition/Characteristics

- Autonomy (in a significant way) from central server
- Use of resources at the edge of the network (storage, content, CPU cycles, etc)
- Resources (nodes) churn (not always connected, come and go)

Applications/Systems

- Unstructured/file sharing - Napster, Gnutella, KaZaA, etc.
- Structured DHTs and their applications - Chord, CAN, Pastry, Tapestry, etc.
- Communication - VoIP (Skype), instant messaging
- Other applications - PlanetLab, wireless/adhoc networking?
- Computation - seti@home

Overlay Networks



Overlay (cont)

- Virtual edges (e.g., through TCP connections)
- Maintenance
 - Need to make sure neighbor is still alive (ping, or other message exchange)
 - When one neighbor leaves, might want to add another one
 - New nodes need to “insert” themselves into the overlay (bootstrap)

Overlays (cont.)

- Unstructured overlays (e.g., nodes randomly choose N existing nodes as neighbors)
- Structured overlays (e.g., there is a strict structure to how edges are arranged)
- Proximity (in the network sense or geographic sense) is not always considered

All Application Layer

- Flexibility in design, how topology is maintained, what protocols are used (TCP, UDP), how messages are constructed and what message types are used, and so on
- Physical network transparent to (most) developers

Application: file sharing

- Run P2P client on your computer
- When connecting to Internet, can have a new IP address each time
- Register your content with P2P system
- When accessing content
 - Ask for file (e.g., song)
 - Get information on what other peers have that file
 - File copied from one of the peers to your computer
 - During that time, others might copy files from you

File sharing (cont)

- Napster (proof of concept)
- Gnutella (open source)
- KaZaA (proprietary protocol)
- Others?

*What is the secret of success:
lots of capacity in the system,
or “free” content?*

Copyright

- End users who download or upload copyrighted material
- Others: know of end users who do this or contribute to their doing this
- Or, those who are able to control/terminate such use or obtained benefit from this

Copyright (cont.)

- Betamax (VCR) defense (not only/main use); didn't work for Napster
- What should developers do?
 - Either total control (don't allow copyrighted material)
 - Or, no control at all over users (I.e., no way to stop them and no promotion of use of copyrighted material) and decoupling of functions (indexing, searching, transferring)

Application: instant messaging (IM)

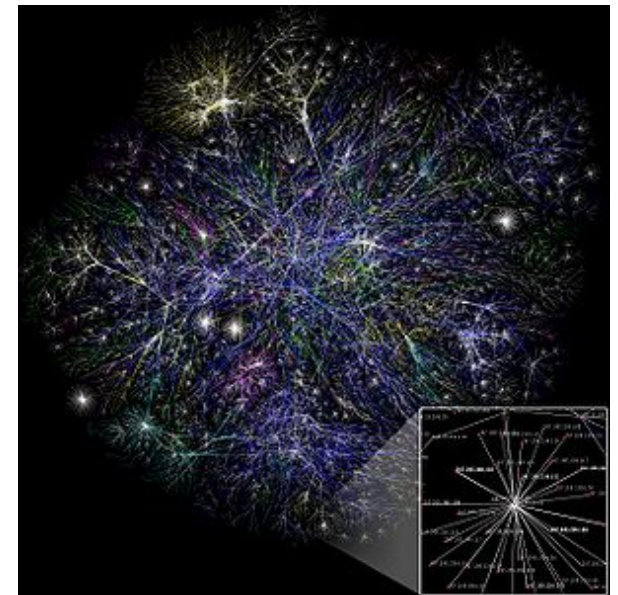
- You run IM client on your computer
- Connect to Internet, when needed, possibly with a different IP address each time
- Register yourself with the system
- Get information from the system as to who is currently active
- Then, connect directly (through TCP) to your friend
- Can be text, voice, video ... e.g., Skype

Application: computation

- Seti@home
- Search for ET intelligence
- Central server collects radio telescope data
- Data is divided into pieces
- User client (runs in background) connects (TCP) to central server, obtains data, does FFT on it, and uploads the results back
- Not strictly P2P (not between peers), but does exploit (in a distributed manner) edge resources

Future Vision

- Your computer is just part of a “big” global computer
- Challenges
 - Heterogeneity of resources
 - Security/privacy
 - Charging/paying
 - Others?



Questions?