Peer-to-Peer Media: Paradigms and Technologies

Dimitris Vyzovitis

Media and Networks

MIT Media Laboratory

vyzo@media.mit.edu

http://mayhem.media.mit.edu

Overview

- Media in the Internet
- From Client-Server to Decentralized Media Distribution
- Peer-to-Peer Networks
- Technology for Next Generation Peer-to-Peer Networks
- Some Related Work at the Media Lab
- Discussion

Media in the Internet

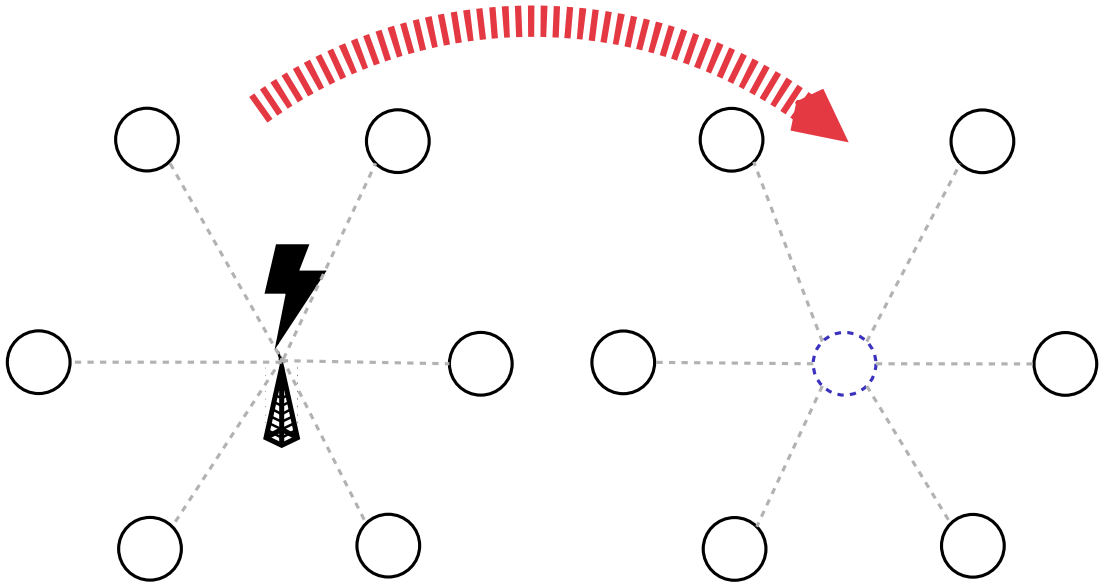
Thesis: The Internet is a fundamentally different medium for communication and media distribution and exchange.

- Open and Dynamic Environment
- Groupwise Nature of Interactions
- Designed for Multiple, Simultaneous Connections and Interactions
- A Pervasive Computation and Communication Environment

Yet this connectivity is unrealized in many ways – both in current applications and mindset . . .

From Broadcast Media to the Internet

The current state of media distribution...



Broadcast media distribution (tv/radio)

Server-centric media distribution

Is this all? Is this what the Internet is about?

Why Peer-to-Peer Media?

Social reasons . . .

- People want to share their content
- People produce their own content and want to distribute it
- People want to find what content is available

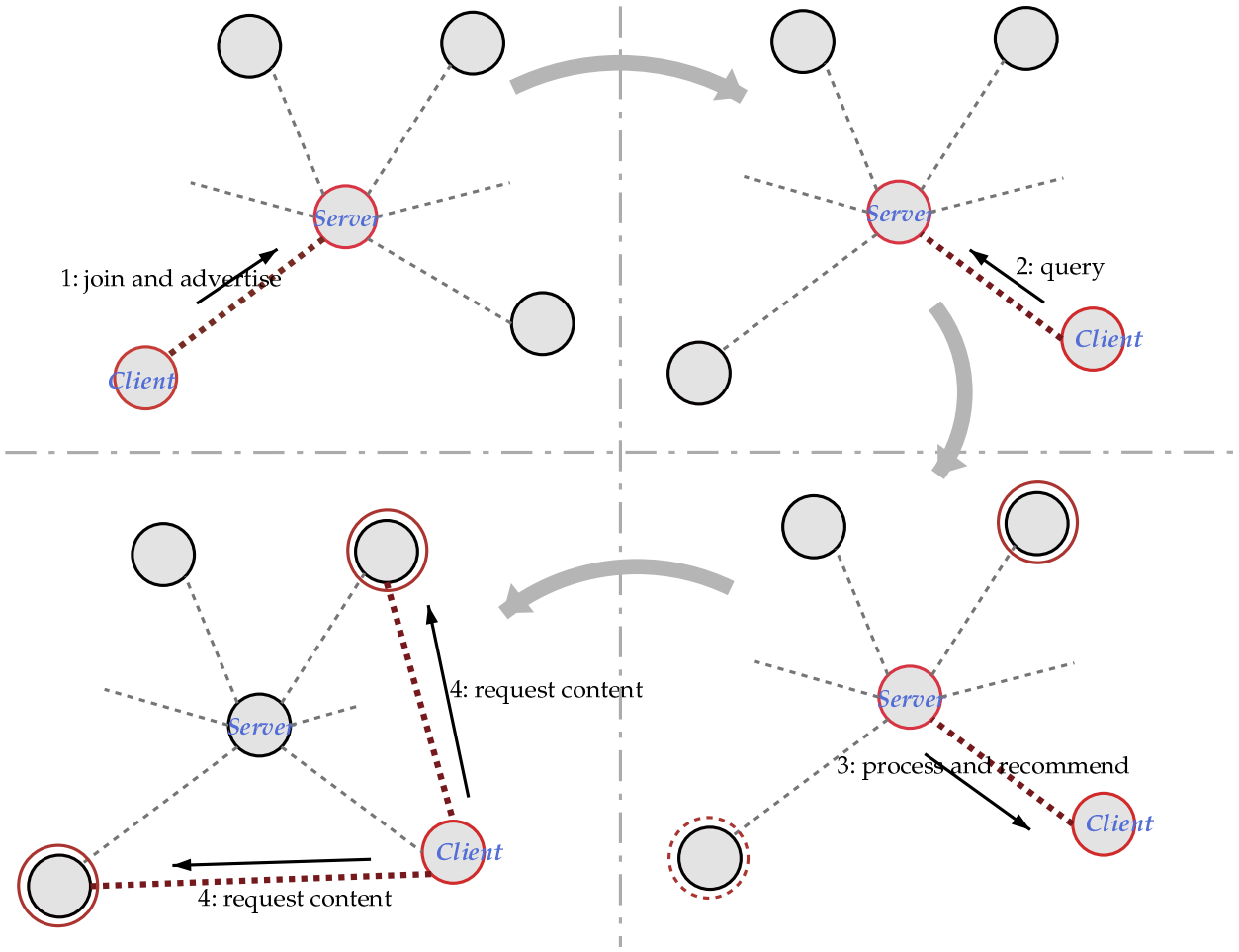
Why Peer-to-Peer Media?

. . . and techinal reasons:

- Content can be dynamically discovered when it is available
- Content can be dynamically moved (locally cached) where it is popular
- Content can be locally distributed and converted to a suitable form
- Network and machine load is reduced

Of course RIAA, MPAA, and their friends don't like it (they lose control) . . .

Peer-to-Peer Networks I: Napster



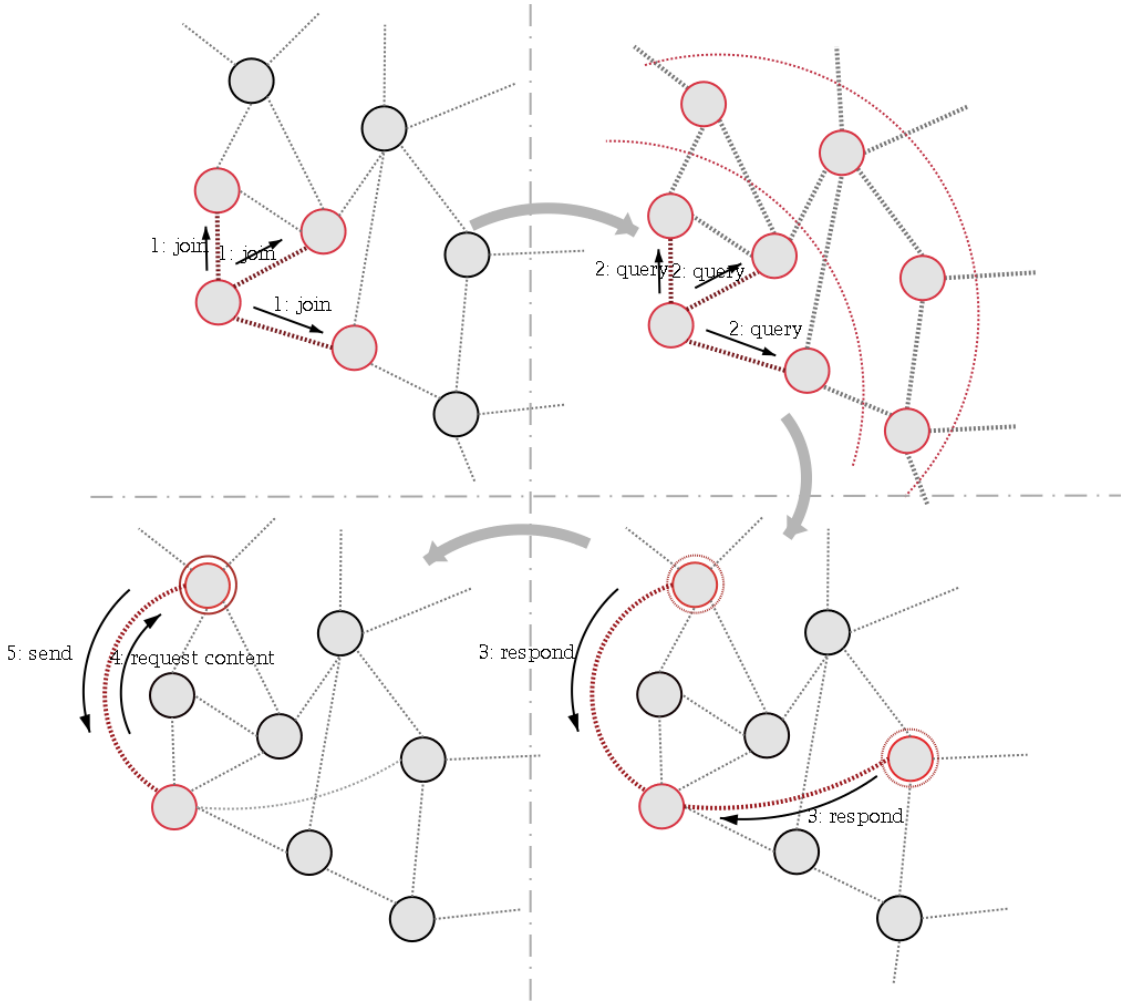
Peer-to-Peer Networks I: Napster cont.

An extremely simple idea, successful because it enables peer interactions. But...

- *Too centralized* - an easy target to attack...
- Inefficient from a network point of view
- No transient and local peer correlation
- No dynamic network establishment

Still, a step in the right direction...

Peer-to-Peer Networks II: Gnutella



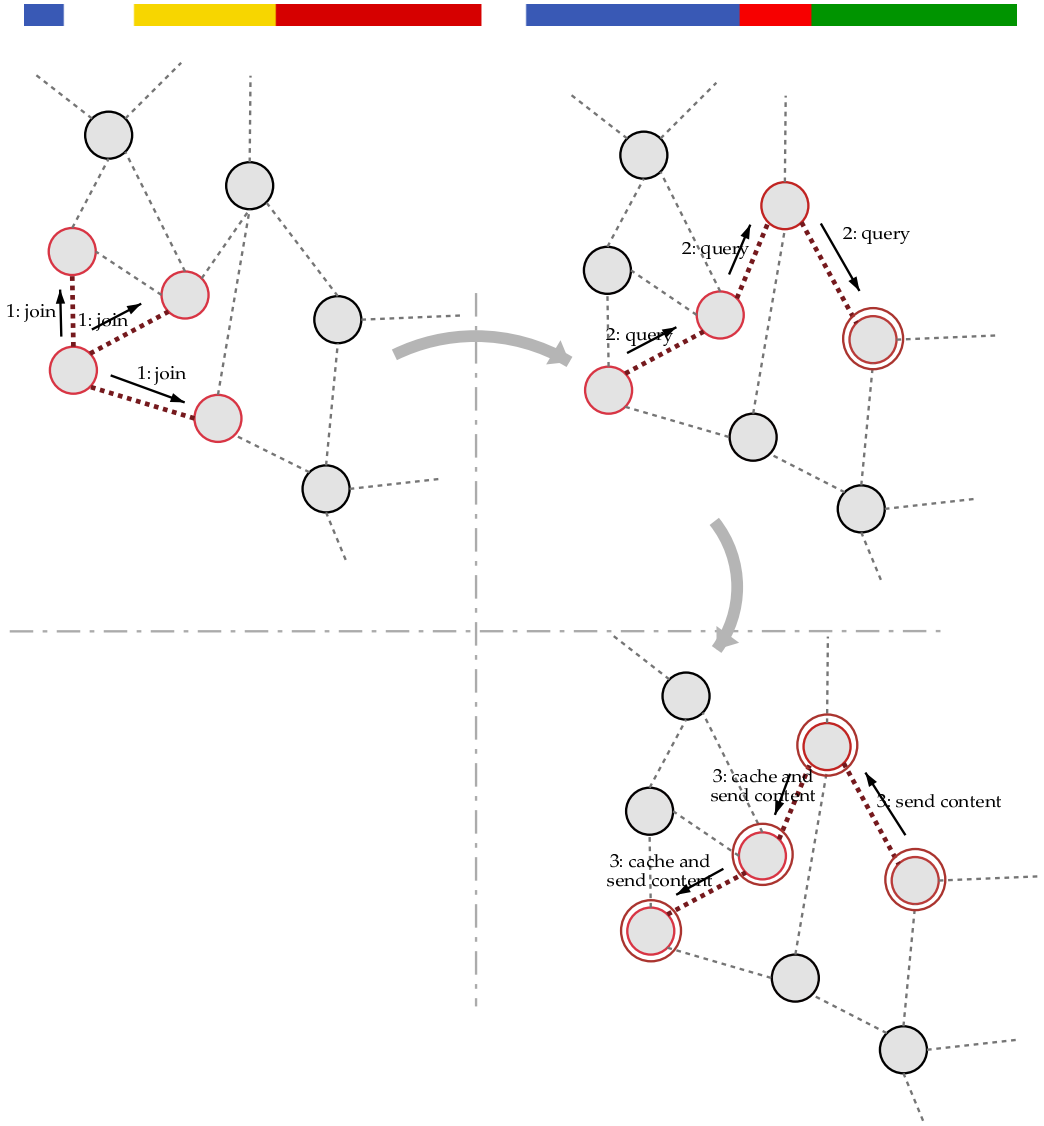
Peer-to-Peer Networks II: Gnutella cont.

A completely decentralized system, based exclusively on peer interactions. But...

- Too inefficient
- Not scalable
- Unreliable
- Does not take advantage of locality of information
- No organization
- Limited communication language
- No security/privacy

The idea is (almost) right, the technology is *wrong*

Peer-to-Peer Networks III: Freenet



Peer-to-Peer Networks III: Freenet cont.

Again a completely decentralized system, based exclusively on peer interactions. But...

- Still inefficient
- Does not take advantage of locality of information
- No organization
- Limited communication language
- No content discovery (you must know the key!)

The idea is again (almost) right, the technology is better, but still *limited*

Peer-to-Peer Networks IV: Lessons learned

Good ideas, bad or limited technology...

- Inefficient and Incompatible protocols
- Do not take advantage of locality of information
- Unreliable and not robust
- No organization
- Limited communication languages
- No resource or peer discovery

And most important: Essentially *glorified file sharing systems*. No connection to actual media applications – real time decoders or encoders or interactive media composition tools...

Peer-to-Peer Networks: The Next Generation

Agenda: Fix the technology/infrastructure to expand the possibilities and cut it loose for the people to explore...

- Dynamic Self-Organization and Discovery Protocols
- Scalable and Efficient Distribution Protocols
- Flexible Communication Languages
- Solid Computational Models

In short: *Provide a framework for connecting actual media applications to the peer-to-peer infrastructure.*

Peer-to-Peer Networks: The Next Generation cont.

Middleware for Peer-to-Peer Networks

- Inter-operability and Protocol/Platform Independence
- Suitable for Open and Heterogeneous Environments
- Programming Interfaces
- Execution Environments
- Embedded Self-Organization and Discovery Protocols
- Expressive Communication and Capability Description Languages
- Security and Privacy

Peer-to-Peer Networks: The Next Generation cont.

Content Distribution Protocols for Peer-to-Peer Networks

- Scalable and efficient Protocols
- Take advantage of locality of information
- Robustness and Reliability
- Real-time Distribution

Peer-to-Peer Networks: The Next Generation cont.

Building Peer-to-Peer Media Applications:

Leverage middleware and decentralized content distribution infrastructure

- Allow people to share and publish their content
- Allow people to find content of relevance
- Allow people to get in touch if they have related interests
- Become transparently integrated and accessible to current computing (and not only) environments

in *real-time*

Related Work at the Media Lab

- Project Mayhem: Agent-oriented middleware for building peer-to-peer applications
- plazza: Mobile peer-to-peer media and group formation
- DiVA: Decentralized media distribution and sharing in broadband networks
- Distributed Multicast: Scalable, efficient, and reliable decentralized content distribution protocols