P2P and Online Social Networks: The Best Has Yet to Come

Peter Marbach,
Dept. of Computer Science
University of Toronto

Research Projects

- Wireless Networks
  - Wireless Mesh Networks
  - Quality-of-Service (VoIP, streaming Video)
  - MIT
- Peer-to-Peer Networks
  - Scalability
  - Traffic
  - Thomson Research Labs, France
- Online Social Networks
  - New Algorithms/Applications
  - Tag-Based Search
  - Microsoft Research, Cambridge, UK

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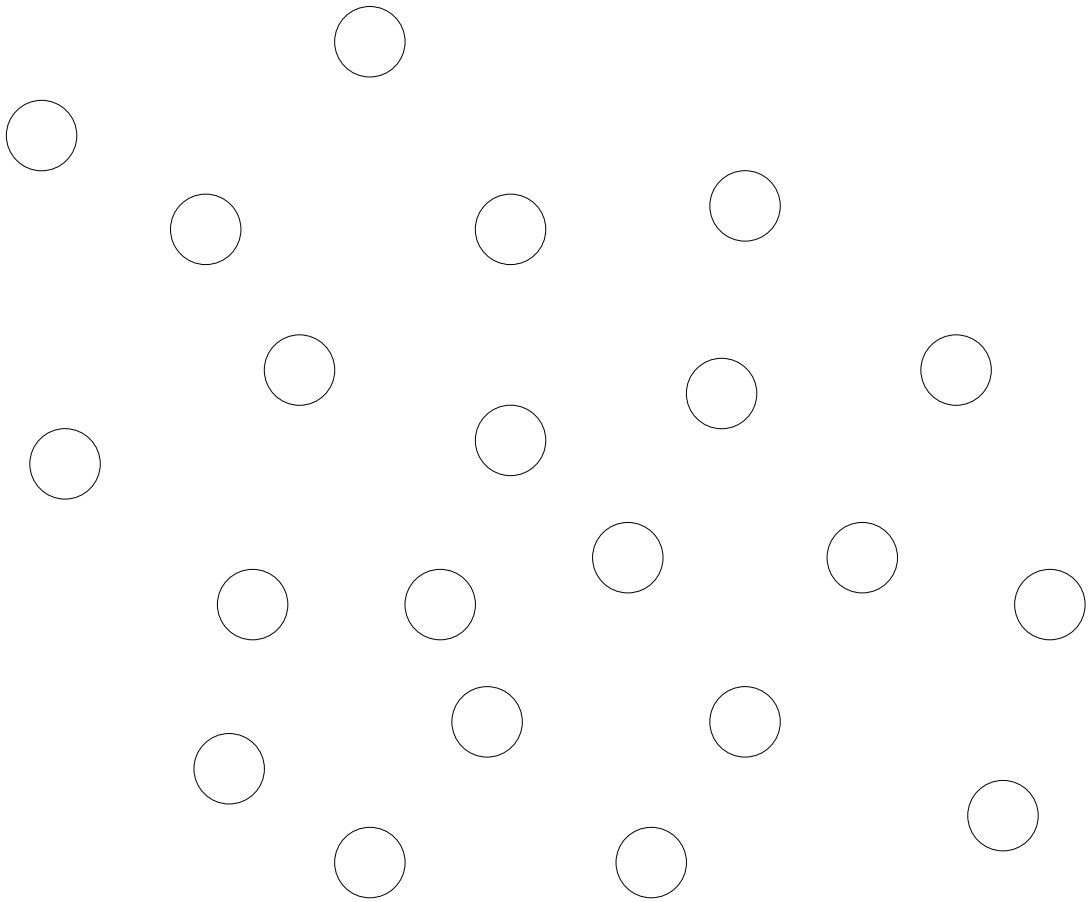
Overview

- Peer-to-Peer Networks
- Social Networks
- Research Questions
- Hybrid Peer-to-Peer Networks

Peer-to-Peer Networks



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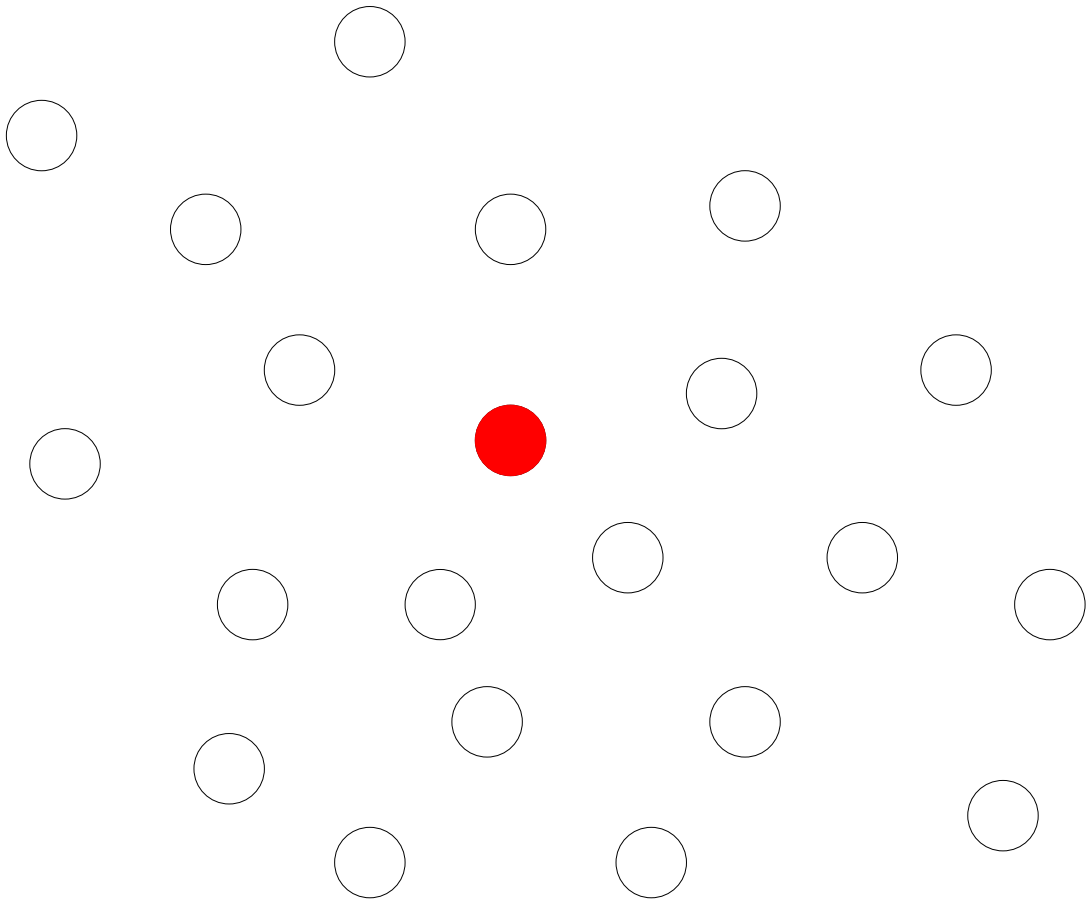

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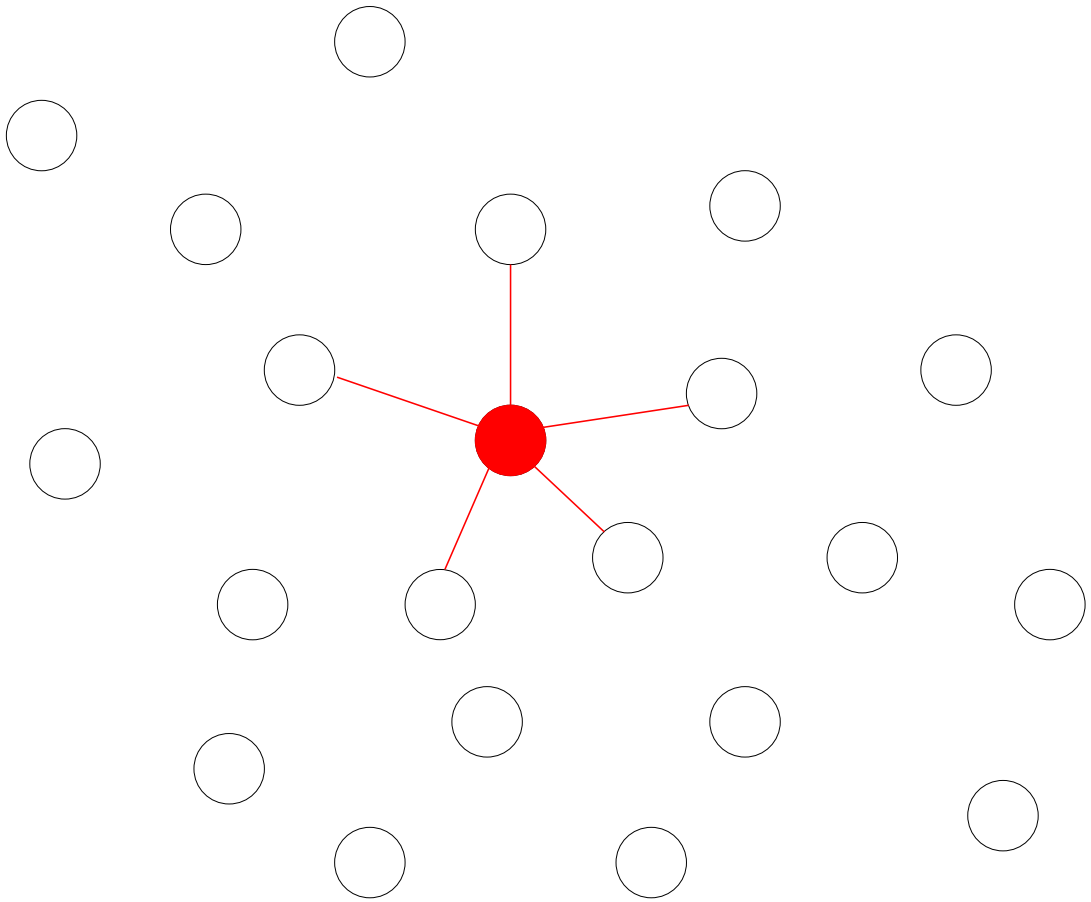

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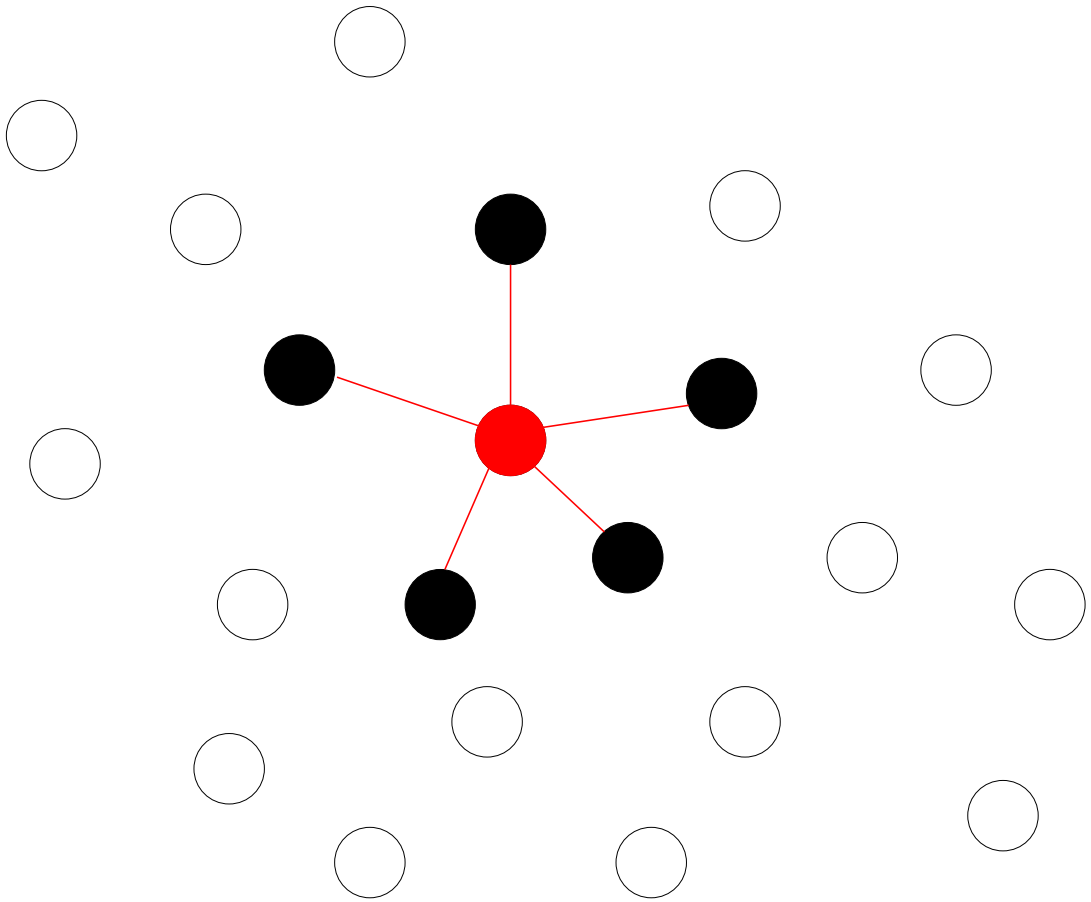

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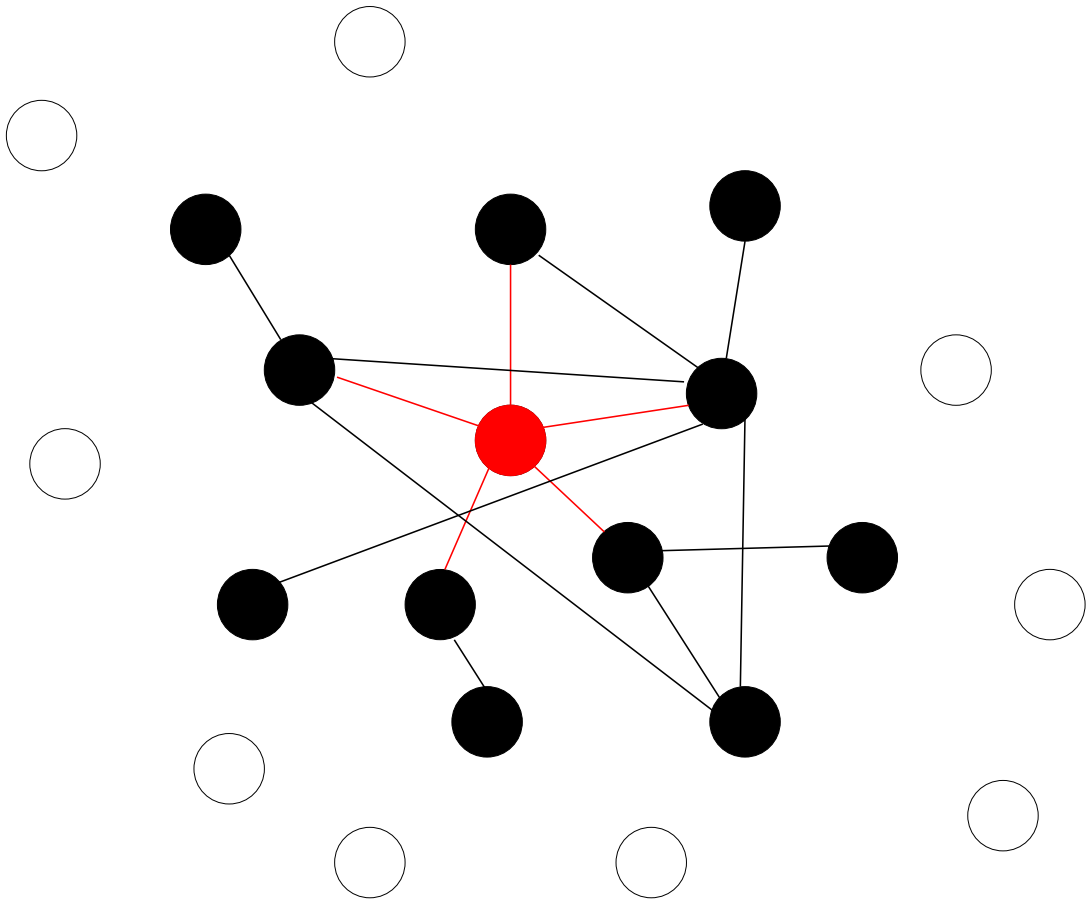

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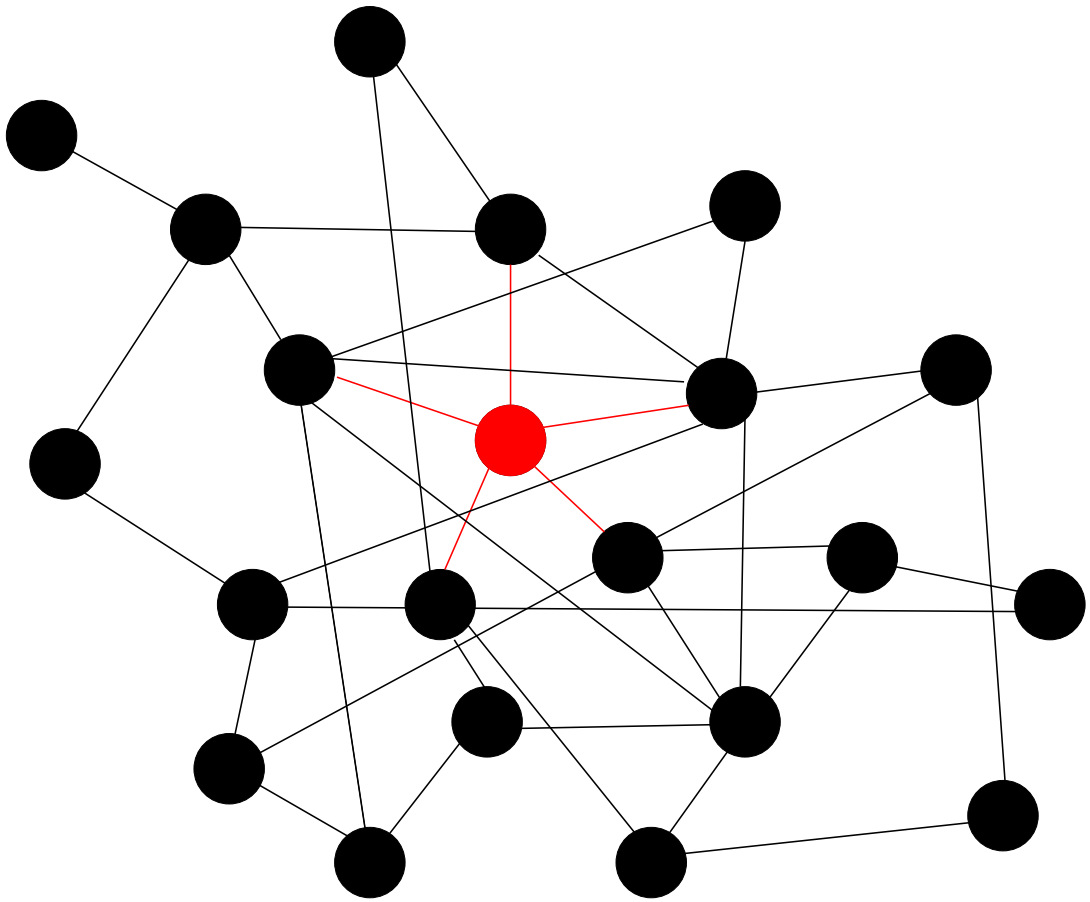
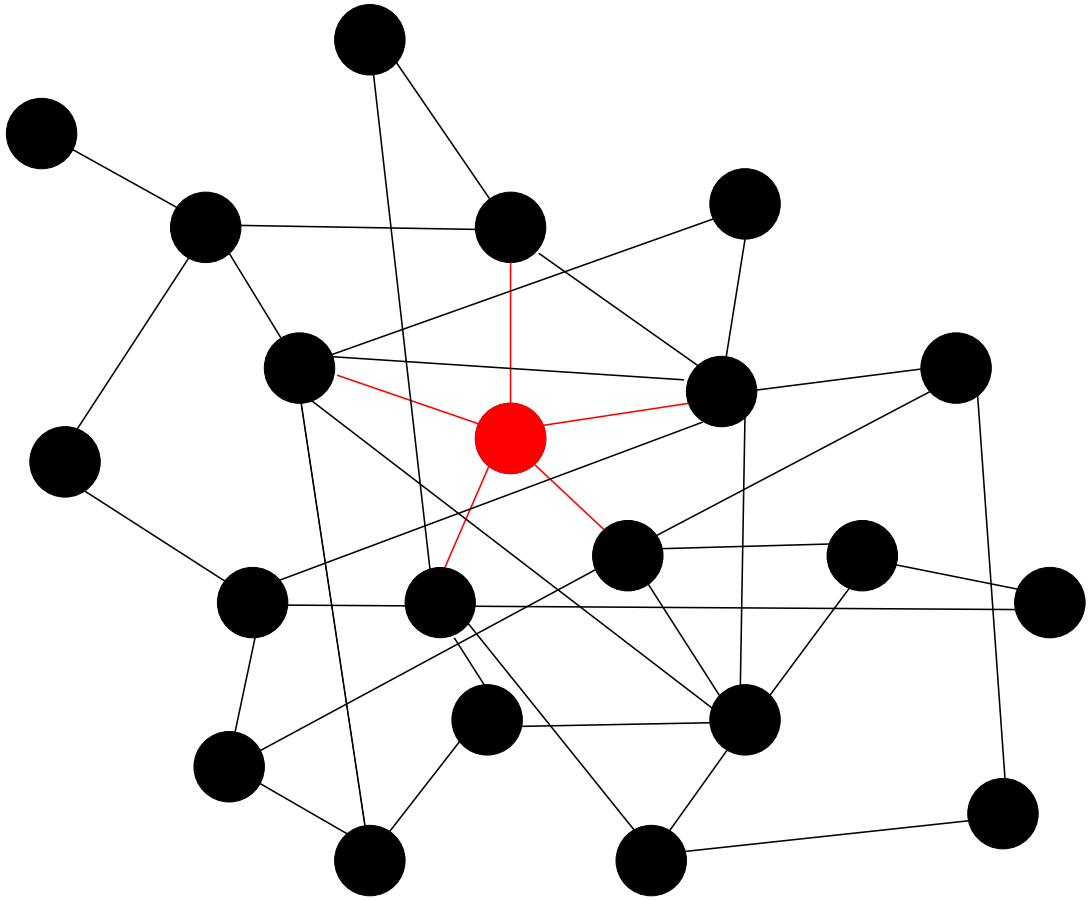


Peer-to-Peer Networks

- File Sharing (Music, Video)
- Real-Time Video Streaming
- Skype

File Sharing



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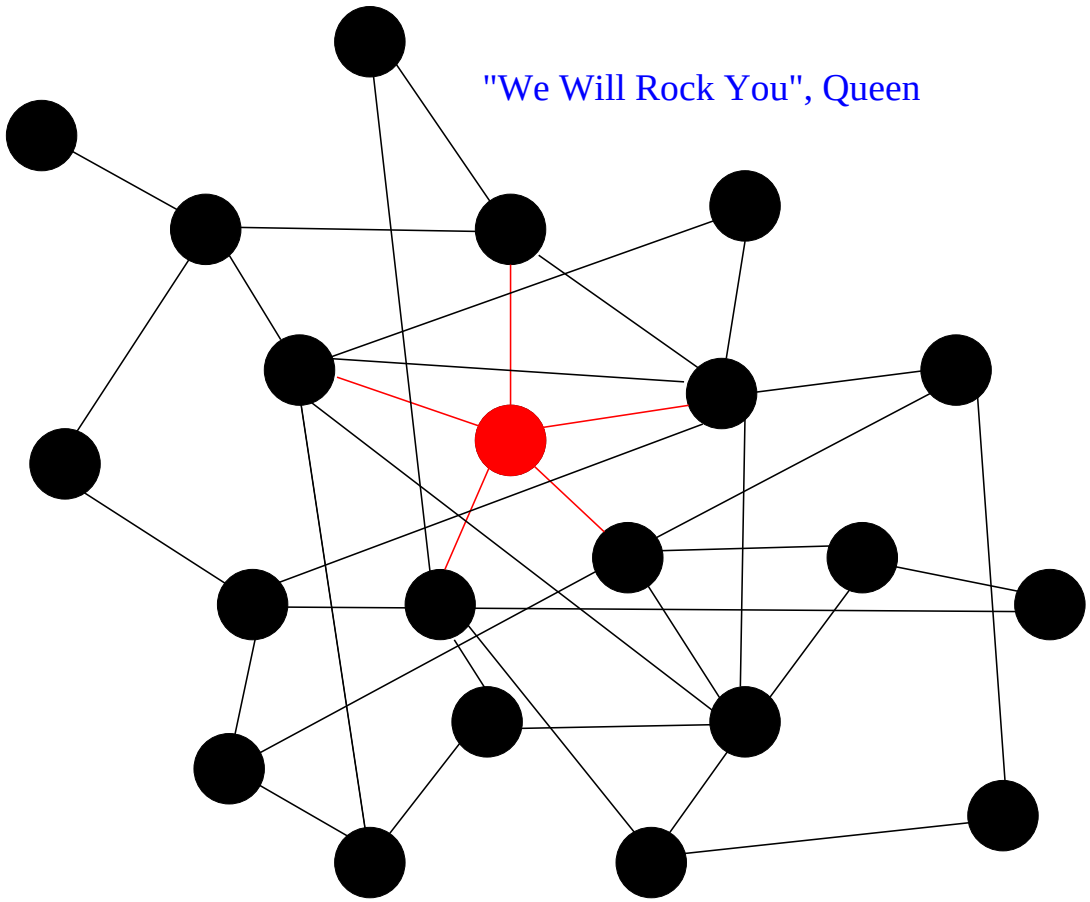

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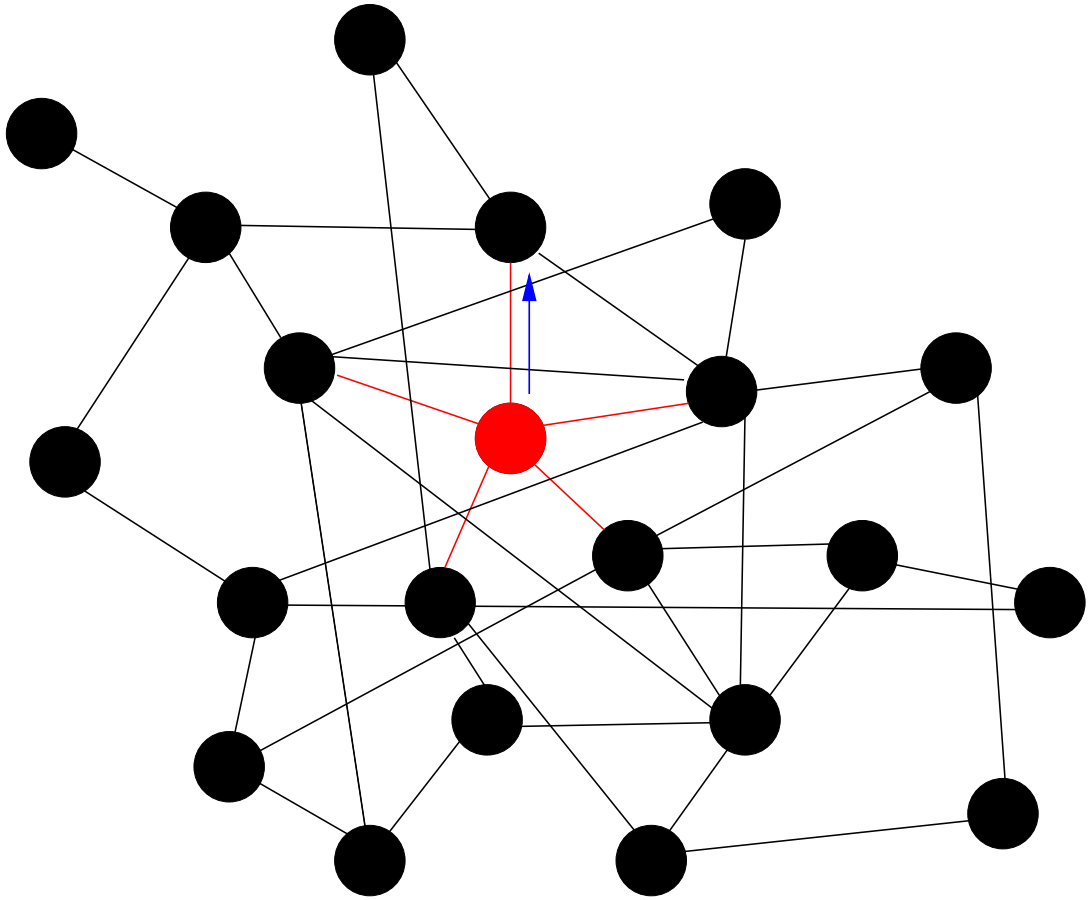

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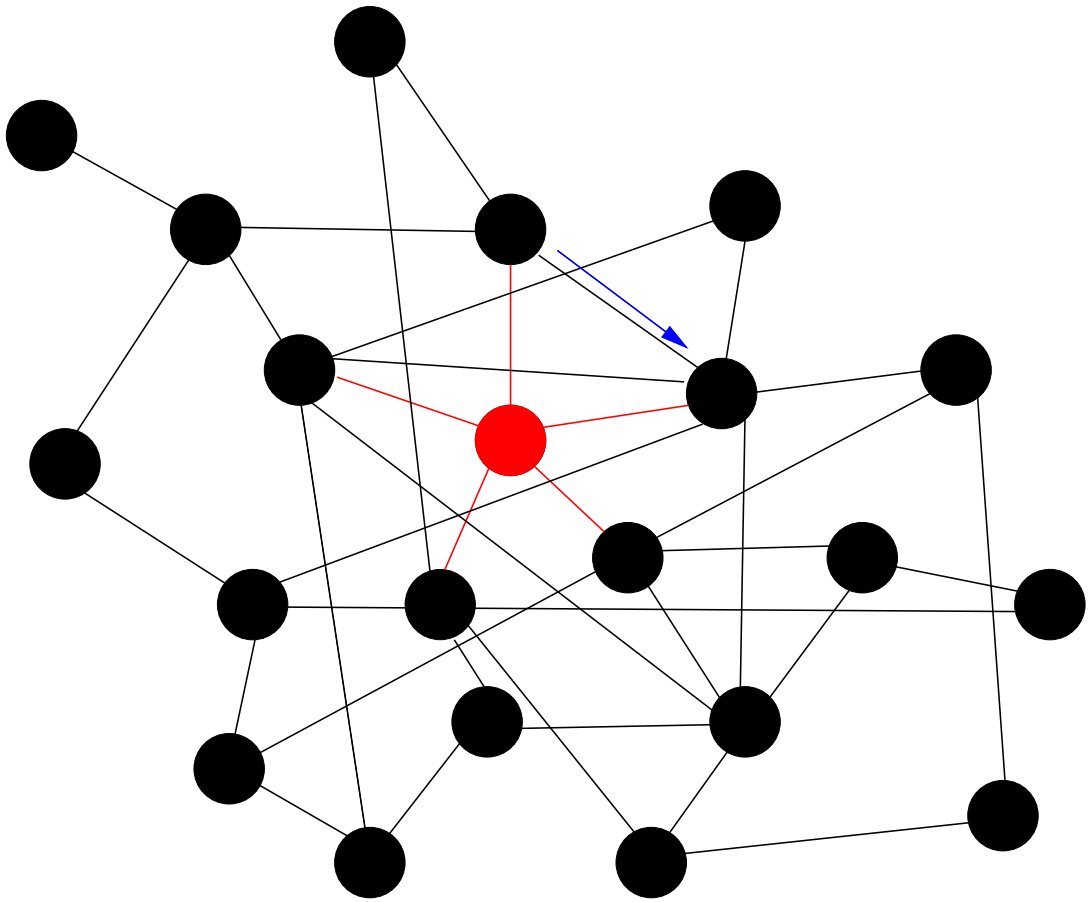

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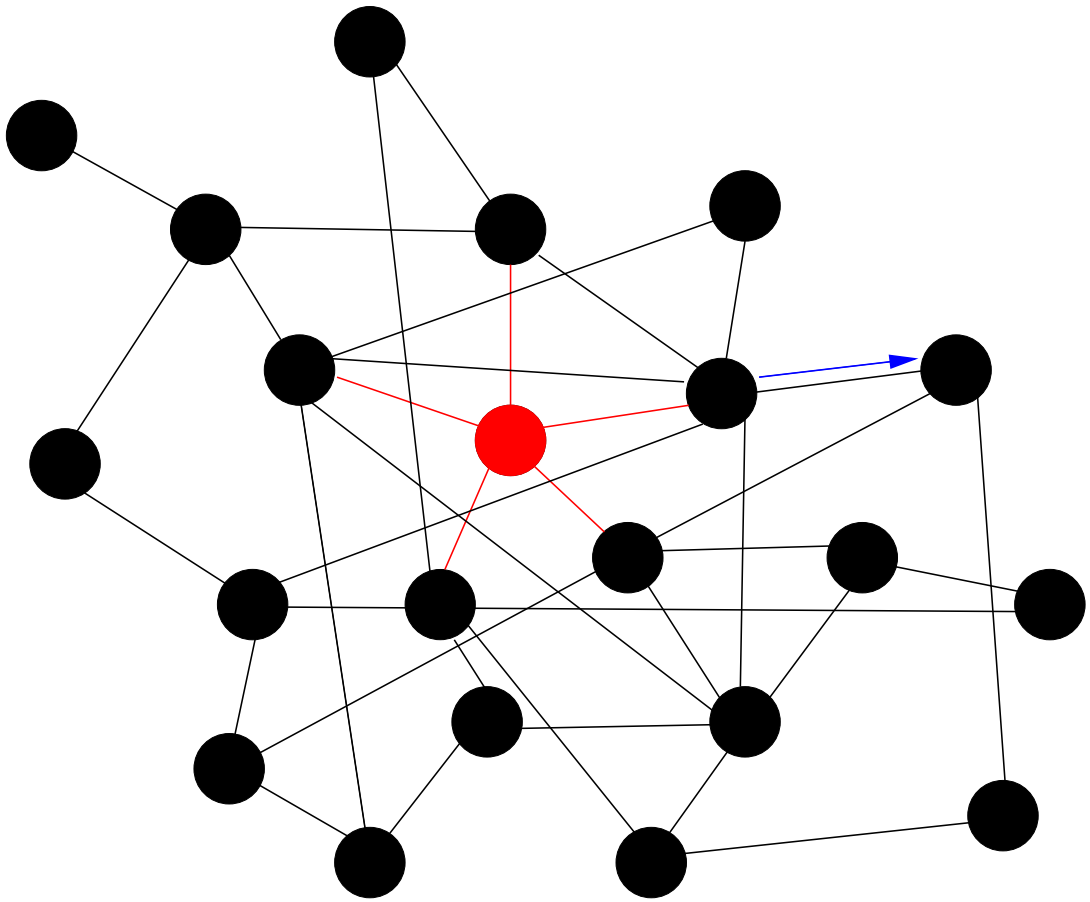

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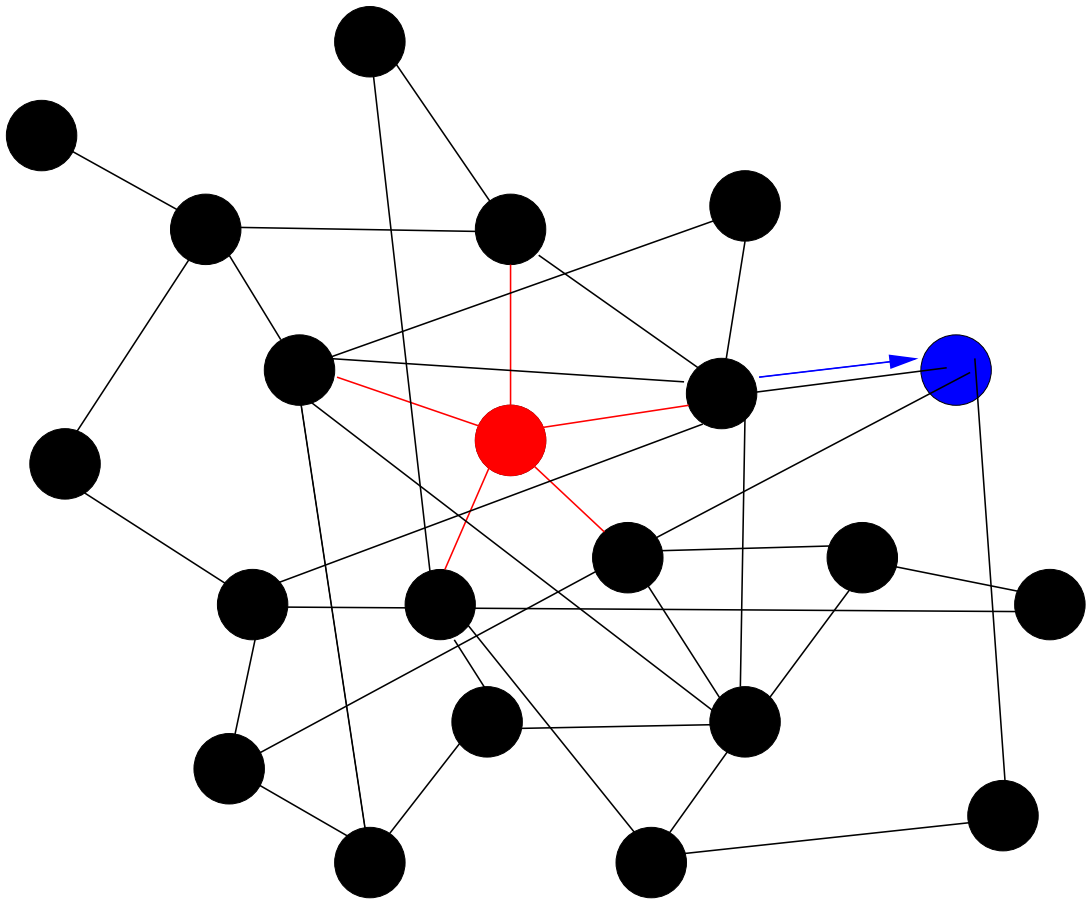

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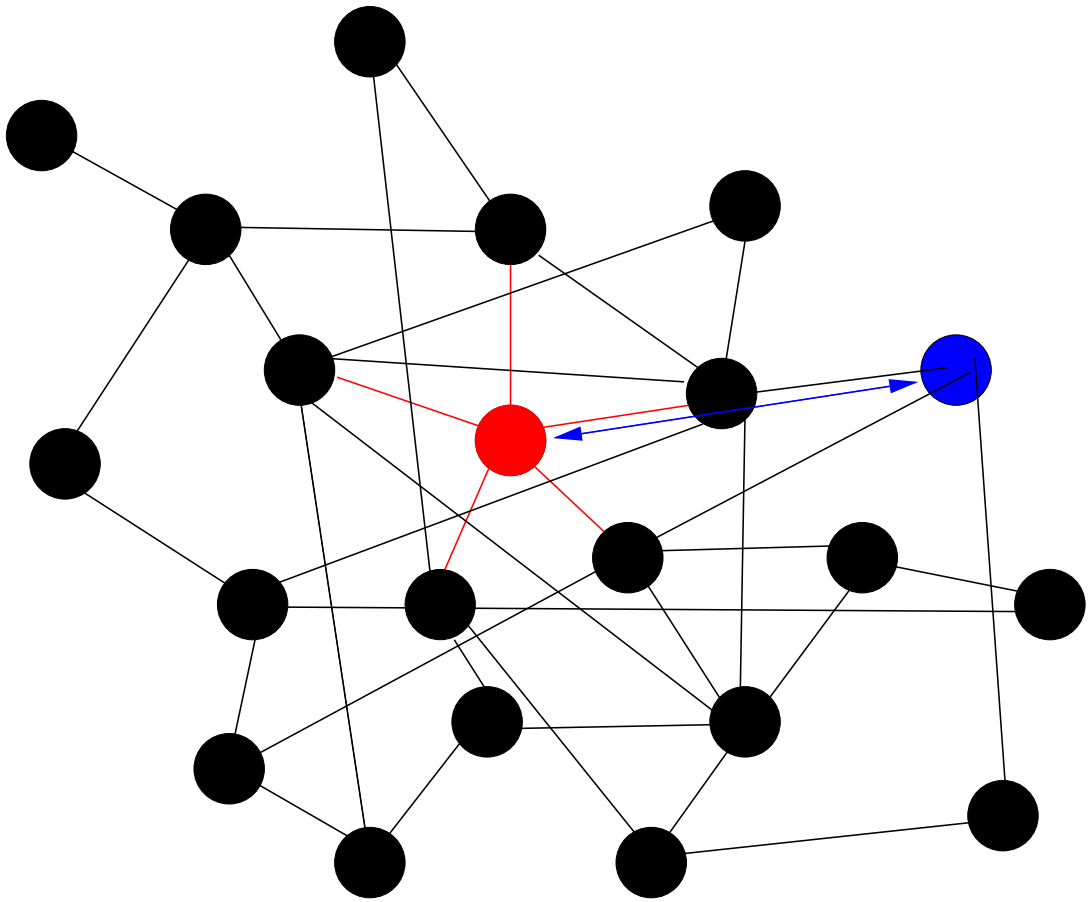
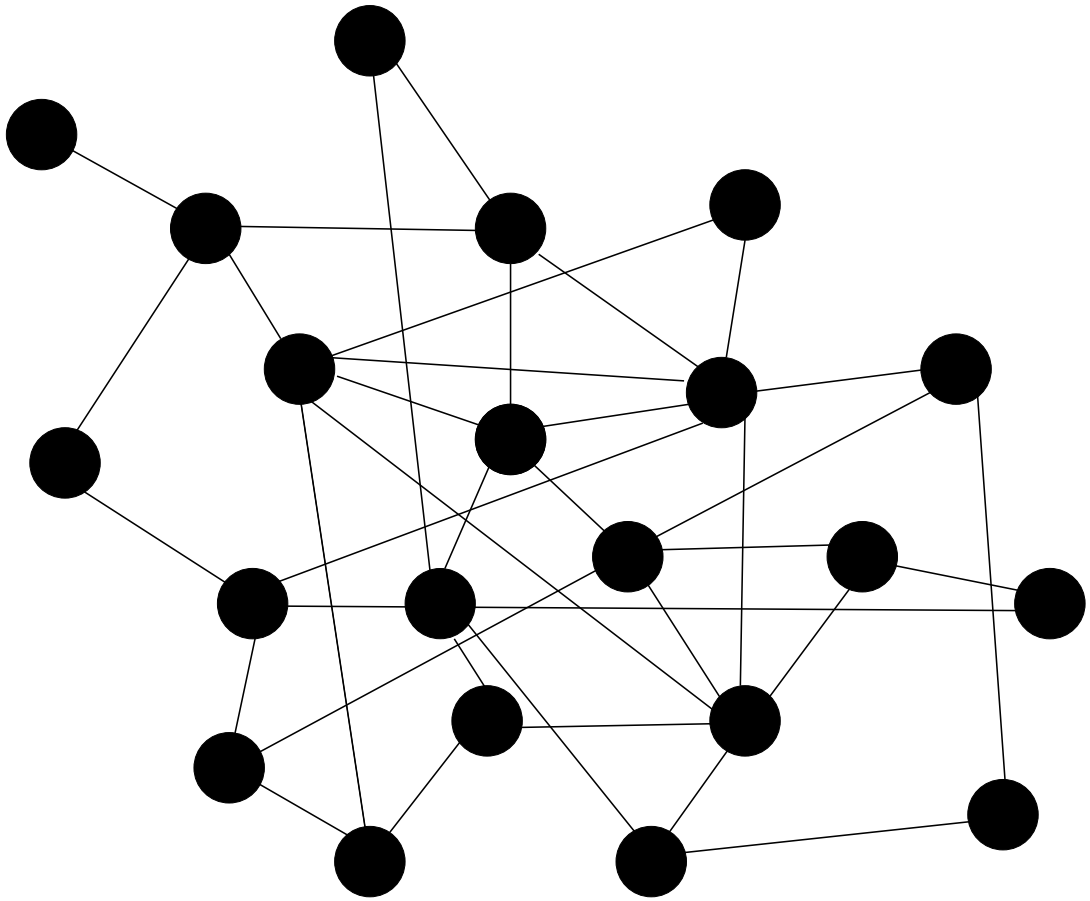


Peer-to-Peer Networks

- Pure Peer-to-Peer Networks
- Hybrid Peer-to-Peer Networks

Pure Peer-to-Peer Networks



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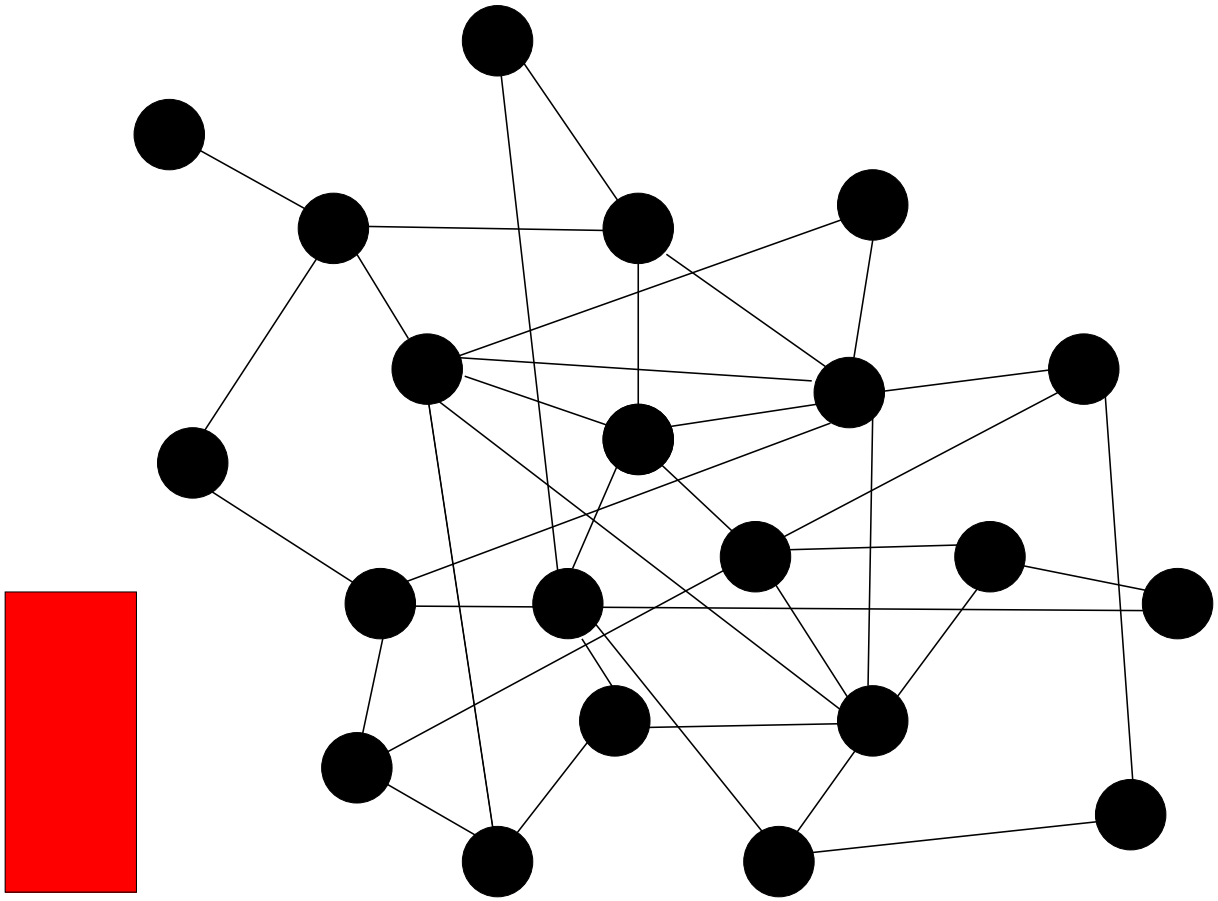

Hybrid Peer-to-Peer Networks

- Peers bring Resources to Networks
- Server Can Push Load to Users (Peers)
- Skype: *“Leveraging all of the available resources in the network allows us to provide high quality telephony without the need for costly centralized resources. Decentralizing our services allows us to free our resources and focus on developing cutting-edge functionality”.*

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Peer-to-Peer Networks

- Dynamic: Peers Enter/Exit the System
- No Structure
- Query Flooding
- **Problem:** High Query Traffic

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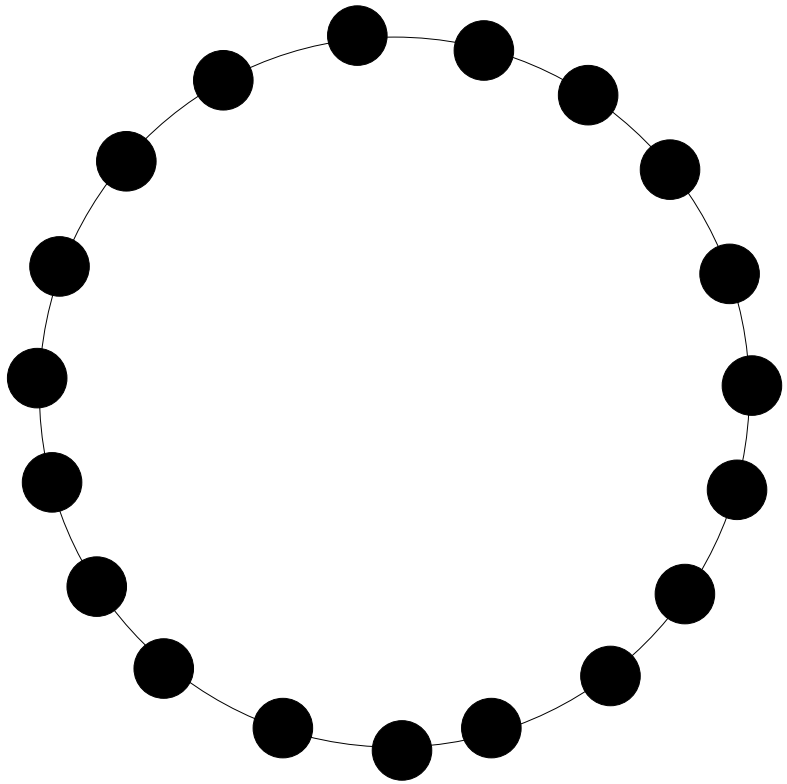
Structured Peer-to-Peer Networks



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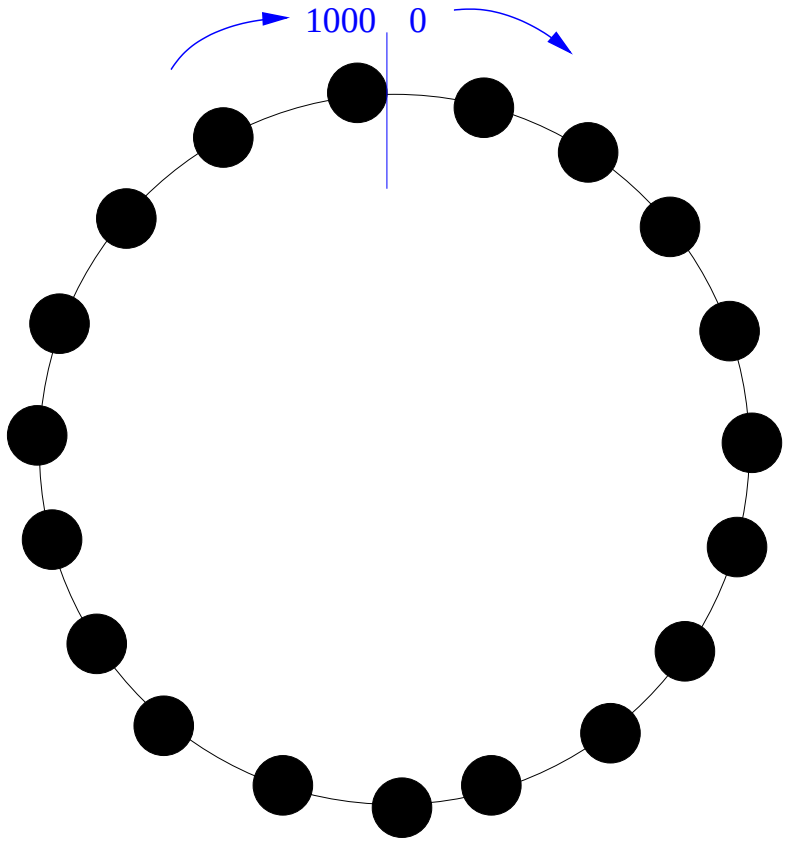

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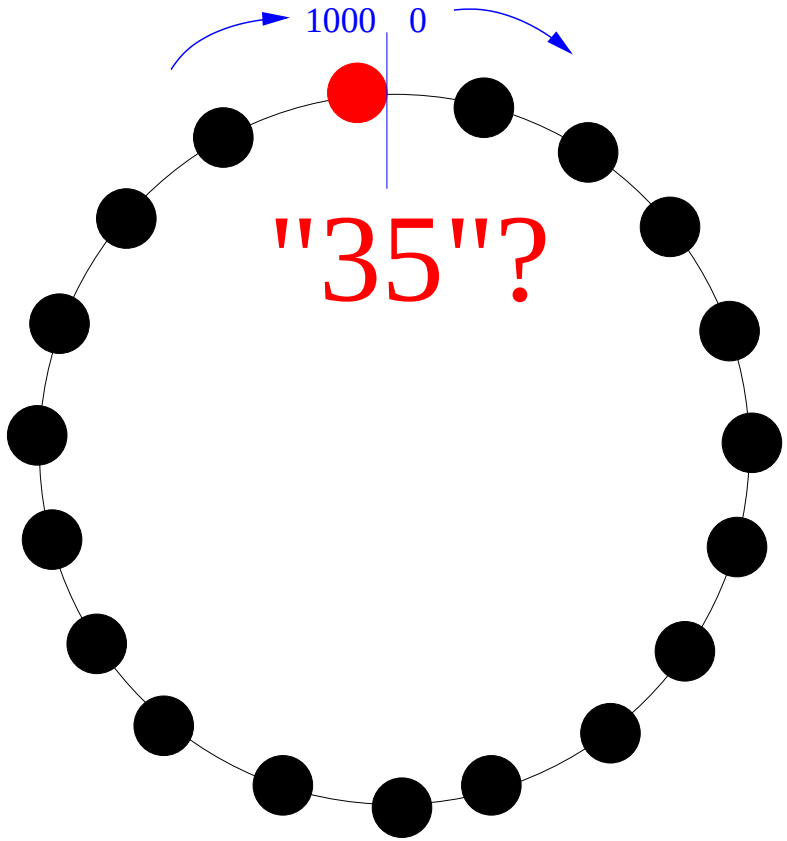

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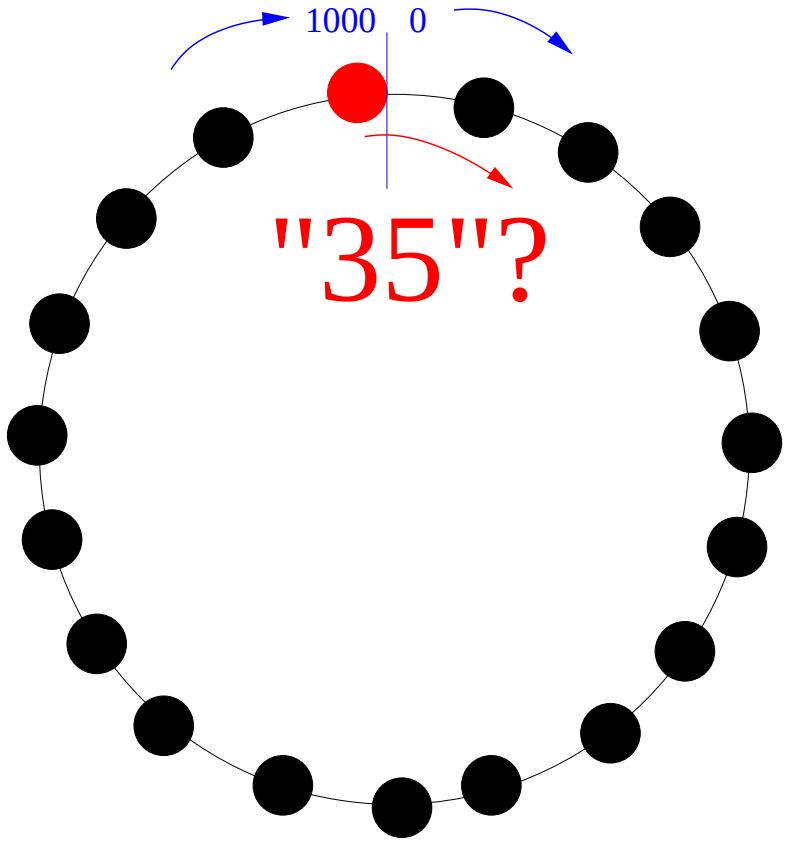
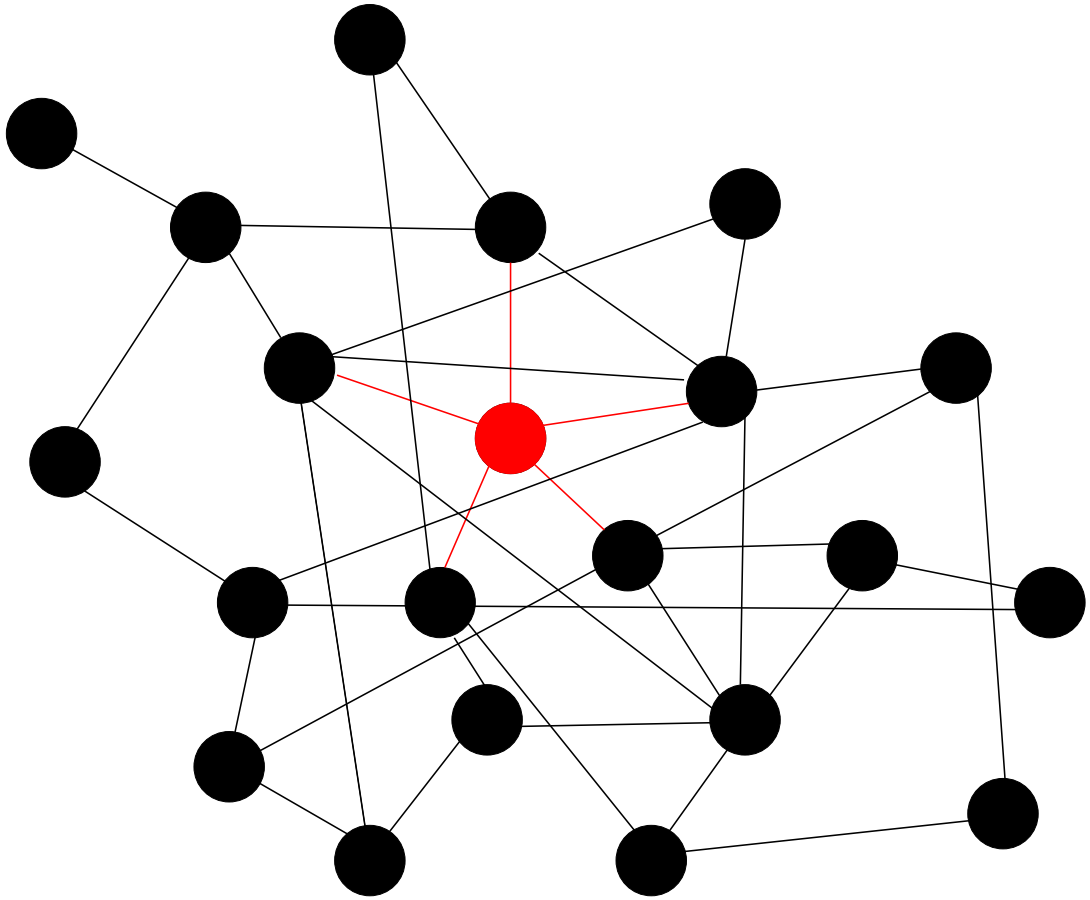


Structured Peer-to-Peer Networks

- High Maintenance Cost
- Can Easily be Attacked

Social Networks



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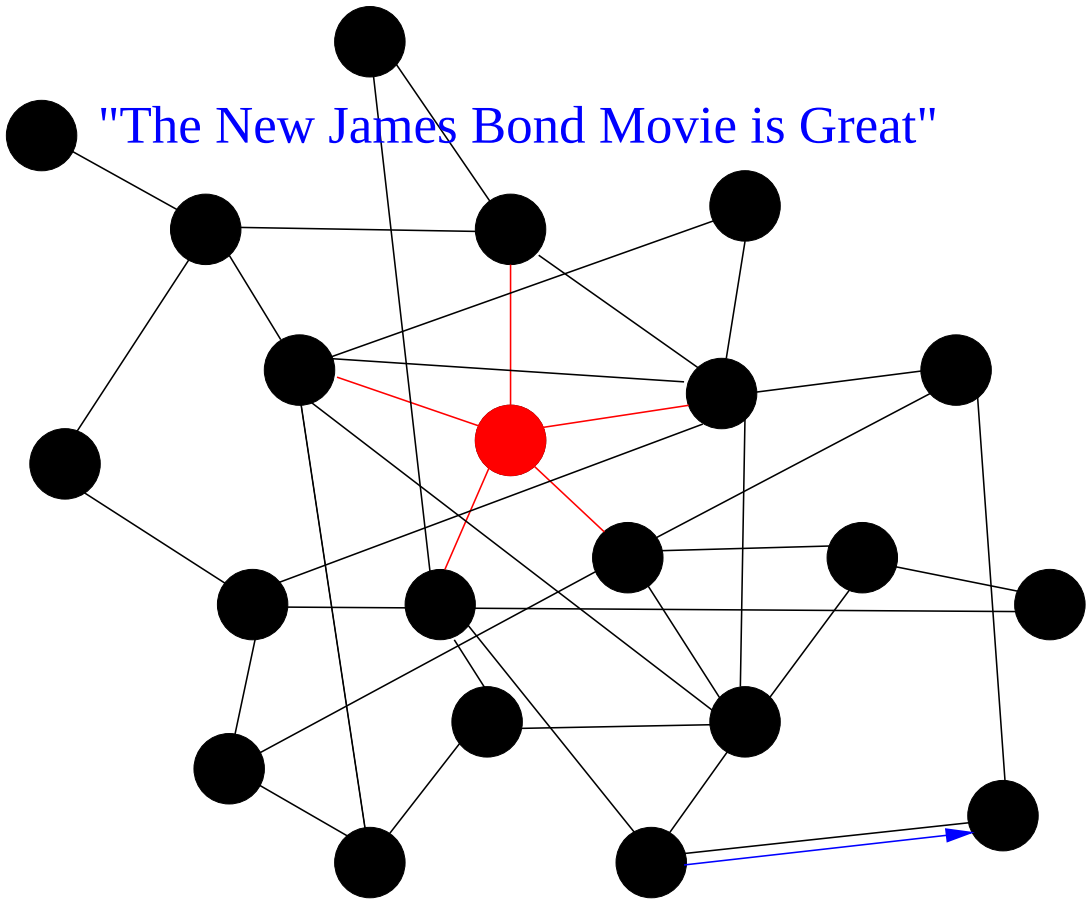

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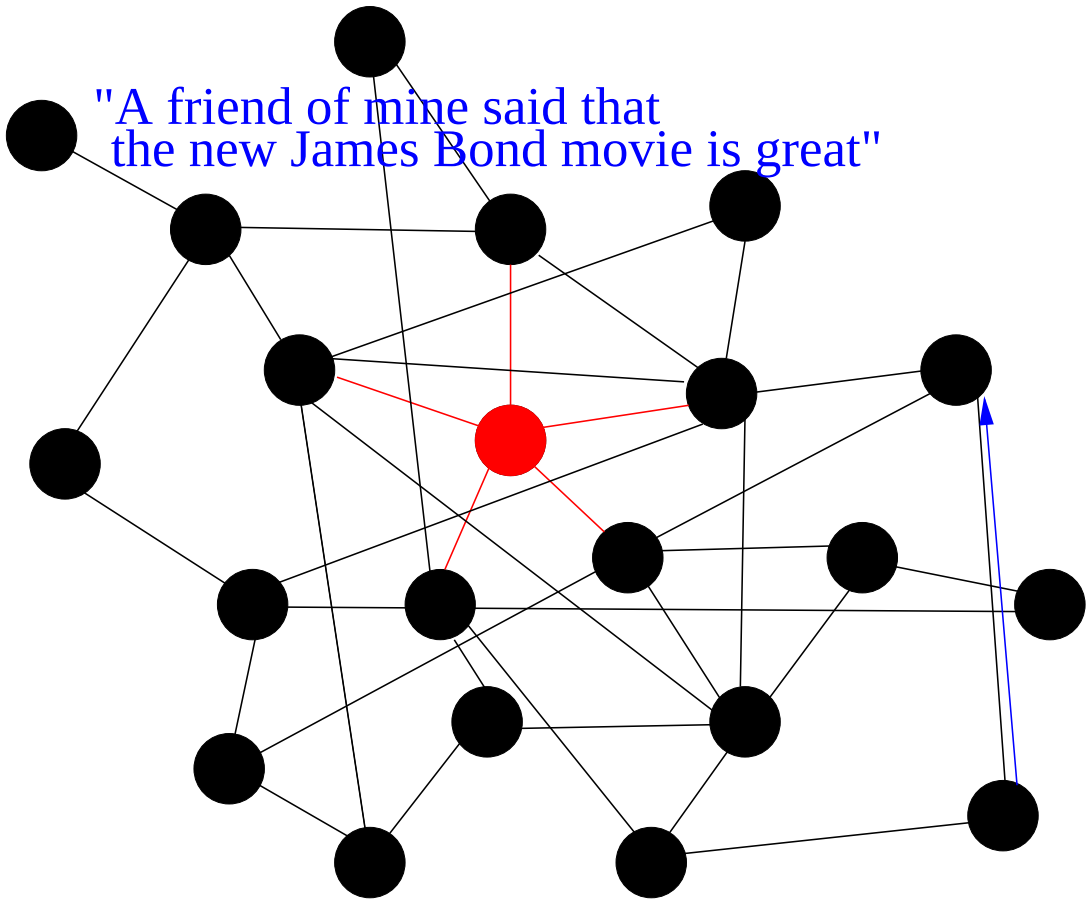

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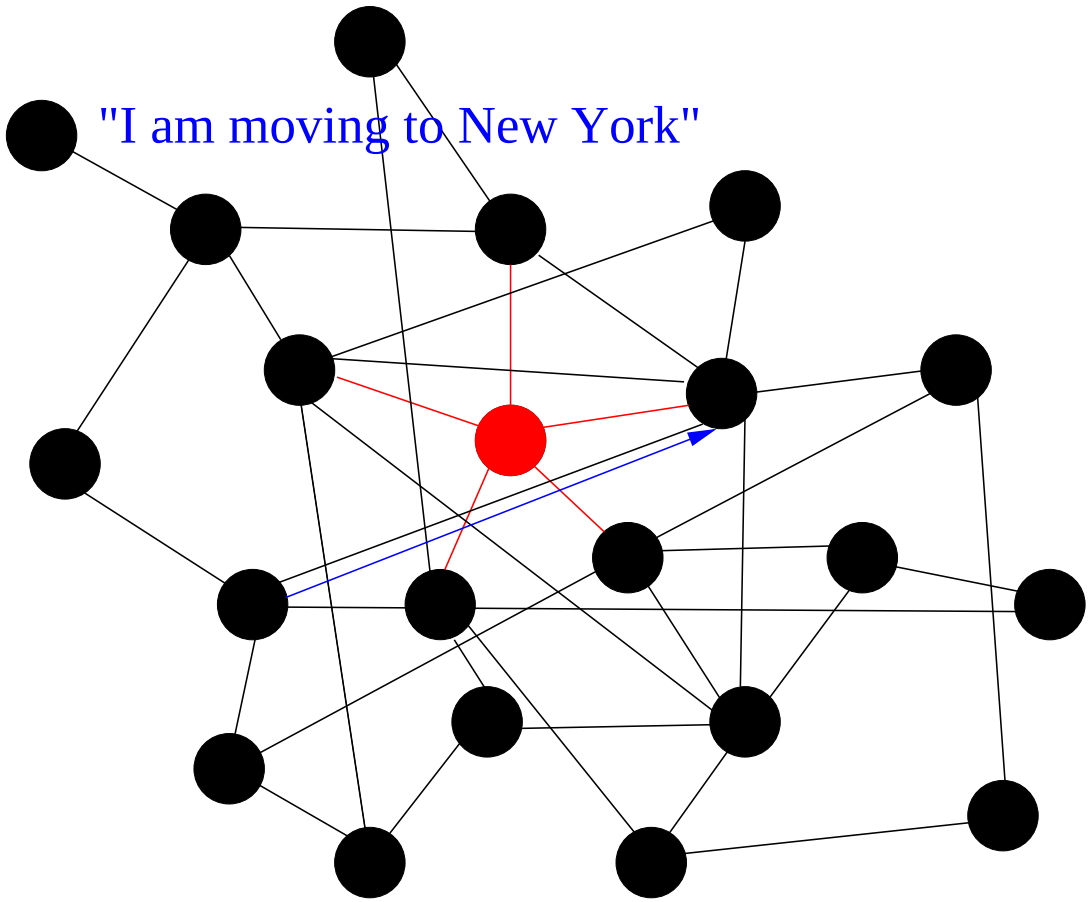

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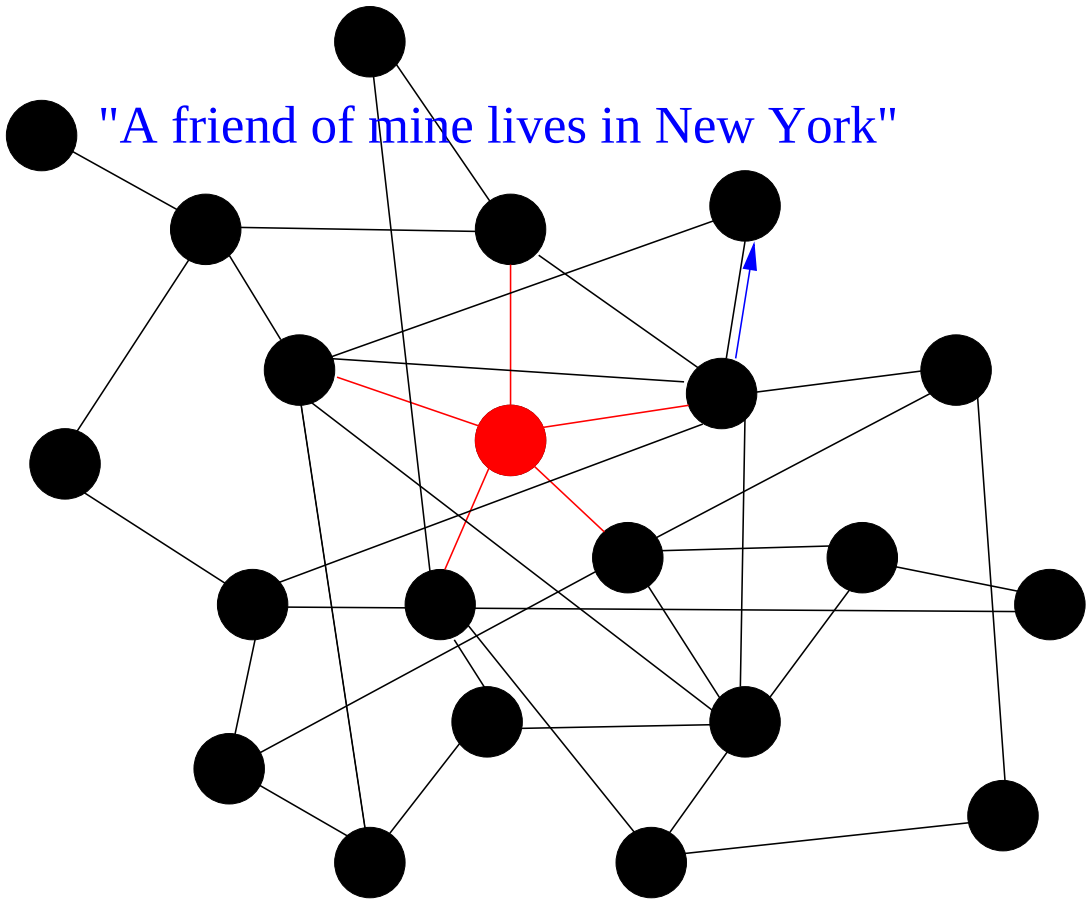
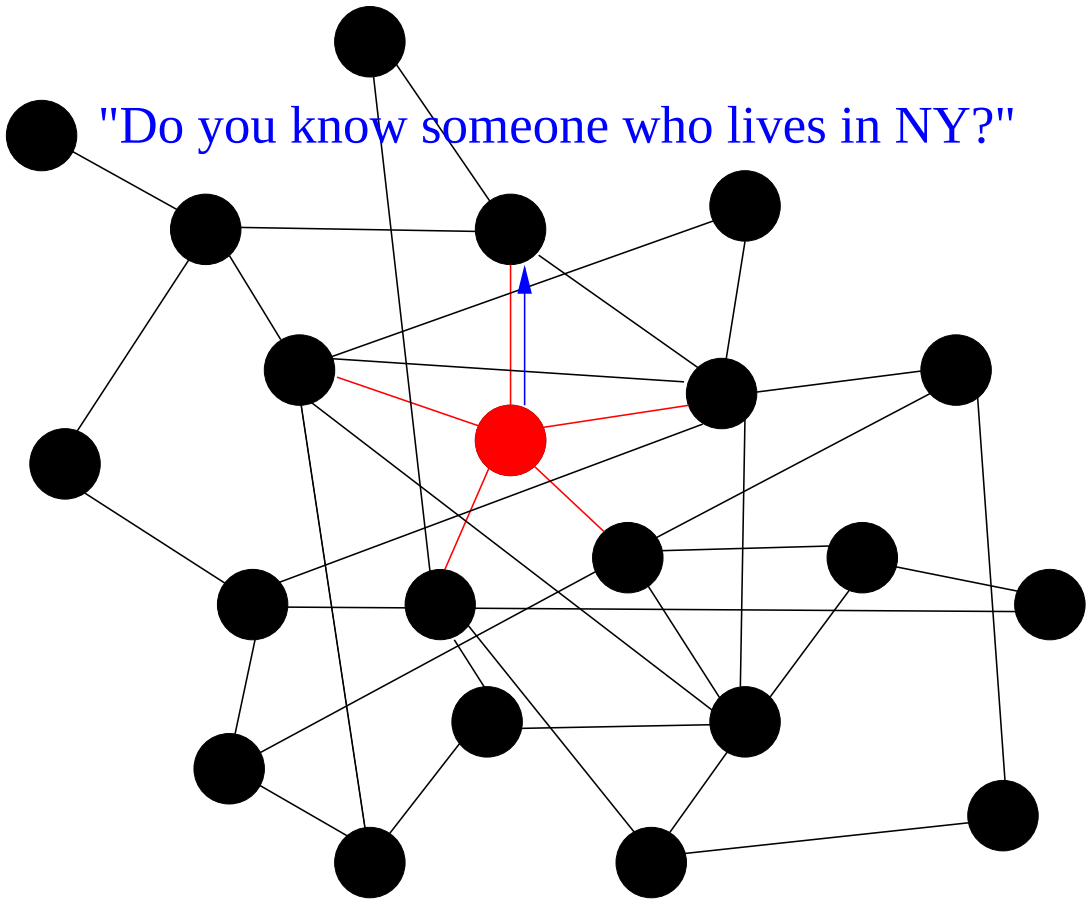


Information Diffusion

- Small Talk
  - Information is Propagated throught the Network
- “Passive” Information Diffusion
- Limited Capacity

Search



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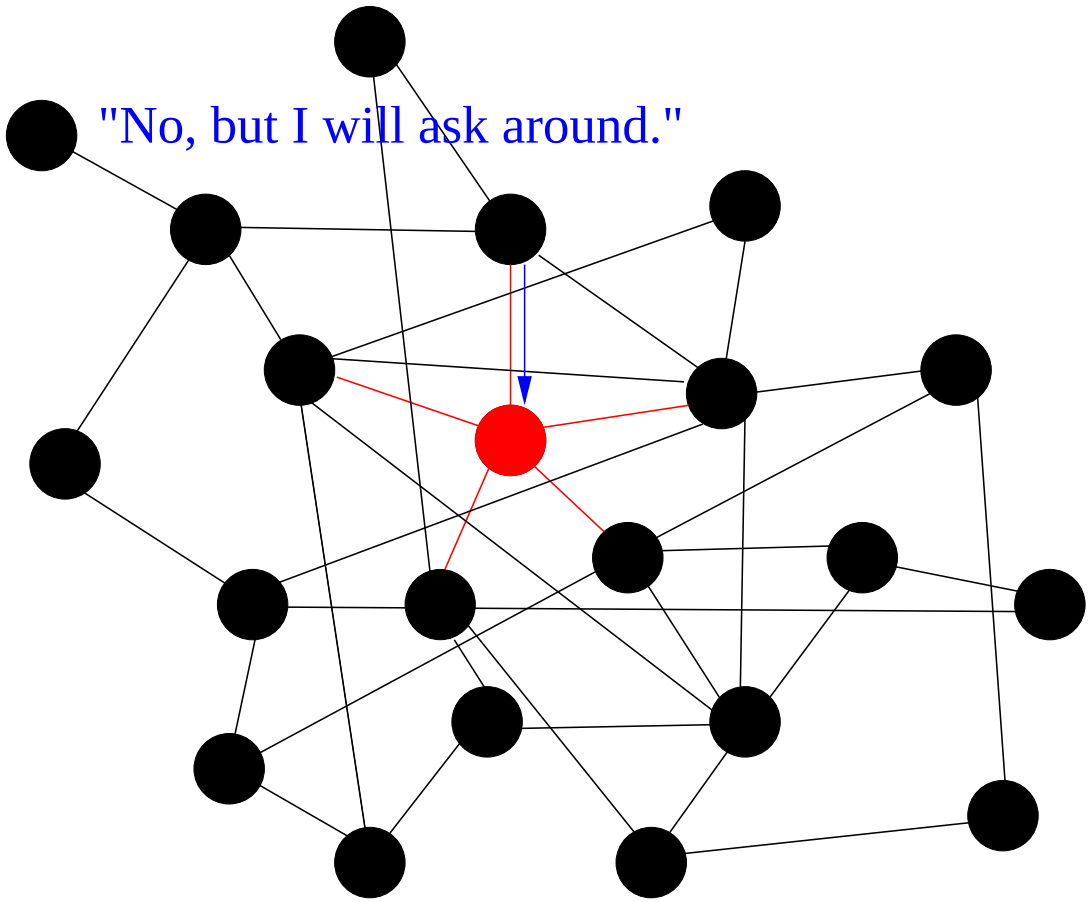

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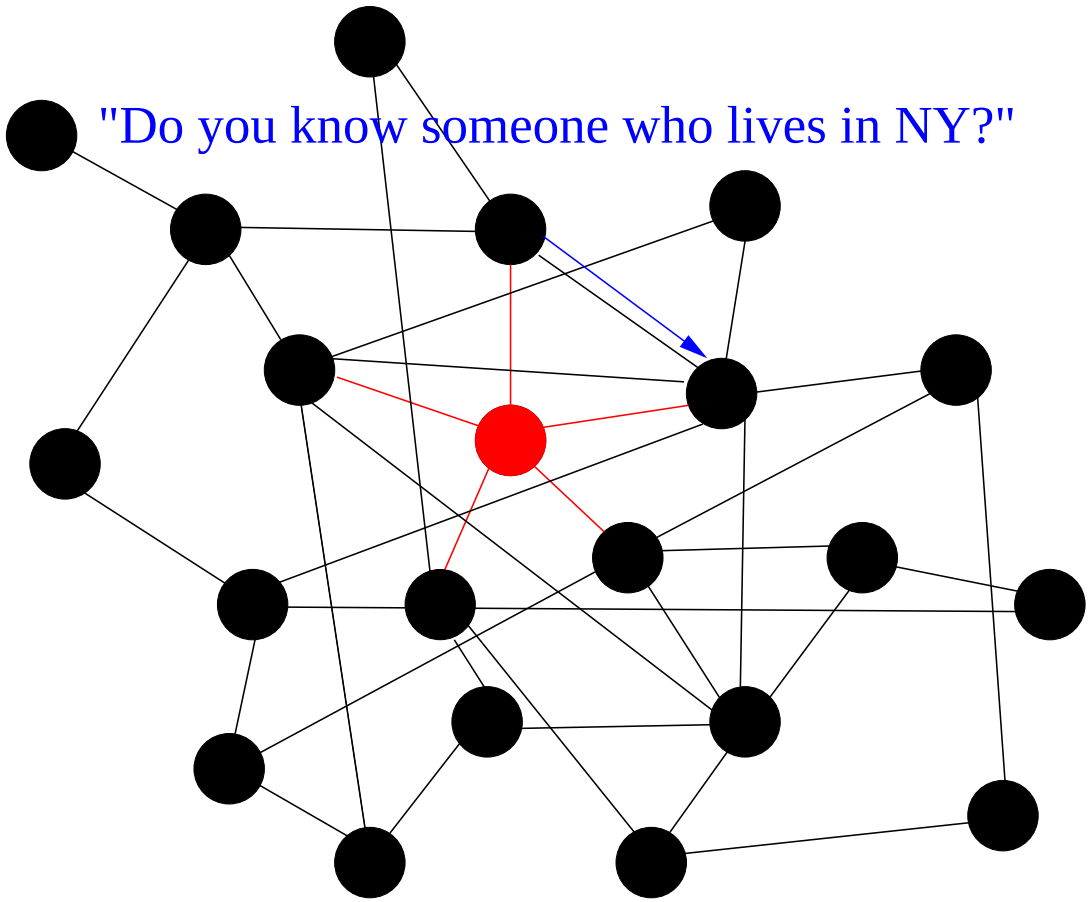

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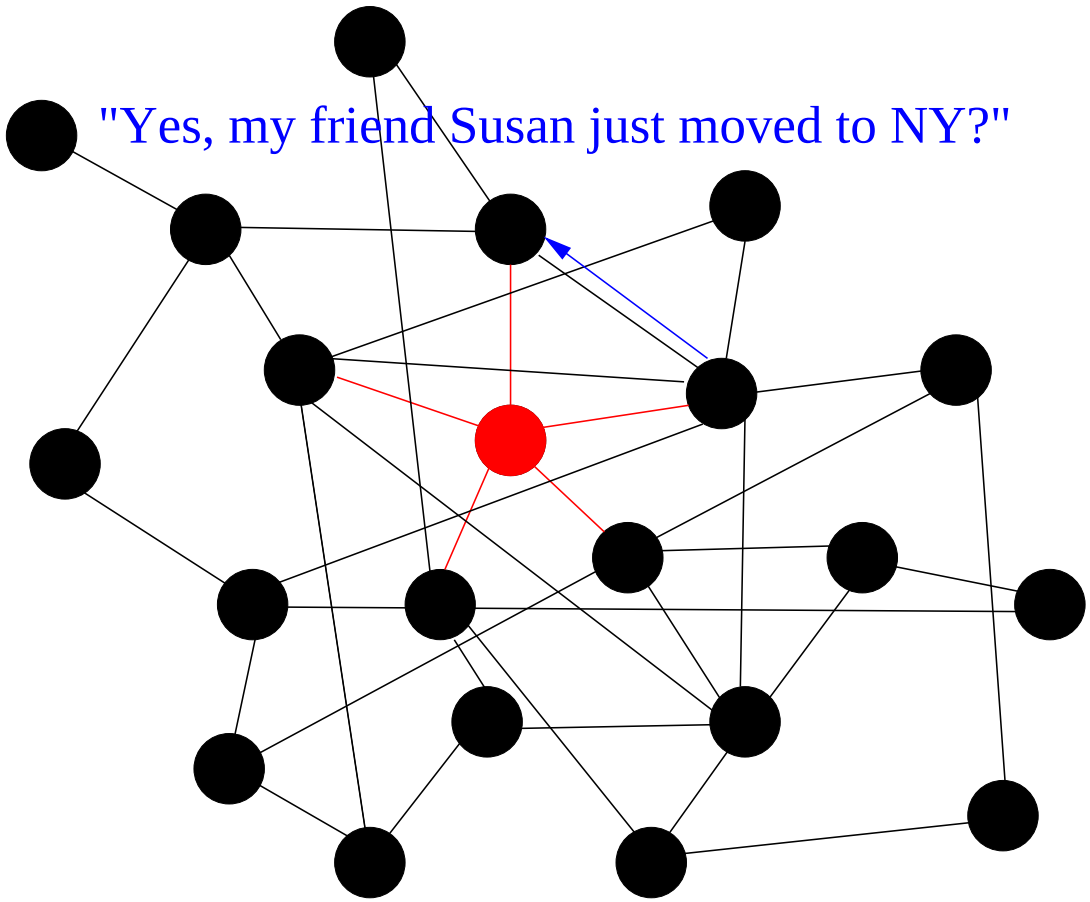
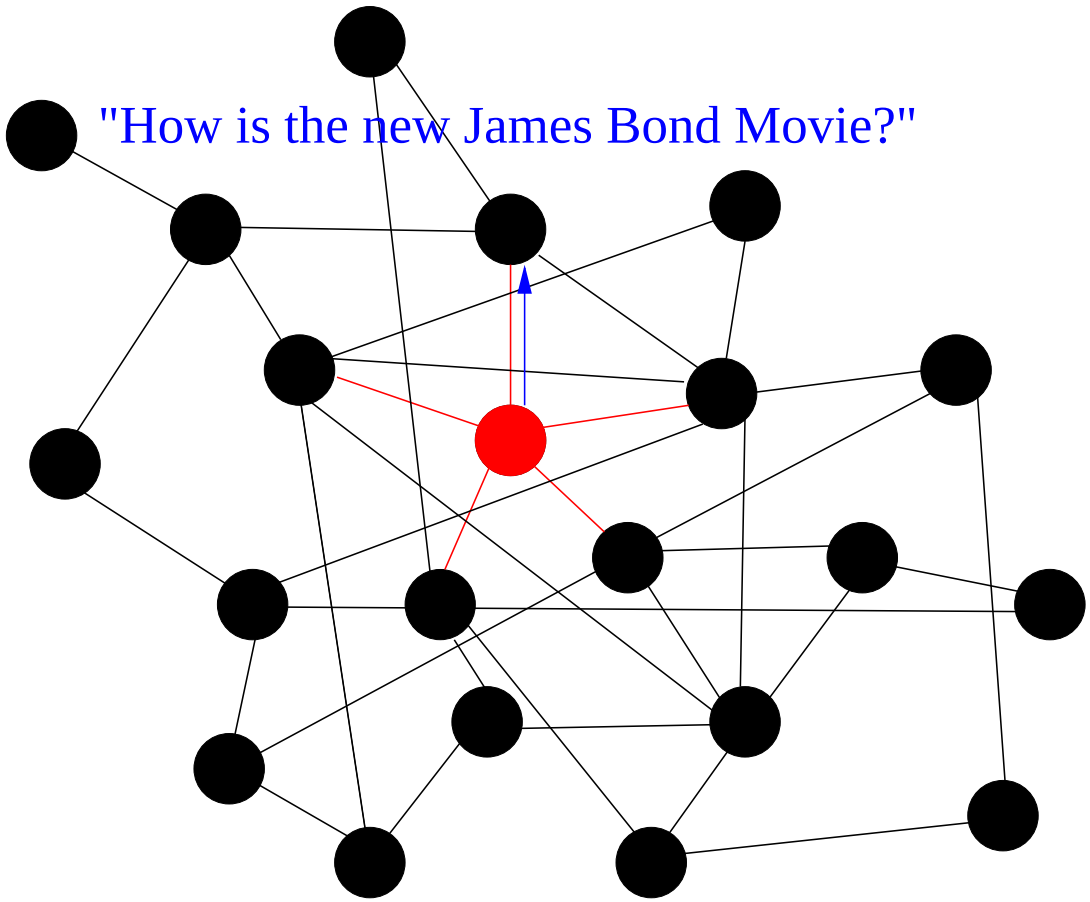


Search

- Queries get Propagated Through the Network
- “Simple” Query Propagation
- How Successful?

Recommendations



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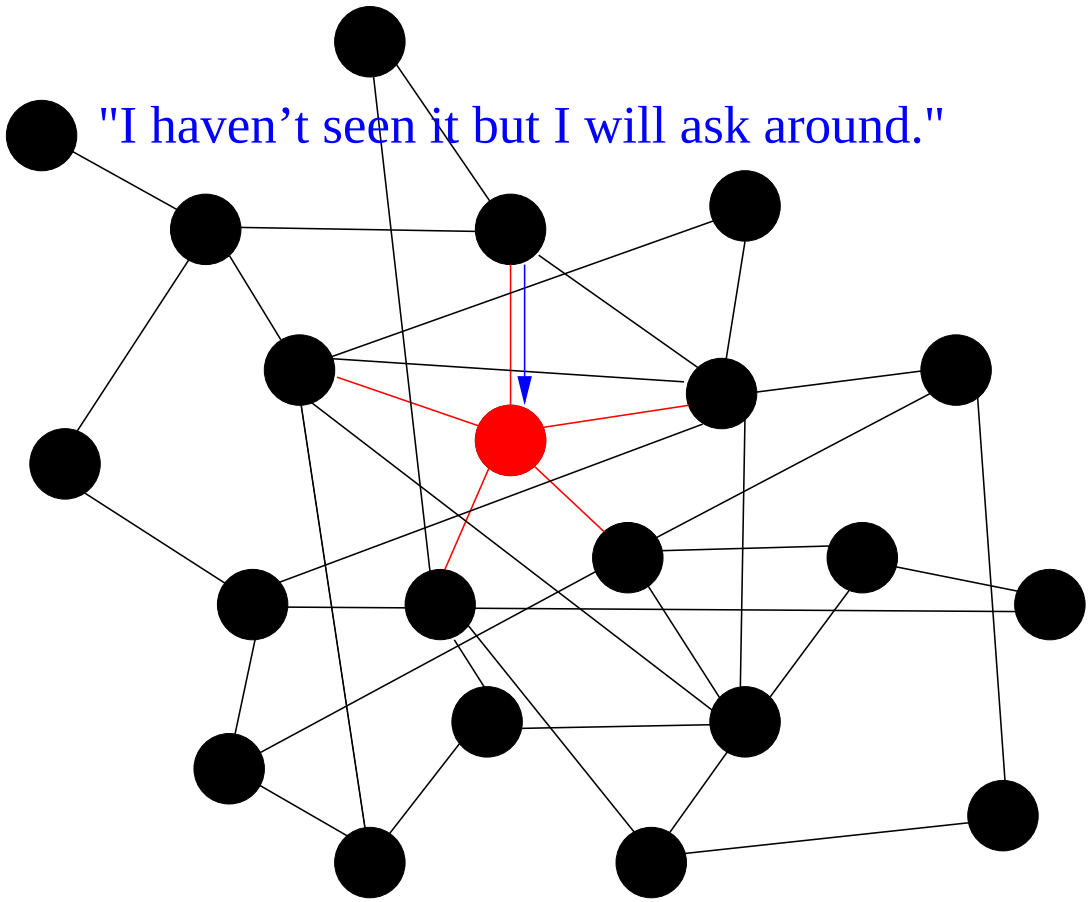

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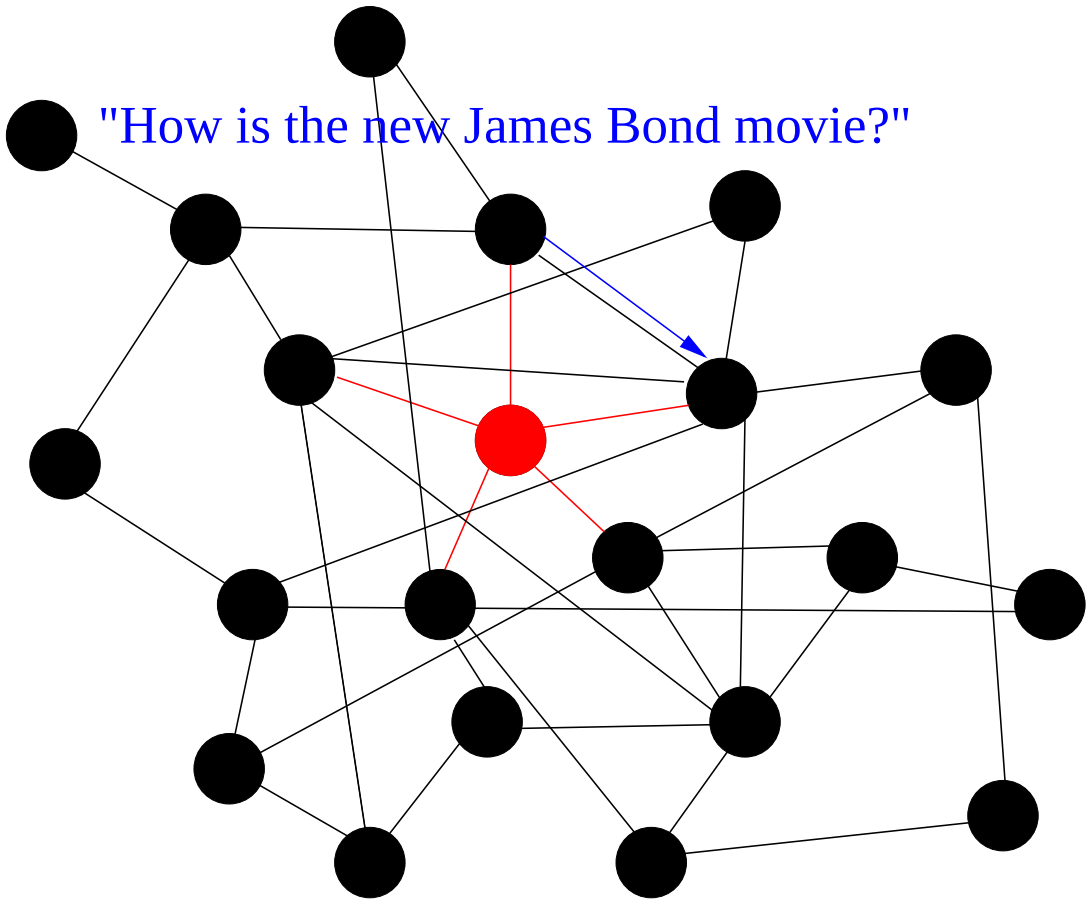

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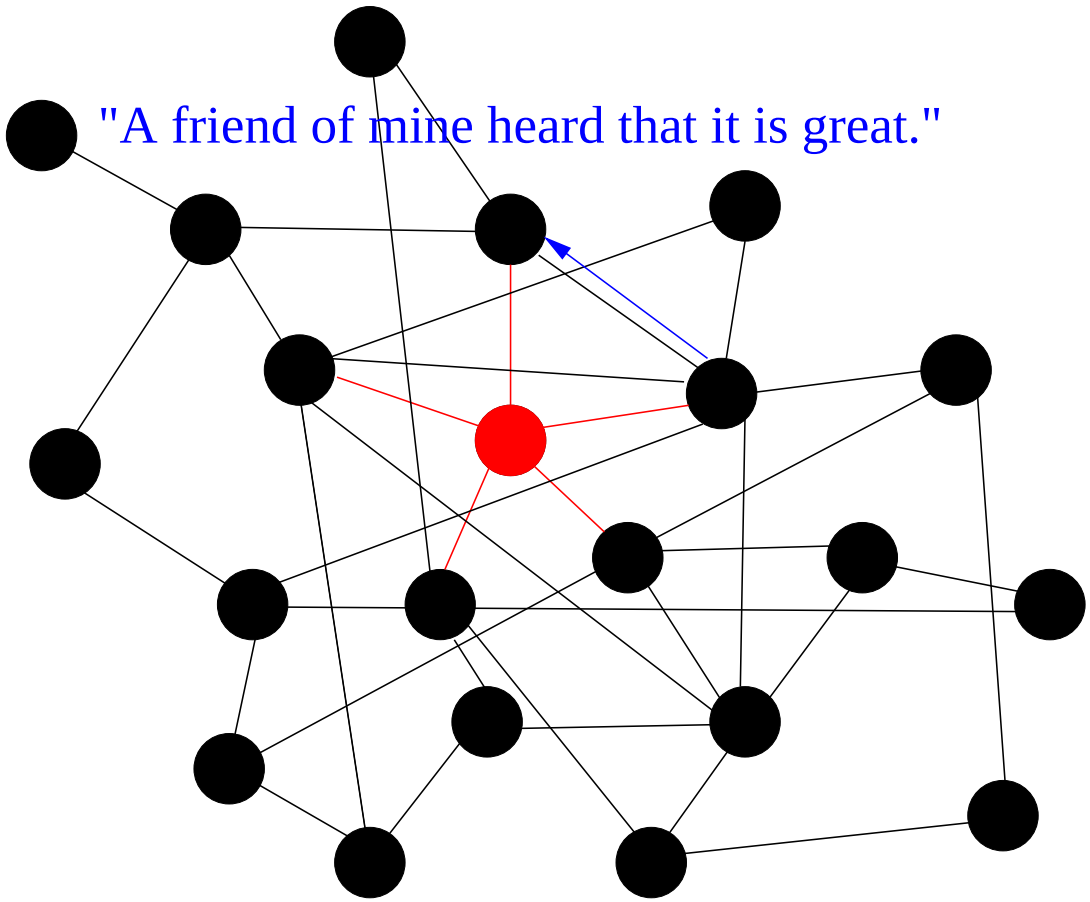

Recommendations

- May get More than 1 Recommendation
- Information Fusion
- How Successful?

Observations

- Social Networks are Useful
- Social Networks are Scalable
- Why?
  - Network Formation
  - Information Diffusion
  - Query Propagation
  - Information Fusion

Research Questions

- Network Formation
- Information Diffusion
- Query Propagation
- Information Fusion

Impact

- Peer-to-Peer Networks
  - Scalable Peer-to-Peer Networks
- Online Social Networks
  - Personalized Search
  - Recommendation System

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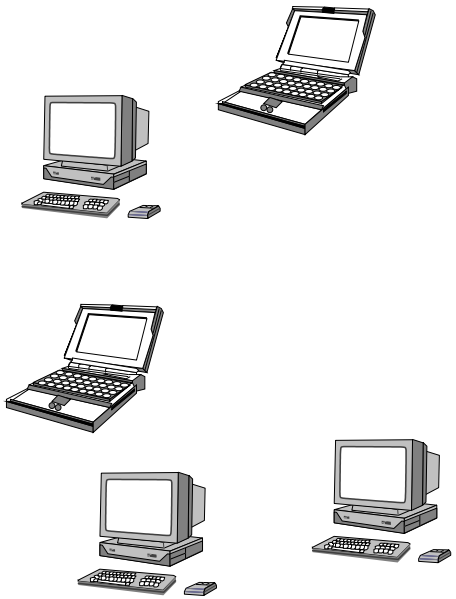
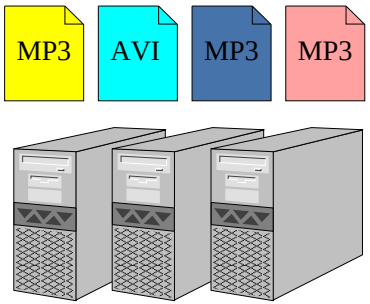
Does it Work?

- Hybrid Peer-to-Peer Networks

Content Distribution Systems





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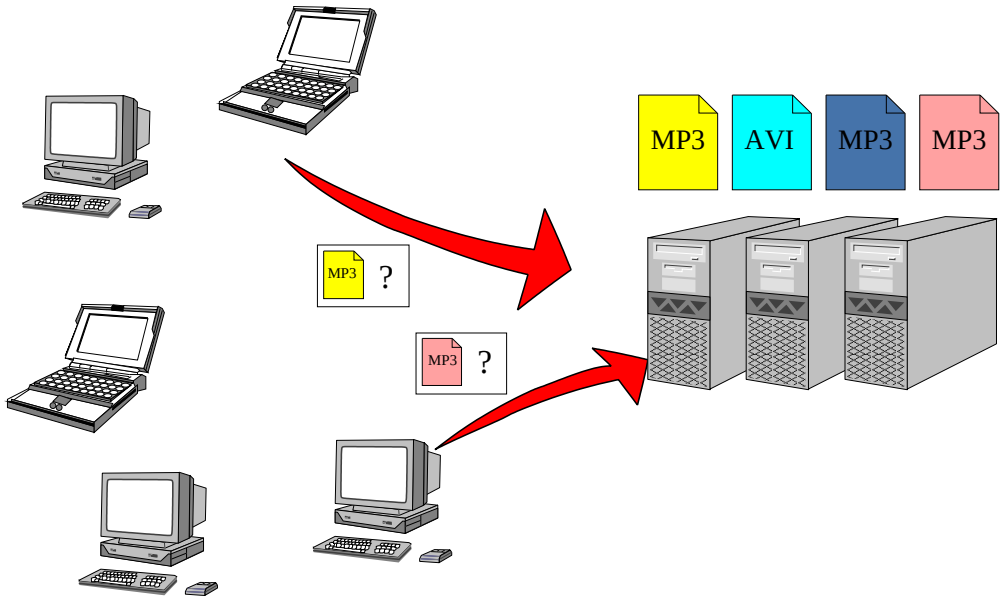

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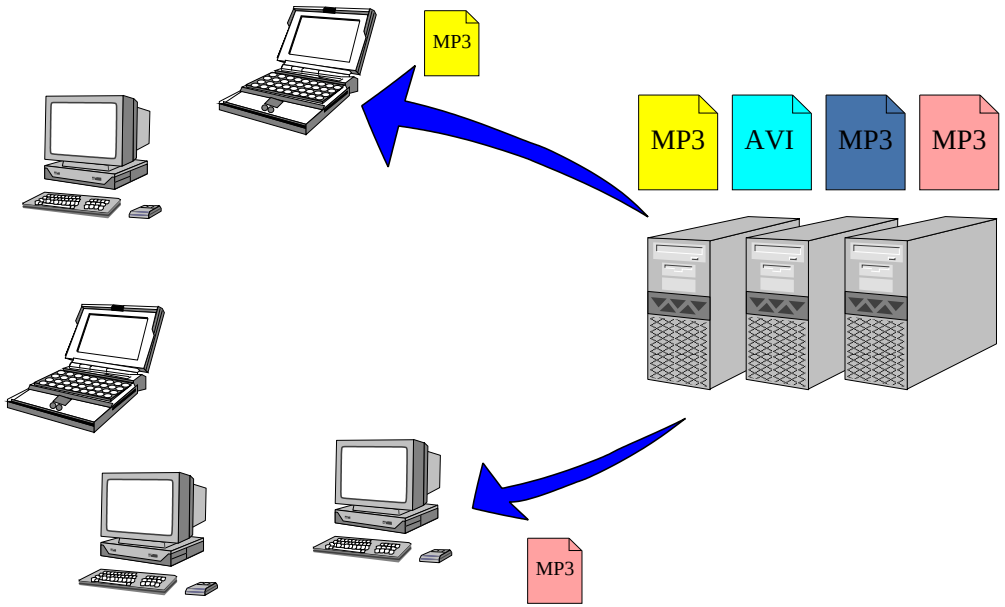

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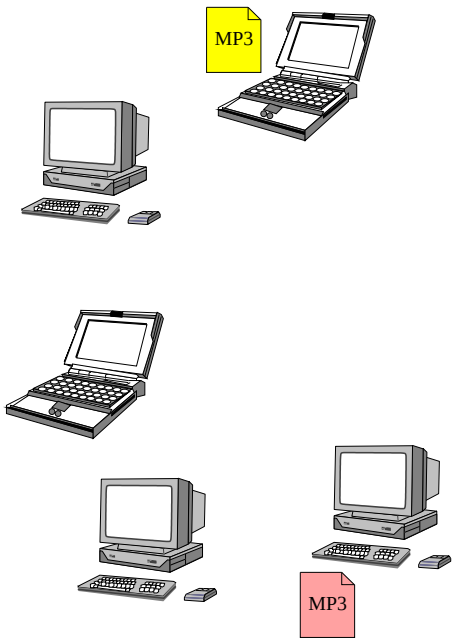

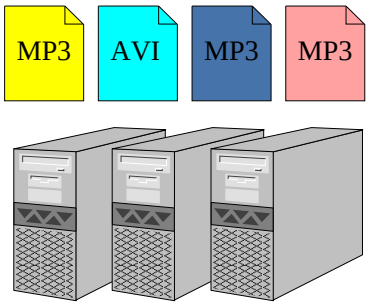

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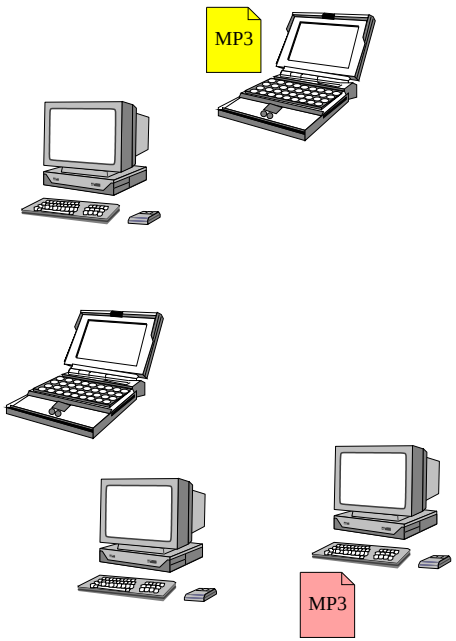

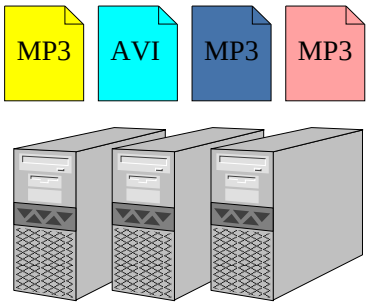

Server traffic $\sim N$

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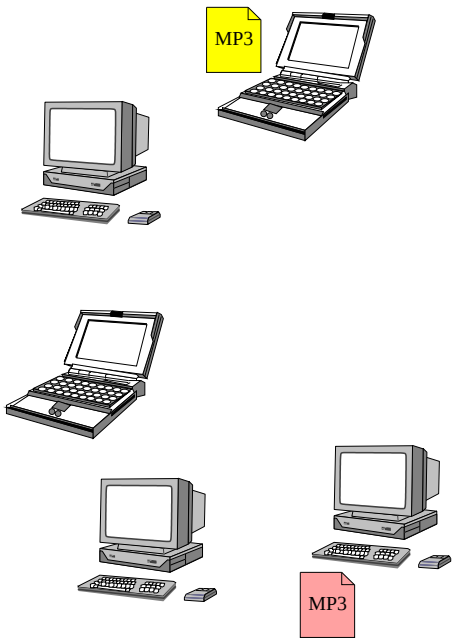
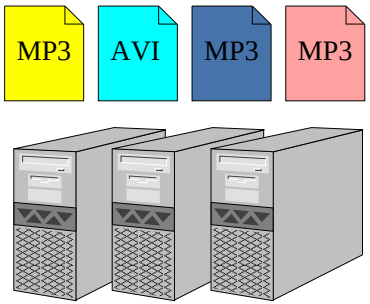
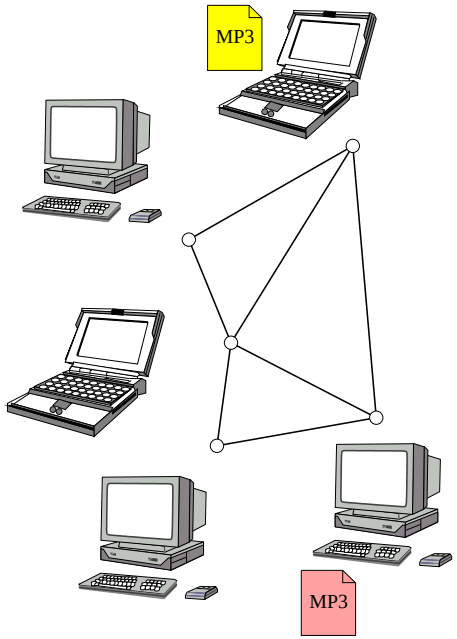
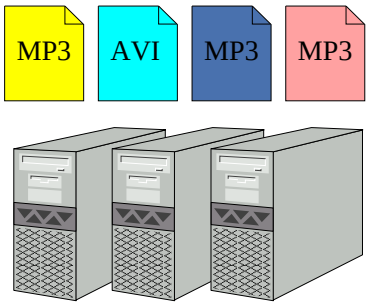




Can we reduce server traffic?

A Hybrid Peer-to-Peer System





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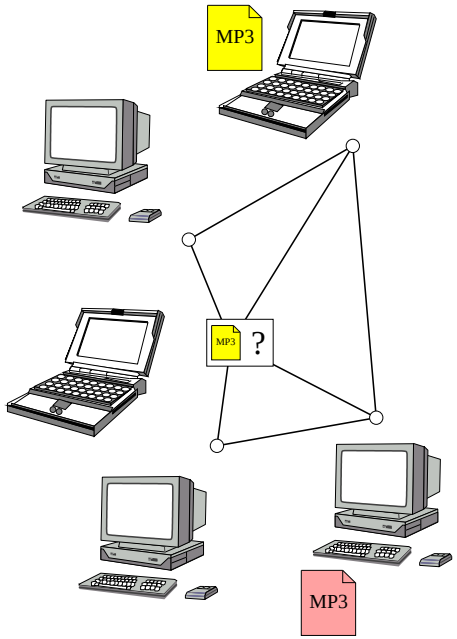
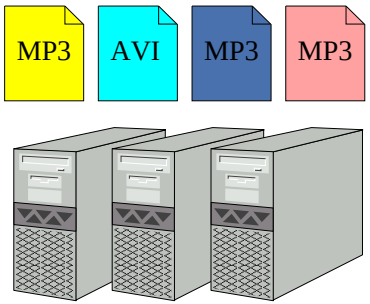
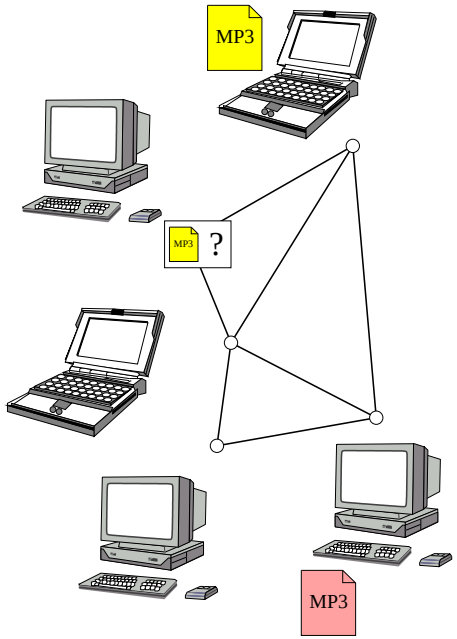
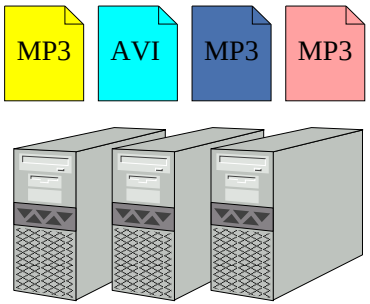




First, search P2P network

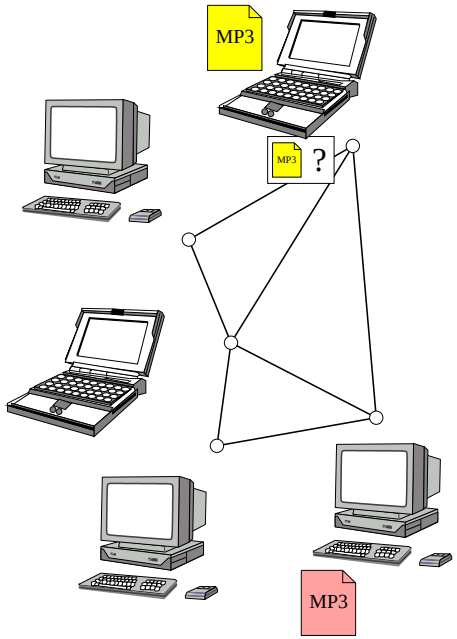
A Hybrid Peer-to-Peer System

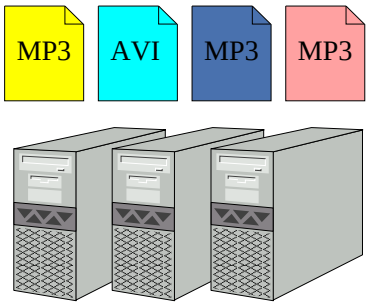




First, search P2P network

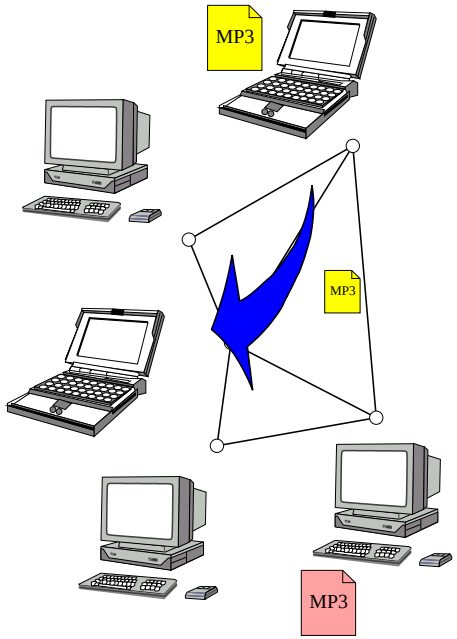
A Hybrid Peer-to-Peer System

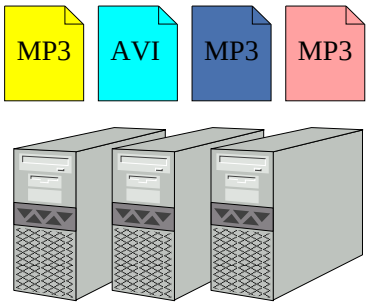




First, search P2P network

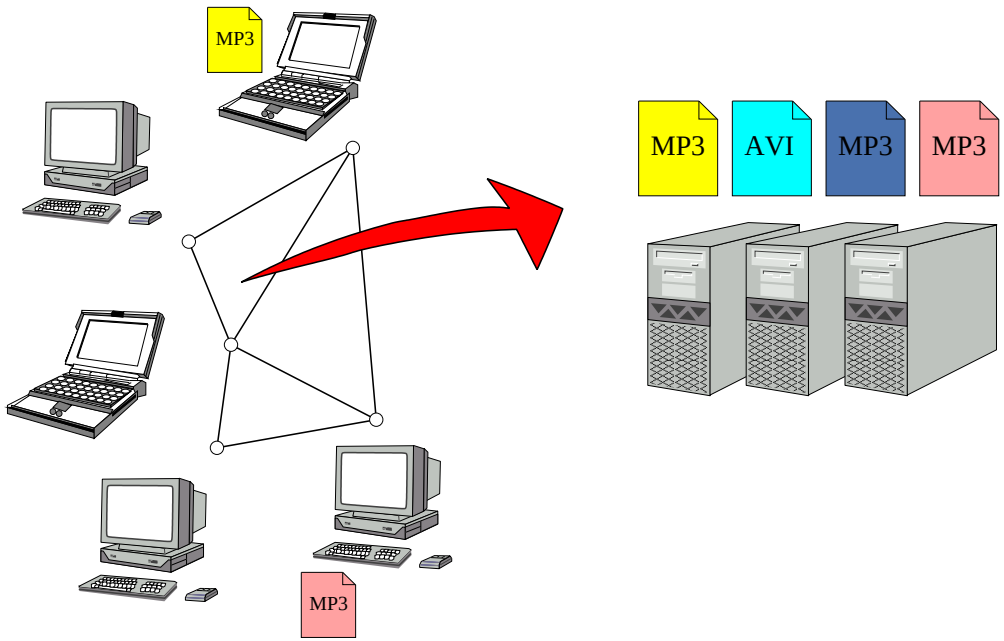
A Hybrid Peer-to-Peer System





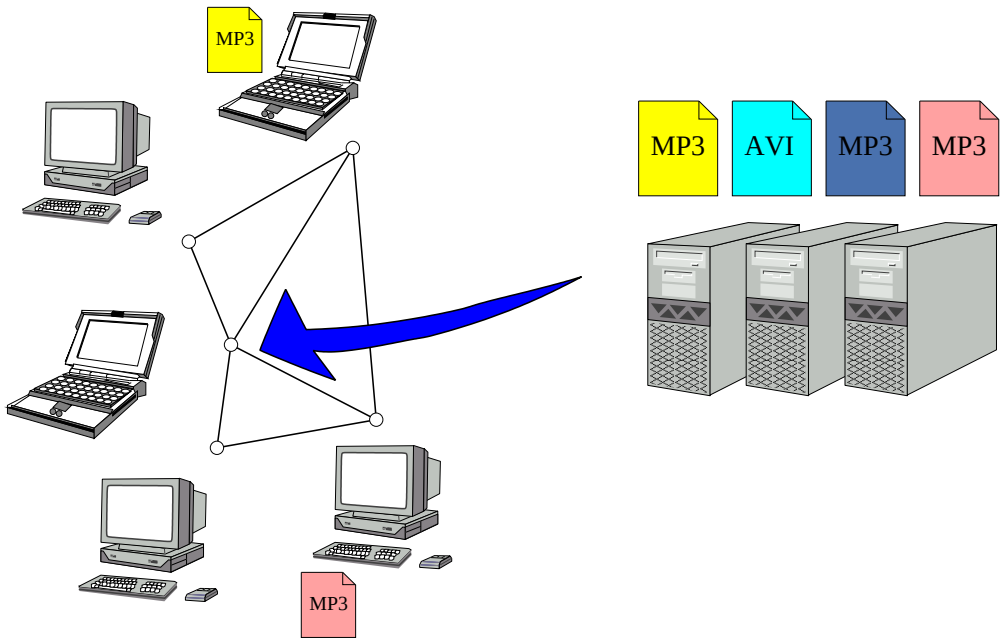
If successful, get file from P2P network

A Hybrid Peer-to-Peer System



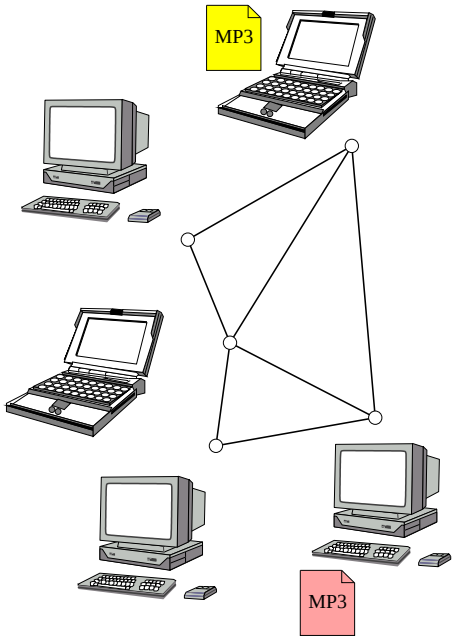
If failure, get file from server

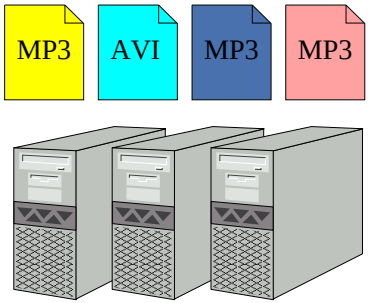
A Hybrid Peer-to-Peer System



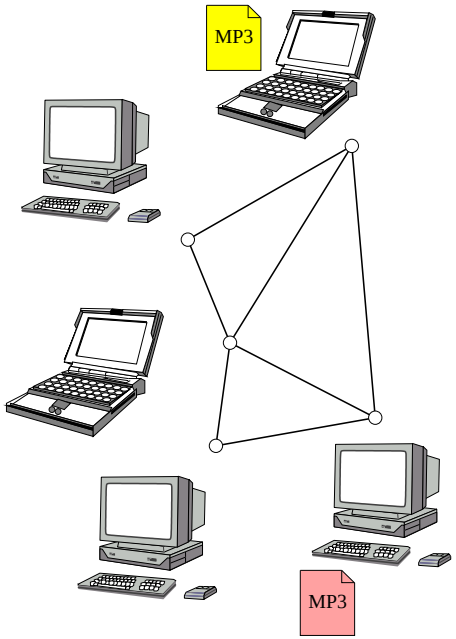
If failure, get file from server

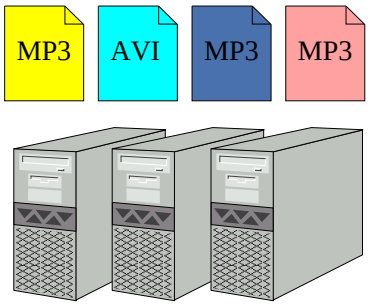
How Effective?





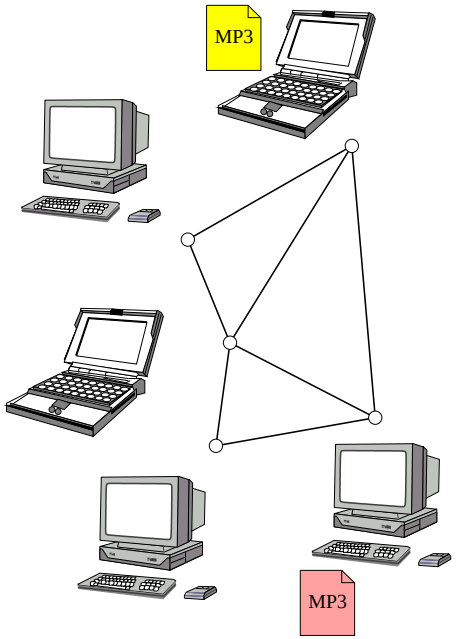
How Effective?

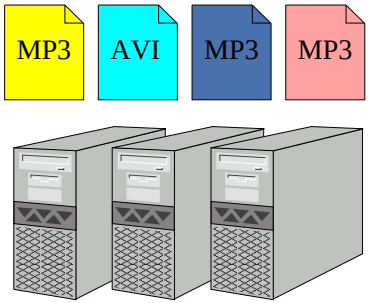




How much can we reduce server traffic?

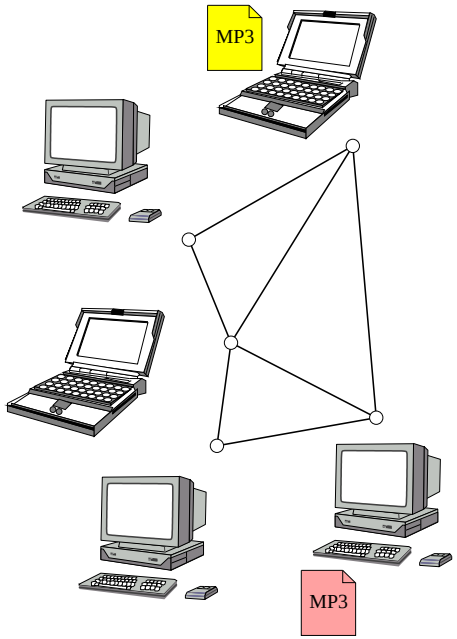
How Effective?

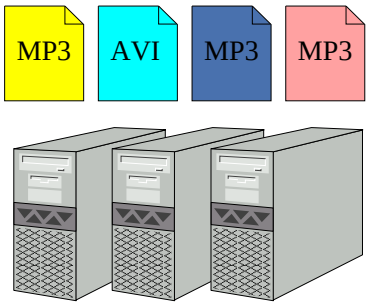




Sever traffic $\sim N$

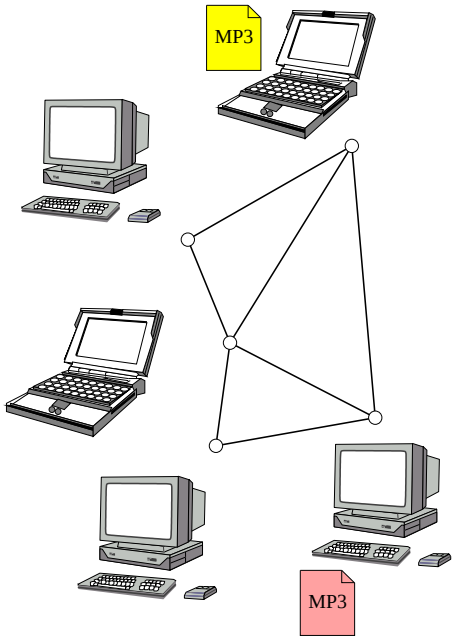
How Effective?

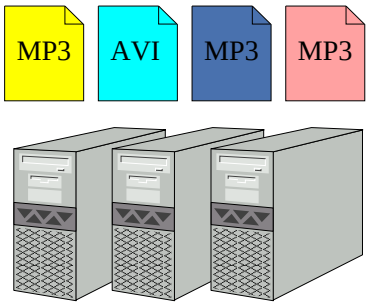




Sever traffic $\sim \sqrt{N}$?

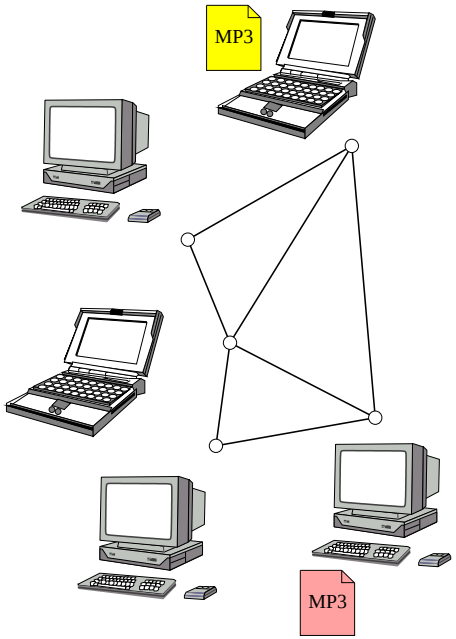
How Effective?

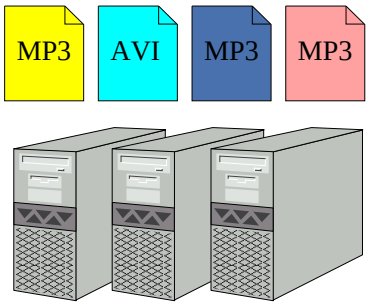




Sever traffic $\sim \log N$?

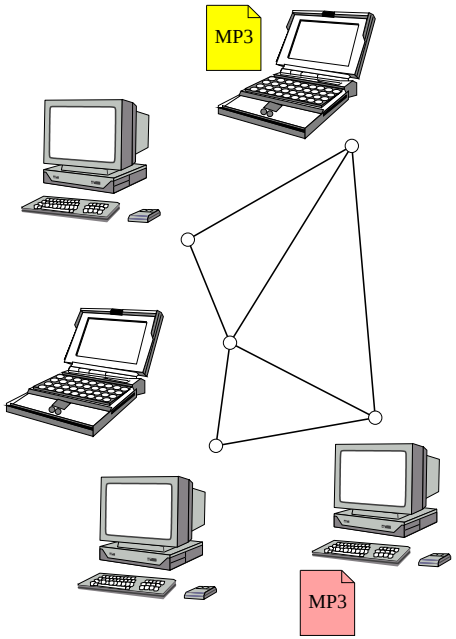
How Effective?

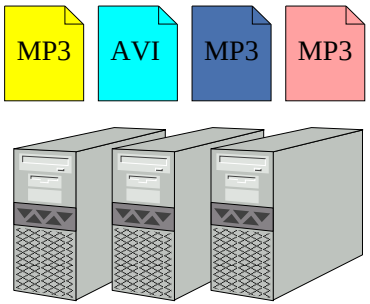




Sever traffic is bounded?

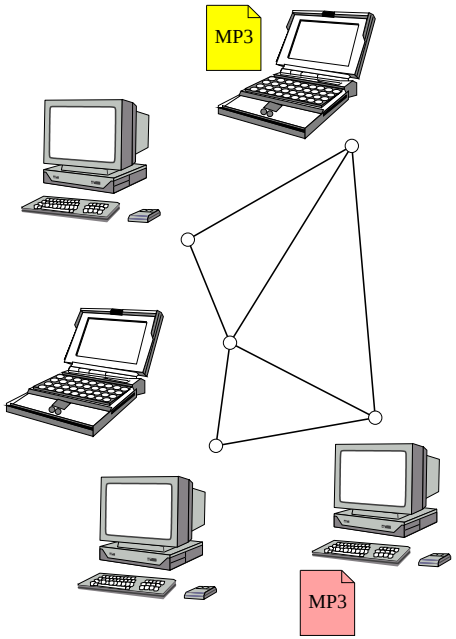
How Effective?

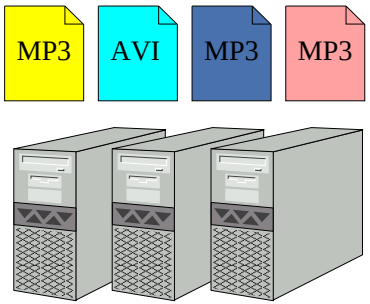




What is the effect on users?

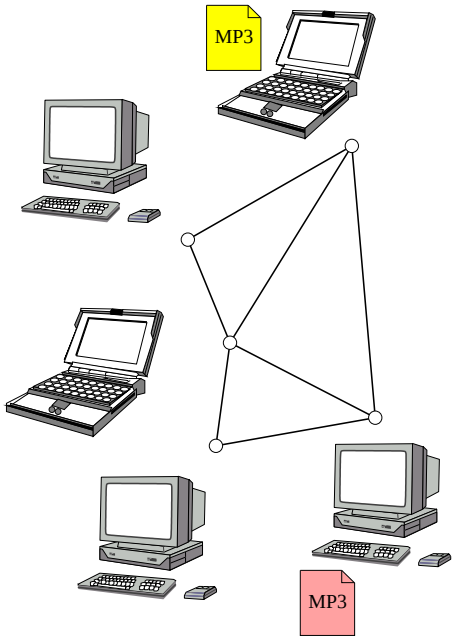
How Effective?

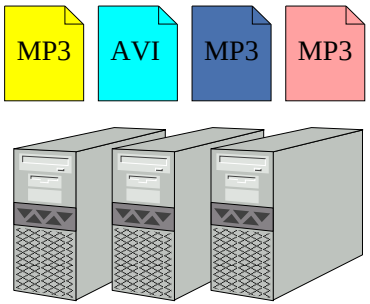




Users have fixed bandwidth.

How Effective?



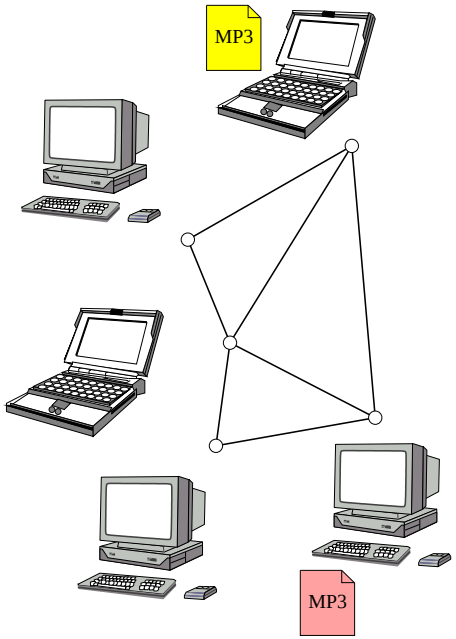


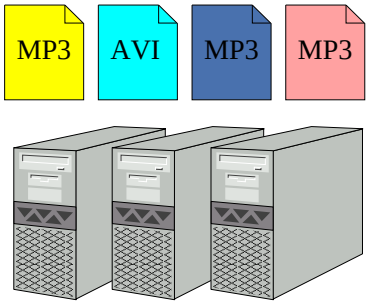
How much can we reduce server traffic, given that traffic imposed on users has to be bounded?

Analysis

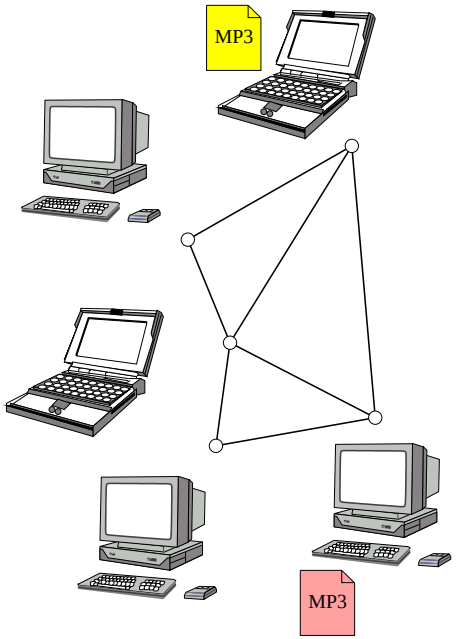
- P2P Network Topology
- Query Propagation Mechanism
- User behavior (*e.g.* file popularity).

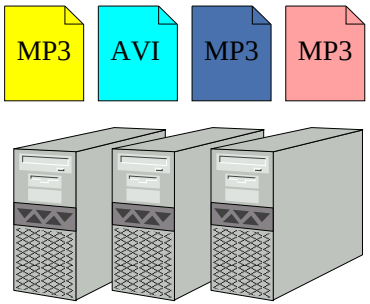
Results





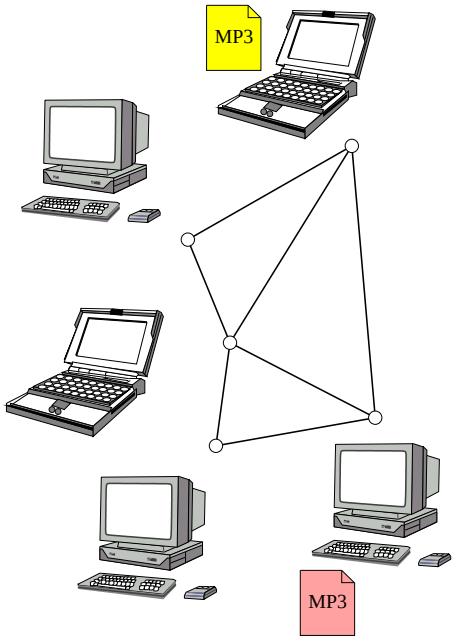
Results

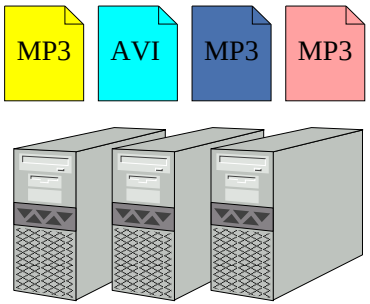




Server traffic?

Results





How much can we reduce server traffic, given that the traffic imposed on users has to be bounded?

Conclusion

- Peer-to-Peer Networks
  - Scalable Peer-to-Peer Networks
- Online Social Networks
  - Personalized Search
  - Recommendation System

Thank You

- Thank You!