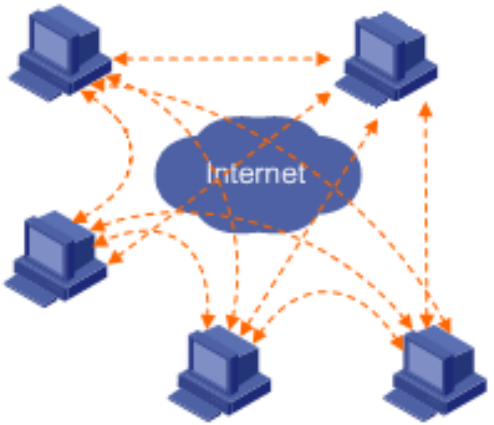
# P2P Networks

by Octavio Herrera-Ruiz

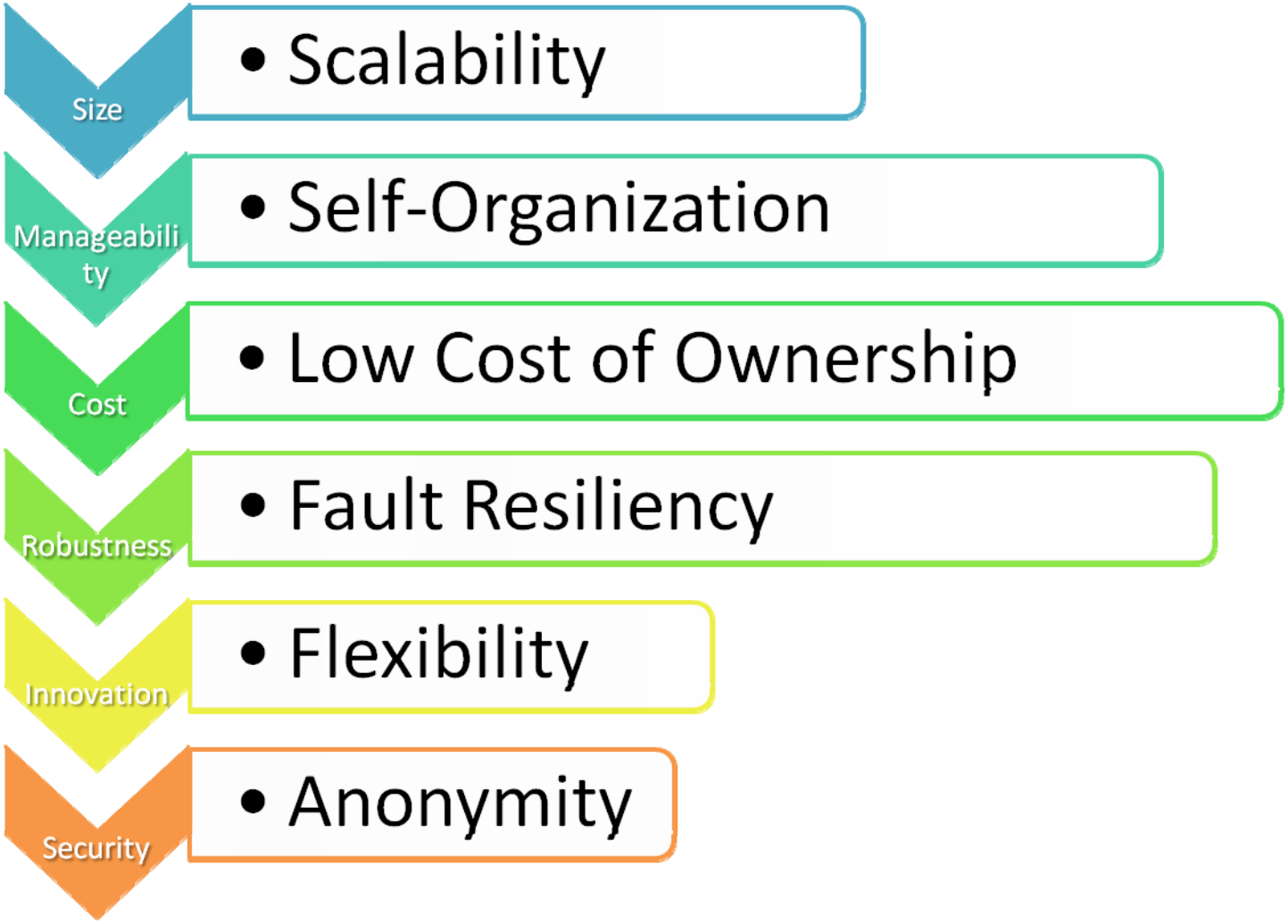
# P2P Definition



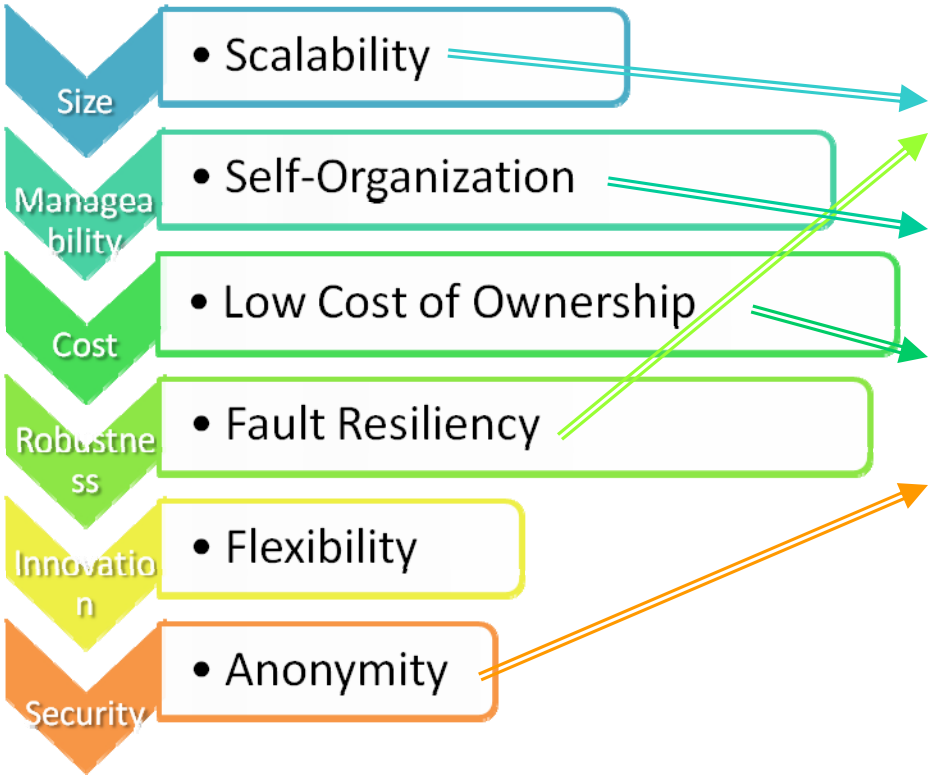

- P2P=Peer-to-Peer
- Distributed Systems
- Nodes are both: *Clients* and *Servers*
- Aggregate Resources
- Nodes organized into network topologies
  - Nodes at the edge of the Internet
- Naming space independent of the DNS

*e-mail (SMTP)*

# P2P Features



# P2P vs Client Server




## Client Server

- Single Point of Failure
- Managed
- Barriers to Entry
- Accountability

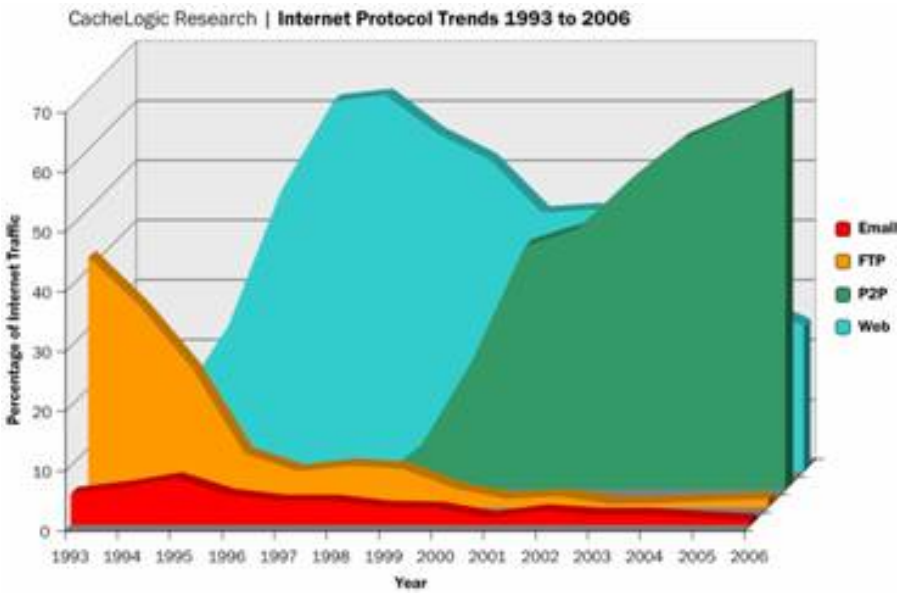
# P2P vs Grid

*Grid*: large-scale coordinated use and sharing of geographically distributed resources

- *Node Availability*: Random (**Low)**
- Best-effort
- Autonomy & Anonymity

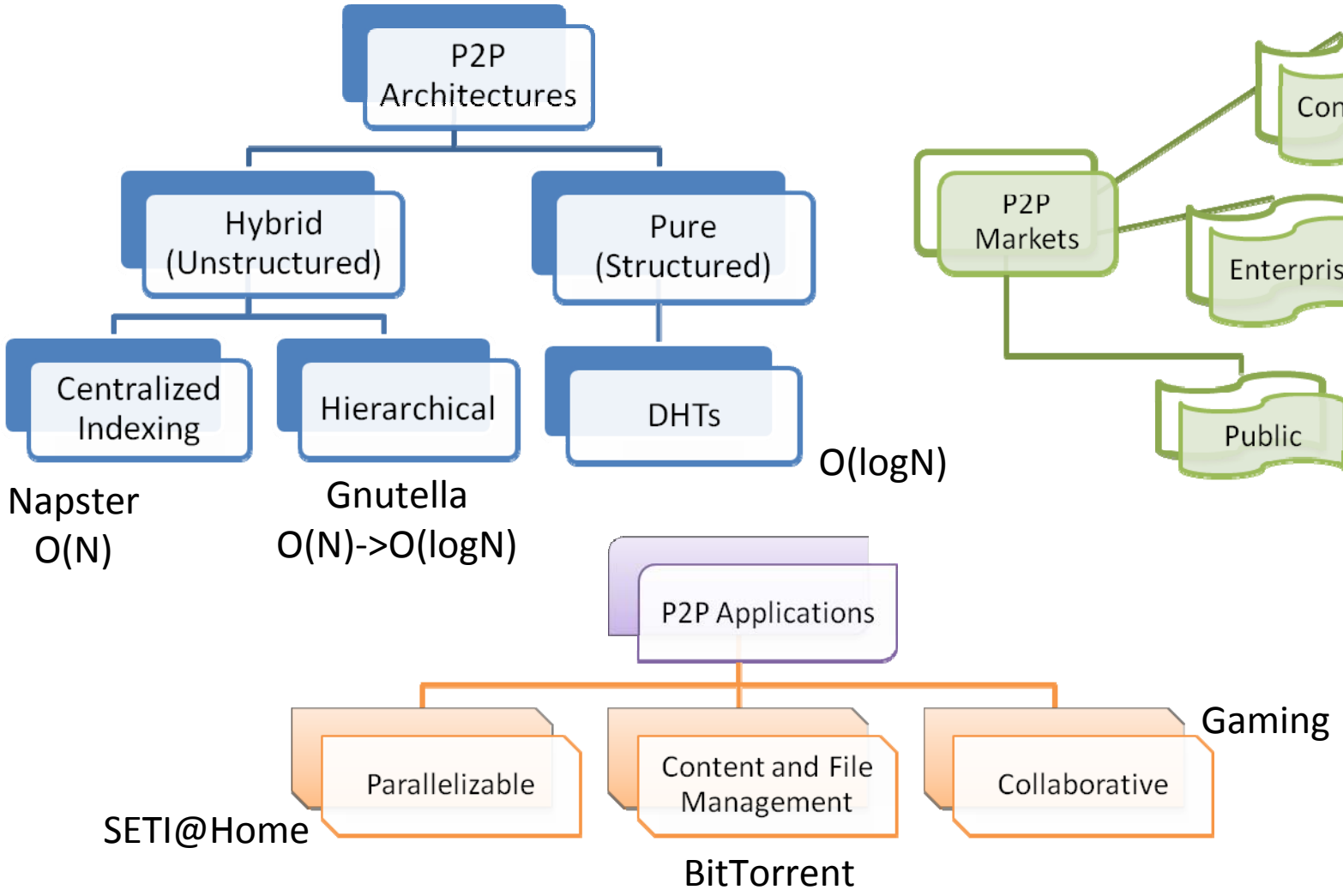
- *Node Availability*: Server-like
- High performance
- Accountability & Access Control

# P2P Traffic



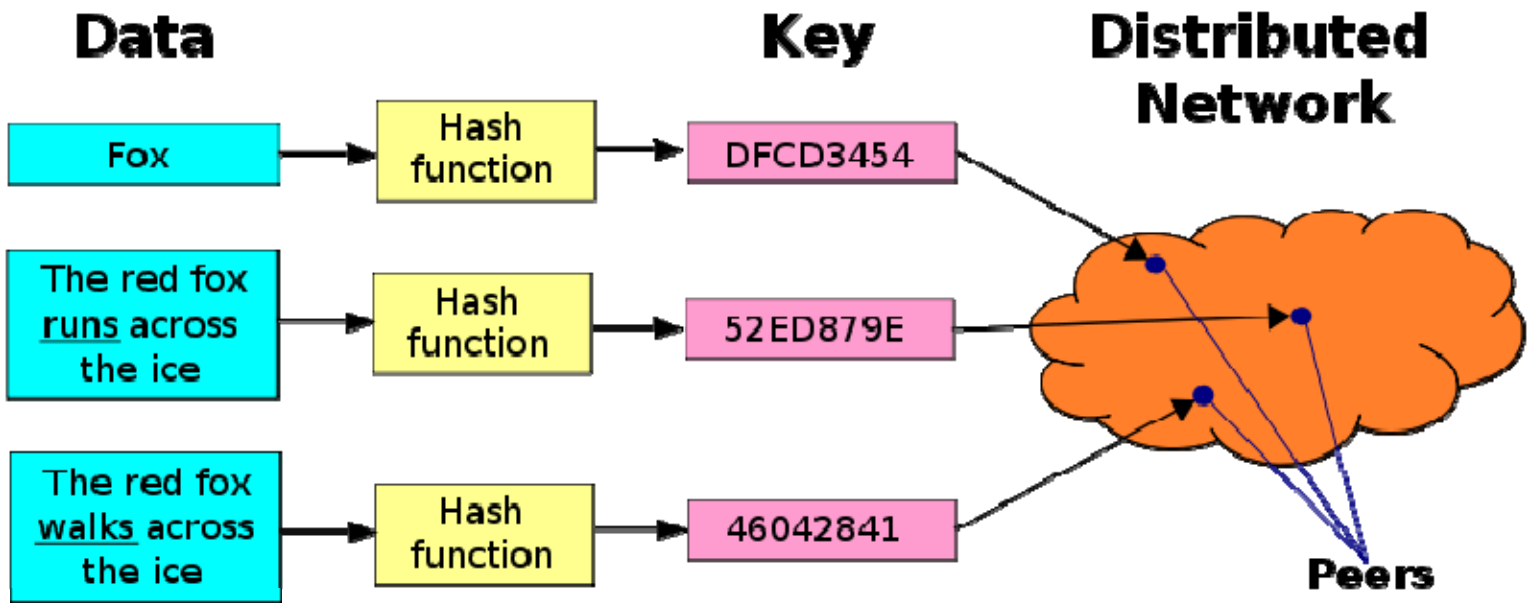

Source: Mihajlo A. Jovanovic, Fred S. Annexstein, Kenneth A. Berman, Scalability Issues in Large Peer-to-Peer Networks A case study of Gnutella. (http://www.medianet.kent.edu/surveys/IAD06S-P2PArchitectures-chibuike/P2P%20App.%20Survey%20Paper.htm)

# P2P Taxonomies



# DHT

- Distributed Hash Tables

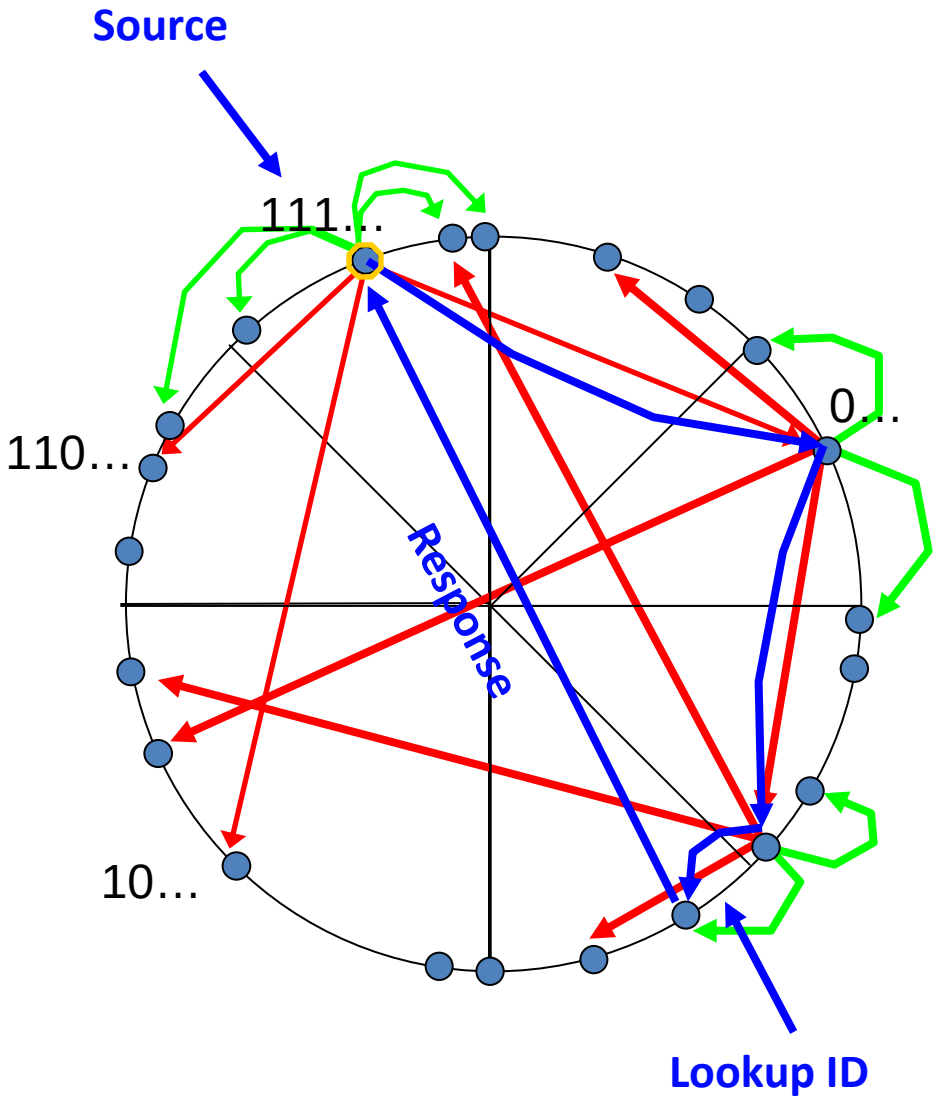



Source: Wikipedia

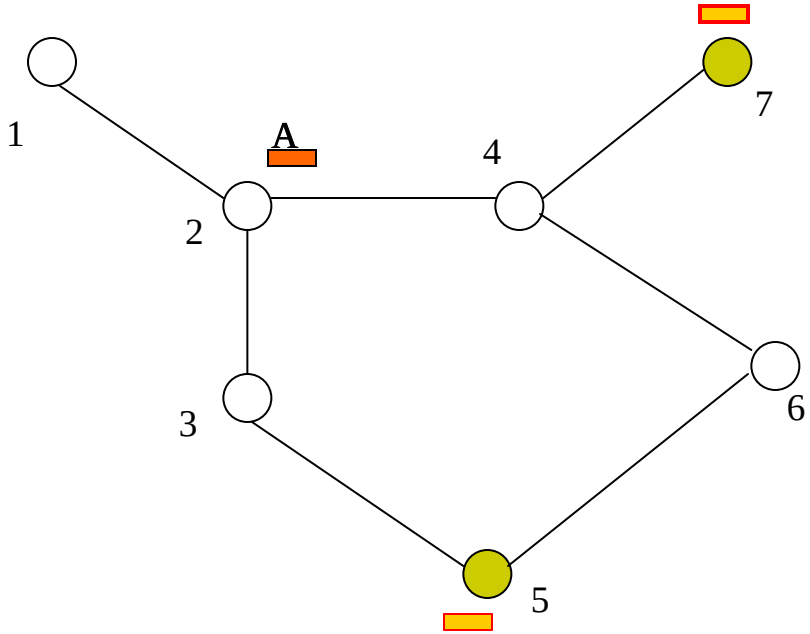
taken from [1]

# How Does Lookup Work?

- Assign IDs to nodes
  - Map hash values to node with closest ID
- Leaf set is successors and predecessors
  - All that's needed for correctness
- Routing table matches successively longer prefixes
  - Allows efficient lookups



# Gnutella Operation




1. Node 2 initiates search for File A
2. Broadcast to all its neighbors
3. Neighbors forward the request (random walk)
4. Nodes that have file initiate reply
5. Reply is back propagated
6. P2P download

# Research in P2P

- **Models/Tools**
  - Topologies
  - Node Behavior (on/off)
  - Simulation
- **Measurement**
  - Heterogeneity
  - Size
  - IP aliasing and firewalls
- **Algorithms/Architectures**
  - Search
  - Security
  - Fairness
- **Applications**
  - Commercial
  - Academic
- **Others**

# Churn in P2P Networks

- **Churn**
  - Continuous and unsynchronized arrival and departures of nodes
- **Effects of churn**
  - Routing
    - Increased maintenance cost
    - Routing table inconsistencies
    - Delayed lookups
  - Content
    - Intermittent availability

# Churn in P2P Networks

**Alleviating Mechanisms**

- Routing
  - Periodic maintenance
  - Dynamic timeouts
- Content
  - Redundancy
  - Bundling
  - Incentives

**Limiting Factors**

- Bandwidth
- Storage Space

**1990 → 2005:**

Disk increased by 8000-fold while bandwidth increased only 50-fold [2]

# Redundancy Maintenance Cost

**Erasure Coding**

$$C_c = \left(1 + {L_c}/{k}\right)\frac{F}{\delta}$$

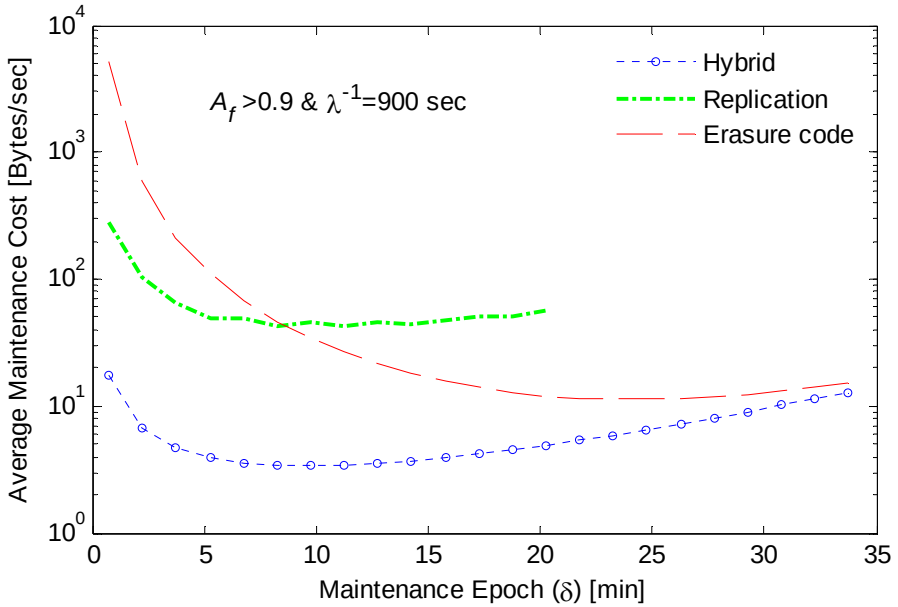
- $L_i$ = # Segments lost
- K = # blocks needed to restore file
- $F$ = File Size
- $\delta$ = Maintenance interval

**Replication**

$$C_r = (L_r)\frac{F}{\delta}$$

**Hybrid**

$$C_h = \left({L_h}/{k}\right)\frac{F}{\delta}$$



# Questions…

Thanks!

# References

[1] “Handling Churn in a DHT”, by Sean Rhea, Dennis Geels, Timothy Roscoe, and John Kubiatowicz, USENIX Annual Technical Conference, June 29, 2004

[2] “High Availability, Scalable Storage, Dynamic Peer Networks: Pick Two” by Charles Blake and Rodrigo Rodrigues. In *Ninth Workshop on Hot Topics in Operating Systems (HotOS-IX)*, (Lihue, Hawaii), May 2003, pp. 1-6.