Modeling The Edge: Peer-to-Peer Reincarnated



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The edge is like a CDN…



- Hierarchical
- Managed
- Omnipresent

The edge is like a CDN…

… but also like a P2P network

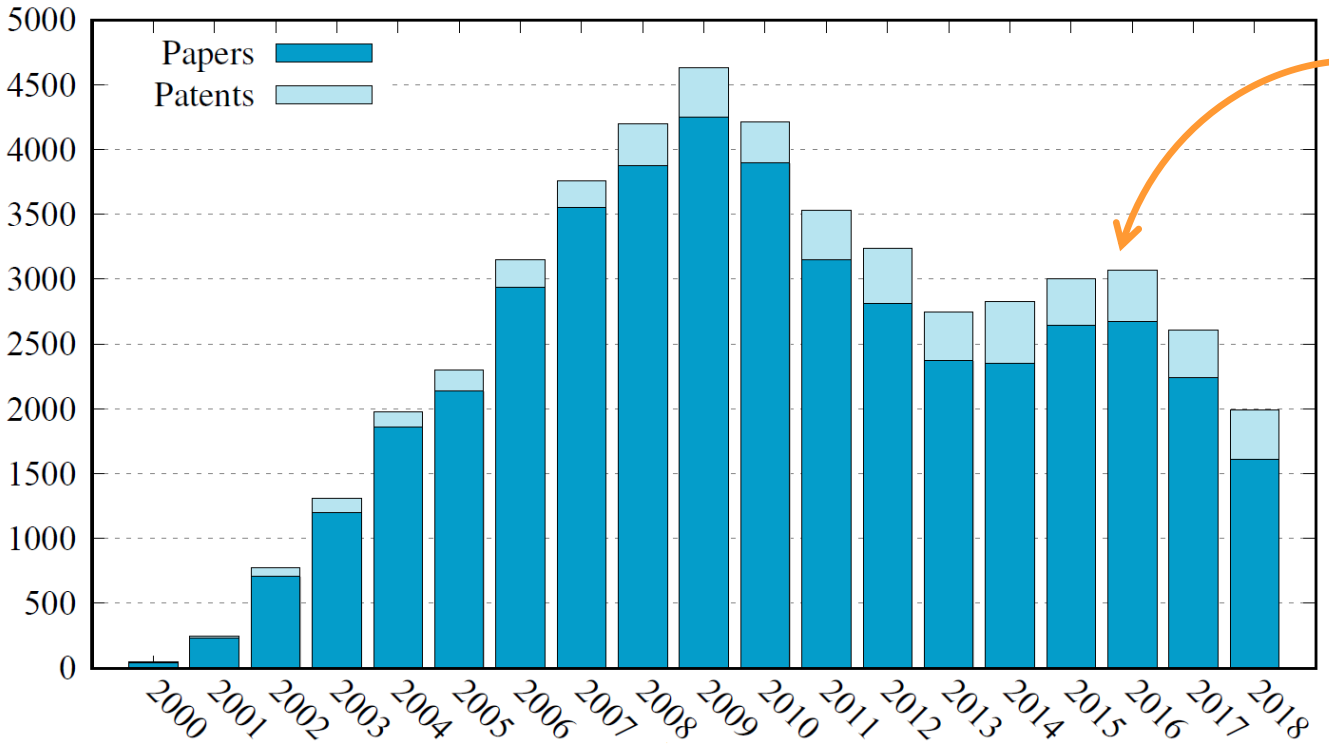




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- Managed
- Omnipresent

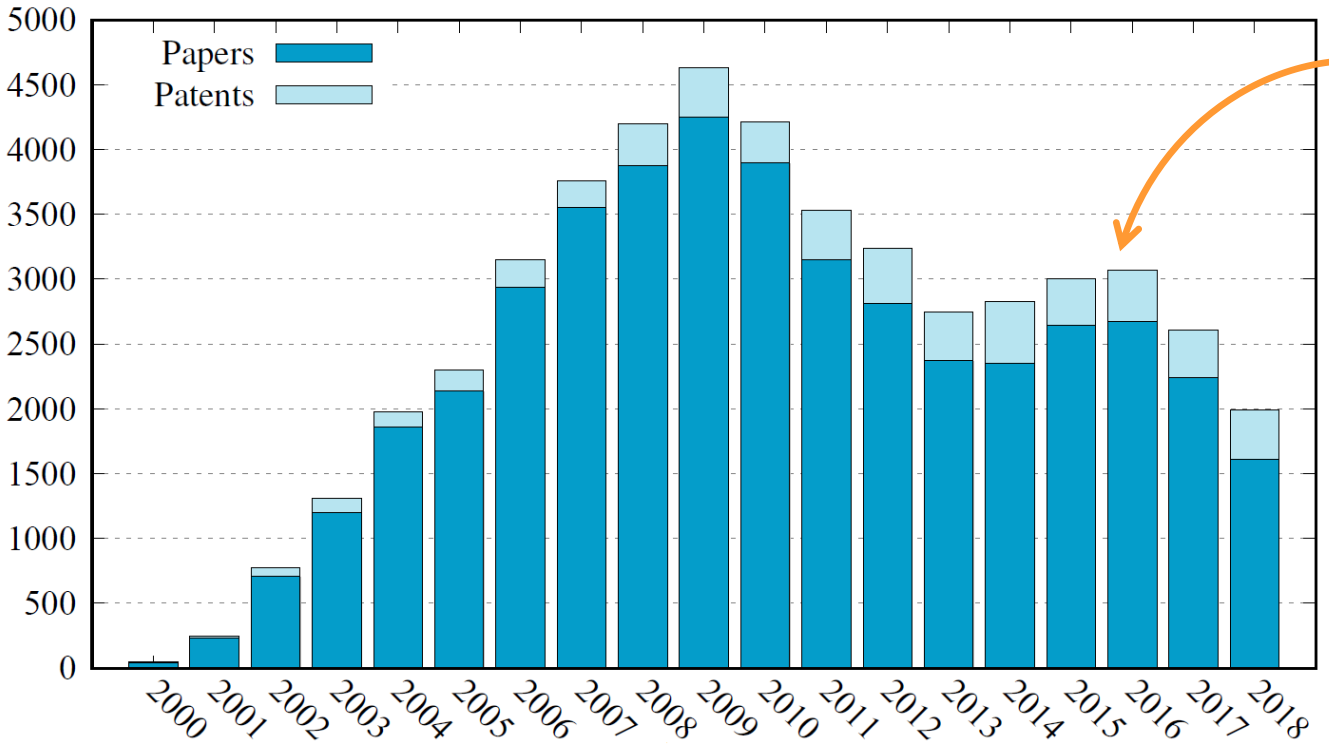
- Unstructured
- Distributed
- Mostly dead…

Papers/Patents on Peer-to-Peer by Year



Mostly dead is slightly alive…

Papers/Patents on Peer-to-Peer by Year



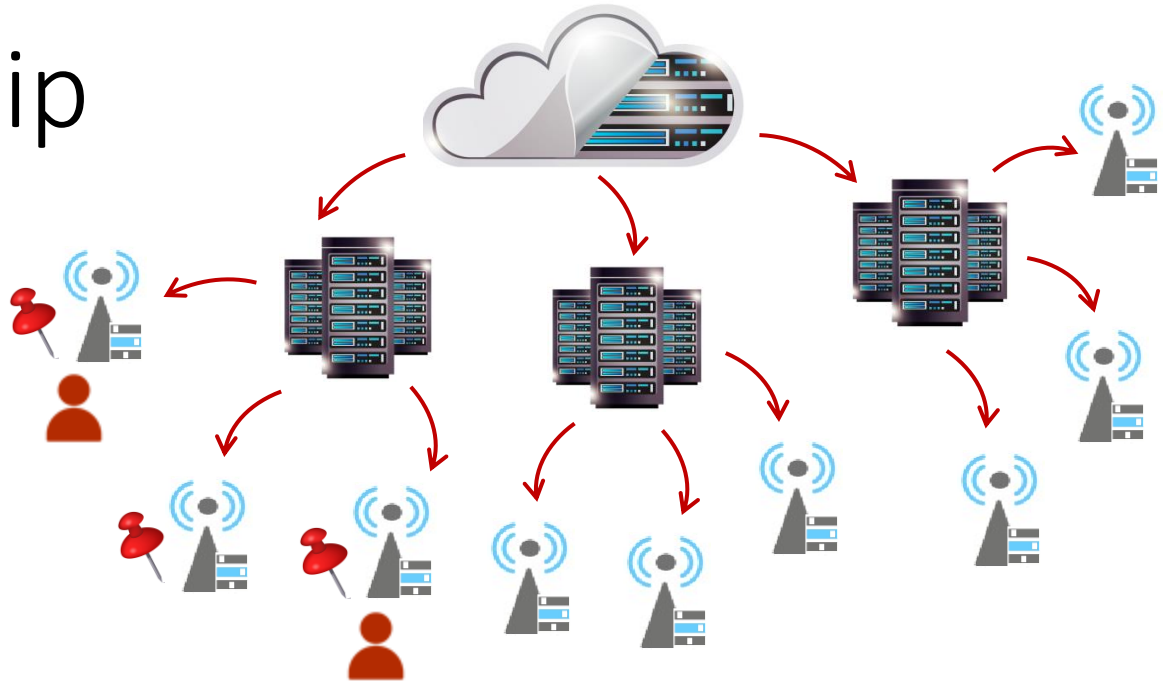
Mostly dead is slightly alive…



→ It's time to revisit the challenges of peer-to-peer

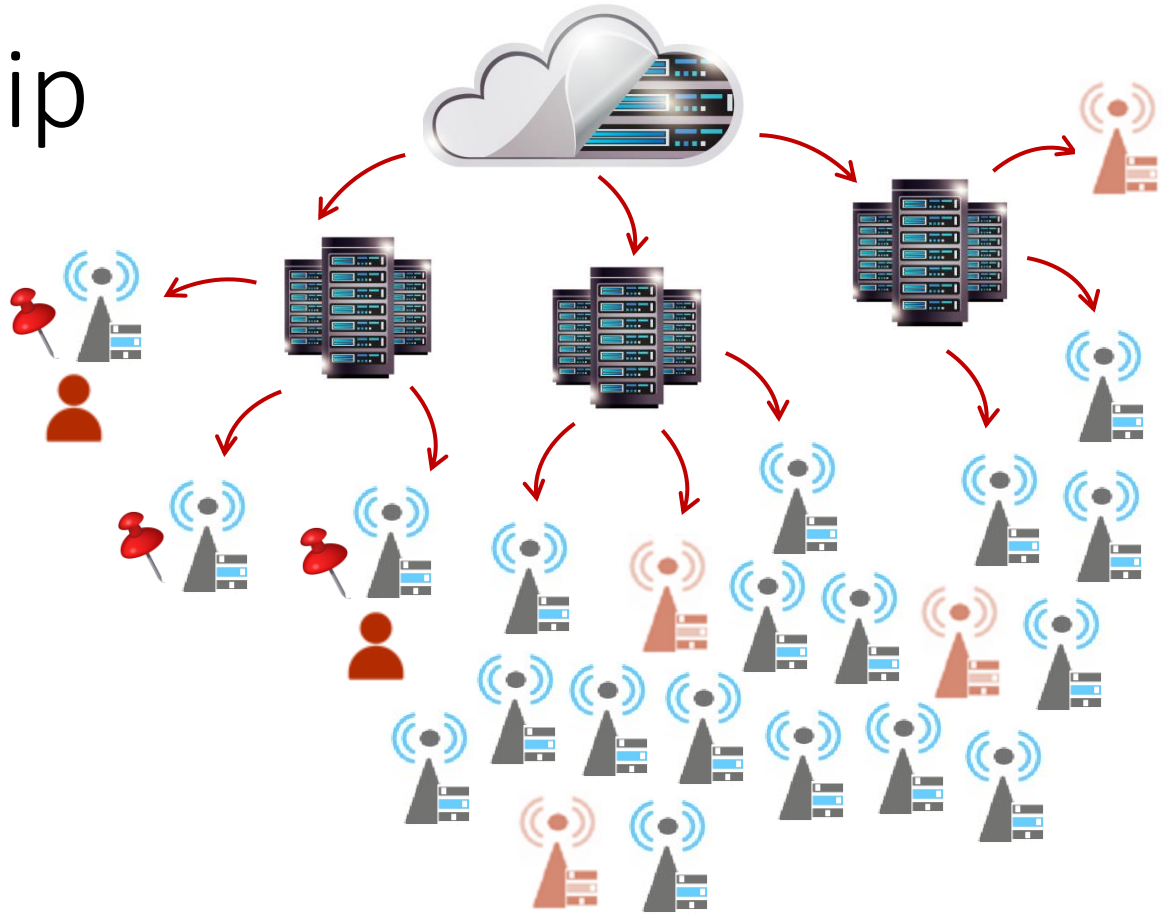
Layout and membership

CDN
- Hierarchy
- Static locations
- Membership



Layout and membership

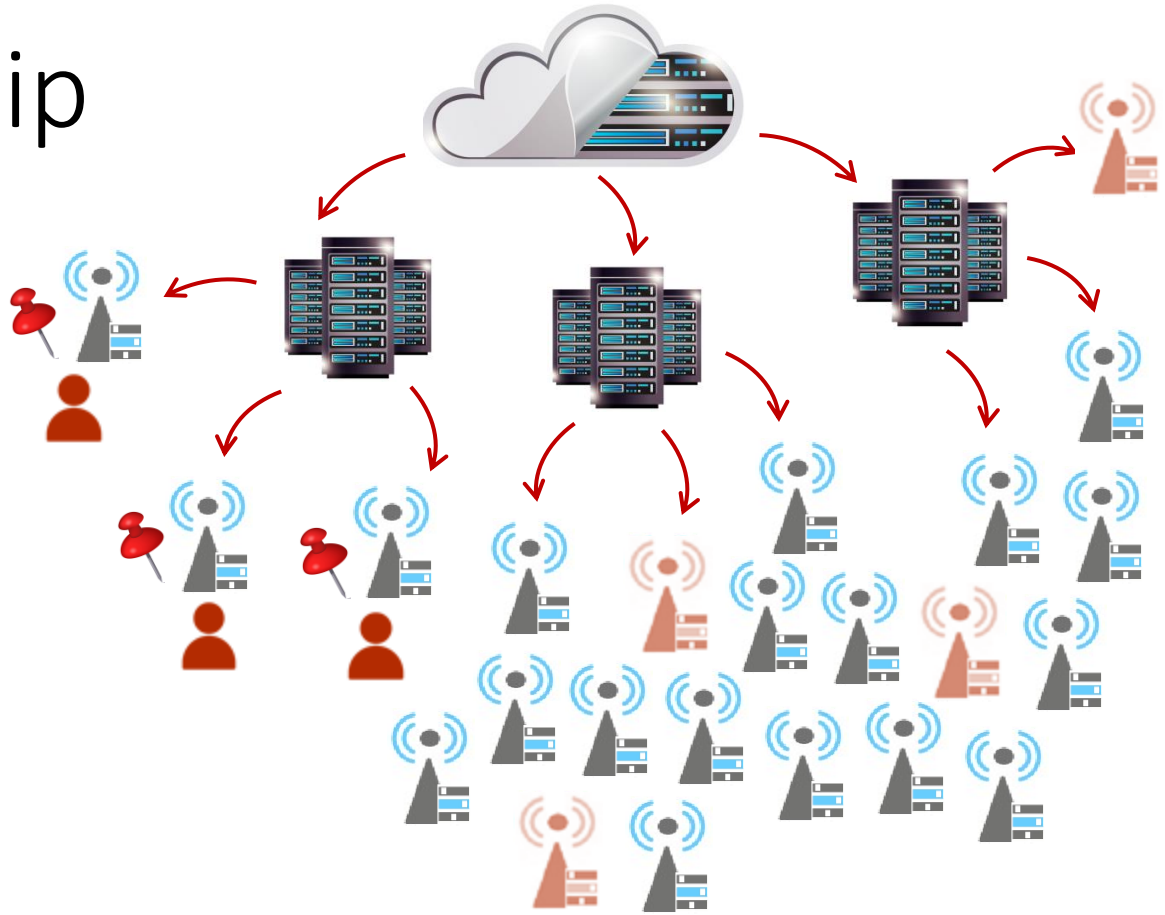
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P2P
- Larger scale
- Lower availability

Layout and membership

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P2P
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Distributed hash tables

Gossip

Swarms

Super-peers

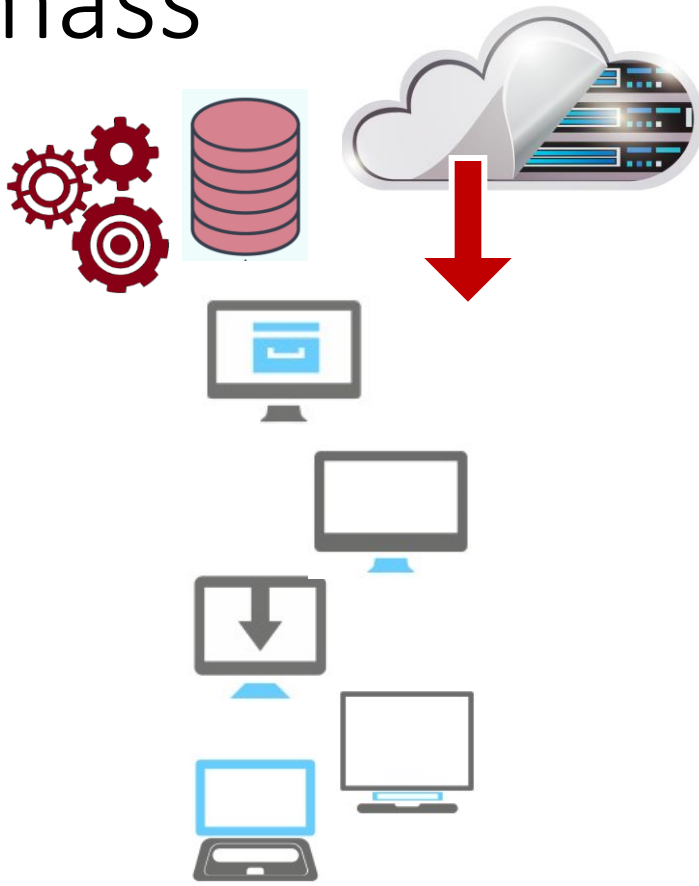
10-way replication

(32,16) erasure coding

→ P2P solutions have very high overheads

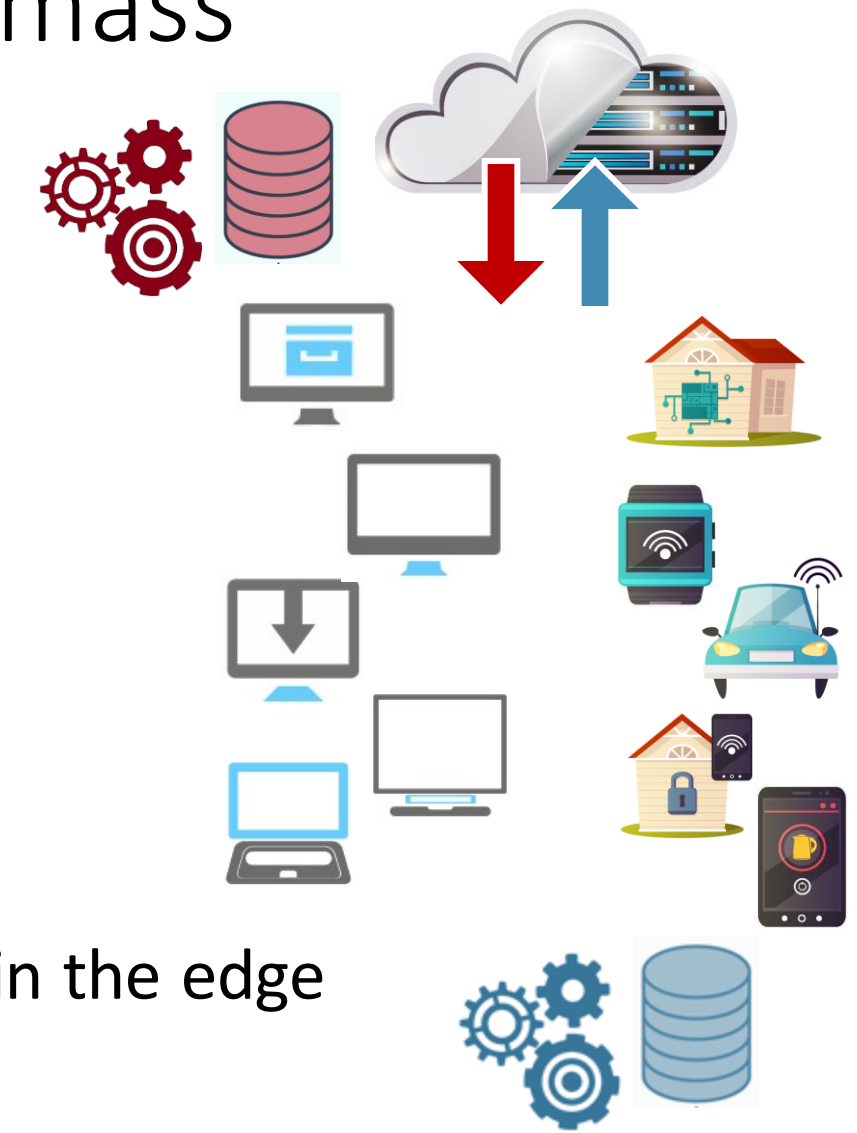
Data and service “center of mass”

CDN
- Edge as cache/accelerator
- Most data and compute in the cloud



Data and service “center of mass”

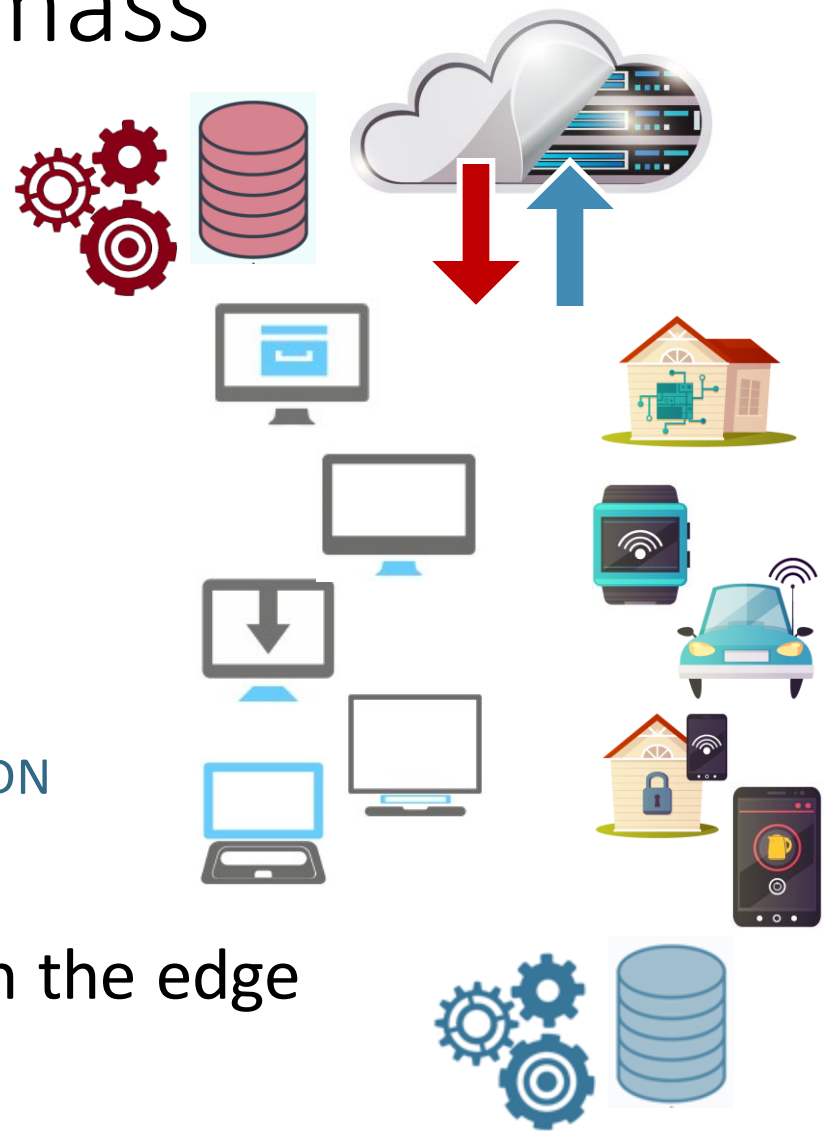
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P2P
- Data generated at the edge
- Preprocessing, aggregation, and logic in the edge

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Collaborative caching

P2P-CDN

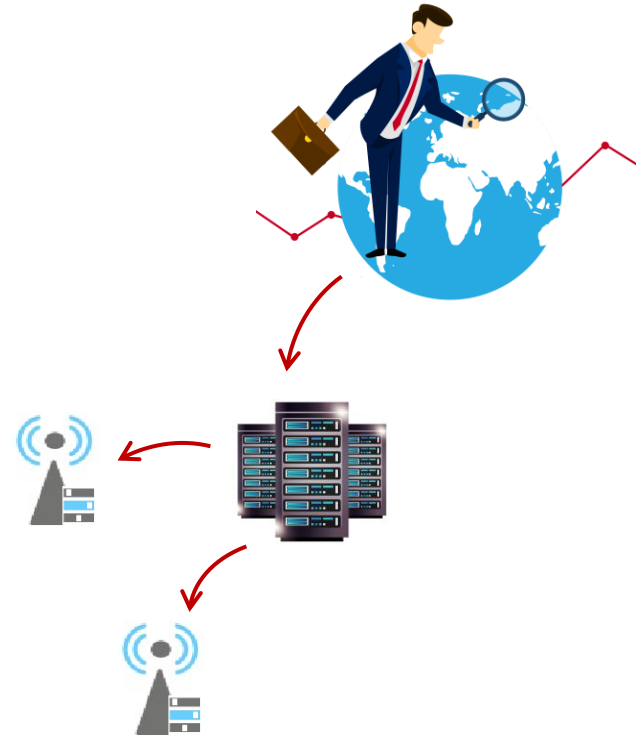
Hybrid-CDN

P2P
- Data generated at the edge
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→ P2P solutions have very high overheads

Ownership and objectives

CDN
- Single large scale owner
- Global objective



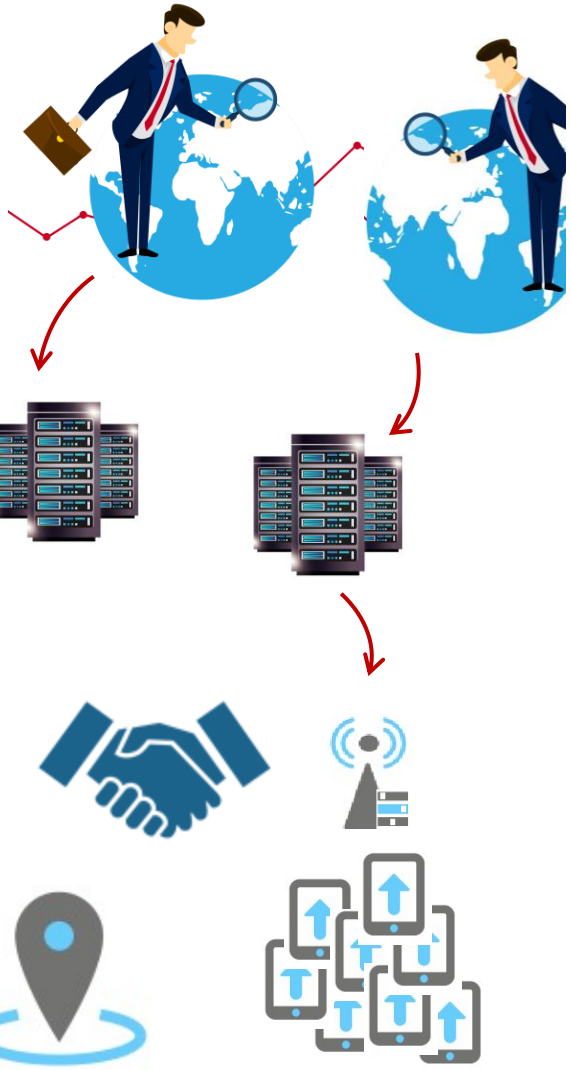
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P2P
- Providers may wish to collaborate
- Local objectives!



Ownership and objectives



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- Single large scale owner
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Selfish collaboration

Incentives



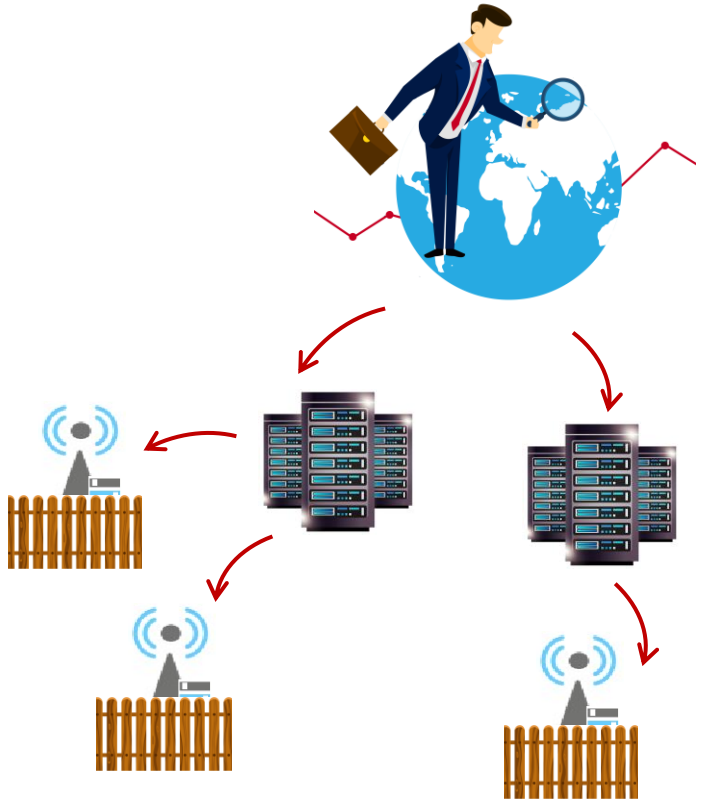
P2P
- Providers may wish to collaborate
- Local objectives!

→ P2P solutions have very high overheads

→ tightly coupled with application

Security, privacy and trust

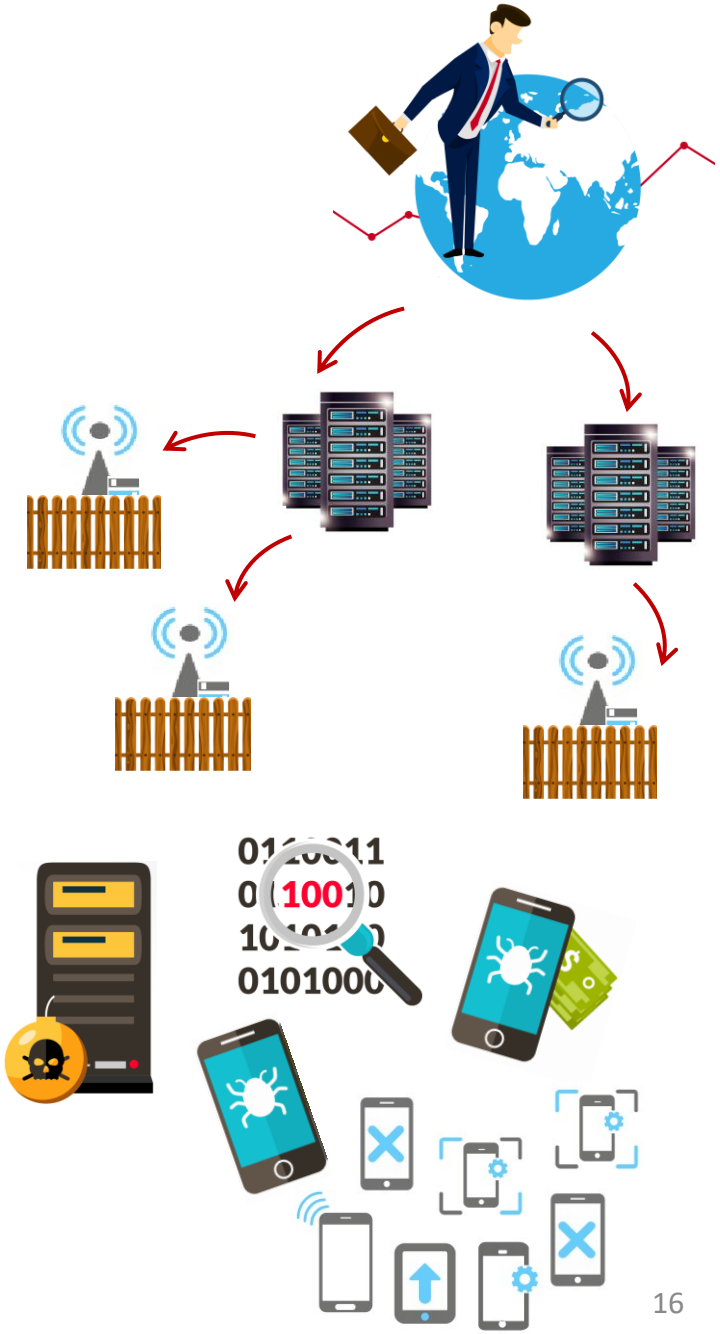
CDN
- Servers deployed by owner
- Physical access secured



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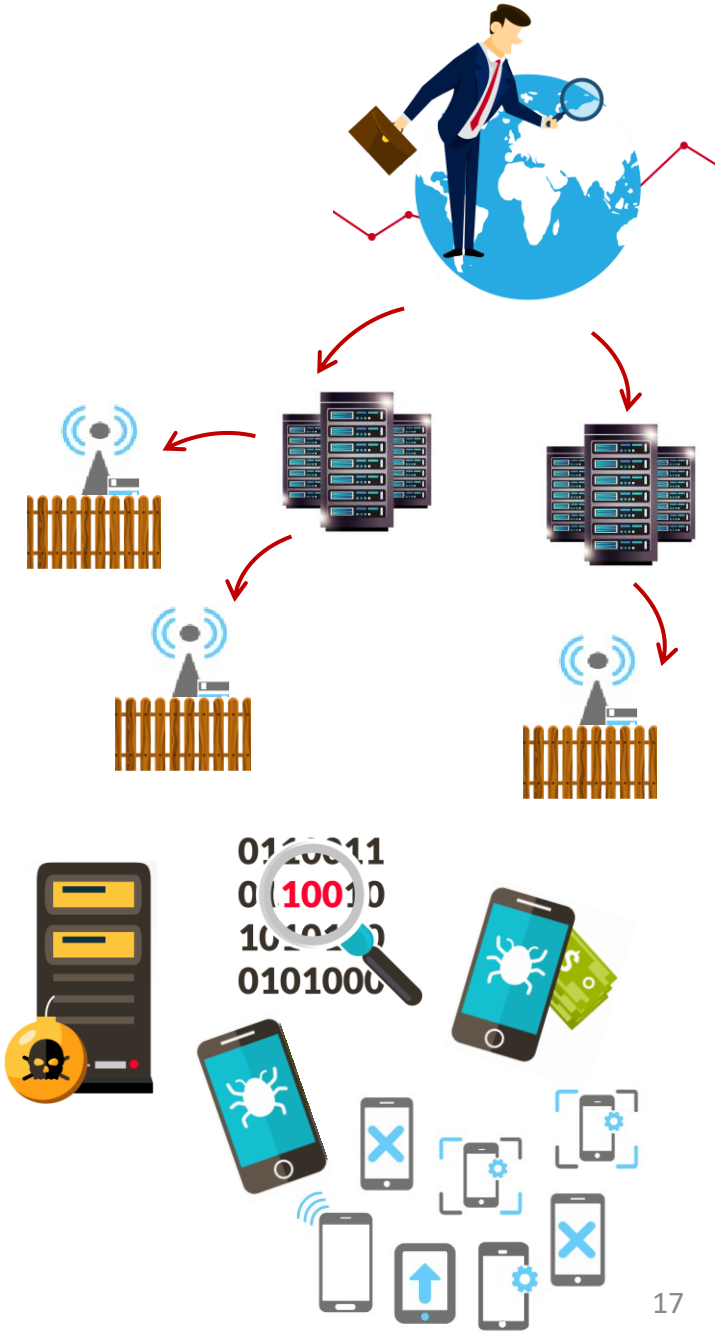
P2P
- Third party code
- Can inject adversarial data

Authorization

Authentication

Byzantine fault tolerance

→ Existing solutions have limited scalability



Summary and discussion

Challenges in common with P2P

Distributed layout



Low center of mass



Selfish local objectives



Low trust



→ Solutions have high overhead

→ How much does the hierarchy help?

→ What is the “price of anarchy”?

→ How badly unreliable is the edge?

→ Are some of the challenges solved?

→ Do we need a general model?

Thank you!