P4P: ISPs and P2P

- Laird Popkin, Pando Networks
- Doug Pasko, Verizon Communications

Overview

- P2P and ISPs
  - P2P market is maturing
  - What are ISPs telling us?
  - How can P2P firms work with ISPs?
- P4P
  - What is in the P4P Working Group?
  - The goals
  - Results so far
  - Next steps

The Opportunity of P2P

- The Internet is the media delivery platform of the future
- New technologies are needed to scale the Internet for higher quality media delivery
- P2P networks present a disruptive market opportunity

"Within five years, all media will be delivered across the Internet."

- Steve Ballmer, CEO Microsoft
D5 Conference, June 2007

Maturing P2P Market

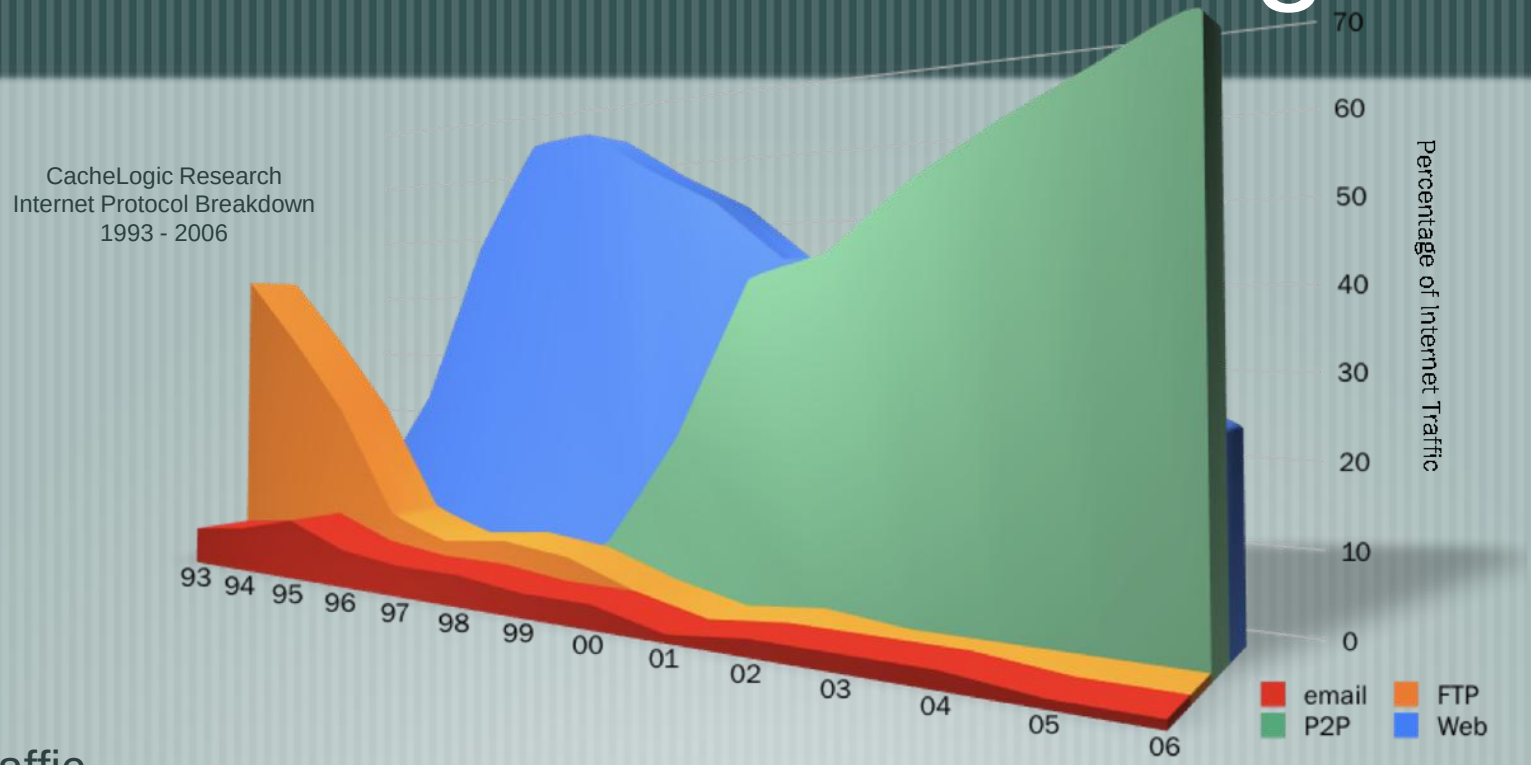
Nascent P2P Market (before 2007)

- Rogue technology
- Stand alone P2P applications

Commercial P2P Market (2007+)

- P2P becomes part of content delivery infrastructure
- Content owners prefer to buy integrated P2P + CDN solutions
- Major content and CDN players select P2P technology partners

P2P : Bandwidth Usage



- Traffic
  - Up to 60-70% of Internet traffic is contributed by P2P applications [CacheLogic]
  - Random peering causes traffic spread across POPs and domains
- Problems
  - Increased network resource usage (e.g., using bandwidth of more links)
  - Increased network operational costs
  - Degraded performance of other applications

Bandwidth Battle

ISPs Address P2P

- Upgrade network infrastructure
- Deploy P2P caching devices
- Terminate user connectivity
- Rate-limit P2P traffic
- Etc.

P2P Countermeasures

- Use random ports
- Encrypt traffic
- Etc.

The battle results in a lose-lose situation

The Fundamental Problem?

- Traditional ISP feedback/controls to application traffic:
  - Routing
  - Rate control through congestion feedback (packet drops)
- These are ineffective for P2P
  - Due to highly dynamic, scattered traffic pattern caused by dynamic, unguided (network-oblivious) peer selection
- Need a mechanism for ISPs to communicate with P2P about network structure and policies

P4P

P4P: Partnership Among ISPs and P2P Networks

P4P Working Group Members

P4P Working Group (P4PWG): Co-Chaired by Pando and Verizon, Based on research from Yale, Hosted by Distributed Computing Industry Association (DCIA)

Core Group

- **AT&T**
- **Bezeq Intl**
- **BitTorrent**
- **CacheLogic**
- **Cisco Systems**
- **Grid Networks**
- **Joost**
- **LimeWire**
- **Manatt**
- **Oversi**
- **Pando Networks**
- **PeerApp**
- **Telefonica Group**
- **VeriSign**
- **Verizon**
- **Vuze**
- **Univ of Washington**
- **Yale University**

P4P Working Group Observers

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Observers

- Abacast
- AHT Intl
- Akamai
- Alcatel Lucent
- CableLabs
- Cablevision
- Comcast
- Cox Comm
- Juniper Networks
- Microsoft
- MPAA
- NBC Universal
- Nokia
- RawFlow
- Solid State Networks
- Thomson
- Time Warner Cable
- Turner Broadcasting

Goals

- Design a framework to enable better ISP and P2P coordination
- Guided P2P connections should yield benefits
  - Improve throughput to P2P users
  - Allow ISPs to manage link utilization
    - Reduce number of links transited by content
    - Push traffic from undesirable (expensive/limited capacity) links to more desirable (inexpensive/available capacity) links

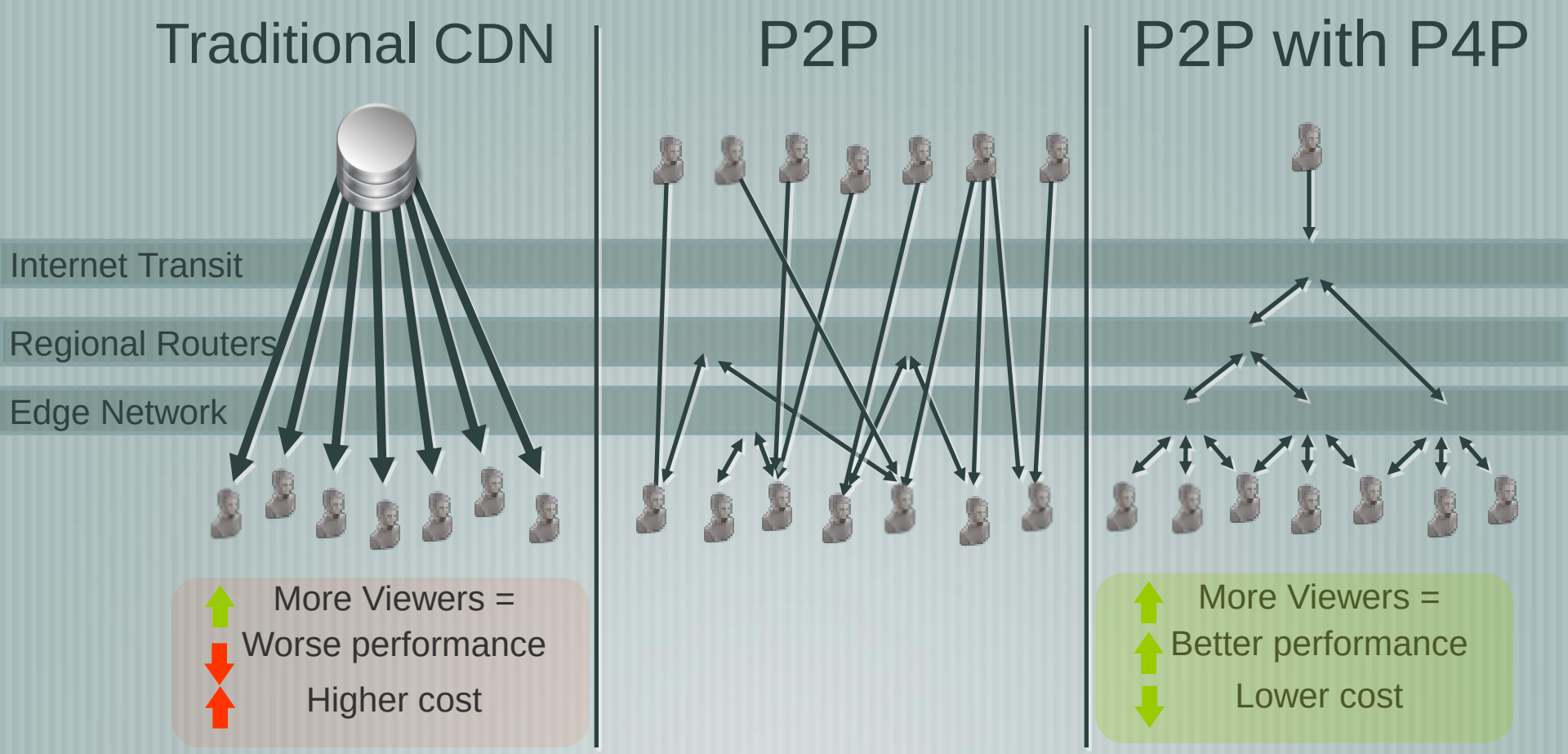
ISP Benefits

- Industry Solution
  - Create cooperative win-win solutions to an industry issue
  - Solve the problem before we have to cope with the problem
- Carrier-Grade P2P
  - Opportunity for new services
  - What if fastest path from A to B is P2P?

P2P Benefits

- P2P Applications with P4P benefits
  - Faster downloads for users
  - Decrease incentives for ISPs to “manage” P2P traffic

P4P Enables Efficient Delivery

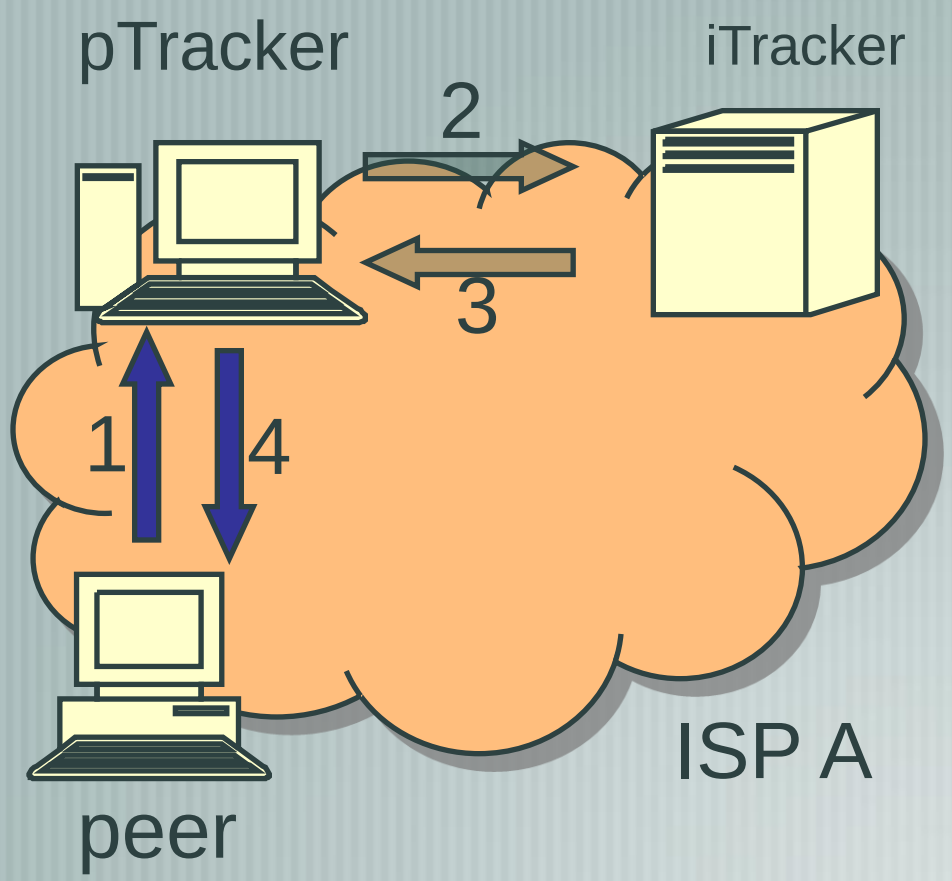


NETWORK AWARE P2P will reduce costs, improve performance

P4P Framework – Goals

- Performance improvement for both ISPs and P2P
- Scalability
  - Support a large number of P2P users and networks in dynamic settings
- Privacy preservation
- Flexibility -- apply to many P2P architectures
  - Application-specific requirements
  - Tracker-based and trackerless P2P systems
  - “Gossip” among peers
- Ease of implementation (“low hanging fruit”)
- Open standard: any ISP, P2P can easily implement it

P4P: Architecture



- Use BitTorrent in a single ISP as an example
  - **pTracker** runs P2P system
  - **iTracker** makes suggestions for peering relationships
- Information flow:
  1. peer queries pTracker
  2. pTracker asks iTracker for guidance (occasionally)
  3. iTracker returns high-level peering suggestions
  4. pTracker selects and returns a set of active peers, according to the suggestions
- iTracker can be run by trusted third parties, P2P network, or ISPs

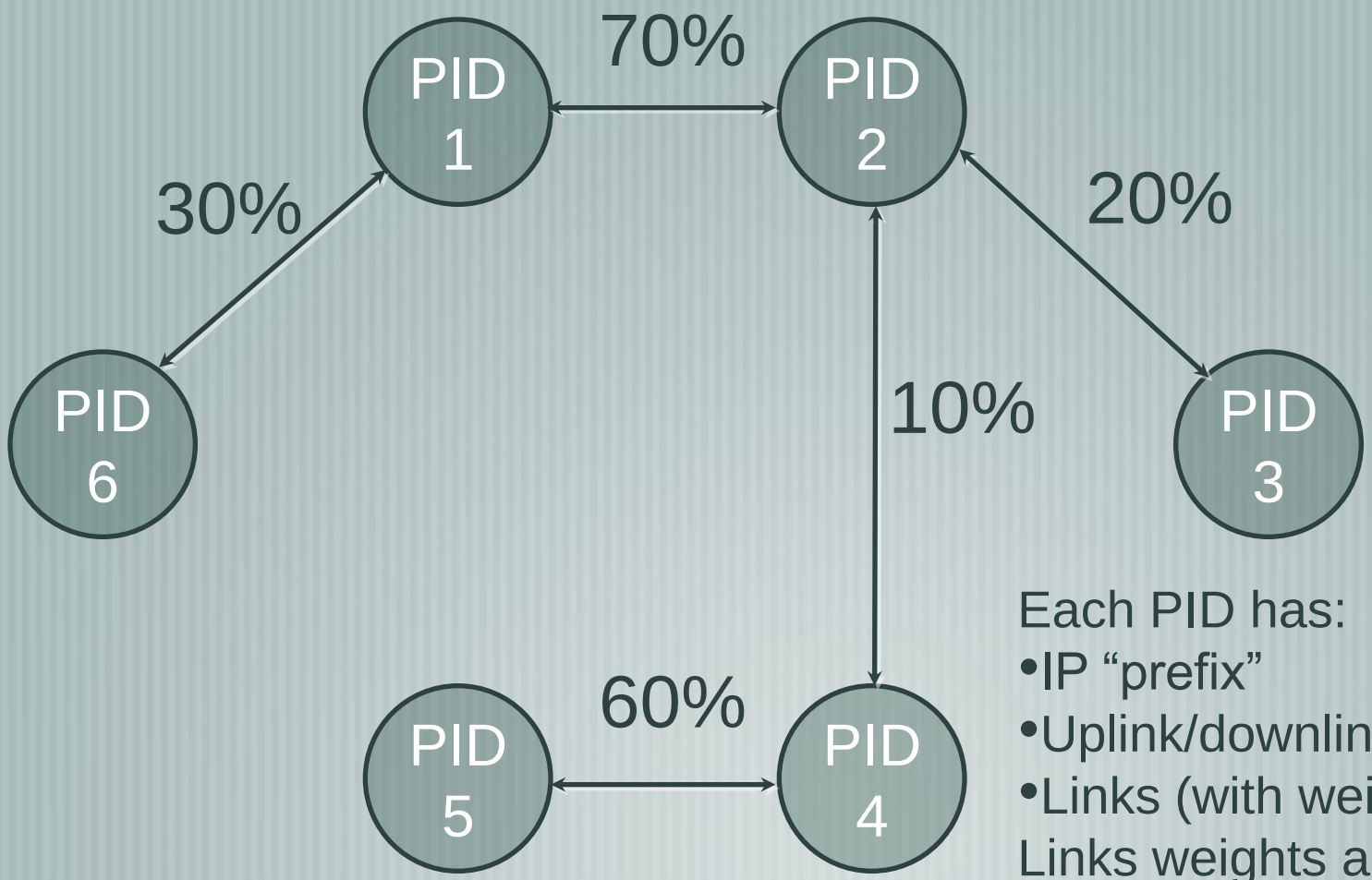
Optimizing P2P Peering

- Formulate as a joint optimization problem
  - ISP’s objective: minimize network utilization by P2P (e.g.)
  - P2P’s objective: maximize throughput (e.g.)
  - Joint objective: protect and improve customer experience

P4P Data

- The following data is exchanged in P4P:
  - ISPs provide network maps to iTracker
  - iTracker provides “weight matrix” to P2Ps
    - Does not reveal ISP topology to P2P

Network Map (Illustration)



Each PID has:

- IP “prefix”
- Uplink/downlink capacity
- Links (with weights)

Links weights are directional

Weight Matrix (Illustration)

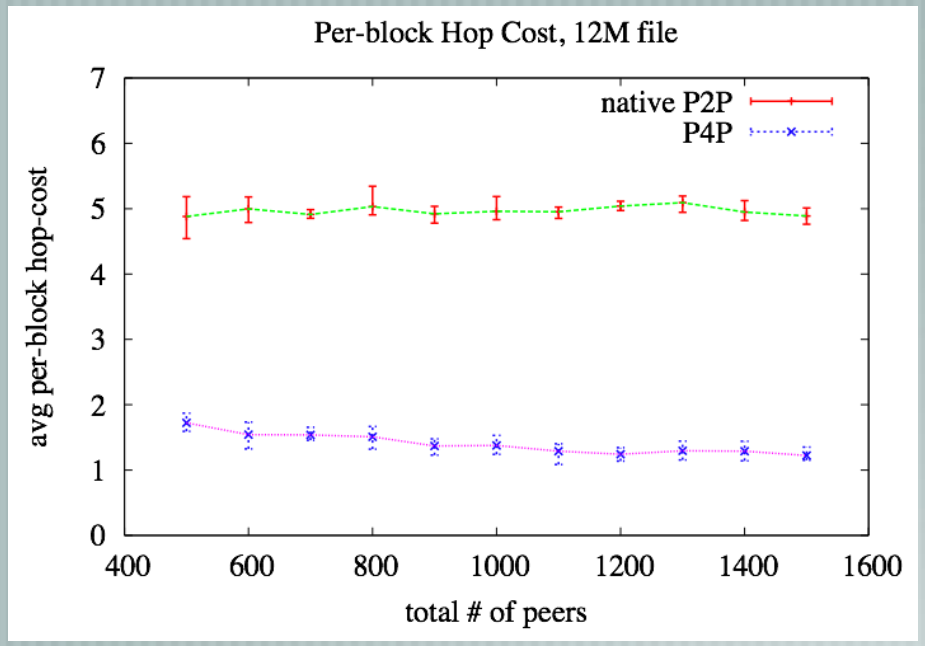
Are connected to users in these PIDs

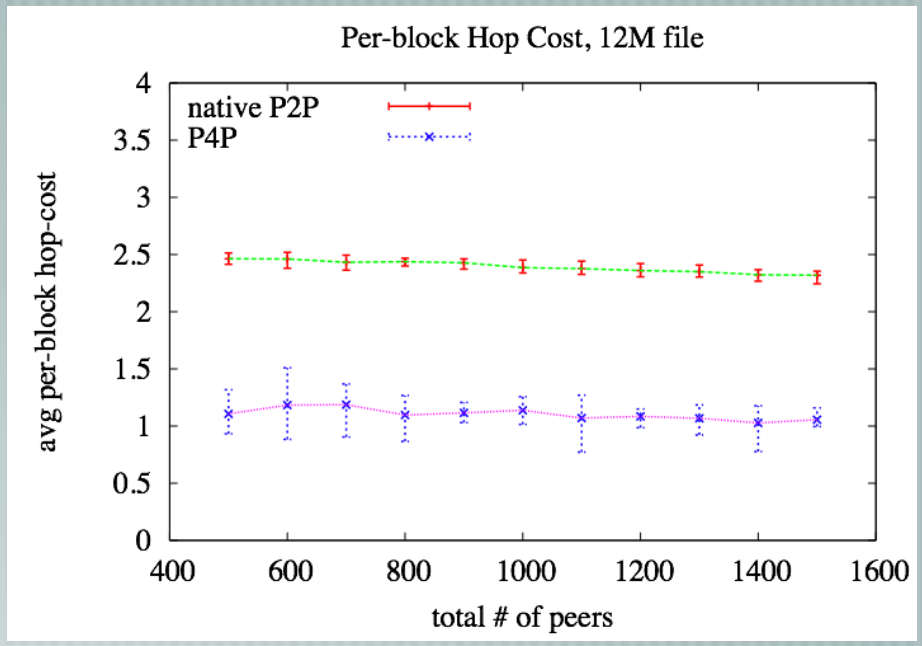
Users in PIDs	PID1	PID2	PID3	PID4	PID5	PID6
PID1		30%	10%	5%	3%	20%
PID2	30%		20%	10%	6%	10%
PID3	30%	50%		5%	3%	
PID4	7%	10%	2%		60%	3%
PID5	4%	6%	1%	60%		1%
PID6	30%	25%	5%	2%	1%	

Evaluation – Simulations

- Simulation Methodology
  - Discrete-event simulation
    - a module for modeling BitTorrent protocol
    - a module for modeling underlying network topology and data transfer dynamics using TCP rate equation
  - Network topology provided by Telefonica and Verizon

Results: Good for ISPs



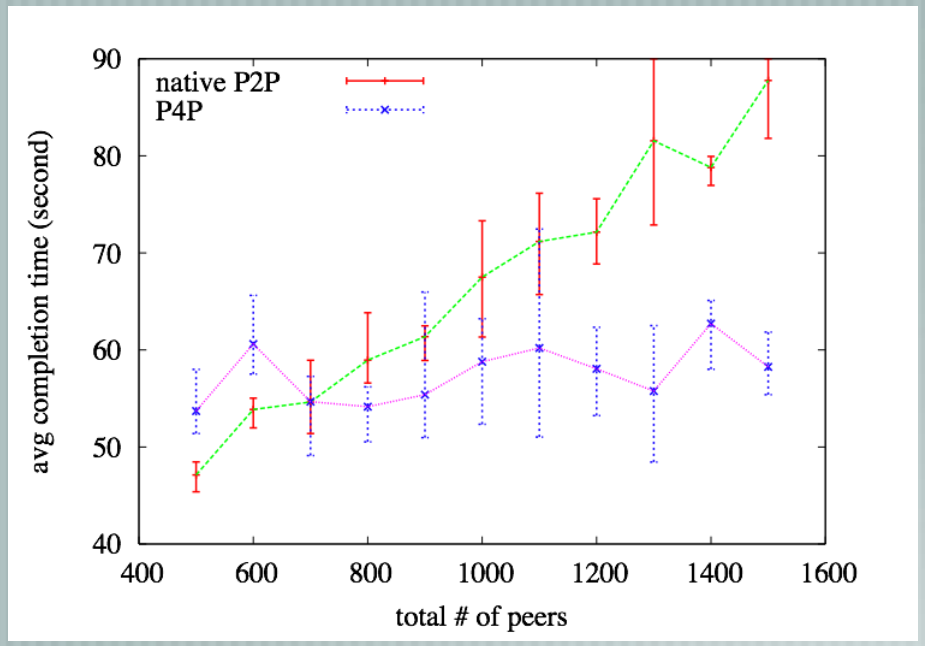


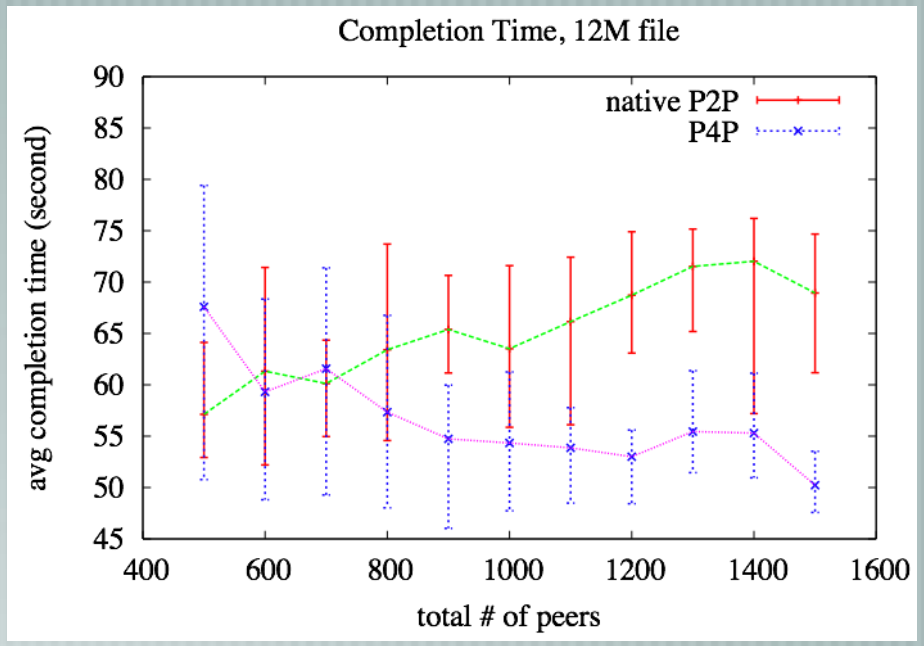
Telefonica Simulation

Verizon Simulation

- P4P yields a dramatic drop in data delivery average “hop count,” which equates to lower cost to ISPs

Results: Good for P2Ps





Telefonica Simulation

Verizon Simulation

- P4P yields a dramatic improvement in data delivery speed, which results in faster downloads for users

Interested?

- P4PWG is free to join
  - Monthly meetings / conference calls
  - Mailing list participation
  - Field test now underway
- Working Group Mission:
  - Evaluate the P4P design through large-scale experiments
  - Formalize and promote adoption of P4P protocols
  - Serve as a forum for ISPs and P2P networks
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