Fair Layered Coding Streaming

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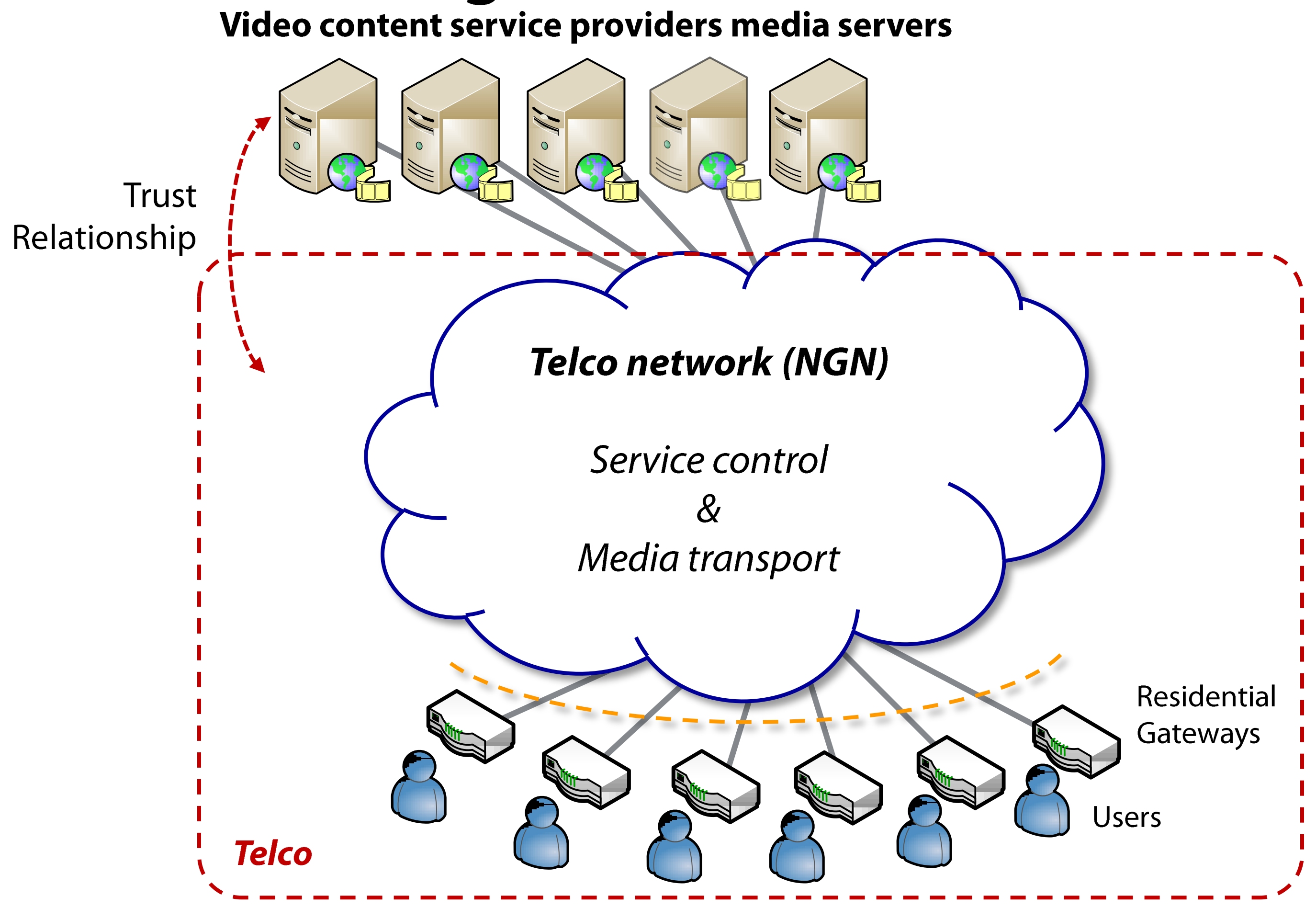
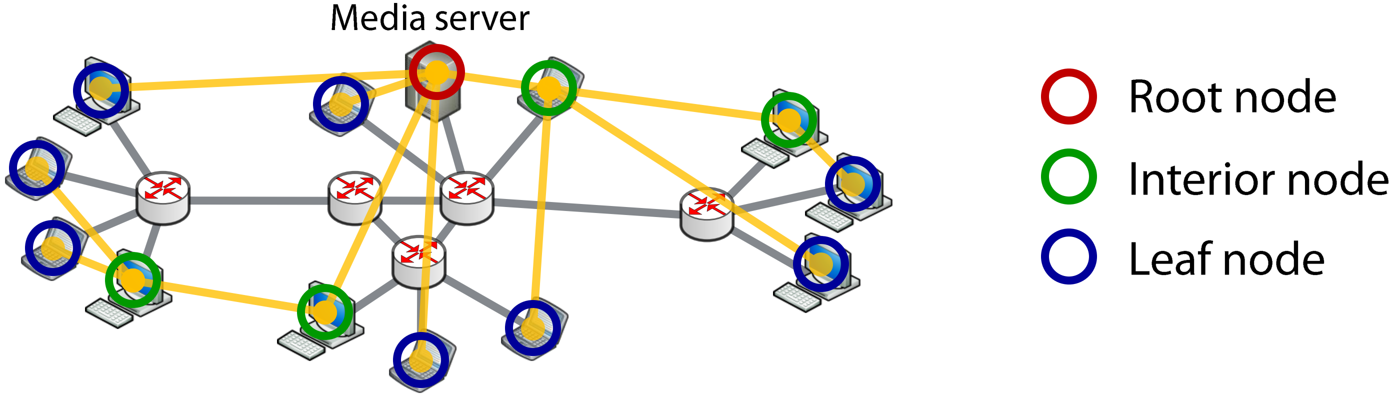
Our scenario

- Video streaming in a QoS-enabled network



Streaming mechanism

- Application Level Multicast: how and why?



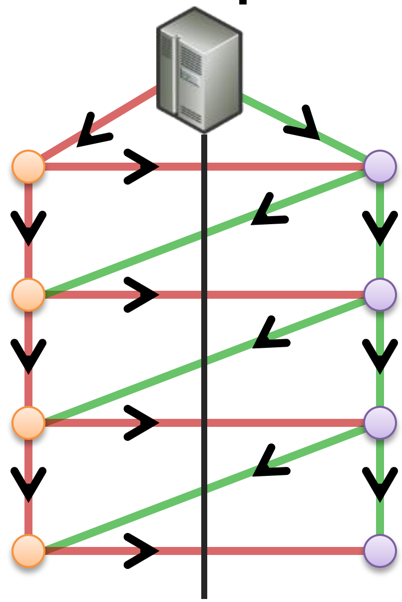
- Packet replication is done by the peers
  - … meaning the same packets traverse same links several times
  - … but peer uplink bandwidth is (very) limited
  - … logical neighbors may be many hops away
  - … peers (i.e. nodes) come and leave as they wish (churn)

Solution to the uplink limitation

- Divide the video stream in several sub-streams (stripes, descriptions)

Example: 2 stripes

These peers can be interior nodes only for the red stripe



These peers can be interior nodes only for the green stripe

- Mesh-like streaming structure
  - Although content for a stripe is still pushed along a tree

P2P architecture (1/3)

- FLaCoSt is similar to SplitStream:
  - P2P protocol used to create multicast trees for video streaming
  - Based on Scribe/Pastry
  - Uses multiple stripe delivery (more robust, supports multiple description coding)
- However:
  - Takes into account the uplink resources at any time
  - Only peers with resources are considered interior nodes
  - Connecting children can easily identify these peers
  - Peers re-compute resources whenever something changes

P2P architecture (2/3)

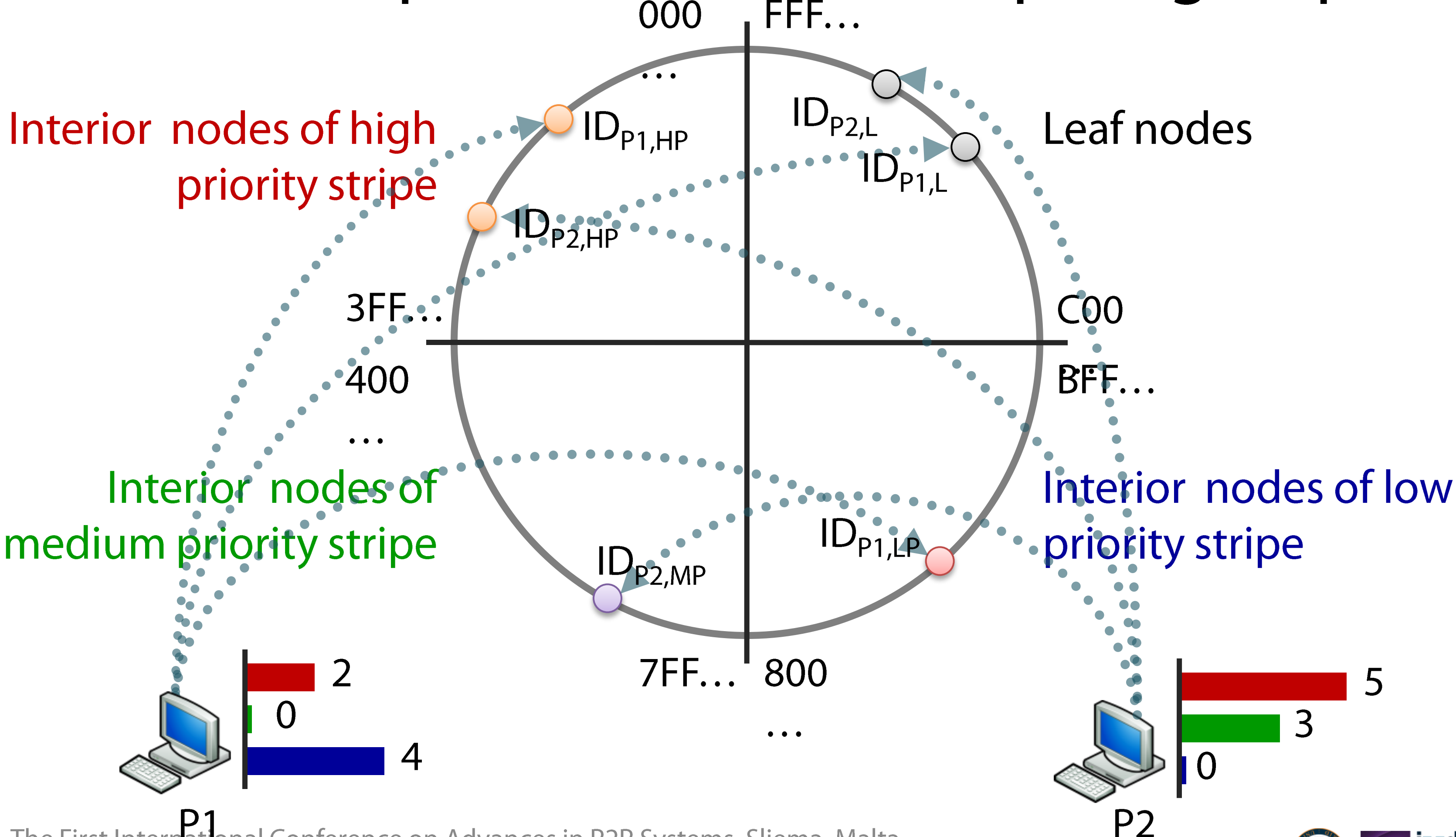
- For the purposes of this presentation
  - We have three stripes with a different priority

Example: 3 stripes

  - Use a slice in the hash space to contain nodes that can be interior nodes for each stripe
  - Use an extra slice to contain nodes that cannot be interior nodes
  - A peer computes its resources and can become a node in each slice

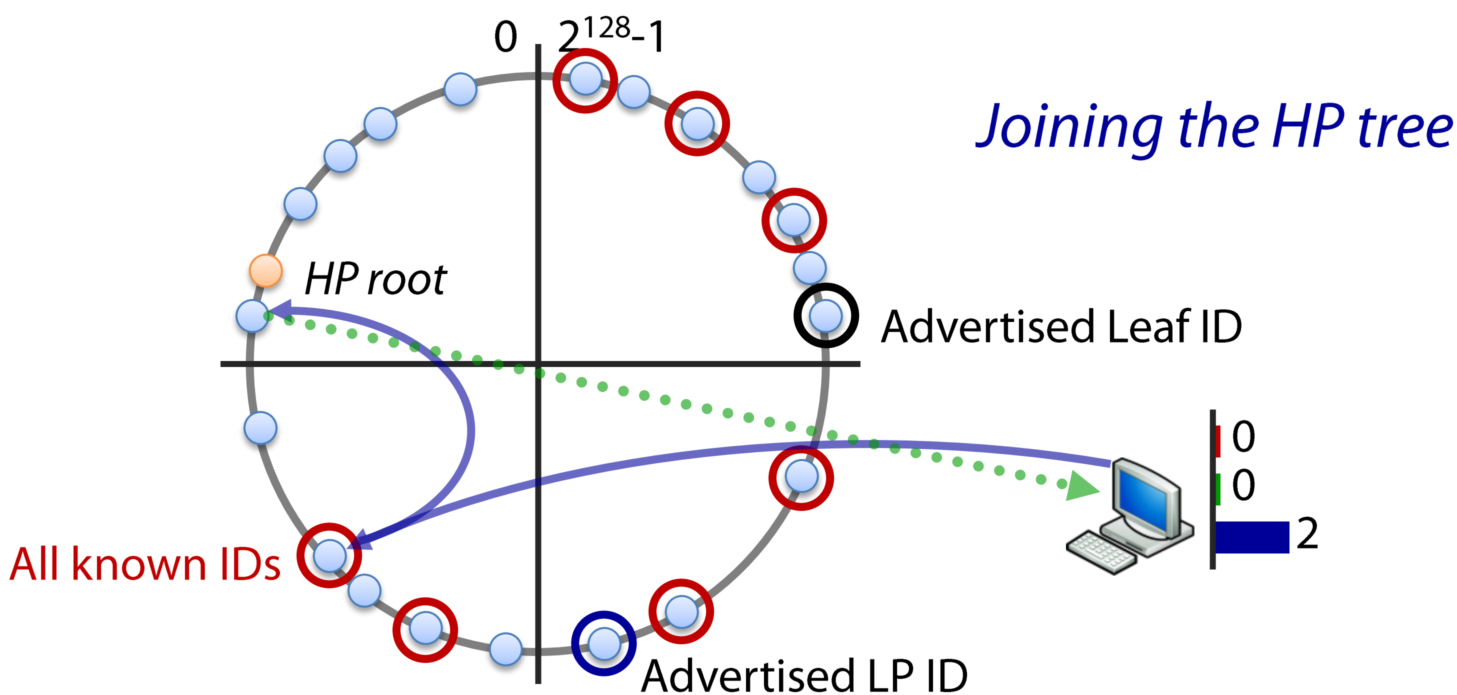
P2P architecture (3/3)

- The hash space is divided into peer groups



Tree searching

- The initiator will use the closest neighbor
- If the neighbor is a passive peer, it forwards the request



P2P simulation results

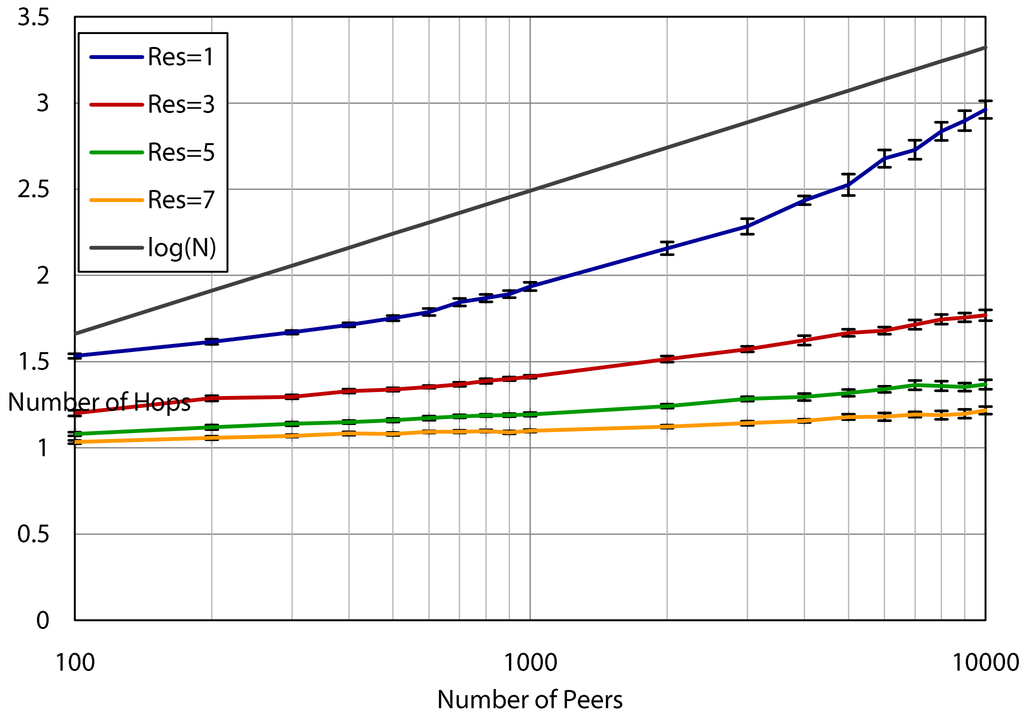
- Evaluate multicast tree behavior
  - In resource limited scenarios, but otherwise ideal conditions
  - Determine joining effort, geometry of multicast tree and success ratio
- Scenario
  - Each peer has resources: (0/Res, 0/Res, 0/Res)
  - Four scenarios: Res is 1, 3, 5, 7

A resource of 1 for one stripe ≈33% of the video stream bit rate

Res	Peer Total Average	Necessary Uplink
1	1.5	50%
3	4.5	150%
5	7.5	250%
7	10.5	350%

Joining Tree Performance

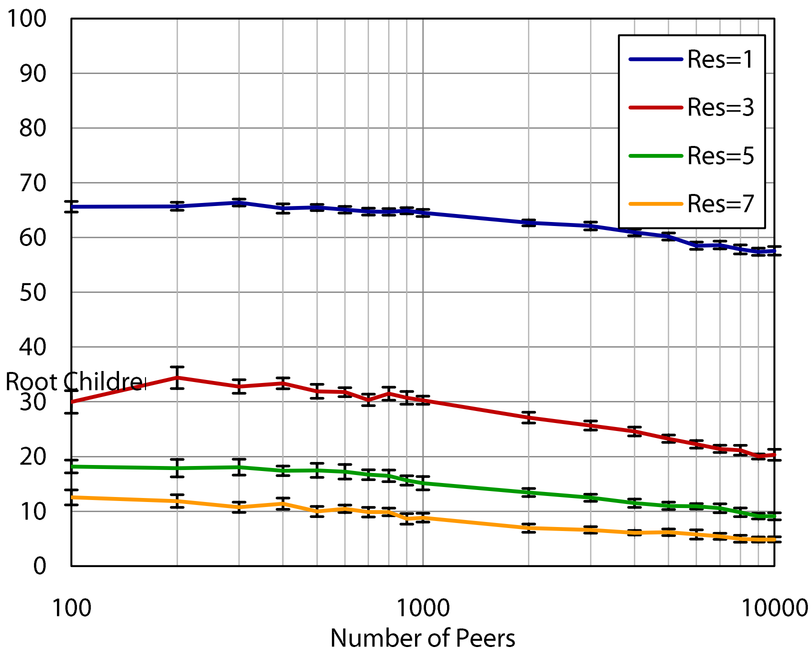
- Number of hops needed to join the tree

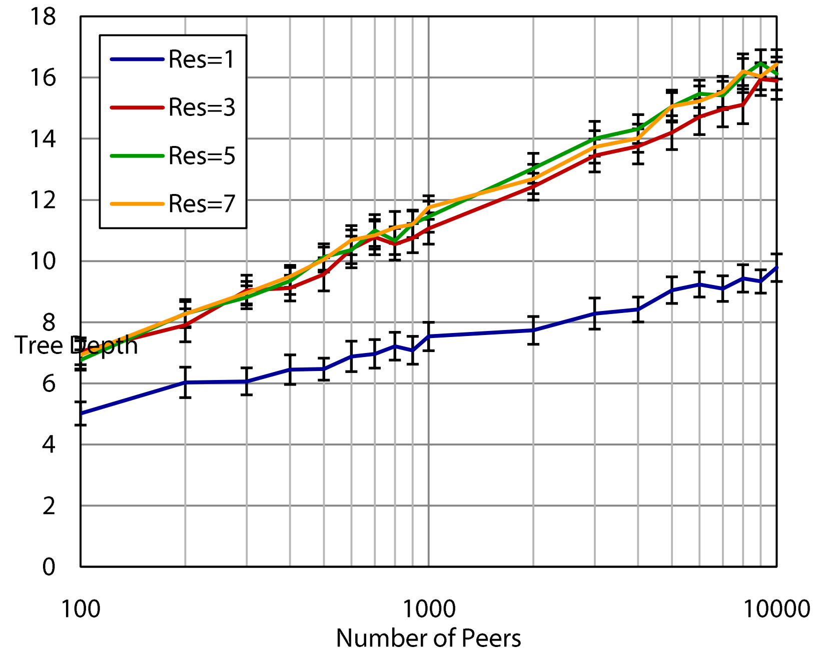


- Decreases with increasing the resources
- The improvement is significant when resources are low

Tree Geometry

- Let's see if we use P2P or client/server

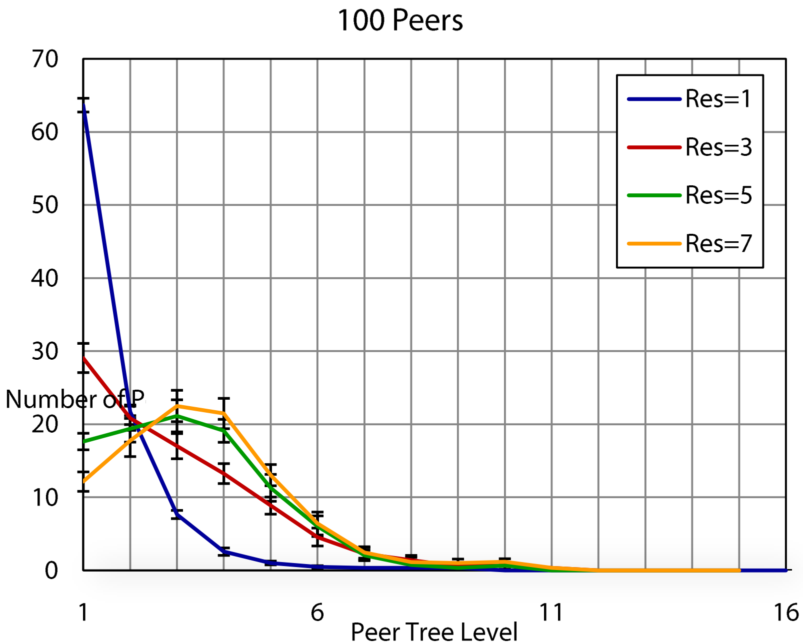


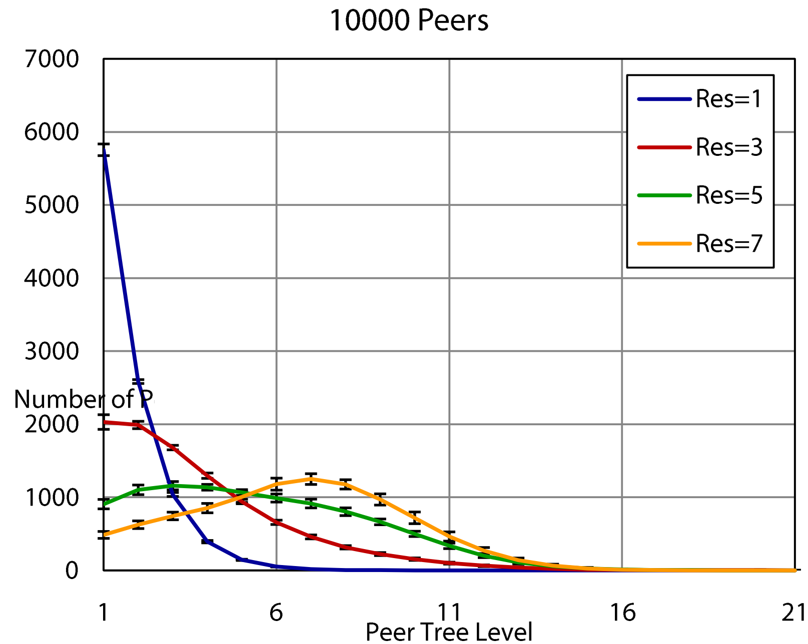


- Probably we don't want each peer to have 50% resources
- Otherwise, the root load is lower even for 10000 peers
- Tree depth is reasonable, but increases with the resources

Peer Level

- At what level are most of the peers?

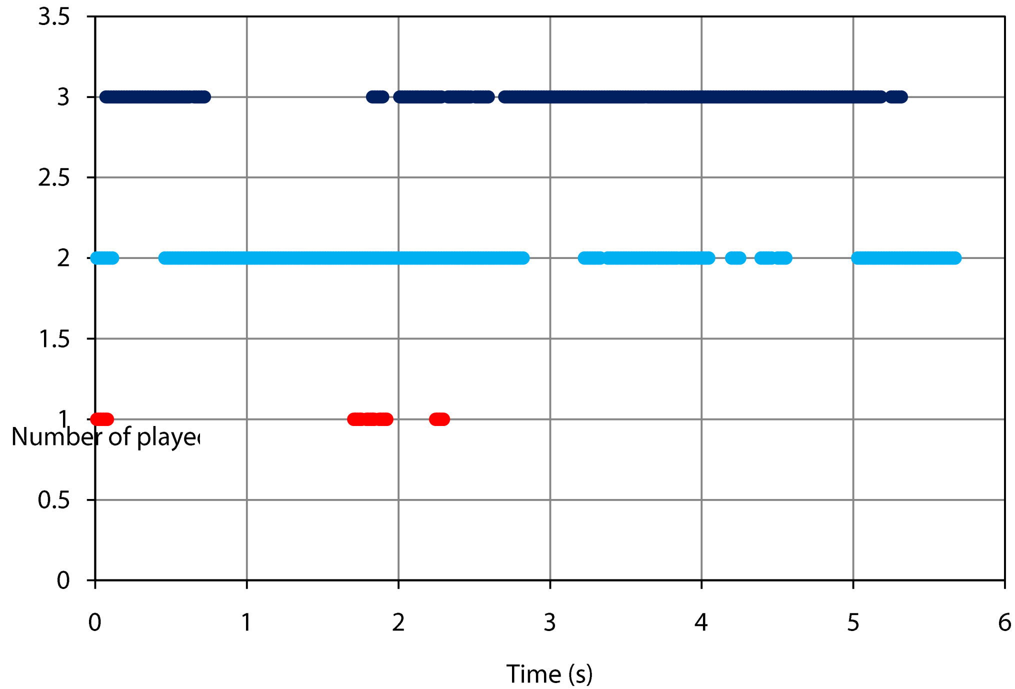




- Average peer level increases with the resources
- Takes the load off the root (media server)
- However, increases the tree depth

Played stripes

- Number of received stripes for a given user



- Best quality (3 stripes): 51.72 % of time
- Good quality (2 stripes): 47.95 % of time

Conclusions

- FLaCoSt: a P2P architecture for video streaming
  - QoS-enabled network such as an NGN
  - Video streams using several multicast trees (video stripes)
  - New Scribe-based P2P protocol to select parent peers
- Simulation and real implementation results show
  - The P2P algorithm is robust given a reasonable amount of peer resources
  - Most of the time (> 99%) users receive a good or best quality video

Thank you