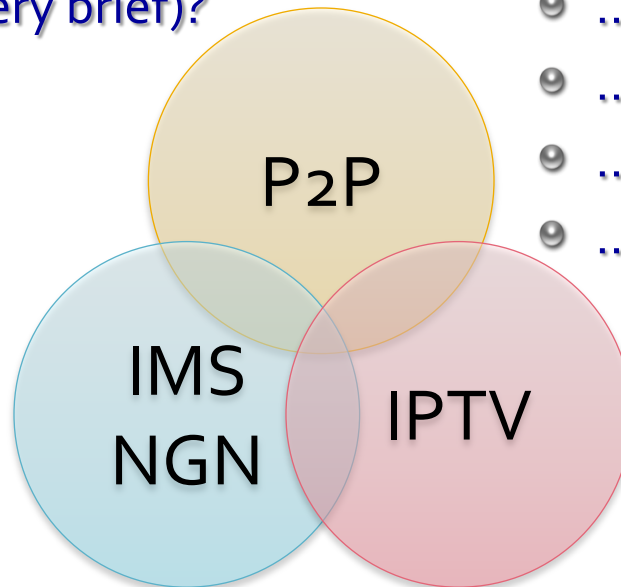# Nozzilla: P2P IPTV Distribution for an IMS-based NGN

Alex Bikfalvi, Jaime García-Reinoso, Iván Vidal, Francisco Valera

IMDEA Networks / University Carlos III of Madrid

alex.bikfalvi@imdea.org

Overview: P2P, NGN and IPTV

- **Peer-to-peer Technologies**
  - ... what is P2P (very brief)?
  - ... why P2P?
  - ... what content?
  - ... how?

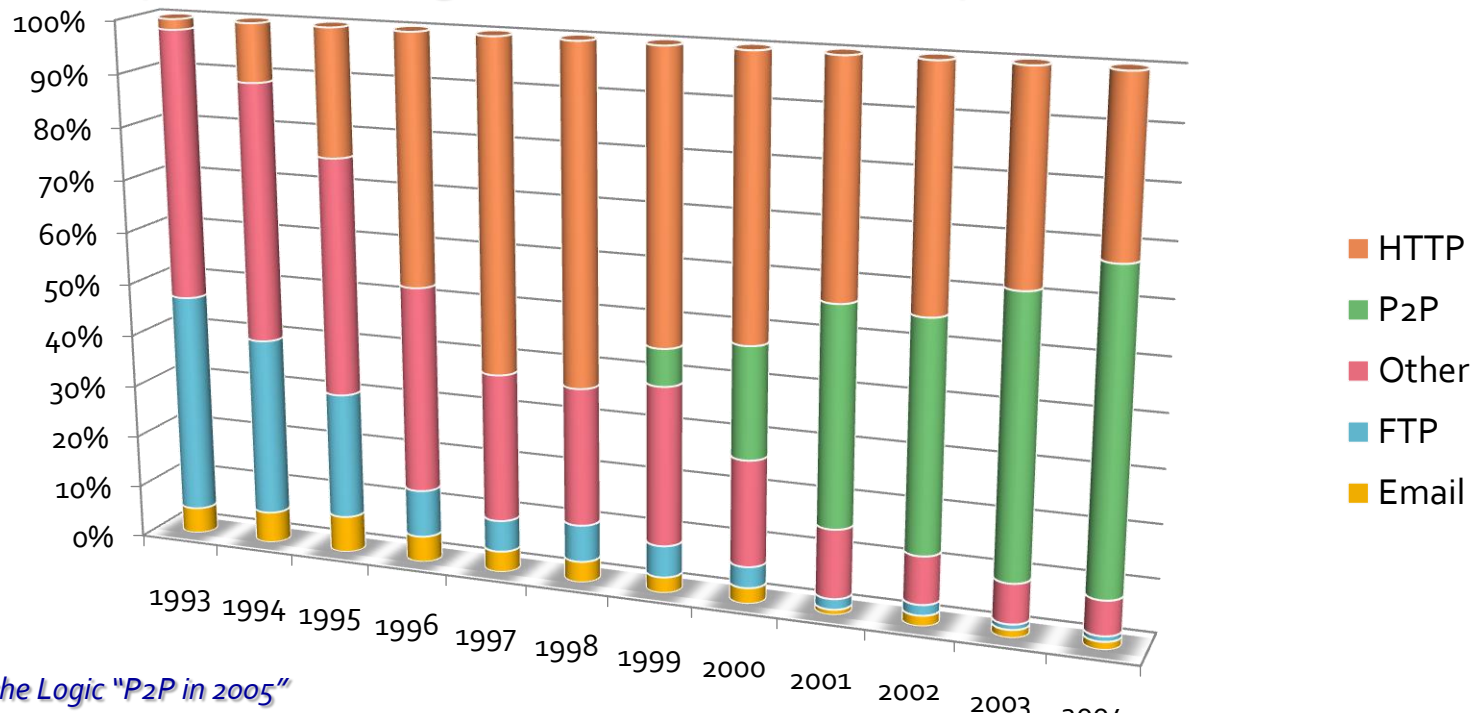- **Next Generation Networks**
  - ... IMS & NGN?
  - ... what is NGN/IMS?
  - ... why IMS?
  - ... how?

P2P

IMS
NGN

IPTV

- Does it make sense combining P2P and NGN (IMS) technologies?
- How can we do this?

The Internet... in 2004

- **P2P traffic was 60% and rising**
  - ISPs identified P2P as a major challenge in network design
  - It affects the QoS for all users
  - Mostly, file-sharing: BitTorrent, eDonkey, Kad, Gnutella

Source: Cache Logic "P2P in 2005"

The Internet... in 2007

- Lately... the HTTP traffic is gaining the share back
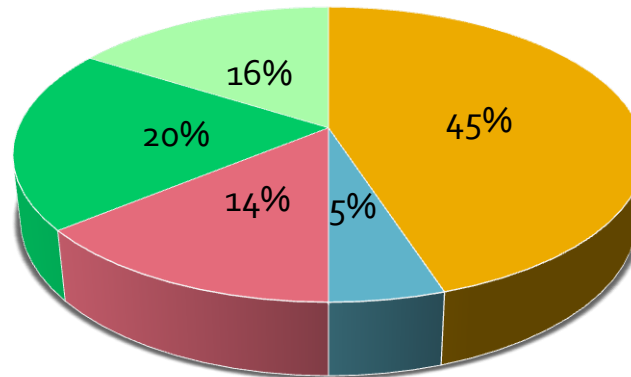 - ... in terms of percentage of total traffic (not absolute value)

Legend: HTTP, P2P, Other, FTP, Email
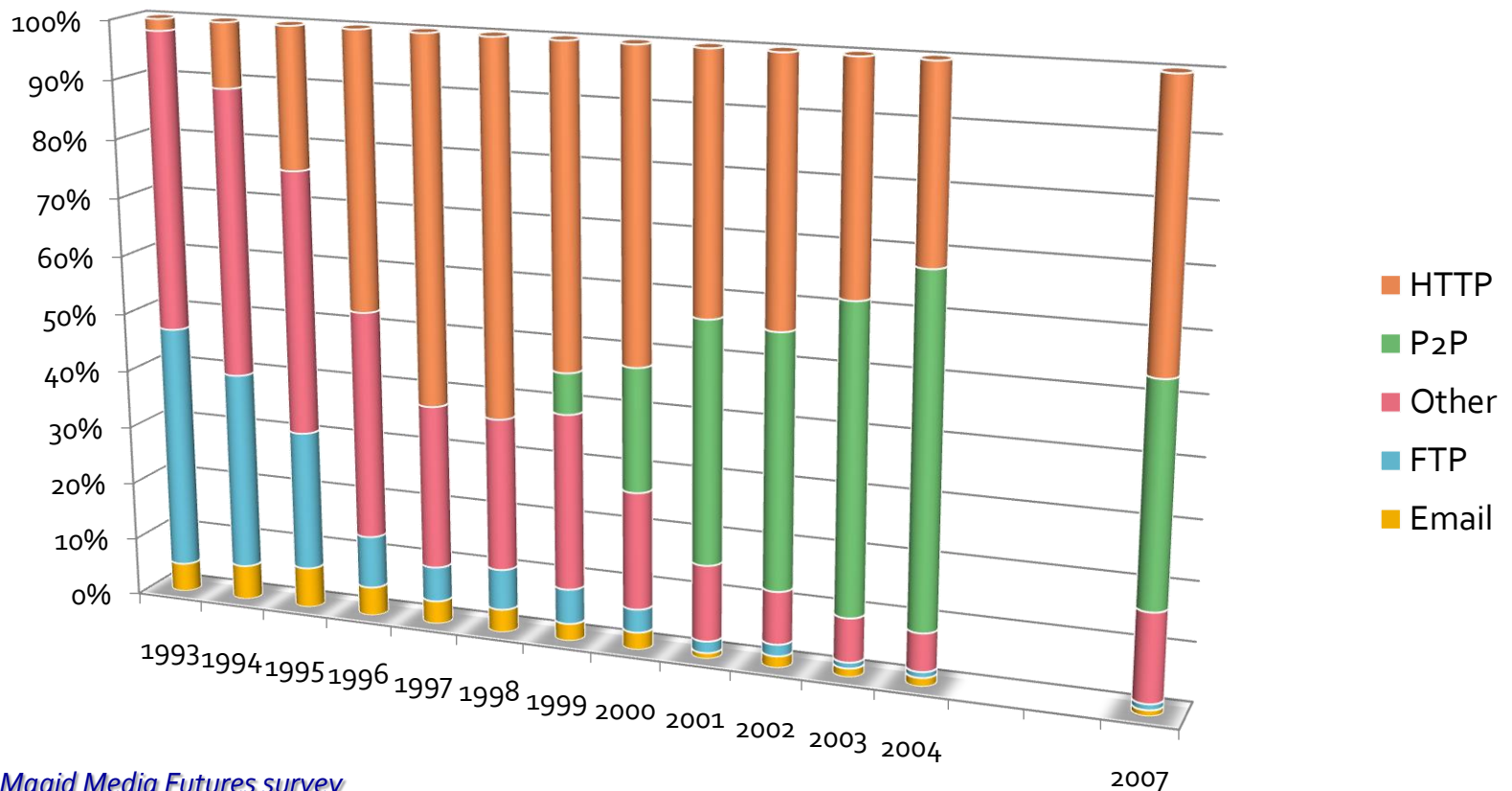
Source: Magid Media Futures survey

The Internet… in 2007 and beyond

- More than a third of the HTTP traffic is video streaming
- YouTube is the most popular; counts for around 20%
- That's about 10% of all Internet traffic

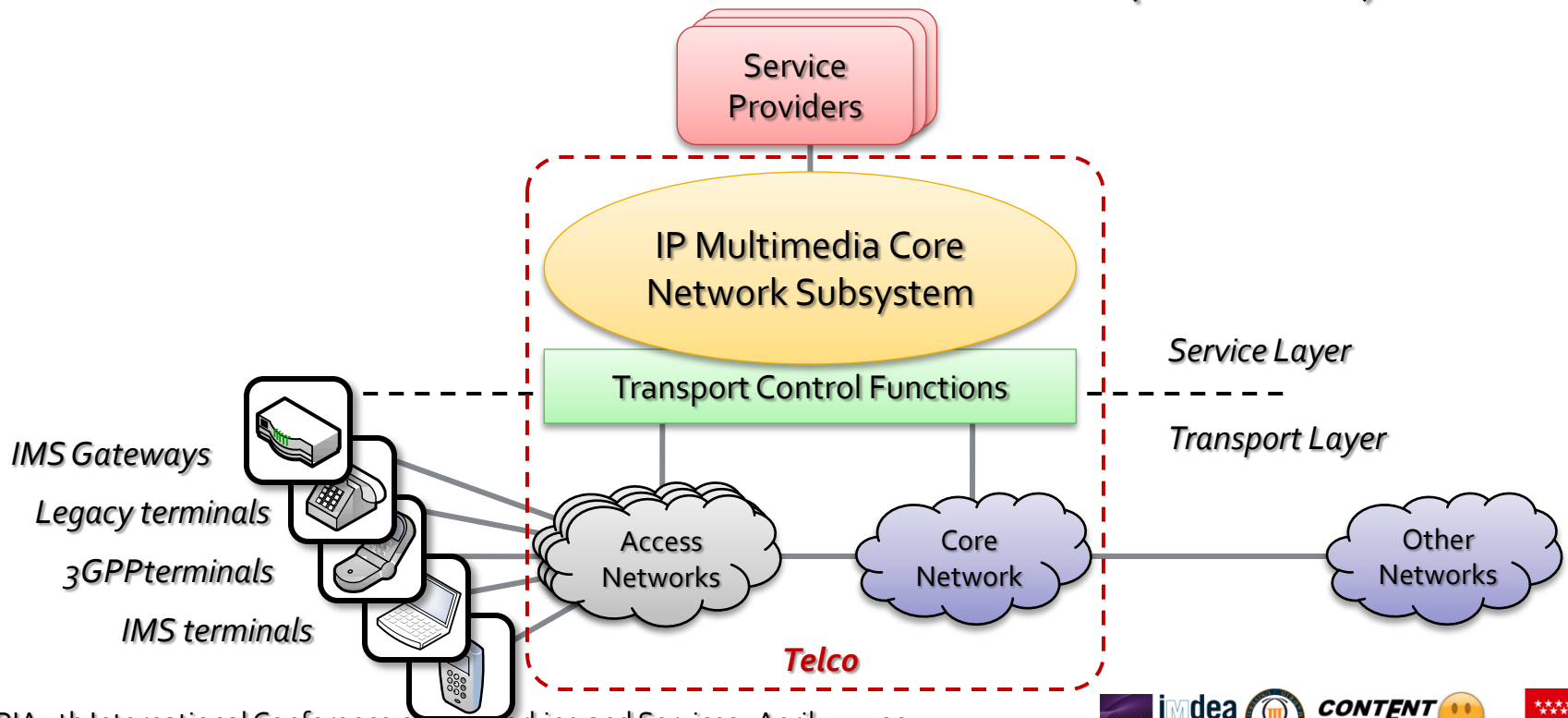Legend: ■ Web ■ Audio ■ Other ■ YouTube ■ Other Video

45%
5%
14%
20%
16%

Source: Magid Media Futures survey

- The (near) future…
  - Internet video, the new broadband "killer" application?
  - More "***Tube" service providers?
  - User generated content and commercial content

IP Multimedia Subsystem

- A platform for IP multimedia services
  - Initially designed by 3GPP as an evolution of GSM/UMTS
  - Currently extended to many more access networks
- Core of a Next Generation Network (TISPAN)

Service Providers

IP Multimedia Core Network Subsystem

Service Layer

Transport Control Functions

Transport Layer

IMS Gateways

Legacy terminals

3GPPterminals

IMS terminals

Access Networks

Core Network

Other Networks

Telco

imdea networks
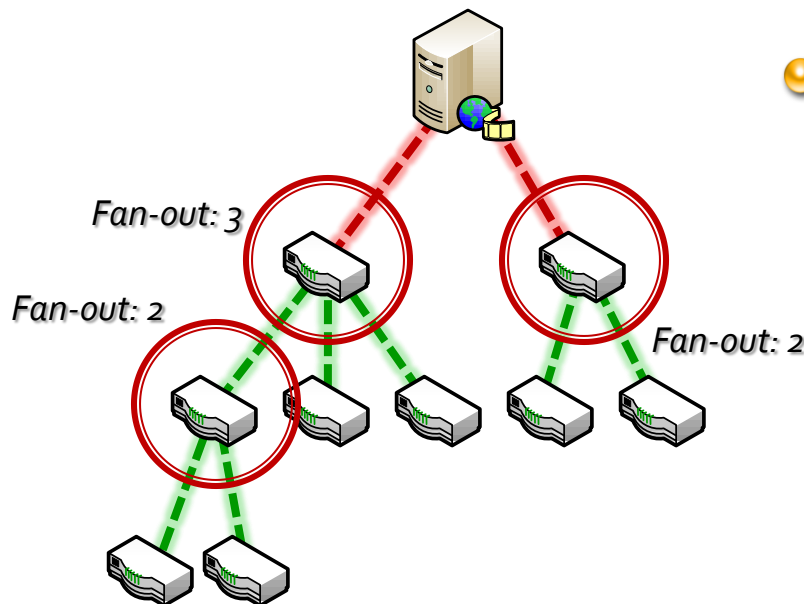
CONTENT
Content Distribution Network Research

BioGridNet

Why P2P?

- Media streaming is extremely expensive
  - Video streaming applications target a lot of receivers
  - Streaming servers need a lot of bandwidth and computing power
  - They may not be able to serve everybody
- Existing solutions in the Internet

Solution	Pros	Cons
Client/Server	Simple	Not scalable
CDN	Server not overloaded	Complex and costly
IP Multicast	Good network utilization	Lack of deployment
P2P	Availability and cost	Utilization, reliability

P2P issues

- P2P looks fine… but:
  - Peers may have an unpredictable behavior
  - Resources (bandwidth, delay) may not be adequate
  - We need uplink resources as well

Fan-out: 3

Fan-out: 2

Fan-out: 2

- However, in NGN/IMS:
  - Some peers may be considered stable (e.g. RGW, STB)
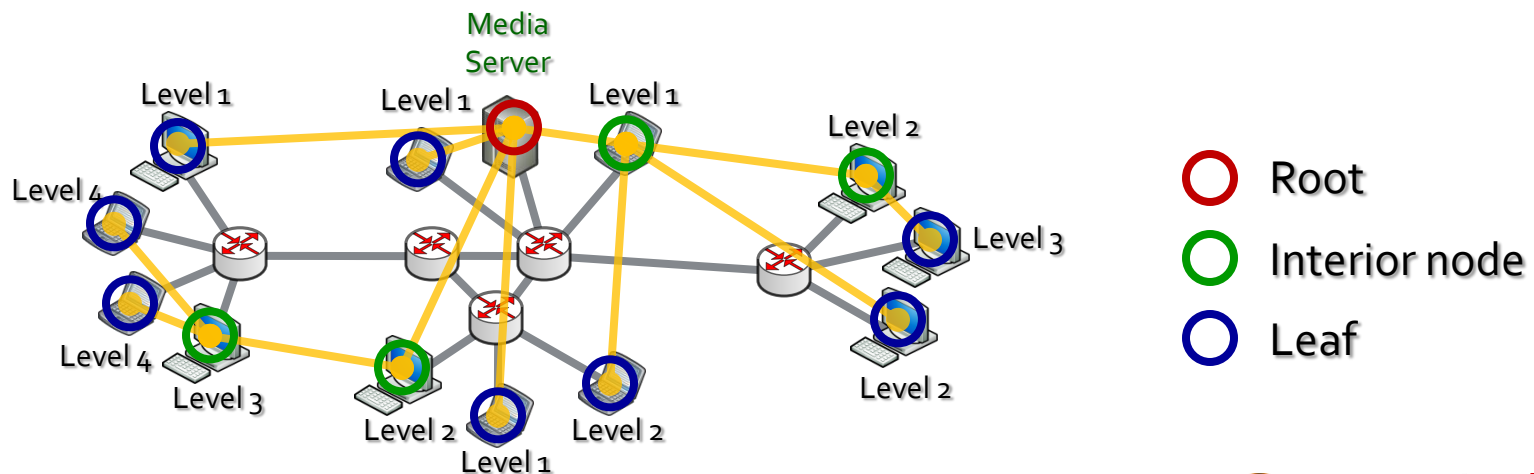 - Resources are known and reserved
  - Once reserved, they are guaranteed

Trees vs. meshes

- Trees
  - Mimic multicast
  - Each peer selects a parent peer
  - The content/stream can be divided and sent across several trees
- Meshes
  - A peer obtains pieces from any available peer
  - There is not a strict relationship: child-parent
  - Instead peers can collaborate in sharing pieces

Application Level Multicast

- 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
- Multicast overlay topology: tree
  - The root can be the media server or a client peer

Media Server

Level 1   Level 1   Level 1   Level 2

Level 4   Level 3

Level 4

Level 3   Level 2   Level 2   Level 2

Level 1

○ Root
○ Interior node
○ Leaf

Where P2P?

- P2P media vs. P2P signaling
  - Until now we discussed P2P in media plane
- What is P2P signaling?
  - Discovery of other peers using a P2P protocol
  - For trees: a structured protocol (DHT) to find a parent
  - For meshes: an unstructured protocol to find other peers
- With P2P signaling
  - The functionality is distributed
 - No need of a central entity

What is Nozzilla?

The Nozzilla service is intended as an adaptation layer between the multimedia content and the mechanism (P2P or otherwise) used for content distribution

- Video content may be the new killer app, but…
  - … other services can benefit from P2P too (conferencing, software distribution)
  - … even video may have different requirements (IPTV ≠ VoD)
- Nozzilla Content Distribution Service Provider
  - Intermediary between the IPTV Service Provider and IMS + transport layer
  - Makes the content distribution transparent for the IPTV provider
 - Hides the specifics of the media content to the IMS/transport

imdea networks   CONTENT Content Distribution Network Research   BioGridNet

Nozzilla

- A distributed IPTV streaming system in an NGN
  - Is a feature offered by the transport provider to the service provider
  - Can use the spare capacity in the transport network
  - Spares the service provider of equipment and bandwidth costs
  - The transport provider will charge the service provider
- Problem analysis
  - P2P network made of NGN residential gateways (RGW)
    - Expected low churn rate (a higher stability than in usual P2P networks)
    - Traffic quality of service is guaranteed (flow QoS reservation)
    - RGW can utilize "spare capacity": capacity that physically exists on the subscriber line, but is not paid for by the customer
  - P2P traffic is allowed by default in the TP network
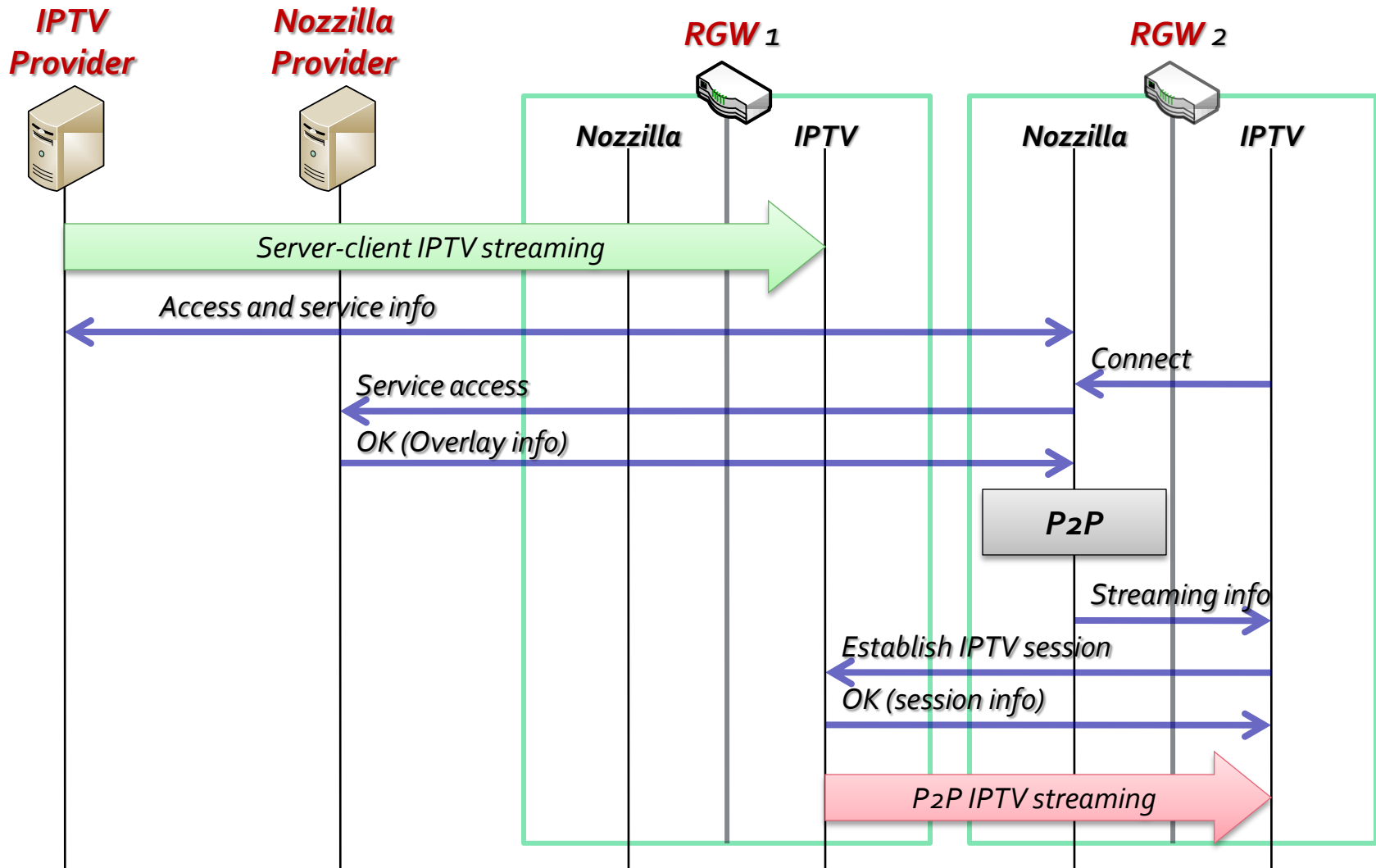 - TV streaming traffic is reserved with IMS (using SIP signaling)

A possible business model
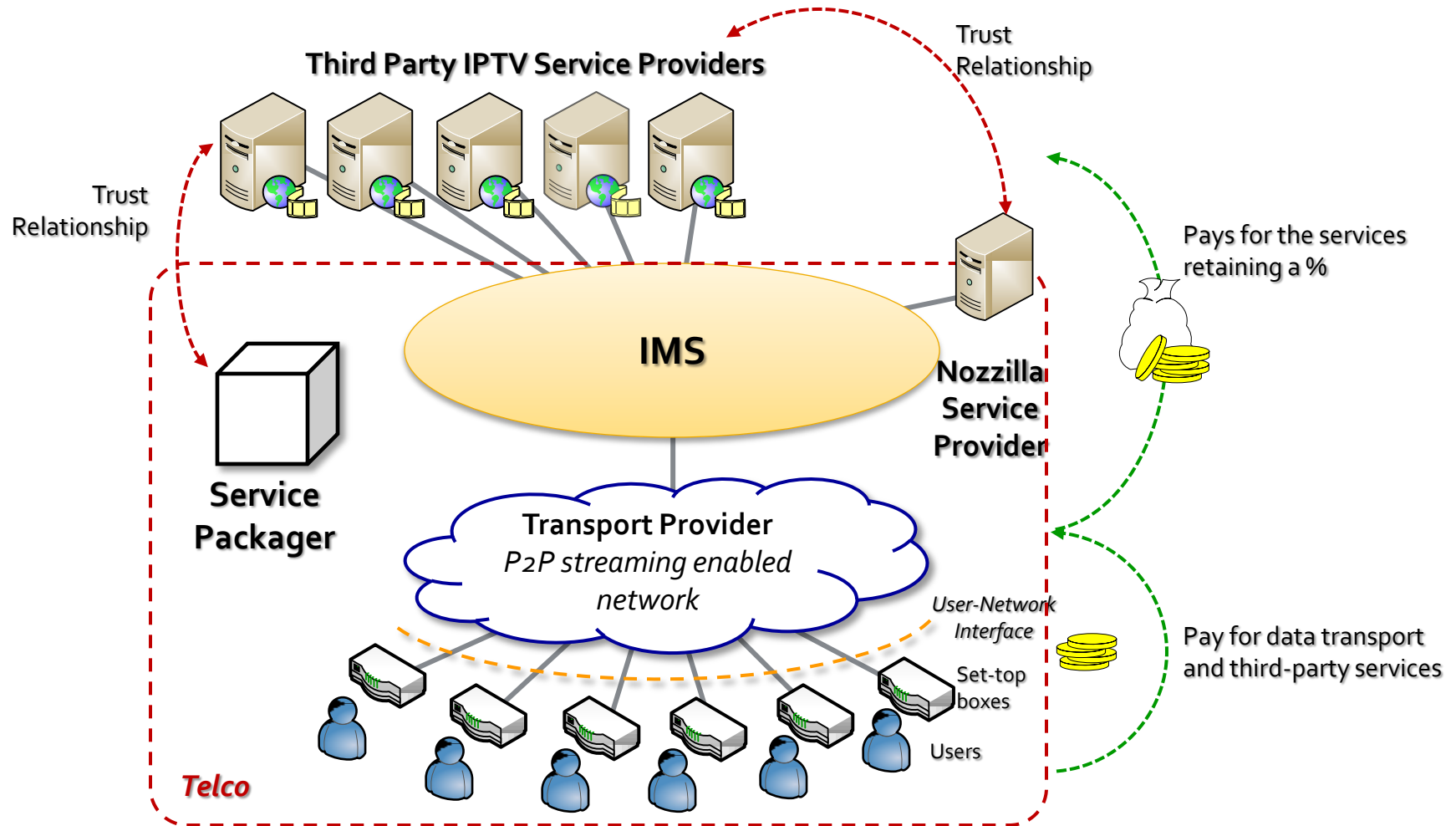
Connecting to the IPTV service
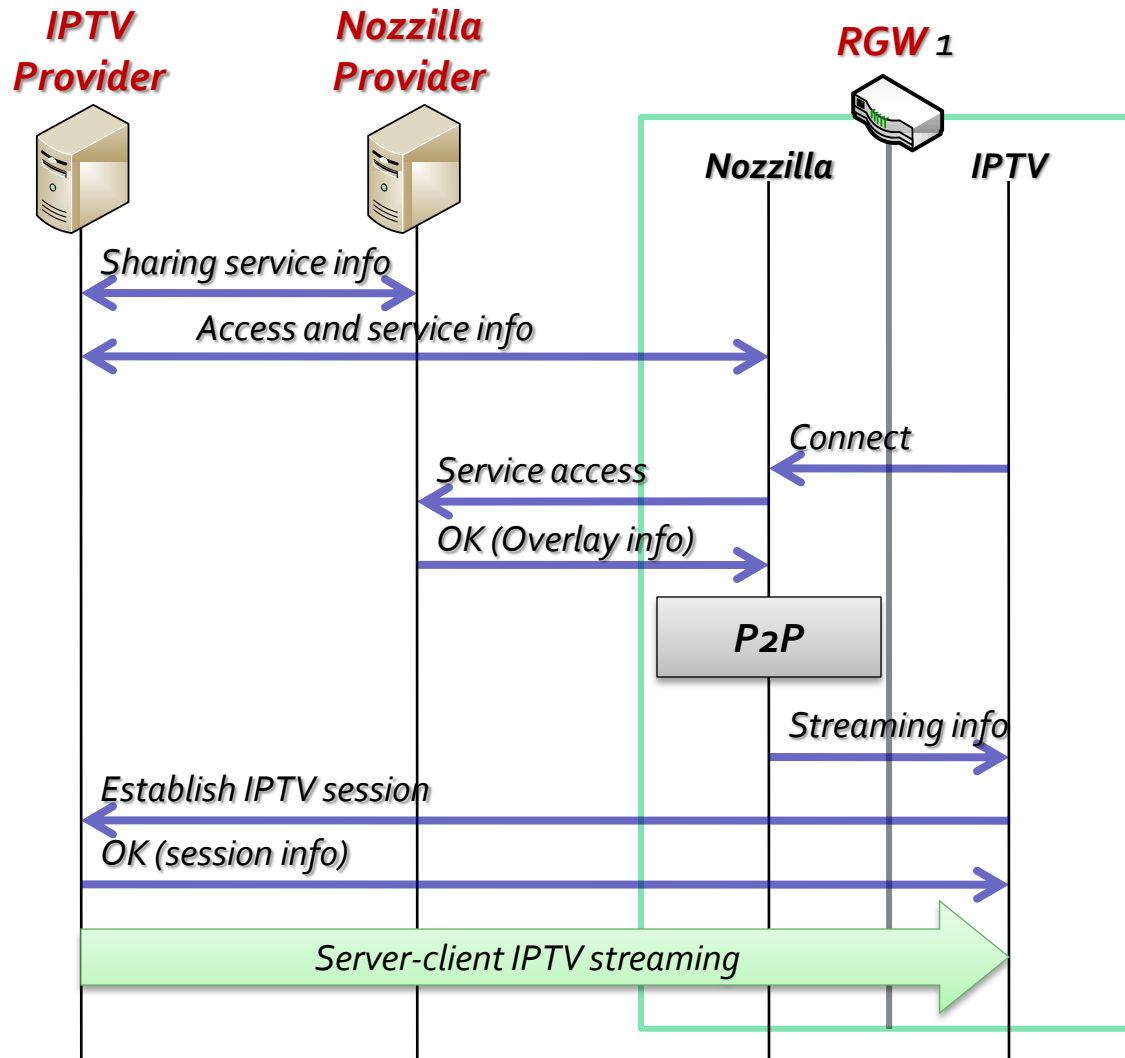
Connecting to the IPTV service

P2P prototype

- Initial research: P2P in signaling *and* media
- Nozzilla 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
  - Peers with resources are always considered interior nodes
  - Children can easily identify these peers
  - Peers re-compute resources whenever something changes

P2P prototype

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

Example: 3 stripes

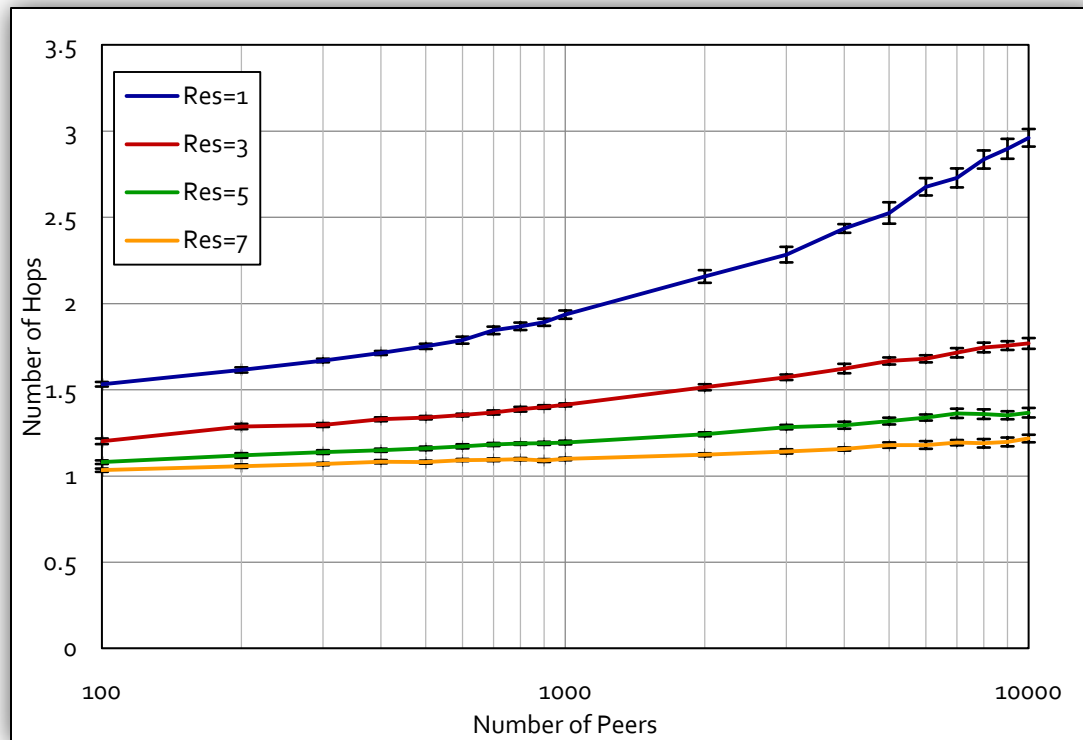High priority (HP)   Medium priority (MP) Low priority (LP)

- 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
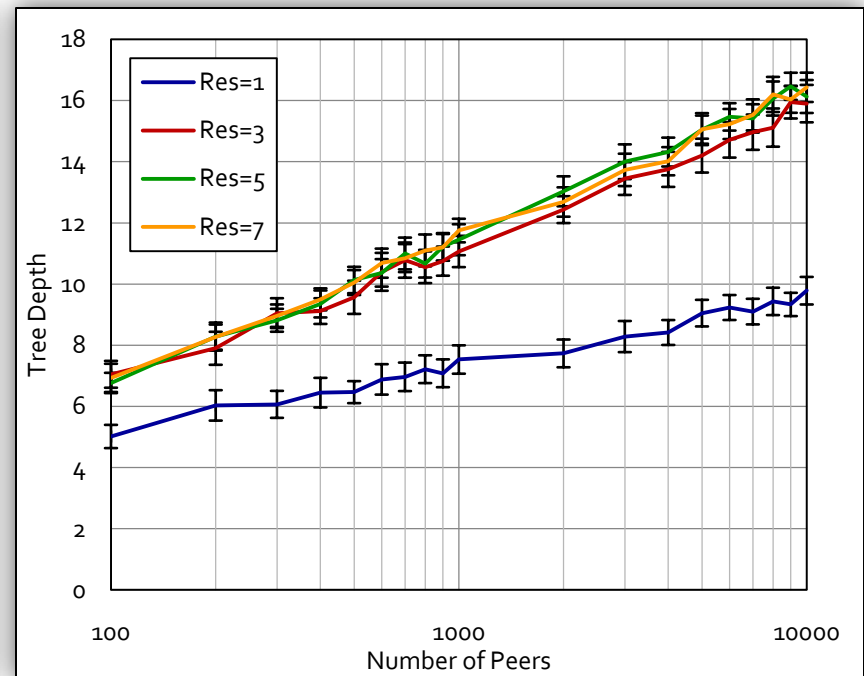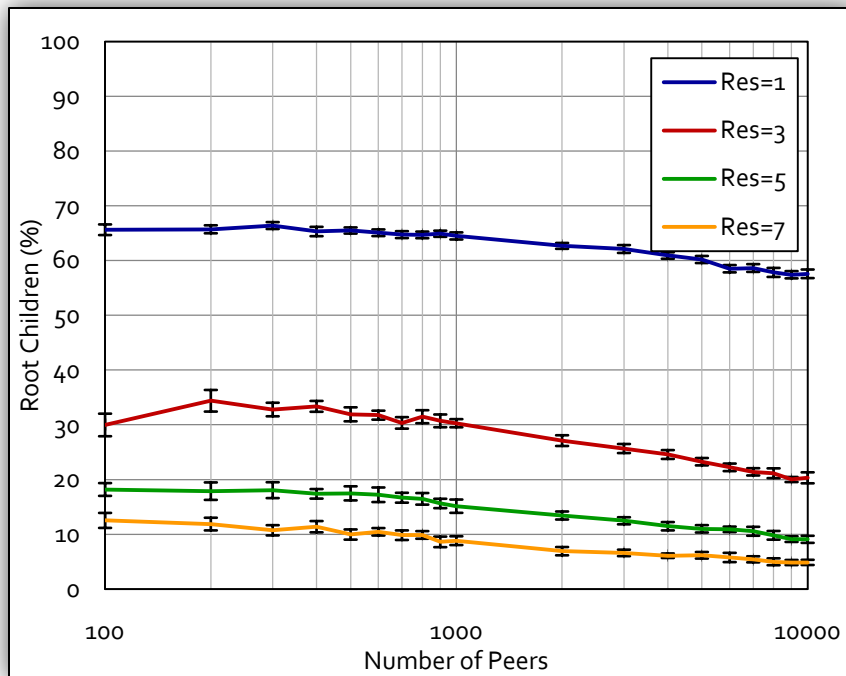
Joining Tree Performance

- 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

Summary for Nozzilla prototype

- **Characteristics**
  - P2P protocol to create multicast trees for video streaming
  - Multi-path video delivery (multiple stripes)
  - Takes into account uplink resources
  - Changes the geometry of the multicast tree to decrease the root load (enables hybrid topologies)
- **Behavior**
  - Low joining effort
  - Low root load for reasonable resources
  - Lengthier video path, may impact reliability

Conclusions

- P2P content distribution in IMS = P2P in a managed network
- Does it make sense?
  - Bulk of the Internet traffic: P2P and video
  - Telcos don't make money from selling bandwidth
  - IMS/NG is the right platform for telcos
  - P2P in the transport layer could be a cost-effective approach
  - TISPAN began working in this direction (first draft Nov '08)

ThankYou