

MPLS Quality of Service – What Is It?



Carsten Rossenhövel
EANTC (European Advanced Networking Test Center)

About EANTC

EANTC offers vendor independent network quality assurance since 1991



EANTC Berlin - Charlottenburg

Business Areas

- **Test and certification** of network components for manufacturers
- Network design **consultancy** and **proof of concept tests** for service providers
- **RfP support** and **acceptance tests** for large enterprises and government organizations
- Vendor-neutral technology **seminars** (MPLS, Analyzer Workshops)

EANTC Research Areas

Knowledge Base

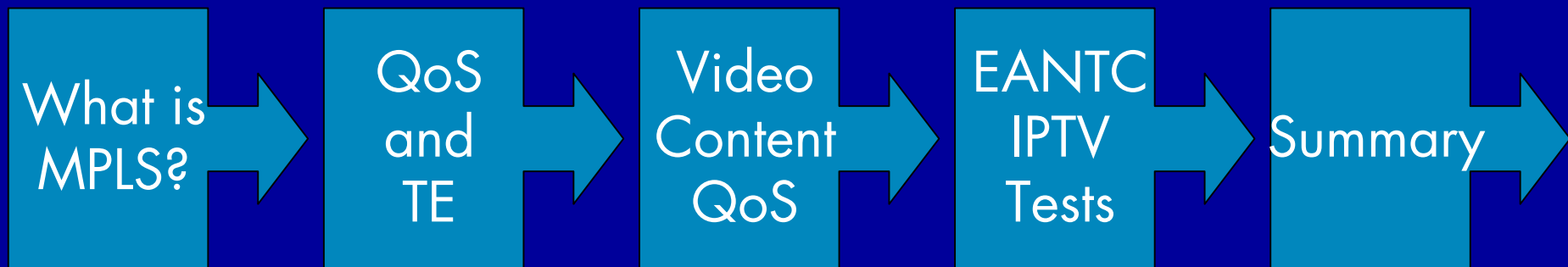
- Test Plan Database
- Development of advanced test plans for new technologies (Carrier Ethernet, IPTV, Wireless mesh, Content filtering, etc.)

Active Participation in Industry Forums

- We create abstract test suites for certification
- Verify functions of new standards in their early stages
- Offer multi-vendor test opportunities to vendors
- Events throughout Europe (next: Carrier Ethernet World Congress in Geneva, September 2007)



Agenda



Primer: What Is MPLS?

- Label-switched forwarding (tunneling)
- Uses an underlying IP backbone infrastructure
- Extensive traffic engineering functionality
- Virtual Private Network (VPN) Services
 - IP-based
 - Ethernet-based
 - ATM- and TDM-based
- Very mature (developed since 1999)
- Complex to configure and operate
- Service provider takes the burden

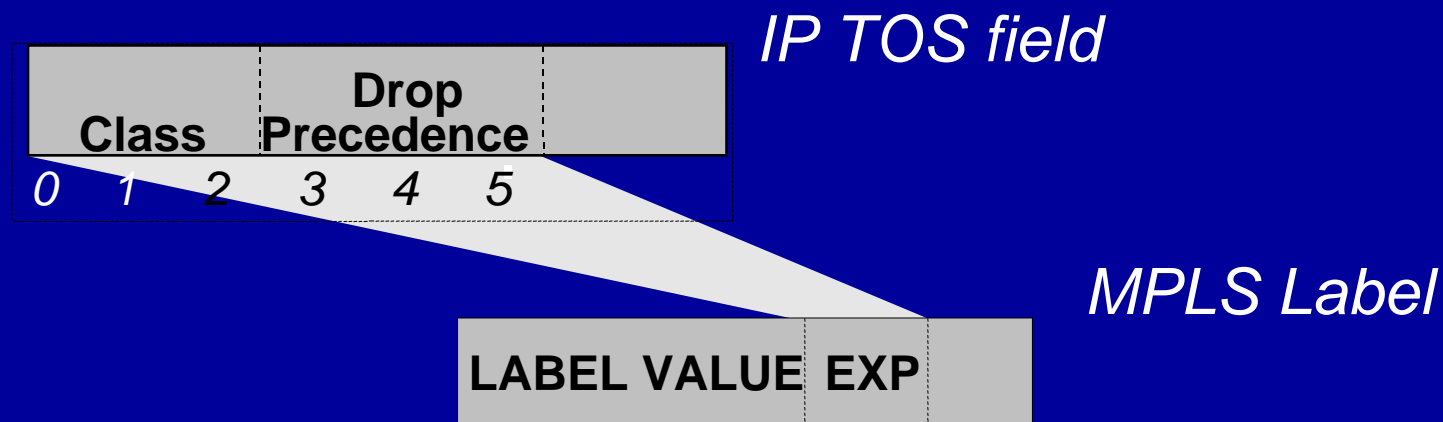
QoS and Traffic Engineering Options in MPLS

Simple Quality of
Service - DiffServ

Standard Quality of Service and Traffic
Engineering – IntServ, Manual
Tunnels, Fast Rerouting

Advanced Traffic Engineering – DiffServ-Aware

Simple MPLS Differentiated Services

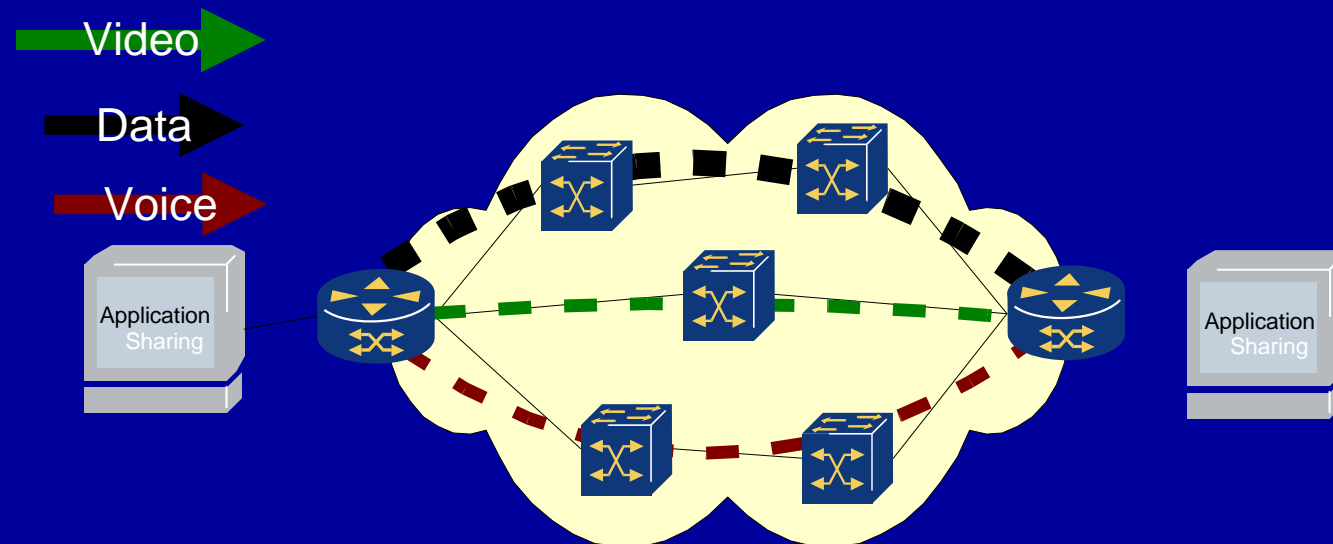


IP DiffServ converted to MPLS

- MPLS uses fewer classes (8 instead of 48); suitable mapping from IP required (true for E-LSPs)

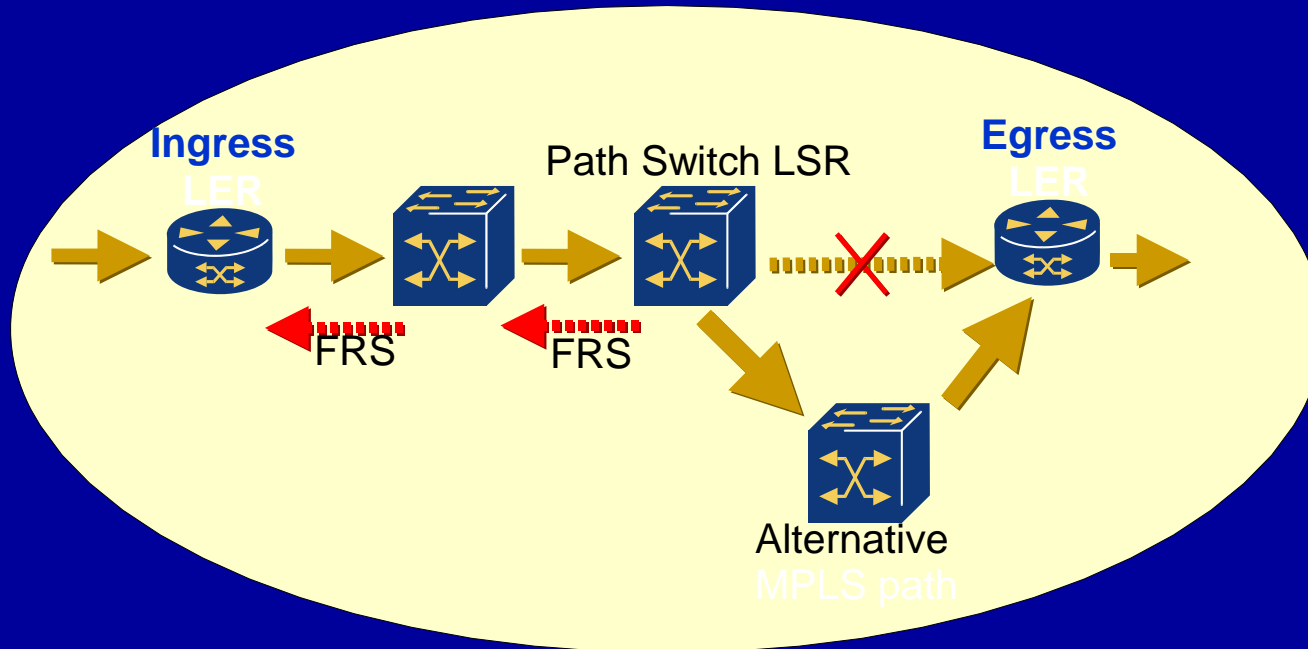
Sufficient for coarse grain backbone QoS handling

MPLS Integrated Services



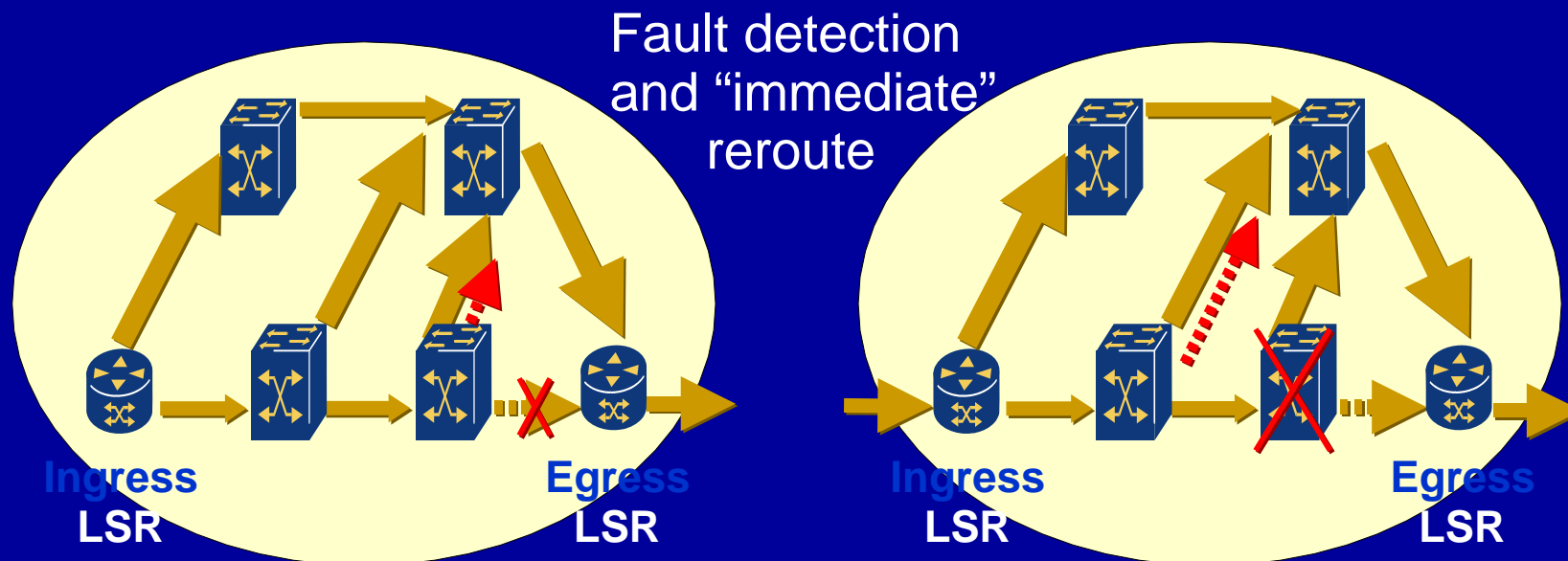
Individual tunnels (manually) created for different types of application data

Fast Rerouting – Global Repair



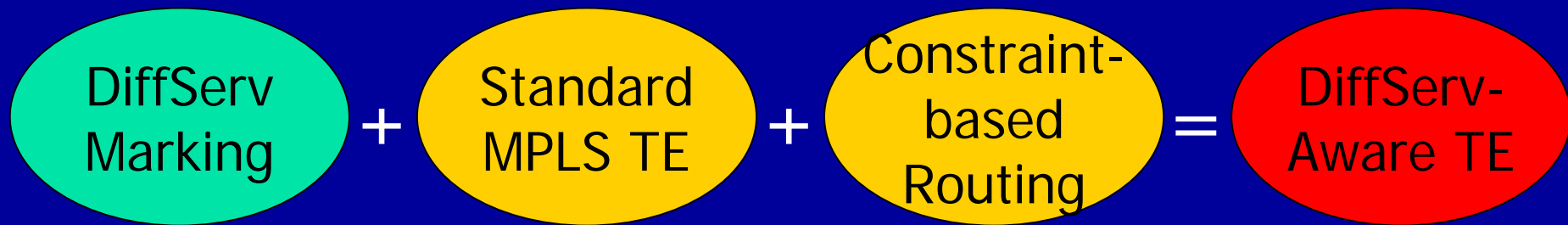
End-to-end backup tunnels are created manually,
automatically switched over globally

Fast Rerouting – Local Repair



Backup tunnels are automatically created for each segment of the primary tunnel, switched locally

DiffServ-Aware Traffic Engineering



Dynamic path selection using OSPF-TE

- Network knows about available resources, globally

New tunnels preempt existing less important ones

BUT: Do operators want this?

Agenda

What
Requirements
Does Video
Content
Impose
For QoS?



Which QoS / TE Functions Are Important For Video Content?

| | |
|---|---|
| <p>Packet Loss</p> <p>Caused By:</p> <ul style="list-style-type: none">▪ Oversubscription▪ Link/Node Failure▪ QoS Issues | <p>Extremely important</p> <p>One lost IP packet can contain up to eight MPEG frames</p> |
| <p>Latency</p> | <p>Important only for live or conversational (two-way) content</p> <p>Nobody cares about movie play-out delay</p> |
| <p>Inter-Arrival Time ("Jitter")</p> | <p>Important only for studio quality content</p> <p>High jitter values require large receiver buffers</p> |

What Does Packet Loss Mean For Video Content?



Web Content:
TCP based,
non-real-time

Will react to
packet loss by
reducing the
transmit rate



Video Content:
RTP/UDP based,
real-time

Will NOT be
able to react to
packet loss; user
will experience
dropouts

Agenda

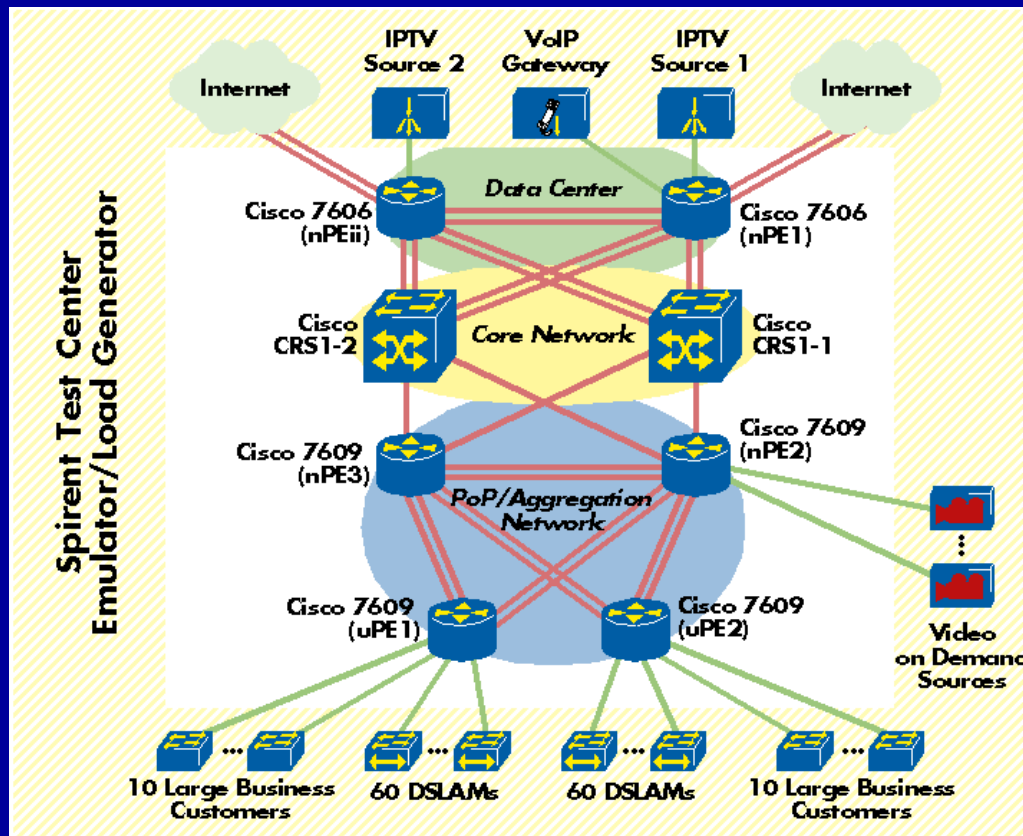
Recent EANTC
Experiences
Of Video Testing



Light Reading / EANTC Test of Cisco IPTV Solution

- IPTV is the hot topic of the year 2007
- Light Reading commissioned EANTC to conduct an independent IPTV infrastructure test of a Cisco solution
- Unique in that an end-to-end solution is tested to the scale of a backbone for 1 Million customers and a full POP infrastructure servicing 60,000 customers
- Published on June 14 after nine months of preparation

Light Reading Test Topology



- EANTC sent a Request for Proposal with functional requirements for a residential Triple Play network
- Cisco proposed a technical solution
- MPLS over native IP!

Light Reading Test Areas Summary



**Performance
& Scalability**

**Quality of
Service**

**Network
Resiliency**

VQE

**CAC for
Video**

Light Reading Test Results Summary

Performance and Scalability

60Gb MCast replication per router
Line rate performance
Zero packet drop

Quality of Service

Cisco QoS ensures triple play experience
Only best effort traffic dropped in congestion
Mcast prioritization is solid

Network Resiliency

Link, Node mcast source failure
Sub-second service disruption during failure
<150ms service disruption during recovery

VQE

VQE maintains perfect video & voice from 0-10% packet loss level

CAC For Video

Call Admission Control for multicast and Video on Demand Services is effective

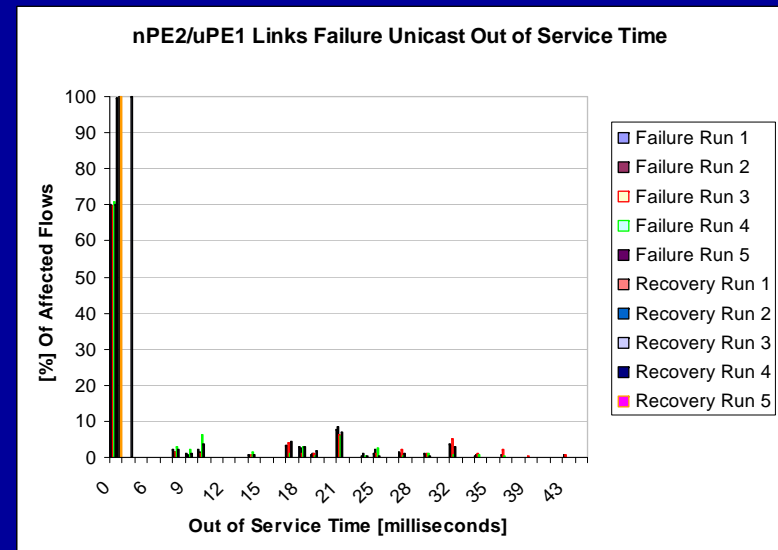
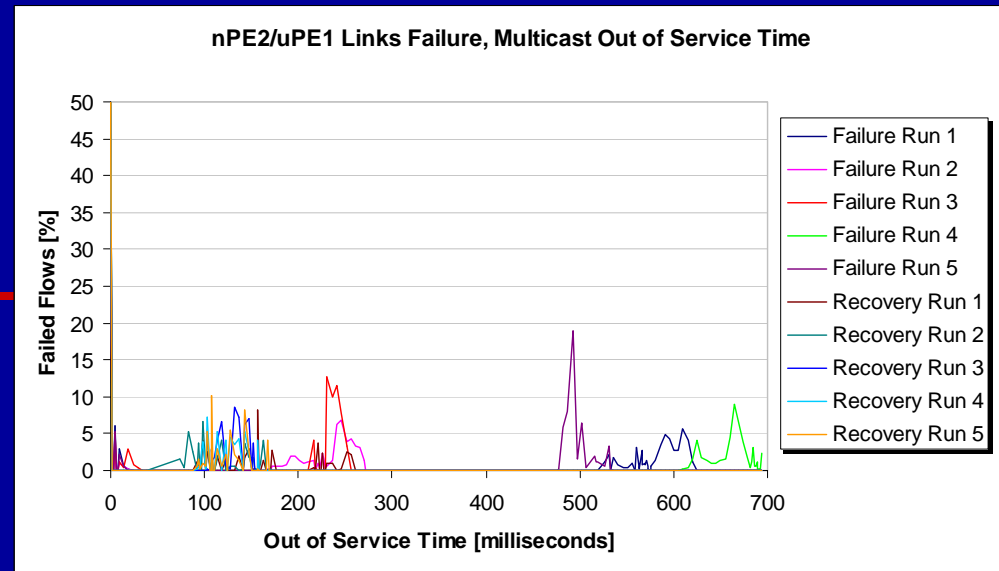
Oversubscription Test Results

- No unicast video traffic lost
- 99.9999% of high-priority multicast traffic forwarded
- All video traffic in low-latency real-time queue!

| Service | Baseline | | DSLAM Port Oversubscription | | NPE to CRS1-1 Oversubscription | | UPE - NPE2 Link Oversubscription | |
|--|----------|---------|--------------------------------|---------|-----------------------------------|---------|-------------------------------------|---------|
| | Loss | Latency | Loss | Latency | Loss | Latency | Loss | Latency |
| Oversubscription Rate per DSLAM | 0 | | 2.50% | | 9.70% | | 13.60% | |
| IPTV | No | Ok | No | Ok | 0.00001% | Ok | 0.00001% | Ok |
| Video on Demand | No | Ok | No | Ok | No | Ok | No | Ok |
| Voice over IP | No | Ok | No | Ok | No | Ok | No | Ok |
| Internet - Residential Downstream | No | Ok | Yes | N/A | Yes | N/A | Yes | N/A |
| Internet - Residential Upstream | No | Ok | No | Ok | No | Ok | No | Ok |
| Internet - Business Downstream | No | Ok | No | High | No | High | No | High |
| Internet - Business Upstream | No | Ok | No | Ok | No | Ok | No | Ok |
| Large Business Customers Downstream | No | Ok | No | Ok | No | High | No | High |
| Large Business Customers Upstream | No | Ok | No | Ok | No | Ok | No | Ok |

Failover Tests

- We failed links in a Cisco 7600 infrastructure serving 30,000 users (unicast + multicast)
- 90% unicast flows were rerouted within 5 ms, 100% within 45 ms
- 50% multicast flows rerouted within 250 ms, all within 700 ms



Additional Sources of Trouble

Too many video streams on the network

- Call Admission Control necessary

Packet loss caused by physical layer issues

- Lost packets need to be rerequested
- Cisco provided VQE solution

Lessons Learned

Video content (multicast and unicast) *can* be transported over MPLS

High quality of experience achievable by careful configuration of quality of service and traffic engineering

A video network can be operated much more efficient using these mechanisms

Thank you for your interest!

For further information, please contact us:

EANTC AG

Einsteinufer 17

D-10587 Berlin

Germany

Phone: +49.30.318 05 95-0

Fax: +49.30.318 05 95-10

E-mail: info@eantc.de

www.eantc.de