Admission Control in IP and MPLS Networks

BRKIPM-3007

Francois Le Faucheur

Cisco Networkers 2007

HOUSEKEEPING

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- Please remember to wear your badge at all times including the Party!
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Caveat

- This presentation focuses on Service Provider space
- CAC for Voice and Video in Enterprise is discussed in other Networkers 2007 sessions

  e.g. BRKUCT-2010 CAC Design for Enterprise WAN

Agenda

- **Introduction and CAC Taxonomy**
- **Requirements and Business Case**
- **CAC Methods**
  - **Topology Unaware Off-Path**
  - **Endpoint Measurement-Based**
  - **Endpoint PCN-based**
  - **Topology-Aware Off-Path**
  - **On-Path RSVP**
  - **On-Path Multicast**
- **Case Studies**
  - **Triple Play Provider: RSVP VoD CAC**
  - **Residential Broadband: BPM CAC for Voice and VoD**
  - **PSTN Replacement: BPM CAC for Voice**
  - **Mobile Phone Trunking: RSVP Aggregation over MPLS TE**
- **Conclusions**

Admission Control: Why?

Ensuring Traffic Fits in Network:

- The Over-Provisioning Model: Adjust Network capacity to peak Traffic
- The TCP Congestion Control Model: Adjust every elastic flow to its share of Network capacity
- The Admission Control Model: Reject Flows that don't fit

- Many environments live happily through combination of Over-Provisioning and TCP Congestion Control

  e.g. The Internet, Campus networks, …

- Some environments require Admission Control. Typically, where
  - Important Traffic is inelastic ("steep utility curve"), like Voice/Video
  - inelastic traffic is in high proportion, like Video in Metro Aggregation
  - Determinism is required

  e.g. Mobile Phone Trunking, Triple Play, Enterprise WAN, Military Ad-hoc networks

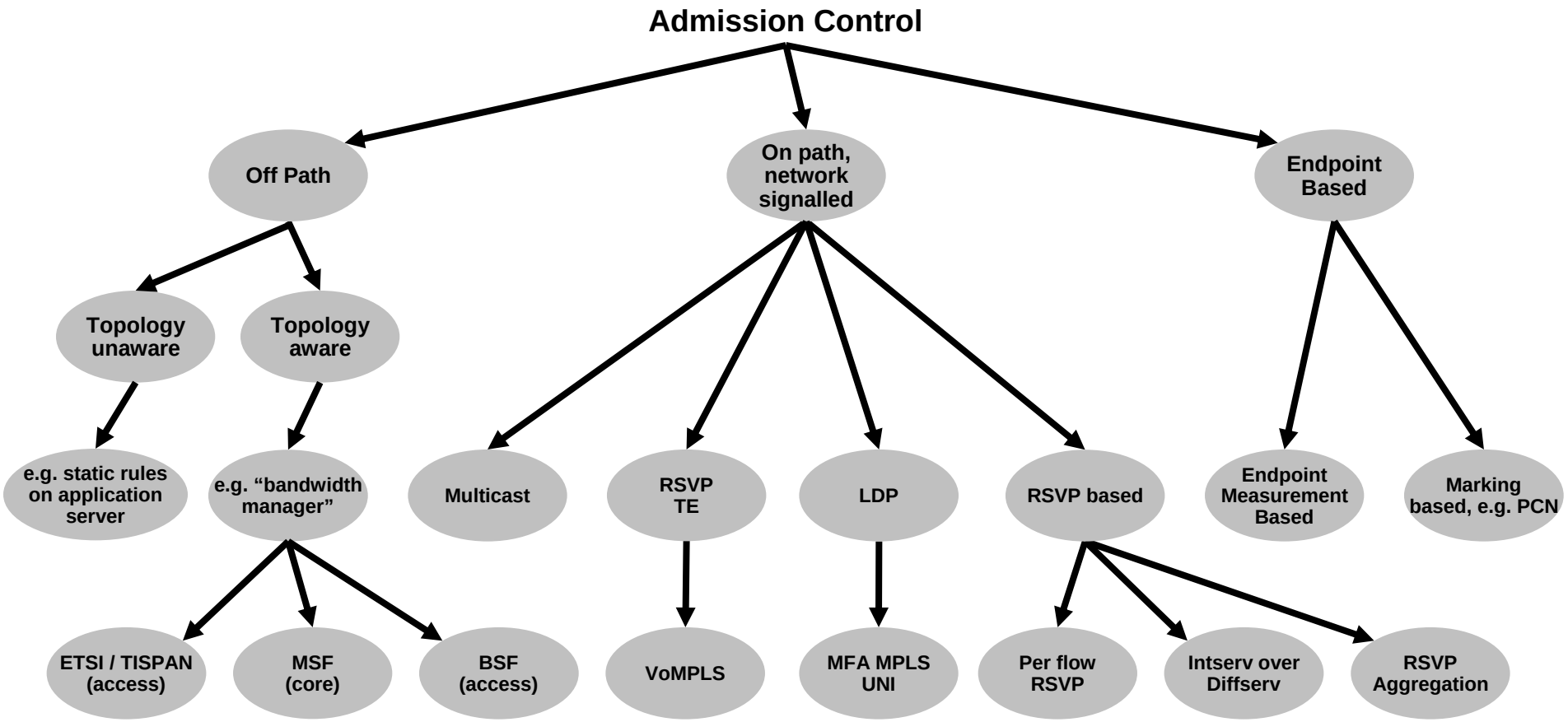
Admission Control: What?

- A technology for:

  (i) Deciding which flow fits or doesn't fit into network.

  (ii) Providing explicit notification to Application so it can do the right thing (e.g send busy tone). Often challenging, as it requires the "Network" and the "Application" to communicate

Admission Control: How?
Taxonomy for Admission Control



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Wireline CAC Requirements

<table>
<tr><th></th><th>ACCESS LINK (last mile)</th><th>AGGREGATION NETWORK</th><th>CORE</th></tr>
<tr><td>VoIP</td><td># of calls generally limited at the application level, i.e. call server, and bw requirements small compared to video
➔ CAC only needed as part of call server (eg SBC with on-board P-CSCF)</td><td>Bw requirements small compared to video and generally provisioned with sufficient class bw to cope with peak during working and failure case
➔ CAC not generally needed</td><td>With the move to NGNs supporting the integration of the PSTN into IP networks, adding support for deterministic admission control is essential
➔ CAC needed in some cases, generally to cover failures rather than normal condition</td></tr>
<tr><td>Broadcast video (multicast)</td><td rowspan="2">Today:Video services generally marketed with total display capacity below access line rate (e.g. 1 SDTV port + 1 SDTV/HDTV port on 12Mb/s line).
# of streams easily limited at the end-system or application level
➔no additional CAC needed
In the future: Video services could be marketed with total display capacity above access line rate (e.g. 2 SDTV/HDTV ports on 12 Mb/s line).
➔ integrated CAC solution covering mcast and unicast needed in future?</td><td>Generally provisioned with sufficient class bw to cope with peak during working and failure case
➔CAC not generally needed
In a few SPs, potential for congestion on DSLAM uplink and Aggregation (very high nb of channels, HDTV)
➔CAC needed in some cases</td><td>Some requirements for trunk level admission control (p-mp TE) but not with feedback to the application
Generally provisioned with sufficient class bw to cope with peak during working and failure case
➔ CAC not needed</td></tr>
<tr><td>VoD (unicast)</td><td>Potential for congestion both in working and network failure cases
➔ CAC highly needed</td><td>Generally provisioned with sufficient class bw to cope with peak during working and failure case
➔ CAC not generally needed
In few SPs potential for congestion in areas of the network both in working and network failure cases
➔ CAC needed in some cases</td></tr>
<tr><td>Business</td><td colspan="3">Tight SLA commitments not compatible with call blocking probability of CAC. Requires stringent capacity planning (and possibly TE like traffic engineering) both in normal and failure conditions
➔CAC with feedback to application not needed</td></tr>
</table>

VoD CAC Requirements in Aggregation

- Each VoD Stream is big (eg. 1.5-4Mb/s SD, 8-12Mb/s HD)
- Aggregation network cannot be dimensioned to cope with simultaneous VoD use by all users
- Aggregate VoD load is very hard to predict
  (unlike aggregate Broadcast Video load)

  scales with peak number of simultaneous users

  depends on many external variables (service uptake, content attractiveness, promotions,…)
- Video encodings intolerant to loss
- If the aggregate Video load sessions exceeds the capacity, ALL Video sessions degrade
- Failures in Aggregation makes problem even worse

CAC Highly Needed for VoD in Aggregation

CAC Business Case

- Can be expressed in three ways:

  For <given peak load, given QoE target>, reduces required network Bandwidth and hence reduces Capex

  For <given peak load, given bandwidth>, increases QoE and hence customer satisfaction

  For <given bandwidth, given QoE target>, increases peak load that can be accepted and hence increases revenue

CAC Business Case

- Can be expressed in three ways:

  For <given peak load, given QoE target>, reduces required network Bandwidth and hence reduces Capex

Example Business Case for Triple Play operator (*)

Assumptions:

- resilient connectivity in Aggregation (ring)
- trunk failure ➔ 50% capacity lost
- 900 COs, 4 M subs, 15% concurrency, 25/75% MPEG2/4
- $500/mo per GE, $5000/mo per 10GE

Capacity Planning Options:

- "**Gambler's Approach**": Build capacity so that Peak load fits in absence of failure, accept that all VoDs of all users degrade if Failure happens during Peak time (hope it doesn't happen too often)
- "**Rolls Royce Approach**": Build capacity so that Peak load fits during Trunk Failure
- "**Smart Approach**": Build capacity so that Peak load fits in absence of failure, deploy CAC to reject excess load if Failure happens during Peak time

Results:

- Smart Approach and Gambler's Approach **save ~$140M over 5 years**, vs Rolls Royce Approach
- Gambler's approach generally not acceptable

(*) Business Case by Network Strategy Partner, more detailed info available on request

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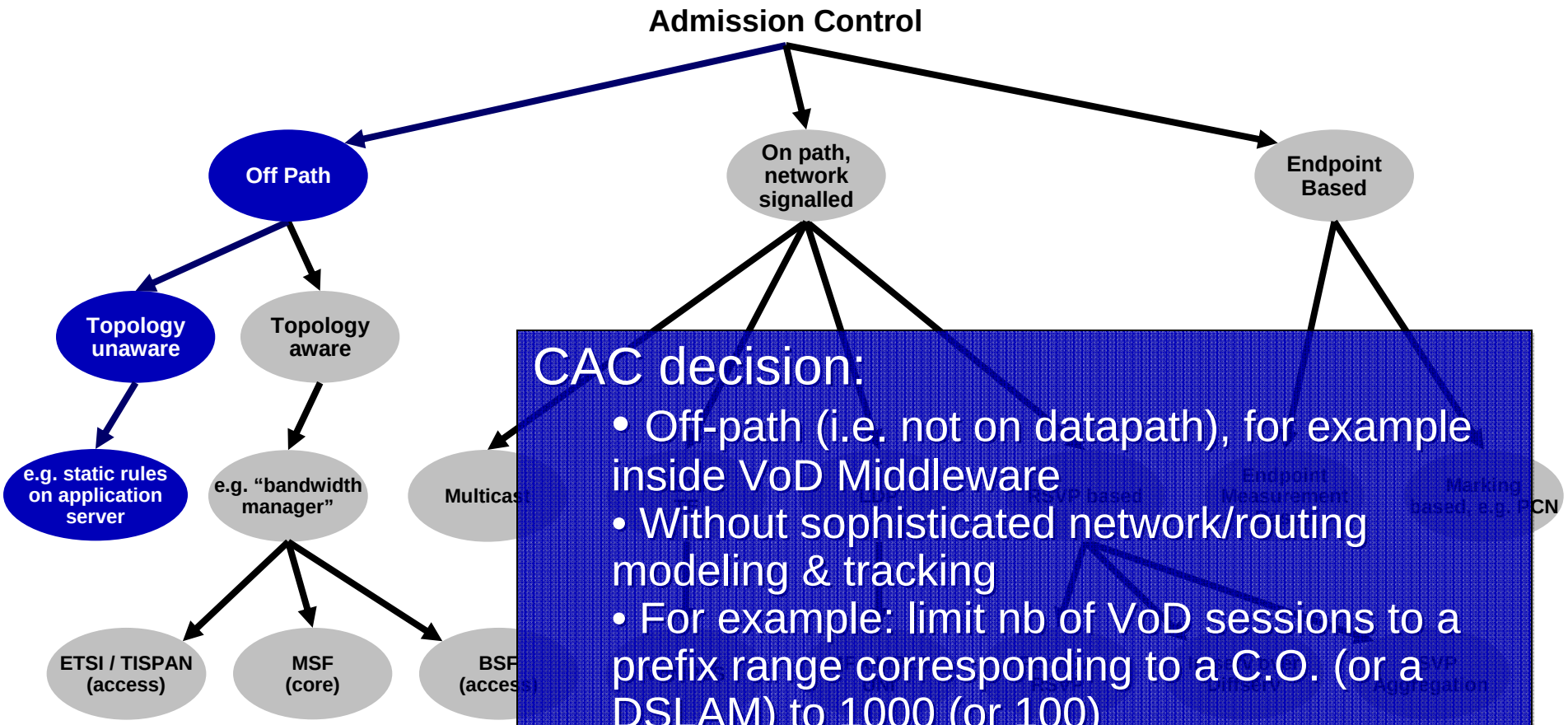
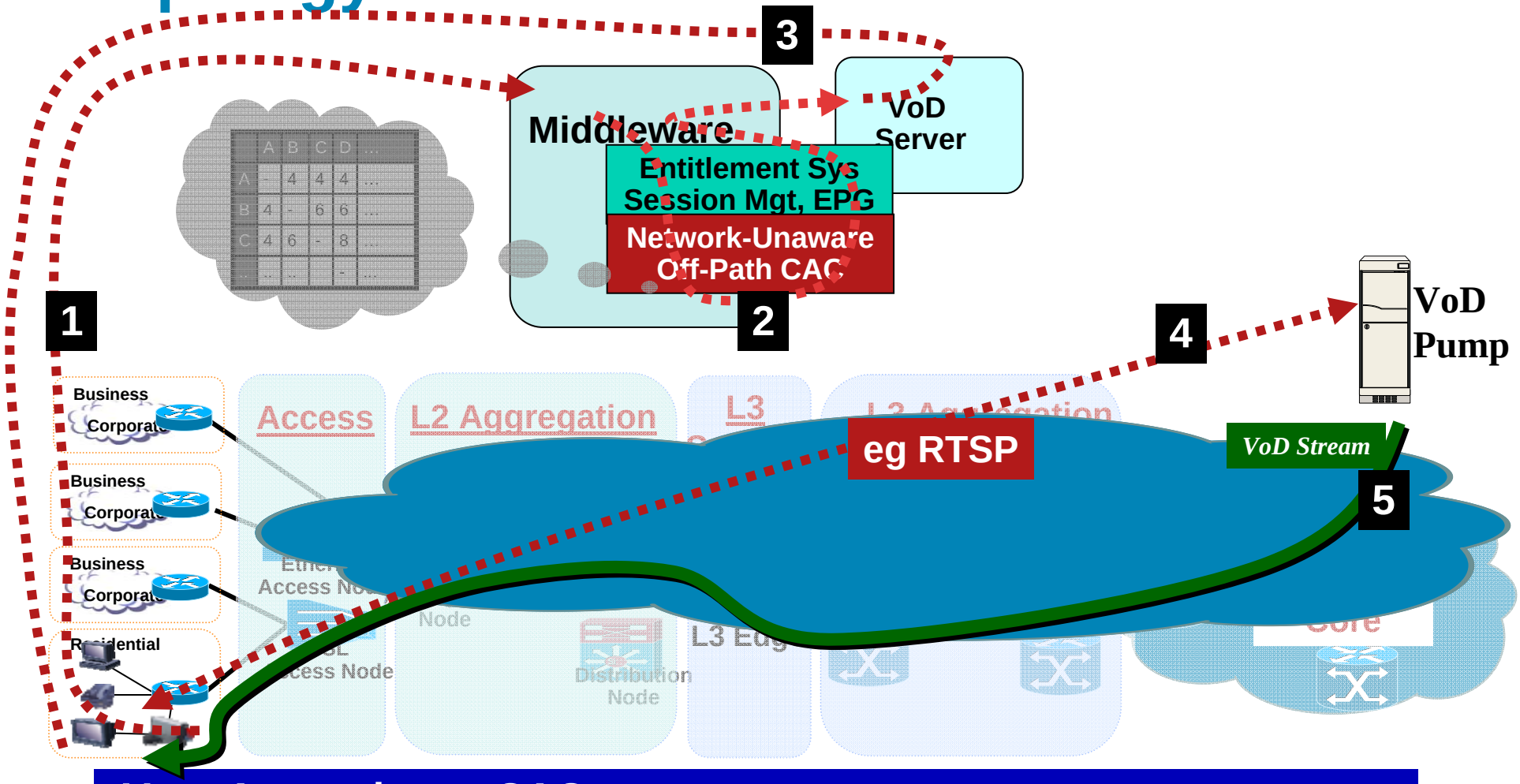
Topology Unaware Off-Path CAC

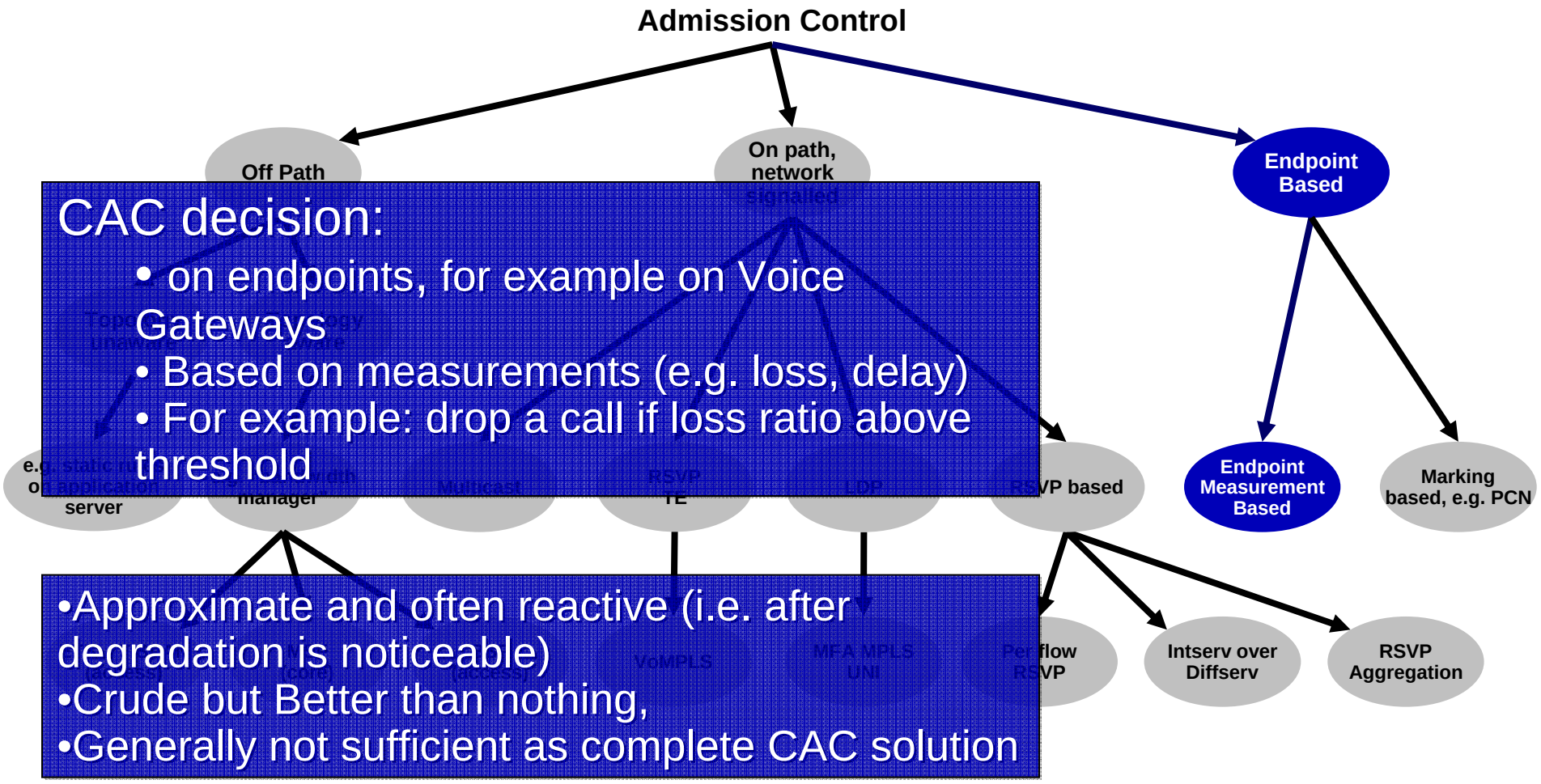


Topology-Unaware Off-Path CAC

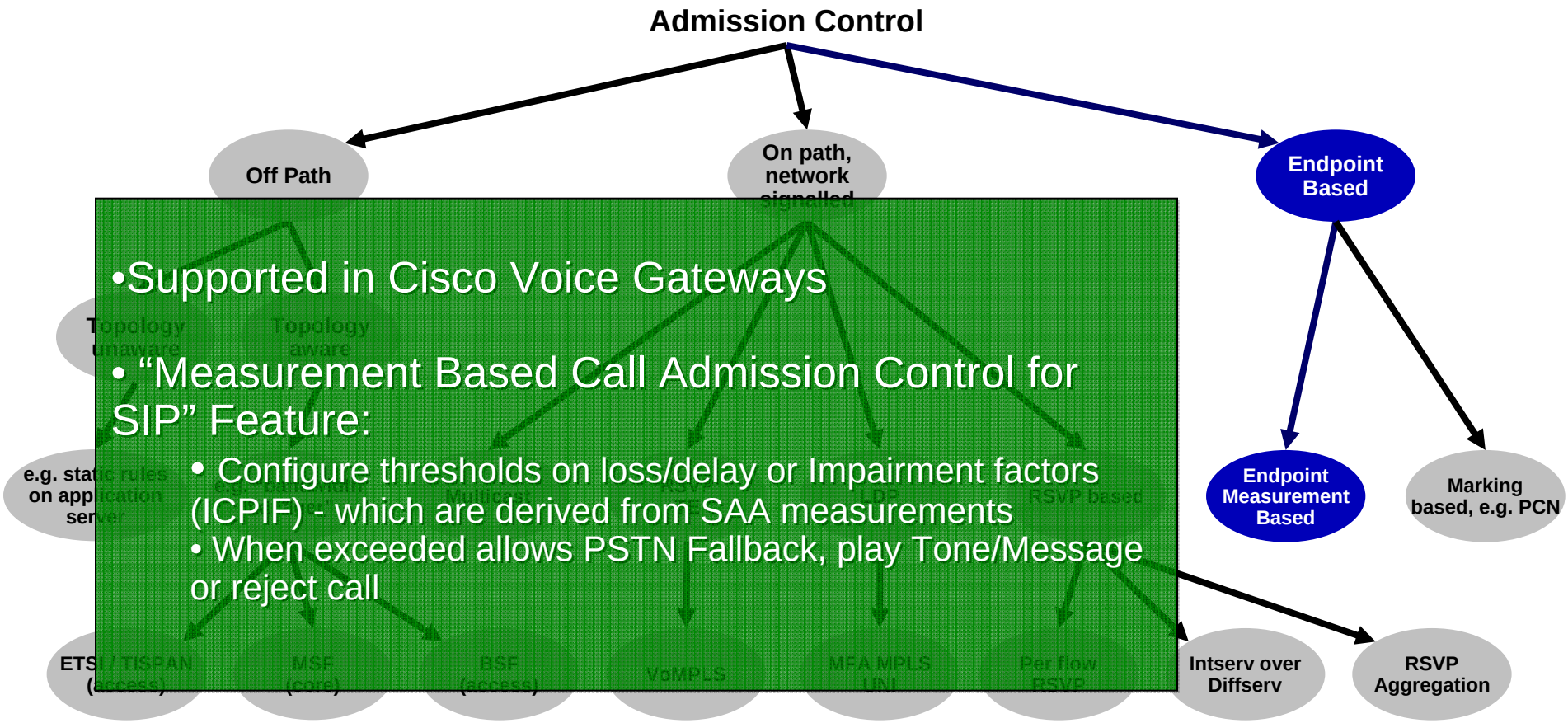


- Very Approximate CAC
- → has to be very conservative (eg in case a link goes down)
- → Very wasteful (eg 50% VoD bandwidth wasted)
- → Sometimes better than nothing but not a "real" CAC solution

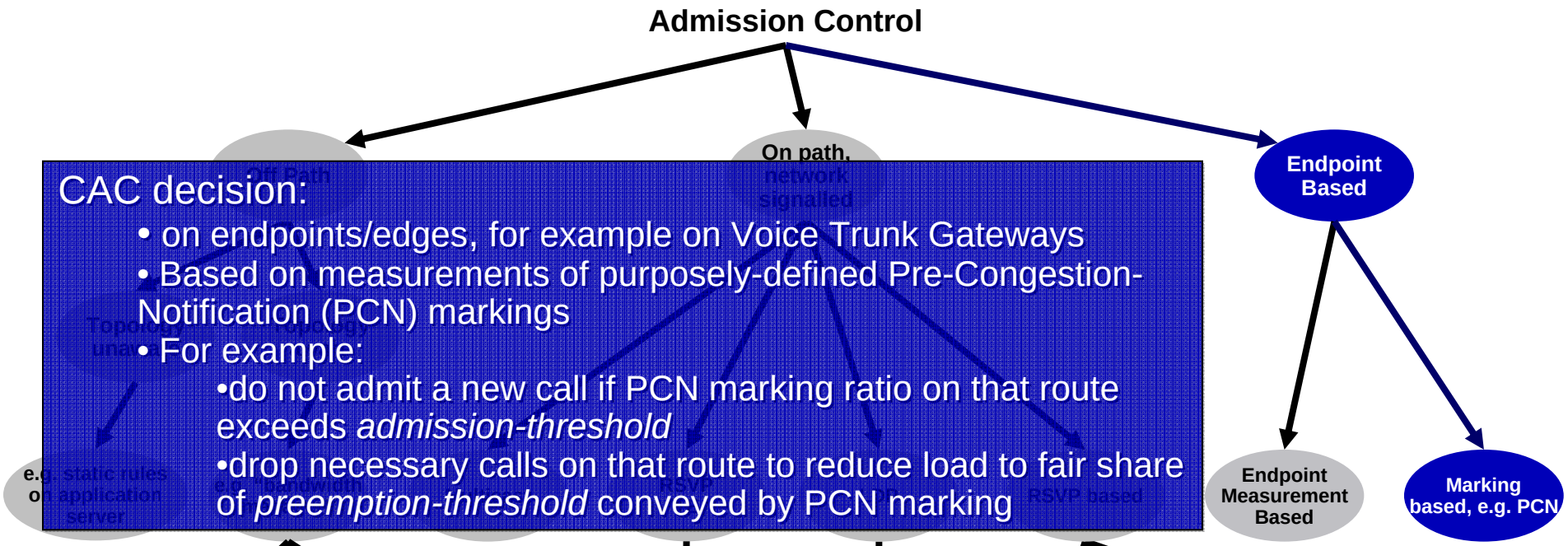
Endpoint Measurement-Based CAC



Endpoint Measurement-Based CAC

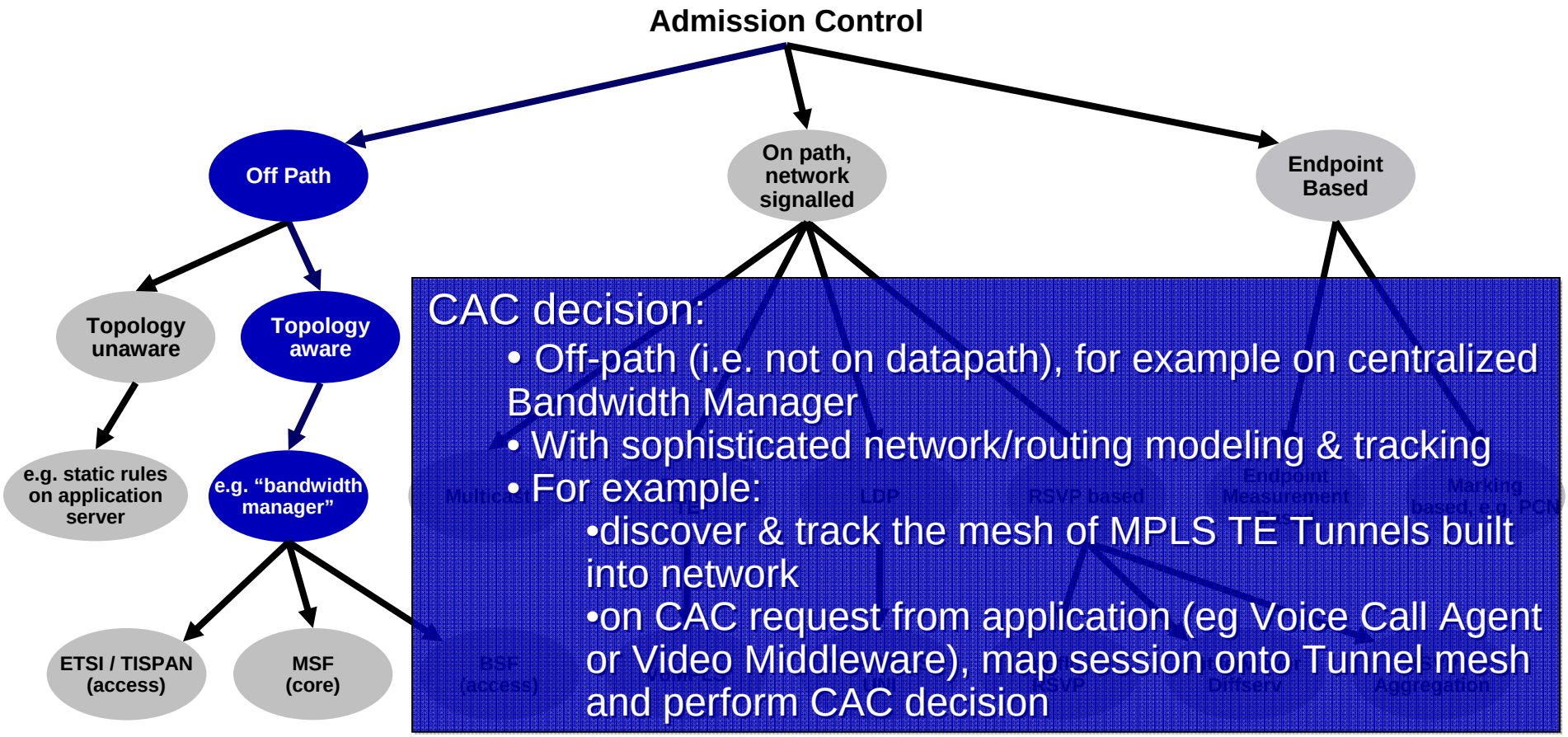


Endpoint PCN-based CAC



- PCN work was initiated under Transport Area Working Group
- IETF now forming a new PCN Working Group (pcn@ietf.org)
- See draft-briscoe-tsvwg-cl-architecture-04, draft-briscoe-tswg-cl-phb-03
- PCN aims at fixing issues with current endpoint measurement based approach (e.g. provide indication BEFORE congestion, provide quantitative feedback on how much load to drop in case of sudden congestion)
- Will not be applicable to all deployment environments
- Early days but interesting approach to watch

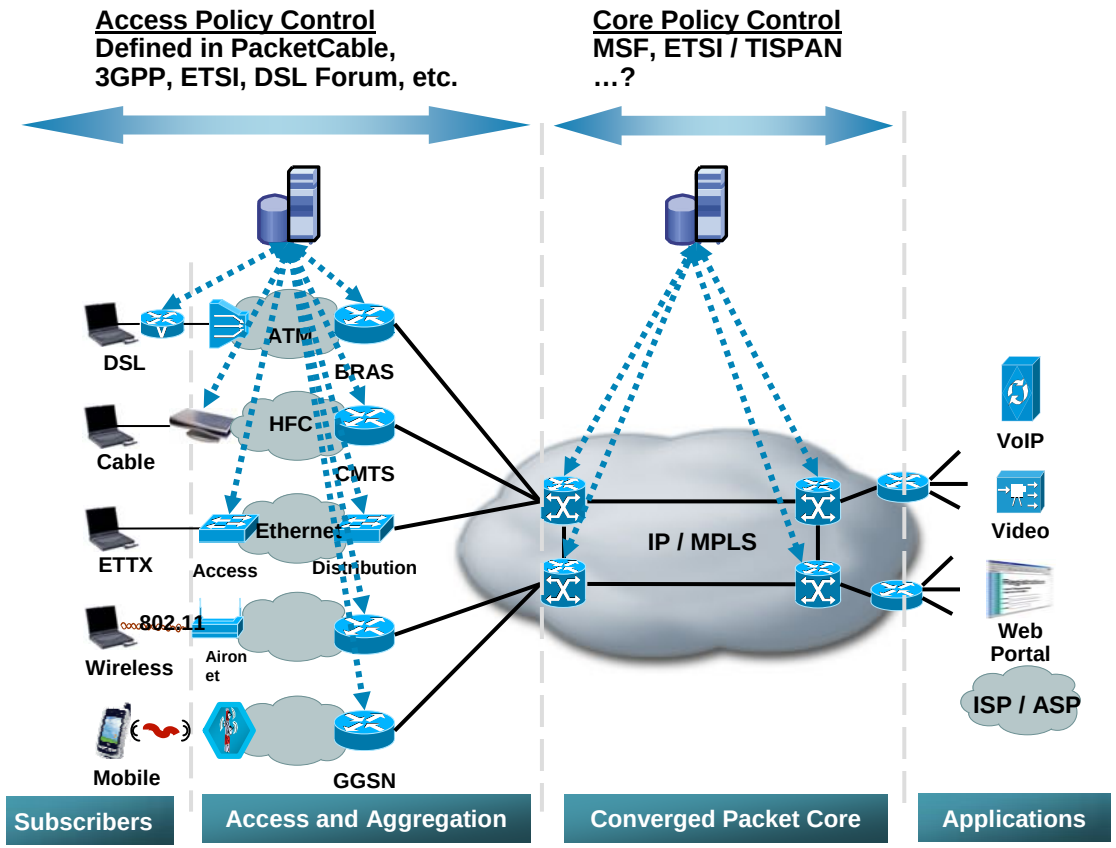
Off-Path Topology Aware CAC



Resource Management Standards Status

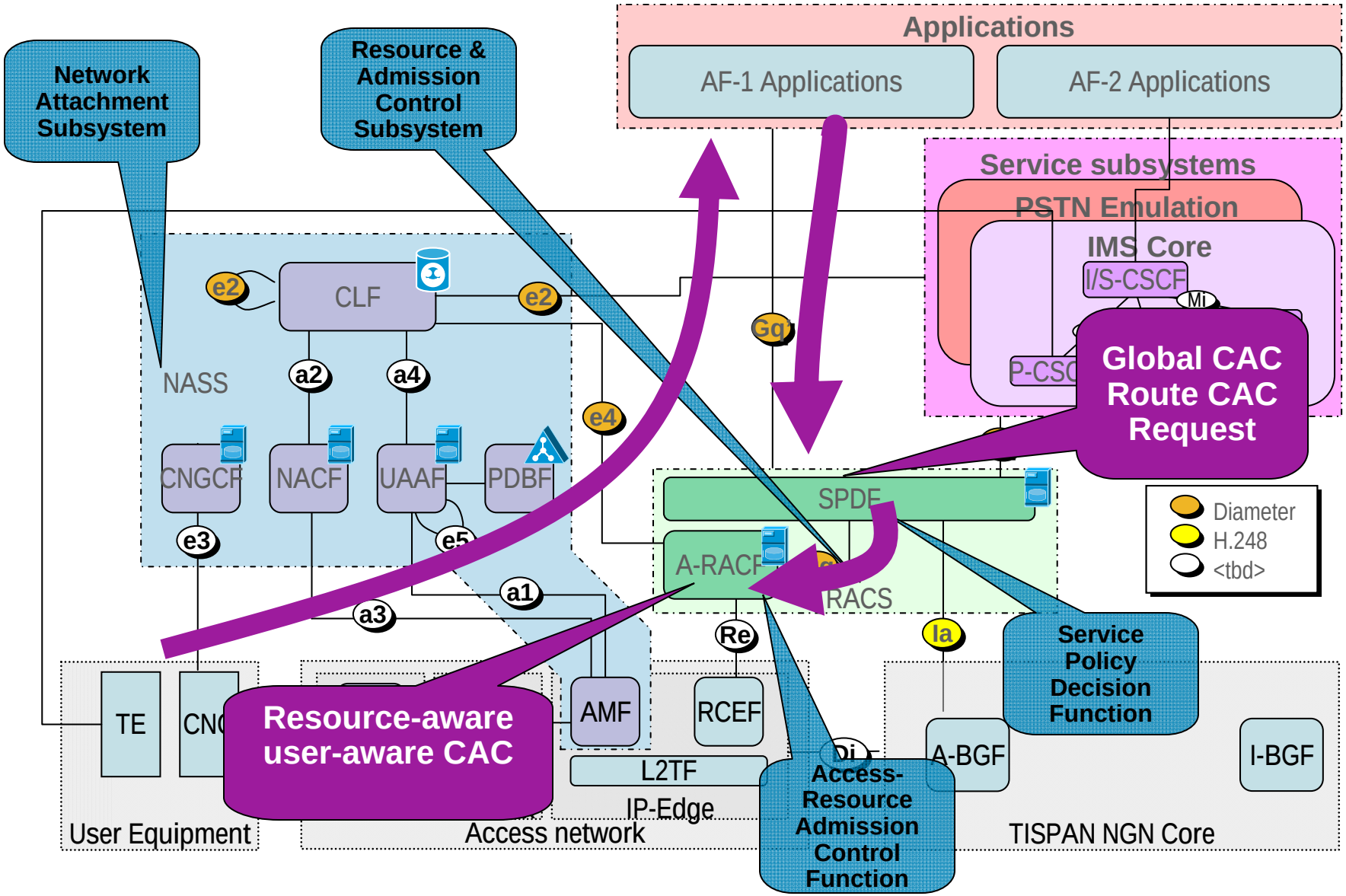
- A number of standards bodies are currently defining policy and/or resource/bandwidth management functions:
  - ETSI TISPAN
  - ITU [TR-RACS]
  - 3GPP [3GPP Draft TS23.802]
  - MSF [MSF-TR-QoS-001-FINAL]
  - DSL Forum [WT-134]
  - CableLabs PCMM
- Some of these standardisation efforts are addressing a wider scope than resource/bandwidth management
  - Adding application pin holing, and session border control functionality for example
- Some standards focus on access specific functions, others on the core

Resource Management Standards Status

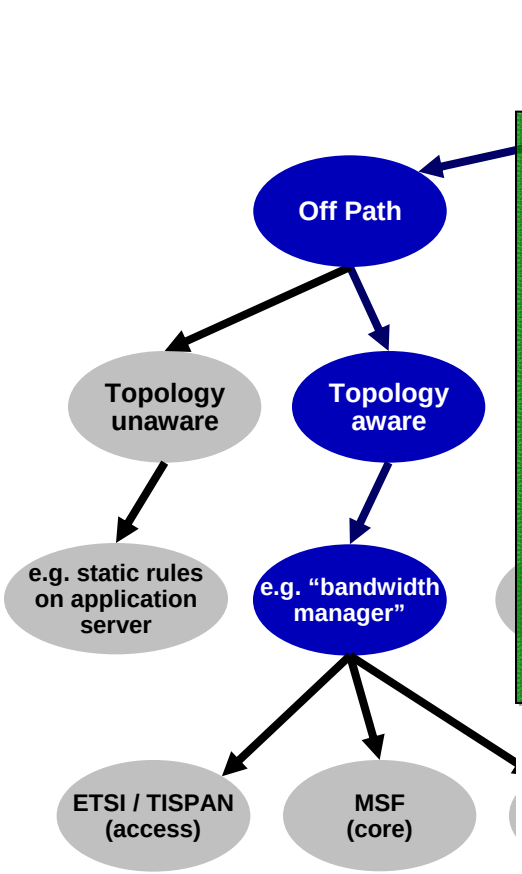


- ETSI TISPAN (access) and MSF (core) currently define off-path bandwidth management functionality

TISPAN Resource Admission Control System



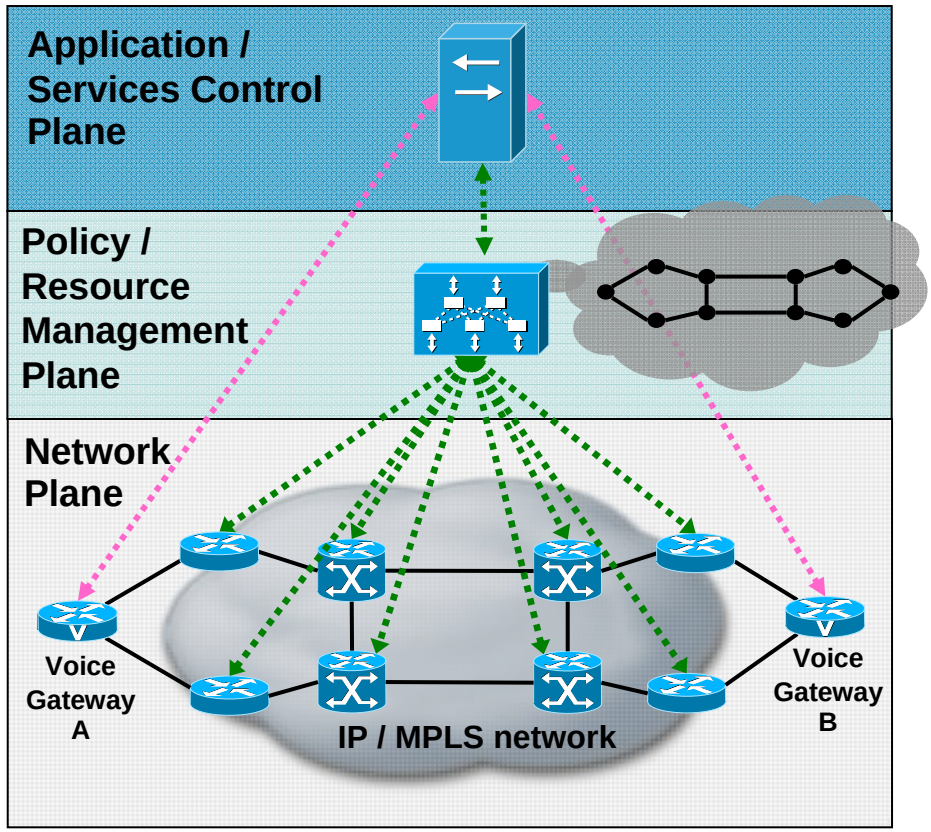
Off-Path Topology-Aware CAC with Cisco BPM



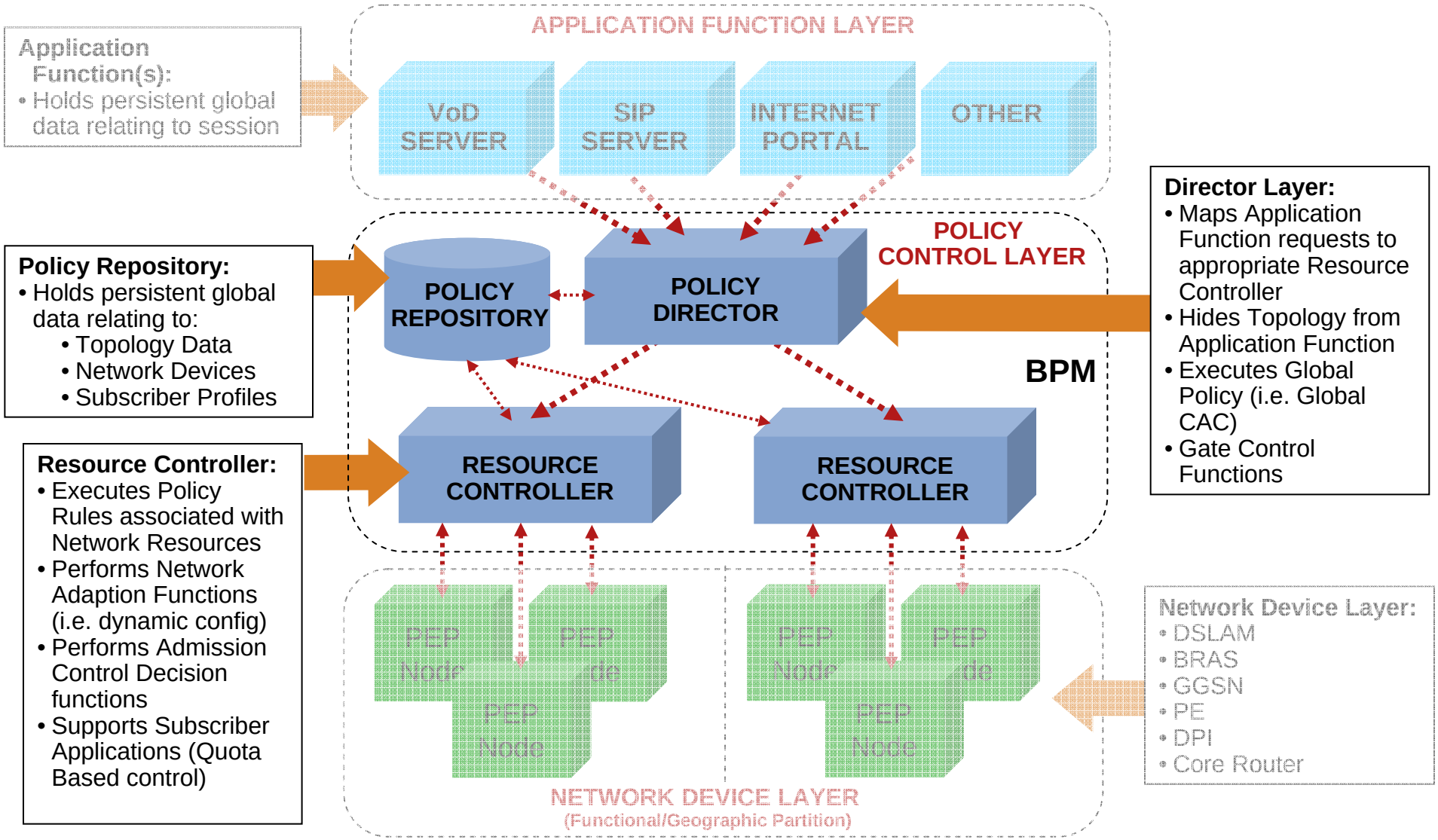
- Cisco Broadband Policy Manager (BPM) is a specific inception of a system capable of supporting the off-path resource/bandwidth management functions defined in the various standards
- Built on top of the industry leading network policy control server platform
  - Flexible application interfaces
  - Per-call CAC scaling to PSTN loads
  - Carrier-class availability

Off-Path Topology Aware CAC with Cisco BPM

- BPM maintains a view of network bandwidth resources and processes admission control decisions based upon that view
  - View may be abstracted from physical topology
- Can be applied to access and core, L2, L3 and MPLS
- Can be applied to heterogeneous service environments (Voice, Video, Gaming,…)
- Integral part of Cisco Policy Control solution

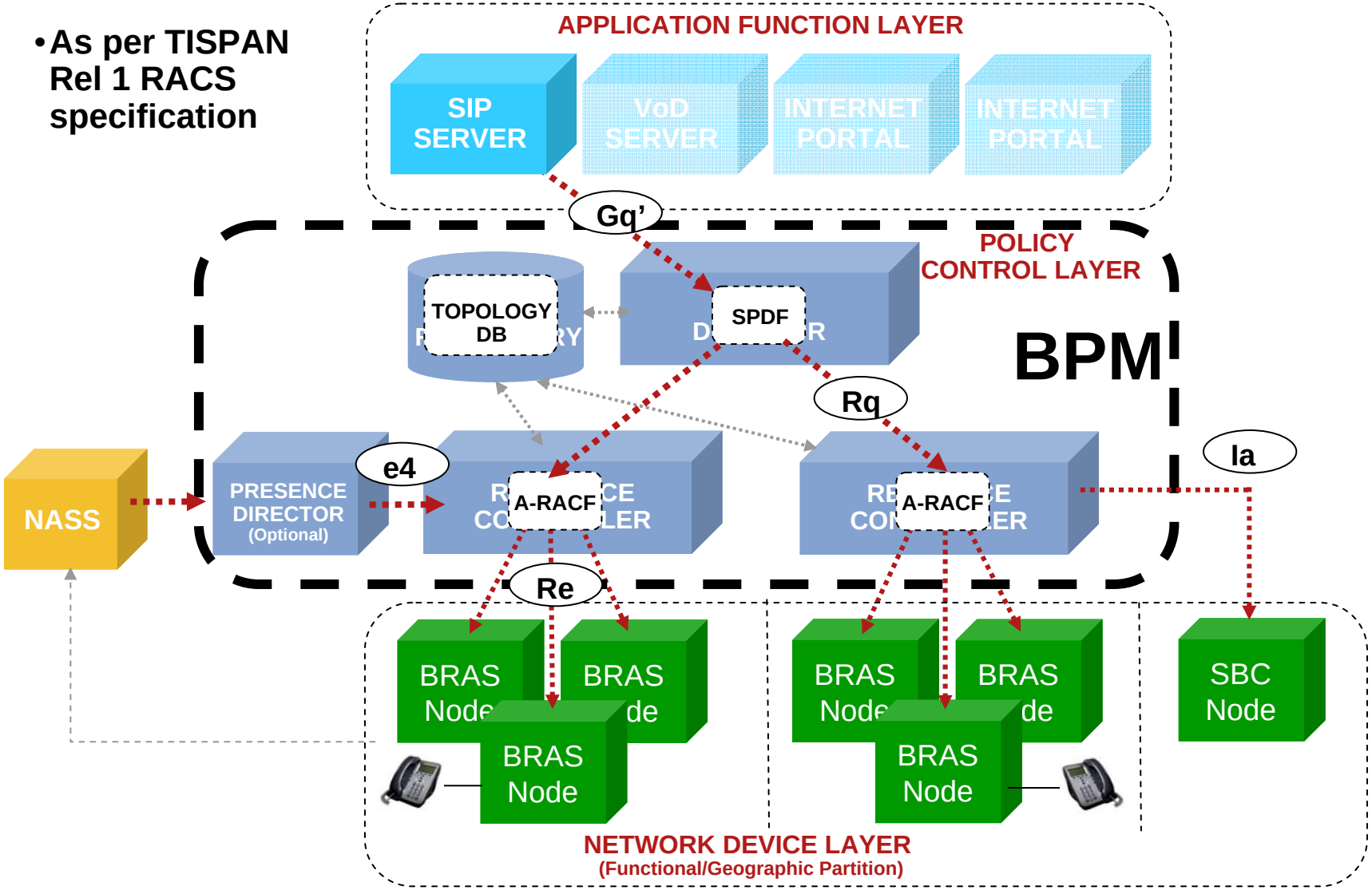


Cisco BPM: Component Overview



Cisco BPM: Application to TISPAN / RACS

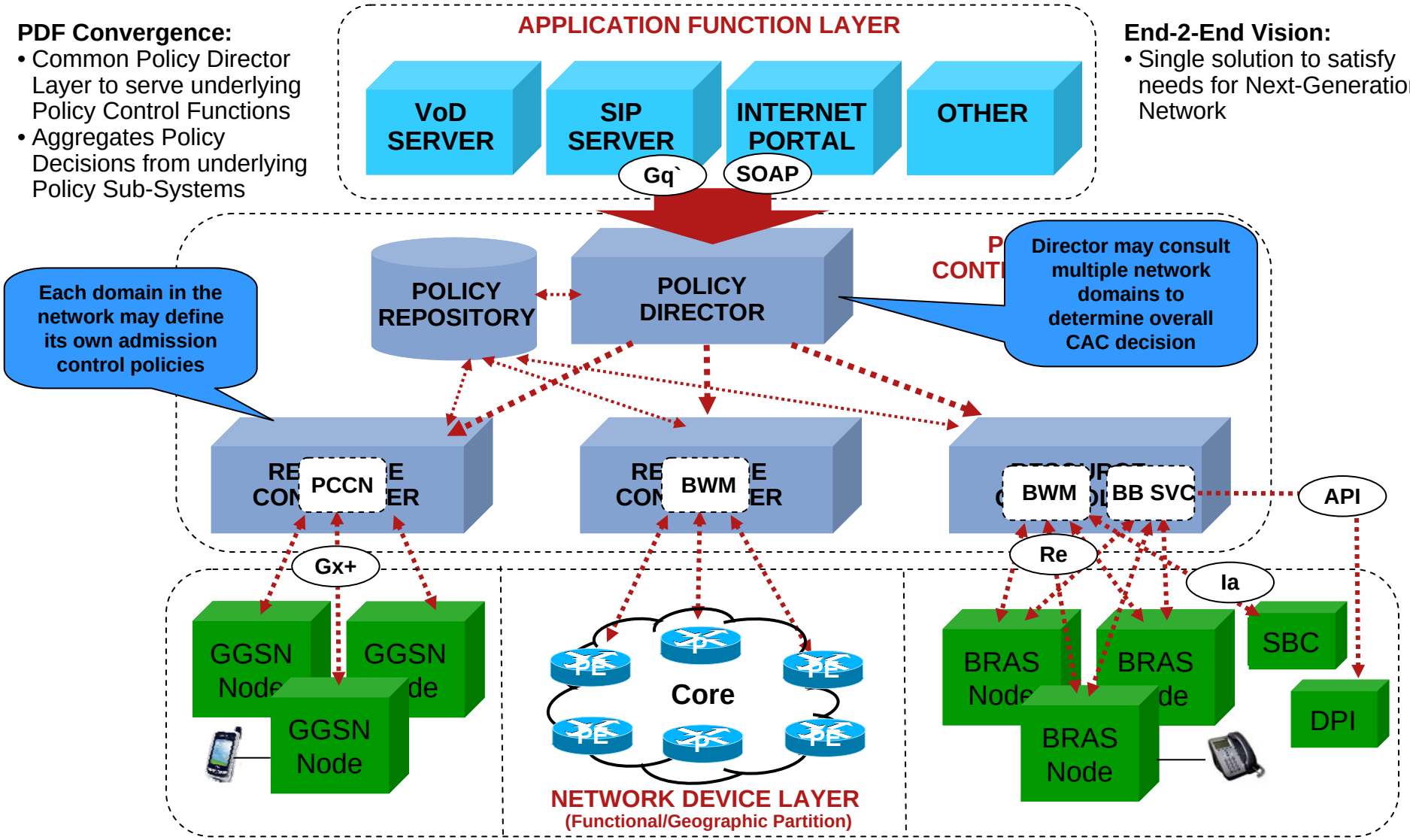
- As per TISPAN Rel 1 RACS specification



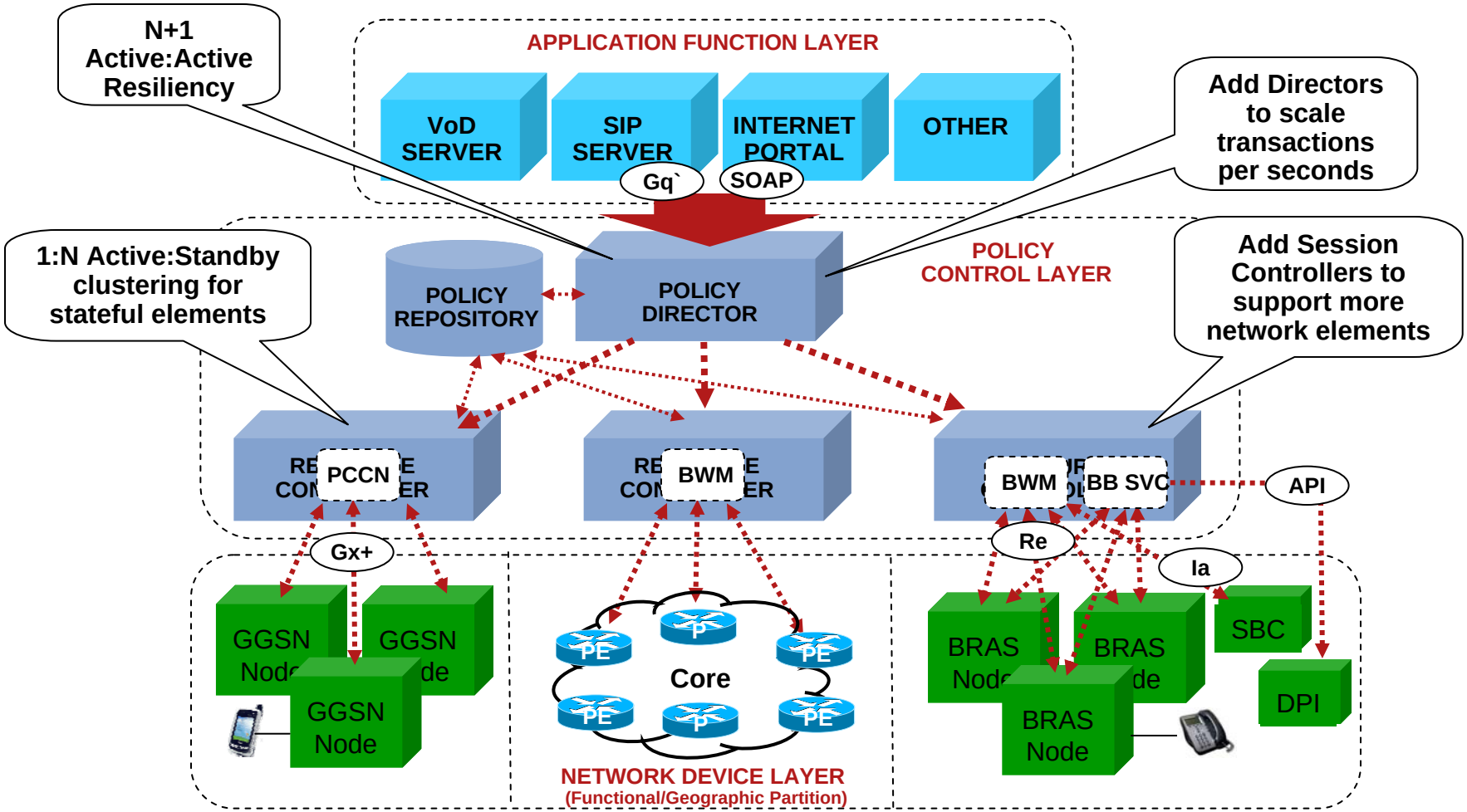
Cisco BPM:
Multi-Domain Admission Control

PDF Convergence:
- Common Policy Director Layer to serve underlying Policy Control Functions
- Aggregates Policy Decisions from underlying Policy Sub-Systems

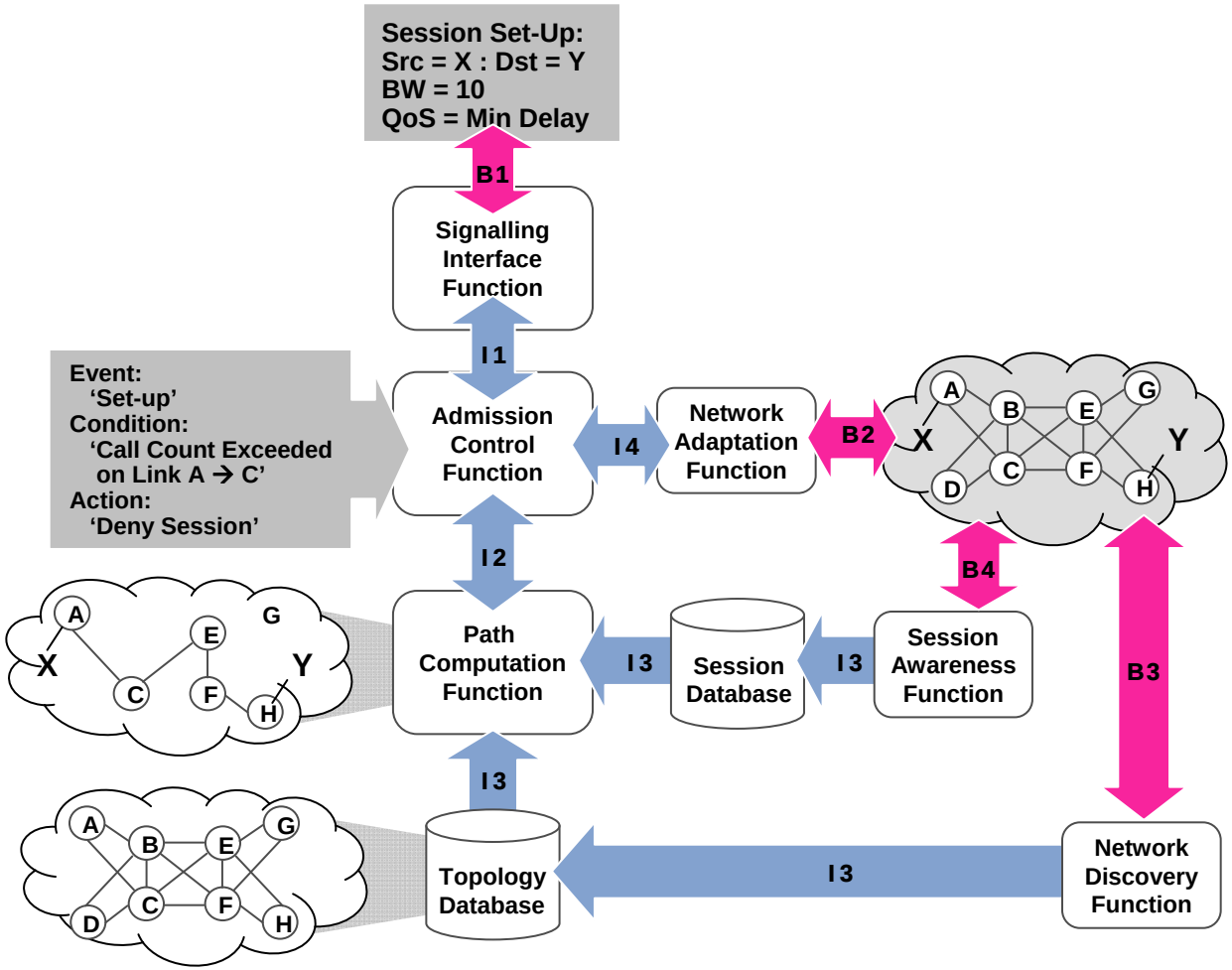
End-2-End Vision:
- Single solution to satisfy needs for Next-Generation Network



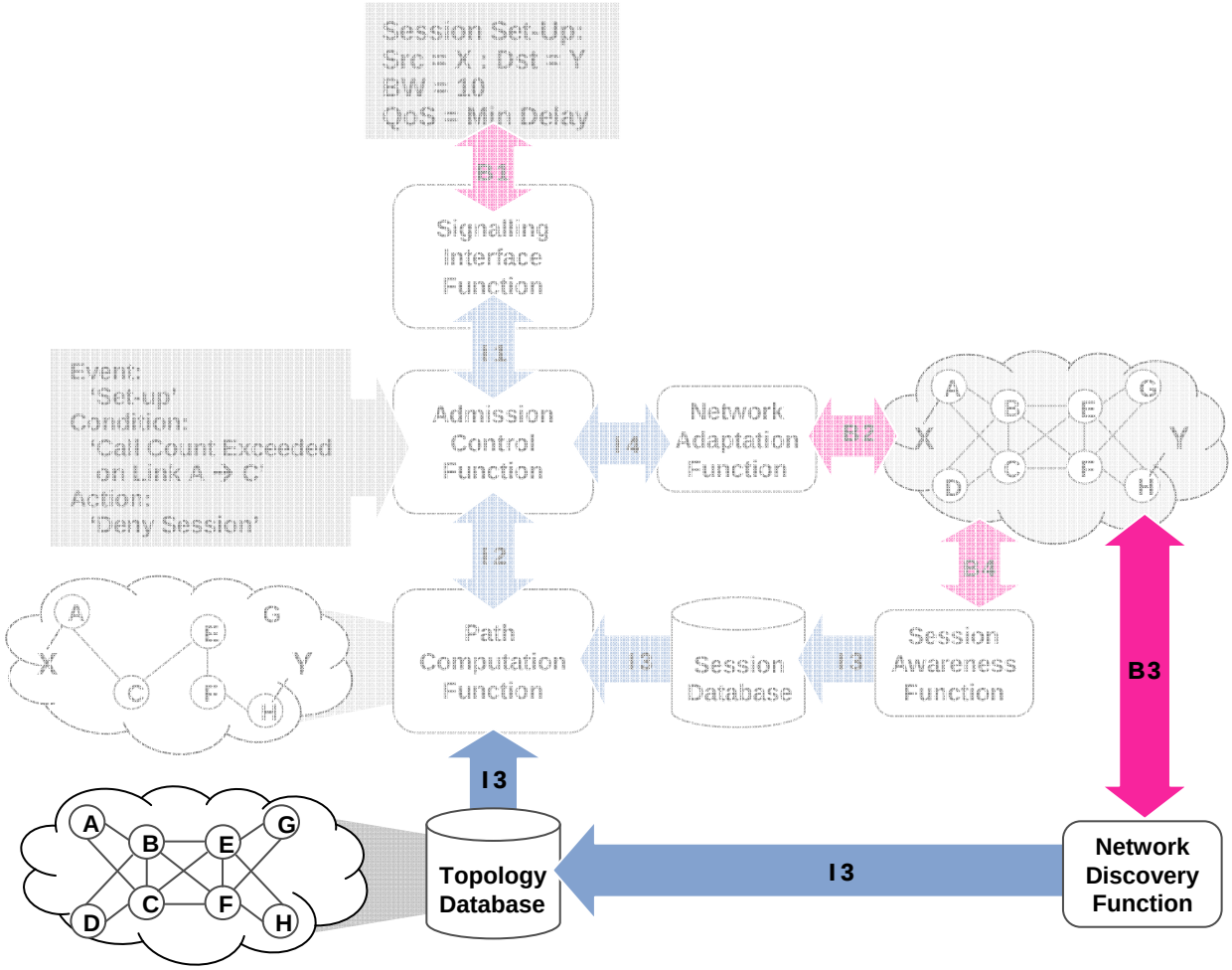
Cisco BPM: Carrier Class



Cisco BPM: Functional Architecture

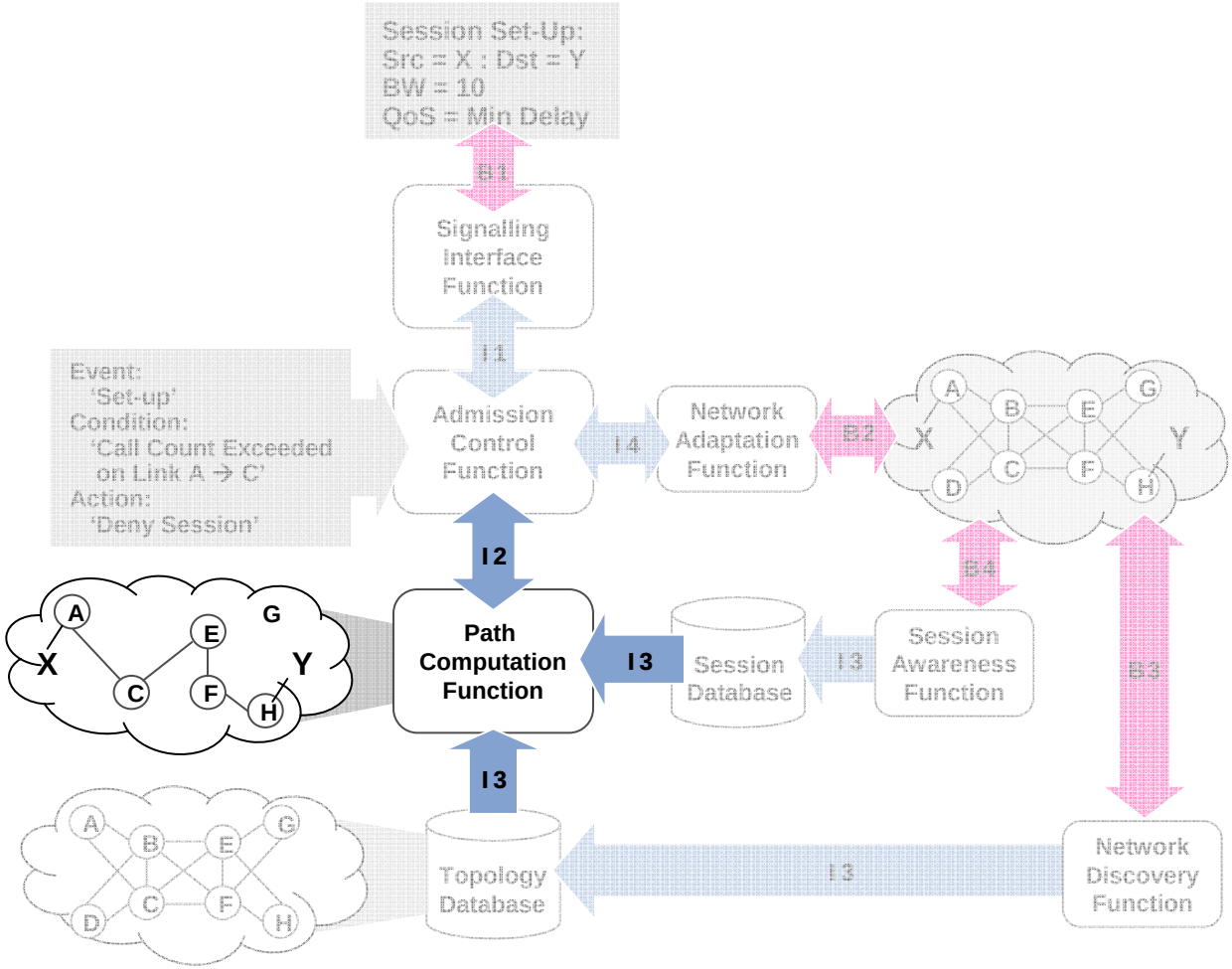


Cisco BPM:
Topology Discovery Function



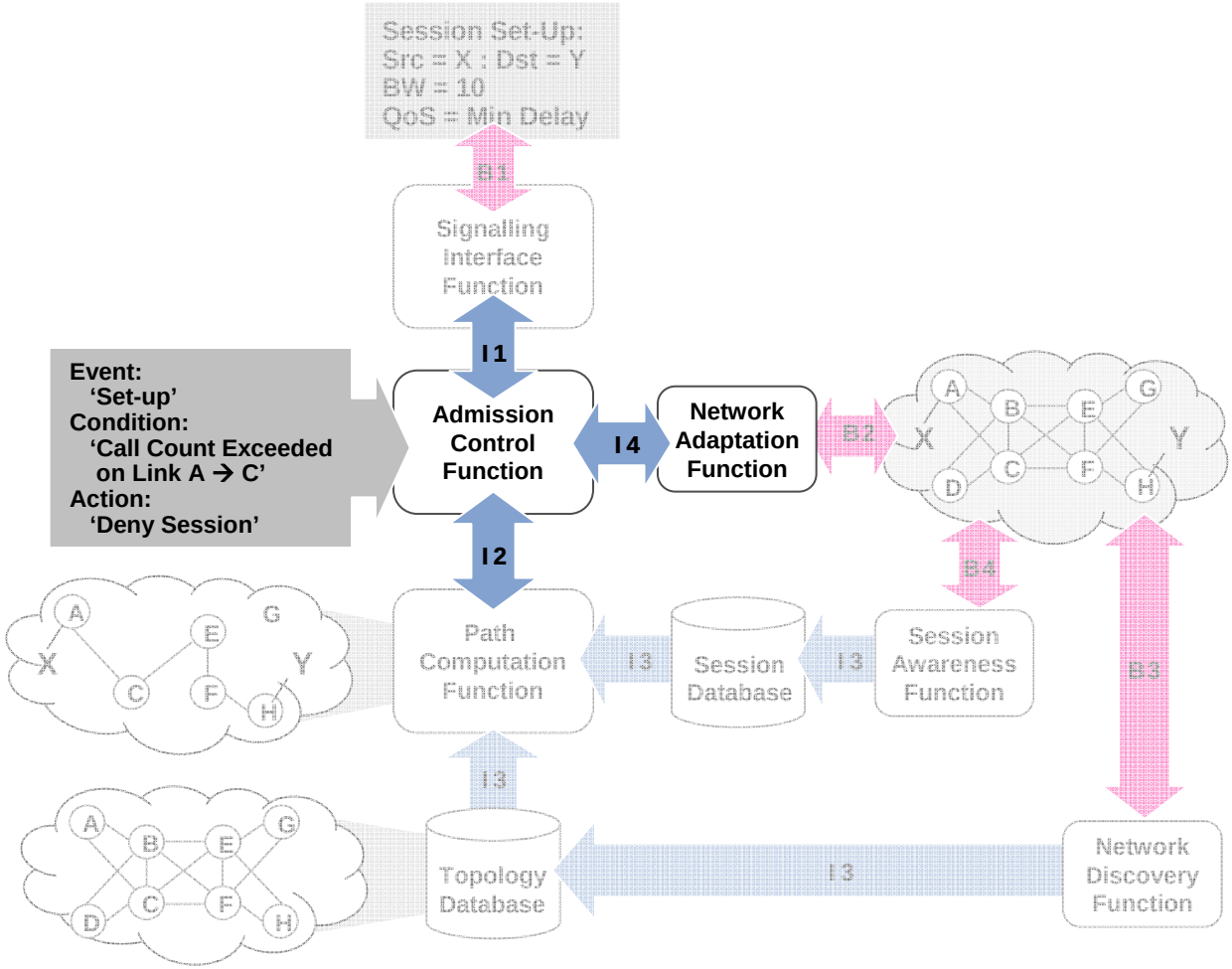
- Topology discovery agents depend upon specific deployment model
- Discovered topology may be an abstraction of the physical topology, e.g. TE tunnel topology
- Possible options:
  - Discovery: CLI, CDP, SNMP
  - External database: e.g. ISC:TEM for MPLS TE
  - Routing protocols: IGP, BGP
  - Provisioning System API
  - Manually configured

Cisco BPM:
Path Computation Function



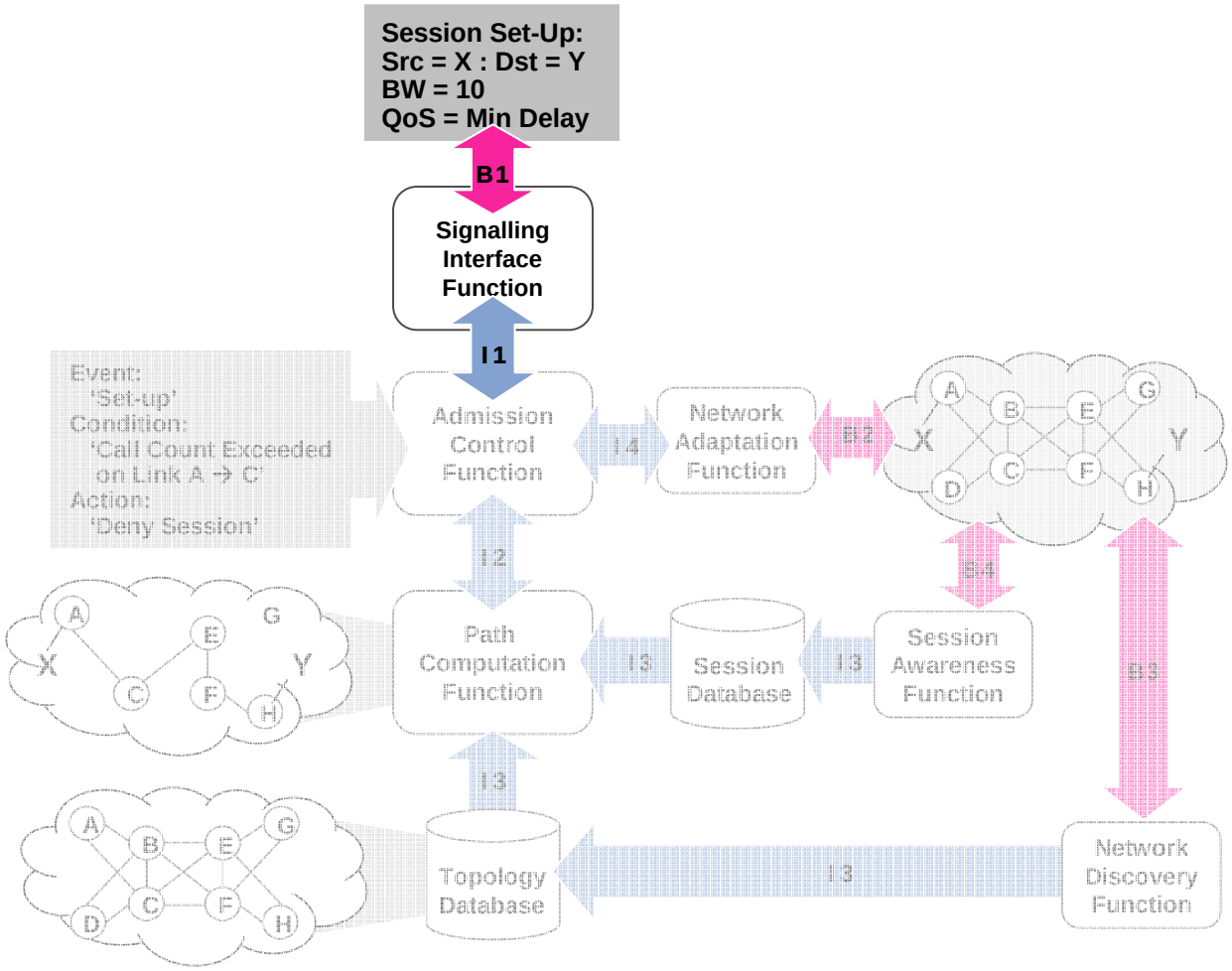
- Each CAC request is resolved to one or more underlying network components determined by one or more Path Computation Elements (PCE)
- PCE type/location depends upon the underlying network and resource management model
- An end-to-end CAC may require a combination of approaches
  - IGP
  - MPLS TE
  - Ethernet STP

Cisco BPM: Admission Control Function



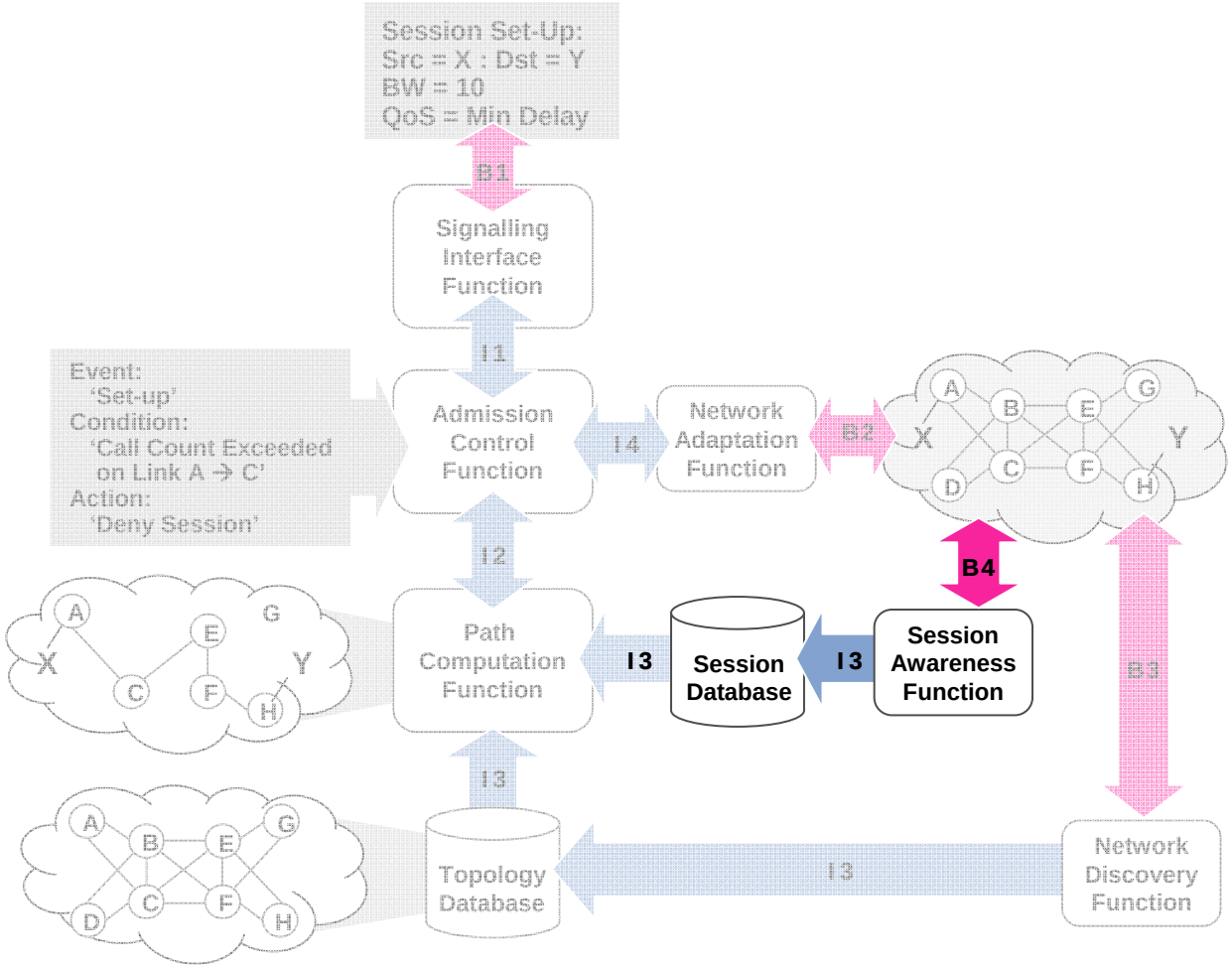
- Actual admission control decisions can be based upon a number of criteria and policies
  - Call counting
    - If current_calls + new_call < 8000, then PERMIT new_call
  - Bandwidth accounting
    - If accounted current_bw + new_call < 100Mbps, then PERMIT new_call
  - Bandwidth / utilization measurement
    - If measured current_utilisation + new_call < 75%, then PERMIT new_call

Cisco BPM: Application Interfaces



- Multiple standards being pursued in different forums
  - MSF – H.248
  - TISPAN – DIAMETER / Gq'
  - 3GPP – Gq, Rx, Rx+
- Some applications require direct interface to BPM
- Some applications interface indirectly via Policy Decision and Charging Rules functions

Cisco BPM:
Session Awareness Function

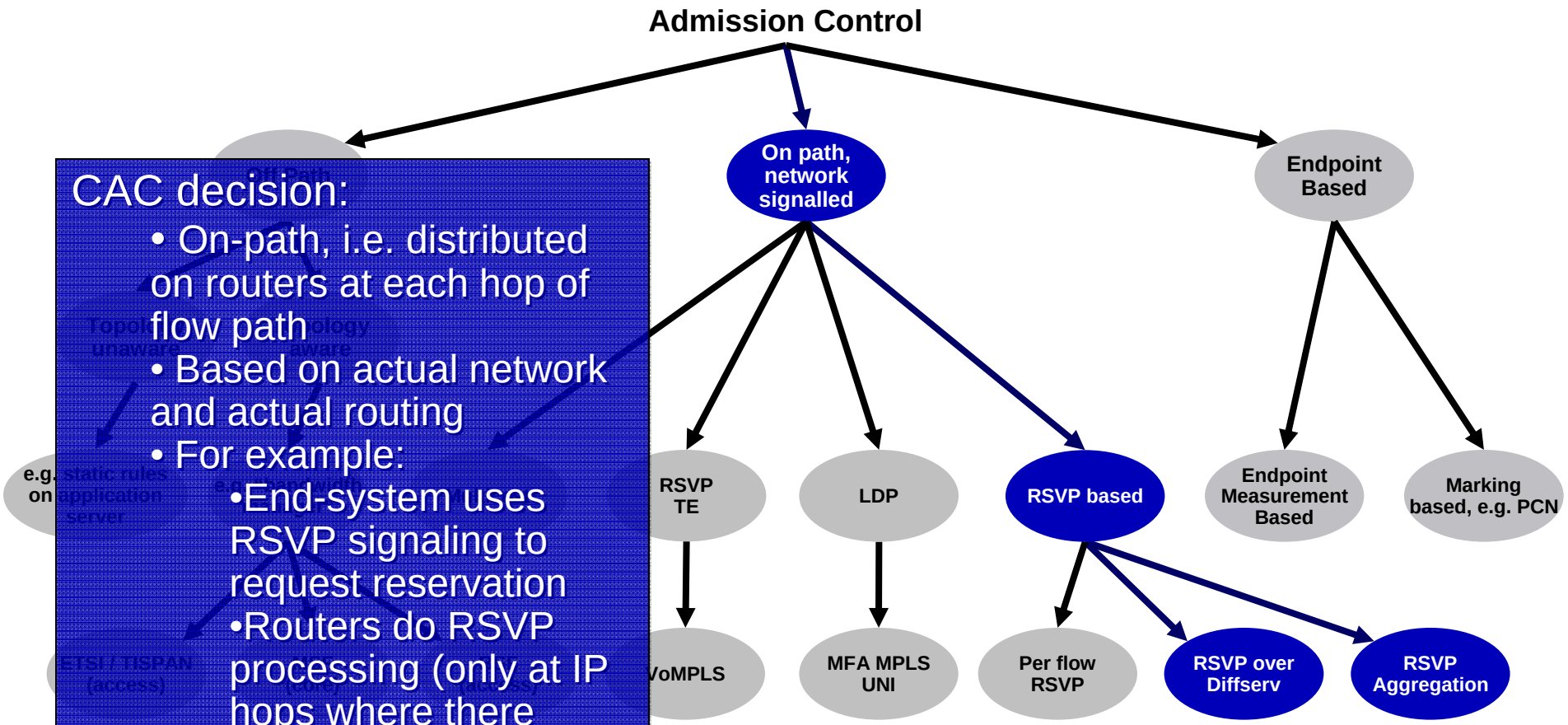


- Tracks in real time the bindings between users, IP addresses and network resources
- Supports
  - DHCP
  - PPP
  - API

Cisco BPM: Summary

- Industry leading off-path topology aware admission control system
  - Carrier-Class, Custom policy definition
- Supports the MSF bandwidth manager architecture and ESTI / TISPAN RACS
- Integrated part of Cisco's policy control solution
- Can support CAC for access and core, L2 and L3, IP and MPLS
- Can be applied to heterogeneous service environments
- Integrated with Cisco IP/MPLS core network solution

On-Path RSVP CAC

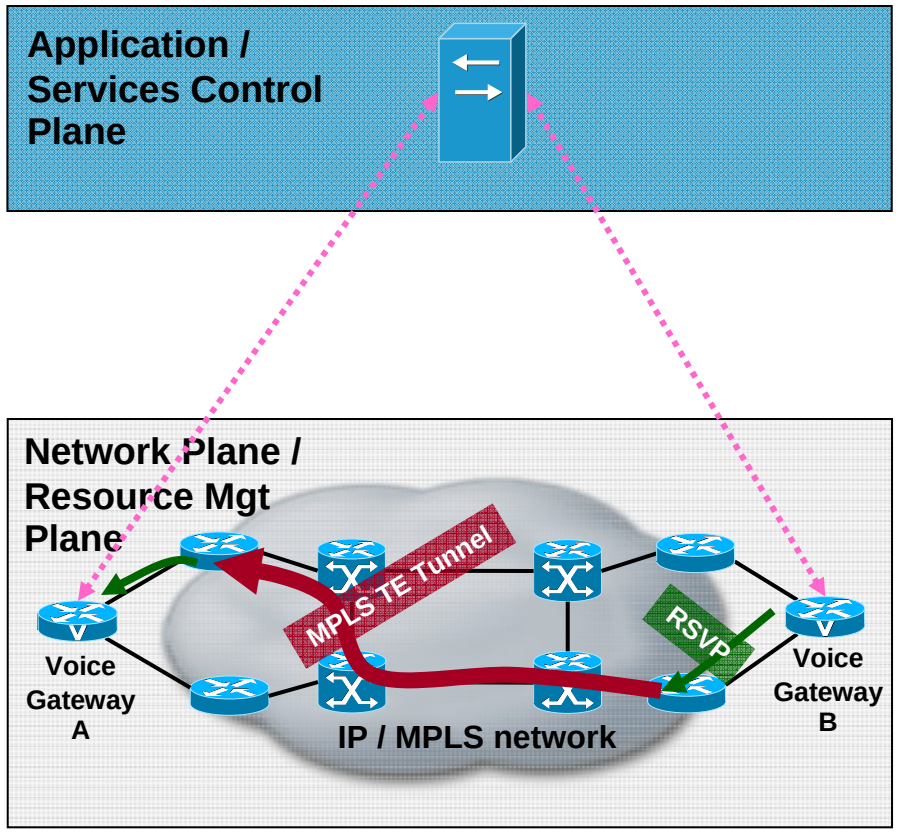


CAC decision:

- On-path, i.e. distributed on routers at each hop of flow path
- Based on actual network and actual routing
- For example:
  - End-system uses RSVP signaling to request reservation
  - Routers do RSVP processing (only at IP hops where there could be congestion)

On-Path RSVP CAC

- No external device modeling the network
- Resource Management is done by the network itself
- Can be applied to access and core, L3 today (and MPLS in next phase)
- Can be applied to heterogeneous service environments (Voice, Video,…)
- policy control will be integrated (in next phases) through ISG/RSVP integration

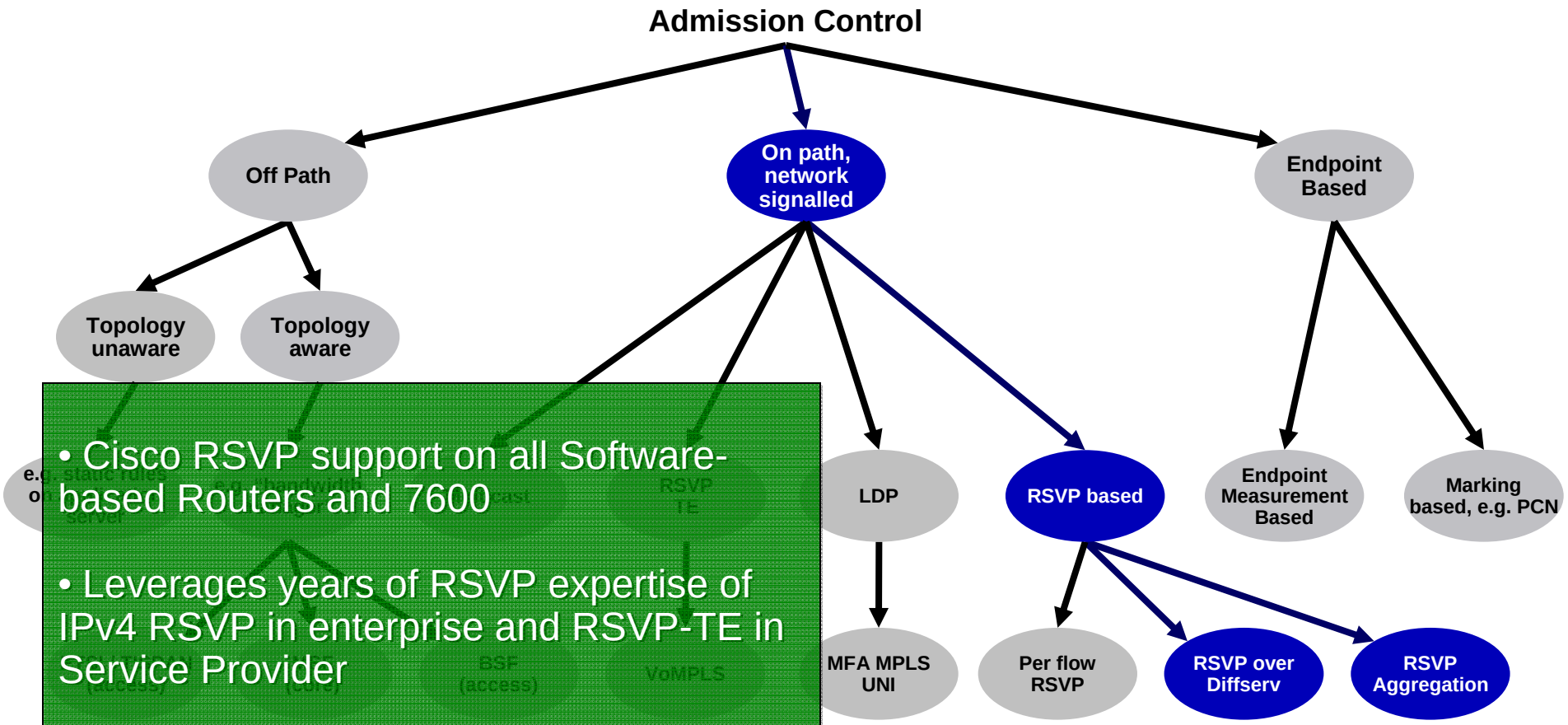


Resource Management Standards Status

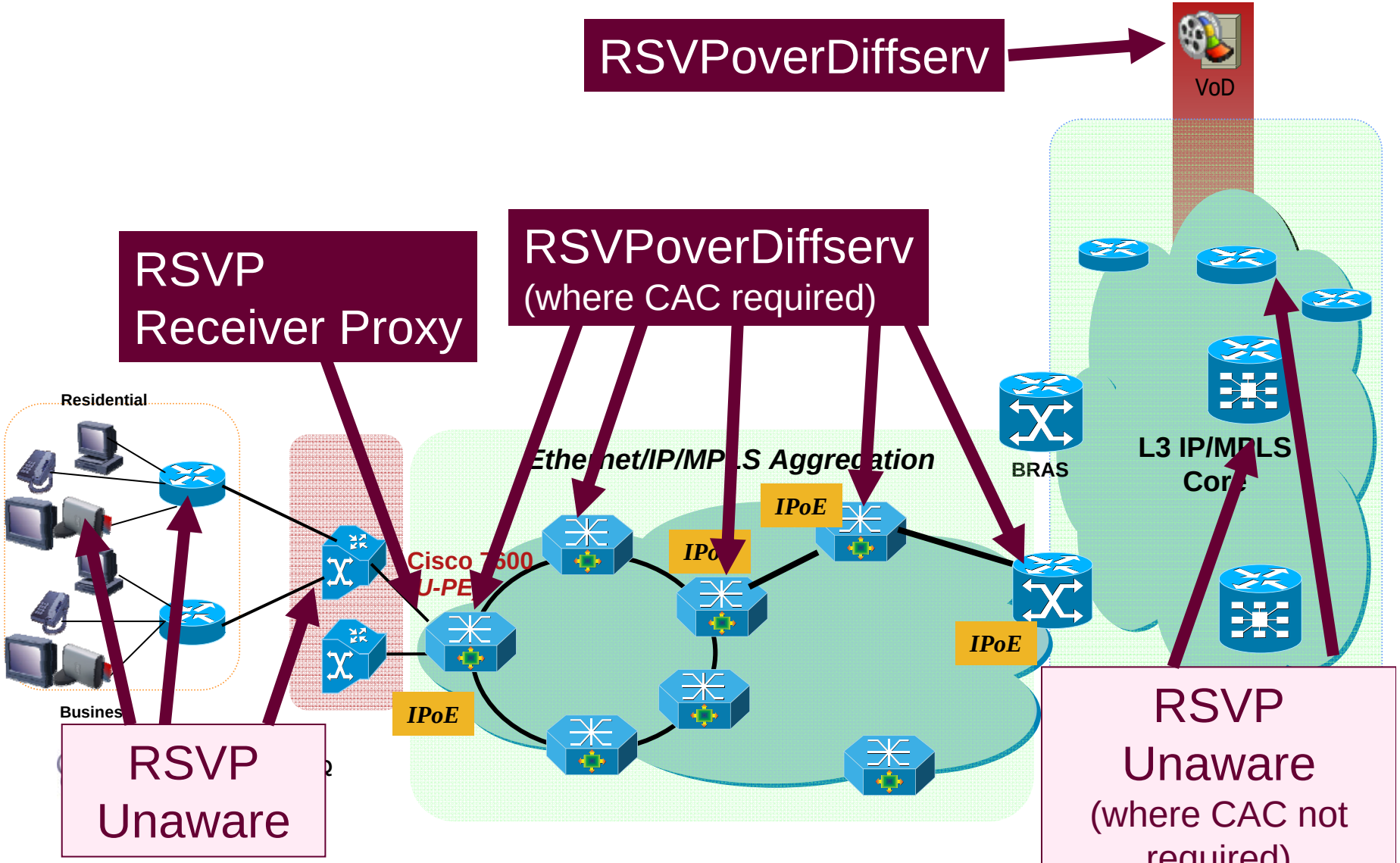
- Necessary RSVP extensions for IPTV & NGN being finalized in IETF
  - RSVP Proxy: draft-lefaucheur-tsvwg-rsvp-proxy

  See “Appendix A: RSVP-based VoD CAC in Broadband Aggregation Networks”
  - RSVP Aggregation over MPLS TE/DS-TE: draft-ietf-tsvwg-rsvp-dste
  - RSVP extensions for Emergency: draft-ietf-tsvwg-rsvp-emergency
- On-Path RSVP CAC now being considered/added into telco Standards bodies:
  - DSL Forum: incorporated in [WT-134]: Appendix A- Use Case describing On-Path CAC for VoD
  - ETSI TISPAN: contributions proposing specification of RSVP for VoD CAC in Rel 2 (which adds support for IPTV)
  - ITU [TR-RACS]: contributions proposing specification of RSVP for VoD CAC

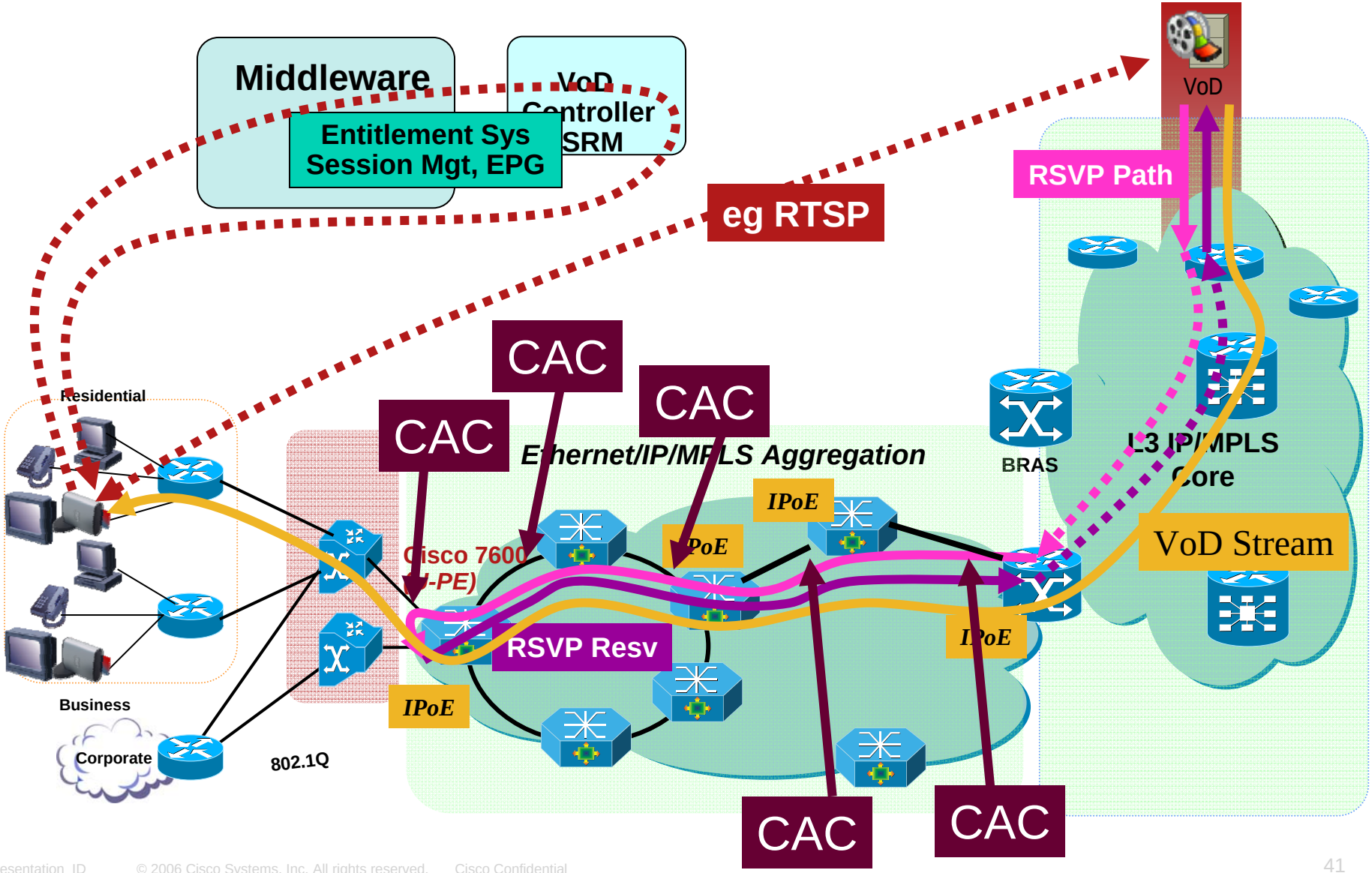
On-Path RSVP CAC



RSVP-based VoD CAC:
RSVP Components



RSVP-based VoD CAC:
Synchronization between RSVP and VoD Streaming



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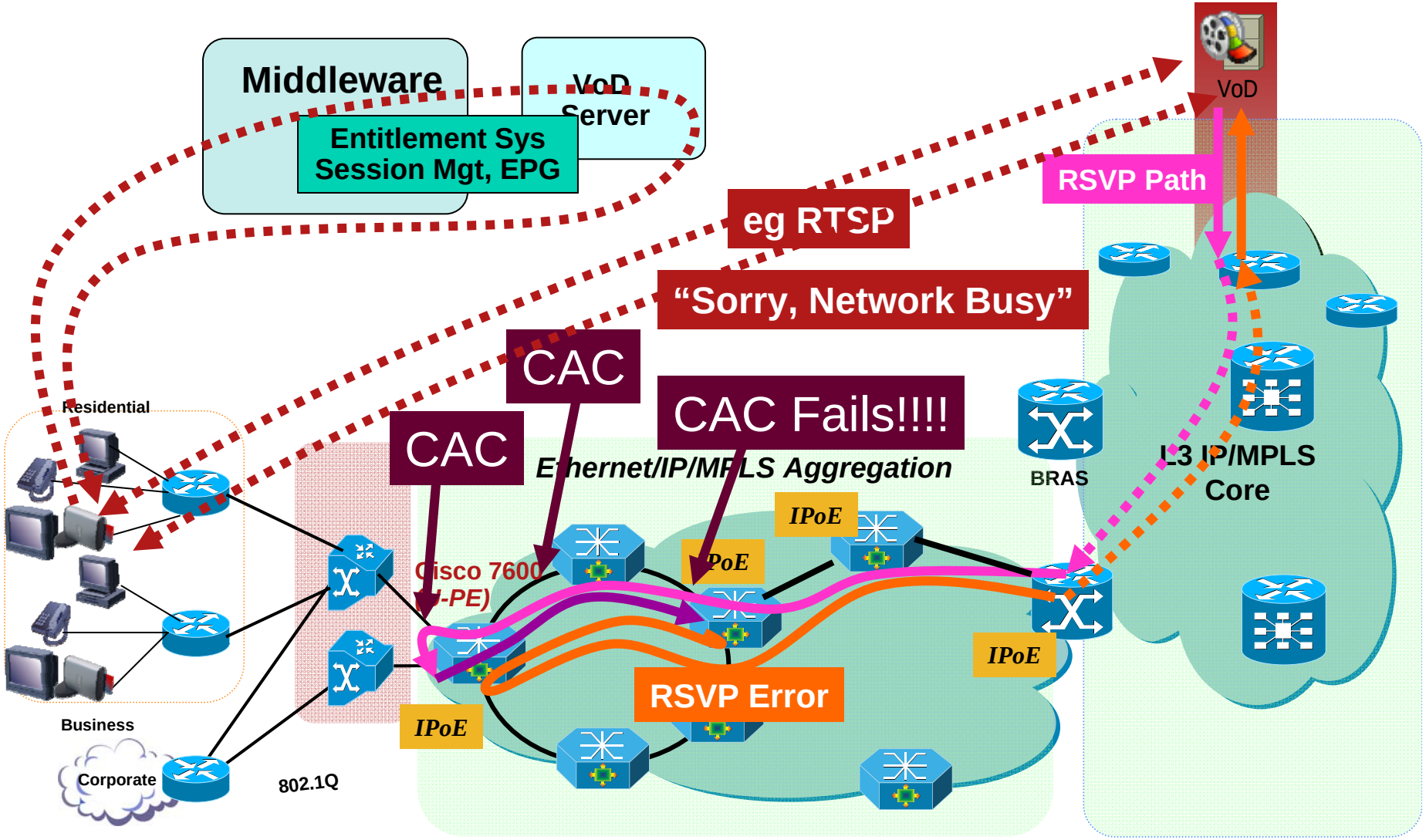
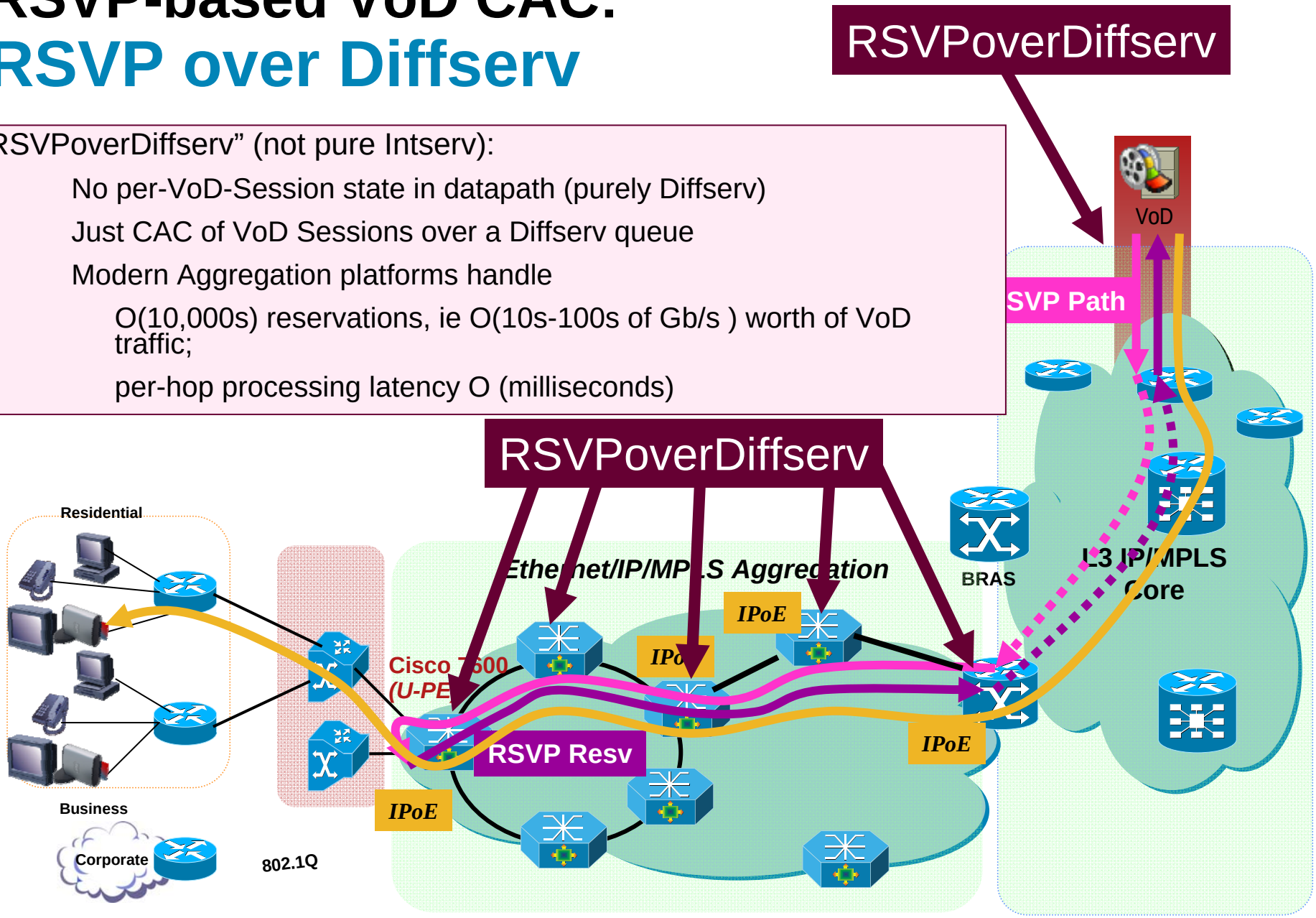


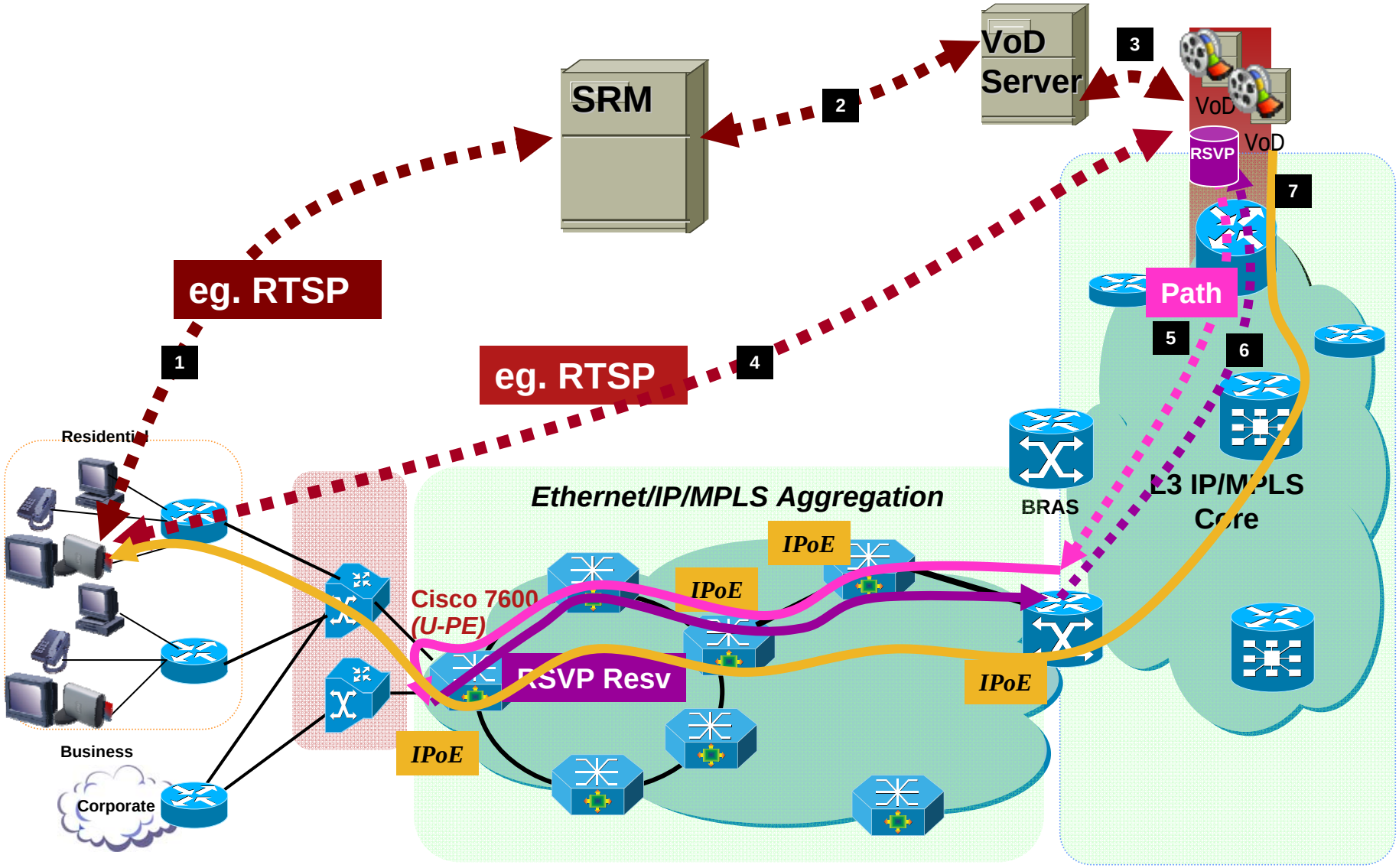
RSVP-based VoD CAC:
RSVP over Diffserv

"RSVPoverDiffserv" (not pure Intserv):

- No per-VoD-Session state in datapath (purely Diffserv)
- Just CAC of VoD Sessions over a Diffserv queue
- Modern Aggregation platforms handle
  - O(10,000s) reservations, ie O(10s-100s of Gb/s) worth of VoD traffic;
  - per-hop processing latency O (milliseconds)



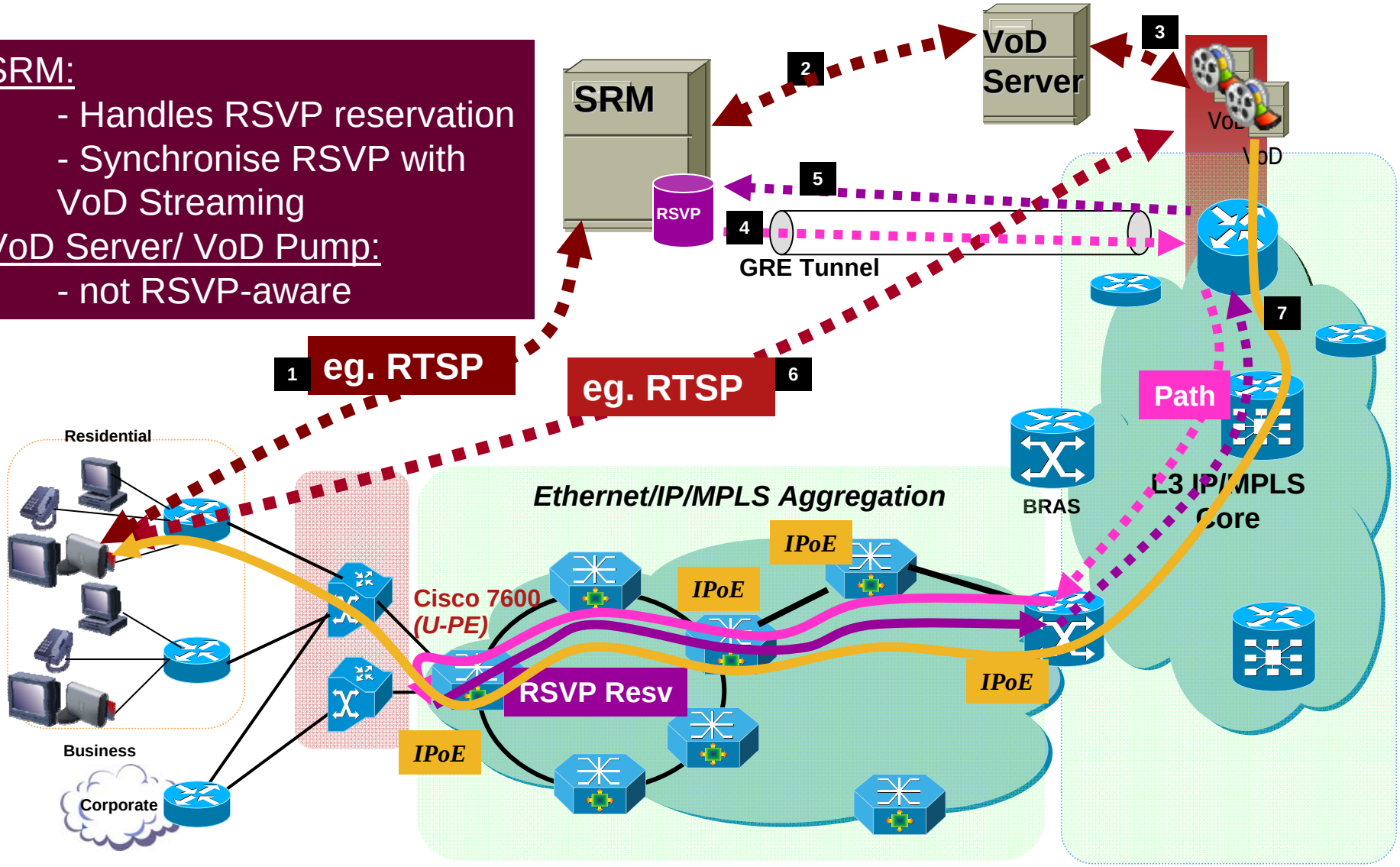
RSVP Support on VoD Gear
Option 1: RSVP on VoD Server/VoD Pump



RSVP Support on VoD Gear
Option 2: RSVP on SRM/VoD Server

SRM:
- Handles RSVP reservation
- Synchronise RSVP with VoD Streaming

VoD Server/ VoD Pump:
- not RSVP-aware



RSVP Implementation on VoD Gear

- Cisco cooperates with VoD vendors to help them implement RSVP:
  - -Detailed Tech Spec for RSVP Implementation on VoD Gear
  - -Face-to-face meetings to discuss RSVP implementation details
- BitBand: have RSVP implementation on VoD Pump
- iMake: have implemented RSVP on their SRM for deployment by European Triple Play provider
- Seachange & Kasenna: have our RSVP Spec, could implement when they get customer request
- EMEA Customer Bespoke SRM: Planning to add RSVP

RSVP-based VoD CAC:
Status and Roadmap

- Target Platform is 7600
- 12.2SXF:
  - RSVP over DiffServ
  - RSVP Refresh Reduction & RSVP Reliable Messaging
  - Flexible RSVP Receiver Proxy
  - Sender Notification by Proxy in case of CAC failure
  - RSVP Local Policy
  - Preemption
  - Can be used for Deployment with some restrictions (*)

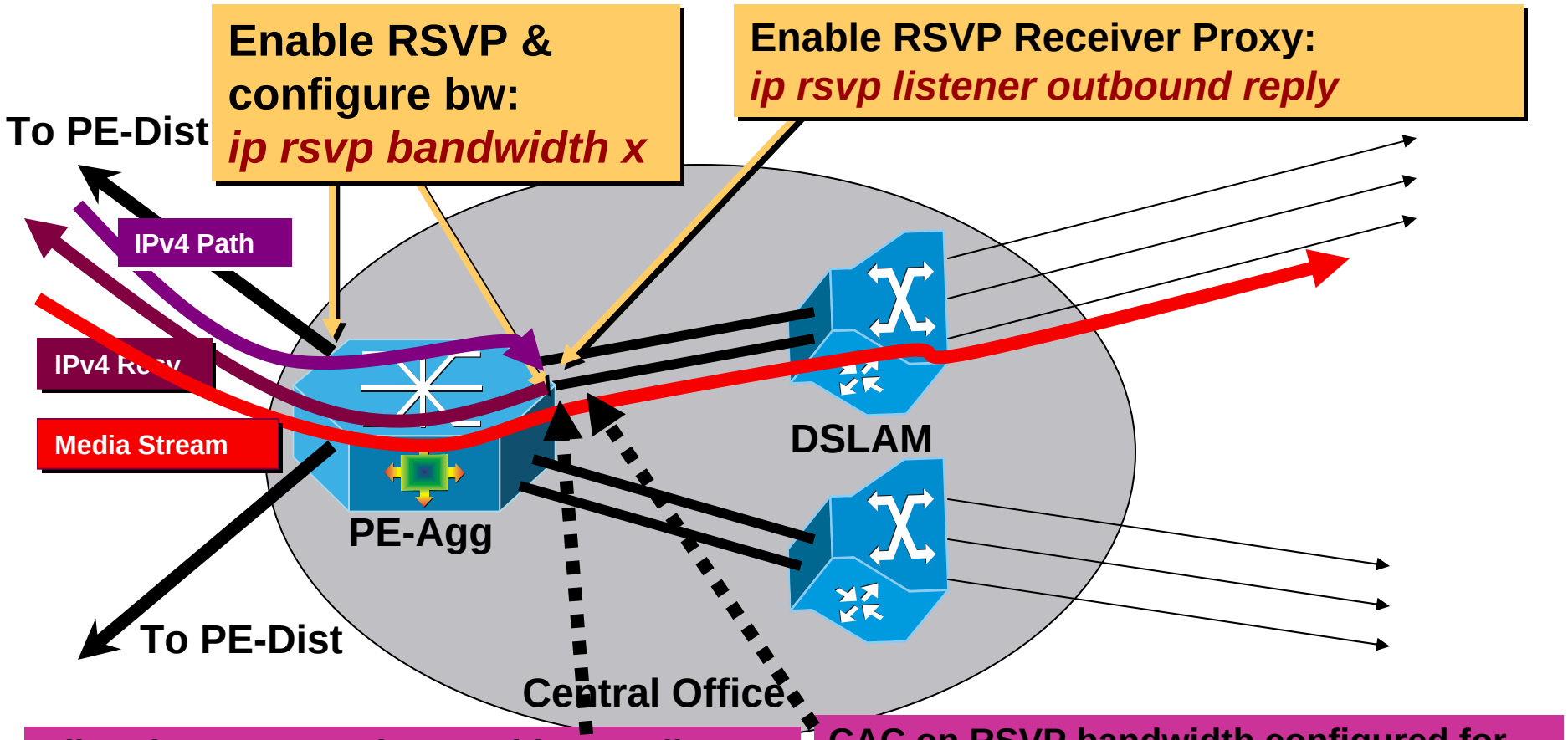
(*) Validate Design first

- 12.2 SRB:
  - RSVP Fast Local Repair (fast CAC recovery in case of link/node failure)
  - RSVP over ECMP
  - RSVP over Link Bundling (with dynamic bandwidth adjustments)
  - RSVP Local Policy Enhancement (Application-ID)
  - Recommended release for Deployment

RSVP-based VoD CAC: Status and Roadmap

- Next:
  - RSVP simultaneously with FRR
    - RSVP CAC for VoD with LinkP/NodeP for Business
  - TBAC (Tunnel Based Admission Control)
    - RSVP CAC over MPLS TE Tunnel
    - RSVP CAC for VoD with LinkP/NodeP for Business & VoD

RSVP and RSVP Receiver Proxy

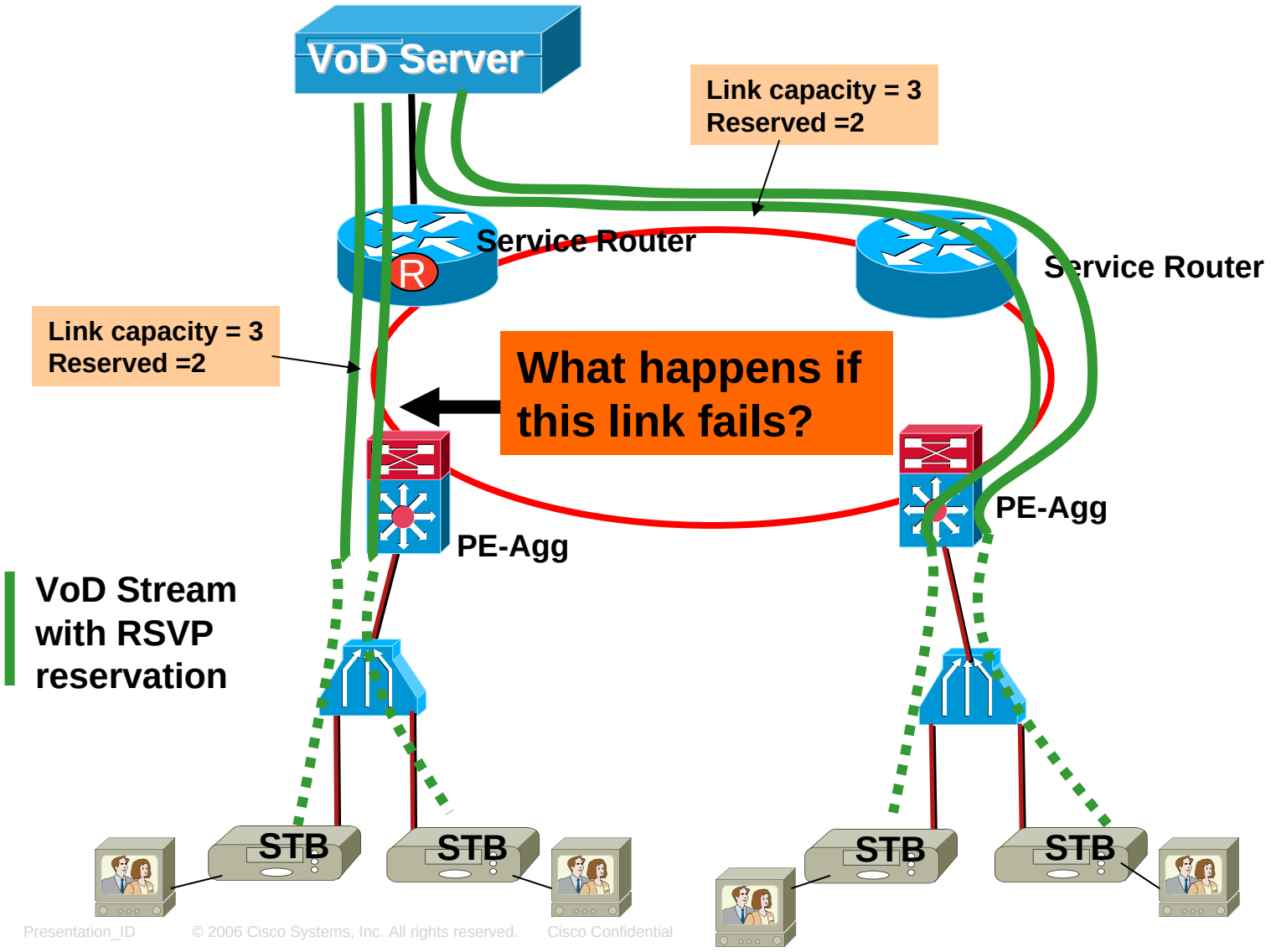


All Path messages that would normally egress on THAT interface are terminated. Resv message generated upstream which mirrors Path message parameters

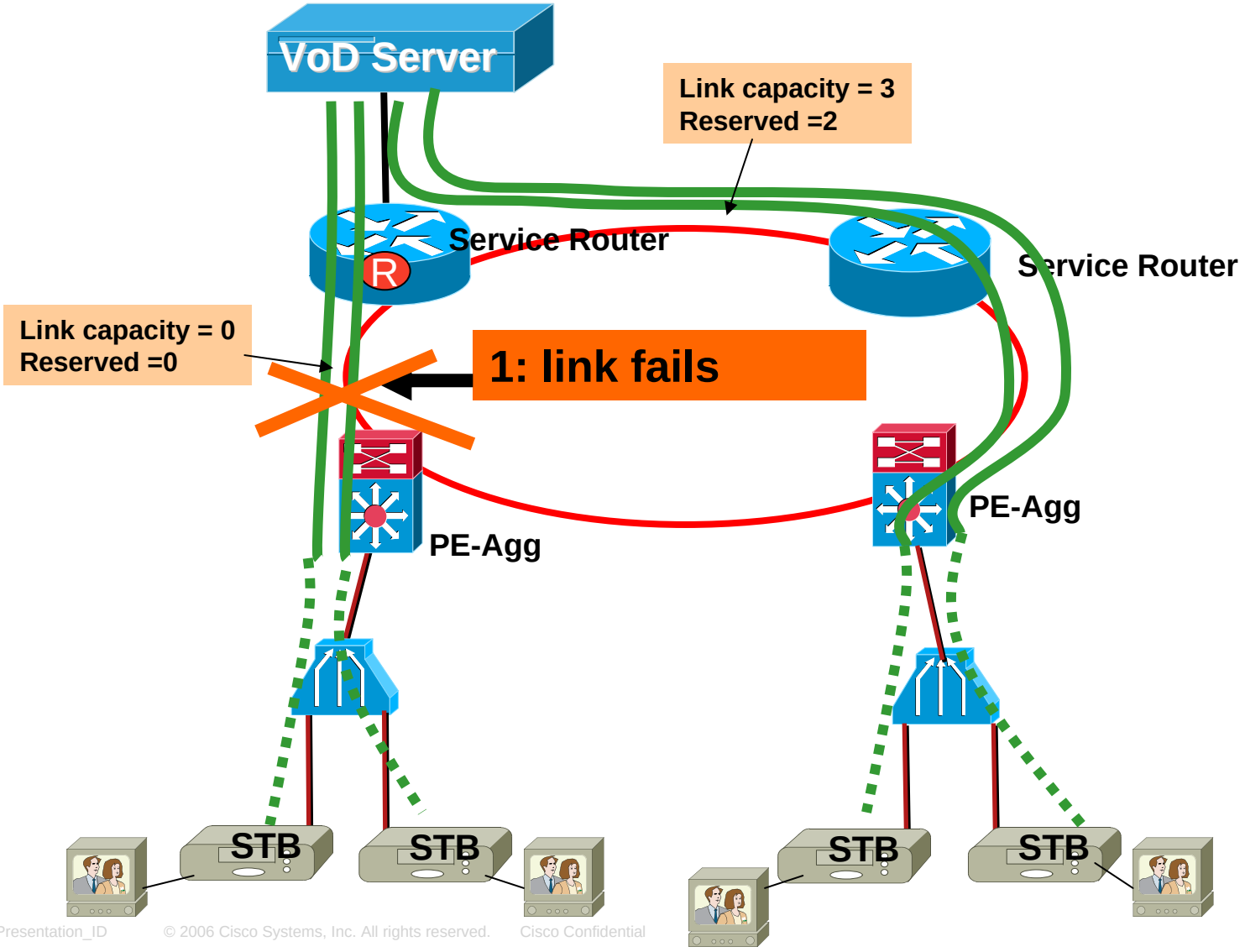
CAC on RSVP bandwidth configured for PE-Agg-->DSLAM link

VoD CAC RSVP

RSVP Fast Local Repair (FLR)



VoD CAC RSVP
RSVP Fast Local Repair (FLR)



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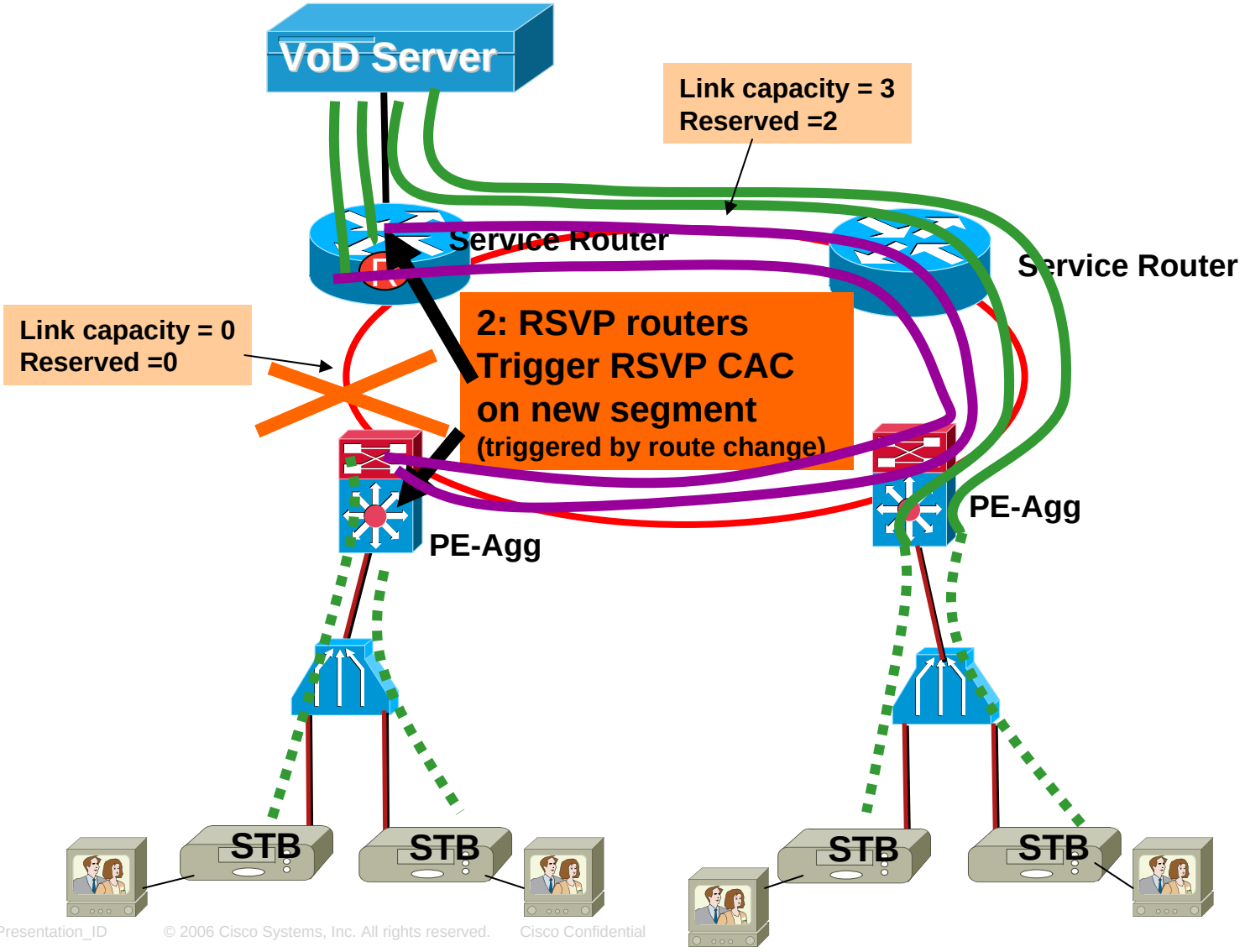
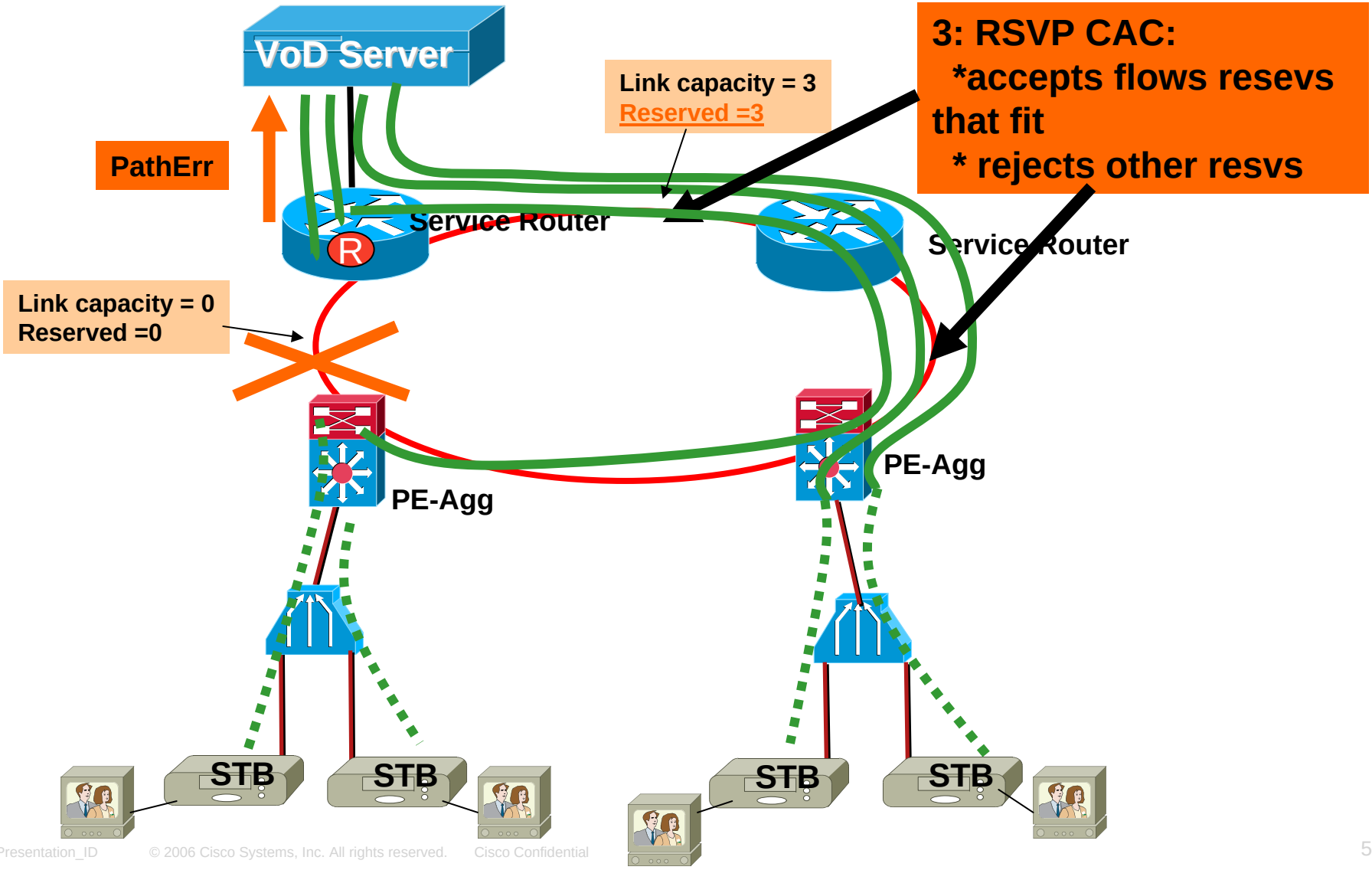
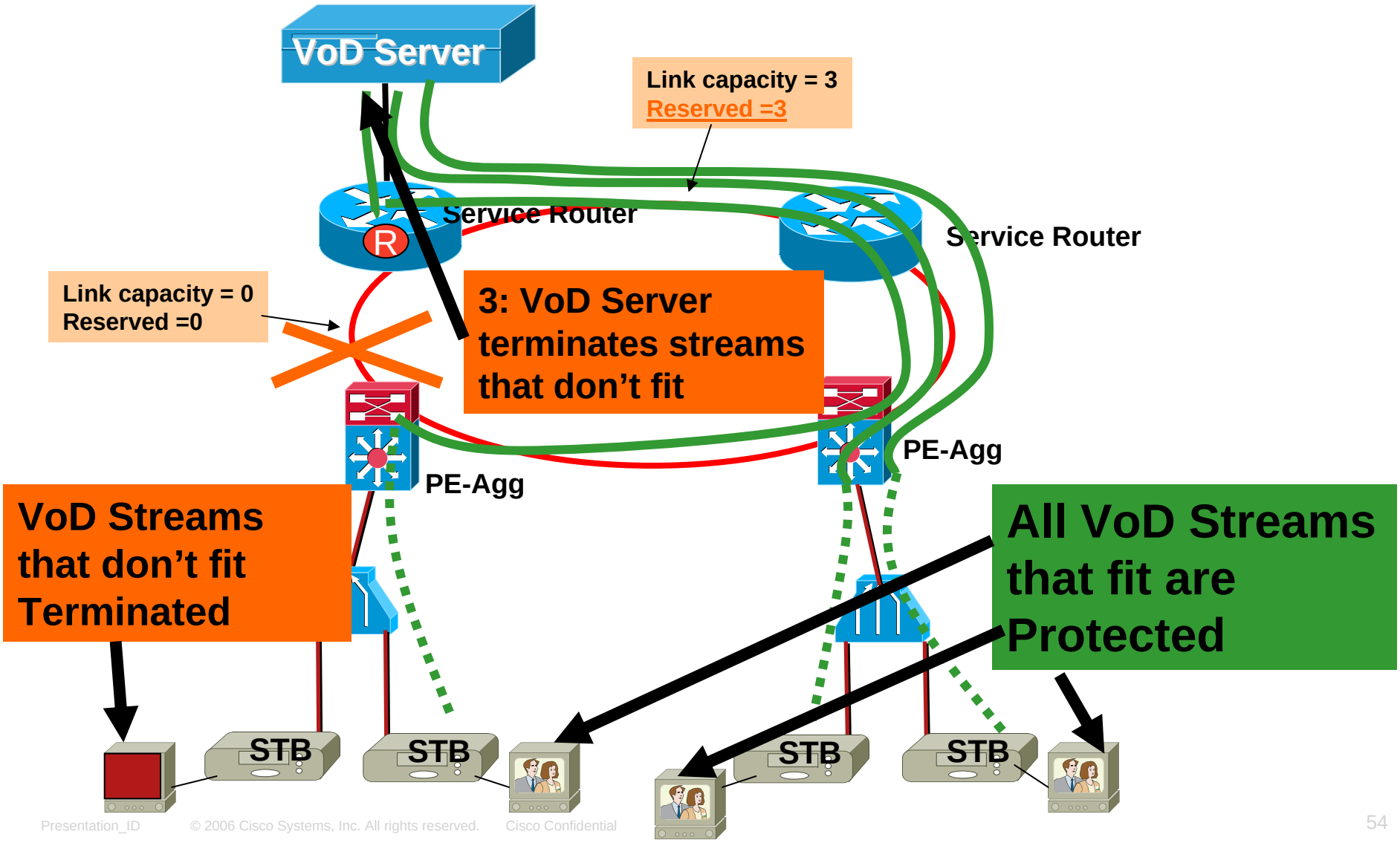


VoD CAC RSVP
RSVP Fast Local Repair (FLR)



VoD CAC RSVP
RSVP Fast Local Repair (FLR)



VoD CAC RSVP
RSVP Fast Local Repair (FLR)

- In the Absence of Failure:

  100% of capacity can be used to carry VoD streams

- In the Presence of Failure:

  Only VoD streams which (i) are affected by reroute and (ii) which no longer fit, are terminated

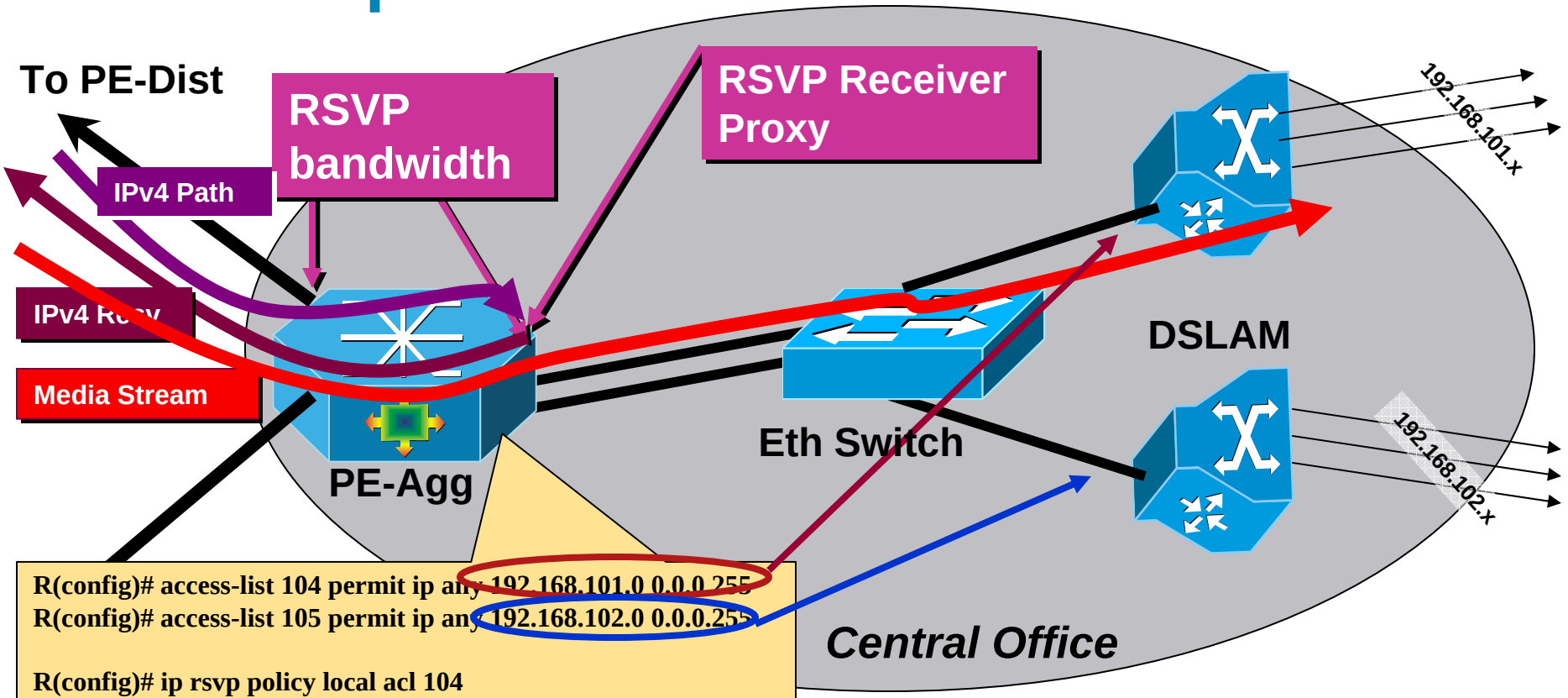
  All other VoD streams have their QoS protected

  100% of remaining capacity can be used to carry VoD

  Shorted-live QoS degradation only in the transient period during which all rerouted VoD streams are re-subjected to RSVP CAC (ie the “FLR Convergence Time”)

Close to optimum CAC behavior

RSVP Local Policy: per-DSLAM Uplink CAC in presence of L2 Switch




```
R(config)# access-list 104 permit ip any 192.168.101.0 0.0.0.255
R(config)# access-list 105 permit ip any 192.168.102.0 0.0.0.255

R(config)# ip rsvp policy local acl 104
R(config-rsvp-policy-local)# forward all
R(config-rsvp-policy-local)# maximum bandwidth group 600000
R(config-rsvp-policy-local)# maximum bandwidth single 4000
R(config-rsvp-policy-local)# end

R(config)# ip rsvp policy local acl 105
R(config-rsvp-policy-local)# forward all
R(config-rsvp-policy-local)# maximum bandwidth group 600000
R(config-rsvp-policy-local)# maximum bandwidth single 4000
R(config-rsvp-policy-local)# end
```

Works when separate address-pools are used per-DSLAM

On-Path RSVP VoD Summary

- Since RSVP message follow exact same path as flow, RSVP CAC :
  - Is Accurate in any arbitrary topology (ring, mesh, star, hub, chain,…)
  - Dynamically adjusts to reroute, failures, capacity increase
    - eg from Nx1GE to (N+1)x1GE, from Nx1GE to 10 GE
  - Is Completely independent of VoD Content Distribution
- RSVP CAC can cover all links in Aggregation
- RSVP CAC also covers DSLAM uplinks
- RSVP CAC brings a lot of value as soon as aggregation topology is non-trivial
- Requires VoD Transport over native IP or over LDP/Global (transport also over MPLS TE/VPN in next phases)

On-Path RSVP VoD Summary

- Reduced Capex: Maximum Utilization of bandwidth in Access & Aggregation
- Reduced Opex:

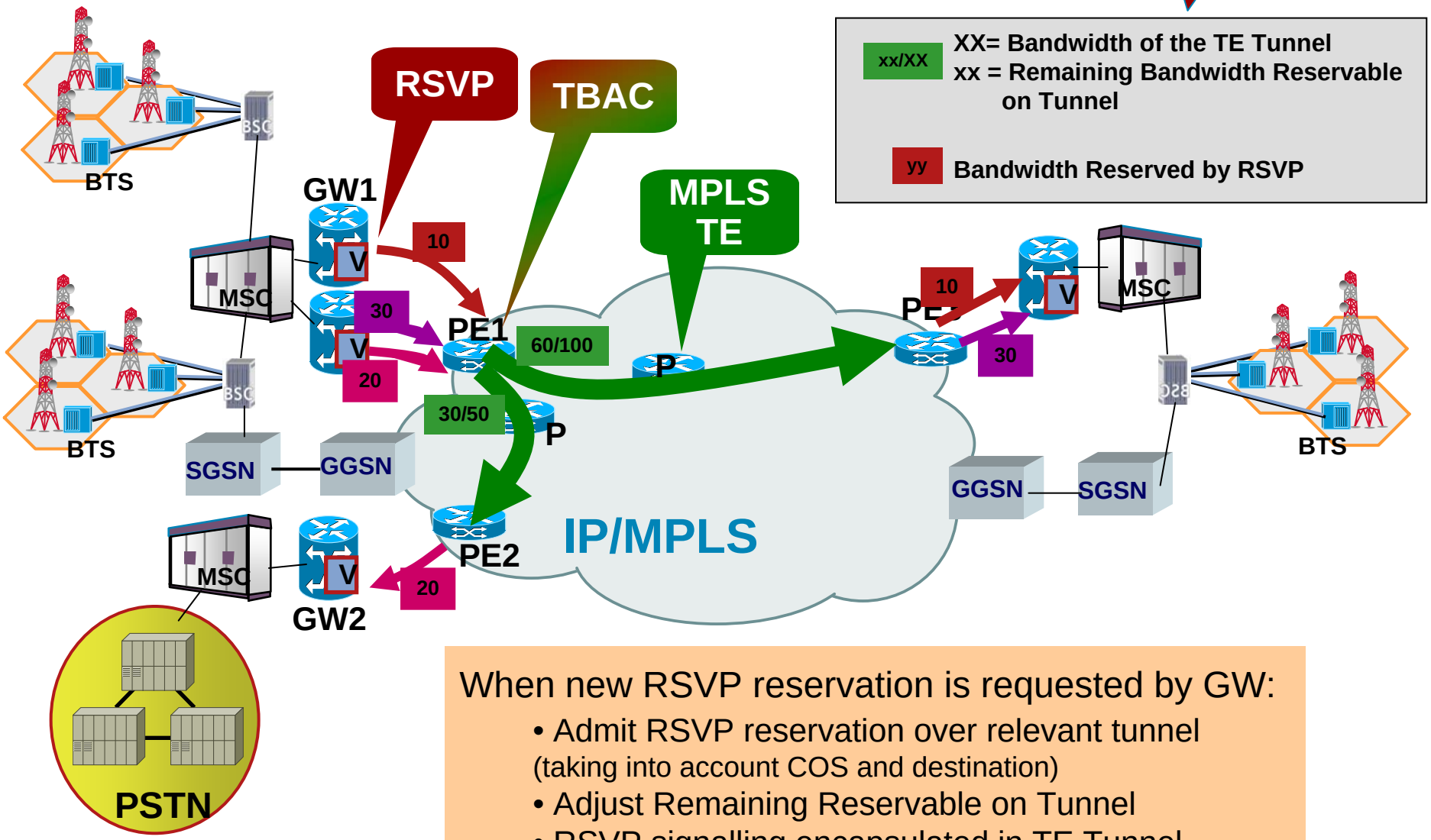
  Dynamically adjusts to reduced capacity, new capacity, changed VoD Content distribution, etc … without any CAC reconfiguration
- High Quality of Experience

  Very Fast reaction to network change →tight QoS guarantees
- Time to Market and Capex Reduction

  No Systems Integration

RSVP Aggregation over TE Tunnel
TBAC Feature (Tunnel Based Admission Control)

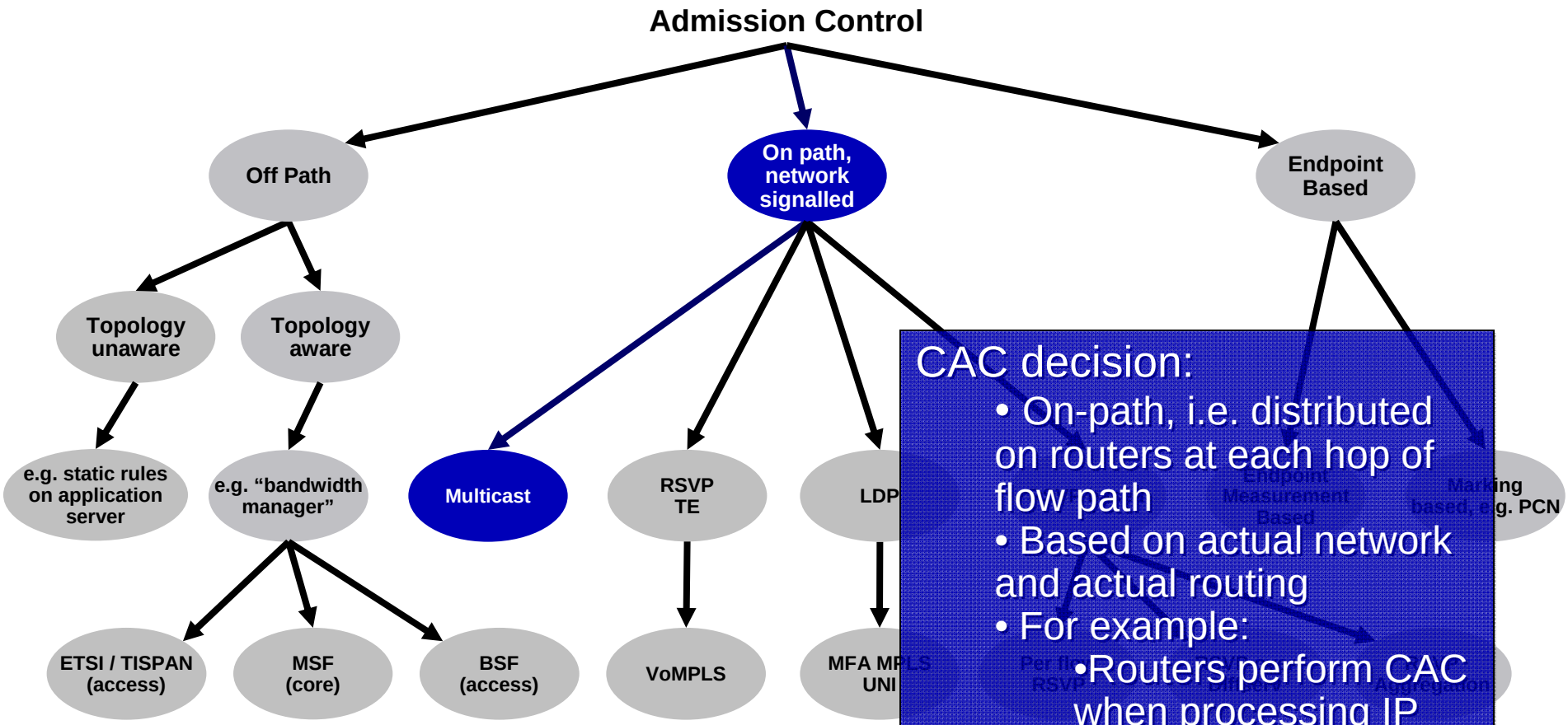
Future



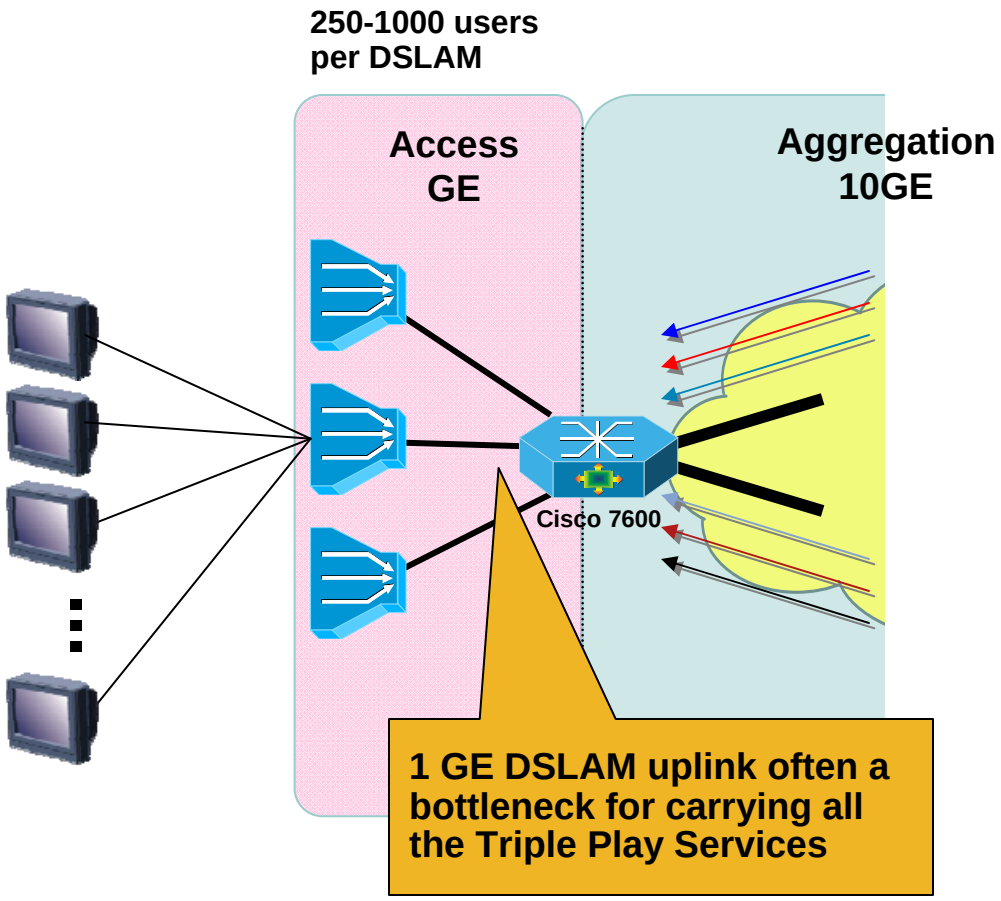
When new RSVP reservation is requested by GW:

- Admit RSVP reservation over relevant tunnel (taking into account COS and destination)
- Adjust Remaining Reservable on Tunnel
- RSVP signalling encapsulated in TE Tunnel

Multicast CAC



Multicast CAC Example Application:
Managing Oversubscription of DSLAM uplink



250 – 1000 end users need to be supported on a 1 Gbps DSLAM uplink.

Triple Play Services need to support 250 – 1000 users

1. - Voice : 2 IP phone connections per home
2. - Broadcast TV : 200 – 500 channels
3. - Data : Internet
4. VOD : 10 % users using VOD

If 250 homes on a single DSLAM are all watching a different channel, the total BW required for Broadcast video alone would be 250 x 4Mbps = 1Gbps!

Multicast CAC is the Solution to Manage Video Broadcast Oversubscription!

Cisco 7600 Multicast CAC
(Single) Per Interface IGMP State Limit

MCAC Use Case Phase 1 (Switched Digital Video)

1. Say the total number of SDTV channels offered by a Service Provider is 300.

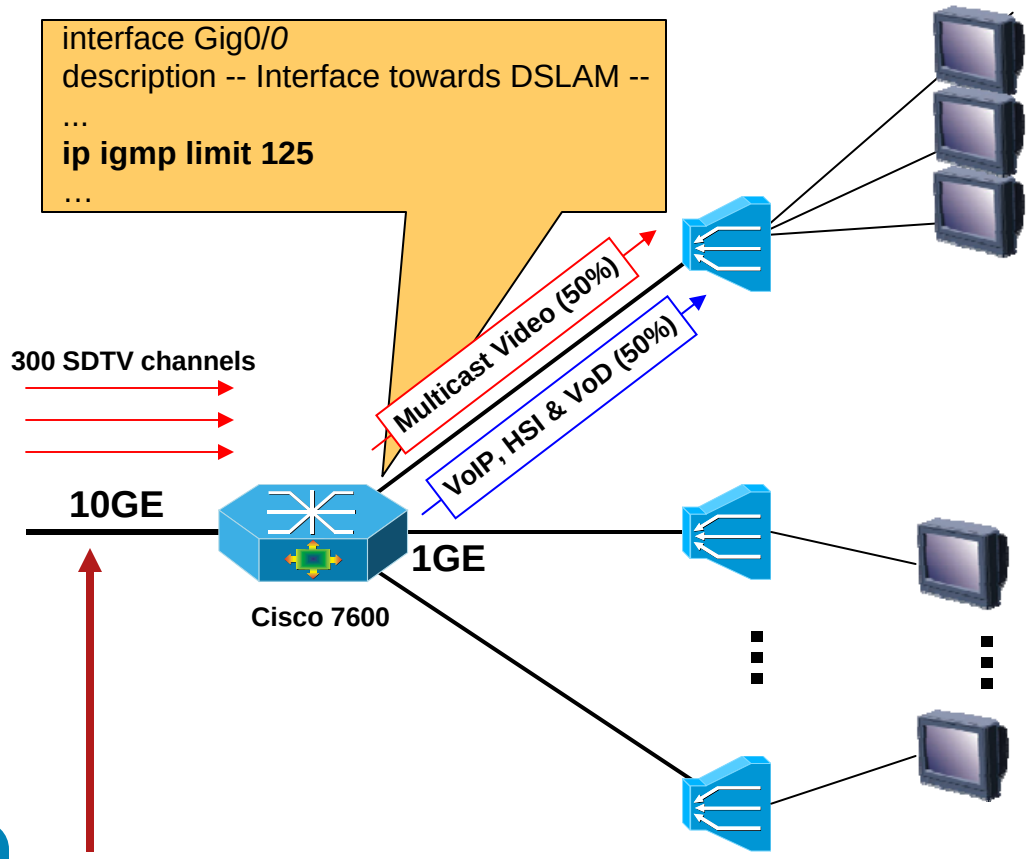
2. Each SDTV channel is approximately 4Mbps.

3. 50% of each outgoing 1Gbps link (500Mbps) needs to be provisioned for Broadcast TV leaving the remaining 50% for Voice, Internet & VoD.

4. The required CAC needed per interface comes out to: 500Mbps/4Mbps = 125 mroutes

When limit is reached, router does not honor a new join
No explicit CAC-reject notification sent to user ➔black screen

Cisco IOS® IGMP State Limit



300 channels offered

300 channels x 4Mbps = 1.2Gbps

Cisco 7600 Multicast CAC
(Multiple) Per Interface Mroute State Limits

MCAC Use Case Phase 2

1. Say the total number of SDTV channels offered by a Service Provider is 300.

2. Each SDTV channel is ca. 4Mbps.

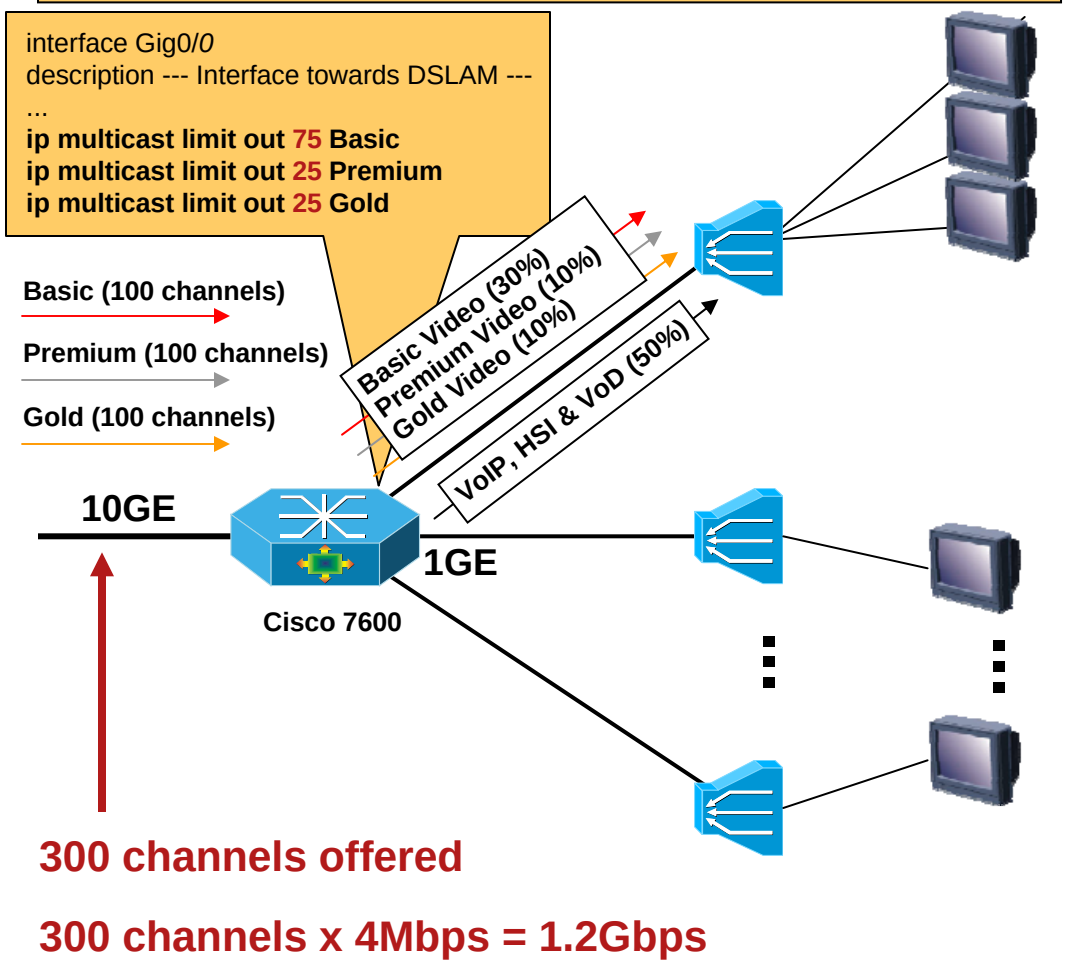
3. Service Provider will offer three TV bundles (Basic, Premium, Gold). Each bundle will have 100 channels.

4. 50% of each outgoing 1Gbps link (500Mbps) needs to be provisioned for Broadcast TV leaving the remaining 50% for Voice, Internet & VoD.

5. Within this provisioned 50%:
   - 60% will be for Basic (300Mbps)
   - 20% will be for Premium (100Mbps)
   - 20% will be for Gold (100Mbps)

6. The required CAC needed per interface comes out to:
   - Basic mroute limit = 300/4 = 75
   - Premium mroute limit = 100/4 = 25
   - Gold mroute limit = 100/4 = 25

Cisco IOS® Per Interface Mroute State Limit
with support for ingress, egress, PIM/IGMP, ASM/SSM



300 channels offered

300 channels x 4Mbps = 1.2Gbps

Cisco 7600 Multicast CAC

Cost factor for per-interface Mroute State Limits

MCAC Use Case Phase 3

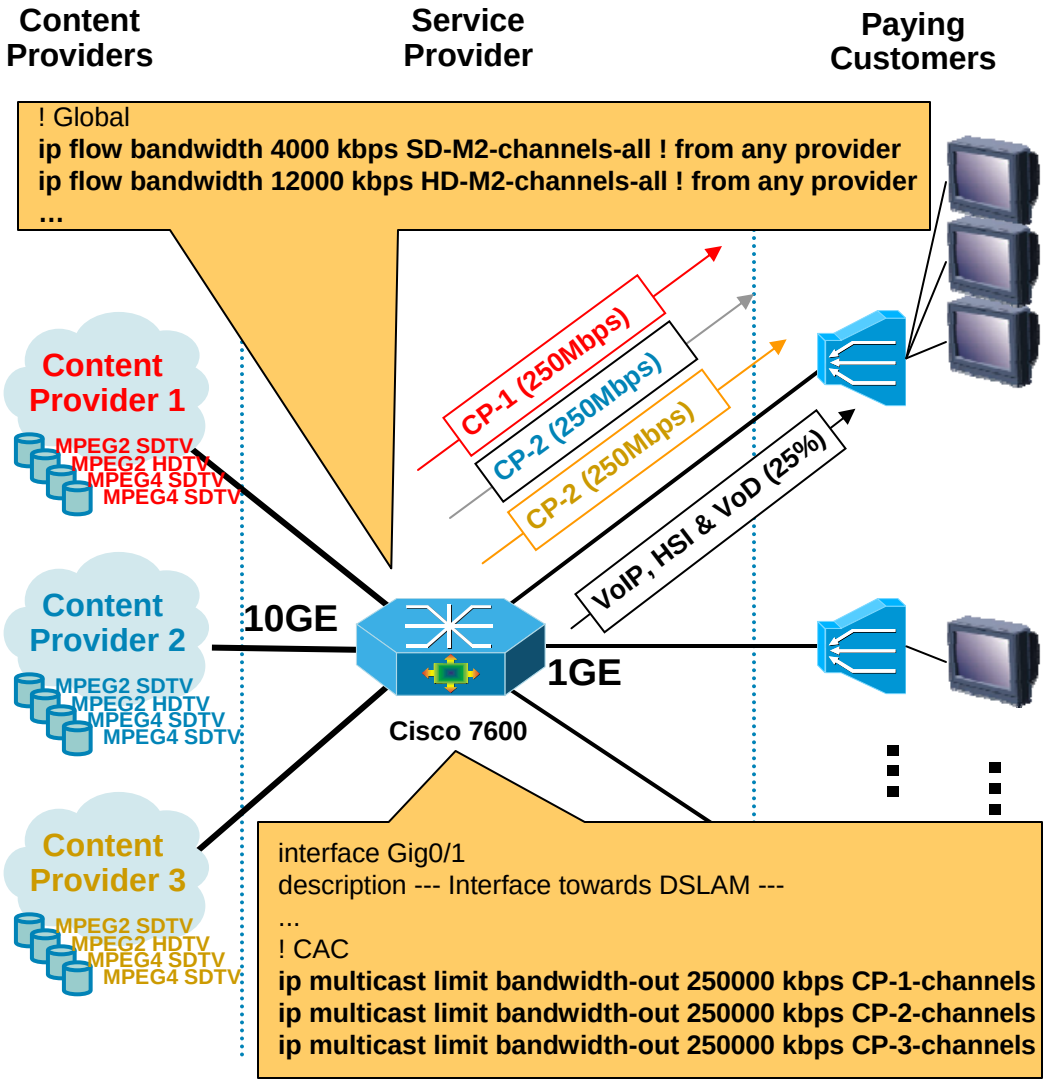
1. Consider the following. Three Content Providers (CPs) are providing multicast content.

2. Multiple CP will have TV programs w/ different BW:
   - MPEG2 SDTV: 4 Mbps
   - MPEG2 HDTV: 12 Mbps
   - MPEG4 SDTV: 1.6 Mbps
   - MPEG4 HDTV: 6 Mbps

3. Service Provider (SP) would like to provision fair sharing of bandwidth between these three content providers to its consumers across 1Gbps links.

4. 250Mbps for each CP, 250 Mbps for Voice/Internet/VoD.

5. Simple extension of multicast limits: global cost factor config.



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- **Requirements and Business Case**
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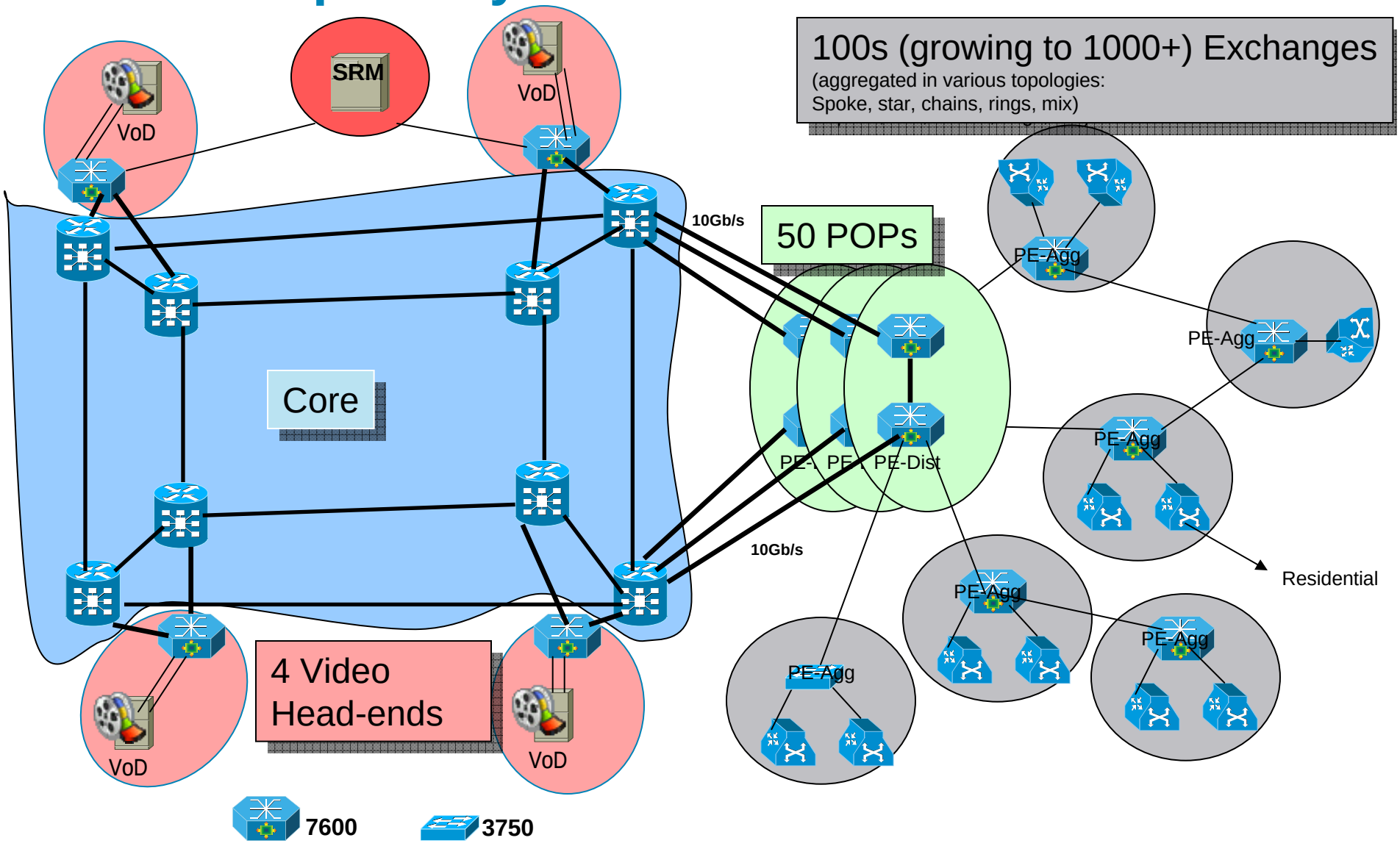
- **Case Studies**
  - **Triple Play Provider: RSVP VoD CAC**
  - **Residential Broadband: BPM CAC for Voice and VoD**
  - **PSTN Replacement: BPM CAC for Voice**
  - **Mobile Phone Trunking: RSVP Aggregation over MPLS TE**
- **Conclusions**

Case Study
EMEA Triple Play Provider: RSVP VoD CAC

- 10 Gig/s National Core
- Extending own DSL Access Network via Local Loop Unbundling
- Upgrading Aggregation Network to cope with growth and new Triple Play services:
  - Metro links are a very important part of overall cost
  - RSVP VoD CAC on 7600 allows controlled capacity planning and hence provides key savings
- VoD Service from 4 Video Head-ends
- Centralized Highly-Resilient Session Resource Manager (SRM)
- RSVP signaling handled by SRM

Case Study
EMEA Triple Play Provider: RSVP VoD CAC



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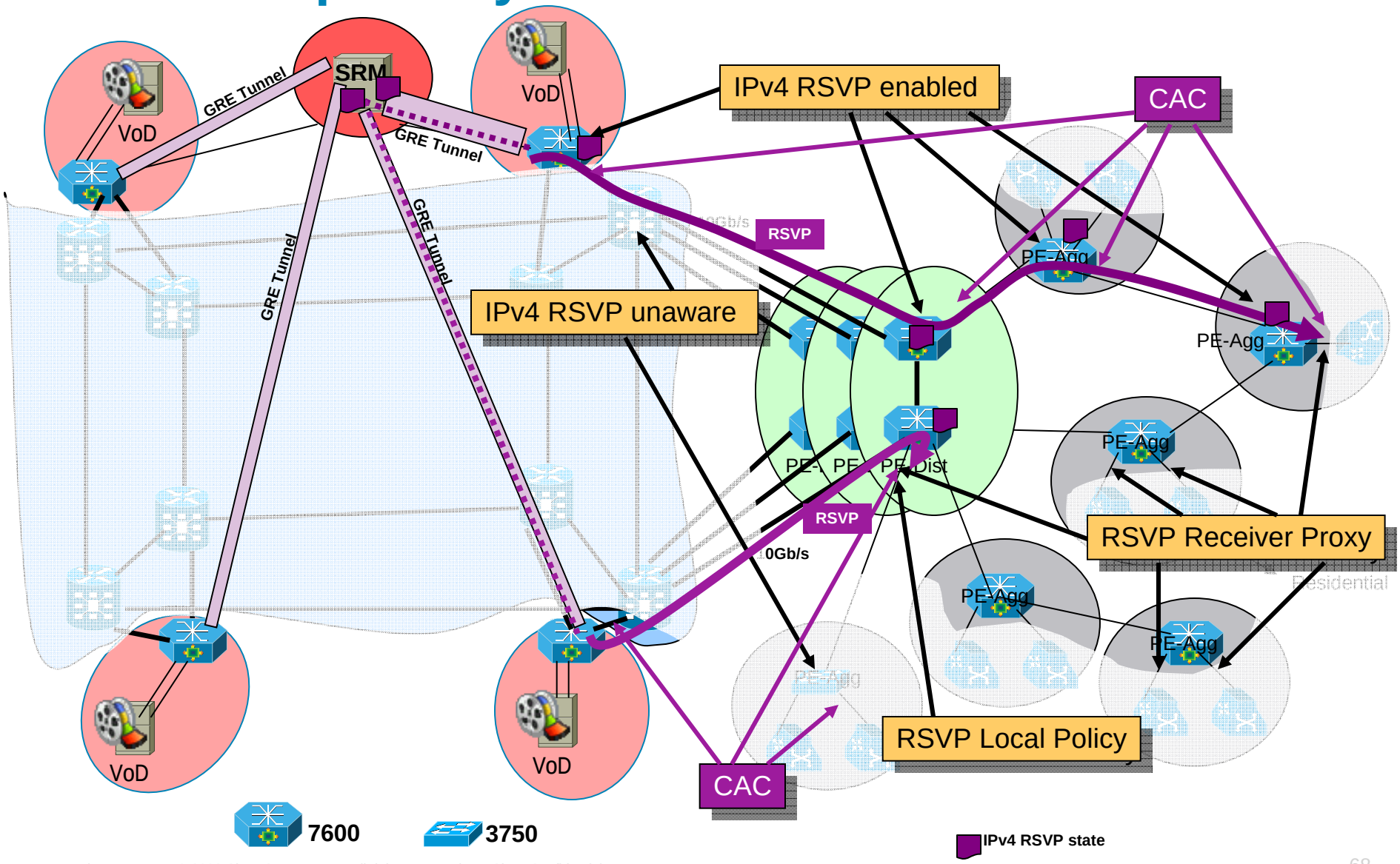


Case Study
EMEA Triple Play Provider: RSVP VoD CAC

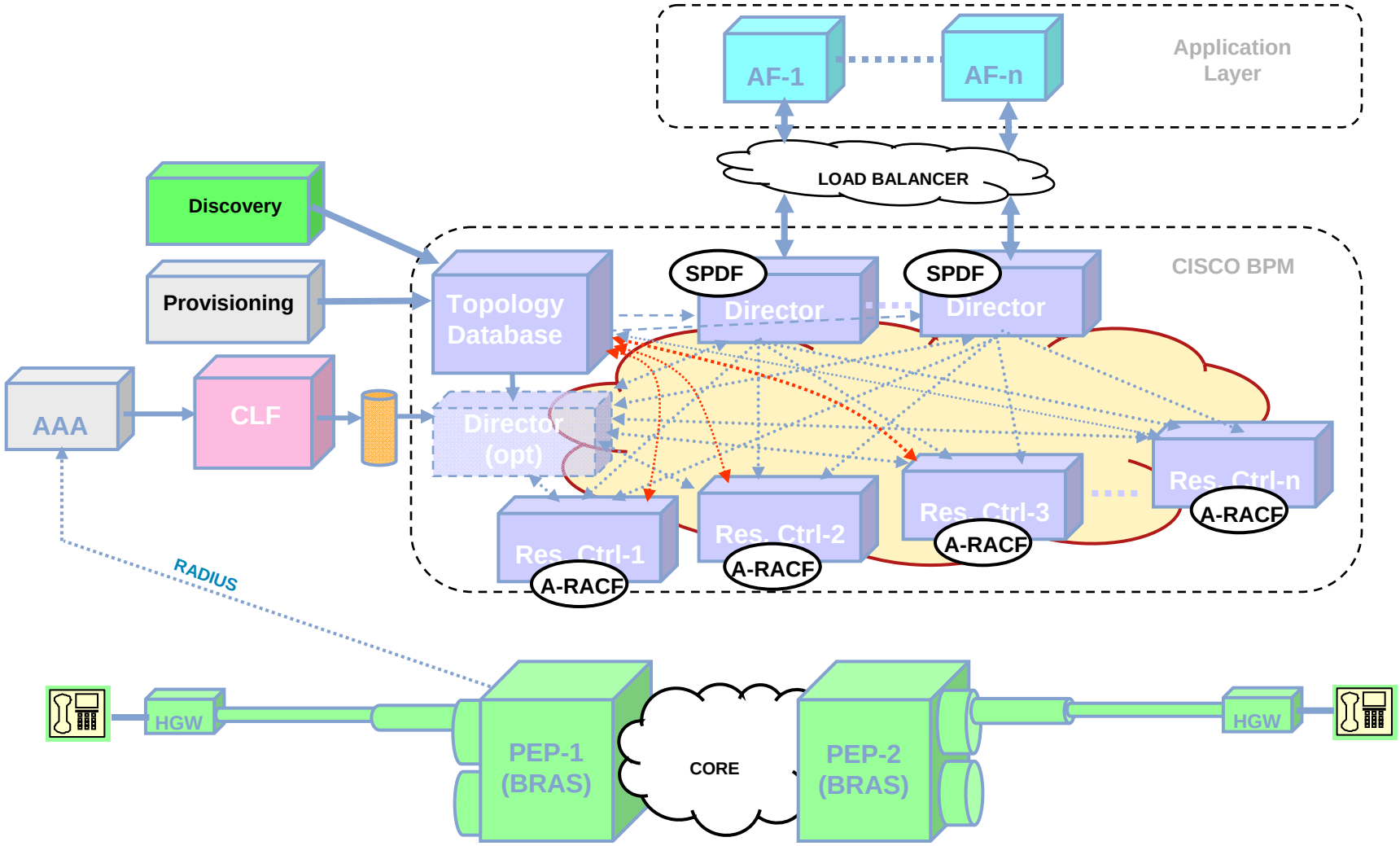
- Very strong business case for CAC for VoD on Aggregation
- RSVP on-path fitted best:

  -Off-the box (no additional off-path server to operate, no systems integration for interfacing with Application)

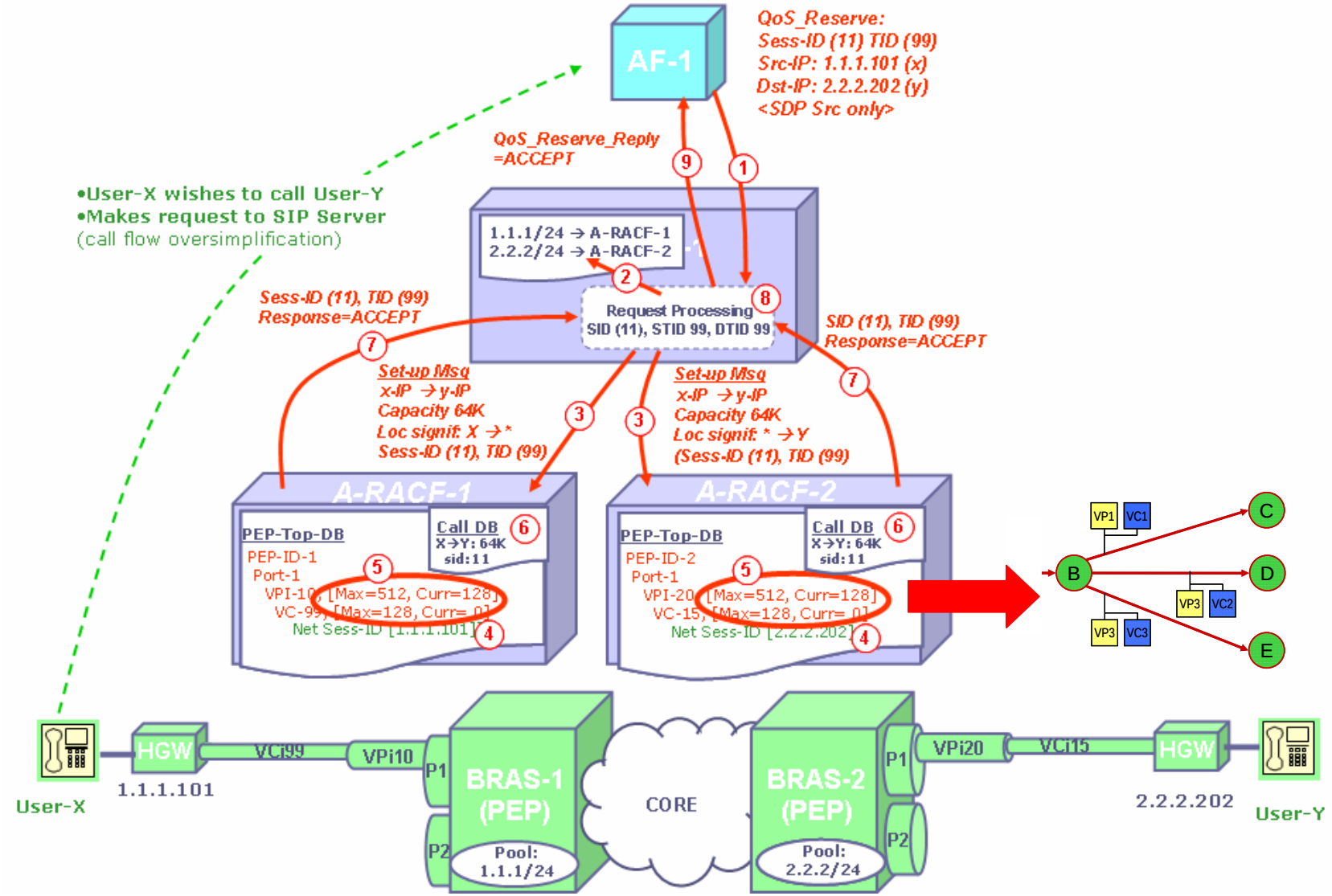
  -Easy operation in an evolving network (ie no reconfiguration when links added, topology changed, additional VoD Servers distributed in POPs)

  -Solution ready for production deployment mid 07

Case Study: BPM Residential Broadband CAC BPM Deployment Architecture

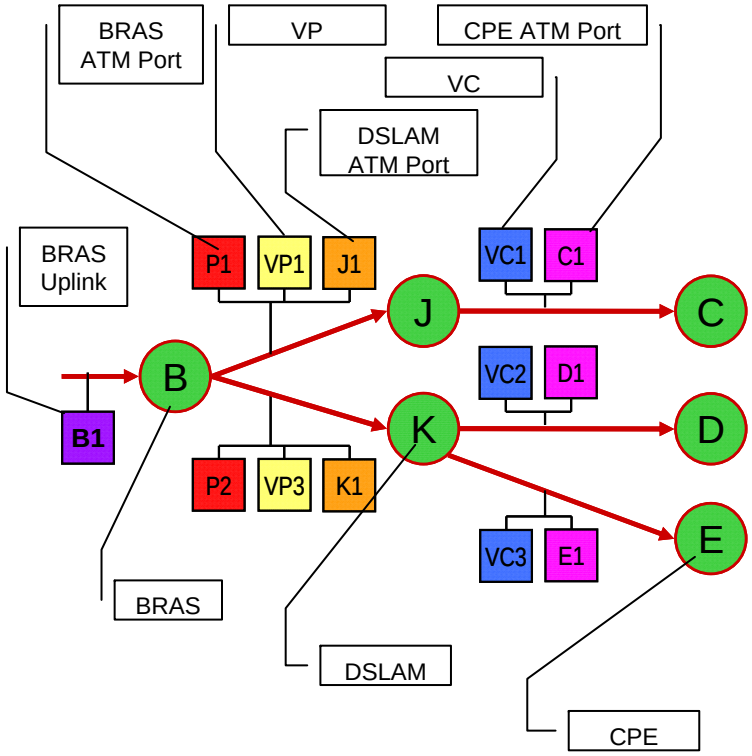


Case Study: BPM Residential Broadband CAC VoIP CAC: ATM DSL access



Case Study: BPM Residential Broadband CAC Abstract Representation of ATM Topology

- Topology stored as nodes and links – attributes may be associated with both
  - Stores capacity information for links and link hierarchies
  - Captures relationships between nodes
- Associates physical topology (nodes, ports) to abstract topology (VP, VC)
- Number of ways of populating / modifying topology model
  - Discovery
  - External systems
  - Manually

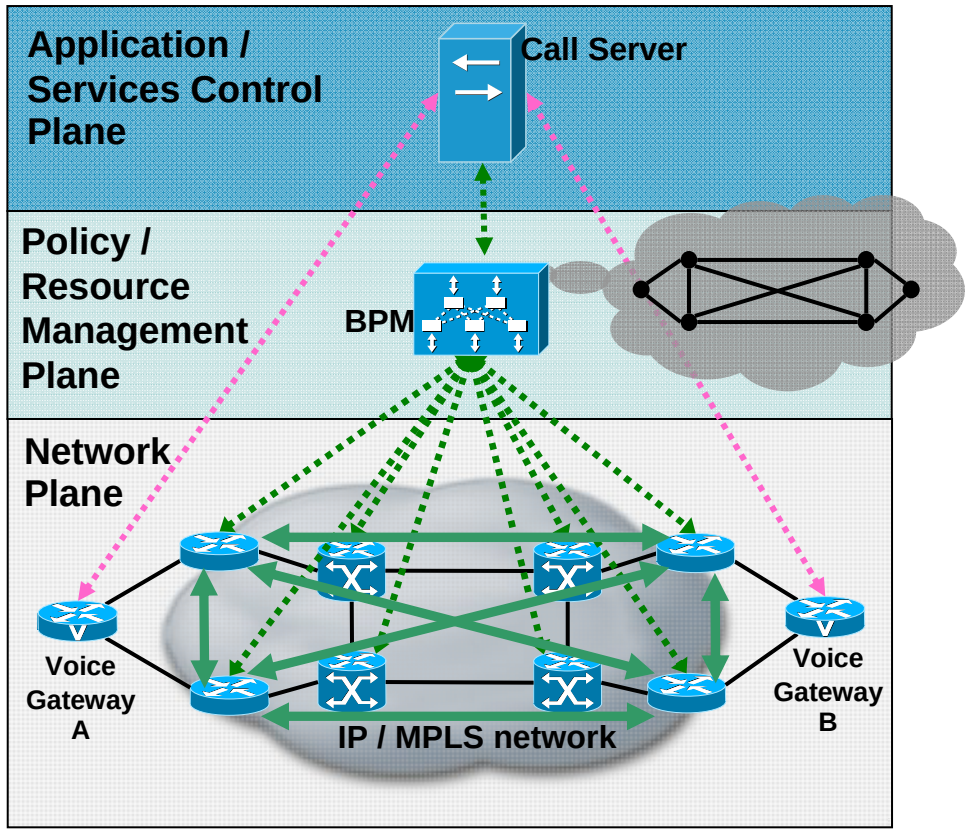


Case Study: BPM Residential Broadband CAC

- Strong requirement for CAC in Aggregation because of overbooking of VP/VLAN
- BPM off-path best fit:
  - Can support CAC for L2 and L3, IP and MPLS
  - Can be applied to heterogeneous service environments
  - Can be integrated part of policy control solution
  - Supports ETSI / TISPAN requirements

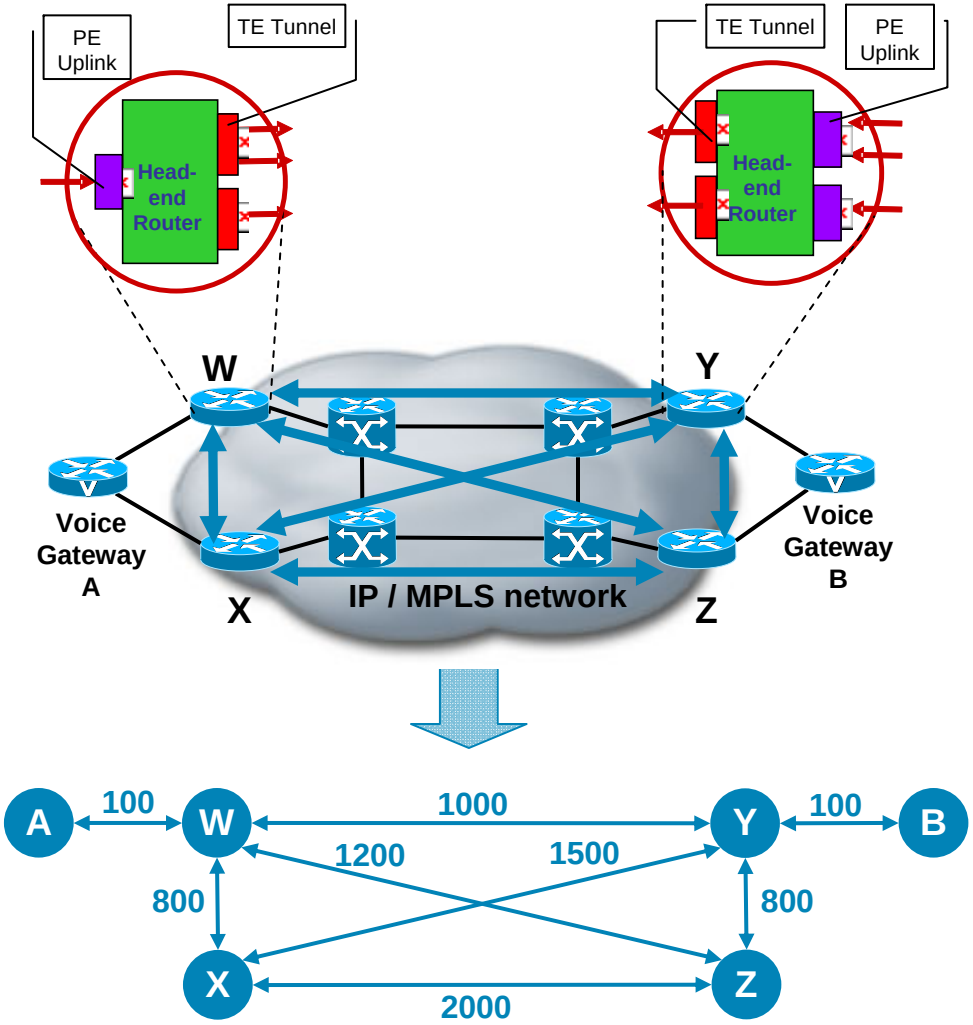
Case Study: BPM CAC for PSTN Replacement

- Based on core CAC work carried out by the MSF
- BPM tracks status of bandwidth resources (e.g. TE tunnels), interfaces to application/services and manages admission control decisions into available bandwidth
- MPLS TE tunnels provide an explicit routing and signalled CAC capability which can be used to keep core network behaviour and CAC decisions in lock step
- Available

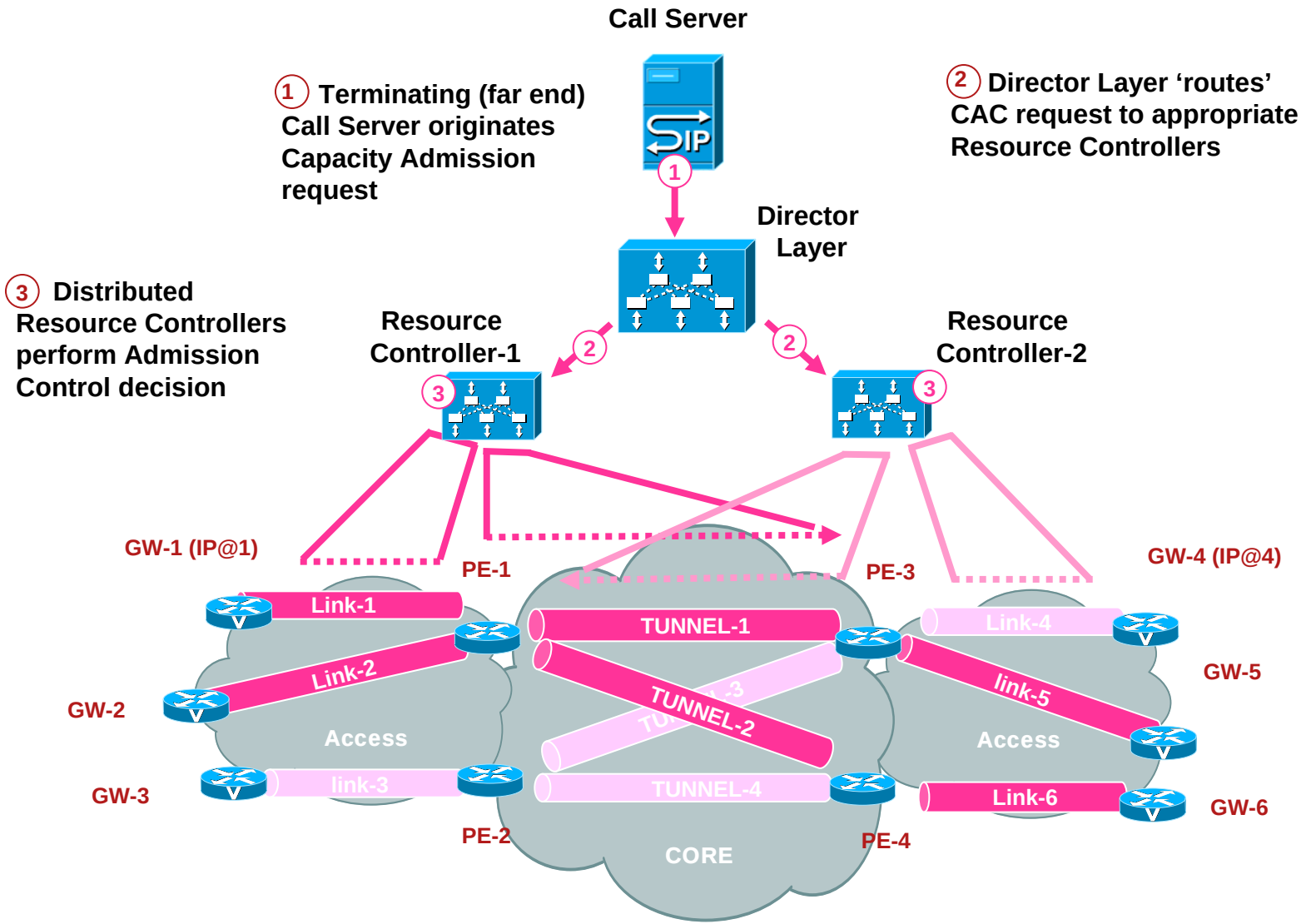


Case Study: Off Path Core Admission Control TE Tunnel Modeling

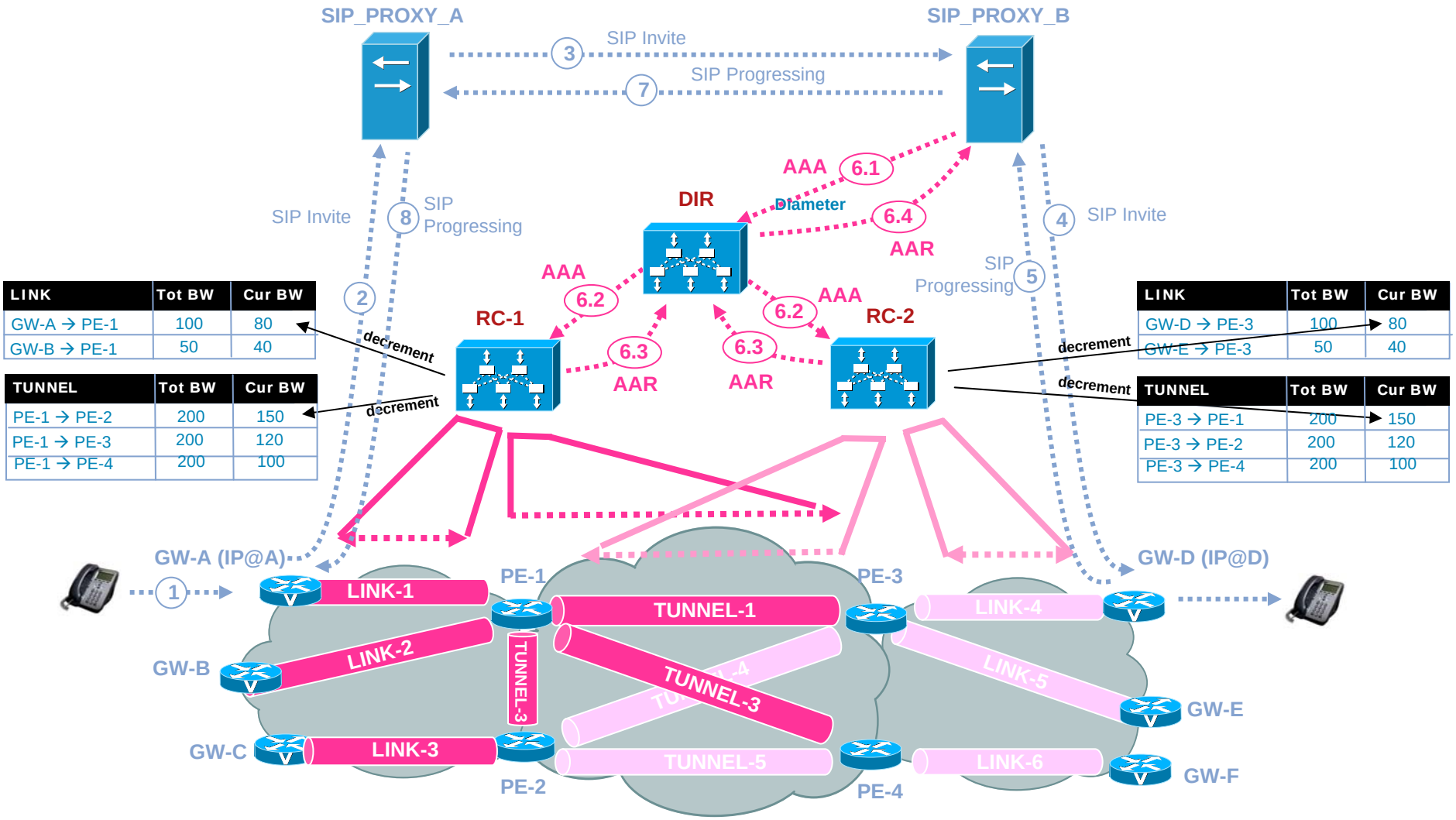
- BPM maintains an abstract view of network bandwidth resources:
  - TE tunnel topology and
  - Access network bandwidth



Case Study: BPM CAC for PSTN Replacement Hierarchical Deployment Architecture



Case Study: BPM CAC for PSTN Replacement MPLS TE for core CAC



Case Study: BPM CAC for PSTN Replacement

- TE Tunnel Sizing and Path Computation:

  BPM is preconfigured with the size of statically configured, but dynamic signaled TE tunnels

  BPM tracks tunnel status and controls admission decisions into available TE tunnel bandwidth accordingly

  TE tunnel head-end routers are responsible for explicit path calculation, both for CAC and for bandwidth optimisation

  In the future, will consider dynamic TE resizing by BPM based on current demand + global TE Tunnel reoptimization

Case Study: BPM CAC for PSTN Replacement

- Strong requirement for CAC to cope for Multiple Failures scenarios
- BPM off-path best fit:
  - Does not require any special functionality on voice gateways
    - Could provide a solution for voice CAC with any Gq' compliant softswitch
  - Can be integrated part of policy control solution
  - Could apply policy in conjunction with admission control
    - e.g. #1: if 90% of capacity used, only allow emergency calls
  - Supports MSF requirements

Case Study: Mobile Phone Trunking

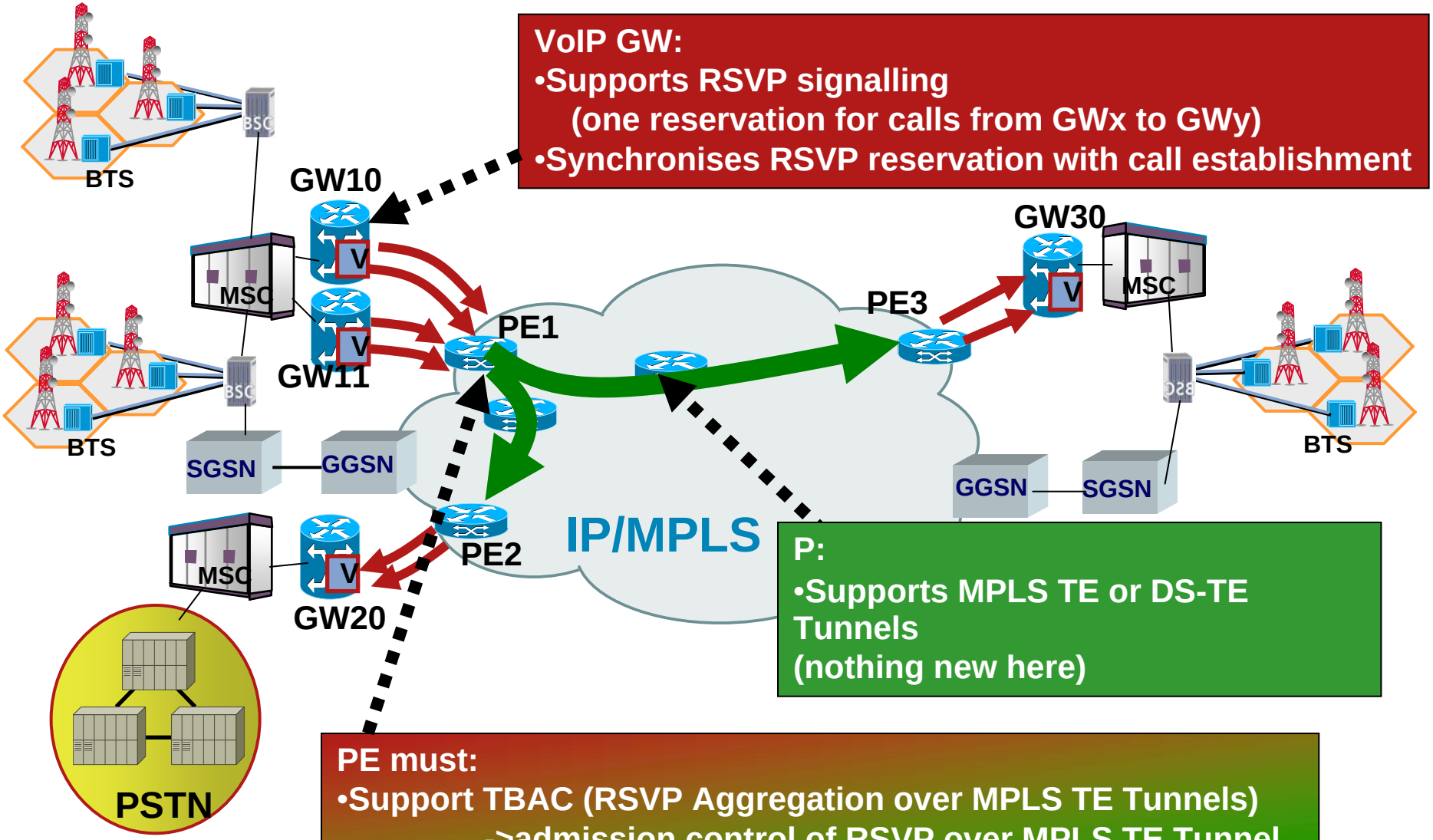
- Mobile Operator using Packet Core today
- Packetized Voice is transported over MPLS TE Tunnels which are dynamically resized by Head-ends based on measured load (Autobandwidth)
- In some cases, a given TE Tunnel can no longer be increased:

  →Operator investigating methods to stop admitting new calls in that case
- Considering RSVP on-path solution:

  RSVP pre-aggregate Signaling on Voice Trunk Gateways

  RSVP Aggregation over TE Tunnels on PE (TBAC)
- Target deployment timeframe compatible with future implementation of RSVP on Voice GW and of TBAC on Cisco PEs

Case Study: Mobile Phone Trunking



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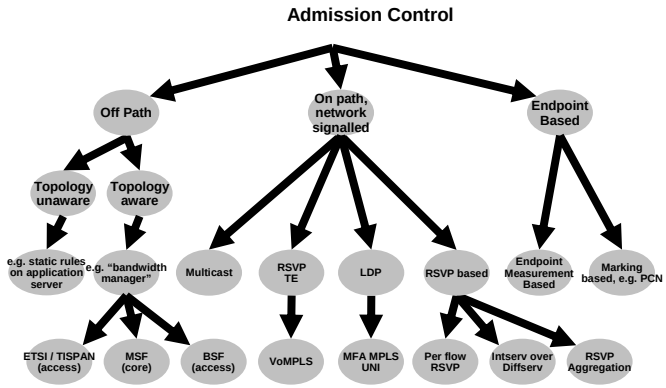
Conclusions

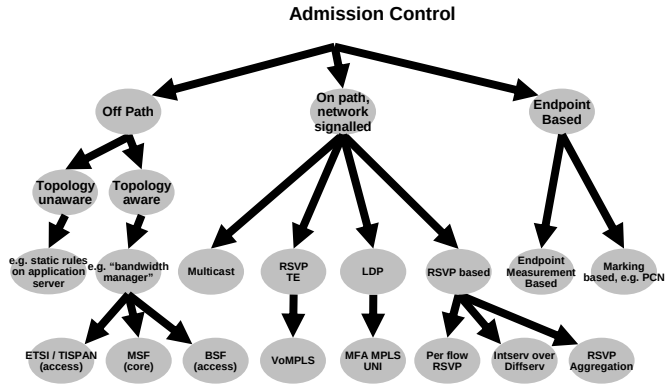


- Many potential methods to do CAC
- No single "one-size-fits-all" method
- Cisco aiming for industry leading implementation for the two main comprehensive methods:

  On-Path (RSVP for unicast, Multicast Routing for Multicast)

  Off-Path (Broadband Policy Manager)
- Solutions ready for deployment in Production networks

Conclusions



- Best method depends on actual environment
- Considerations include:

  If pure Cisco IP/LDP based aggregation network architecture, on-path is well suited (TE based aggregation coming in next phase)

  If RSVP-incapable 3rd party aggregation network equipment, or non-IP/LDP based access (eg pure L2 Ethernet Switching, VPLS), off-path approach may be better suited

  If off-the box solution is important, on-path is attractive

  If integration with Policy Management is important, off-path may be better suited at present

  If topology is non-resilient, off-path may be well suited

  …

Meet the Experts
IP and MPLS Infrastructure Evolution

- Andy Kessler
  Technical Leader
- Beau Williamson
  Consulting Engineer
- Benoit Lourdelet
  IP services Product manager
- Bertrand Duvivier
  Consulting Systems Engineer
- Bruce Davie
  Cisco Fellow
- Bruce Pinsky
  Distinguished Support Engineer



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  Technical Leader
- John Evans
  Distinguished Systems Engineer
- Oliver Boehmer
  Network Consulting Engineer
- Patrice Bellagamba
  Consulting Engineer
- Shannon McFarland
  Technical Leader





Meet the Experts
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- Andres Gasson
  Consulting Systems Engineer

- Steve Simlo
  Consulting Engineer

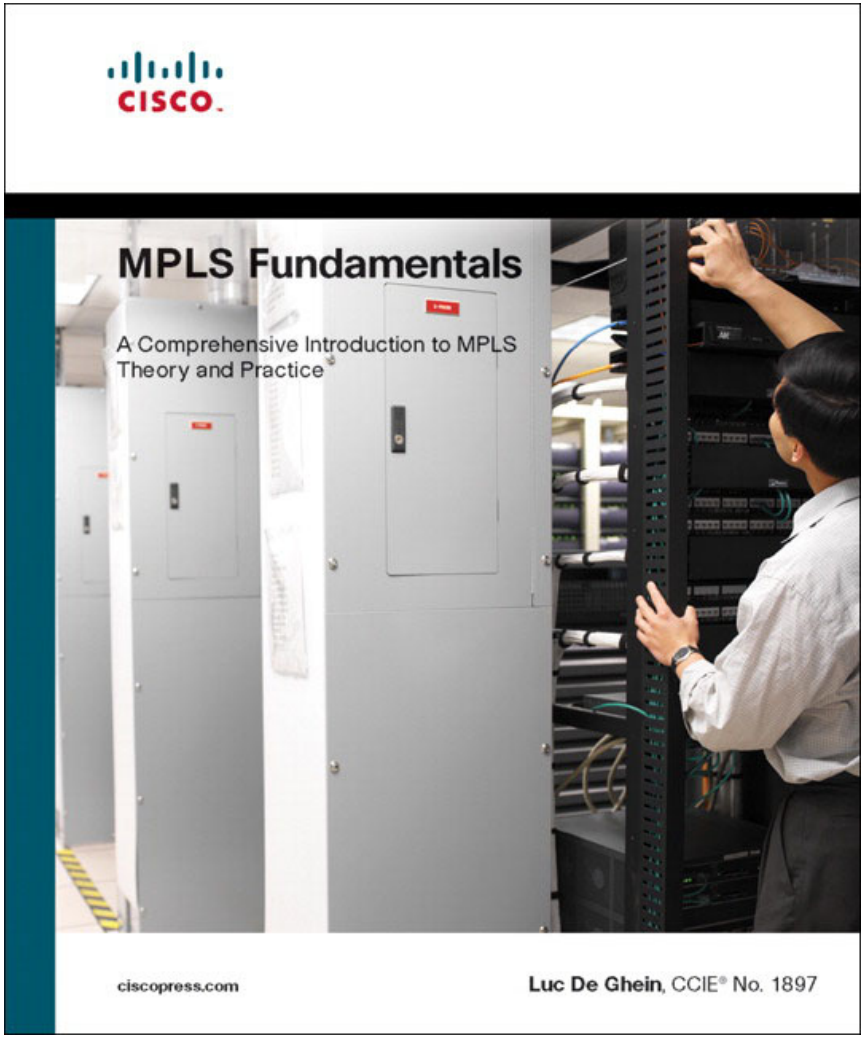
- Toerless Eckert
  Technical Leader

- Dino Farinacci
  Cisco Fellow & Senior Software Engineer

Recommended Reading

BRKIPM -3007

- MPLS Fundamentals



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