

# Network Design for Video Conferencing and Telepresence

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Interop NY 2008



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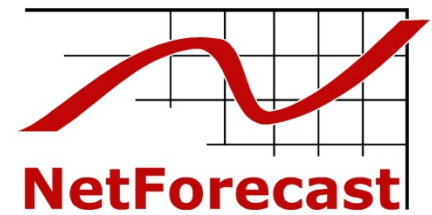
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# Agenda

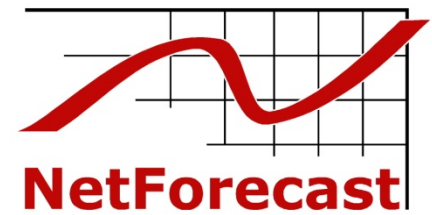
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- **Clean up your network**
- **Real -Time Traffic**
- **Quality of Service (QoS)**
- **Bandwidth**
- **Testing & Monitoring**
- **Global Connectivity & B2B Calling**

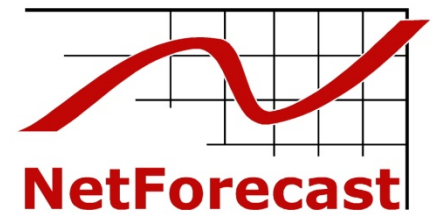
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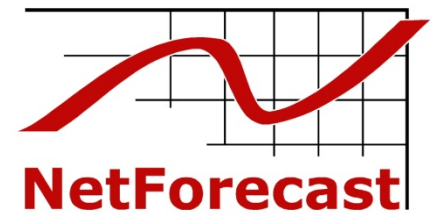
# Clean up your network!



- **Simple problems in the network cause packet loss**
  - **Routers with old software revisions (QoS)**
  - **Half-full duplex mismatches**
  - **Cat 3 cables and extended runs**
  - **Noisy copper connections (T1 / E1)**
  - **Poor grade switches / desktop switches / built-in switches**
- **TCP traffic rides through these problems with ease**
- **Voice & Video suffer**
- **End-to-end testing can find these problems**
  - **More on testing at the end of the briefing**

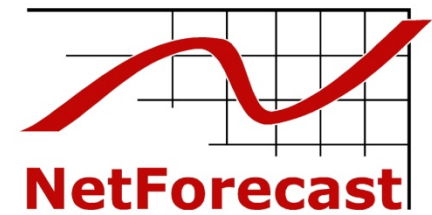
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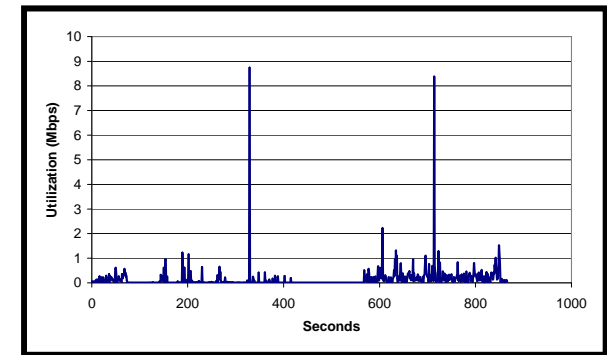
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# Real-Time Traffic is Different!

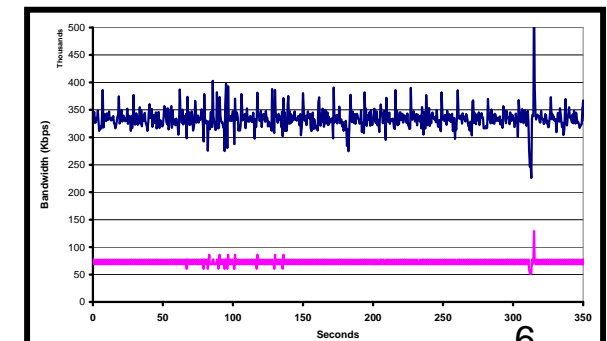


- Data focuses on moving blocks of info from one computer to another
- Bandwidth use is bursty
- Voice / Video move a continuous stream of data to recreate an analog event
- Bandwidth is constant
- Data (TCP) creates and manages packet loss
- Real-time traffic does not recover lost packets, and degrades quickly when packets are not delivered

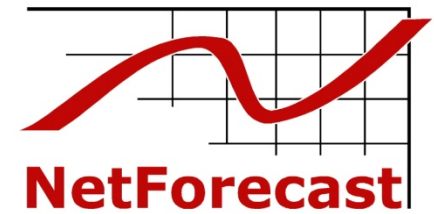
## Data Traffic



## Real-Time Traffic



# Queues cause Jitter and Loss



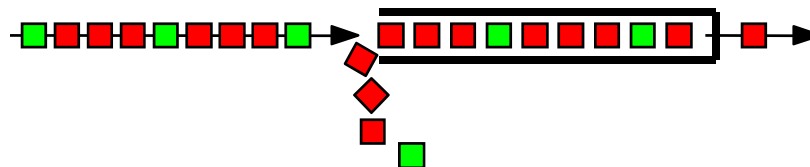
Packets pass through queues in switches and routers



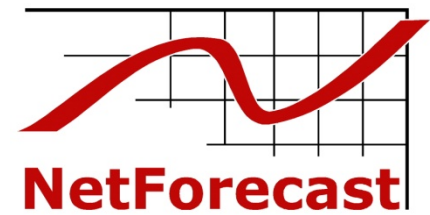
Queue depth affects delay, causing jitter



Insufficient bandwidth causes packet loss

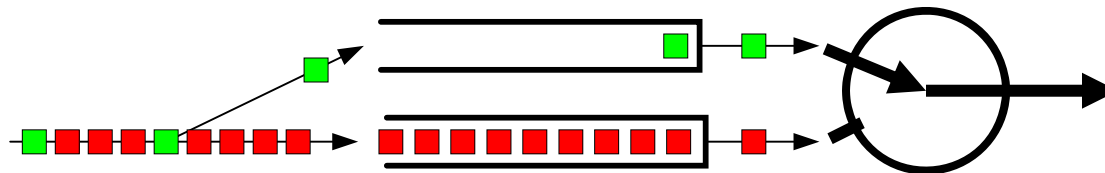


# QoS Uses Additional Queues



- An additional high-priority queue is created
- Traffic is identified as being 'high priority'
- High priority traffic is queued in the high priority queue
- The high priority queue is always emptied before lower priority traffic is forwarded

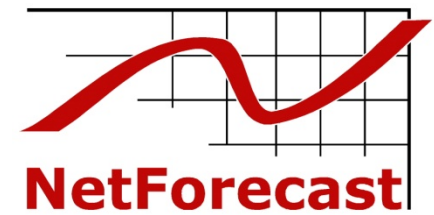
Priority queues allow high priority traffic to bypass slow data queues



Additional queues cause processing loads for the routers

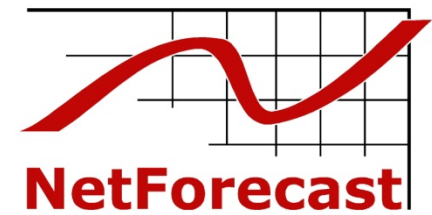
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- Real -Time Traffic
- **Quality of Service (QoS)**
- Bandwidth
- Testing & Monitoring
- Global Connectivity & B2B Calling

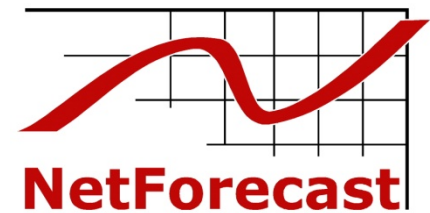
# Quality of Service (QoS)



- **Four parts to Quality of Service:**
  - **Classification**
  - **Class of Service Support in the Network**
  - **Bandwidth Management (CAC)**
  - **Testing and Monitoring**
  
- **All four components must be in place for a successful real-time deployment (voice & video)**

1. Classification
2. CoS Implementation
3. Bandwidth Mgmt
4. Testing

# Classification



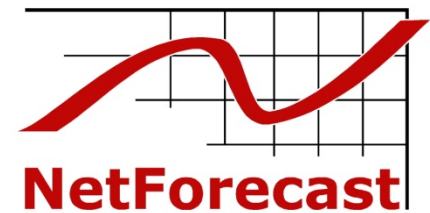
## ● Classification

- Audio and video streams must be marked to ensure network gives them priority treatment
- Endpoints (Video Codecs) can mark traffic, through a configuration parameter (recommended)
- Routers must be provisioned to 'trust' the ports attached to video codecs so that priority markings are recognized
- For additional security, trust can be limited to identified IP addresses or UDP ports through ACLs on the edge router
- Classification should be done near the network edge, and markings then carried through the network



- Your enterprise needs a strategy for marking and trusting marks on high priority packets

# Priority Mechanism – CoS



- **Enable CoS Support in the Network**

- Layer 3 LAN and Private WAN, use DiffServ
- Layer 2 LAN, use IEEE 802.1p and .1Q (VLANs)

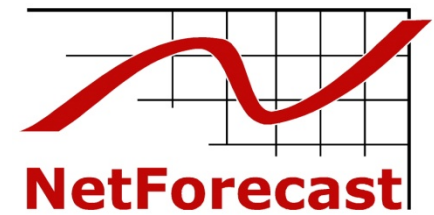
- **Voice is highest priority, Video is next**

- IETF Recommendation RFC 4594 suggests how to categorize applications into priority classes

- Voice (VoIP) traffic marked EF (Diffserv) or Level 5 (LAN)
- Video and Audio of Video Conference marked CS4 or AF41 (Diffserv) or Level 4 (LAN)
- Interactive and best effort traffic marked with classes lower than video conferencing

- **Over-provisioning is not sufficient**

# QoS Design



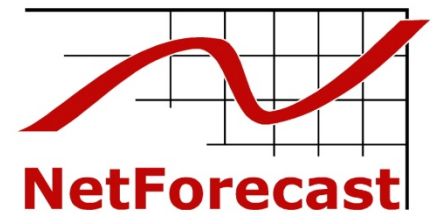
- **QoS Baseline per RFC 4594**
- **Determine which applications belong in each category**
- **Assign bandwidth to each category**
- **Video Conferencing belongs in CS4 or AF41 in this hierarchy**

Application	L3 Classification		L2 Clsf
	PHB	DSCP	CoS
Network Control	CS6	48	COS 6
VoIP Telephony	EF	46	COS 5
Call Signaling	CS5	40	COS 5
Multimedia Conferencing	AF41	34	COS 4
Real-Time Interactive	CS4	32	COS 4
Multimedia Streaming	AF31	26	COS 3
Broadcast Video	CS3	24	COS 3
Low-Latency Data	AF21	18	COS 2
OAM	CS2	16	COS 2
High-Throughput Data	AF11	10	COS 1
Best Effort	DF	0	COS 0
Low-Priority Data	CS1	8	COS 1

- **QoS is required in the WAN as well as the LAN**
- **Service provider should be providing separate priority levels for Voice, Video and Data (at least three levels)**
  
- **Look for a true MPLS network provider**
  - **MPLS core network**
  - **MPLS all the way to the access edge**
  - **Ability to recognize DiffServ packet markings**
  - **Measurement tool to show network performance characteristics**
  
- **Service Level Agreement**
  - **Note the SLA measurement period**
  - **You need the network to meet QoS specifications during the business day busy hours**

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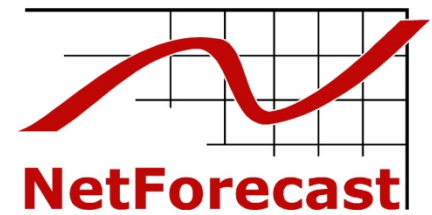
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# Bandwidth

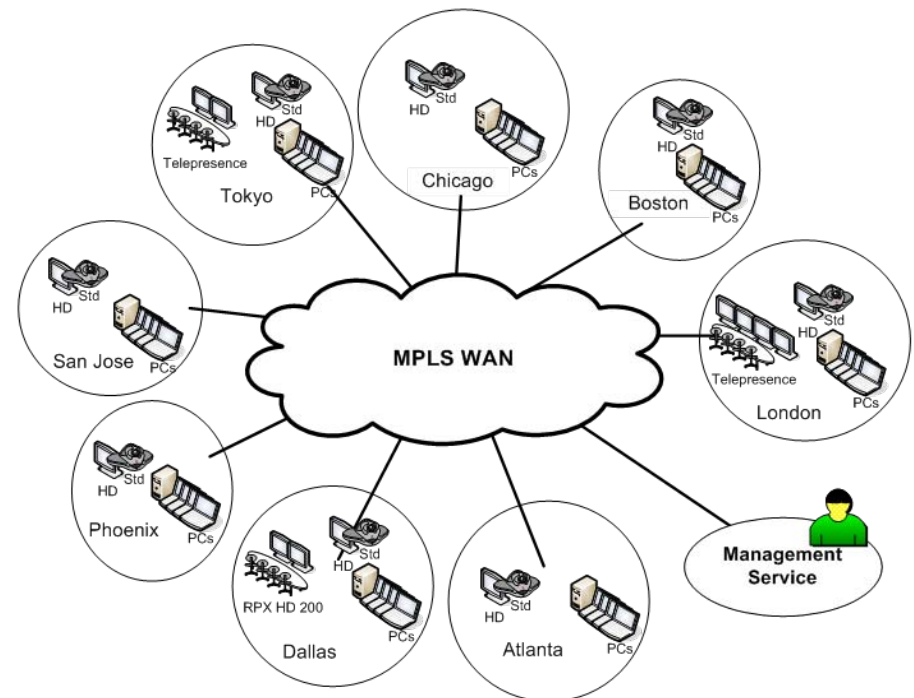
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- **Bandwidth Demand**
- **Bandwidth Support**
- **Bandwidth Concentration**
- **Bandwidth Management**

# Bandwidth Demand

- **Goal: Determine bandwidth demand of video on each major link of the network**
- **Map out network links and speeds**
- **Build a chart of video conferencing use and concurrent demand**
- **Add up the concurrent calls per link**
- **Add 20% IP overhead**
- **Size links to support existing data and voice demand plus calculated video demand**



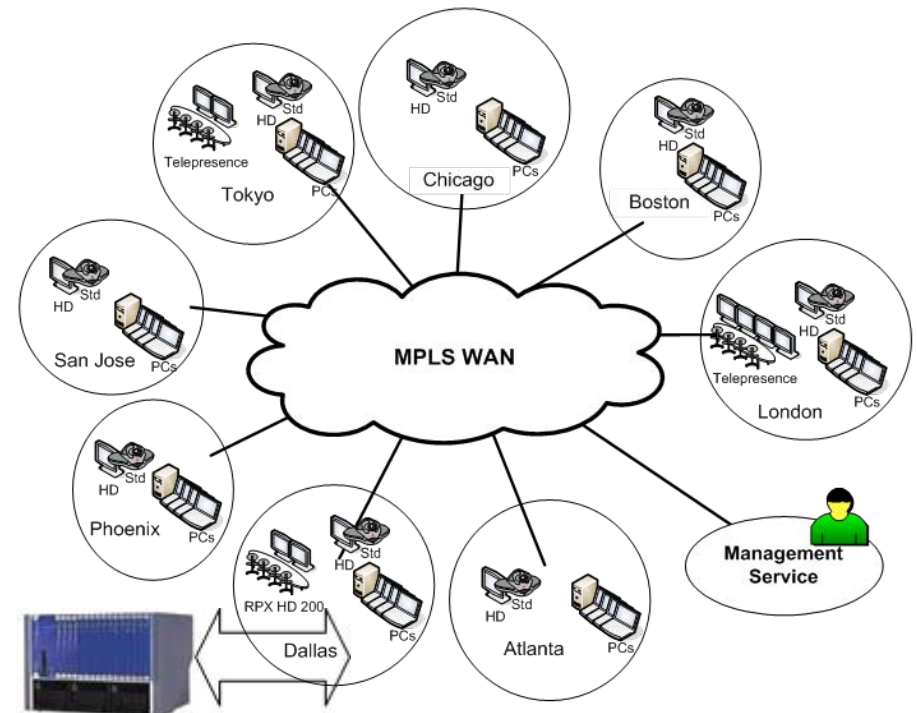
- **WAN and LAN Network Links**

- **Is there sufficient bandwidth to support the video demand?**
- **Is there sufficient bandwidth to support current data usage?**
- **Remember that data traffic needs to be bursty, so it needs peak bursts well above its average usage**
- **Cannot constrain data bandwidth based on the ‘average’ utilization shown by management tools**

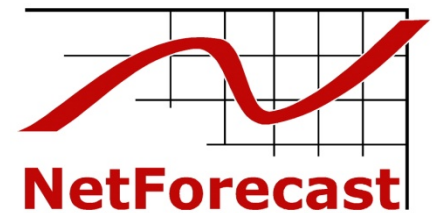
- **Overlay networks are a valid option**

# Bandwidth Concentration

- The conferencing bridges concentrate bandwidth demand
- Location of the bridges is a key design decision
- Locate bridge based on:
  - Calling patterns
  - Bandwidth of connections
  - Cost of IP bandwidth
- Consider locating bridge in service provider cloud (collocation facility)



# Bandwidth Management

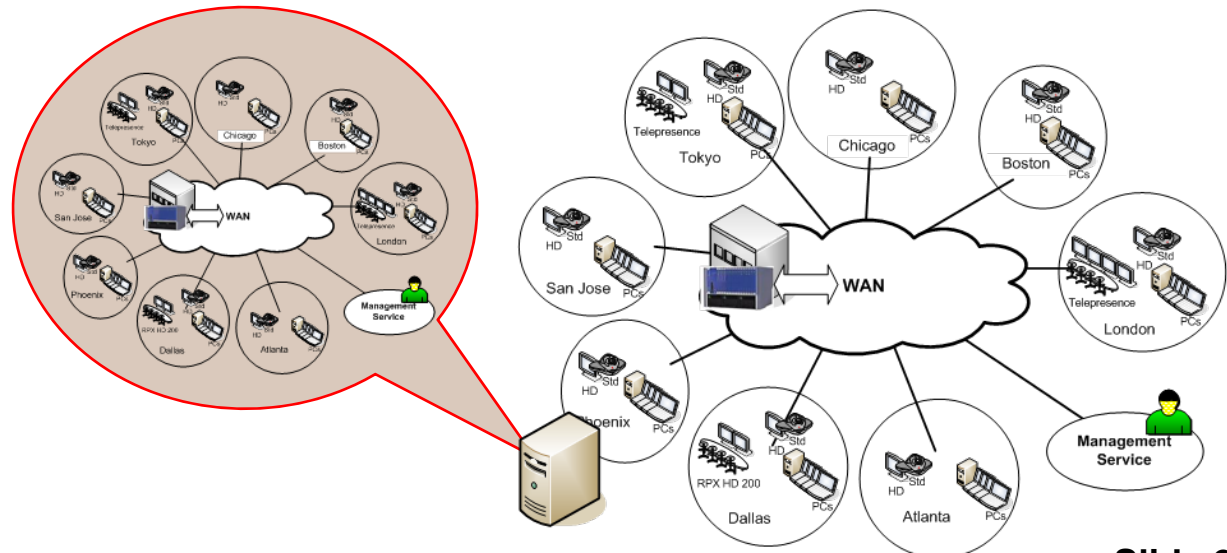


- The network design will allocate video bandwidth to each link
- Routers will be configured to support priority forwarding for video on those links ***up to the specified bandwidth***
- ***Policing is deployed to ensure video does not exceed design bandwidth***
- ***If excess bandwidth is presented to the router, packet loss will occur across the video class***
- The application is responsible for keeping bandwidth demand within the design constraints
- Thus we require call admission control (CAC)



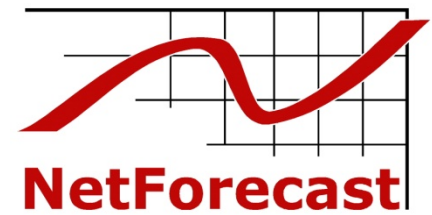
# Bandwidth Management for Video

- Gatekeeper uses a simplified model of the network
- All video calls request permission from the gatekeeper
- Gatekeeper tracks utilization by link
- Gatekeeper denies calls exceeding designed bandwidth



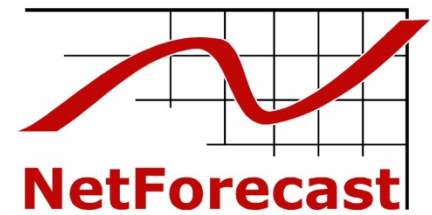
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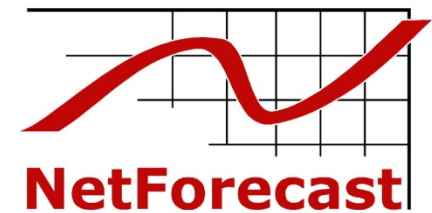
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# Testing and Monitoring



- **This is the on-going, operational version of Network Verification**
- **Testing and Monitoring**
  - Network testing should be done end-to-end
  - Most data networking tools are insufficient
  - Operational tool shows network performance in real-time as well as capturing historical information about network performance
  - Allows network team to stay ahead of real-time quality issues
- **Tool promotes good working relationship between video team and network team**
  - Provides quick isolation about whether problems are with the network or the video equipment
  - Gets problems resolved quickly, minimizes finger pointing
  - Helps with capacity planning as well

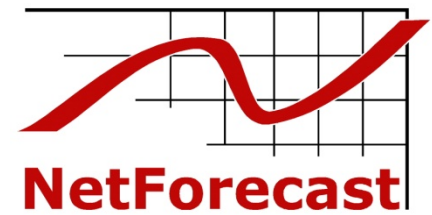
# Testing Vendors and Tools



- **Qualify the Network**
  - AGT - Fathom
  - Apparent Networks - AppCritical
  - Ixia - Chariot
  - NetIQ - Vivinet Assessor
  - Fluke/Viola – NetAssessor
- **Monitor the network**
  - Apparent Networks - AppCritical
  - Brix – Brixworks
  - NetIQ App Manager for Voice
  - Psytechnics – Experience Manager
  - RADcom - Performer
  - Telchemy - Vqmon
  - Fluke/Viola - NetAssessor
- **Debug the Network**
  - Apparent Networks - AppCritical
  - Ixia Chariot
  - NetIQ Vivinet Diagnostics
- **Consider stats in the endpoints**
- **Collect and database Call Data Records (CDRs)**

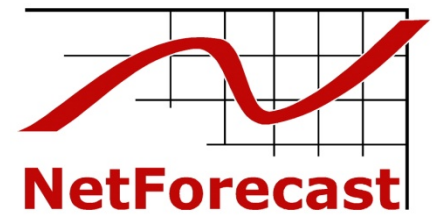
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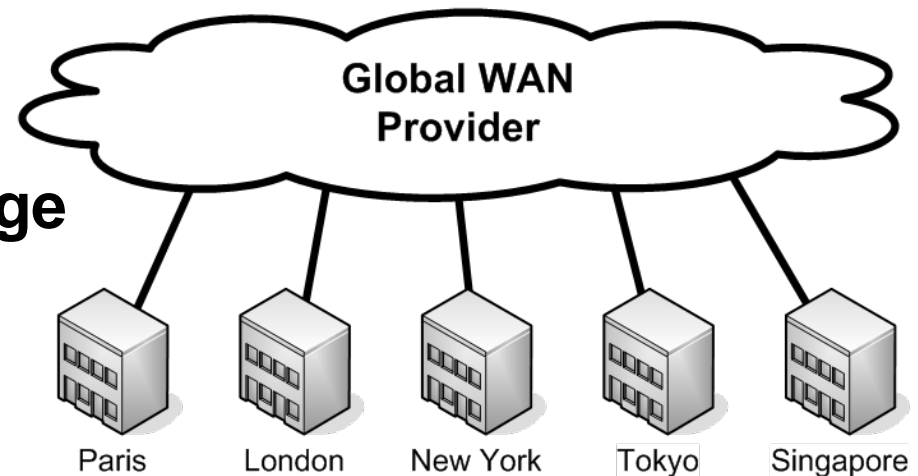
# Global Connectivity



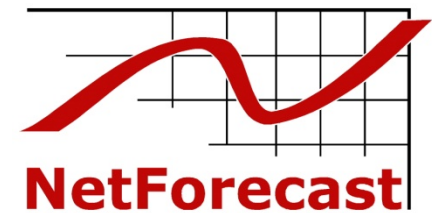
- **How do we connect geographically disparate locations successfully?**
- **How do we optimize using WAN service providers?**
- **Simple is better**
- **Create the right Service Level Agreement**
- **Measure WAN Performance**
- **Lets look at the WAN architecture choices for a global video conferencing / telepresence deployment**

# Simple is Best

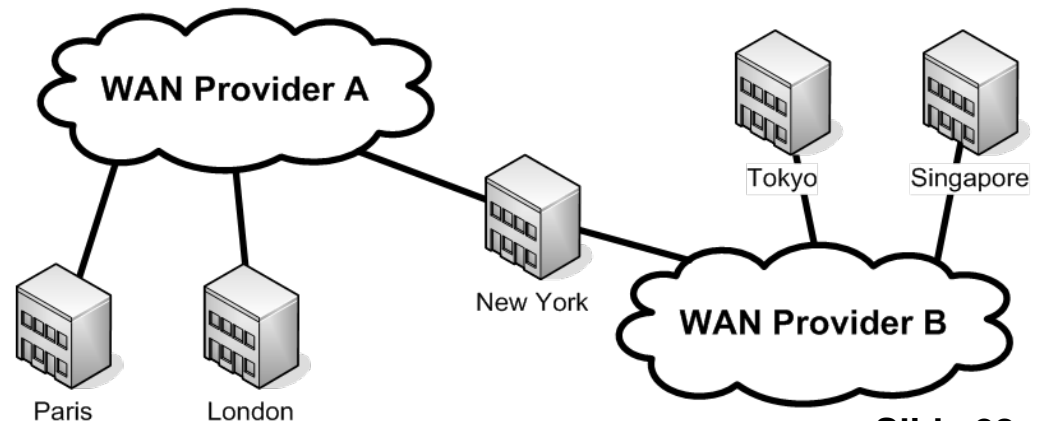
- If possible, use a single WAN Provider
- Bandwidth analysis is simple
  - Demand per link
  - Backbone handled by service provider
- Single SLA agreement
  - Site to site specifications are consistent
- One relationship to manage
- One provider responsible for quality of the interconnect
- This approach may not be possible for a number of reasons



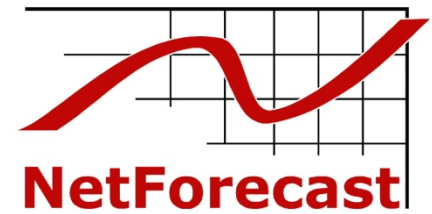
# Multiple WAN Provider Issues



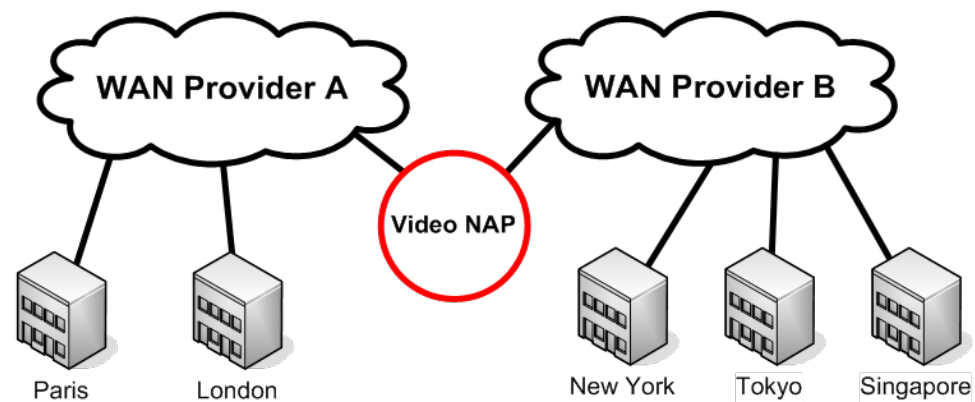
- **Bandwidth bottleneck in New York**
  - All traffic traversing from provider A to provider B must pass thru New York
  - As deployment scales, bandwidth to NYC must scale as well
- **May not have SLA consistency**
  - Providers request different QoS tags for priority traffic
  - Not providing similar loss/latency/jitter specifications
- **Network problems now have to be isolated to the appropriate carrier**
  - Measurement system in NYC tests both directions



# Video NAP Approach

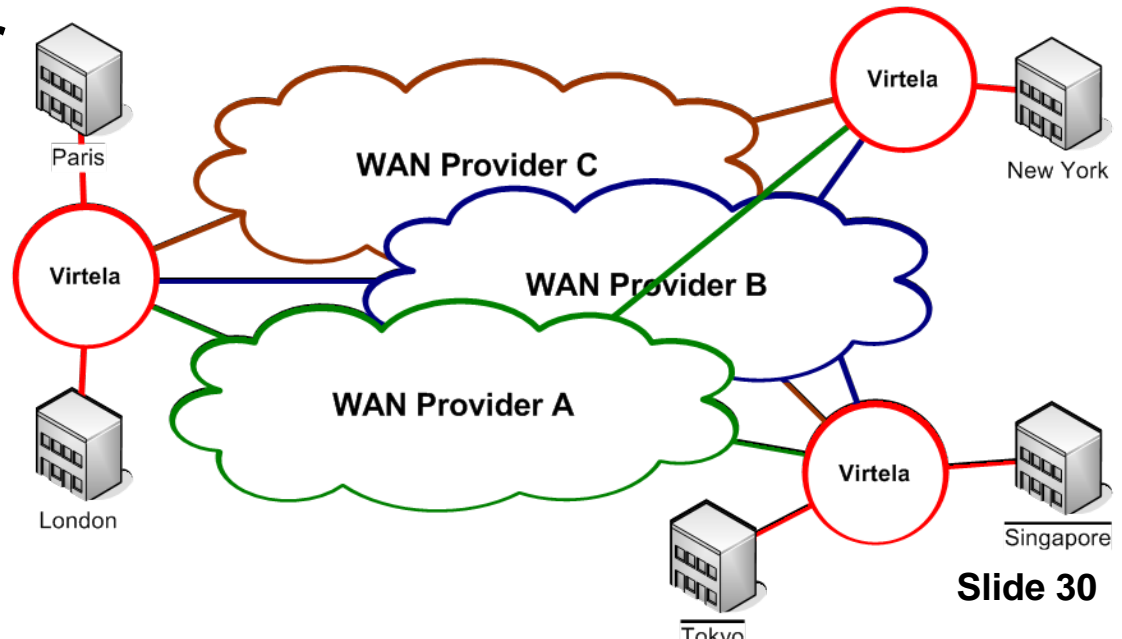


- We need a common connection point to resolve carrier differences and to monitor carrier quality
- Video NAP is able to:
  - Monitor quality in both directions
  - Connect private MPLS-VPN from Provider A to MPLS-VPN on Provider B
  - Translate QoS tags as required
  - Translate private addressing as required
- Becomes a high-quality Video peering point between service providers
- IPV Gateways provides this kind of service

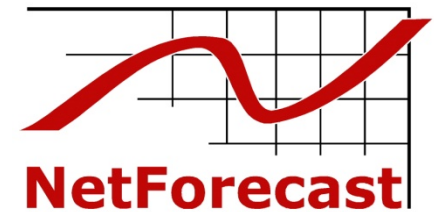


# Video NAP - Distributed

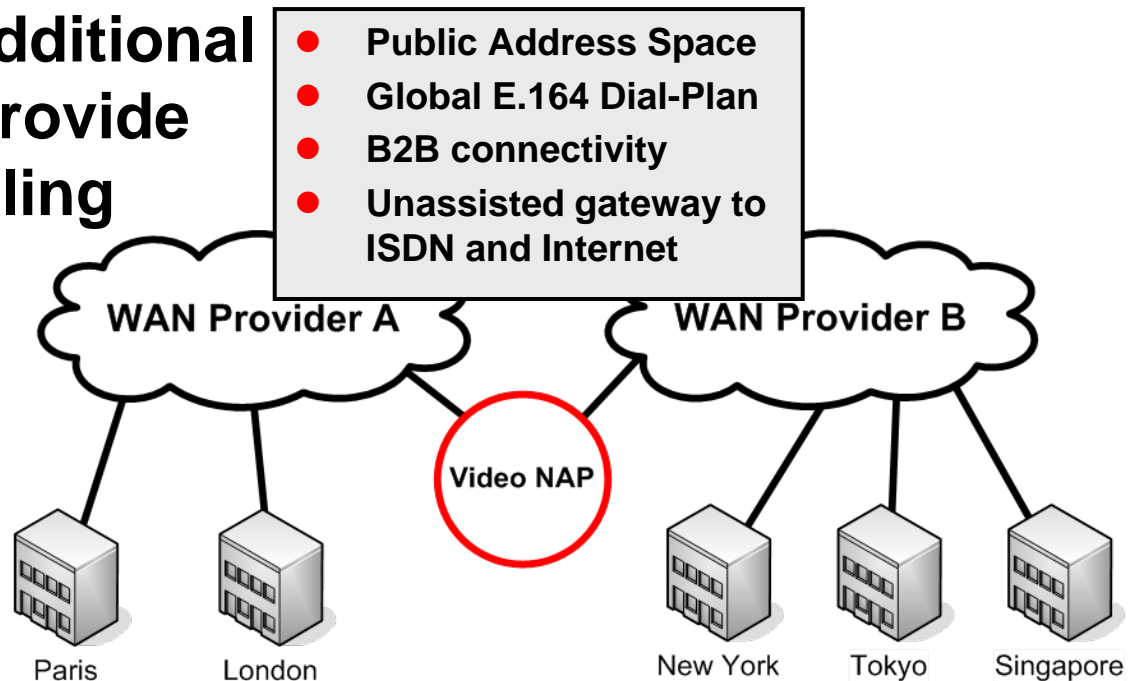
- Virtela provides a similar approach, but in a distributed manner
- Virtela does not own their backbone, but instead optimizes traffic across the big carriers
- So Virtela is by definition connected to most of the WAN service providers and can provide the same kind of carrier-to-carrier connectivity



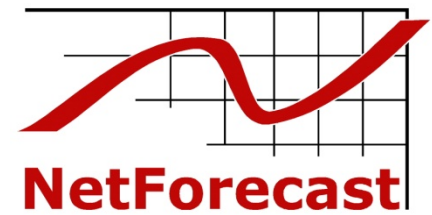
# Telepresence Exchange (TEN)



- Glowpoint is offering their 'Telepresence Exchange Network' or 'TEN'
- Approach provides a Video NAP from major locations around the globe
- Glowpoint offers additional video features to provide 'telephone' like dialing ability
- Multiple levels of security provide tradeoffs between flexibility and isolation



# Network Evolution



- The demand for video interconnection is new
- Innovative players are leading the pack
- Expect bigger carriers to become involved
  
- Major issues yet to be addressed:
  - B2B Directory
  - B2B Dynamic Security Management
  - Transcoding between incompatible systems (Cisco, HP, Polycom, Tandberg) (compression, protocol, frame rates, etc.)
  - Telepresence suite compatibility (camera angles, screen count, light compensation, etc.)

# Questions and Answers?

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Thank You.



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