

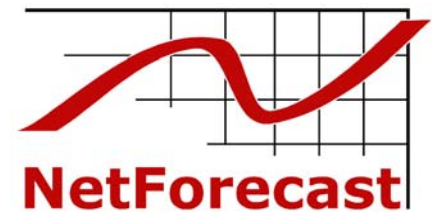
Supporting Voice and Video in the Enterprise Network

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Supporting Voice and Video in the Enterprise Network

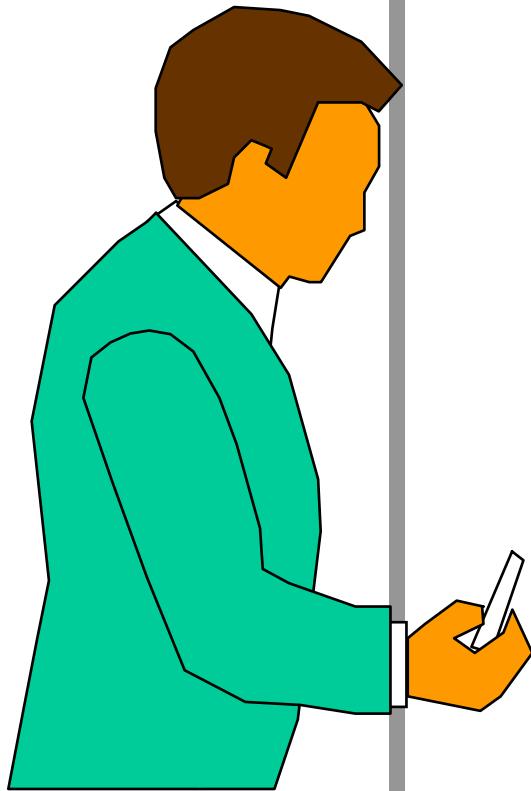


Voice and video traffic have very different characteristics than normal data traffic. Successful support of voice and video on the enterprise IP network requires rethinking how to configure, test, support and monitor your network. This session discusses the needed changes, reviews why they are necessary, and suggests methodologies for managing a successful converged network.

Agenda

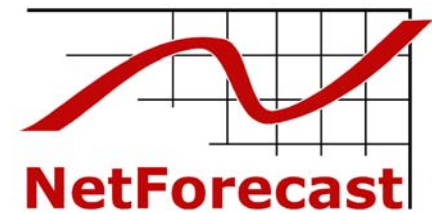


- **Real-Time Traffic is Different**
- **Why do we need QoS?**
- **The Four Parts of QoS Implementation**
- **An Enterprise SLA**
- **Q&A**

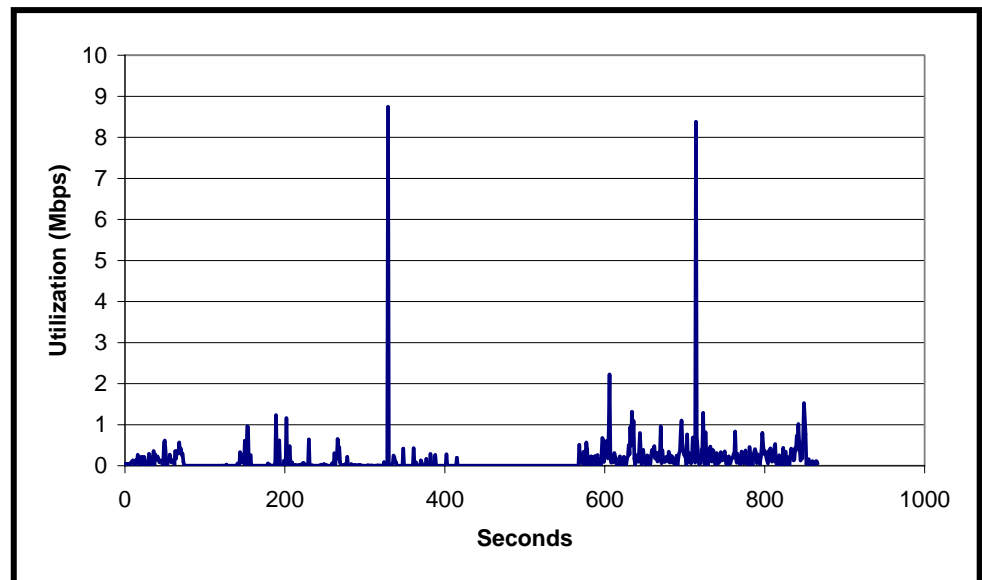


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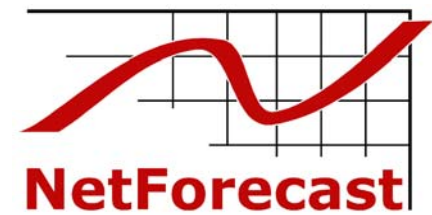
Data Traffic Characteristics



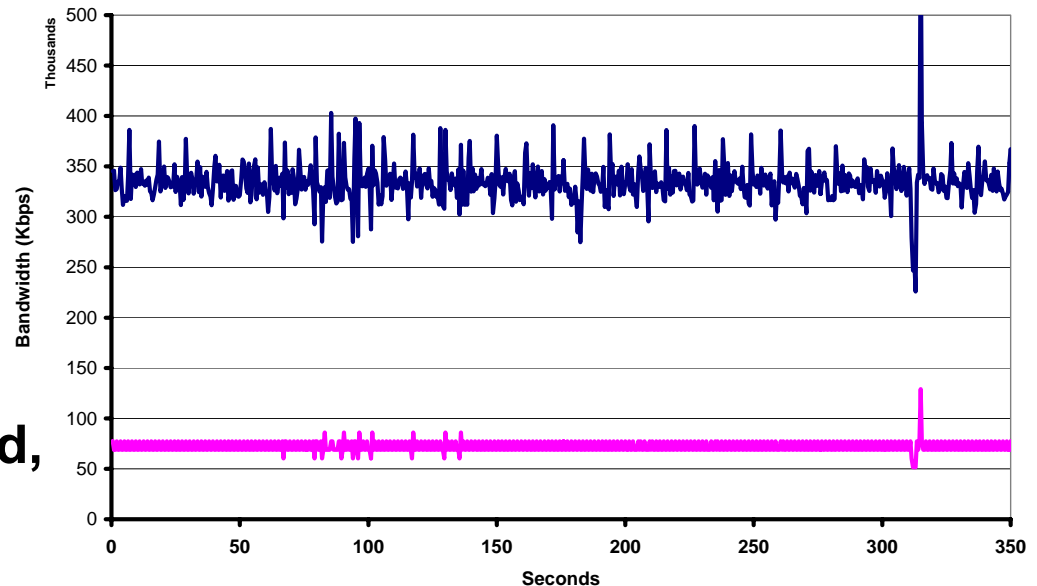
- Data traffic is very bursty, often peaking an order of magnitude above the average traffic level
- Data traffic depends on peak bursts to obtain application performance
- Data traffic easily recovers from packet loss, TCP uses loss to manage bandwidth
- Data traffic degrades gracefully as bandwidth becomes scarce
- Of primary importance – data must arrive 100% correct



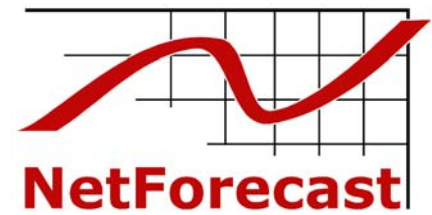
Real-time Traffic Characteristics



- Voice and video encode a continuous stream of data to capture and transfer speech or images
- Bandwidth is capped by the codec algorithm
- Voice / Video quality relies on delivery of all packets
- Voice / Video degrades abruptly when packets are lost
- Of primary importance – packets must be delivered, and delivered in a timely manner

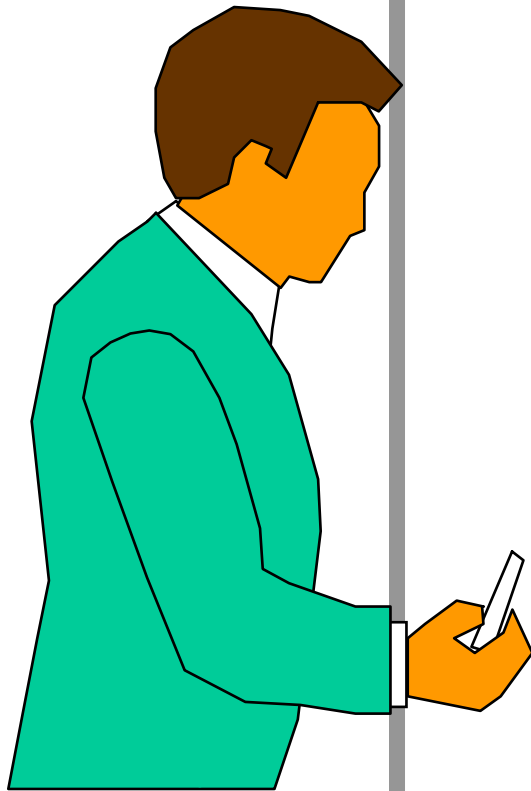


Real-Time Traffic Summary



- **Voice / Video packets must be delivered, and delivered in a timely manner (i.e. low packet loss, low jitter)**
- **There is no time to retransmit a lost packet, so lost packets cause poor quality**
- **Data traffic will interfere with this goal**
- **QoS is required to keep voice & video separated from normal data traffic**
- **How does QoS Work?**

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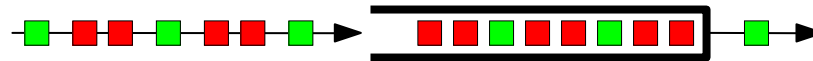
Queues cause Jitter and Loss



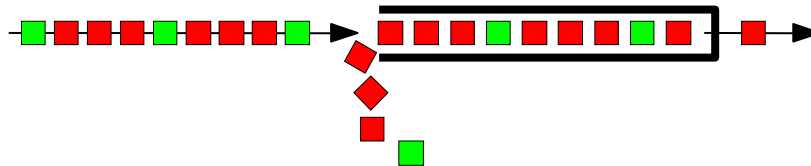
Packets pass through queues in switches and routers



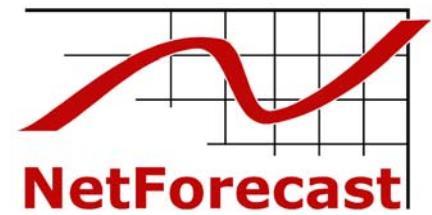
Queue depth affects delay, causing jitter



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

What does QoS do for us?



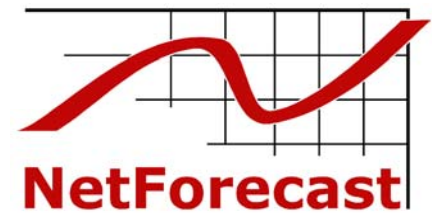
- **Manage Latency & Jitter**

- If traffic always flows through priority queues and
- If high priority queues can handle the volume
 - There is little or no queuing / waiting before being forwarded
- Latency (end to end delay) is minimized
- Jitter (variation in end to end delay) is minimized

- **Manage Packet Loss**

- Packet loss is not eliminated by QoS
- But it is significantly reduced
- Lets take a look at this effect

Impact on Best Effort Traffic



- **Remember it is a zero sum game**

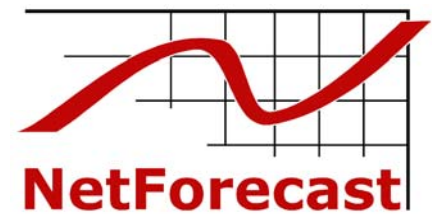
The problem we are trying to solve is to give “better” service to some at the expense of giving worse service to others – QoS fantasies to the contrary, it’s a zero sum game.

- Van Jacobson

- **High priority traffic gets to always go first**

- **The impact on existing applications must be evaluated to insure they will still deliver appropriate performance**

Biz Priority vs. App Priority



- Management sometimes confuses business priority with application priority

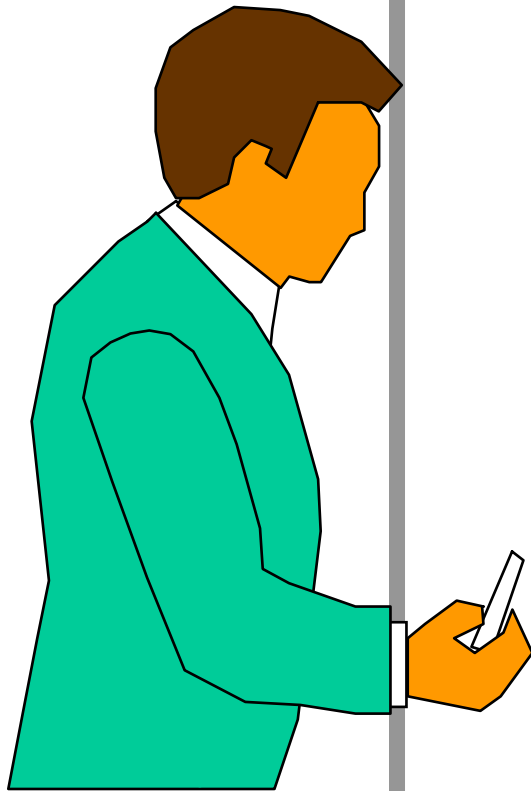


“I am the president.
My email should have
the highest priority”



- Use QoS priority to address application requirements
- Use Bandwidth to address business priorities

- Real-Time Traffic is Different
- Why do we need QoS?
- **The Four Parts of QoS Implementation**



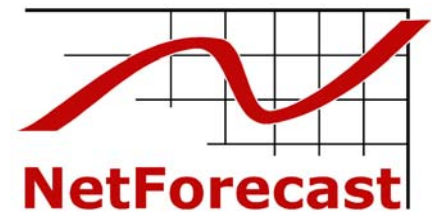
Classification

Network QoS Implementation

Bandwidth Management

Testing, Measuring and Monitoring

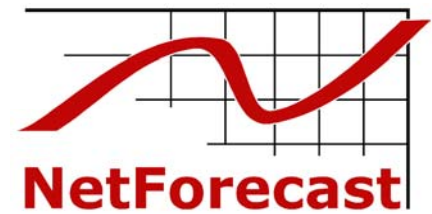
Classification



- This is the job of deciding which traffic is high priority traffic, and which is not
- For a router making a decision about how to treat packets
 - Must be some way of identifying that this packet is high priority or not
- To limit this decision to the edges of the network:
 - Packets must be identified and then marked as high priority with one of the following:
 - With IEEE 802.1p priority marking
 - With IEEE 802.1q VLAN identification
 - With IP TOS marking
 - With DHCP code point

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

Classification Tradeoff



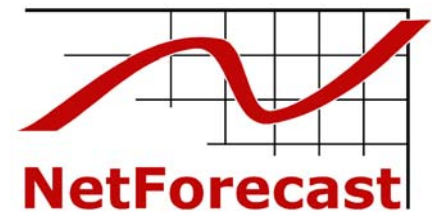
● End point vs. network

- Multimedia clients/servers can mark their traffic with DiffServ code point to identify it as high priority
- Endpoint is the best place to distinguish between real-time and other traffic, because it is close to the application
- Network may not want to trust the endpoint to determine priority
 - Has a more global point of view
 - Distrust of end user (gamer? hacker?)
 - Network has to manage total amount of high priority traffic
- Who gets to decide?

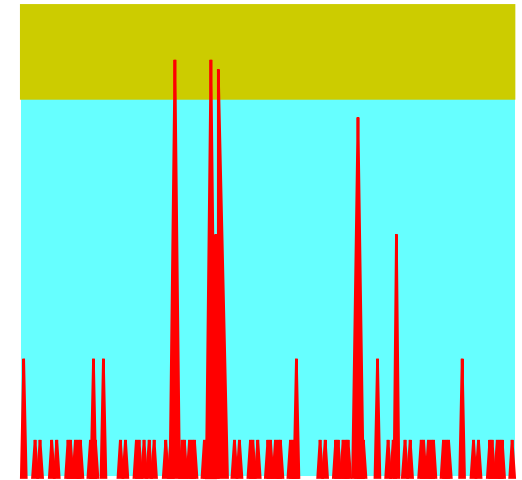
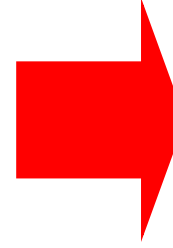
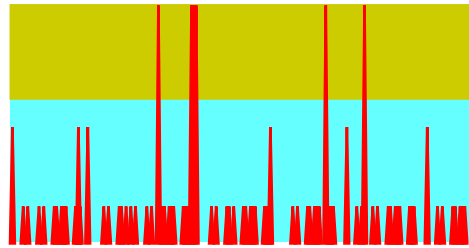
● Work out the best answer for your enterprise

1. Classification
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Over Provision (add Bandwidth)



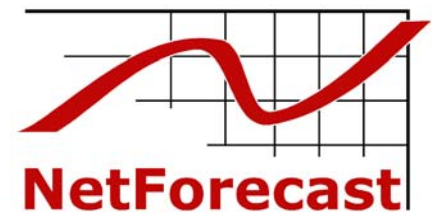
- Adding bandwidth allows real-time traffic and data traffic to coexist



- Inexpensive in the LAN, expensive in the WAN
- Works some of the time ...
- Over provisioning is a statistical game, loss still occurs
- TCP applications expand to take advantage of available bandwidth
- Traffic growth will shift the balance again, causing packet loss
- Requires constant monitoring of utilization and loss to insure success

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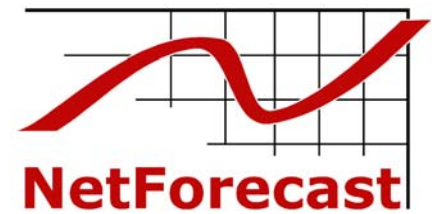
Integrated Services (IntServ) (RSVP)



- IntServ will provide guaranteed bandwidth through your network
- IntServ requires each router in the path to support each flow separately
- Do your routers have sufficient capacity to support per flow management for the number of real-time streams you expect to support?
- Endpoints need ability to signal RSVP to ask for bandwidth reservations
- Solution provides excellent QoS, but does not scale well

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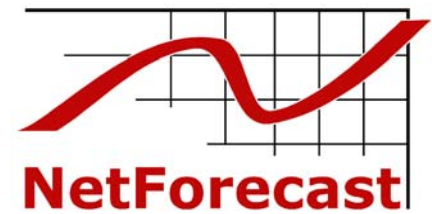
Differentiated Services (DiffServ)



- DiffServ has a lower impact on core routers
- DiffServ does not guarantee sufficient bandwidth is available
- The WAN may be using DiffServ
- Endpoints can mark packets with DiffServ code point
- Edge routers can police or modify those markings to insure consistency
- Core routers treat each class of traffic with appropriate priority
- Requires bandwidth management to insure traffic classes are not over-utilized

1. Classification
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WAN QoS Implementation



- **If the WAN is direct links owned or leased by the enterprise:**
 - WAN can be treated the same way as LAN (see above) except,
 - Over provisioning is not usually an economically viable alternative

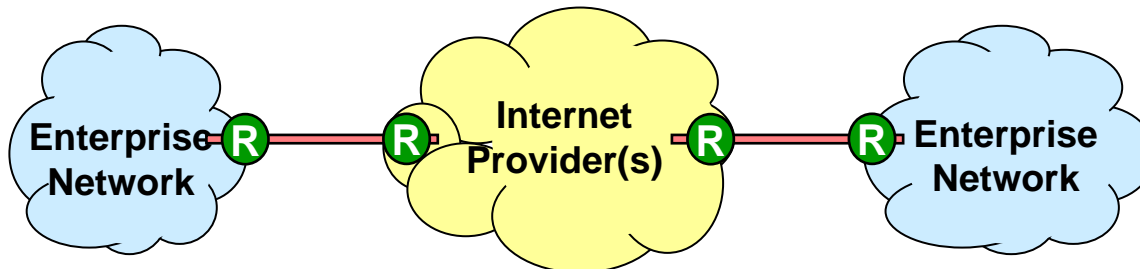
- **If the WAN is a service provider:**
 - Frame Relay, MPLS or VPN
 - My not offer QoS
 - QoS offered is usually DiffServ based

- **Service provider may not implement QoS in the core**
 - But will carry DiffServ markings through their cloud
 - Make sure they will prioritize traffic onto the access link

1. Classification
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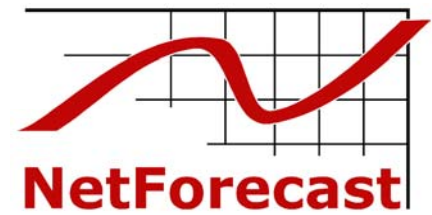
WAN over VPN

- Enterprise using VPN over Internet has additional issues
- Better chance of success of all endpoints are using the same service provider
- May be able to get provider to carry DiffServ markings, and honor them at access link router



- Need to insure DiffServ markings are promoted to encapsulated frame at VPN boundary
- Without a common service provider, quality is likely to be poor

Bandwidth Management

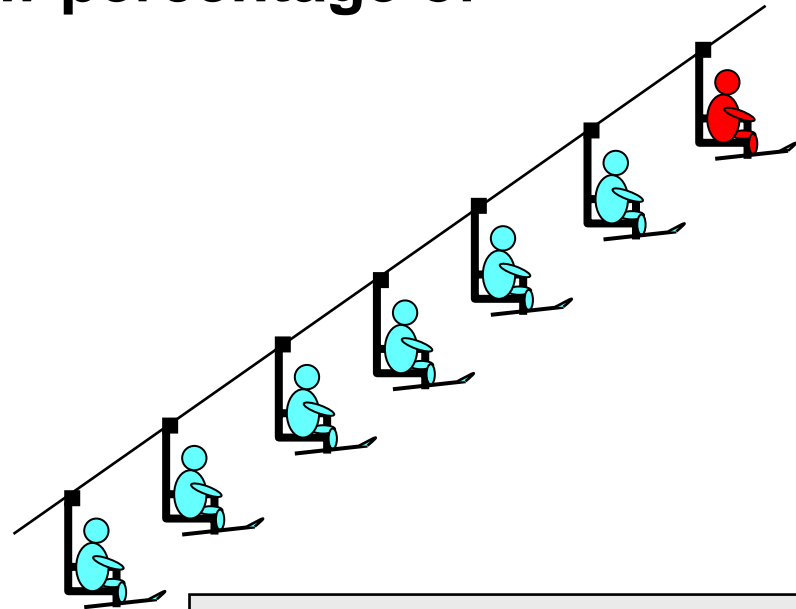
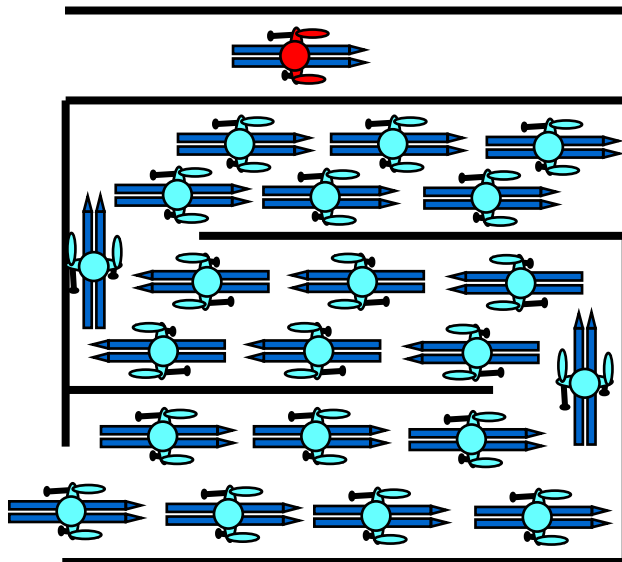


- Quality of Service only works on a limited percentage of the link bandwidth
- When all the traffic is high priority traffic, there is no QoS
- We have to manage the amount of high priority traffic in our networks to insure QoS will work as planned

1. Classification
2. QoS Implementation
3. **Bandwidth Mgmt**
4. Testing

Bandwidth Management

- Priority mechanisms only work if the prioritized traffic is a low percentage of overall traffic

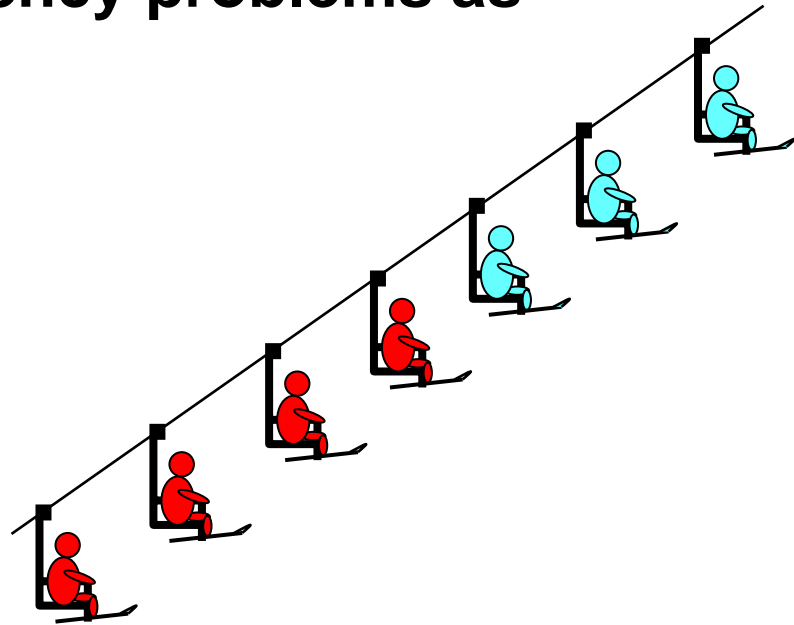
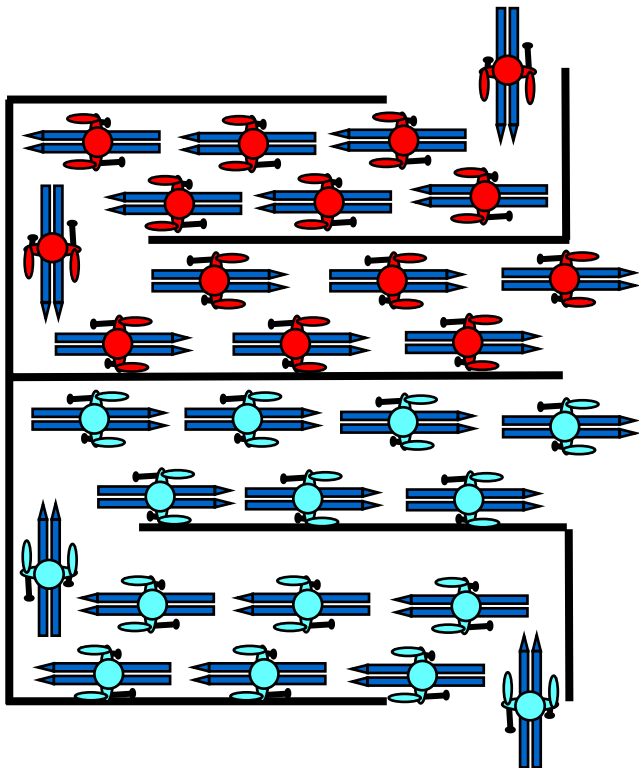


Ski patrol get high priority access to the lift

Insures ski patrol has a predictable cycle, top of hill to top of hill

Bandwidth Management (2)

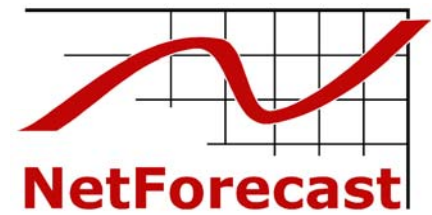
- High volumes of high priority traffic have the same loss and latency problems as low priority traffic



Too many patrol skiers cause queuing, delay, jitter

Low priority (paying) skiers are choked out by high priority excess

Bandwidth Management Challenge



- **The good news is:**

- Voice and video have very predictable bandwidth consumption
- Voice and video understand the concept of a busy signal, and/or can be rerouted through the PSTN

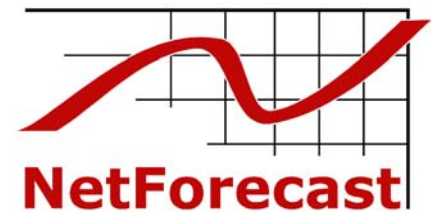
- **The bad news is:**

- Data traffic does not have predictable bandwidth
- Data applications need significant overhead to perform properly
- Data traffic must be always connected, no busy signal

- **A bandwidth management strategy is needed**

1. Classification
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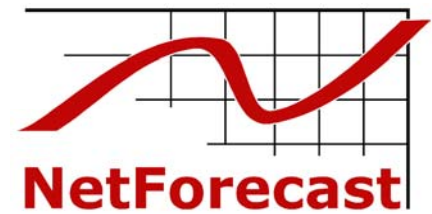
Network Testing, Required!



- **We have to test the network and monitor the call quality to know what is going on**
 - Are we delivering the quality voice/video service we want to?
 - Is the problem with the voice equipment, or the transport?
 - Where and when is the network causing problems?
- **Must test as close to end-to-end as possible**
 - Voice is subject to very local problems (echo, local connection, poor equipment) as well as network problems
- **Must isolate problems in the network**
 - So this call had poor quality, which part of this complex network caused the problem?
- **Must find problems in time domain**
 - Micro-outages cause momentary burst packet loss
 - Testing or sniffing after the fact has little value

1. Classification
2. QoS Implementation
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4. **Testing**

Testing Vendors and Tools



- **Qualify the Network**

- Ixia Chariot
- NetIQ Vivinet Assessor
- Viola NetAssessor

- **Monitor the network**

- Acterna PVA-1000
- Brix
- NetIQ Vivinet Manager
- Qovia
- RADcom Performer
- Telchemy Vqmon
- Volia NetAssessor
- Prominence

- **Debug the Network**

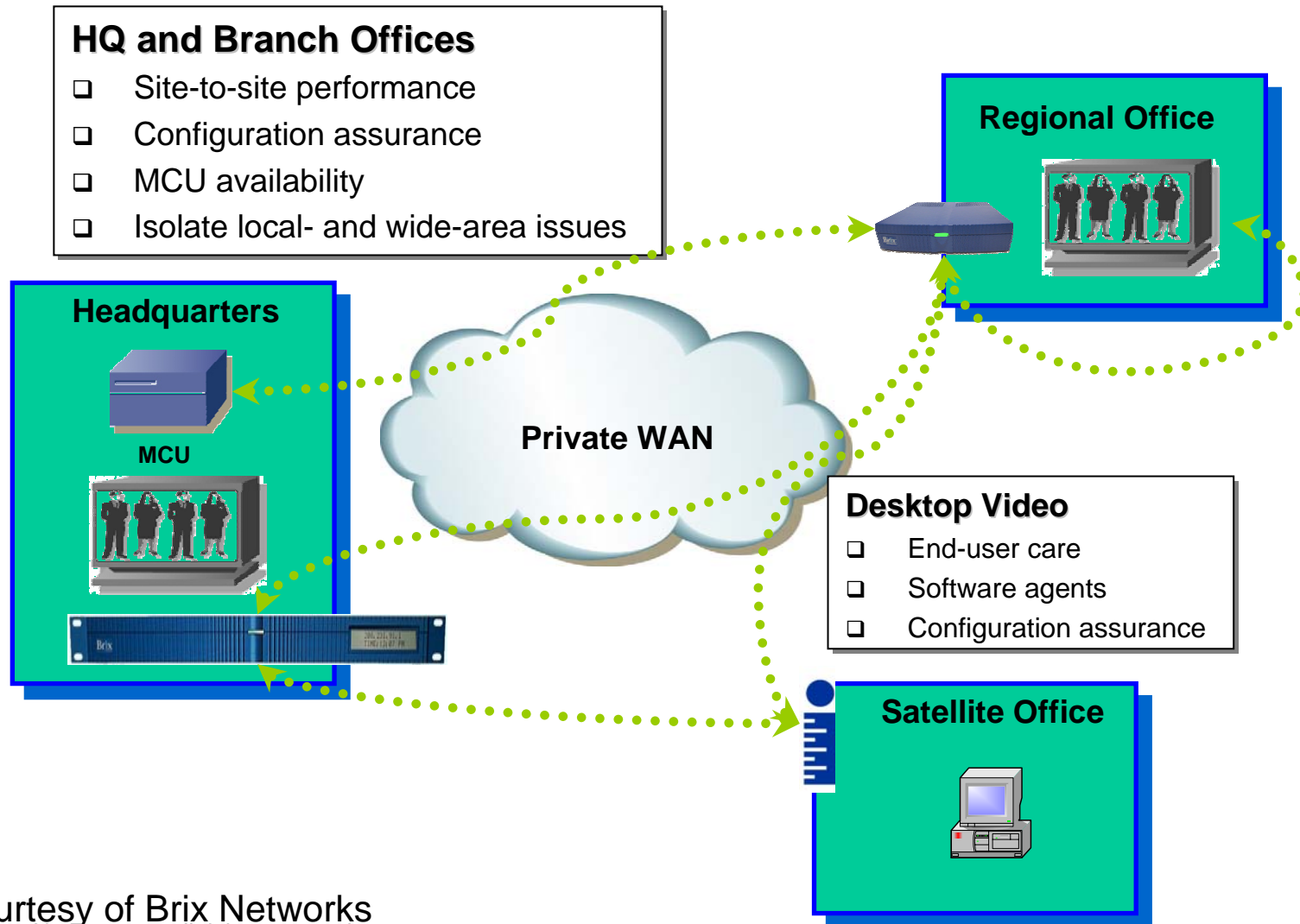
- Acterna PVA-1000
- Ixia Chariot
- NetIQ Vivinet Diagnostics

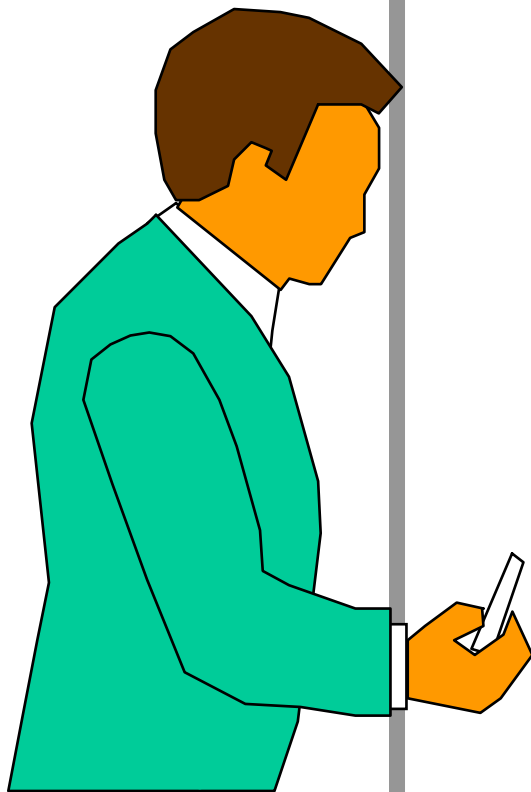
- **Consider stats in the endpoints**

- **Collect and database Call Data Records (CDRs)**

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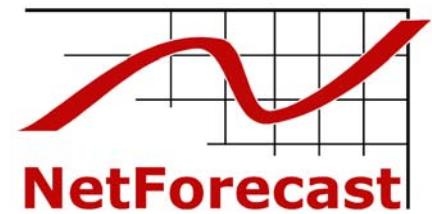
Monitoring Network to Support Enterprise Video Conferencing





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Service Level Agreements (SLA)



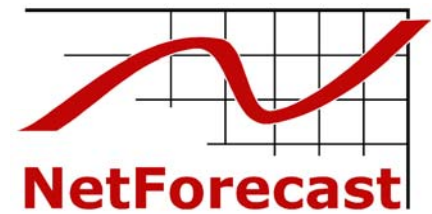
- **A Service Level Agreement defines the required network behavior to properly support your application(s)**
- **SLAs often contain specifications on availability, service response times, service windows and specify who is responsible for which equipment**
- **Additionally SLAs can specify network behavior characteristics**
 - **Bandwidth, loss, latency, jitter**
- **We will have a more extensive discussion about Service Provider SLAs on Thursday at 11:30**

An Enterprise SLA



- **Consider creating an SLA within the Enterprise**
- **Enterprise SLA specifies network requirements of high priority applications**
 - **Bandwidth, Loss, Latency, Jitter**
- **Job of the network team is to meet the specified requirements during the specified business hours**
- **Business or application groups can monitor network for compliance**
- **Video / Voice / HP apps can be managed to insure bandwidth stays within specified constraints**

Consider an Enterprise SLA



- **Often conflicting priorities between the voice or video conferencing group and the networking group**
- **Developing an SLA agreement between the two groups up front solves this problem**
- **SLA is valuable to both application and networking groups:**
 - **Defines requirements for network, allows testing and isolation**
 - **Defines volume limit for voice or conferencing bandwidth so networking group can manage their resources**
 - **Provides cost justification for IT management by defining the amount of resources required for voice / video**

Thank you! Questions?



Some reference information:

“Economics of QoS on WAN Access Lines”, Business Communications Review, October 2004 issue, p16 by Bartlett, Moore and Sevcik

“Understanding Web Performance”, Business Communications Review, October 2001, p28 by Sevcik and Bartlett

NetForecast Report 5075 “Real Time Applications on IP Networks: Overcoming Economic Constrains on Quality of Service”

NetForecast Report 5076 “Effect of Rivulet Based Traffic on Existing Data”

- Reports and articles available at www.netforecast.com

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