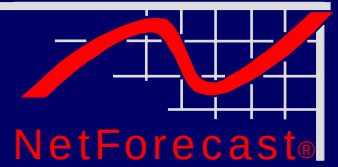
Supporting Voice and Video in the Enterprise Network

VoiceCon Fall 2006

22-August-2006



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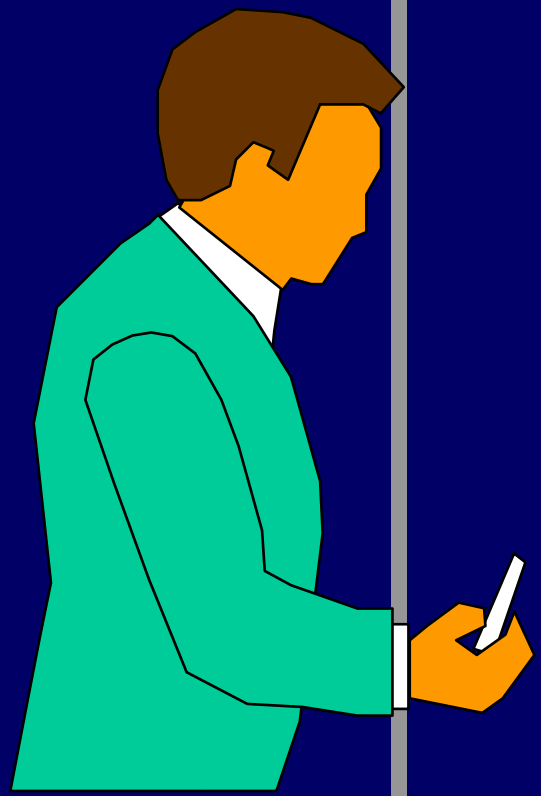
Agenda



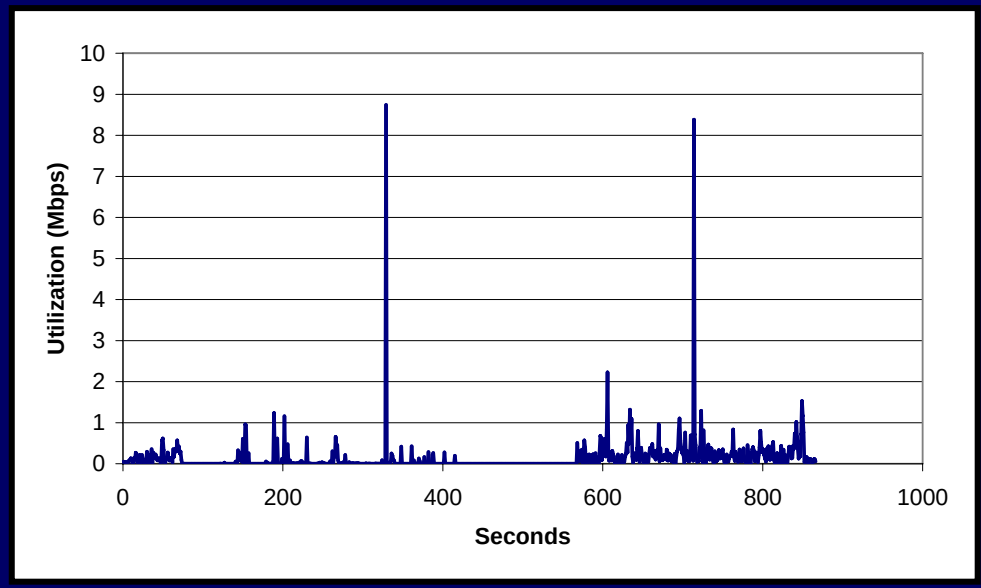
- Real-Time Traffic is Different
- Why do we need QoS?
- The Four Parts of QoS Implementation
- Q&A

Agenda

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

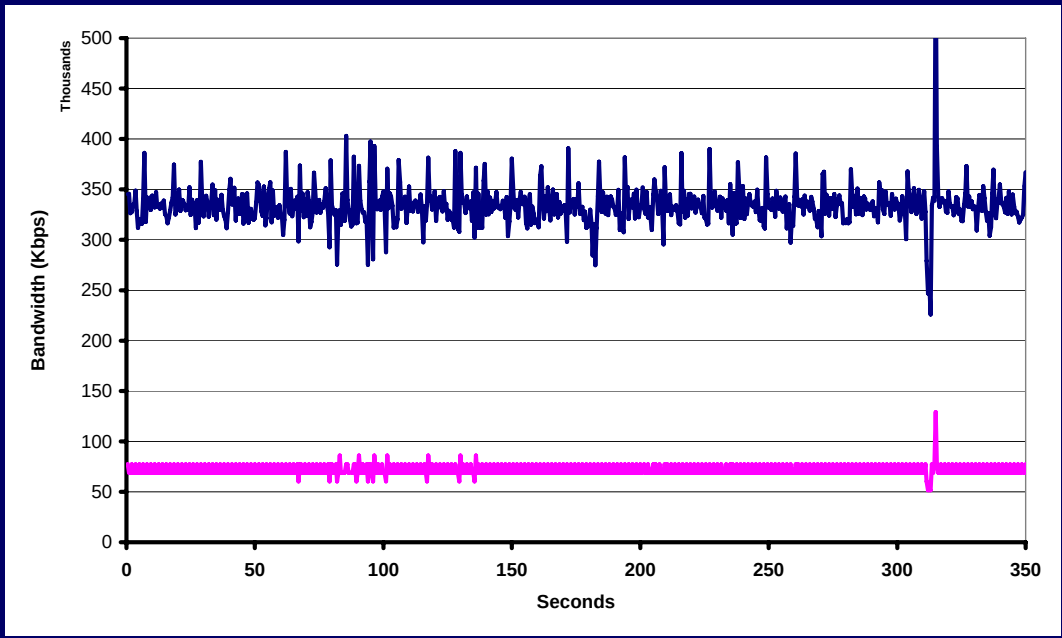
Data Traffic Characteristics

- 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

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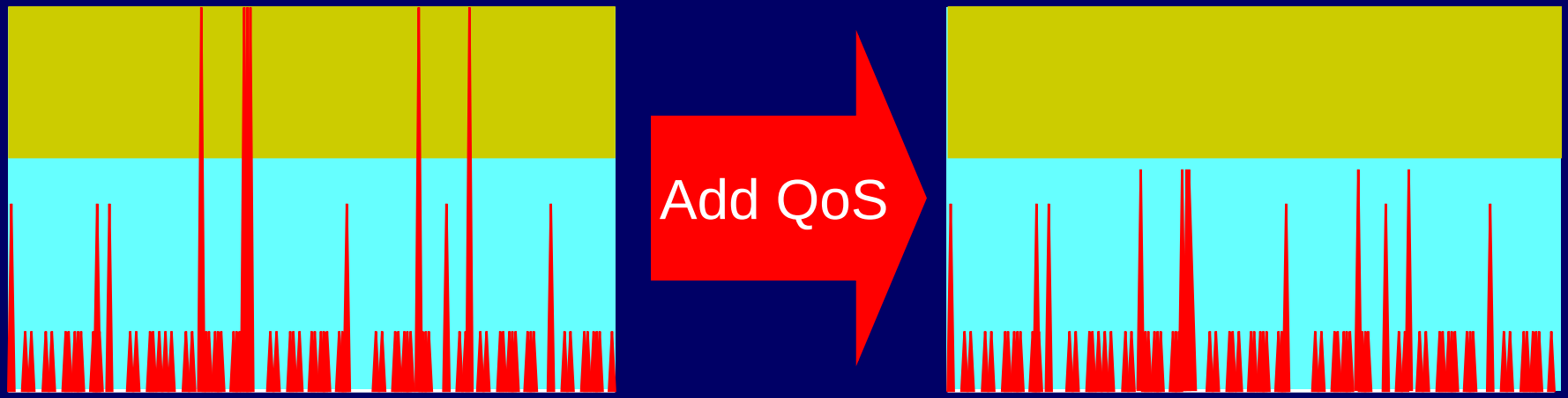
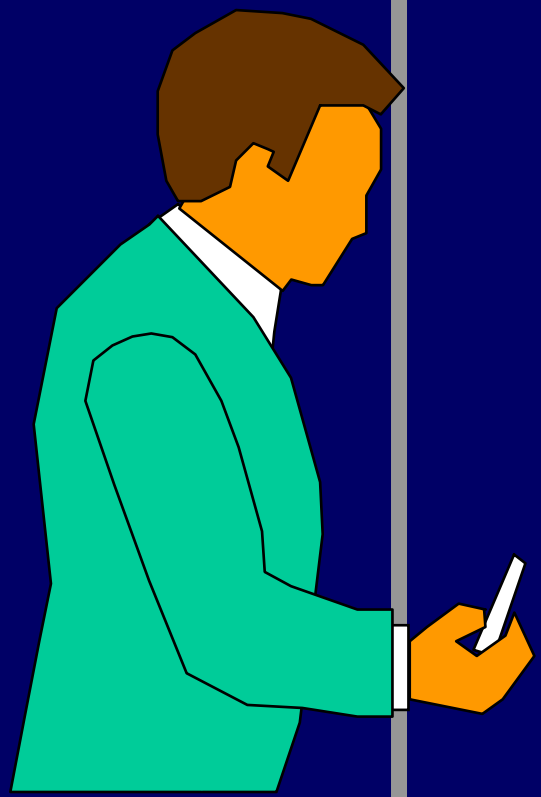
- Voice / Video packets must be delivered, and delivered in a timely manner (i.e. low packet loss, low jitter)
- There is no time to retransmit a lost packet, so lost packets cause poor quality
- Data traffic will interfere with this goal
- QoS is required to keep voice & video separated from normal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

Data and Voice Interference



- QoS gives priority to the real-time traffic
- This holds down the peaks of the data packets, and prevents packet loss and jitter in the real-time streams
- Where is this interference occurring and why?
- How does QoS work?

Agenda



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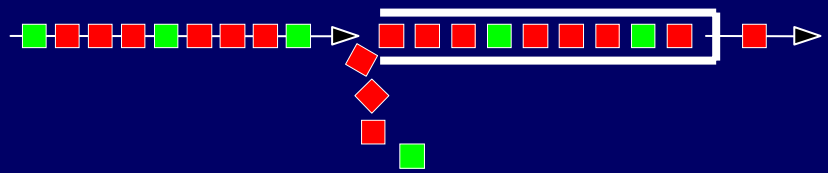
Queues cause Jitter and Loss

Packets pass through queues in switches and routers

Queue depth affects delay, causing jitter

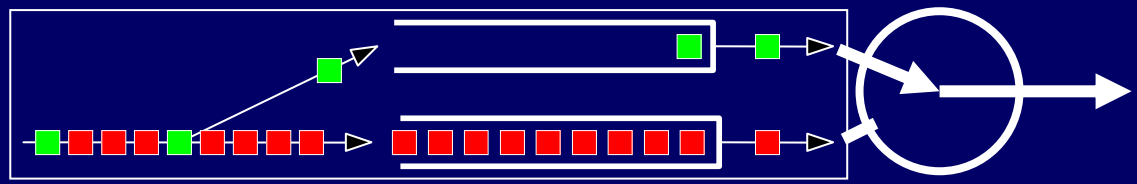
Insufficient bandwidth causes packet loss



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 IF:**
  - **If we manage the bandwidth properly**

Impact on Best Effort Traffic

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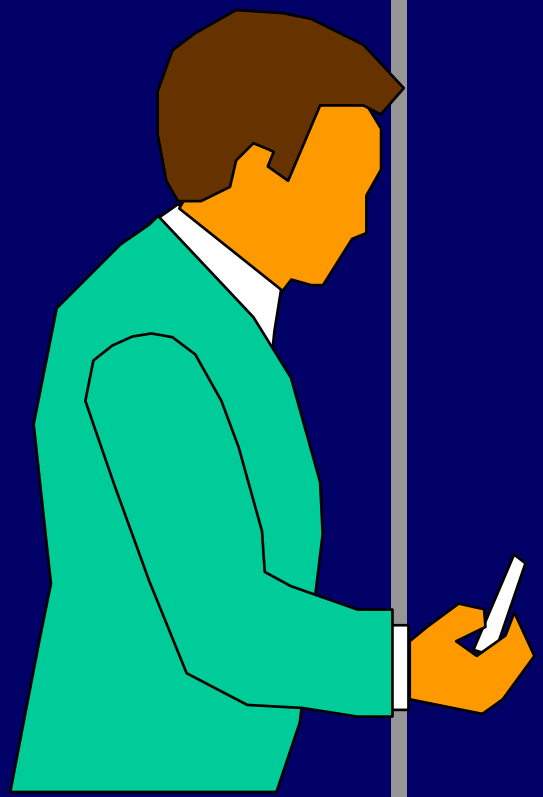
- Remember it is a zero sum game
- High priority traffic gets to always go first
- The impact on existing applications must be evaluated to ensure they will still deliver appropriate performance

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

Agenda



- Real-Time Traffic is Different
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- ***The Four Parts of QoS Implementation***

Classification

Network QoS Implementation

Bandwidth Management

Testing, Measuring and Monitoring

Classification

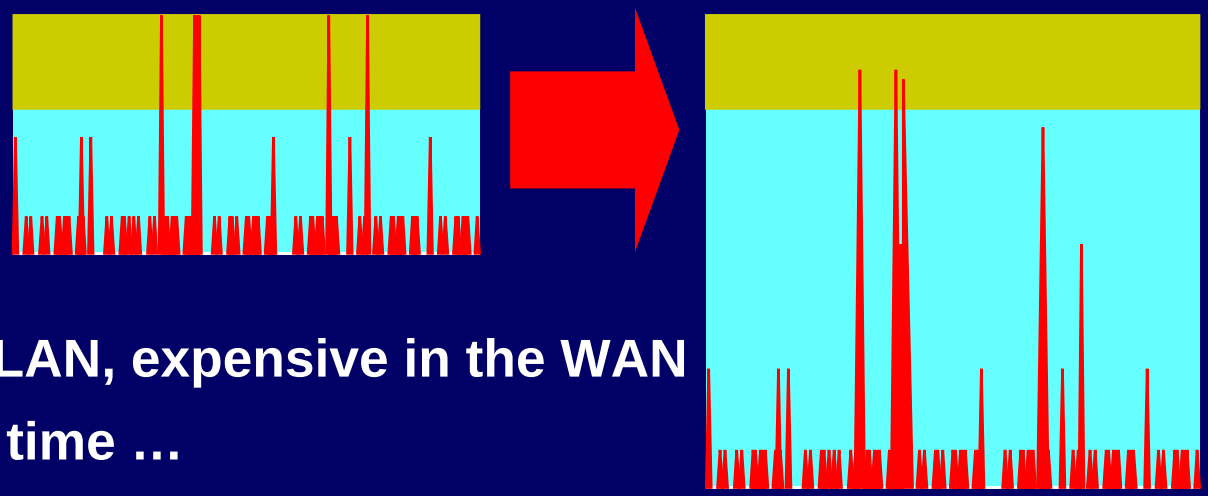
- **This is the job of deciding which traffic is high priority traffic, and which is not**
- **For a router making a decision about how to treat packets**
  - **Must be some way of identifying that this packet is high priority or not**
- **To limit this decision to the edges of the network:**
  - **Packets 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 DiffServ code point

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

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 ensure success

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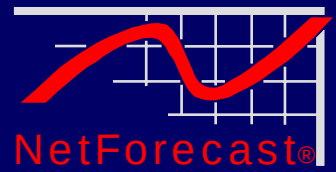
Integrated Services (IntServ) (RSVP)



- 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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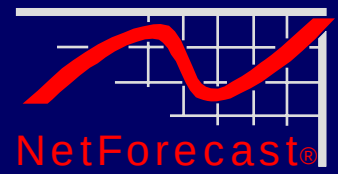
Differentiated Services (DiffServ)



- 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 ensure consistency
- Core routers treat each class of traffic with appropriate priority
- Requires bandwidth management to ensure traffic classes are not over-utilized

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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
  - May 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

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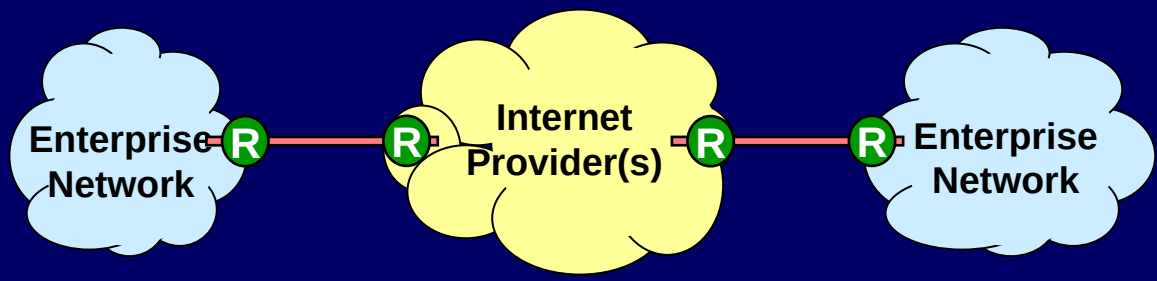
WAN over VPN

- Enterprise using VPN over Internet has additional issues
- Better chance of success if 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 ensure 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 ensure QoS will work as planned

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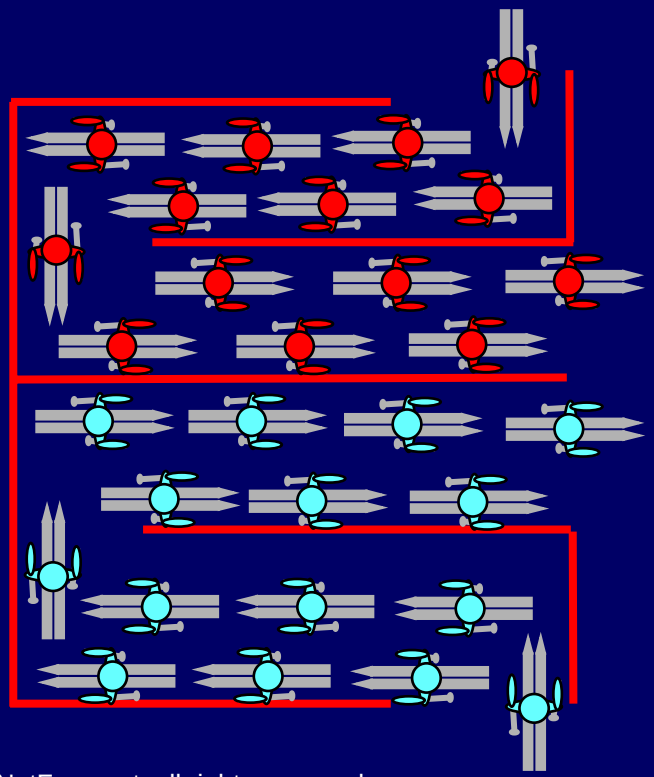
Bandwidth Management

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

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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

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Testing Vendors and Tools

- **Qualify the Network**
  - Ixia Chariot
  - NetIQ Vivinet Assessor
  - Viola NetAssessor
  - Apparent Networks
- **Monitor the network**
  - Acterna PVA-1000
  - Apparent Networks
  - Brix
  - NetIQ Vivinet Manager
  - Qovia
  - RADcom Performer
  - Telchemy Vqmon
  - Volia NetAssessor
  - Prominence
- **Debug the Network**
  - Acterna PVA-1000
  - Apparent Networks
  - Ixia Chariot
  - NetIQ Vivinet Diagnostics
- **Consider stats in the endpoints**
- **Collect and database Call Data Records (CDRs)**

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