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Challenges in deploying QoS in contemporary networks

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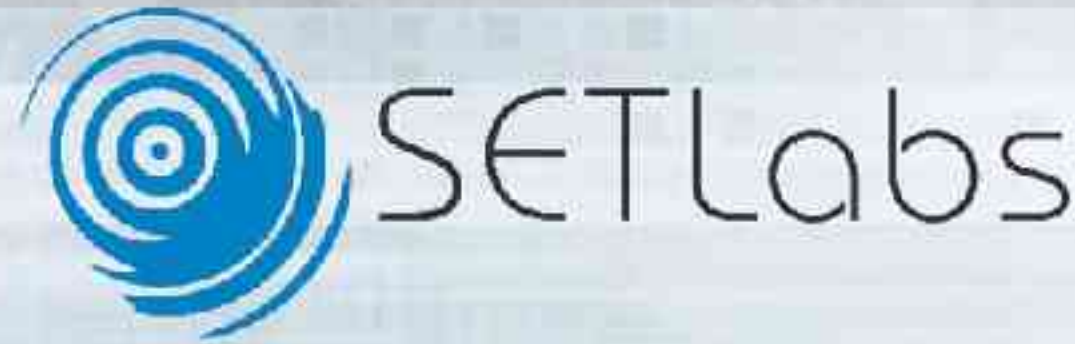


Agenda

- Introduction to Internet QoS
- Deploying IP QoS: Best Practices
- The Utopia of end-to-end QoS
- Questions ☺

Internet QoS

QoS mechanisms provide the intelligence to satisfy diverse application demands from the IP network.

	Voice	FTP	ERP and Mission-Critical
Bandwidth	Low to Moderate	Moderate to High	Low
Random Drop Sensitive	Low	High	Moderate To High
Delay Sensitive	High	Low	Low to Moderate
Jitter Sensitive	High	Low	Moderate

- Applications have varying demands from the network.
- IP networks are not typically engineered with this in mind.
- Additional intelligence has to be added to satisfy applications requirements.

QoS defined

- **Quality of Service (QoS) is a "set of qualities related to the collective behavior of one or more objects."**

- **It is the ability of the network to service an application effectively, without affecting its performance and functionality.**

Different definitions, but one goal:

Handle the diversity of traffic in manner that provides satisfactory user experience in a transparent manner.

QoS Architectures – The IETF standards

1. Integrated Services
2. Differentiated Services

Parameter	IntServ	DiffServ
Coordination for service differentiation	End to end	Per hop
Scope of service differentiation	Unicast or multicast path	Anywhere in the network or in specific paths.
Scalability	Limited by number of flows	Limited by number of classes of service
Network accounting	Based on flow characteristics and QoS requirement	Based on class usage
Network Management	Similar to circuit switching	Similar to IP networks
Inter domain deployment	Multilateral agreements	Bilateral agreements

Technology specific QoS mechanisms

No.	Technology	QoS mechanisms
1	Ethernet flavours	IEEE 802.1q
2	Frame relay	Supported by various parameters and policing mechanisms Uses DE bit, CIR, Bc, Be parameters
3	ATM	Very comprehensive framework Uses Traffic contracts and CLP bit for implementation
4	MPLS	Uses Forwarding Equivalent Class (FEC) for setting up explicit routed LSPs

CHALLENGE:
Integrate these with DiffServ for seamless QoS

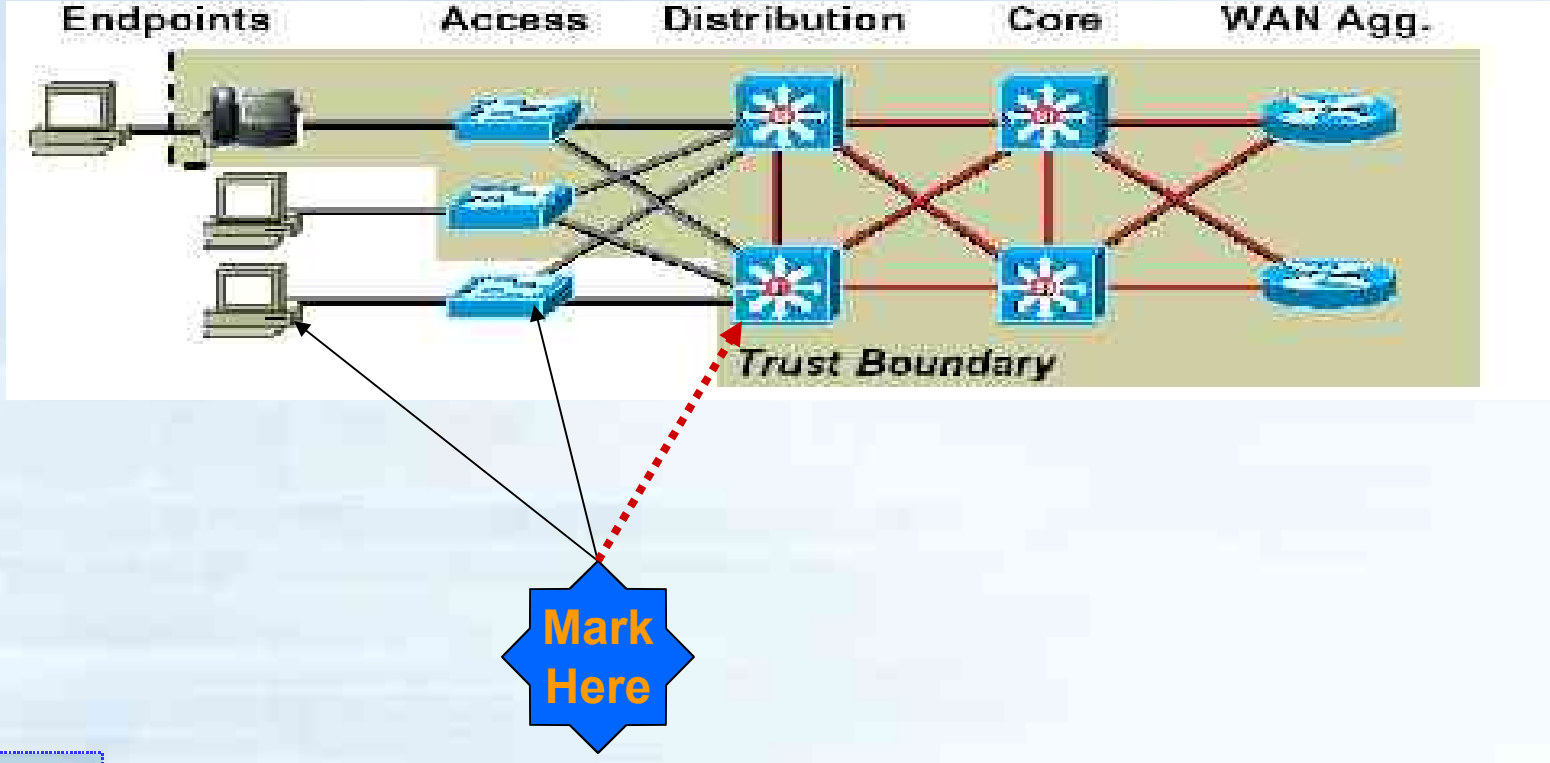
Deploying QoS

- Plan, Plan, Plan: No shortcuts to be taken
- Steps in deployment
  - Step 1: Identify and Classify Applications
  - Step 2: Define QoS Policies
  - Step 3: Test QoS Policies
  - Step 4: Implement Policies
  - Step 5: Monitor and Adjust

Best Practices – 1

- Packet classification and marking puts heavy load on QoS devices. Implement these operations as close to the end devices themselves.

- Classification & marking in the core is a strict no!



Best Practices - 2

- Use advanced classification tools if available.
  - Such tools automate discovery of applications.
  - Especially useful in classifying applications using random ports.
  - Use application recognition and traffic monitoring together to understand the load generated by applications.

Best Practices – 3

- On the LAN, enable CoS to ToS / DSCP mappings.
  - This will ensure that 802.1q enabled devices are able to convey the L2 QoS level to L3 QoS.
  - A simple yet effective method for "over the horizon" QoS.

Best Practices – 4

- Use strict priority queuing for delay sensitive applications like Voice and Video.
- Use congestion *avoidance* queuing algorithms like WRED for data
- Achieve higher link layer efficiencies
  - Do not fragment voice packets.
  - Compress IP / RTP headers.
  - Use link layer specific methods like LFI and FRF.12 to achieve better efficiencies on low speed links.

Best Practices – 5

- Handle disruptive traffic close its source.
- Shape / Police it in the end-user devices or at the most in the access layer.
- Again, use automated application identification tools for classifying such applications.

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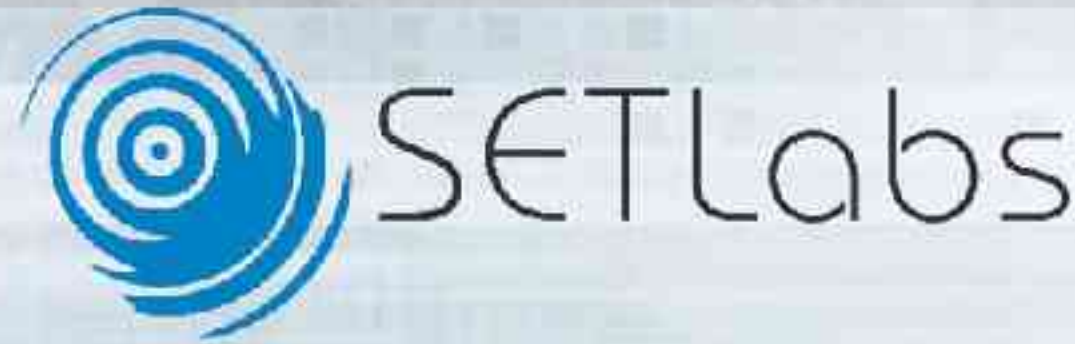
Challenges !



Is Internet scale QoS deployment possible? - 1

- Questions and more questions
  - Are the routers geared to provide true Internet scale QoS?
  - Is QoS mapping between DiffServ and technology-specific QoS mature?
  - Are scalable device independent policy-based QoS management tools available?
  - Bilateral / multilateral cooperation in a multi-vendor Internet?

Key is provide technology and vendor agnostic solutions to above issues.

Is Internet scale QoS deployment possible? - 2

- Should we deploy QoS on a public IP network?
  - Public IP networks have treated IP packets fairly till now.
  - Marking of packets as high priority will be make them easily identifiable.
- Using VPNs and mapping DSCP from IP header into the VPN tunnel header can be a solution.

Value of QoS

- QoS does not create additional capacity in the network.
- Any QoS mechanism will not improve performance on a under-provisioned network
  - Sufficient capacity provisioning is a must!
- Then why have QoS?
  - Endless capacity provisioning is impossible.
  - QoS can offer better utilization of capacity.
  - QoS can be used to create more service offerings!

Emergence of Wireless ISPs (WISPs)

- Wireless Internet ushers in a new era of opportunities and problems.

- The problems:
  - QoS in wireless networks is a topic of research and solutions are not fully mature.
  - QoS mapping between wireless access networks and DiffServ / IntServ still not mature.
  - Wireless Internet allows mobility. Deploying QoS in a mobility environment is still a grey area.

Open questions

- The technical perspective:
  - Key issue is how to "pre-allocate" resources for a mobile user!
    - When should the allocation be made?
    - For how long should the allocation be held valid for a mobile user?
    - How to ensure that resource allocation latency is low so that it does not affect real time traffic like video?
  - Ensure uniform QoS provisioning independent of factors like user density or distance from a base point
    - E.g. QoS provisioning in WLAN hotspot.

Open questions

- The management perspective
  - Key is to achieve cooperation between different WISPs
    - Billing mechanisms for inter-ISP roaming.
  - Shift pricing and charging from a flat structure
    - Service-level based.
    - Usage-level based.
    - Auction-based (bidding for reserving resources in a congested network).
    - Combination.
  - Most importantly, how to keep it simple for the average user to understand the pricing structure!

Summary

- QoS is not a silver bullet! It is not an alternative to having sufficient network capacity.
- QoS deployment should be planned thoroughly.
- Lot of vendor specific deployment and management tools are available. Leverage them.
- QoS is still a happening area!
  - Lot of scope for research
  - Possibilities for inter-ISP collaboration and cooperation.

Questions

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