IP QoS

2000. 2. 23.

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“Everything over IP”
21. 21

- Streaming, VoIP, VPN, ERP
- QoS
- IP multicast
- AAA
- 
- , 
1998년: 
33.6kbps
2002년: 
2Mbps
2010년: 
10/100Mbps
**RTT** Packet Loss
- RTT 76 ~ 1,250 ms
- 76 / 125 / 1250 ms
- RTT 76 ~ 1,250 ms

**Path**
- Path 2 ~ 22
- Path 2 ~ 3
- Routing Failure

*
### Network Traffic Analysis

<table>
<thead>
<tr>
<th>Application</th>
<th>Flow</th>
<th>Pkt.</th>
<th>Byte</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTTP</td>
<td>62%</td>
<td>56%</td>
<td>78%</td>
</tr>
<tr>
<td>FTP</td>
<td>0.6%</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>TELNET</td>
<td>0.1%</td>
<td>0.4%</td>
<td>0.4%</td>
</tr>
<tr>
<td>SMTP</td>
<td>0.5%</td>
<td>0.5%</td>
<td>0.01%</td>
</tr>
<tr>
<td>DNS</td>
<td>10%</td>
<td>2%</td>
<td>0.6%</td>
</tr>
<tr>
<td>I-Phone</td>
<td>~0%</td>
<td>4%</td>
<td>1%</td>
</tr>
<tr>
<td>Real Audio</td>
<td>~0%</td>
<td>0.1%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Battle Net</td>
<td>16%</td>
<td>23%</td>
<td>3%</td>
</tr>
</tbody>
</table>
- 애로 1: 15
- 애로 2: 280 ~ 590 ms
- 애로 3: 5 ~ 20%
- 애로 4: (표준, 평균, 최소, 최대) (표준, 평균, 최소, 최대) (표준, 평균, 최소, 최대) (표준, 평균, 최소, 최대) (표준, 평균, 최소, 최대) (표준, 평균, 최소, 최대) (표준, 평균, 최소, 최대) (표준, 평균, 최소, 최대) 
- 애로 5 / 애로 6
- 애로 7
QoS (Quality of Service)  
- Internet Access (ISP)  
- e-mail  
- Conference  
- Fax  

Network Address:  
- IP address  
- MAC address
CIDR, IPv6, IPsec, QoS
Best Effort Service --> Differentiated Service
Hop-by-hop Routing --> End-to-End source Routing
Distributed Node Management --> Centralized Policy Control
Open Access --> Access Policy
Connectionless scheme --> Reservation based Scheme

QoS Internet
Mobility Internet
Security Internet
Multicast Internet
QoS
IP QoS
QoS
QoS
QoS
QoS

- QoS
  - 
  - QoS
  - QoS
  - QoS
QoS (Quality of Service)

- ITU-T Rec. E.800
  - “The collective effect of service performance which determines the degree of satisfaction of a user of the service”

- QoS, QoS, QoS, QoS, QoS, QoS
- QoS

(QoS)

- Latency Time
- Interactivity
- Traffic Engineering & Policy
- Resource Management
- Hop-level QoS
- End-to-End-level QoS
QoS

- Over-Provisioning QoS
- Point QoS
- End-to-End QoS

- Priority Control
- QoS-based Routing
- QoS-based Policy Control
- QoS, Traffic Engineering, and Resource Management

- (Plentiful capacity)
- (Traffic engineering)

- Dynamic resource reservation protocol
- dynamic resource reservation protocol
IETF [Internet Integrated Service]

IntServ, RSVP

(Internet Differentiated Service)
QoS

- QoS

- [보기1]
  - [보기2]
  - [보기3]

- [보기4]
  - [보기5]

- [보기6]
  - [보기7]
- **PHB (Per-Hop-Behavior)**
  - DSCP
  - Classifier, Meter, Marker, Shaper, Dropper

- **Traffic Conditioner**
  - Classifier, Meter, Marker, Shaper, Dropper
  - (Traffic Aggregation, DSCP, Classifier, Meter, Marker, Shaper, Dropper)

- **Policy Agent**
  - Policy
  - Policy Agent (SLA)
QoS 概念

资源（Resources）

管理（Mgmt System）

策略（Policies）

控制（Control）

应用（Applications）

资源可用（Resources available）

QoS 需求（QoS needed）

---

End-to-end QoS Guarantee
End-to-end QoS Control

- Two-Tier QoS
  - Intra-domain
  - Inter-domain

Intra-domain
- provisioning
- manual configuration, or SNMP
- RSVP setup protocol

Inter-domain
- pre-negotiated neighboring relation, Service Level Agreement (SLA), long lived
Domain = Region of shared trust, administration, provisioning

end-to-end QoS
QoS brightness

- QoS monitoring
- QoS monitoring of QoS monitoring

- Protocol Monitoring
- Network Monitoring
- End-to-end QoS Monitoring
Protocol Monitoring
- RTMF (Realtime Traffic Flow Measurement)

Network Monitoring
- RTMF (Realtime Traffic Flow Measurement)

End-to-end QoS Monitoring
- RTMF (Realtime Traffic Flow Measurement)
NPMS의 IP 주소를 이용하여 접속할 수 있다 (IP 주소, IP 주소, IP 주소)

QoS를 이용하여 접속할 수 있다 (ITU-T E.210, QoS)

IP 주소를 이용하여 접속할 수 있다 (IP 주소, IP 주소, IP 주소)
Availability
- Service Uptime
- Reachable Test
- Resource Availability

Reliability
- Service Interruption
- Completeness
- Packet Loss

Performance
- Round-Trip Time(response)
- Traffic Bandwidth
- Packet Loss
- Download Time

Scalability
- ByTime
QoS
IP QoS
QoS
QoS
QoS
QoS
QoS
- Integrated Services (intserv)
- Policy Framework (policy)
- Resource Reservation Protocol (RSVP)
- Differentiated Services (diffserv)
- IP Performance Metrics (ippm)
- Internet Traffic Engineering (tewg)
- Distributed Management (disman)
- Remote Network Monitoring (rmonmib)
- Routing Policy System (rps)
- Multiprotocol Label Switching (mpls)
- Open Shortest Path First (ospf)
- Resource Allocation Protocol (rap)
Integrated Services

- Guaranteed Service
- Controlled-load Service
- Packet Scheduler, Classifier, Admission Control, Resource Reservation
Internet Traffic Engineering

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Differentiated Services

- Class of Service

- Differentiated Services
  - Diffserv Routers
  - Per Hop Behavior Identification Codes
IP Performance Metrics

- 
- A One-way Delay Metric
- A Round-trip Delay Metric
- A One-way Packet Loss Metric
- One-way Loss Pattern Sample Metrics
Policy Framework

- Policy
- IETF Policy Framework WG for policy based management
- IETF RAP WG’s COPS (Common Open Policy Service)
IP

1: Integrated Services
2: Impact to telecomm access infrastructures to IP application
3: Interworking between IP-based network and switched-circuit network, including wireless networks
4: Multimedia applications over IP
5: Numbering and addressing
6: Transport for IP-structured signals
7: Signaling support, IN and routing for services on IP-based networks
8: Performance
9: Integrated management of telecom and IP-based networks
10: Security aspects
11: Network capabilities including requirements for resource mgnt
12: Operations and Maintenance (OAM) for IP
- IP

- Contact agent, Exchange agent, Transport agent

- CORBA+IDL

- ITU-T SG13, Q.29, ICA (Information Communication Architecture)
Multimedia applications over IP

- Voice over IP
- Fax over IP
- Multimedia conferencing
- Multicasting
- Narrowcasting
- Webcasting & broadcasting over IP
- Media stream coding
- Best effort (classic IP)
- One-size fits all (classic telephony)
- Selectable priority/selectable features
- Select individual performance value allocation/accumulation in a multiple service provider environment

IP ¼­ºñ½º QoS ¼­ºñ½º
- (segregation)
IP QoS

- IP QoS

Premium QoS

- Guaranteed Services: Per Flow Rate Reservation

- Very Fair Priority Classes: Per Flow WFQ

- Fair Priority Classes: Class-Based Queuing (WFQ)

- Single-Class Best Effort

No QoS

Integrated Switching

IP Routing
- Qbone

[Diagram showing network components and connections]

- LDAP Server
- Optivity Policy Server
- RT Stereo Video
- RT Stereo Video Source
- SOX / vBNS
- ATM
- BLN ASN Ethernet Switch
- ATM / DS-3
- ATM / OC-3
- 100BT
- Accelar 1200
- COPS
- Highway 1 Washington D.C.
- MCNC, RTP
- UNC, Chapel Hill
- Nano-Manipulator
- Video Conferencing
1st scenario: IP precedence based QoS mechanisms (1999 ñana
- TF-TANT)
- IP precedence marked traffic is carried by a dedicated ATM connection

2nd scenario: differ serv architecture (1999 ñana
- TF-TANT)

1. Packet classification
2. Packet labelling
3. Policy control
4. PHB mapping
5. Traffic conditioning
6. Policy control
3rd scenario: mixed diffserv-intserv architecture

- Policing
- Classification
- Re-shaping
- Admission control

Intserv stub region  Diffserv transit region  Intserv stub region
APAN-KR - APAN-QBone

STUB (RSVP) CNU

QBone-KR Seoul

QBone-JP Tokyo

QBone-SG

Multiple PVCs with CoS

APAN/TransPAC (Transit Network)

STAR TAP

Edge Router

QBone BB

QBone BB

QBone BB

QBone BB

APAN-QBone
QoS

- (QoS 설정 및 관리)
  - QoS 설정 및 관리

- Pr. 템플
  - CoS 설정 및 관리

- Principle
  - DiffServ 설정 및 관리 (Policy based)
  - IP 설정 및 관리
    - IP flow 설정 및 관리
QoS

<table>
<thead>
<tr>
<th></th>
<th>IP Today</th>
<th>IP &amp; DiffServ</th>
<th>IP with QoS &amp; New Routing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WWW</strong> (TCP)</td>
<td><img src="image" alt="10ms" /> (Slow Start 10ms)</td>
<td><img src="image" alt="10ms" /> (Slow Start 10ms)</td>
<td><img src="image" alt="1ms" /> (1ms)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(&gt;100 ms)</td>
<td><img src="image" alt="50ms" /> (50ms)</td>
<td><img src="image" alt="50ms" /> (50ms)</td>
<td><img src="image" alt="50ms" /> (50ms)</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="10%" /></td>
<td><img src="image" alt="10%" /></td>
<td><img src="image" alt="10%" /></td>
</tr>
<tr>
<td>TCP</td>
<td><img src="image" alt="10%" /></td>
<td><img src="image" alt="10%" /></td>
<td><img src="image" alt="10%" /></td>
</tr>
</tbody>
</table>

(NGN 99%)
QoS QoS
IP QoS QoS
QoS QoS QoS
QoS QoS QoS
Node (Hub, Switch, Modem, ..) Node (MPLS SW, MM Terminal, ..) Node (DS, VPN ..)

- (QoS) 
- MPLS SW QoS
- VPN, DS QoS
- VPN, DS (QoS)
Hub, Switch, Modem, ...

MPLS SW, MM Terminal, ...

QoS (DS, VPN, ...)
IP QoS

- QoS: progressive improvements

- Key areas: ETRI, KT, ICU

- Development:
  - ’99-’01
  - 48% (’99: 13.5%) → ETRI: 11%, KT: 1.5%, ICU: 1%
  - 40% (’99: 15.2%) → ETRI: 10.8M/Y, KT: 2M/Y, ICU: 2.4M/Y
AniServer

AniServer : QoS

ISP A  
ISP B
AniServer

- ETRI

Admin

Proprietary

Service User

Routing Advisor

Policy Server

I-DNS Session Manager

Security

Routing Table & Lookup Table

Execution

Routing Table & Lookup Table

PEP
WS  AniServer