

ISP

QoS

ISP

QoS

^o,, **, *, *

*KT

**

End-to-end QoS provisioning on ISP network

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Diffserv
ISP

QoS

ISP

QoS

ISP
Diffserv
QoS

VoIP,
ISP

ISP

1.

가 가 ADSL, VDSL

가 Mbps

2. ISP

QoS

가
VoIP

가

POP(Point of Presence)

ISP

POP 가

random drop

ISP

IDC(Internet Data Center),
IX(Internet Exchange)

VoIP

IP QoS
Intserv [1], Diffserv [2], [3]

QoS

[1]
ISP

가

ISP

가
layer 2

Intserv flow status 가

, layer 3

가

ISP end-to-end QoS

Diffserv

MPLS

POS(Packet Over SONET)가
point-to-

ISP

가
point

QoS , 2
, 3

ISP

가

, 4

5

QoS

layer 2

shared media

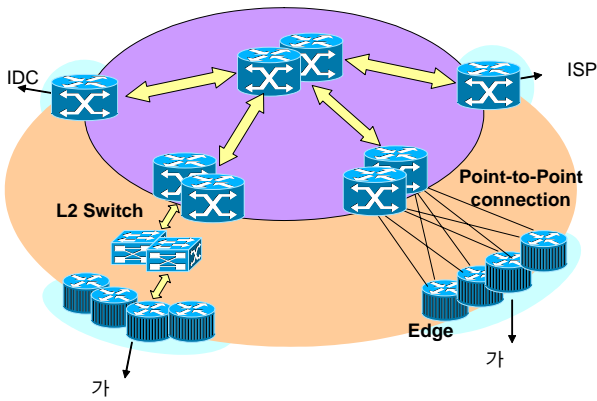
full

ISP

QoS

가

mesh point-to-point



[1]

ISP

가

	QoS			
		Latency	Jitter	
VoIP		150ms		
VoIP				
Game				
Best Effort	-	-	-	-

[1]

QoS

QoS (core)

(edge)

가

가

, 가

, ADSL

, VDSL

, ONU(Optical Network Unit)

IP

Diffserv

, layer 2

802.1p

QoS

가

QoS

QoS

가 QoS

가

가

ISP

QoS

가

, ISP

“

VoIP

QoS

TCP/UDP

QoS

가

. VoIP

가 VoIP

VoIP

(classification)

QoS

QoS

VoIP, VPN,

QoS

([1]).

VoIP

가

, VoIP

가

QoS

가

ISP

3.

QoS

가

ISP

QoS

, 가

(rate-limit)

가

VoIP

. 가

가

marking

drop

가

가

marking

CoS

MPLS

MPLS

marking

DSCP, IP precedence

layer 2

marking

. Layer 3

layer 2

802.1p

3 CoS

IP

precedence

, layer 2

. Layer 2

, layer 3

layer 4

802.1p

가

[4],

layer 2

QoS

marking

per hop behavior

Cisco

QoS

, Cisco

congestion avoidance

ISP

QoS

WRED(Weighted Random Early Detection) [7]
 MDRR(Modified Deficit Round Robin) [7]
 drop rate

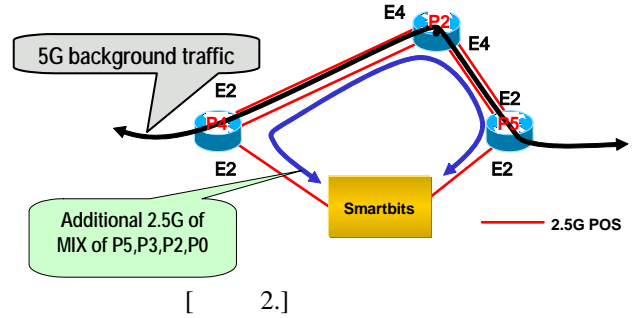
WRED IP precedence
 min/max threshold
 Best effort
 threshold
 threshold
 queue
 drop rate

RED[6]
 average queue
 minimum drop
 maximum
 min/max
 drop
 min/max

WRED
 MDRR
 MDRR DRR[5]
 queue quantum
 quantum queue
 queueing)
 low latency queue(priority
 가 가
 Low latency queue
 Strict low latency queue 가
 Strict queue
 low latency queue
 가
 Strict low

4. QoS

Cisco 12000 [2]
 2 2.5Gbps POS
 5Gbps
 2 2.5Gbps POS
 Smartbits
 Smartflow QoS Testing[9]
 가
 6000B[8]
 가
 best effort
 IP precedence 가 0



Smartbits
 2.5Gbps POS
 5Gbps 150%(7.5Gbps)
 Smartbits
 Precedence 가 [2]
 IP precedence

	VoIP	VoIP	Game	Best Effort
IP Precedence	5	3	2	0

[2] IP precedence

Smartflow [4]
 VoIP H.323 SIP
 4000 flow 16~32000
 Smartflow "Game":
 "VoIP H.323": "VoIP H.323": "VoIP SIP":
 "Best Effort" [3]

	precedence				
Game	2	23.5%	128	TCP	4000
VoIP	5	5.8%	128	UDP	16 ~ 32000
VoIP H.323	3	5.8%	128	TCP	1718
VoIP SIP	3	5.8%	128	UDP	5060
Best Effort	0	58.8%	128	Any	any

[3]

2.5Gbps POS
 WRED MDRR

WRED maximum threshold
 minimum threshold IP Precedence

ISP

threshold [4]

precedence		Minimum threshold	max threshold
0	58.8%	$6220 * 0.588 = 3657$	20736
2	23.5%	$10368 * 0.235 = 2436$	20736
3	11.7%	$12441 * 0.117 = 1455$	20736

[4] WRED threshold

MDRR quantum

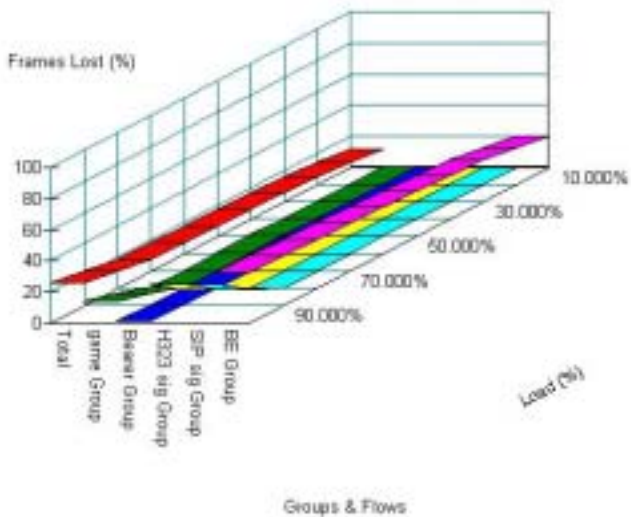
precedence 5 , queue 5 가
 queue quantum 10% ,
 quantum [5]
 VoIP low latency queue
 queue

	IP precedence	quantum	quantum/total
0.588235	0	16348	0.605661
0.235294	2	6108	0.226289
0.117647	3	3036	0.112478
0.058824	5	1500	0.055572
Total		26992	1

[5] MDRR

, Smartflow

[3] [4]
 2.5G Smartbits
 10% Smartbits 0.25G



[3]

[3] , VoIP (bearer)

, best effort(BE)

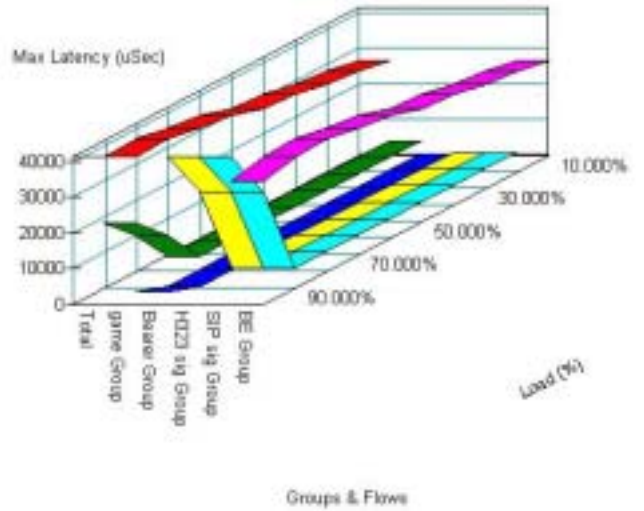
QoS

70%

[4]

, WRED , MDRR queue

가



[4]

5.

ISP

QoS

ISP

QoS

avoidance

, congestion

IP Precedence

8

가

POP

POP

POP

가

가

QoS

QoS

QoS

6.

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