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8	42

1.

90

(World Wide Web)[45]

, MIME[1, 2],

IMAP[3, 4], POP[5]

Best-Effort

(non real-time traffic)

(real-time

traffic) 가

(throughput)

(transparency),

(reliability)

[36].

telnet, ftp, mail, news, smtp

1

IP

Type of

Service (TOS)

TCP/IP

가

가

가

가

가

가

1 TOS

<i>Application</i>	<i>minimize delay</i>	<i>maximize throughput</i>	<i>maximize reliability</i>	<i>minimize monetary cost</i>	<i>Hex value</i>
Telnet/Rlogin	1	0	0	0	0x10
FTP					
Control	1	0	0	0	0x10
Data	0	1	0	0	0x08
SMTP					
Command	1	0	0	0	0x10
Data	0	1	0	0	0x08
SNMP	0	0	1	0	0x04
NNTP	0	0	0	1	0x02

가 가

가

가

(Best-Effort)

TCP

UDP

control) (congestion) (flow

가 LAN

가 WAN

가

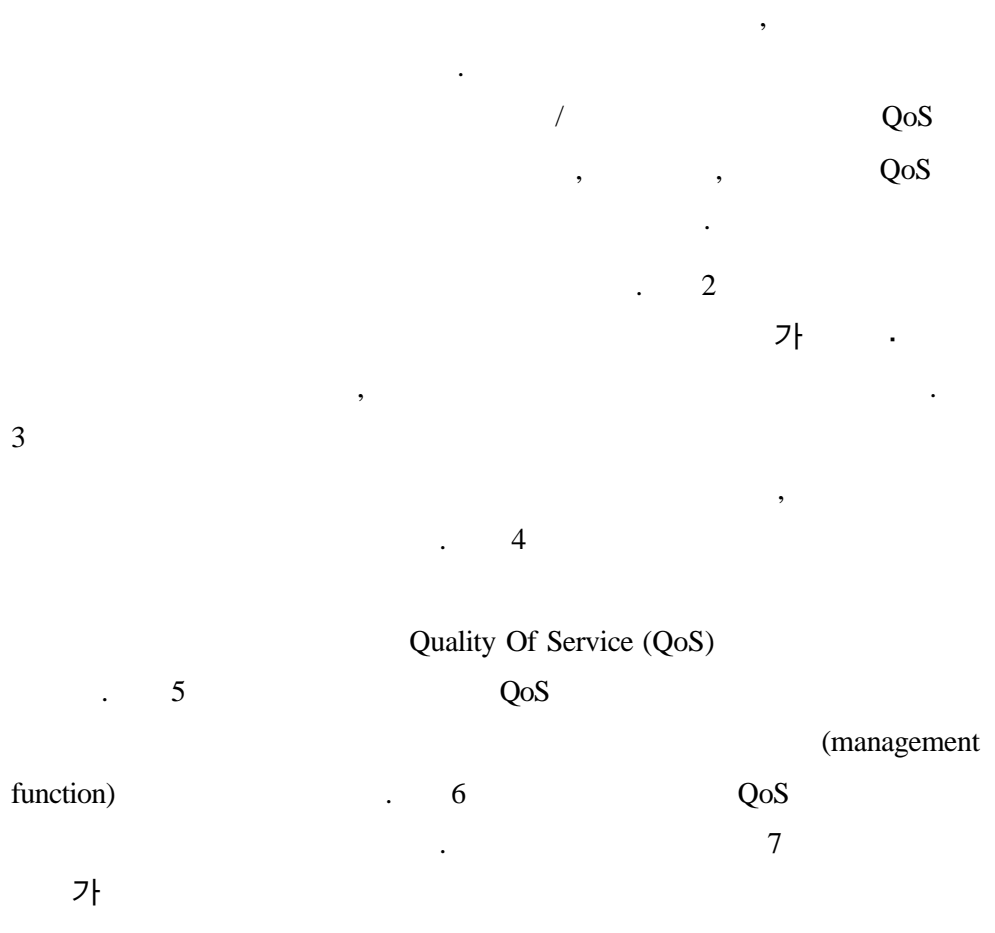
가

가

(Best Effort)

[6, 17, 24, 26].

가



2.

가

가

가

IETF

IntServ [6] DiffServ [17]

Best-Effort

FEC [23, 25], RESCU [24]

2.1 IntServ

Integrated Service [6] Video/Audio

1 IntServ

[7]

1

가

Admission Control, Reservation Setup Agent, Classifier, Scheduler 4 가

. Admission Control

가

. Reservation Setup Agent

가

Resource Reservation

Protocol (RSVP)[11]

. Admission Control,

Reservation Setup Agent

Traffic Control DataBase

Classifier Scheduler가

. Classifier

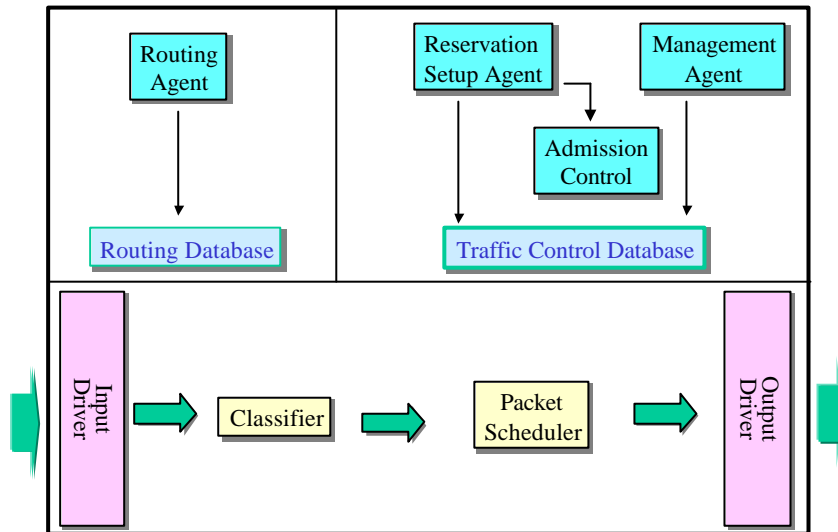
. Packet Scheduler

Random Early Detection (RED) [39], Weighted Fair Queuing(WFQ) [37,38]

Management Agent

IntServ Router

가



1 IntServ Router

IntServ

service

Controlled-load service [9] Guaranteed service [10]가

service

admission

control, policy control module 가

packet classifier,

packet scheduler

2.1.1 Controlled-load Service

unloaded state, loaded state, congested state
가 unloaded state best-effort
가 가 time-
critical 가 . Controlled-load Service
가 loaded congested unloaded
resource
RSVP Resv message parameter

2.1.2 Guaranteed Service

Guaranteed Service
가 가
host resource
parameter . host
Quality
host RSVP Resv message Tspec
Rspec maximum datagram size, bucket depth, peak rate
가

2.2 RSVP

Resource Reservation Protocol (RSVP) [11] IETF rsvp working
group Internet Integrated Service [6]

QoS

RSVP multi-source to multi-destination

TCP/IP protocol suit IP layer receiver
 resource receiver가
 가 path가
 가

[12,13,14,15].

RSVP Path message Resv message

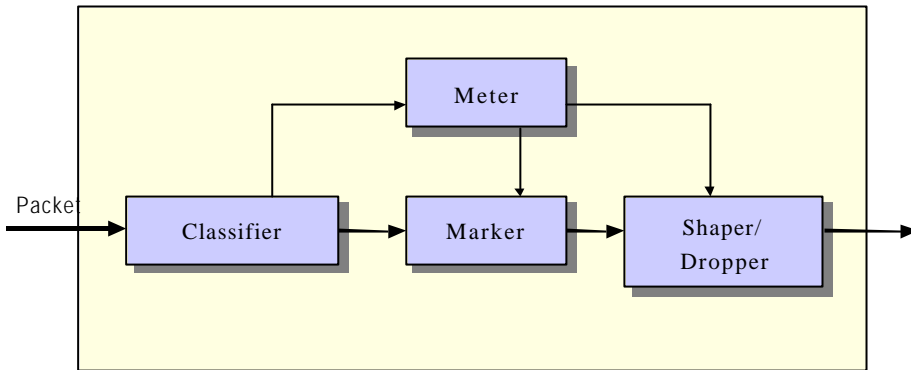
[12]. Path message

Path message
 host host
 Path message host IP
 address, TCP/UDP port number
 multimedia data host
 Resv message host가 가 가
 path
 path host
 Resv message resource ,
 Resv message Resv
 message host host

, message acknowledgement

PathErr, ResvErr, PathTear, ResvTear, ResvConf message

bit . DSCP IntServ flow
 flow
 2 DiffServ [18].



2 DiffServ

Classifier DSCP
 , Meter . Meter
 / Marker, Marker, DSCP
 Shaper/Dropper . Marker DSCP
 . DSCP
 Shaper가 , Drop dropper가
 . DiffServ DSCP
 (PHB : Per Hop Behavior)[19, 22]
 PHB . DiffServ PHB
 Edge Router Core Router
 . Edge Router 가
 DSCP Core Router

DSCP PHB . DSCP
 Meter 가 drop
 Assured Forwarding PHB Group (AF)[21]
 An Expedited Forwarding PHB Group (EF)[20]
 2 AF DSCP .

2 AF Class DSCP

	Class 1	Class 2	Class 3	Class 4
Low Drop Prec	001010(AF11)	010010(AF21)	011010(AF31)	100010(AF41)
Medium Drop Prec	001100(AF12)	010100(AF22)	011100(AF32)	100100(AF42)
High Drop Prec	001110(AF13)	010110(AF23)	011110(AF33)	100110(AF43)

2.4 FEC

Forward Error Correction (FEC) [23, 25]
 drop drop
 가 . 가 UDP
 drop MPEG-1[41]
 H.261[26] temporal dependency 가 data가
 , index frame sample
 .
 FEC frame n n+k
 . n
 frame frame
 k .
 k .
 Linear Block Coding (LBC) . LBC k-way XOR
 k
 . audio audio ADPCM

LPC

LPC

FEC

가

가

2.5 RESCU

FEC

가 Recovery from Error Spread using Continuous Update
(RESCU) [24] . RESCU

reference frame

FEC

가

2.6 Buffering

[26,27]

가

가

real-media[26], VOD/AOD

가

가

latency 가

가

IntServ [6] RSVP [11], DiffSrv [17]

FEC [25], RESCU [24],

Buffering

IntServ DiffServ 가 가

FEC, RESCU, Buffering

TCP

$$8000 \times 8 = 64,000 \text{ bit (64Kbyte)}$$

30 frame , pixel 8bit 1 , CIF 1 ,
data .

$$352 \times 288 \times 8 \times 30 = 24,330,240 \text{ bit (3.041280 Mbyte)}$$

가
temporal
redundancy 가 frame 가
가
(quality) 가
44100Hz QCIF
10 frame/sec
가

가

ADPCM
temporal redundancy

H.261

가
reference frame 가

3.2

가

가

가 .

(congestion)

가 가 .

가

FEC RESCU

. TCP

TCP

congestion avoidance

slow start

가 congestion .

FEC RESCU

가

가 .

가 가

가

가 .

VOD ,

가 가

TCP

QoS

3.3 QoS

QoS 가

3.3.1

, 가 가

3.3.2

가

QoS

가

3.3.3

가

best effort

가

가

TCP

(error

recovery)

가

,

UDP

가

RESCU

가

3.3.4

(flow control),

(error recovery),

(congestion control)

. TCP

TCP

UDP

4 가

(QoS parameters)
functions)

,

QoS

,

QoS
(QoS management
QoS

4. QoS

QoS

4.1 QoS

가
CD
가 , 가 ,
가 , 가
가 5, 10 15, 30
가
QoS
가
QoS

4.2 QoS

QoS

3 /

3 QoS

Video		Audio	
fame rate	(frame/sec)	sampling rate	(Hz)
permission	(bit)	Channel	{mono, stereo}
resolution	(pixel)	Precision	bit
encoding method	(%)	encoding method	(%)

/ 가 QoS

4.2.1

frame rate 1 frame 5, 10, 15, 30 frame
 가 . 가 . 5
 frame 30 frame

6

precision 가 pixel
 bit . 8bit

$2^8 = 256$ color

16bit 24bit, 32bit

frame

resolution frame
 frame pixel 가
 frame pixel 가 4
 frame
 QCIF CIF format
 QCIF CIF format 4

4

<i>Format</i>	<i>Size (X x Y)pixels</i>	<i>Full name</i>	<i>Etc</i>
NTSC	640 x 480	National Television Standards Committee	USA standard
PAL	768 x 576	Phase Alternation by Line	Europe standard
QCIF	176 x 144	Quarter CIF	Multimedia standard
CIF	352 x 288	Common Interchange Format	Multimedia standard

Encoding method

, 가

MPEG MPEG-1 [41], JPEG Motion JPEG [42], ITU-T
 H.261 [26], H.263 [46], H.323 [47]
 H.261

가

가

4.2.2

가
4 가 .

sampling rate 1 .
8000Hz CD
44100Hz 가
8000, 11025, 22050, 44100 .
channel .

precision sample bit .
quantization error가
, precision error

encoding method 가

ADPCM [44] , ITU-T G.721 [49], G.723
[48] Interactive Multimedia
Association(IMA) 가 ADPCM [44]
real-audio .

4.3

QoS

가 ,
 . QoS

5

5 QoS

$D_{audio} = A_s * A_c * A_p * A_e$ $D_{video} = V_f * V_p * V_r * V_e$ $D_{total} = D_{audio} + D_{video}$	A_s : audio sampling rate A_c : audio channel A_p : audio precision A_e : audio encoding method V_f : video frame rate V_r : video resolution V_p : video precision V_e : video encoding method
D_{audio} : audio Bandwidth D_{video} : video bandwidth D_{total} : total bandwidth	

가

6

6 QoS

Video		Audio	
Frame rate	15 frame/sec	sampling rate	11025 Hz
Resolution	QCIF (176x144)	channel	Mono
Precision	8bit	precision	16bit
Encoding method	MJPEG (50%/frame)	encoding method	G.721 (4bit/sample)

1 (D_{video})

$15 \times (176 \times 144) \times 8 \times 1/2 \times 60 = 1,520,640 \text{ bit}$

1 (D_{audio})

$$11025 \times 1 \times 16 \times 1/4 = 88,200 \text{ bit}$$

$$1,520,640 + 88,200 = 1,608,840 \text{ bit/sec}$$

(D_{total})

.

5. QoS

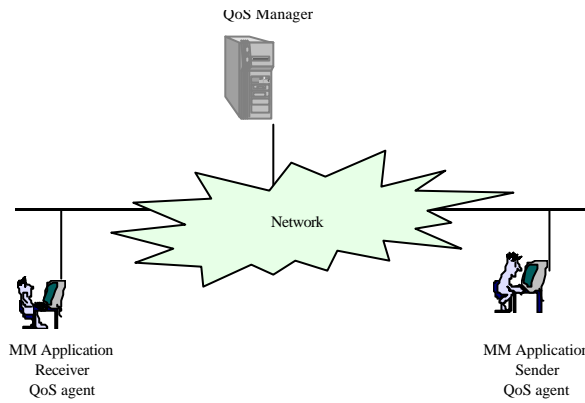
4

QoS

가
가

3

QoS 가



3 QoS

QoS

QoS

가

가

가

5.1

(QoS negotiation)

가

가

가

4

QoS

QoS

negotiation controller

Negotiation controller

QoS config DB

QoS

QoS

QoS

QoS

negotiation controller

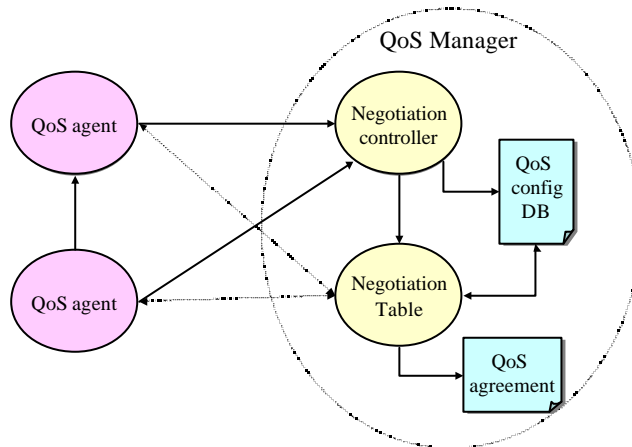
QoS Config DB

QoS

가

가 가 QoS Agreement
DB 가
가

4



4 QoS

5.2

(Multimedia Traffic Monitoring) QoS

가

QoS

가

best effort

가

가

가

QoS

가

가

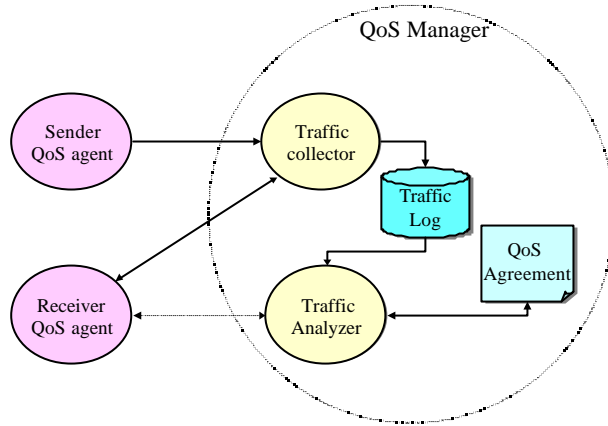
가

가

가

QoS

가 . 5



5

5.3

(QoS Control) 가

가

가

가

가 TCP
traffic

가 가
가

가
TCP

가

QoS

가

가

7

가

가

가

7QoS

<i>Video</i>	<i>Audio</i>
$V_f < V_p < V_r < V_e$	$A_s < A_c < A_p < A_e$

가

가

가

, frame rate (V_f) 가

가

가

sampling rate(A_s) 가

encoding method

가

가

가

가

가

TCP

가

(Loss_th1, Loss_th2)

(Time_th) 6 0 ~ Loss_th1

가

Loss_th1 ~ Loss_th2 가

가

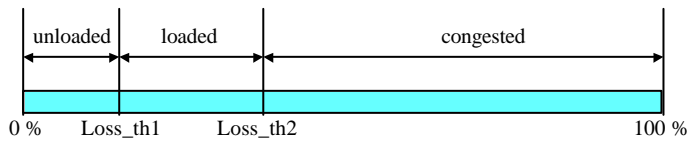
Loss_th2 가

가

가

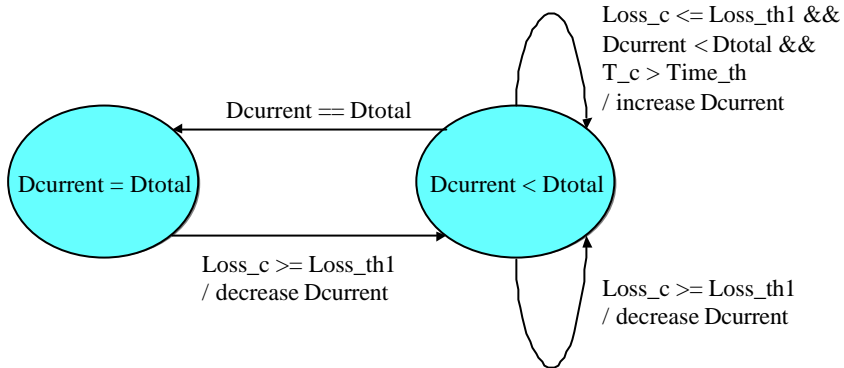
QoS

QoS



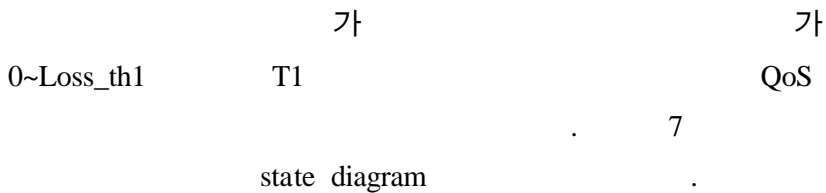
6

가



7

state transition diagram



```

If ( Loss_c >= Loss_th2 )
    decrease bandwidth by assign a new value to a user parameter;
else if ( Loss_c <= Loss_th1 && Dcurrent < Dtotal && T_c > Time_th )
    increase bandwidth by assign a new value to a user parameter;
else if ( T_current > 0 && Loss_c < Loss_th1 )
    keep current transfer rate
  
```

Loss_th1, Loss_th2 Time_th

가

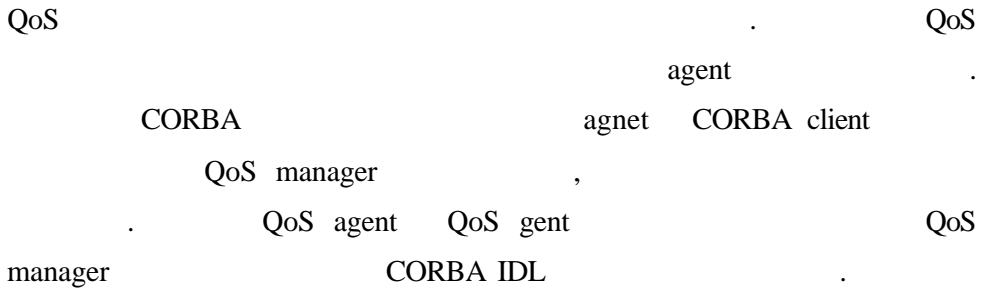
management system

가

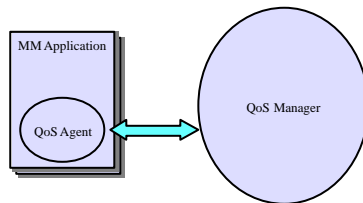
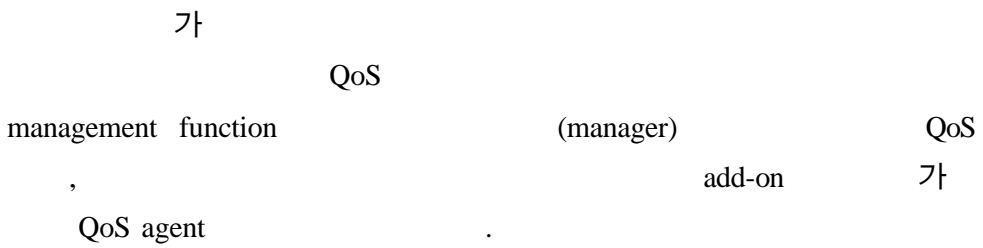
가

가

6.



6.1



8 QoS Manager QoS Agent

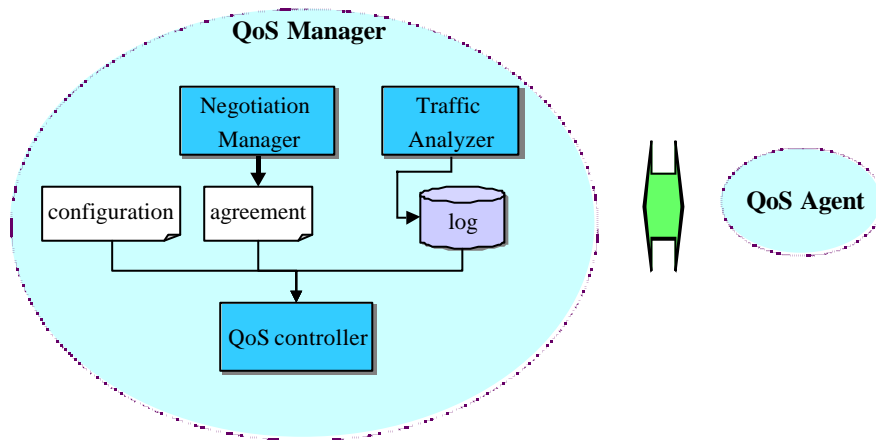
3

QoS agent .
QoS , ,

QoS agent

6.1.1 QoS manager

QoS manager QoS agent agent
 manager, QoS negotiation manager, agent
 analyzer module
 configuration DB, logging DB data
 base 9 QoS Manager



9 QoS Manager

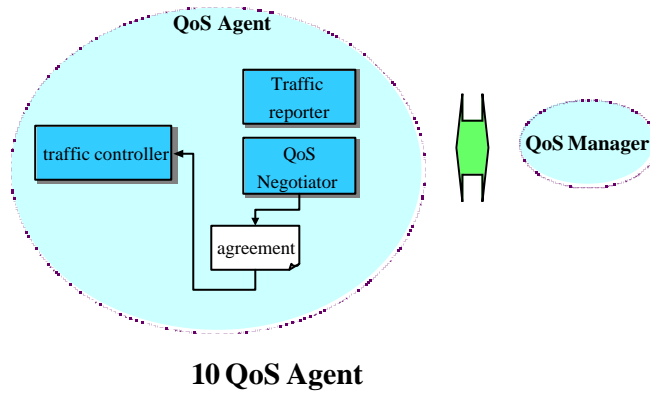
6.1.2 QoS agent

QoS agent QoS manager

QoS agent

QoS agent 10 QoS negotiator, Traffic reporter, Traffic controller . QoS negotiator agreement

DB . Traffic Reporter , frame rate QoS (transmission rate), (transmission time), (loss rate) QoS Traffic Controller QoS



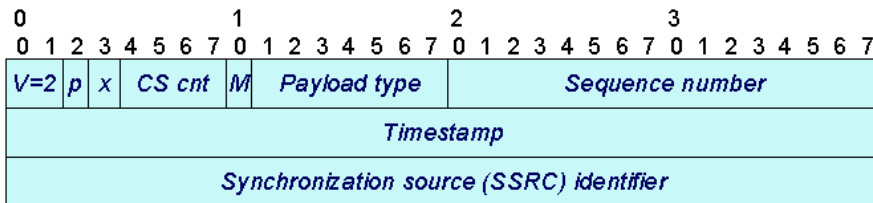
6.2

QoS QoS QoS agent 가

agent , , , QoS QoS

6.2.1

IETF
 Audio/Video Transport [28]
 Real-time transport protocol (RTP) [29]
 TCP UDP
 UDP application
 RTP 가
 Data data part control message
 control part (RTCP) . UDP RTP가 data part
 control part port . 11 RTP
 head format .



11 RTP header format

RTP Message format header payload

. Head 12byte payload type, timestamp,
 sequence number, marker bit payload
 가 . control message
 RTCP sender가 server report destination receiver
 report . sender report data message
 synchronization receiver data
 audio/video lip-synch . receiver
 report receiver가 message , delay, loss rate
 sender . sender
 bandwidth .

RTP

가 .
 QoS

6.2.2

agent , QoS QoS
 . OMG [31] CORBA IDL [32]
 .
 CORBA [32]

Traffic

RTP

RTCP

IDL ,
 . QoS manager CORBA
 . QoS manager
 CORBA가

6.3

QoS CORBA

8

8

<i>CORBA product</i>	<i>machine Type</i>	<i>OS type</i>
IONA Orbix 2.3 Solaris	SUN sparc 20	Solaris 2.5.1
IONA Orbix 2.3 Windows NT	SUN ultra-4 Intel Pentium Pro Intel Pentium II, III	Solaris 2.6 Windows 95/98 Windows NT

QoS Manager IONA Orbix2.3 [32, 33] solaris version 2.6

QoS Agent

Windows 95/98

Orbix 2.3c

Microsoft MCI[34]

```

Module Qmso {
    struct QosParam {
        long FramePerSec;
        long BitsPerPixel;
        long Resolution;
        long VideoCordingMethod;
        long SamplesPerSec;
        long BitsPerSample;
        long Channel;
        long AudioCodingMethod;
    };

```

```

interface qServer {
    long NewServer();
    long RefServer(in long num);
    void DelServer(in long num);

    void SetServerQoS(in long num, in QoSParam s);
    QoSParam GetServerQoS(in long num);
    void SetRequestQoS(in long num, in QoSParam r);
    QoSParam GetRequestQoS(in long num);

    long IsRequest(in long num);
    void ReplyForRequest(in long num, in boolean reply);
    long IsReply(in long num);
    long GetReplyForRequest(in long num);

    void SenderReport( in long transfer);
    void ReceiverReport( in long error, in long transfer);
    boolean UpdateQoS();
};
};

```

QoS Manger Interface IDL QoS

Manager QoS Agent QoS QoSParam

struct . SetServerQoS(), GetServerQoS() QoS Agent가 QoS

Manager QoS interface .

SenderReport() ReceiverReport()

. QoS Manager UpdateQoS() function QoS Agent가

, QoS

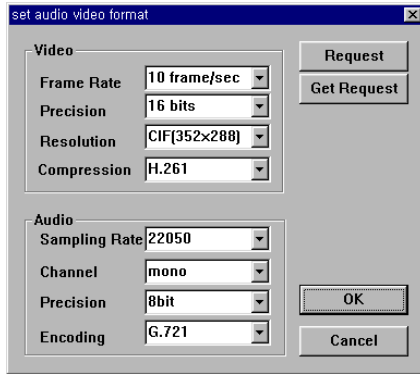
Get QoS .

12 QoS

. Request, Get Request

OK, Cancel

가



12 QoS

Osprey 1000k

video capture card

13



13

7.

가

가 가
가

Best-Effort

가 가

가

가 가

가

QoS

가

QoS

가

CORBA RTP

QoS Manager

RTCP

CORBA IDL

CORBA IDL

RTCP

가

QoS Manager

FEC RESCU

가

가

,
jitter

drop

가

QoS가

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