

1.	1
2.	4
2.1	4
2.2	6
2.2.1	6
2.2.2	8
2.3	9
3.	14
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3.4	22
3.4.1	22
3.4.2	24
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3.4.5	28

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4.2.2	Analyzer 32
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4.3.2	Performance Information Collector..... 35
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4.3.4	Network Measurer 37
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6.44

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10.	28
11.	30
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14. Measurement Agent	35
15. HTTP Client Simulator	36
16.	39
17.	40
18.	42

1.

가 가

[13].

가

가

가

[1, 13].

가

가

가

[2, 3, 4,

5].

(Response Time Threshold)

가

가

[3, 4],
[5].

가

가 . , 가

,

,

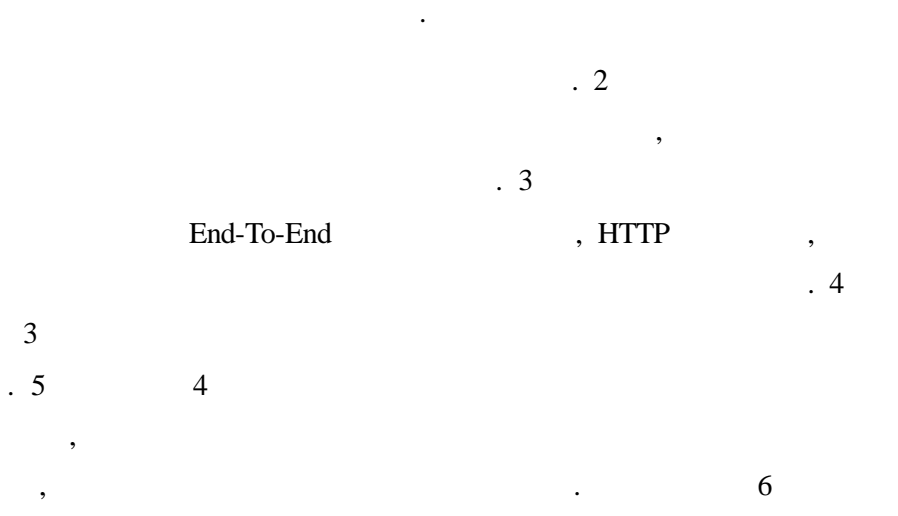
가

[6].

가 (Congestion) ,

가

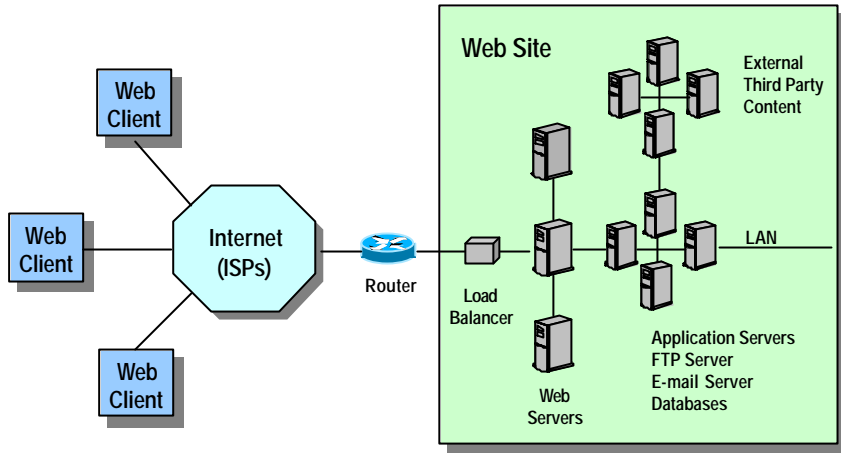
HTTP



2.

2.1

WWW(World Wide Web)[14] ,
(Hypertext)
(Hypermedia) .
,
,
,
,
,
HTTP(HyperText Transfer
Protocol)[15] . HTTP
.
HTML (HyperText Markup Language)[16]
,
HTML
SGML(Standard Generalized Markup Language)[17]



1.

1 [4, 22]

(Web Servers) (Application Servers, FTP Server, E-mail Server, Database), (External Third Party Content)

(Web Servers)

(Application Servers)

CGI(Common Gateway Interface)[27], FTP E-mail, Database

ISP(Internet Service Provider)[18]

(Web Clients)

2.2

가

가

가

가

가

2.2.1

[1, 7]

2 a)

가

(Performance

Metric)

(Response Time),

(Throughput),

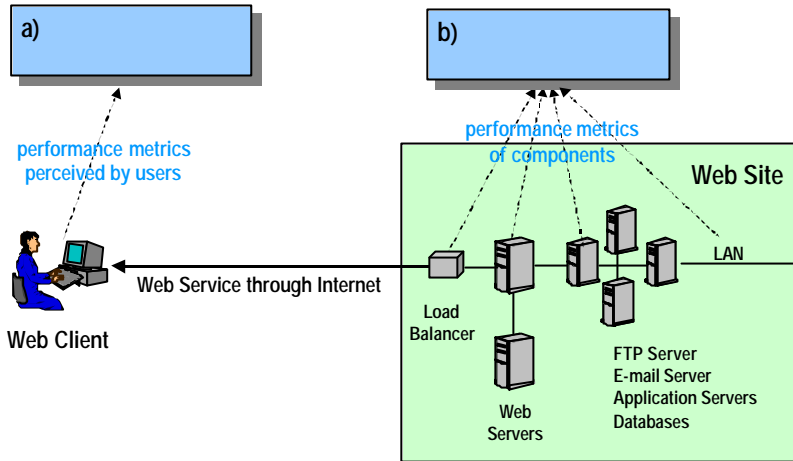
(Error

Rate)

[4, 23].

(Threshold)

가



2.

[1, 7, 8]

2 b)

가

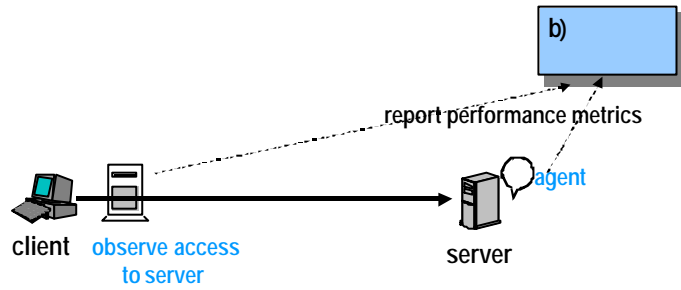
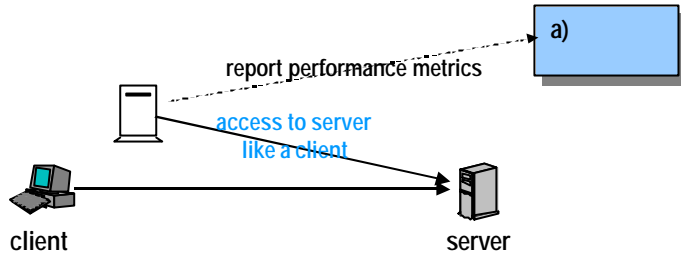
, CUP

, Memory

가

가

2.2.2



3.

[1, 8]

3 a)

가

HTTP GET

[26].

가

가

[1, 8] 3 b)
가

,
가
,
가 [24].
가

가 [8].

2.3

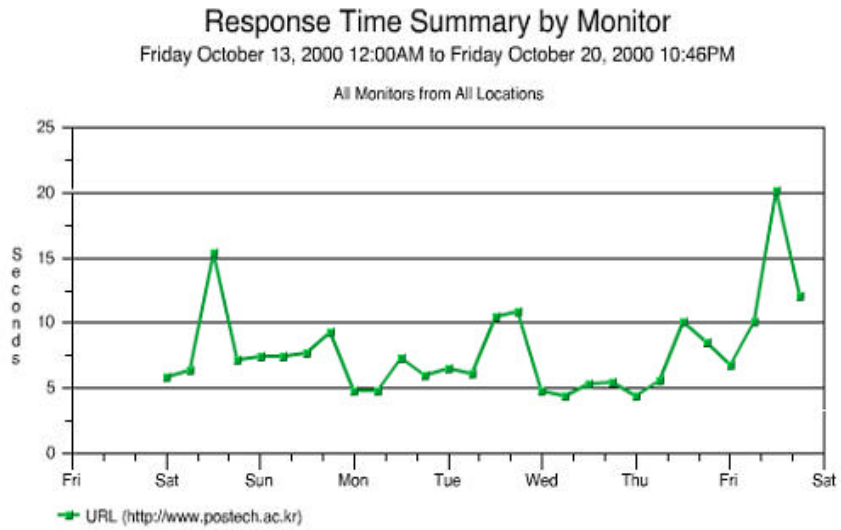
가

가
가

가
가
[2, 3, 4, 5].

(Response Time Threshold)

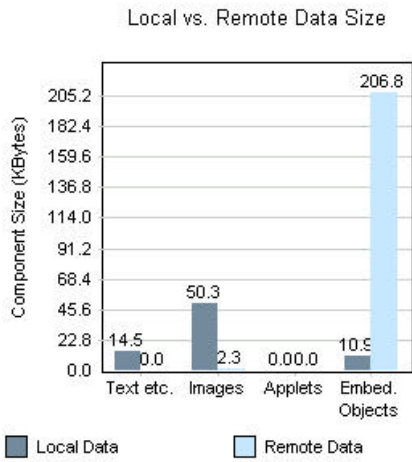
가 가



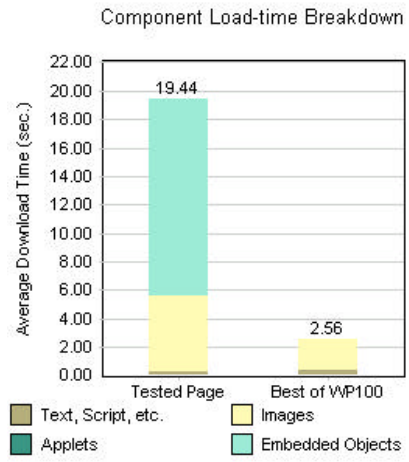
4. Remote Monitor

4 Remote Monitor[4] <http://www.postech.ac.kr/>

가



a) Local vs. Remote Data Load Time



b) Component Load Time Breakdown

5. SecretShopper

5 SecretShopper[3] <http://www.postech.ac.kr/>

a)

5

5 b)

가

6 ActiveWatch[5]

DNS Resolution, Connection, Server Time, Server/Network Overlap, Network Time, Client Time

6

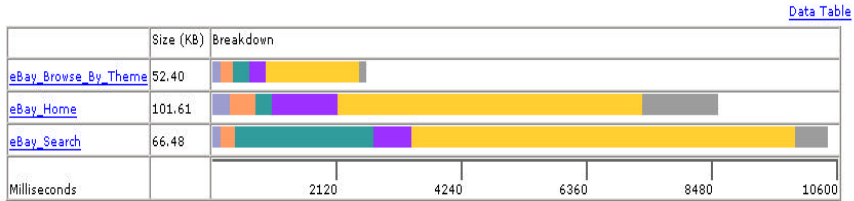


Transaction Breakdown

Period: Nov. 8, 2000 12:00 AM - 11:59 PM

Profile: MercuryLiveDemo
699 total transactions

- DNS Resolution
- Connection
- Server Time
- Server/Network Overlap
- Network Time
- Client Time



6. ActiveWatch

가

가

(Performance Metric)

가

가

가

가

[6, 11,

12].

가

(Congestion)

가

3.

가

(Performance Metric)
(Web Service Transaction) 가

HTTP

3.1 End-To-End

/

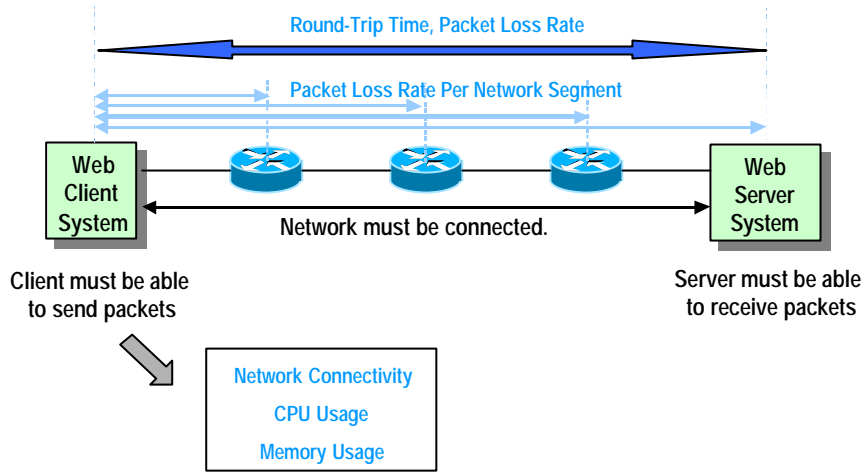
, TCP/IP[28] 가

[6, 9, 12, 25].

HTTP 가 HTTP 가 가
7 가 가
(Web Client System)
(Web Server System)

가

가



7. End To End

HTTP

End-To-End

3.1.1

IP

ICMP[29]

Les Cottrell and John Halperin

[12].

ICMP

Stanford

Oxford

[19, 20, 21]. Ping

Packet

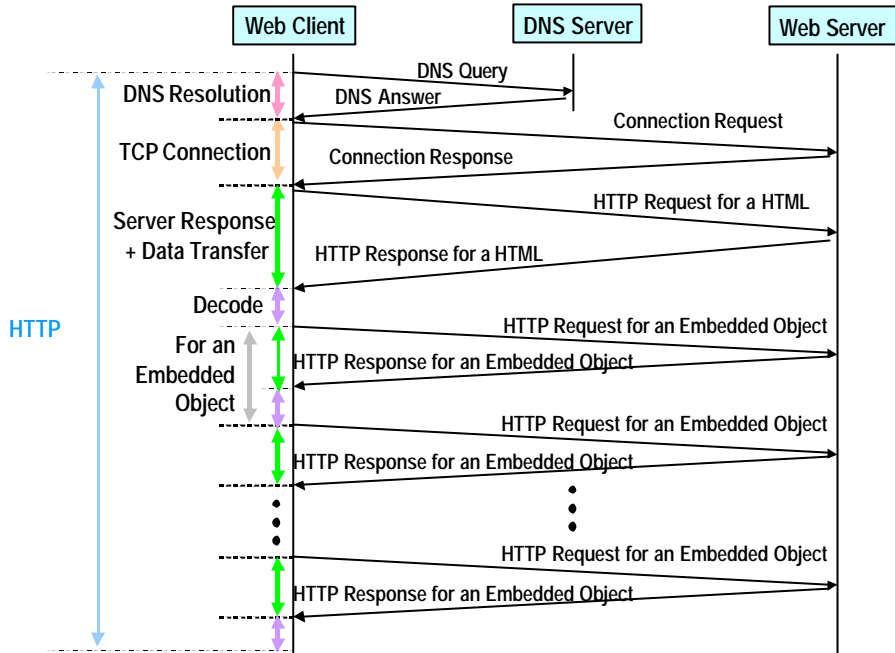
Loss Rate Round Trip Time ,
 (Congestion) 가 [20]. Traceping[21]
 . Traceping
 traceroute ,
 ping Packet Loss Rate . Packet Loss가
 [21].

3.1.2

,
 .
 ,
 가
 .
 CPU Usage Memory Usage
 . Unix top, vmstat
 , Windows registry

3.2 HTTP

3.1 End-To-End 가
 , HTTP 가 .
 HTTP
 가
 HTTP (HTTP Transaction)



8. HTTP

HTTP 8 . URL(Uniform Resource Locators)[30] IP

. DNS . IP . TCP , URL . URL 가

. 가 . TCP [1, 10]. HTTP

HTTP HTTP

RT(x)가 x Response Time , T(x, y)가 x가 y
 . H가 HTTP Transaction , $D_i (1 \leq i \leq n)$ 가 H

$$RT(H) = T(H, DNS\ Resolution) + T(H, TCP\ Connection) + \sum_{i=1}^n RT(D_i) \quad (3.1)$$

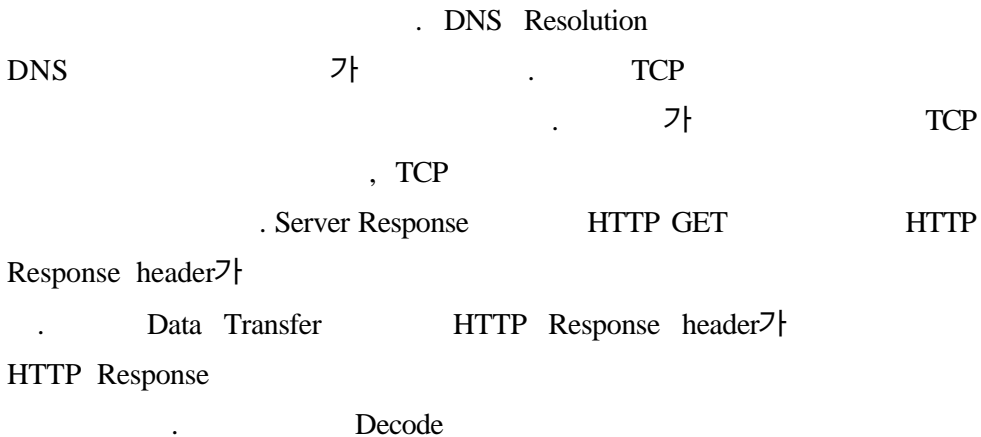
$$RT(D_i) = T(D_i, Server\ Response) + T(D_i, Data\ Transfer) + T(D_i, Decode) \quad (3.2)$$

(3.1) (3.2)

$$RT(H) = T(H, DNS\ Resolution) + T(H, TCP\ Connection) + \sum_{i=1}^n T(D_i, Server\ Response) + \sum_{i=1}^n T(D_i, Data\ Transfer) + \sum_{i=1}^n T(D_i, Decode) \quad (3.3)$$

$\sum_{i=1}^n T(D_i, Server\ Response) = DNS\ Resolution\ Time$
 $\sum_{i=1}^n T(D_i, Data\ Transfer) = TCP\ Connection\ Time$
 $\sum_{i=1}^n T(D_i, Decode) = Server\ Response\ Time + Data\ Transfer\ Time + Decode\ Time$

HTTP (3.3) DNS Resolution Time, TCP Connection Time, Server Response Time, Data Transfer Time, Decode Time



End-To-End

Transfer

Decode

D_j Local, D_k Non-Local

$$D_i = D_j + D_k \quad (3.1)$$

$$\begin{aligned}
RT(H) &= T(H, DNS\ Resolution) + T(H, TCP\ Connection) \\
&+ RT(D_j) + RT(D_k) \\
&= DNS\ Resolution\ Time + TCP\ Connection\ Time \\
&+ Local\ Data\ Response\ Time \\
&+ NonLocal\ Data\ Response\ Time
\end{aligned} \quad (3.4)$$

D_x Text Data, D_y Image Data, D_m Applet Data, D_n Other Embedded Data

$$D_i = D_x + D_y + D_m + D_n$$

(3.1)

$$\begin{aligned}
RT(H) &= T(H, DNS\ Resolution) + T(H, TCP\ Connection) \\
&+ RT(D_x) + RT(D_y) + RT(D_m) + RT(D_n) \\
&= DNS\ Resolution\ Time + TCP\ Connection\ Time \\
&+ Text\ Data\ Response\ Time + Image\ Data\ Response\ Time \\
&+ Applet\ Data\ Response\ Time \\
&+ Other\ Embedded\ Data\ Response\ Time
\end{aligned} \quad (3.5)$$

HTTP

DNS Resolution Time TCP Connection

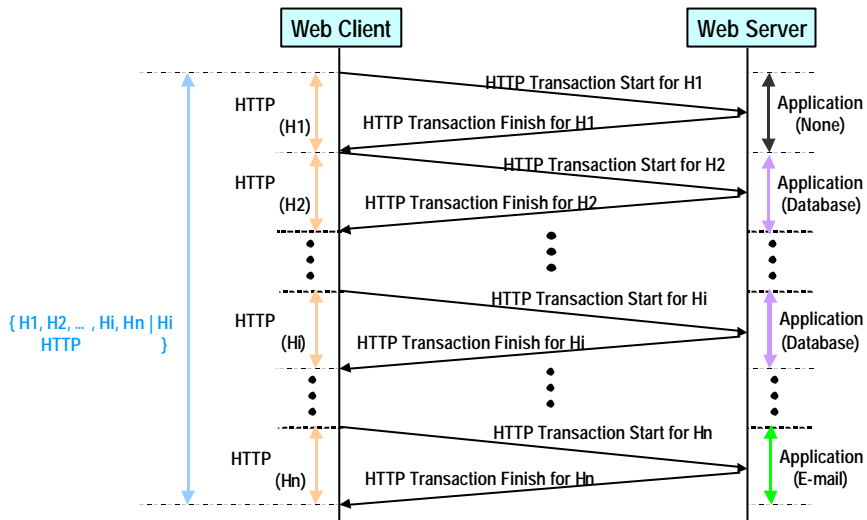
$$\text{Time} = \dots \quad (3.4)$$

$$\dots \quad (3.5)$$

가 Text Image, Applet, Other

Embedded

3.3



9.

HTTP 가 ,

가 가

가 ,

가 , 가
 (Web Service Transaction)
 가 HTTP ,
 가
 .
 .
 9 .
 가 HTTP .
 HTTP
 (Response Time Threshold)
 ,
 가 가

RT(x)가 x Response Time . W가 Web Service Transaction
 , H_i ($1 \leq i \leq n$)가 Web Service Transaction HTTP
 Transaction

$$RT(W) = \sum_{i=1}^n RT(H_i) \quad (3.6)$$

H_x A_x , H_y A_y , H_z
 A_z , H_i 가 H_x, H_y, H_z , (3.6)

$$RT(W) = RT(H_x) + RT(H_y) + RT(H_z) + RT(A_x) + RT(A_y) + RT(A_z) \quad (3.7)$$

(3.6) HTTP

, (3.7)

CGI, Database, Email

가 HTTP

. HTTP

HTTP

가

3.4

가

HTTP

End-To-End

End-To-End

End-To-End

, HTTP

3.4.1

ICMP

(Congestion)

가

[19, 20].

가 Packet Loss Rate Round-Trip Time,
 Packet Loss Rate Per Network Segment(%)

3.4.1.1 Packet Loss Rate

PLR(x) x Packet Loss Rate(%), SN(x, y) x
 y, RN(x, y) x y .
 W가 ,

$$PLR(W) = \frac{[SN(W, ICMPEcho) - RN(W, ICMPEchoReply)]}{SN(W, ICMPEcho)} * 100 \quad (3.8)$$

Packet Loss Rate (3.8)

가 가
 Packet Loss Rate
 (Congestion) 가 .

3.4.1.2 Round-Trip Time

RTT(x) x Round-Trip Time(sec), ST(x, y) x y
 , RT(x, y) x y .
 W가 ,

$$RTT(W) = RT(W, ICMPEchoReply) + ST(W, ICMPEcho) \quad (3.9)$$

Round-Trip Time(RTT) (3.9)

RTT

RTT

가 .

3.4.1.3 Packet Loss Rate Per Network Segment

$$\begin{aligned}
 & R_i \quad , \\
 & NS_i \quad , \\
 & PLR(NS_i) = PLR(R_i) \\
 & = \frac{[SN(R_i, ICMPEcho) - RN(R_i, ICMPEcho Reply)]}{SN(R_i, ICMPEcho)} * 100 \quad (3.10)
 \end{aligned}$$

Packet Loss Per Network Segment(%) (3.10)

Packet Loss Rate .

Packet Loss Rate

3.4.2

가 CPU Usage Memory Usage, Network Conectivity

3.4.2.1 Network Connectivity

(good bad)

Network Connectivity가 good ,

Network Connectivity가 bad . End-To-End

가 .

3.4.2.2 CPU Usage

가 CPU
(%) .
CPU .

3.4.2.3 Memory Usage

가 Memory
(%) .
Memory .

3.4.3 HTTP

HTTP
HTTP Response Time, Throughput, Error Rate

3.4.3.1 Response Time

Response Time(sec) HTTP
, (3.1) DNS Resolution Time, TCP Connection Time,
Response Time . Response Time HTTP
(3.3) HTTP
(3.4) (3.5) DNS Resolution Time
TCP Connection Time
HTTP

HTTP Resolution Time Data Transfer Time Decode Time End-To-End
 DNS HTTP

3.4.3.2 Throughput

$$T_{put}(x) = \frac{DV(x)}{RT(x)} \quad (3.11)$$

Throughput(Kbytes/sec), x

H7 HTTP, (3.11)

$$T_{put}(H) = \frac{DV(H)}{RT(H)} \quad (3.12)$$

(3.12) Thoroughput HTTP HTTP

3.4.3.3 Error Rate

$$ER(x) = \frac{EN(x)}{MN(x)} * 100 \quad (3.13)$$

Error Rate(%), x

H7 HTTP, (3.13)

$$ER(H) = \frac{EN(H)}{MN(H)} * 100 \quad (3.14)$$

(3.14) Error Rate HTTP 가

가 HTTP

3.4.4

가

가

Response Time, Throughput, Error Rate

3.4.4.1 Response Time

Response Time(sec)

, (3.6)

Response Time

Response Time

HTTP

(3.6)

HTTP

HTTP

HTTP

End-To-End

(3.7)

HTTP

3.4.4.2 Throughput

W가

, (3.11)

$T_{put}(W) = DV(W) / RT(W)$

(3.15)

(3.15) Throughput(Kbytes/sec)

3.4.4.3 Error Rate

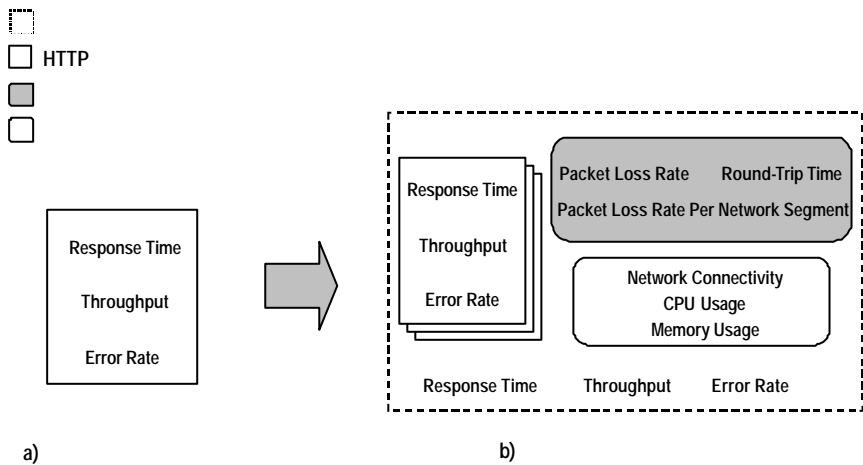
W가 , (3.13)

$$ER(W) = \{EN(W) / MN(W)\} * 100 \quad (3.16)$$

(3.16) Error Rate(%) 가

HTTP 가

3.4.5



10

a)

HTTP Response
가

Time Throughput, Error Rate
, Response Time

b)

가

가

End-To-End

(Response Time
Threshold) (Error Rate Threshold)

가 End-To-

가 HTTP

HTTP DNS Resolution, TCP
Connection, Server Response, Data Transfer, Decode . Data
Transfer 가

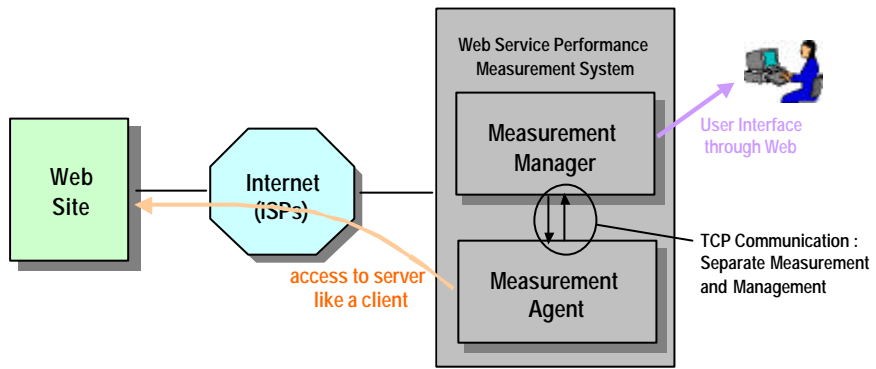
Packet Loss Rate

가

4.

3

4.1



11.

가

11

Measurement Agent . Measurement Manager
가
Measurement Agent가
. Measurement Agent
Measurement Manager

HTTP

3.4

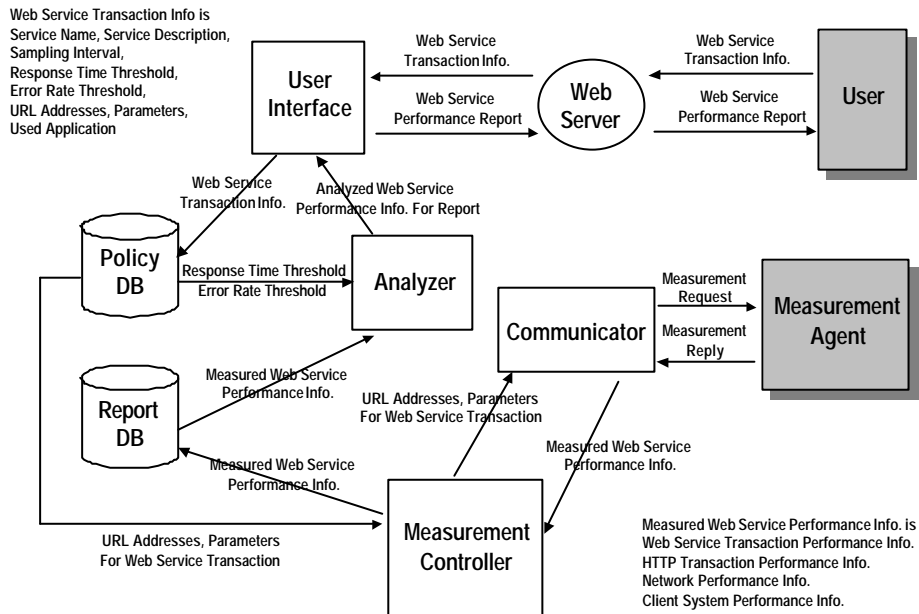
Measurement Manager Measurement Agent가 TCP

가

Measurement Agent

가

4.2 Measurement Manager

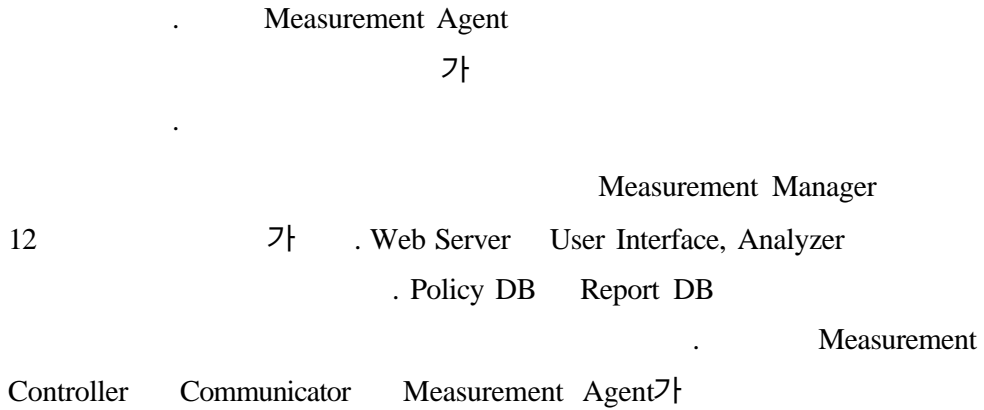


12. Measurement Manager

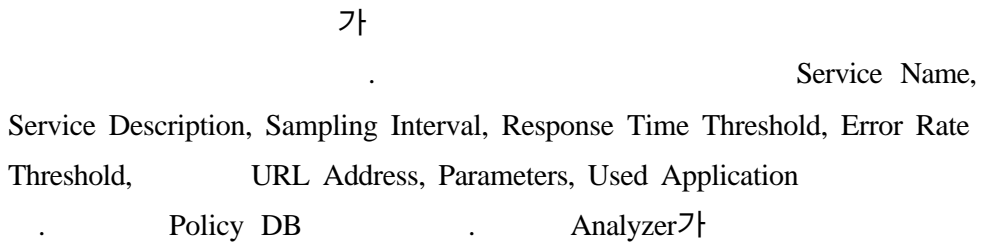
Measurement Manager

가

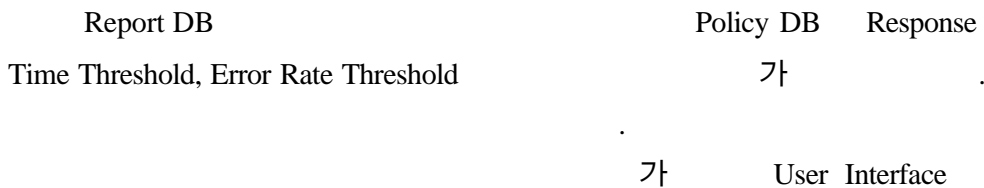
Measurement Agent가



4.2.1 User Interface



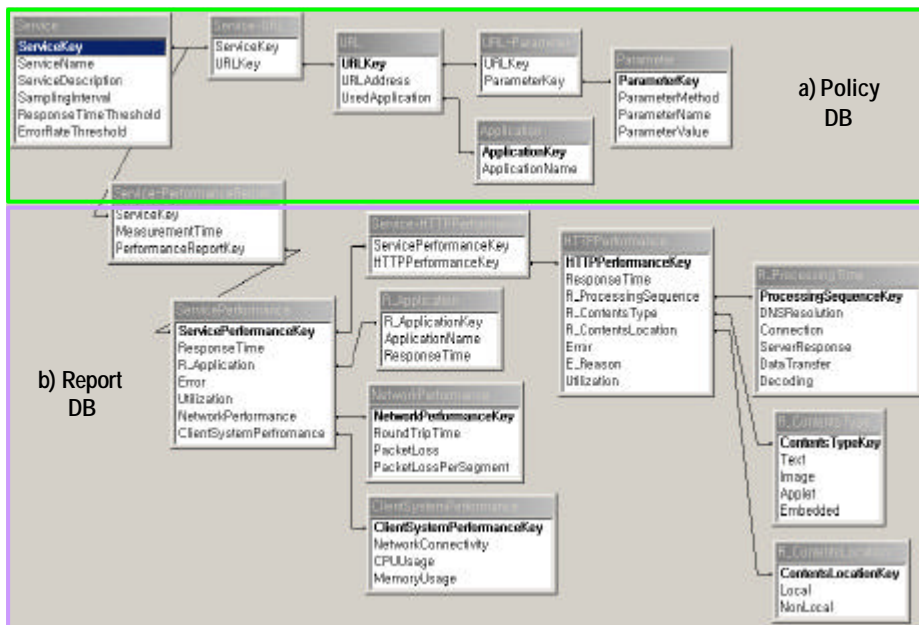
4.2.2 Analyzer



4.2.3 Policy DB Report DB

Policy DB
Report DB

3



13.

Policy DB Report DB (Relational Data Model)[32] , 13 Policy DB
13 a) Report DB 13
b)

4.2.4 Measurement Controller

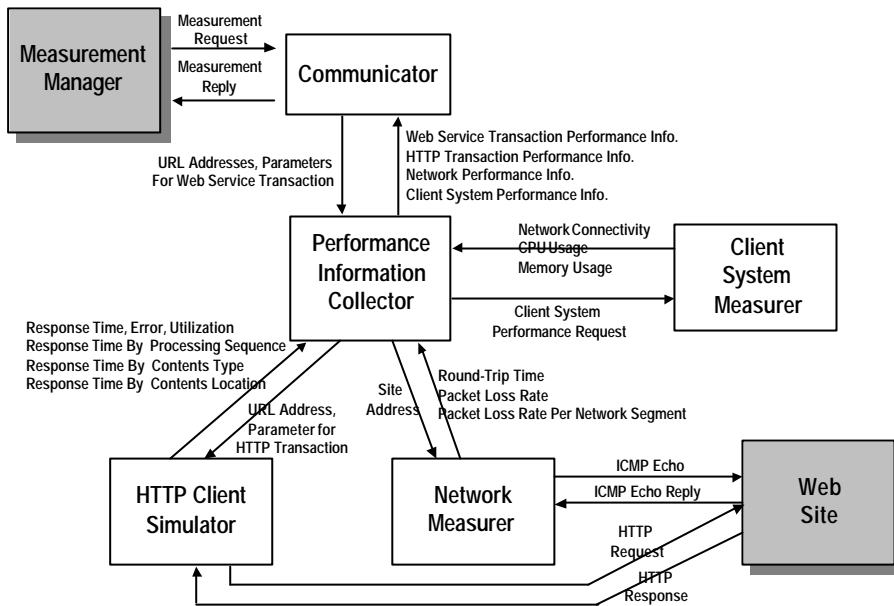
Measurement Agent가 , Policy DB 가 Measurement Request . Measurement Agent Measurement Reply Report DB .

4.2.5 Communicator

Measurement Agent TCP , Measurement Request Measurement Reply . Measurement Request 가 , Message Reply 가 .

4.3 Measurement Agent

Measurement Agent 가 . 가 3.4 . Measurement Agent 14 가 . Communicator Measurement Manager , Performance Information Collector, HTTP Client Simulator, Network Measurer, Client System Measurer .



14. Measurement Agent

4.3.1 Communicator

Measurement Manager TCP . TCP
 Measurement Request Performance Information
 Collector Performance Information Collector
 , Measurement Reply ,
 Measurement Manager .

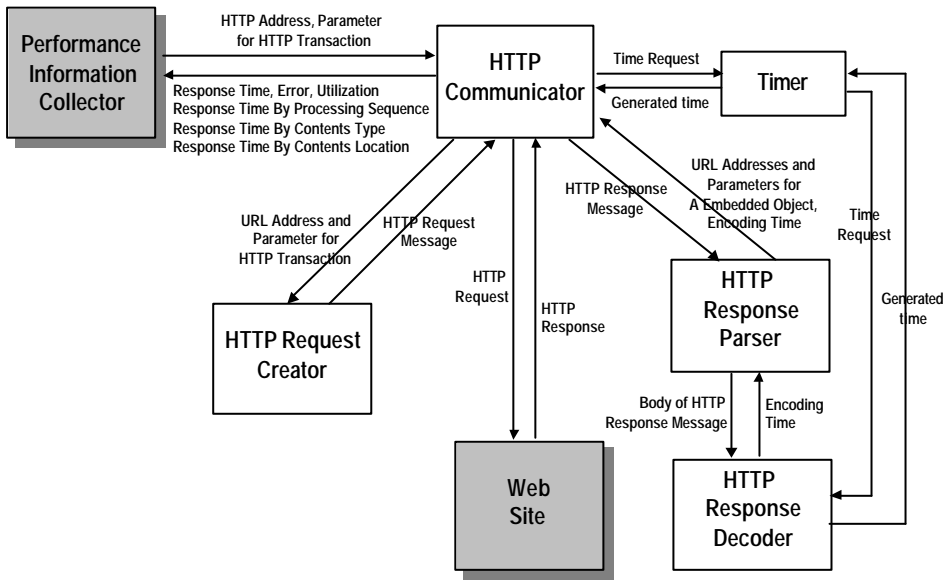
4.3.2 Performance Information Collector

Communicator Client
 System Measurer Network Measurer , 3.3

HTTP Client Simulator
 HTTP
 , Communicator가 Message
 Reply 가 Communicator

4.3.3 HTTP Client Simulator

HTTP Client Simulator 3.2 HTTP
 HTTP
 Response Time Throughput, Error State . Response Time HTTP



15. HTTP Client Simulator

HTTP Client Simulator 15 가 . HTTP

Communicator HTTP .
 HTTP
 , HTTP
 . HTTP Request Creator HTTP Communicator
 URL Address Parameter 가 HTTP Request .
 HTTP Response Parser HTTP Response
 , HTTP Response Decoder HTTP Response Body
 . Timer

4.3.4 Network Measurer

3.4.1

. Performance Information Collector
 . Ping Round Trip Time Packet
 Loss Rate . tracroute
 , Packet Loss Rate .
 Performance Information Collector .

4.3.5 Client System Measurer

Network Connectivity, CPU Usage, Memory
 Usage .
 가 (Network Connectivity) .
 Unix top ,
 Windows registry file
 CPU Usage Memory Usage .

5.

4

5.1

~~4/4~~

CPU	Intel Pentium III, 450MHz
Memory	128MB

~~4/4~~

Operating System	Windows 2000
Language	C, PHP
Database	MS-Access 2000
Web Server	IIS 4.0
Graphic library	GD 1.6.2

5.2

General Information

Service Name:

Service Description:

Sampling Interval: min

Response Time Threshold: sec

Error Rate Threshold: %

URL Composition

No.	URL Address	URI
1		
2		
3		

Add URLs

OK Cancel

a) The Registration Form for Web Service Transaction

Select one application used for a url.

Registered Applications:

or

New Application:

Select One Application

c) The Input Form for Application

General Information

URL Address:

Used Application:

Parameter Composition

No.	Method	Name	Value
1	<input type="text" value="None"/>	<input type="text"/>	<input type="text"/>
2	<input type="text" value="None"/>	<input type="text"/>	<input type="text"/>
3	<input type="text" value="None"/>	<input type="text"/>	<input type="text"/>
4	<input type="text" value="None"/>	<input type="text"/>	<input type="text"/>
5	<input type="text" value="None"/>	<input type="text"/>	<input type="text"/>

OK

b) The Registration Form for HTTP Transaction

16.

16

3.3

Threshold, Error Rate Threshold, Sampling Interval, Response Time

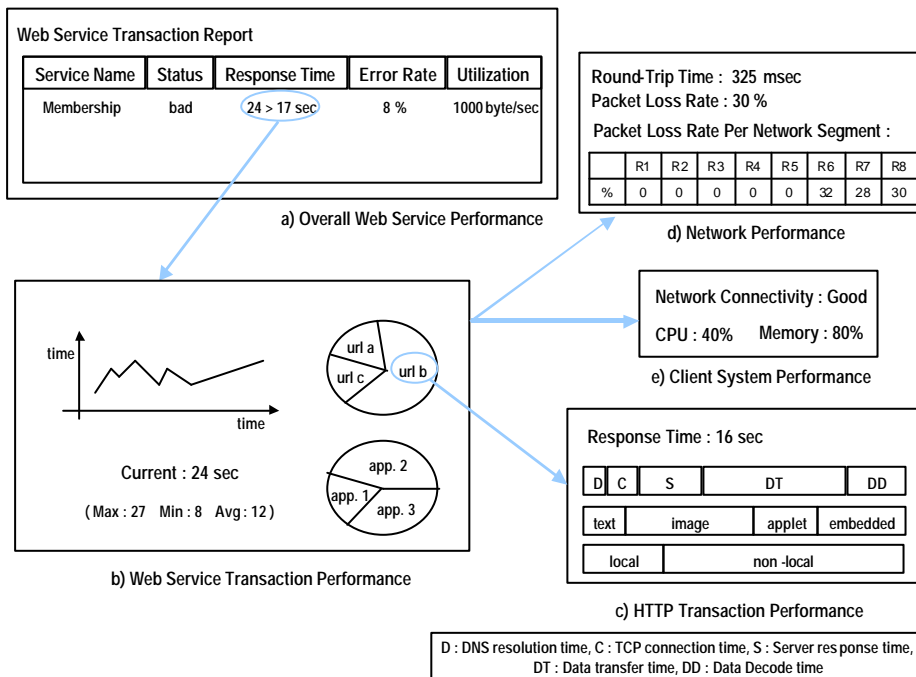
HTTP 가 . HTTP URL Address

URL 가 . URL 가

5.3

가

HTTP



17.

가 , , .
3 URL
17 가 .

17 a)
(Response Time Threshold)

가
17 b)

, 가 .
URL

URL URL b
URL b HTTP
17 c) , URL b

가 ,
Image
Data Transfer
17 d) 6 Packet Loss가

6
가 , Image
, 6

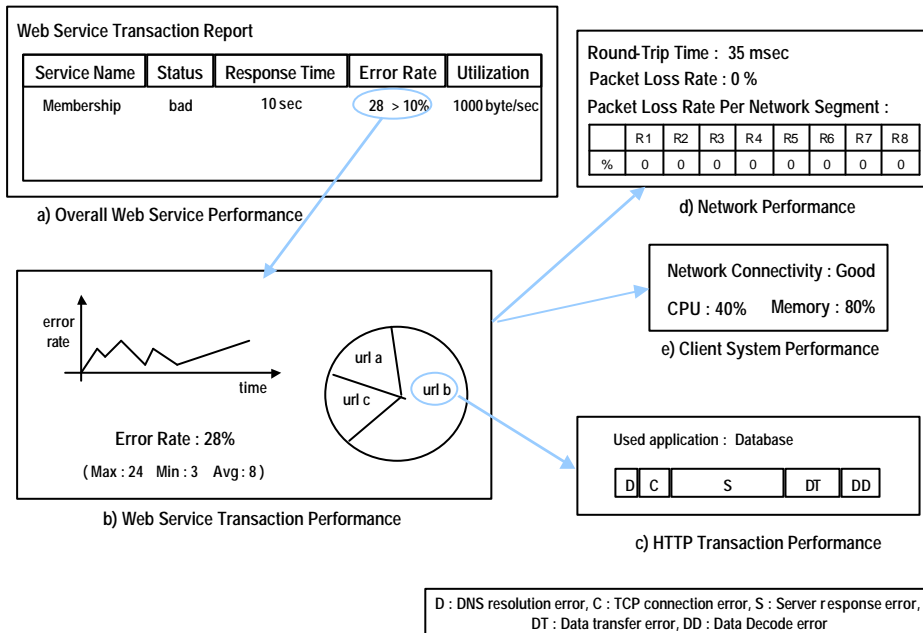
가
, End-To-End

가
가 .

5.4

HTTP

5.3



18.

18 a)

(Error Rate)

(Error Rate Threshold) 가

가

18 b) 가

가 ,

URL URL b 가

URL b HTTP 18 c)

. HTTP Server Response 가

. Server Response 3.2

HTTP Request HTTP Response Header

, HTTP Request

. 18 d) 가 ,

URL URL

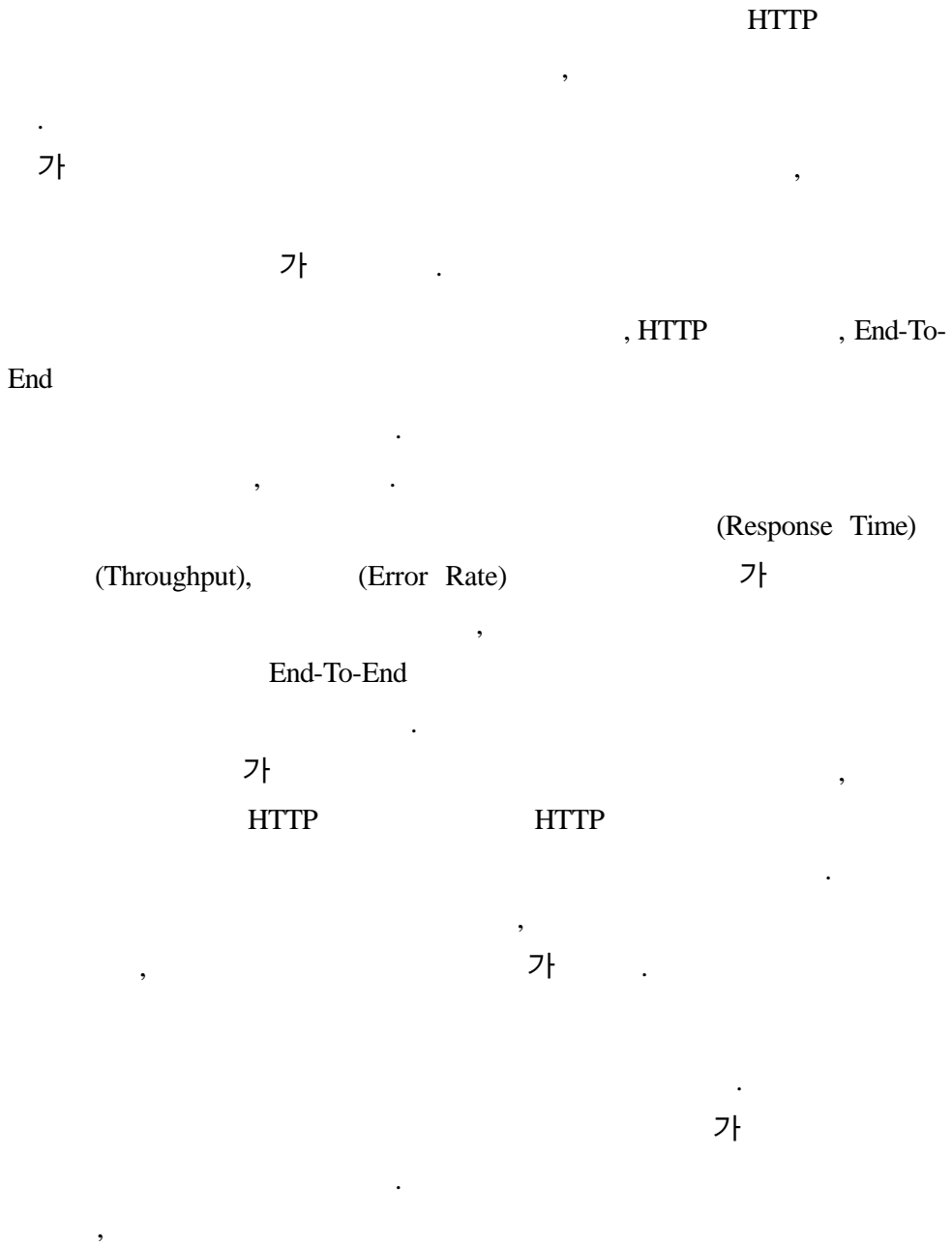
가 가

가

가

가

6.



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