A WWW Server Benchmark System in IPv6 Environment

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- With the spread of IPv6 technology, we can use various services in IPv6
- Many ISPs are beginning to offer IPv6 services
 - WWW, Mail, IRC...



- Measurement in IPv6 is needed
- Network administrator have accumulated much know-how
- Whether the know-how can be applied for IPv6?

- We focus WWW server
 - Most important service in the Internet
- Measurement system of WWW server
 - Kernel monitoring system
 - Packet monitoring system
 - Benchmark system
- Can these systems be applied in IPv6 ?

- Collect information in the kernel
 - Virtual memory statistics
 - CPU activity
 - Kernel I/O statistics
- Common UNIX systems have program that reports above parameters
- These parameters are independent of network
- This method can be applied in IPv6

Packet monitoring system (1/2)

- Monitoring the packets that go the WWW server in and out
 - This method does not cause the performance degradation
 - The server scale and OS are independent
 - This method can measure the server in operation

Packet monitoring system (2/2)

- Packet monitoring tool for WWW
 - Tcpdump
 - General packet monitoring tool
 - Many log analysis tools
 - ENMA
 - Specialized in WWW developed by our research group
- Packet capture library can capture an IPv6 packet
- This method can be applied in IPv6

- Benchmark system can make clear performance indices of WWW server
 - Connection continuation time
 - Throughput
 - Connection establishment time
- Typical benchmark system
 - Httperf
 - SPECweb
 - Webstone

Benchmark system(2/2)

- Typical benchmark systems are not support IPv6
- We develop a new benchmark system
 - We named our benchmark system ANMA (Active Network Measurement Agent)

Requirements of benchmark system in IPv6

- Requests of both IPv6 and IPv4 can be sent
- Request rate of IPv6 and IPv4 can be specified
- Statistics data are outputted about both of IPv6 and IPv4

- NIC has two or more addresses
- ANMA reads address list file
 - Get address family by getaddrinfo()
- ANMA sends requests
 - Read address is IPv6 IPv6 request is send
 - Read address is IPv4
 IF
- IPv6 request is send IPv4 request is send



How to control the ratio of requests

 The ratio of IPv6 and IPv4 in address list

The ratio of requests



- Performance indices about a period of time
 - Connection establishment time
 - Connection continuation time



- Types of connection closed status
 - NORMAL closed
 - Demanded file is received normally
 - RESET closed
 - Connection is reset from server
 - TIMEOUT closed
 - Connection continues for 5 seconds
- When the load of WWW server is high, the number of RESET and TIMEOUT is increased

- Platform
 - FreeBSD
- Parameters
 - IP address of target WWW server
 - Target file name
 - The number of total requests
 - The number of concurrent connections
- ANMA reports
 - Avg. of connection continuation time
 - Avg. of connection establishment time
 - Statistics of connection data

Experiment

- Machine spec
 - Pentium-III 800MHz
 - 256MB memory
 - FreeBSD-4.7
- Experiment network



Experiment

- Configuration parameter
 - Target file size : 4kbytes
 - Total requests : 10,000
 - Concurrent connections : 1,000
 - The ratio of IPv6 and IPv4 : 5 patterns

(A) IPv6 : IPv4 = 1 : 1
(B) IPv6 : IPv4 = 4 : 1
(C) IPv6 : IPv4 = 1 : 4
(D) IPv6 : IPv4 = 1 : 0
(E) IPv6 : IPv4 = 0 : 1

Result (connection data)

	Ratio of IPv6 : IPv4		Sent request		# of NORMAL		# of RESET	
			IPv6	IPv4	IPv6	IPv4	IPv6	IPv4
Α	1	1	5,000	5,000	4,536	4,537	464	463
В	4	1	8,001	1,999	7,276	1,822	725	177
С	1	4	2,001	7,999	1,815	7,522	186	747
D	1	0	10,000	0	9,064	0	936	0
E	0	1	0	10,000	0	8,993	0	1,007

- Request is sent at the specified ratio
- Rate of RESET is about 10%
 - WWW server is in normal state by our precedence research
 - Takao Nakayama, Yutaka Nakamura, and Hideki Sunahara. `The Real-Time State Observation System for WWW Server.'. In INET2002, (2002-Jun).

Result (time data)

	Ratio of		Avg. conn establishr	ection nent (us)	Avg. connection continuation (ms)		
	IPv6	: IPv4	IPv6	IPv4	IPv6	IPv4	
Α	1	1	12.4	1.3	2.7113	1.9317	
В	4	1	14.4	1.5	2.7146	1.9640	
С	1	4	8.7	0.9	2.7339	1.9154	
D	1	0	10.0		2.7176		
E	0	1		1.3		1.8871	

- Each result is independent of the ratio of IPv6 and IPv4
 - Connection continuation time
 - IPv6 2.7msec, IPv4 1.8msec
 - Connection establishment time
 - IPv6 10usec, IPv4 1usec

- Requests transmission by SSL
- Control of a request transmission rate
 - processing rate is one of the performance indices
- Consideration of Dynamic contents
- Consideration of network delay
 - To construct an experimental network near to the actual environment
 - dummynet is often used for implementation of network delay, but can't handle IPv6



- Measurement in IPv6 is needed with the spread of IPv6
- Principal benchmark systems are not support IPv6
- We developed a new benchmark
 - ANMA can specify request ratio of IPv6 and IPv4
 - We confirmed our benchmark
 - Requests are sent at specified ratio
 - IPv6 has some overheads compared with IPv4

More information

- ANMA
 - http://enma.aist-nara.ac.jp/anma/
- ENMA
 - http://enma.aist-nara.ac.jp/