SCTP as Alternative Transport to TCP and UDP

Introduction

- High growth of Internet
- Most internet user are using HTTP
- HTTP uses TCP as transport Protocol
- SCTP as a newer transport protocol over few new features

Background Theory
UDP

- No initialization
- Header is small
- Connectionless (no feature *flow control*, *error control*, retransmission)

Background Theory
TCP

- Connection oriented
- Byte-stream protocol
- Initialization with three-way handshake
- Have a congestion control

Background Theory
SCTP

- Started on 1997 as *Multi-network Datagram Transmission Protocol* (MDTP)
- October 2000 RFC 2960 SCTP
- Connection oriented
- Initialization with four-way handshake + Cookie
- Congestion control similar with TCP
- Introduce new feature : multi stream, multi homing

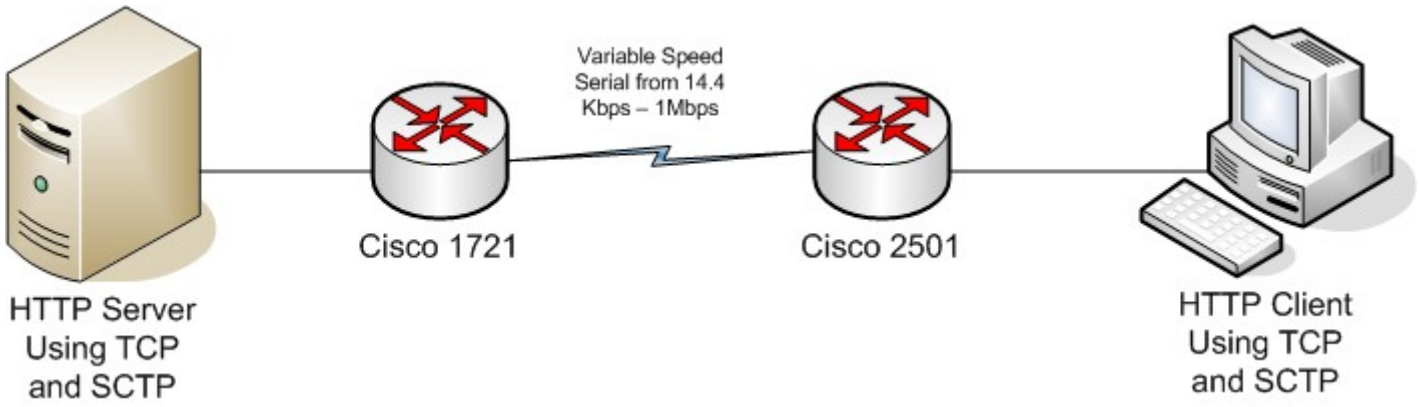
Background Theory
Comparison UDP TCP SCTP

Service/Feature	SCTP	TCP	UDP
Full-duplex Data Transmission	Yes	Yes	Yes
Connection-oriented	Yes	Yes	No
Reliable Data Transfer	Yes	Yes	No
Partial Reliable data transfer	Optional	No	No
Ordered data delivery	Yes	Yes	No
Unordered data deliver	Yes	No	Yes
Flow and congestion control	Yes	Yes	No
Explicit congestion notification support	Yes	Yes	No
Selective acks	Yes	Optional	No
Preservation of message boundaries	Yes	No	Yes
Path maximum transmission unit discovery	Yes	Yes	No
Application data fragmentation/bundling	Yes	Yes	No
Multistreaming	Yes	No	No
Multihoming	Yes	No	No
Protection to SYN flooding attack	Yes	No	N/A
Half-closed Connection	No	Yes	N/A

Environment

- Thttpd Web Server 2.25 (standard and with the SCTP patched) using PC pentium IV 2 Ghz
- Httperf Web Client (standard dan with SCTP patched) using notebook Centrino 1.7 Ghz
- Linux Ubuntu with kernel module SCTP
- Ethereal to analyze the packets
- Cisco Router 1721 dan 2501

Physical Topology

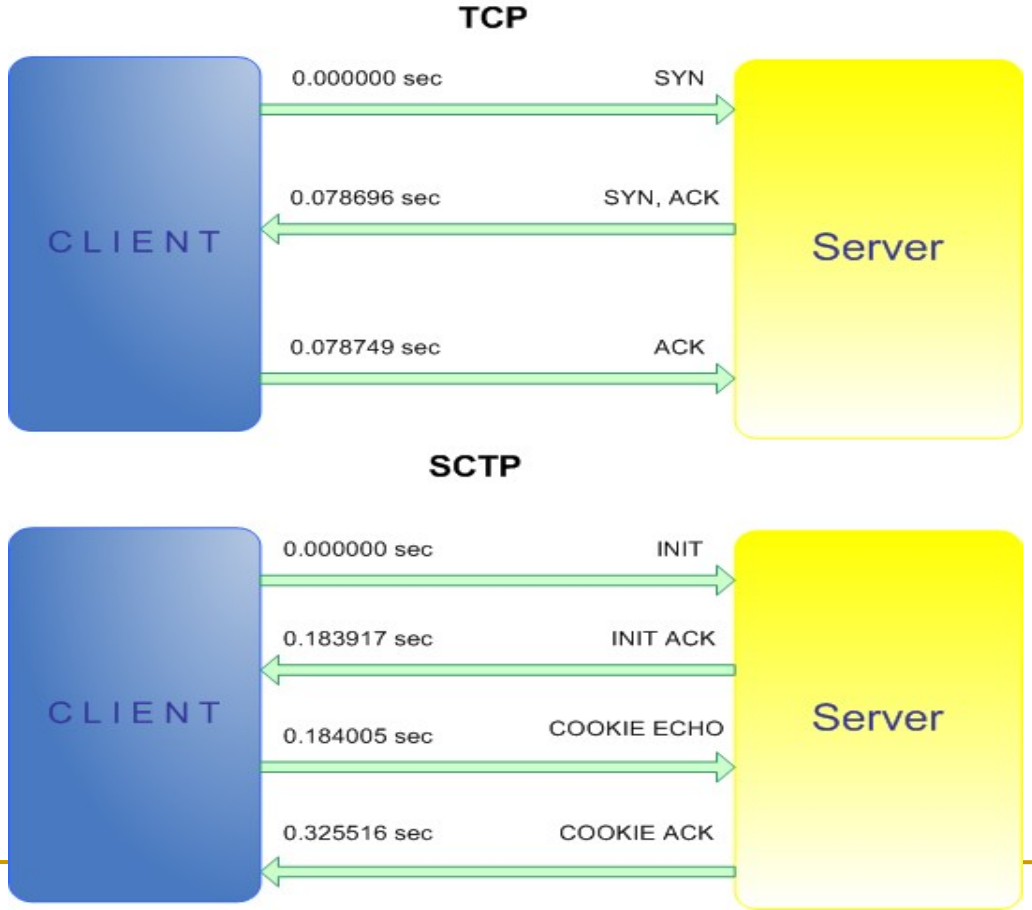


Case Study

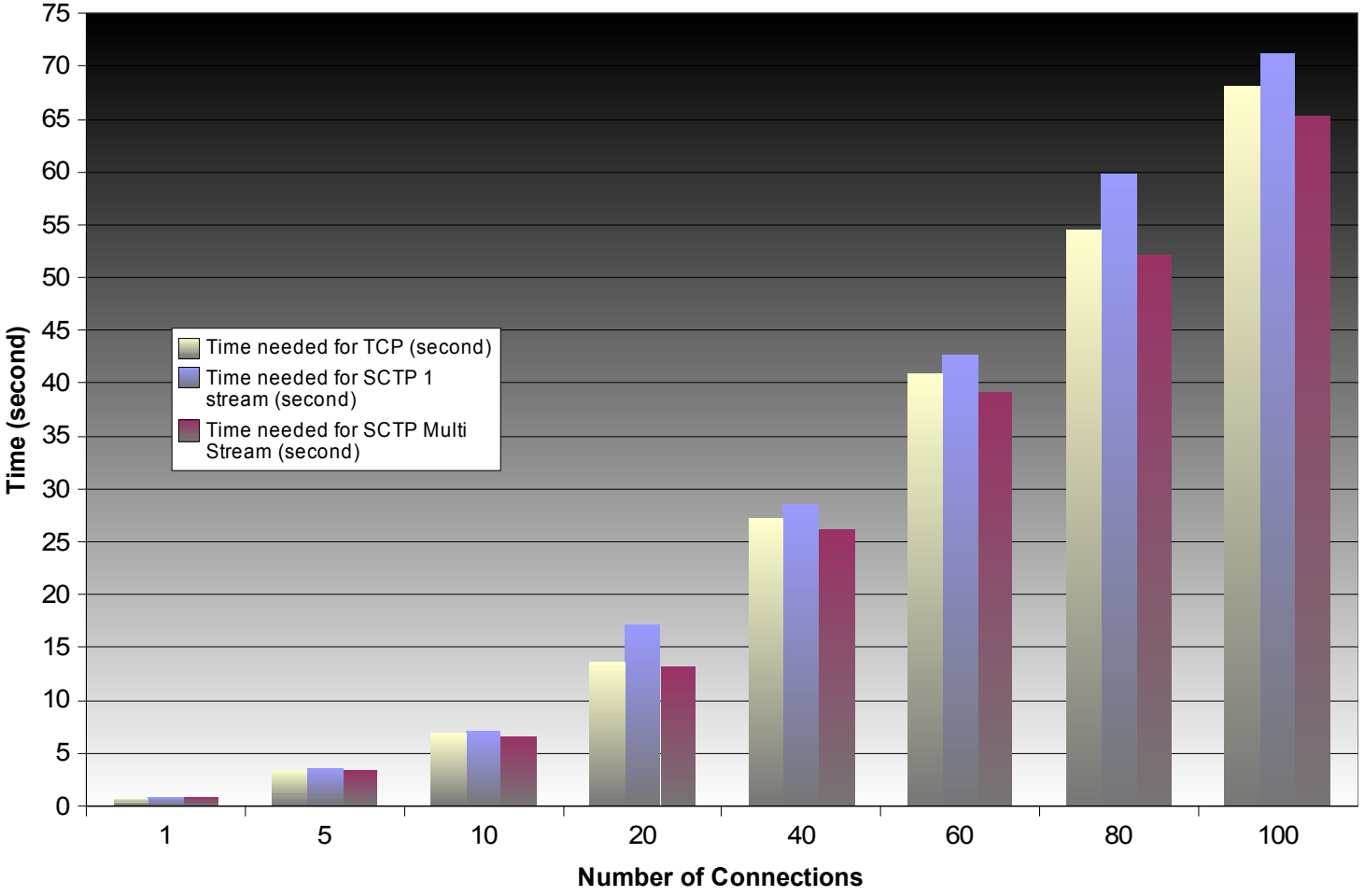
- Downloading HTML file with size 9KB using number of connection : 1, 5, 10, 20, 40, 60, 80, 100. Each variation using speed 14,4 Kbps, 32 Kbps, 64 Kbps, 128 Kbps
- Downloading binary file with size 6MB using variation speed of : 14,4 Kbps, 32 Kbps, 64 Kbps, 128 Kbps, 512 Kbps and 1 Mbps
- First test use TCP, SCTP 1 stream and SCTP multi-stream and second test using TCP and SCTP 1 stream

Test Result

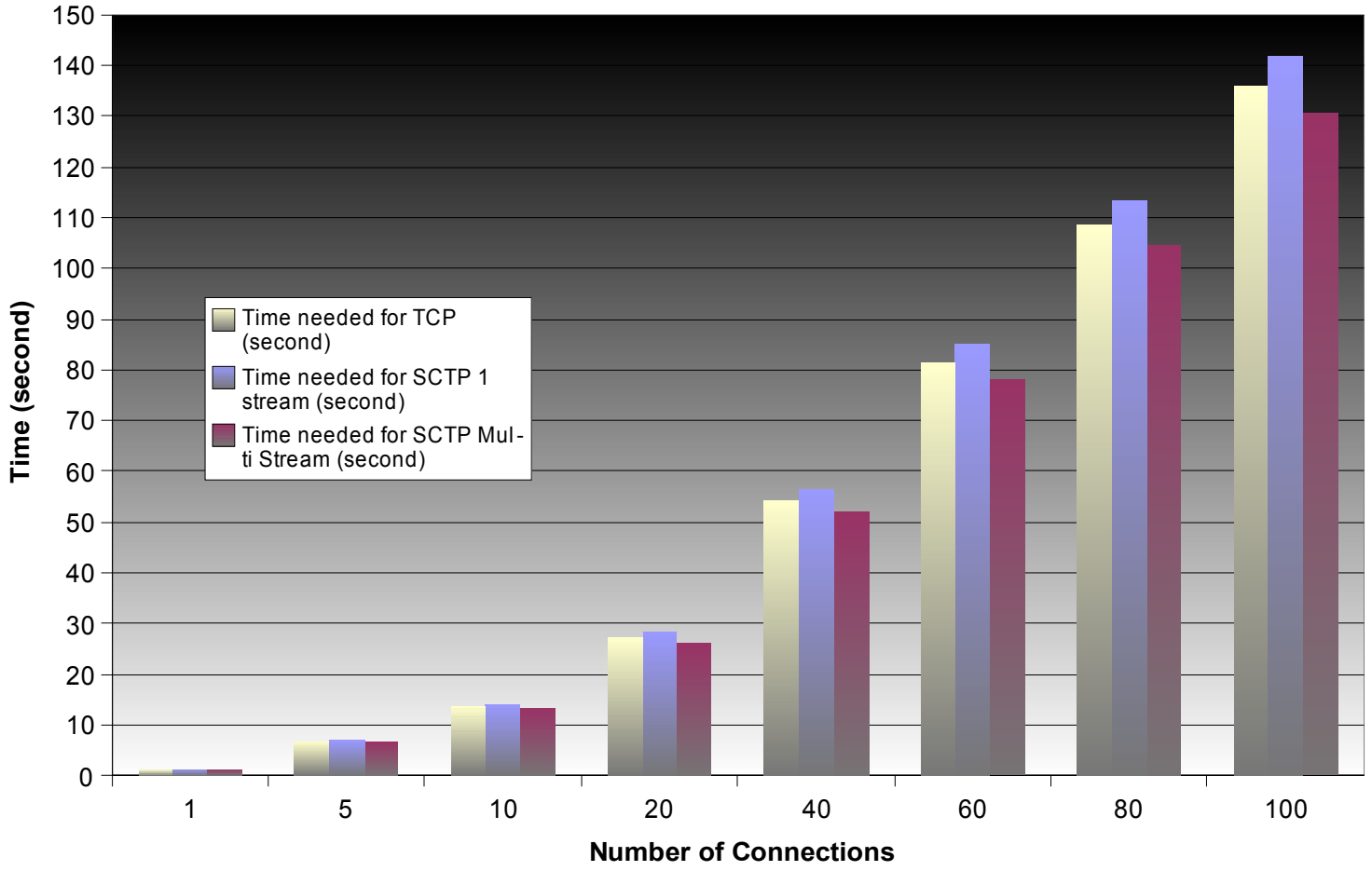
- Time for SCTP initialization is longer than TCP



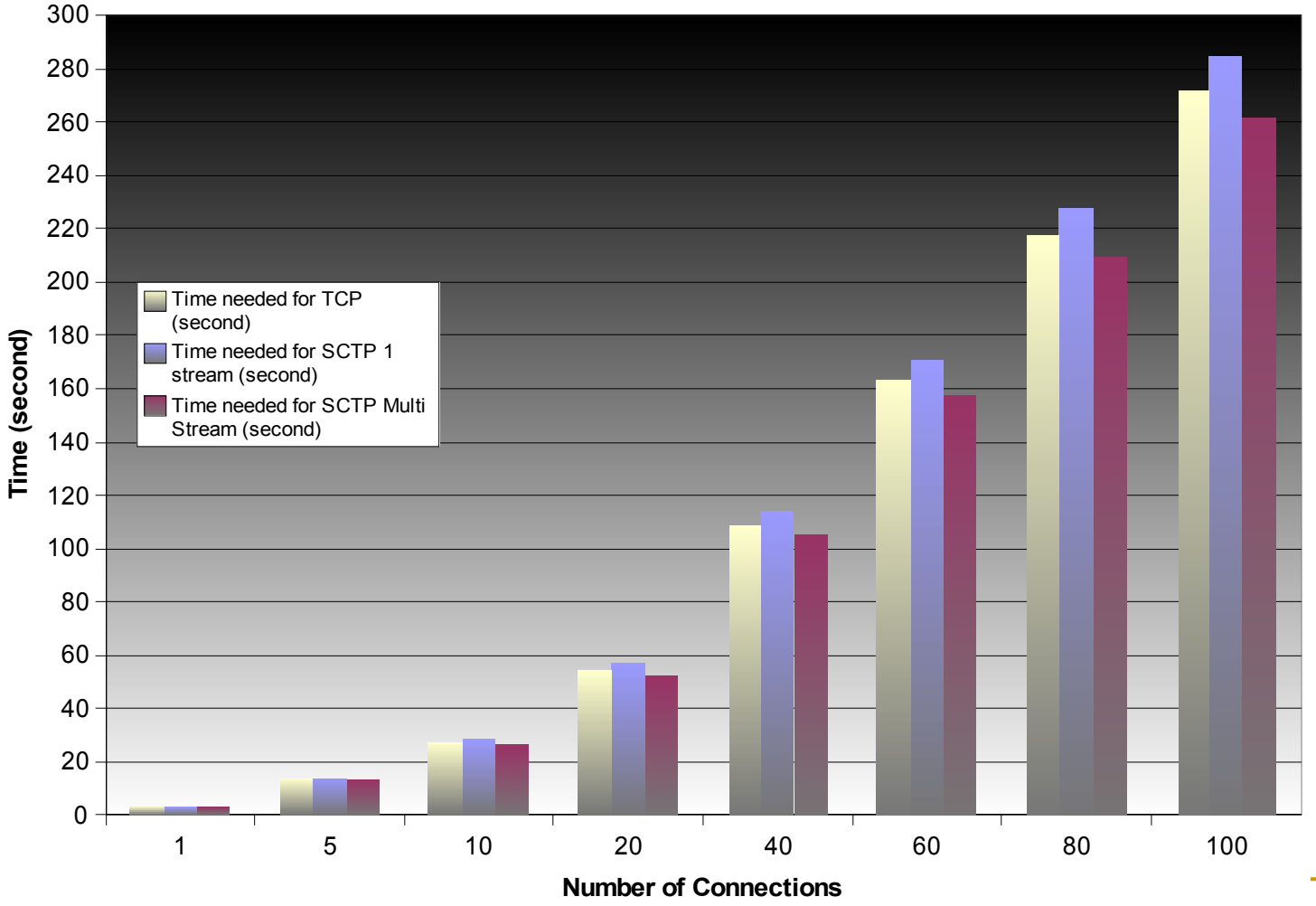
Test Result
Speed 128 Kbps



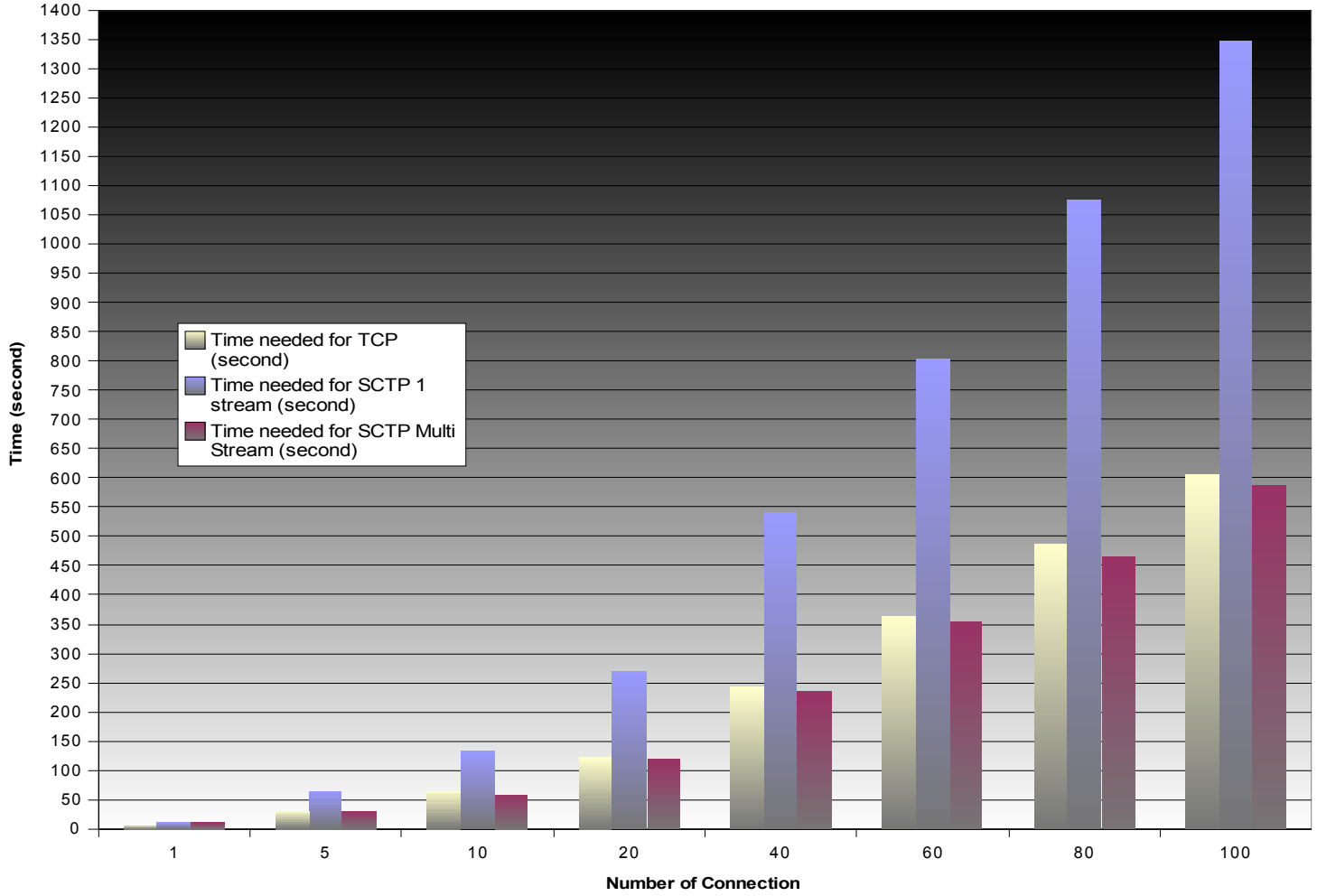
Test Result
Speed 64 Kbps



Test Result
Speed 32 Kbps



Test Result
Speed 14,4 Kbps



Test Result
Speed 14,4 Kbps Con't

- There is retransmission on SCTP 1 stream
- Timeout on HTTP witch SCTP module could be longer to improve performance

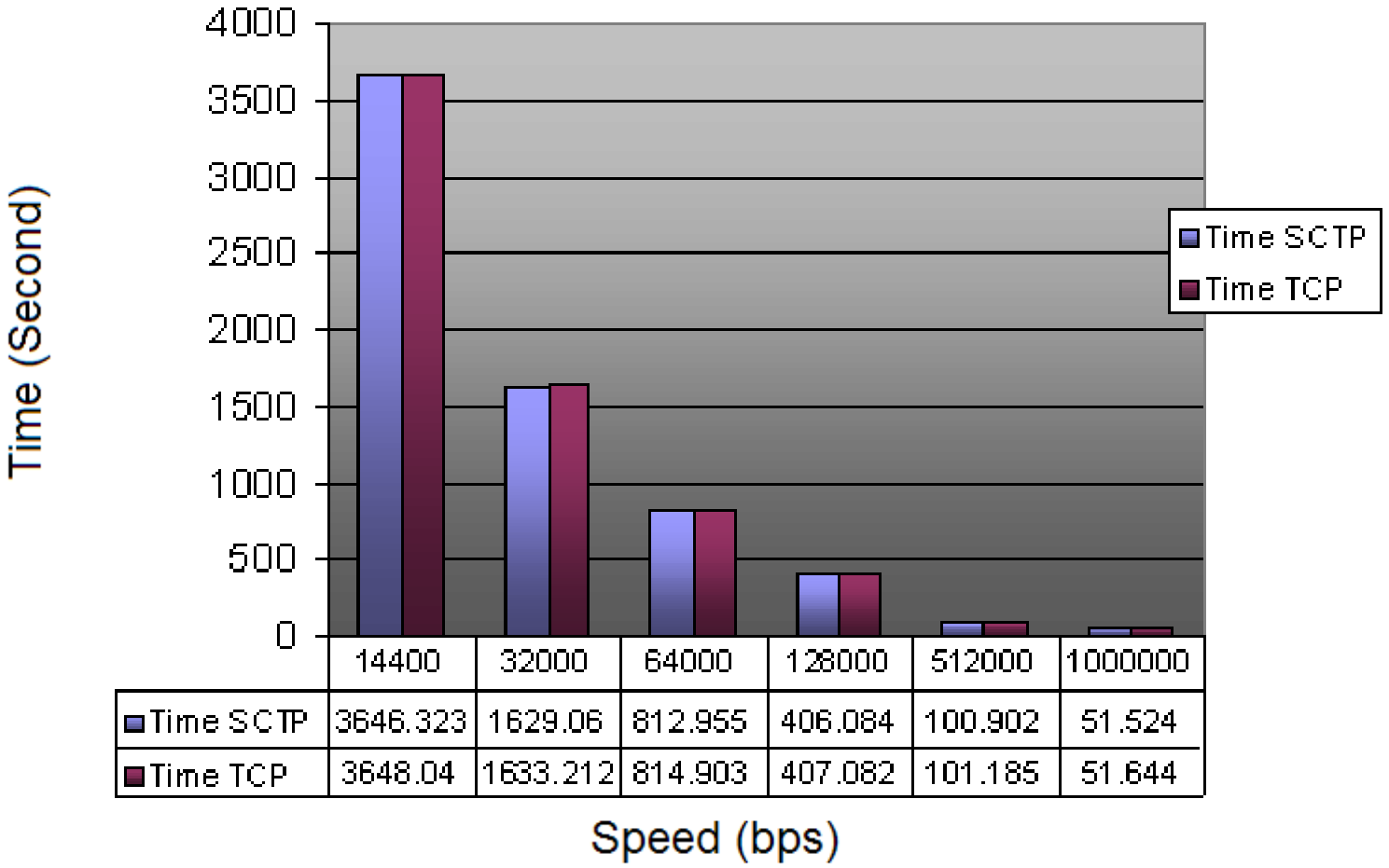
4	*REF*	192.168.1.100	192.168.3.3	SCTP	INIT
5	0.000123	192.168.3.3	192.168.1.100	SCTP	INIT_ACK
6	0.250712	192.168.1.100	192.168.3.3	SCTP	COOKIE_ECHO
7	0.250827	192.168.3.3	192.168.1.100	SCTP	COOKIE_ACK
8	0.349327	192.168.1.100	192.168.3.3	SCTP	DATA
9	0.349383	192.168.3.3	192.168.1.100	SCTP	SACK
10	0.349712	192.168.3.3	192.168.1.100	SCTP	DATA
11	0.349804	192.168.3.3	192.168.1.100	SCTP	DATA
12	0.349887	192.168.3.3	192.168.1.100	SCTP	DATA
13	0.350035	192.168.3.3	192.168.1.100	SCTP	DATA
14	0.581331	192.168.1.100	192.168.3.3	SCTP	SACK
15	0.581397	192.168.3.3	192.168.1.100	SCTP	DATA
16	1.581122	192.168.3.3	192.168.1.100	SCTP	DATA
17	1.593972	192.168.1.100	192.168.3.3	SCTP	SACK
18	1.594013	192.168.3.3	192.168.1.100	SCTP	DATA
19	1.594036	192.168.3.3	192.168.1.100	SCTP	DATA

same packet re-send

same packet re-send

same packet re-send

Test Result
Downloading Single Binary File



	14400	32000	64000	128000	512000	1000000
Time SCTP	3646.323	1629.06	812.955	406.084	100.902	51.524
Time TCP	3648.04	1633.212	814.903	407.082	101.185	51.644

Test Result
Sampling 50 Packet from Ethereal

- 50 packet sampling from Binary download test that show SCTP has a faster transfer speed compared to TCP

	50 Packet SCTP	50 Packet TCP
Time to finish (second)	4.62078	4.79071
Payload Data (bytes)	1400	1448
Speed (bps)	121191.63	120900.74

Test Result from other place

- Test Result from Pfützenreuter [PFU04] :
  - SCTP multistream have better performance compared to TCP or SCTP 1 stream.
  - TCP 1 stream is better compared to SCTP 1 stream
- Test Result from Osterdahl :
  - Similar result with Pfützenreuter

Summary

- *Multi stream* SCTP could minimize *overhead* on initialization phase and will give significant effect if more streaming used
- Single *stream* TCP is better than SCTP single stream on HTML file because *overhead* on SCTP single stream is larger
- SCTP with single stream shows better performance to TCP on downloading big binary file
- SCTP offer few new feature like security and high availability with performance not so different with TCP

Thank You