z/OS V1R13 Communications Server Performance Summary

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z/OS Communications Server Performance Team

The following z/OS Communications Server Performance team members contributed to this report :

Charbel Alwan
Dan Patel
Dave Herr
Kevin Stalnaker
Mike Fitzpatrick
Pat Brown
Tom Moore

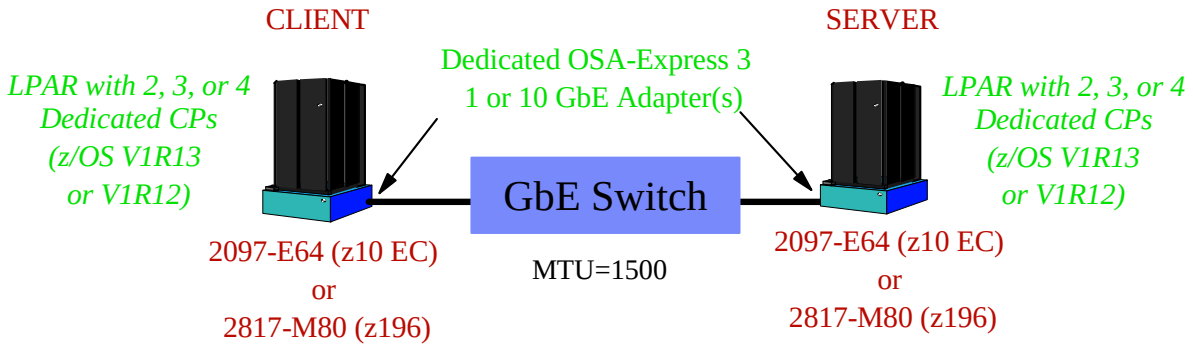
Goals

- Show performance of z/OS V1R13 Communications Server line items.
- Compare z/OS V1R13 vs V1R12 Relative Performance using Communications Server Performance workloads.
- Show z/OS V1R13 vs V1R12 Detailed Performance using Communications Server Performance workloads.
- Show capacity planning performance information for:
  - TN3270 (Clear Text, AT-TLS, IPSec with and without zIIP)
  - FTP (Clear Text, AT-TLS, IPSec with and without zIIP)

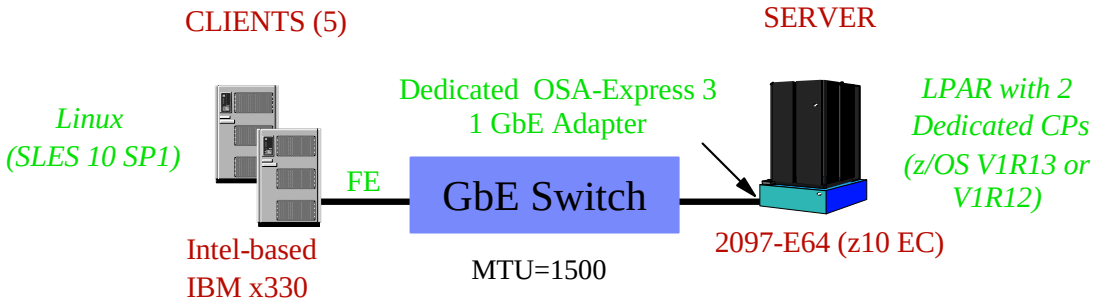
z/OS CS Configurations and Workloads

Hardware/Software Configurations

➢ **AWM Client/Server Benchmarks (RR, CRR, STR)**



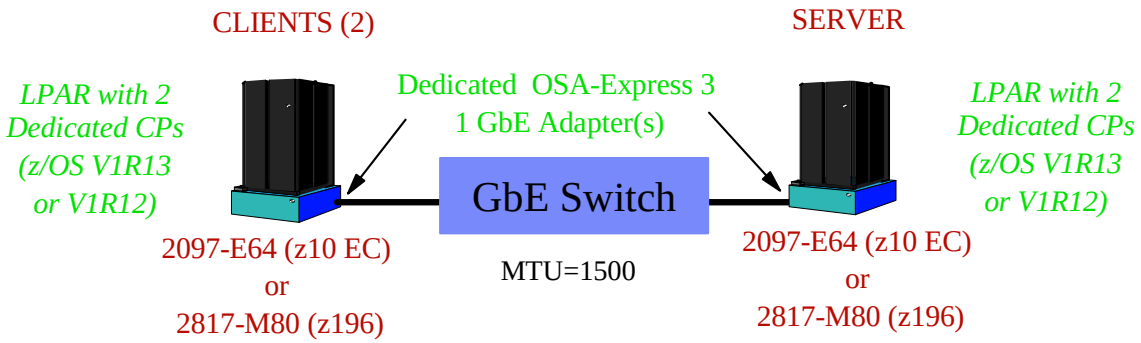
➢ **CICS Sockets**



Note: Large send (Segmentation Offload) was disabled for all measurements unless otherwise stated.

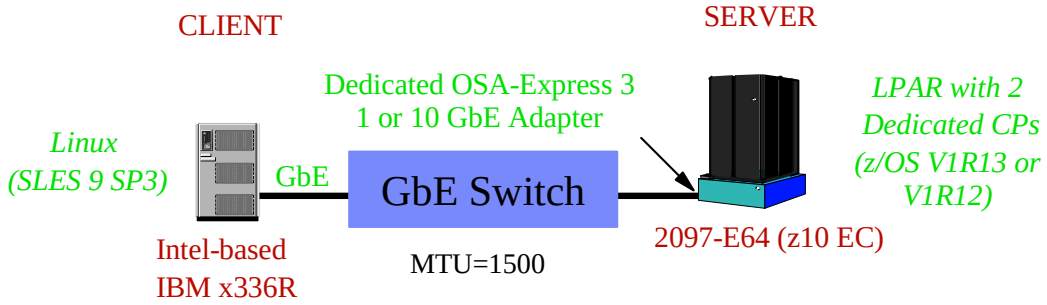
Hardware/Software Configurations

➢ **TN3270E**



Note: Two TPNS's on each client system were used to drive TN3270E traffic
Server: TN3270E Server, four ITPECHO applications

➢ **FTP**

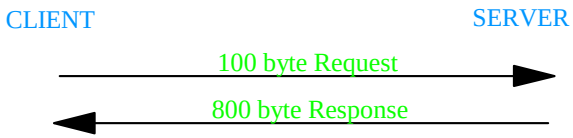


Note: Large send (Segmentation Offload) was disabled for all measurements unless otherwise stated.

AWM Benchmark Descriptions

RR Workload

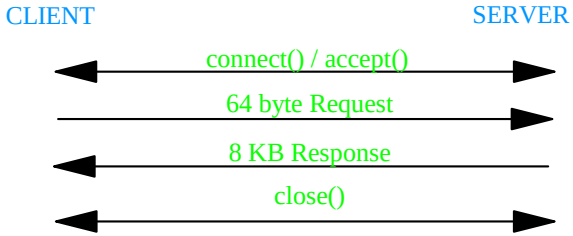
- Request-Response
  - Simulate TN3270
  - Interactive workloads



- 20 connections, 30 connections, and 60 connections

CRR Workload

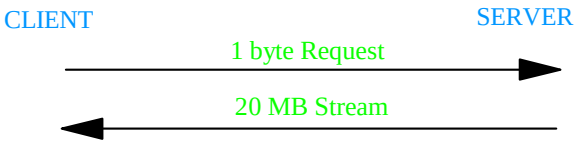
- Connect-Request-Response
  - Static Web Serving



- 9 connections and 20 connections

STR Workload

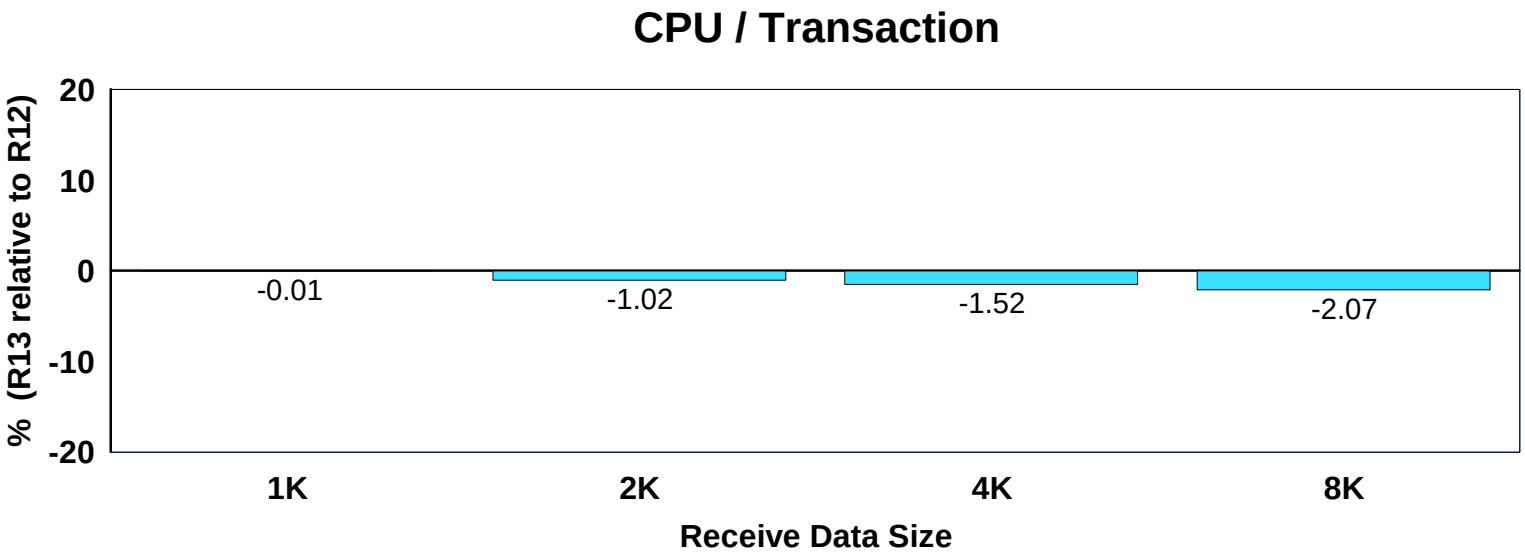
- Streaming
  - Simulate FTP or TSM
  - Memory-to-Memory



- 3 connections and 10 connections

z/OS CS V1R13
Line Item Performance

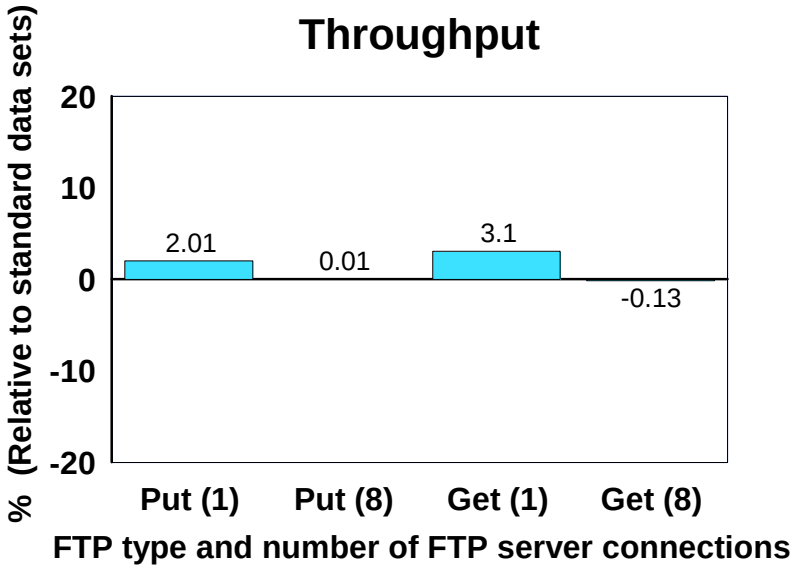
TN3270 Receive Buffer Enhancements

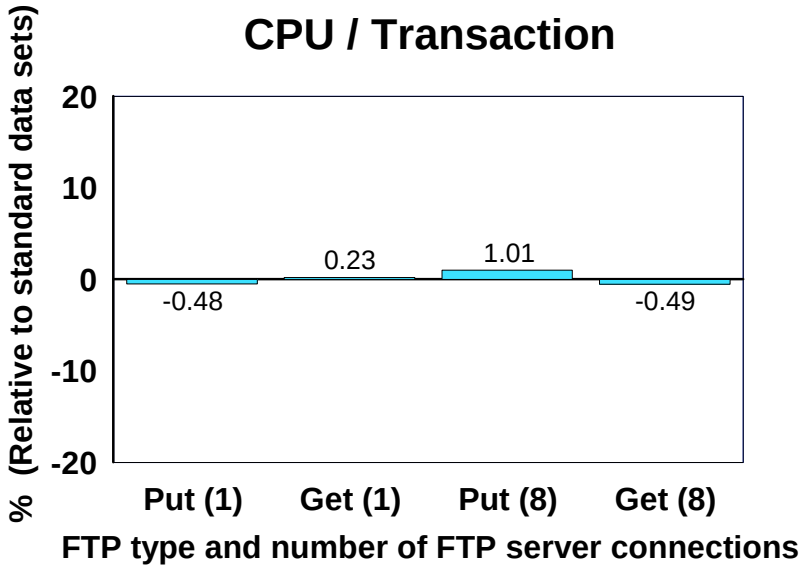


- TN3270 Server: 1K to 8K receive buffer sizes; 8K sessions.
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 0.01% to 2.07% lower CPU cost per transaction compared to V1R12 (Avg= 1.01% lower). The CPU savings increases as the receive data size increases.
- No customer action is required to take advantage of these enhancements.

FTP Extended Address Space Volumes with EAS Data Sets

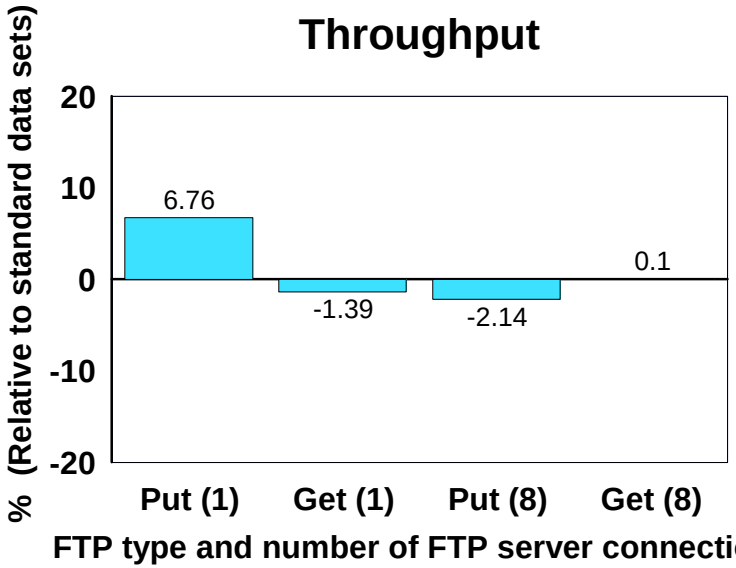


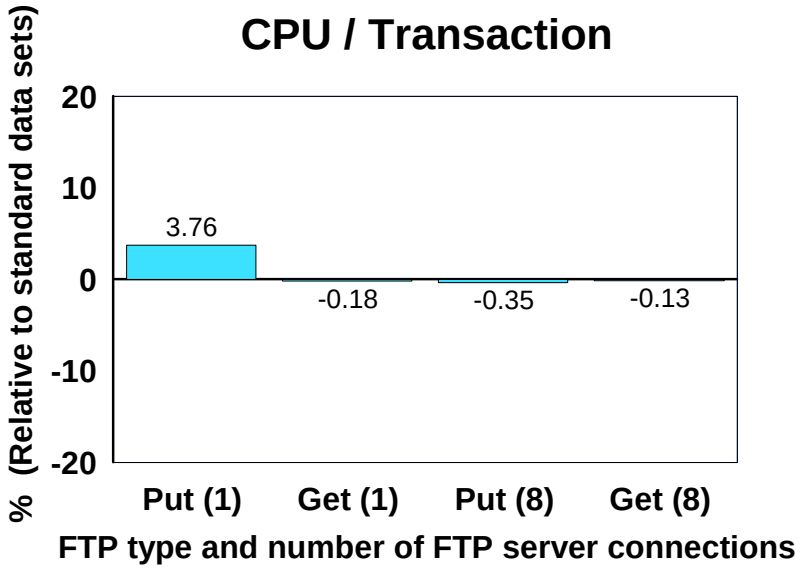


- FTP Server: 1 or 8 sessions, Puts and Gets to/from DASD, 20 MB / 1 or 1 / 20 MB
- Put: Binary and ASCII Put; Get: Binary and ASCII Get
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- Use of Extended Address Space (EAS) data sets with z/OS V1R13 provides 0.13% lower to 3.01% higher throughput compared to standard data sets (Avg= 1.25% higher).
- Use of Extended Address Space data sets with z/OS V1R13 provides 0.49% lower to 1.01% higher CPU cost per transaction compared to standard data sets (Avg= 0.07% higher).

FTP Large Format Data Sets





- FTP Server: 1 or 8 sessions, Puts and Gets to/from DASD, 20 MB / 1 or 1 / 20 MB
- Put: Binary and ASCII Put; Get: Binary and ASCII Get
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- Use of Large Format data sets with z/OS V1R13 provides 2.14% lower to 6.76% higher throughput compared to standard data sets (Avg= 0.83% higher).
- Use of Large Format data sets with z/OS V1R13 provides 0.35% lower to 3.76% higher CPU cost per transaction compared to standard data sets (Avg= 0.80% higher).

Traces Relocated to 64 Bit Storage

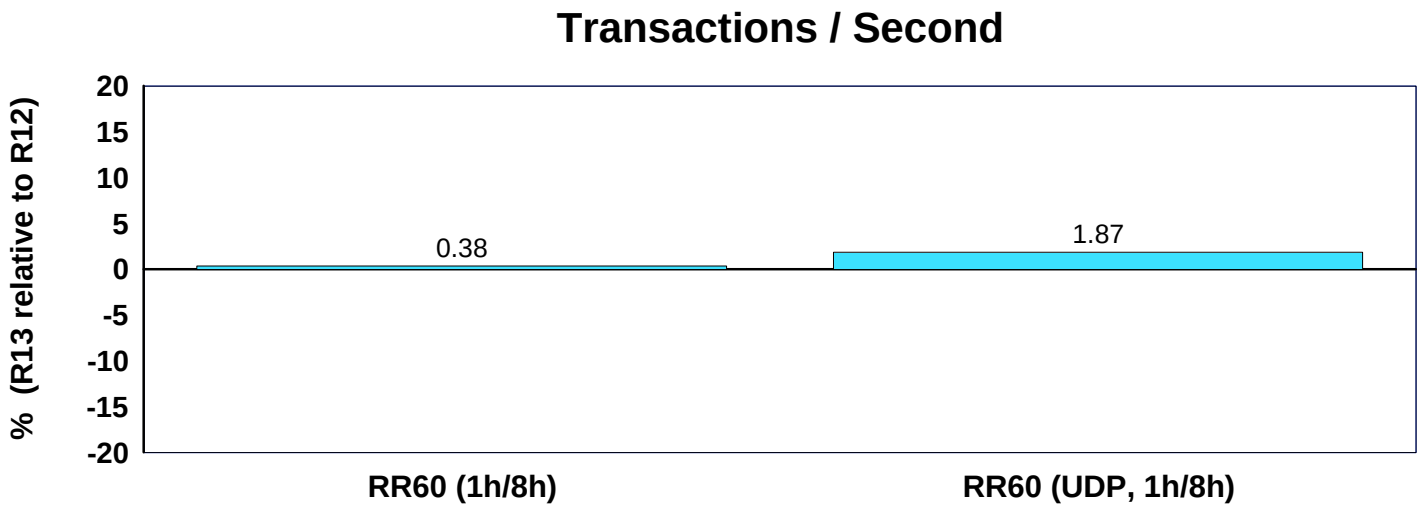
- Below the bar storage requirements are significantly reduced for V1R13.
  - The VTAM Internal Trace (VIT) has been moved from ECSA to 64 bit common.
  - Many CTRACE components have been moved from data space to 64 bit common.
  - The TN3270E trace has been moved from TN3270E private to 64 bit private.

- The maximum size for the trace buffer for component SYSTCPIP (TCP/IP and Telnet server) has been increased to one Gigabyte.

CTRACE Component	Current Location	z/OS V1R13 Change	User
SYSTCPIP	TCPIPDS1 Dataspace	64 bit common	Stack
SYSTCPIP	TN3270E Private Storage	64 bit private	TN3270E
SYSTCPDA	TCPIPDS1 Dataspace	64 bit common	Stack (NMI)
SYSTCPIS	TCPIPDS1 Dataspace	64 bit common	Stack
SYSTCPCN	TCPIPDS1 Dataspace	64 bit common	Stack (NMI only)
SYSTCPSM	TCPIPDS1 Dataspace	64 bit common	Stack (NMI only)
SYSTCPRE	Private SP229	No change	Resolver
SYSTCPRT	OMPROUTE Private Storage	No change	OMPROUTE
SYSTCPIK	IKE Daemon Private Storage	No change	IKESMP
SYSTCPOT	TCPIPDS1 Dataspace	64 bit common	OSAENTA
SYSTCPNS	NSS Daemon Private Storage	No change	Security Server

z/OS CS V1R13 vs V1R12 Relative Performance

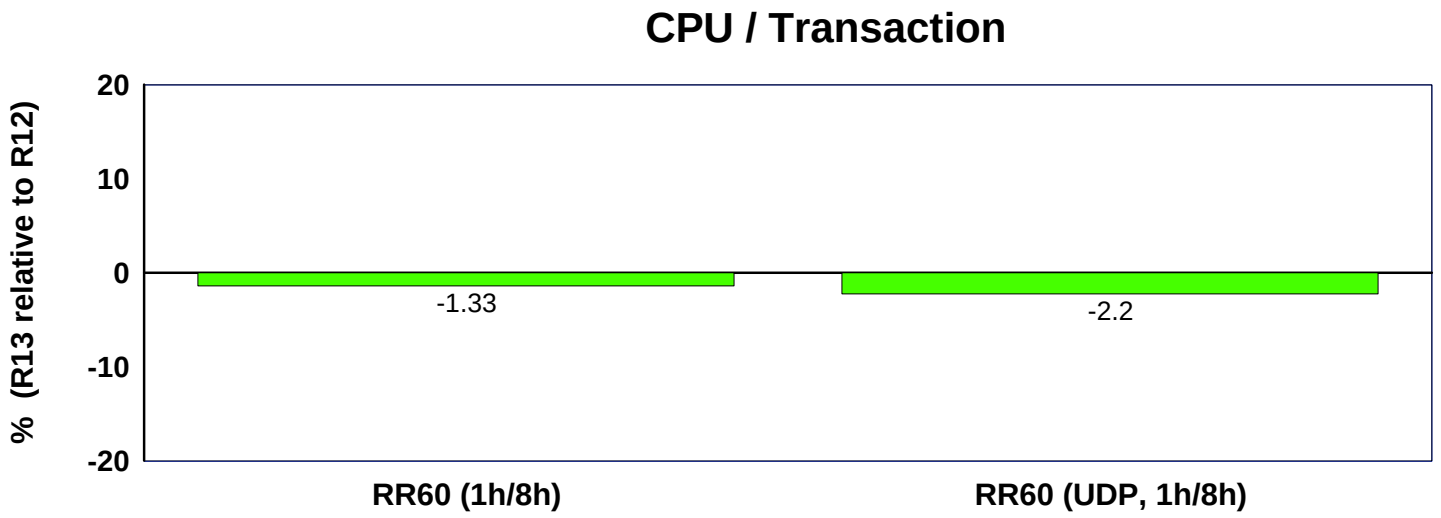
IPv4 AWM Primitives Relative Performance (RR Throughput)



- Request-Response workload
- RR60 (1h/8h): 60 sessions, TCP, 100 / 800
- RR60 (UDP, 1h/8h): 60 sessions, UDP, 100 / 800
- All transactions are memory to memory (no DASD used)
- Hardware: z10 using OSA-E3 (1 GbE) INBPERF DYNAMIC used
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 0.38% to 1.87% higher throughput compared to V1R12 (Avg= 1.12% higher).

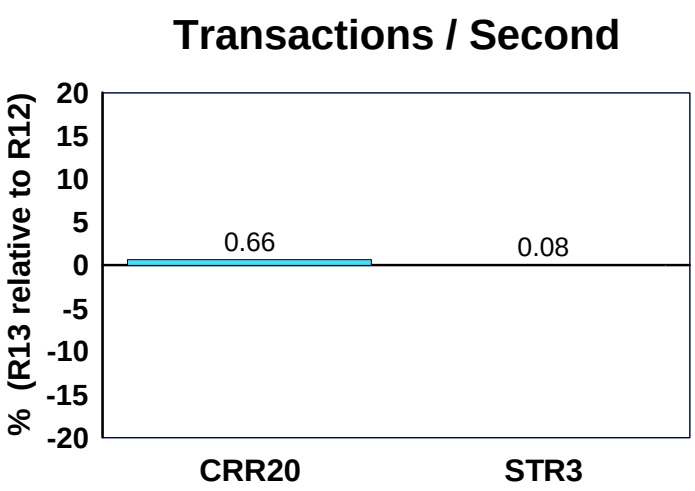
IPv4 AWM Primitives Relative Performance (RR CPU/Transaction)

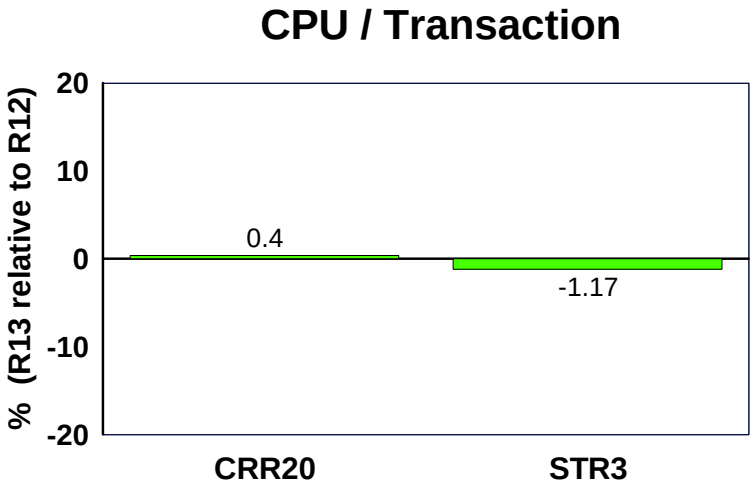


- Request-Response workload
- RR60 (1h/8h): 60 sessions, TCP, 100 / 800
- RR60 (UDP, 1h/8h): 60 sessions, UDP, 100 / 800
- All transactions are memory to memory (no DASD used)
- Hardware: z10 using OSA-E3 (1 GbE) INBPERF DYNAMIC used
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 1.33 to 2.2% lower CPU cost per transaction compared to V1R12 (Avg= 1.76% lower).

IPv4 AWM Primitives Relative Performance (CRR and STR)

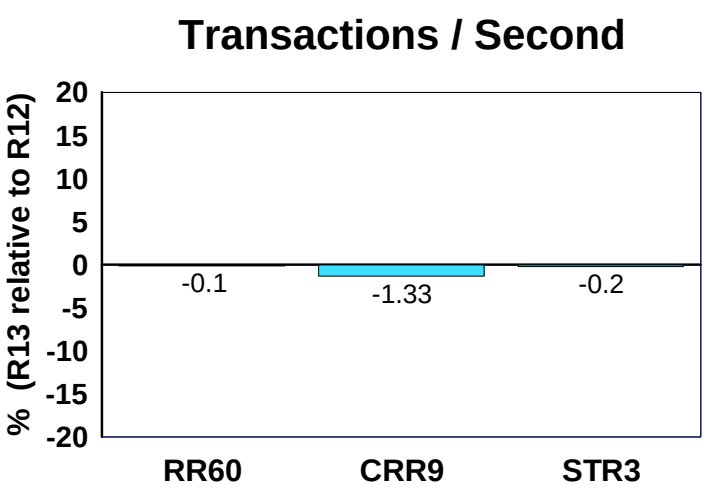


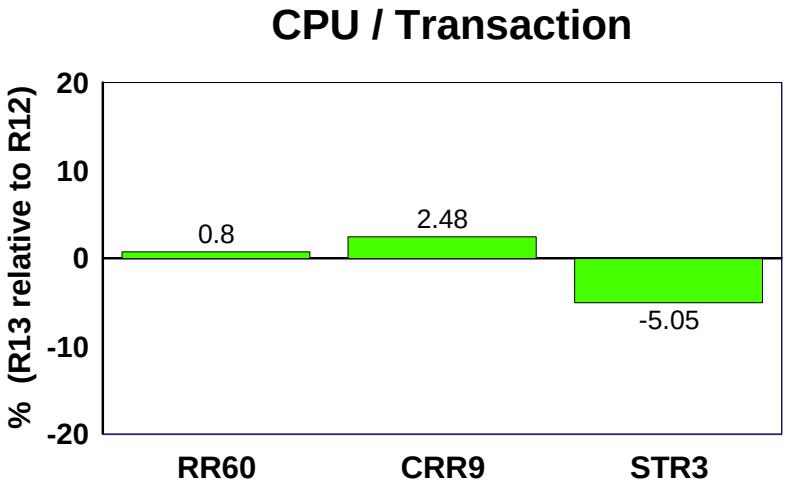


- Connect-Request-Response and Streaming workloads
- CRR20: 20 sessions, 64 / 8 KB
- STR3: 3 sessions, 1 / 20 MB
- All transactions are memory to memory (no DASD used)
- Hardware: z10 using OSA-E3 (1 GbE) INBPERF DYNAMIC for CRR and OSA-E3 (10 GbE) for STR workload
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 CRR and STR provide equivalent throughput compared to V1R12.
- z/OS V1R13 CRR provides 0.4% higher CPU cost per transaction compared to V1R12.
- z/OS V1R13 STR provides .08 to 1.17% lower CPU cost per transaction compared to V1R12 (Avg= 0.62% lower).

IPv6 AWM Primitives Relative Performance (RR, CRR and STR)

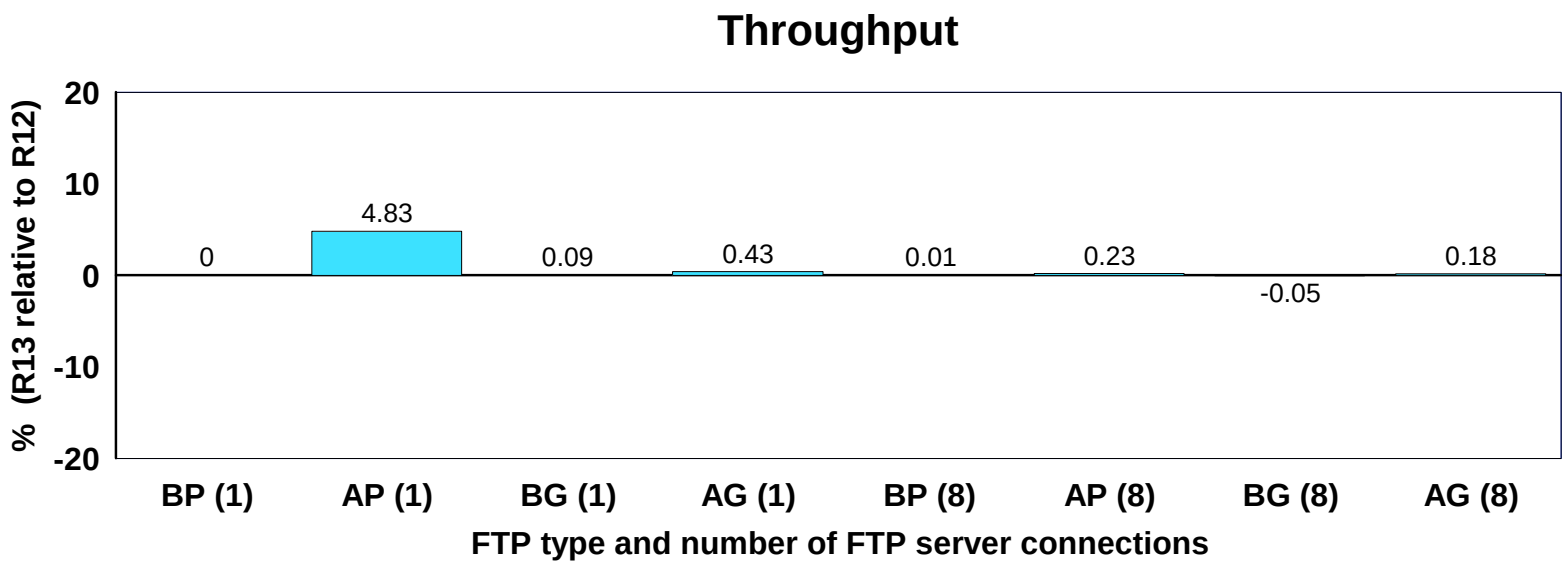




- Request-Response, Connect-Request-Response, and Streaming workloads
- RR60: 60 sessions, 100 / 800
- CRR9: 9 sessions, 64 / 8 KB
- STR3: 3 sessions, 1 / 20 MB
- All transactions are memory to memory (no DASD used)
- Hardware: z10 using OSA-E3 (1 GbE) INBPERF DYNAMIC for RR and CRR, and OSA-E3 (10 GbE) for STR workload
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 IPv6 RR, CRR and STR provide equivalent throughput compared to V1R12.
- z/OS V1R13 IPv6 RR provides equivalent CPU cost per transaction compared to V1R12.
- z/OS V1R13 IPv6 CRR provides 2.48% higher CPU cost per transaction compared to V1R12.
- z/OS V1R13 IPv6 STR provides 5.05% lower CPU cost per transaction compared to V1R12.

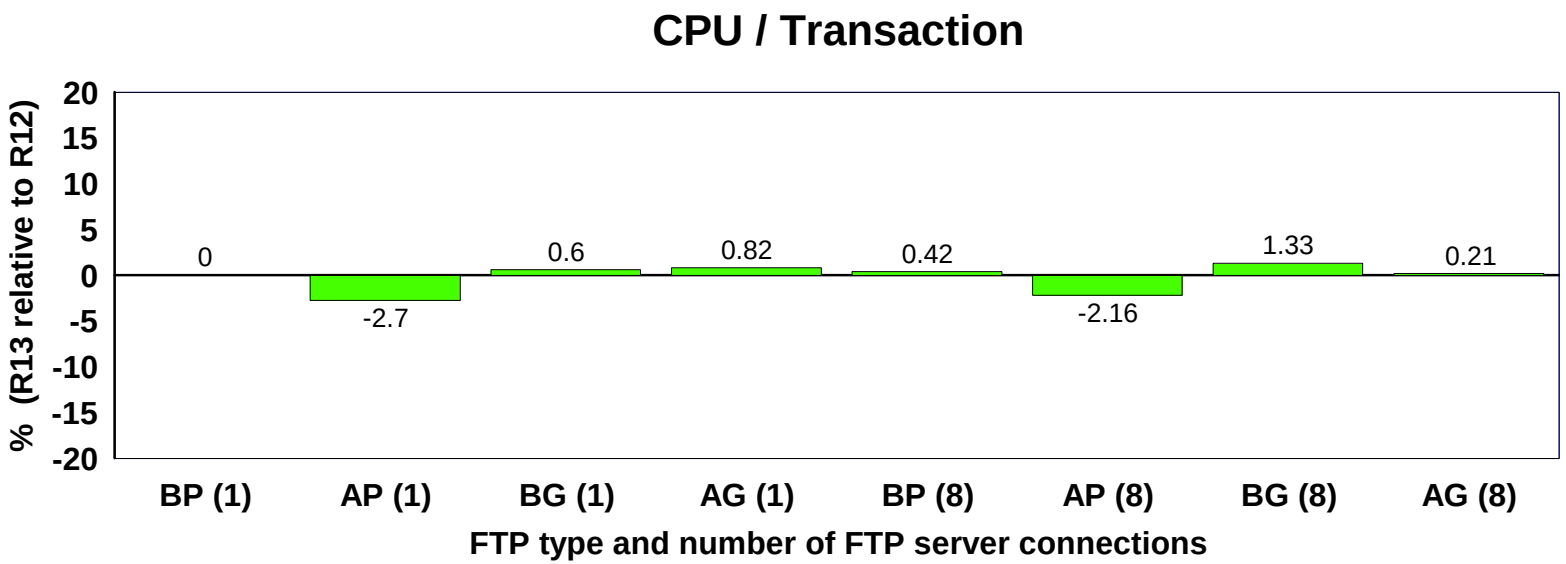
IPv4 FTP Server Relative Performance (Throughput)



- FTP Server: 1 or 8 sessions, Puts and Gets to/from DASD, 20 MB / 1 or 1 / 20 MB
- BP: Binary Put; AP: ASCII Put; BG: Binary Get; AG: ASCII Get
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 0.05% lower to 4.83% higher throughput compared to V1R12 (Avg= 0.71% higher).

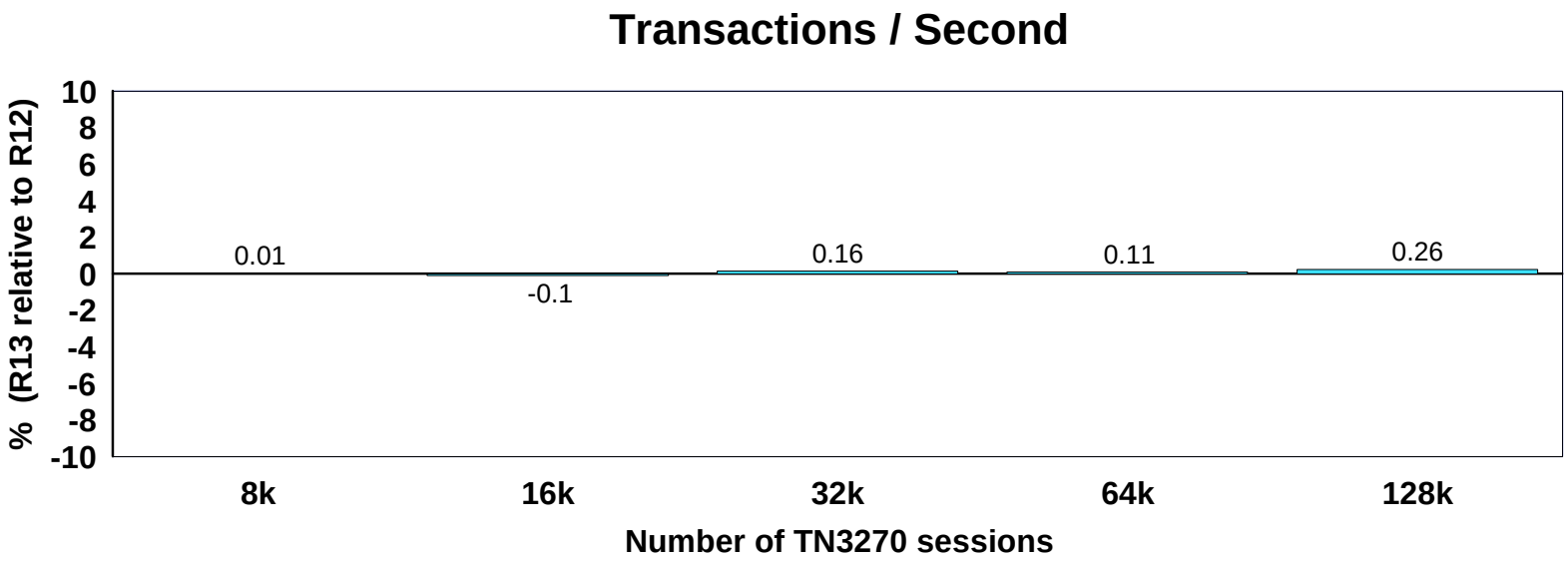
IPv4 FTP Server Relative Performance (CPU/Transaction)



- FTP Server: 1 or 8 sessions, Puts and Gets to/from DASD, 20 MB / 1 or 1 / 20 MB
- BP: Binary Put; AP: ASCII Put; BG: Binary Get; AG: ASCII Get
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 2.7% lower to 1.33% higher CPU cost per transaction compared to V1R12 (Avg= 0.18% lower).

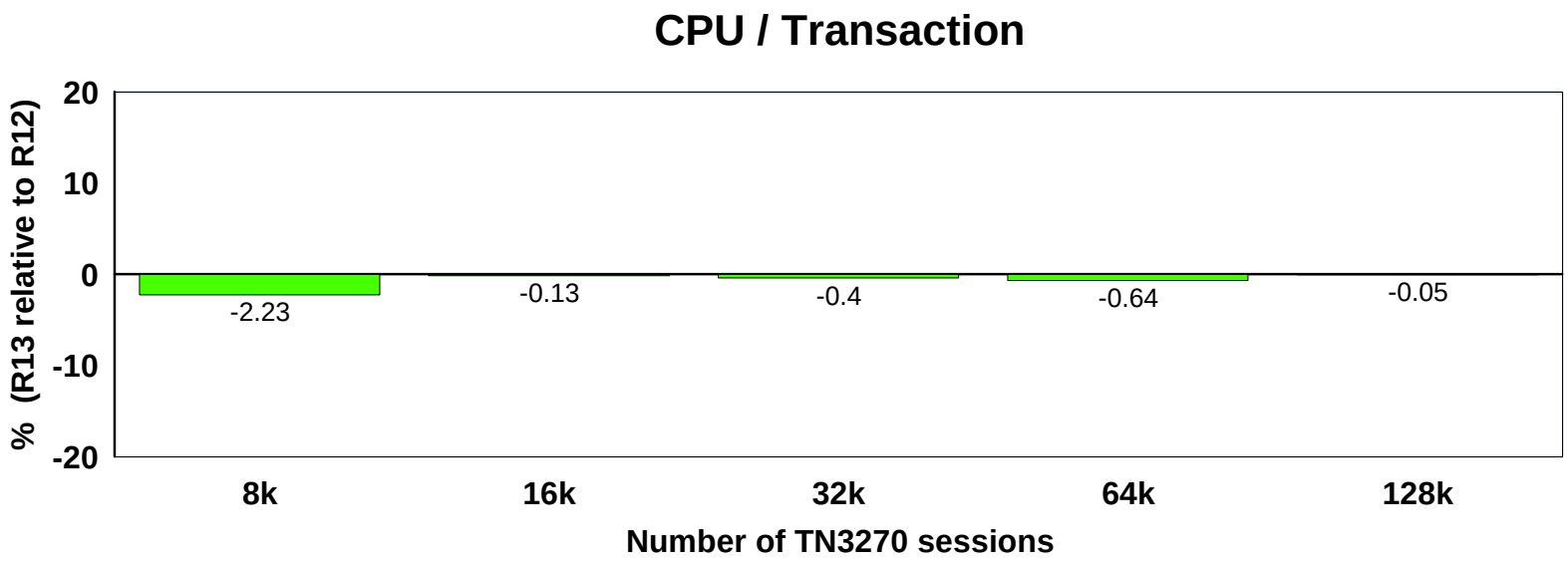
IPv4 TN3270 Server Relative Performance (Throughput)



- TN3270 Server: 8k to 128k sessions, 10 second think time, 100 / 800
- Throughput is about the same since a fixed think time is used between user transactions
- Hardware: z196 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides equivalent throughput compared to V1R12.

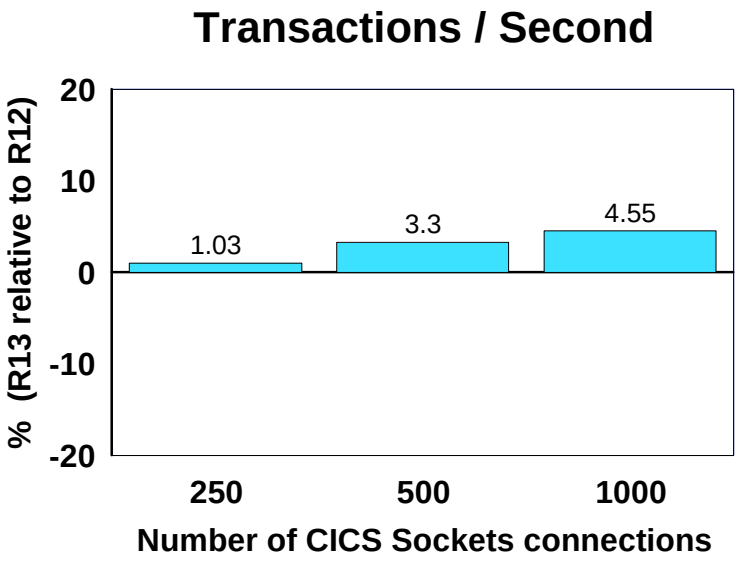
IPv4 TN3270 Server Relative Performance (CPU/Transaction)

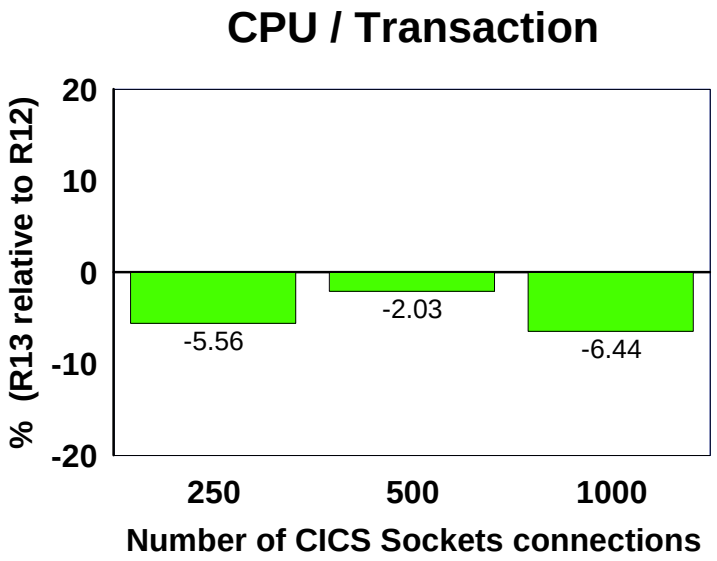


- TN3270 Server: 8k to 128k sessions, 10 second think time, 100 / 800
- Hardware: z196 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 0.13% to 2.23% lower CPU cost per transaction compared to V1R12 (Avg= 0.67% lower).

IPv4 CICS Sockets Relative Performance

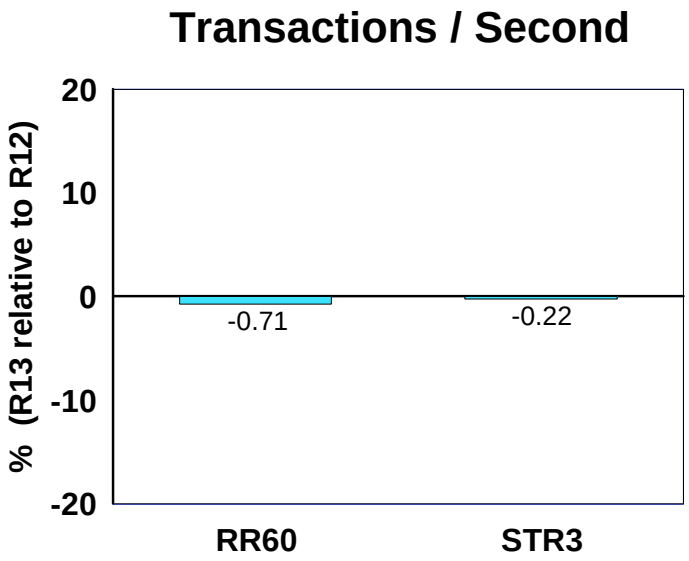


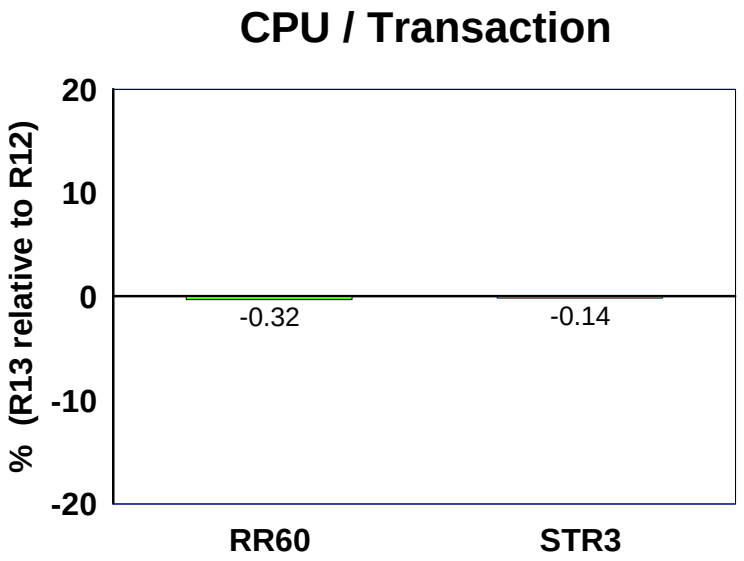


- CICS Sockets: 250 to 1000 sessions, 0.5 second think time, OTE, 200 / 200
- Throughput is about the same since a fixed think time is used between user transactions
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12, CICS TS 4.1

- z/OS V1R13 provides 1.03 to 4.55% higher throughput compared to V1R12 (Avg= 2.96% higher).
- z/OS V1R13 provides 2.03 to 6.44% lower CPU cost per transaction compared to V1R12 (Avg= 4.67% lower).

IPv4 Enterprise Extender (EE) Relative Performance

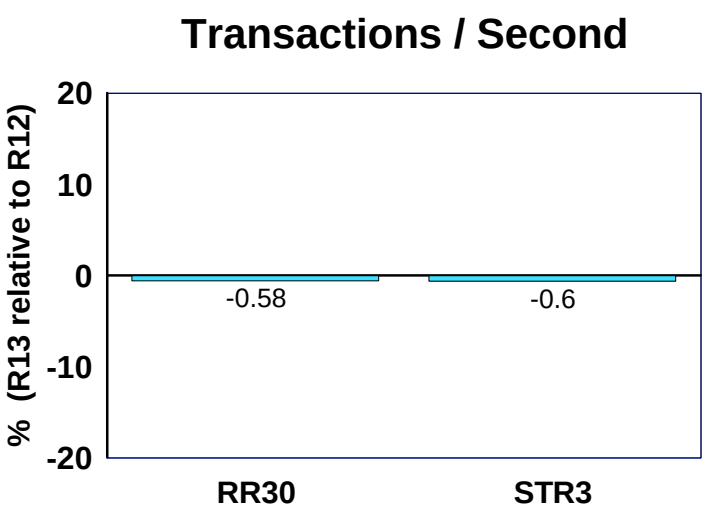


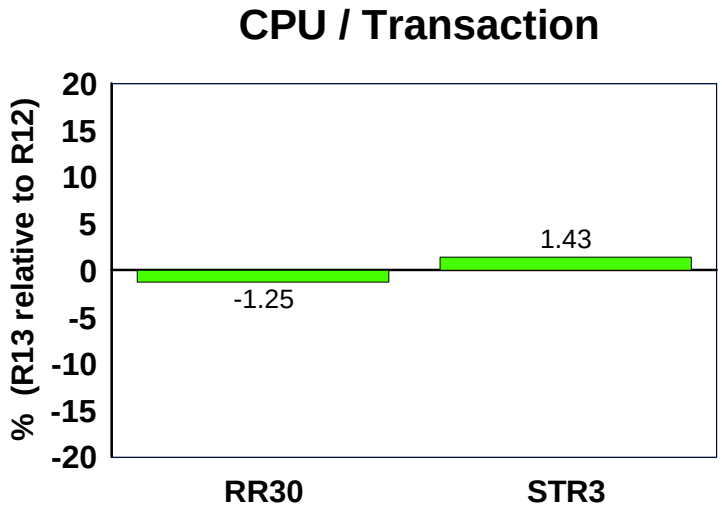


- Request-Response workload
- RR60: 60 sessions, 100 / 800
- STR3: 3 sessions, 1 / 20 MB
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 0.22 to 0.71% lower throughput compared to V1R12 (Avg= 0.46% lower).
- z/OS V1R13 provides equivalent CPU cost per transaction compared to V1R12.

IPSec Relative Performance

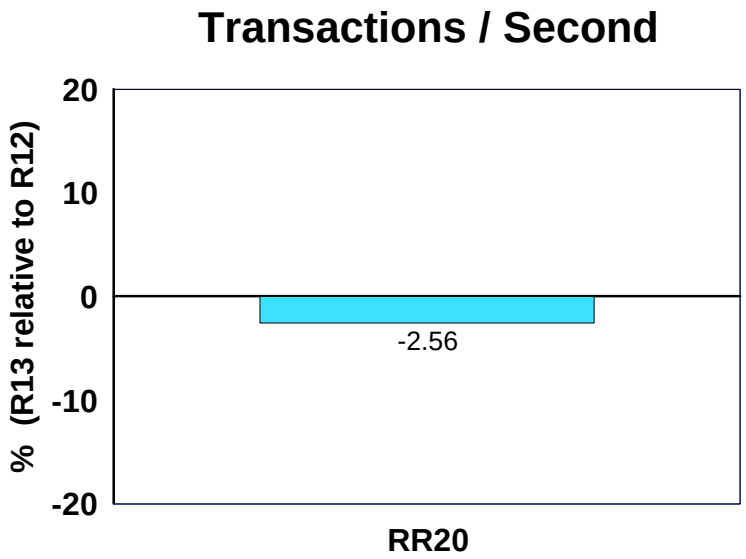


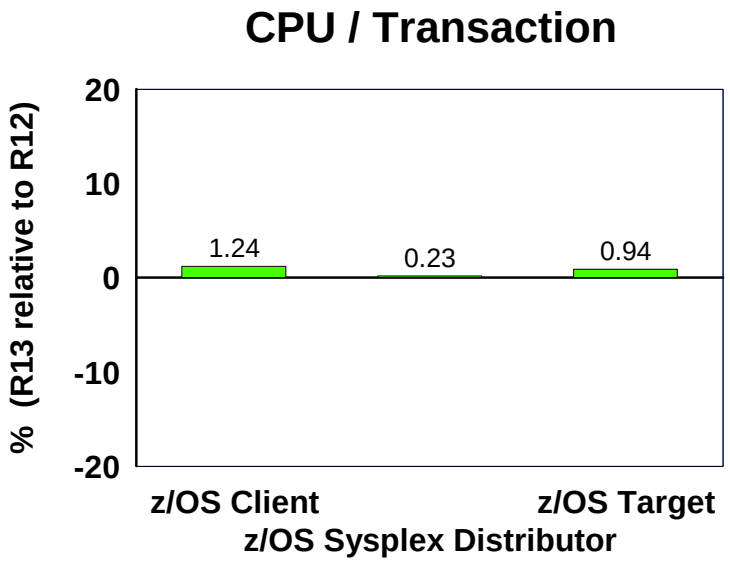


- Request-Response and Streaming workloads
- RR30: 30 sessions, 100 / 800
- STR3: 3 sessions (Sending 20 Mbytes / Receiving 1 byte)
- Encryption: 3DES, Authentication: SHA
- Hardware: z10 (2 CPs) using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 0.6% lower throughput compared to V1R12.
- z/OS V1R13 provides 1.25% lower to 1.43% higher CPU cost per transaction compared to V1R12 (Avg= 0.09% higher).

Sysplex Distributor Relative Performance

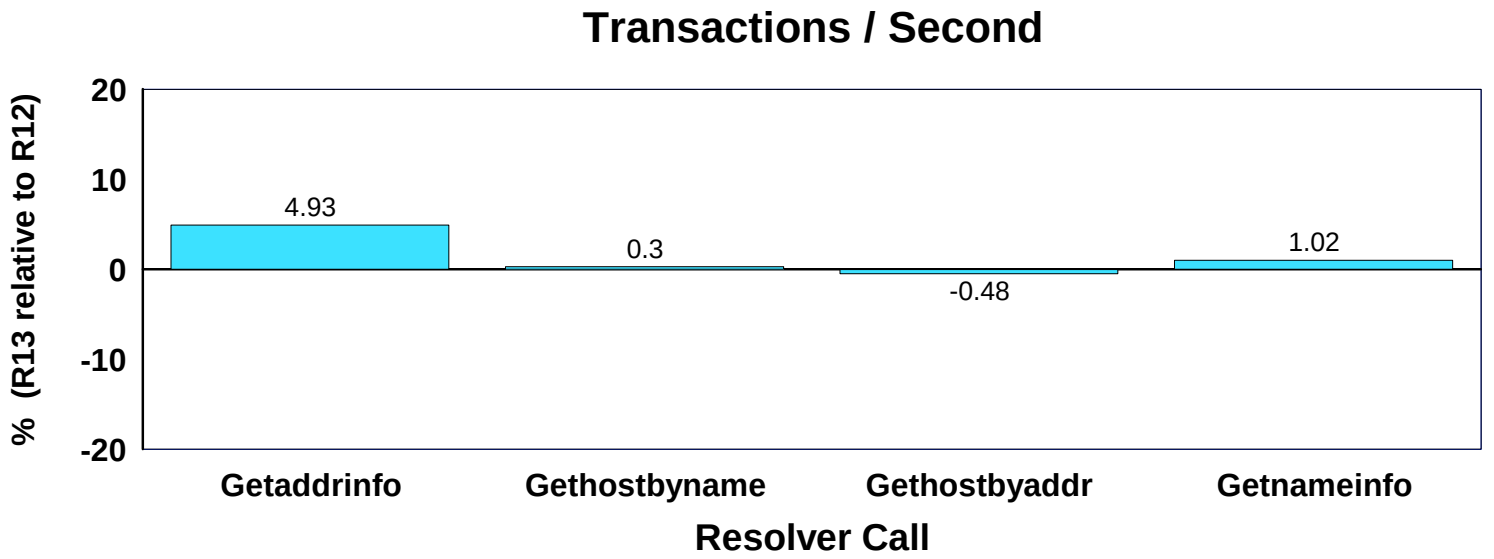




- Request-Response workload
- RR20: 20 sessions, 100 / 100
- Hardware: z10 client, z196 distributor and target, using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 2.56% lower throughput compared to V1R12.
- z/OS V1R13 provides 0.23% to 1.24% higher CPU cost per transaction compared to V1R12 (Avg= 0.80% higher).

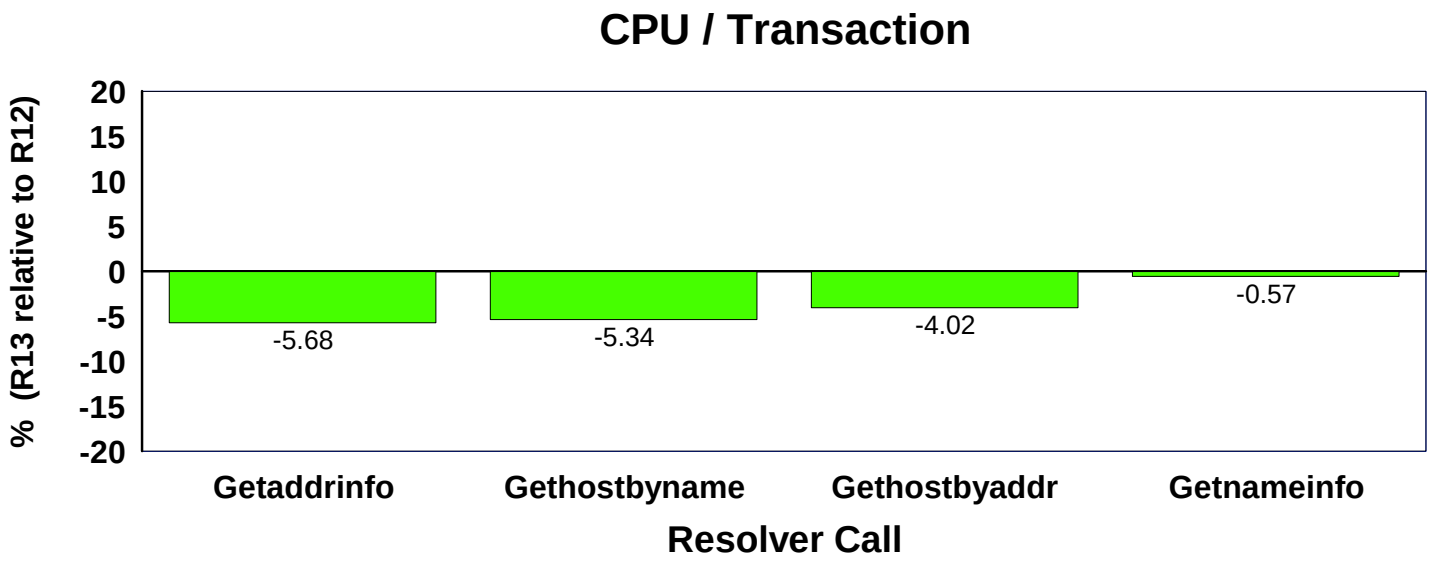
Resolver Relative Performance (Throughput)



- Resolver Lookup: DNS: Resolves IP address on remote DNS server (Linux)
- Transaction: GETADDRINFO, GETHOSTBYNAME, GETHOSTBYADDR, and GETNAMEINFO calls
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 0.48% lower to 4.93% higher throughput compared to V1R12 (Avg= 1.44% higher).

Resolver Relative Performance (CPU/Transaction)

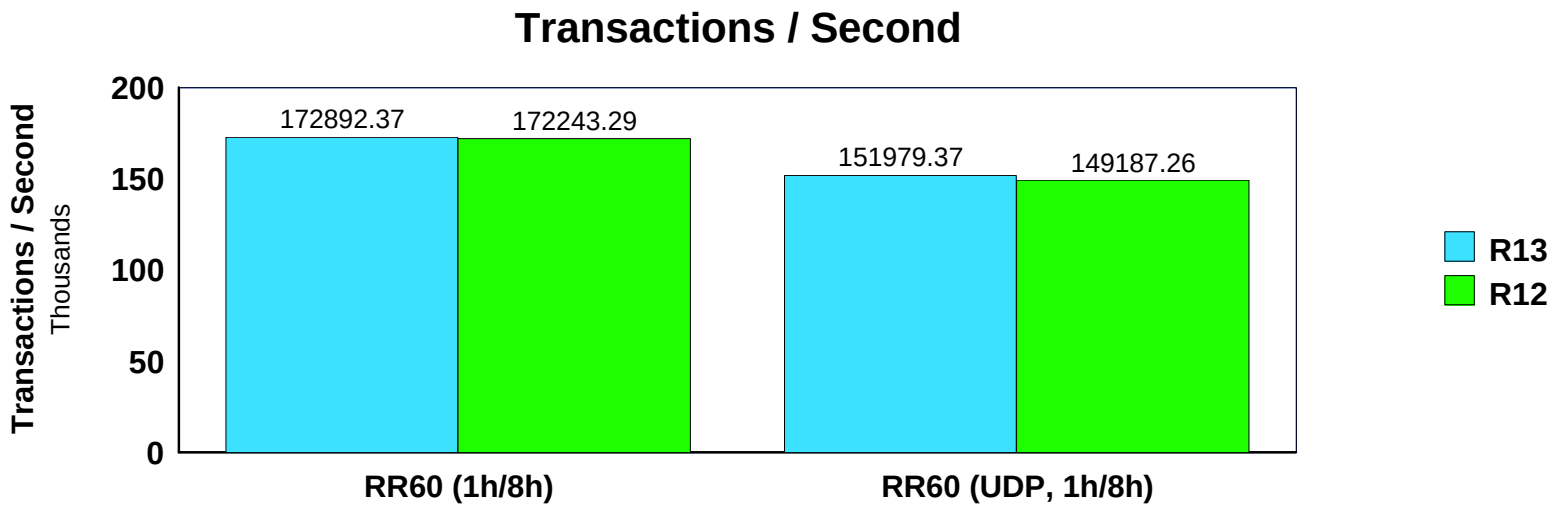


- Resolver Lookup: DNS: Resolves IP address on remote DNS server (Linux)
- Transaction: GETADDRINFO, GETHOSTBYNAME, GETHOSTBYADDR, and GETNAMEINFO calls
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 0.57 to 5.68% lower CPU cost per transaction compared to V1R12 (Avg= 3.90% lower).

z/OS CS V1R13 vs V1R12 Detailed Performance

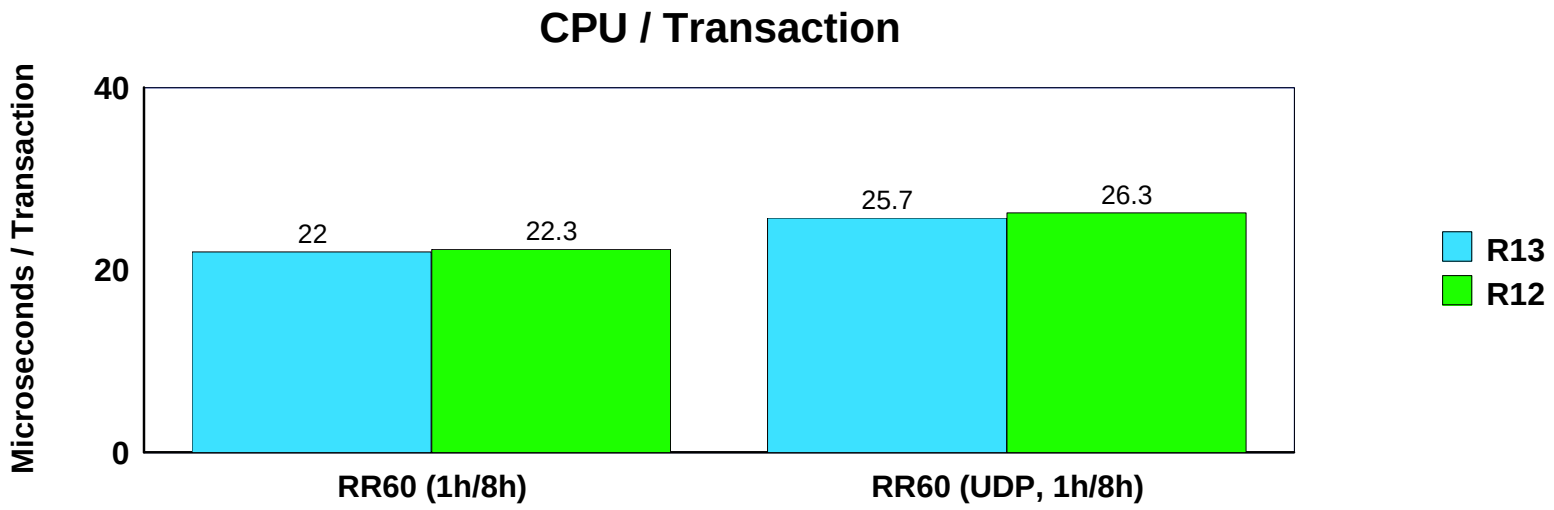
IPv4 AWM Primitives Detailed Performance (RR Throughput)



- Request-Response workload
- RR60 (1h/8h): 60 sessions, TCP, 100 / 800
- RR60 (UDP, 1h/8h): 60 sessions, UDP, 100 / 800
- All transactions are memory to memory (no DASD used)
- Hardware: z10 using OSA-E3 (1 GbE) INBPERF DYNAMIC used
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 0.38% to 1.87% higher throughput compared to V1R12 (Avg= 1.12% higher).

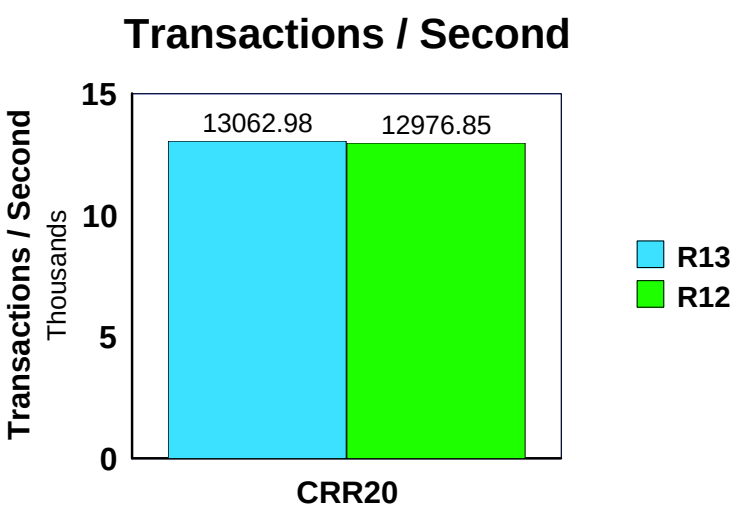
IPv4 AWM Primitives Detailed Performance (RR CPU/Transaction)

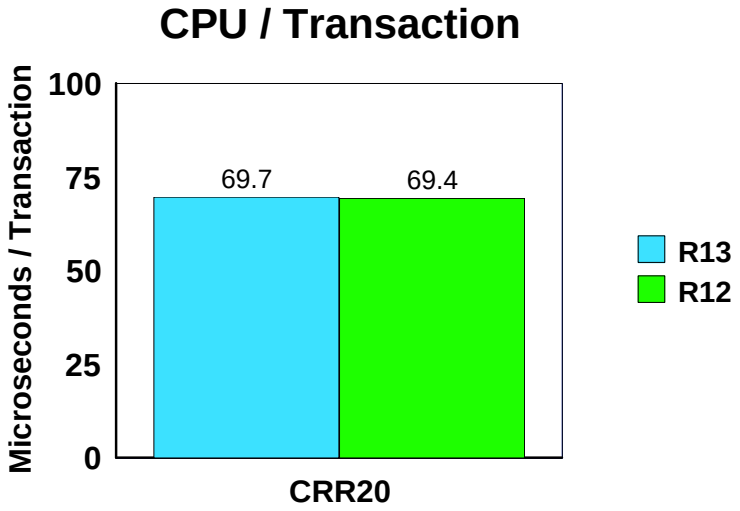


- Request-Response workload
- RR60 (1h/8h): 60 sessions, TCP, 100 / 800
- RR60 (UDP, 1h/8h): 60 sessions, UDP, 100 / 800
- All transactions are memory to memory (no DASD used)
- Hardware: z10 using OSA-E3 (1 GbE) INBPERF DYNAMIC used
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 1.33 to 2.2% lower CPU cost per transaction compared to V1R12 (Avg= 1.76% lower).

IPv4 AWM Primitives Detailed Performance (CRR)

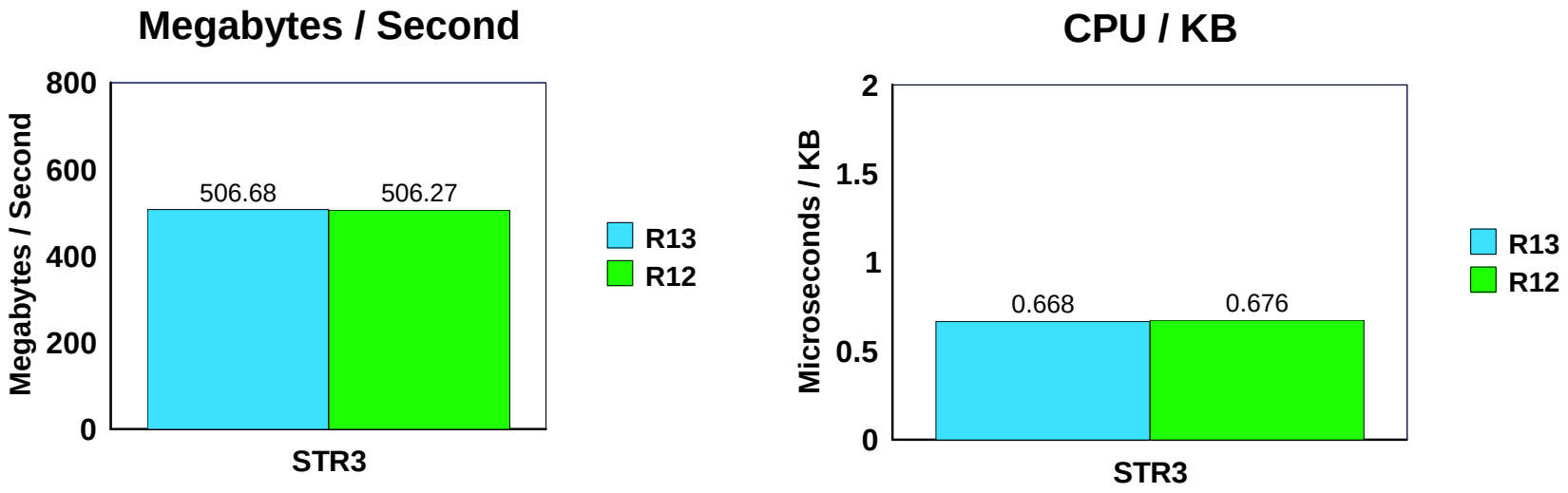




- Connect-Request-Response workload
- CRR20: 20 sessions, 64 / 8 KB
- All transactions are memory to memory (no DASD used)
- Hardware: z10 using OSA-E3 (1 GbE) INBPERF DYNAMIC used
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides equivalent throughput compared to V1R12.
- z/OS V1R13 provides 0.4% higher CPU cost per transaction compared to V1R12.

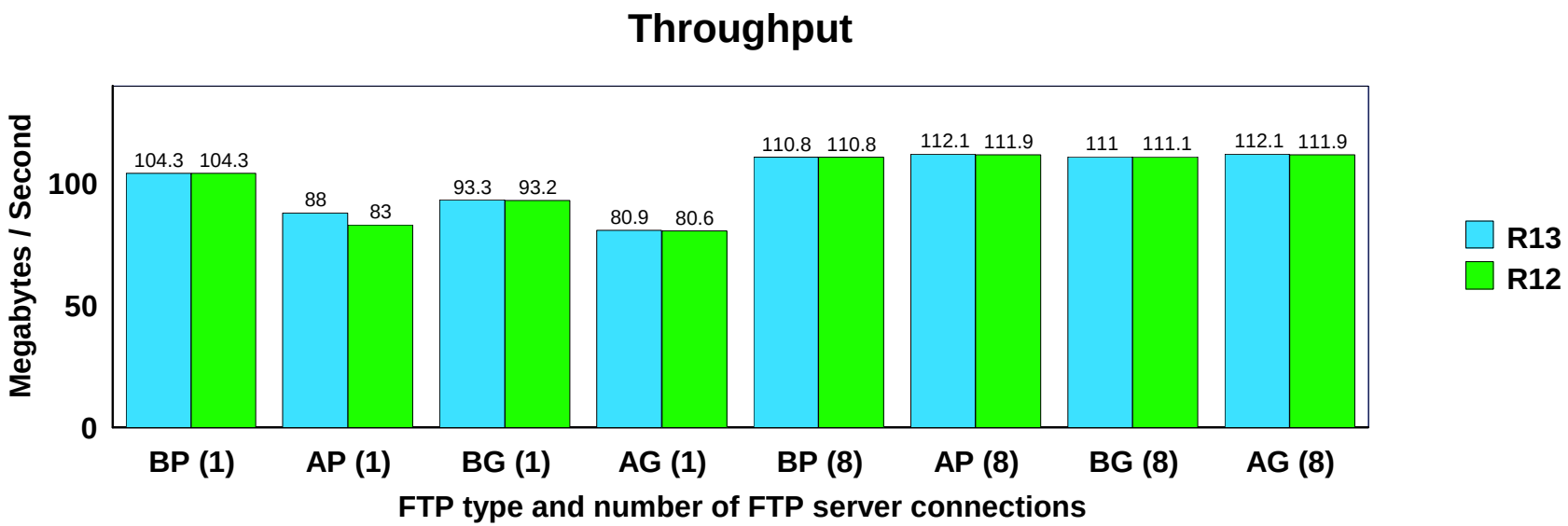
IPv4 AWM Primitives Detailed Performance (STR)



- Streaming workload
- STR3: 3 sessions, 1 / 20 MB
- All transactions are memory to memory (no DASD used)
- Hardware: z10 using OSA-E3 (10 GbE) INBPERF DYNAMIC used
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides equivalent throughput compared to V1R12.
- z/OS V1R13 provides 0.08 to 1.17% lower CPU cost per transaction compared to V1R12 (Avg= 0.62% lower).

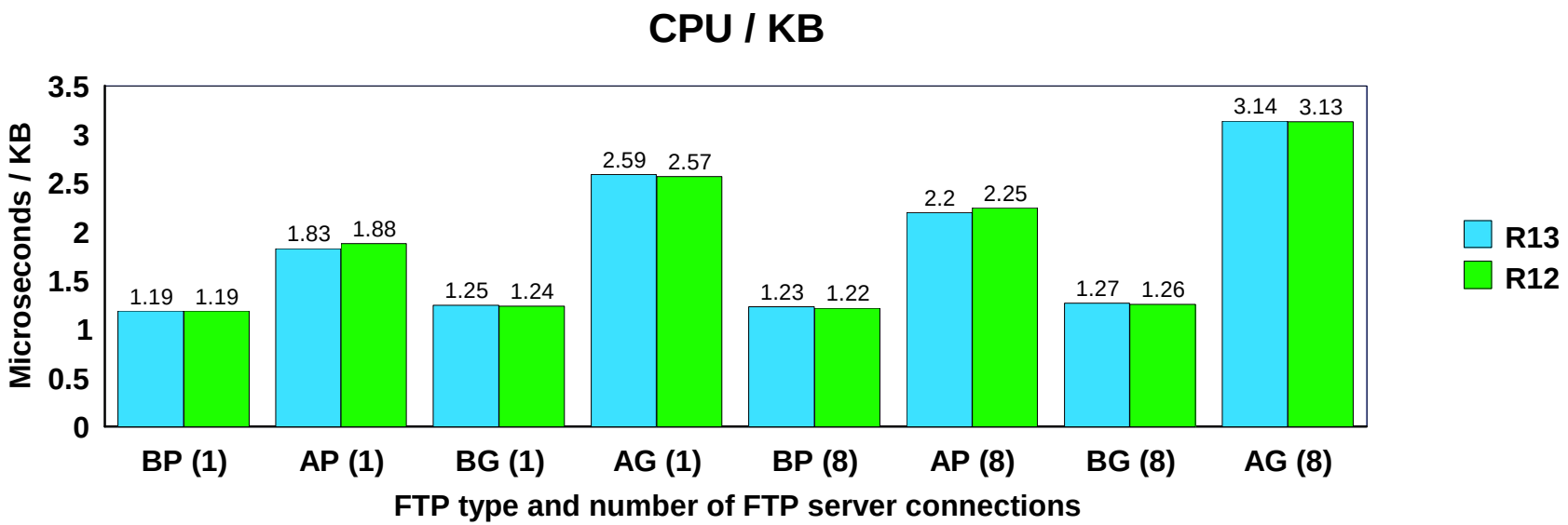
IPv4 FTP Server Detailed Performance (Throughput)



- FTP Server: 1 or 8 sessions, Puts and Gets to/from DASD, 20 MB / 1 or 1 / 20 MB
- BP: Binary Put; AP: ASCII Put; BG: Binary Get; AG: ASCII Get
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 0.05% lower to 4.73% higher throughput compared to V1R12 (Avg= 0.71% higher).

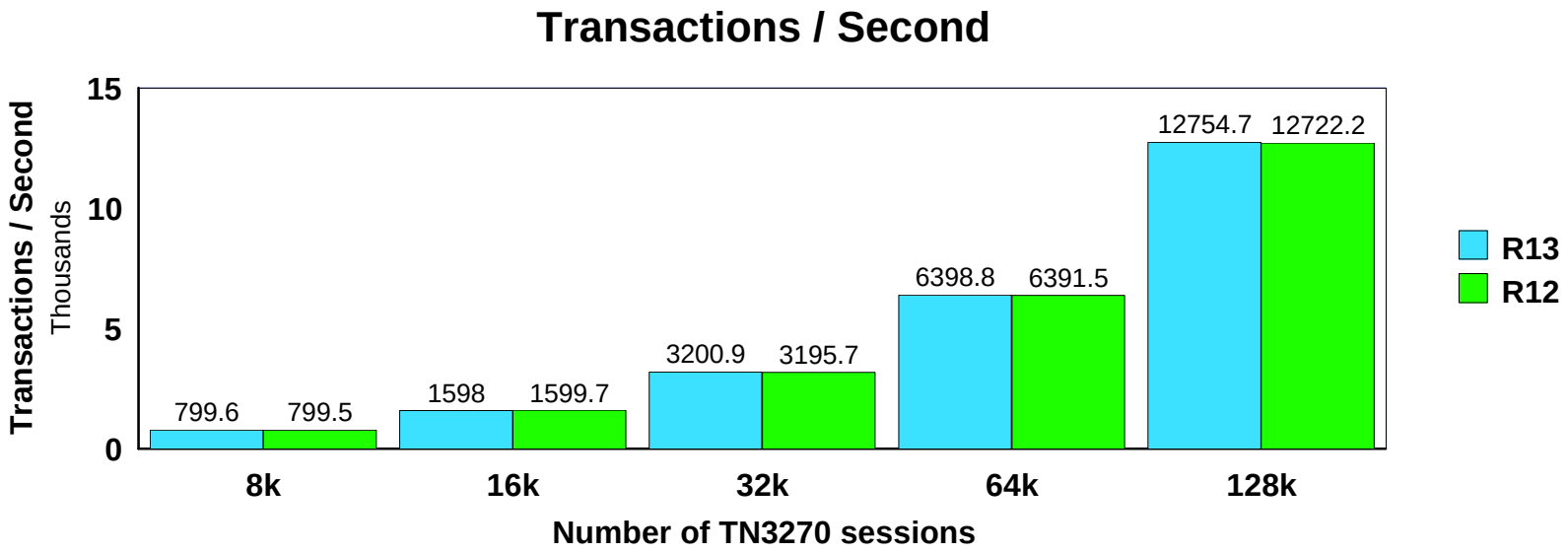
IPv4 FTP Server Detailed Performance (CPU/KB)



- FTP Server: 1 or 8 sessions, Puts and Gets to/from DASD, 20 MB / 1 or 1 / 20 MB
- BP: Binary Put; AP: ASCII Put; BG: Binary Get; AG: ASCII Get
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 2.7 lower to 1.33% higher CPU cost per kilobyte compared to V1R12 (Avg= 0.18% lower).

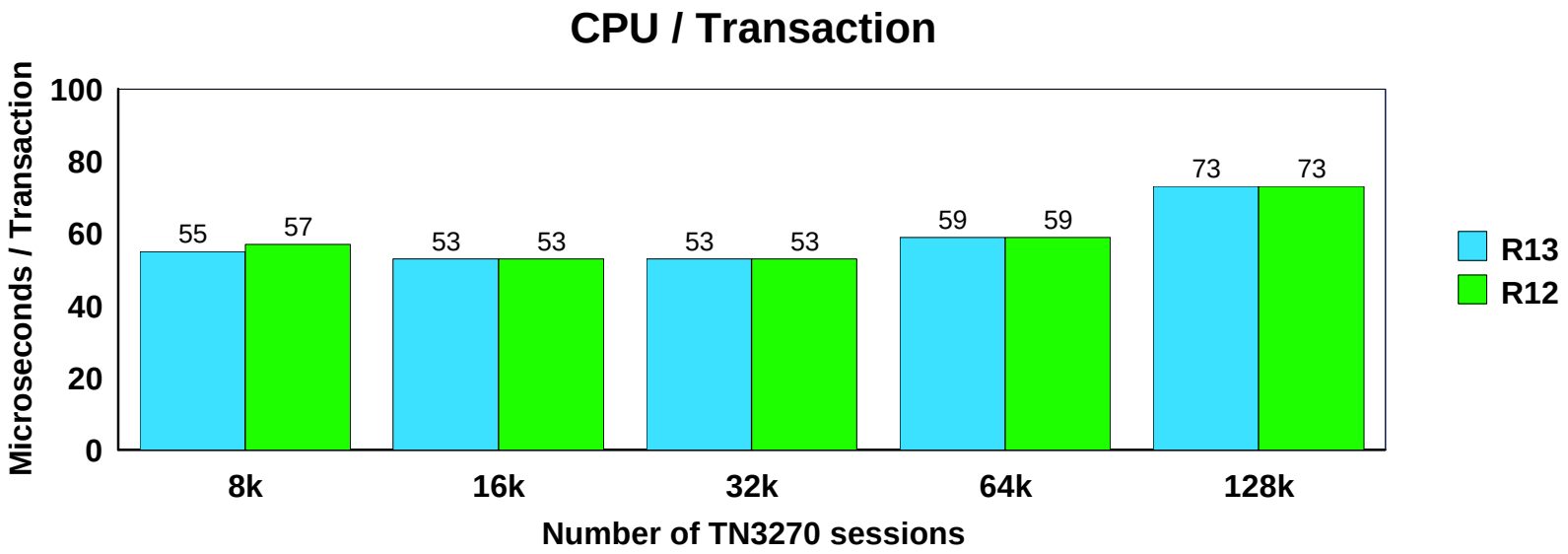
IPv4 TN3270 Server Detailed Performance (Throughput)



- TN3270 Server: 8k to 128k sessions, 10 second think time, 100 / 800
- Throughput is about the same since a fixed think time is used between user transactions
- Hardware: z196 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides equivalent throughput compared to V1R12.

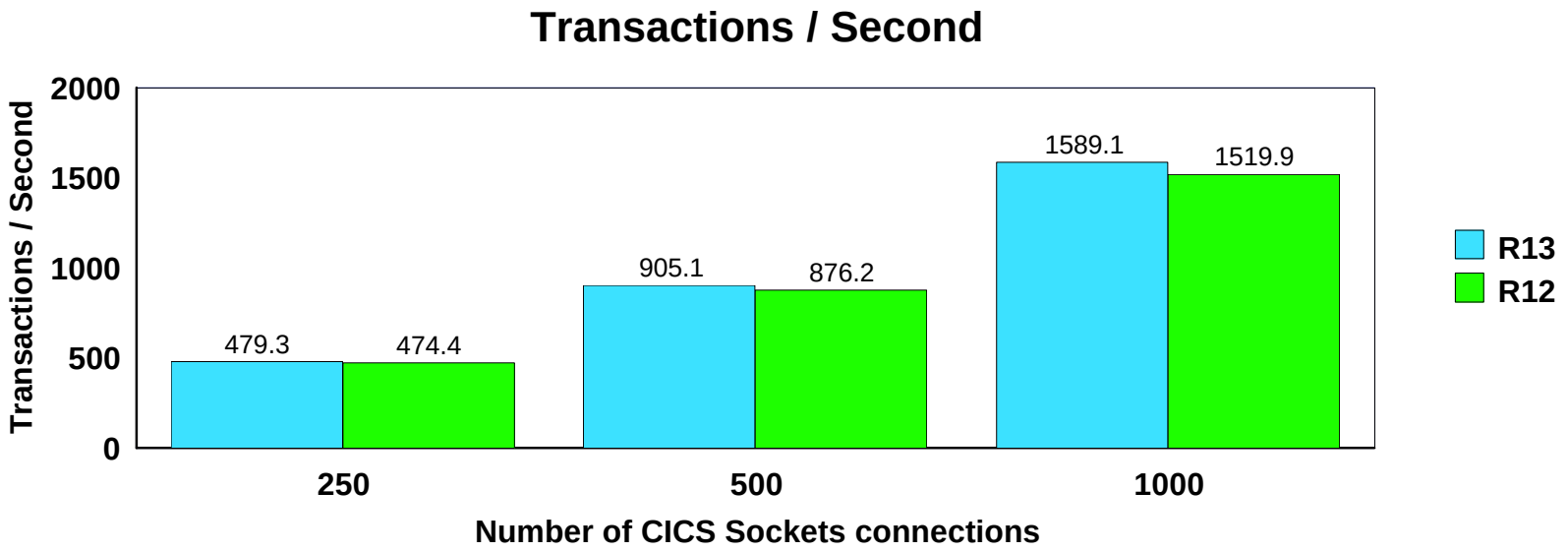
IPv4 TN3270 Server Detailed Performance (CPU/Transaction)



- TN3270 Server: 8k to 128k sessions, 10 second think time, 100 / 800
- Hardware: z196 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 0.13 to 2.23% lower CPU cost per transaction compared to V1R12 (Avg= 0.67% lower).

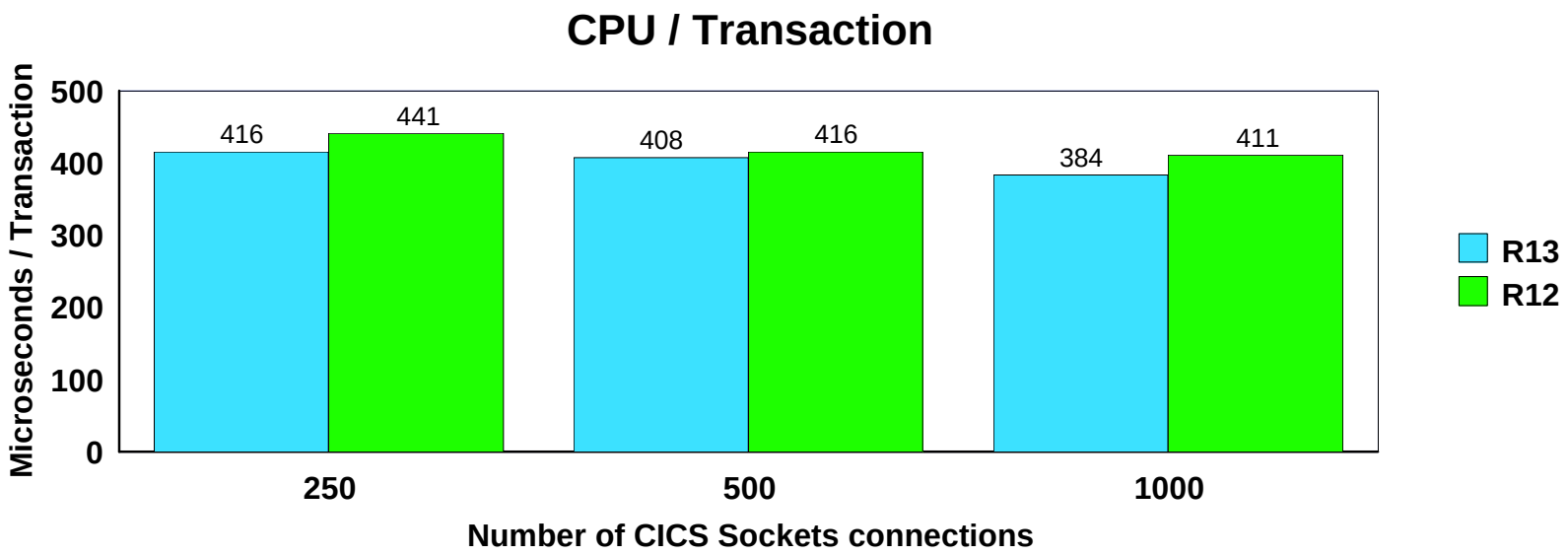
IPv4 CICS Sockets Detailed Performance (Throughput)



- CICS Sockets: 250 to 1000 sessions, 0.5 second think time, OTE, 200 / 200
- Throughput is the same due to using a fixed think time between user transactions
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12, CICS TS 4.1

- z/OS V1R13 provides 1.03 to 4.55% higher throughput compared to V1R12 (Avg= 2.96% higher).

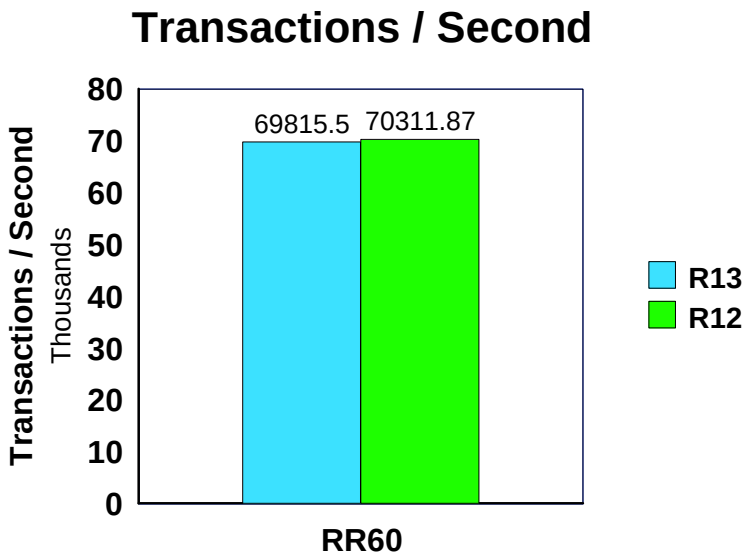
IPv4 CICS Sockets Detailed Performance (CPU/Transaction)

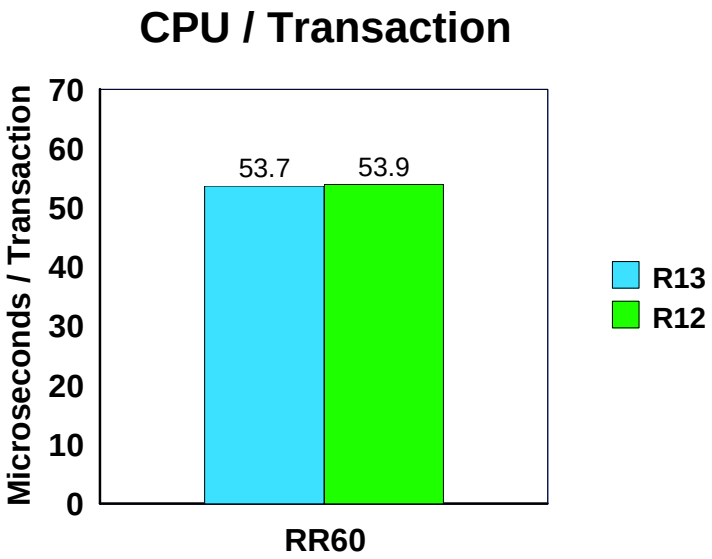


- CICS Sockets: 250 to 1000 sessions, 0.5 second think time, OTE, 200 / 200
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12, CICS TS 4.1

- z/OS V1R13 provides 2.03 to 6.44% lower CPU cost per transaction compared to V1R12 (Avg= 4.67% lower).

IPv4 Enterprise Extender (EE) Detailed Performance (RR)

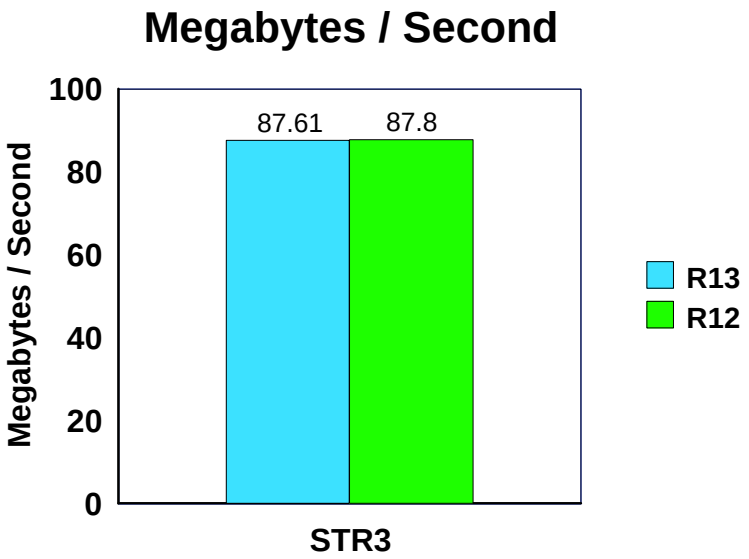


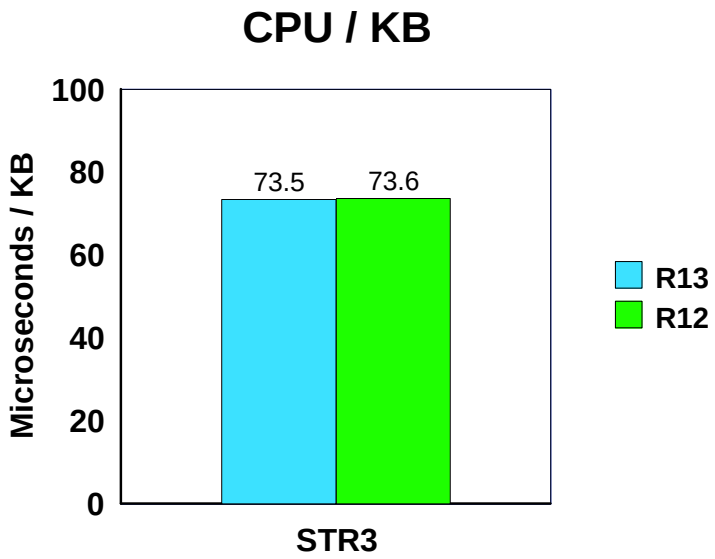


- Request-Response workload
- RR60: 60 sessions, 100 / 800
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 0.71% lower throughput compared to V1R12.
- z/OS V1R13 provides equivalent CPU cost per transaction compared to V1R12.

IPv4 Enterprise Extender (EE) Detailed Performance (STR)

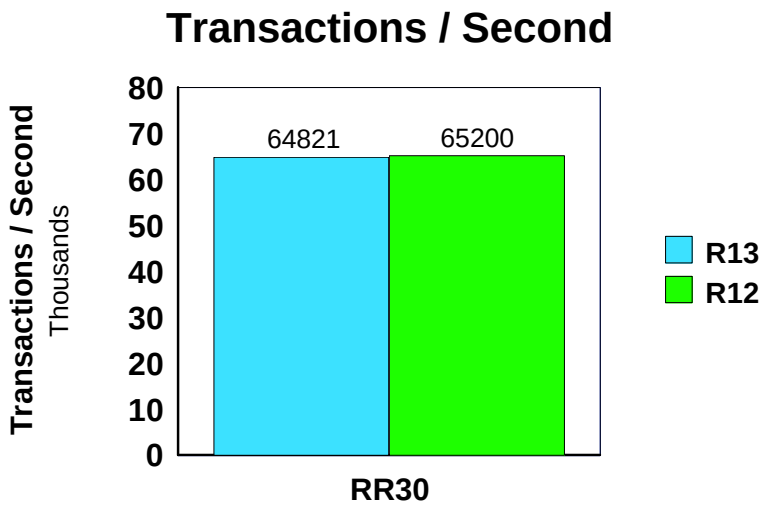


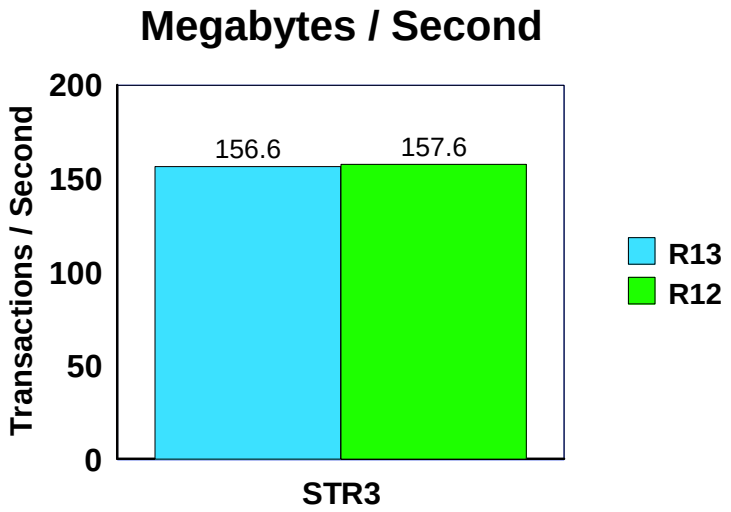


- Streaming workload
- STR3: 3 sessions, 100 / 800
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides equivalent throughput compared to V1R12.
- z/OS V1R13 provides equivalent CPU cost per transaction compared to V1R12.

IPSec Detailed Performance (Throughput)

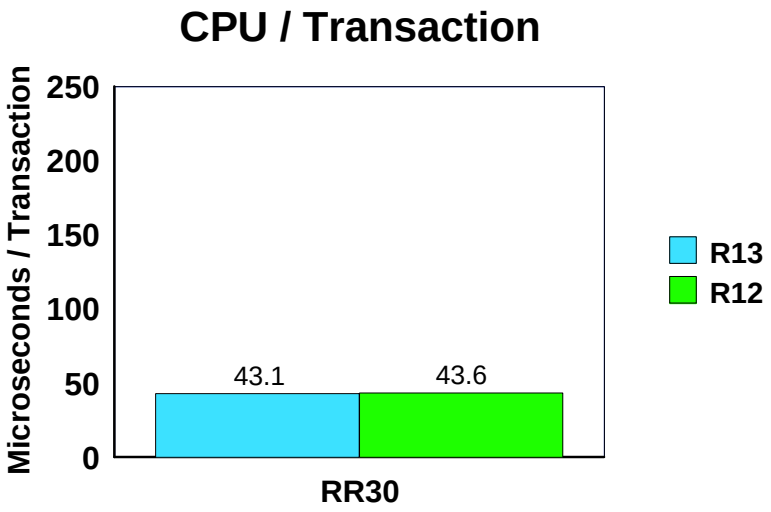


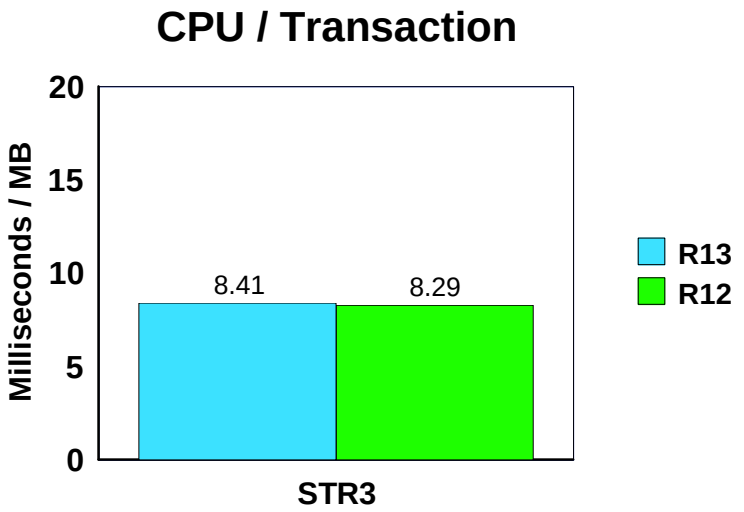


- Request-Response and Streaming workloads
- RR30: 30 sessions, 100 / 800
- STR3: 3 sessions (Sending 20 Mbytes / Receiving 1 byte)
- Encryption: 3DES, Authentication: SHA
- Hardware: z10 (2 CPs) using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 0.6% lower throughput compared to V1R12.

IPSec Detailed Performance (CPU/Transaction)

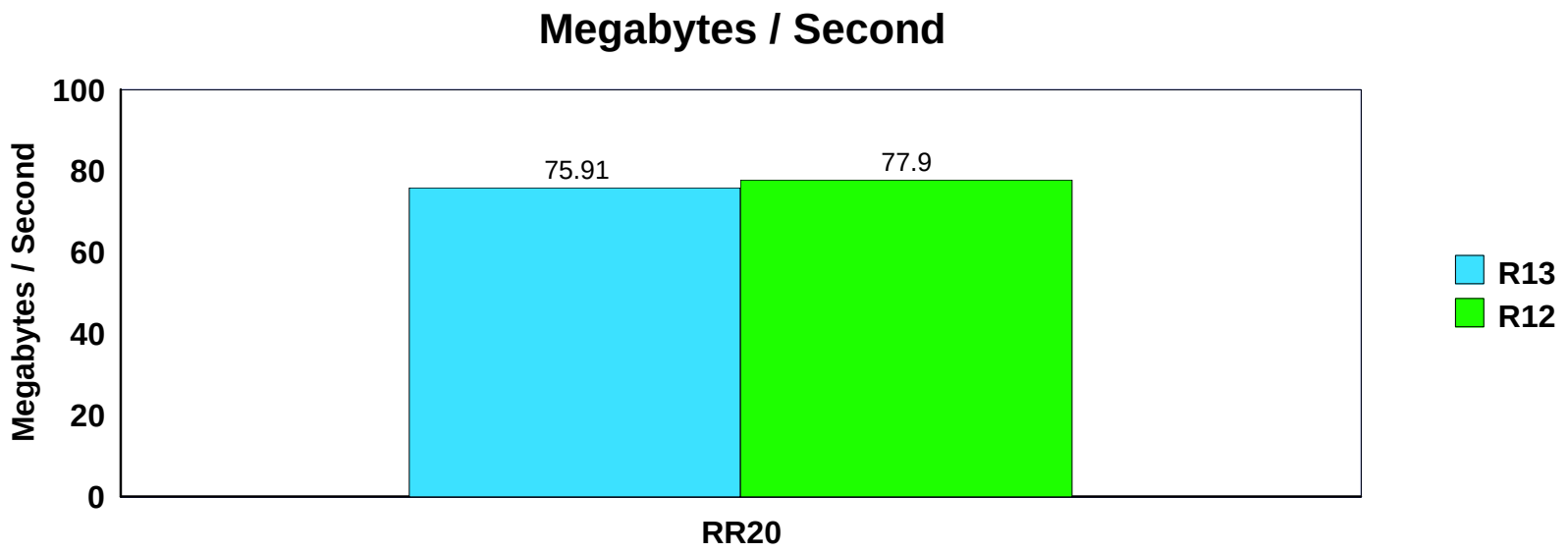




- Request-Response and Streaming workloads
- RR30: 30 sessions, 100 / 800
- STR3 (Outbound): 3 sessions (Sending 20 Mbytes / Receiving 1 byte)
- Encryption: 3DES, Authentication: SHA
- Hardware: z10 (2 CPs) using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 1.25% lower to 1.43% higher CPU cost per transaction compared to V1R12 (Avg= 0.09% higher).

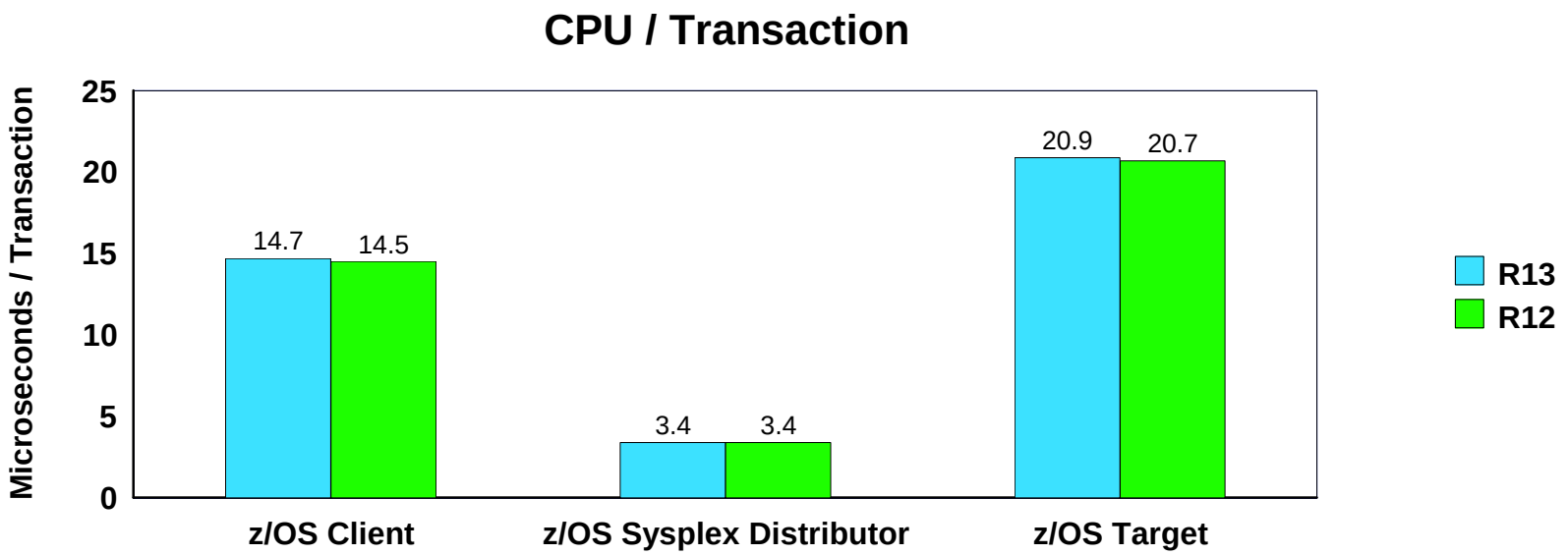
Sysplex Distributor Detailed Performance (Throughput)



- Request-Response workload
- RR20: 20 sessions, 100 / 100
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 2.56% lower throughput compared to V1R12.

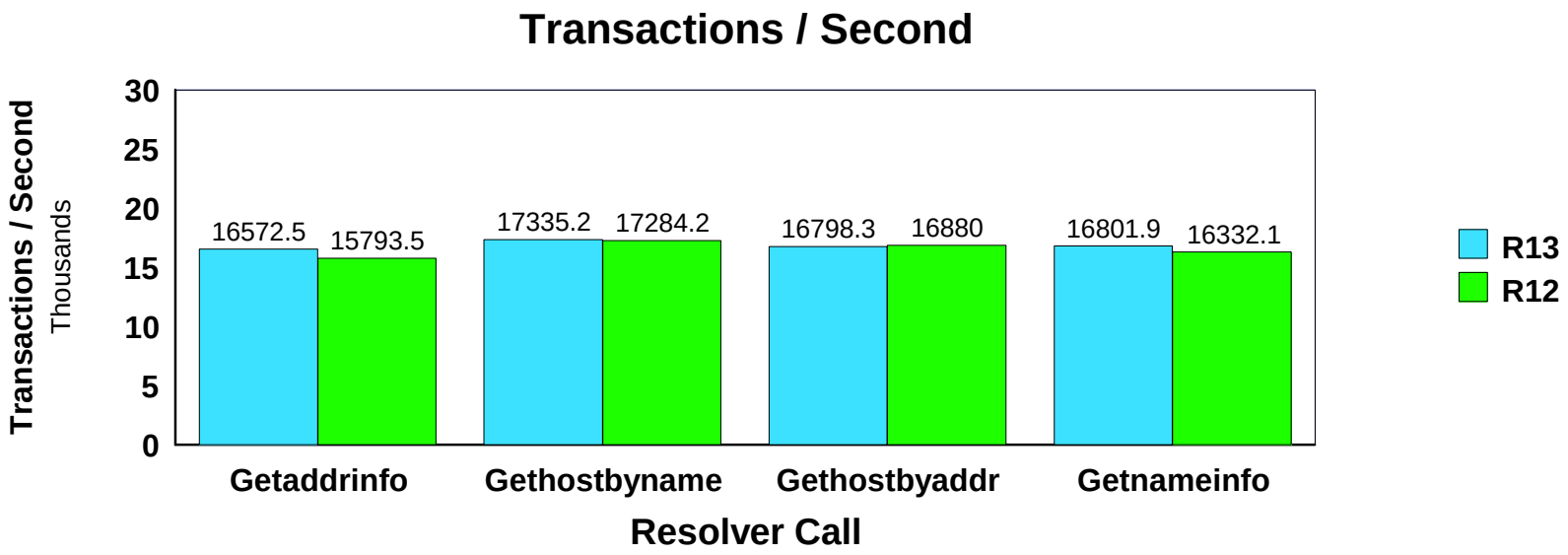
Sysplex Distributor Detailed Performance (CPU/Transaction)



- Request-Response workload
- RR20: 20 sessions, 100 / 800
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 0.23 to 1.24% higher CPU cost per transaction compared to V1R12 (Avg= 0.80% higher).

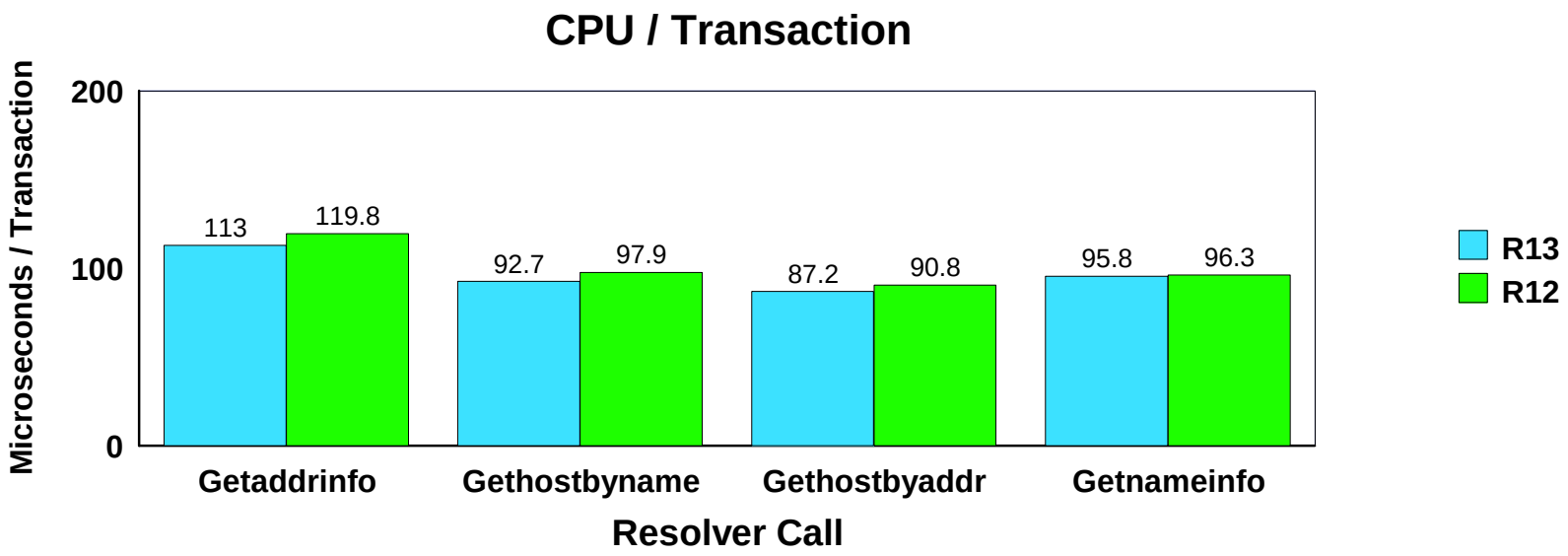
Resolver Detailed Performance (Throughput)



- Resolver Lookup: DNS: Resolves IP address on remote DNS server (Linux)
- Transaction: GETADDRINFO, GETHOSTBYNAME, GETHOSTBYADDR, and GETNAMEINFO calls
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 0.48% lower to 4.93% higher throughput compared to V1R12 (Avg= 1.44% higher).

Resolver Detailed Performance (CPU/Transaction)

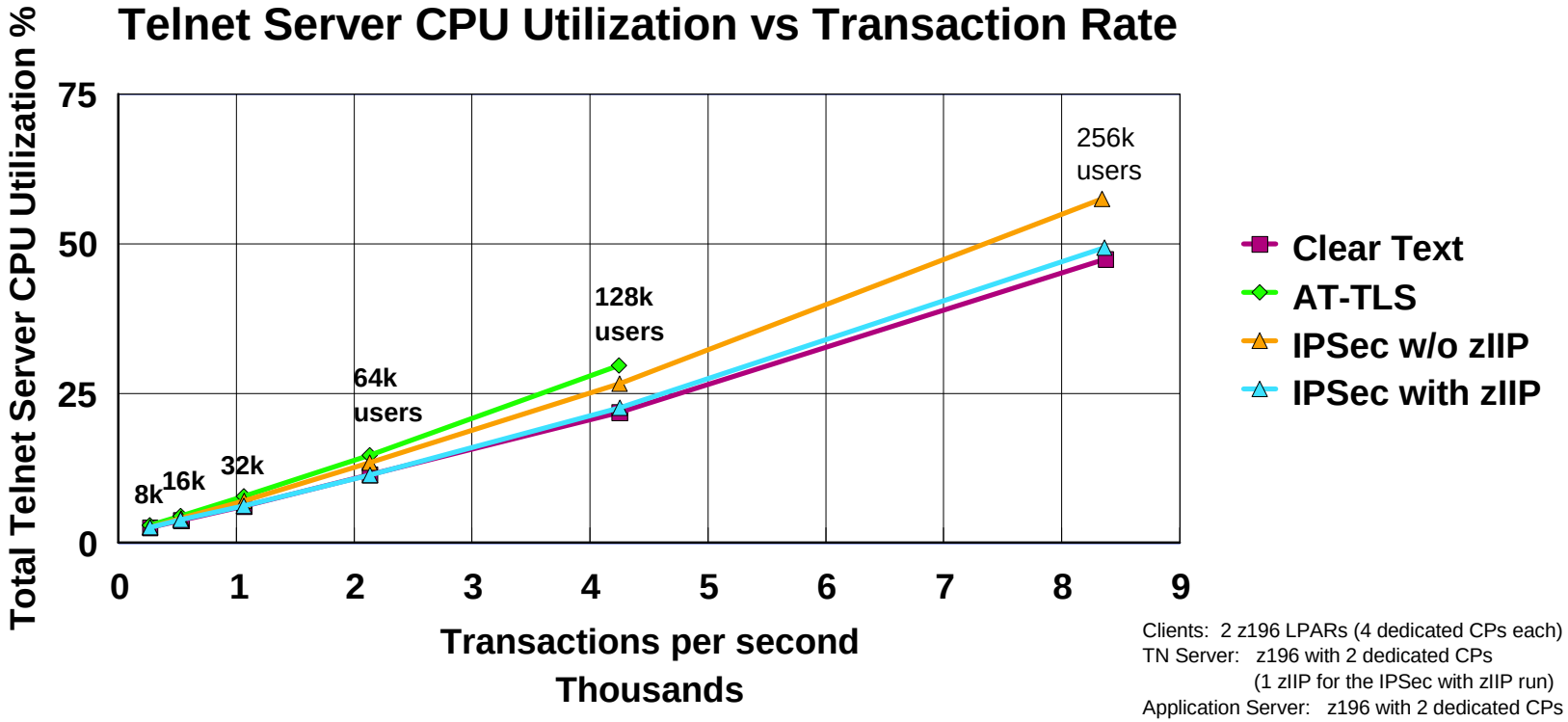


- Resolver Lookup: DNS: Resolves IP address on remote DNS server (Linux)
- Transaction: GETADDRINFO, GETHOSTBYNAME, GETHOSTBYADDR, and GETNAMEINFO calls
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R13 or V1R12

- z/OS V1R13 provides 0.57 to 5.68% lower CPU cost per transaction compared to V1R12 (Avg= 3.90% lower).

z/OS CS V1R13 Capacity Planning

z/OS CS V1R13 TN3270E Security Performance (IPSec vs AT-TLS vs Clear Text)

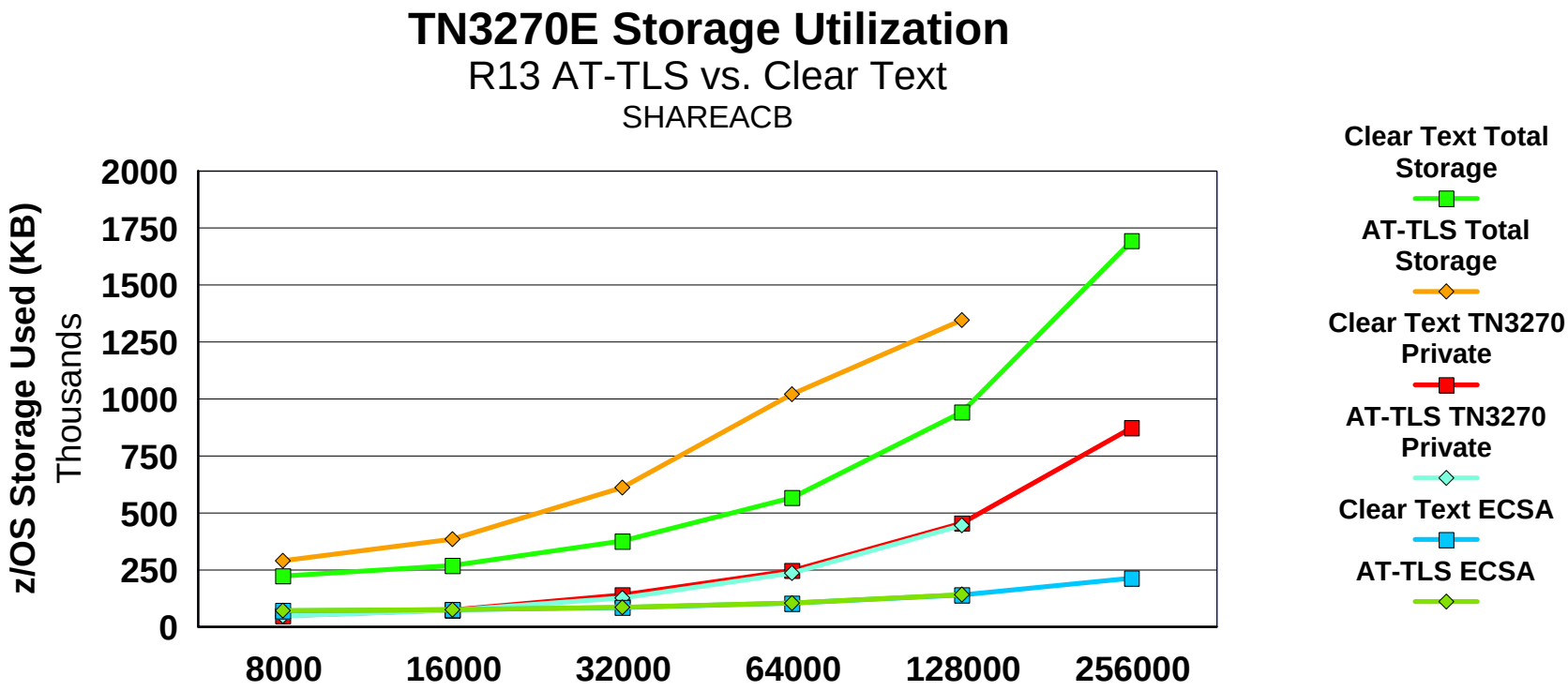


Clients: 2 z196 LPARs (4 dedicated CPs each)
TN Server: z196 with 2 dedicated CPs
(1 zIIP for the IPSec with zIIP run)
Application Server: z196 with 2 dedicated CPs
Connectivity: OSA-E3 1 GbE and SNA MPC
Transaction: 100 / 800 bytes
Think time: 30 seconds
Number of sessions: 8000 to 256000
Encryption / Authentication: 3DES / SHA
Driver Tool: TPNS (4)

Total CPU Utilization % = (Avg CPU Utilization %) x (# of CPs)

AT-TLS vs Clear Text CPU/Transaction delta is 15.4 to 35.3% higher (Avg= 24.9% higher).
IPSec w/o zIIP vs AT-TLS CPU/Transaction delta is 8.4 to 12.7% lower (Avg= 10.2% lower).
IPSec with zIIP vs AT-TLS CPU/Transaction delta is 12.8 to 23.8% lower (Avg= 18.6% lower).

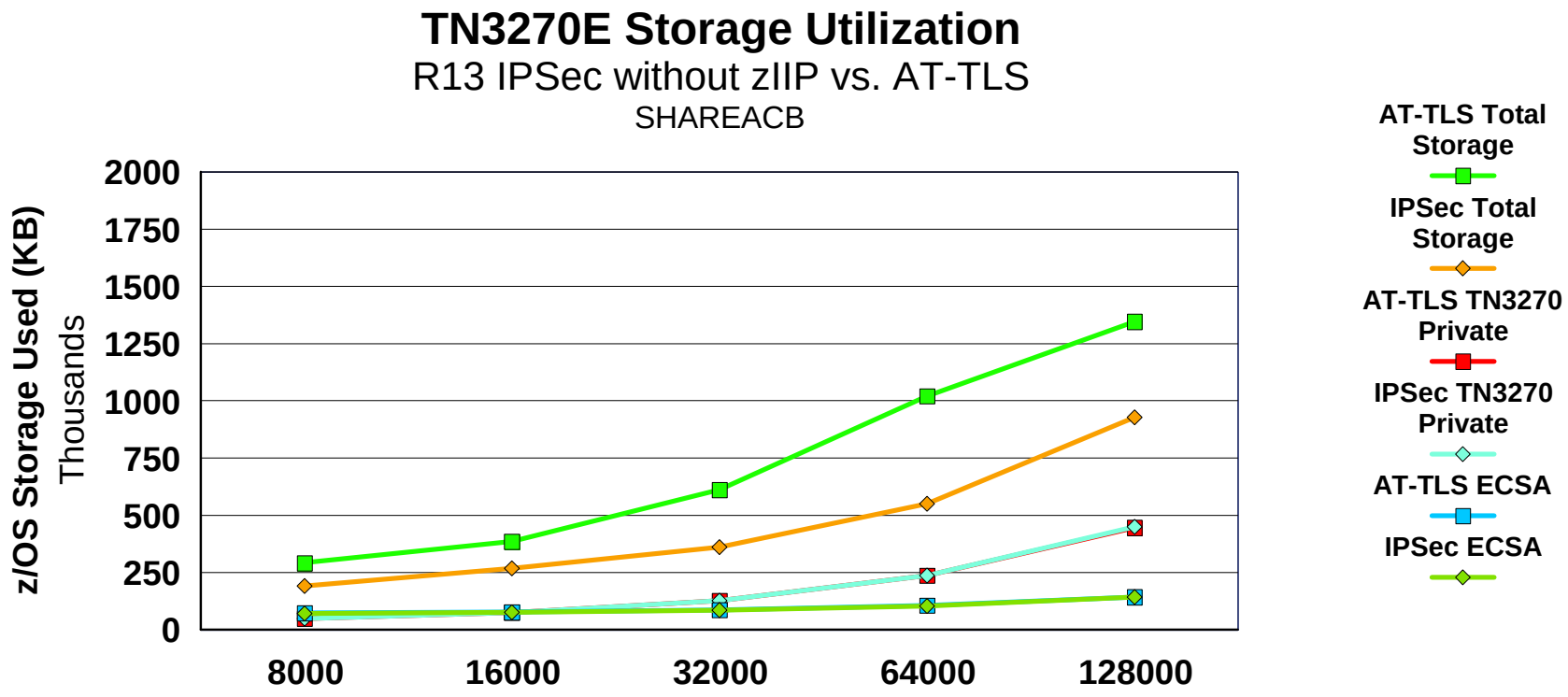
z/OS CS V1R12 TN3270E Security Performance (AT-TLS vs Clear Text)



TN3270 Server: 8k to 128k or 256k sessions, 30 second think time, 100 / 800, SHAREACB option
Hardware: z196 using OSA-E3 (1 GbE)
Software: z/OS V1R13
Connectivity (TN Server to Appl Server): SNA MPC over Ficon
AT-TLS Encryption: Triple-Des, AT-TLS Authentication: SHA

z/OS V1R13 AT-TLS uses 30 to 80% more Total Storage compared to Clear Text (Avg= 51% more).

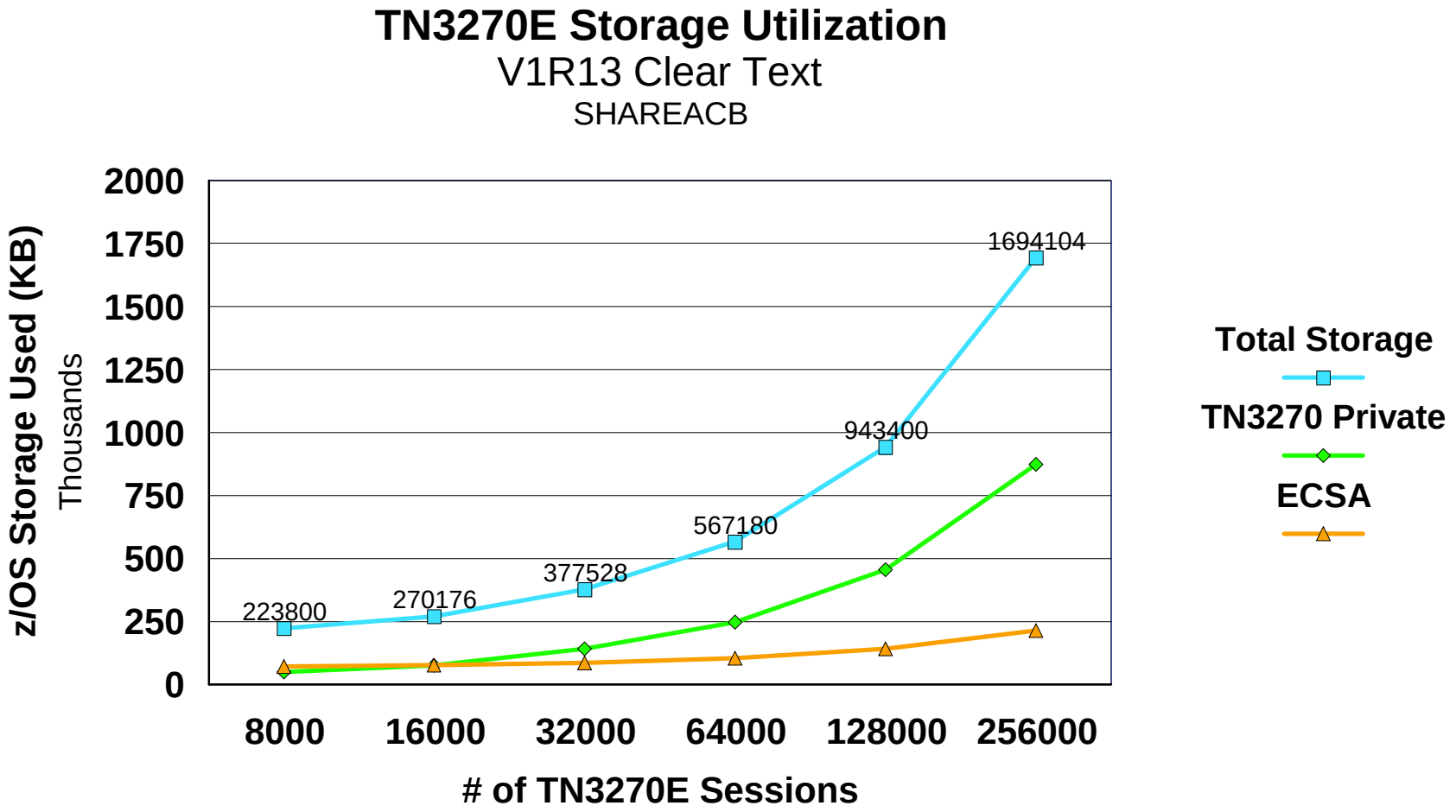
z/OS CS V1R12 TN3270E Security Performance (IPSec vs AT-TLS)



TN3270 Server: 8k to 256k sessions, 30 second think time, 100 / 800, SHAREACB option
Hardware: z10 using OSA-E3 (1 GbE)
Software: z/OS V1R12
Connectivity (TN Server to Appl Server): SNA MPC over Ficon
Encryption: Triple-Des, Authentication: SHA

z/OS V1R13 IPSec uses 31 to 41% less Total Storage compared to AT-TLS (Avg= 37% less).

TN3270 Storage Summary (no security)

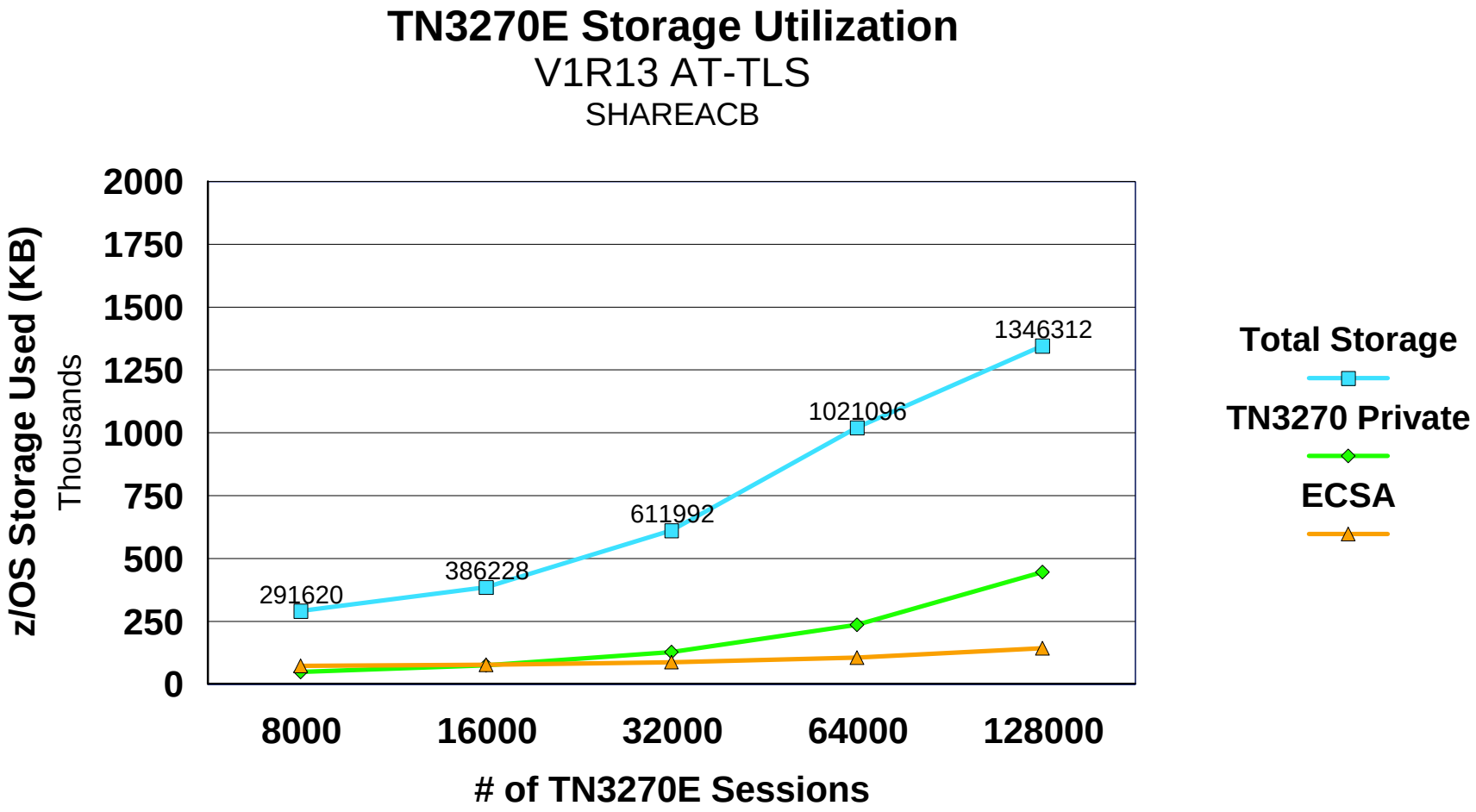


TN3270 Storage Summary (no security)

# of TN3270E Sessions	8000	16000	32000	64000	128000	256000
TCP/IP Below	128	128	128	128	128	128
TCP/IP Above	20,200	20,200	20,200	20,200	20,200	20,200
TCP/IP LSQA/SWA/229/230 Below	192	192	192	192	192	192
TCP/IP LSQA/SWA/229/230 Above	36,900	52,900	85,200	149,000	278,000	536,000
TN3270 Below	464	480	480	540	540	540
TN3270 Above	4,068	4,076	4,076	4,108	4,108	4,108
TN3270 LSQA/SWA/229/230 Below	280	248	248	276	276	276
TN3270 LSQA/SWA/229/230 Above	45,200	70,900	137,000	243,000	452,000	869,000
CSM Data Space	27,632	27,616	27,268	28,000	30,120	31,624
System CSA Below	436	436	436	436	436	436
System CSA Above	72,100	76,800	86,000	105,000	142,000	215,000
System SQA Below	300	300	300	300	300	300
System SQA Above	15,900	15,900	16,000	16,000	16,100	16,300
Total TCP/IP Private	57,420	73,420	105,720	169,520	298,520	556,520
Total TN3270 Private	50,012	75,704	141,804	247,924	455,924	873,924
Total Below	1,800	1,784	1,784	1,872	1,872	1,872
Total Above	222,000	268,392	375,744	565,308	941,528	1,692,232
Total	223,800	270,176	377,528	567,180	943,400	1,694,104

All numbers are expressed in kilobytes.

TN3270 Storage Summary (AT-TLS)

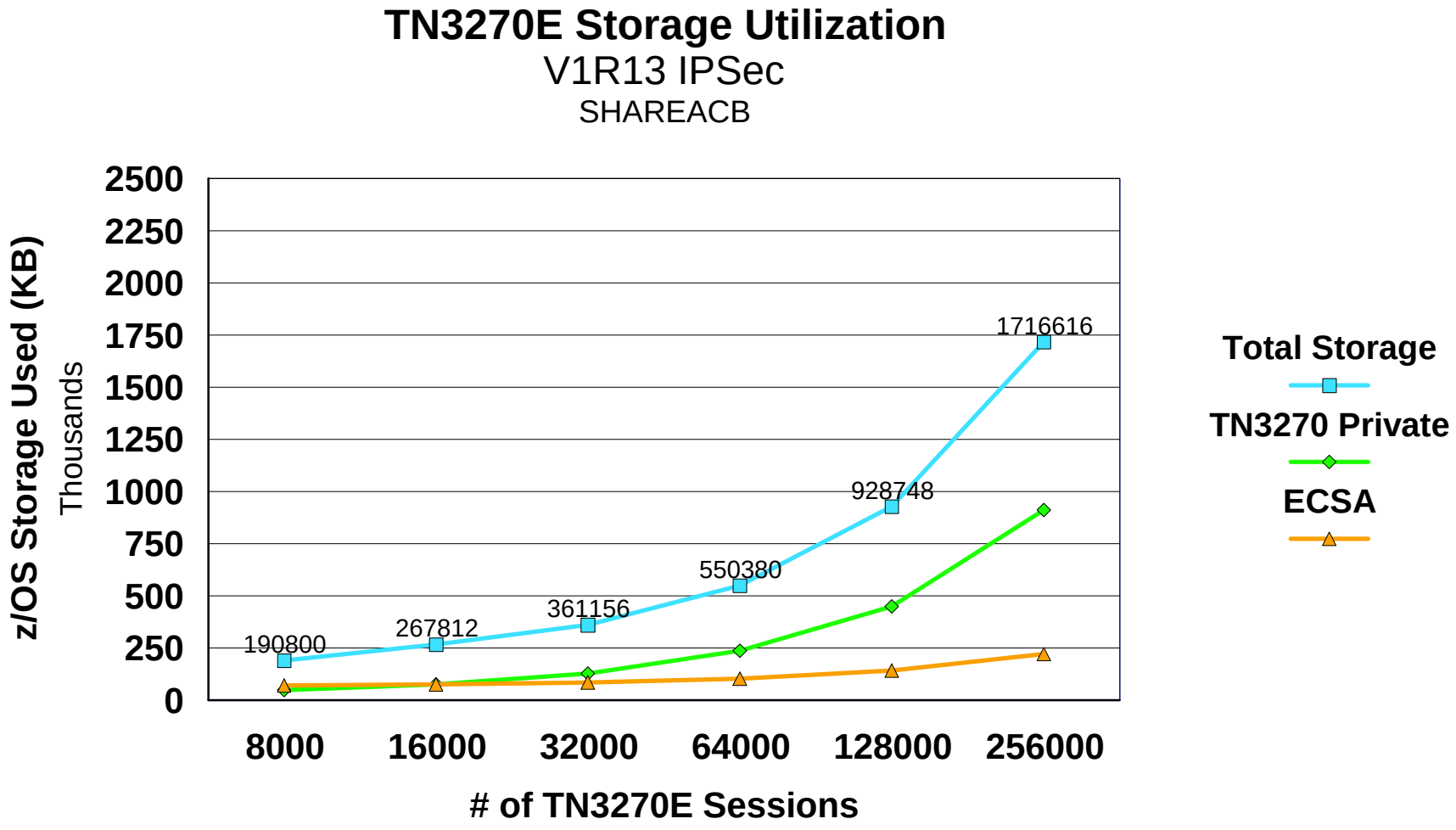


TN3270 Storage Summary (AT-TLS)

# of TN3270E Sessions	8000	16000	32000	64000	128000
TCP/IP Below	152	152	152	152	152
TCP/IP Above	25,600	23,800	28,600	25,500	25,100
TCP/IP LSQA/SWA/229/230 Below	368	368	368	368	368
TCP/IP LSQA/SWA/229/230 Above	105,000	172,000	329,000	612,000	691,000
TN3270 Below	464	480	480	640	656
TN3270 Above	4,068	4,076	4,076	4,156	4,164
TN3270 LSQA/SWA/229/230 Below	232	236	236	272	272
TN3270 LSQA/SWA/229/230 Above	44,400	70,100	123,000	232,000	441,000
CSM Data Space	21,096	21,076	22,040	23,268	24,880
System CSA Below	436	436	436	436	436
System CSA Above	73,500	77,200	87,300	106,000	143,000
System SQA Below	304	304	304	304	304
System SQA Above	16,000	16,000	16,000	16,000	15,000
Total TCP/IP Private	131,120	196,320	358,120	638,020	716,620
Total TN3270 Private	49,164	74,892	127,792	237,068	446,092
Total Below	1,956	1,976	1,976	2,172	2,168
Total Above	289,664	384,252	610,016	1,018,924	1,344,144
Total	291,620	386,228	611,992	1,021,096	1,346,312

All numbers are expressed in kilobytes.

TN3270 Storage Summary (IPSec)



TN3270 Storage Summary (IPSec)

# of TN3270E Sessions	8000	16000	32000	64000	128000	256000
TCP/IP Below	128	128	128	128	128	128
TCP/IP Above	11,800	11,800	11,800	11,800	11,800	11,800
TCP/IP LSQA/SWA/229/230 Below	200	200	200	200	200	204
TCP/IP LSQA/SWA/229/230 Above	20,300	64,900	95,100	155,000	276,000	519,000
TN3270 Below	464	480	480	588	588	604
TN3270 Above	4,068	4,076	4,076	4,132	4,132	4,140
TN3270 LSQA/SWA/229/230 Below	244	252	252	272	272	272
TN3270 LSQA/SWA/229/230 Above	44,600	70,900	123,000	232,000	445,000	906,000
CSM Data Space	21,420	22,500	24,044	25,584	30,752	37,292
System CSA Below	472	472	472	472	472	472
System CSA Above	71,000	76,000	85,400	104,000	143,000	220,000
System SQA Below	304	304	304	304	304	304
System SQA Above	15,800	15,800	15,900	15,900	16,100	16,400
Total TCP/IP Private	32,428	77,028	107,228	167,128	288,128	531,132
Total TN3270 Private	49,376	75,708	127,808	236,992	449,992	911,016
Total Below	1,812	1,836	1,836	1,964	1,964	1,984
Total Above	188,988	265,976	359,320	548,416	926,784	1,714,632
Total	190,800	267,812	361,156	550,380	928,748	1,716,616

All numbers are expressed in kilobytes.

TN3270 CPU Requirements Formula

z/OS CPU Requirements:

$$\frac{\text{\# trans/user x \# users x CPU secs/tran}}{\text{Elap secs}} = \frac{\text{CPU secs}}{\text{Elap secs}}$$

Example: z/OS V1R13, 8000 users, 6 tr/min/user (**data from page 41**)

$$\frac{\text{6 trans/user x 8000 users x 0.000055 CPU secs/tr (N1)}}{\text{60 Elap secs}} = \frac{\text{0.0440 CPU secs}}{\text{1 Elap secs}}$$

N1: z/OS TCP/IP + VTAM + TN3270 address spaces (z196, 2817-M80 two CP LPAR); CPU cost per transaction data is from the TN3270 benchmark on page 41.

If the CPU secs / Elap secs ratio is greater than 1, more than one processor would be required.

TN3270 CPU Utilization Formula

z/OS CPU Utilization:

CPU secs/Elap secs
---------- x 100 % = CPU Utilization %
# of processors

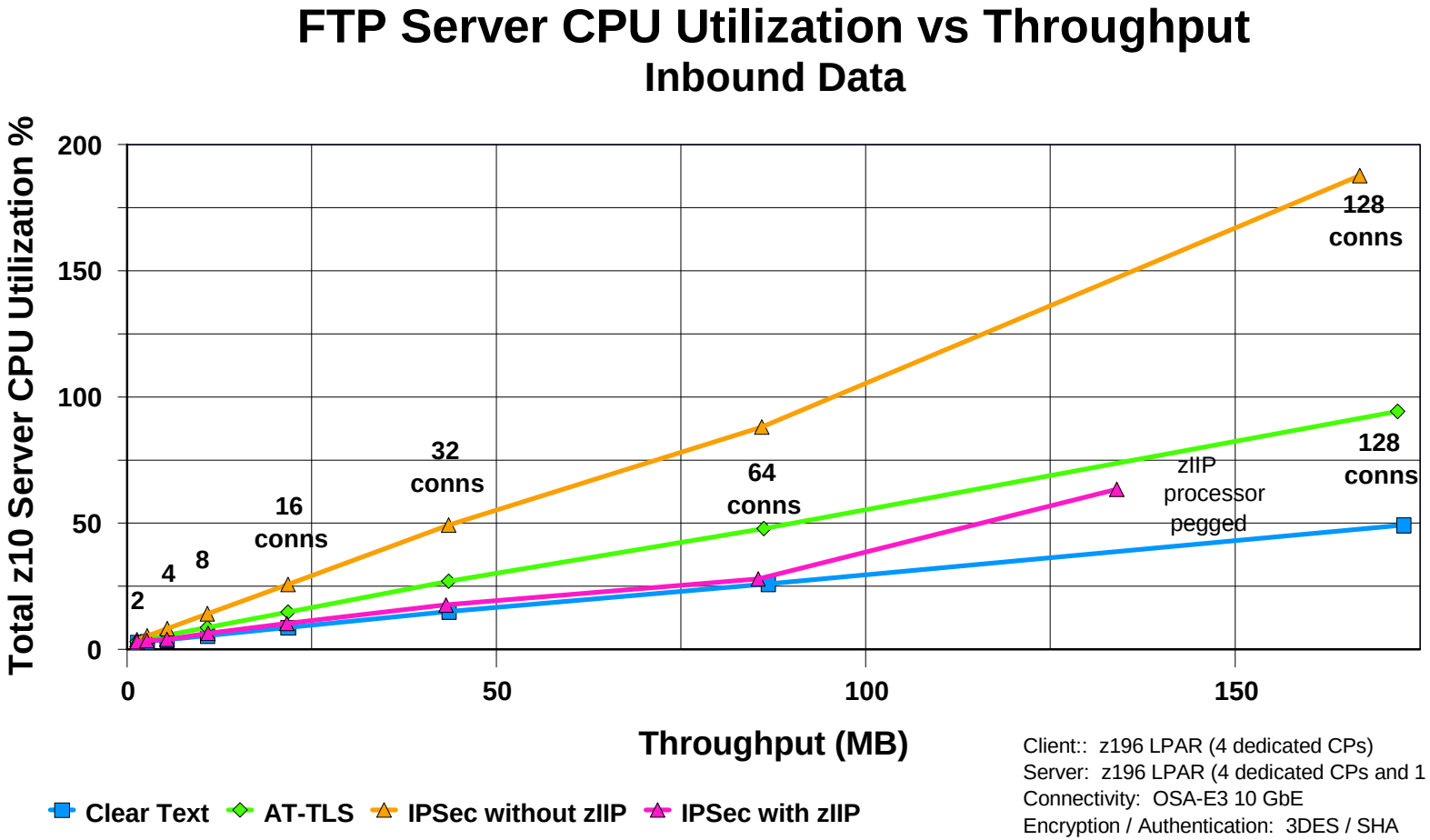
Example: z/OS V1R13, 8000 users, 6 tr/min/user (**data from page 62**)

0.0440 CPU secs/Elap secs
---------- x 100% = 2.2%
2 processors

Thus, the CPU requirement for z/OS TCP/IP + VTAM + TN3270 address spaces for this 8000 TN3270 user measurement is 3.8% of a two processor 2817-M80 LPAR.

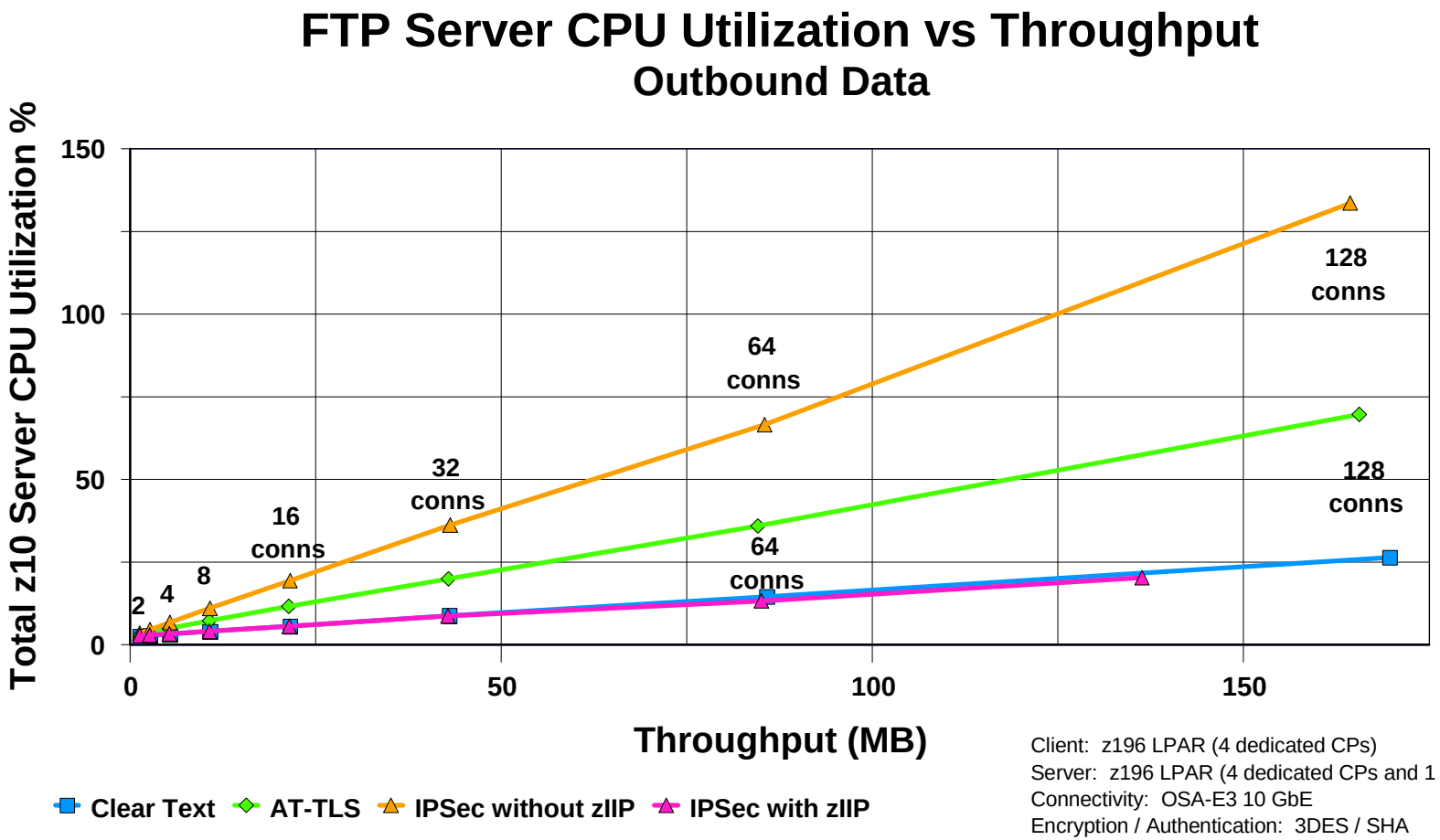
LSPR can be used to adjust for other processors types.

z/OS CS V1R13 FTP Security Performance (IPSec vs AT-TLS vs Clear Text)



Client:: z196 LPAR (4 dedicated CPs)
Server: z196 LPAR (4 dedicated CPs and 1 zIIP)
Connectivity: OSA-E3 10 GbE
Encryption / Authentication: 3DES / SHA
Transaction: 2 MB / 1 byte
Target data sets: MVS data sets on 3390 DASD
Think time: 1500 ms
Number of connections: 1 to 128
Driver tool: AWM

z/OS CS V1R13 FTP Security Performance (IPSec vs AT-TLS vs Clear Text)



Client: z196 LPAR (4 dedicated CPs)
Server: z196 LPAR (4 dedicated CPs and 1 zIIP)
Connectivity: OSA-E3 10 GbE
Encryption / Authentication: 3DES / SHA
Transaction: 1 byte / 2 MB
Target data sets: MVS data sets on 3390 DASD
Think time: 1500 ms
Number of connections: 1 to 128
Driver tool: AWM

FTP Storage Summary (Inbound data with no security)

# of Inbound FTP Sessions	1	2	4	8	16	32	64	128
TCP/IP Below	128	128	128	128	128	128	128	128
TCP/IP Above	20,200	20,200	20,200	20,200	20,200	20,200	20200	20200
TCP/IP LSQA/SWA/229/230 Below	192	192	192	192	192	192	192	192
TCP/IP LSQA/SWA/229/230 Above	19,100	19,100	19,300	19,400	19,900	20,400	42,600	24,500
CSM Data Space	27,632	27,616	27,268	22,526	22,176	23,964	22,960	24,852
System CSA Below	436	436	436	436	436	436	436	436
System CSA Above	21,732	21,780	70,000	70,300	70,200	70,300	75,800	71,400
System SQA Below	284	288	288	288	292	296	336	336
System SQA Above	16,300	16,300	16,300	16,400	16,800	17,100	19100	19500
Total TCP/IP Private	39,720	36,620	39,820	39,920	40,420	40,920	63,120	45,020
Total Below	1,040	1044	1,044	1,044	1,048	1,052	1092	1092
Total Above	105,064	104,996	153,068	148,826	149,276	150,964	181,660	160,452
Total	106,104	106,040	154,112	149,870	150,324	152,016	182,752	161,544

All numbers are expressed in kilobytes.

FTP Storage Summary (Outbound data with no security)

# of Outbound FTP Sessions	1	2	4	8	16	32	64	128
TCP/IP Below	128	128	128	128	128	128	128	128
TCP/IP Above	20,200	20,200	20,200	20,200	20,200	20,200	20200	20200
TCP/IP LSQA/SWA/229/230 Below	192	192	192	192	192	192	192	192
TCP/IP LSQA/SWA/229/230 Above	19,200	19,300	19,400	19,900	20,400	21,900	42,600	29,900
CSM Data Space	21,932	22,116	22,236	22,526	22,680	23,864	23,732	24,668
System CSA Below	436	436	436	436	436	436	436	436
System CSA Above	69,500	70,800	70,400	70,500	70,600	71,200	77,800	75,900
System SQA Below	288	288	288	288	292	296	332	336
System SQA Above	16,400	16,300	16,300	16,500	16,800	17,200	19100	19600
Total TCP/IP Private	39,720	39,820	39,920	40,420	41,020	42,420	63,120	50,420
Total Below	1,044	1044	1,044	1,044	1,048	1,052	1088	1092
Total Above	147,232	148,716	148,536	149,626	150,780	153,364	183,432	170,268
Total	148,276	149,760	149,580	150,670	151,828	154,416	184,520	171,360

All numbers are expressed in kilobytes.

FTP CPU Requirements Formula

z/OS CPU Requirements:

Max KB		CPU secs		CPU secs
Elap secs	x	KB	=	Elap secs

Example: (**data from the FTP Server Benchmark on pages 38 and 39**)

110.8 MB/sec; Work Station --> z/OS, Binary Put, 20 MB file, z/OS V1R13, OSA-E3 GbE

113459.2 KB		**.00000123** (**N1**)		0.140 CPU secs
1 Elap secs	x	1 KB	=	1 Elap secs

N1: z/OS TCP/IP + VTAM + FTP address spaces (z10, 2097-E64 two CP LPAR).
CPU cost per KB data is from the FTP Server benchmark on page 39.

If the CPU secs / Elap secs ratio is greater than 1, more than one processor would be required.

FTP CPU Utilization Formula

z/OS CPU Utilization:

CPU secs/Elap secs
---------- x 100 % = CPU Utilization %
# of processors

Example: (**data from page 66**)

110.8 MB/sec; Work Station --> z/OS, Binary Put, z/OS V1R13, OSA-E3 GbE

0.140 CPU secs/Elap secs
---------- x 100% = 7.00%
2 processors

Thus, the CPU requirement for z/OS TCP/IP + VTAM + FTP address spaces for this FTP Binary PUT is 7% of a two processor 2097-E64 LPAR.

LSPR can be used to adjust for other processors types.

CSM Usage

Application	#users / clients	Workload Throughput	Max CSM (ECSA)	Max CSM (Dataspace)	Max CSM (Fixed)
CICS Sockets (z10, transaction = 200 / 200)	250 500 1000	475.3 Trans/Sec 905.1 1589.1	780 KB 916 1.12 MB	20.17 MB 20.26 20.45	28.04 MB 28.04 29.08
TN3270 (z196 with Think Time, SHAREACB option, Echo transactions, 100 / 800)	8000 16000 32000 64000 128000 256000	266.5 Trans/Sec 533.4 1066.7 2133.0 4259.3 8433.9	800 KB 896 880 900 1.28 MB 1.34	27.63 MB 27.62 27.27 28.00 30.12 31.62	33.64 MB 34.04 34.44 35.24 37.64 40.44
FTP Inbound Data Binary Put (z196, with and without Think Time, transaction= 2 MB / 1)	1 2 4 8 16 32 64 128	1.30 MB/Sec 2.56 5.19 10.41 20.80 41.53 82.24 164.04	600 KB 656 692 712 708 884 1.16 MB 996 KB	21.73 MB 21.78 22.41 22.56 2218 22.96 23.96 24.85	30.04 MB 30.76 32.32 33.92 32.72 33.52 41.88 35.12
FTP Outbound Data Binary Get (z196, with and without Think Time, transaction = 1 / 2 MB)	1 2 4 8 16 32 64 128	1.29 MB/Sec 2.55 5.11 10.24 20.43 40.92 80.69 157.93	1.01 MB 672 KB 1.21 MB 900 KB 1.60 MB 2.00 2.62 3.74	21.93 MB 22.12 22.24 22.24 22.68 22.86 23.73 24.67	30.76 MB 31.12 32.32 32.72 33.08 33.88 42.16 36.40

VTAM Buffer Usage

Application	#users / clients	Workload Throughput	IO00 Buffer	LF00 Buffer	CRPL Buffer	TI00 Buffer	CRA4 Buffer
CICS Sockets (z10, transaction = 200 / 200)	250 500 1000	475.3 Trans/Sec 905.1 1589.1	5 5 5	5 5 5	54 54 54	18 18 18	4 4 4
TN3270 (z196 with Think Time, SHAREACB option, Echo transactions, 100 / 800)	8000 16000 32000 64000 128000 256000	266.5 Trans/Sec 533.4 1066.7 2133.0 4259.3 8433.9	255 389 397 500 2283 2283	3 3 3 3 3 3	1934 1934 1934 1934 1934 1934	304 453 626 626 2614 2614	12 12 15 24 28 28
FTP Inbound Data Binary Put (z196, with and without Think Time, transaction= 2 MB / 1)	1 2 4 8 16 32 64 128	1.30 MB/Sec 2.56 5.19 10.41 20.80 41.53 82.24 164.04	1 1 1 1 1 1 5 1	3 3 3 3 3 3 4 3	1 1 1 1 1 1 2 1	12 12 12 12 12 12 12 12	4 4 4 4 4 4 5 5
FTP Outbound Data Binary Get (z196, with and without Think Time, transaction = 1 / 2 MB)	1 2 4 8 16 32 64 128	1.29 MB/Sec 2.55 5.11 10.24 20.43 40.92 80.69 157.93	1 1 1 1 1 1 5 5	3 3 3 3 3 3 4 4	1 1 1 1 1 1 2 2	12 12 12 12 12 12 12 12	4 4 4 4 4 4 5 5

Summary

z/OS CS V1R13 vs V1R12 Performance Summary by Workload

CS Workload	V1R13 Throughput relative to V1R12	V1R13 CPU/Transaction relative to V1R12
AWM Primitives (1 GbE) RR60 (100/800) CRR20 (64/8K) STR3 Server (1/20M) 10 GbE	+ 1.12 % Equivalent Equivalent	- 1.76 % + 0.40 % - 0.62 %
FTP Server (1 GbE)	+ 0.71 %	- 0.18 %
TN3270 Server (1 GbE)	Equivalent (with think time)	- 0.67 %
CICS Sockets (1 GbE)	+ 2.96 %	- 4.67 %
Enterprise Extender	- 0.46 %	Equivalent

- On average, z/OS V1R13 provides similar to slightly improved throughput for all workloads.
- On average, z/OS V1R13 provides similar to slightly reduced CPU cost for all workloads.

Overall Summary

- z/OS Communication Server V1R13:
  - For most workloads, CPU cost per transaction will be slightly lower.
  - For most workloads, throughput will be slightly higher.
  - Some small performance improvements can be expected when using CICS sockets.
  - Some small CPU reduction can be expected in TN3270 workloads when receiving large data buffers.
  - FTP Extended Address Space and Large Format data sets provide slightly better throughput and similar CPU cost per transaction compared to standard data sets.
  - Below the bar storage use is significantly reduced.
    - VIT trace moved from ECSA to 64 bit common.
    - Many CTRACE components moved from data space to 64 bit common.
    - TN3270 trace moved from TN3270E private to 64 bit private.

Appendix

IBM Application Workload Modeler (AWM)

- **The majority of the performance benchmarks in this document were obtained using the IBM Application Workload Modeler (AWM) for z/OS (V1R1).**
  - ***"IBM Application Workload Modeler for z/OS Release 1 provides the ability to model, measure, and analyze the performance of networks and applications in a client/server, multiprotocol, multiplatform environment. With Application Workload Modeler R1, you can more accurately plan for the roll-out of additional software or function, and determine where upgrades may be required in your network and systems."***
  - **For more information, visit the Application Workload Modeler web site:**

    http://www.ibm.com/software/network/awm

z/OS CS Performance References

- z/OS Communications Server Performance Information
  - z/OS Communications Server performance index:

    This is an index to all published performance information for the z/OS Communications Server. This index is updated when updates are made to existing documentation or additional documentation is added. You may want to bookmark this link.

    http://www.ibm.com/support/docview.wss?rs=852&uid=swg27005524

  - System z10 vs. System z9 Communications Server Performance:

    http://www.ibm.com/support/docview.wss?rs=852&context=SSSN3L&dc=DA400&uid=swg27013719

- SHARE presentations (http://www.share.org)
  - zIIP-Assisted IPSec (session 3945, August 2008)
  - z/OS Communications Server Performance Improvements (session 3901, 08/2006)
  - TCP/IP for z/OS - Performance Tuning Tips and Capacity Planning (session 3919, 08/2005)

For More Information...

URL	Content
http://www.ibm.com/systems/z	IBM Enterprise Servers (zSeries & S/390)
http://www.ibm.com/systems/z/networking	zSeries Networking
http://www.ibm.com/software/network/commserver	IBM Communications Severs
http://www.ibm.com/software/network/commserver/zos	z/OS Communications Server
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http://twitter.com/IBM_Commserver	z/OS Communications Server on twitter
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http://www.redbooks.ibm.com	ITSO Redbooks
http://www.ibm.com/support/techdocs	Technical Information Data Base (Flashes, Presentations, White Papers, etc.)
http://www.ibm.com/software/network/awm	IBM Application Workload Modeler (AWM)
http://www.ibm.com/software/network/tpns	IBM Teleprocessing Network Simulator (TPNS)
http://www.ibm.com/support/docview.wss?rs=852&uid=swg27005524	z/OS Communications Server Performance