z/OS V1R12 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 :

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Goals

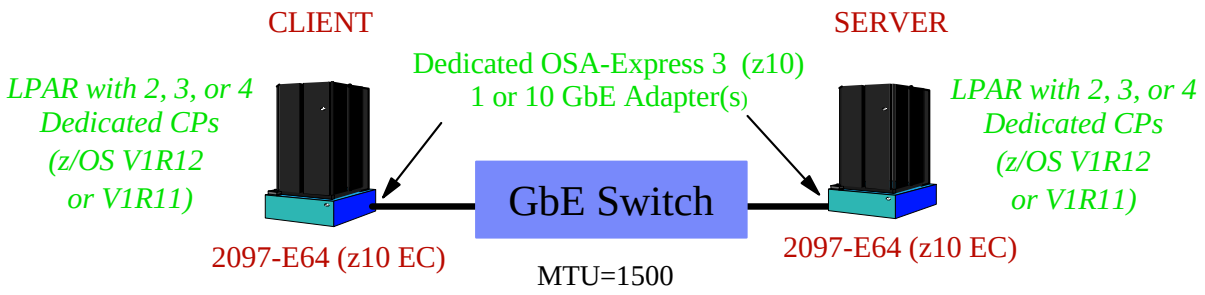
- Show performance of z/OS V1R12 Communications Server line items.
- Compare z/OS V1R12 vs V1R11 Relative Performance using Communications Server Performance workloads.
- Show z/OS V1R12 vs V1R11 Detailed Performance using Communications Server Performance workloads.
- Show capacity planning performance for:

  TN3270 (Clear Text, AT-TLS, IPSec with and without zIIP)
  FTP (Clear Text, AT-TLS, IPSec with and without zIIP)
  CICS Sockets

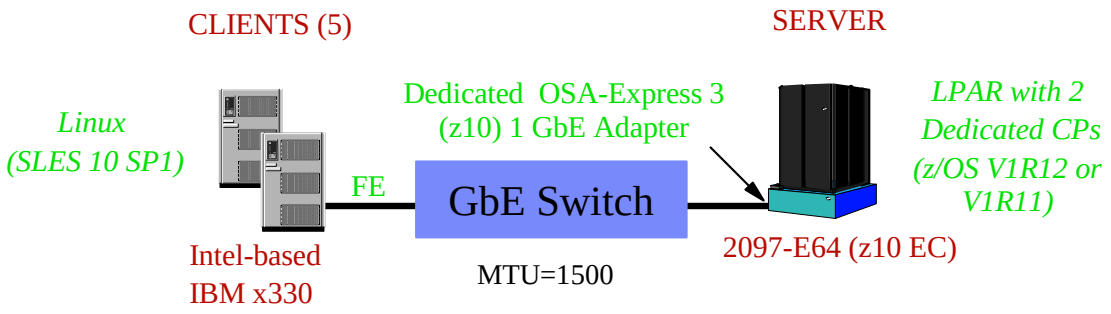
z/OS CS Configurations and Workloads

Hardware/Software Configurations

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



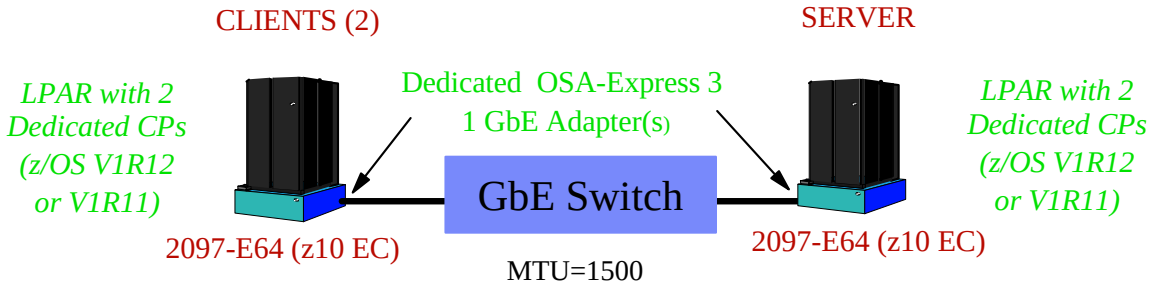
- **CICS Sockets**



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

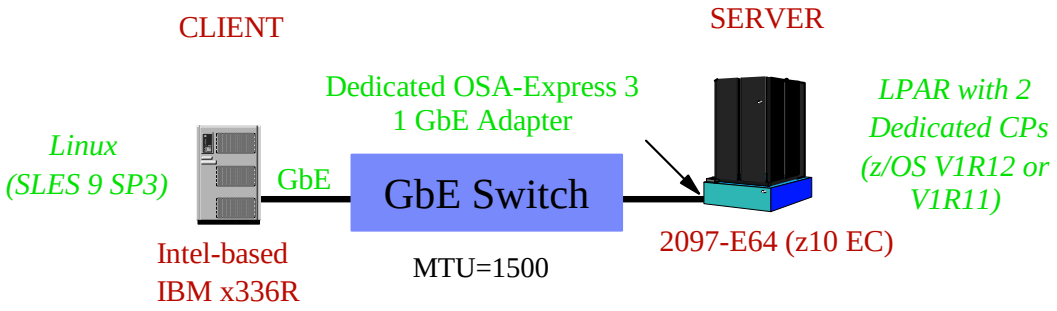
Hardware/Software Configurations

- **TN3270E**



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

- **FTP**

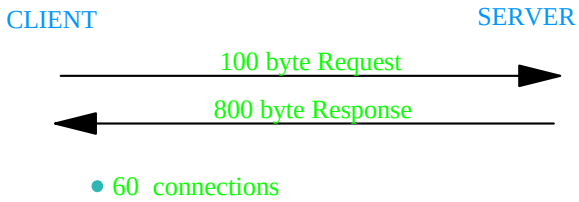


Note: Large send (Segmentation Offload) was disabled for all measurements unless otherwise stated.

AWM Benchmark Descriptions

RR Workload

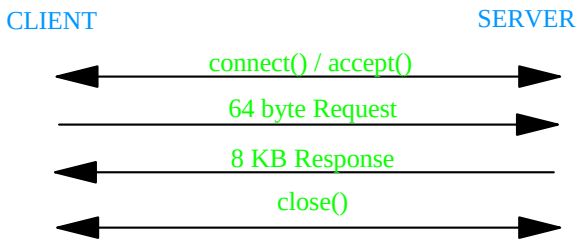
- Request-Response
  - Simulate TN3270
  - Interactive workloads



- 60 connections

CRR Workload

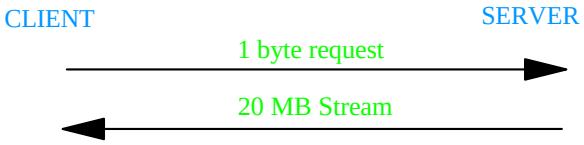
- Connect-Request-Response
  - Static Web Serving



- 9 connections

STR Workload

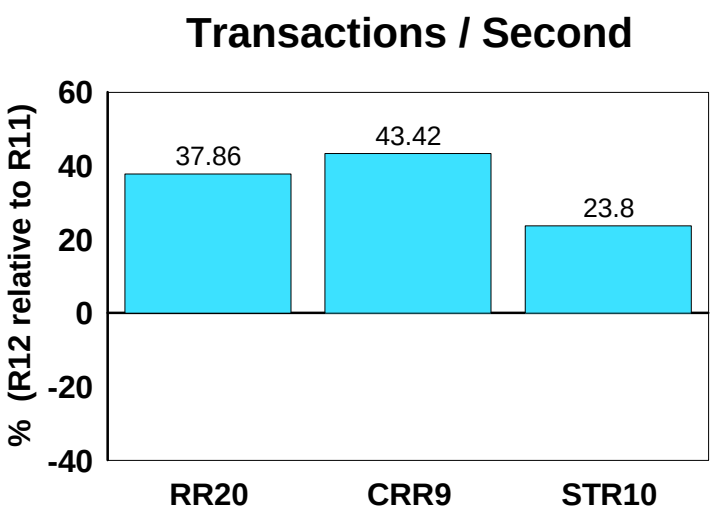
- Streaming
  - Simulate FTP or TSM
  - Memory-to-Memory

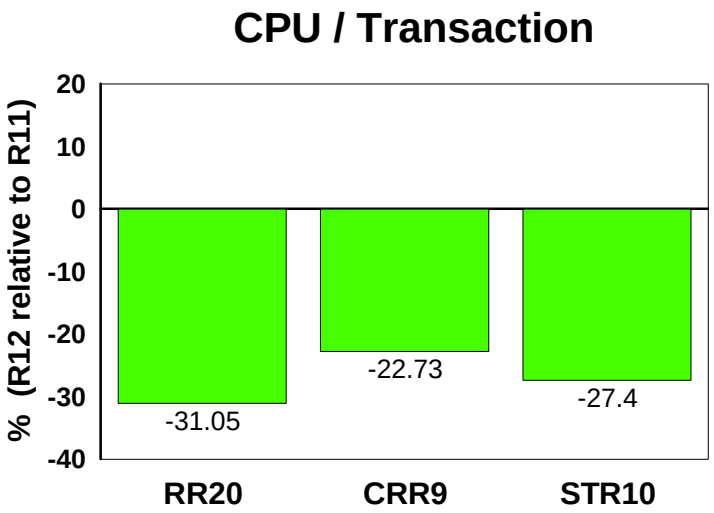


- 10 connections

z/OS CS V1R12
Line Item Performance

AT-TLS Performance Enhancements



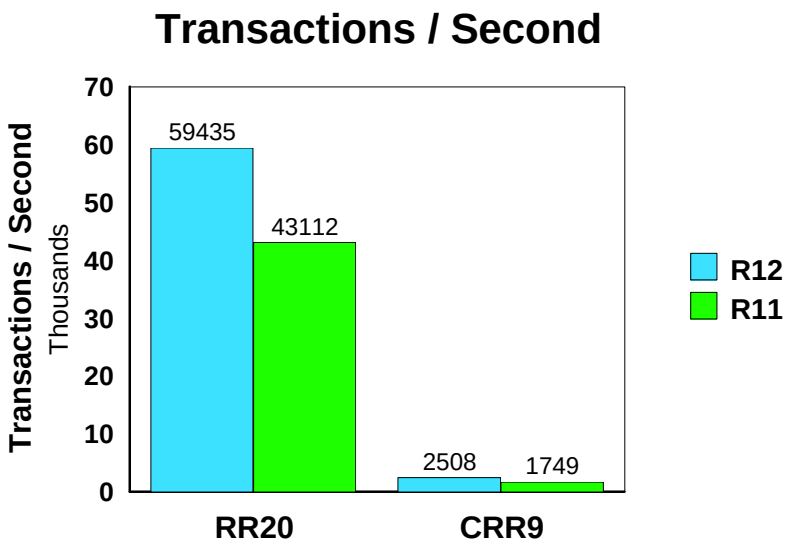


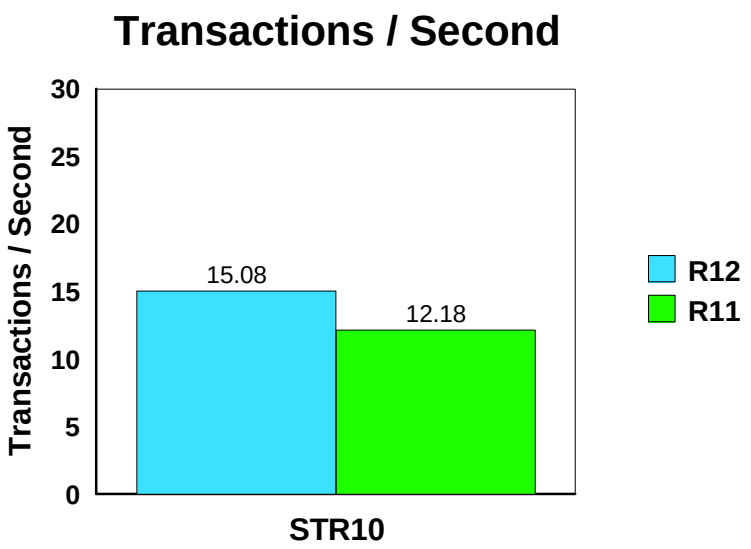
- RR20: 20 sessions, 100 / 100
- CRR9: 9 sessions, 64 / 8192
- STR10 (Outbound) : 10 sessions (Sending 20 Mbytes / Receiving 1 byte)
- Encryption: 3DES, Authentication: SHA
- Hardware: z10 (2 CPs) using OSA-E3 (1 GbE for RR and CRR And 10 GBE for STR)
- Software: z/OS V1R12 or V1R11

- **AT-TLS performance when encrypting and decrypting data has been enhanced.**

- z/OS V1R12 provides 23.8% to 43.42% higher throughput compared to V1R11 (Avg= 35.03% higher).
- z/OS V1R12 provides 22.73% to 31.05% lower CPU cost per transaction compared to V1R11 (Avg= 27.07% lower).

AT-TLS Detailed Performance (Throughput)

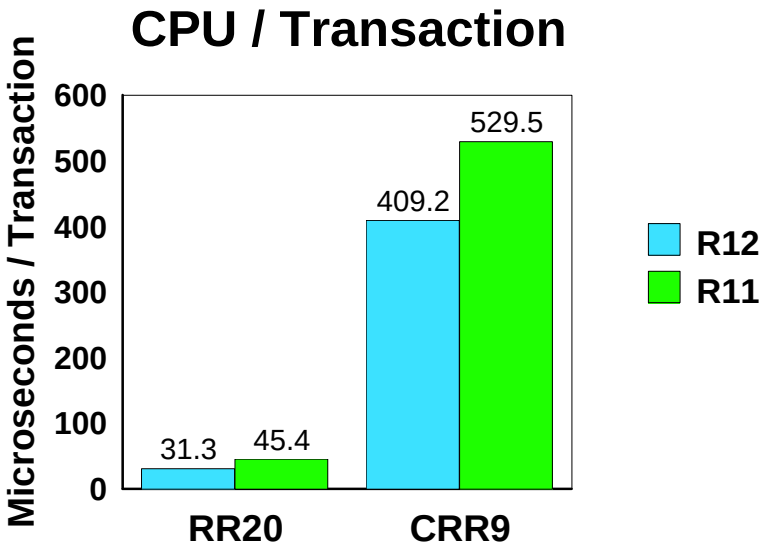


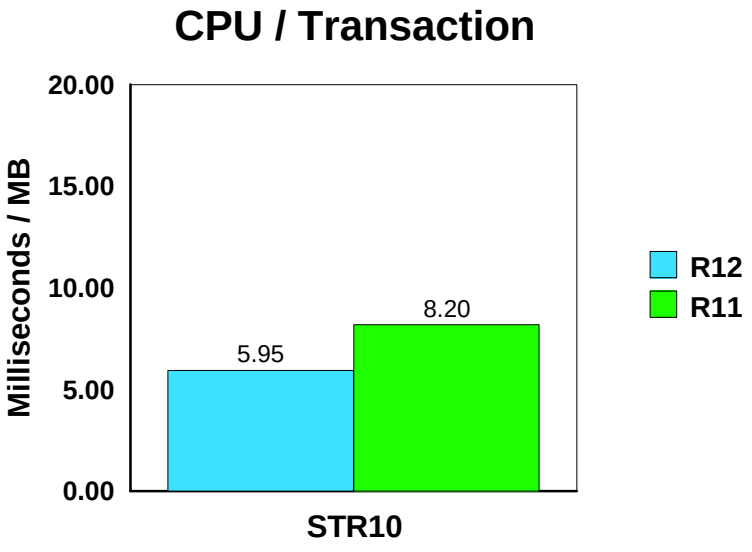


- Request-Response workload
- RR20: 20 sessions, 100 / 100
- CRR9: 9 sessions, 64 / 8192
- STR10 (Outbound): 5 sessions (Sending 20 Mbytes / Receiving 1 byte)
- Encryption: 3DES, Authentication: SHA
- Hardware: z10 (2 CPs) used OSA-E3 (1 GbE for RR and CRR and 10GBE for STR workload)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 throughput is 37.8% higher for RR, 43.4% higher for CRR and 23.8% higher for STR compared to V1R11 (Avg= 35.0% higher).

AT-TLS Detailed Performance (CPU/Transaction)



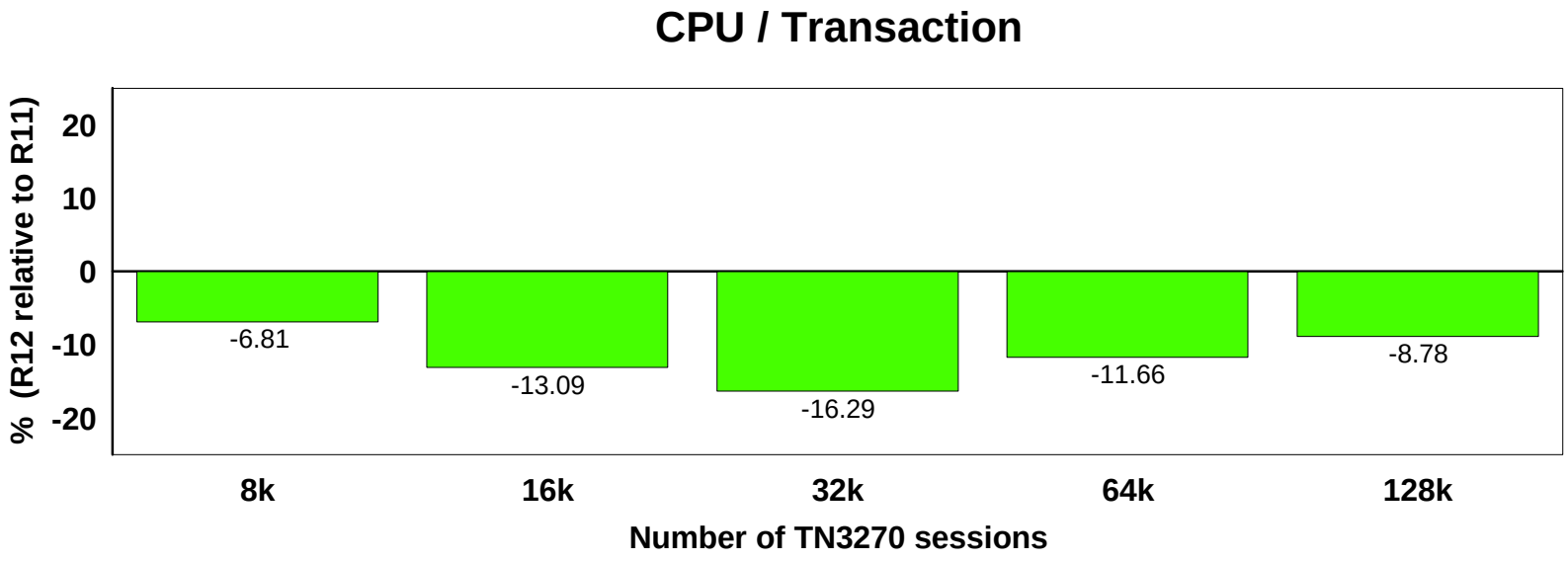


- Request-Response workload
- RR20: 20 sessions, 100 / 100
- CRR9: 9 sessions, 64 / 8192
- STR10 (Outbound): 10 sessions (Sending 20 Mbytes / Receiving 1 byte)
- Encryption: 3DES, Authentication: SHA
- Hardware: z10 (2 CPs) using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides 22.7% to 31.1% lower CPU cost per transaction compared to V1R11 (Avg= 27.07% lower).

AT-TLS Performance Enhancements

IPv4 TN3270 Server AT-TLS Performance

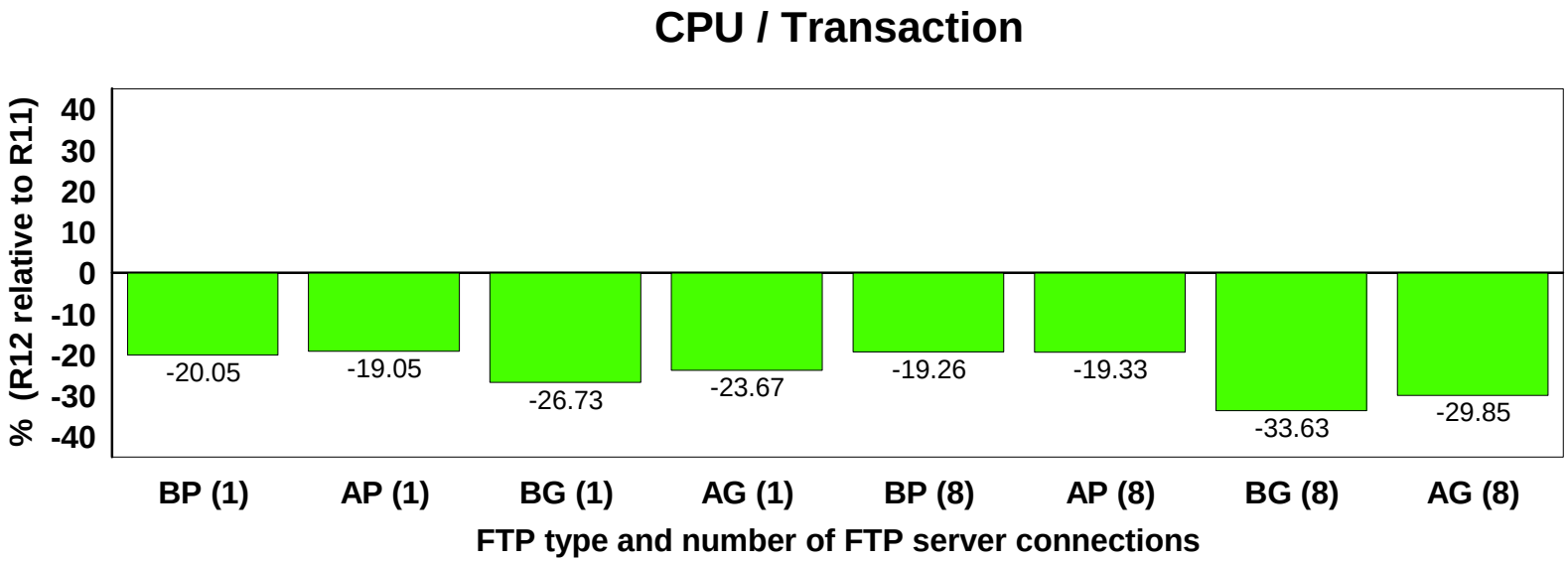


- TN3270 Server: 8k to 128k sessions, 10 second think time, 100 / 800, 3DES / SHA
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 TN3270 AT-TLS provides 6.81% lower to 16.29% lower CPU cost per transaction compared to V1R11 (Avg= 11.33% lower).

AT-TLS Performance Enhancements

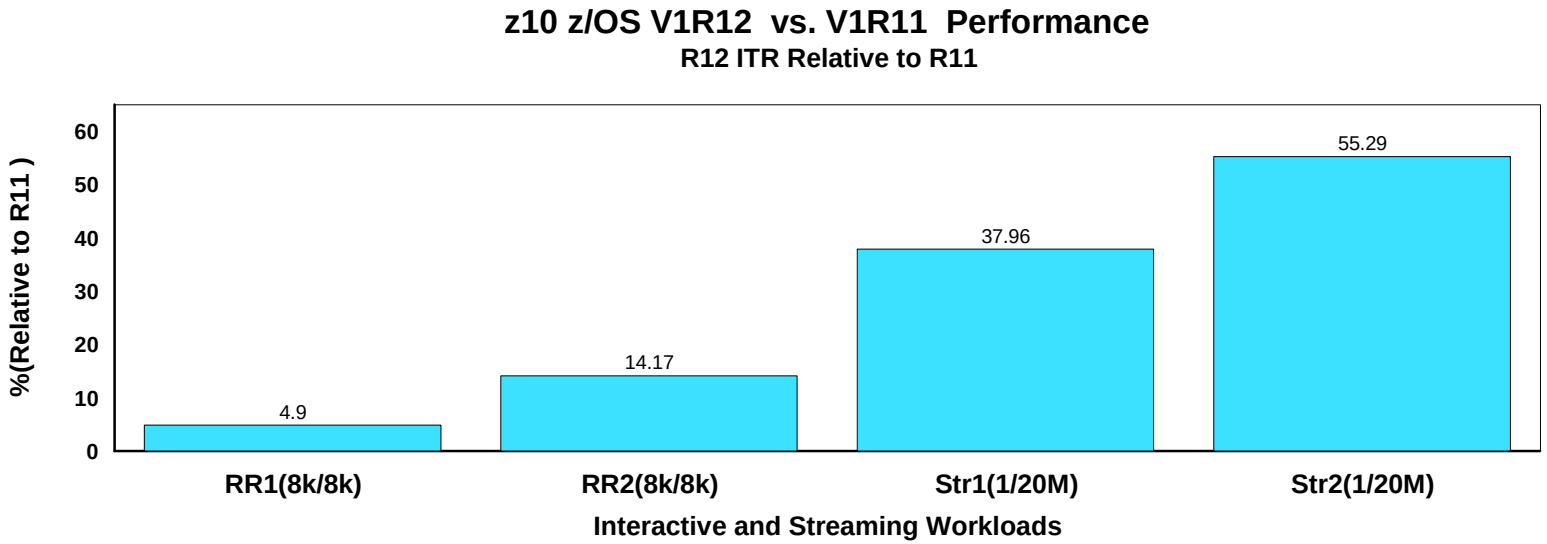
IPv4 FTP Server AT-TLS Performance



- FTP Server: 1 or 8 sessions, Puts and Gets to/from DASD, 20 MB / 1 or 1 / 20 MB, 256 AES
- BP: Binary Put; AP: ASCII Put; BG: Binary Get; AG: ASCII Get
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 FTP AT-TLS provides 19.05% to 33.63% lower CPU cost per kilobyte compared to V1R11 (Avg= 24.56% lower).

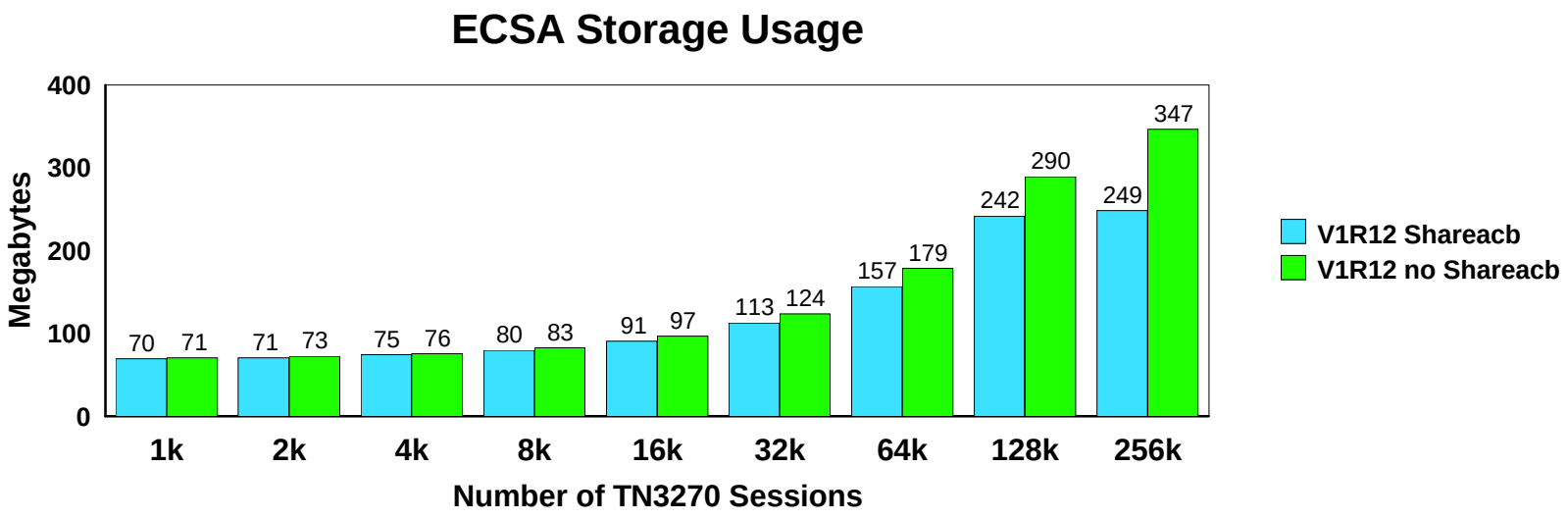
Fast Local Sockets Performance Improvement



- Fast Local Sockets :
  - Bypasses processing on both sending and receiving side
  - Data no longer placed on TCP Send queue
  - Data is placed directly onto receive queue bypassing TCP inbound processing
  - Data no loger ACK'd
  - Function is automatically enabled for all applications using sockets to communicate with other applications in the same z/OS system.
- RR1: 1 session, 8192 / 8192; RR2: 2 sessions 8192 / 8192
- STR1 (Outbound): 1 session (Sending 20 Mbytes / Receiving 1 byte)
- STR2 (Outbound): 2 sessions (Sending 20 Mbytes / Receiving 1 byte)
- Hardware: z10 (2 CPs) using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 interal throughput rate is 4.9 to 14.17% higher for RR and 37.96% to 55.29% higher for STR compared to V1R11 (Avg= 9.53% higher).

Common Storage Reduction for TN3270E Server (Shared acb)



- TN3270: 1k, 2k, 4k, 8k, 16k, 32k, 64k, 128k, and 256k sessions
- Hardware: z10 (2 CPs) using OSA-E3 (1 GbE)
- Software: z/OS V1R12

- z/OS V1R12 with the share acb option provides 1% to 28% lower Total ECSA storage usage compared to V1R12 without the share acb option (Avg= 9.05% lower). The savings delta increases as the number of sessions increases.
- z/OS V1R12 with the share acb option provides 28% lower Total ECSA storage usage for 256K TN3270 sessions compared to V1R12 without the share acb option.

QDIO Inbound Workload Queueing Enhancements for OSA Express3

For mixed interactive|streaming workloads, the new OSA-Express3 IWQ mode may provide substantial throughput and response time improvements for interactive traffic. In the lab, we've measured a peak interactive throughput boost of 84%, which translates to a 46% improvement in interactive response time.

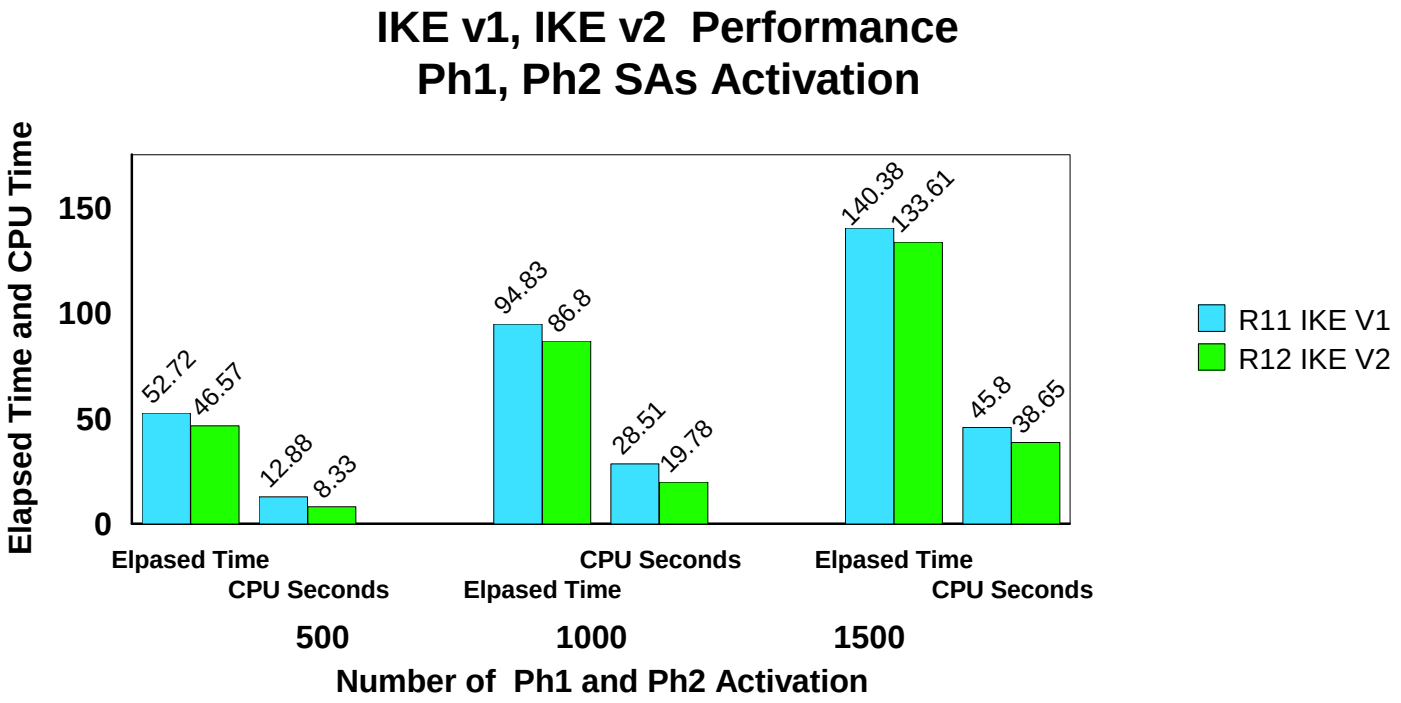
For purely-streaming workloads, the new IWQ mode may also deliver substantial throughput improvement. This throughput boost appears to be delivered with no increase in normalized (per MegaByte) CPU processing expense. (In fact, in some tests, the improvements in raw throughput were also accompanied by a decrease in per-MB CPU consumption.) Our lab results show a peak throughput boost of 41% (measured for z/OS streaming outbound to AIX over 10 Gigabit Ethernet), and a reduction in per-MB CPU consumption of up to 12%.

It is strongly recommended that z/OS Communications Server PTF UK61028 be applied before deploying IWQ mode.

The completed performance analysis will be found in the index for z/OS Communications Server Performance reports with the title "z/OS V1R12 Communications Server Performance Study: OSA Express3 Inbound Workload Queueing ".

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

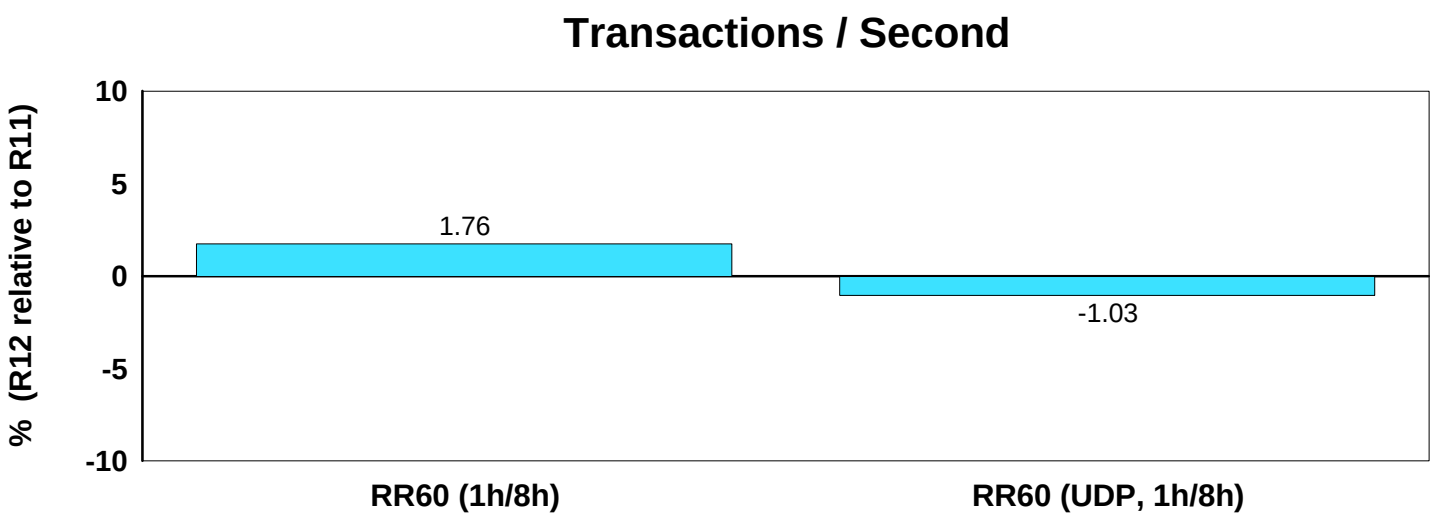
R12 IKE v2 and R11 IKE v1 Ph1, Ph2 SAs Activation



- z/OS V1R12 IKE v2 provides significantly lower elapsed time and cpu time for ph1, ph2 security associations compared to R11 IKE v1.

z/OS CS V1R12 vs V1R11 Relative Performance

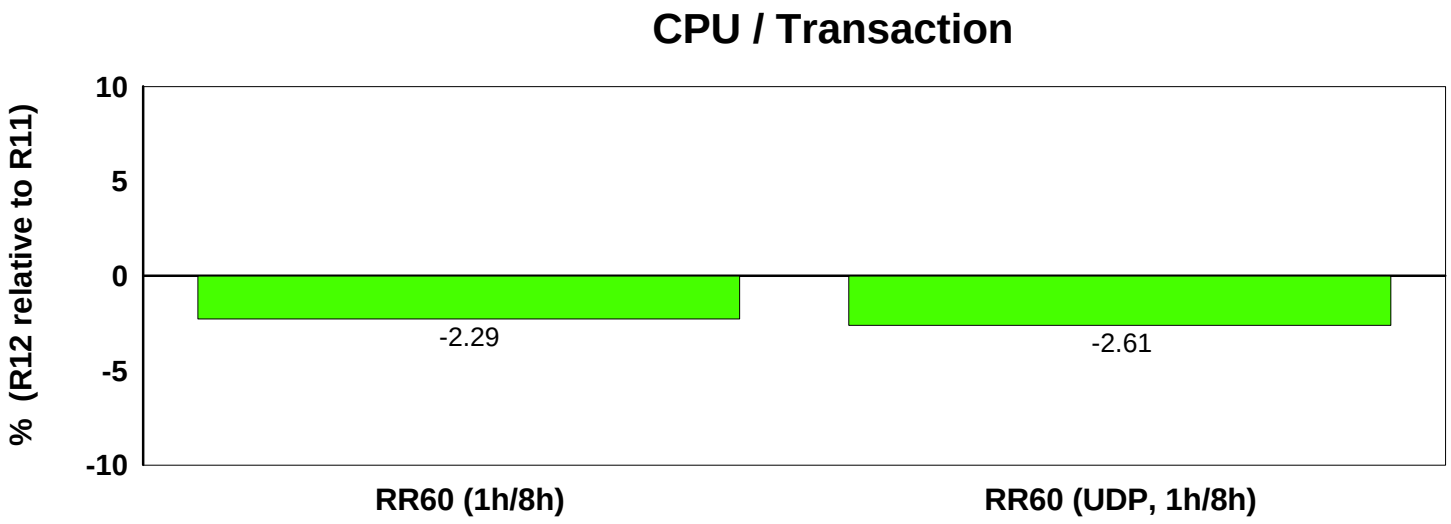
IPv4 AWM Primitives Relative Performance (RR Throughput)



- 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 V1R12 or V1R11

- z/OS V1R12 provides 1.03% lower to 1.76% higher throughput compared to V1R11 (Avg= 0.37% higher).

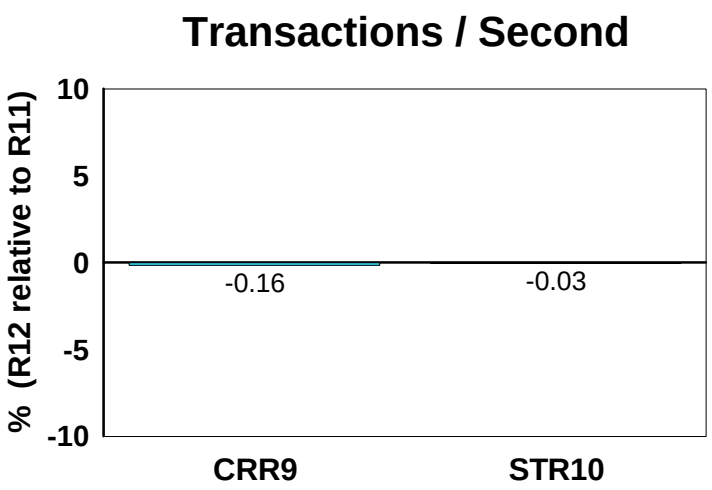
IPv4 AWM Primitives Relative Performance (RR CPU/Transaction)

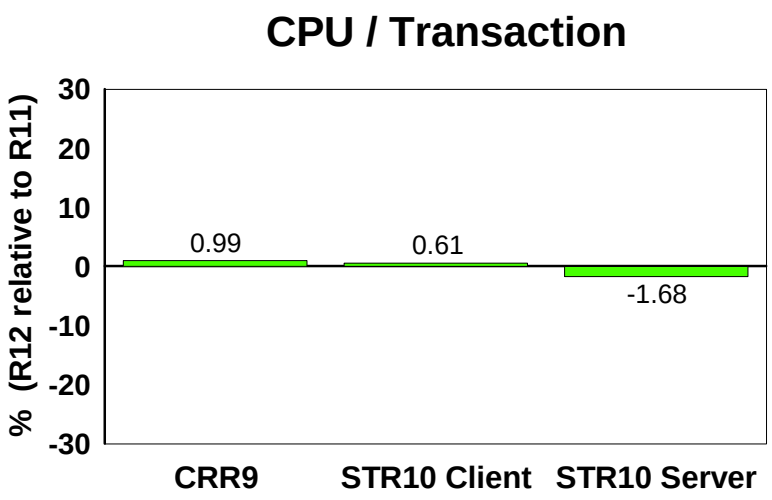


- Request-Response workload
- RR60 (1h/8h): 60 sessions, TCP, 100 / 800
- RR60 (UDP,1h/8h): 60 sessions, UDP, 100 / 800
- All transactions are memory to memory (no DASD used)
- Hardware: z10 using OSA-E3 (1 GbE) INBPERF DYNAMIC used
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides 2.29 to 2.61% lower CPU cost per transaction compared to V1R11 (Avg= 2.45% lower).

IPv4 AWM Primitives Relative Performance (CRR and STR)

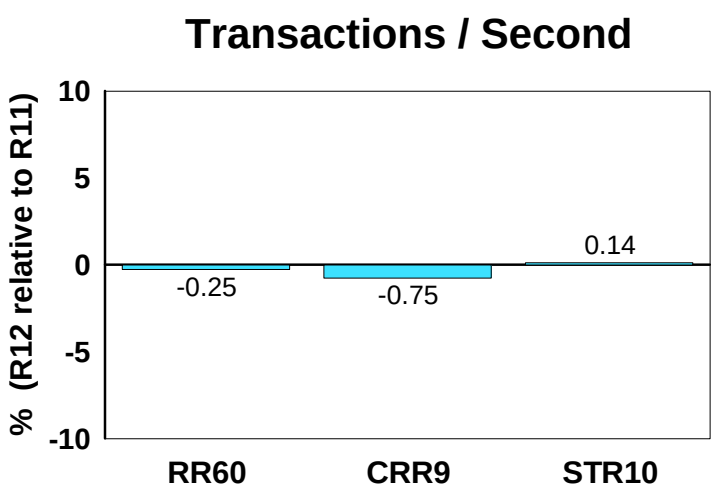


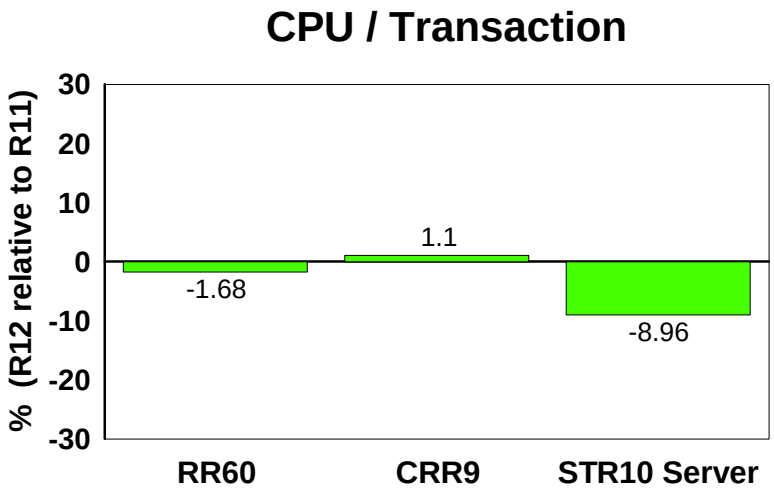


- Connect-Request-Response and Streaming workloads
- CRR9: 9 sessions, 64 / 8 KB
- STR10: 10 sessions, 1 / 20 MB
- All transactions are memory to memory (no DASD used)
- Hardware: z10 using OSA-E3 (1 GbE) INBPERF DYNAMIC for CRR and OSA-E3 (10 GbE) for STR workload
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 CRR and STR provide equivalent throughput compared to V1R11.
- z/OS V1R12 CRR provides 0.99% higher CPU cost per transaction compared to V1R11.
- z/OS V1R12 STR provides 1.68% lower to 0.61% higher CPU cost per transaction compared to V1R11 (Avg= 0.53% lower).

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

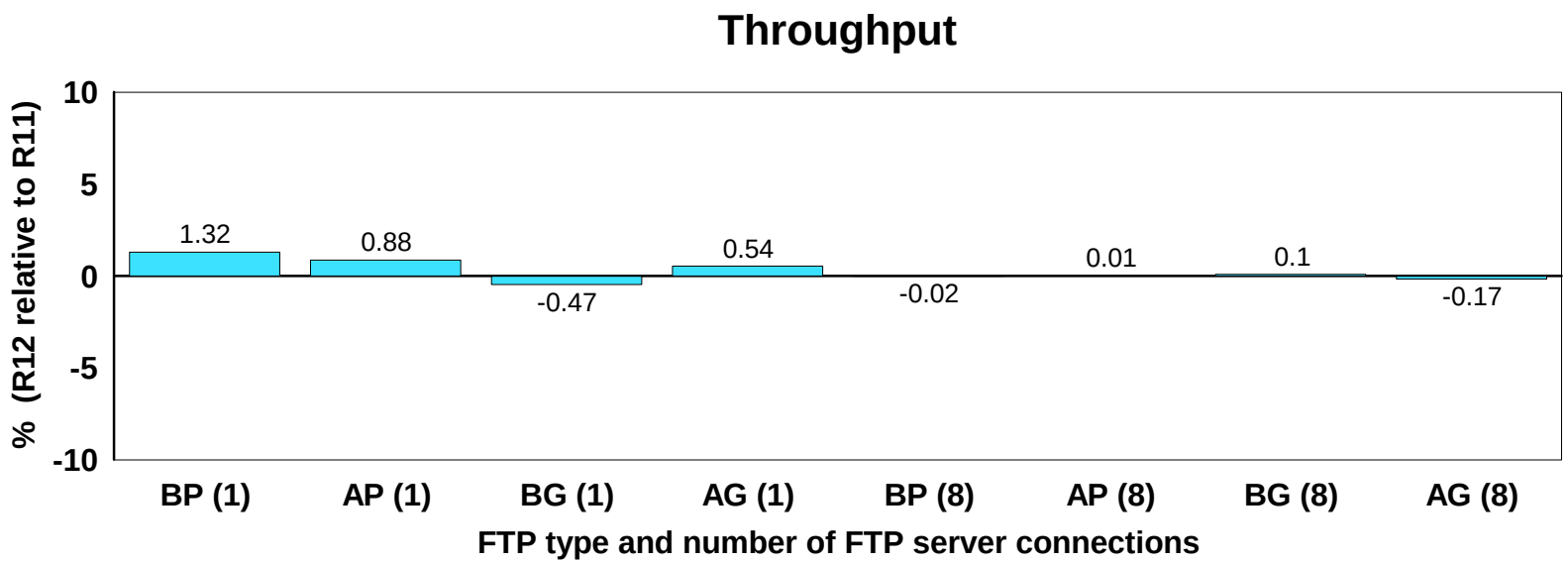




- Request-Response, Connect-Request-Response and Streaming workloads
- RR60: 60 sessions, 100 / 800
- CRR9: 9 sessions, 64 / 8 KB
- STR10: 10 sessions, 1 / 20 MB
- All transactions are memory to memory (no DASD used)
- Hardware: z10 using OSA-E3 (1 GbE) INBPERF DYNAMIC for RR and CRR, and OSA-E3 (10 GbE) for STR workload
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 IPv6 RR, CRR and STR provide equivalent throughput compared to V1R11.
- z/OS V1R12 IPv6 RR provides 1.68% lower CPU cost per transaction compared to V1R11.
- z/OS V1R12 IPv6 CRR provides 1.1% higher CPU cost per transaction compared to V1R11.
- z/OS V1R12 IPv6 STR provides 8.96% lower CPU Cost per transaction compared to V1R11.

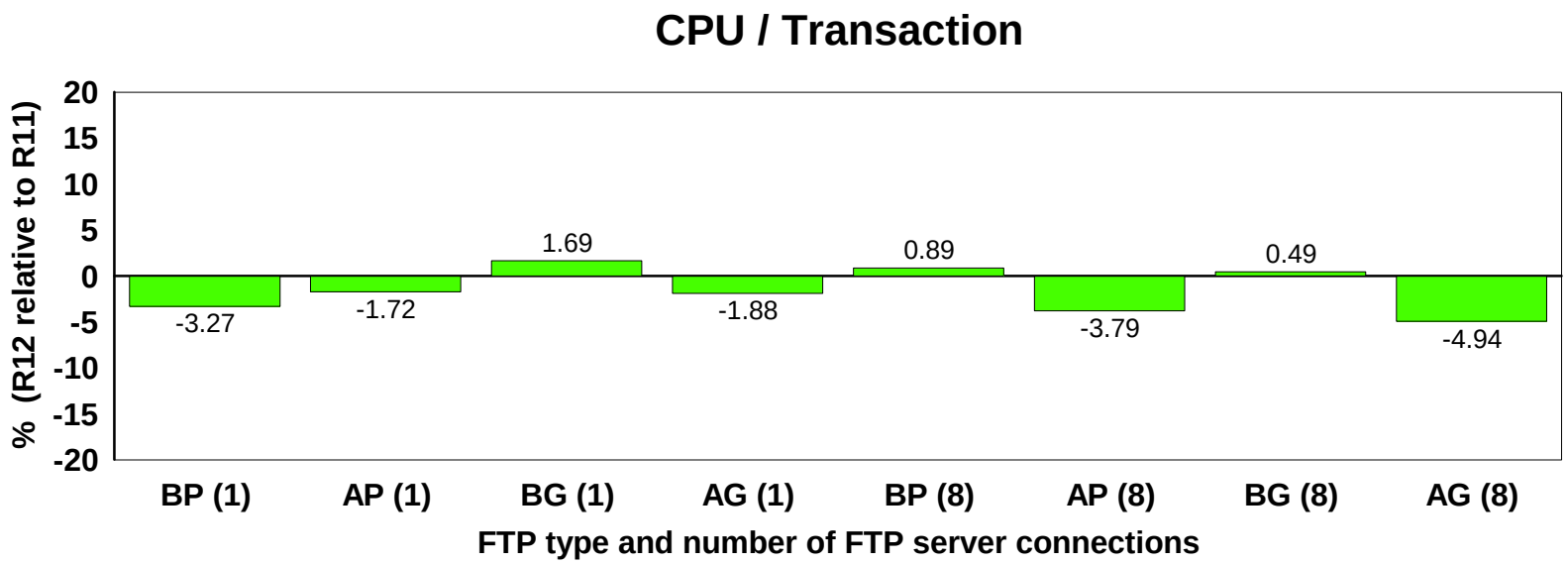
IPv4 FTP Server Relative Performance (Throughput)



- 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 V1R12 or V1R11

- z/OS V1R12 provides 0.47% lower to 1.32% higher throughput compared to V1R11 (Avg= 0.27% higher).

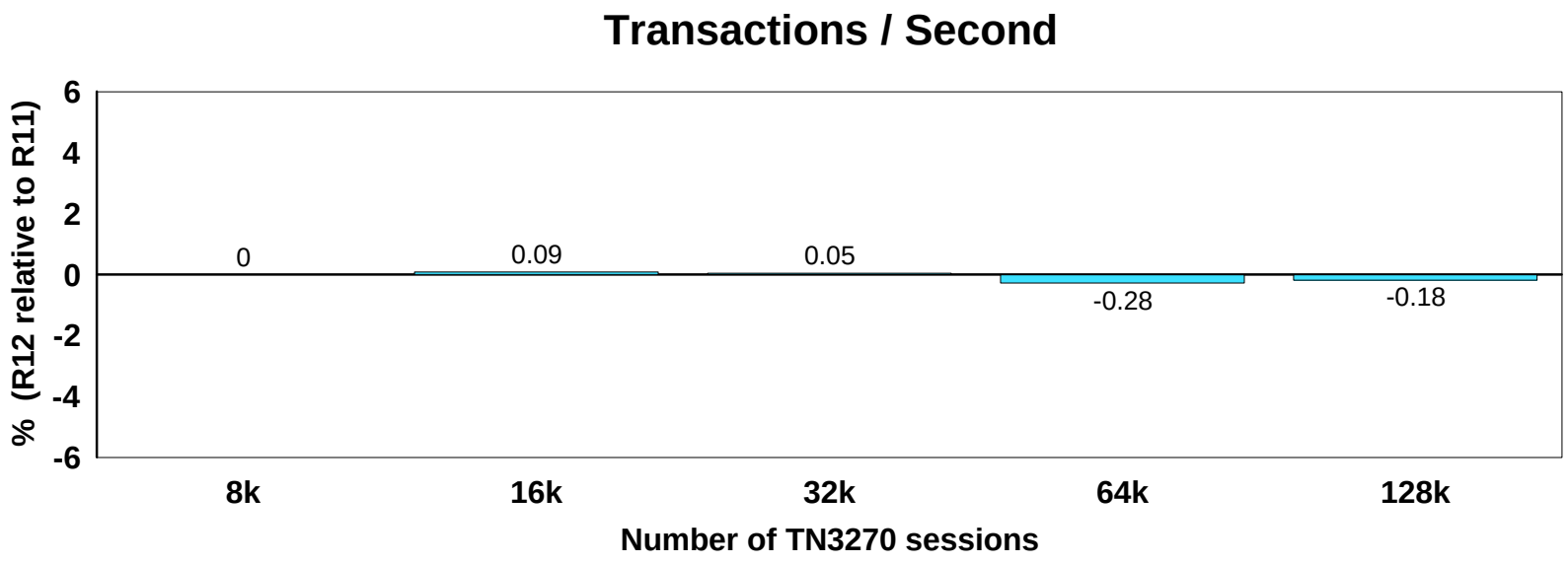
IPv4 FTP Server Relative Performance (CPU/Transaction)



- 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 V1R12 or V1R11

- z/OS V1R12 provides 1.69% higher to 4.94% lower CPU cost per transaction compared to V1R11 (Avg= 1.57% lower).

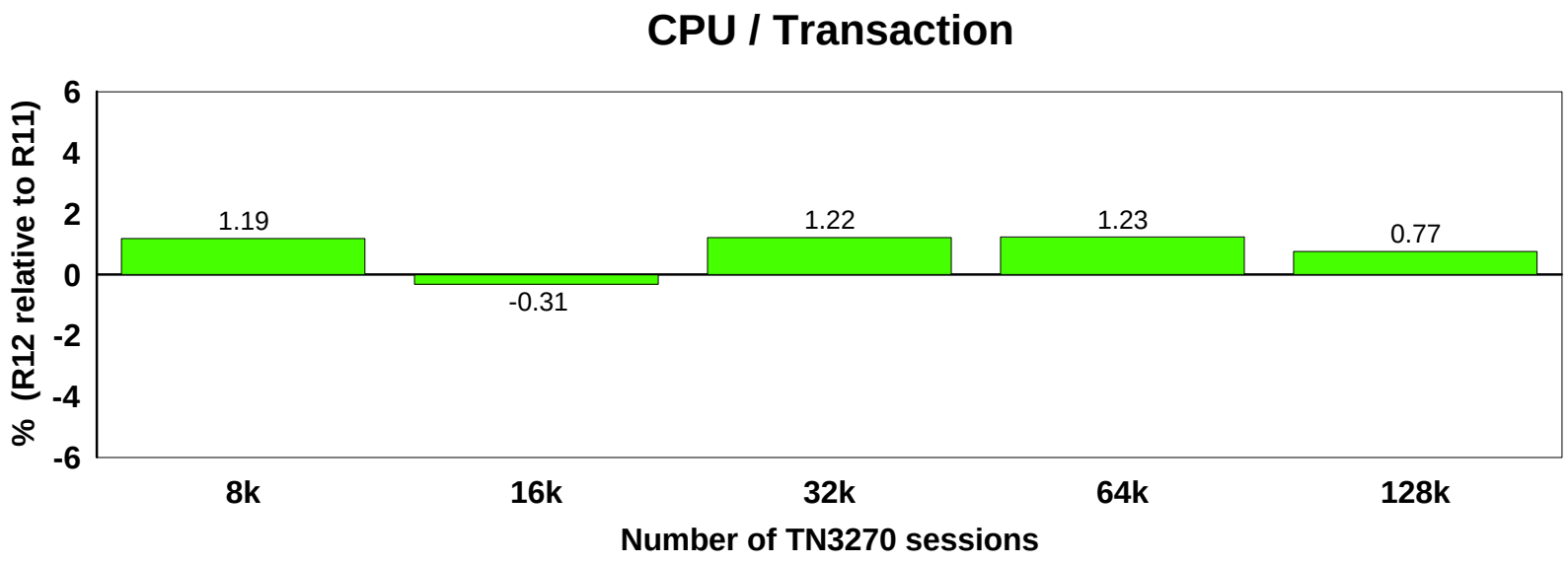
IPv4 TN3270 Server Relative Performance (Throughput)



- 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: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides equivalent throughput compared to V1R11.

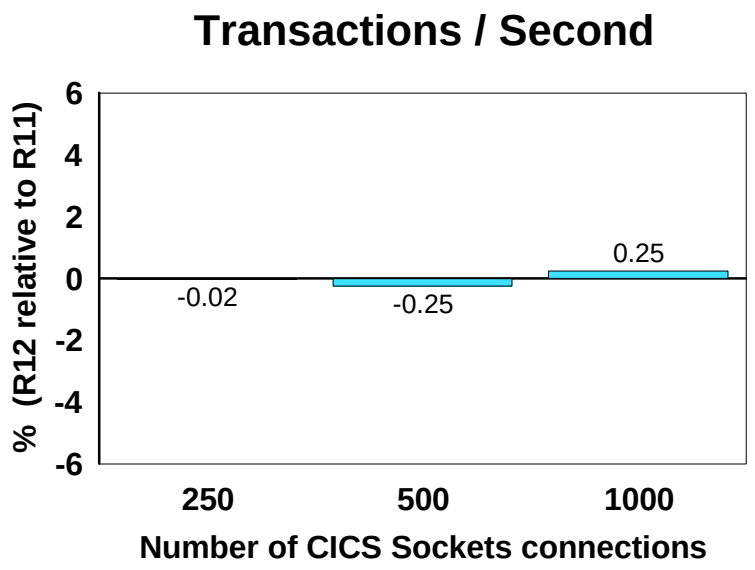
IPv4 TN3270 Server Relative Performance (CPU/Transaction)

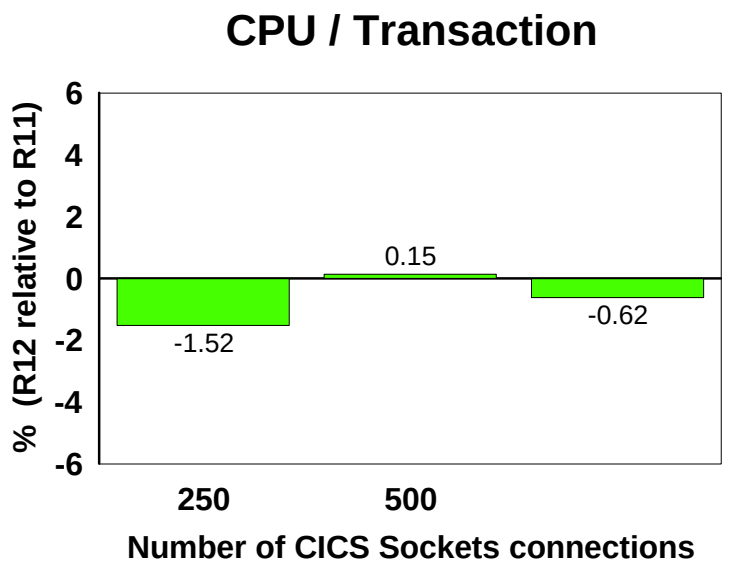


- TN3270 Server: 8k to 128k sessions, 10 second think time, 100 / 800
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides 1.23% higher to 0.31% lower CPU cost per transaction compared to V1R11 (Avg= 0.82% higher).

IPv4 CICS Sockets Relative Performance

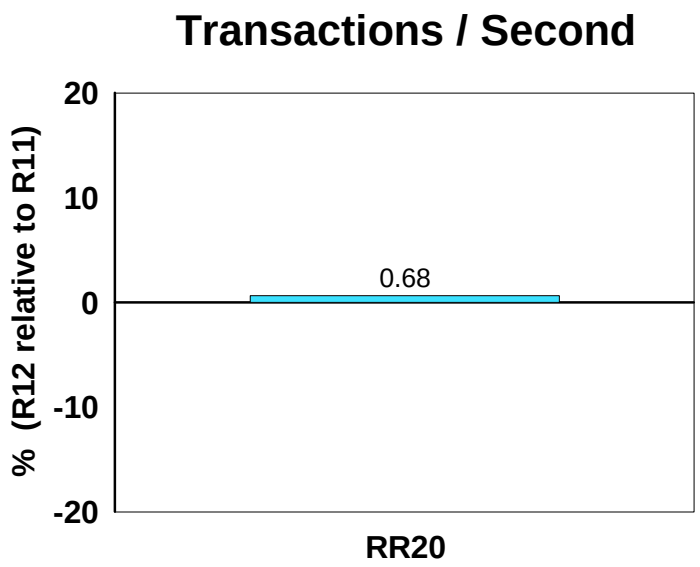


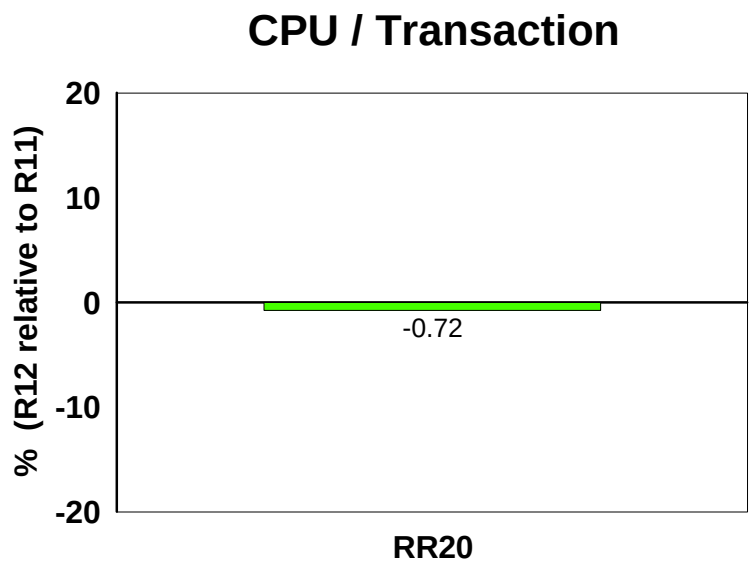


- CICS Sockets: 250 to 1000 sessions, 0.5 second think time, OTE, 200 / 200
- Throughput is about the same since a fixed think time is used between user transactions
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11, CICS TS 4.1

- z/OS V1R12 provides equivalent throughput compared to V1R11.
- z/OS V1R12 provides 0.15 higher to 1.52% lower CPU cost per transaction compared to V1R10 (Avg= 0.66% lower).

IPv4 Enterprise Extender (EE) Relative Performance

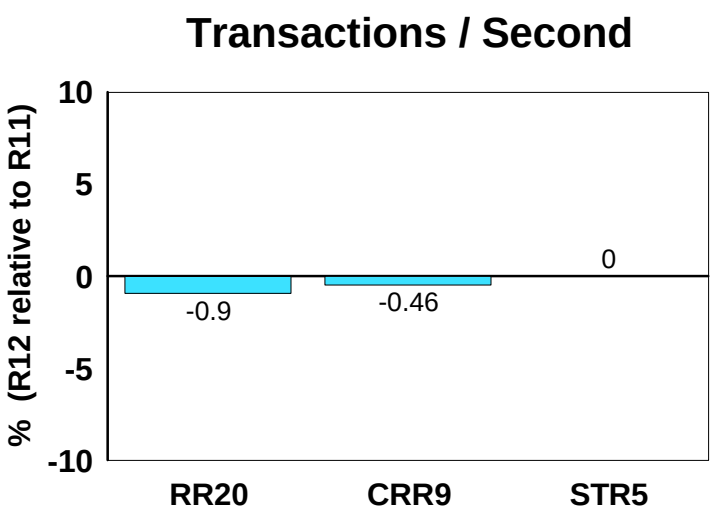


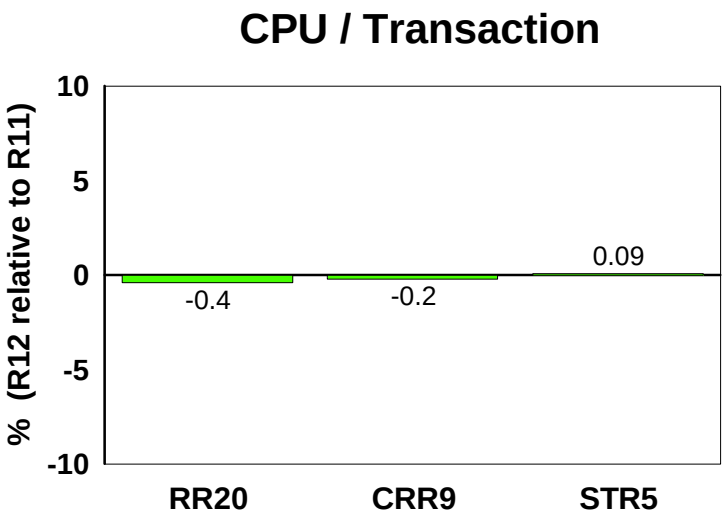


- RR20: 20 sessions, 100 / 800
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides 0.68% higher throughput compared to V1R11.
- z/OS V1R12 provides 0.72% lower CPU cost per transaction compared to V1R11.

IPSec Relative Performance

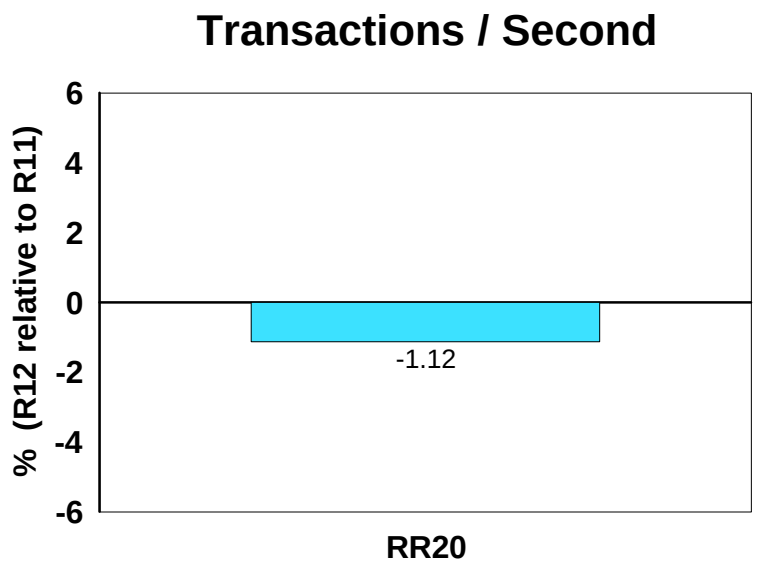


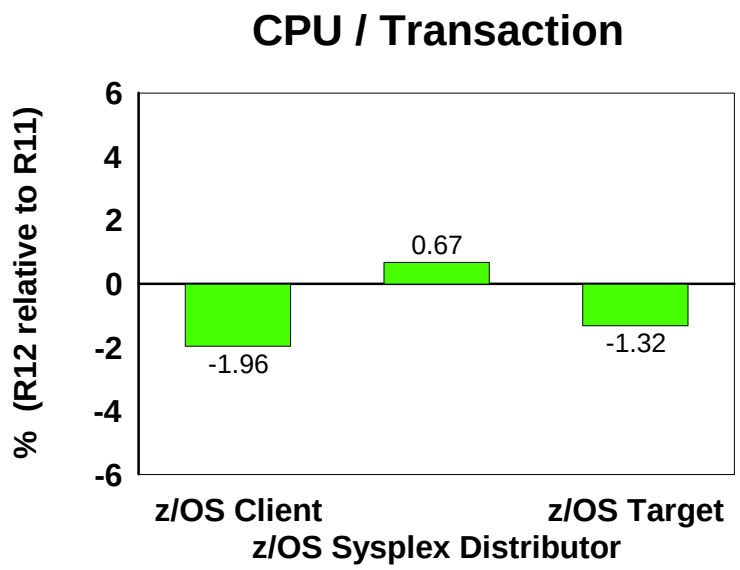


- RR20: 20 sessions, 100 / 800
- CRR9: 9 sessions, 64 / 8192
- STR5 (Outbound): 5 sessions (Sending 20 Mbytes / Receiving 1 byte)
- Encryption: 3DES, Authentication: SHA
- Hardware: z10 (2 CPs) using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides equivalent throughput compared to V1R11.
- z/OS V1R12 provides equivalent CPU cost per transaction compared to V1R11.

Sysplex Distributor Relative Performance

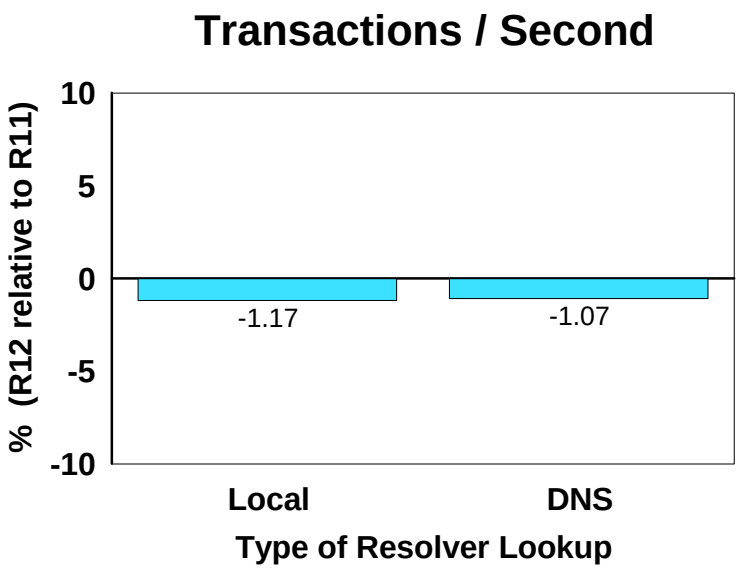


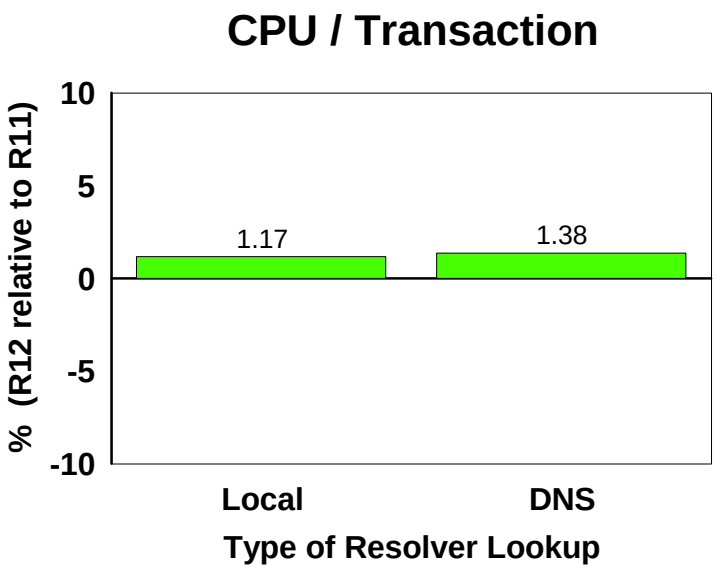


- RR20: 20 sessions, 100 / 100
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides 1.12% lower throughput compared to V1R11.
- z/OS V1R12 provides 0.67% higher to 1.96% lower CPU cost per transaction compared to V1R11 (Avg= 1.09% lower).

Resolver Relative Performance

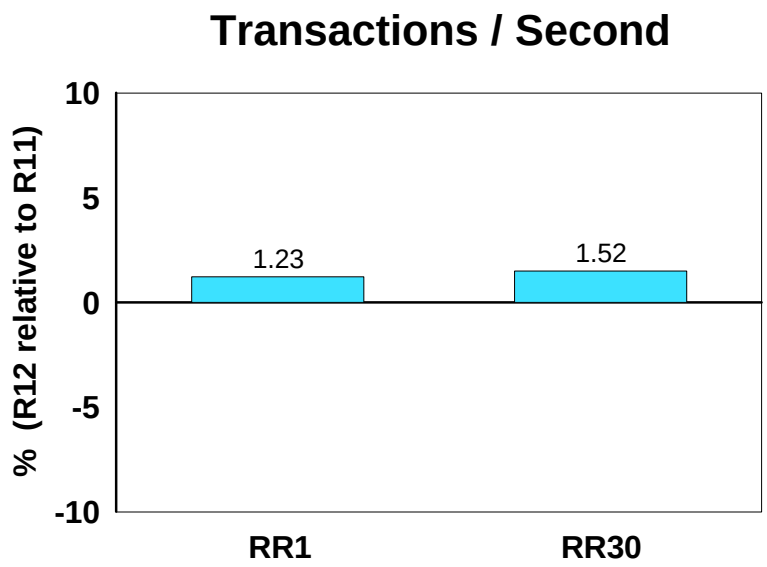


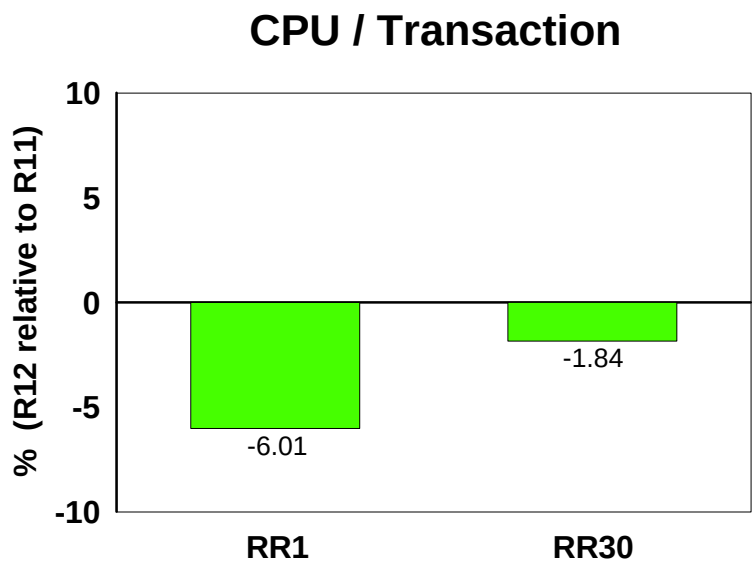


- Resolver Lookup: Local: Resolves IP address on local system (using IPNODES file)
  DNS: Resolves IP address on remote DNS server (Linux)
- Transaction: GETADDRINFO() and FREEADDRINFO() calls
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides 1.07 to 1.17% lower throughput compared to V1R11 (Avg= 1.12% lower).
- z/OS V1R12 provides 1.17 to 1.38% higher CPU cost per transaction compared to V1R11 (Avg= 1.28% higher).

Async I/O Relative Performance



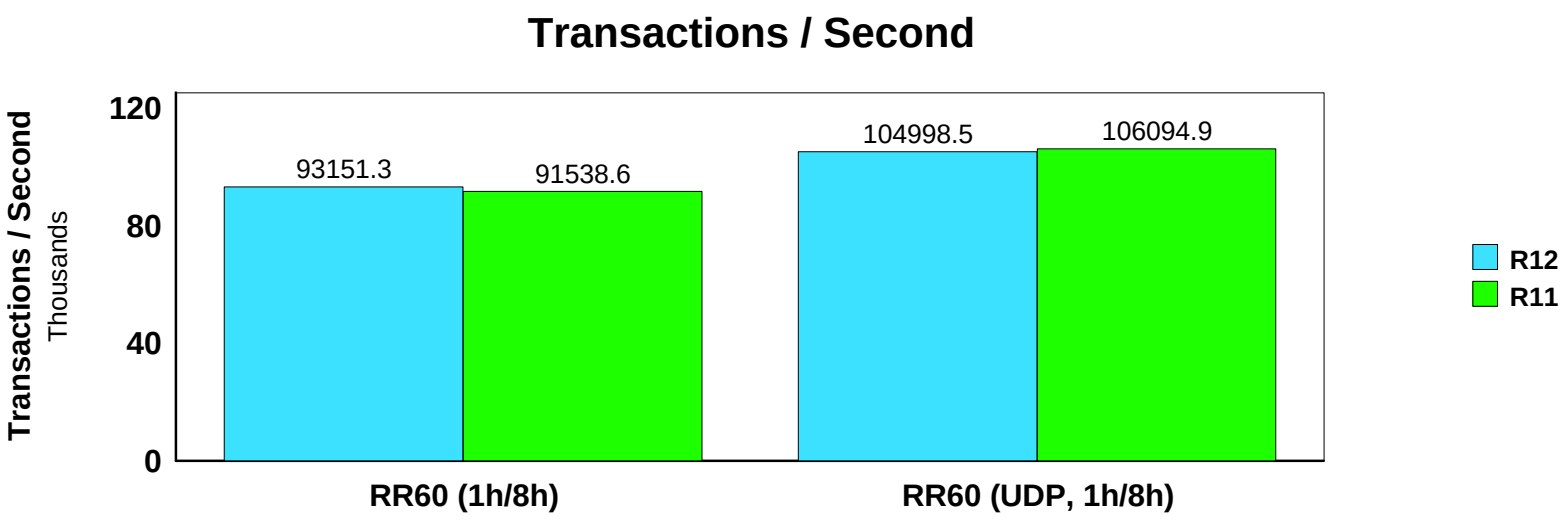


- RR1: 1 session, 100 / 100
- RR30: 30 sessions, 100 / 100
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides 1.23% to 1.52% higher throughput compared to V1R11 (Avg= 1.37% higher).
- z/OS V1R12 provides 1.84% to 6.01% lower CPU cost per transaction compared to V1R11 (Avg= 2.92% lower).

z/OS CS V1R12 vs V1R11 Detailed Performance

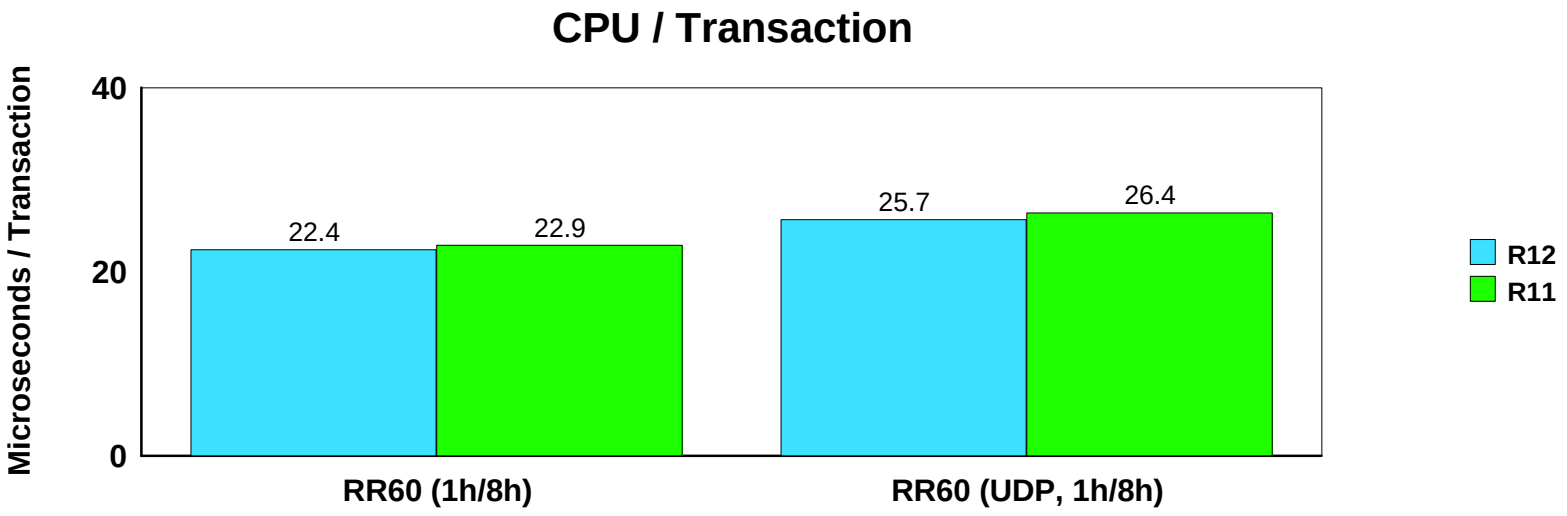
IPv4 AWM Primitives Detailed Performance (RR Throughput)



- 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 V1R12 or V1R11

- z/OS V1R12 provides 1.03% lower to 1.76% higher throughput compared to V1R11 (Avg= 0.37% higher).

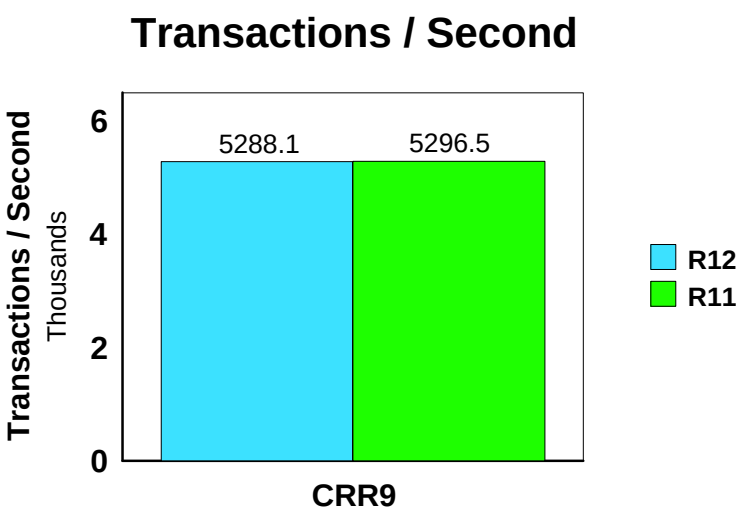
IPv4 AWM Primitives Detailed Performance (RR CPU/Transaction)

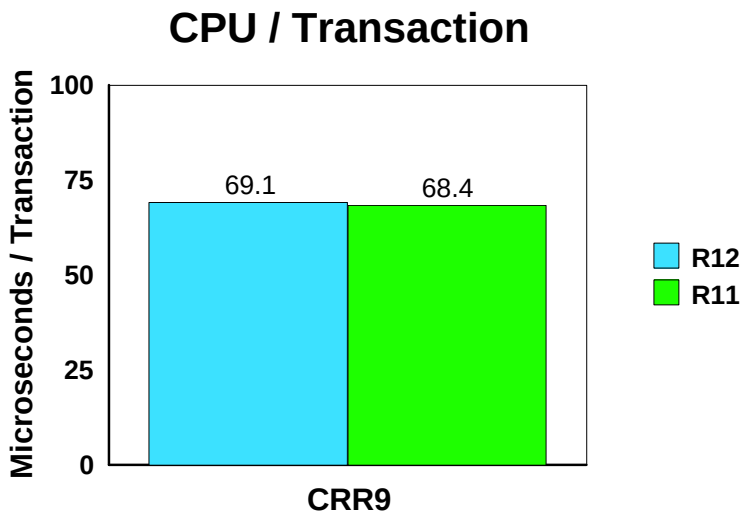


- Request-Response workload
- RR60 (1h/8h): 60 sessions, TCP, 100 / 800
- RR60 (UDP,1h/8h): 60 sessions, UDP, 100 / 800
- All transactions are memory to memory (no DASD used)
- Hardware: z10 using OSA-E3 (1 GbE) INBPERF DYNAMIC used
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides 2.29 to 2.61% lower CPU cost per transaction compared to V1R11 (Avg= 2.45% lower).

IPv4 AWM Primitives Detailed Performance (CRR)

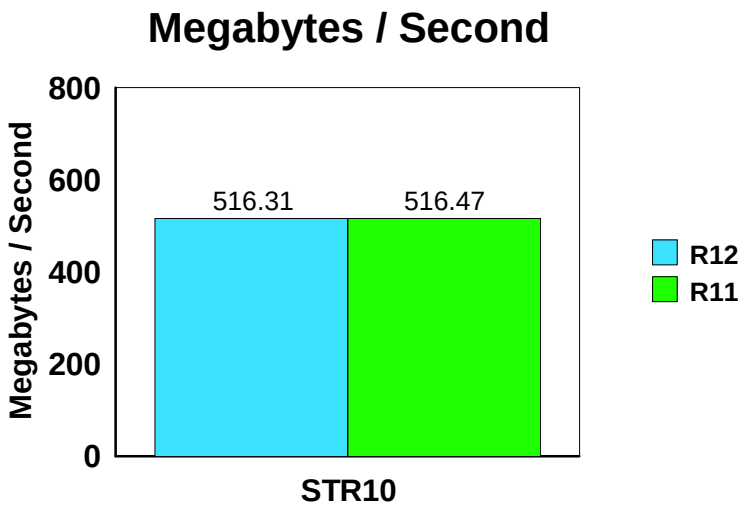


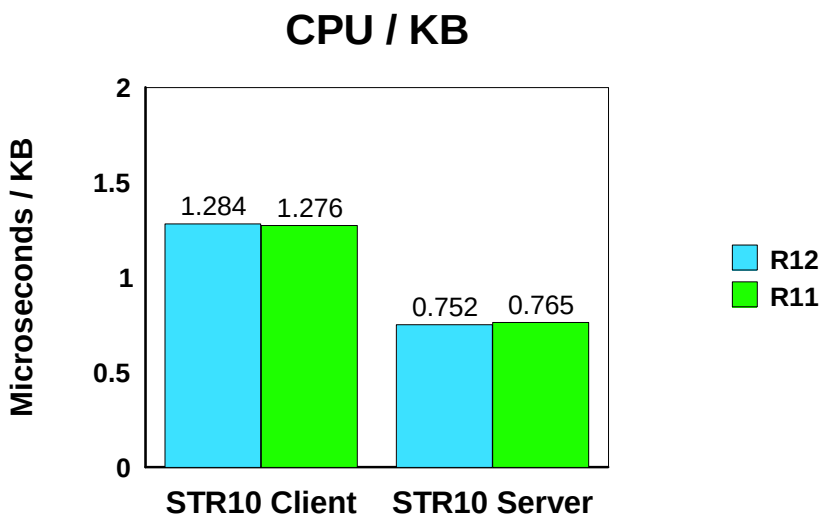


- Connect-Request-Response workload
- CRR9: 9 sessions, 64 / 8 KB
- All transactions are memory to memory (no DASD used)
- Hardware: z10 using OSA-E3 (1 GbE) INBPERF DYNAMIC used
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides equivalent throughput compared to V1R11.
- z/OS V1R12 provides 0.99% higher CPU cost per transaction compared to V1R11.

IPv4 AWM Primitives Detailed Performance (STR)

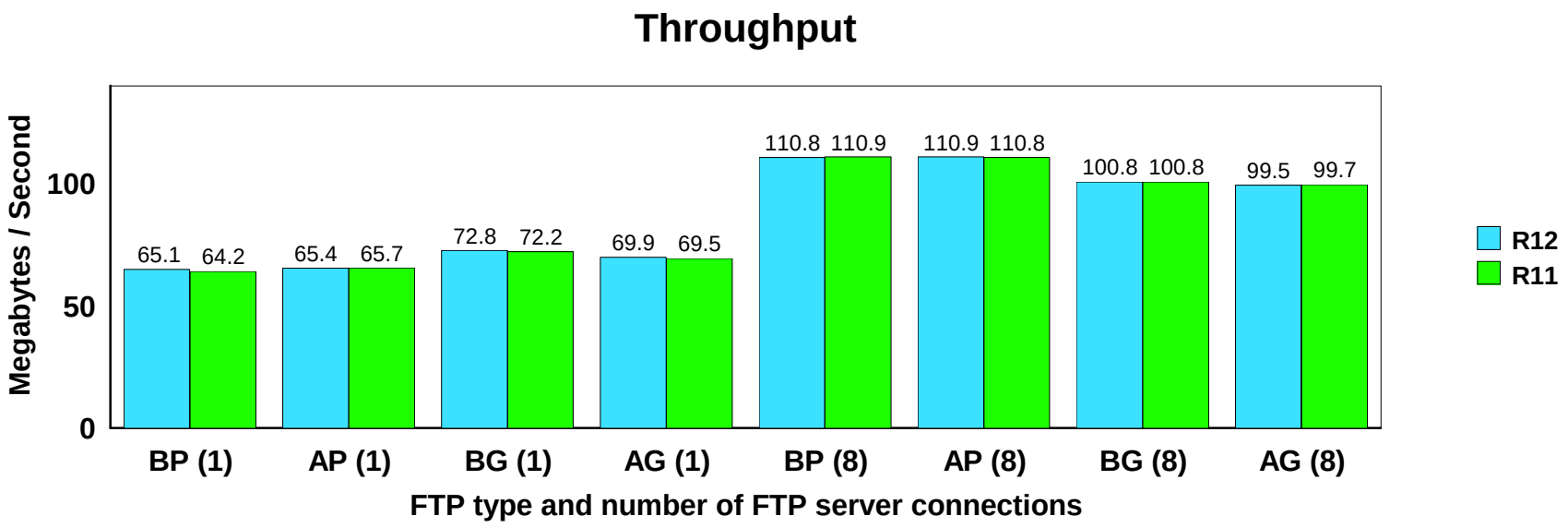




- Streaming workload
- STR10: 10 sessions, 1 / 20 MB
- All transactions are memory to memory (no DASD used)
- Hardware: z10 using OSA-E3 (10 GbE) INBPERF DYNAMIC used
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides equivalent throughput compared to V1R11.
- z/OS V1R12 provides 0.61% higher to 1.68% lower CPU cost per transaction compared to V1R11 (Avg= 0.54% lower).

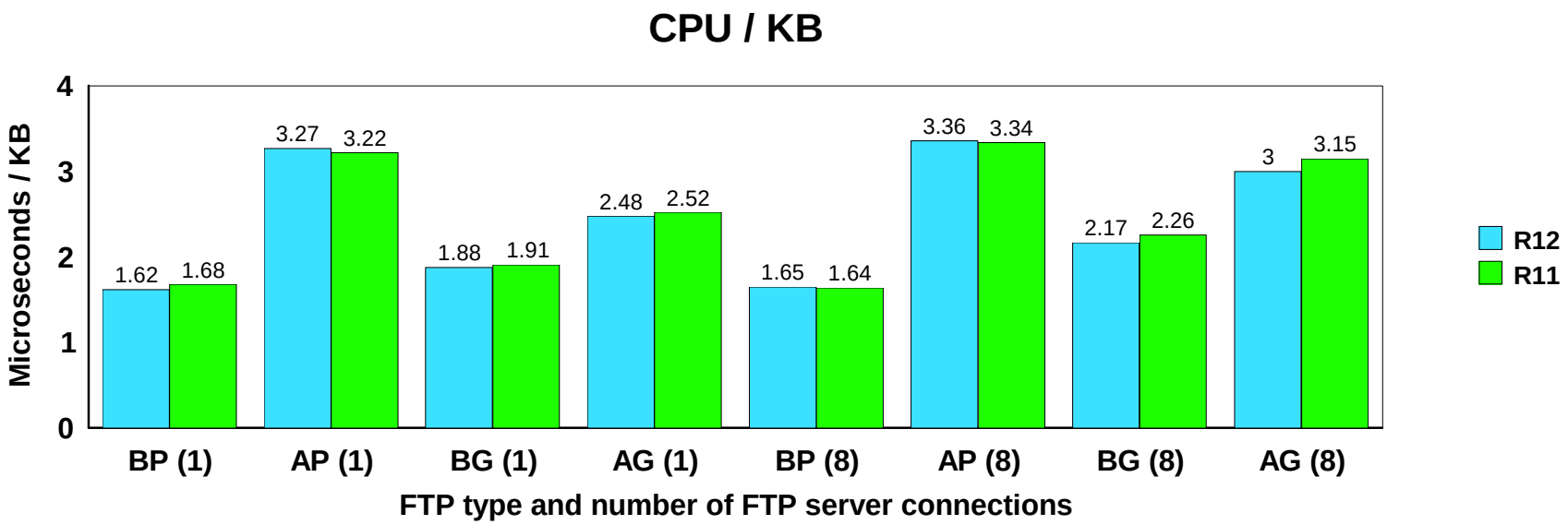
IPv4 FTP Server Detailed Performance (Throughput)



- 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 V1R12 or V1R11

- z/OS V1R12 provides 0.47% lower to 1.32% higher throughput compared to V1R11 (Avg= 0.27% higher).

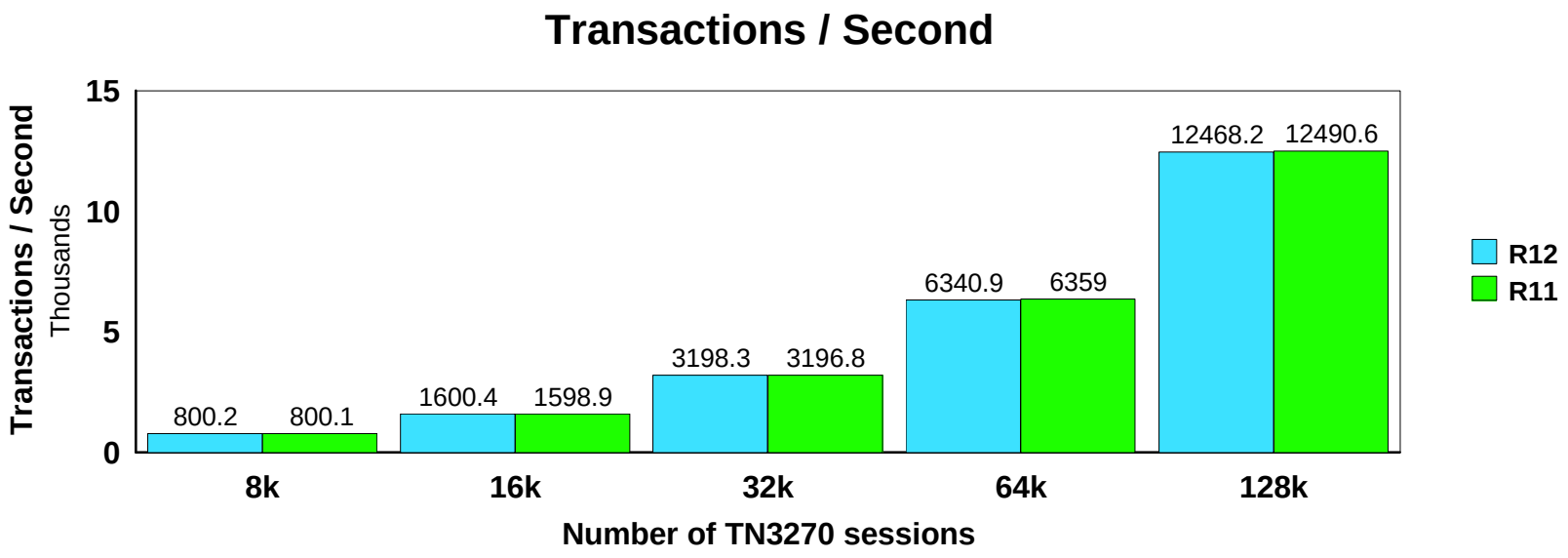
IPv4 FTP Server Detailed Performance (CPU/KB)



- 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 V1R12 or V1R11

- z/OS V1R12 provides 1.69% higher to 4.94% lower CPU cost per kilobyte compared to V1R11 (Avg= 1.57% lower).

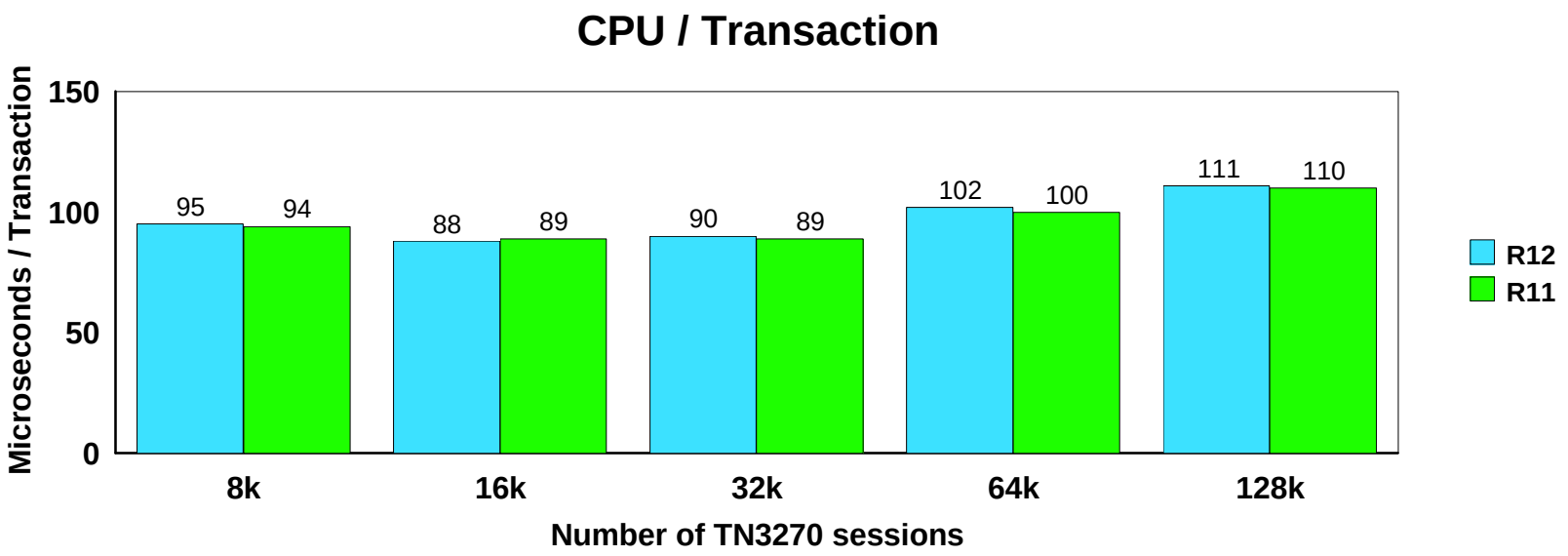
IPv4 TN3270 Server Detailed Performance (Throughput)



- 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: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides equivalent throughput compared to V1R11.

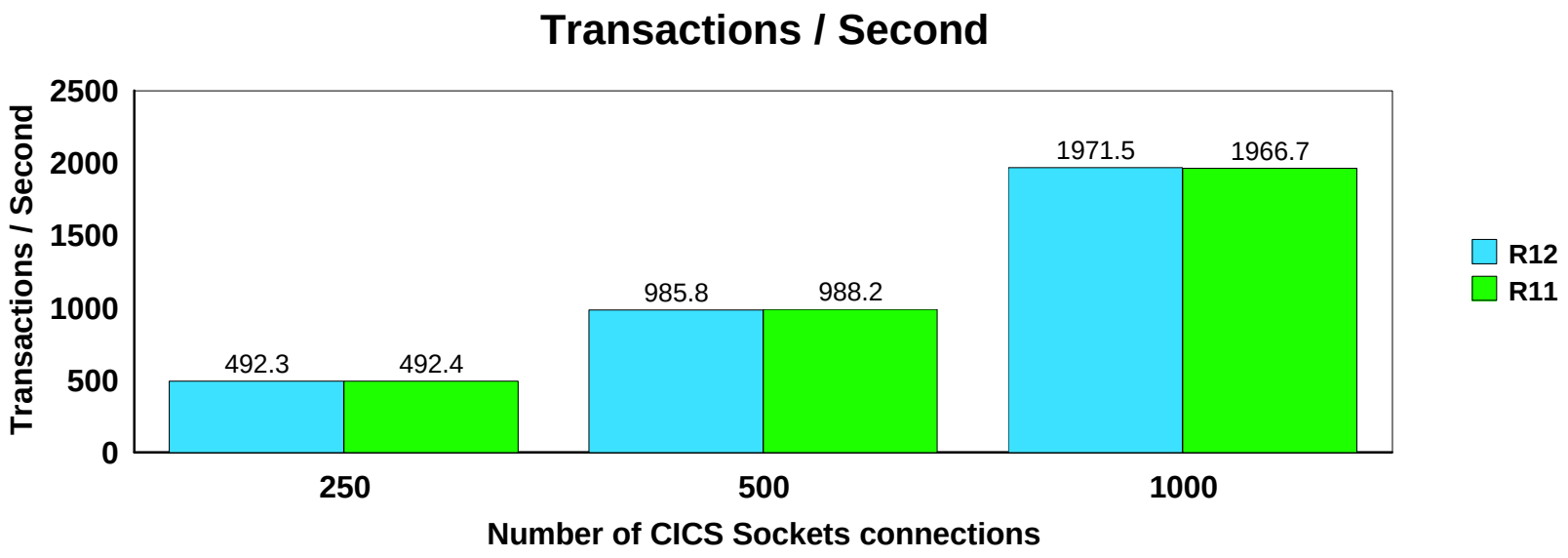
IPv4 TN3270 Server Detailed Performance (CPU/Transaction)



- TN3270 Server: 8k to 128k sessions, 10 second think time, 100 / 800
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides 1.23% higher to 0.31% lower CPU cost per transaction compared to V1R11 (Avg= 0.82% higher).

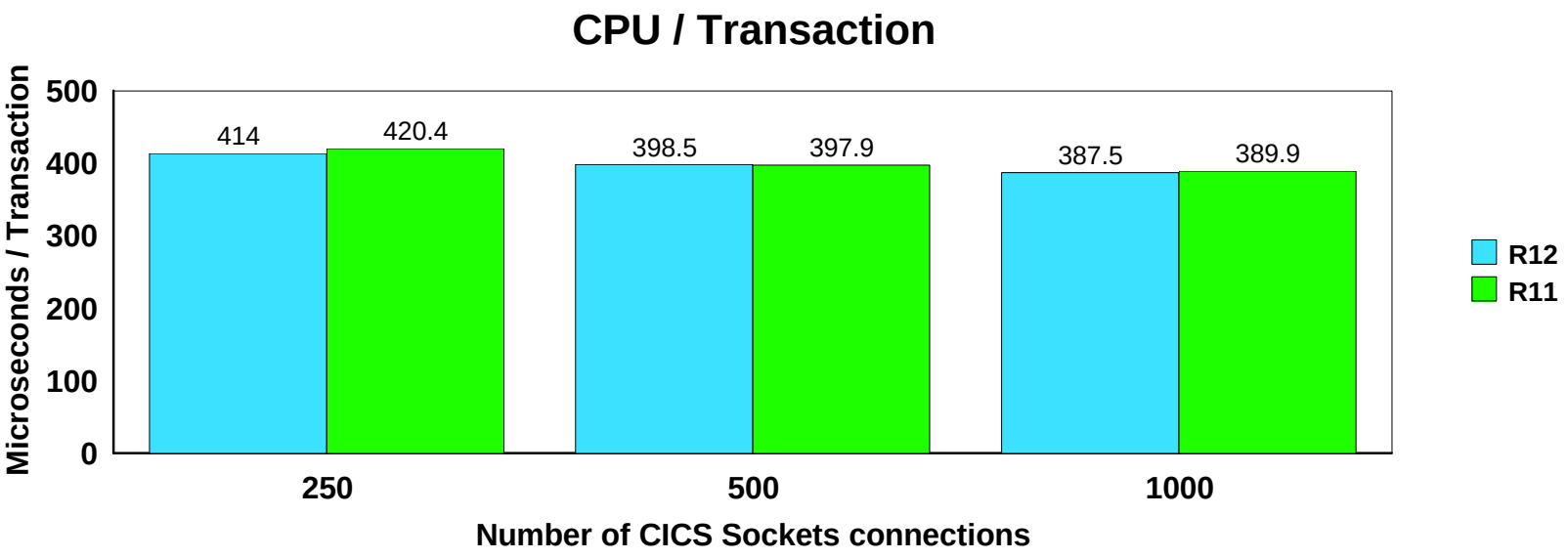
IPv4 CICS Sockets Detailed Performance (Throughput)



- 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 V1R12 or V1R11, CICS TS 4.1

- z/OS V1R12 provides equivalent throughput compared to V1R11.

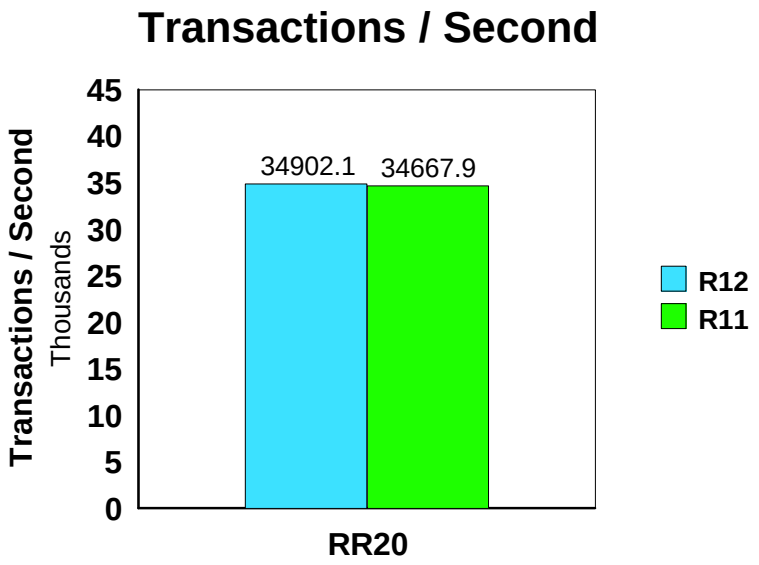
IPv4 CICS Sockets Detailed Performance (CPU/Transaction)

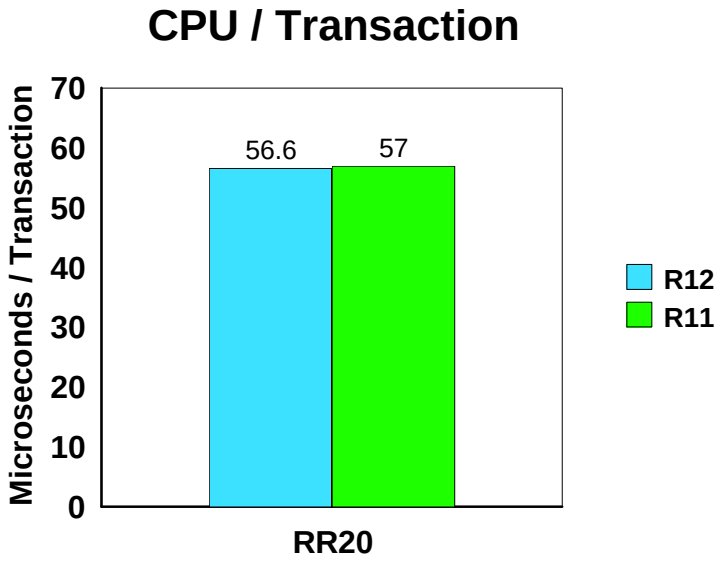


- CICS Sockets: 250 to 1000 sessions, 0.5 second think time, OTE, 200 / 200
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11, CICS TS 4.1

- z/OS V1R12 provides 0.15% higher to 1.52% lower CPU cost per transaction compared to V1R11 (Avg= 0.66% lower).

IPv4 Enterprise Extender (EE) Detailed Performance

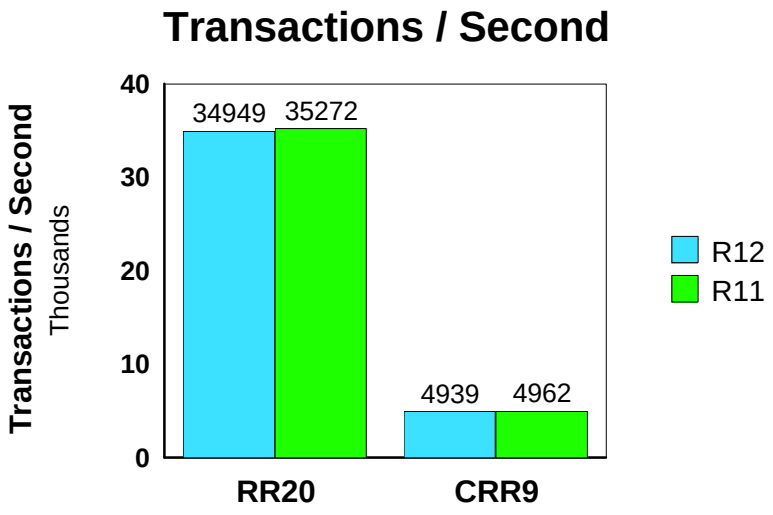


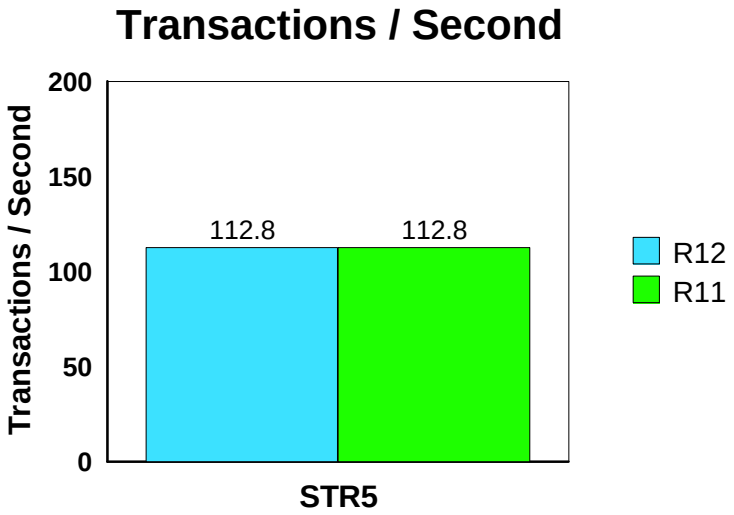


- Request-Response workload
- RR20: 20 sessions, 100 / 800
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides 0.68% higher throughput compared to V1R11.
- z/OS V1R12 provides 0.72% lower CPU cost per transaction compared to V1R11.

IPSec Detailed Performance (Throughput)

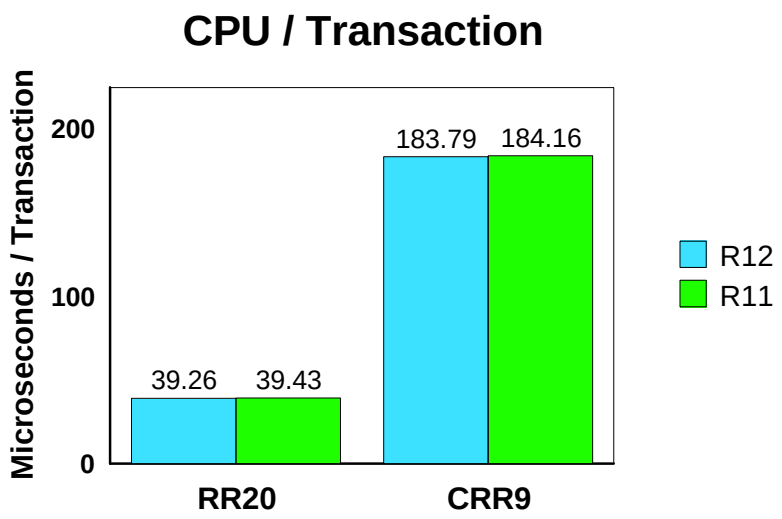


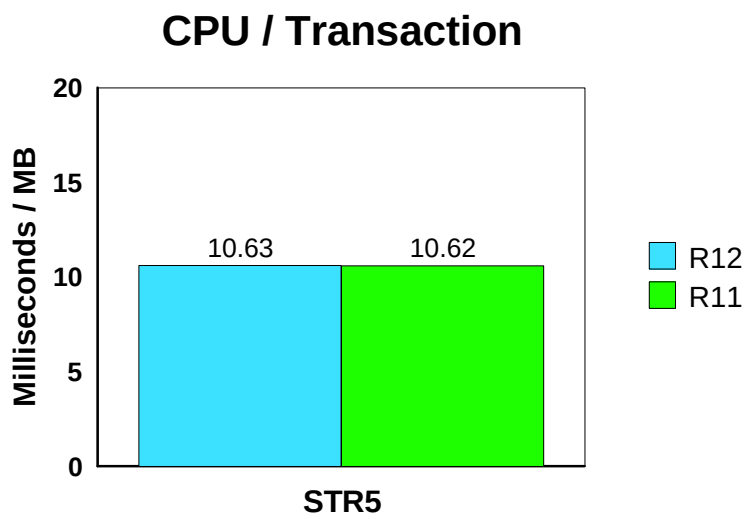


- Request-Response, Connect-Request-Response, and Streaming workloads
- RR20: 20 sessions, 100 / 800
- CRR9: 9 sessions, 64 / 8192
- STR5 (Outbound): 5 sessions (Sending 20 Mbytes / Receiving 1 byte)
- Encryption: 3DES, Authentication: SHA
- Hardware: z10 (2 CPs) using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides equivalent throughput compared to V1R11.

IPSec Detailed Performance (CPU/Transaction)

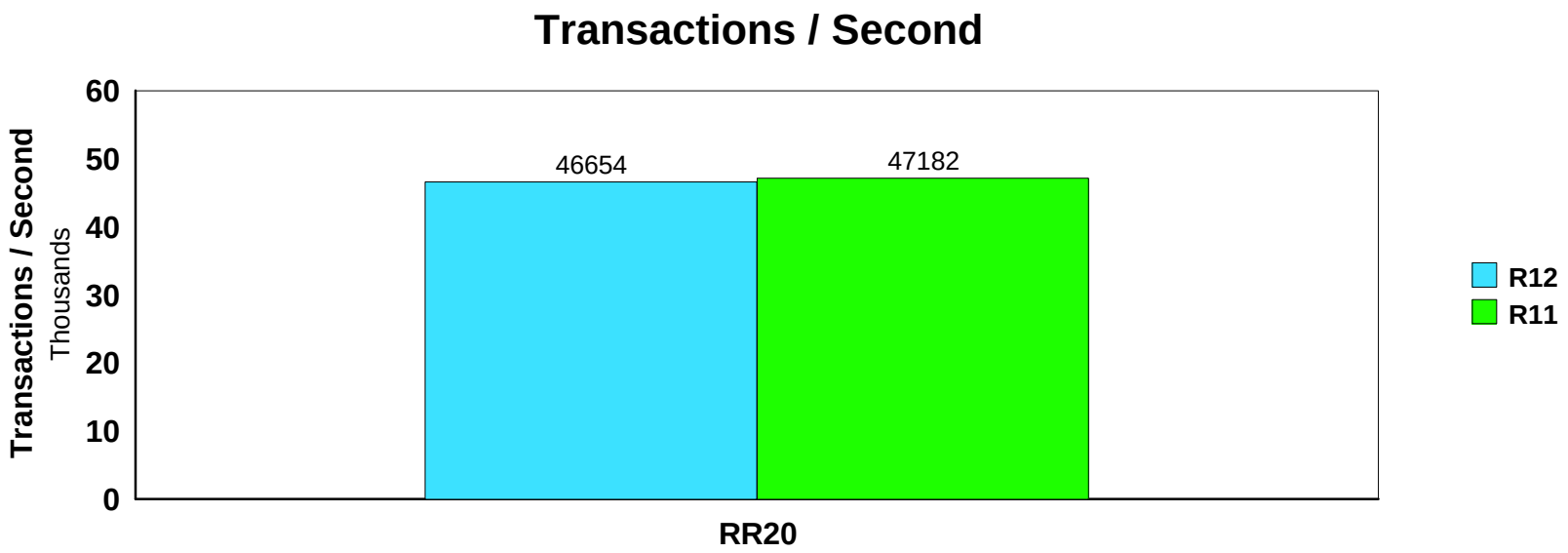




- Request-Response, Connect-Request-Response, and Streaming workloads
- RR20: 20 sessions, 100 / 800
- CRR20: 20 sessions, 64 / 8192
- STR5 (Outbound): 5 sessions (Sending 20 Mbytes / Receiving 1 byte)
- Encryption: 3DES, Authentication: SHA
- Hardware: z10 (2 CPs) using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides equivalent CPU cost per transaction compared to V1R11.

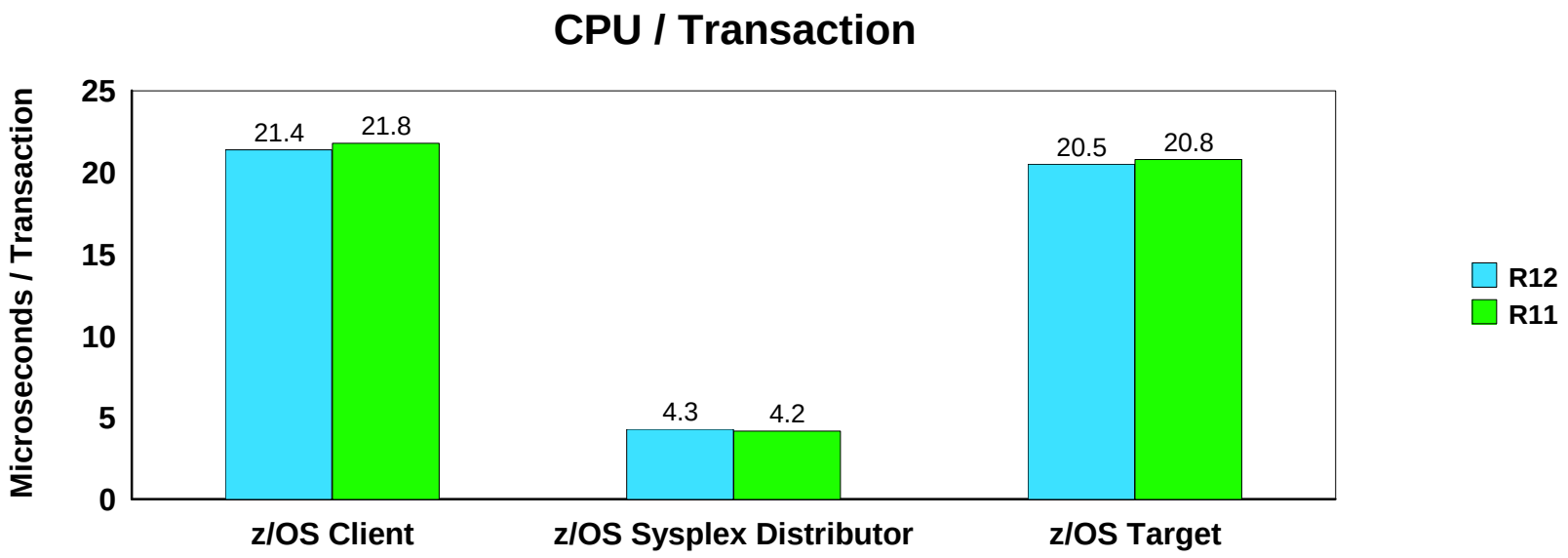
Sysplex Distributor Detailed Performance (Throughput)



- Request-Response workload
- RR20: 20 sessions, 100 / 100
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides 1.12% lower throughput compared to V1R11.

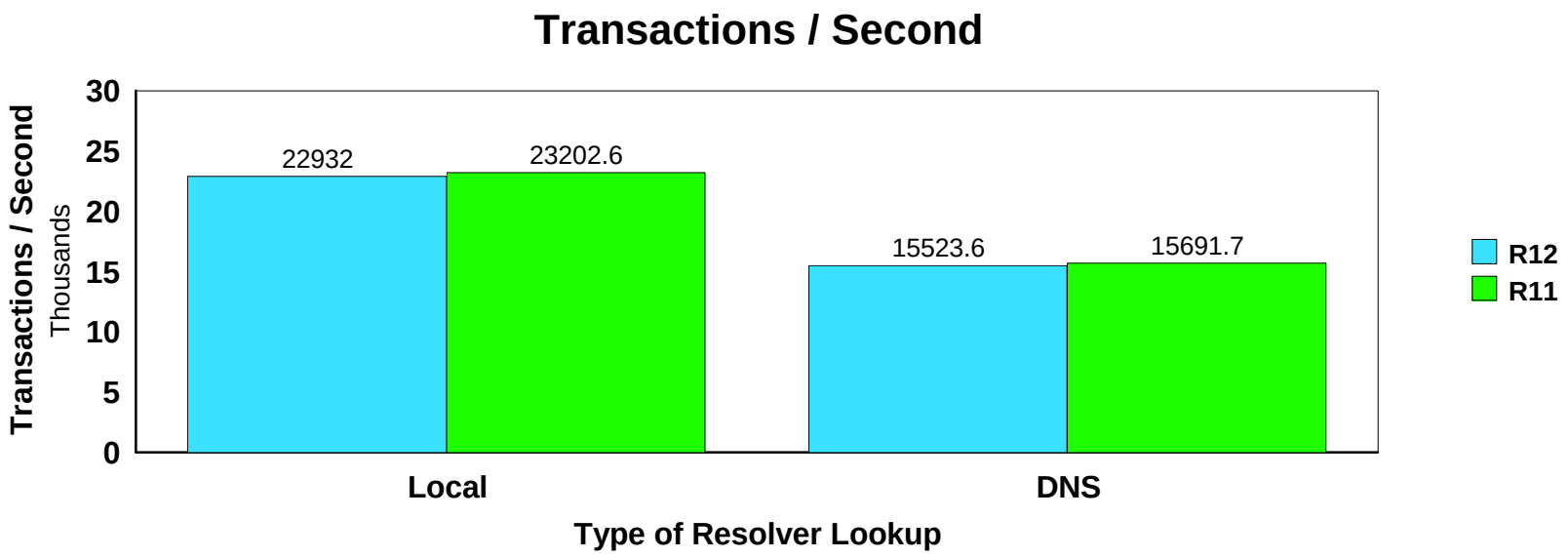
Sysplex Distributor Detailed Performance (CPU/Transaction)



- Request-Response workload
- RR20: 20 sessions, 100 / 800
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides .067% higher to 1.96% lower CPU cost per transaction compared to V1R11 (Avg= 1.09% lower).

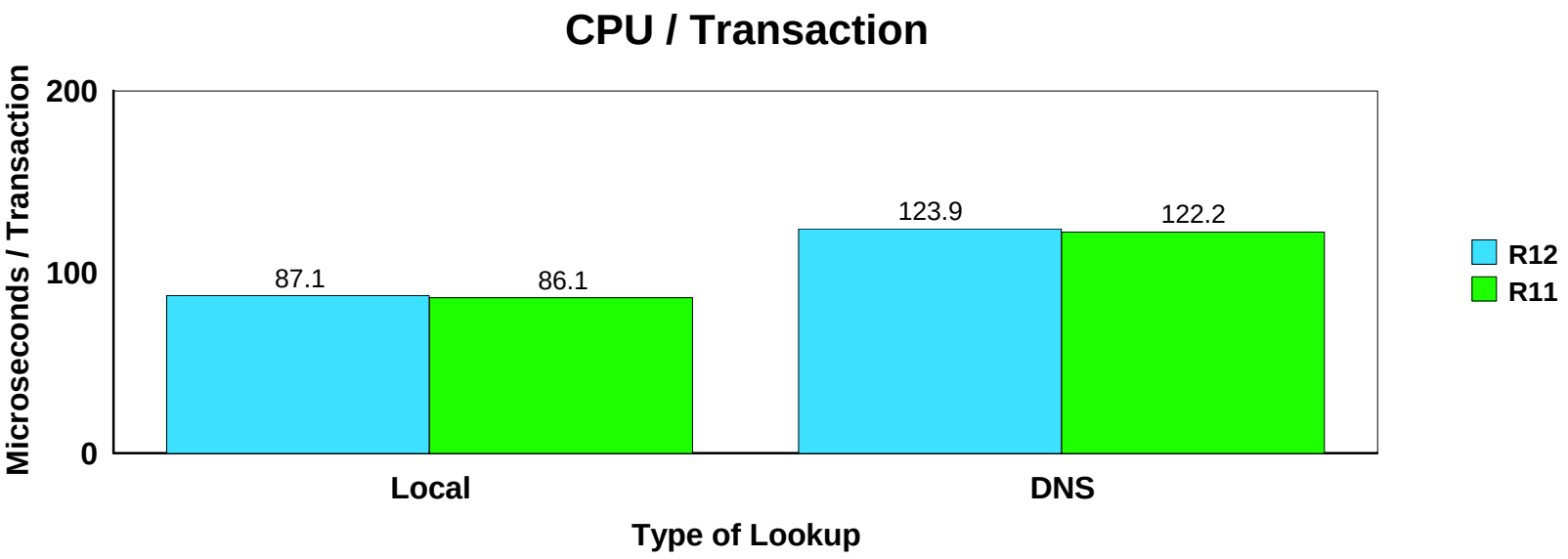
Resolver Detailed Performance (Throughput)



- Resolver Lookup: Local: Resolves IP address on local system (using IPNODES file)
  DNS: Resolves IP address on remote DNS server (Linux)
- Transaction: GETADDRINFO() and FREEADDRINFO() calls
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides 1.07 to 1.17% lower throughput compared to V1R11 (Avg= 1.12% lower).

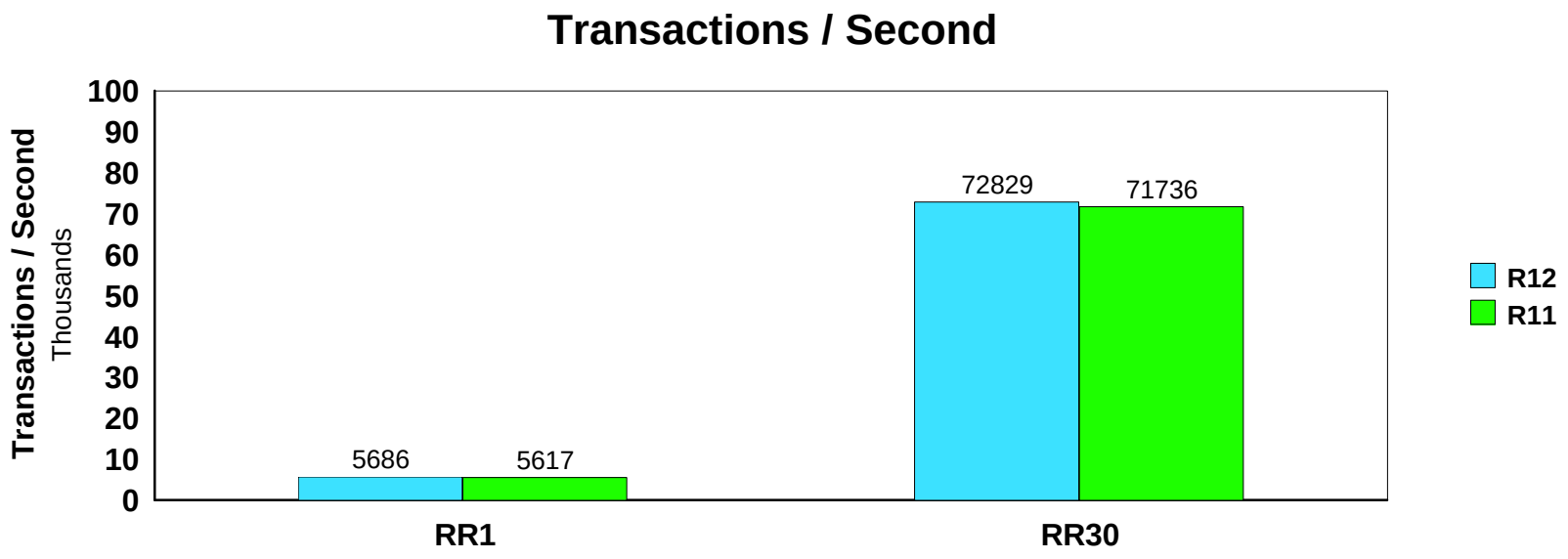
Resolver Detailed Performance (CPU/Transaction)



- Resolver Lookup: Local: Resolves IP address on local system (using IPNODES file)
  DNS: Resolves IP address on remote DNS server (Linux)
- Transaction: GETADDRINFO() and FREEADDRINFO() calls
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides 1.17 to 1.38% higher CPU cost per transaction compared to V1R11 (Avg = 1.28% higher).

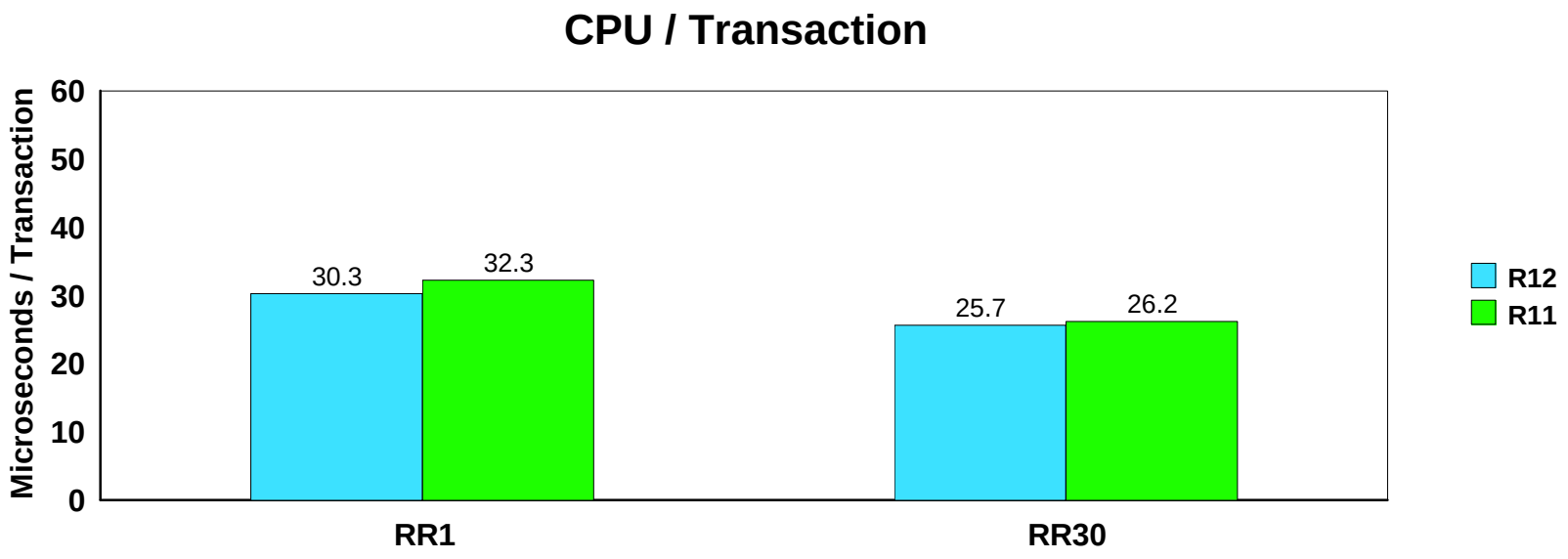
Async I/O Detailed Performance (Throughput)



- Request-Response workload
- RR1: 1 session, 100 / 100
- RR30: 30 sessions, 100 / 100
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R11 provides 1.23% lower to 1.52% higher throughput compared to V1R11 (Avg= 1.37% higher).

Async I/O Detailed Performance (CPU/Transaction)

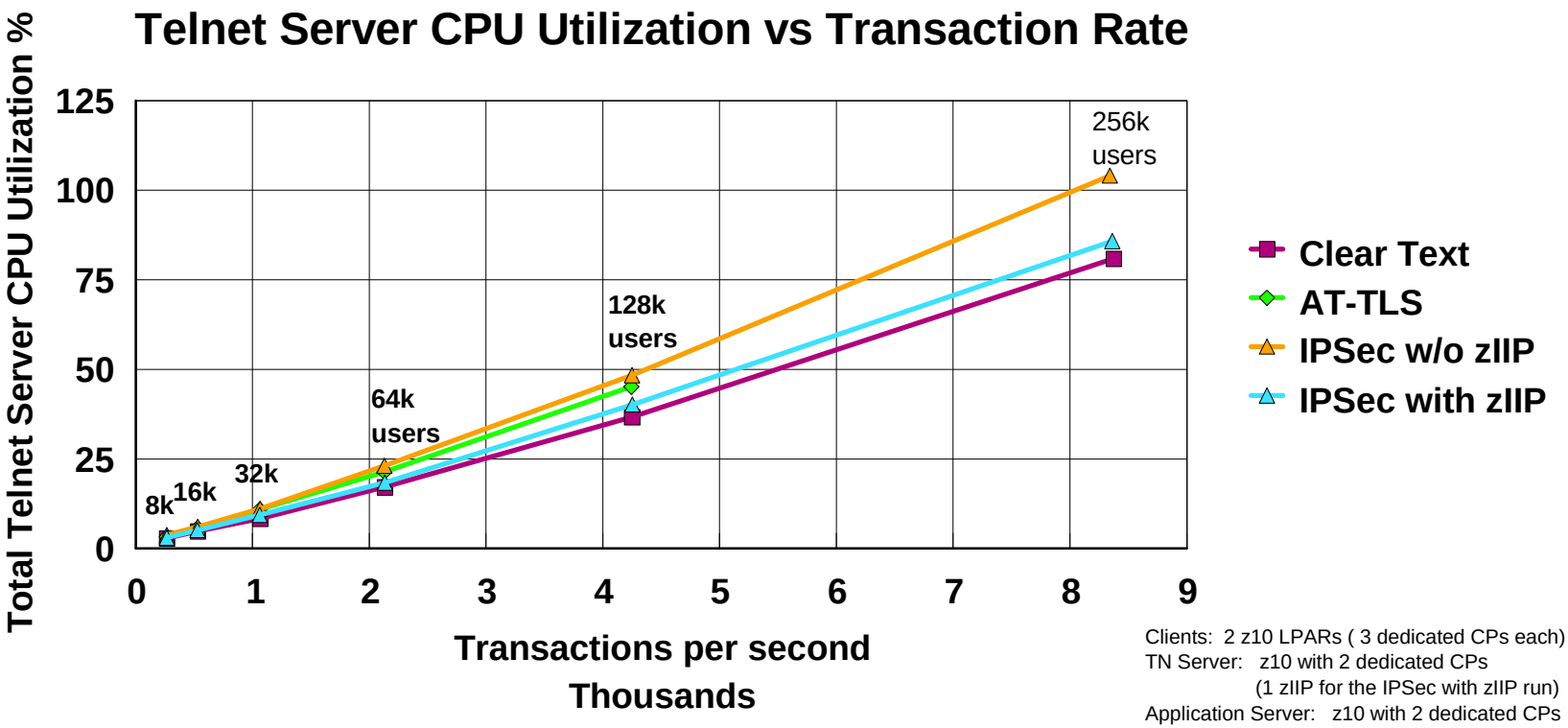


- Request-Response workload
- RR1: 1 session, 100 / 100
- RR30: 30 sessions, 100 / 100
- Hardware: z10 using OSA-E3 (1 GbE)
- Software: z/OS V1R12 or V1R11

- z/OS V1R12 provides 1.84% higher to 6.01% lower CPU cost per transaction compared to V1R11 (Avg= 2.92% lower).

z/OS CS V1R12
Capacity Planning

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

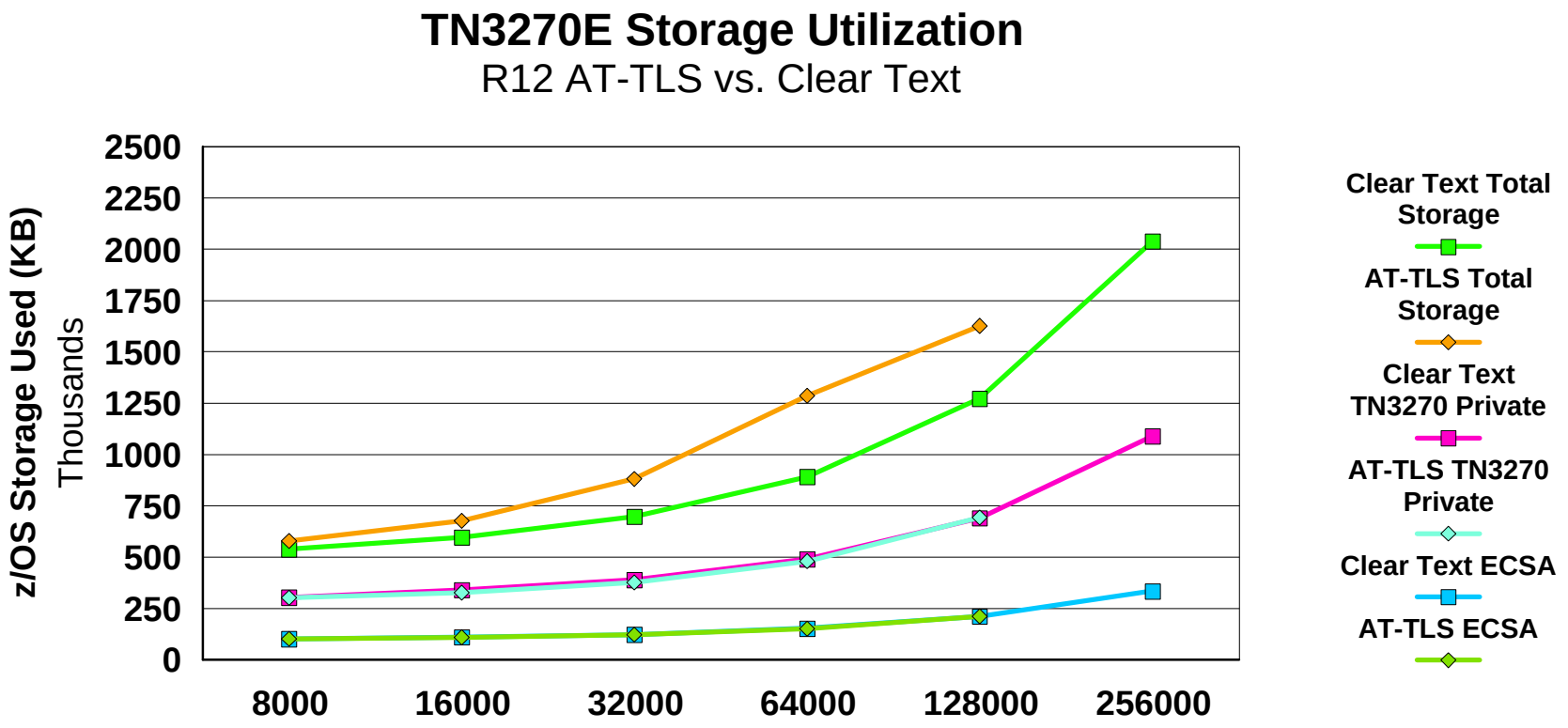


Clients: 2 z10 LPARs (3 dedicated CPs each)
TN Server: z10 with 2 dedicated CPs
(1 zIIP for the IPSec with zIIP run)
Application Server: z10 with 2 dedicated CPs
Connectivity: OSA-E3 1 GbE and SNA MPC
Transaction: 100 / 800 bytes
Think time: 30 seconds
Number of sessions: 8000 to 256000
Encryption / 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 15.3 to 29.6% higher (Avg= 22.4% higher).
IPSec w/o zIIP vs AT-TLS CPU/Transaction delta is 2.0 to 10.6% higher (Avg= 6.4% higher).
IPSec with zIIP vs AT-TLS CPU/Transaction delta is 7.8 to 20.0% lower (Avg= 11.2% lower).

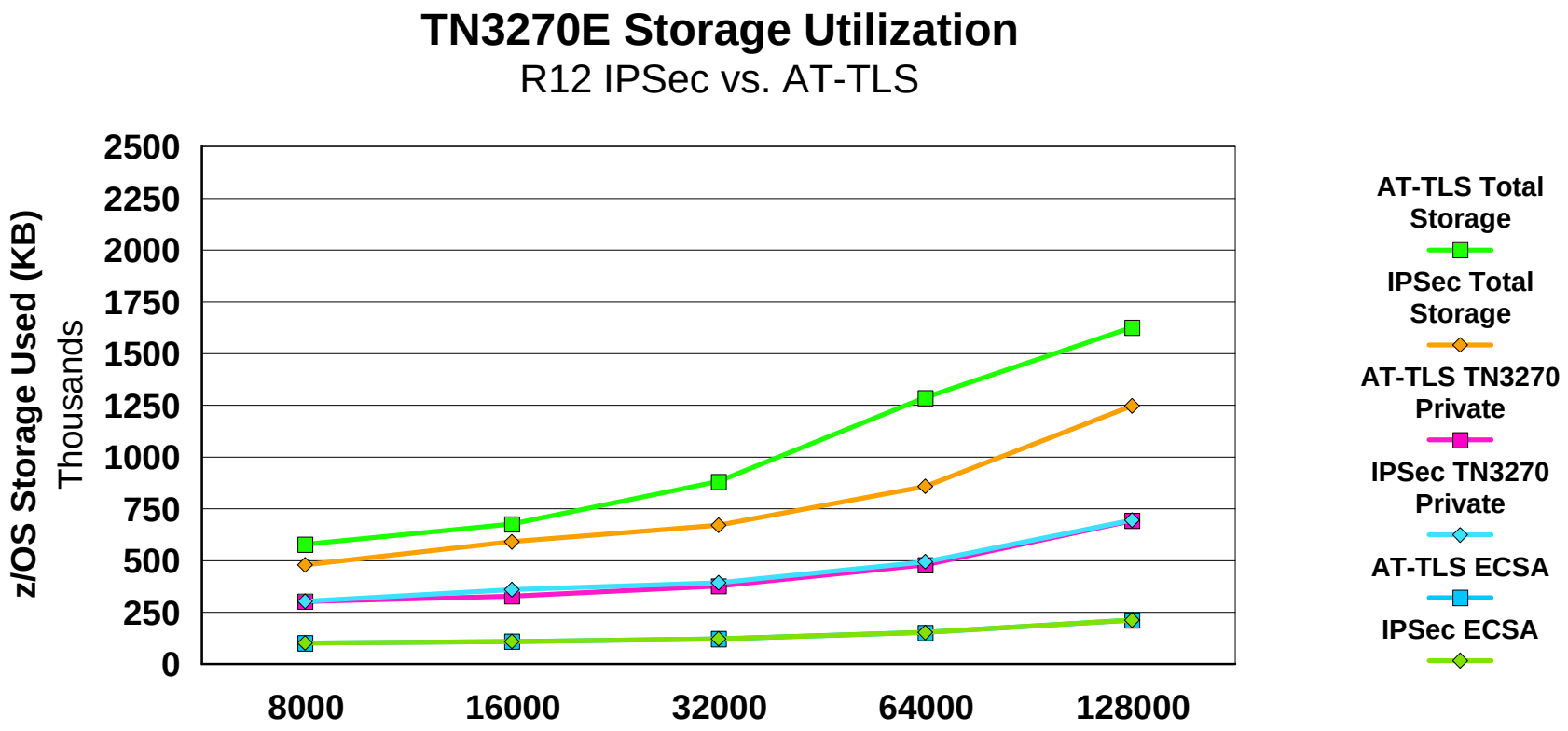
z/OS CS V1R12 TN3270E Security Performance (AT-TLS vs Clear Text)



TN3270 Server: 8k to 128k or 256k sessions, 30 second think time, 100 / 800
Hardware: z10 using OSA-E3 (1 GbE)
Software: z/OS V1R12
Connectivity (TN Server to Appl Server): SNA MPC over Ficon
AT-TLS Encryption: Triple-Des, AT-TLS Authentication: SHA

z/OS V1R12 AT-TLS uses 7 to 44% more Total Storage compared to Clear Text (Avg= 24% more).

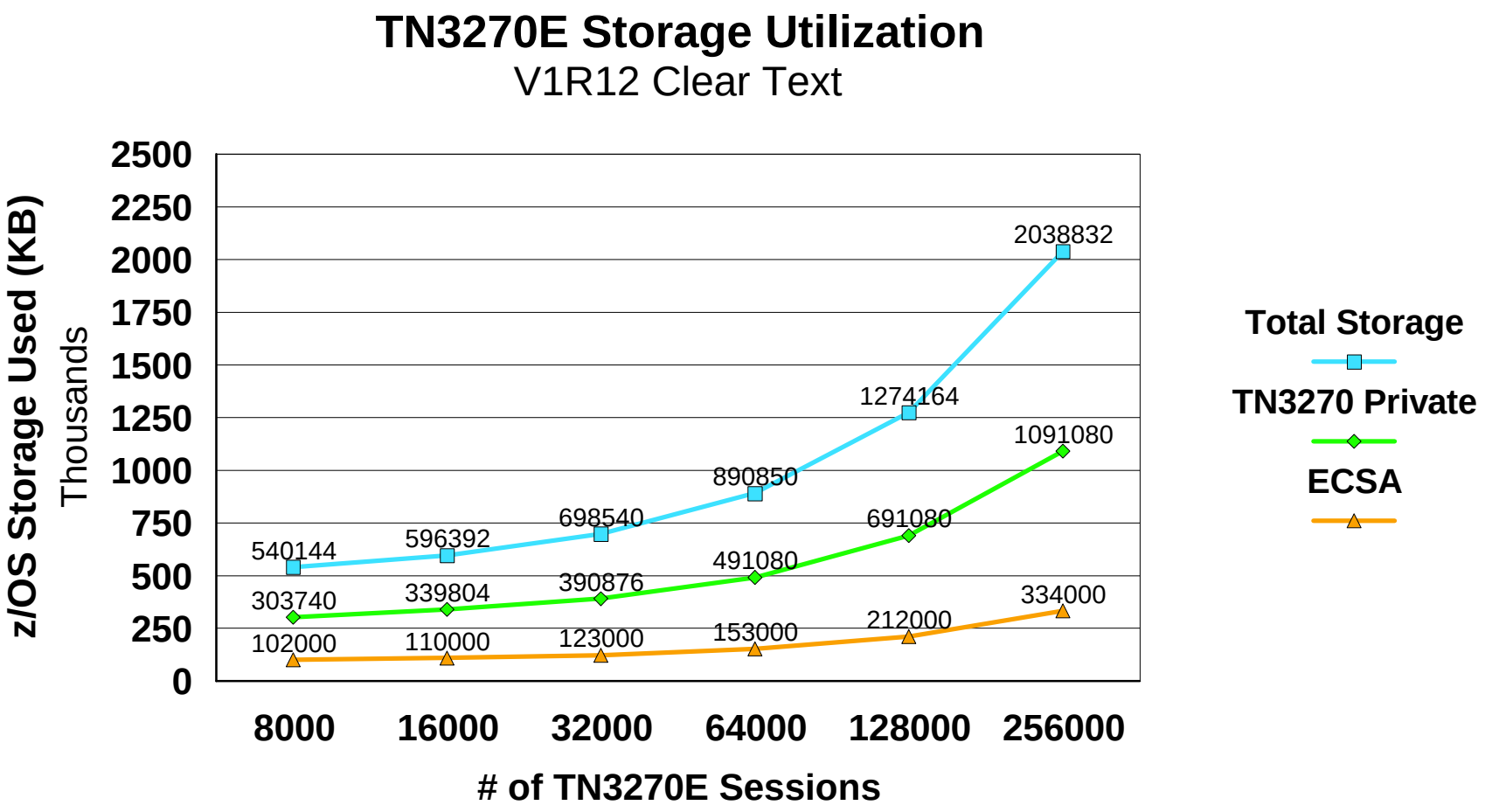
z/OS CS V1R12 TN3270E Security Performance (IPSec vs AT-TLS)



TN3270 Server: 8k to 256k sessions, 30 second think time, 100 / 800
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 V1R12 IPSec uses 13 to 24% less Total Storage compared to AT-TLS (Avg= 22% less).

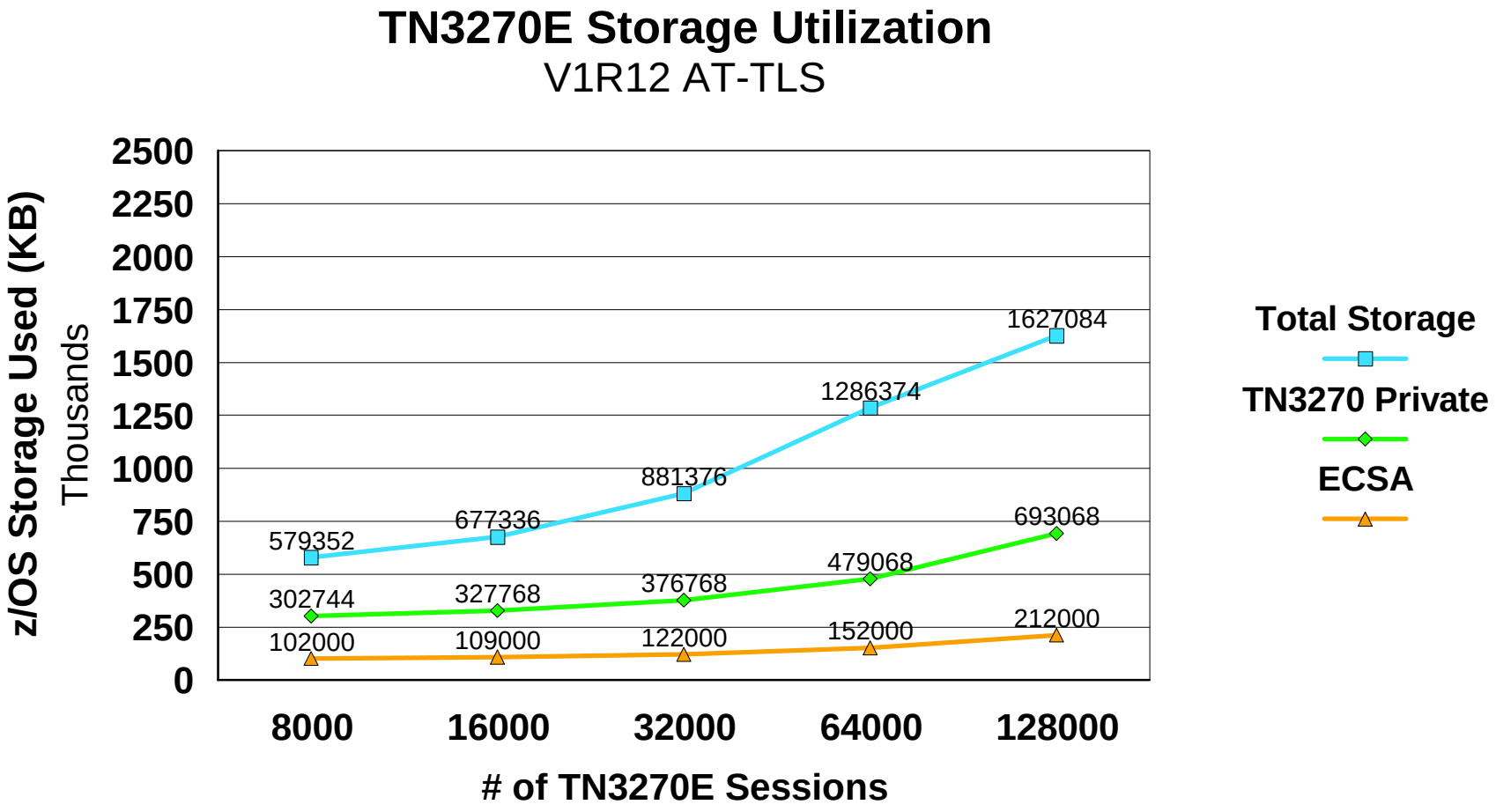
TN3270 Storage Summary (no security)



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	18,900	18,900	18,900	18,900	18,900	18,900
TCP/IP LSQA/SWA/229/230 Below	200	200	200	200	200	204
TCP/IP LSQA/SWA/229/230 Above	46,100	60,900	91,000	151,000	273,000	515,000
TN3270 Below	464	480	528	528	528	528
TN3270 Above	3,996	4,004	4,028	4,028	4,028	4,028
TN3270 LSQA/SWA/229/230 Below	280	320	320	524	524	524
TN3270 LSQA/SWA/229/230 Above	299,000	335,000	386,000	486,000	686,000	1,086,000
CSM Data Space	54,616	51,900	59,576	61,482	63,296	62,960
System CSA Below	280	180	280	280	280	280
System CSA Above	102,000	110,000	123,000	153,000	212,000	334,000
System SQA Below	280	280	280	280	280	280
System SQA Above	13,900	14,100	14,300	14,500	15,000	16,000
Total TCP/IP Private	65,328	80,128	110,228	170,228	292,228	534,232
Total TN3270 Private	303,740	339,804	390,876	491,080	691,080	1,091,080
Total Below	1,632	1,588	1,736	1,940	1,940	1,944
Total Above	538,512	594,804	696,804	888,910	1,272,224	2,036,888
Total	540,144	596,392	698,540	890,850	1,274,164	2,038,832

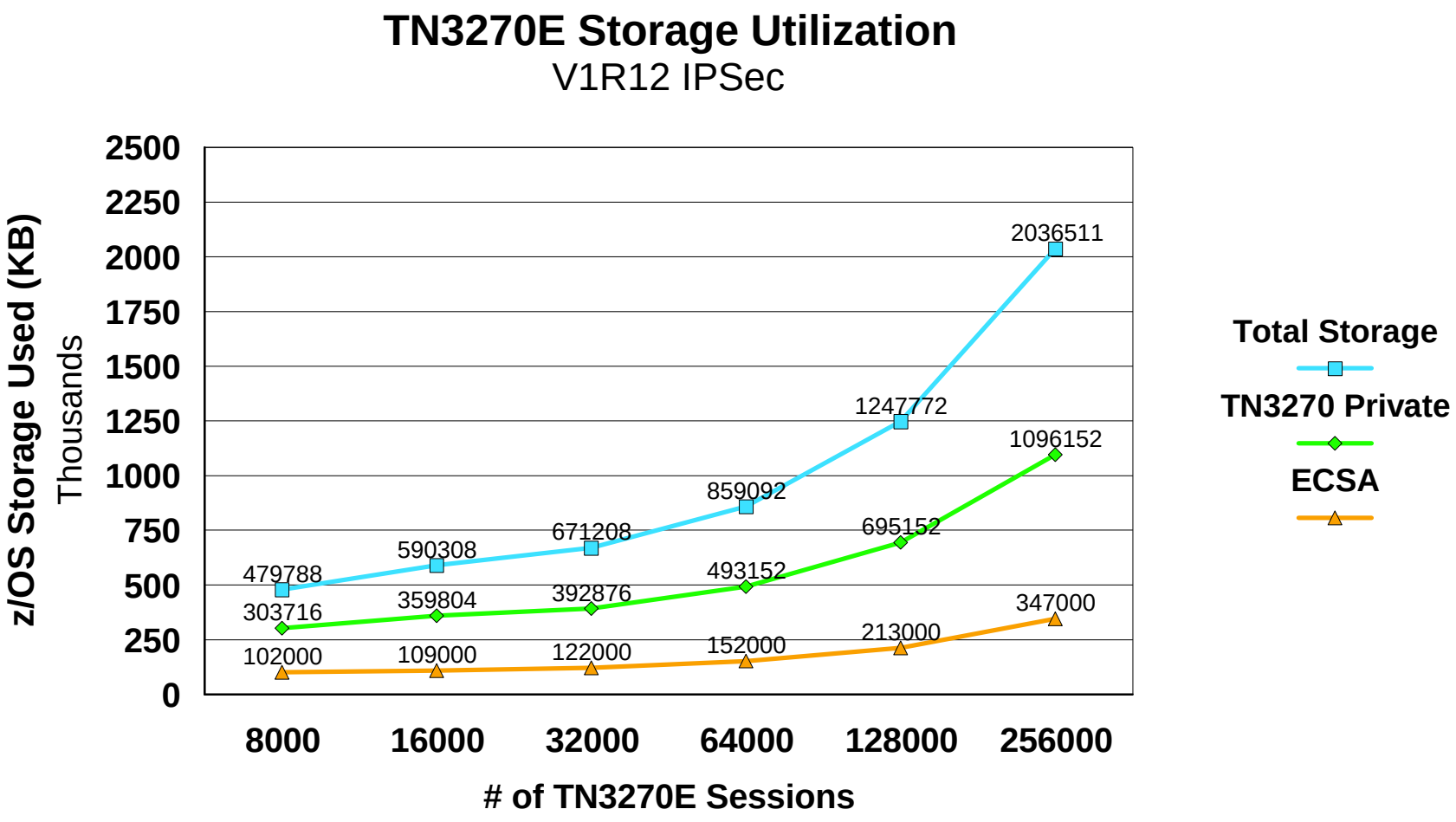
TN3270 Storage Summary (AT-TLS)



TN3270 Storage Summary (AT-TLS)

# of TN3270E Sessions	8000	16000	32000	64000	128000
TCP/IP Below	152	152	152	152	152
TCP/IP Above	24,800	24,000	25,400	25,400	25,100
TCP/IP LSQA/SWA/229/230 Below	320	320	320	322	340
TCP/IP LSQA/SWA/229/230 Above	112,000	178,000	316,000	587,000	650,000
TN3270 Below	464	480	480	512	512
TN3270 Above	3,996	4,004	4,004	4,020	4,020
TN3270 LSQA/SWA/229/230 Below	284	284	284	536	536
TN3270 LSQA/SWA/229/230 Above	298,000	323,000	372,000	474,000	688,000
CSM Data Space	22,768	23,528	26,068	27,564	30,856
System CSA Below	284	284	284	284	284
System CSA Above	102,000	109,000	122,000	152,000	212,000
System SQA Below	284	284	284	284	284
System SQA Above	14,000	14,000	14,100	14,300	15,000
Total TCP/IP Private	137,272	202,472	341,872	612,874	675,592
Total TN3270 Private	302,744	327,768	376,768	479,068	693,068
Total Below	1,788	1,804	1,804	2,090	2,108
Total Above	577,564	675,532	879,572	1,284,284	1,624,976
Total	579,352	677,336	881,376	1,286,374	1,627,084

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	528	560	560	560
TN3270 Above	3,996	4,004	4,028	4,044	4,044	4,044
TN3270 LSQA/SWA/229/230 Below	256	320	320	548	548	548
TN3270 LSQA/SWA/229/230 Above	299,000	355,000	388,000	488,000	690,000	1,091,000
CSM Data Space	27,148	29,680	34,208	31,616	35,696	45,331
System CSA Below	208	308	308	308	308	308
System CSA Above	102,000	109,000	122,000	152,000	213,000	347,000
System SQA Below	288	288	288	288	288	288
System SQA Above	14,000	14,200	14,300	14,600	15,200	16,300
Total TCP/IP Private	32,428	77,028	107,228	167,128	288,128	531,132
Total TN3270 Private	303,716	359,804	392,876	493,152	695,152	1,096,152
Total Below	1,544	1,724	1,772	2,032	2,032	2,036
Total Above	478,244	588,584	669,436	857,060	1,245,740	2,034,475
Total	479,788	590,308	671,208	859,092	1,247,772	2,036,511

TN3270 CPU Requirements Formula

z/OS CPU Requirements:

```
# trans/user x # users x CPU secs/tran      CPU secs
---------------------------------------------------- =  --------------
Elap secs                                              Elap secs
```

Example: z/OS V1R12, 8000 users, 6 tr/min/user (**data from page 47**)

```
6 trans/user x 8000 users x 0.000095 CPU secs/tr (N1)      0.0760 CPU secs
-------------------------------------------------------------------------- =  -----------------------
60 Elap secs                                                                     1 Elap secs
```

N1: z/OS TCP/IP + VTAM + TN3270 address spaces (z10, 2097-E64 two CP LPAR); CPU cost per transaction data is from the TN3270 benchmark on page 47.

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

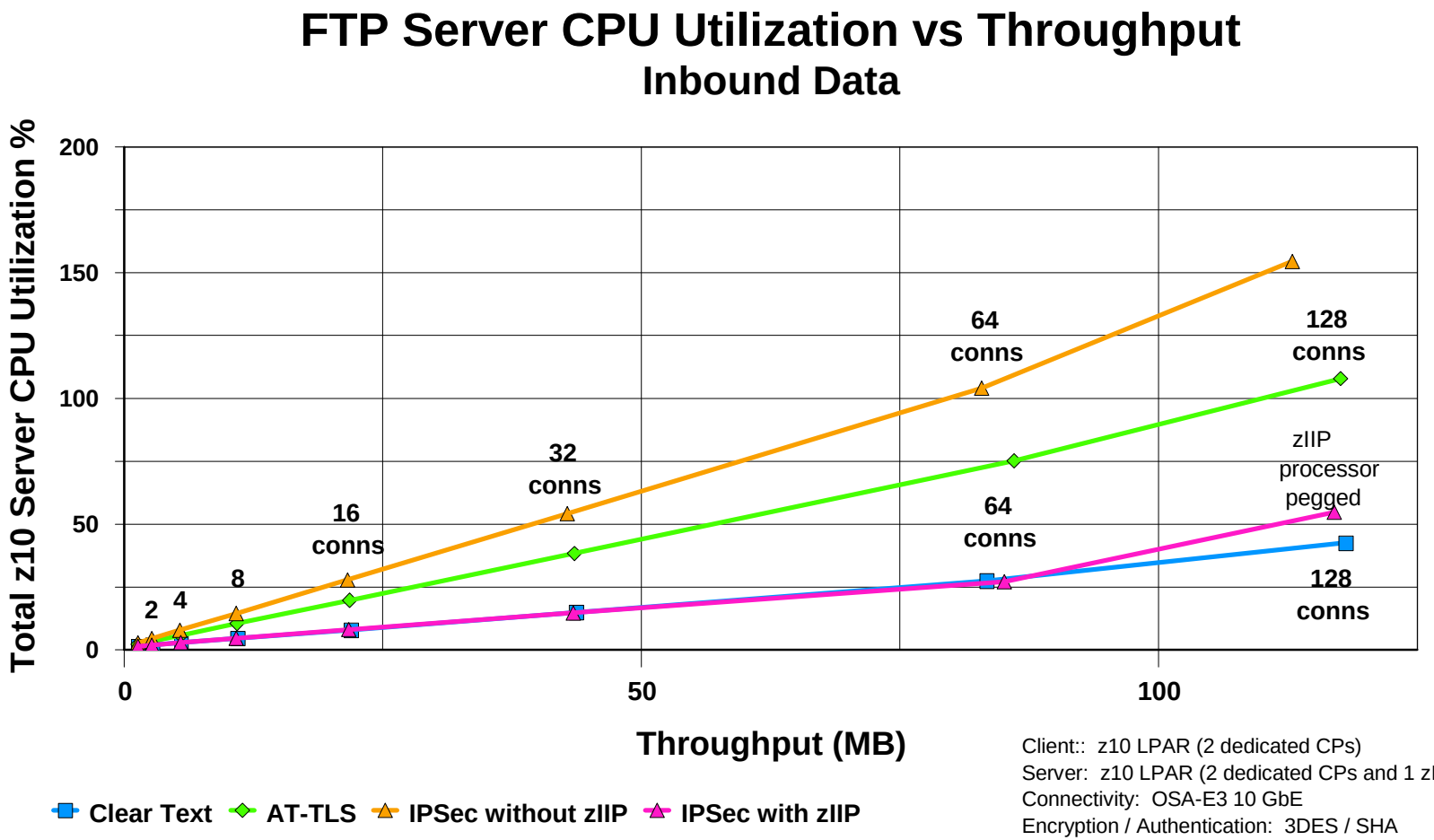
Example: z/OS V1R12, 8000 users, 6 tr/min/user (**data from page 69**)

0.0760 CPU secs/Elap secs
---------- x 100% = 3.8%
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 2097-E64 LPAR.

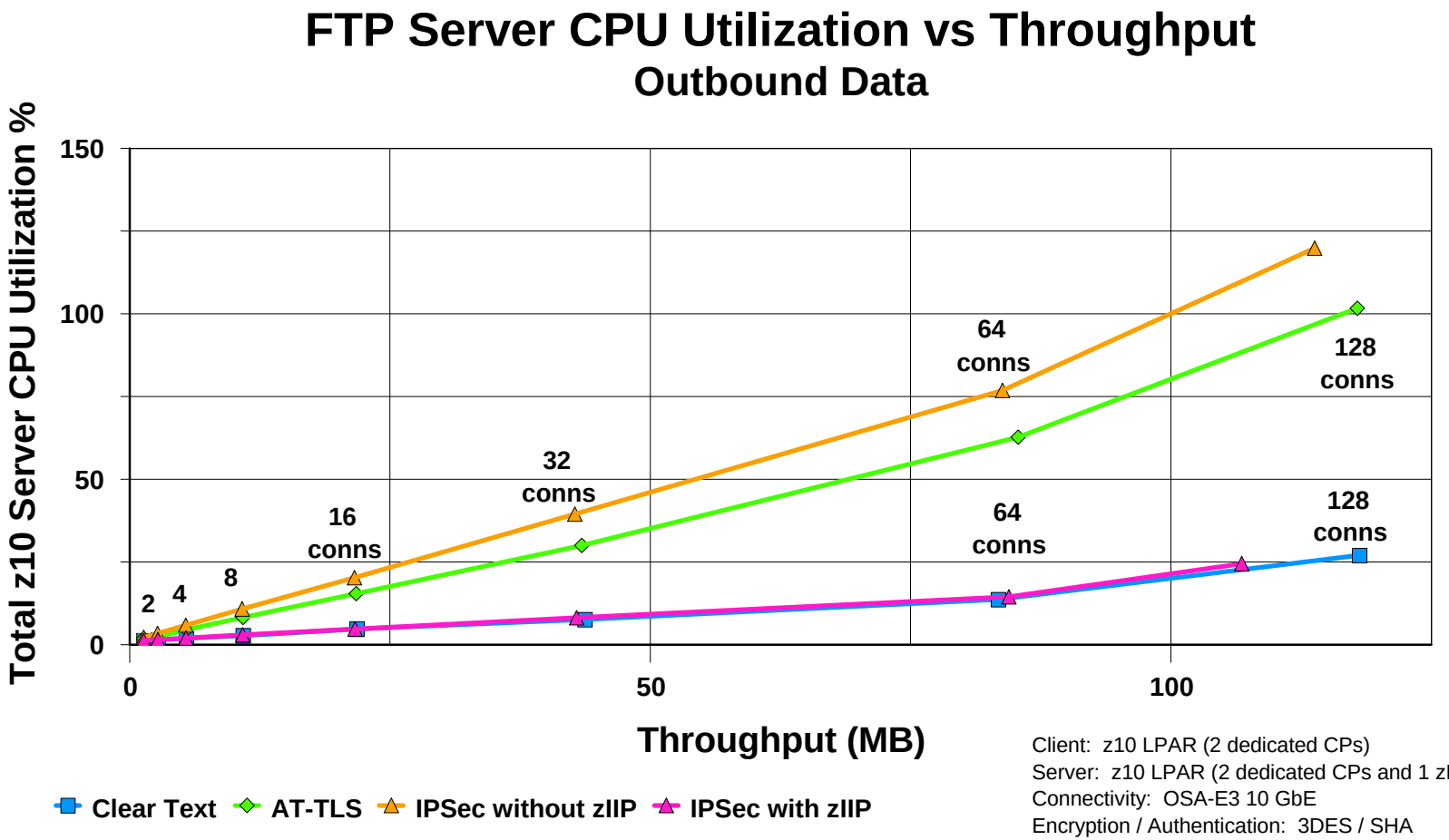
LSPR can be used to adjust for other processors types.

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



Client:: z10 LPAR (2 dedicated CPs)
Server: z10 LPAR (2 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 V1R12 FTP Security Performance (IPSec vs AT-TLS vs Clear Text)



Client: z10 LPAR (2 dedicated CPs)
Server: z10 LPAR (2 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 CPU Requirements Formula

z/OS CPU Requirements:

```
Max KB        CPU secs      CPU secs
------------- x ------------- = ---------------
Elap secs     KB              Elap secs
```

Example: (**data from the FTP Server Benchmark on page 44 and 45**)

110.8 MB/sec; Work Station --> z/OS, Binary Put, 20 MB file, z/OS V1R12, OSA-E3 GbE

```
113459.2 KB     .00000165 (N1)     0.187 CPU secs
----------------- x -------------------- = ---------------------
1 Elap secs          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 45.

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 73**)

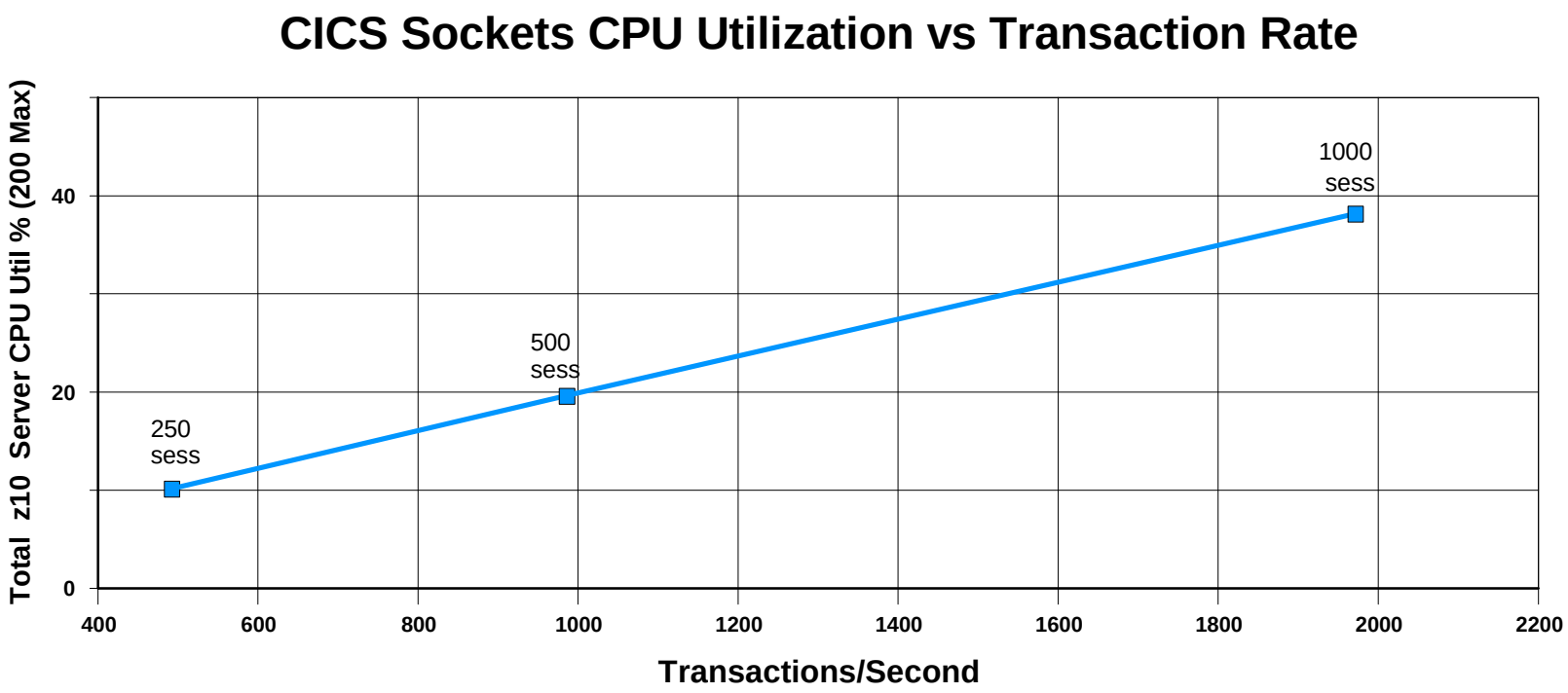
110.8 MB/sec; Work Station --> z/OS, Binary Put, z/OS V1R12, OSA-E3 GbE

0.165 CPU secs/Elap secs
---------- x 100% = 8.25%
2 processors

Thus, the CPU requirement for z/OS TCP/IP + VTAM + FTP address spaces for this FTP Binary PUT is 11.3 % of a two processor 2097-E64 LPAR.

LSPR can be used to adjust for other processors types.

z/OS V1R12 CICS Sockets Performance



z/OS V1R12, z10, OSA-E3

Clients: 5 Linux WS (x330, SLES 10 SP2),
Server: z10 (2 Dedicated CPs, OSA-E3),
z/OS V1R11, CICS TS 4.1
Transaction: Connect, 200 bytes in / 200 bytes out, Disconnect
Number of sessions: 250 to 1000
Think Time: 500 milliseconds
CICS Sockets Parms (OTE): NTASKS=000, DPRTY=000, SMSGSUP=YES, OTE=YES, TRACE=NO, BACKLOG=999, NUMSOCK=100
Driver Tool: AWM

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	492.3 Trans/Sec 985.8 1971.5	1.08 MB 1.14 MB 1.13 MB	30.92 30.23 30.26	38.84 MB 38.84 38.84
TN3270 (z10 with Think Time, Echo transactions, 100 / 800)	8000 16000 32000 64000 128000 256000	266.6 Trans/Sec 532.7 1065.1 2132.2 4249.7 8378.8	776 KB 2.81 MB 3.30 3.46 3.12 5.30	54.62 MB 51.90 59.58 61.45 60.19 62.96	65.53 MB 86.87 86.87 43.63 66.87 94.41
FTP Inbound Data Binary Put (z10, with and without Think Time, transaction= 2 MB / 1)	1 2 4 8 16 32 64 128	1.38 MB/Sec 2.75 5.50 10.99 21.95 43.70 83.41 118.09	800 KB 804 776 800 836 888 960 1.11 MB	30.62 MB 30.60 30.38 31.23 31.36 32.35 31.90 36.04	39.96 MB 39.96 39.96 41.04 41.44 41.44 41.16 48.59
FTP Outbound Data Binary Get (z10, with and without Think Time, transaction = 1 / 2 MB)	1 2 4 8 16 32 64 128	1.36 MB/Sec 2.73 5.46 10.92 21.61 43.44 85.26 118.54	836 KB 836 1.15 MB 1.02 1.80 2.38 8.29 24.91	30.40 MB 30.32 30.29 31.32 31.50 32.41 36.73 38.38	39.96 MB 39.96 40.32 41.44 41.40 42.16 49.49 71.55

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	492.3 Trans/Sec	5	5	54	28	3
	500	985.8	5	5	54	28	3
	1000	1971.5	5	5	54	28	3
TN3270 (z10 with Think Time, Echo transactions, 100 / 800)	8000	266.6 Trans/Sec	260	8003	1677	443	13
	16000	532.7	307	16003	1677	443	19
	32000	1065.1	424	32003	1677	447	19
	64000	2132.2	1124	64003	1677	1284	20
	128000	4249.7	3157	128003	1677	3699	26
	256000	8373.8	8050	256003	1677	9063	101
FTP Inbound Data Binary Put (z10, with and without Think Time, transaction= 2 MB / 1)	1	1.38 MB/Sec	5	4	2	28	4
	2	2.75	5	4	2	28	4
	4	5.50	5	4	2	28	4
	8	10.99	5	4	2	28	4
	16	21.95	5	4	2	28	4
	32	43.70	5	4	2	28	4
	64	83.41	1	3	1	28	4
	128	118.09	1	3	1	28	4
FTP Outbound Data Binary Get (z10, with and without Think Time, transaction = 1 / 2 MB)	1	1.36 MB/Sec	4	4	2	28	4
	2	2.73	5	4	2	28	4
	4	5.46	5	4	2	28	4
	8	10.92	5	4	2	28	4
	16	21.81	5	4	2	28	4
	32	43.44	5	4	2	28	4
	64	85.26	1	3	1	28	4
	128	118.54	1	3	1	28	4

Summary

z/OS CS V1R12 vs V1R11 Performance Summary by Workload

CS Workload	V1R12 Throughput relative to V1R11	V1R12 CPU/Transaction relative to V1R11
AWM Primitives (1 GbE) RR60 (100/800) CRR9 (64/8K) STR10 Server (1/20M) 10 Gb	+ 0.37 % Equivalent Equivalent	- 2.45 % Equivalent - 1.68 %
FTP Server (1 GbE)	+ 0.27 %	- 1.57 %
TN3270 Server (1 GbE)	Equal (with think time)	+ 0.82 %
CICS Sockets (1 GbE)	Equal (with think time)	- 0.66 %
Enterprise Extender	+ 0.68 %	- 0.72 %
AT-TLS RR20 (100/100) CRR20 (64/8K) STR5 (20M/1)	+ 37.86 % + 43.42 % + 23.80 %	- 31.05 % - 22.73 % - 27.40 %

- On average, z/OS V1R12 provides equivalent throughput and reduces CPU cost for all workloads.
- z/OS V1R12 AT-TLS reduces CPU cost significantly for these workloads.

Overall Summary

- z/OS Communication Server V1R12:
  - For most workloads, CPU cost per transaction will be slightly lower.
  - Significant performance improvements can be expected when using AT-TLS for all workloads.
    - AWM primitive workloads using AT-TLS increase throughput by 35% and reduce CPU cost by 27% on average.
    - TN3270 AT-TLS reduces CPU cost by 11.3%.
    - FTP AT-TLS reduces CPU cost by 24.6%.
  - QDIO Inbound Workload Queueing
    - In the lab, a peak interactive throughput boost of 84% was measured, which translates to a 46% improvement in interactive response time.
    - Our lab results show a peak throughput boost of 41% (measured for z/OS streaming outbound to AIX over 10 Gigabit Ethernet), and a reduction in per-MB CPU consumption of up to 12%.
  - TN3270E Server (Shared ACB)
    - Shared ACB provides 9% lower total ECSA storage usage compared to without the shared ACB option. The savings delta increases as the number of sessions increases.
    - The shared ACB option provides 28% lower total ECSA storage usage for 256K TN3270 sessions compared to without the shared ACB option.
  - Fast Local sockets provides significantly higher throughput when communicating with other applications in the same z/OS system.

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
http://www.ibm.com/software/network/commserver/zos/support	z/OS Communications Server Technical Support
http://www.facebook.com/IBMCommserver	z/OS Communications Server facebook page
http://twitter.com/IBM_Commserver	z/OS Communications Server on twitter
http://www-03.ibm.com/systems/z/os/zos/bkserv/r12pdf/	z/OS Communications Server product library
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