Linux for z/Series Performance Overview

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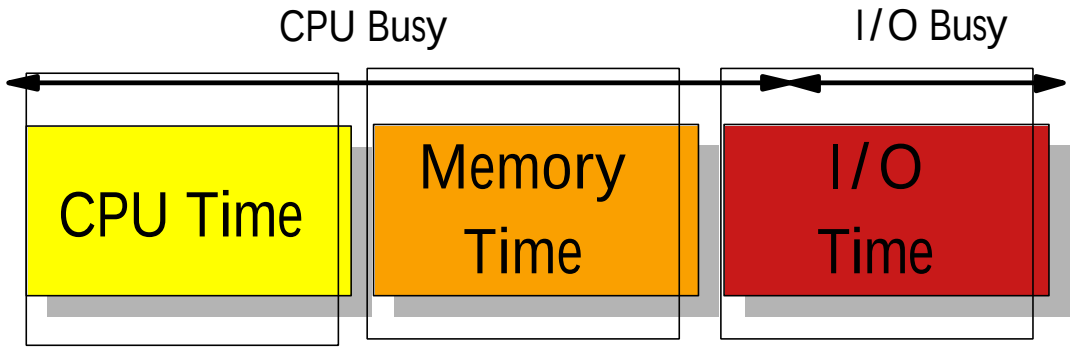
Agenda

- Relative system capacity
- z900 Hardware
- Scalability
- DASD I/O
- Networking
- Crypto
- Linux under VM

Relative System Capacity

- Components of Capacity
  - Processor
  - Memory Hierarchy
  - I/O Structure

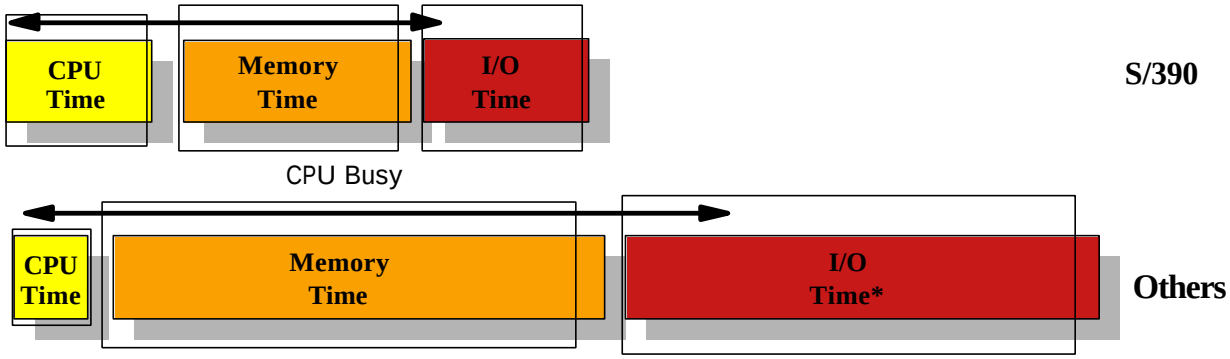


- Processor, Memory and I/O time vary greatly with application

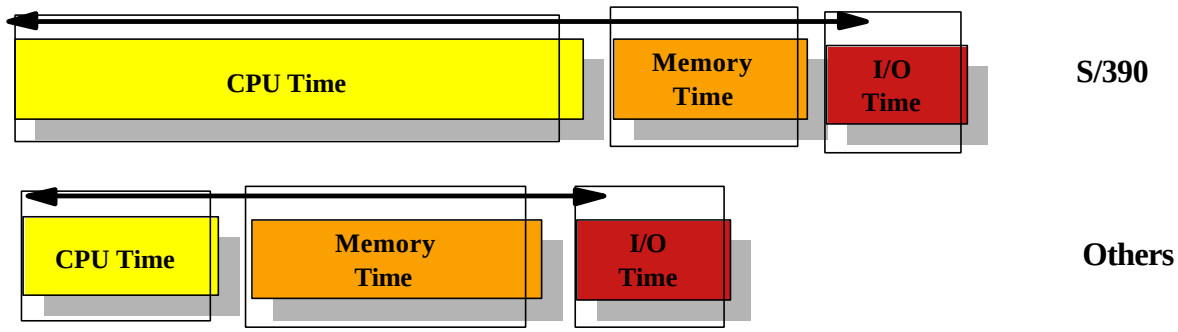
- Processor designs vary greatly in the balance of capacity across components which results in a wide range of relative capacity.

Relative System Capacity

- Data Intense work such as BI, Very Large Data Base, Classical OLTP or "cache killer" workloads (Object oriented code or context switching) will potentially run much better on S/390



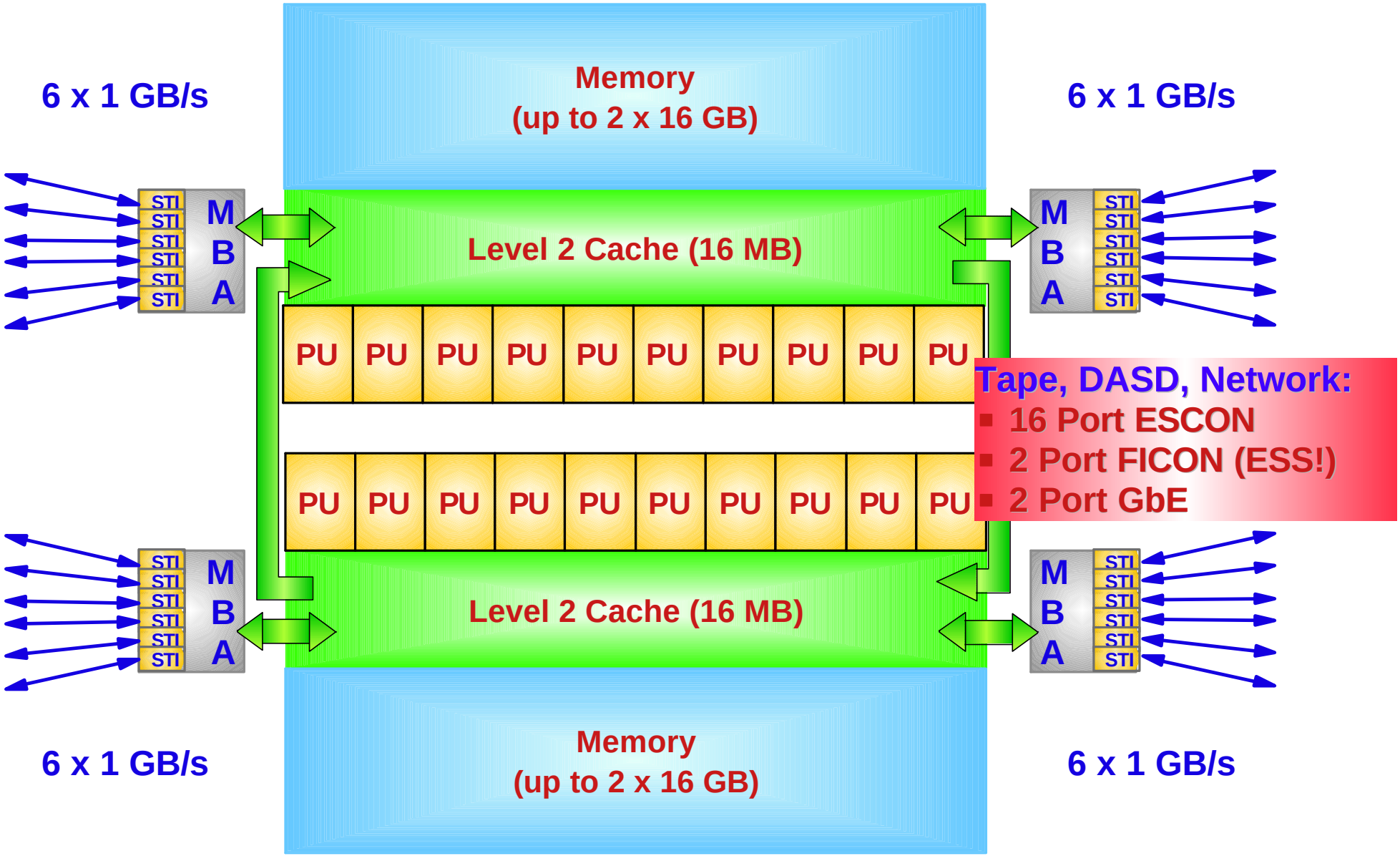
- CPU Intense work such as SPECint, Deep Computing, Graphic Rendering, will perform relatively poorly on S/390



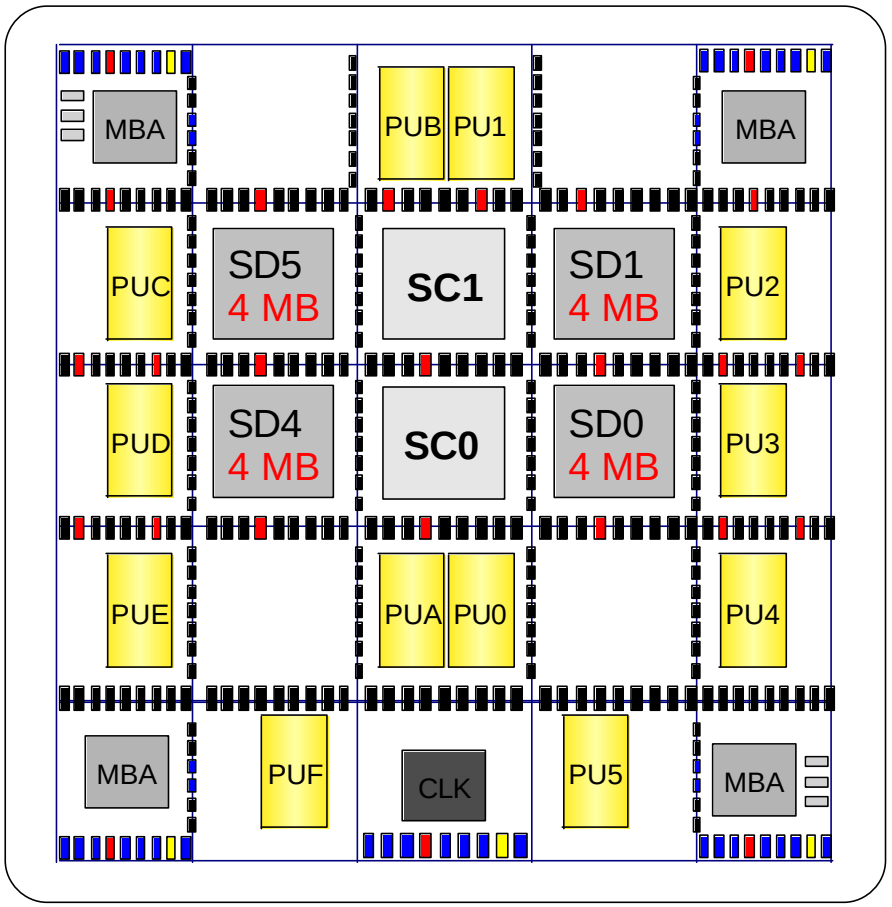
Relative System Capacity

- S/390 is not for "Deep Computing"
- Most commercial applications range between CPU and Data intensity
- z/Series is very good at "data intense" work for many users.

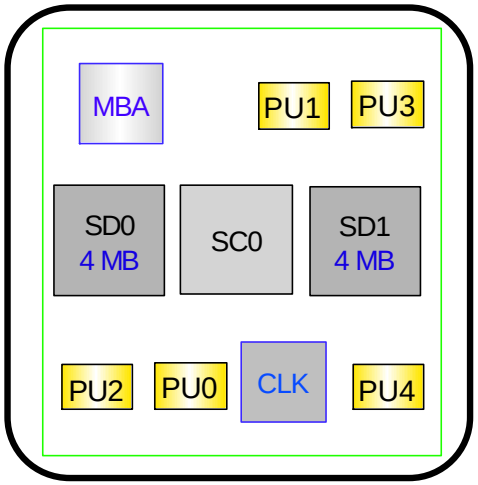
z900 Systemstructure: Optimized for maximum external bandwidth



From 2064-10x (z900) to 2066-yyy (z800)

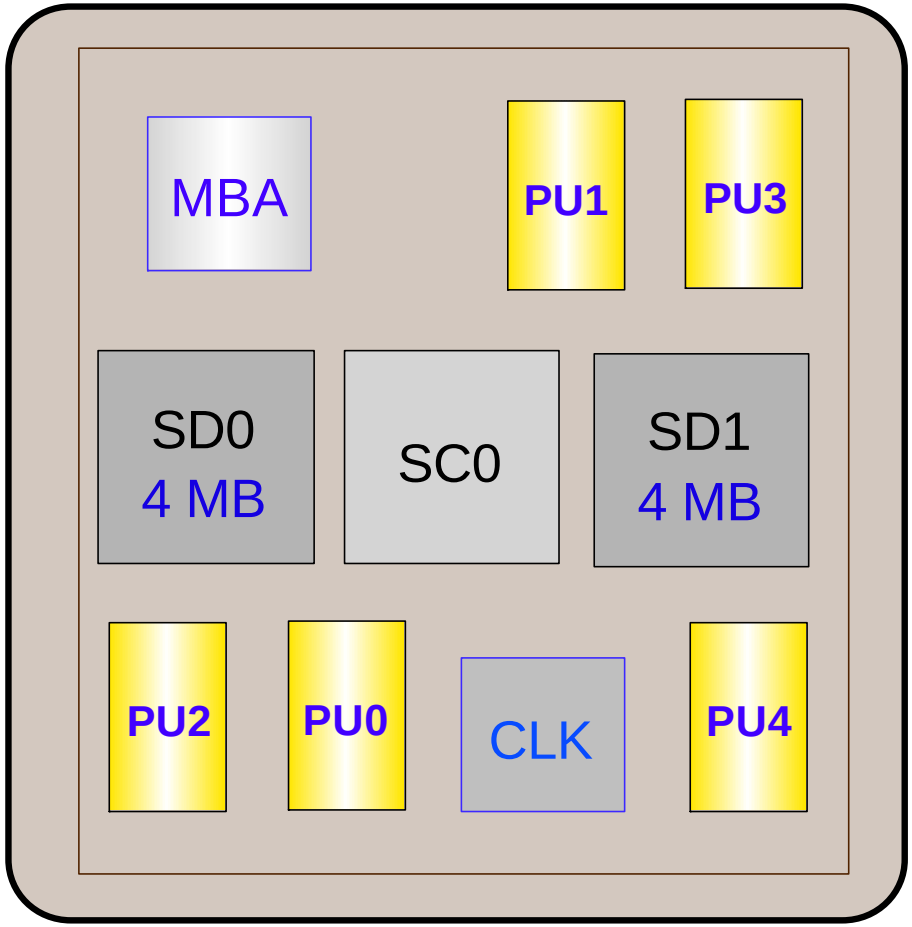


- 12 PU Chips @ 1.3 ns
- 2 SAP's, 1 spare
- Up to 9 CP's
- Up to 8(9) ICF's/IFL's



- 5 PU Chips @ 1.6 ns
- 1 SAP
- up to 4 CP's
- up to 4 ICF's/IFL's
  - Linux Only version (0LF), CF
  - 16 IO-Slots (z900 Cards)
- New Pricing-Models

2066-yyy (z800)



CMOS 8SE and 8S Technologie
- Internal Copper-wiring

10 Chips
- 5 CMOS 8SE
- 3 CMOS 8S
- 2 CMOS 7S

MCM Packaging
- 71 mm x 71 mm
- 5 Processor Units (PUs)
  - 17.9 mm x 9.9 mm
  - 44M transistors
  - L1 cache/CP
    - 256 KB I-cache
    - 256 KB D-cache
  - 1.6 ns Cycle Time
- 2 System Data (SD) Cache Chips
  - L2 Cache
    - 234M transistors
    - 4 MB/Chip, 8MB/Module
- 1 Storage Control (SC) Chip
- 1 Memory Bus Adapter (MBA) Chip
- 1 Clock (CLK) chip (7S)
- Glass-Ceramics (42 layers), Thin Film

z800 Model 0LF (announced 01/29/2002)

1 - 4 z800 Integrated Facility for Linux (IFL) Processors

- 4 Standard-Configurations:

Feature Nr.	CP's (IFL's)	SAP's	Spare	Memory (GB)	ESCON Channels	OSA-E Channels	FICON Channels
3605	1	1	3	8	28	4	4
3606	2	1	2	8	28	4	4
3607	3	1	1	16	28	4	4
3608	4	1	0	16	28	4	4

16 I/O Slots

- 16-Port ESCON channels, max. 240 ports
- FICON-Express channels, max. 32 ports
- OSA-Express, max. 24 ports
- PCICA, max. 12 ports

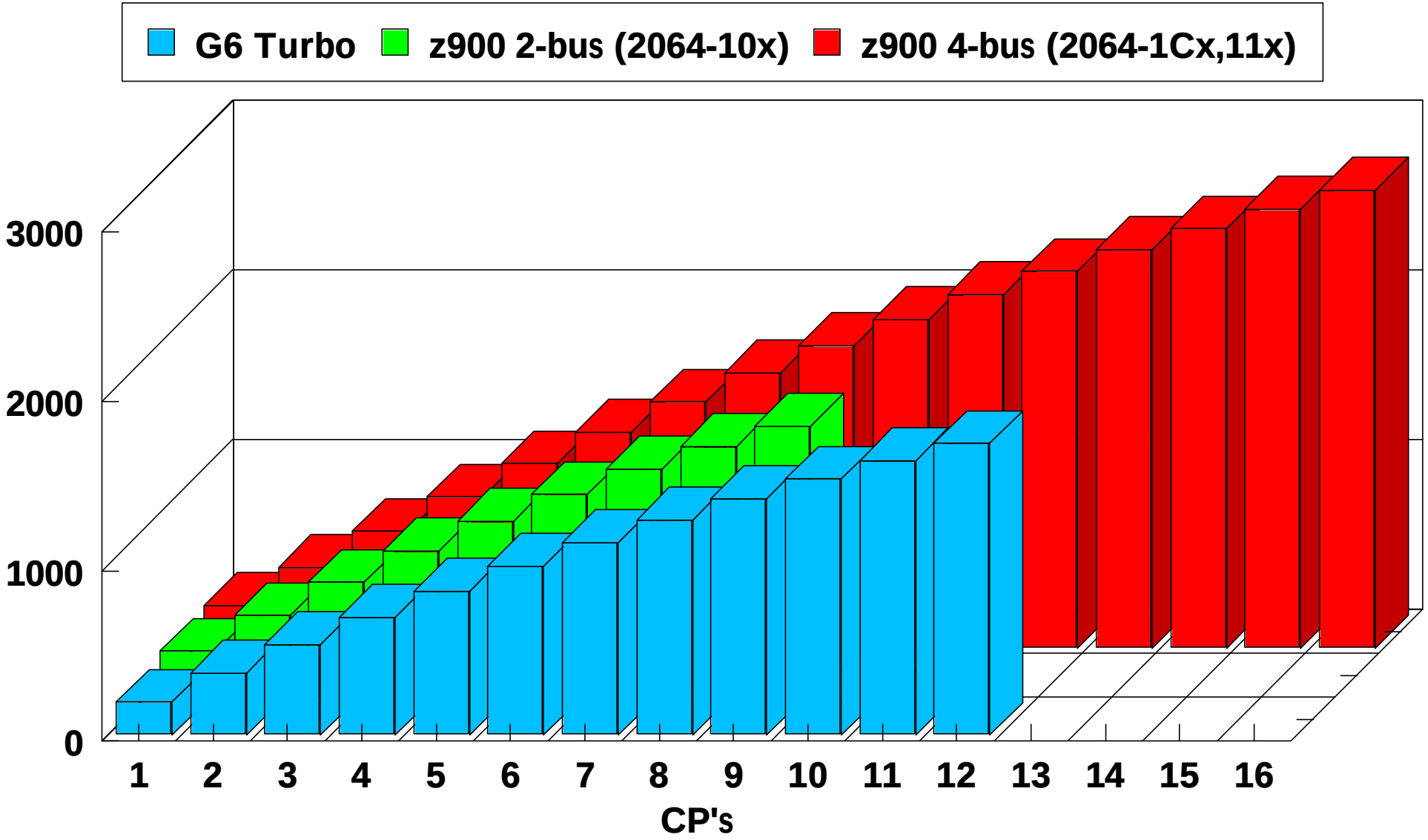
3 Years Hardware Support

- 1 year warranty + 2 years maintenance

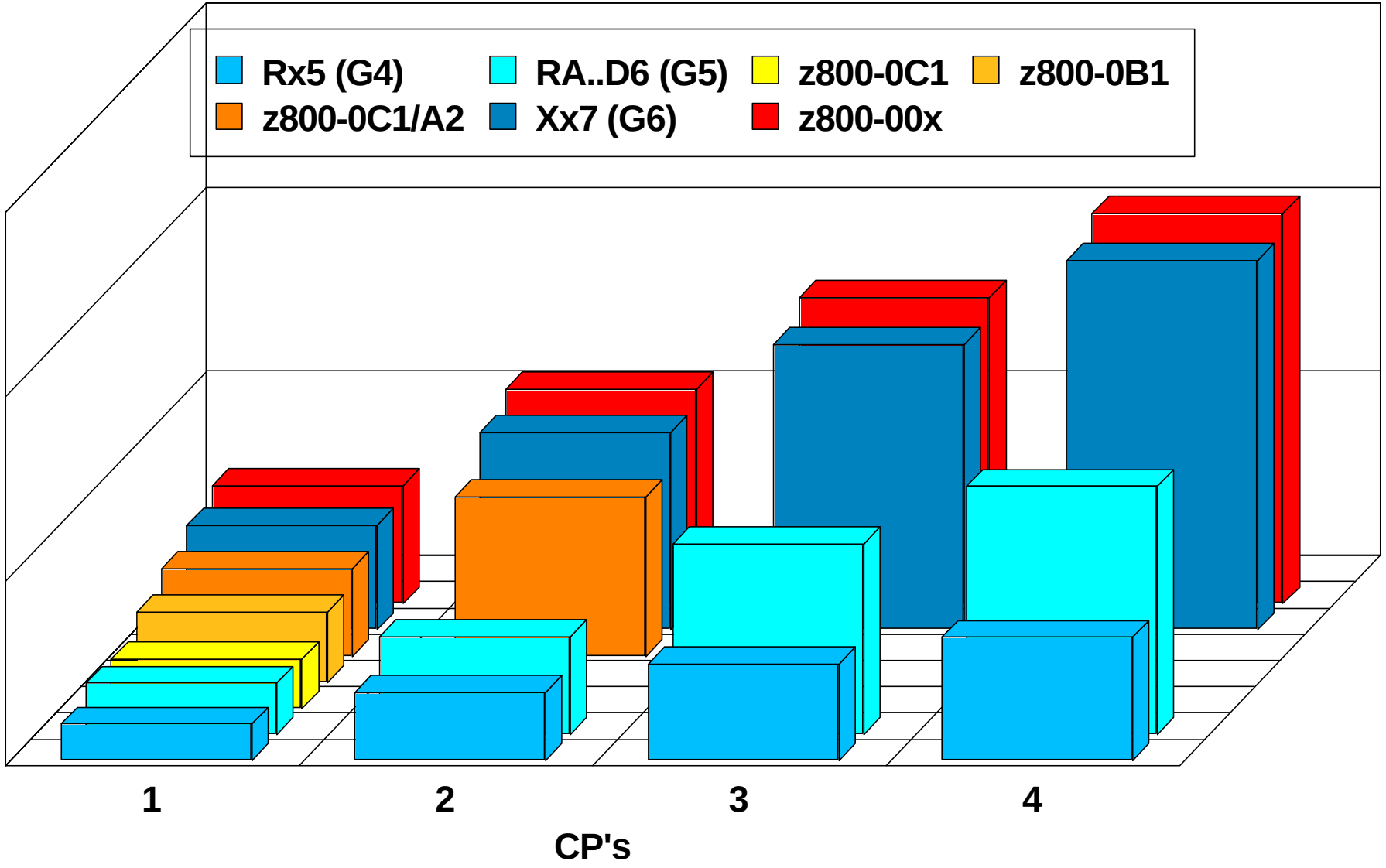
z/VM Version 4

- 3 years support

Relative Performance: G6 vs z900



z800 Performance



z800perf

Our Hardware for measurements

2064-116 (z900)

- 1.3ns (770MHz)
- 2 * 16 MB L2 Cache (shared)
- 64 GB
- LPAR
- ESCON
- FICON
- HiperSockets
- OSA Express GbE

2105-F20 (Shark)

- 384 MB NVS
- 16 GB Cache
- 128 * 36 GB disks
- 7200 RPM
- 4 FCP (1 port)
- 6 ESCON (2 port)
- 4 FICON (1 port)

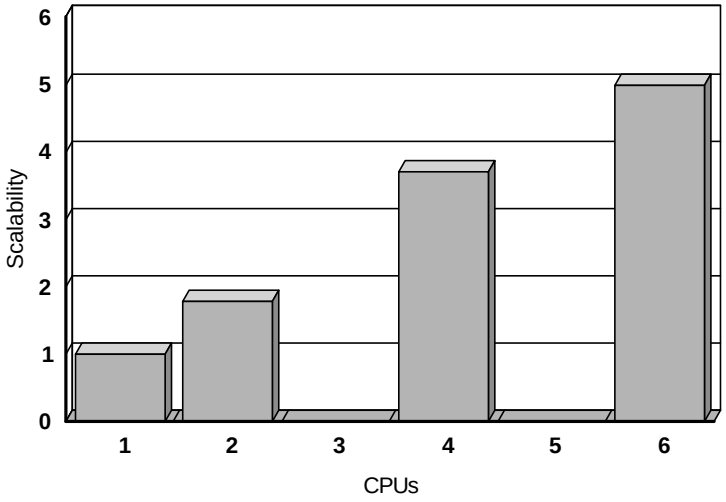
8681-7RY (8-way Netfinity)

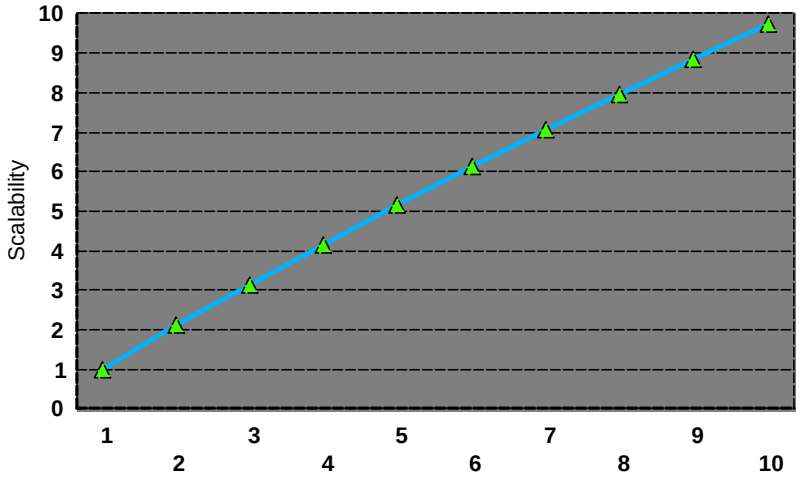
- Pentium III,700 MHz
- 8 * 1 MB L2 Cache (private)
- 4.5 GB
- 2 * 37 GB SCSI

But isn't Linux SMP scalability limited to a 4 way??

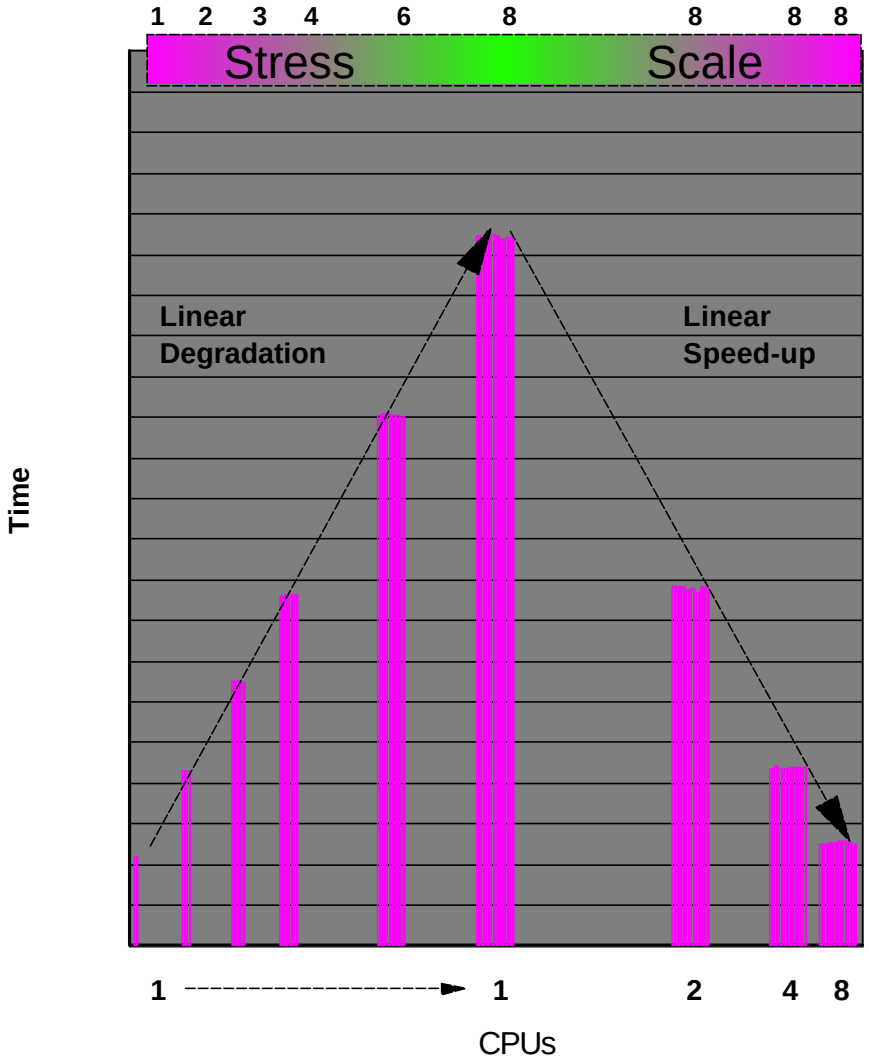
....well maybe on some platforms but not from what we are seeing on S/390

WebSphere

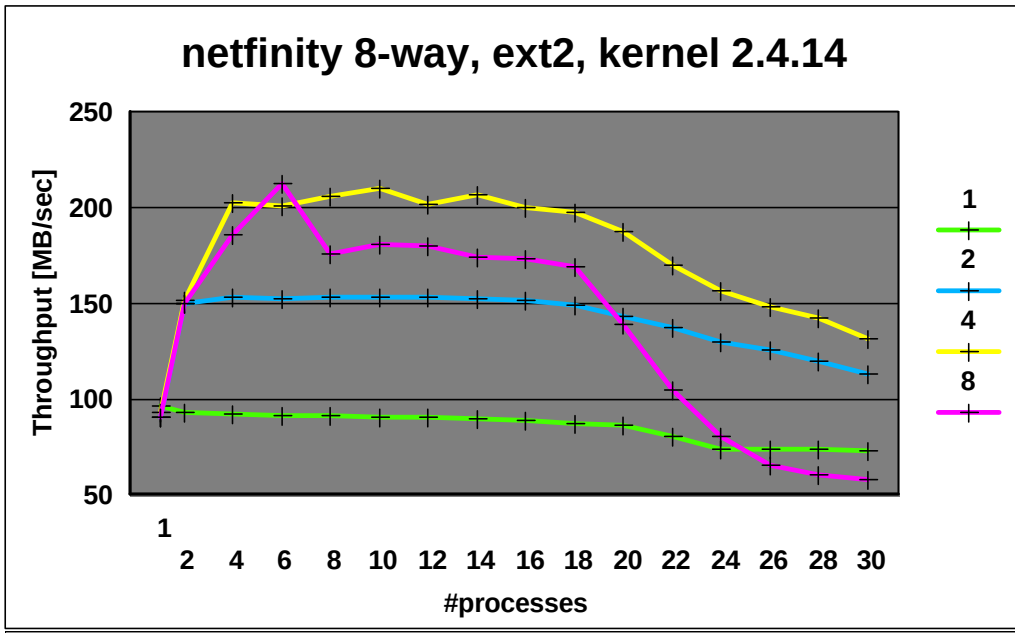


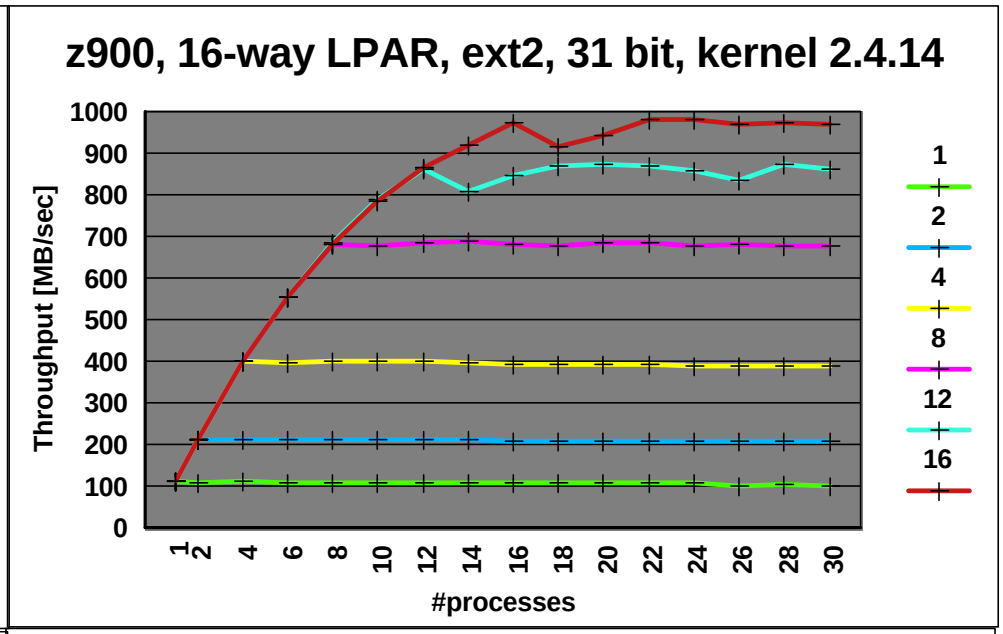


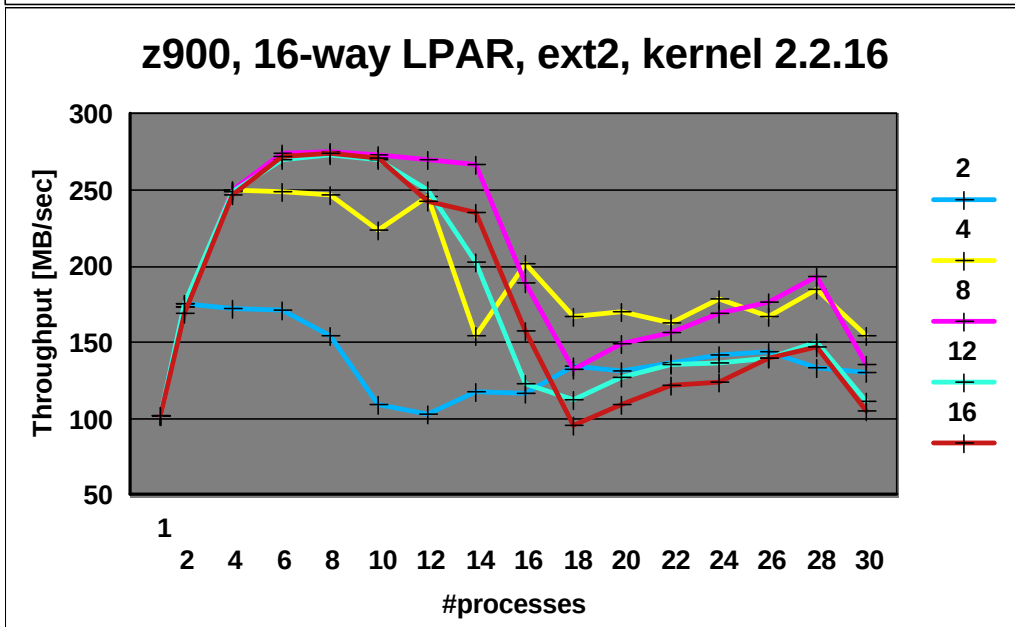
Business Intelligence

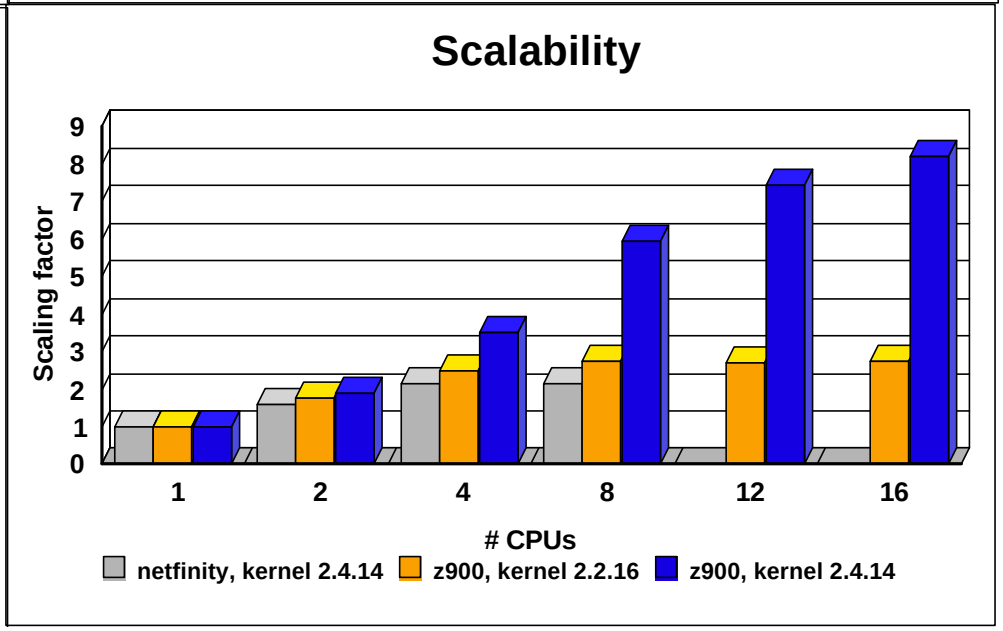


Scalability: file system benchmark

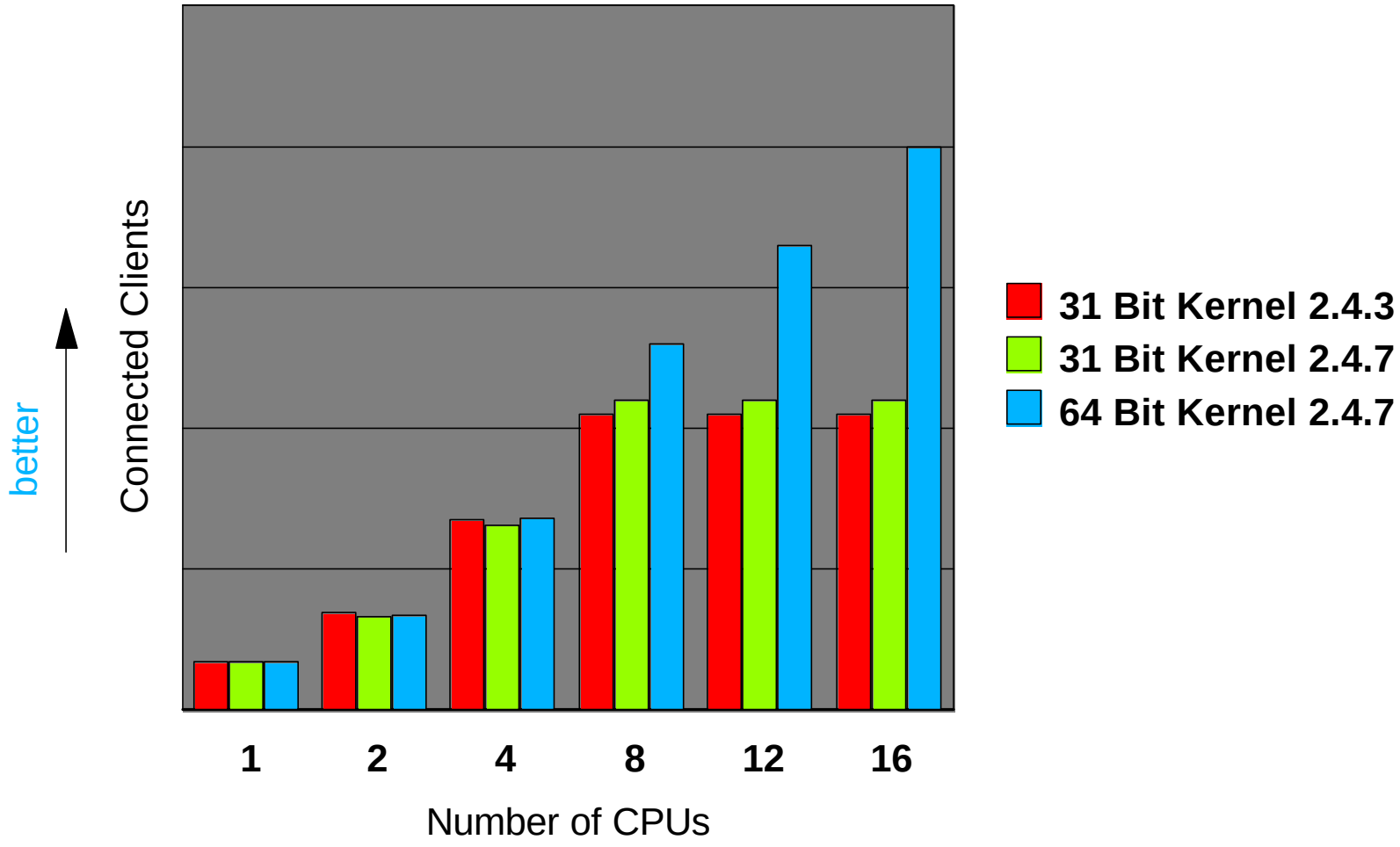






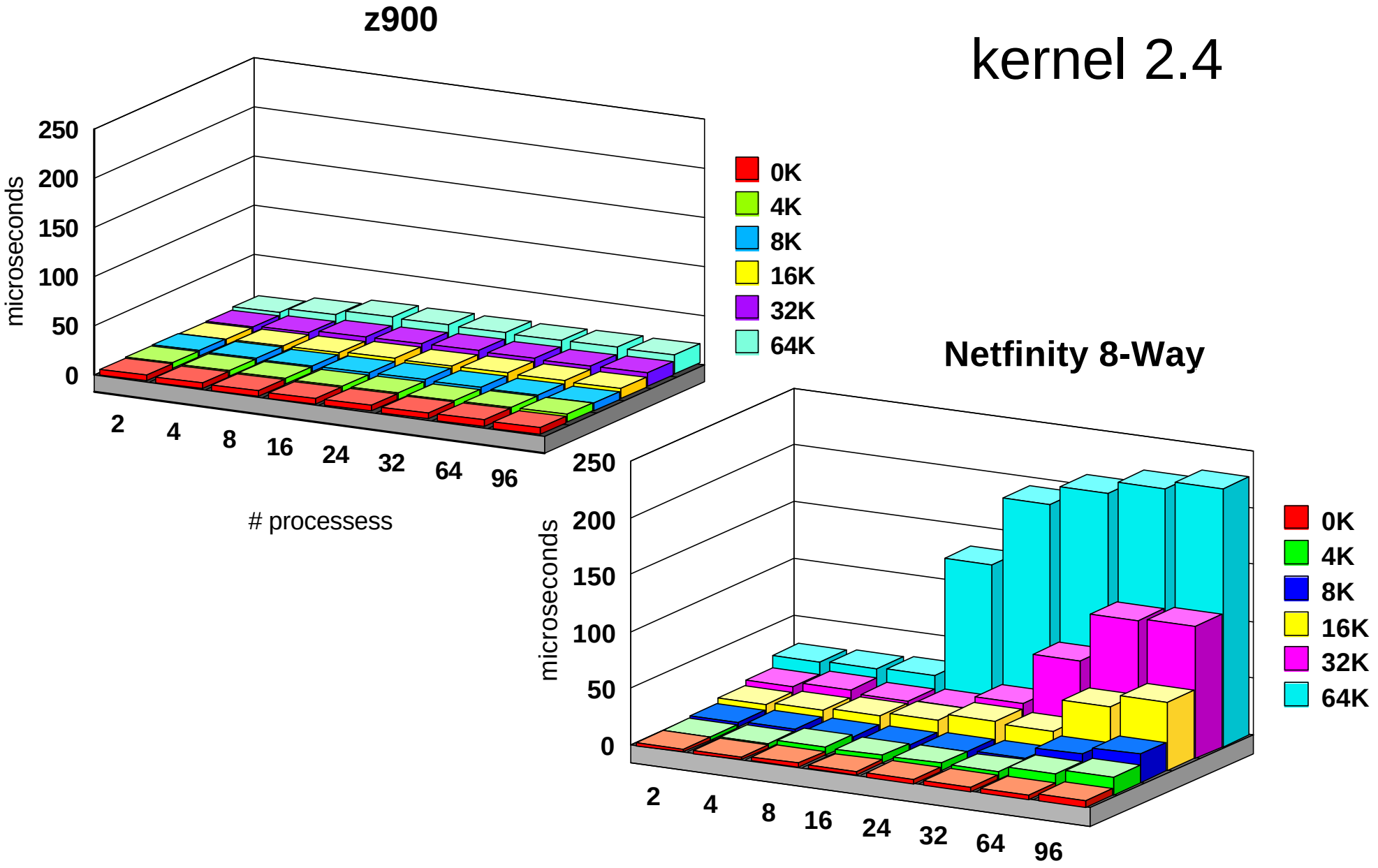


Scalability, Webbased benchmark



context switching

kernel 2.4



DASD I/O

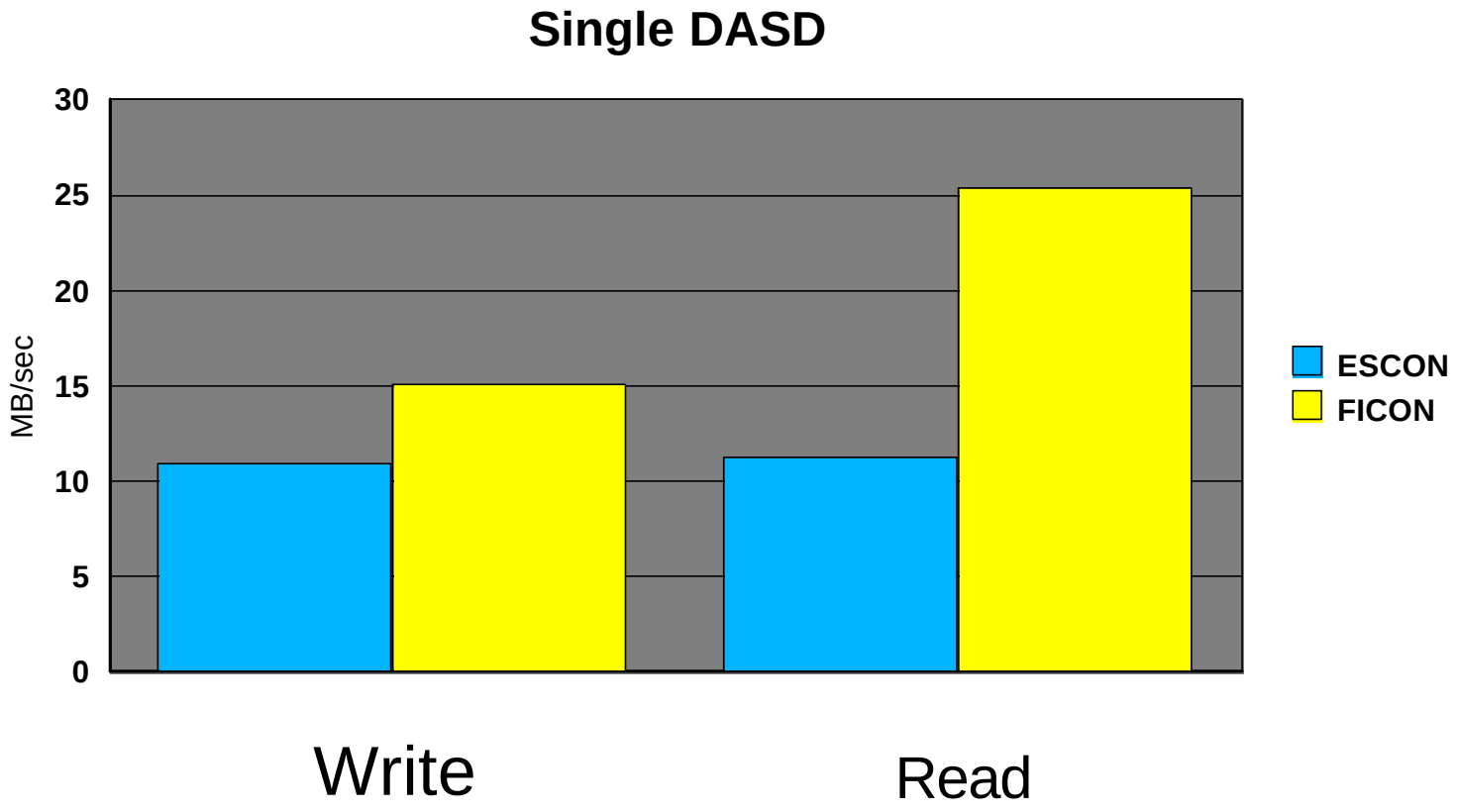
- ESCON
- FICON (Express)

ESCON, FICON (Express)

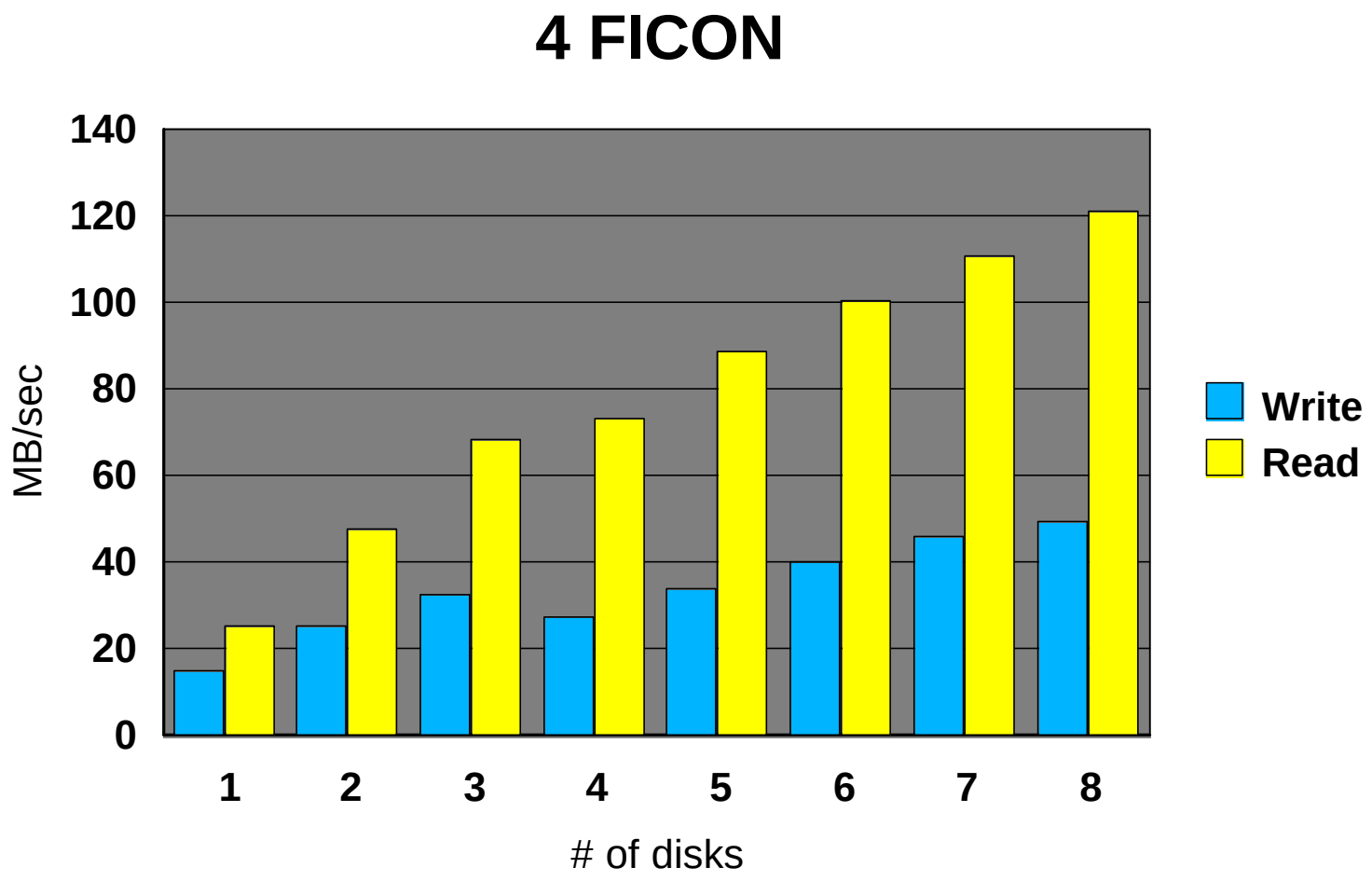
- ESCON
  - 17 MB half duplex
  - 3 km w/o repeaters
  - 43 km w/ repeaters
  - data rate droop at 9km
  - separate CTC function
- FICON (Express)
  - (>) 100 MB full duplex
  - 20 km w/o repeaters
  - 100 km w/ repeaters
  - no data rate droop
  - integrated CTC function
  - consolidation of 4-8 ESCON channels to 1 FICON channel

FICON and FICON Express Channel Performance
White Paper GM13-0120-00

ESCON vs. FICON

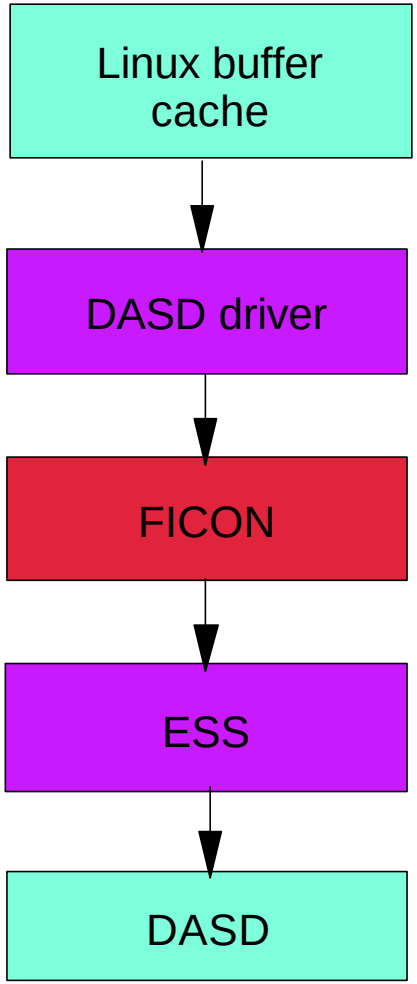


Sequential DASD I/O



DASD access translations

today:



color coding:

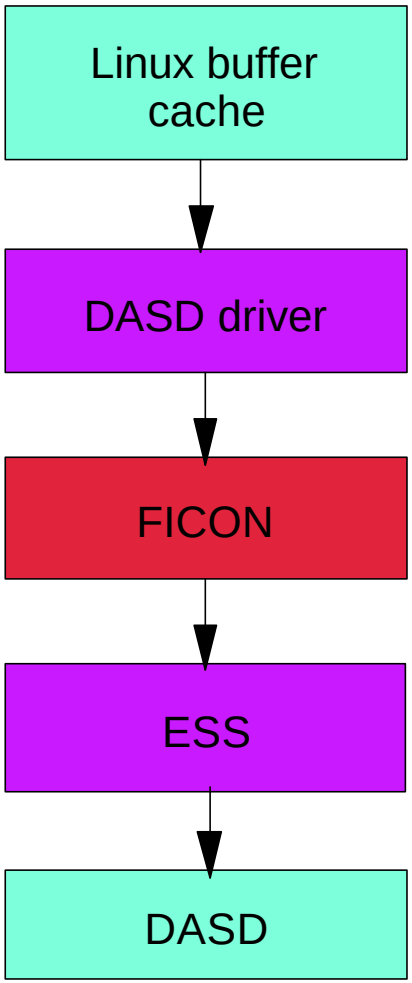
block format

translation block <--> ECKD

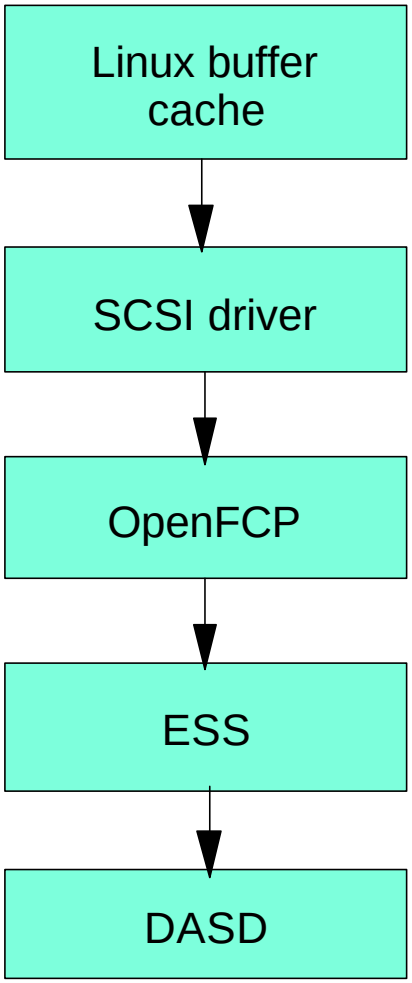
ECKD format

DASD access w/o translations

today



we are working on:

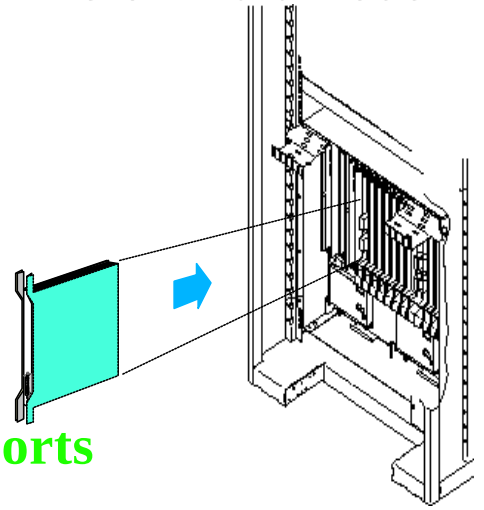


Networking

- OSA Express
- HiperSockets

OSA Express Features

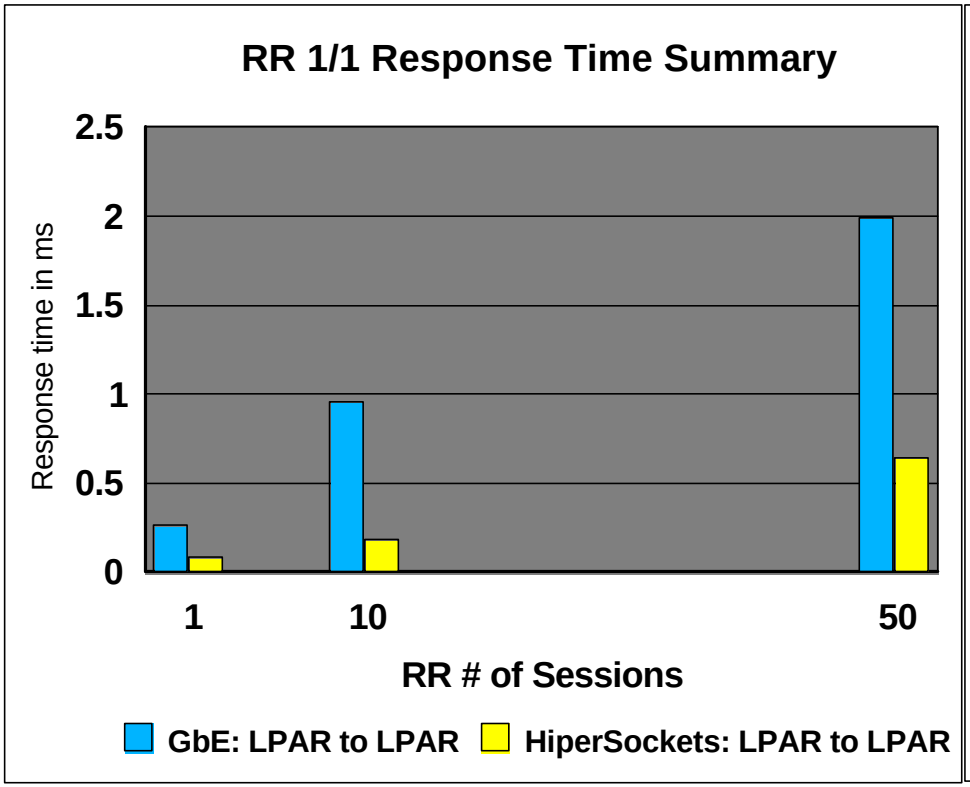
- **Features for z800, z900, and S/390 G5, G6**
  - **Gigabit Ethernet LX** (long wavelength) full duplex, 50/62.5 micron multimode (with mode conditioning patch cables) or 9 micron single mode
  - **Gigabit Ethernet SX** (short wavelength) full duplex, 50/62.5 micron multimode
  - **Fast Ethernet** (10 or 100 Mbps full duplex)
  - **155 ATM Single Mode** (9 micron)
  - **155 ATM Multimode** (62.5 micron)
- **Feature for z800, z900**
  - **Token Ring** (4, 16, or 100 Mbps full duplex)
- **Up to 12 OSA-Express Features per System**
  - **S/390 features have one port, z800, z900 features have 2 ports**
  - **independent of OSA-2**
- **Direct attach to Self-Timed Interconnect (STI) bus**
  - **S/390 STI bus supports up to 333 megabytes/second**
  - **z900 STI bus supports up to 1 gigabyte/second**
- **Port attaches to:**
  - LAN (full-duplex support if connected to a switch) or ATM network
  - Direct connected workstation (or server)
  - Multiple LPARs (port sharing)

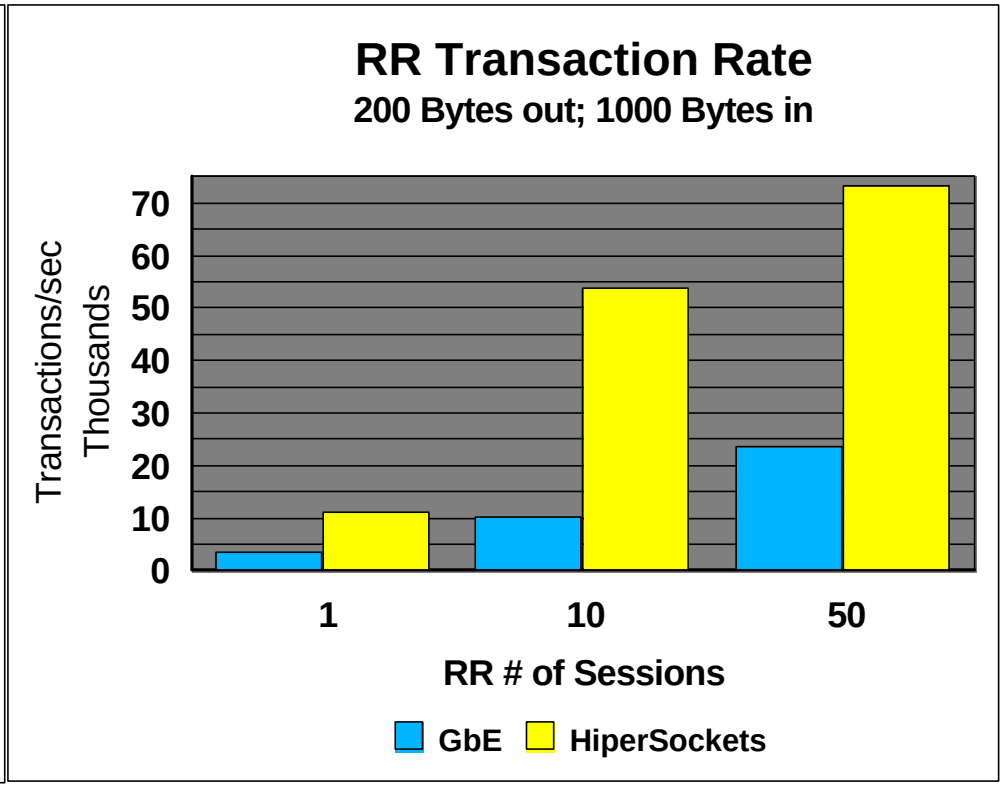


HiperSockets Hardware Elements ('Network in a box')

- Synchronous data movement between LPARs and virtual servers within a zSeries server
  - Provides up to 4 "internal LANs". HiperSockets accessible by all LPARs and virtual servers
  - Up to 1024 devices (TCP/IP stacks) across all 4 HiperSockets
  - Up to 4000 IP addresses
  - Similar to cross-address-space memory move using memory bus
- Extends OSA-Express QDIO support
  - LAN media and IP layer functionality (internal QDIO = iQDIO)
  - Enhanced Signal Adapter (SIGA) instruction
    - New "thin interrupt" without use of System Assist Processor (SAP)
  - optional dispatcher polling mechanism
- HiperSockets Hardware I/O Configuration with new CHPID type = IQD
  - Controlled like regular CHPID
  - Each CHPID has configurable Maximum Frame Size
- Works with both standard and IFL CPs
- No physical media constraint, no physical cabling, no priority queueing
- Secure connections
- Both 31 bit and 64 bit operating systems supported
- Pre-req: **IBM eServer zSeries 900 Licensed Internal Code (LIC) Update**

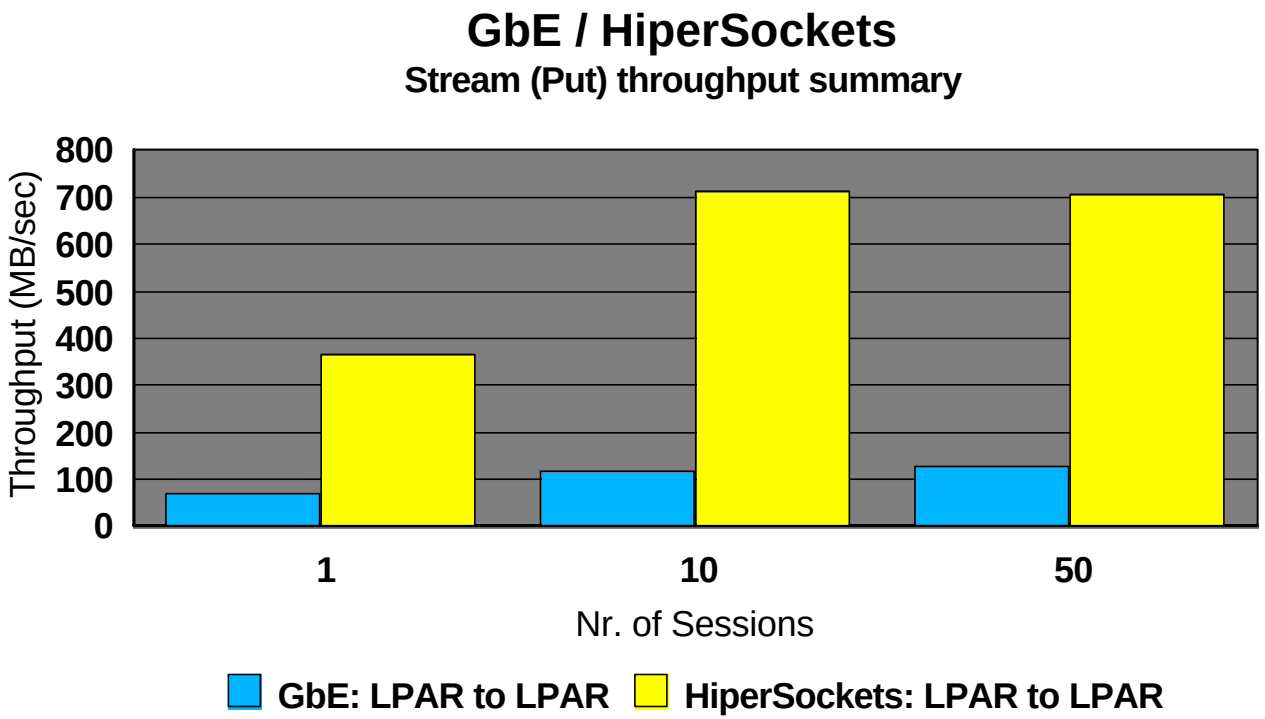
HiperSockets Performance (Interactive Transactions) Linux to Linux





RedHat 7.2, kernel 2.4.9, 31-bit
OCO-modules from developerworks (1/2002)
Two LPARs, each w/ 4 non-dedicated CPUs and 2 GB
OSA-Express GbE card shared between LPARs
Default TCP Send/Receive buffer size (64 KB)
MTU: 9000 (GbE), 32K (HiperSockets)

HiperSockets Performance (Bulk Data Xfer)
Linux to Linux



RedHat 7.2, kernel 2.4.9, 31-bit
OCO-modules from developerworks (1/2002)
Two LPARs, each w/ 4 non-dedicated CPUs and 2 GB
OSA-Express GbE card shared between LPARs
20 MB out, 20 Bytes in
Default TCP Send/Receive buffer size (64 KB)
MTU: 9000 (GbE), 32K (HiperSockets)

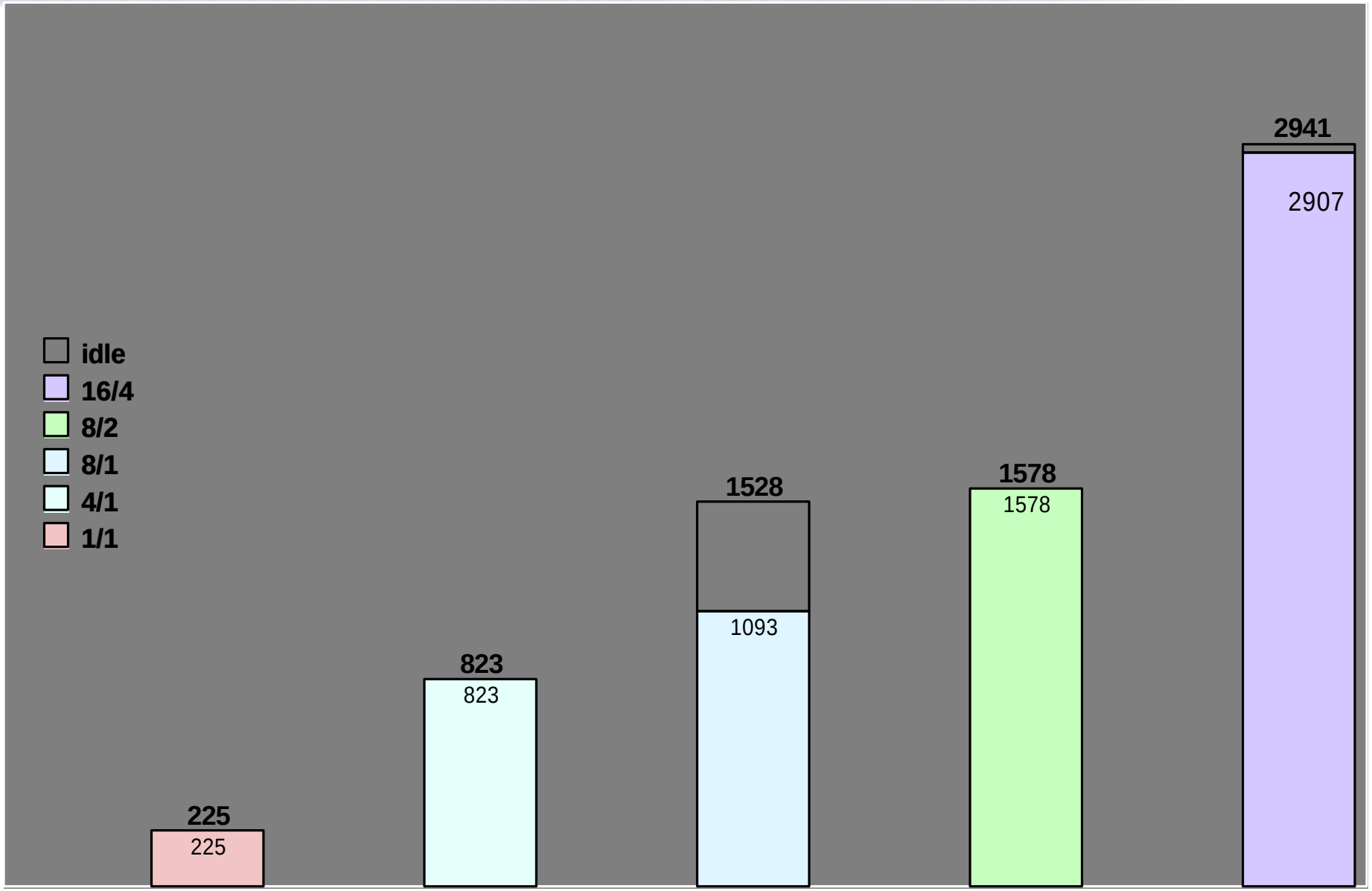
Crypto performance

- Linux SSL-RC4
- VM Linux SSL-RC4

ITR (ETR + idle) for LINUX SSL-RC4 MD5 US

Non-Cached,1024 bit keys, 2*2048 bytes

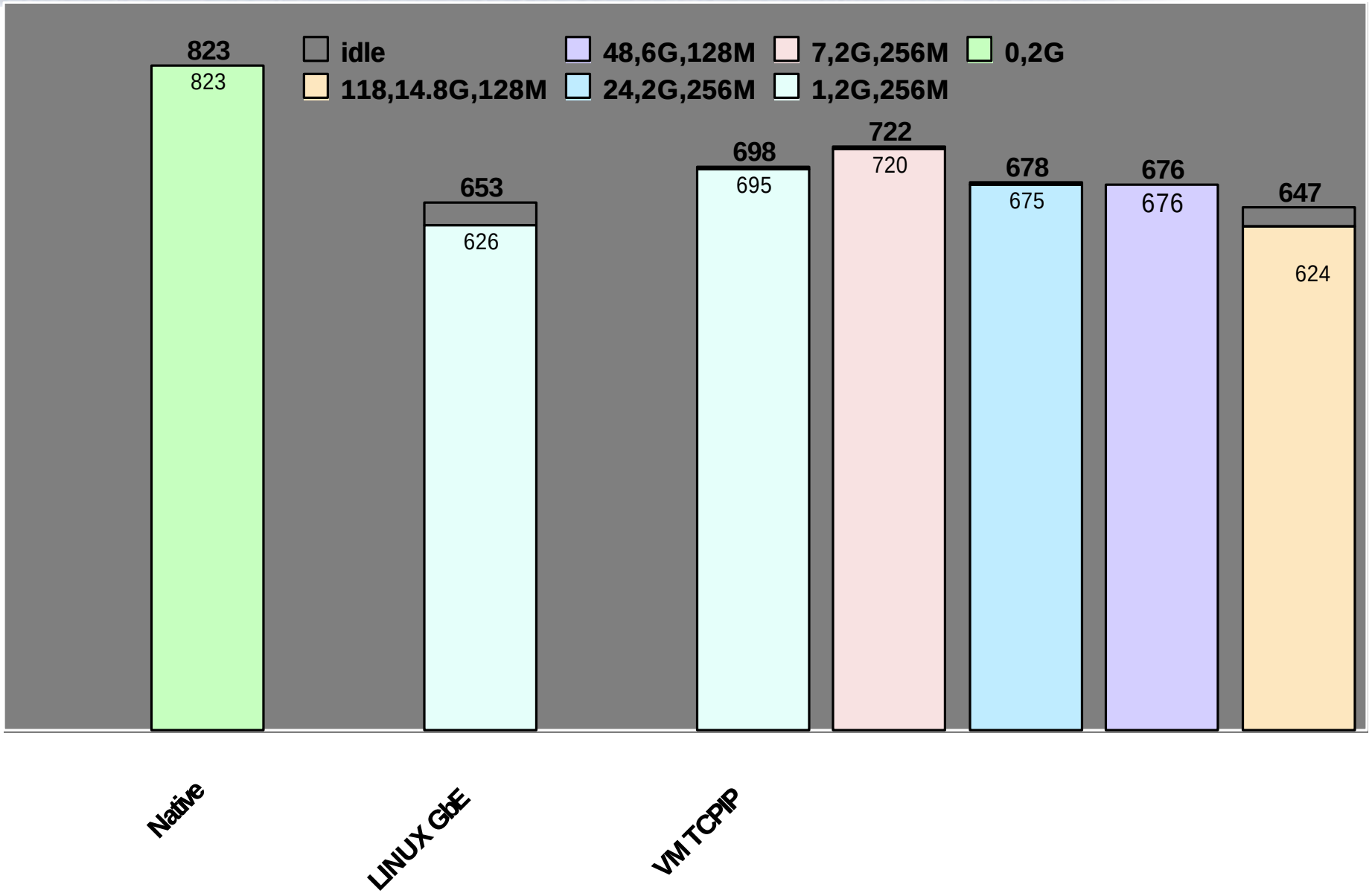
2064-116 by # processors and PCICAs



ITR (ETR + idle) for VM LINUX SSL-RC4 MD5 US

Non-Cached,1024 bit keys, 2*2048 bytes

2064-104, 1 PCICA by # of LINUX Guest



Linux 'jiffies'

- 100 Hz timer 'wakes up' kernel
- Linux uses Clock Comparator
- timer count stored in variable named 'jiffies'
- to VM, the guest is always busy
- affects VM's paging
- overhead for idle Linux guest: 0.3% of one G5 CPU

The Timer Patch

- Recommended Patch on DeveloperWorks
- Reduces overhead for idle guest close to zero
- Interrupts only when necessary
- Clock Comparator for absolute timer events
- CPU Timer for process related events
- 'jiffies' is checked on every system entry