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SUMMIT

Maximizing Six-Core AMD Opteron™ Processor Performance with RHEL

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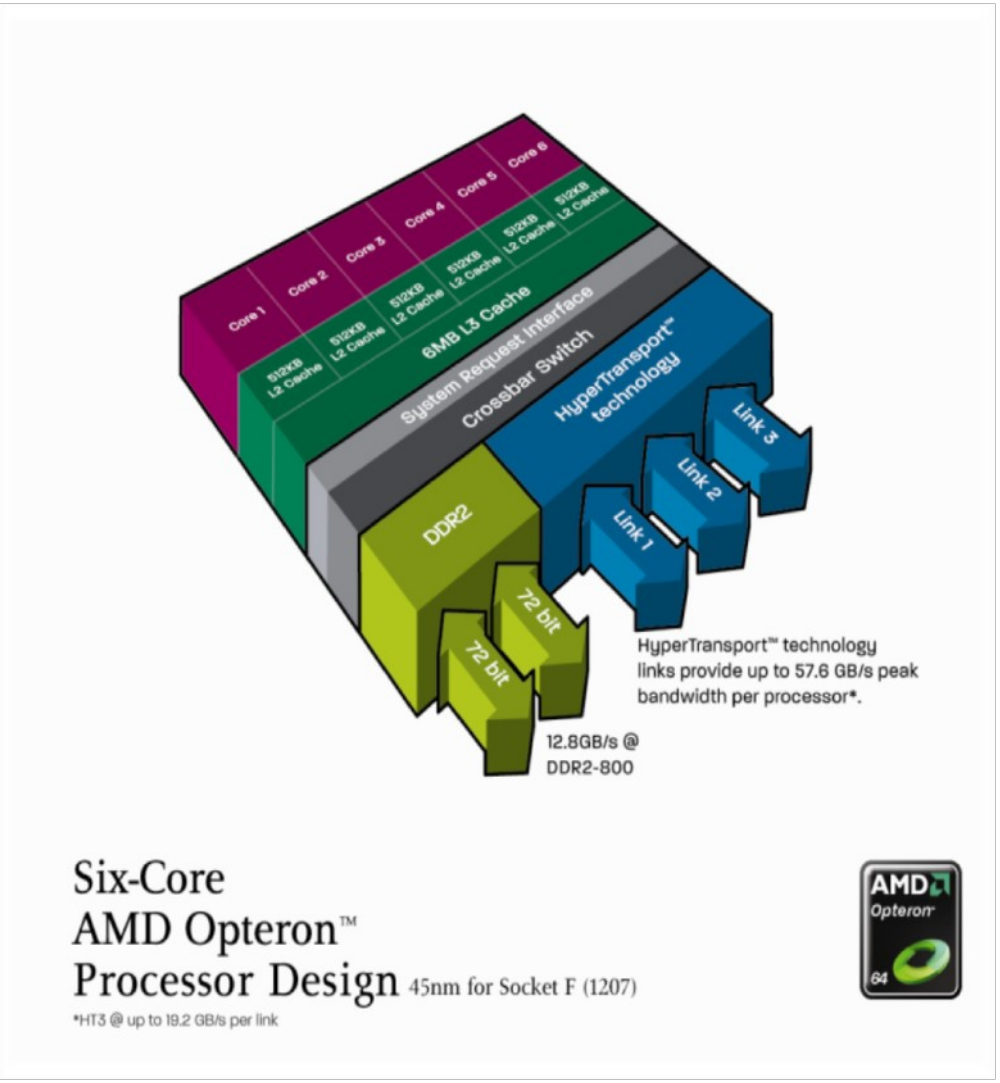
presented by

Agenda

- Six-Core AMD Opteron™ processor codenamed "Istanbul" – overview
- Six-Core AMD Opteron™ processor feature support
  - Continued virtualization support
  - New Innovations
- Red Hat Enterprise Linux software support
- Performance benchmarking results
- Conclusions

Six-Core AMD Opteron™ Processor ("Istanbul")

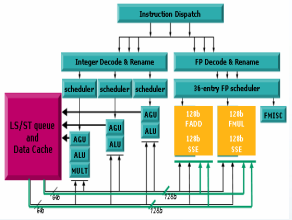


- Six True Cores
- New HyperTransport™ Technology HT Assist
- Increased HyperTransport™ 3.0 Technology (HT3) Bandwidth
- Higher Performing Integrated Memory Controller
- Same power/thermal envelopes as Quad-Core AMD Opteron™ Processor
- Continued AMD Virtualization™ (AMD-V™) technology support, Rapid Virtualization Indexing

Prior Generation Innovations that Continue

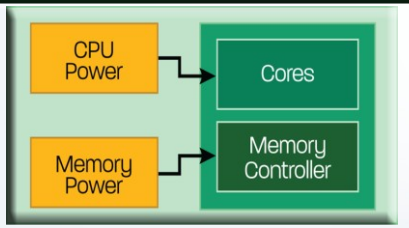
All the performance-enhancing features of Quad-Core AMD Opteron™ processor

AMD Wide Floating-Point Accelerator

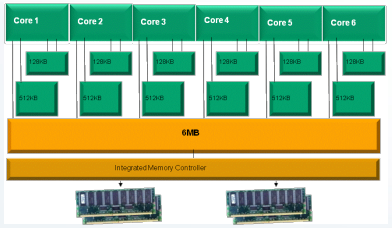


AMD Memory Optimizer Technology

Dual Dynamic Power Management™

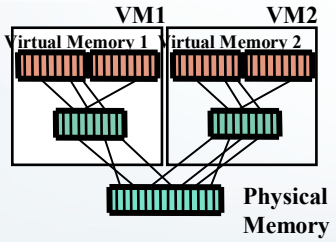


AMD Balanced Smart Cache



HyperTransport™ 3 Technology

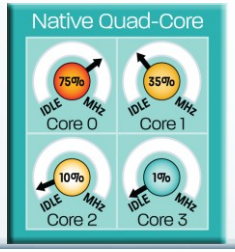
AMD Virtualization™ (AMD-V™) technology



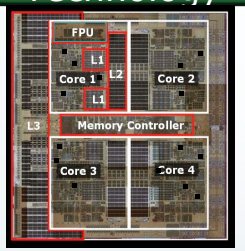
Prior Generation Innovations that Continue

All the power-efficiency features of Quad-Core AMD Opteron™ processor

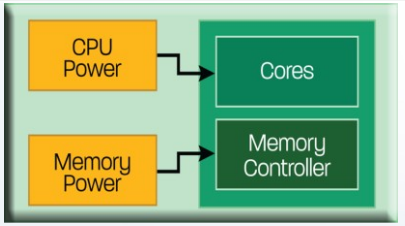
Independent Dynamic Core Technology



AMD CoolCore™ Technology

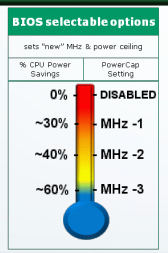


Dual Dynamic Power Management™

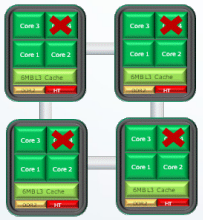


Low-Power DDR2 Memory

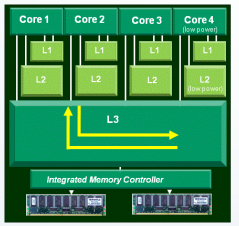
AMD PowerCap manager



Core Select



AMD Smart Fetch technology



New Innovations in Six-Core AMD Opteron™ processor ("Istanbul")

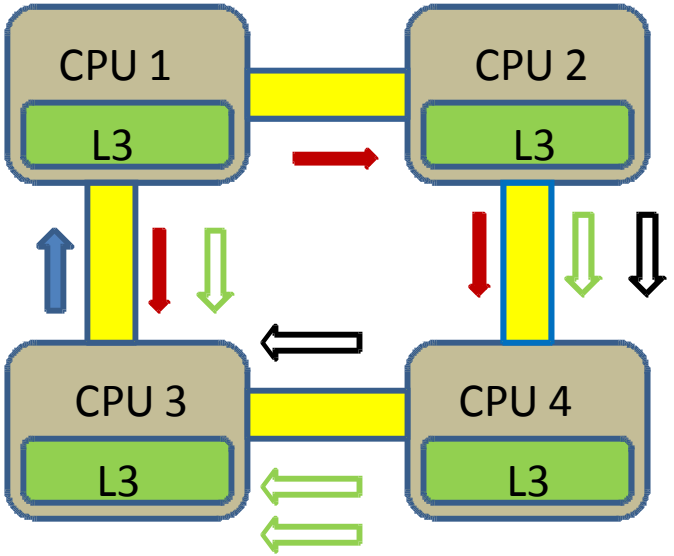
- Six cores per socket
  - Six core support for F (1207) socket infrastructure
  - Improves performance (compared to Quad-Core AMD Opteron™ processor)
- HT Assist – in multi-socket systems:
  - Reduces probe traffic
  - Resolves probes more quickly
- Higher HyperTransport™ 3.0 Technology Speeds
  - Support for up to 4.8GT/s per link
  - Overall system performance

HT Assist : *What* is it?

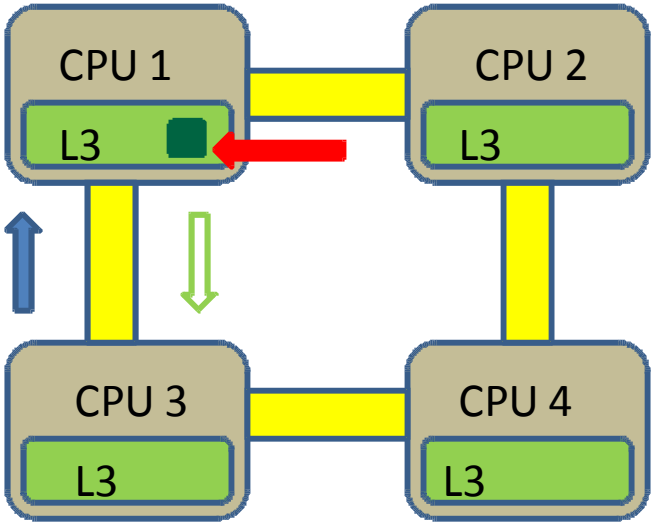
- Micro-architectural feature in Six-Core AMD Opteron™ processor
  - Helps reduce memory latency
  - Helps increase overall system performance in 4-socket and 8-socket systems
- Improves HyperTransport™ technology link efficiency and increases performance by:
  - Reducing probe traffic
  - Resolving probes more quickly
- Probe “broadcasting” can be eliminated in 8 of 11 typical CPU-to-CPU transactions

HT Assist : *How* does it work?

Query Example:



Without HT Assist
(Total 10 transactions)



With HT Assist
(Total 2 transactions)

= Data Request

= Probe Request

=L3 Directory

= Data Response

= Probe Response

=Directory Read

HT Assist : *What* is the cache directory?

- The HT Assist is a sparse directory cache
  - Associated with memory controller of home node
  - Tracks all lines cached in the system from home node
  - Logically part of the memory controller
  - Physically in L3 cache, occupying 1MB of L3 cache
- For many transactions, eliminates probe broadcasts
  - Host CPU knows exactly which CPU to probe for data
  - local accesses get local DRAM latency,
  - less queuing delay due to lower HT traffic overhead
- Results in reduced latency and increased system performance in multi-socket systems

HT Assist: *What* is the result?

- Helps reduce memory latency
- Helps increase overall system performance
- 4-way stream memory bandwidth performance improves by ~60% (42 GB/s with HT Assist, and 25.5 GB/s without HT Assist)*
- Can result in faster query times that can increase performance for cache sensitive applications:
    - Database
    - Virtualization
    - HPC

*See backup slides for performance and configuration information.

HyperTransport™ 3.0 Technology

- Advantages of HyperTransport™ 3.0 technology (HT3)
  - Compared to HyperTransport™ 1.0 technology (HT1), improves system bandwidth between CPUs and I/O
  - Increased interconnect rate (from 2GT/s with HT1 up to 4.8GT/s per link with HT3)
  - Improves overall system balance and scalability, especially in commercial applications (database, web server, etc.)

Six-Core AMD Opteron™ Processor Support For Red Hat Enterprise Linux®

- Excellent relationship with Red Hat
  - Hardware enablement
  - Virtualization and performance collaboration
- Six-Core AMD Opteron™ processor works best with RHEL5.4
- Continued support for AMD-V™ with Rapid Virtualization Index
- Continued support for AMD Power Now!™ technology driver
- Continued support for Xen 2MB super pages

Six-Core AMD Opteron™ Support For Red Hat Enterprise Linux®

- RHEL5.4: New Features and support
  - Supports Six-Core AMD Opteron™ processors
  - AMD-Vi on SR5690 enabled systems
  - KVM virtualization support
- RHEL6.0: New Features and support
  - 1GB huge page table

RHEL5.4 Performance Testing on Six-Core AMD Opteron™ "Istanbul"

- Bare Metal Scalability Testing with Oracle OLTP workload
- Multiple instance testing with OLTP workload
- Taking advantage of NUMA
- KVM multiguest testing with Oracle OLTP workload
- KVM multiguest testing with Sybase OLTP workload

RHEL5.4 Testing on Six-Core AMD Opteron™ "Istanbul"

Hardware Configuration

System

4 Socket - Six-Core AMD Opteron(tm) Processor 8431 @ 2400.099 MHz

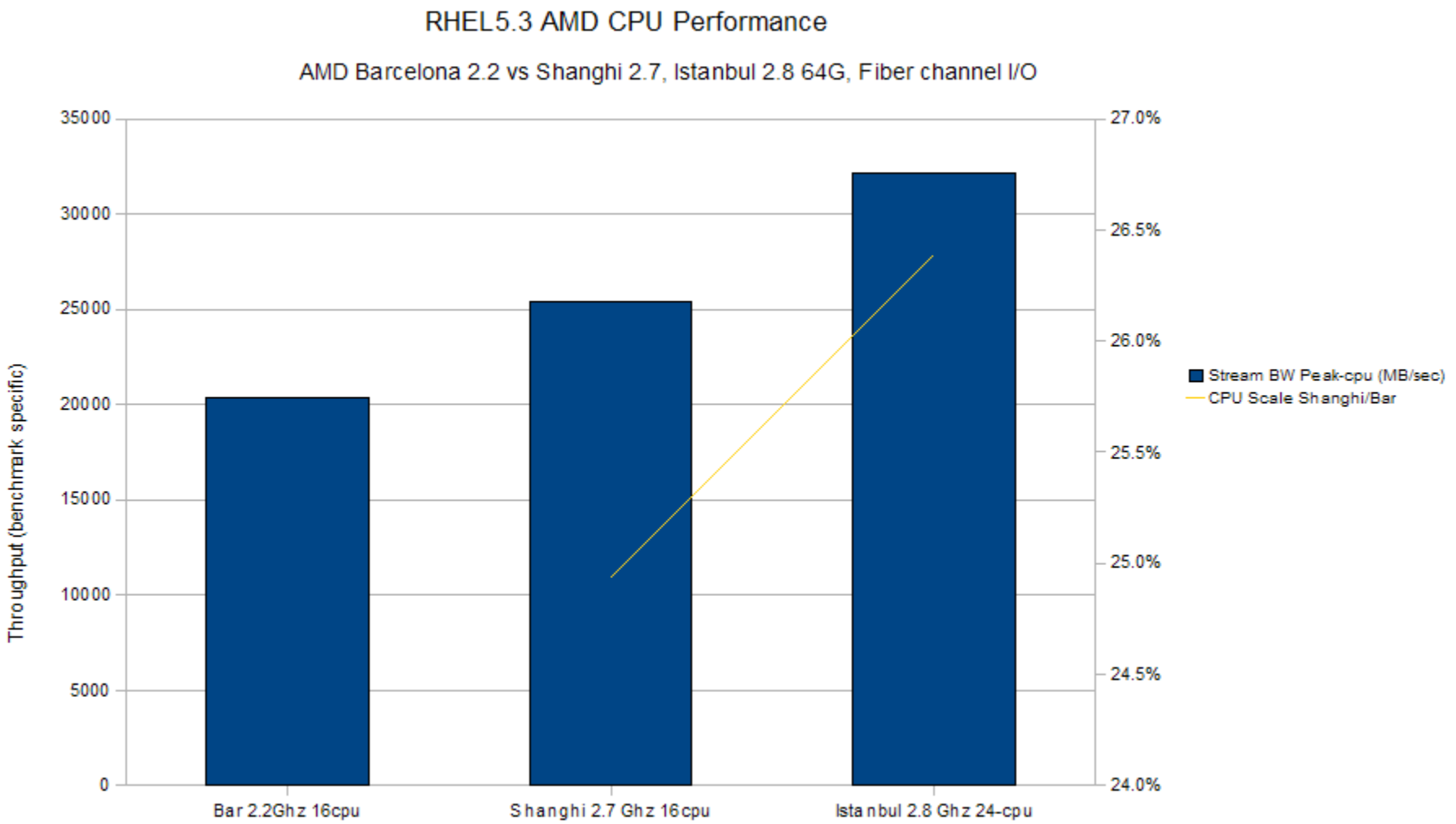
64 GB Memory

Storage

HP – HSV300 (Fibre Channel Storage)

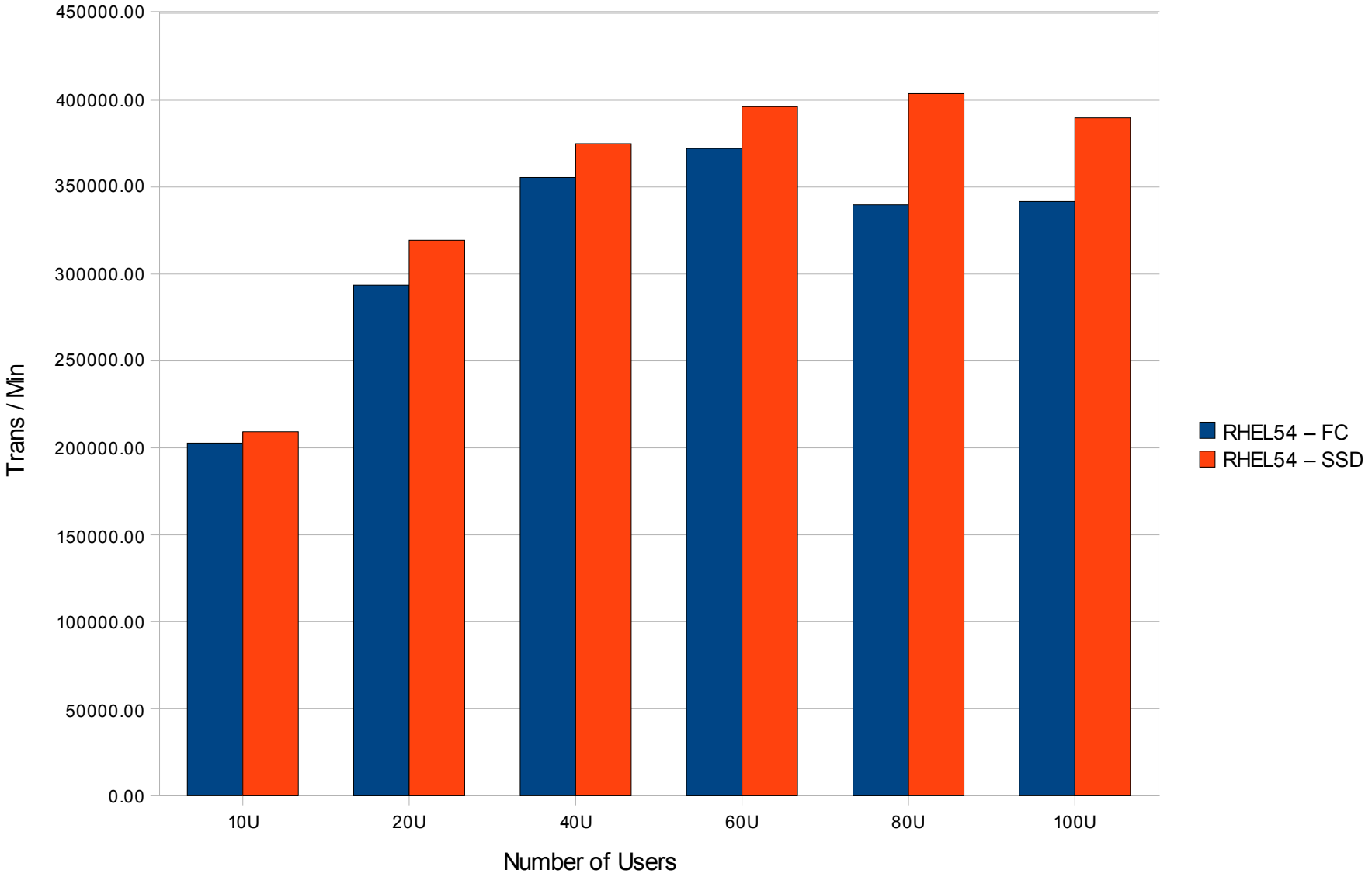
Fusion IO SSD Device

AMD RHEL 5.3 Istanbul Performance



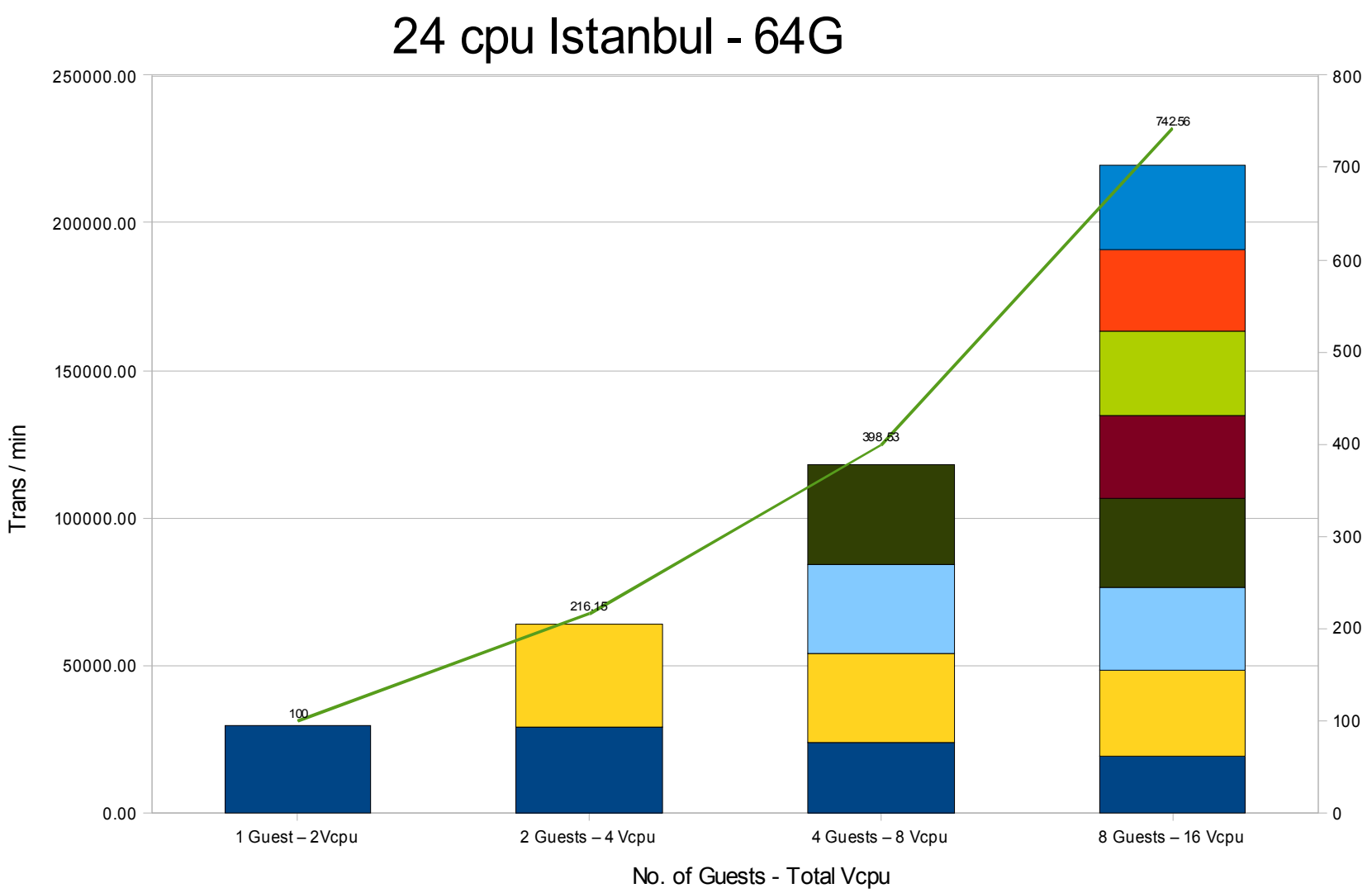
The Streams memory BW test shows ~25% improvement from Barcelona to Shanghai by virtue of CPU speedup and ~25% improvement from Shanghai to Istanbul by virtue of having more cores

Scaling with Oracle OTLP workload



Graph shows scaling with Oracle OLTP workload (Running in batch commit mode)
Scaling improves with storage with low latency higher throughput characteristics

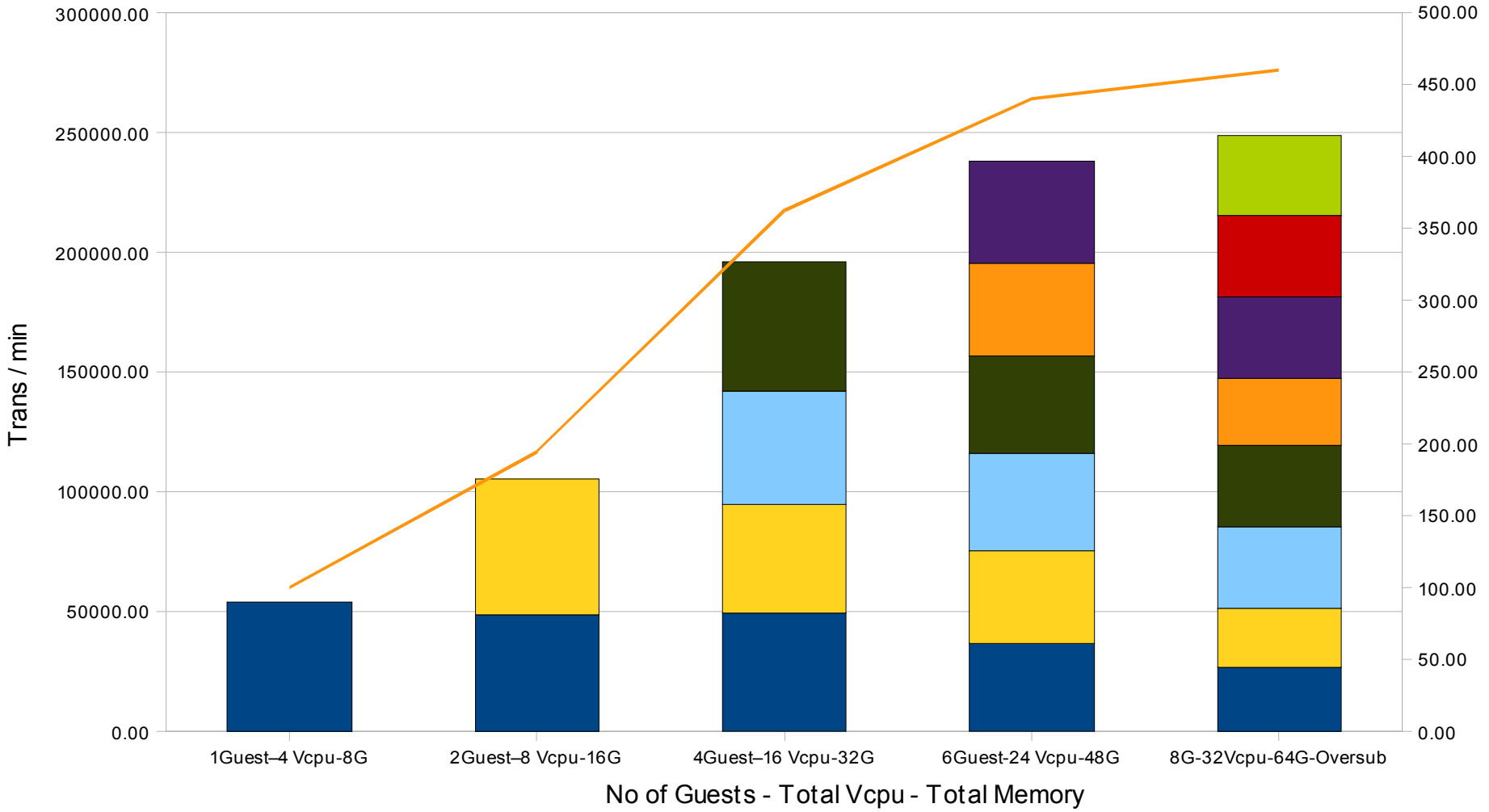
KVM – 2 Vcpu Multi guest - Oracle OLTP



Scaling with multiple 2 Vcpu guests running Oracle OLTP workload – Near linear Scaling

KVM – 4 Vcpu Multi guest - Oracle OLTP

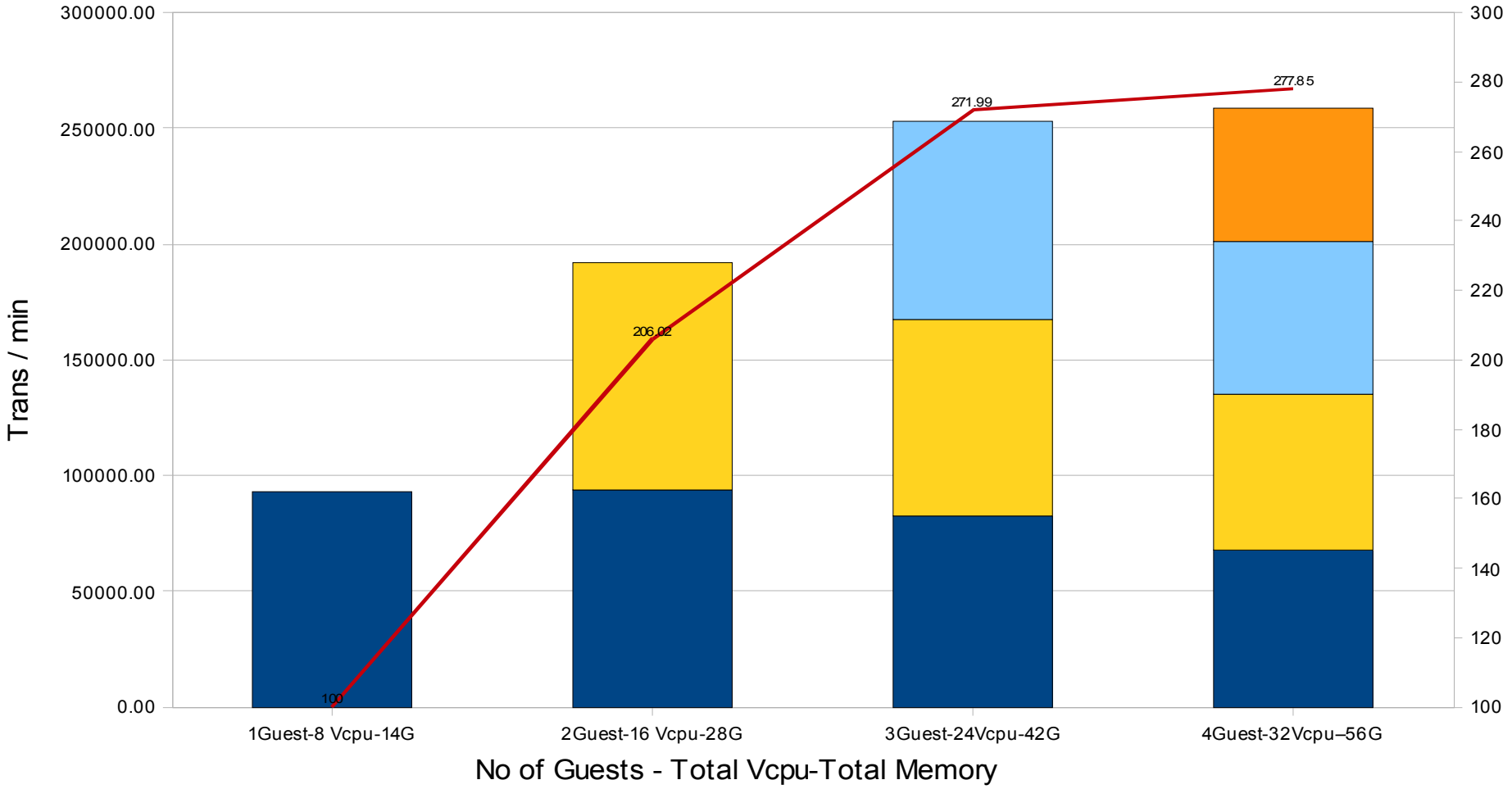
24 cpu Istanbul - 64G



4 vcpu multi guest testing with Oracle OLTP workload shows good scaling
Last bar shows no significant penalty with oversubscription of cpus

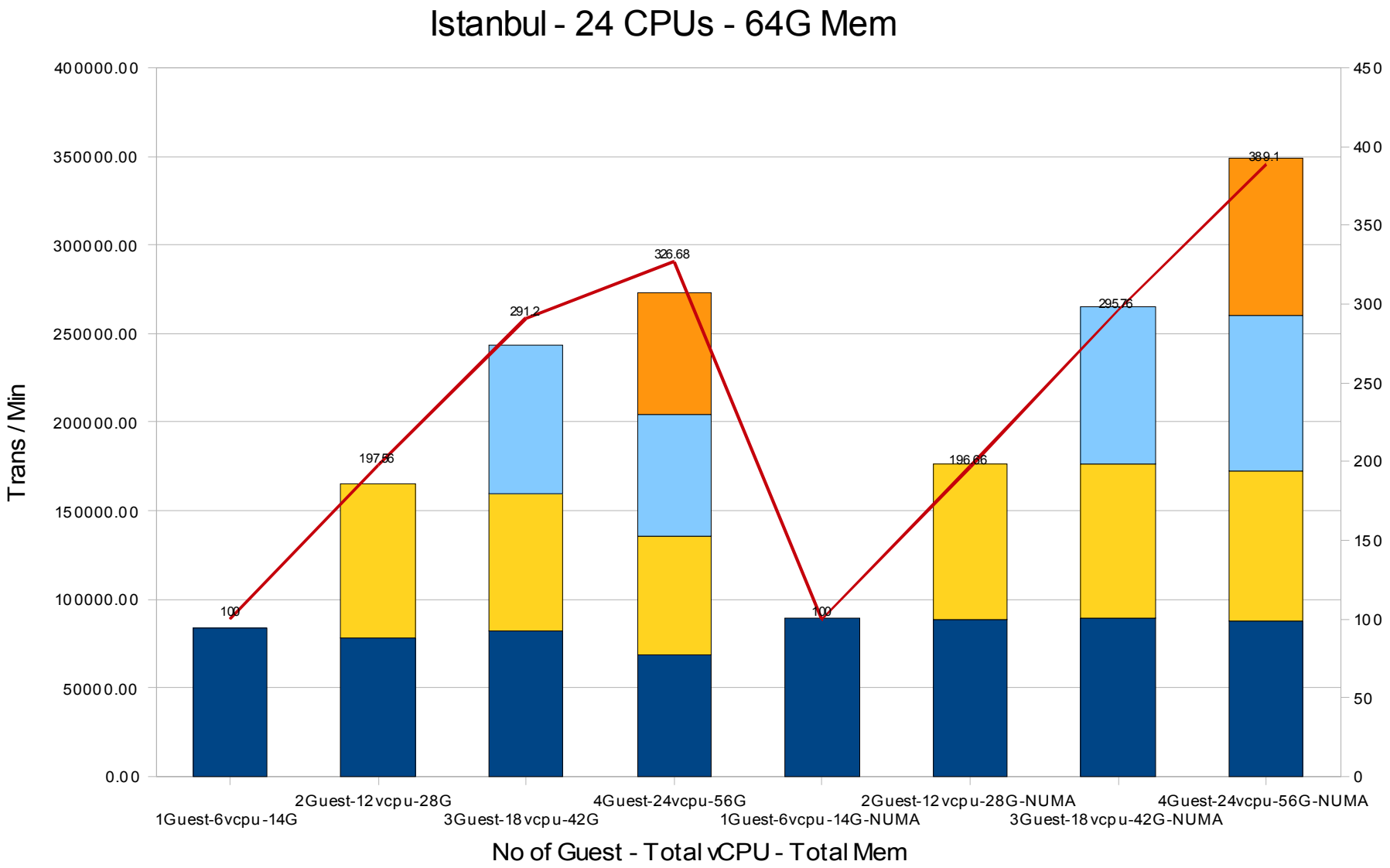
KVM – 8 Vcpu Multi guest - Oracle OLTP

Istanbul - 24 cpus - 64G



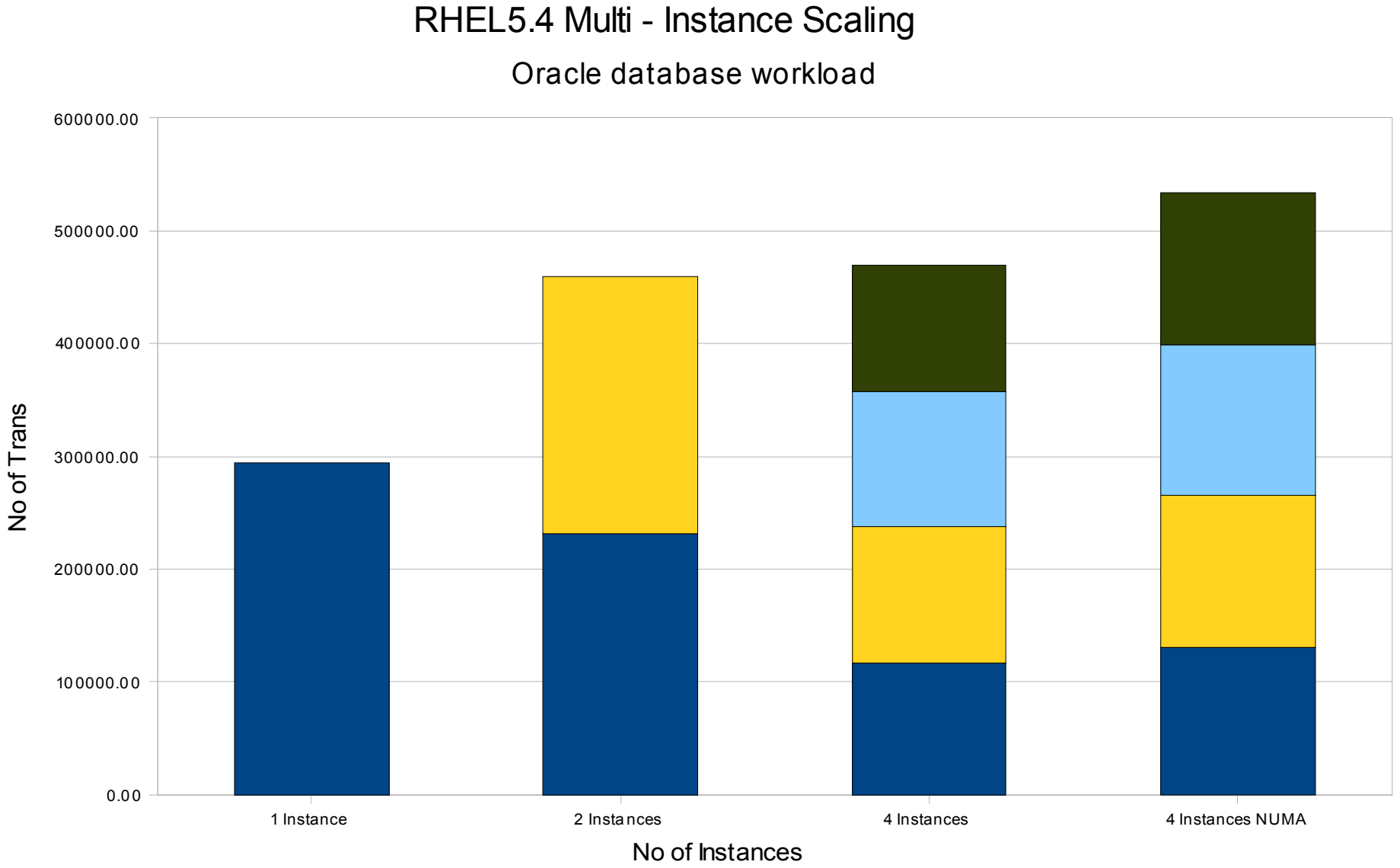
8 vcpu multi guest testing with Oracle OLTP workload shows linear scaling
Last bar shows no significant penalty with oversubscription of cpus

NUMA – pinning with numactl



Platform shows good scaling without NUMA tuning (Bars 1-4)
Using numactl, linear scaling is achieved with multiple guests (Bars 5 -8)

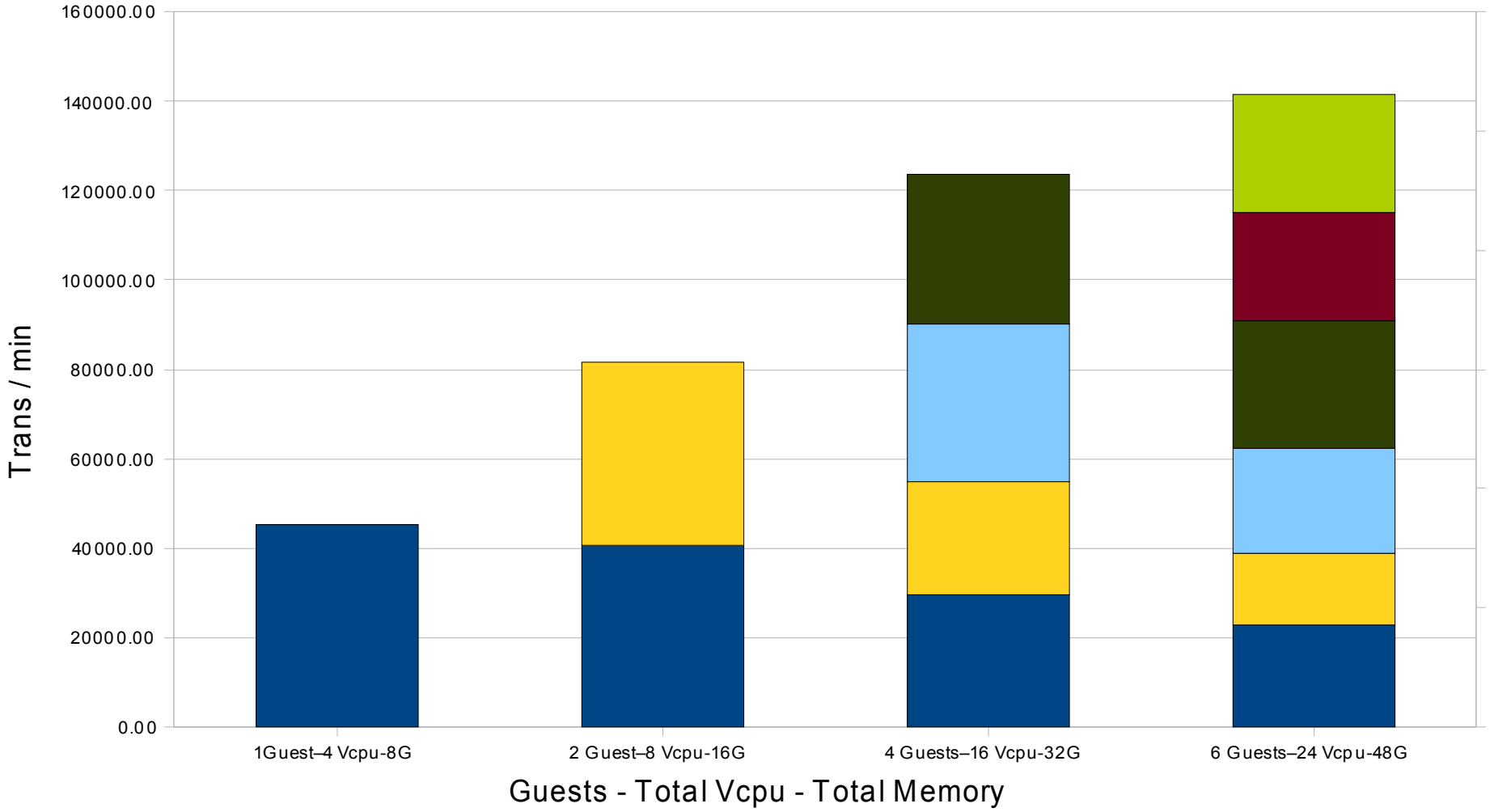
NUMA – Pinning with taskset



The platform supports NUMA. By pinning 4 database instances into 4 NUMA nodes a 10% performance improvement was seen (Compare bar 3 & 4)

KVM – 4 Vcpu Multi guest - Sybase OLTP

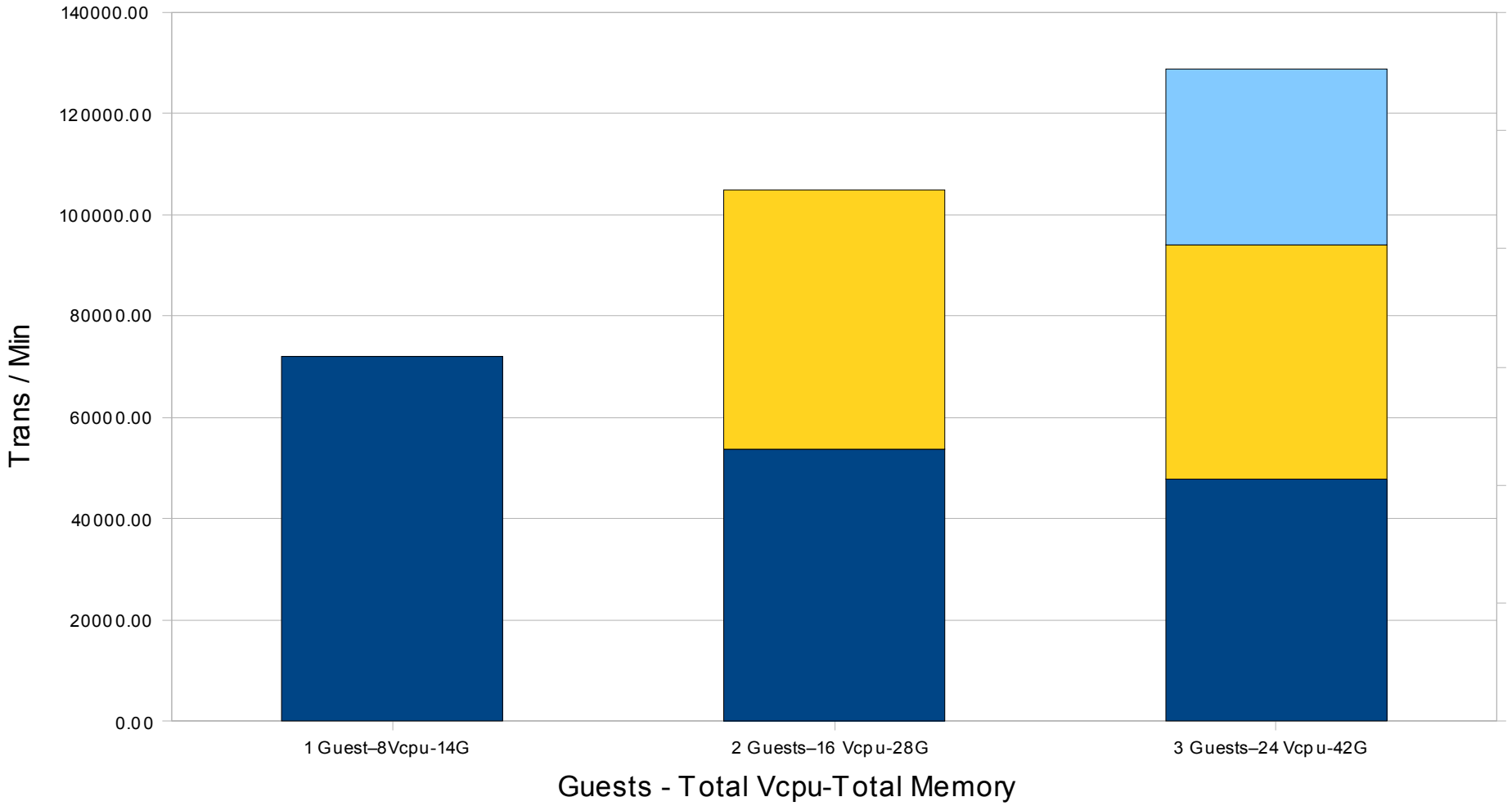
Istanbul - 24 cpu - 64G



4 vcpu guests showed scaling trend as more guests were added.
Scaling was not linear as the workload was not tuned to run in KVM guest

KVM – 8 Vcpu Multi guest - Sybase OLTP

Istanbul 24 cpu - 64G



8 vcpu guests showed scaling trend as more guests were added.
Scaling was not linear as the workload was not tuned to run in KVM guest

Conclusion

Six-core AMD Opteron™ Processor “Istanbul” has shown:

- Good Vertical scaling
  - Storage (low latency)
  - Memory (Dense memory)
- Good Horizontal scaling
  - Consolidation
  - Virtualization
    - Storage (low latency , high bandwidth)
    - Memory (Dense memory)
    - NUMA

Conclusion (contd)

Six-core AMD Opteron™ Processor “Istanbul”:

- Retains the prior generation innovations
- Adds new innovations
  - six-core, HTAssist, higher HyperTransport 3.0 bandwidth
- Optimized on RHEL, new hardware features enabled
- System consolidation in data centers
- What is your data center story?

Questions?

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Backup

Four-Socket STREAM Performance Improvement with HT Assist (slide 10)

42GB/s using 4 x Six-Core AMD Opteron™ processors (“Istanbul”) Model 8435 in Tyan Thunder n4250QE (S4985-E) motherboard, 32GB (16x2GB DDR2-800) memory, SuSE Linux® Enterprise Server 10 SP1 64-bit (with HT Assist enabled)
25.5GB/s using 4 x Six-Core AMD Opteron™ processors (“Istanbul”) Model 8435 in Tyan Thunder n4250QE (S4985-E) motherboard, 32GB (16x2GB DDR2-800) memory, SuSE Linux® Enterprise Server 10 SP1 64-bit (with HT Assist disabled)
24GB/s using 4 x Quad-Core AMD Opteron™ processors (“Shanghai”) Model 8384 in Tyan Thunder n4250QE (S4985-E) motherboard, 32GB (16x2GB DDR2-800) memory, SuSE Linux® Enterprise Server 10 SP1 64-bit
9GB/s using 4 x Hex-Core Intel Xeon processors (“Dunnington”) Model E7450 in Supermicro X7QC3+ motherboard, 32GB (16x2GB DDR2-667 FB-DIMM) memory, SuSE Linux® Enterprise Server 10 SP1 64-bit

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