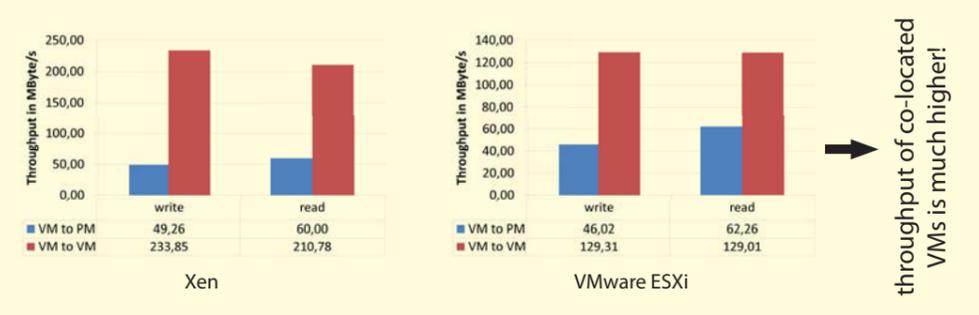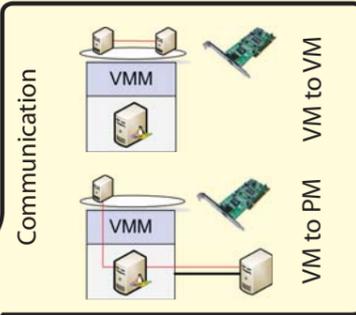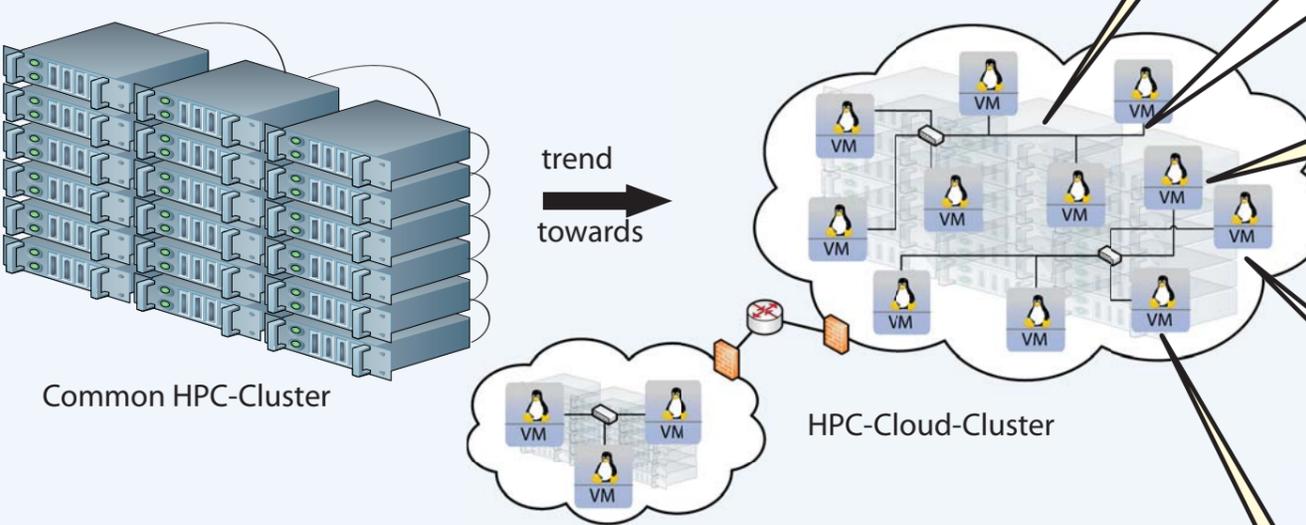# High Performance Cloud Computing - Why not?!
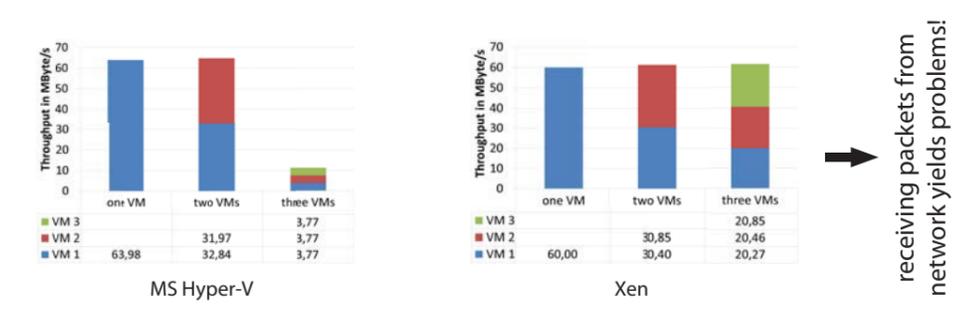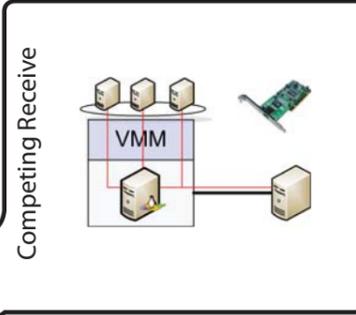
Dieter Kranzlmüller, Tobias Lindinger, Nils gentschen Felde
Ludwig-Maximilians-Universität München
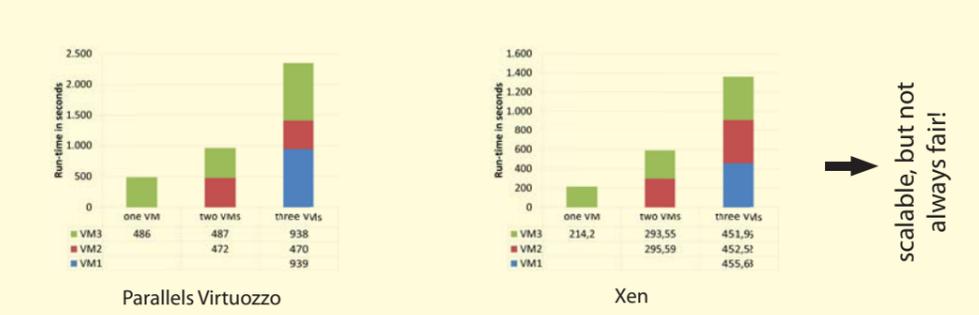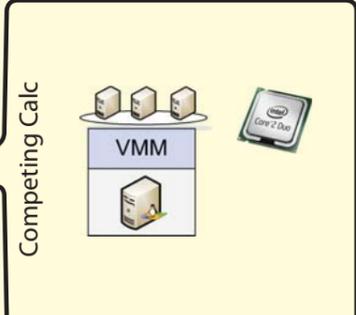{kranzlm, lindinge, felde}@mnm-team.org

MNM TEAM
MUNICH NETWORK MANAGEMENT TEAM

HPC-Cloud-Cluster

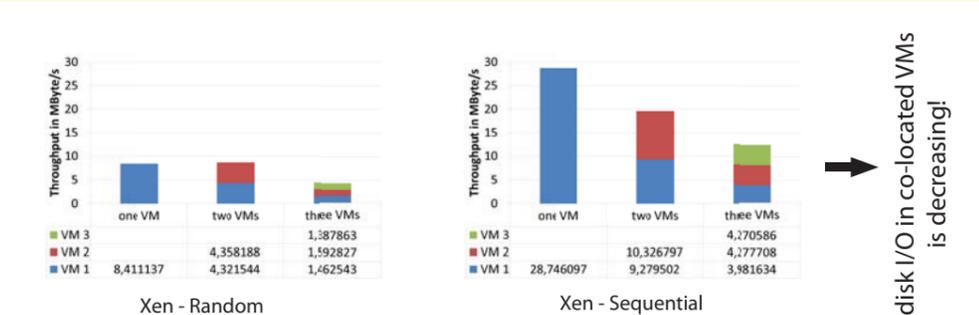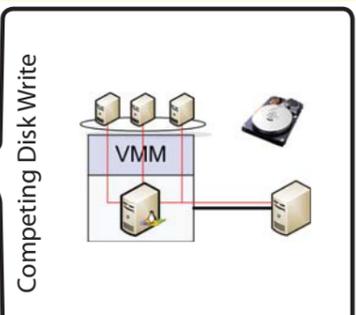|	PROs	CONs
Fault	• Failures of physical machines can be compensated without resetting the whole cluster to a checkpoint	• Faults and their causes may be "cloudy"
Configuration	• Easy, dynamic and fine grained partitioning of a cluster • Management and configuration of the system can be simplified and automized	• *Very* dynamic changes of configuration expected • CMDBs for virtual infrastructures do not yet exist
Accounting	• New accounting methods possible	• Accounting measures are still subject of research

Performance	• Loadbalancing is possible due to Live Migration
	  • intra computing center
	  • inter computing center
		• Virtualization overhead decreases performance
		• VMs may influence each other
		• Changing the network topology by the use of VM migrations will decrease MPI performance

Security	• Better security because sandboxing of processes is possible	• Virtualization layer may yield access to entire cluster

Common HPC-Cluster

trend towards

HPC-Cloud-Cluster

Communication
VM to VM
VM to PM

throughput of co-located VMs is much higher!

Xen — VMware ESXi

Competing Receive
MS Hyper-V — Xen

receiving packets from network yields problems!

Competing Calc
Parallels Virtuozzo — Xen

scalable, but not always fair!

Competing Disk Write
Xen - Random — Xen - Sequential

disk I/O in co-located VMs is decreasing!

Read from RAM

Virtualization of main memory is efficient!

Recommendations

static	dynamic
• I/O of VMs is highly CPU intense	• Group communicating VMs on a physical server instance

• Disk-I/O of VMs tends to be inefficient, sequential access to a virtual disk may be mapped to non-sequential access on physical disks	• Avoid migration of VMs due to minor loadbalancing issues
	  • during migration response time of migrated VM may increase
	  • network optimized MPI implementations will get in trouble

• Check your Hypervisor / VMM for fair scheduling implementations	• Separate VMs with high I/O (network, disk, ...)
• Don't overcommit CPU ressources - attach VMs to CPUs/cores exclusively	
• Binding VMs to physical CPUs/cores will preserve caches	
• Allocate CPU quota to Hypervisor / VMM	

Future Work / Trends

• More CPU-cores in parallel will cause high failure rates due to huge amount of components. New techniques for resilience and fault tolerance will be necessary!
• MPI must be extended in order to support virtual networks
• Intelligent distributions of virtual machines must be calculated and realized automatically

Conclusions / Observations

• Trend towards virtualization also in HPC -> exascale-roadmap
  But: No HPC-Cloud-Cluster in (upper) TOP 500
• Virtualization is efficient and effective
  But: Coevally running VMs on same hardware reveal side-effects
• Virtualization may offer great additional benefits:
  • management, especially fault mgmt, resilience, desaster recovery
  • performance by "intelligent" VM distributions
• A lot more research needed!