

Advanced Resource Sharing in the Cloud

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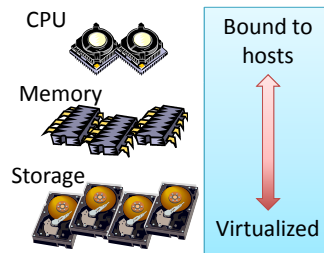
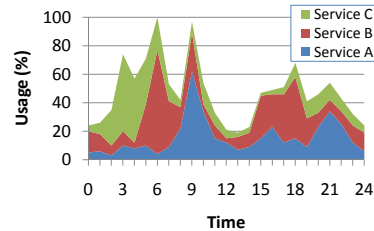
Cloud computing

- Goal
 - Cost effectiveness
 - Scale-out
 - Elasticity
- Methodology
 - Virtualization of every computing resource
 - System elements (IaaS: Infrastructure as a Service)
 - Ex: processor, memory, storage, network, ...
 - Middleware services (PaaS: Platform as a Service)
 - Ex: database, overlay communication, security, ...
 - Application services (SaaS: Software as a Service)
 - Ex: e-mail, wordprocessor, accounting information system, ...



Sharing everything

- Benefit of cloud computing is derived from statistical multiplexing
 - Sharing computing resources among users, applications, and computing systems
 - Flexible resource sharing to maximize the statistical multiplexing is the key
- Storage sharing (virtualization) is a hot topic in data center networks
 - FC, iSCSI, FCoE, etc
- Next step: memory sharing in cloud
 - Memory price is dropping sharply

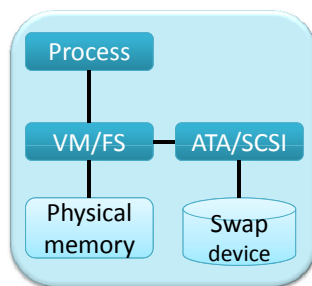


Three approaches to large scale memory sharing

- Virtual machine migration
 - Move a guest VM to a host with more free memory
 - Pro: Easy deployment
 - Con: High migration cost
- Explicit Shared memory
 - Programming with memory sharing API
 - Pro: High flexibility (programmability)
 - Con: High implementation cost and low manageability
- Remote memory mapping
 - Import memory of a remote host into the local virtual memory space
 - Pro: High manageability
 - Con: High deployment cost (no de facto implementation)

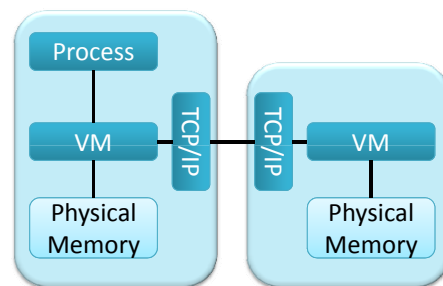
Virtualization of virtual memory

- Our approach: mount remote memory as swap device
 - Physical memory is already virtualized in OS (VM: virtual memory)
 - Pro: High performance
 - Con: (straightforward) implementation in kernel VM layer is highly difficult



Normal system

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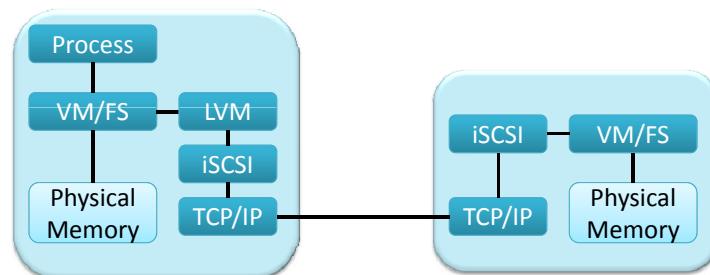
Extended system

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Leveraging LVM and iSCSI

- System configuration is highly flexible, thanks to modern LVM (logical volume management) mechanism
 - Dynamic attachment/detachment of remote memory linked to the memory usage
- iSCSI performance in high latency networks is well-studied
 - Distributed cloud environment

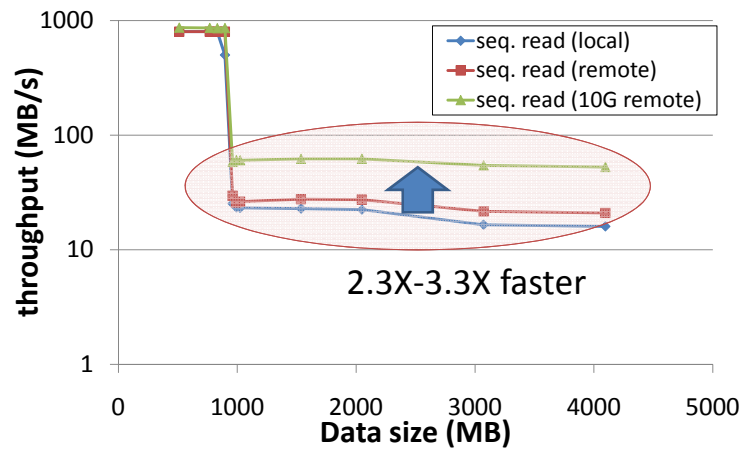


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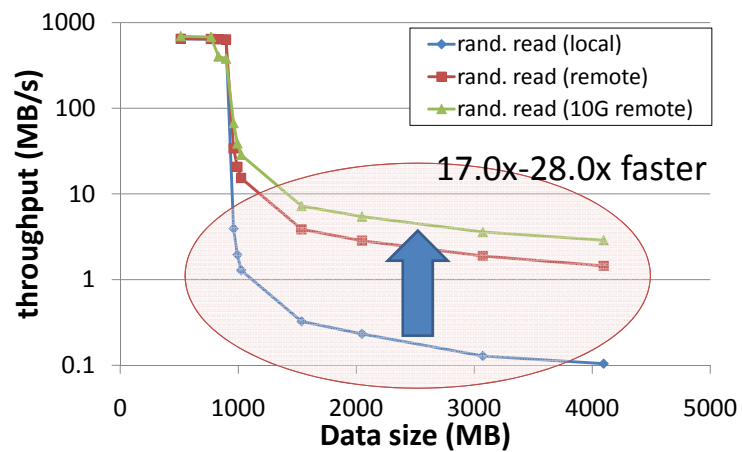
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Performance: sequential access (read)



Performance: random access (read)



Summary

- Memory sharing is a forthcoming technology to be deployed in the cloud
- We proposed a low-cost memory sharing mechanism with LVM and iSCSI
- Future work
 - Engineering iSCSI performance over long distant networks (including JP-TH JGN2plus network!!)
 - Memory cluster management mechanisms

Thank you