System and Virtualization Management :
Standards and the Cloud

Corset :
Service-oriented Resource Management System in Linux

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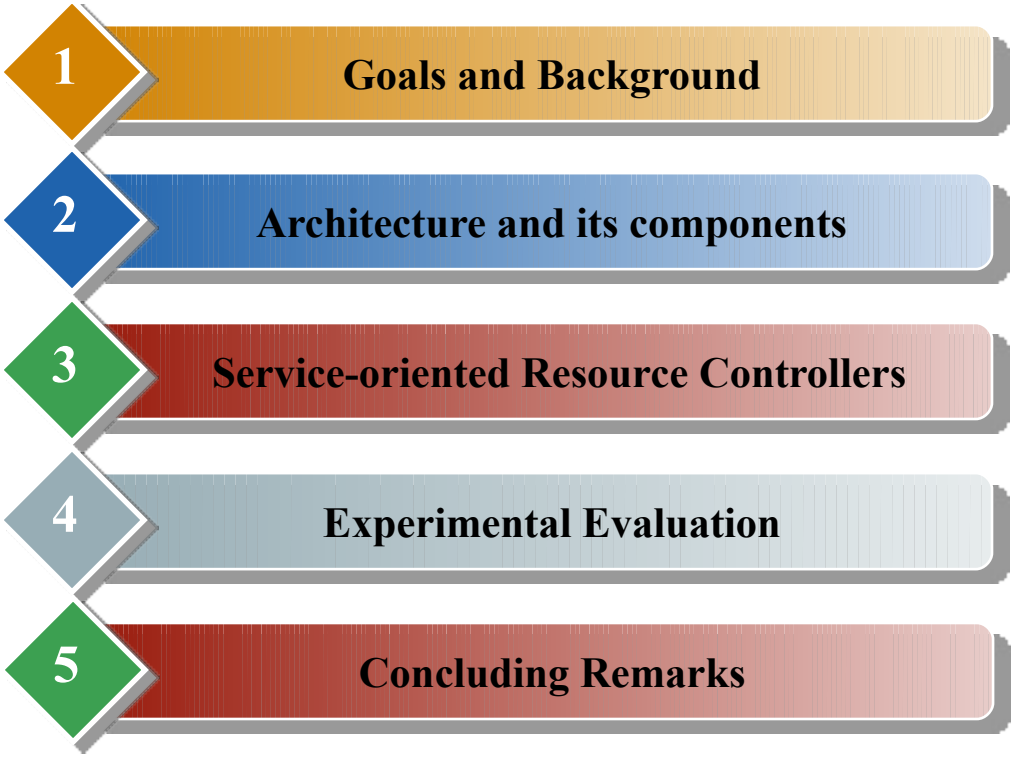
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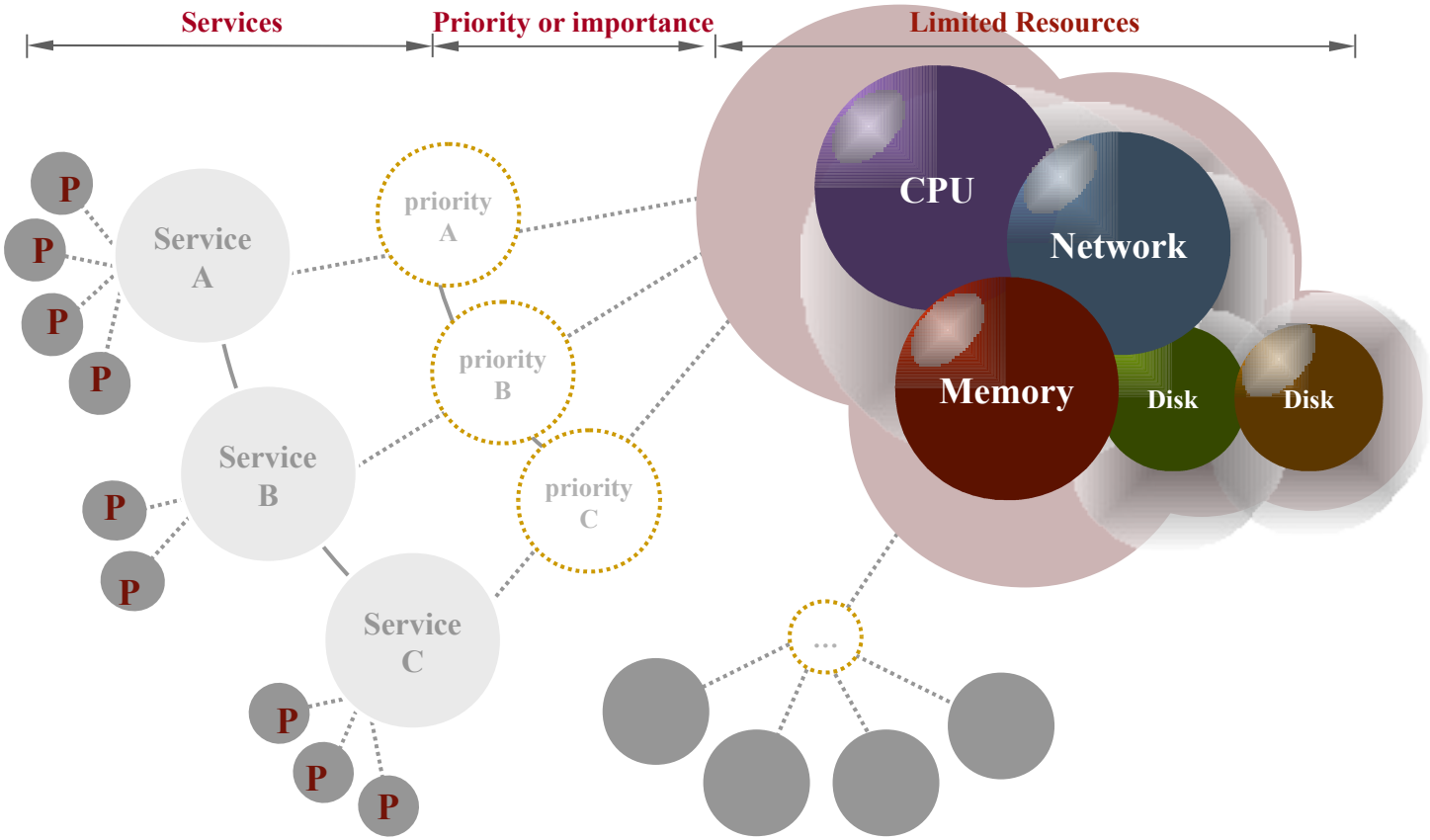
Goal & Problems

- Goal
  - Guaranteeing the service QoS or stability in unexpected workload situation

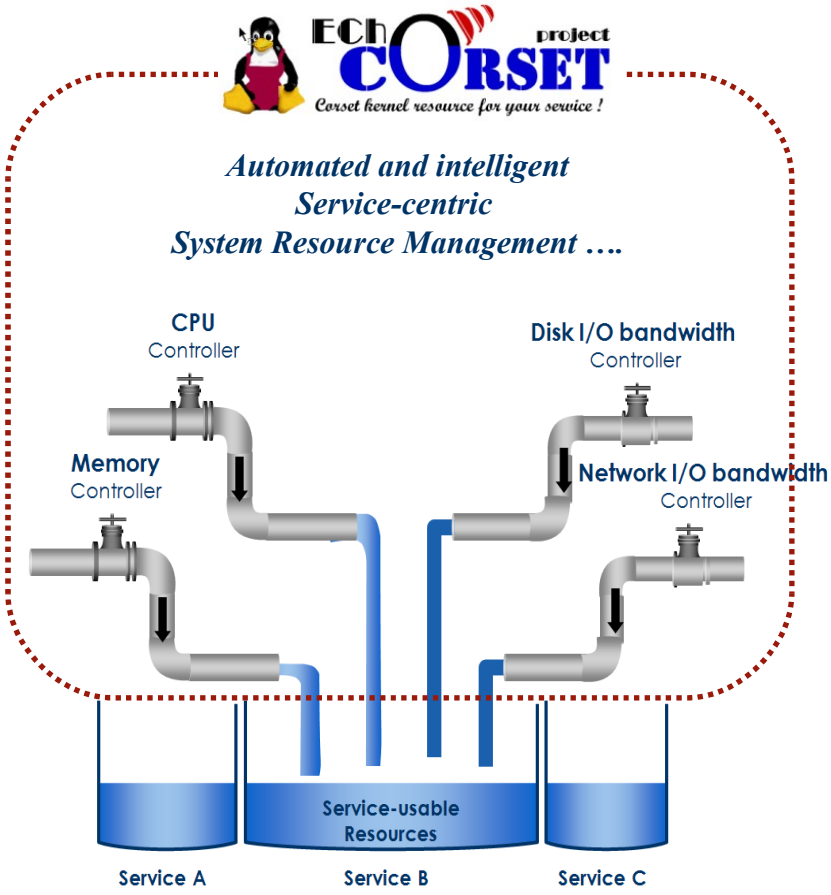
- Problems
  - System resources are not enough for many running services and application in a system
  - As the service is more complex, process-unit or system-unit resource management is not enough for guaranteeing the service performance or QoS
  - All services running in a system don't have same importance
  - Administrator can't guarantee that the specific service has proper resources in unsettled workload situation
  - System resource management is not easy for administrators

Background

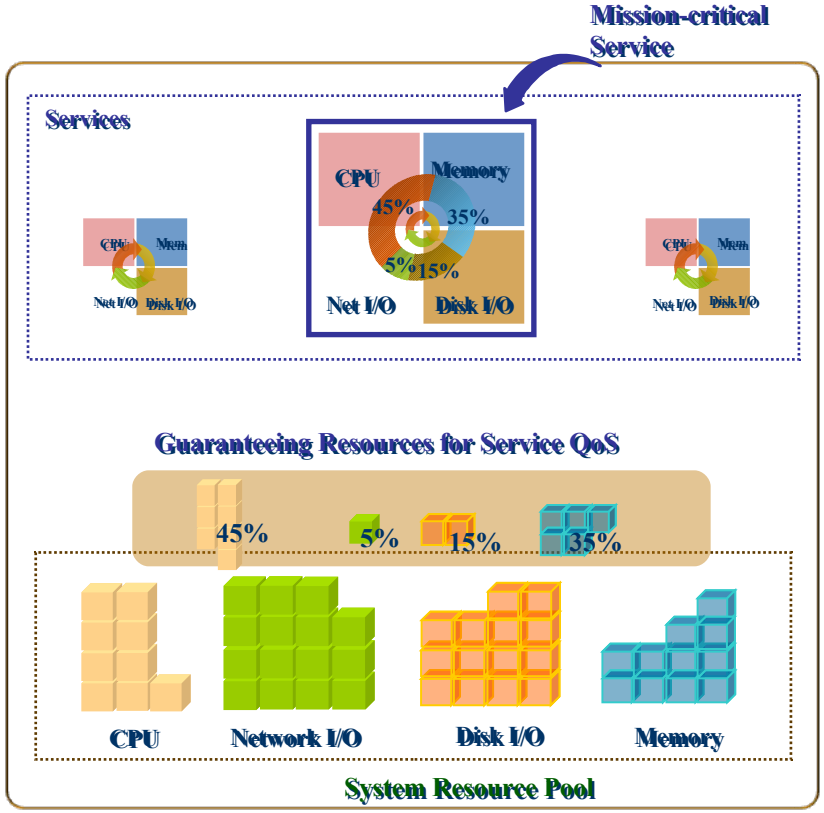

Services
Priority or importance
Limited Resources
Service A
Service B
Service C
priority A
priority B
priority C
P
CPU
Network
Memory
Disk
Disk
...

Concept of Corset

What is ….?



What can we do with ….?



Corset Architecture

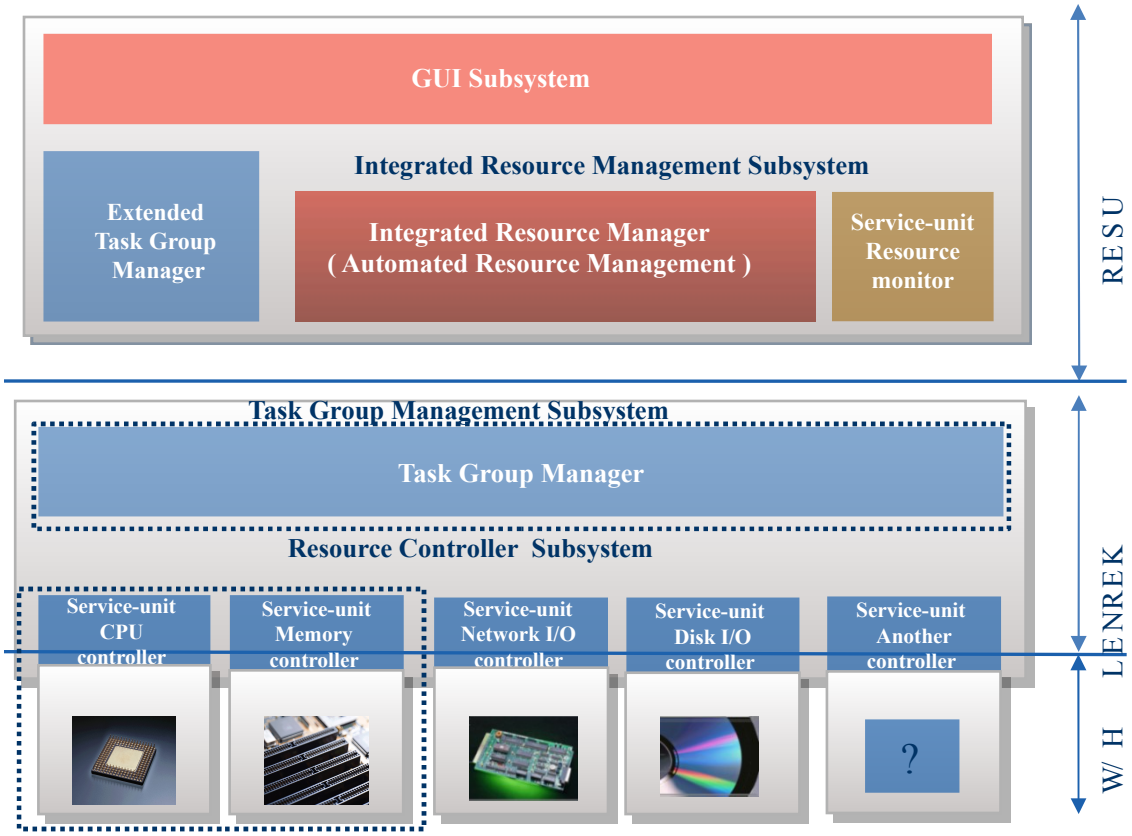


Fig. This is whole architecture of CORSET that consists of four subsystems.

Components of Corset (1/2)

- Resource controller subsystem
  - May be a kind of resource scheduler or controller
    - Allocate or withdraw each resource to/from the specific service
    - Support predicable or proportional sharing of resources according to service priority
    - CPU, Memory, Disk I/O bandwidth, Network I/O bandwidth and so on

- Task group management subsystem
  - Allow administrator to organize a new service with the processes he/she want to include based on PID
    - Create or destroy service
    - Add/delete/move processes to/from specific service

Components of Corset (2/2)

- Integrated management subsystem
  - Support dynamic & autonomic reconfiguration according to changeable and unexpected workload
  - create and provides service-unit resource information to assist service-unit resource management

- GUI management subsystem
  - Support convenient and easy environment for system resource management by abstracting the complex interfaces of below blocks

Service-oriented Resource Controllers(1/3)

- Service-oriented CPU and Memory Controller
  - We adapt existing functionalities in linux kernel (about upper kernel-2.6.24)
  - CPU
    - CFS scheduler + cgroup framework
    - Proportional share
  - Memory
    - mem_cgroup + page_cgroup
    - Limiting the maximum usage

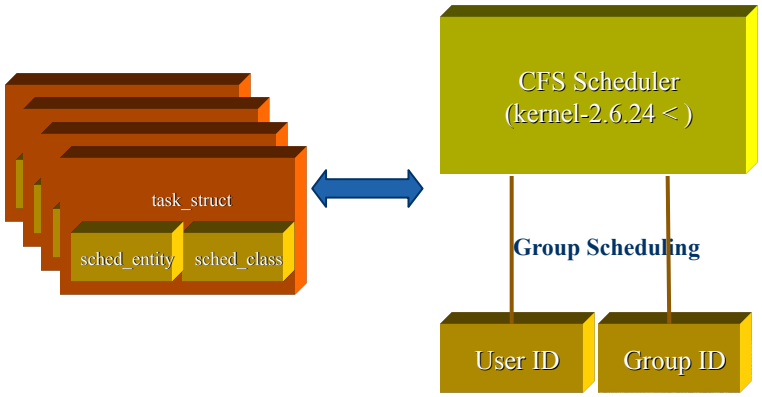


Fig. CPU Control using existing functionality

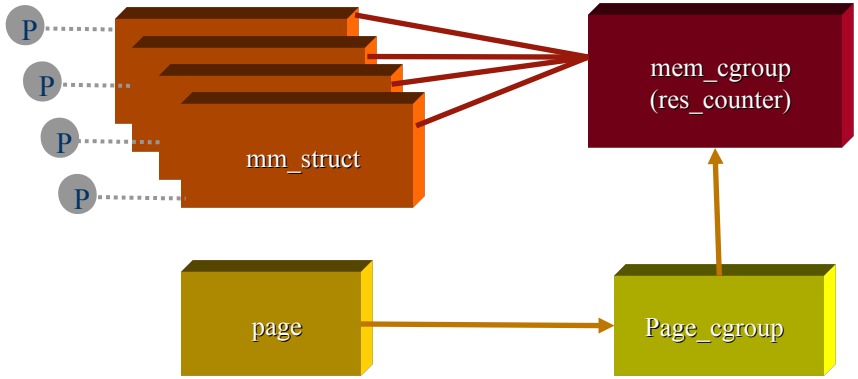


Fig. Memory Control using existing functionality

Service-oriented Resource Controllers(2/3)

- Service-oriented Disk I/O Controller
  - A kind of new device mapper driver
  - Independent of underlying specific I/O schedulers
  - Supported policies
    - Proportional share(weight)
    - Range share(range-bw)

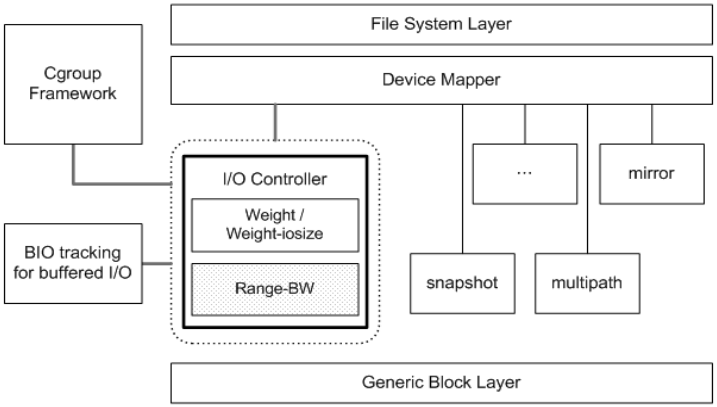


Fig. Overview of Disk I/O Controller

- http://sourceforge.net/projects/ioband

Service-oriented Resource Controllers(3/3)

- Service-oriented Network Controller
  - TC(traffic control) module already support the limiting or fixed bandwidth
    - Based on IP, port and something like that
  - TC didn't support the process group based bandwidth control
    - We added assigning, exporting and importing P.G ID in TC

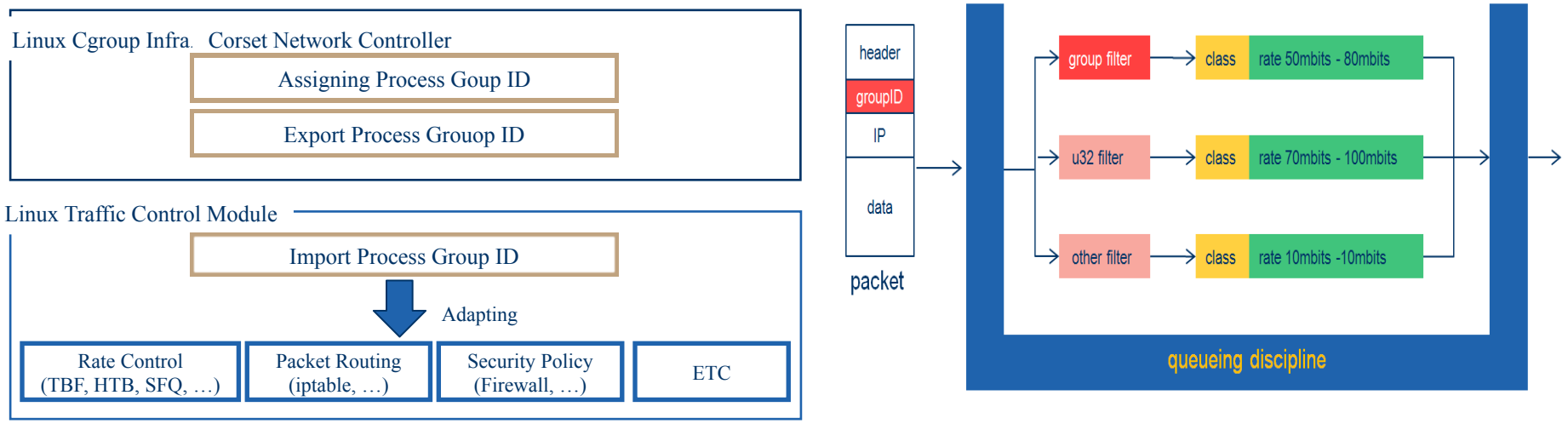


Fig. Overview of Netwrok I/O Controller

Evaluation Environment

- Category for Evaluation
  - Resource guaranteeing test
    - groupA : groupB : groupC = 1 process : 50 or 100 processes : 50 or 100 processes
  - Resource limitation test
    - groupA : groupB : groupC = 1 process : 1 processes : 50 or 100 processes
  - Resource isolation test
    - groupA : groupB : groupC = 50 or 100 processes : 50 or 100 processes : 50 or 100 processes
- H/W and S/W Specification for test

	Evaluation System Specification (H/W & S/W)					
	System	OS	Disk	CPU	Mem	Workloader
Spec	SAMSUNG Smart Server ZSS108	linux (kernel-2.6.30-rc1)	SAMSUNG SATA-2, 7,200rpm, 80G	2-way, Intel Pentium4 3.4 GHz	2 GB	CPU : ebizzy Mem : ebizzy Disk : fio-1.26 Net : iperf-2.0.4

Experimental Evaluation (Disk I/O BW)

Group1 : group2 : group3 = 2(1) : 1(100) : 1(100)

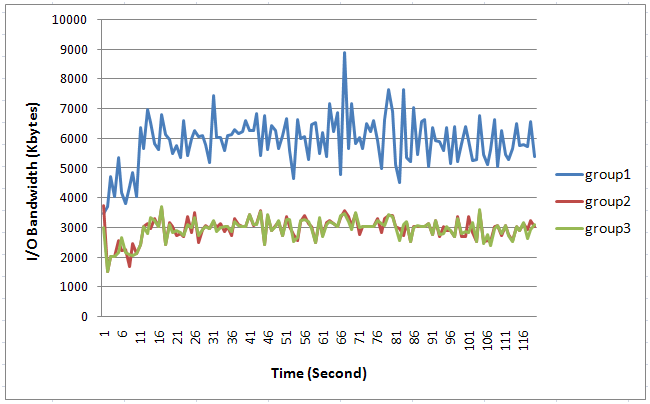


Fig. I/O bandwidth in resource guaranteeing test(proportional)

Group1 : group2 : group3 = 11~12M(1) : 5~6M(100) : 5~6M(100)

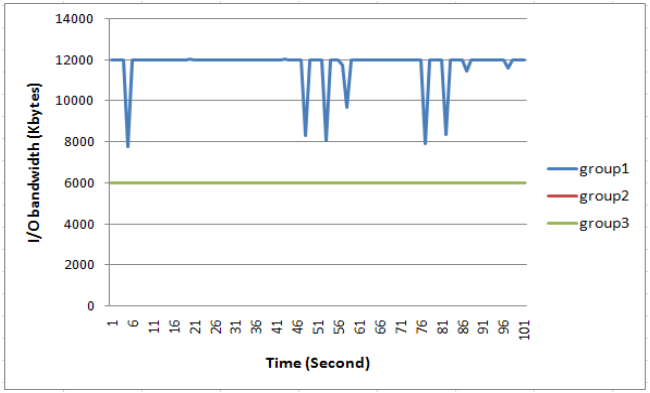


Fig. I/O bandwidth in resource guaranteeing test(range-bw)

Group1 : group2 : group3 = 1(100) : 2(1) : 2(1)

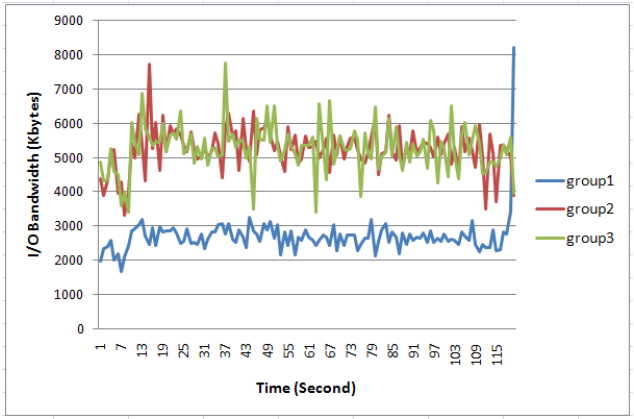


Fig. I/O bandwidth in resource limitation test(proportional)

Group1 : group2 : group3 = 1(100):5(100):9(100)

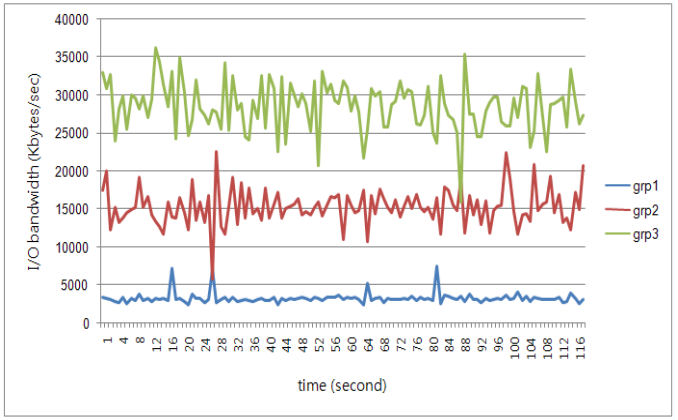


Fig. I/O bandwidth in resource isolation test(proportional)

Experimental Evaluation (Network I/O BW)

Group1 : group2 = 600Mbps(10) : 300Mbps(up to 100)

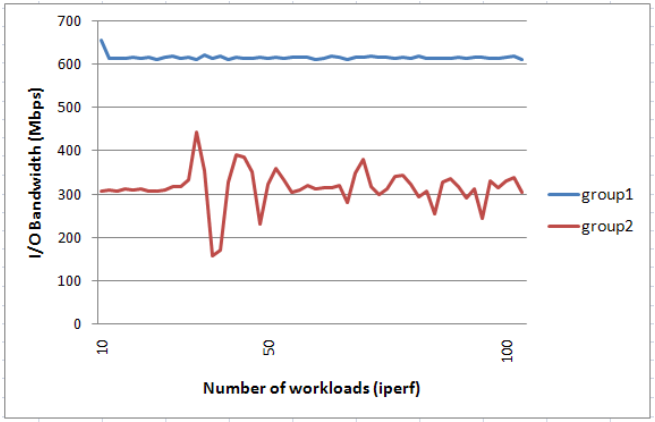


Fig. I/O bandwidth in resource guaranteeing test

Group1 : group2 = 700Mbps(10) : 200Mbps(up to 100)

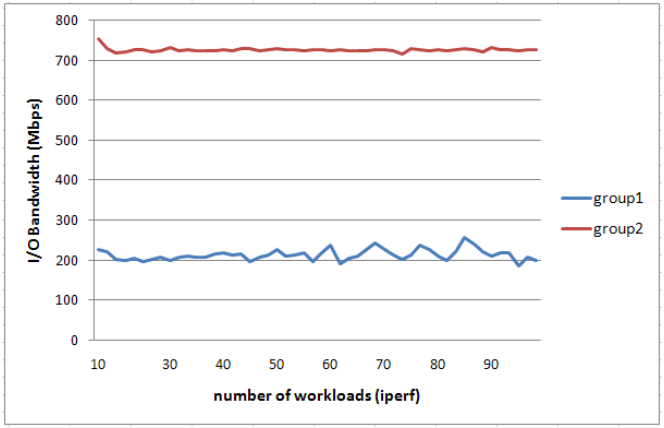


Fig. I/O bandwidth in resource limitation test

Group1 : group2 : group3 = 10Mbps(50) : 30Mbps(50) : 60Mbps(50)

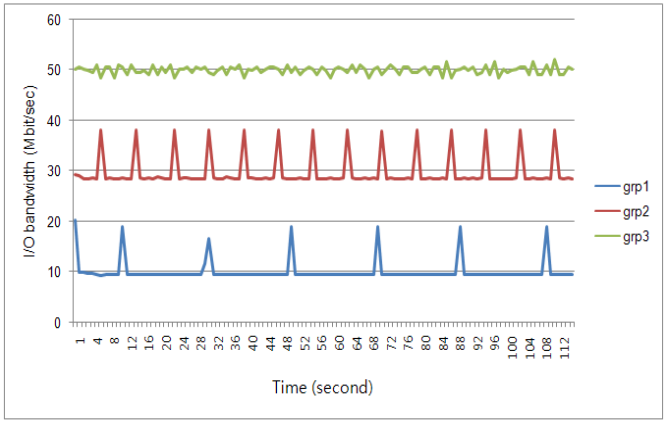


Fig. I/O bandwidth in resource isolation test

Experimental Evaluation (Memory)

Group1 : group2 : group3= 10M(1) : 200M(1) : 700M(1)

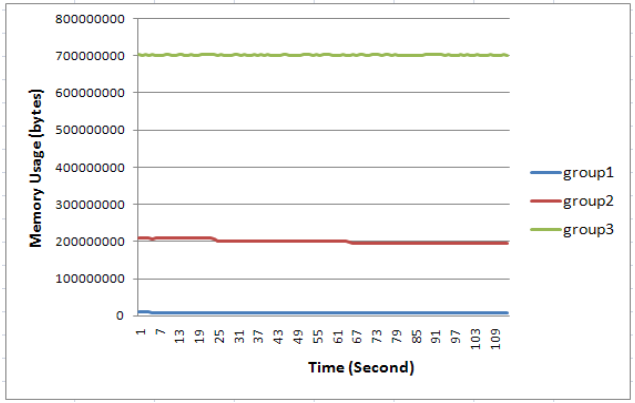


Fig. Memory control in normal test

Group1 : group2 : group3= 500M(1) : 250M(50) : 250M(50)

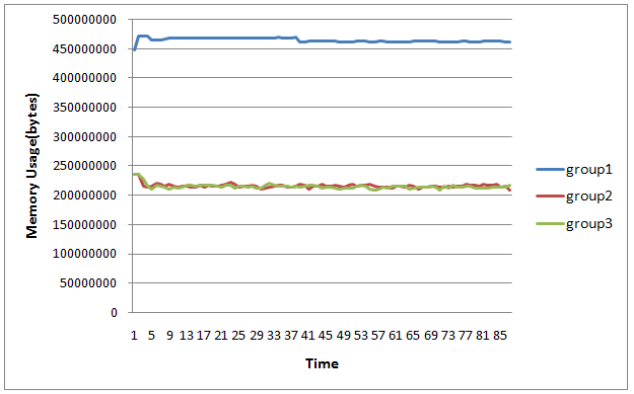


Fig. Memory control in resource guaranteeing test

Group1 : group2 : group3= 200M(50) : 400M(1) : 400M(1)

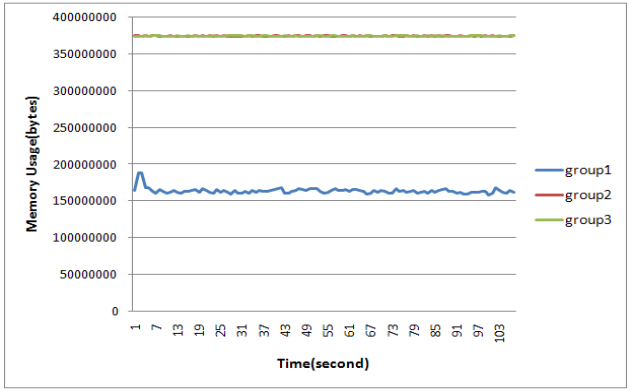


Fig. Memory control in resource limitation test

Group1 : group2 : group3= 500M(50) : 333M(50) : 166M(50)

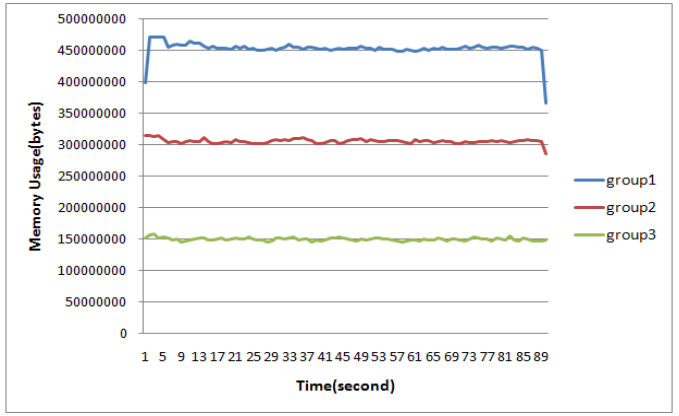


Fig. Memory control in resource isolation test

Experimental Evaluation (CPU)

Group1 : group2 = 2(1) : 1(200)

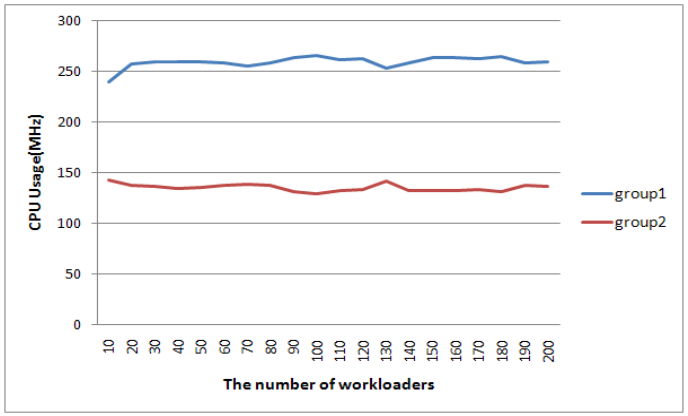


Fig. CPU usage in resource guaranteeing test

Group1 : group2 = 1(1) : 2(continuous increase up to 200)

Fig. CPU usage in resource limitation test

Group1 : group2 : group3 : group4 : group5 = 1(100) : 1(100) : 1(100) : 1(100) : 1(100)

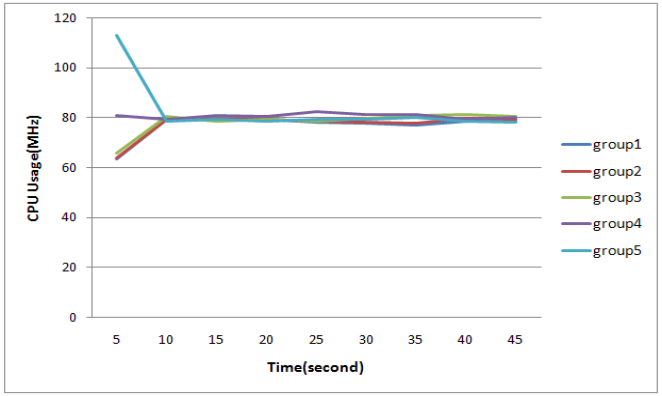
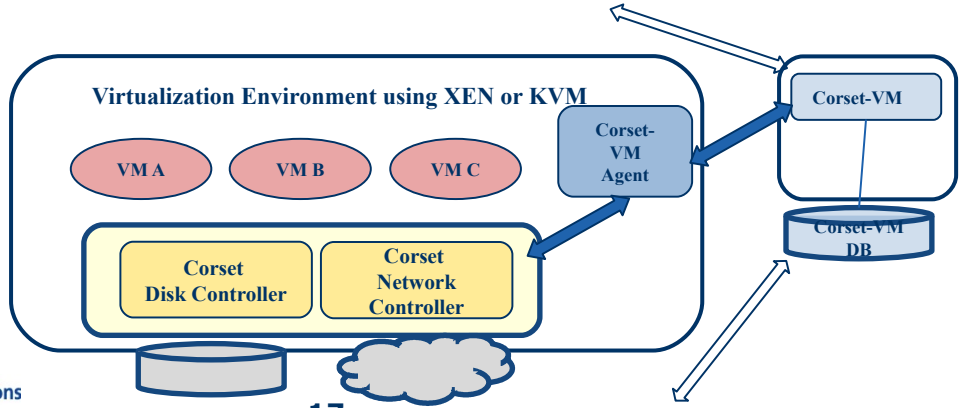


Fig. CPU usage in resource isolation test

Concluding Remarks

- Features of Corset
  - Suggested service-oriented resource management system
    - Allocates the system resources focused on service according to its priority
    - Supports the expectable resources to each service to maintain the its QoS
      - Proportional allocation
      - Fixed allocation
      - Range allocation
  - Makes the limited system resources to be used efficiently
  - Supports the dynamic controls of the system resources
- Future works
  - Supports the I/O control method for virtual machines



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Thank You !

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