Planning and optimizing HPC configuration based upon problem based thinking

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Seattle, WA, 11-12. Nov. 2011

Problem based thinking

Medical attendance is more and more shifting towards the transparent, accountable, technology-based approach.

An increasing proportion of the chronic ill children's parents require special services that adapt to their requirements, lifestyle and life quality.

In our INFCARE8 R&D project we elaborate and realize the system of the integrated mechatronic and IT environment at prototype level.

System proposed

This system consists of the following subsystems:

- 24-hour video supervision system, in a portable design, with simple local installation and an automatic data storing and alarm system (including taking of a full-value recording of the covered patient),
- AAL technology-based intelligent bed modules for three functions (controlled medicine storage and medication; patient-nurse-physician communication; supporting of learning-culture-entertainment),
- Development of mobile diagnostic head unit (the wireless EEG "helmet"),
- Integrated middleware framework to realise the critical messaging,
- HPC based robust and reliable back-office architecture

Planning of HPC back office

System requirements based on problem based thinking:

- Possibility of converge different information source like CT, MRI and EEG
  - Large memory can help
- High speed data coming (40-50 MB/m) for a long time (around the clock)
  - Large common high speed strorage
  - High availability (no single point of failure)

Architecture

HPC architecture based on problem based thinking:

- Large fat node cluster
- Common large cluster storage based on Infiniband
- High availability (no single point of failure) means everything should be duplicated

Cooperation

- Széchenyi University can’t set-up a super computer alone
  - Cooperation with Hungarian Academy and other Universities
- We can setup three centers one mini in Győr (cc. 1TFLOP) a small at Budapest (cc. 5 TFLOP) and a larger in Szeged (cc. 14 TFLOP)
- All three configuration has different technology
  - Mini – C3000 blade Infiniband DDR, Intel 2 socket
  - Small – SL165 tray Infiniband QDR, AMD 2 socket
  - Large – C7000 blade Infiniband QDR, AMD 4 socket

Optimization: Problem&Solution

Problem: Cooling in small configuration

SL165 servers seems to be ” tired”

12:54:04	START SLEEP (300)						
START: 12:59:40:00	WC01L2C2	103679	144	15	48	227.40	3.267e+03
START: 13:03:37:00	WC01L2C2	103679	144	15	48	261.68	2.839e+03
START: 13:08:08:00	WC01L2C2	103679	144	15	48	304.75	2.438e+03
13:13:02	START SLEEP (360)						
START: 13:19:22:00	WC01L2C2	103679	144	15	48	201.19	3.693e+03
START: 13:22:53:00	WC01L2C2	103679	144	15	48	254.79	2.916e+03
START: 13:27:17:00	WC01L2C2	103679	144	15	48	297.07	2.501e+03
13:32:02	START SLEEP (420)						
START: 13:39:24:00	WC01L2C2	103679	144	15	48	192.43	3.861e+03
START: 13:42:46:00	WC01L2C2	103679	144	15	48	245.48	3.027e+03
START: 13:47:01:00	WC01L2C2	103679	144	15	48	293.42	2.532e+03
13:52:00	START SLEEP (480)						
START: 14:00:06:00	WC01L2C2	103679	144	15	48	190.08	3.909e+03
START: 14:03:26:00	WC01L2C2	103679	144	15	48	238.08	3.121e+03
START: 14:07:33:00	WC01L2C2	103679	144	15	48	284.87	2.608e+03

Solution: HP Watercool rack optimization

Optimization: Problem&Solution

Problem: High available boot in diskless environment

In diskless environment we use NFS as a central OS image store with CMU. The NFS server can be put in high available configuration. The compute nodes can be hang if NFS failover occur.

Solution: Boot sequence of RHEL should be change (initrd)

- First we have to put the Ethernet port under a bond interface
- We have to mount the NFS share over UDP instead of TCP (which is the RHEL5 default)
- Big lessons learned Redhat NEVER mention NFS over TCP is NOT state less ergo not fail safe!

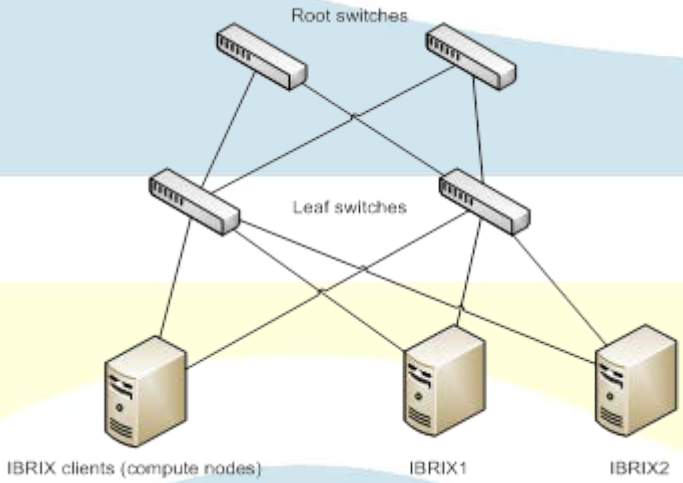
Optimization: Problem&Solution

Problem: High available cluster filesystem

We use HP X9320 storage solution (IBRIX) on top of Infiniband. The high availability on Infiniband has limitations, what we didn't know.

Solution: Just only one fat-tree topology can be used

- IBRIX using Linux bonding for HA
- IB bond driver support just mode 1
- Two separate IB network run well with MPI but not wit IPoIB bond

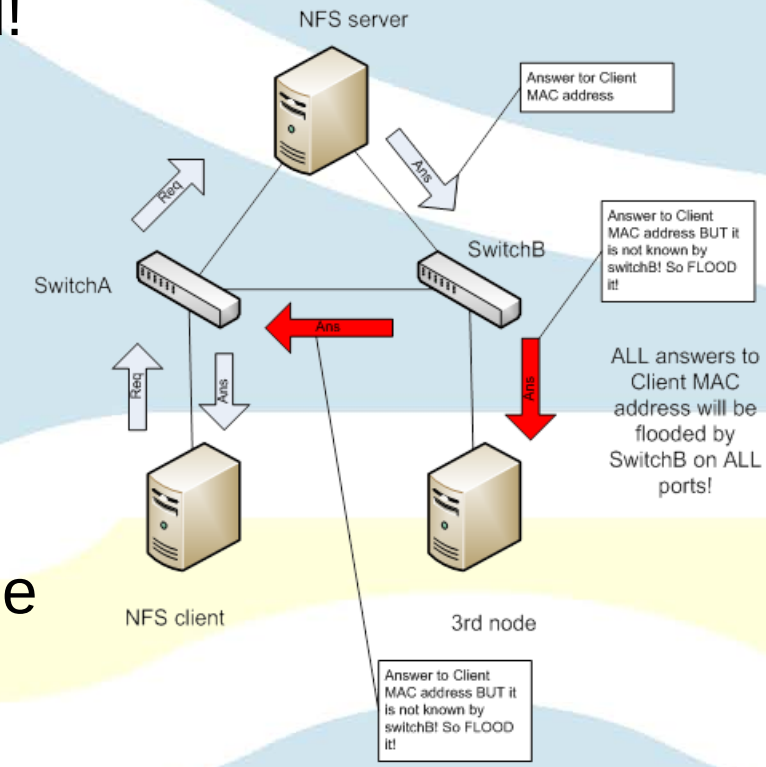


Optimization: Problem&Solution

Problem: Unsolicited unknown unicast flood

HP cluster platform using Procirve switches, IBRIX solution using bond mode 6 on Ethernet. This situation can cause large amount of unknown unicast flood!

Problem understanding:



Solution:

Use 3com switches with IRF instead of Procurve or send a broadcast on every compute node in every 300 second

Optimization: Problem&Solution

Problem: High failing rate of disk drives in HP X9320

After 6 month of operation we can imagine a very high failure rate of disk drives in cluster file system (cc. 60 drives left the RAID set from 192 in 6 month!)

HP stated out 2TB midline SAS drives should not have more than 40% I/O load, but who switch of a 240 TB file system every day?

Solution: There is a problem fixing project now to change all MDL SAS drives to enterprise category one.

Lessons learned

- If you know (the problem) better, you'll do (the project) better.
- Thermal problem can occur inside the server (ILO default two high for AMD systems)
- Using IBRIX in a HPC configuration needs high attention!
- Network problems in a cluster both Infiniband and Ethernet could come from the nodes and not just from the network device!

Thanks for your attention!