AccessionIndex: TCD-SCSS-T.20121208.095
Accession Date: 8-Dec-2012
Accession By: Dr.Brian Coghlan
Object name: csTCDie Beowulf Cluster
Vintage: 1998
Synopsis: Departmental cluster using 100Mbps Ethernet as interconnect, the second cluster constructed in the Department of Computer Science, Trinity College Dublin.

Description:
In the 1994 Thomas Sterling and Donald Becker of NASA created their *Beowulf* cluster [1] with multiple commodity nodes exchanging messages over a commodity interconnect. Beowulf clusters run Linux or another UNIX-lookalike plus messaging libraries such as MPI or PVM. This innovation prompted the building of this cluster.

The first Irish Beowulf cluster was constructed in 1997 by the School of Cosmic Physics in the Dublin Institute for Advanced Studies. The second Irish Beowulf cluster was constructed in the middle of the same year by the Department of Computer Science in Trinity College Dublin, a highly experimental configuration of 4-nodes that used a SCSI interconnect, the first of a number of clusters constructed by the department, some very production-oriented, others more adventurous, see elsewhere in this catalog.

The next cluster constructed in the department was a more straightforward Beowulf cluster that used 100Mbps Ethernet as interconnect. It was constructed with strong support from Prof.J.G.Byrne, for use by the Dept.Computer Science, Trinity College Dublin, but also to acquire knowledge of Beowulf clustering techniques.

This 16 cluster nodes were generic PC/AT-compatible machines with **(Pentium ?)** CPUs, **??MB** of memory, **??GB** of disk, interconnected with a 100Mbps Ethernet switch, all mounted on two custom-built shelving units. Account management was handled by primary and secondary NIS servers, and there were also a local DNS cache and an NTP time server, all mounted alongside UPSes below the cluster.

A common shared NFS-compatible filesystem was provided by a Windows-NT server with a RAID-5 subsystem using Vortex RAID controllers and running an Intersys NFS-to-NTFS service. This service was easy to administer but not bug-free. The RAID array was inherited from earlier research on a *Stable Disk* within the EU-funded FASST project, see elsewhere in this catalog.

A lot was learnt from the operation of this cluster. The initial support for parallel programming focussed on PVM, but MPI soon followed. Links with like-minded academics were also begun that continued through EU projects for the next 15 years. One of the most interesting episodes occurred when hackers outside the department but inside the university intensively attacked the cluster, initially bringing it to its knees within two minutes of a reboot. This forced the rapid evolution of a Linux `proxy-arp` firewall on a DEC Alpha machine pretending to be a Windows x86 machine (our thanks to Mark Gantly of DEC for quickly donating an Alpha server).

This cluster was superceded in 1999 by a cluster with firstly a ring-structured, then a second generation switched, SCI interconnect, see elsewhere in this catalog.

Apart from the RAID array, it was thought that no remnants of this cluster remained, but then two decades after decommissioning, the primary NIS server (cagraidsvr04, a Tatung *"pizza box"* PC with Cyrix MediaGXm 266MHz CPU, 32MB of memory, ST34321A 4.3GB IDE disk, 3.5" floppy disk and 24X CD-ROM drive) has been discovered (see figures below), and surprisingly found to be still operational and running Linux 2.0.6 (released on 12-Jul-1996 [2]), a really early Linux kernel only used in Redhat 3.x releases [3][4][5] (known to have been installed from a RedHat CD [6]). Given the early kernel, the original IDE hard disk has been cloned to an SSD, which has then been connected in place of the original hard disk so that the kernel is preserved working 'live' for posterity and to be available for detailed investigation in the potentially distant future. There are mail logs beginning on 13-Oct-1998 through to 2004. The disk contents have been found to be fully accessible, with what appear to be backups of the cluster software; digging into the OS and these backups may reveal more about the configuration of this early cluster as a whole.

The homepage for this catalog is at: https://www.scss.tcd.ie/SCSSTreasuresCatalog/
Click *'Accession Index'* (1st column listed) for related folder, or *'About'* for further guidance. Some of the items below may be more properly part of other categories of this catalog, but are listed here for convenience.

Accession Index	Object with Identification
TCD-SCSS-T.20121208.095	csTCDie Beowulf Cluster, Departmental cluster using 100Mbps Ethernet as interconnect, the second cluster constructed in the Department of Computer Science, Trinity College Dublin, 1998.
TCD-SCSS-T.20121208.095.01	csTCDie Beowulf Cluster NIS server. Login name server from second cluster constructed in the department. 1998.
TCD-SCSS-T.20121208.095.02	csTCDie Beowulf Cluster NIS server. Backup of login name server IDE disk from second cluster constructed in the department. 1998.
TCD-SCSS-T.20150217.003	Prototype RAID, First RAID chassis built in the Dept.Computer Science, TCD, with five SCSI-1 disks and PC/AT power supply. PSU S/N: 7X705993, c.1990
TCD-SCSS-T.20121208.094	Experimental SCSI Cluster, 4-node prototype cluster using SCSI as interconnect, the first cluster constructed in the Department of Computer Science, Trinity College Dublin, and second cluster constructed in the Republic of Ireland, 1997.
TCD-SCSS-T.20141120.003	csTCDie Grid-Ireland SCI Cluster, 16-node cluster using 400MB/s SCI switched interconnect, the third cluster constructed in the Department of Computer Science, Trinity College Dublin, c.1999.
TCD-SCSS-T.20121208.097	VRengine, 9-node virtual reality engine using 600MB/s SCI 2-d toroidal interconnect, c.2005.
TCD-SCSS-T.20121208.098	csTCDie Grid Site Beowulf Clusters and Datastore, Complex of clusters & storage (1500 cores/600 TB) using 1Gbps Ethernet interconnect and 10Gbps backbone, participant in DataGrid, EGEE, EGI, and CERN LHC computing. From 2013 repurposed as SCSS Cloud, c.2009.
TCD-SCSS-T.20121208.106	csTCDie PS3 Cluster, Ten nodes from a 16-node Sony Playstation PS3 cluster plus build machine, using 1Gbps

	Ethernet interconnect and running Yellow Dog Linux, c.2009.
TCD-SCSS-T.20121208.099	csTCDie GPU Cluster, 64-core/32-GPU/16-node cluster using 1Gbps Ethernet interconnect, c.2011.

References:

1. Wikipedia, *Beowulf cluster*, see:
   https://en.wikipedia.org/wiki/Beowulf_cluster
   Last browsed to on 30-May-2023.

2. `mirror.cs.msu.ru`, *Linux Kernel Version History: 2.0 series kernels*, (table last updated on 30-Jan-2001 at 00:53:59 GMT), see:
   https://mirror.cs.msu.ru/oldlinux.org/Linux.old/docs/history/2.0.html
   Last browsed to on 30-May-2023.

3. Wikipedia, *Red Hat Linux*, see:
   https://en.m.wikipedia.org/wiki/Red_Hat_Linux
   Last browsed to on 30-May-2023.

4. OpenSkills, *RedHat: History of releases*, see:
   https://openskills.info/infobox.php?ID=1094
   Last browsed to on 30-May-2023.

5. Fedora Project Wiki, *History of Red Hat Linux*, see:
   https://fedoraproject.org/wiki/History_of_Red_Hat_Linux
   Last browsed to on 30-May-2023.

6. Brian Coghlan, *Personal recollection*, 30-May-2023.

Figure 1: csTCDie Beowulf Cluster NIS server, top three-quarter view

Figure 2: csTCDie Beowulf Cluster NIS server, front view

Figure 3: csTCDie Beowulf Cluster NIS server, rear view

Figure 4: csTCDie Beowulf Cluster NIS server, rear view closeup

Figure 5: csTCDie Beowulf Cluster NIS server, manufacturing label

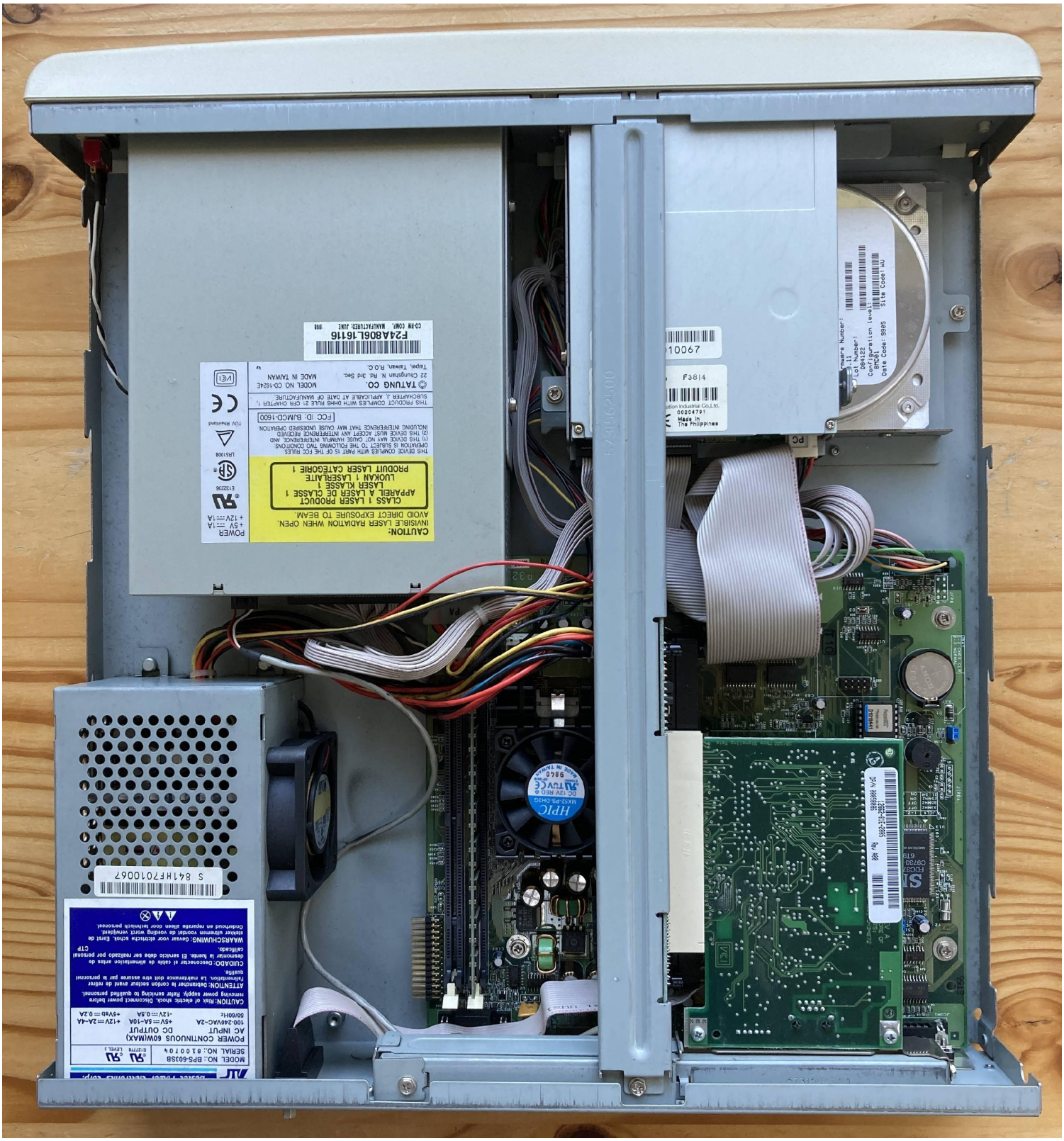


Figure 6: csTCDie Beowulf Cluster NIS server, rear view

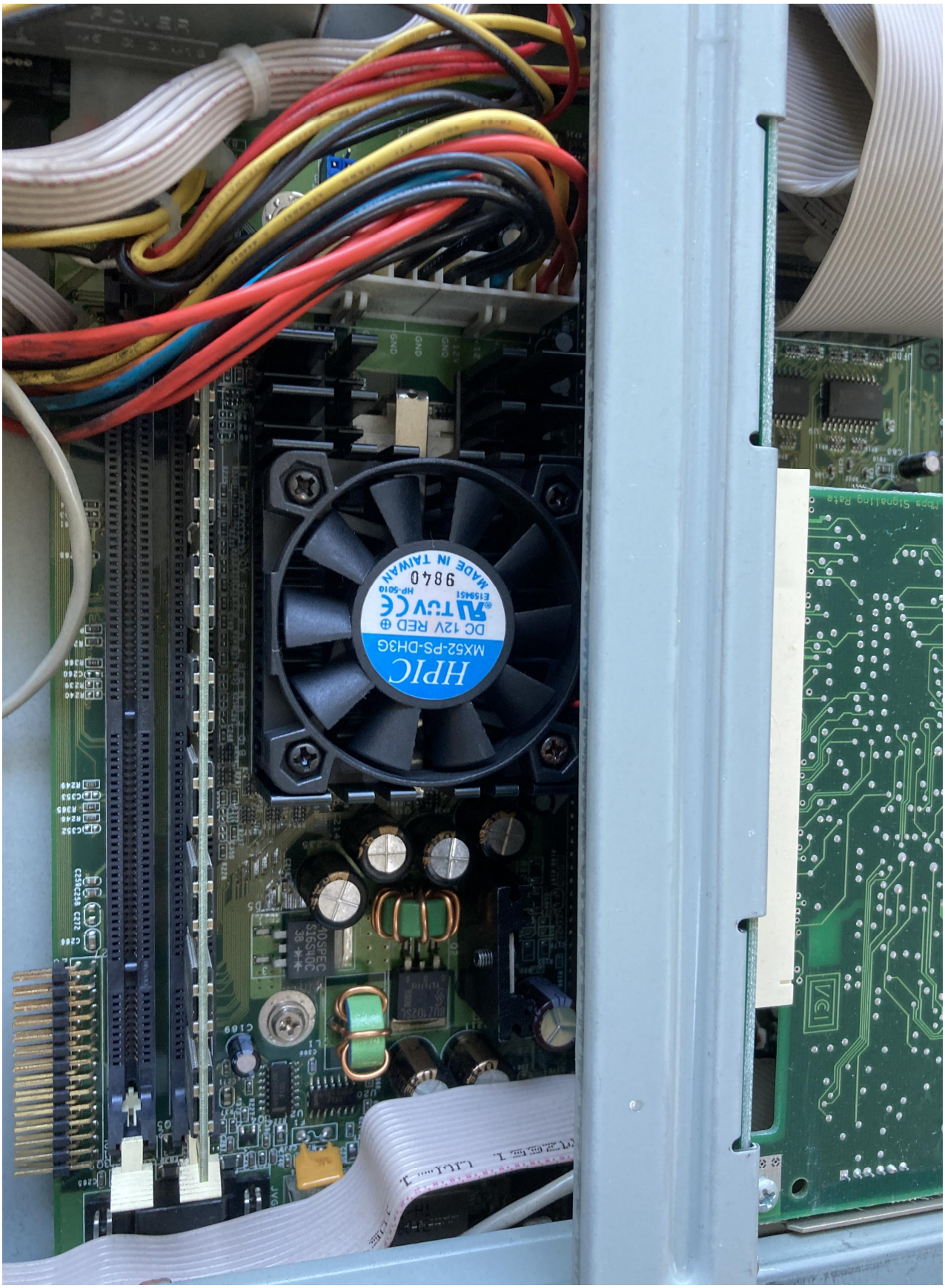


Figure 7: csTCDie Beowulf Cluster NIS server, internal view, CPU and memory

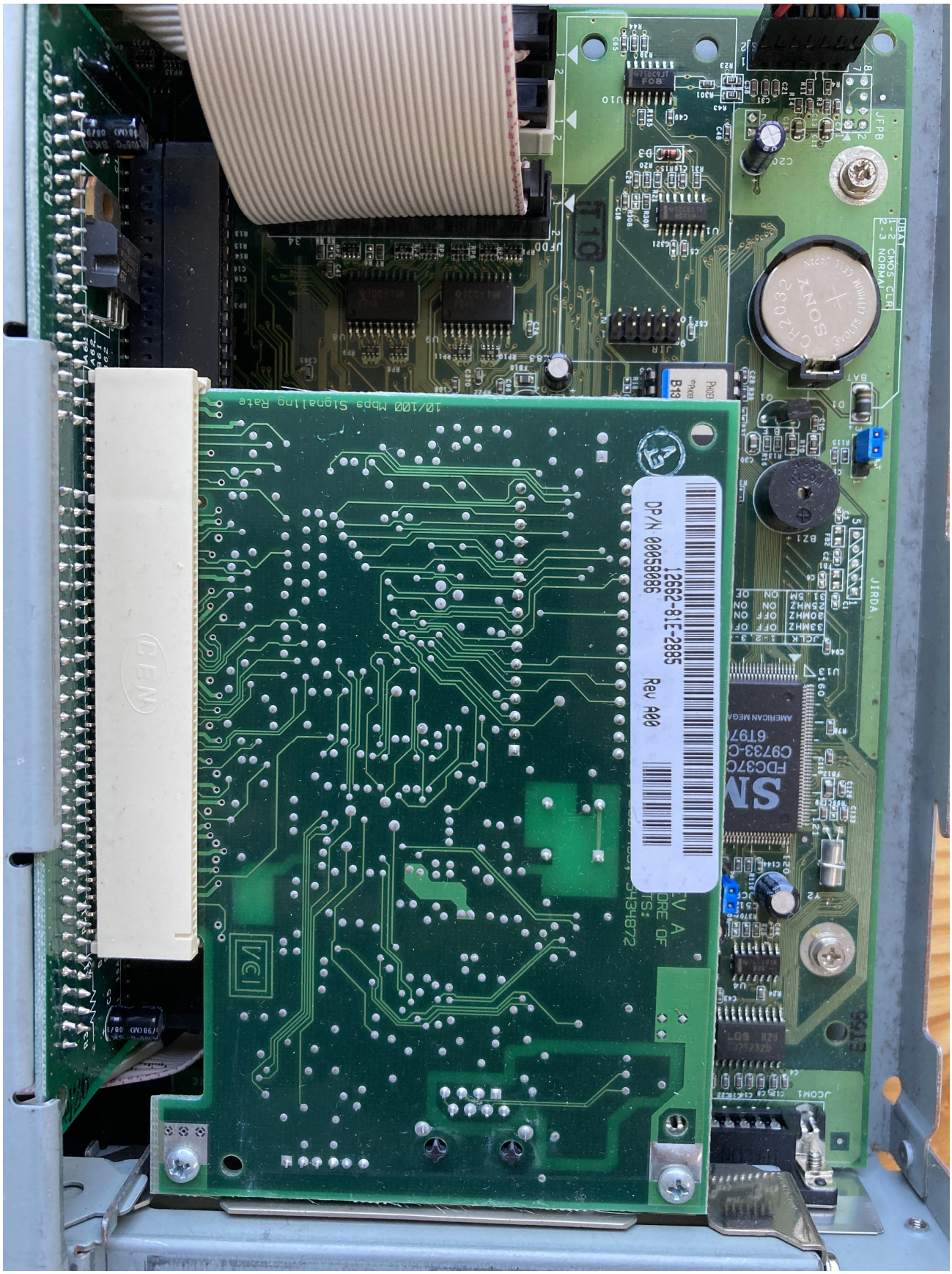


Figure 8: csTCDie Beowulf Cluster NIS server, internal view, Ethernet adapter

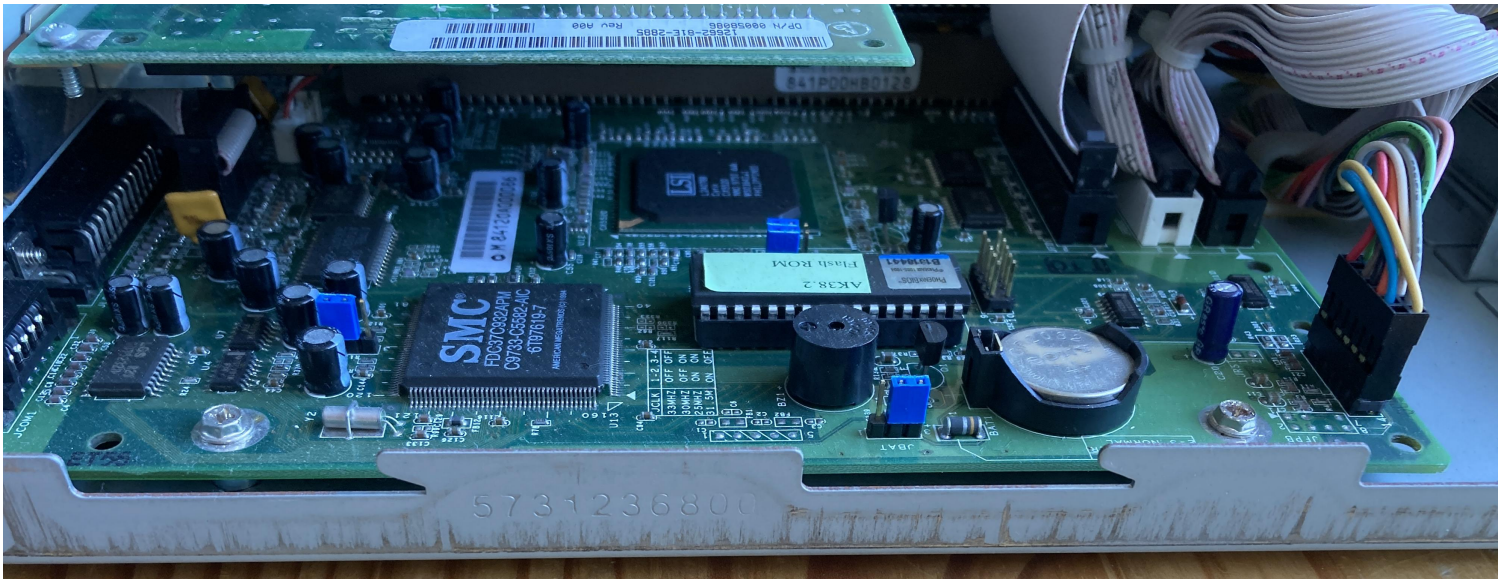


Figure 9: csTCDie Beowulf Cluster NIS server, internal view, motherboard

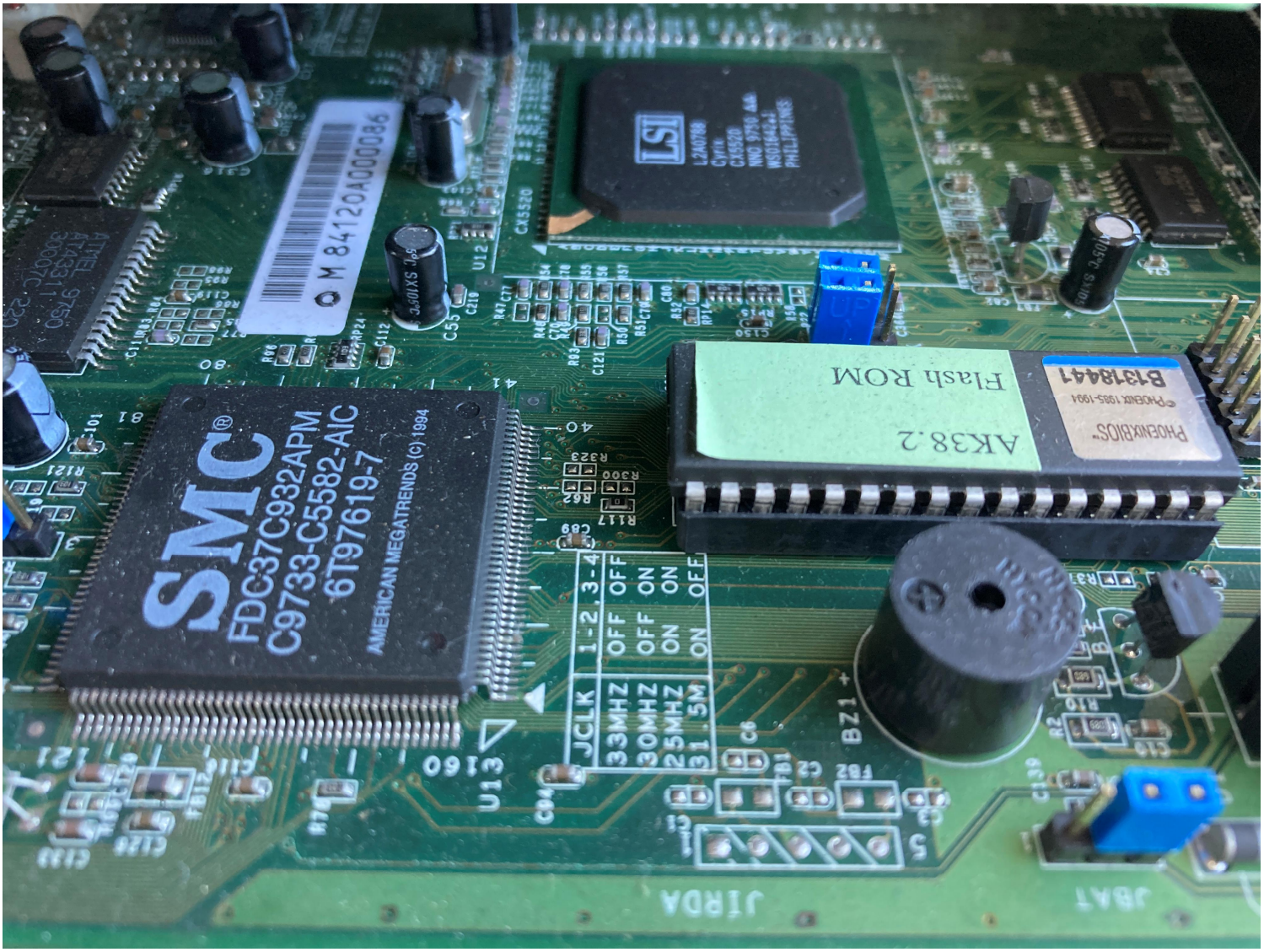


Figure 10: csTCDie Beowulf Cluster NIS server, internal view, motherboard closeup

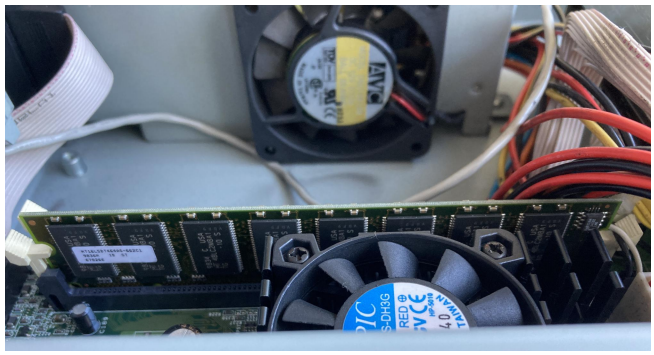


Figure 11: csTCDie Beowulf Cluster NIS server, internal view, memory

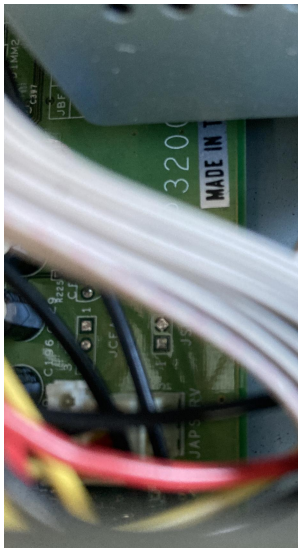


Figure 12: csTCDie Beowulf Cluster NIS server, internal view, partially obscured motherboard identification

Figure 13: csTCDie Beowulf Cluster NIS server, internal view, hard disk identification

Seagate ST34321A 4.3GB IDE hard disk, 5 heads, 17 sectors of 512 bytes, 33344 cylinders

/hda1: blocks 1-890,	*37768+ blocks,*	*ID=83 (Linux)*
/hda2: blocks 891-98725,	*4158000 blocks,*	*ID=5 (ext)*
/hda5: blocks 891-3914,	*128488 blocks,*	*ID=82 (swap)*
/hda6: blocks 3915-6938,	*128488 blocks,*	*ID=82 (swap)*
/hda7: blocks 6939-9962,	*128488 blocks,*	*ID=82 (swap)*
/hda8: blocks 9963-12986,	*128488 blocks,*	*ID=82 (swap)*
/hda9: blocks 12987-98369,	*3628768 blocks,*	*ID=83 (Linux)*

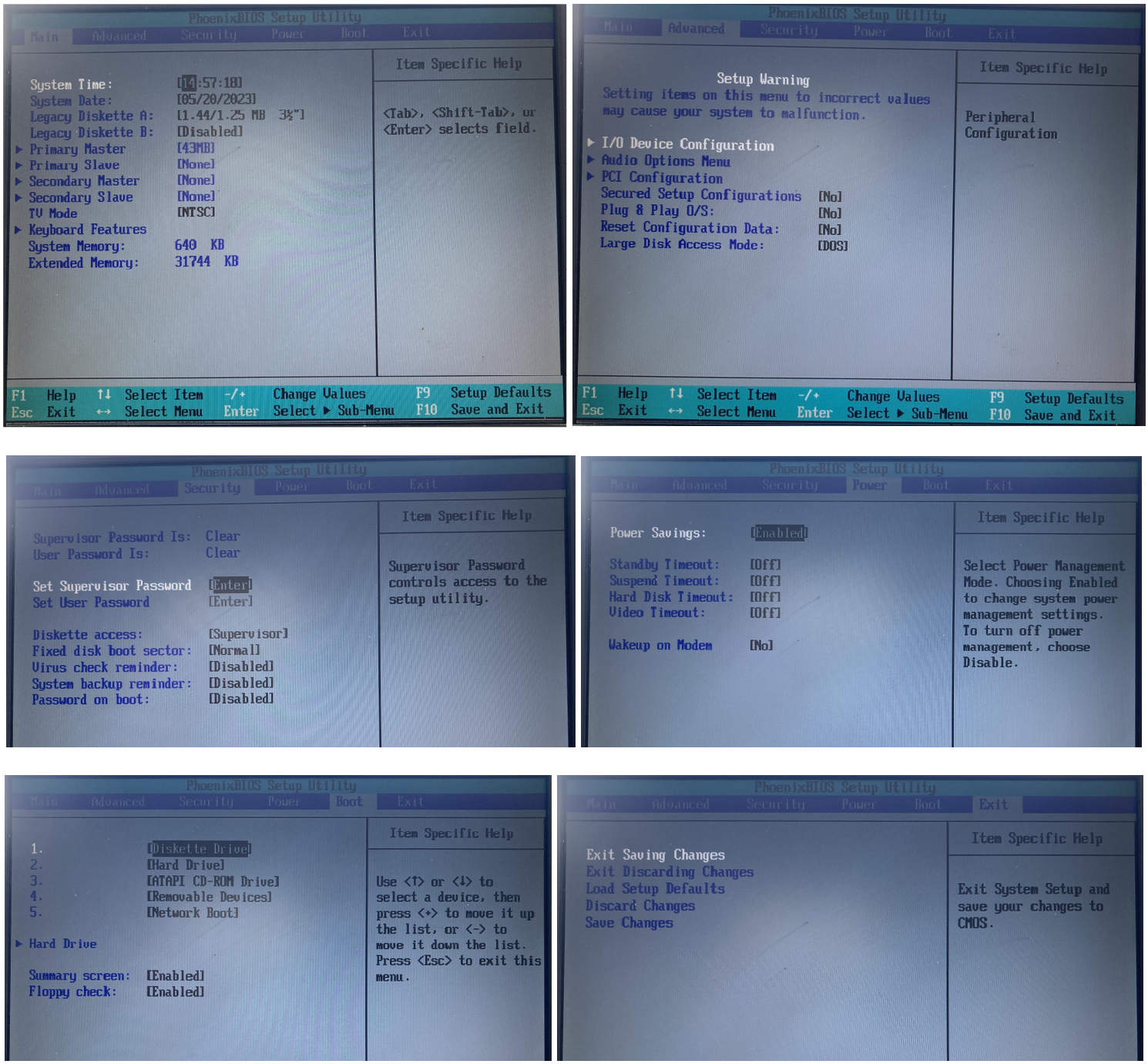
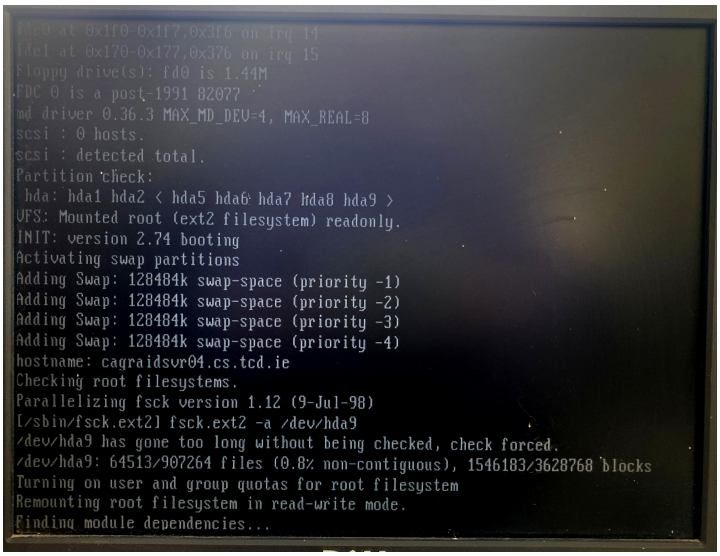
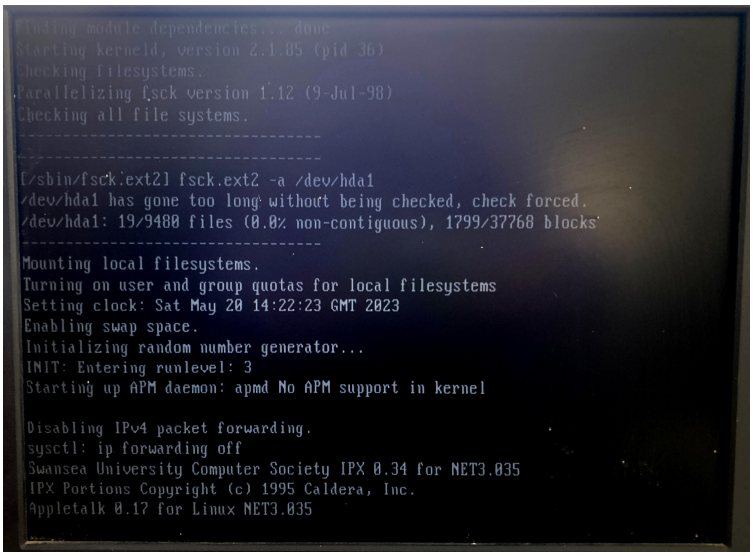


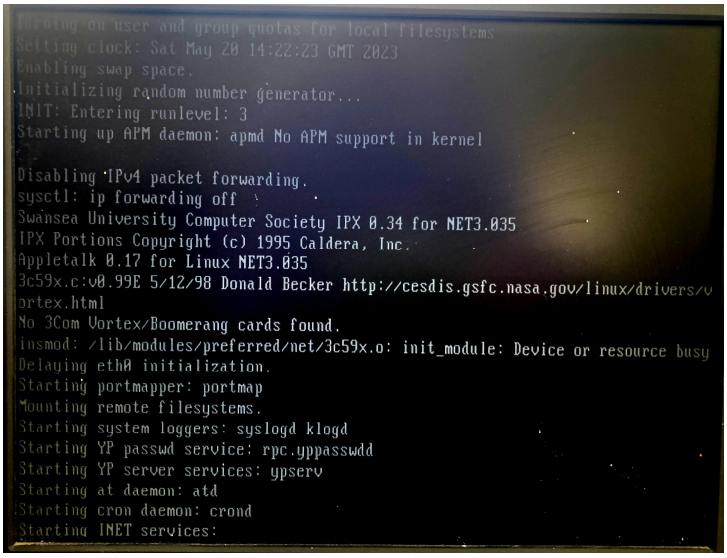
Figure 14: csTCDie Beowulf Cluster NIS server, BIOS screenshots 1-6



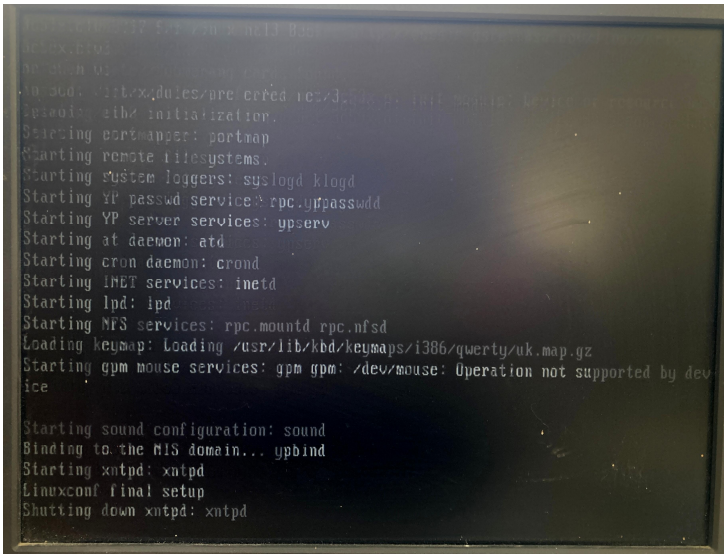
Screenshot 1



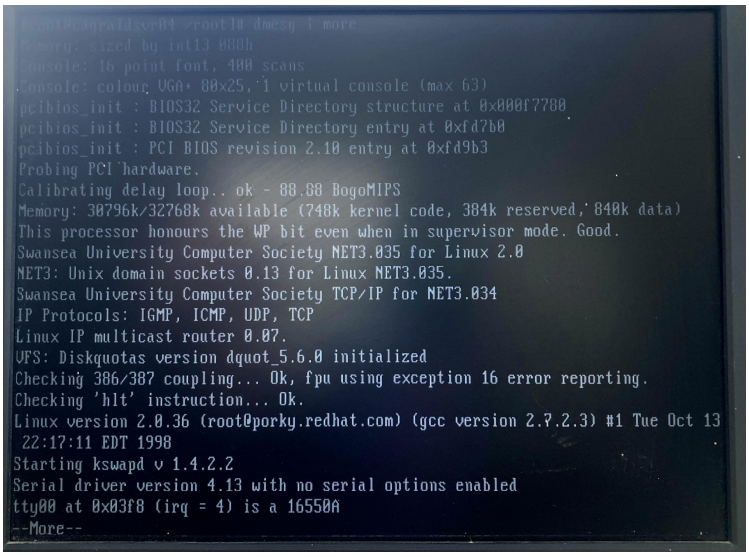
Screenshot 2



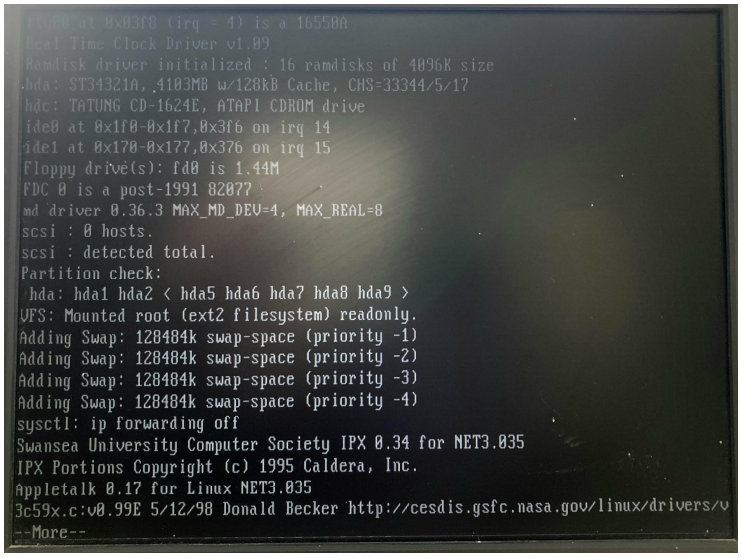
Screenshot 3



Screenshot 4

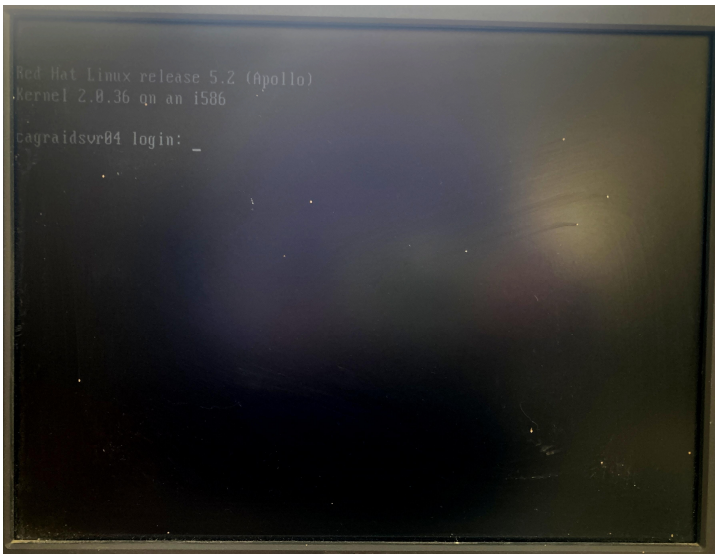


Screenshot 5

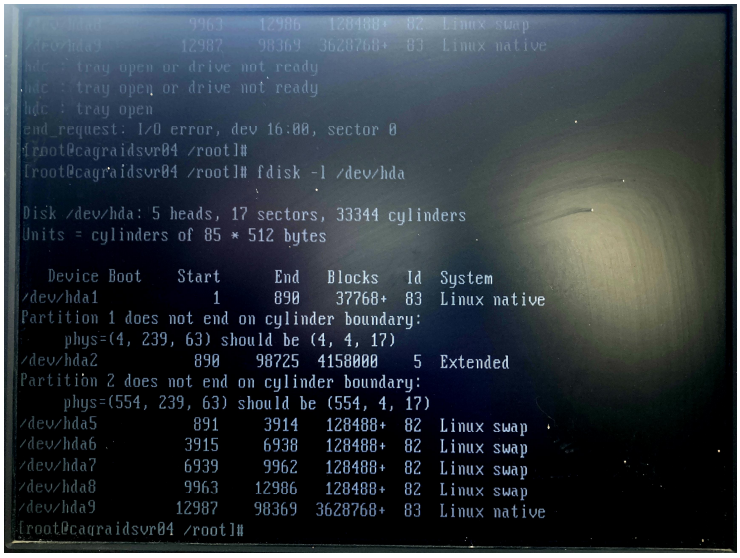


Screenshot 6

Figure 15: csTCDie Beowulf Cluster NIS server, Linux boot screenshots 1-6



Screenshot 7



Screenshot 8

Figure 16: csTCDie Beowulf Cluster NIS server, Linux console screenshots 7-9

Figure 17: csTCDie Beowulf Cluster NIS server, RAID array
TCD-SCSS-T.20150217.003