Appendix A

LittleFe - Parts Manifests

A.1 Parts Manifests

The following parts manifests (Table A.1 and Table A.2) capture the v3 production series of *LittleFe*, *circa* 2007.

As with any reference design based on digital technology the particular details of the mainboards, disks, and networking components must be revisited every 6-12 months. While it creates extra work, overall this pace of change favors *LittleFe* in the long run since it serves to drive the performance up and the cost down. The basic framework remains constant while the technology it encloses continually evolves.

Table A.1: LittleFe v3 Computer Parts Manifest

Component	Part Number	#	Each	Per Unit	Source
Mainboard	VIA CN10000	6	173.00	1,038.00	Logic Supply
Memory	DDR2 533 memory 1GB	1	122.00	122.00	Logic Supply
Memory	DDR2 533 memory 512MB	5	64.00	320.00	Logic Supply
Power supply	Pico PSU 120W	1	49.00	49.00	Logic Supply
Power supply	Pico PSU 80W	5	39.00	195.00	Logic Supply
Frame	Aluminum ends and rails	1	100.00	100.00	Locally Supplied
Switch	D-Link DSS-8+ 10/100 switch	1	17.00	17.00	NewEgg
Power supply	MeanWell SP-320-12	1	90.00	90.00	PowerGate
Jumpers	1 per motherboard plus 1 uplink	7	2.00	14.00	Locally supplied
Disk drive	Travelstar 7K100 Hitachi	1	100.00	100.00	Directron
CD drive	Panasonic CW-8124-B CD/DVD	1	77.00	77.00	Logic Supply
NIC	Low-profile 10/100 PCI card	1	12.50	12.50	Logic Supply
Well nuts	Feet for the frame	8	1.65	13.20	Ace Hardware
Aluminum	1/2" x 1/2" angle, in feet	12	1.00	12.00	Ace Hardware
Retainers	Hitch pins	8	0.12	0.96	Ace Hardware
Standoffs	Nylon, mainboards and switch	28	0.12	3.36	Ace Hardware
12V Input	Lead, mainboard and switch	7	1.90	13.30	Mouser
110/220VAC	Line input and switch	1	14.00	14.00	Mouser
IDE-IDE	Motherboard to 3.5" IDE cable	1	10.00	10.00	Logic Supply
IDE-LPFF	Motherboard to 2.5" IDE cable	1	10.00	10.00	Logic Supply
Power control	Case front panel switch	6	10.00	60.00	Xoxide.com
Cards	Luan plywood mounting cards	8	0.50	4.00	Locally supplied

Table A.2: LittleFe v3 Traveling Case Parts Manifest

Component	Part Number	Quantity	Each	Per Unit	Source
Case	Pelican 1610	1	173.00	173.00	Commonly available
Cups	Case mounting	8	0.20	1.60	Ace Hardware

Appendix B

LittleFe - Assembly Instructions

B.1 Overview

Assembling *LittleFe* from a parts kit requires only basic knowledge of handtools and computer components. You will need large and small flat and philips screwdrivers, pliers and cable ties to complete the assembly. In addition to these illustrated instructions there is a narrated video of the assembly process available at `http://LittleFe.net`.

B.2 Hardware Assembly

B.2.1 Frame

The frame is assembled from the rails, card-edge guides, and end plates, see Figure B.1.

The rails and card-edge guides are assembled first. Layout the rails on a table lining-up the holes so that the ends with the shorter hole spacing are together and

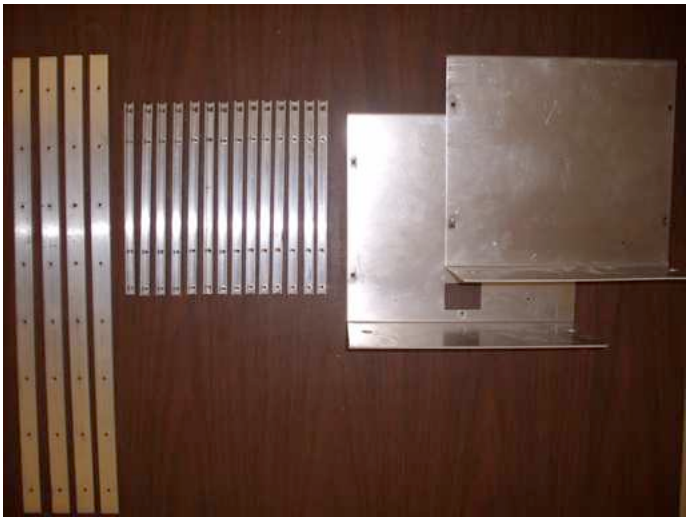

Figure B.1: Rails, card-edge guides, and end plates. Note that only one of the end plates is prepped for the 110/220VAC line input switch and the shorter spacing between the holes in the rails and the end of the rails at the bottom of the picture.

to the right. Lay the card-edge guides on top of the rails so that the large hole is facing away from you, see Figure B.2.

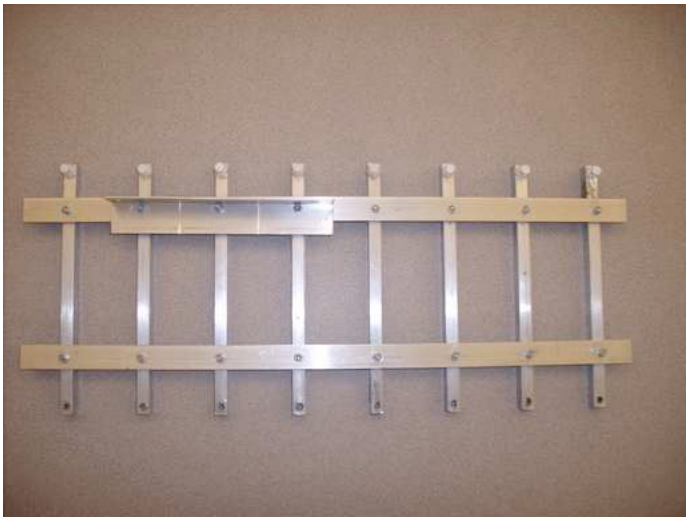

Figure B.2: Assembly of the first set of rails and card-edge guides. Note the shorter hole spacing to the right, the 110/220VAC regulated power supply mounting bracket, and the larger holes at the bottom of the fourth card-edge guide from the left.

Using the flat-head screws and nylon lock nuts mount the card-edge guides to the rails. The bracket which holds the regulated power supply should be placed on the

left end of one assembly with the right-most mounting hole on the fourth card-edge bracket from the left. Two of the the card-edge guides have larger holes at the bottom, these should be placed fourth from the left (this is where the cross-tie bar goes). Before tightening the screws be sure the rails are aligned properly, the easiest way to do this is to use a carpenter's square.

The second rail card-edge assembly is a mirror image of the first, that is the short spacing would be to the left on the table as you assemble it. This ensures that when combined with the end plates that the card-edge guides face each other, see Figure B.3

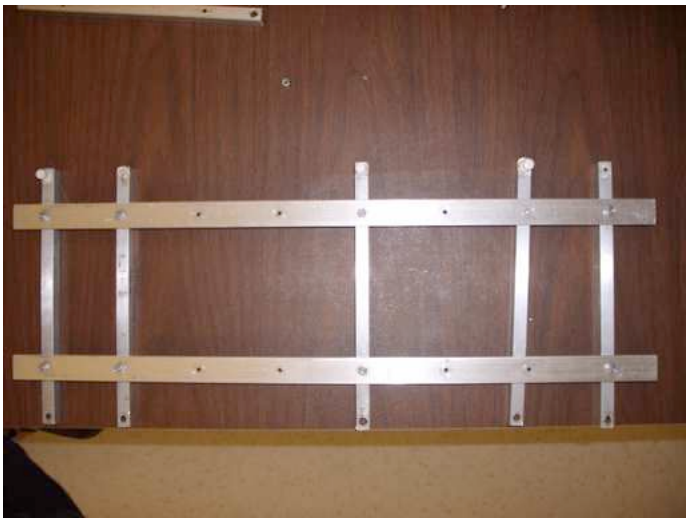

Figure B.3: Assembly of the second set of rails and card-edge guides. Note the shorter hole spacing to the left and the absence of the 110/220VAC regulated power supply mounting bracket.

Next mount the card-edge supports to each card-edge guides, these go in the large hole in the bottom of each card-edge guide, with the threaded end facing out, and are secured with nylon lock nuts. The fourth card-edge from the left on each rail set is for the cross-tie bar, see Figure B.4.

Next the end plates are assembled. This consists of mounting the rubber feet on the top and bottom and mounting the 110/220VAC line input switch. The smaller

Figure B.4: Card-edge supports and the cross-tie bar mounted to the card-edge guides.

rubber feet go on the top and the larger feet on the bottom, see Figure B.5. The line input switch mounts with two screws, make sure that the switch is mounted such that it's accessible from the outside of the frame, see Figure B.6.

Figure B.5: End plate showing placement of small and large rubber feet.

Now that the rail/card-edge assemblies and end plates are complete the frame can be assembled. Note that the end-plate with the 110/220VAC line input switch should be attached to the end of the rails with the longer hole spacing, see Figure

Figure B.6: End plate showing placement of 110/220VAC line input switch.

B.7.

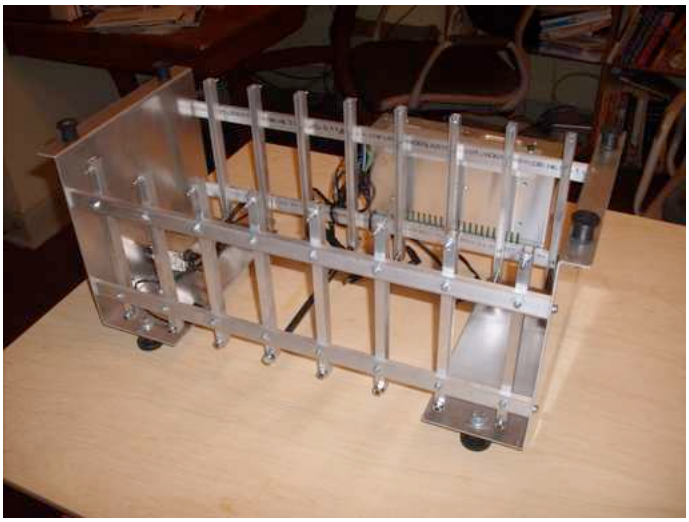

Figure B.7: Completed end plate and rail assemblies.

The frame is now ready for the installation of the high voltage wiring, low voltage wiring, and 110/220VAC regulated power supply.

B.2.2 Wiring

The 110/220VAC regulated power supply is mounted to the bracket with two screws and lock washers. The end with the connection block should face to the right as you look at the frame from the outside, see figure B.8. The 110/220VAC power supply cable should be attached to the line input switch and then to the marked terminal locations on the regulated power supply. Take care to insure that load (white), neutral (black), and ground (green) are all properly connected, see Figures B.9 and B.11. Routing and securing the 110/220VAC feed line can be seen in Figure B.10.

Figure B.8: 110/220VAC regulated power supply mounting.

B.2.3 Network

The network switch should be mounted to the card with the indicator lights facing up and the network connections facing down. Before inserting the network card into the frame the network jumpers should be installed starting with port 1, note that the cables are numbered, lf0 should go to port 1, lf1 to port 2, *etc.* See Figure B.11

Place the network card in the frame routing the cables underneath the rails in preparation for securing them to the rails as illustrated in Figure B.12. Secure the

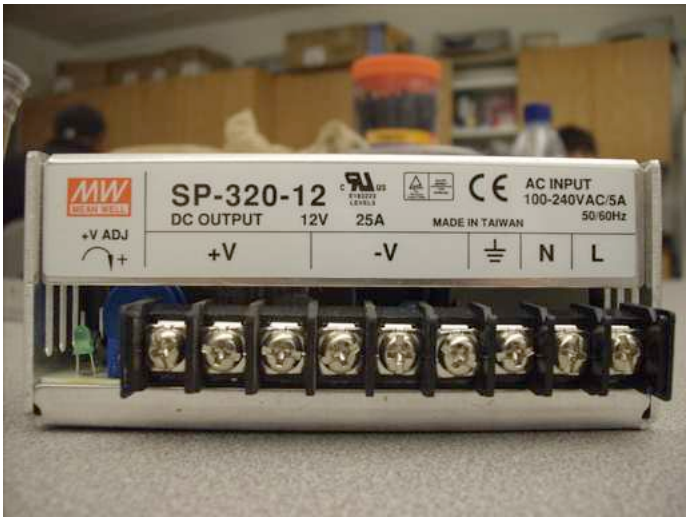

Figure B.9: 110/220VAC regulated power supply connection block showing ground, neutral, and load lugs (the three on the far right).

Figure B.10: Routing and mounting the 110/220VAC feed line.

cables to each rail as shown in Figure B.13 with nylon cable ties. Take care to ensure that the network jumpers each have a smooth path with no sharp bends or kinks.

Figure B.11: Network switch mounted to the plate with the first two network jumpers installed.

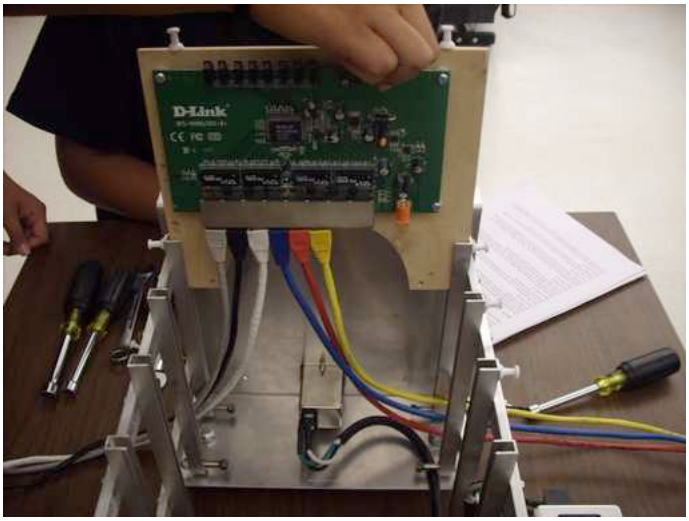

Figure B.12: Routing the network jumpers.

B.2.4 CPU and Disk Cards

The mainboards are mounted to the cards using bolts, 1/8" nylon spacers, and nylon lock nuts. The nuts should go on the card side, the bolt heads on the mainboard side. The corner opposite the power supply connector uses a 1/16" nylon spacer and flat metal washer in conjunction with the angle bracket, this provides a mount for 12VDC input connector, see figure B.14. Note that the nylon spacer

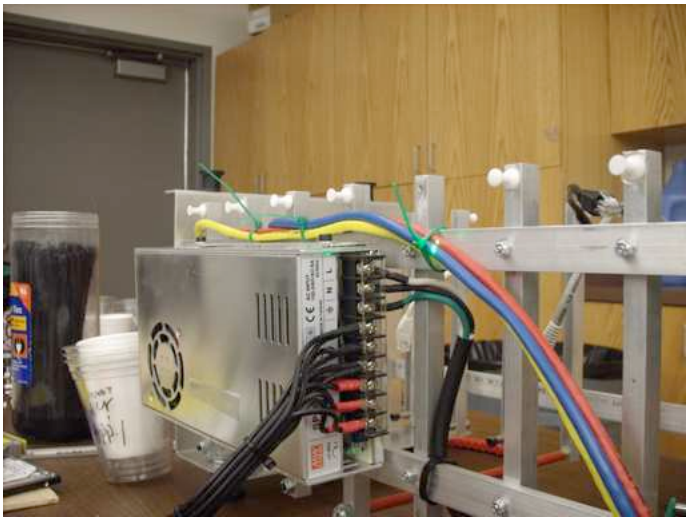

Figure B.13: Securing the network jumpers.

should be in contact with the mainboard, then the angle bracket, then the flat metal washer which is in contact with the card.

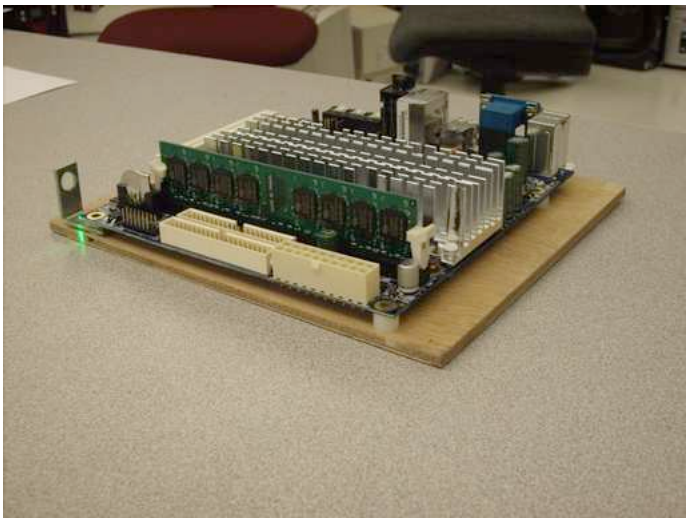

Figure B.14: The angle bracket which holds the 12VDC input feed is highlighted with a green laser on the left-hand side of the figure.

Once the mainboard is mounted to the card the on-board ATX power supply can be inserted into the mainboard connector and the 12VDC input connector can be mounted to the angle bracket, see figure B.15.

The power switch is mounted with a single screw and nylon lock nut to the top of

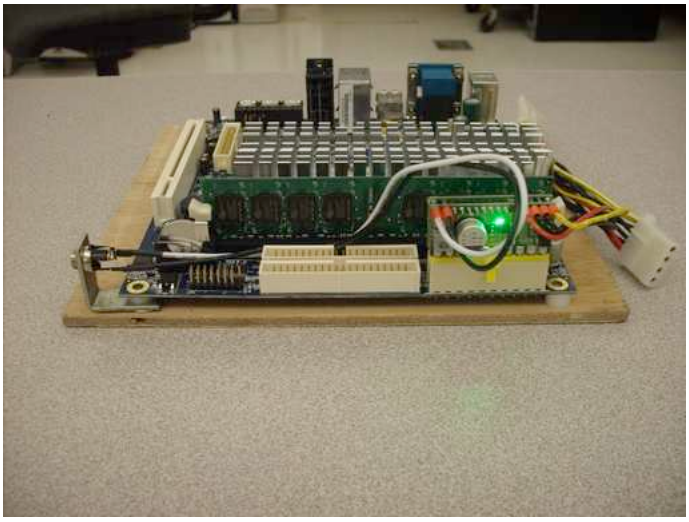

Figure B.15: The on-board ATX power supply is highlighted on the right with a green laser, the 12VDC input connector is on the left in the bracket.

the audio out/PS2 block on the front of the mainboard. The wires are routed around the heat sink and then the connectors are placed onto the header pins located on the back of the mainboard near the angle bracket, see figures B.16 and B.17.

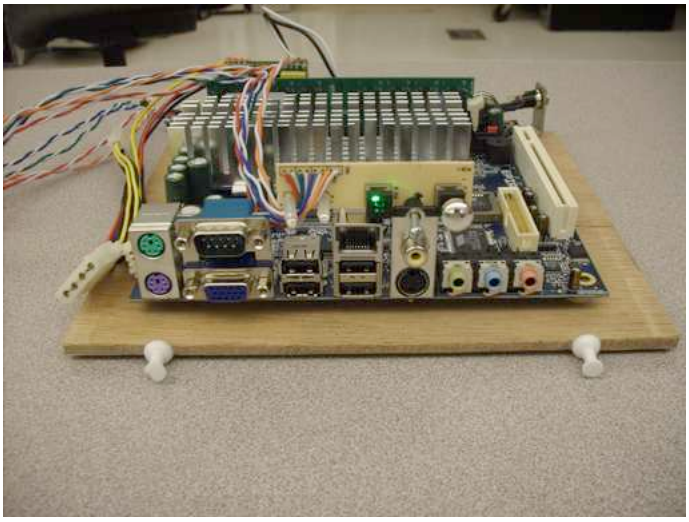

Figure B.16: The power switch mounted on top of the audio/PS2 block.

The connectors from the power switch are labeled power switch, HDD LED, reset switch, *etc.*. See the mainboard manual for a pin-out of the header to which they are connected.

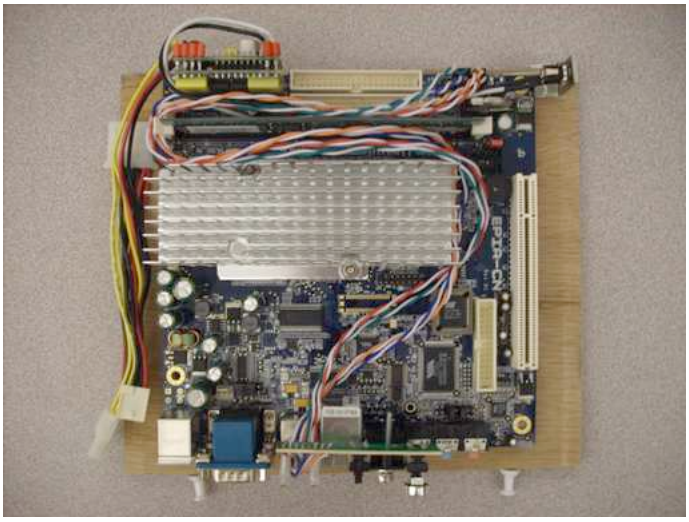

Figure B.17: Overhead view showing the routing of the power switch cables to the header pins located in the upper right-hand corner of the board near the 12VDC input connector.

The uplink NIC uses the PCI bus connector on the head-node's mainboard. After removing the RJ-45 socket bezel from the card install it. A very small cable tie can be used to secure the card from wiggling free of the PCI connector.

Cable management is done using nylon cable ties. Re-usable cable ties, *i.e.* ones with a release tab, facilitate easy dissassembly and reassembly which in turn makes it possible to use *LittleFe* to show students the inner workings of a computational system. The extra Molex connectors are secured along the side of the mainboard with one cable tie on each mounting screw. The wires for the power switch are included in the bundle at the rear of the board, see figure B.18.

Once the on-board ATX power supplies and power switches are mounted the five compute mainboard cards can be installed in the frame, see figure B.19.

The CD/DVD drive and disk drive are mounted to the drive card using O rings as illustrated in figures B.20 and B.21. Note the orientation of the drives, this is important for the cabling between the drive card and the head node mainboard card.

Install the drive cables to the drives and then to the head-node mainboard as

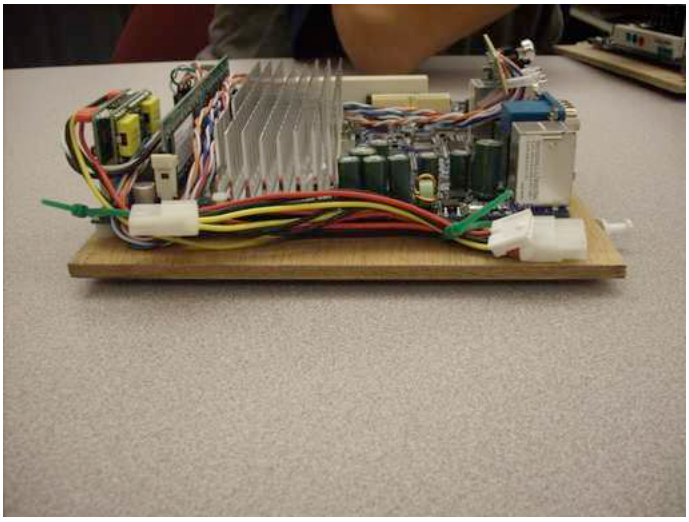

Figure B.18: Detail showing the cable management for the Molex connectors on the side of the mainboard.

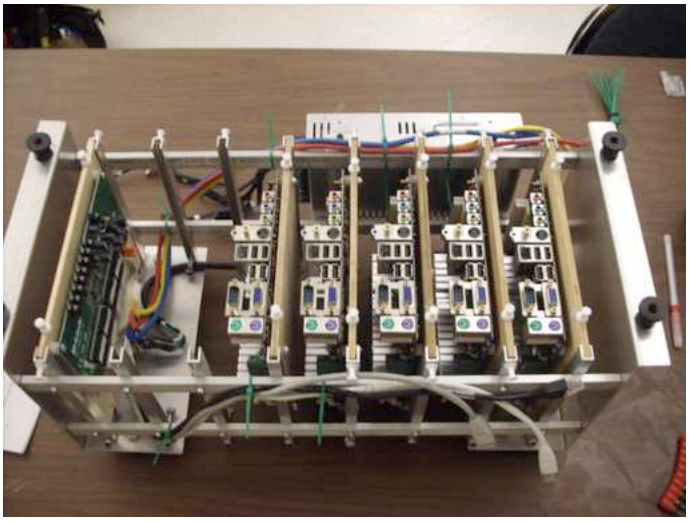

Figure B.19: The five compute mainboard cards installed in the frame.

illustrated in figure B.22.

Once the drive card has been assembled and cabled to the head-node mainboard those two cards can be installed in the frame as illustrated in figure B.23.

Figure B.20: The CD/DVD drive, disk drive, and disk card with the O rings mounted on it.

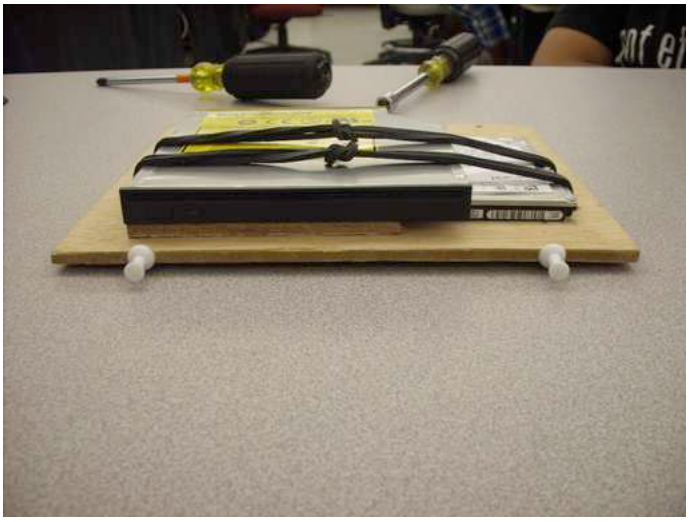

Figure B.21: The drives mounted on the disk card.

B.2.5 BIOS Configuration

The five compute nodes should have their BIOSs configured to boot over the LAN using PXE. The head-node BIOS should be set to boot from the IDE disk first and CD/DVD second. For testing and debugging purposes all of the compute node BIOSs should be set to boot from CD/DVD second.

Figure B.22: Drive and power cabling for the disk drive card.

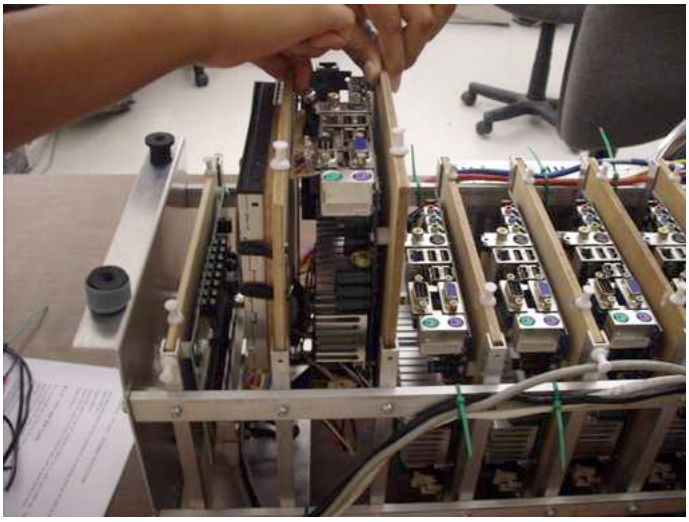

Figure B.23: Installing the head node mainboard card and disk card into the frame. Note the orientation of the disk card.

B.2.6 Testing

A basic test of the system can be performed by booting from an ISO such as the BBCD. While this only tests the head node is does ensure that the disk subsystem is functioning correctly and prepares us for installing the BCCD in the next section. If you have access to a USB CD/DVD drive you can test each of the compute nodes in a similar fashion.

B.3 Software Installation

B.3.1 BCCD

LittleFe runs the Bootable Cluster CD (BCCD) image [Gray, 2004]. The BCCD project is re-working their web presence as of January, 2009. Currently there are two sources of information and software for the BCCD, the 2.x codeline is available at `http://bccd.net` and what is known as the NG release or 3.x codeline is available at `http://cluster.earlham.edu/trac/bccd-ng`. When the dust settles the URLs below will be updated with the correct, stable URLs for each codeline.

B.3.2 Liberation

Liberation is the process of taking the BCCD 3.x live ISO and installing the software image onto the disk drive attached to *LittleFe's* head node.

Instructions for performing an initial liberation and subsequent updates can be found at
`http://cluster.earlham.edu/trac/bccd-ng/wiki/InstallInstructions`.

B.3.3 Testing

There are a small set of software package tests available for the BCCD 3.x codeline at `http://cluster.earlham.edu/trac/bccd-ng/wiki/Tests`. Users are encouraged to contribute tests for software packages they add to their BCCD installation. This is easy to do with *e.g.* Debian's `apt` environment.

B.3.4 Adding Functionality

Since the BCCD 3.x codeline is built on the Debian Linux distribution it's easy to customize your local installation of the BCCD with Debian's `apt` environment. More information is available with the `man` command.

If you would like to build your own live ISO based on the BCCD 3.x codeline with additional functionality or configuration information it's easy to do so. Step-by-step instructions for building from source are available at `http://cluster.earlham.edu/trac/bccd-ng/wiki/DevelopmentInstructions`.