Fermi National Accelerator Laboratory

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COMPUTER NETWORKING AT FERMILAB*

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1 INTRODUCTION

The data communications group in the Computing Department provides services both inside and outside of Fermilab. The group was formed in 1980 when it was decided that comprehensive data communications networking was needed to assist in the growth of interactive computing. Fermilab's current data communications facilities serve about 3000 asynchronous computer terminals and printers, and about 400 computer systems both on-site and off-site.

2 LOCAL AREA NETWORKING (ON-SITE)

Our on-site computer networking consists of a variety of telecommunications equipment and media that has been assembled and is used in a hierarchical arrangement. This arrangement allows us to distribute large volumes data throughout the laboratory with a high performance network, and then use a low performance (and low cost) network for distribution to individual terminals. By doing so, we are able to provide a variety of services with a wide performance range at a reasonable cost per termination.

2.1 Ferminet (Broadband Network)

The underlying media for most on-site data communications is a broadband CATV system called Ferminet, which serves as a backbone-type carrier for high-speed data traffic between major network nodes. For various reasons, including maintainability and cost avoidance, there is no intent or desire to extend Ferminet for local distribution (e.g. individual asynchronous terminal attachments). Ferminet is a bi-directional CATV trunk that operates with a mid-band split. With this arrangement, Ferminet has about 100 Mhz of usable bandwidth. Ferminet actually consists of two separate CATV trunks, one of which serves the Industrial Center, and the buildings around the Main Ring (e.g. B0, C0, D0, E0.). The other trunk runs between Wilson hall and the experimental areas (See figure 1). We will be adding a third trunk which will run between Wilson Hall and the new Computing Building. Between these three trunks, we will have over 300 Mhz of usable bandwidth with Ferminet.

For distribution of Decnet site-wide, we use 100 Kbs RF modems that run on Ferminet. We also use RF modems to provide point-to-point Decnet connections over a range of speeds between 100Kbs to 1 Mbs.

Ferminet is also used to link port selectors together. For this we use T1 (1.544 Mbs) RF modems.

2.2 Micom Network (Baseband Twisted-pair Based)

The Micom network is not a network type per se, but is used by more HEP users than any other network we support. With some exceptions, all asynchronous terminals and host ports are each attached as subscribers to one of four Micom Micro-600/2A port selectors via private twisted-pair cables, dedicated telephone (Bell 3010 and 3002) circuits, or Micom 800/2 statistical multiplexers. The four port selectors are networked together so that subscribers on each one may "call" subscribers on the others. The interconnection circuits run through Ferminet at T1 speeds (1.544Mbps), currently carrying up to 128 9600 baud channels each. This arrangement appears as a single system to the user. This is accomplished by using Micom's interconnect option. There are over 4000 terminal connections that are available to connect, 3000 of which are active. Our Micom network handles approximately 3000 to 4000 user terminal sessions per day. Micom port selector service is limited to a maximum speed of 9600 bps.

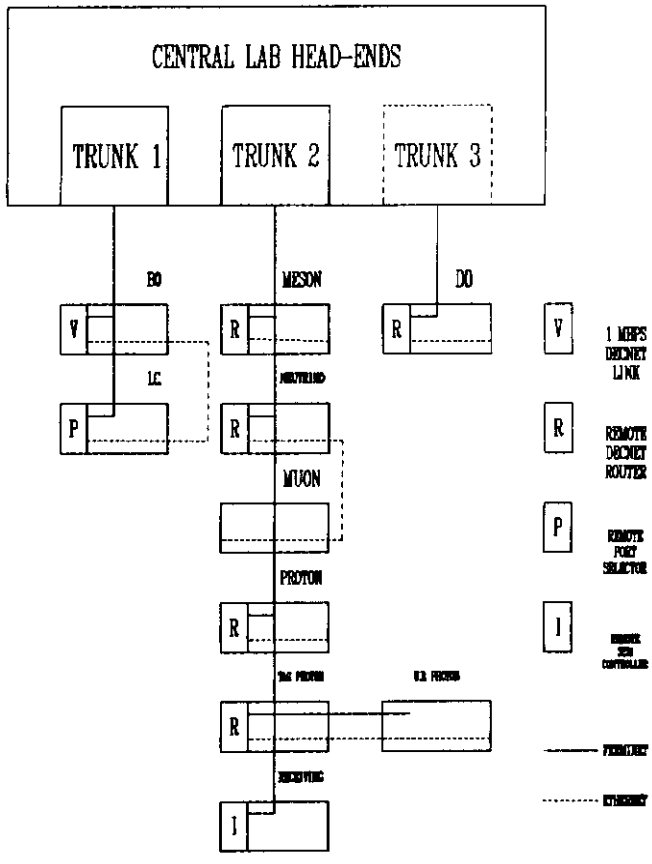

FIGURE 1.

These systems provide 70 classes of service (usually a computer system) which represent about 850 ports. Other service classes include out-dial facilities, prom-burning systems, and weather information.

The Micom network will continue to be used as long as it is cost-effective. We intend to use the port selectors for initial distribution of our new acquisition computer system(s) in 1987. For this additional capacity, we will be installing a total of three port selectors in a ring configuration (there are currently two systems connected in this manner), and installing an additional port selector in the new Computing Building. We will be installing expansion bays to both the Cross-Gallery and BO port selectors soon, and will install a new port selector in DO when that area is occupied. For the Experimental areas, we will be installing mini-port selectors (Micro 600/1 versions). These will allow more terminal connections and better access to data acquisition systems in these areas.

2.3 Decnet/Ethernet (Baseband Coaxial Based)

Our site-wide Decnet consists of several small-scale baseband local area networks (Ethernets) which provide host-to-host communications for about 35 VAX computer systems distributed throughout our site. Adjacent Ethernets are joined with router-to-router circuits running at 100Kb through Ferminet. Today our Ethernets provide distribution specifically for Decnet. We intend to replace our Decnet routers (which logically connect Ethernets) with Ethernet bridges. Doing so will allow us to use our Ethernets to support protocols other than Decnet. This will increase the range of applications that the Ethernets can support. For this reason we intentionally have limited our Micom network for terminal service at speeds no greater than 9600 Bps. We will use our Ethernets for terminal service for the faster speeds as well as for other higher performance applications. These new applications will include PC and workstation inter-communications, file and print service (and servers) to mainframe traffic.

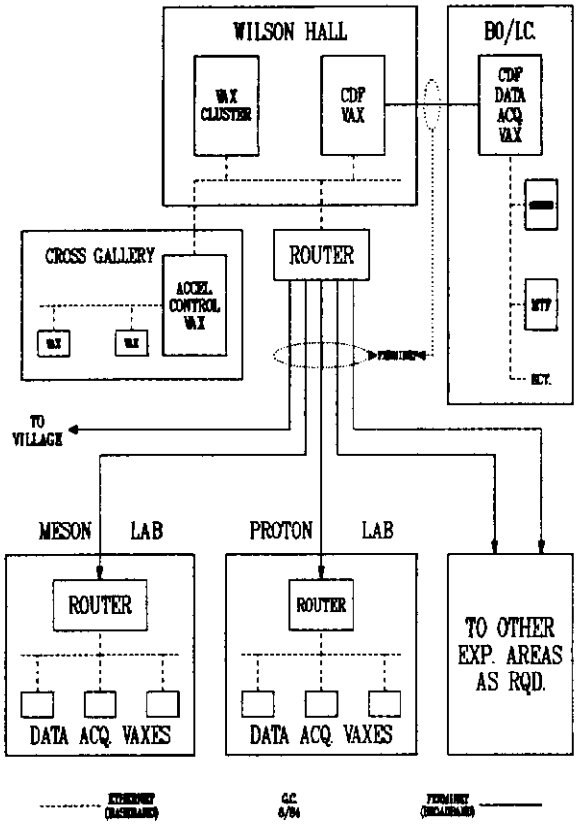

FIGURE 2.

3 WIDE AREA (OFF-SITE) COMPUTER NETWORKING

Fermilab is connected to several different external networks, each for a different purpose (See figure 3). The majority of our external networking is at no cost to Fermilab directly, but is borne by the universities desiring communications to our laboratory. Several different protocols are used to support our requirements.

3.1 Micom Network (off-site)

Our off-site use of the Micom network is an extension of our on-site system which provides access to all of Fermilab's computer systems. There are 10 universities which have leased lines and statistical multiplexers connected to our Micom network. The Micom's also have an access path to Stanford

Linear Accelerator Laboratory (SLAC) which allows logons to and from both laboratories.

We also provide modem access to our Micom network. For this we have three separate modem banks. Vadic 3400 series 1200 baud modems are the most popular and reliable modems for long-distance communications. We also support Bell 212 and 103 modem types. By the end of the year we will have a bank of 2400 baud ECC (error correcting) modems available for use. We currently are in the evaluation phase for this service.

The external use of Fermilab's Micom network averages about 400 terminal sessions per day.

3.2 Tymnet (Public X.25network)

Fermilab is connected to Tymnet for the purpose of allowing login access to our various computer systems. We have several member universities that use Tymnet in lieu of direct long distance telephone calling where leased lines are not cost effective. Our Tymnet connection currently terminates into a 16 channel X.25 PAD which connects to our Micom port selectors thus providing login access to any Fermilab computer system.

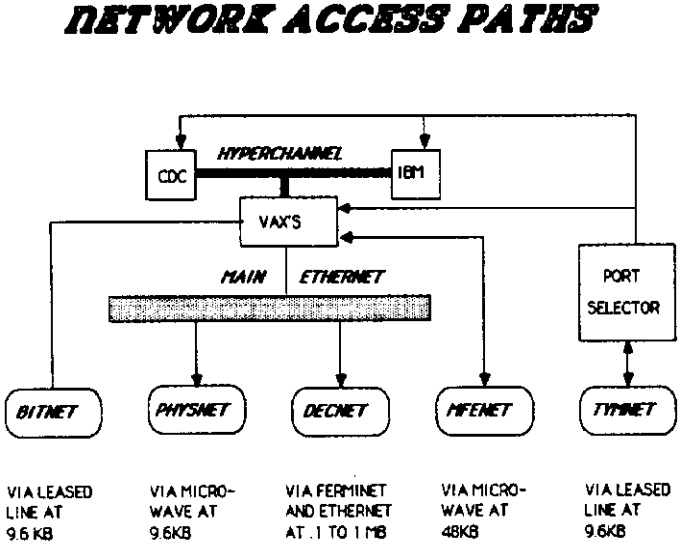

FIGURE 3.

Many European and Japanese collaborations use Tymnet to access Fermilab computer systems so they can participate in program development and experimental activities.

Additionally, we administer both in-coming and out-going accounts and billing between Tymnet and GSA. We also provide consulting for our Tymnet users.

This year we will attempt to install an X.25 switch on our Tymnet connection. This would allow us to connect a channel one of our Decnet routers. If this works, our Tymnet connection could be used for Decnet by those who do not have leased lines to Fermilab.

3.3 Physnet (off-site Decnet)

All of the larger experiments at Fermilab have DEC VAX systems as part of

their data acquisition systems. The HEP community in the USA has almost exclusively adopted DEC VAX systems as the "standard" computer system for data acquisition, program development, and some analysis.

Given this single vendor environment, the USA HEP community has chosen Decnet as "the protocol" for the majority of their needs. Large collaborations of universities collectively share the data processing tasks and communicate amongst themselves using Physnet. The features of Decnet allow the collaborations to share common data bases because Decnet gives them record level access to files through the network as well as direct access to directories on remote systems.

Fermilab's current major external connection to Physnet is through a microwave connection to Argonne National Laboratory. Additionally there are leased lines to Brookhaven National Laboratory (BNL) and Lawrence Berkeley Laboratory (LBL) that are used for for Decnet. Most of the Physnet circuits are at 9600 baud (see appendix A for additional information). Fermilab itself is a major hub and user of Physnet. Of the 450 nodes on Physnet, 35 of these nodes are VAXes at Fermilab (See appendix B-D). In addition to our nodes, 12 universities lease lines into Fermilab to gain access to Physnet, and three Laboratories are connected to us (See appendix A).

Historically Physnet has been an informal network with no central management. Fermilab soon plans to install a centralized network management system that will provide utilization statistics and fault isolation. At present, Physnet has no means of providing this information.

We estimate that our Physnet data traffic is between one and two million blocks of data per month where one block is equal to 512 bytes. Decnet can also be used to logon to any system connected to the network.

3.4 Bitnet

Fermilab has been connected to Bitnet since 1983. Bitnet is a university/IBM sponsored and managed network that has direct access to over 2000 nodes in the USA and Europe. Bitnet is run on IBM's RSCS protocol. Due to the nature of the protocol, Bitnet is only usable for file transfer and electronic mail. Fermilab has several member universities that are only connected to Bitnet. For these universities, Bitnet is the only means of communicating with their collaborators.

Bitnet is also very useful for communications with the CERN in Geneva Switzerland. Fermilab has a considerable amount of traffic going to CERN and other laboratories in Europe.

Our typical monthly usage of Bitnet is about 12,000 to 14,000 files sent and received which accounts for about four to six million records.

3.5 Mfenet

Fermilab is connected to Mfenet in support of the Energy Research program for access to super computers. This is accomplished through one of Fermilab's VAX systems.

Fermilab gains Mfenet access through a microwave channel to Argonne National Laboratory (shared with other networks) at 48 Kb.

3.6 Hepnet

Fermilab will participate in Hepnet when it is available. We will configure all of our networks to be compatible with Hepnet as it matures. Hepnet should be by definition compatible with our existing networks. By design, it will be a protocol independent network that should better distribute Fermilab's off-site network traffic.

4 CONCLUSION

There are a variety of networks and services that the data communications group provides the user community. Our facilities have been structured to provide flexible and cost-effective networking for Fermilab.

APPENDIX A

LEASED LINES TO FERMILAB AND THEIR USAGE

LOCATION	SPEED	CHANNELS	PROTOCOL
U OF COLORADO	9600	8	STAT. MUX
COLUMBIA	9600*	11	STAT. MUX
	4800	1	DECNET
MICHIGAN STATE	9600*	15	STAT. MUX
	4800	1	DECNET(4/86)
MIT	9600	8	STAT .MUX
PRINCETON	9600*	7	STAT. MUX
	4800	1	DECNET
RUTGERS	9600*	7	STAT. MUX
	4800	1	DECNET(4/86)
U OF CHICAGO	9600	8	STAT. MUX
	9600	1	DECNET
U IF ILLINOIS (URBANA)	9600*	7	STAT. MUX
	2400	1	DECNET
U OF CALIF SB	9600	8	STAT. MUX
VIRGINIA POLY.	9600	8	STAT. MUX
HARVARD	9600	1	DECNET
U OF WISC.	9600	1	DECNET
U OF ROCHESTER	9600	1	DECNET
NORTHWESTERN	9600	1	DECNET
U OF ILL. (CHICAGO)	9600	1	BITNET (RSCS)
U OF FLORIDA	9600*	7	STAT. MUX (4/84)
	4800	1	DECNET

VANDERBILT	9600*	7	STAT. MUX (4/84)
	4800	1	DECNET

INTER-LABORATORY LEASED LINE AND OTHER CIRCUITS TYPES

ARGONNE NAT. LAB*	9600**	1	DECNET
	48K **	1	MFENET
	48K **	1	BITNET(RSCS-IBM ONLY)
BROOKHAVEN	9600	1	DECNET
LAWRENCE BERKELEY	9600	1	DECNET
	4800*	12	STAT. MUX (LATER-85)

* INDICATES BANDWIDTH OF CIRCUIT SHARED BETWEEN PROTOCOLS USING A SYNCHRONOUS CHANNEL ON THE STATISTICAL MULTIPLEXER

** INDICATES MICROWAVE CIRCUIT

APPENDIX B

PHYSNET NODES AREA 41 (LBL/SLAC)

41.1	(TKYO)	University of Tokyo at LBL
41.2	(PHYS)	LBL-Physics 785
41.3	(TPCS)	SLAC/PEP
41.4	(UCLA)	UCLA-High Energy Physics
41.5	(TPCT)	LBL-Physics at PEP
41.6	(JHUP)	Johns Hopkins University-Physics
41.7	(UCR)	UCR-Physics
41.8	(TWGM)	SLAC/PEP
41.9	(MAC)	SLAC/PEP
41.10	(HRS)	SLAC/PEPics 780
41.11	(SLD)	SLAC/PEP
41.12	(PCR)	SLAC/PEP
41.13	(MKII)	SLAC/PEPc[B
41.14	(SLC)	SLAC/SLC/ Stanford Linear Collider
41.15	(UCSB)	UCSB/PEP
41.16	(UCSD)	UCSD at PEP
41.17	(NIKHEF)	NIKHEF at PEP
41.18	(MK3)	SLAC/PEP
41.19	(ESA)	SLAC
41.20	(CB)	SLAC/PEP
41.21	(LBLG)	LBL-Computation/Computer Science Research
41.22	(LBLH)	LBL-Computation/CSR 780
41.23	(LBL)	LBL-Computation/CSR 750 DECnet/Milnet Gateway
41.24	(LBLF)	LBL-Computation/CSR
41.25	(LBLK)	LBL-Computation/CSR
41.26	(RIX)	LBL-Computation/CSR/Department of Labor
41.27	(RX)	LBL-Computation/CSR/Department of Labor
41.28	(ETADC)	LBL-Computation/CSR/Department of Labor
41.29	(ETADCB)	LBL-Computation/CSR
41.30	(ETADCC)	LBL-Computation/CSR
41.31	(LBL31)	LBL-Computation/CSR
41.32	(EPVX)	LBL-Computation/CSR/Environmental Protection Agency
41.33	(RINC)	LBL-Computation/CSR
41.34	(RIVX)	LBL-Computation/CSR/ Rockwell International VAX
41.35	(RICA)	LBL-Computation/CSR
41.36	(BCLVXB)	LBL-Computation/CSR
41.37	(RSB23)	LBL-Computation/CSR
41.38	(PDAS23)	LBL-Computation/CSR
41.39	(EVN23)	LBL-Computation/CSR
41.40	(BEAM40)	LBL

41.41 (LBL41) LBL-Computation/ Accounting and Data Acquisition
41.42 (LBL42) LBL-Computation/ DECnet Gateway 11/44
41.43 (NMC) LBL-Computation/ Numerical Modeling Computer 780
41.44 (LBL44) LBL-Computation/ Program Development Machine 780
41.45 (IGM) LBL-Computation/Interactive Development Machine 780
41.46 (PET280) LBL-Biomed/Research Medicine 11/44
41.47 (ASTRO) LBL-Physics 11/23
41.48 (PET600) LBL-Biomed 11/44
41.49 (NRCC) LBL-Applied Science 780
41.50 (THERMO) LBL-Physics 730 {Latimer Hall UCB-Chem Pitzer 19.6K Multi)
41.51 (HISS) LBL-Nuclear Science/Heavy Ion Spectrometer System 780
41.52 (COLDBX) LBL-Nuclear Science 11/23
41.53 (DIPOLE) LBL-Nuclear Science 11/34
41.54 (MAGMAP) LBL-Nuclear Science 11/41.5
41.55 (APPLE) LBL-Nuclear Science 11/45
41.56 (HISSFE) HISS Front End 11/750
41.60 (CITHEX) California Institute of Technology/High Energy Physics 780
41.61 (MCC) SLAC
41.62 (TBF) SLAC
41.63 (UCD) SLAC
41.65 (SPEAR) SLAC-SPEAR
41.66 (GSI) Garching Schwerionen Institut at LBL 780
41.67 (RTSGRT) LBL/Real Time Systems Group
41.68 (RTSGVX) LBL/Real Time Systems Group 780
41.73 (GSIB) Garching Schwerionen Institut at LBL
41.75 (JANUS) LBL-Nuclear Science
41.76 (MUON) LBL-Physics
41.77 (TSTBED) LBL-Physics
41.78 (ECCTST) LBL-Physics
41.79 (MUTEST) LBL-Physics
41.80 (ICS) LBL-Physics
41.81 (UCRPH1) UCR-Physics HEP 780
41.82 (UCRPH2) UCR-Physics/Heavy Ion Group 11/23
41.83 (UCRAC1) UCR-Physics Academic Computing 750
41.84 (UCRAC2) UCR-Physics Academic Computing 780
41.85 (HRS1) SLAC/ High Resolution Spectrometer
41.86 (HRS2) SLAC/High Resolution Spectrometer
41.87 (HRS3) SLAC/High Resolution Spectrometer
41.88 (HRS4) SLAC/High Resolution Spectrometer
41.89 (HRS5) SLAC/High Resolution Spectrometer
41.99 (PHYSIX) LBL-Cluster Virtual Node
41.101 (BEVAX) LBL-Nuclear Science
41.102 (LBL102) LBL-Computation/ Advanced Computer Architecture Lab
41.103 (LBL103) LBL-Computation/ Advanced Computer Architecture Lab
41.104 (LBL104) LBL-Computation/ Advanced Computer Architecture Lab
41.105 (LBL105) LBL-Computation/ Advanced Computer Architecture Lab
41.107 (2BETA) LBL-MicroVAX II
41.108 (NMR2D1) LBL-MicroVAX
41.109 (ICAMS) LBL-Nuclear Science
41.110 (DLS) LBL-Nuclear Science 780/ Di-Lepton Spectrometer
41.111 (PSEUDO) UCB-Physics 785 {UCB Campus}
41.112 (BCSVAX) LBL-Computation/ 780 GENeral purpose computer
41.113 (DOLBLO) LBL Physics
41.114 (PETVAX) LBL Bio-med VAX
41.115 (ADAM) LBL Bio-med/ PDP41.11/44

41.116 (EVE) LBL Bio-med/ PDP41.11/34
41.117 (BIOVAX) LBL 780 {Pitlock}
41.118 (HIREM) LBL 725 {Glacier}
41.119 (RTSGEX) LBL RTSG/Real Time Systems Group Experimental Vax
41.120 (RTSG11) LBL-real time systems group
41.121 (SDPH1) UCSD-Physics
41.171 (ASP) SLAC
41.172 (CAD) SLAC
41.173 (UMKII1) SLAC
41.174 (USLD1) SLAC
41.175 (UCRID) SLAC
41.176 (M2) SLAC
41.177 (SCS) SLAC
41.178 (TRLA) SLAC
41.179 (SLCU1) SLAC
41.180 (SLDU2) SLAC
41.187 (MICH1) University of Michigan
41.188 (MICH2) University of Michigan
41.189 (MICH) University of Michigan
41.196 (CSA1) LBL-Computation
41.197 (CSA2) LBL-Computation
41.198 (CSA3) LBL-Computation
41.199 (CSA4) LBL-Computation
41.200 (CSA5) LBL-Computation 8600 Cluster
41.222 (UCRTS1) UCR 16-Line Terminal Server
41.223 (UCRPH3) UCR Heavy Ion Group 11/23
41.224 (UCRPH4) UCR HEP 11/23
41.251 (UCSBAP) U.C.-Santa Barbara
41.252 (SBTIP) U.C.-Santa Barbara
41.253 (SBPHY) U.C.-Santa Barbara
41.257 (SBXTAL) U.C.S.B.-Chemistry

APPENDIX C

PHYSNET NODES AREA 42 (FERMILAB/ARGONNE)

```
42.1    (FNAL  ) FCCF VAX Cluster 785
42.2    (FNALA ) Fermilab Central Computing Facility {FCCF} VAX Cluster 785
42.3    (FNALB ) FCCF VAX Cluster 8600  {temp. on CDF offline cluster, 4/26/85}
42.5    (CDF   ) CDF at FNAL 780 {Offline VAX Cluster, see CDFSFT}
42.6    (CDFSFT) CDF at FNAL 780 {Offline VAX Cluster, see CDF}
42.7    (FNALC)  Fermilab Computing Department {Cluster VAX 8600}
42.9    (BISON ) Fermilab Computing Department Software Development 780
42.10   (BSNDBG) Fermilab Computing Department Hardware/Software Debug 780
42.11   (CDFHRD) CDF at FNAL 730 Hardware Test Stand
42.12   (CDFDSG) CDF at FNAL 730 Data Systems Group
42.13   (CDFCRT) CDF at FNAL 730 Cosmic Ray Test Stand
42.14   (CDFNW ) CDF at FNAL 730 Neutrino West Test Beam
42.15   (BOHOST) CDF at FNAL 785 {BO Host 780 for Secondaries Online Cluster}
42.16   (BOSCCA) CDF at FNAL 750 {BO Secndry Cntrl Cmptr A Online Cluster}
42.17   (BOSCCB) CDF at FNAL 750 {BO Secndry Cntrl Cmptr B Online Cluster}
42.18   (BOSCCC) CDF at FNAL 750 {BO Secndry Cntrl Cmptr C Online Cluster}
42.19   (CDFUV1) CDF at FNAL MicroVAX  1
42.20   (CDFPIG) CDF at FNAL 730 Particle Instrumentation Group
42.21   (OPER  ) Fermilab Accelerator Controls Operational VAX
42.22   (DEVL  ) Fermilab Accelerator Division VAXCluster {Controls Development}
42.23   (ADCALC) Fermilab Accelerator Division VAXCluster {Calculations}
42.24   (OSIRIS) Fermilab Accelerator Division
42.25   (MDTF  ) Fermilab Magnet Development _Test Facility 730
42.26   (MDTF01) Fermilab Magnet Data Test Facility
42.27   (MDTF02) Fermilab Magnet Data Test Facility
42.28   (MDTF03) Fermilab Magnet Data Test Facility
42.29   (FNACP1) Fermilab Advanced Computer Project MicroVAX  1
42.30   (FNACP2) Fermilab Advanced Computer Project Microvax  2
42.31   (CDFRTO) Fermilab Computing Department Wilson Hall Router
42.32   (FNALRO) Fermilab Computing Department Wilson Hall Router
42.33   (FNALR1) Fermilab Computing Department Meson Laboratory Router
42.34   (FNALR2) Fermilab Computing Department Neutrino Laboratory Router
42.35   (FNALR3) Fermilab Computing Department Proton Area Router
42.36   (FNALR4) Fermilab Computing Department Wilson Hall Router
42.37   (FNALTO) Fermilab Computing Department Terminal Server
42.38   (FNAL05) Fermilab Computing Department Experimenter 780 {E743, 3/26/85}
42.39   (FNAL06) Fermilab Computing Department Experimenter 780 {E744, 3/26/85}
42.40   (FNAL07) Fermilab Computing Department Experimenter 780 {E605, 3/26/85}
42.41   (FNAL17) Fermilab Computing Department Experimenter 780 {E691, 3/26/85}
42.42   (FNAL18) Fermilab Computing Department Experimenter 780 {E711, 3/26/85}
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42.43 (FNAL26) Fermilab Computing Department Experimenter 780 {E687 }
42.45 (FNAL27) Fermilab Computing Department Experimenter 780 {E665}
42.46 (FNCMU) Fermilab Experiment E653 750
42.47 (FNEVAL) Fermilab Evaluation Group MicroVAX II
42.48 (FNNET) Fermilab Data Communications Group MicroVAX II
42.49 (SSGDVL) Fermilab Operations Department Software Group Devl 11/70
42.50 (UIHEPA) U. of I., Champaign-Urbana H.E.P. Group 780 Cluster
42.51 (UIHEPB) U. of I., Champaign-Urbana H.E.P. Group 785 Cluster
42.52 (UIHEPC) U. of I., Champaign-Urbana H.E.P. Group
42.53 (UIHEPD) U. of I., Champaign-Urbana H.E.P. Group
42.54 (UIHEPE) U. of I., Champaign-Urbana H.E.P. Group MicroVAX-I (FASTBUS)
42.55 (UIHEPF) U. of I., Champaign-Urbana H.E.P. MicroVAX-II
42.56 (UIHEPG) U. of I., Champaign-Urbana H.E.P. MicroVAX-II
42.57 (UIHEPH) U. of I., Champaign-Urbana H.E.P. MicroVAX WS-II
42.58 (UIHEPI) U. of I., Champaign-Urbana H.E.P. MicroVAX WS-II
42.59 (UIHEPJ) U. of I., Champaign-Urbana H.E.P.
42.60 (NEVIS) Columbia University at Nevis VAX 11/780
42.61 (NEVIS1) Columbia University at Nevis MicroVAX I
42.62 (HUHEPL) Harvard University High Energy Physics Lab 11/780
42.63 (HUHEPV) Harvard University High Energy Physics Lab 8600
42.64 (BRND) Brandeis University
42.65 (ANLHEP) Argonne National Lab HEP Division VAX 11/780
42.66 (ANHEP1) Argonne National Lab HEP Division VAX 11/750
42.67 (ANHEP2) Argonne National Lab HEP Division VAX 11/730
42.68 (IND) University of Indiana
42.69 (MINN) U. of Minnesota
42.70 (MINE) U. of Minnesota
42.71 (PURDUE) Purdue University 11/780
42.72 (PURD1) Purdue University 11/750
42.73 (PURD2) Purdue University 11/750
42.74 (SSGTST) Fermilab Operations Department Software Support Group 11/44
42.75 (HUHEPT) Harvard University
42.76 (UCHEP) University of Chicago HEP 8600
42.77 (UCOPAL) University of Chicago HEP 11/750
42.78 (FNAL03) Fermilab Computing Dept. Experimenter 11/780 {E705}
42.79 (BOALRM) BO MicroVAX
42.80 (BOVS01) BO MicroVAX Workstation
42.81 ( ) BO DECserver 100 Terminal Server
42.82 (BOUV02) BO MicroVAX II
42.83 (WRKAT1) Accelerator Division IBM PC/AT
42.84 (ADCAD1) Accelerator Division MicroVAX II
42.85 (BOBFM) BO MicroVAX II
42.86 (CDBS) Accelerator Division 11/785
42.87 (URHEP) University of Rochester VAX 11/780
42.88 (URMUV1) University of Rochester MicroVAX II
42.89 (FNACP3) Fermilab Advanced Computer Project Microvax II 3
42.90 (NUHEP) Northwestern University HEP 11/780
42.91 (DOMUON) DO Experimenter VAX 11/780
42.92 (PUPHEP) Princeton High Energy Physics VAX 11/750
42.93 (FNDAQT) Fermilab Data Acq. Test VAX 11/780
42.94 (FNFAF) Fermilab Film Analysis VAX 11/780
42.95 (BOL3) BO MicroVAX II
42.96 (FNDAQU) Fermilab Data Acq. MicroVAX II
42.97 (PUPGG) Princeton University Physics
42.200 (UIHEPK) U. of Ill., Champaign-Urbana HEP PRO-350

42.201 (UIHEPL) U. of Ill., Champaign-Urbana HEP PRO-350
42.202 (UIHEPM) U. of Ill., Champaign-Urbana HEP Rainbow 100+
42.203 (UIHEPN) U. of Ill., Champaign-Urbana HEP Rainbow 100+
42.204 (UIHEPO) U. of Ill., Champaign-Urbana HEP
42.205 (UIHEPP) U. of Ill., Champaign-Urbana HEP
42.206 (UIHEPQ) U. of Ill., Champaign-Urbana HEP
42.207 (UIHEPR) U. of Ill., Champaign-Urbana HEP
42.208 (UIHEPS) U. of Ill., Champaign-Urbana HEP
42.209 (UIHEPT) U. of Ill., Champaign-Urbana HEP
42.245 (UINPLA) U. of Ill., Champaign-Urbana; Nuclear Physics Lab VAX 11/785
42.289 (PHENOE) U. of Wis. Phenomenology MicroVAX II
42.290 (JOINER) Jnet Support Node
42.291 (PHENOA) U. of Wis. Phenomenology MicroVAX I
42.292 (PHENOB) U. of Wis. Phenomenology MicroVAX I
42.293 (PHENOC) U. of Wis. Phenomenology MicroVAX I
42.294 (PHENOD) U. of Wis. Phenomenology MicroVAX II
42.295 (PHENO1) U. of Wis. Phenomenology Terminal Server
42.296 (RTRA) U. of Wis. Router
42.297 (RTRB) U. of Wis. Router
42.298 (PSLA) Physical Sciences Lab at University of Wisconsin 11/780
42.299 (PSLB) Physical Sciences Lab at University of Wisconsin 11/780
42.300 (PSLC) Physical Sciences Lab at University of Wisconsin 8600
42.301 (PSLX) Physical Sciences Lab at University of Wisconsin 11/750
42.302 (OAS) Physical Sciences Lab at University of Wisconsin 11/750
42.303 (SRC) U. of Wis. Synchrotron Radiation Center (at PSL)
42.304 (MICRO) U. of Wis. 11/750 at PSL
42.305 (CADA) U. of Wis. Microvax I cad machine at PSL
42.306 (CADB) U. of Wis. Microvax I cad machine at PSL
42.307 (CADC) U. of Wis. Microvax I cad machine at PSL
42.308 (MADNUC) U. of Wis. 11/750
42.309 (SPACE) U. of Wis.
42.310 (TSDEVA) U. of Wis. Terminal Server
42.311 (TSDEVB) U. of Wis. Terminal Server
42.312 (TSDEVC) U. of Wis. Terminal Server
42.313 (TSDEVD) U. of Wis. Terminal Server
42.314 (JUNO) U. of Wis. Physical Sciences Lab PDP 11
42.315 (AURORA) U. of Wis. Physical Sciences Lab PDP 11
42.316 (ATHENA) U. of Wis. Physical Sciences Lab PDP 11
42.317 (DAWN) U. of Wis. Physical Sciences Lab PDP 11
42.320 (FNL26A) Fermilab Experiment E687 11/24
42.350 (ANLVMS) Argonne

APPENDIX D

PHYSNET NODES AREA 43 (BROOKHAVEN)

43.10	(BNLAMM)	BNL Applied Math Dept. MicroVAX II
43.11	(BNLCL1)	BNL Applies Math Dept. - Cluster
43.12	(BNLCL2)	BNL Applies Math Dept. - Cluster
43.13	(BNLCL3)	BNL Applies Math Dept. - Cluster
43.14	(BNLCL4)	BNL Applies Math Dept. - Cluster
43.16	(BNLAMD)	BNL Applied Math Dept
43.30	(BNLDAG)	BNL Data Acquisition
43.31	(BNLHEP)	BNL Physics Dept.
43.32	(BNLMPS)	BNL Physics Dept.
43.33	(BNL734)	BNL Experiment 734
43.34	(BNL787)	BNL Experiment 787
43.35	(BNLMP1)	BNL Physics Dept.
43.36	(BNLHP1)	BNL Physics Dept.
43.37	(BNLKO1)	BNL Physics Dept.
43.40	(BNL802)	BNL Physics Dept.
43.60	(BNLDO1)	BNL Physics Dept. Decnet Router
43.61	(BNLDOR)	BNL Physics Dept. Router
43.70	(BNLRS1)	BNL Applied Math Dept. Router
43.71	(BNLRS2)	BNL Applied Math Dept. Router
43.75	(BNLTS1)	BNL Applied Math Terminal Server
43.76	(BNLTS2)	BNL Applied Math Terminal Server
43.77	(BNLTS3)	BNL Applied Math Terminal Server
43.78	(BNLTS4)	BNL Applied Math Terminal Server
43.101	(SBNUC1)	SUNY - SB Nuclear Physics Vax 1
43.111	(SBNSLA)	SUNY - SB Nuclear Structure Physics PDP11/60
43.112	(SBNSLB)	SUNY - SB Nuclear Structure Physics PDP11/60
43.113	(SBNSLC)	SUNY - SB Nuclear Structure Physics PDP11/84
43.121	(SBHEP1)	SUNY - SB High Energy Physics Vax 1
43.122	(SBHEP2)	SUNY - SB High Energy Physics Vax 2
43.200	(UPENN1)	University of Pennsylvania
43.201	(UPENN2)	University of Pennsylvania
43.250	(CUSB85)	Columbia U. / SUNY - SB
43.251	(LNS61)	Cornell University
43.252	(LNS62)	Cornell University