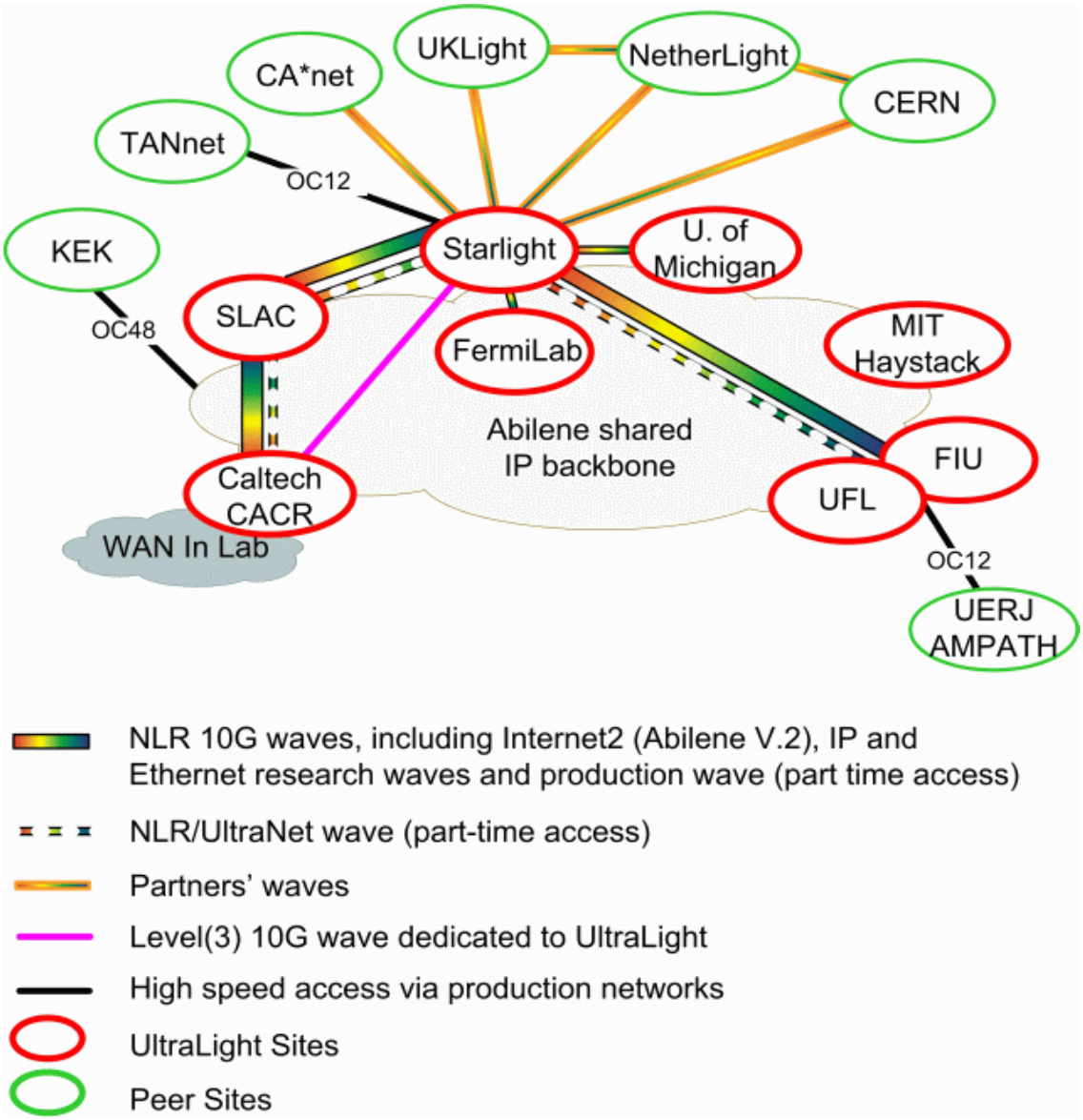
Facilities, Equipment and Other Resources

UltraLight Network Phase I

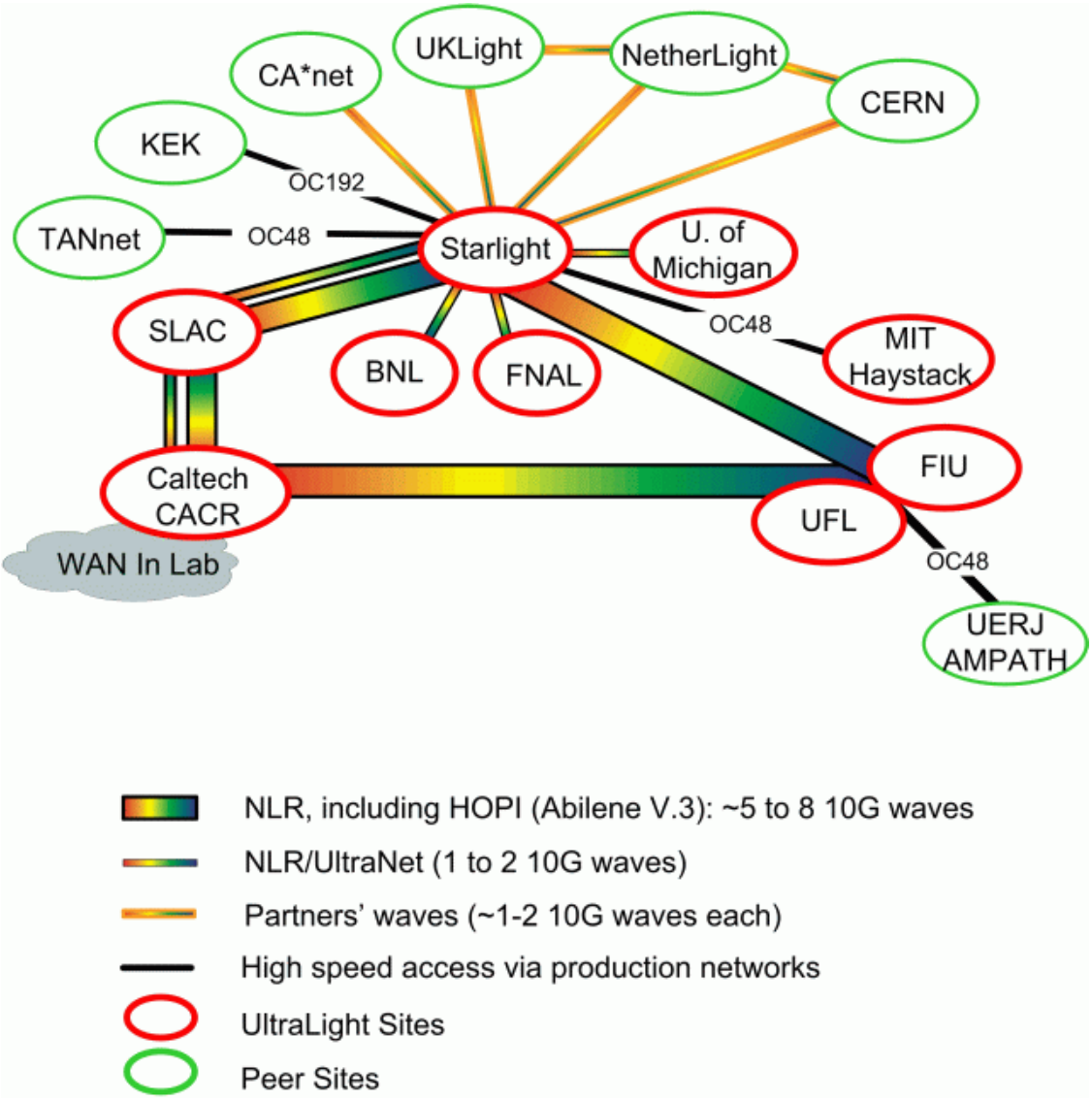
Figure 1 UltraLight Network Phase 1



Facilities, Equipment and Other Resources

UltraLight Network Phase 2

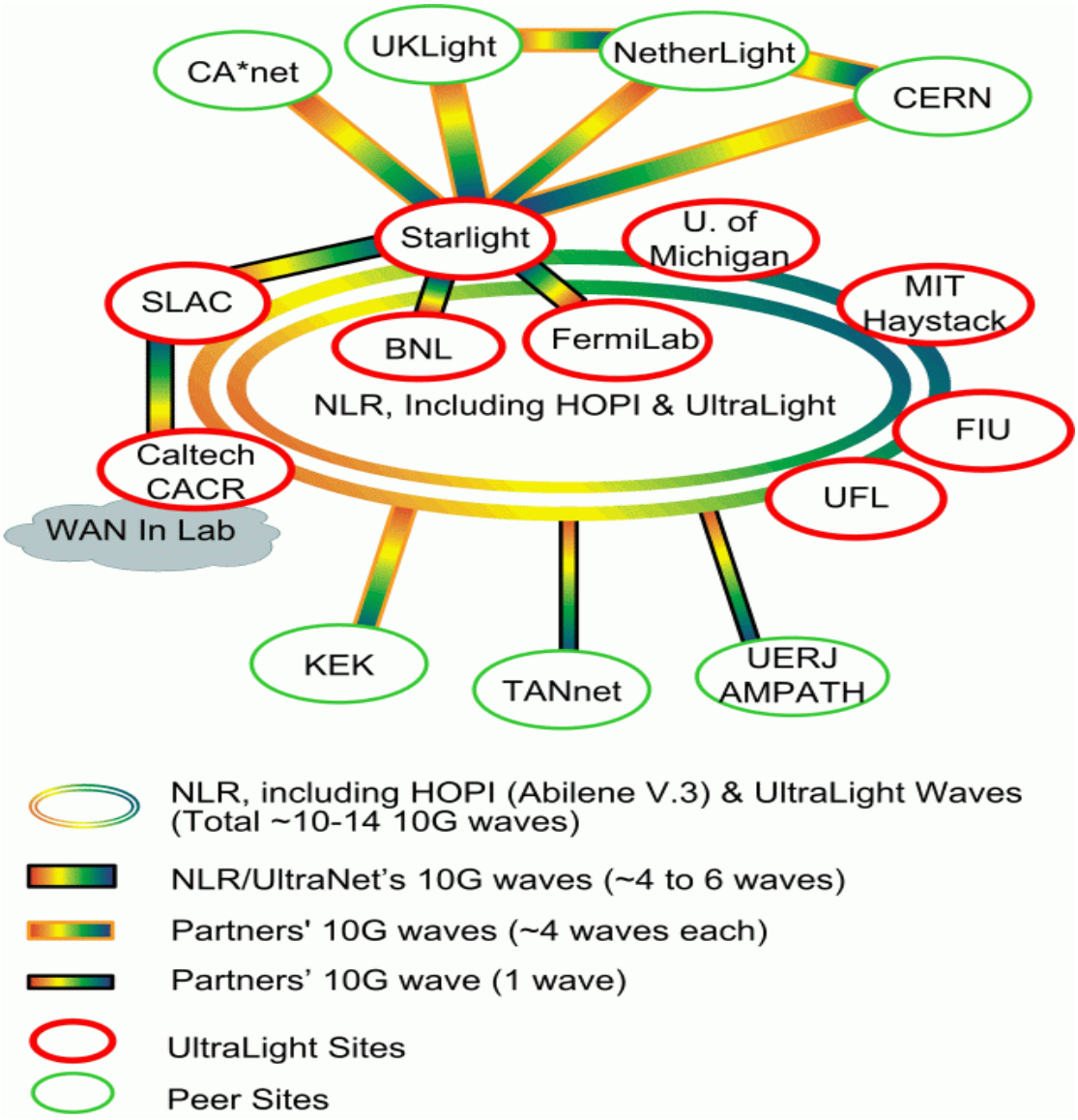
Figure 2 UltraLight Network Phase 2



Facilities, Equipment and Other Resources

UltraLight Network Phase 3

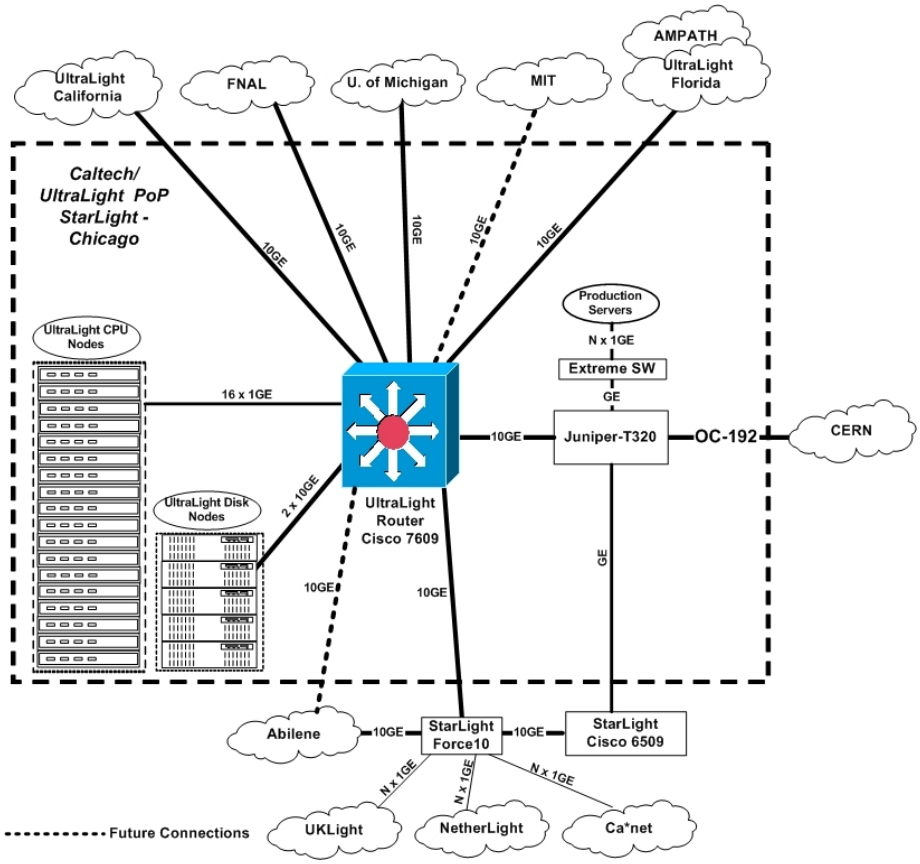
Figure 3 UltraLight Network Phase 3



Facilities, Equipment and Other Resources

UltraLight Optical Switching Fabric

Figure 4 UltraLight Phase 1 Optical Switching Fabric

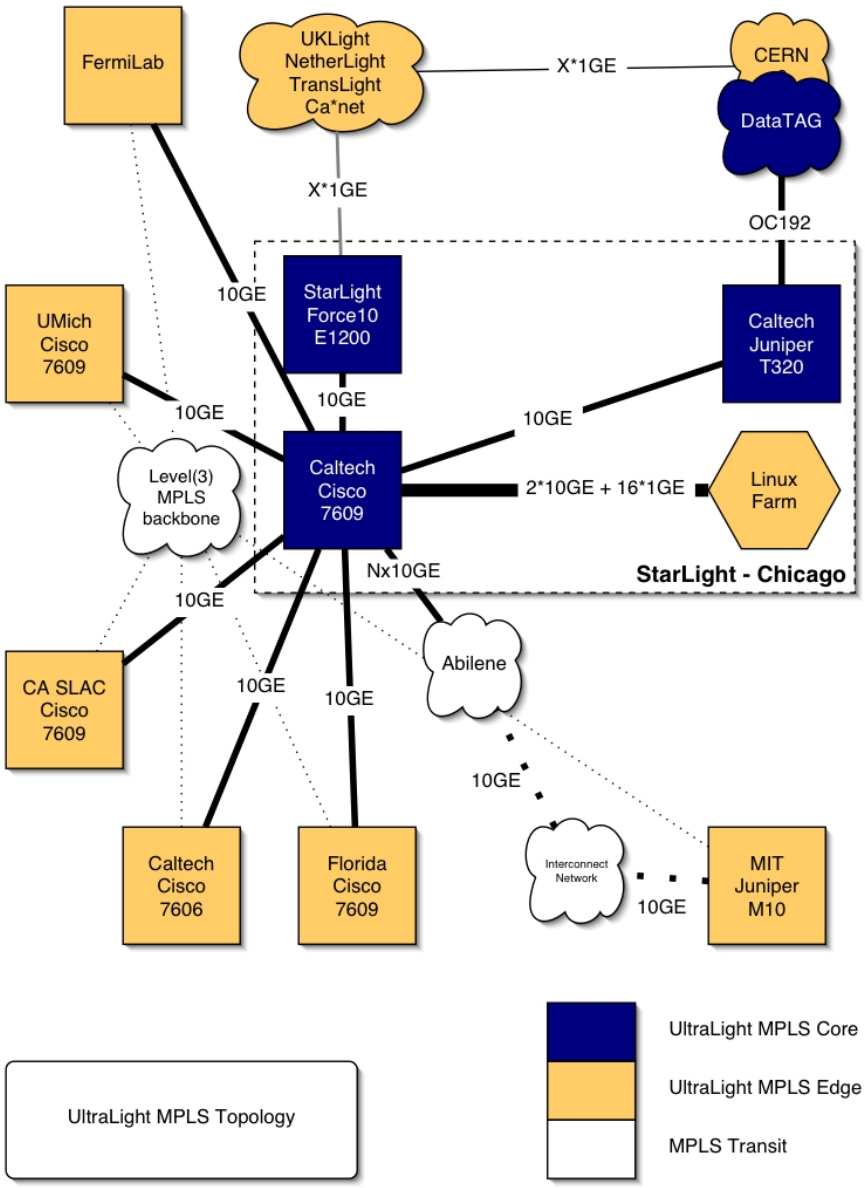


UltraLight MPLS Network Architecture

The MPLS network architecture for UltraLight will consist of a core of Cisco and Juniper Label Switch Routers (see Figure 3 below). These routers will interconnect the various edge sites where the Label Edge Routers will reside. Physically, the network will be connected in a star topology. It will provide basic transport services with and without bandwidth reservation, differentiated services support, and more advanced services such as Virtual Private Networks and Virtual Private LAN services. The UltraLight MPLS network will peer with other MPLS networks and use techniques such as priority queuing and shaping to interwork with those networks and provide end to end MPLS services for sites not directly connected into the UltraLight MPLS core. The UltraLight MPLS network will be integrated closely with the autonomous agents that make up the intelligent monitoring and management infrastructure.

Facilities, Equipment and Other Resources

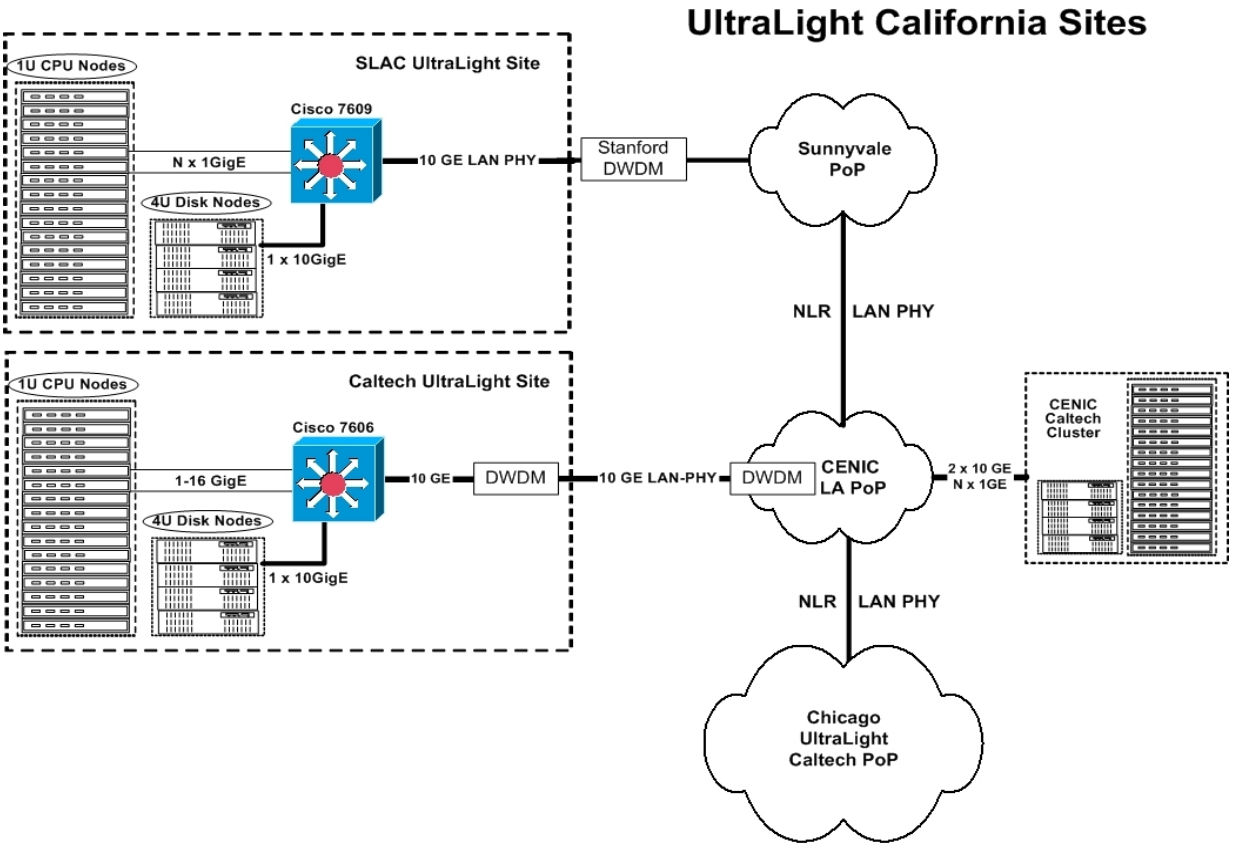
Figure 5 UltraLight Phase 1 MPLS Network



Facilities, Equipment and Other Resources

Caltech

Figure 6 California Phase 1 Network and Storage Servers Site Diagram



Leveraged Facilities at Caltech

The Caltech Tier2 center, located at the Center for Advanced Computing Research (CACR), basically comprises four different clusters, namely the Caltech Production Cluster (PG), the Caltech Integrated Grid Testbed Cluster (IGT), the Caltech Developmental Grid testbed Cluster (DGT) and the Caltech Grid3 Cluster (Caltech-Grid3). The PG is used for full fledged CMS Monte-Carlo productions on a 24x7 basis, the IGT for intermediate production and data analysis, the DGT for development and tests of grid software and the Grid3 cluster for interoperability exercises and demonstrations among various experiments. . The main objective of the Tier2 center is to develop an infrastructure for research and development efforts in grid computing, high performance networking and data analysis needed for the highly data intensive LHC physics programme. The center is currently a fully participating component of various grid projects that include GriPhyN, iVDGL, PPDG and Grid3.

Here follows a detailed list of the equipment and facilities involved:

Caltech Production Grid Cluster (PG):

1. ACME 6012PE (Dual Intel P4 Xeon 2.4GHz) 12
   1U Rack-mounted server, 1GB PC 2100 ECC
   SDRAM Reg. memory, 1 10/100, 1 Gigabit
   ethernet and 1 Syskonnect Gigabit card,
   ATI Rage XL PCI graphic controller,

Facilities, Equipment and Other Resources

1 Maxtor IDE 80 GB 7200 RPM drive

2. Supermicro SC812I-400Ccase, 1U rackmount server on Supermicro X5DPE-G2 motherboard, dual Intel 2.8 GHz CPU, 1GB PC 2100 ECC Registerd DDR memory, 80 GB Maxtor IDE drive, dual Intel copper gigabit ports, 1 1.445 MB Floppy drive, 1 slim cdrom drive. 20

3. 4U Rack-mounted Disk Server based on Supermicro P4DPE-G2 motherboard with dual Intel P4 Xeon 2.4 GHz processors, Intel E7500 chipset, 2 GB of PC2100 ECC Registered DDR memory, Syskonnect gigabit card, ATI Rage XL PCI graphic controller, 2 3ware 7500-8 RAID controllers, 16 Western Digital IDE disk drives for RAID and 1 for system 2

4. Dell Powerconnect 5224 Rackmounted managed configurable network switch with 24 10/100/1000 Mbps (RJ-45 connector) and 4 SPF fiber ports 2

Caltech Integrated Grid Testbed Cluster (IGT):

5. Dell PowerEdge 4400 Rack-mounted server dual Intel Xeon PIII 1 GHz processors 2 GB PC133 SDRAM main memory, 1 Intel 10/100 ethernet and 2 Syskonnect cards, ATI 3D Rage graphics controller, Adaptec SCSI 39160 and AHA-2940U2 cards, 7 SCSI internal hard drives 1

6. 2U Rack-mounted compute nodes with dual 800MHz Pentium III processors, 512 MB memory 10/100 Ethernet, 2x36 GB disk drives 20

7. 4U Winchester FlashDisk OpenRAID rack-mounted SCSI RAID storage with total capacity of 2.5 TB 3

8. Dell Powerconnect 5224 Rackmounted managed configurable network switch with 24 10/100/1000 Mbps (RJ-45 connector) and 4 SPF fiber ports 1

9. APC Smart-UPS Model: 3000 UPS power supply unit 1

Caltech Developmental Grid Testbed Cluster (DGT):

10. A.Serv 1U-A1210 Rack Server, Dual AMD Athlon 1900+ processors on Tyan S2462NG K7 Thunder motherboard, 1 GB PC2100 DDR ECC Register memory, 1 Intel Pro/1000T Gigabit and one 3Com 10/100 ethernet ports 1

11. A.Serv 2U-2200 Rack Server, Dual AMD Athlon 1900+ processors on Tyan S2466N Tiger MPX 3

Facilities, Equipment and Other Resources

motherboard, 512 MB PC2100 DDR ECC Registered memory, 1 Intel Pro/1000T Gigabit and one 3Com 10/100 ethernet ports, ATI XPERT PCI XL video chipset

12. 1U Athlon based NAS storage server 1

13. Asante IntraCore 35160T gigabit switches 2

Caltech Grid3 Cluster (Caltech-Grid3):

14. 3U Disk Server on Supermicro X5DPE-G2 motherboard with dual Intel 2.40 Ghz CPUs, 2 GB ECC Registered memory, 1 3ware SATA RAID controller, 8 SATA disk drives, 1 1.44 MB floppy drive and 1 slim CDROM drive, dual Intel copper gigabit ports 1

15. Supermicro SC812I-400C case, 1U rackmount server on Supermicro X5DPE-G2 motherboard, dual Intel 2.4 GHz CPU, 1GB PC 2100 ECC Registerd DDR memory, 80 GB Maxtor IDE drive, dual Intel copper gigabit ports, 1 1.445 MB Floppy drive, 1 slim cdrom drive. 4

16. Dell Powerconnect 5224 Rackmounted managed configurable network switch with 24 10/100/1000 Mbps (RJ-45 connector) and 4 SPF fiber ports 1

Network Servers at Caltech:

17. 1U rackmount server on Supermicro X5DPE-G2 motherboard, dual Intel 2.8 GHz CPU, 1GB PC 2100 ECC Registerd DDR memory, 80 GB Maxtor IDE drive, dual Intel copper gigabit ports, 1 1.445 MB Floppy drive, 1 slim cdrom drive. 1

18. ACME 6012PE (Dual Intel P4 Xeon 2.4GHz) 1U Rack-mounted server, 1GB PC2100 ECC SDRAM Reg. memory, 1 10/100, 1 Gigabit ethernet and 1 Syskonnect Gigabit card, ATI Rage XL PCI graphic controller, 1 Maxtor IDE 80 GB 7200 RPM drive 1

Monalisa Servers at Caltech:

19. 1U rackmount server on Supermicro X5DPE-G2 motherboard, dual Intel 2.8 GHz CPU, 1GB PC 2100 ECC Registerd DDR memory, 80 GB Maxtor IDE drive, dual Intel copper gigabit ports, 1 1.445 MB Floppy drive, 1 slim CDROM drive. 1

20. 2U Rack-mounted node with dual Intel 800 Mhz Pentium III processors, 512 MB memory 1

Facilities, Equipment and Other Resources

10/100 Ethernet, 2x36 GB disk drives

Network equipment at Starlight (Chicago):
Juniper T320
T320 Flexible PIC Concentrator (accepts PC series PICs)
1-port 10GBASE-LR Interface
T320 Flexible PIC Concentrator (accepts M160-FPC2 PICs)
2port Gigabit Ethernet PIC, SX Optics
Role: Production router connected to the transatlantic OC192 circuit

OSR-Cisco 7609:
Catalyst 6000 SU22/MSFC2 SERVICE PROVIDER W/VIP (supervisor)
1-port OC-48/STM-16 SONET/SDH OSM, SM-SR, with 4 GE
4-port Gigabit Ethernet Optical Services Module, GBIC
Catalyst 6500 16-port GigE module, fabric enable
Catalyst 6500 Switch Fabric Module (WS-C6500-SFM)
Role: Element of the multi-platforms testbed (Datatag project).

Cisco 7609:
Catalyst 6500 / Cisco 7600 Supervisor 720 Fabric MSFC3
6500 Series 4 Port 10GbE Module (4 XENPAC)
Catalyst 6500 10 Gigabit Ethernet Module with 1310nm long haul OIM and DFC card
Cat6500 16-port GigE mod, 2 fab I/F, (SX GBICs)
4000W DC Powr Sup for CISCO7609/13, Cat6509/13 chassis
Role: Element of the multi-platforms testbed (Datatag project).

Cisco 2950
24 10/100 ports + 2*1000BASE-SX ports
Role: Fast Ethernet switch for production with 2 Gbps uplinks.

Cisco 7507
One-port ATM enhanced OC-3c/STM1 Multimode PA (PA-A3-OC3MM)
One-port Fast Ethernet 100BaseTx PA (PA-FE-TX)
Two-port T3 serial PA enhanced (PA-2T3+)
One-port Packet/SONET OC-3c/STM1 Singlemode (PA-POS-SM)
Gigabit Ethernet Interface Processor, enhanced (GEIP+)
One-port Packet/SONET OC-3c/STM1 Singlemode (PA-POS-SM)
Role: Old router for backup and tests (IPv6 and new IOS software release tests).

Juniper M10
1port SONET/SDH OC48 STM16 SM, Short Reach w/Eje
2 ports PE-1GE-SX-B (2*1 port Gigabit Ethernet PIC, SX Optics, with PIC ejector)
Role: Element of the multi-platforms testbed (Datatag project). In particular, it is dedicated to level 2 services.

Extreme Summit 5i GbE
Gigabit Ethernet switch with 16 ports
Role: Network elements interconnection at Gbps speed.

Cisco 7204VXR
Two-port T3 serial PA enhanced (PA-2T3+)
Gigabit Ethernet Port Adapter (PA-GE)
Role: Old router for backup and tests.

Network equipment at Los Angeles (CENIC PoP)

Facilities, Equipment and Other Resources

Cisco 7606:
Catalyst 6500 / Cisco 7600 Supervisor 720 Fabric MSFC3
6500 Series 4 Port 10GbE Module (4 XENPAC) (part of the Ultralight proposal)
Role: Provide connection to research backbone.

Network equipment at Caltech (campus)
Cisco 7606:
Catalyst 6500 / Cisco 7600 Supervisor 720 Fabric MSFC3
6500 Series 4 Port 10GbE Module (4 XENPAC)
Catalyst 6500 10 Gigabit Ethernet Module with 1310nm long haul OIM and DFC card
Cat6500 16-port GigE mod, 2 fab I/F, (SX GBICs)
Role: Network element of the Grid Clusters.

Caltech VRVS System

1. 1 VRVS.ORG web server CPU Dual Pentium III (Coppermine) 1GHZ RAM 512M HD ~32G
2. 1 VRVS 2.5 demo and development server CPU Single Pentium III (Coppermine) 845MHZ RAM 512M HD ~33G
3. 1 VRVS 3.0 web server CPU Dual Intel(R) XEON(TM) CPU 2.20GHz RAM 2G HD ~65G
4. 1 VRVS MPEG2 MCU and web server CPU Single Pentium III (Coppermine) 800MHZ RAM 256M HD ~4.3G
5. 1 VRVS CALTECH reflector CPU Single Pentium III (Coppermine) 700MHZ RAM 256M HD ~16G
6. 1 VRVS 3.0 development server CPU Dual Intel(R) XEON(TM) CPU 2.40GHz RAM 1G HD ~65G
7. 1 VRVS 3.0 CALTECH StarLight reflector CPU Dual Intel(R) XEON(TM) CPU 2.40GHz RAM 1G HD ~65G

Caltech MonaLisa Monitoring System

1. 1 Locate at CACR: 1U rackmount servers based on Supermicro X5DPE-G2 motherboard, Dual Intel Xeon 2.8 GHz CPUs with 512K cache and 533 MHz FSB, 1GB PC2100 ECC Reg. memory, onboard Intel dual 82546EB gigabit Ethernet controller, Maxtor 80GB 7200 RPM hard drive, onboard ATIRAGE XL 8MB PCI graphics controller, slim FDD and CDROM drives.
2. 1 Locate at Chicago: 1U rackmount servers based on Supermicro X5DPE-G2 motherboard, Dual Intel Xeon 2.8 GHz CPUs with 512K cache and 533 MHz FSB, 1GB PC2100 ECC Reg. memory, onboard Intel dual 82546EB gigabit Ethernet controller, Maxtor 80GB 7200 RPM hard drive, onboard ATIRAGE XL 8MB PCI graphics controller, slim FDD and CDROM drives.

Caltech TeraGrid Network Equipment at CACR

1. 1 ONI Systems Online Metro DWDM
2. 1 Juniper T640: 3 STM-64/OC-192 SONET SMF-SR-2 3 Ethernet 10GBASE-LR
3. 1 Force 10 E1200:2 LC-ED-10GEL-2Y 10GBASE-LR module 1 LC-ED-RPM management module 6 LC-ED-1GE-24P 24 port GbE module

Caltech TeraGrid Network Equipment at CENIC

1. 1 ONI Systems Online Metro DWDM
2. 1 Juniper T640:3 STM-64/OC-192 SONET SMF-SR-2 3 Ethernet 10GBASE-LR

Caltech servers at CERN (GVA), Starlight (CHI) and Los-Angeles (LA)

Network servers at Starlight (Chicago)
6 4U Dual Xeon Nodes:

- Dual Intel® Xeon™ processors , 2.20GHz with 512K L2 cache
- SuperMicro P4DP8-G2Motherboard
- Intel E700 chipset

Facilities, Equipment and Other Resources

- 1 GB RAM, PC2100 ECC Reg. DDR,
- Onboard Adaptec AIC-7902 dual channel Ultra320 SCSI controller
- 2*Seagate 36.7GB SCSI 80pin 10KRPM Ultra 160
- On board Intel 82546EB dual port Gigabit Ethernet controller
- 2*SysKonnect Gigabit Ethernet card SK-9843 SK-NET GE SX
- 4U Rack-mounted server
- 420W

3 4U Dual Xeon Nodes:

- Dual Intel Xeon processors, 3GHz with 512K L2 cache
- SuperMicro X5DPE-G2 Motherboard
- 2 GB RAM, PC2100 DDR ECC Registered
- 2*3ware 7500-8 or 7506-8 RAID controllers
- 16 WD IDE disk drives for RAID and 1 for system
- 2 Intel 82550 fast Ethernet
- 1 Intel 10GE LR PCI Card
- 4U Rack-mounted server

Network servers at Los-Angeles (CENIC PoP)
1 4U Dual Opteron Node:

- Dual processor AMD Opteron 244 - 1.8Ghz
- 1 Maxtor 80Gb IDE Boot Drive and 16x160GB Seagate 150 7200RPM SATA Drives
- 2 3ware 8500-8 SATA IDE Raid Controllers
- 2 onboard Broadcom BCM5704 Gigabit Ethernet Ports
- 4U Rack-mounted server

2 4U Dual Xeon Nodes:

- Dual Intel Xeon processors, 3GHz with 512K L2 cache
- SuperMicro X5DPE-G2 Motherboard
- 2 GB RAM, PC2100 DDR ECC Registered
- 2*3ware 7500-8 or 7506-8 RAID controllers
- 16 WD IDE disk drives for RAID and 1 for system
- 2 Intel 82550 fast Ethernet
- 1 Intel 10GE LR PCI Card
- 4U Rack-mounted server

1 1U Dual Xeon 3.20GHz Node:

- Dual Intel Xeon processors, 3.06GHz with 1MB L3 cache
- SuperMicro X5DPE-G2 Motherboard
- 2 GB RAM, PC2100 DDR ECC Registered
- 120G Maxtor 7200rpm HD
- 1 Intel 10GE LR PCI Card
- 1U Rack-mounted server

9 1U Dual Xeon 2.40GHz Nodes:

- Dual Intel Xeon processors, 2.40GHz with 512K L3 cache
- SuperMicro P4DPR-I Motherboard
- 1 GB PC2100 DDR ECC Registered
- 2 Intel 82550 fast Ethernet on board
- Hard Drive : 80GB IDE, Maxtor, 7200 RPM
- 1*SysKonnect Gigabit Ethernet card SK-9843 SK-NET GE SX

Network servers at CERN:

Facilities, Equipment and Other Resources

2 4U Dual Xeon Nodes:

- Dual Intel® Xeon™ processors , 2.20GHz with 512K L2 cache
- SuperMicro P4DP8-G2Motherboard
- Intel E700 chipset
- 1 GB RAM, PC2100 ECC Reg. DDR
- Onboard Adaptec AIC-7902 dual channel Ultra320 SCSI controller
- Hard drive : Seagate 36.7GB SCSI 80pin 10KRPM Ultra 160
- On board Intel 82546EB dual port Gigabit Ethernet controller
- 2*SysKonnect Gigabit Ethernet card SK-9843 SK-NET GE SX
- 4U Rack-mounted server
- 420W

3 4U Dual Xeon Nodes:

- Dual Intel® Xeon™ processors , 3.02 GHz with 512K L2 cache
- SuperMicro P4DPE-G2 Motherboard:
- 2 GB RAM, PC2100 ECC Reg. DDR
- 2 3ware 7500-8 RAID controllers
- 16 WesternDigital IDE disk drives for RAID and 1 for system
- 2 Intel 82550 fast Ethernet
- 1*SysKonnect Gigabit Ethernet card SK-9843 SK-NET GE SX
- 10 GE Intel card.
- 4U Rack-mounted server
- 480W to run 600W to spin up

3 4U Dual Xeon Nodes:

- Dual Intel® Xeon™ processors , 2.40GHz with 512K L2 cache
- SuperMicro P4DP8-G2Motherboard
- Intel E700 chipset
- 2 GB RAM, PC2100 ECC Reg. DDR,
- Hard drive: 1 x 140 GB - Maxtor ATA-133
- On board Intel 82546EB dual port Gigabit Ethernet controller
- 2*SysKonnect Gigabit Ethernet card SK-9843 SK-NET GE SX
- 4U Rack-mounted server
- 420W

Facilities, Equipment and Other Resources

Internet2

Internet2's contributions will encompass several resources.

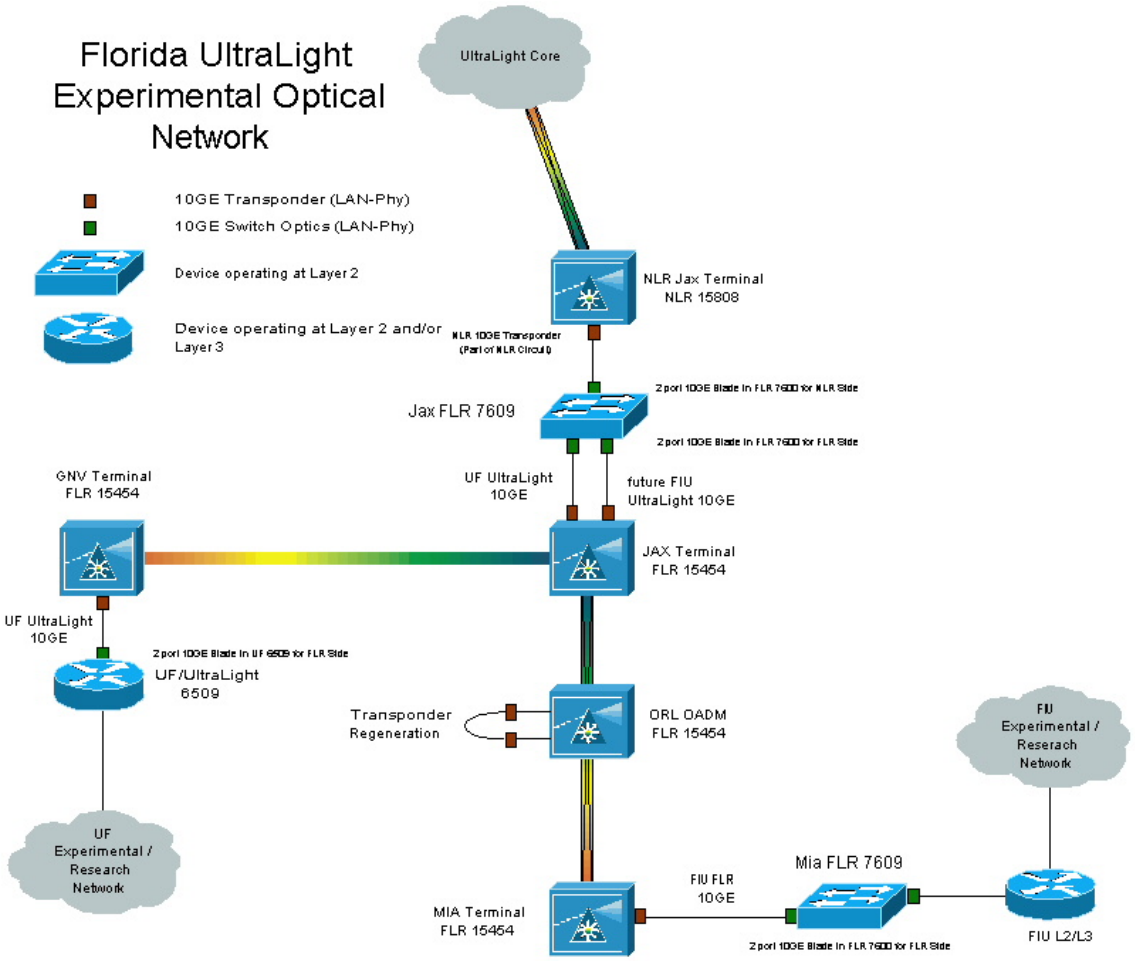
1. A special experimentally focused interconnection in Chicago of UltraLight to Internet2's 10 Gb/s Abilene backbone network. At a minimum, this will be done using Abilene's existing 10 Gb/s connection to the StarLight switch. If a separate fiber pair is made available, this will be done with a new dedicated 10 Gb/s connection to the UltraLight switch.
2. Leveraging Internet2's role as a founding member of the NLR effort, engineering resources will be made available to help with the design and engineering of UltraLight's NLR-based facilities.
3. The one-way delay measurement technology as well as other techniques developed in the Abilene Observatory project will be made available for us in the performance measurement activities of UltraLight.
4. Leveraging Internet2's capabilities in end-to-end performance, engineering resources will be made available to study the performance achieved for aggressive applications over the UltraLight facility, and to compare it with the performance achieved over the Internet2 infrastructure.
5. Internet2 will collaborate in the consideration of specific experimentally focused MPLS tunnels between designated sites on the UltraLight facility and on the Internet2 infrastructure, both to broaden the reach of UltraLight's experimental facility and to test the relative efficacy of the MPLS-based techniques developed as part of the UltraLight project.

More generally, Internet2 will engage with UltraLight in understanding how to support UltraLight applications most effectively, both in the current Internet2 production infrastructure, in the proposed UltraLight experimental infrastructure, and in future forms of Internet2's production infrastructure.

Facilities, Equipment and Other Resources

University of Florida

Figure 7 Florida UltraLight Optical Network



University of Florida (UF) and Florida International University (FIU) will use Florida's emergent Florida Lambda Rail (FLR) optical network to create an experimental network to connect to UltraLight. FLR will connect to National Lambda Rail (NLR) in Jacksonville. UFL and FIU each will provision 10GbE LAN-PHY wavelengths to the optical cross-connect (OXC) in Jacksonville, from where UFL and FIU will share another 10GbE LAN-PHY wavelength across NLR that will connect Florida's UltraLight network to the UltraLight optical core.

The FLR network is scheduled to be in service by October 2004. The initial service will be a 10GbE shared IP service that will connect member universities in Florida. FLR will establish an OC192c connection to Internet2's Abilene network, also by October 2004. UF and FIU will be able to participate in UltraLight experimental and research activities through this new OC192c connection.

Leveraged Facilities at UF

The University of Florida computing equipment is configured as a prototype Tier2 site as part of the 5-Tier global computing infrastructure for the CMS experiment at the LHC. It includes many rack-mounted servers and several TeraBytes of RAID storage. The system is intended for use as a general-purpose computing environment for LHC physicists. Other tasks include large-scale production of Monte Carlo simulations, high-speed network transfers of object collections for analysis, and general prototyping and

development efforts in the context of the work on the International Virtual Data Grid Laboratory (iVDGL), which is setting up a global grid testbed. The Tier2 includes a fully up to date software environment with the latest versions of operating systems, firmware, Grid software and tools, PPDG, GriPhyN and iVDGL software.

The Florida Tier2 and Network equipment details follow:

1. 70 dual-CPU compute servers, 2U (P3, 1.0 GHz, 0.5 GB, 75 GB, 1x100 Mbps)
2. 50 dual-CPU compute servers, 1U (P4, 2.6 GHz, 1.0 GB, 80 GB, 2x1 Gbps)
3. 2 dual-CPU head nodes, 2U (P3, 1.0GHz, 1.0 GB, 80 GB, 2x100 Mbps)
4. 2 dual-CPU head nodes, 1U (P4, 2.6 GHz, 2.0 GB, 160 GB, 2x1 Gbps network, 0.5 TB RAID (Sun T3, Fibrechannel) 1.0 TB RAID (Winchester Flashdisk, Fibrechannel, 1 Gbps), 4.8 TB RAID (2 IDE RAID, 2.4TB apiece, 2 CPU, 16x180 disks, 1x1Gbps), 9.0 TB RAID (2 IDE RAID, 4.5TB apiece, 2 CPU, 16x320 disks, 2x1Gbps)
5. 1 Cisco 4006 switch with 4 blades
6. 3 Dell 5324 switches

Campus backbone = Dual GigE (2x1 Gbps)
Wide-area connection = OC12c (622 Mbps) to Abilene

In addition to the aforementioned facilities, the University of Florida is currently underway in the development of a new research center and experimental campus-wide research grid. The overall objective of this new research center and its facility will be to foster innovative research at UF in high-performance and data-intensive computing. In its role as an experimental research grid for grid infrastructure and applications research, the new facility will be leveraged as a testbed resource to support research activities with the UltraLight project.

The center will feature a set of three new clusters built in three phases and located in a distributed facility spanning the colleges of arts and sciences, engineering, and health sciences. The center's facility will serve as the computation and storage hub linking together existing clusters across campus via high-speed networks to form a campus-wide research grid. This grid will be used for two roles of strategic importance to the university. First, the grid will serve as a development platform for research on novel grid computing, storage and networking technologies such as those in the UltraLight infrastructure. Second, the initiative will provide infrastructure to tackle large-scale problems beyond the reach of present facilities in high-energy physics, computational sciences, biomedical computing, nanoscience and nanotechnology, brain imaging, radiation oncology, digital arts, cybersecurity and e-commerce.

The first phase of the new facility will come on-line in early 2004, with the second and third phases expected to do so in early 2005 and 2006, respectively. When complete in 2006, resources for the new hub of the campus research grid are expected to include on the order of 1000 dual-CPU compute servers, storage servers with a total capacity on the order of 350TB, and a multi-Gigabit Ethernet networking infrastructure. A summary of the equipment currently being procured for the Phase I acquisition is provided below.

The Florida campus research grid equipment details for the Phase I hub follow:

1. 192 Dell PowerEdge 1750 dual-CPU compute servers, 1U (P4 Xeon, 2.8GHz, 2 GB, 75GB, 2x1 Gbps)
2. 4 Dell PowerEdge 2650 dual-CPU storage servers, 2U (P4 Xeon, 2.8 GHz, 2 GB, 4.0TB SCSI RAID, 2x1 Gbps)
3. 4 dual-CPU storage servers, 2U (P4 Xeon, 2.8 GHz, 2 GB, 4.0TB IDE RAID, 2x1 Gbps)
4. 2 PowerVault 136T LT02 tape backup units
5. 10 Cisco 3750 switches

Facilities, Equipment and Other Resources

Florida International University

FIU to UltraLight Connectivity Description

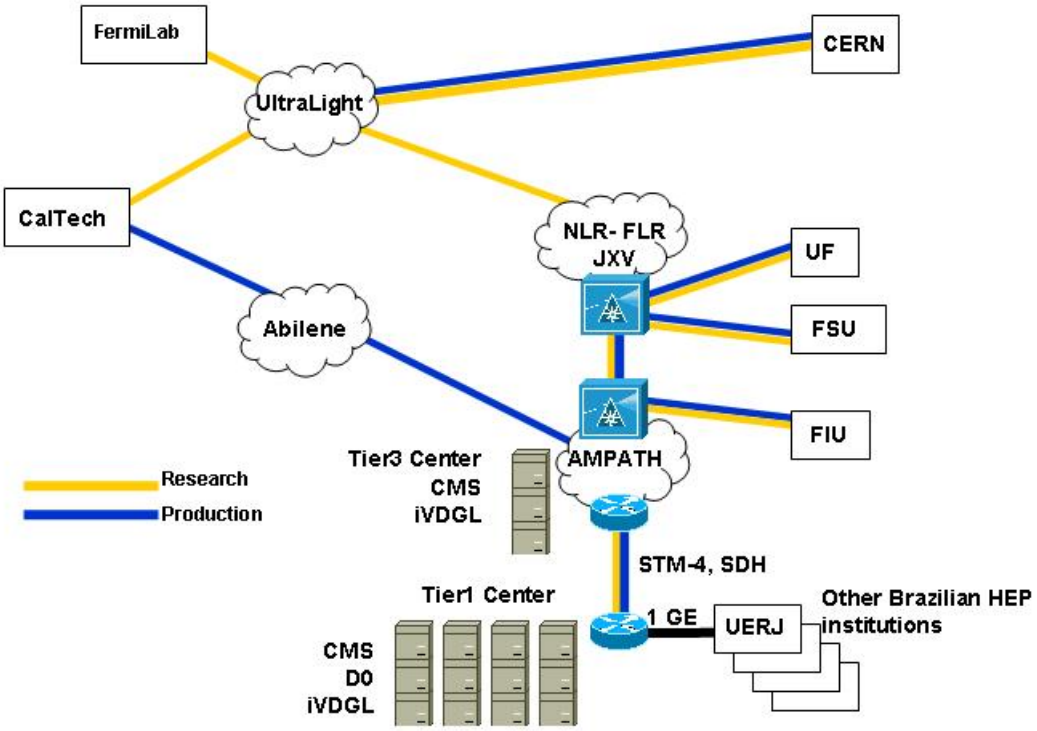
FIU will connect to UltraLight through a 10GbE LAN-PHY wavelength interconnecting Miami to Jacksonville, then sharing a 10GbE LAN-PHY wavelength to the UltraLight optical core with UFL (see Figure 1 above). The connection in Miami will be from the NAP Of The Americas, where the AMPATH PoP is located. AMPATH serves as the international exchange point for research and education networks in the Americas. In year 1, FIU will utilize its OC12c to Abilene to participate in UltraLight activities. By October 2004, Florida Lambda Rail plans are to offer a 10G shared IP bearer service in Florida. This will provide FIU with additional resources to participate in UltraLight, interconnecting with National Lambda Rail in Jacksonville. FIU will pursue funding for a dedicated wave to fully participate in UltraLight activities and to support its experimental and research networking activities.

Leveraged Facilities at FIU

FIU is the lead institution, in collaboration with Caltech, University of Florida and Florida State University, proposing to develop an inter-regional Center for High-Energy Physics Research Education and Outreach (CHEPREO). CHEPREO is a 5-year NSF funded program (MPS 0312038), that in year 1, would establish an STM-4 (622 Mbps) SDH-based transport service between Miami and Rio. CHEPREO would also establish a Tier3 CMS Grid facility in Miami for FIU. The STM-4 circuit would be used for research and experimental networking activities, and production. Through the CHEPREO program, UltraLight could leverage the availability of an experimental network to South America. Likewise, the Tier1 facility in Rio and Brazil's HENP community can access UltraLight for connectivity to the Global Grid community. Figure 2 shows how the emergent Grid Physics Tier1 facility at the State University of Rio de Janeiro (UERJ) would be connected to Miami and UltraLight.

Facilities, Equipment and Other Resources

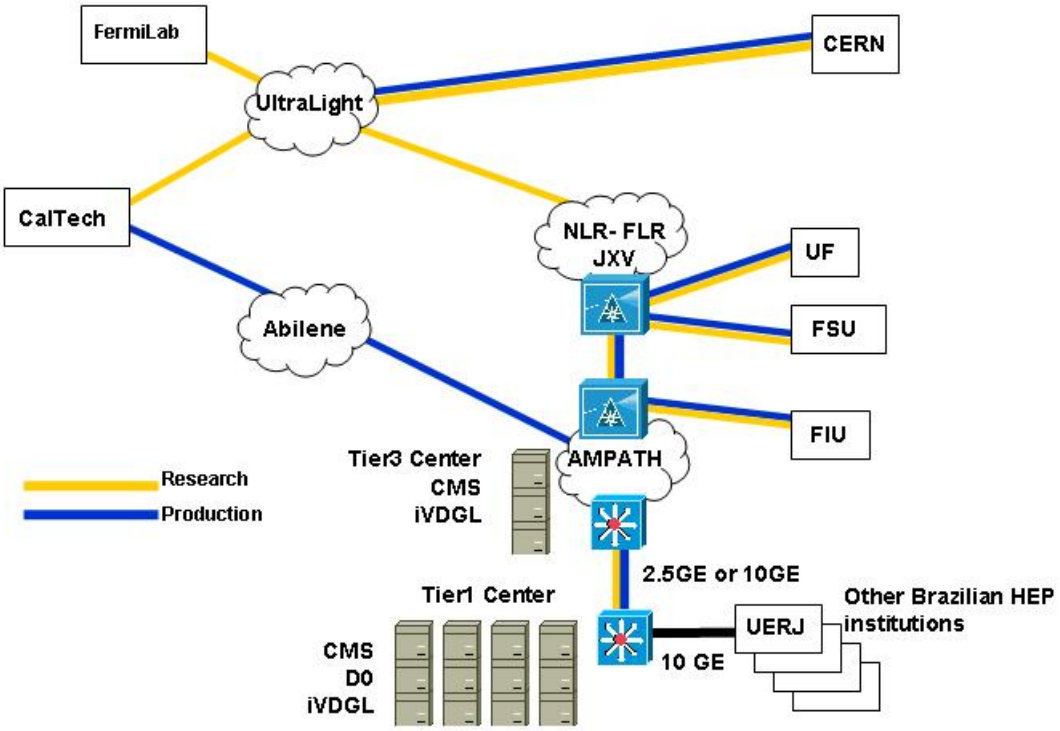
Figure 8 UltraLight International Connection to Brazil (years 1-3)



Leveraging the experimental network in Florida, and then transiting NLR, Brazil and South America would be able to participate in UltraLight. By year 3 or possibly sooner, the load on the inter-regional STM-4 circuit is expected to reach capacity. As soon as possible, this circuit should be upgraded to a 2.5G or 10G wavelength and a Layer2 connection extended to South America, as is to other UltraLight Peer Sites. The following figure shows L2-L3 equipment by which South America can connect to the UltraLight optical fabric.

Facilities, Equipment and Other Resources

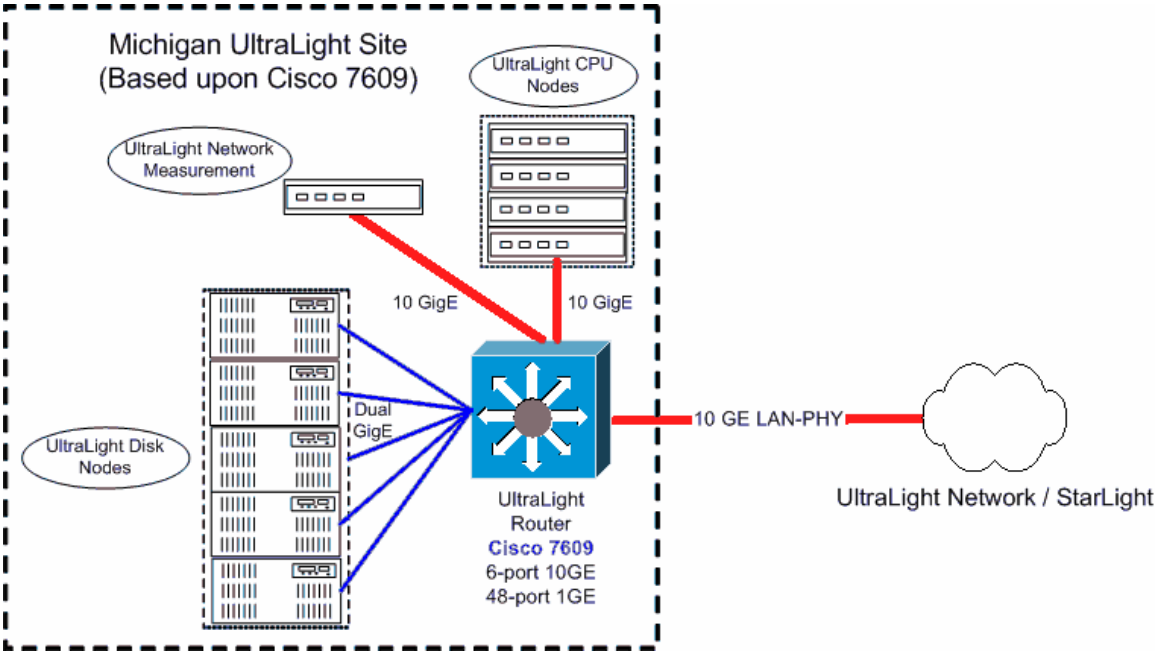
Figure 9 UltraLight International Connection to Brazil (years 4-5)



Facilities, Equipment and Other Resources

University of Michigan

Figure 10 University of Michigan Network Site Diagram



University of Michigan to UltraLight Connectivity Description

As shown in the above figure, Michigan will have a 10 GE LAN-PHY connection to UltraLight via a University of Michigan owned fiber from Ann Arbor to StarLight in Chicago. We intend to populate the Michigan UltraLight PoP with three kinds of equipment:

1. Network storage servers based upon commodity components, capable of driving the full 10 Gigabits/sec of UltraNet bandwidth via numerous Gigabit Ethernet connections operating in parallel
2. ,A small number of CPU nodes connected at 1 Gigabit.
3. A network monitoring and testing station connected at 10 Gigabits

Michigan will provide the wave transport for the UltraLight 10GE connection.

Leveraged Facilities at the University of Michigan

Michigan hosts one of eight US ATLAS GRID testbed sites. Our site is currently composed of 12 dual cpu systems, with memory ranging from 256 Mbytes up to 1 Gigabyte per system. The storage systems are a combination of SCSI and IDE RAID 5 configurations totaling over 4.5 terabytes of storage. Some of these nodes will be co-located at the Michigan UltraLight PoP. The Michigan Grid Research and Infrastructure Development (MGRID) group and the Center for Advanced Computing operates significant computational and storage resources that will available for use by the Ultralight project. This equipment will be used for infrastructure simulation, data backup for the University of Michigan Ultralight equipment, and for providing Ultralight access for NPACI and CAC users. The list of equipment includes:

1. AMD Athlon Opteron Cluster Nyx
   320 computational nodes, 200 interconnected via gigabit ethernet using a Force10 E1200 ethernet switch. All of the nodes contain two AMD Opteron 240 processors. The memory configuration is as follows: 64 nodes, 3 GB/CPU; 64 nodes, 2 GB/CPU; 192 nodes, 1 GB/CPU. 63% of Nyx is dedicated to NPACI users.

Facilities, Equipment and Other Resources

2. AMD Athlon MP Cluster Morpheus
   67 computational nodes interconnected via Myrinet with a 3.5 TB storage subsystem. 50 nodes contain 100 Athlon MP 1600+ processors, 17 nodes contain 34 Athlon MP 2200+ processors. All nodes contain 2 GB of RAM. 63% of this system is dedicated to use by NPACI users.

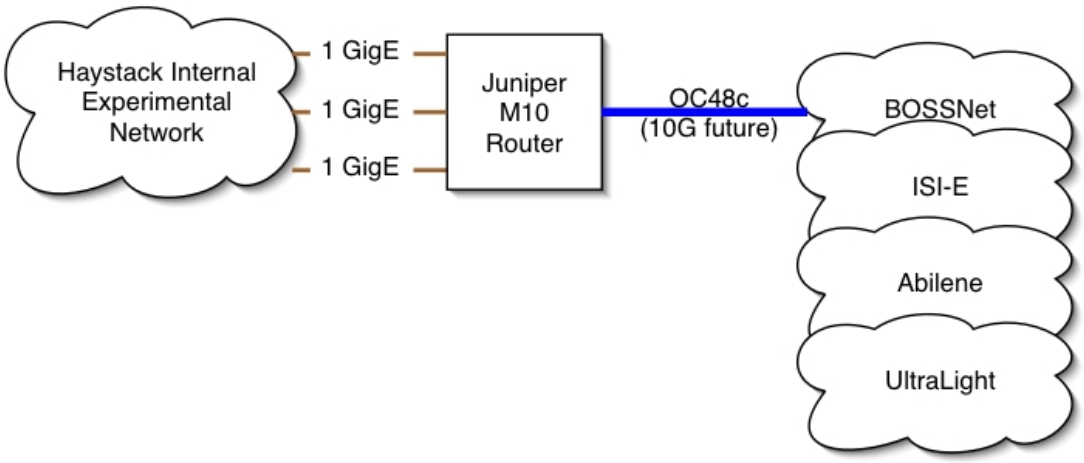
3. AMD Athlon MP Cluster Hypnos
   154 compuational nodes, 128 of which are interconnected via Myrinet and the remainder connected via Ethernet. 128 of the nodes contain 256 Athlon 2000+ processors and 26 of the nodes contain 52 Athlon MP 2400+ processors. Each node contains 2GB of RAM and has access to a shared 1TB RAID. 80% of this system is dedicated to use by NPACI users.

4. Intel Cluster Treehouse
   32 compuational nodes interconnected via gigabit ethernet containing 64 Intel Pentium III 800 MHz processors. Each node contains 1GB of RAM.

5. Tivoli Mass Storage System
   72 TB mass storage system running IBM Tivoli software. This system will be used for backups for the University of Michigan Ultralight computational and storage nodes.

MIT/Haystack

Figure 11 MIT/Haystack Network Site Diagram



MIT/Haystack to UltraLight Connectivity Description

MIT/Haystack Observatory is currently connected into StarLight via Abilene with a 1 GigE connection via Bossnet and ISI-E. As part of the UltraLight project, Caltech will loan Haystack Observatory a Juniper M10 router to allow Haystack to upgrade this connection to OC-48c (2.5 Gbps), as shown in the above Figure. MIT/Haystack Observatory will also look towards upgrading this link to 10GE in phase 3 of the project. Use of Glownet/Bossnet to connect from Haystack Observatory to ISI-E is courtesy of MIT Lincoln Laboratory, who support these connections for other uses.

Facilities, Equipment and Other Resources

Leveraged facilities at Haystack Observatory

The following existing facilities will be leveraged in the execution of the work under this proposal:

1. Mark 4 VLBI correlator facility, supported by NASA and NSF
2. Westford and Haystack radio telescopes
3. Mark 5 e-VLBI data systems – supported by NASA, NSF and DARPA (http://web.haystack.mit.edu/mark5/Mark5.htm)
4. Glownet (fiber connection from Haystack Observatory to MIT Lincoln Lab) –supported by MIT Lincoln Laboratory, including various routers and switches (ftp://web.haystack.edu/pub/e-vlbi/demo_report.pdf)
5. Juniper M10 router; on loan from Caltech
6. Bossnet (fiber connection from MIT Lincoln Lab to ISI-E) – supported by MIT Lincoln Laboratory, including various routers and switches (http://www.ll.mit.edu/AdvancedNetworks/bossnet.html)
7. Facilities of ISI-E – supported by Information Sciences Institute of USC, including routers and switches (http://www.east.isi.edu/)
8. Facilities of MAX – supported by the Mid-Atlantic Crossroads consortium, including routers and switches (http://www.maxgigapop.net/)