



Internet² Network

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Abilene Network

Current Infrastructure



- Carrier provisioned backbone on Qwest footprint
 - A highly reliable 10-Gbps ‘best effort’, over-provisioned IP network
 - Dual stack IPv4/IPv6, native multicast, MPLS LSPs
- Abilene is widely used – it has the vast majority of the R&E community’s traffic, the applications, the users, the peerings, and the experiments.
- 35 direct connections (OC-3c → 10 Gbps)
- 246 Primary Participants – research universities and labs
 - 150+ Sponsored Participants - Individual institutions, K-12 schools, museums, libraries, research institutes
- Federal Peers: ESnet, DREN, NISN, NREN, USGS

See: <http://abilene.internet2.edu/>

80+ Networks Reachable via International Peerings

Europe-Middle East

Austria (ACOnet)
Belgium (BELNET)
Croatia (CARNet)
Czech Rep. (CESNET)
Cyprus (CYNET)
Denmark
(Forskningsnettet)
Estonia (EENet)
Finland (Funet)
France (Renater)
Germany (G-WIN)
Greece (GRNET)
Hungary
(HUNGARNET)
Iceland (RHnet)
Ireland (HEAnet)
Israel (IUCC)
Italy (GARR)
Jordan (JUNET)
Latvia (LATNET)
Lithuania (LITNET)
Luxembourg (RESTENA)

Malta (Univ. Malta)
Netherlands (SURFnet)
Norway (UNINETT)
Palestinian Territories
(Gov't Computing Center)
Poland (POL34)
Portugal (RCTS2)
Qatar (Qatar FN)
Romania (RoEduNet)
Russia (RBnet)
Slovakia (SANET)
Slovenia (ARNES)
Spain (RedIRIS)
Sweden (SUNET)
Switzerland (SWITCH)
Syria (HIAST)
United Kingdom
(JANET)
Turkey (ULAKBYM)
*CERN

Asia-Pacific

Australia (AARNET)
China (CERNET, CSTNET,
NSFCNET)
Fiji (USP-SUVA)
Hong Kong (HARNET)
Indonesia (INHERENT)
Japan (SINET, WIDE, JGN2)
Korea (KOREN, KREONET2)
New Zealand (NGI-NZ)
Philippines (PREGINET)
Singapore (SingAREN)
Taiwan (TANet2, ASNet)
Thailand (UNINET, ThaiSARN)
Vietnam (Vinaren)

Central Asia

Armenia (ARENA)
Georgia (GRENA)
Kazakhstan (KAZRENA)
Tajikistan (TARENA)
Uzbekistan (UZSCI)

Americas

Argentina (RETINA)
Brazil (RNP2/ANSP)
Canada (CA*net)
Chile (REUNA)
Costa Rica (CR2Net)
Mexico (Red-CUDI)
United States (Abilene)
Panama (RedCyT)
Peru (RAAP)
Uruguay (RAU2)
Venezuela (REACCIUN2)

Africa

Algeria (CERIST)
Egypt (EUN/ENSTIN)
Morocco (CNRST)
Tunisia (RFR)
South Africa (TENET)

The New Internet² Network

Fundamental Changes in Researchers' Needs

- In the community there is:
 - Great interest in hybrid networks
 - Greater availability of circuit-based capabilities
 - Greater interest worldwide to bring circuit-based services closer to the edge
 - Most regional optical networks have these capabilities
- Researchers now require a wide ranging set of attributes on a single network
 - Type: Shared (IP) to dedicated (wavelength)
 - Temporal: Dynamic to static
 - Robustness: Experimental (breakable) to production quality

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Researched Community Requirements

- Examined a wide variety of projects with different types of capabilities
 - DRAGON and CHEETAH - NSF funded projects examining dynamic provisioning
 - ESnet's OSCARS
 - Science related projects such as UltraLight and eVLBI
 - OptIPuter and TeraGrid
 - Internet²'s HOPI (Hybrid Optical Packet Infrastructure) Testbed
- Input from the international community
 - GEANT2 already providing hybrid types of capabilities
 - GLIF and lightpath capabilities for scientific work

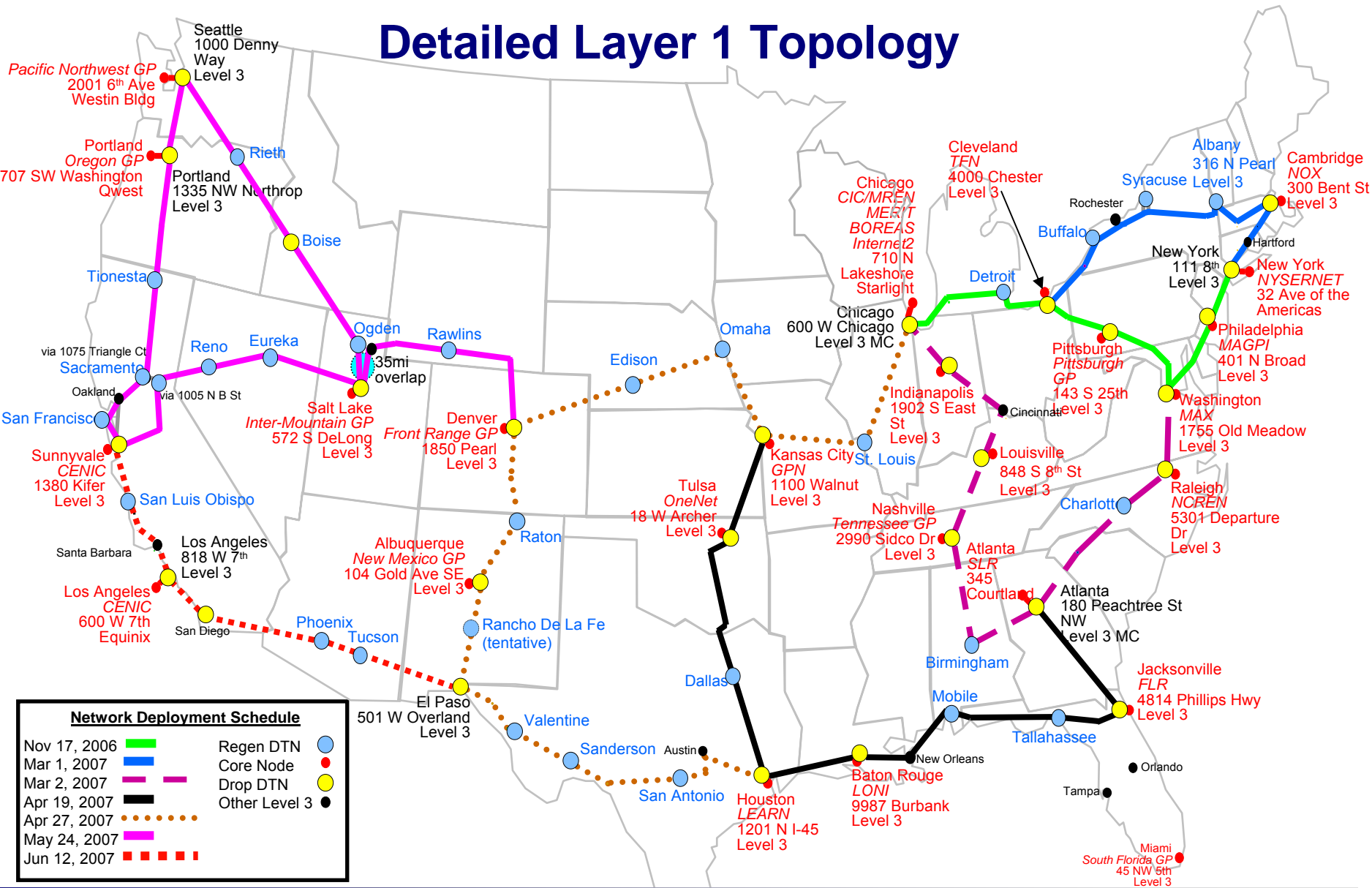
The New Internet² Network

Network Services

- Same highly reliable IP network built on top of optical system
 - Professional NOC and experience running near 5 9's IP network
 - Commodity and content peering service offering
- “On-net” Waves: point-2-point full wavelength or sub- λ circuits
 - Free short-term, dynamically provisioned, deterministic STS-1 (50Mbps) granularity circuits with framing either SONET or GFP mapped Ethernet – subject to blocking.
 - Guaranteed medium to long-term circuits – price determined by distance, speed, duration
 - Long-term waves for a minimum of 1 year with guaranteed SLAs
 - Can provide ultra-high availability waves (protected) utilizing Infinera protection capabilities
- “Off-net” Waves: OC-x or DS-x provisioned services on the Level(3) footprint beyond Internet² Network backbone

The Internet2 Network

Detailed Layer 1 Topology



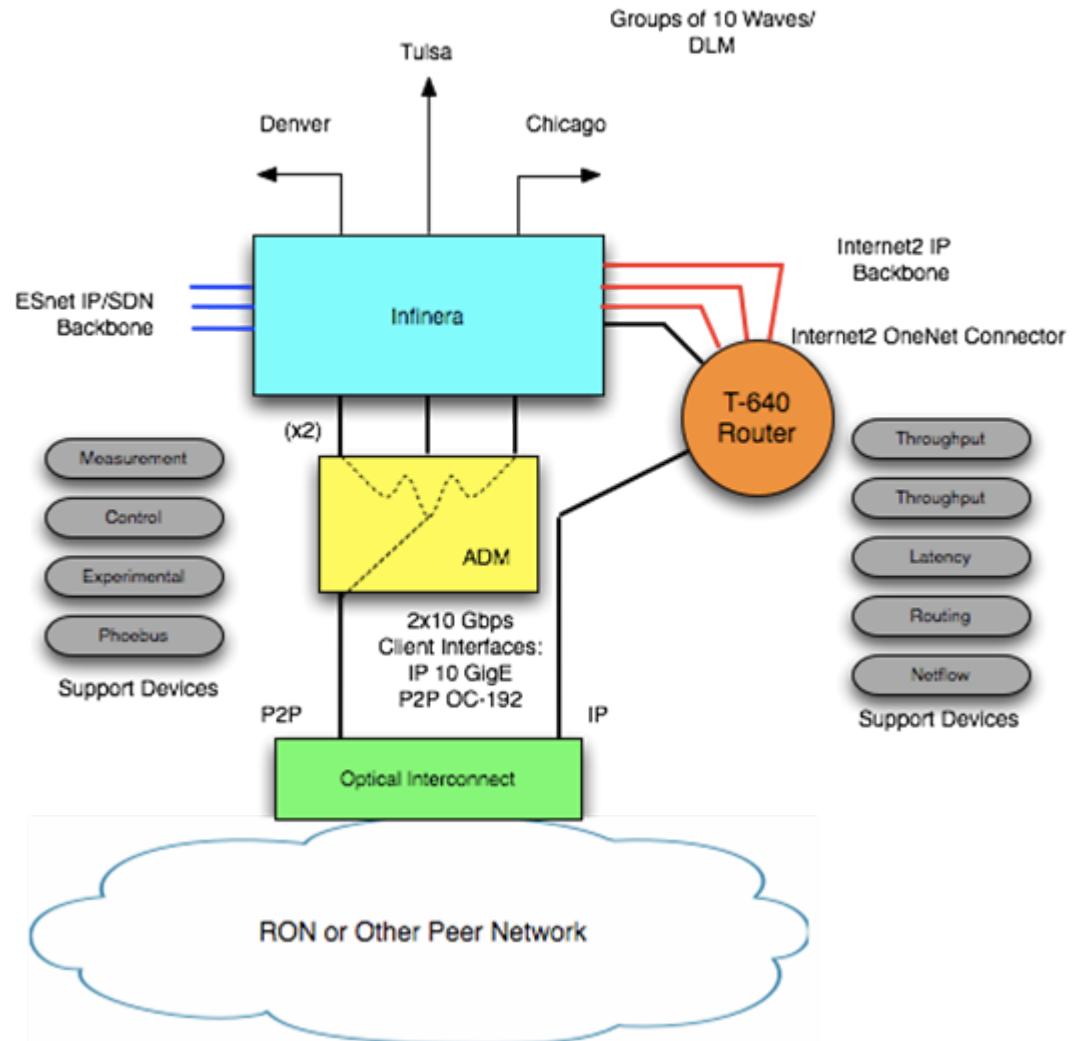
Network Deployment Schedule	
Nov 17, 2006	Regen DTN
Mar 1, 2007	Core Node
Mar 2, 2007	Drop DTN
Apr 19, 2007	Other Level 3
Apr 27, 2007	
May 24, 2007	
Jun 12, 2007	

Node Architecture

- Advanced optical DWDM equipment – Infinera DTN
- Grooming capabilities in Ciena CoreDirector to provide sub channels
- Simplified and standardized interface to connectors, exchange points, and other global research and education networks - 2 x 10 Gbps interfaces
- Greatly enhanced support for the Observatory enabling the collection of network data at nodes

Kansas City, MO

Connector: GPN



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Example Projects on the New Network

- Dynamic services
 - Creating lightpaths across multiple administrative domains in seconds
 - Development of “Domain Controllers”
 - Support for applications - setup of “Application Specific Topologies”
- Dynamic inclusion of optical paths into IP networks for backup or expansion
- Phoebus Project - TCP data transfers over long segments not requiring congestion control
- Network research projects deploying programmable Ethernet capable chipsets at each optical node using “NetFPGA” cards from Stanford
- Service trial with GEANT2 on dynamic provisioning of 1 GigE circuits across Internet² and GEANT2

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Network Research Support

- The Internet² Network is an ideal platform for network research - the ability to support both highly experimental projects along with production-based services is a key objective
- The Abilene Observatory will be expanded to include the new capabilities of the network
 - Data collection at all layers of the network, with datasets made available to network researchers
 - Support for collocation of equipment in optical nodes
- Flexibility is key feature of the new network
 - Smaller projects at lower bandwidths can be supported on variable footprints
 - Projects can also be supported for variable lengths of time
- NSF projects like VINI and GENI can be supported by the new network