

StarLight Connects Global Research Community Using Force10 TeraScale E-Series

Customer PROFILE

Customer

Starlight Networks

Industry

Scientific Research

STARLIGHT™

Applications

Optical Network Exchange

Highlights

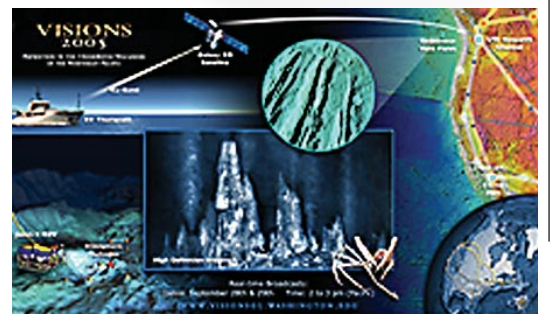
Starlight chooses the Force10 TeraScale E-Series as the foundation of their large scale network that interconnects most of the world's major high performance research and education networks.

Sharing ideas and data as well as equipment is crucial for scientists and researchers who are pushing the frontiers of physics, astronomy, biology, and other fields. Today, all science is "e-science," and researchers need to be able to remotely access data generated by costly instruments, such as supercomputers or storage systems, and distributed computational resources, regardless of where in the world they reside.

Moreover, the need to collaborate with colleagues and access very large datasets in real time is creating demand for high performance networks. The global grid of computing, storage, and visualization resources is being extended to the LambdaGrid of computer resources connected by multi-lambda or multi Gigabit and 10 Gigabit networks. This new approach allows the networks themselves to be directly controlled resources – for example scheduled for dedicated use – just like the computer devices attached to them.

As a result, universities, research institutes, and government agencies are building a global e-science infrastructure comprised of computing, storage, visualization, and networking facilities, that enables researchers worldwide to share information, collaborate remotely, and integrate the resources they need to collect and process data. High performance networks are an essential component of this infrastructure, as are the exchange points that connect these international, national, regional, and local networks.

Since 2001, StarLight has been a cornerstone of the evolving e-science infrastructure. Located on Northwestern University's downtown Chicago



Real-time, uncompressed, high-definition video from deep-sea, high-temperature venting systems is transmitted from the seafloor robot JASON to the Research Vessel Thompson.

campus, StarLight is one of the world's largest optical network exchanges for national and international research and education networks.

StarLight provides optical switching for wavelengths at one and 10 GbE speeds with its Gigabit Ethernet (GbE) switch/router facility. This advanced infrastructure also serves as a proving ground for network services optimized to support high performance, global e-science applications and experimental research equipment. To interconnect these varied networks, StarLight required the scalability and resiliency of the Force10 Networks TeraScale E-Series family of switch/routers.

Building a Powerful Exchange

With funding from the National Science Foundation, StarLight was developed by the Electronic Visualization Laboratory (EVL) at the University of Illinois at Chicago (UIC), the International Center for Advanced Internet Research (iCAIR) at Northwestern University, and the Mathematics and Computer Science Division at Argonne National Laboratory, in partnership with Canada's CANARIE and the Netherlands' SURFnet.

StarLight Connects Global Research Community Using Force10 TeraScale E-Series

Customer PROFILE

“The Force10 E-Series enables us to provide a foundation upon which to build large-scale, cost-effective network services without compromising performance.”

Tom DeFanti

Director of the University of Illinois at Chicago's Electronic Visualization Laboratory and Starlight Founder

The networks that peer at StarLight include regional networks, state-wide networks (Illinois' I-WIRE), national research and education networks (National LambdaRail and Internet2's Abilene), all major federal agency networks (US Department of Energy's [DOE] ESnet and UltraScience Network), international networks, and optical network testbeds (CAVEwave and OMNInet). Interconnecting these networks requires a highly scalable, highly reliable switch/router capable of supporting large numbers of GbE and 10 GbE interfaces. After thoroughly testing and evaluating platforms, StarLight's developers selected the Force10 Networks TeraScale E-Series to handle the demanding peering functions within the exchange.

“StarLight interconnects most of the world's major high performance research and education networks in support of large scale, data-intensive e-science applications and requires not only scalable high performance networking but also resiliency and reliability,” said Tom DeFanti, director of the University of Illinois at Chicago's Electronic Visualization Laboratory and one of StarLight's founders.

“The Force10 E-Series enables us to provide a foundation upon which to build large scale, cost-effective network services without compromising performance, especially as additional 10 GigE circuits are added and data volumes increase.”

The Force10 E-Series combines leading port density and performance with high availability and resiliency features. The E1200, for example, supports up to 1,260 GbE and 224 10 GbE ports. Currently, StarLight has nearly 36 line-rate 10 GbE ports and 96 one GbE ports in use as well as additional ports for testbed research. The E-Series line cards, switch fabric, backplane, central processor, and operating system have all been optimized to process terabits of traffic at line rate in a reliable, predictable fashion.

Resiliency features include the E-Series three-CPU architecture, which distributes switching, routing, and management functionality between distinct processors. This design allows faults to be contained while protecting other parts of the system. In addition, the E-Series has a fully redundant architecture, including fault-tolerant switch fabrics with hitless failover technology that ensures the secondary components are activated with zero packet loss in the event of a failure.

The port density, availability and resiliency features of the Force10 E1200 provide a scalable, cost-effective foundation for StarLight's high performance exchange. The high scalability of the E-Series means that a single chassis can deliver the functionality that other vendors would need multiple boxes to provide, which translates to lower capital, operational and management expenses.

Platform for Experimentation

While many of the advanced networks connected to StarLight support production science, several links are used exclusively for LambdaGrid application experiments. StarLight research is developing new architectures, technologies,



Using both the 100 Megapixel LambdaVision display and the auto-stereo Personal Varrier, scientists can effectively and simultaneously view every step of a multi-scale microscopy correlation process.

StarLight Connects Global Research Community Using Force10 TeraScale E-Series

Customer PROFILE

and techniques that allow for unprecedented levels of distributed network resource integration. Among the methods used are optical signaling, control and management protocols, new UDP-based transport protocols, security and authentication capabilities, data mining techniques for real-time correlation, and real-time visualization and collaboration toolkits for very-large datasets.

Collectively, these advanced networks comprise the Global Lambda Integrated Facility (GLIF), an international partnership of countries, consortia, institutions, and individual research initiatives that support data-intensive scientific research and middleware development.

“The Force10 equipment is currently supporting multiple national and global advanced applications, including leading edge prototypes that cannot be supported by traditional infrastructure,” said Joe Mambretti, director of iCAIR and manager of the StarLight facility.

As one of the platforms for StarLight, the E1200 is helping support the growing e-science infrastructure that will enable researchers to push the frontiers of science even as StarLight’s developers continue to push the boundaries of technology.

About StarLight

StarLight is an advanced optical infrastructure and proving ground for network services optimized for high performance applications. Operational since summer 2001, StarLight is a one GbE and 10 GbE switch/router facility for high performance access to participating networks and also offers true optical switching for wavelengths. StarLight is being developed by the Electronic Visualization Laboratory (EVL) at the University of Illinois at Chicago (UIC), the International Center for Advanced Internet Research (iCAIR) at Northwestern University, and the Mathematics and Computer Science Division at Argonne National Laboratory, in



GridLab develops application tools and middleware for grid environments, and will include capabilities such as dynamic resource brokering, monitoring, data management, security, information, and adaptive service.

partnership with Canada’s CANARIE and the Netherlands’ SURFnet. STAR TAP and StarLight are made possible by major funding from the US National Science Foundation to UIC. StarLight is a service mark of the Board of Trustees of the University of Illinois. See www.startap.net/starlight.

About GLIF

GLIF is a collaboration of institutions, organizations, consortia, and country National Research and Education Networks (NRENs) that voluntarily share optical networking resources and expertise for the advancement of scientific collaboration and discovery. GLIF’s mission is to create and sustain a global facility that supports leading-edge capabilities based on new and emerging technologies and paradigms related to advanced optical networking. These capabilities will enable high-performance applications and services, including the timely transfer of massive amounts of data, distributed computing, data analysis, collaboration and visualization, and control of remote instruments. GLIF provides leadership in advanced technologies and pre-production services on behalf of NRENs, NREN consortia, or pan-continental R&E networks, creating new models that they can implement. Once such services are available from NREN consortia, GLIF will refocus on new and emerging paradigms to support its communities. For more information, see www.glif.is.

“The Force10 equipment is currently supporting multiple national and global advanced applications, including leading edge prototypes that cannot be supported by traditional infrastructure.”

Joe Mambretti
Director of iCAIR and
Manager of the StarLight Facility



StarLight Connects Global Research Community Using Force10 TeraScale E-Series

Customer PROFILE



StarLight International Advanced Networks

ASNet
Research Network of Academia Sinica, Taiwan,
2.5 Gbps.

CA*net4
An advanced optical network of the Canadian
Network of the Advancement of Research, Industry
and Education (CANARIE), 3 x 10 Gbps.

CERNET/NSFCNET
Chinese Research and Education Network, 45 Mbps.

DOE Office of HEP/CERN
LHCNet is the principal link for US HEP transatlantic
networking, particularly for LHC. The DOE Office of
HEP through Caltech is the principal funder of the
link, through the US Link Consortium (USLIC), in
partnership with CERN, 10 Gbps.

EuroLink/TransLight
The NSF-funded Euro-Link initiative currently
provides a 10 Gbps link between StarLight and the
Netherlands; 5 Gbps is for Abilene/CA*net/GEANT
research and education router-based production
traffic and 5 Gbps for StarLight/NetherLight switch-
based networking traffic.

JGN-II (Japanese Gigabit Network II), 10 Gbps

GLORIAD-China/CSTNet
The Beijing to Hong Kong section of GLORIAD is
connected at 2.5 Gbps. From Hong Kong to Chicago,
the Chinese Academy of Sciences (CAS)'s CSTNet
now comes to Chicago at 155 Mbps.

GLORIAD-Russia
As part of GLORIAD, the Russian Backbone
Network (RBNet) is connected from Russia via
Amsterdam to New York and then over CA*net4
to Chicago at 622 Mbps.

HARNET
Hong Kong Academic and Research Network,
managed by the Joint Universities Computer Centre
(JUCC), 1 Gbps.

KREONet2/KOREN
Korea Research Environment Open Network 2
(KREONet2) and Korean advanced REsearch
Network (KOREN).

SINET
Japan's Science Information Network (SINET), 1 Gbps.

SURFnet
SURFnet is the Research and Education Network of
the Netherlands, and has a 10 Gbps connection to
StarLight. SURFnet also manages "NetherLight,"
StarLight's "sister" facility in Europe, and carries the
international traffic of CESNET, the national R&E
network of the Czech Republic, which maintains a
10 Gbps link to NetherLight. SURFnet also carries
international traffic of NORDUnet, the R&E network
of Sweden, Denmark, Finland, Iceland and Norway,
which maintains a 10 Gbps link to NetherLight.

TaiwanLight/TWAREN
The optical service of Taiwan's R&E network
TWAREN (formerly TANet2) has a 1 Gbps link from
Seattle to StarLight via CA*net4.

UKLight
The advanced optical networking initiative
of the United Kingdom, 10 Gbps.

StarLight Connects Global Research Community Using Force10 TeraScale E-Series

Customer PROFILE



Abilene



StarLight National Networks

UCAID/Abilene
U.S. University Corporation for Advanced Internet Development (UCAID)
Two 10 Gbps links; one for domestic peering and one for international peering.

DREN
Defense Research and Education Network, U.S. Department of Defense, 1 Gbps.

ESnet
Energy Sciences Network, U.S. Department of Energy, 1 Gbps and 10 Gbps connections.

National LambdaRail
A national infrastructure for research and experimentation in networking technologies and applications. NLR has 30 Gbps between Pittsburgh and the TeraGrid PoP at StarLight.

NISN
NASA Integrated Services Network, 155 Mbps.

NREN
NASA Research and Education Network, 155Mbps.

UltraScience Net
UltraScience Network, U.S. Department of Energy, 10 Gbps (coming soon).

USGS
U.S. Geological Survey Network, U.S. Department of Interior, 45 Mbps.

StarLight - Other National/Regional Networks

CAVEwave
UIC/EVL has a persistent 10 GbE connection to the University of Washington in Seattle and the University of California, San Diego via its own private wavelength on the National LambdaRail (NLR). CAVEwave is dedicated to networking research and development, 10 Gbps.

Fermi LightPath
Fermi National Accelerator Laboratory,
Two 10 Gbps and two 1 Gbps.

I-Light
Indiana's Optical Fiber Network
A cross-state, university-owned fiber optic network linking IU at Bloomington, IUPUI and Purdue University to each other, the Internet and Internet2. I-Light comes to StarLight, where it connects with the TeraGrid.

I-WIRE
Illinois Wired/Wireless Infrastructure for Research and Education
A state of Illinois-funded dark-fiber network connecting UIC, NU, ANL, NCSA, Illinois Institute of Technology, Illinois Century Network and University of Chicago. I-WIRE provides point-to-point lambda services between I-WIRE sites with a minimum of one 2.5 Gbps lambda connectivity to StarLight.

MREN
Metropolitan Research and Education Network
MREN is the oldest and most advanced GigaPoP servicing the Midwest. MREN sites are connected to StarLight via 1-10 Gbps.

OMNInet
Optical Metro Network Initiative
OMNInet is a Nortel and SBC equipment and fiber expenditure to prototype an optical metro-scale network initiative in Chicago, in partnership with NU, UIC and Canada's CANARIE.

TeraGrid
TeraGrid is an NSF Major Resource Equipment (MRE) initiative for a distributed supercomputer. StarLight is the Illinois "hub" that connects a 40 Gbps optical network (the DTFnet) between Chicago and Los Angeles; in August 2003, a 10 Gbps link was installed between Chicago and Pittsburgh, which has since tripled to 30 Gbps.

USAWaves
An initiative to procure dark fiber and networking equipment to grow scientific capacity regionally and nationally.



Force10 Networks, Inc.
1440 McCarthy Boulevard
Milpitas, CA 95035 USA
www.force10networks.com

408-571-3500 PHONE
408-571-3550 FACSIMILE

© 2006 Force10 Networks, Inc. All rights reserved. Force10 and the Force10 logo are registered trademarks, and EtherScale, FTOS and TeraScale are trademarks of Force10 Networks, Inc. All other brand and product names are trademarks or registered trademarks of their respective holders. Information in this document is subject to change without notice. Certain features may not yet be generally available. Force10 Networks, Inc. assumes no responsibility for any errors that may appear in this document.

CP26 306 v1.3

[PAGE 5 OF 5]