IEEE Globecom 2004 Review: Virtualization of IT resources, fiber build-outs, and regulatory trends will stimulate Grid Computing

Alan J Weissberger
aweissberger@sbcglobal.net

A. IEEE Globecom

One of two premier IEEE telecommunications conferences each year, IEEE Globecom was held in Dallas, TX from November 29 through December 3, 2004. The conference featured Keynote speeches from industry luminaries, a Telecom Business Forum, Design and Developers Forum, Research Oriented papers, and several tutorials- including one on **High-Performance Global Grid Networks** (download abstract from: http://www.globecom2004.org/workshop_w05.html)

B. Keynote Speech

In his conference opening keynote address, Dr. Hossein Eslambolchi (President, Global Networking Technology Services, CTO, CIO, AT&T) listed several **networking and IT technology trends that augur well for grid computing** and the interconnection of multiple grid sites. His talk, entitled "Future Directions in Networks" emphasized AT&T's campaign to transform its multiple legacy networks to one global IP / MPLS network. Dr Eslambolchi stated that AT&T's packet network carries 4 tera-byes of traffic per day. (It was not clear whether the "packet network" was AT&T's IP/Internet or their traffic engineered IP-MPLS network or the sum of traffic on both networks).

Dr Eslambolchi identified the top 10 trends in both networking and IT.

The top 10 Networking trends:

1. "IP will eat everything:" confirming that IP will be the single dominant networking technology and be pervasive throughout the enterprise and residential networks (Grid networks are based on IP for the Network layer)
2. Convergence of communications and applications will be a reality
3. *Ethernet will be universally deployed, including in the WAN. (Optical Ethernet will provide bandwidth on demand as well as cost effective multi gigabit connectivity between grid sites.)
4. Wireless Internet will drive mobility
5. *Sensor nets (e.g. RFID based) will be everywhere, but IPv6 will be required for the large address space needed. (Sensor networks will be part of many grids and will stimulate the movement to IP v6, with its much larger address space then IP v4).

6. *Death of locality, since geography is not relevant in IP based networks (This should make it more cost effective to interconnect widely dispersed grid sites- including sites located in different countries)
7. Broadband access will be common *(Isn't it already?)*
8. Wireless and wire line networks will converge, with wireless eventually subsuming wire line *(Editor does not agree with this)*
9. *Information mining will transform the way we do business. (Information mining will be done on almost all grids to classify and extract relevant information from the tremendous volume of scientific and financial data that seems to be doubling every year- or less).
10. Home LANs will proliferate- many alternative technologies now exist.

The top 10 IT trends:

1. *Data volume and storage explosion is moving faster then Moore's law (We'll need grid based storage servers to manage this proliferation of data – see related networking trend 9. above)
2. *eCollaboration will dominate the workplace *(this implies use of Web Services for eBusiness applications and for multi-site grid management and control planes)*
3. A universal communications device is emerging that will supply all video, audio, and communications needs
4. *Self adapting networks will eliminate human intervention for network management (Implies auto fault detection, self healing, and re-configuration of networks to meet new user requirements. This will be an inherent capability of grid networks)
5. *Knowledge based mining will drive on line business processes and give rise to "just in time decision making." (This will push the need for more efficient use of compute resources and the movement towards grids)
6. *Networks will appear as a computer utility- the complexity of the applications will be masked. (Virtualization of networks and compute resources will be facilitated by grids)
7. *IT Cybernation will drive operational costs much lower (Part of IT Cybernation is the throughput monitoring, job scheduling, and load balancing which is inherent in grid computing)
8. *Investment in IT security and its complexity will escalate. Perimeter security around the network will be essential (Several levels of security will be required for grids, including SSL, WS Security, and authentication/ authorization)
9. *Open source software will be everywhere. Dr Eslambolchi claimed that 73% of Web Services software is already available as open source code. (There are already several open source organizations committed to development of grid middleware stacks, e.g. Globus Alliance)
10. PINs and passwords will be replaced by biometric ID's.

* These trends seem to be especially important for accelerating the adoption of Grid computing networks on a large scale. Please note parenthetical remarks form this editor.

In closing, Dr. Eslambolchi examined what AT&T has learned from current activities to automate its network wherever possible. He also talked about the technical developments necessary to achieve AT&T's desired goal of a "Cybernetic Network" that will automatically configure itself to provide robust and secure new capabilities.

C. Global Market and Regulatory Trends

This pragmatic session featured panelists from Goldman Sachs and McKinsey (including Reed Hundt, former SEC chairman).

In his talk on Carrier Economics, C. Krishnamurthy of McKinsey identified three triggers for carrier migration to next generation networks (that would offer services such as managed interconnection of grid computing sites):

1. Competitive Imperative- defensive reaction to competitors before economics of the new services are proven
2. Early replacement- may be more cost effective where network operators face higher operations cost
3. Regulatory incentives or disincentives along with capital markets willing to finance the new investments- this will directly impact telco capex.

It was suggested that new services (e.g. video) would drive Fiber to the Premises (FTTP) and Fiber to the Node (FTTN) and this has now just started to happen on a worldwide scale. However, telco's need to consider how soon they would realize a payback from their investments before they could commence a major fiber build-out. *The implication was that fiber is being driven closer to the subscriber, which would enable higher speed interconnection of grid sites, as well as higher speed remote access to grid based server clusters.*

Chris Fine of Goldman Sachs provided a capital markets perspective of telecoms. He stated that last mile migration form copper/TDM to fiber/IP was moving slower then many expected. This was because the telco needed at least a 60% equipment price reduction to consider replacement of class 5 central office switches. Chris noted that without new revenue sources, the FTTN business case would be challenging. A telco moving to FTTN (or FTTP) was betting on new applications or competitive threats (from MSO's or wireless telco's). The key question was "how soon will the telco realize a payback from investment in new access infrastructure?"

Chris made several other key points regarding telco investments:

-OPEX was more important then CAPEX to telco's, yet they had limited ability to reduce OPEX through automation. This calls for new ways to automate network operations *(how about use of Web Services?)*
-The movement to IP is getting a growing part of the CAPEX budget
- Broadband rollout is likely to continue at a rapid pace (assume this refers to DSL based Internet access for residential and small business customers).
-Movement to open standards will drive investment costs down and result in better ROI. This will stimulate more investment in new plant and equipment.

-Telecom industry is evolving into a selective and cyclical business.
-Success breeds success and vice-versa (assume to be failure breeds failure and eventually bankruptcy).

Reed Hundt of McKinsey suggested that **communications policy from regulators can "do more by doing less."** That would imply less regulation of U.S. telco's, who have faced an uncertain regulatory environment up till now. That uncertainty (over sharing of facilities and network resources/ equipment with competitive carriers at below ROI prices) has been a deterrent to incumbent telco (ILEC) investment in new plant and equipment, as well as the introduction of new network services. Reed categorized the telco industry as being in "a frozen state." In addition to regulatory uncertainty over sharing of facilities, (local) telco's were faced with: uncertain take rates for new services (resulting in potential low ROI), high fixed costs (for new infrastructure builds), OPEX risks, loss of fixed line phone revenue (cash cow gone to pasture), threats from MSO's (Internet access and cable telephony).

Mr. Hundt believes that we now need **a "new rule of law" for the broadband information sector of a national economy**. The objective would be to stimulate broadband infrastructure creation and encourage innovative new services that could take advantage of such an infrastructure. He was encouraged by the recent FCC ruling that ILECs do not have to unbundle new fiber access systems (e.g. share them with competitive carriers at discount prices) and felt that would stimulate the telecom industry.

D. Fiber access PONs as a potential private network for metro grids?

In the session on Passive Optical Networks (PONs), panelists from Optical Solutions, Alcatel, Freescale Semiconductor, and FTTH Communications made a convincing case for the rollout of Broadband (B) PONs and the migration to Gigabit (G) PONs. They also noted that Ethernet (E) PON deployment had commenced in Japan and trials were being held in Asia. These PONs are intended to serve the small business and residential markets. Video services are seen as a key driver of PONs for the residential market.

This editor observed that for enterprise applications, the Optical Network Unit (ONU) could be placed in the building leased or owned by an enterprise.
-If the ONU also had protocol conversion capability (it is then referred to as an ONT), it could embed the Ethernet LAN frames (from the subscriber equipment) within a PON frame (to the network - OLT).
-If the OLT had an embedded Ethernet VLAN switch (preferably one that used 2 sets of VLAN tags), that would facilitate inter-building communications.

Such a configuration could make the PON a cost effective private metro network for enterprise applications (including grid site interconnect) - one that might compete with a metro switched Ethernet, for example.

This topic will be discussed further in a forthcoming article.

E. Network Management and Operations

The basic premise of this session: telco's need to move beyond traditional Network Management and Operations Support Systems (OSS's) when they deploy next generation network services. The telco should provide a more integrated approach to management and operations on a service level (vs network technology) basis.

Will Chorley of SBC Labs stated that there were several **business challenges for VoIP service**. These include providing acceptable QOS, a reliable service, being cost competitive, and inter-networking with the PSTN. Will noted that VoIP protocols are weak on security and that SBC needs to protect both the network and it's customers from malicious attacks.

The presentation by Lou Berger of Movaz Networks seemed to be particularly relevant to Grid networks: **GMPLS-based control plane for IP/DWDM Networks**. It is quite likely that a GMPLS control plane will be used to set up dedicated, point to point optical channels –either SONET/SDH or Ethernet framed – that **interconnect grid sites**. This has already been done in several research grid networks.

Mr. Berger's premise was that a **GMPLS control plane would greatly contribute to OSS simplification.** Traditional OSS functions such as Planning and Traffic Engineering, Inventory Management, Service Activation, etc could be moved from the backend OSS to the GMPLS based control plane (between EMS and NE's and between adjacent NE's within the network). The OSS based installation functions and parameters can be realized or determined by GMPLS based: auto discovery of topology and circuit end points, auto initialization, auto remote configuration (and path selection), auto power equalization (?). What's left for the OSS is: Facility inventory and assignment, detecting exception conditions, EMS interface (to NMS/OSS).

Likewise, the Customer Network Management (CNM) functionality can be reduced via a GMPLS based control plane. What's left is Customer Relationship Management and Application Server software.

Benefits to the telco providing dedicated optical channels via GMPLS CP include:

-Simplified network inventory discovery (assumes that equipment and service inventory is distributed amongst all the NE's)
-Simplified NE service activation

-NE Service awareness

-Service Level alarm correlation by NE's (assumes that NE faults, e.g. circuit pack, are propagated through the network via GMPLS CP and this enables "per service visibility of faults."

F. Crisis in Telecom Research?

During Wednesday's Telecom Research Lunch Panel discussion, Fred Chang of UT-Austin (formerly director of SBC TRI Labs) admitted that carriers were no longer doing much, if any, research. Telco labs were still doing testing and some investigation of new technologies, but not any forward looking research. What caused this to happen? Fred said that telco management did not want to have to pay for research twice- once by the telco and second time by the research cost built into the network equipment vendor's product.

In effect, telco research has been outsourced to selected equipment vendors, which was observed to be unhealthy for the telecom industry. As a result, the telco's are no longer in control of their future direction and have become ever more dependent on their network equipment vendors*. It looks like a closed, private club.*

Further, the academic research being done by universities was seen as either not being practical for commercial telco deployments of new technologies/ services, or too narrow in focus. A systems solution approach to research is needed, but that is not likely to be a requirement for the research sponsored by government grants.

Finally, the few telecom equipment start-ups still in existence are not funded by their VCs to do any research. They have to worry about getting revenue from tomorrow's product and can not think about "the day after tomorrow's" technologies. Hence, there appears to be a "crisis" in telecom research, which is now mainly done by the large network equipment companies.

Jeff Jaffe, head of R&D at Lucent's Bell Labs called for the US government to take a more active role in funding and supporting government research. Jeff said that R&D needs to evolve as rapidly as technology does, but today we focus on the D and not the R. As telecom provides key infrastructures for other industries, government sponsorship of research is urgently needed.

G. Tutorial on Global Grid Networks

Friday 3 December 2004 • 13:30 – 17:00 •

W05: High-Performance Global Grid Networks

The workshop will focus on the use of novel optical networking concepts that support future global Grid computing applications.

It is now evident to the technical community that local computational resources cannot keep up with the demands generated by some users/applications. Therefore, distributed computing and the concept of a computational Grid are now emerging. Novel network concepts are needed to support such vision and high speed optical networking may be the required infrastructure that will enable global Grids. Optical networks have the potential to support a large portion of Grid networking infrastructures since they offer bandwidth manipulation at the wavelength (wavelength switching) and sub-wavelength level (optical packet and burst switching) supporting not only high service granularity but also the capability to accommodate a wide variety of traffic characteristics. Research on novel optical switching paradigms (such as Optical Burst Switching - OBS) has recently emerged but the technology will not see any boost if there is no proper application space. We believe that the design of new optical network concepts (including OBS) should be linked to the demands of the real emerging applications.
The workshop will try to identify the features and properties of Grid networks and the characteristics of a suitable network infrastructure.

- Photonic Grid network characteristics: functional requirements, network architecture, transport protocols, etc.
- Standardization activities on Photonic Grids
- Control, management & signaling for optical Grid networks.
- Experimental showcases

W05-1: Welcome & Introduction
I. Tomkos (Athens Information Technology Center, Greece)

W05-2: Optical Networking for Grid Services
Dimitra Simeonidou, Reza Nejabati (University of Essex, UK)

W05-3: Radio Astronomy Applications Motivating the Use of Global Grids
R. E. Spencer(University of Manchester, UK)

W05-4: An OBS-based Grid Architecture
M. De Leenheer, E. Van Breusegem, P. Thysebaert, B. Volckaert, F. De Turck, B. Dhoedt, P. Demeester (Ghent University, Belgium); D. Simeonidou, M. J. O'Mahoney, R. Nejabati (Essex University, UK); A. Tzanakaki, I. Tomkos (AIT, Greece)

W05-5: Web Services for User Controlled Integration of Optical Internet and Research Instrumentation to Build Cyber-Infrastructure
Bill St. Arnaud (Canarie, Inc., Canada)

W05-6: A Grid Oriented Lightpath Provisioning System
Jing Wu, Hanxi Zhang, Scott Campbell, Michel Savoie (Communications Research Centre Canada, Canada); Gregor v. Bochmann (University of Ottawa, Canada); Bill St. Arnaud (Canarie Inc., Canada)

W05-7: DWDM-RAM: An Architecture for Data Intensive Services Enabled by Next Generation Dynamic Optical Networks
D. B. Hoang (University of Technology, Sydney, Australia); T. Lavian, I. Monga, H. Cohen, D. Cutrell, F. Travostino (Nortel Networks Labs, USA); S. Figueira, J. S. Naiksatam (Santa Clara University, USA); J. Mambretti (Northwestern University, USA)

W05-8: National LamdaRail
Debbie Montan (National LamdaRail, USA)

W05-9: High Performance Networking Group - GGF Activities
Franco Travostino (Nortel Networks, USA)

Co-Chairs:
I. Tomkos, *Athens Information Technology Center, Greece*
D. Simeonidou, *University of Essex, UK*
Anna Tzanakakir, *Athens Information Technology Center, Greece*