Development of Asia Pacific Academia Networking

Dr. Simon C. Lin  2001/12/02

Future Internet Development

• Bandwidth Glut based on a single Internet Protocol (IP) which will allow existing voice, data and video services running as applications on IP.
• Internet will be everywhere like air, always-on as water and electricity.
• Connectionism, Scalability and Criticality are three major characteristics.
• Internet is a paradigm shift and survival issue, which will provide advanced platform for new service models.

Optical Internet

• WDM fibres where individual wavelengths are the link layer interconnect.
• High Performance Router acts as the main switching routing device instead of SONET/SDH switched.
• Use intrinsic self healing nature of Internet for redundancy and protection (don't require SONET/SDH layer).
• A network with multiple paths, full DNS and http caching can be more reliable than the SONET/SDH network
• Traffic engineering and network management done via MPLS (Multi-Protocol Label Switching).
• It will fundamentally change the traditional carrier-customer relationship
  o Allow LAN economics and engineering concepts to invade the WAN.
• These new concepts in optical networking are starting from the university and research community again.

IP over Dark Fibre

• Low cost
• LAN invades the WAN - no complex SONET or ATM required in network
  o Network Restoral & Protection can be done by customer using a variety of techniques
  o Most Internet reliability problems are NOT network related
• Enables new applications and services not possible with traditional telecom service providers
• Customers will start with dark fiber but will eventually extend further with customer owned wavelengths
  o Extending the Internet model of autonomous peering networks to the telecom world

Next Generation Internet (NGI) Applications

• Broadband
• Always-on
• Everywhere
• Intelligent, Natural, Easy, Trusted
• Internet will provide a powerful and versatile environment for business, education, culture, and entertainment, etc.
• Where are the Content? How do we create, store, manage, retrieve, and deliver these content? Scalability is the keyword!

Internet Revolution is not Over but Prolonged

• Poor business models and bad policies can hamper Internet usefulness
• the governmental regulation body could not realize the tremendous power of this paradigm shift
• Therefore, the point-to-point Internet bandwidth is still not sufficient to afford the NGI Applications
• the public has been led into misconception of the development of telecommunication business model
• Internet is under prolonged revolution for the moment due to the over-expectation of advanced applications where the global infrastructure is not available yet

Network Exponentials
• Network vs. computer performance
  o Computer speed doubles every 18 months
  o Network speed doubles every 9 months
  o Difference = order of magnitude per 5 years
• Network exponentials produce dramatic changes in geometry and geography

Moore's Law vs. storage improvements vs. optical improvements. Graph from Scientific American (Jan-2001) by Cleo Vilett, source Vined Khoslan, Kleiner, Caufield and Perkins.

Drives for Direct Internet Connection

• Increasing needs for Grid architecture
• Distributed Computing
• Collaborative Video communication, HDTV, Large-scale Video conferencing, Music Delivery
• Remote Instrumentation, Medical Imaging
• Digital Libraries/Museum
• ENUM VoIP Service Infrastructure, Wide area pure IP telephony

The Grid Technologies
- The Grid Problem - flexible, secure, coordinated resource sharing among dynamic collections of individuals, institutions, and other resources (virtual organizations)
  Source: "The Anatomy of the Grid: Enabling Scalable Virtual Organizations"
- "Grid" Computing - an application specific resource sharing infrastructure
- The Grid Architecture will enable virtual organizations to share geographically distributed resources, including computers, storage, sensors, networks...
- Factors enable Grid Architecture
  - Very high speed network
  - Quantity and Performance of individual microprocessors

**Layered Grid Architecture**

![Layered Grid Architecture Diagram](image)

**Protocols, Services and APIs Occur at Each Level**
Current Implementations

- Grid Computing has much in common with major industrial services like Business-to-business, Peer-to-Peer, Applications Service Providers, Storage Service Providers, Distributed Computing, Internet Computing, etc.
- Collaboration for design - Airbus, Boeing, DaimlerChrysler, Volvo - all intracompany for now, evolging to support dynamic e-business
- Aggregating resources - NASA Information Power Grid
- Application submission - EuroGRID(UNICORE)
- Sharing Data - BioGrid, DataGrid
- Utilise unused computer cycles - SETI@Home(Lightweight Grid Implementation)

Current Implementations -

SETI@Home
USE YOUR PC AT HOME FOR SETI?

SETI@Home is not a project of the SETI Institute, but you can find links to it below.

Download the screen saver from the SETI@home website located at UC Berkeley.

Note: If you are having technical problems with SETI@home, please check out:

- SETI@Home Help Page
- SETI@Home FAQ

You may recently have heard about a project, called SETI@home, to use thousands of Internet-connected PCs to help in the search for extraterrestrial intelligence. This is not part of the research program of the SETI Institute, but uses data collected with the Arecibo Radio Telescope in Puerto Rico, as part of Project SERENDIP. The SETI Institute is a major supporter of the SERENDIP search.

The idea behind SETI@home is to take advantage of the unused processing cycles of personal computers. The way this would work is as follows: an interested computer owner will download free software from SETI@home. Then, when their computer is idle (for example, when you leave your home office to go out for a burger), this software will download a 300-kilobyte chunk of SERENDIP data for analysis. The results of this analysis are ultimately sent back to the SERENDIP team, combined with the crunched data from the many thousands of other SETI@home participants, and used to help in the search for extraterrestrial signals. The limitations of this system are that only a 2.5 MHz piece of the observed spectrum will be analyzed by SETI@home, and of course the data processing does not occur "real time" so that interesting signals...
Next Generation DLM

- Leveled abstraction of data, information, and knowledge
- Integration of DLM, Grid Environment, and Knowledge Repository
- Mediation of distributed information resources thru common information model
- Demands for New Information Retrieval Paradigm:
  - Multimodal, Multimedia, Multivalent
  - Support effective analysis to correlate related objects
  - Accurate and Quick filtering information in semantic level
- Efficient mechanism of information dissemination and use
- Scale: Thousands of collections, Billions of objects, Petabytes of Data

Japan Gigabit Network Topology
Koren Network Topology
China Education and Research Network (CERN)
Natural Science Foundation of China Network (NSFCNET)

The Map of NSFCNET

Hong Kong Internet eXchange

Schematic Diagram of HKIX (Phase IV)
November 2000

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Singapore Advanced Research and Education Network (SingAREN)
What is GigaPoP?

- Point of Aggregation
- Provides local traffic exchange
- Variety of speed
- Point of policy implementation
  - telecommunication regulation
  - AUPs Portal
- Point of backbone uplink
- Buying power and shared use between collaborating partners

GigaPoP Services

- Resolution to current metropolitan network problems
- Platform for adventurous service models deployment
- Good old IPv4
- Content co-location
- Cache Service
- High capacity & reliability
- Best effort QoS vs Bandwidth
- Multicast
  - one sources to many receivers (lectures)
  - few sources to few receivers (meeting)
Academia Sinica Metropolitan Area Network Topology

Taiwan Island-wide Optical Network
Taiwan Academic Network Topology

Taiwan Academic Network Topology
GigabitEthernet Backbone Topology
and Regional Network Center

Universities, schools and other research institutes connect to the nearest regional network center via Gigabit-Ethernet or Fast-Ethernet fibers.

Asia Pacific Networking Connectivity

Asia Pacific Networking Connectivity
Conclusion

• Many governments have recognised the importance of access to low cost dark fiber as fundamental economic enabler
• Developing countries must take advantage of Internet network principles and abandon the old Telecom's way of thinking
• Digitisation, Presentation and System Technologies for the Next Generation Internet Applications will become mature in the 21st century
• Resource sharing infrastructure may be the next big thing after WWW
• “Grid Computing” is an application specific, resource sharing infrastructure

Conclusion (Cont'd)

• Internet, Scalability, Integration, Structure (ISIS) are 4 major directions for DLM
• Chinese contents need particular culture background and Chinese Processing Technology
• R&E network is a core ingredient and drive of Optical Internet
• TANet will peer with APAN in order to achieve better connectivity in AP area
• TANet is also upgrading its academia network into IP-based Gigabit Ethernet for domestic Universities