Experiences and Technology Trends in Remote Learning

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Outline

- Development in Worldwide Advanced Network Infrastructure
- SingAREN Remote Learning Experience
- Technology Trend in Remote Learning
- Q&A
R&E Network Infrastructure
Research and Education Networks

- A separate non-commercial global network infrastructure
- Deployed and managed independently by the R&E community, often non-profit
- Advanced Capabilities
  - Broadband (up to gigabits per-second)
  - Quality of Service Guaranteed
  - Multicast capability
  - Multimedia capable
  - Testbed for new applications (e.g. remote learning)
- Collaborate through local, regional and international forums and working groups
The SingAREN network infrastructure comprises:

1. dedicated direct international links to APAN-Korea and the Abilene network, and
2. local connections to research and education entities via a broadband network.
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Network Configuration

- SingAREN operates 2 PoPs – Singapore PoP & Seattle PoP
- Seattle PoP aggregate and control traffic entering SingAREN’s international link
- In Seattle SingAREN Connected to:
  - Internet 2 via Abilene (GE Connection)
  - Internet via NTT/Verio (OC3-POS Connection)
  - Other Peering Partner (Such as SIX using GE, PAIX using FE and PNWG using GE)
- Singapore-to-US international link via OC3 POS (155 Mbps) [effective May 2003]
- Singapore-to-APAN(Korea) link at 6 Mbps ATM VBR-nrt. [effective Jan 2003]
SingAREN Peering Arrangements

- **Architecture:**
  - Peer PVC routers
  - Layer 3 via BGP4

- **Domestic peering:**
  - Tertiary institutions, including NUS, NTU, SMU, TP, etc.
  - Research centres, including I’R, IMCB, BH etc.

- **International peering:**
  - US - Abilene (upgraded to 155 Mbps in May 03)
  - Korea & Europe – TEIN (upgraded to 6 Mbps in January 03)
  - Malaysia – (via Satellite link between TP & USM)
  - Asia-Pacific – APAN (6 Mbps)
Overseas R&E Peers

**Americas**
- CANARIE (Canada)
- CRNet (Costa Rica)
- CUDI (Mexico)
- Abilene (USA)
- REUNA (Chile)
- RETINA (Argentina)
- RNP, FAPESP/ANSP (Brazil)
- SENACYT (Panama)
- STARTAP (USA)

**Asia-Pacific**
- AAIREP (Australia)
- APAN (Asia-Pacific)
- APAN-KR (Korea)
- APRU (Asia-Pacific)
- CERNET, CSTNET, NSFCNET (China)
- JAIRC (Japan)
- JUCC (Hong Kong)
- NECTEC/UNINET (Thailand)
- TAnet2 (Taiwan)

**Europe / Middle East**
- ARNES (Slovenia)
- BELNET (Belgium)
- CARNET (Croatia)
- CESnet (Czech Republic)
- DANTE (Europe)
- DFN-Verein (Germany)
- GIP RENATER (France)
- GRNET (Greece)
- HEAnet (Ireland)
- HUNGARNET (Hungary)
- GARR (Italy)
- Israel-IUCC (Israel)
- NORDUnet (Nordic Countries)
- POL-34 (Poland)
- RCTS (Portugal)
- RedIRIS (Spain)
- RESTENA (Luxembourg)
- Stiching SURF (Netherlands)
- SWITCH (Switzerland)
- TERENA (Europe)
- Super Janet (United Kingdom)
Distance Education
S’pore-Canada Distance Learning Demo
Telmin3 June 1998
Stanford-NUS-KTH Distance Learning Project
Global Project Coordination Course (IE 264)
Jointly Conducted by the Three Universities
SingAREN makes Distance Learning a Reality!
Distance Learning
Singapore-MIT Alliance (SMA) Program

- A very selective Master/Ph.D. joint program
- Involves National University of Singapore (NUS), Nanyang Technological University (NTU) & MIT
- Launched in July 1999
- Students undergoes initial orientation in Singapore, then 1 month in MIT followed by continuation of program in Singapore.
- Students earn single degree with indigenous registered institution
- 3 programs totaling about 67.5 conferencing hours/week
- Expanded to 5 programs totaling about 100 hours/week in August 2001
SMA DE Connectivity (cont.)

CC1ATM GW

137.132.4.2
NUS One Arm Router

137.132.2.3
NUS

Firewall

137.132.2.98
NUS

178.18.163.66
NUS

SingNet

SingAREN (Ayer Rajah)
202.8.94.1
202.8.94.50

Internet II

NUS MIT Layer 3 Route

137.132.21.134
NUS PT210

18.39.0.145
MIT PT210

MIT

192.5.89.101
192.5.89.10
18.168.0.14

Abilene

198.32.8.17
198.32.8.2
198.32.8.14
198.32.8.6
198.32.8.26
198.32.8.39

SingAREN (LA PoP)
202.8.94.94
SMA DE Connectivity

NUS Classroom

MIT Classroom

NUS Gateway

SingAREN* GigaPoP

OC-3

90 Mbps ILC

MIT Gateway

Abilene

LA PoP

155 Mbps
SMA DE - Configuration

- Application Sharing via Internet 2
- ISDN
- Audio / Video Conferencing
- Internet 2

- MIT Auditorium
- MIT Auditorium
- SMART Classroom
- SMART Classroom
- Online digitization onto video server
- NUS Auditorium / SMART Classroom
- Student access via web for revision
- View video
- Video Server
SMA DE – Distance Counseling

- Primary instructor works with remote assistants
- Multiple platforms:
  - Email
  - Discussion forum
  - Desktop conferencing
  - Chat rooms
- Lecturers equipped with *Distance Education kits*:
  - Desktop conferencing
  - Scanner
  - Writing tablet mouse
- Students have access to desktop multimedia conferencing stations
The APRU Special President Meeting brought together 30 universities sites in the Asia-Pacific Region in Real-Time.
Technology Trends
Ubiquitous Learning Community

- Good on-line resources and materials
- Greater choice on how and when learning is delivered
- Improved interactivity with teachers and peers
- Access appropriate levels of administrative, educational and technical support on-line
- Emergence of new learning models with workflow analysis
Service-based Remote Learning

VASP – E-Learning,
E-L-NTU
E-L-ISS
E-L-NUS
E-L-SP

Portals –
V.Conf-StarHub
V.Conf.SingTel

Access Networks –
Telco, Broadband
Cable, Hotspots, …

IM, SMS, Mails …
Administrative
Digital library

Service Creation,
Composition &
Delivery
Remote Learning Service Platform

- *Simplifies* VASP service mappings from N-to-N to N-to-1 in business *collaboration*

- *Accelerates* service *provisioning* from months to minutes

- *Improves end user productivity* in a key service sector (e.g. e-learning) through *composition*
Access Grid

- Address the need for persistent electronic spaces, to build true electronic communities through new modes of collaboration.

- Access Grid node involves up to 20 people per site using “virtual spaces” that support high-end audio/video technology for compelling and productive user experience.
Access Grid

- **AG Community**
  - *Is a Virtual Organization!*

- **Virtual Venues**
  - *Virtual space, meet people with different client platforms*

- **Users**
  - **Have Capabilities**
    - Resources (shared or not)
      - Streaming Media
      - Data
      - Applications
    - Services (e.g. multi-session, recording, security)

- **Collaborative Applications**
  - Third party “plug-ins”: shared ppt, web browser etc.

- **Network Services**
  - Data and control interfaces, IP multicast etc.
AG Node Architecture
The Singapore Advanced Research & Education Network

http://www.singaren.net.sg/