Lambda Networking for Grid Applications

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eVLBI
longer term VLBI is easily capable of generating many Gb of data per
The sensitivity of the VLBI array scales with 
(data-rate) and there is a strong push to
Rates of 8Gb/s or more are entirely feasible
under development. It is expected that parallel
orcorrelator will remain the most efficient approach
as distributed processing may have an applica-
ulti-gigabit data streams will aggregate into lar-
or and the capacity of the final link to the dat
Westerbork Synthesis Radio Telescope -
Netherlands
iGrid 2002

September 24-26, 2002, Amsterdam, The Netherlands

• 28 demonstrations from 16 countries: Australia, Canada, CERN, France, Finland, Germany, Greece, Italy, Japan, The Netherlands, Singapore, Spain, Sweden, Taiwan, United Kingdom, United States

• Applications demonstrated: art, bioinformatics, chemistry, cosmology, cultural heritage, education, high-definition media streaming, manufacturing, medicine, neuroscience, physics, tele-science

• Grid technologies demonstrated: Major emphasis on grid middleware, data management grids, data replication grids, visualization grids, data/visualization grids, computational grids, access grids, grid portals

• 25Gb transatlantic bandwidth (100Mb/attendee, 250x iGrid2000!)

www.igrid2002.org
iGrid 2002
September 24-26, 2002, Amsterdam, The Netherlands

Conference issue
FGCS
Number 6 august
22 refereed papers!

THESE ARE THE APPLICATIONS!
A. Lightweight users, browsing, mailing, home use
   Need full Internet routing, one to many

B. Business applications, multicast, streaming, VPN’s, mostly LAN
   Need VPN services and full Internet routing, several to several + uplink

C. Special scientific applications, computing, data grids, virtual-presence
   Need very fat pipes, limited multiple Virtual Organizations, few to few
The Dutch Situation

• **Estimate A**
  – 17 M people, 6.4 M households, 25 % penetration of 0.5 Mb/s ADSL, 40 times under-provisioning
    ==> 20 Gb/s

• **Estimate B**
  – SURFnet has 10 Gb/s to about 12 institutes and 0.1 to 1 Gb/s to 180 customers, estimate same for industry (overestimation) ==> 20-40 Gb/s

• **Estimate C**
  – Leading HEF and ASTRO + rest ==> 80-120 Gb/s
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Need full Internet routing, one to many

B. Business applications, multicast, streaming, VPN’s, mostly LAN  
Need VPN services and full Internet routing, several to several + uplink

C. Special scientific applications, computing, data grids, virtual-presence  
Need very fat pipes, limited multiple Virtual Organizations, few to few
European lambdas to US
- 6 GigEs Amsterdam—Chicago
- 2 GigEs CERN—Chicago
- 8 GigEs London—Chicago

Canadian lambdas to US
- 8 GigEs Chicago—Canada—NYC
- 8 GigEs Chicago—Canada—Seattle

US lambdas to Europe
- 4 GigEs Chicago—Amsterdam
- 2 GigEs Chicago—CERN

European lambdas
- 8 GigEs Amsterdam—CERN
- 2 GigEs Prague—Amsterdam
- 2 GigEs Stockholm—Amsterdam
- 8 GigEs London—Amsterdam

IEEAF lambdas (blue)
- 8 GigEs Seattle—Tokyo
- 8 GigEs NYC—Amsterdam
## Services

<table>
<thead>
<tr>
<th>SCALE</th>
<th>CLASS</th>
<th>2 Metro</th>
<th>20 National/regional</th>
<th>200 World</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Switching/routing</td>
<td>Routing</td>
<td>ROUTER$</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>VPN’s, (G)MPLS</td>
<td>VPN’s Routing</td>
<td>ROUTER$</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>dark fiber Optical switching</td>
<td>Lambda switching</td>
<td>Sub-lambdas, ethernet-sdh</td>
<td></td>
</tr>
</tbody>
</table>
So what are the facts

- Costs of fat pipes (fibers) are one/third of cost of equipment to light them up
  - Is what Lambda salesmen tell me

- Costs of optical equipment 10% of switching 10% of full routing equipment for same throughput
  - 100 Byte packet @ 40 Gb/s -> 20 ns to look up in 140 kEntries routing table (light speed from me to you!)

- Big sciences need fat pipes

- Bottom line: look for a hybrid architecture which serves all users in a cost effective way
Lambda users

• National Research Network’s
• Virtual/Real Organization's
• Institutions
• Extreme applications
• Internet
Lambda workshop

• Amsterdam - Terena
  – Concepts
  – Initial testbed (SURFnet Lambda to StarLight)

• Amsterdam - iGrid2002
  – Rechecking concepts models
  – Initial experiences and measurements
  – Expansion of Lambda testbed

• Reykjavik - NORDUnet
  – Towards persistent demonstrations and applications
UVA/EVL’s 64*64 Optical Switch @ NetherLight in SURFnet POP @ SARA Costs 1/100th of a similar throughput router but with specific services!
MEMS optical switch (CALIENT)
Core Switch Technology

- **3D MEMS structure**
  - Bulk MEMS – High Density Chips
  - Electrostatic actuation
  - Short path length (~4cm)
  - <1.5 dB median loss

- **Completely Non-blocking**
  - Single-stage up to 1Kx1K
  - 10 ms switching time

- **Excellent Transparency**
  - Polarization
  - Bit rate
  - Wavelength
NetherLight UvA Setup

SURFnet backbone

Lambda’s to
• Chicago
• Geneva
• Prague
• Stockholm
• NYC
• London

Dark fiber To Dwingeloo

SURFnet

DAS: 32*2cpu's IBM Myrinet

1 Gbs

FORC

EE

AAA

100Mbs

1 Gbs

Fat pc

4 HP servers

AAA

AAA

OptIPuter

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OptIPuter
Transport in the corners

BW*RTT

Needs more App & Middleware interaction

Full optical future

For what current Internet was designed

# FLOWS
Research topics

• Optical networking architectures and models for usage
• Transport protocols for massive amounts of data
• Authorization of complex resources in multiple domains
• Embedding in Grid environments
Problem Solving Environment
Applications and Supporting Tools
Application Development Support

Collective Grid Services
- Brokering
- Global Queuing
- Co-Scheduling
- Data Cataloguing
- Auditing
- Authorization
- Monitoring
- Fault Management

Common Grid Services
- Grid Information Service
- Uniform Resource Access
- Global Event Services
- Uniform Data Access
- Data Replication
- Communication Services

Grid Security Infrastructure (authentication, proxy, secure transport)

Communication

Grid access (proxy authentication, authorization, initiation)

Fabric
- Grid task initiation

Local Resources
- Resource Manager CPUs
- Resource Manager Monitors
- Resource Manager On-Line Storage
- Resource Manager Scientific Instruments
- Resource Manager Tertiary Storage
- Resource Manager Highspeed Data Transport

layers of increasing abstraction taxonomy

High performance computing and Processor memory co-allocation
Security and Generic AAA
Optical Networking

Researched in other programlines
Imported from the Globus toolkit
The END

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