Global Lambda Integrated Facility

Cees de Laat

University of Amsterdam

www.glif.is

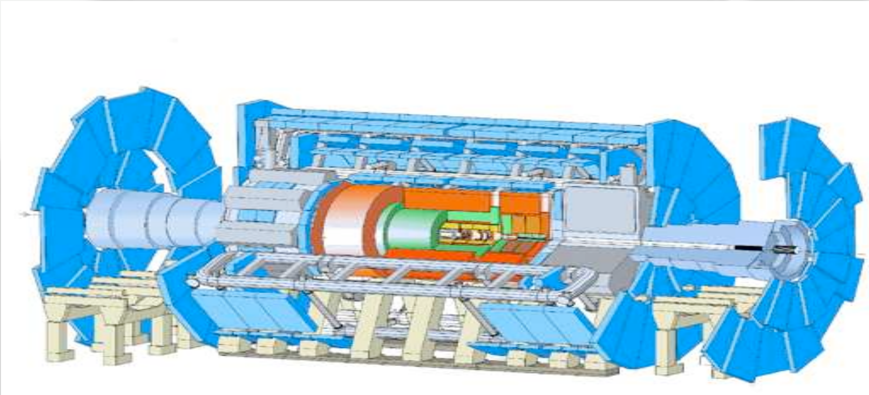
Contents

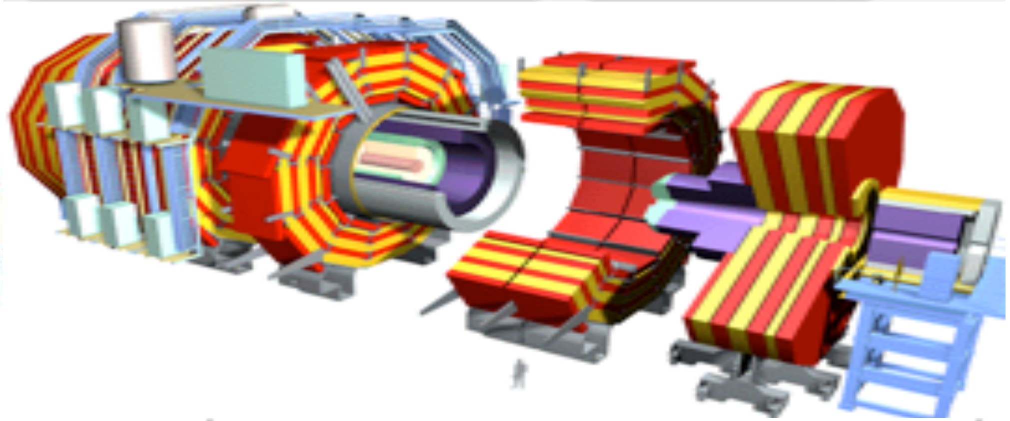
This page is intentionally left blank

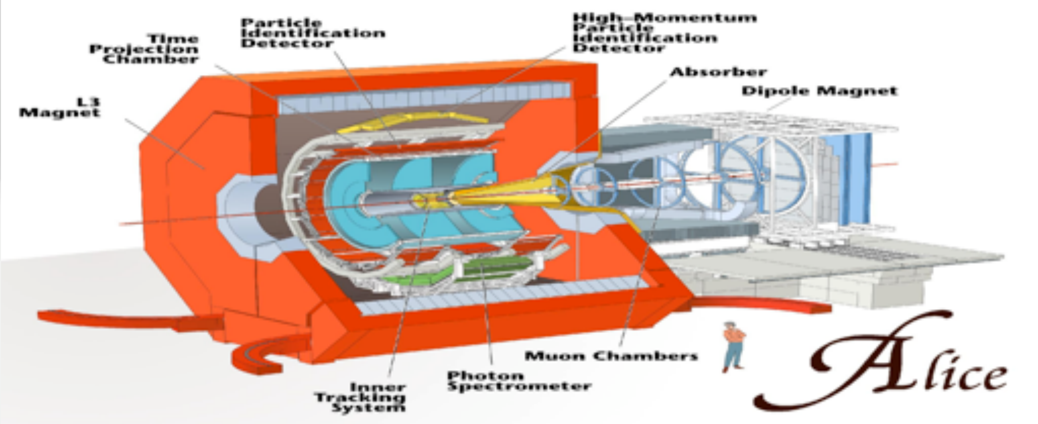
- Ref: www.this-page-intentionally-left-blank.org

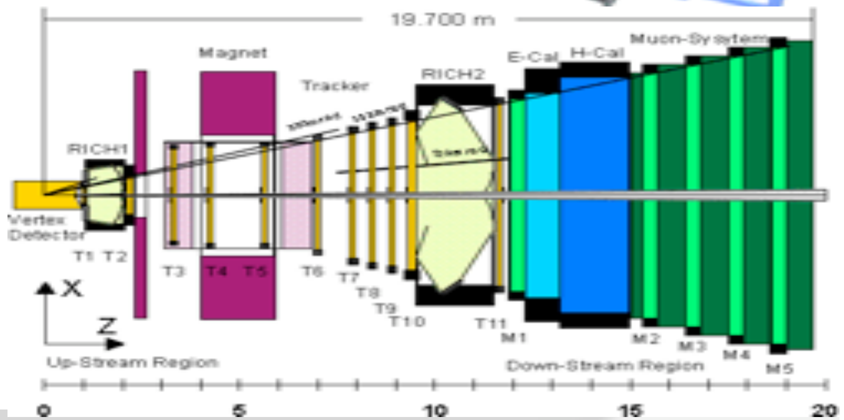
Four LHC Experiments: The Petabyte to Exabyte Challenge

ATLAS, CMS, ALICE, LHCB









6000+ Physicists & Engineers; 60+ Countries; 250 Institutions

Tens of PB 2008; To 1 EB by ~2015

Hundreds of TFlops To PetaFlops

Sensor Grids

eVLBI

longer term VLBI is easily capable of generatin
pe. The sensitivity of the VLBI array scales wit
dth (=data-rate) and there is a strong push to mo
dths. Rates of 8Gb/s or more are entirely feasible.
o under development. It is expected that parallel
ed correlator will remain the most efficient approach
olves dist
, multi-gig
relator and
factor.

~ 40 Tbit/s
www.lofar.org

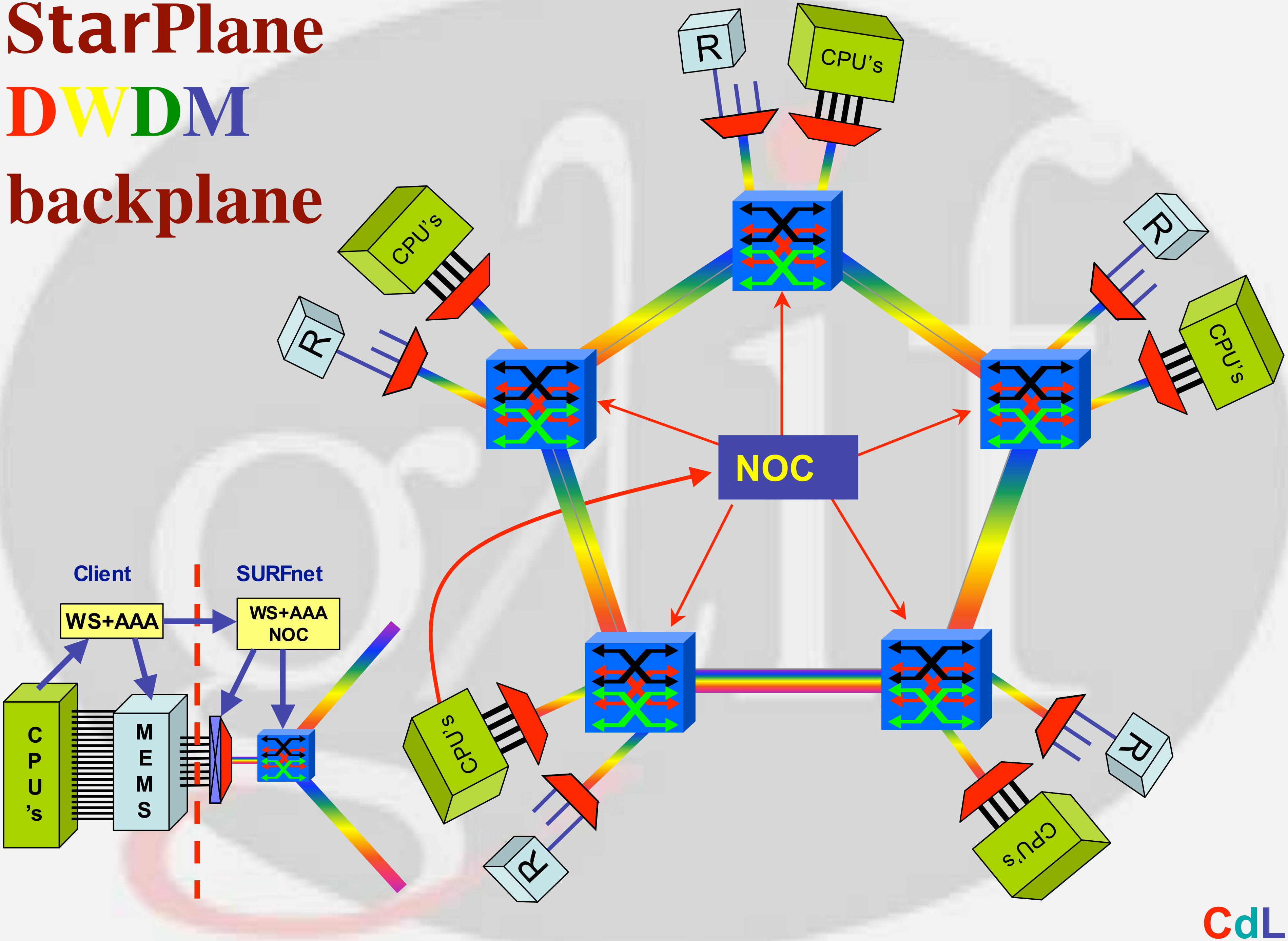
Westerbork Synthesis Radio Telescope - Netherlands

OptIPuter Project Goal: Scaling to 100 Million Pixels

- JuxtaView (UIC EVL) for PerspecTile LCD Wall
  - Digital Montage Viewer
  - 8000x3600 Pixel Resolution~30M Pixels
- Display Is Powered By
  - 16 PCs with Graphics Cards
  - 2 Gigabit Networking per PC

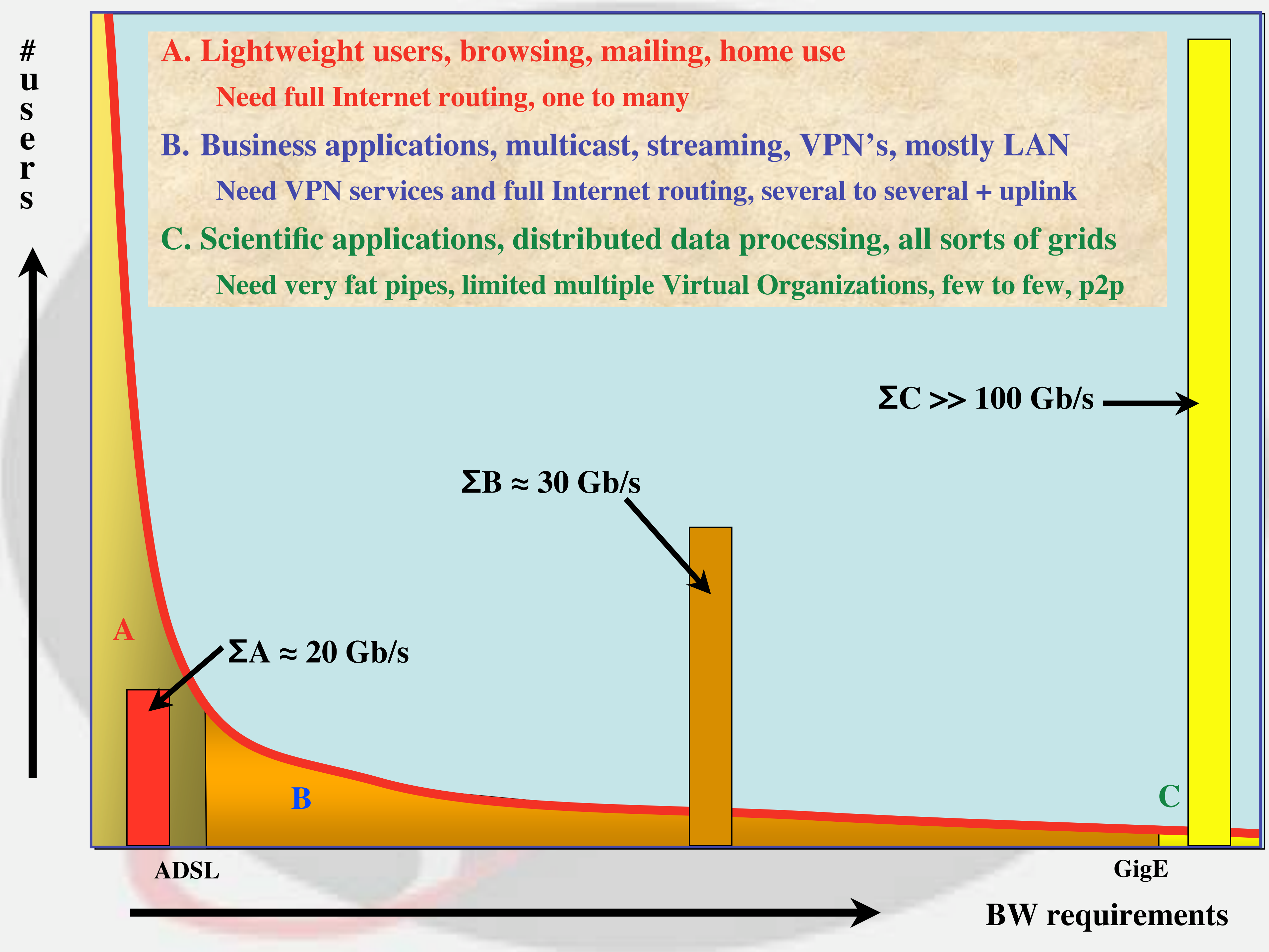
Source: Jason Leigh, EVL, UIC; USGS EROS

StarPlane DWDM backplane



Showed you 4 types of Grids

- Instrumentation Grids
  - Several massive data sources are coming online
- Computational Grids
  - HEP and LOFAR analysis needs massive CPU capacity
  - Research: dynamic nation wide optical backplane control
- Data (Store) Grids
  - Moving and storing HEP, Bio and Health data sets is major challenge
- Visualization Grids
  - Data object (TByte sized) inspection, anywhere, anytime

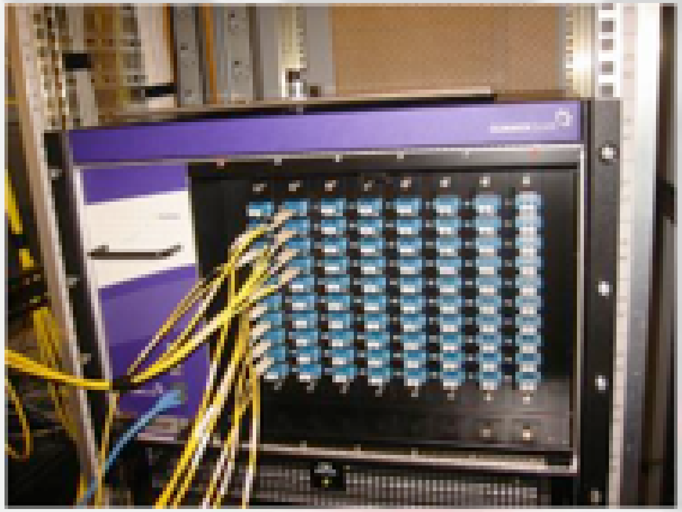


A. Lightweight users, browsing, mailing, home use
Need full Internet routing, one to many
B. Business applications, multicast, streaming, VPN's, mostly LAN
Need VPN services and full Internet routing, several to several + uplink
C. Scientific applications, distributed data processing, all sorts of grids
Need very fat pipes, limited multiple Virtual Organizations, few to few, p2p
users
ΣC >> 100 Gb/s
ΣB ≈ 30 Gb/s
ΣA ≈ 20 Gb/s
A
B
C
ADSL
GigE
BW requirements

So what?

- Costs of optical equipment 10% of switching 10 % of full routing equipment for same throughput
  - 10G routerblade -> 100-500 k$, 10G switch port -> 10-20 k$, MEMS port -> 0.7 k$
  - DWDM lasers for long reach expensive, 10-50k$
- Bottom line: look for a hybrid architecture which serves all classes in a cost effective way (map A -> L3 , B -> L2 , C -> L1)
- Give each packet in the network the service it needs, but no more !

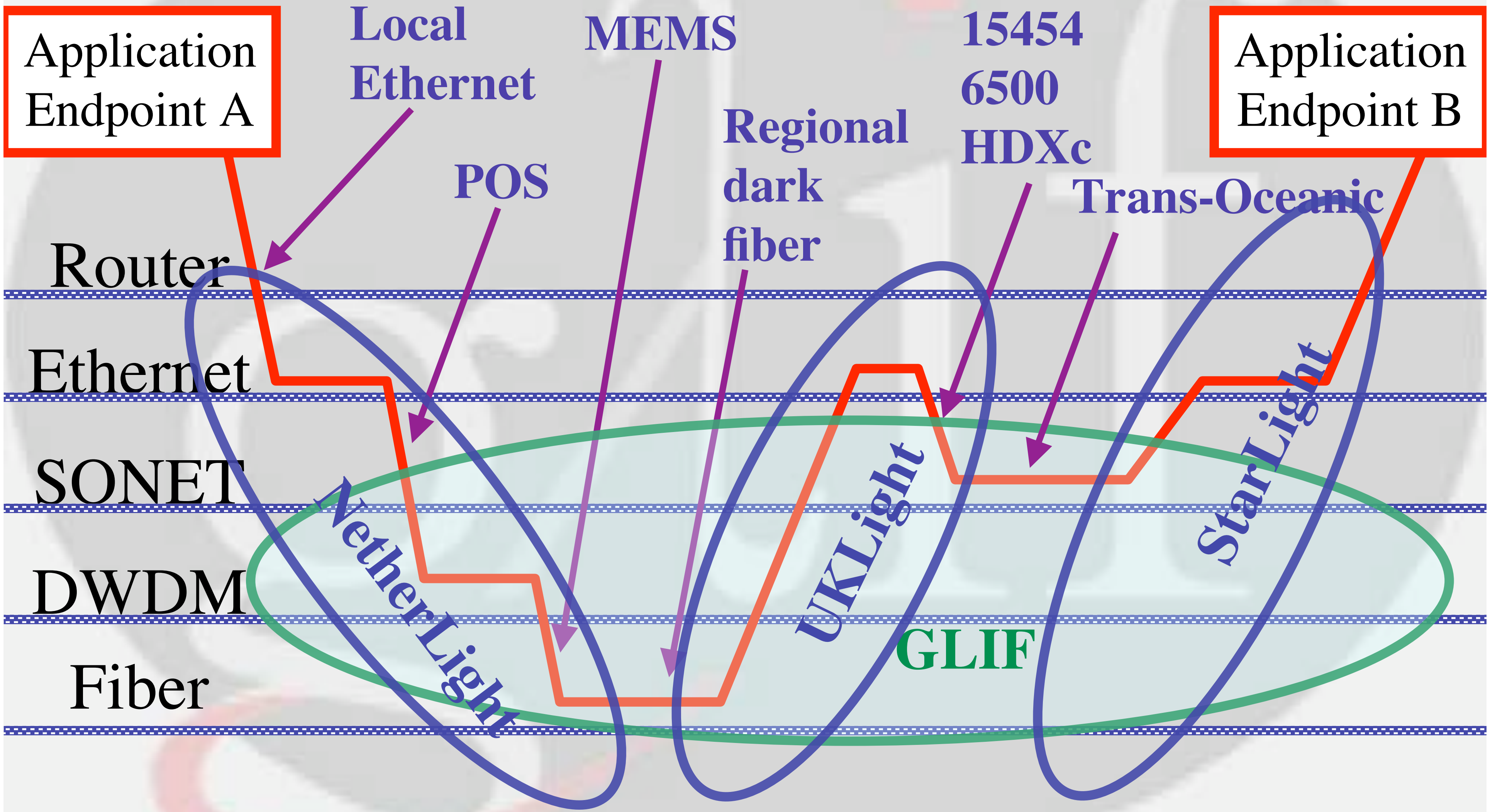
L1 -> 0.7 k$/port



L2 -> 5-15 k$/port

L3 -> 100-500 k$/port

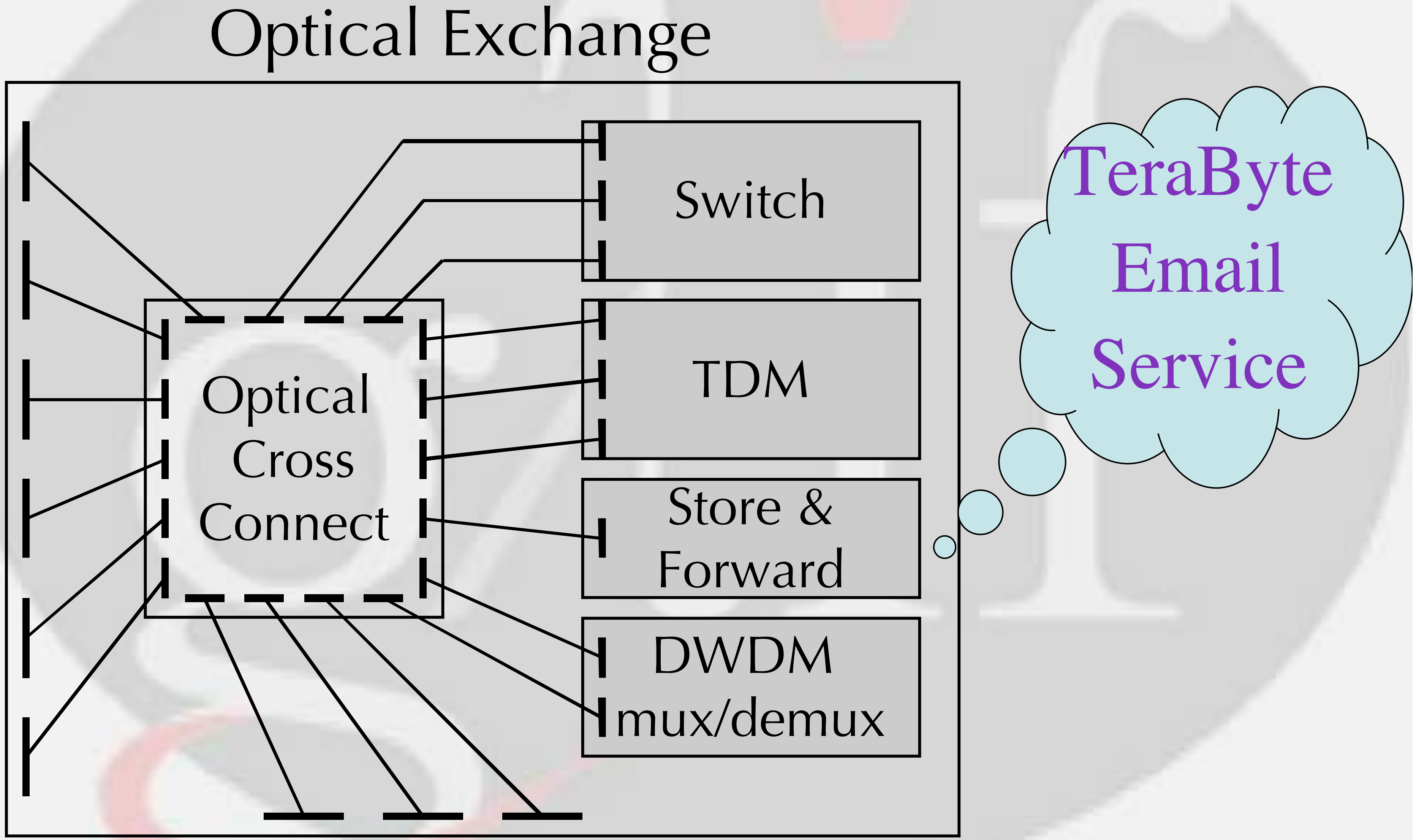
How low can you go?



Services

SCALE / CLASS	2 Metro	20 National/ regional	200 World
A	Switching/ routing	Routing	ROUTER$
B	Switches + E-WANPHY VPN's	Switches + E-WANPHY (G)MPLS	ROUTER$
C	dark fiber DWDM MEMS switch	DWDM, TDM / SONET Lambda switching	Lambdas, VLAN's SONET Ethernet

Optical Exchange as Black Box



Ref: gridnets paper by Freek Dijkstra, Cees de Laat

GLIF History

- Brainstorming in Antalya at Terena conf. 2001
- 1th meeting at Terena offices 11-12 sep 2001
  - On invitation only (15) + public part
  - Thinking, SURFnet test lambda Starlight-Netherlight
- 2nd meeting appended to iGrid 2002 in Amsterdam
  - Public part in track, on invitation only day (22)
  - Core testbed brainstorming, idea checks, seeds for Translight
- 3th meeting Reykjavik, hosted by NORDUnet 2003
  - Grid/Lambda track in conference + this meeting (35!)
  - Brainstorm applications and showcases
  - Technology roadmap
  - GLIF established --> glif.is

GLIF Mission Statement

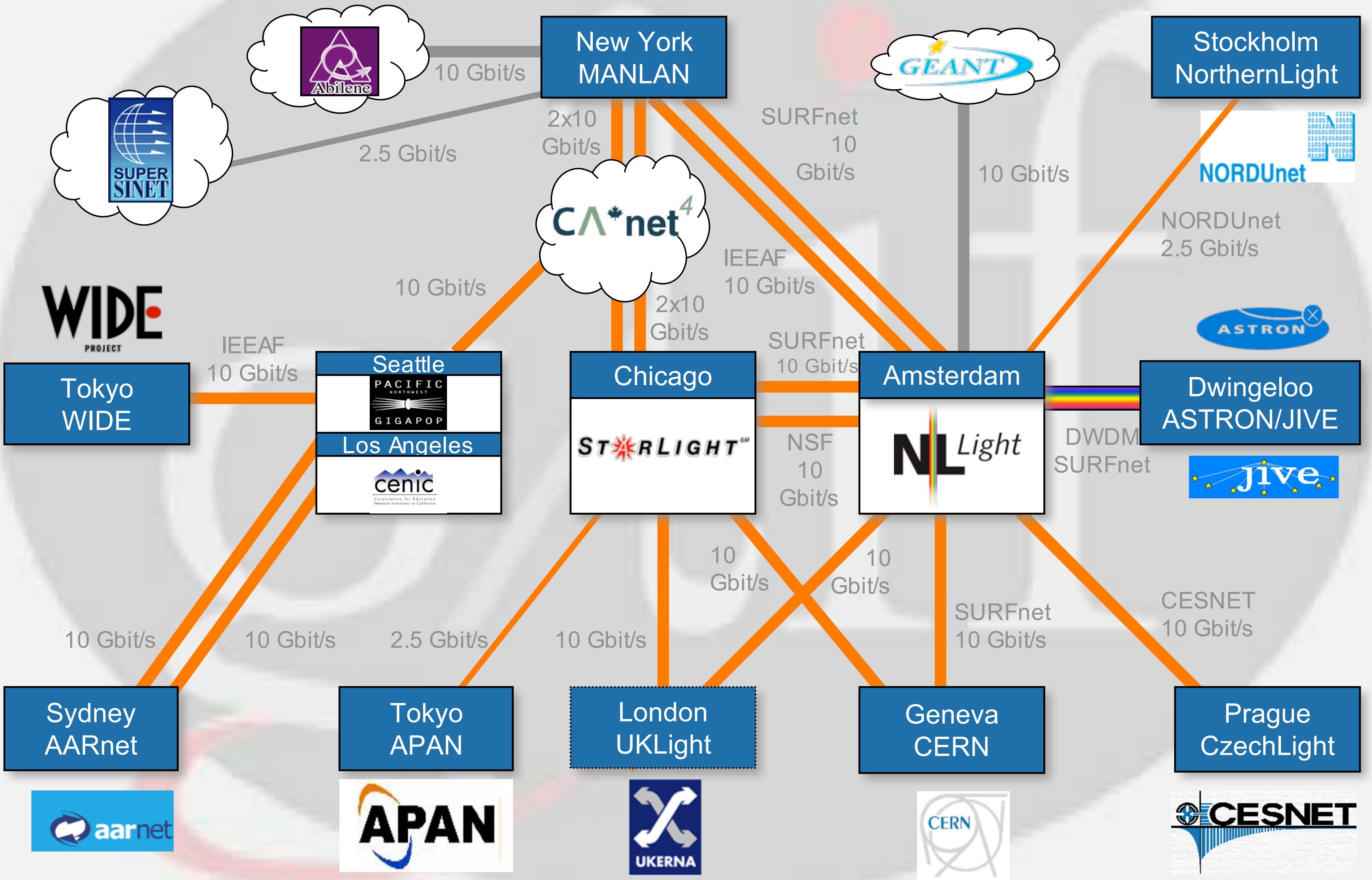
- GLIF is a world-scale Lambda-based Laboratory for application and middleware development on emerging LambdaGrids, where applications rely on dynamically configured networks based on optical wavelengths

- GLIF is an environment (networking infrastructure, network engineering, system integration, middleware, applications) to accomplish real work

GLIF - 4 meeting

- Invitation only
- Nottingham 2-3 September 2004
- 60 participants
- Attendance from China, Japan, Netherlands, Switzerland, US, UK, Taiwan, Australia, Tsjech, Korea, Canada, Ireland, Russia, Belgium, Denmark
- Truly Worldwide!

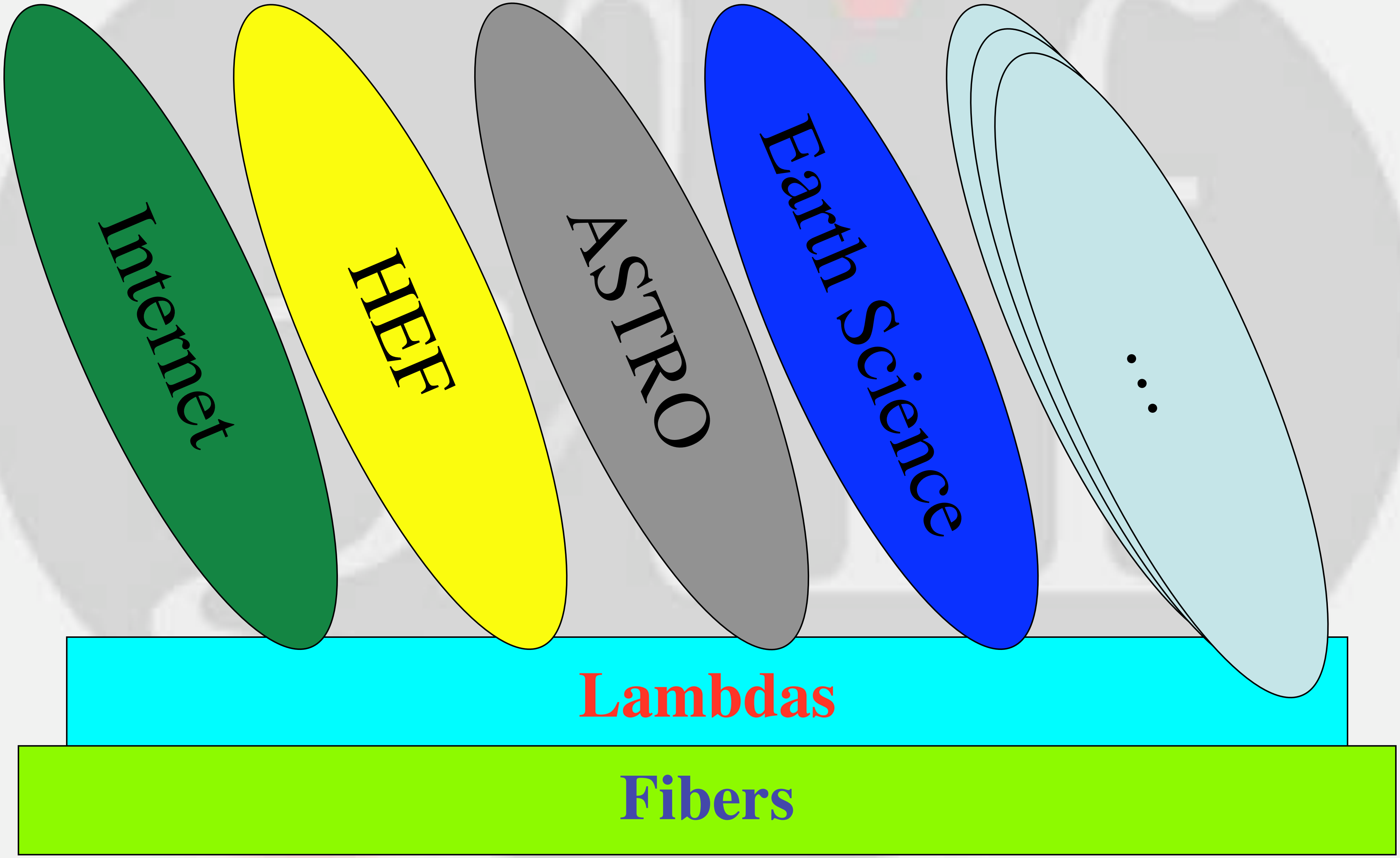
Global Lambda Integrated Facility sept 2004



GLIF 2004

Visualization courtesy of
Bob Patterson, NCSA.

Discipline Networks



The main objectives of the 2004 meeting

GLIF Governance and policy

Our small-scale Lambda Workshop is now turning into a global activity. TransLight and similar projects contribute to the infrastructure part of GLIF. A good and well understood governance structure is key to the manageability and success of GLIF. Our prime goal is to decide upon and agree to the GLIF governance and infrastructure usage policy.

GLIF Lambda infrastructure and Lambda exchange implementations

A major function for previous Lambda Workshops was to get the network engineers together to discuss and agree on the topology, connectivity and interfaces of the Lambda facility. Technology developments need to be folded into the architecture and the expected outcome of this meeting is an agreed view on the interfaces and services of Lambda exchanges and a connectivity map of Lambdas for the next year, with a focus on iGrid 2005 and the emerging applications.

Persistent Applications

Key to the success of the GLIF effort is to connect the major applications to the Facility. We, therefore, need a list of prime applications to focus on and a roadmap to work with those applications to get them up to speed. The demonstrations at SC2004 and iGrid 2005 can be determined in this meeting.

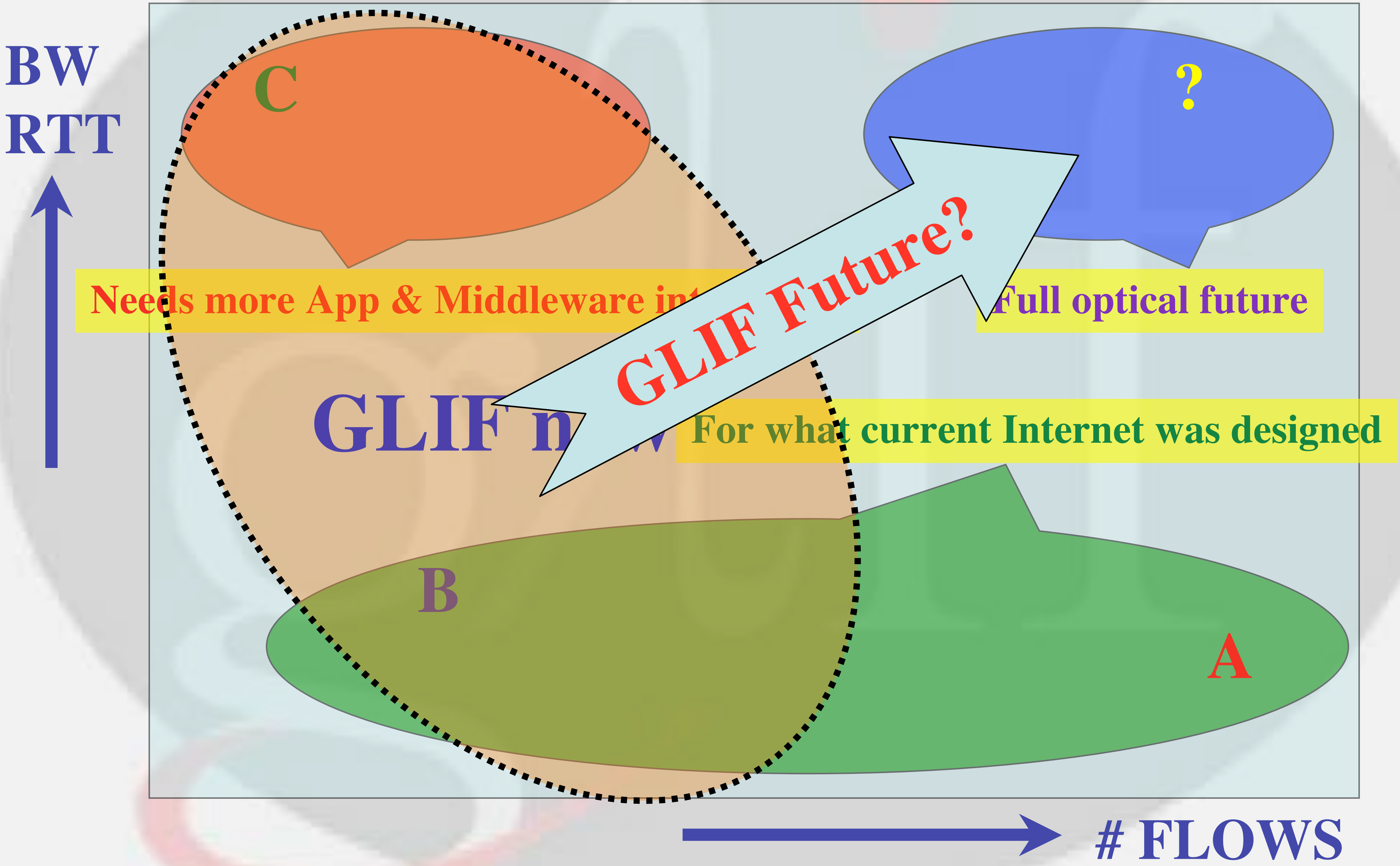
Control Plane and Grid Integration

The GLIF can only function if we agree on the interfaces and protocols that talk to each other in the control plane on the contributed Lambda resources. The main players in this field are already meeting, almost on a bi-monthly schedule. Although not essential, this GLIF meeting could also host a breakout session on control plane middleware.

GLIF - 5 meeting

- Collocated with iGrid2005 San Diego
- CAL-(IT)^2
- Thursday 29 sept 2005
  - Presentations track
- Friday 30 sept 2005
  - Work group meetings
- NOT on invitation only anymore!
  - Open meeting for participants
  - Industry rep's only on workgroup chairs invitation (no marketing!)

Transport of flows



World of Tomorrow - 2005

*i*Grid 2005

THE GLOBAL LAMBDA INTEGRATED FACILITY

September 26-30, 2005
University of California, San Diego
California Institute for Telecommunications and Information Technology [Cal-(IT)^2]
United States