

Optical/Photonic Exchanges

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History

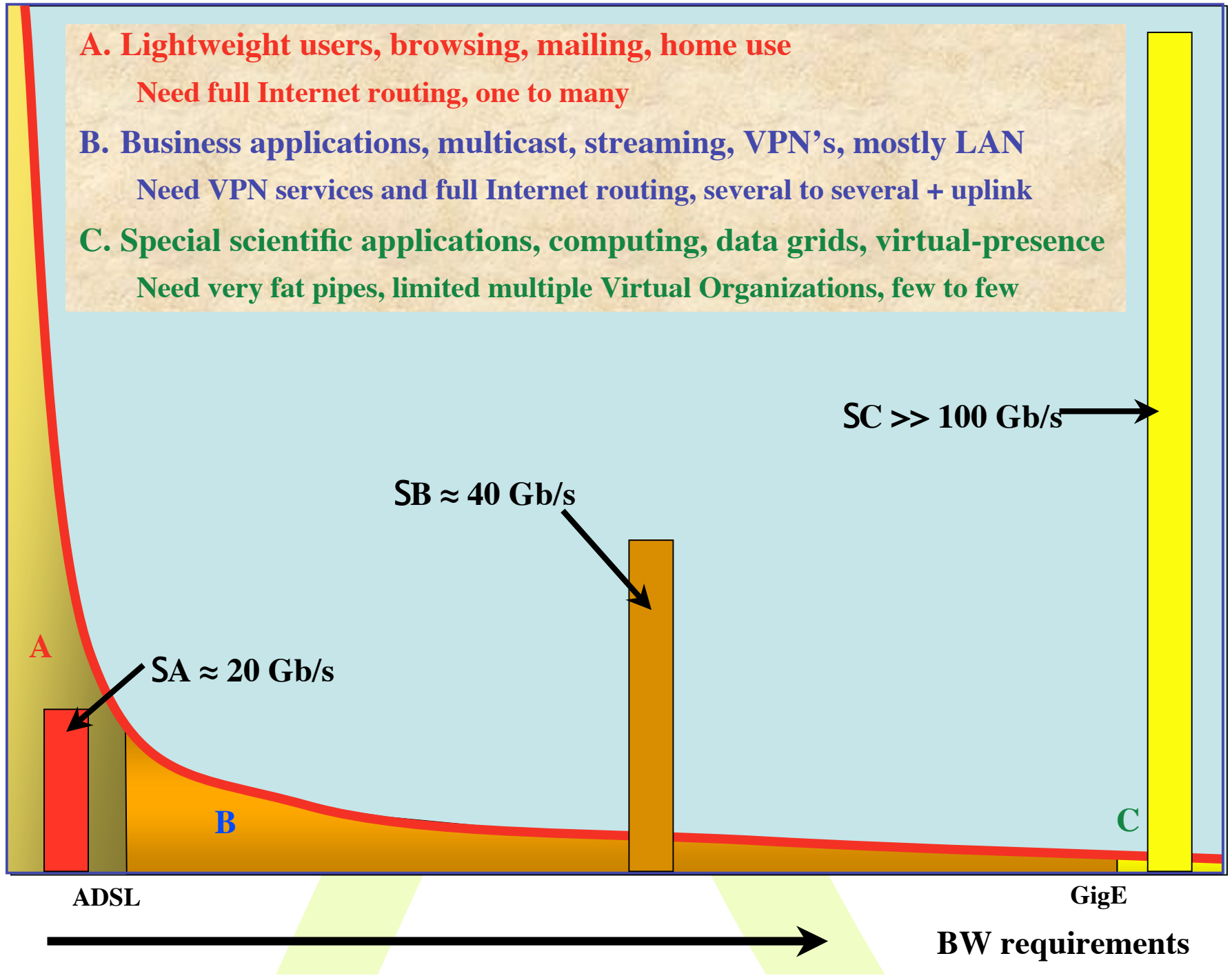
- Started to work on Lambda networking in 2001
- Looked at StarTap, StarLight, NetherLight
- Is it a Star, is it Light?
- What kind of optical networking is going on here?

Exchanges

- Just fibers
 - Each provider has fibers to the other providers [$n*(n-1)$]
- ATM based
 - Through one connection ATM pvc's to all peers [$n*(n-1)$]
constrained
 - StarTap
- Ethernet based
 - Ethernet switch as packet peering point (extended) [n]
differently constrained
 - AMS-IX
- Lambda based
 - DWDM, Ethernet, etc. mix
 - NetherLight++, StarLight++

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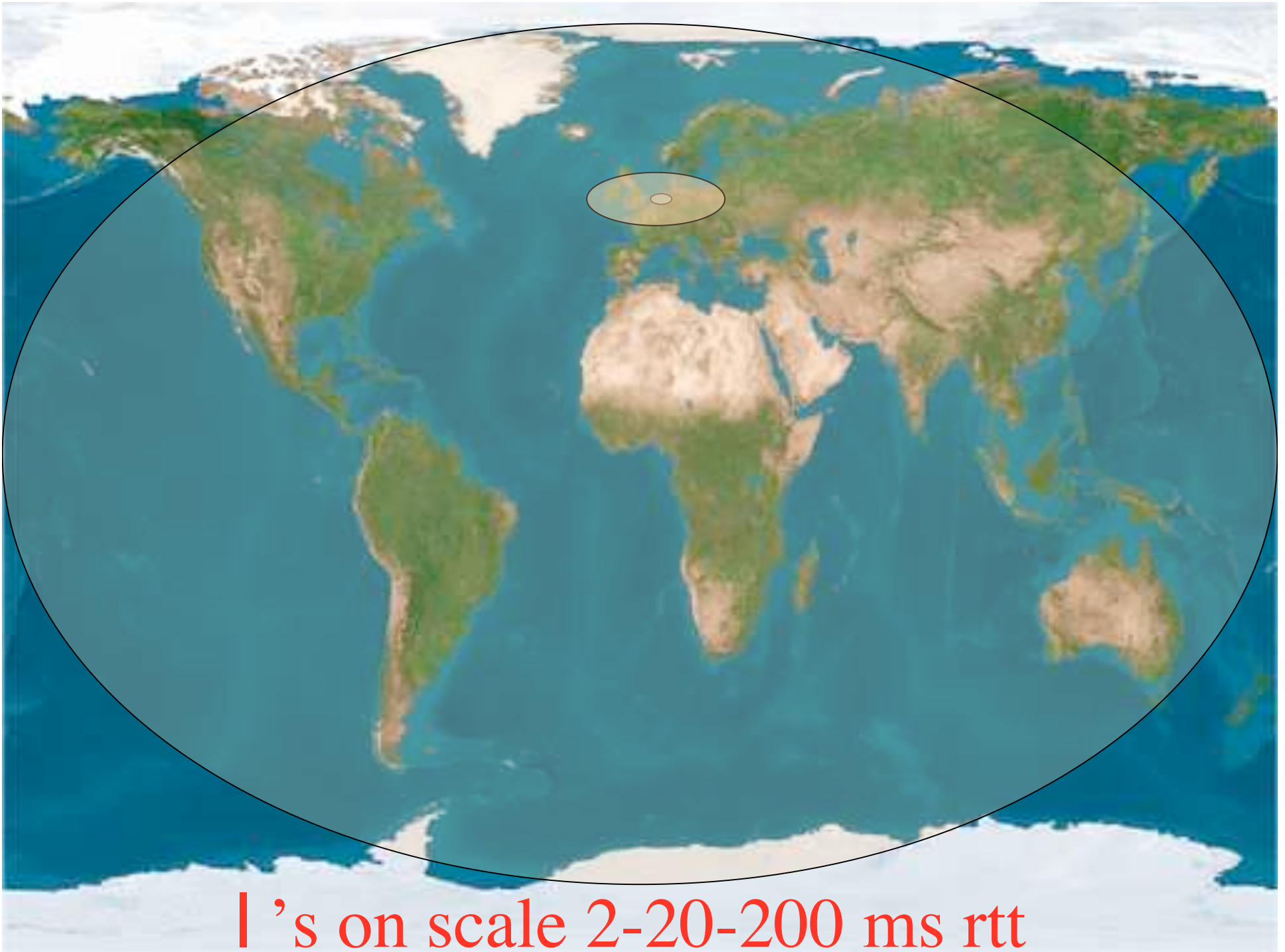
- A. Lightweight users, browsing, mailing, home use**
Need full Internet routing, one to many
- B. Business applications, multicast, streaming, VPN's, mostly LAN**
Need VPN services and full Internet routing, several to several + uplink
- C. Special scientific applications, computing, data grids, virtual-presence**
Need very fat pipes, limited multiple Virtual Organizations, few to few



ADSL

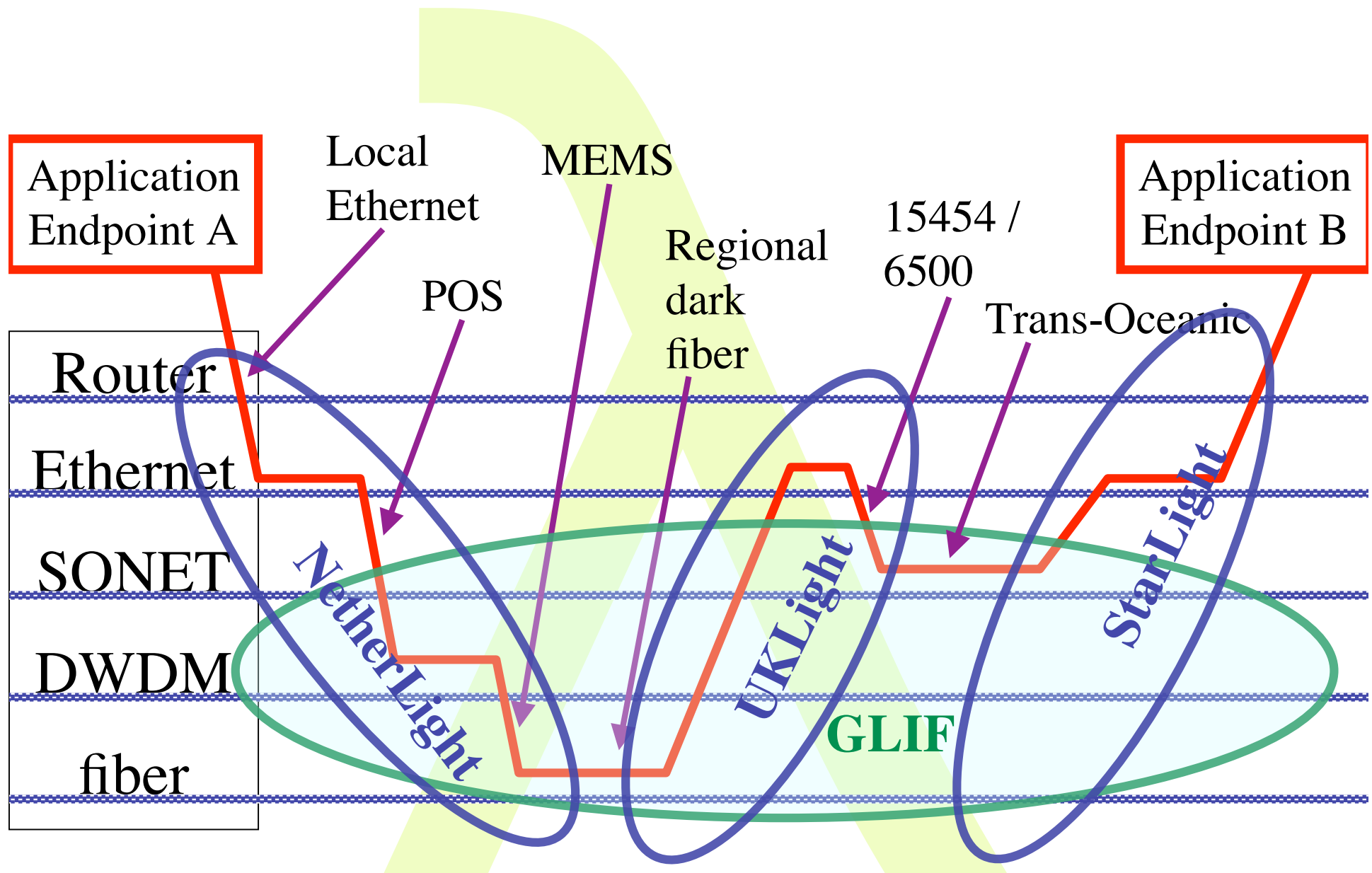
GigE

BW requirements



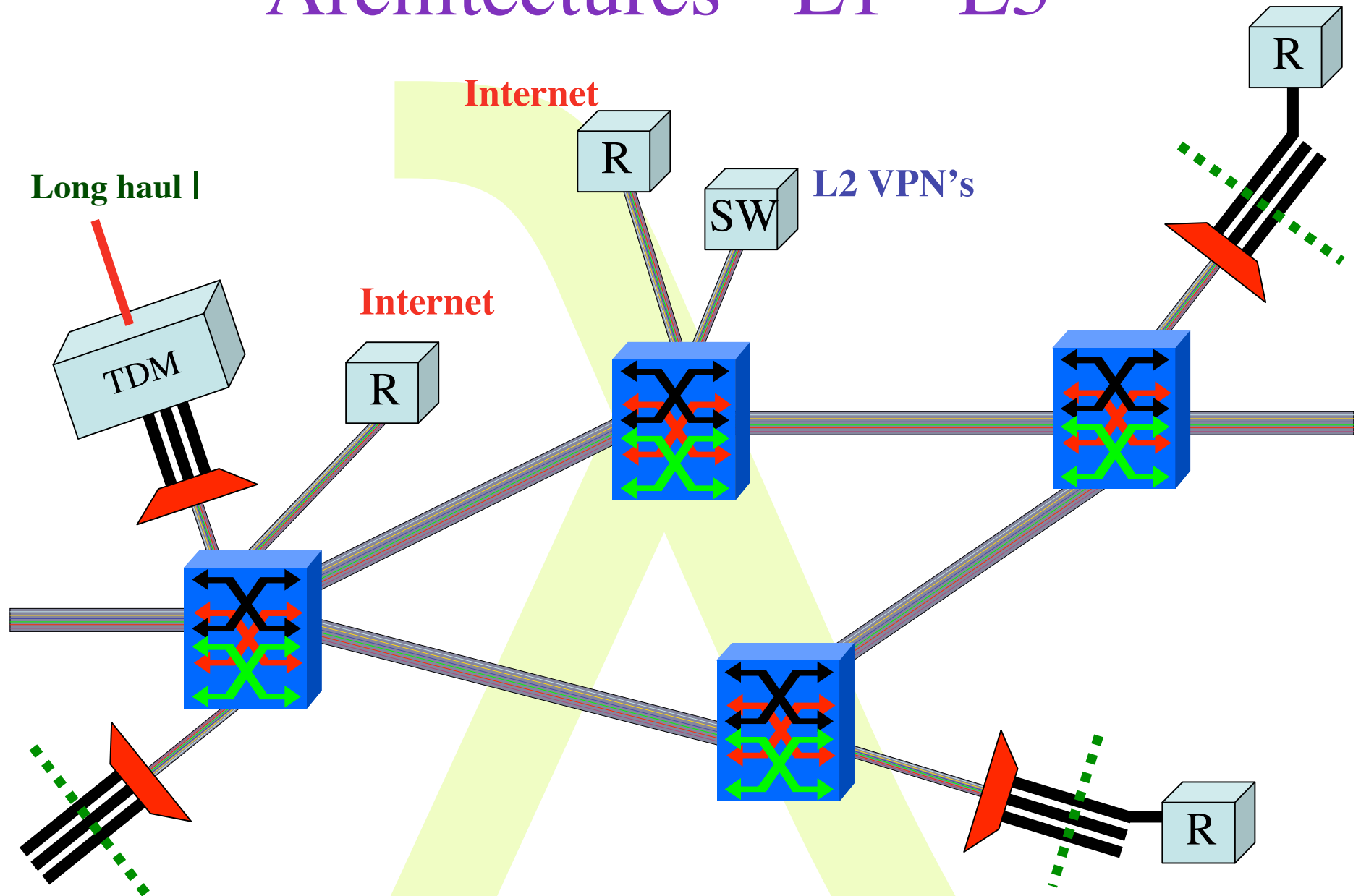
l's on scale 2-20-200 ms rtt

How low can you go?



Architectures - L1 - L3

(10 of 20)



Bring plumbing to the users, not just create sinks in the middle of nowhere

GLIF: Global Lambda Integrated Facility

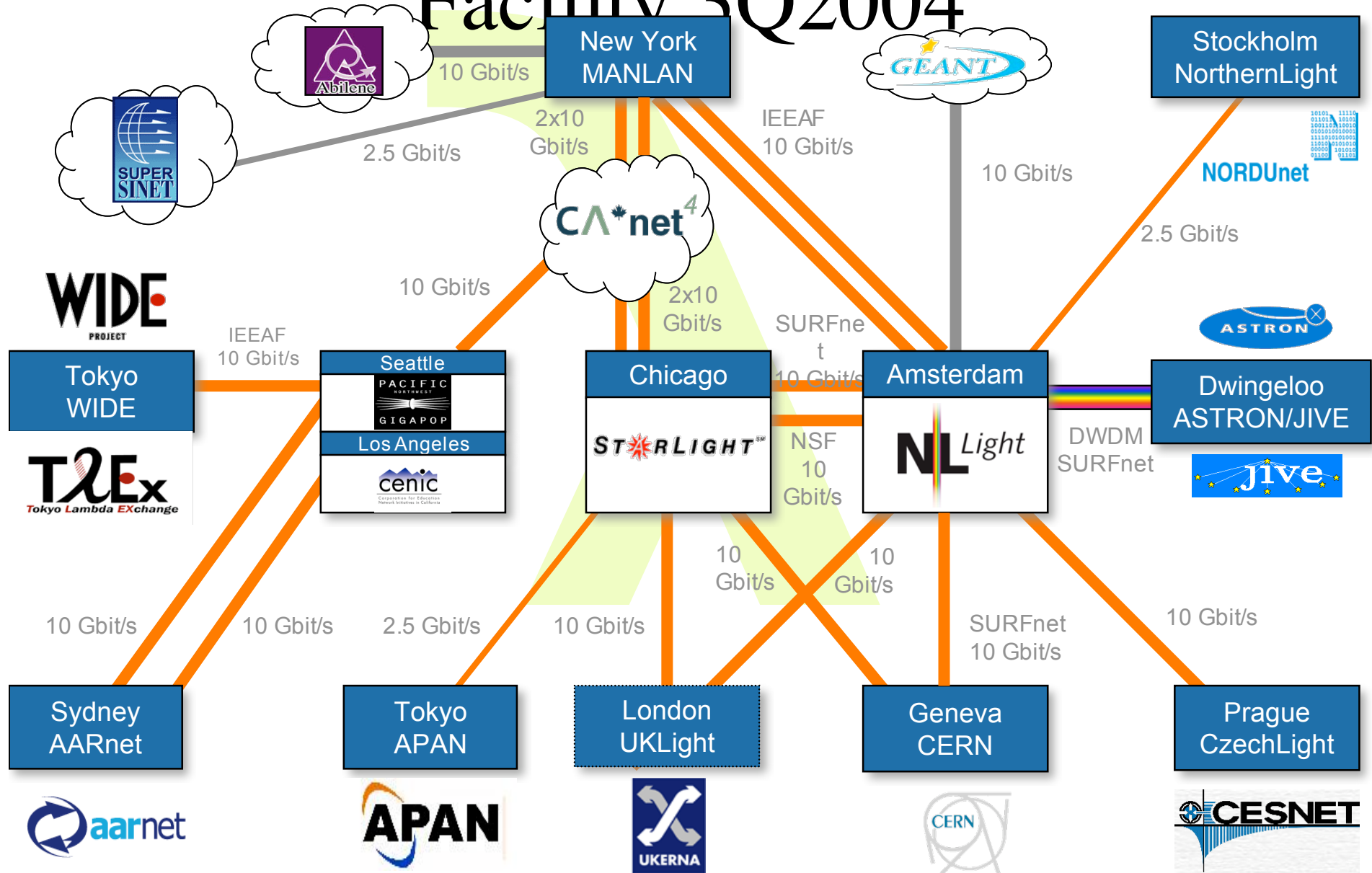
- Established at the 3rd Lambda Grid Workshop, August 2003 in Reykjavik, Iceland
- Collaborative initiative among worldwide NRENs, institutions and their users
- A world-scale Lambda-based Laboratory for application and middleware development

GLIF vision:

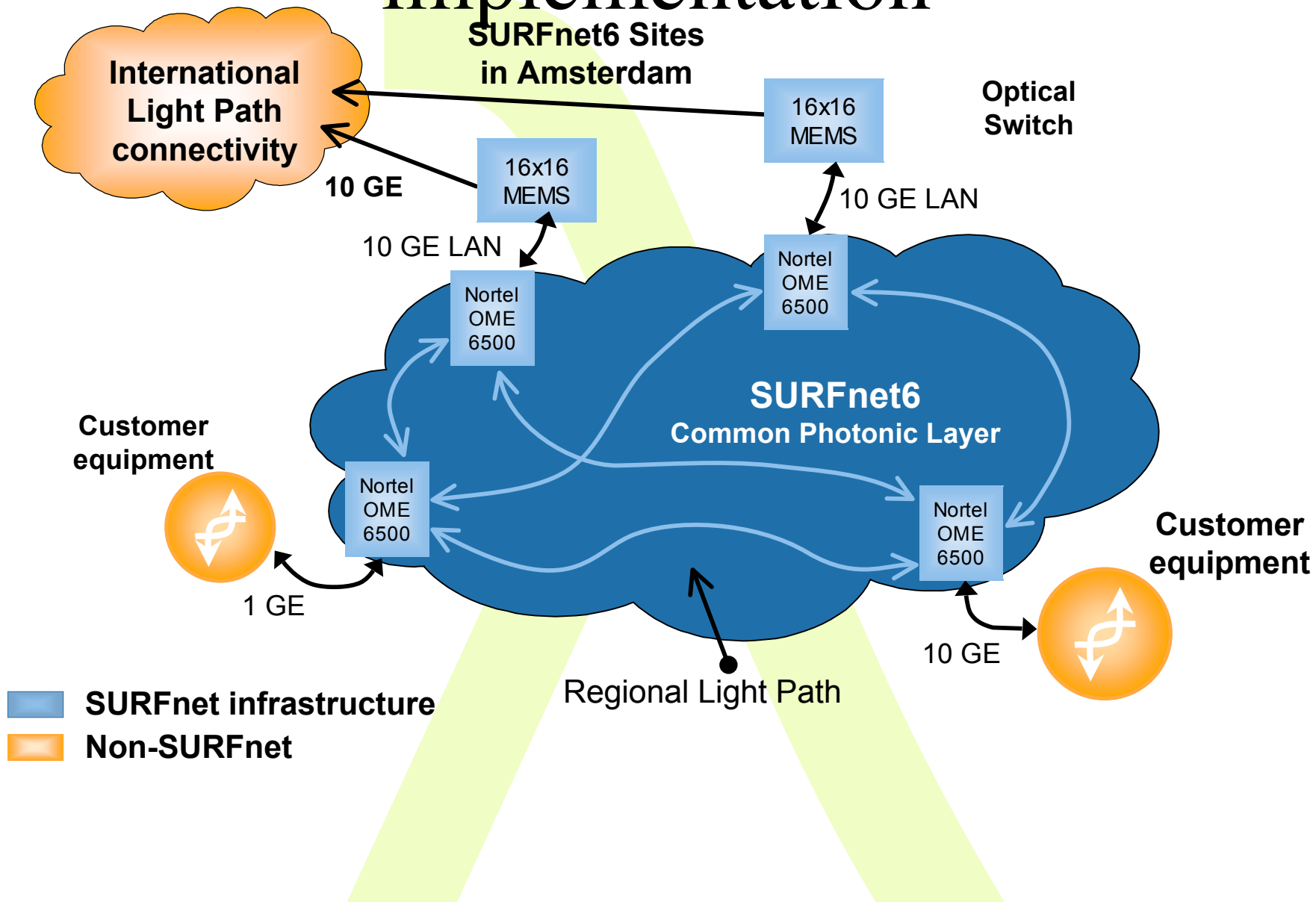
To build a new grid-computing paradigm, in which the central architectural element is optical networks, not computers, to support this decade's most demanding e-science applications.



Global Lambda Integrated Facility 3Q2004

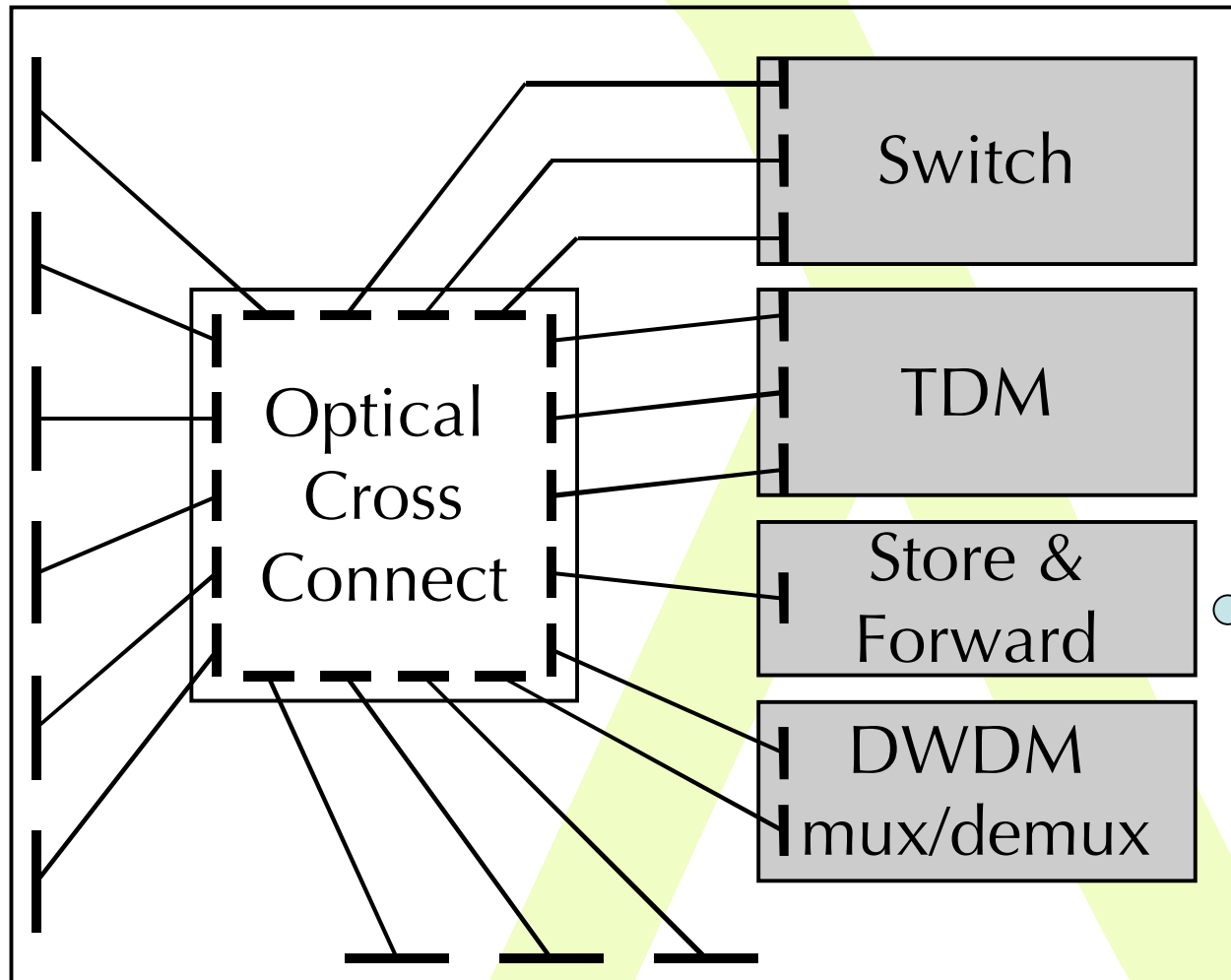


Light Paths provisioning implementation



Optical Exchange as Black Box

Optical Exchange



TeraByte
Email
Service

Service Matrix

From	To	WDM (multiple λ)	Single λ, any bitstream	SONET/ SDH	1 Gb/s Ethernet	LAN PHY Ethernet	WAN PHY Ethernet	VLAN tagged Ethernet	IP over Ethernet
WDM (multiple λ)		cross-connect multicast, regenerate, multicast	WDM demux	WDM demux*	WDM demux *	WDM demux *	WDM demux *	WDM demux *	WDM demux *
Single λ, any bitstream		WDM mux	cross-connect multicast, regenerate, multicast	N/A *	N/A *	N/A *	N/A *	N/A *	N/A *
SONET/SDH		WDM mux	N/A *	SONET switch, +	TDM demux *	TDM demux ⁶	SONET switch	TDM demux *	TDM demux *
1 Gb/s Ethernet		WDM mux	N/A *	TDM mux	aggregate, Ethernet conversion +	aggregate, eth. convert	aggregate, Ethernet conversion	aggregate, VLAN encap	L3 entry *
LAN PHY Ethernet		WDM mux	N/A*	TDM mux ⁶	aggregate, Ethernet conversion	aggregate, Ethernet conversion +	Ethernet conversion	aggregate, VLAN encap	L3 entry *
WAN PHY Ethernet		WDM mux	N/A *	SONET switch	aggregate, Ethernet conversion	Ethernet conversion	aggregate, Ethernet conversion +	aggregate, VLAN encap	L3 entry *
VLAN tagged Ethernet		WDM mux	N/A *	TDM mux	aggregate, VLAN decap	aggregate, VLAN decap	aggregate, VLAN decap	Aggregate, VLAN decap & encap +	N/A
IP over Ethernet		WDM mux	N/A *	TDM mux	L3 exit *	L3 exit *	L3 exit *	N/A	Store & forward, L3 entry/exit+

Control Plane

The grid approach:

- **Services should be exposed at webservices (WSRF)**
- **Brokers will combine multiple webservices (multiple optical exchanges, and even other type of services like storage)**
- **Users will set up an end-to-end lightpath by contacting a broker, who checks the users rights and contacts the individual optical exchanges to do the provisioning**
- **This ties very well with the AAA software written by the University of Amsterdam**

Implementation Discussion

What services and what interfaces may, should or must be supported?

- **One extreme: support all services, and all interfaces**
- **Other extreme: only allow 1 Gbit/s Ethernet encapsulated in SONET circuits, and force users to deliver their traffic in this format**
 - **What encapsulation?**



Not quite The END

Thanks to

SURFnet: Kees Neggers, UIC&iCAIR: Tom DeFanti, Joel Mambretti, CANARIE: Bill St. Arnaud

Freek Dijkstra, Hans Blom, Leon Gommans, Bas van oudenaarde, Arie Taal, Pieter de Boer, Bert Andree, Martijn de Munnik, Antony Antony, Rob Meijer, VL-team.



Partially complete list:

- Caas
- Chase
- Cess
- Kess
- Case

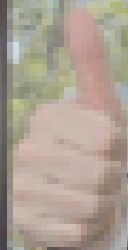
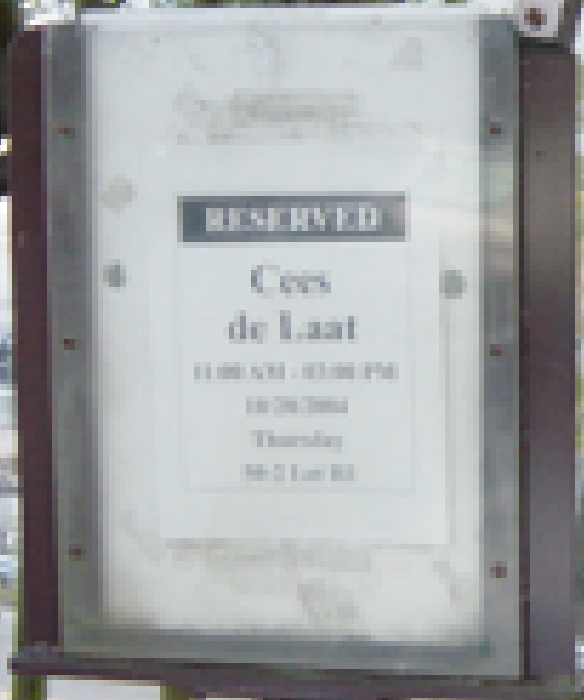


The END

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