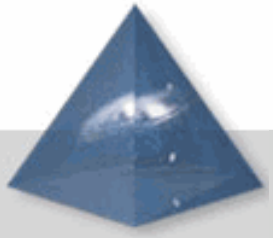
Why is optical networking interesting?

www.science.uva.nl/~delaat

Cees de Laat



Faculty of Science

Why is optical networking interesting?

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Cees de Laat

EU

SURFnet

University of Amsterdam

SARA

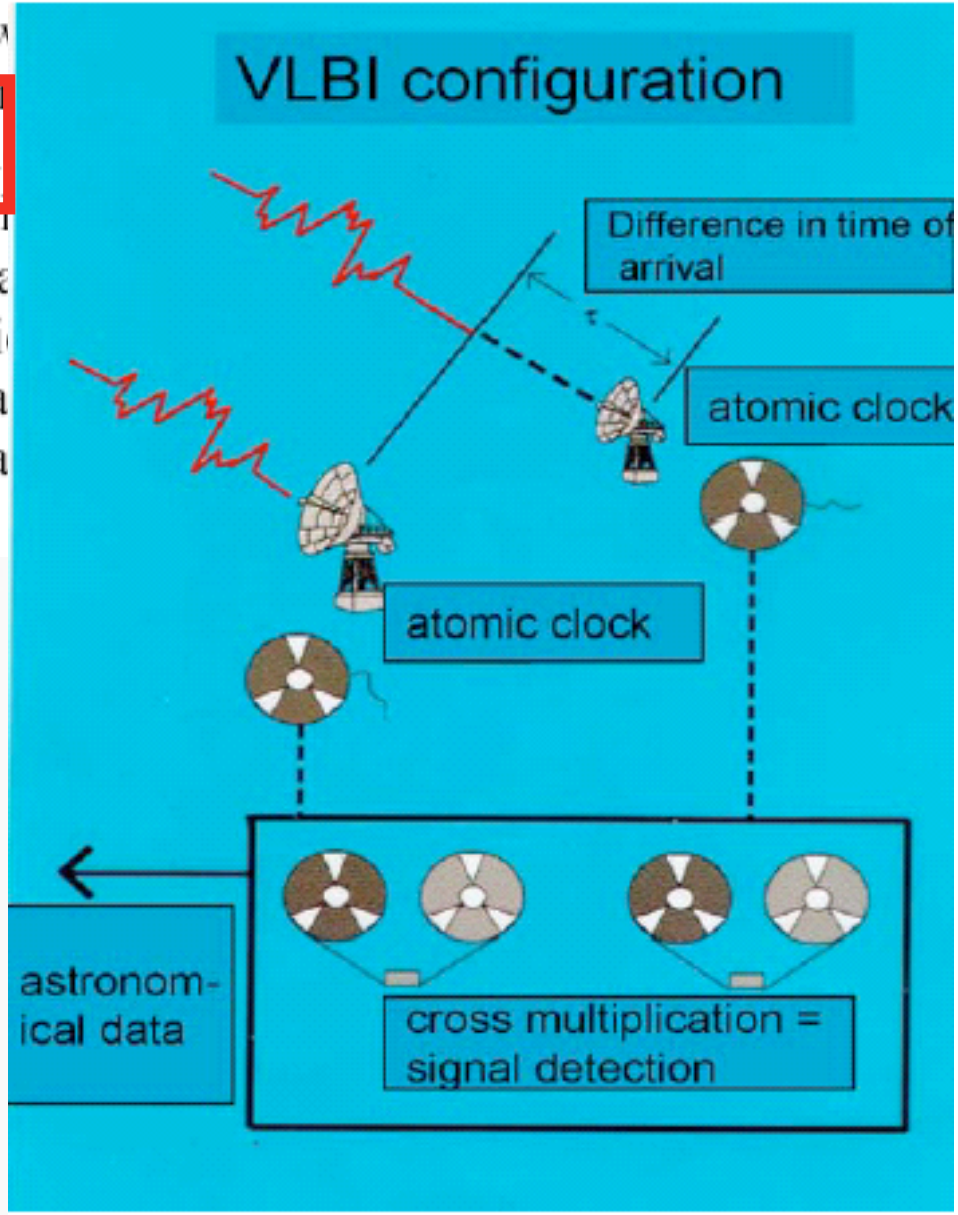
NIKHEF

serena

VLBI

ger term VLBI is easily capable of generating many Gb of data per
The sensitivity of the VLBI array scales w
(=data-rate) and there is a strong push to
. Rates of 8Gb/s or more are entirely feasibl
der development. It is expected that paral
orrelator will remain the most efficient approa
s distributed processing may have an appli
lti-gigabit data streams will aggregate into la
or and the capacity of the final link to the da
tor.

Westerbork Synthesis Radio Telescope - Netherlands



iGrid 2002

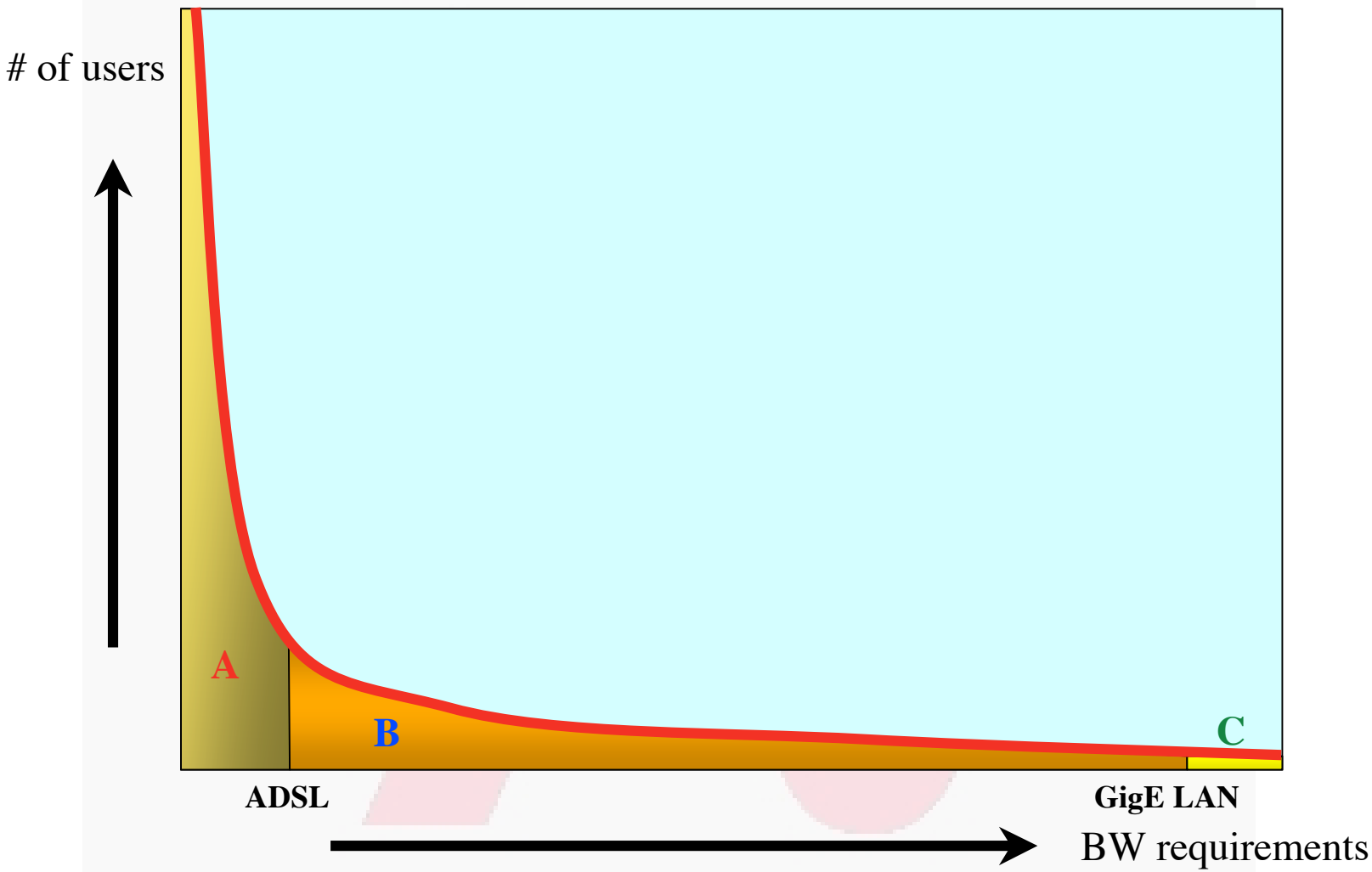
The International Virtual Laboratory

www.igrid2002.org

24-26 September 2002
Amsterdam Science and Technology Centre (WTCW)
The Netherlands

- A showcase of applications that are "early adopters" of very-high-bandwidth national and international networks
  - What can you do with a 10Gbps network?
  - What applications have insatiable bandwidth appetites?
- Scientists and technologists to optimally utilize 10Gbps experimental networks, with special emphasis on e-Science, Grid and Virtual Laboratory applications
- Registration is open (www.igrid2002.org)
- iGrid is not just a conference/demonstration event, it is also a testbed!!
- Contact
  - maxine@startap.net or deLaat@science.uva.nl

Know the user

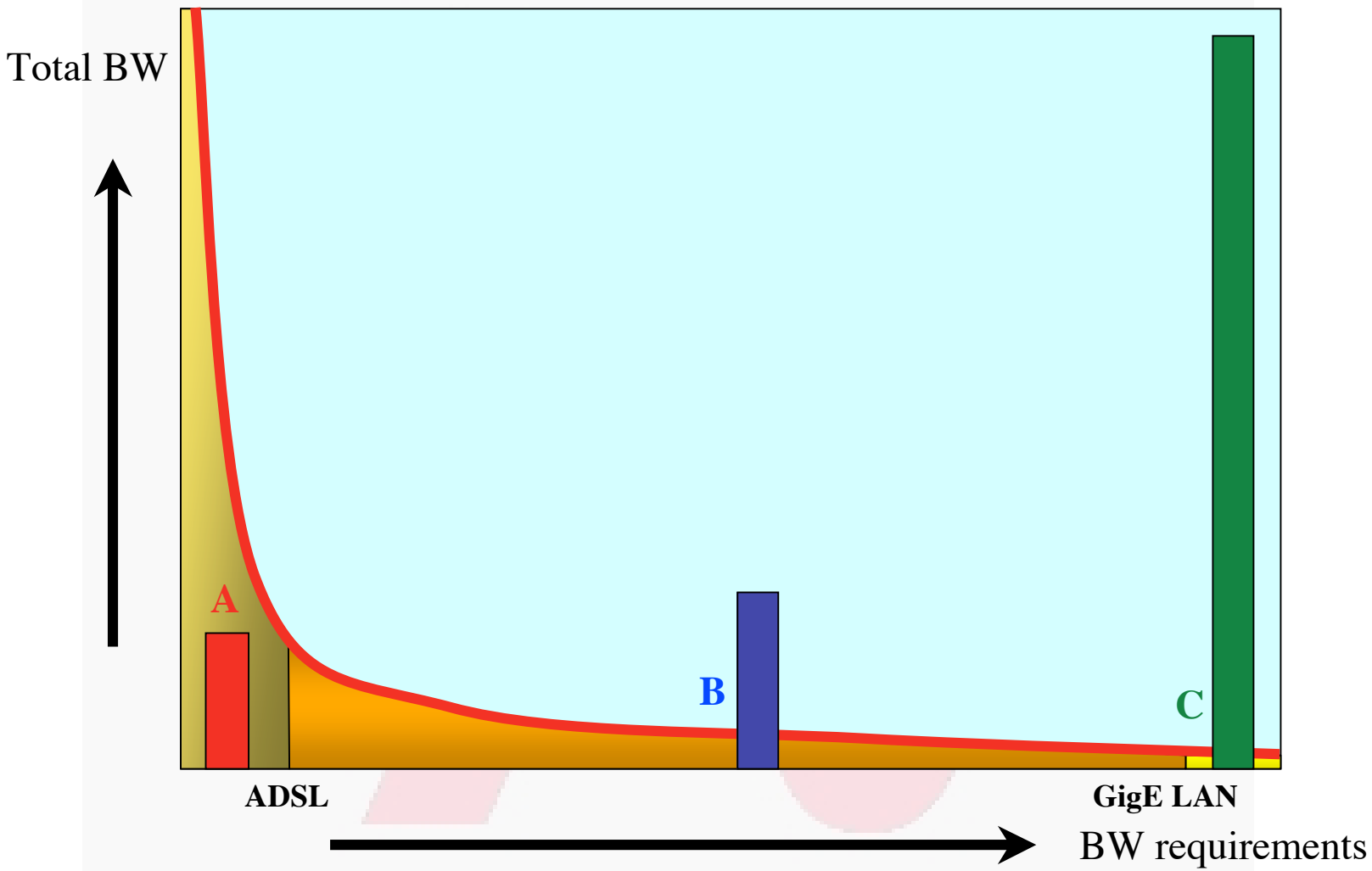


A -> Lightweight users, browsing, mailing, home use

B -> Business applications, multicast, streaming, VPN's, mostly LAN

C -> Special scientific applications, computing, data grids, virtual-presence

What the user



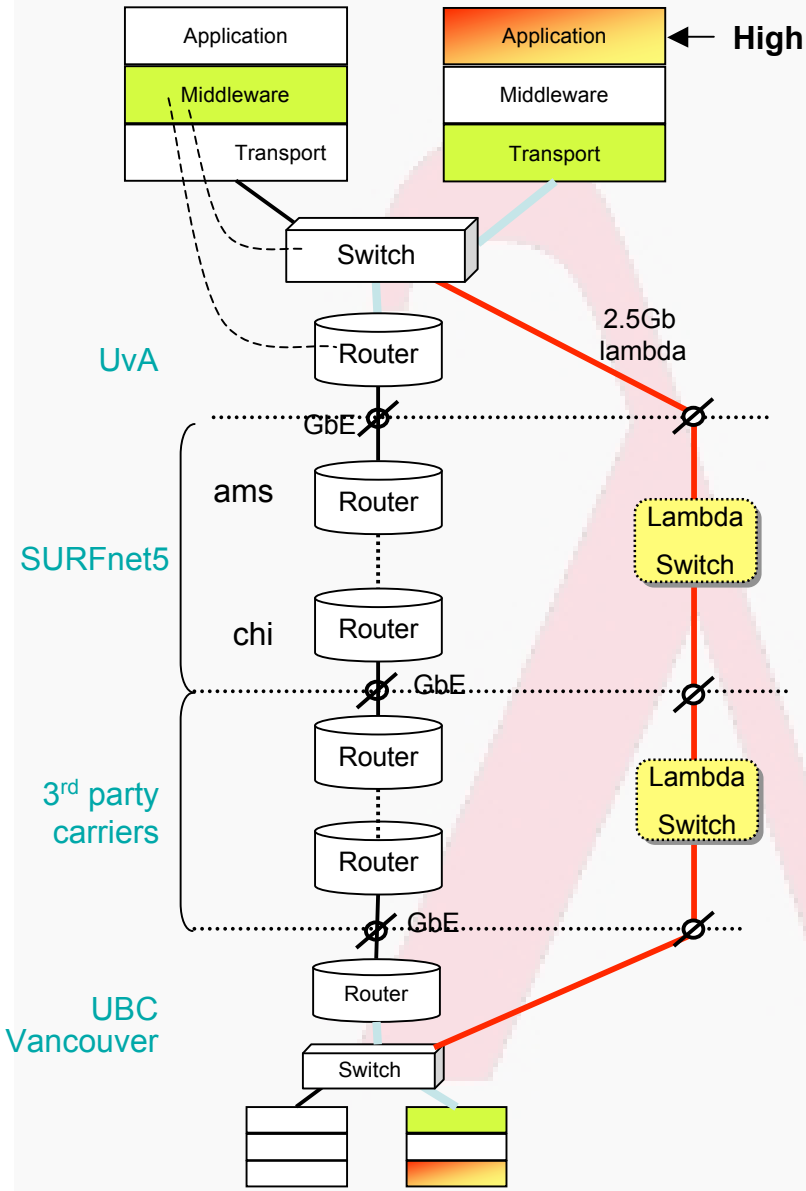
A -> Need full Internet routing, one to many

B -> Need VPN services on/and full Internet routing, several to several

C -> Need very fat pipes, limited multiple Virtual Organizations, few to few

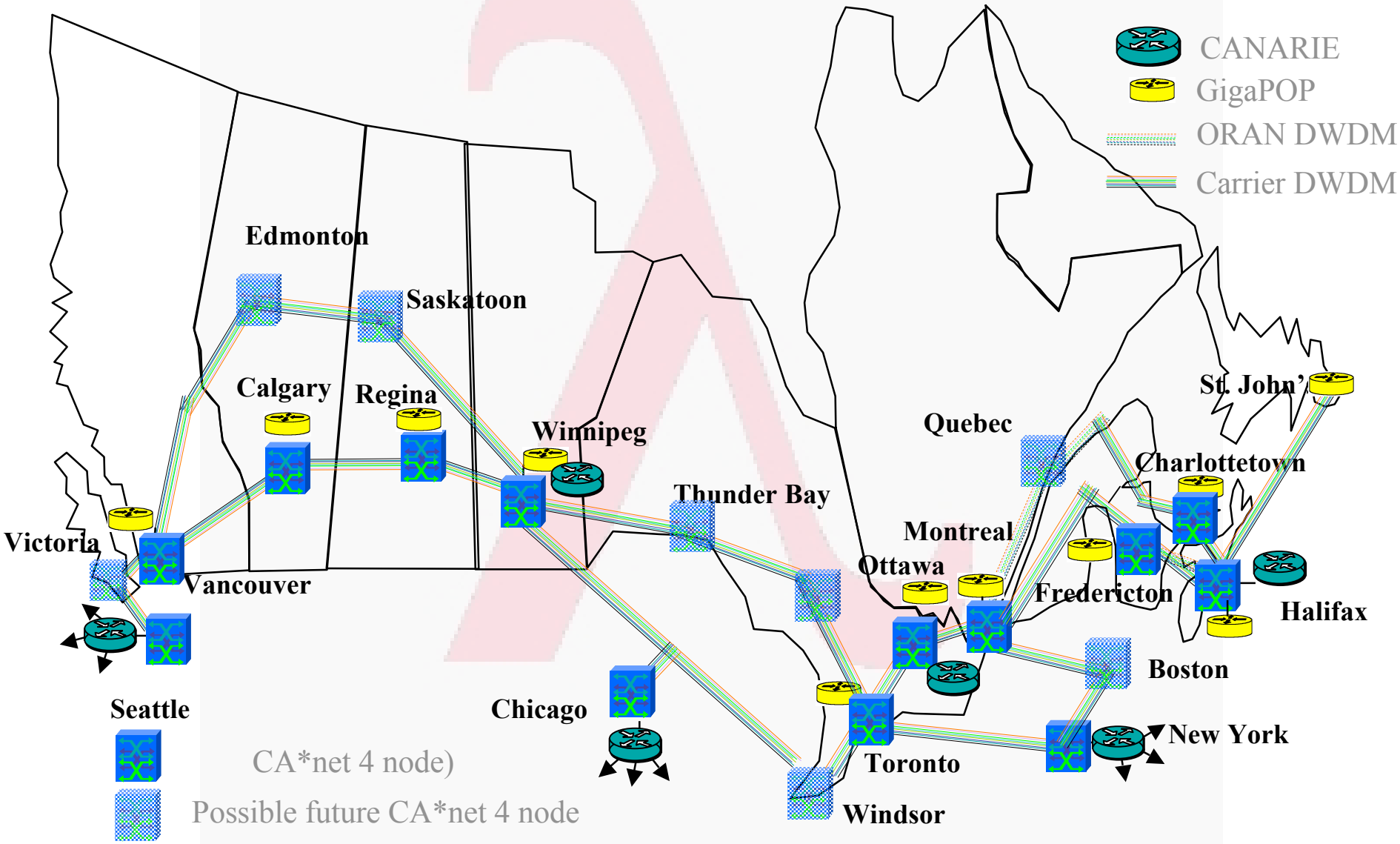
So what are the problems

- Costs of fat pipes (fibers) are one/third of equipment to light them up
  - Is what Lambda salesmen tell me
- Costs of (semi) optical equipment one/fifth of full routing equipment (for same throughput)
  - 100 Byte packet @ 10 Gb/s -> 80 ns to look up in 100 Mbyte routing table (light speed from me to you on the back row!)
- Big sciences need fat pipes
- Bottom line: create a hybrid architecture which serves all users in one consistent cost effective way

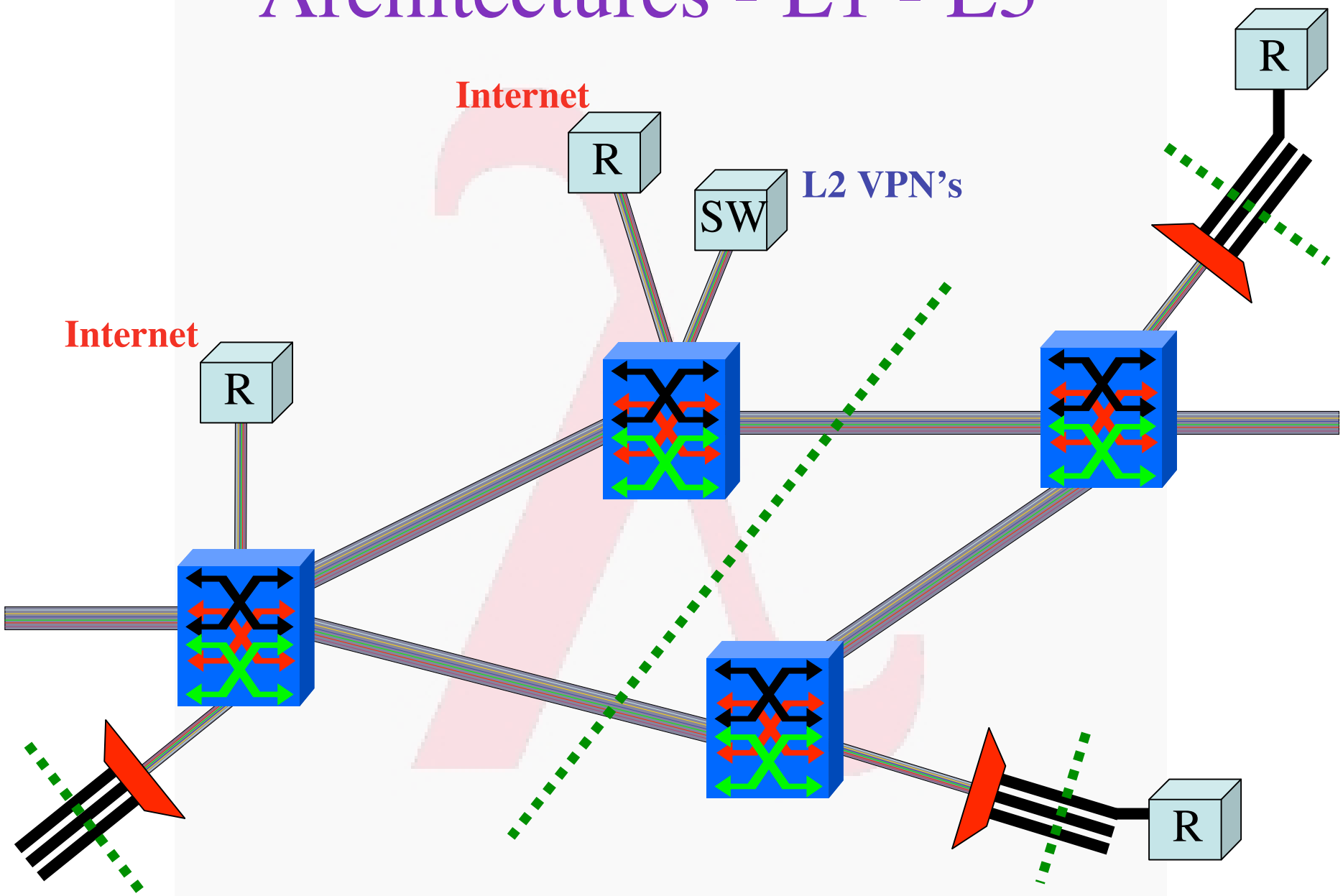


- lambda for high bandwidth applications
  - Bypass of production network
  - Middleware may request (optical) pipe
- RATIONALE:
  - Lower the cost of transport per packet

CA*net 4 Architecture



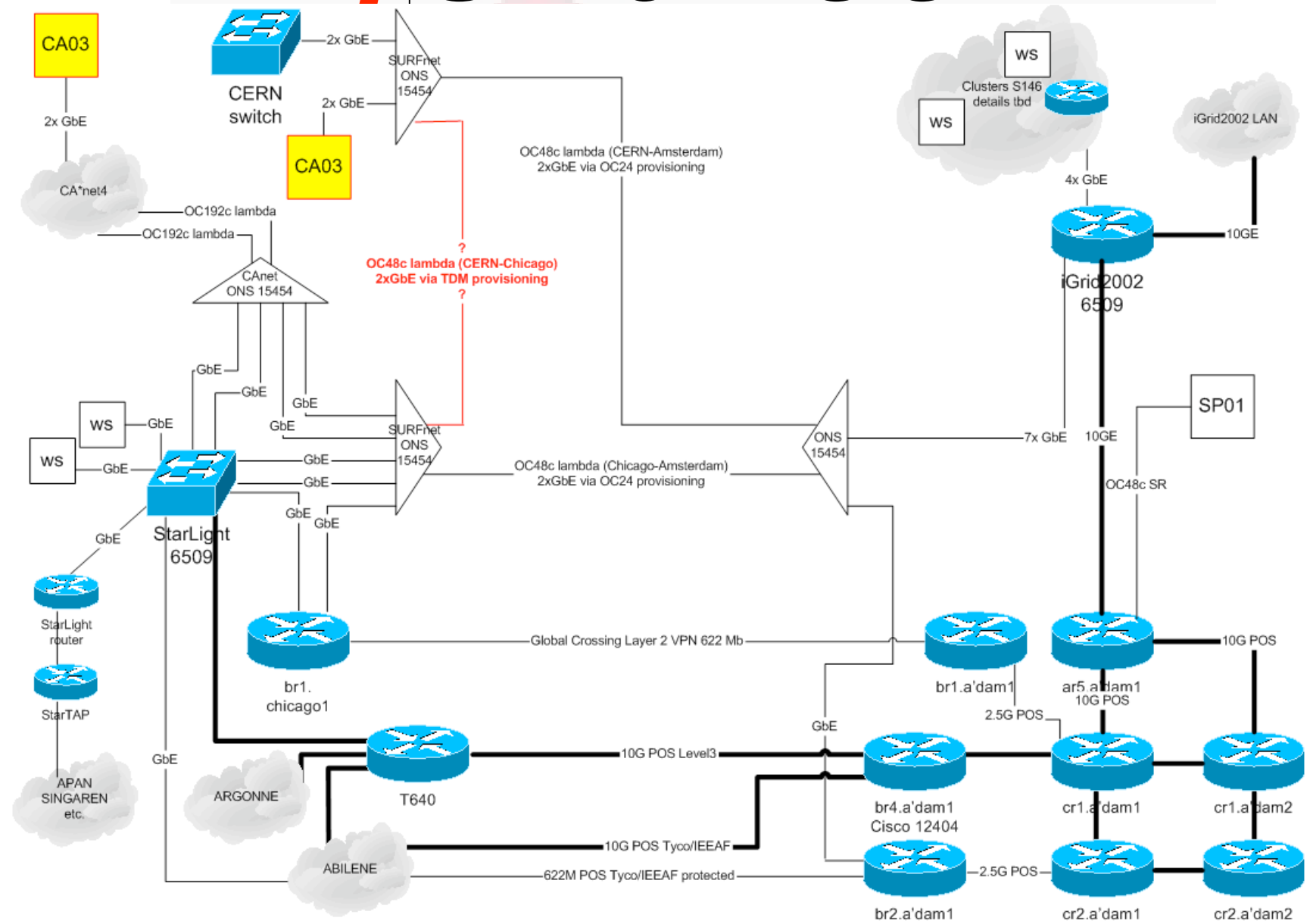
Architectures - L1 - L3



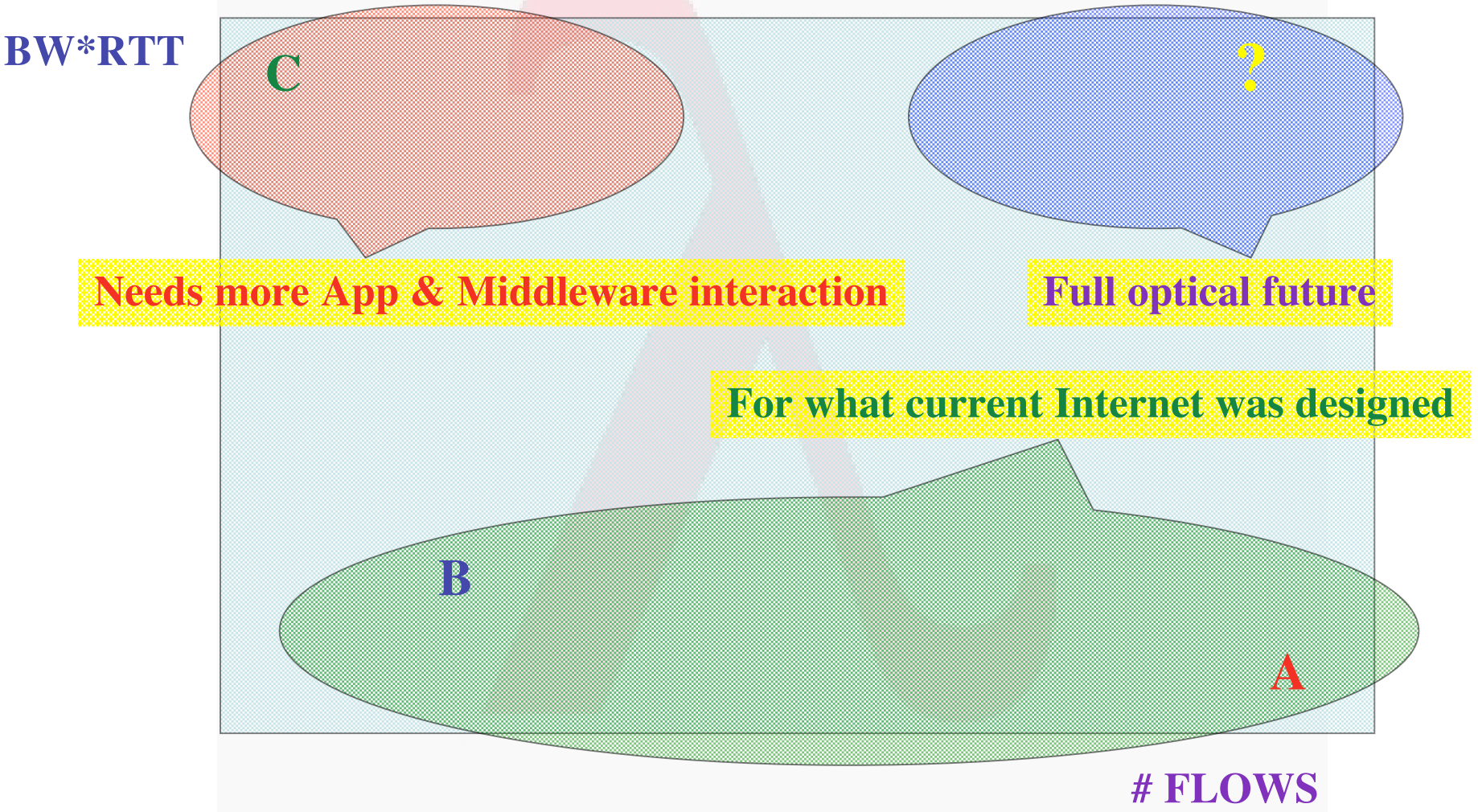
Bring plumbing to the users, not just create sinks in the middle of nowhere

(intermezzo II)

iGrid 2002



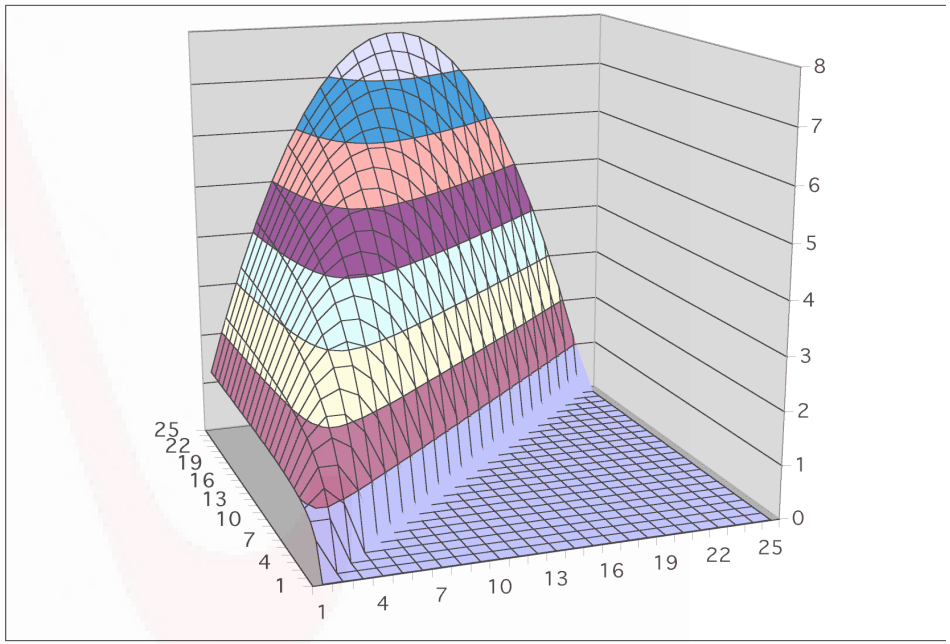
Transport in the corners



Layer - 2 requirements from 3/4

TCP is bursty due to sliding window protocol and slow start algorithm. So pick from menu:

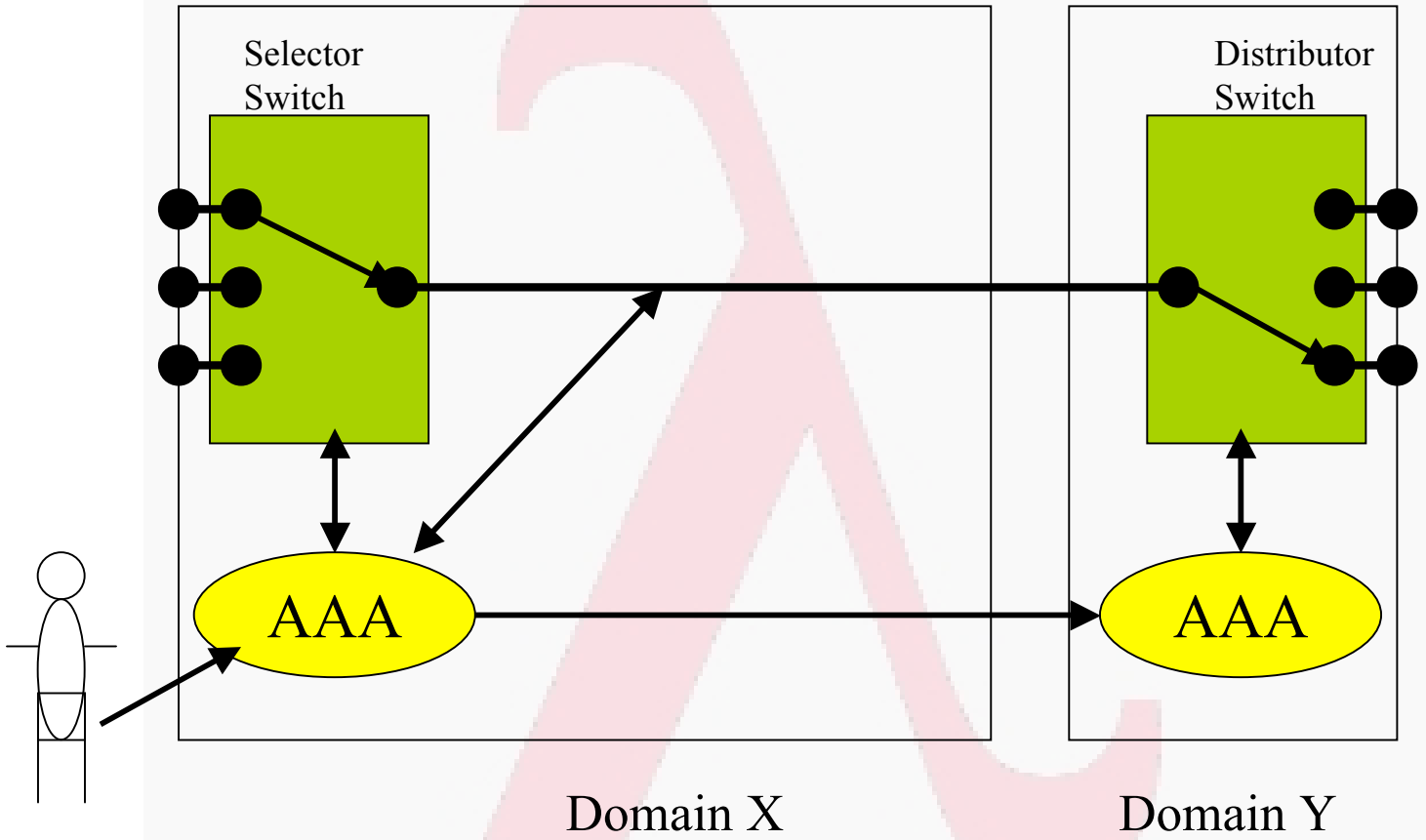
- *Flow control*
- *Traffic Shaping*
- *RED (Random Early Discard)*
- *Self clocking in TCP*
- *Deep memory*

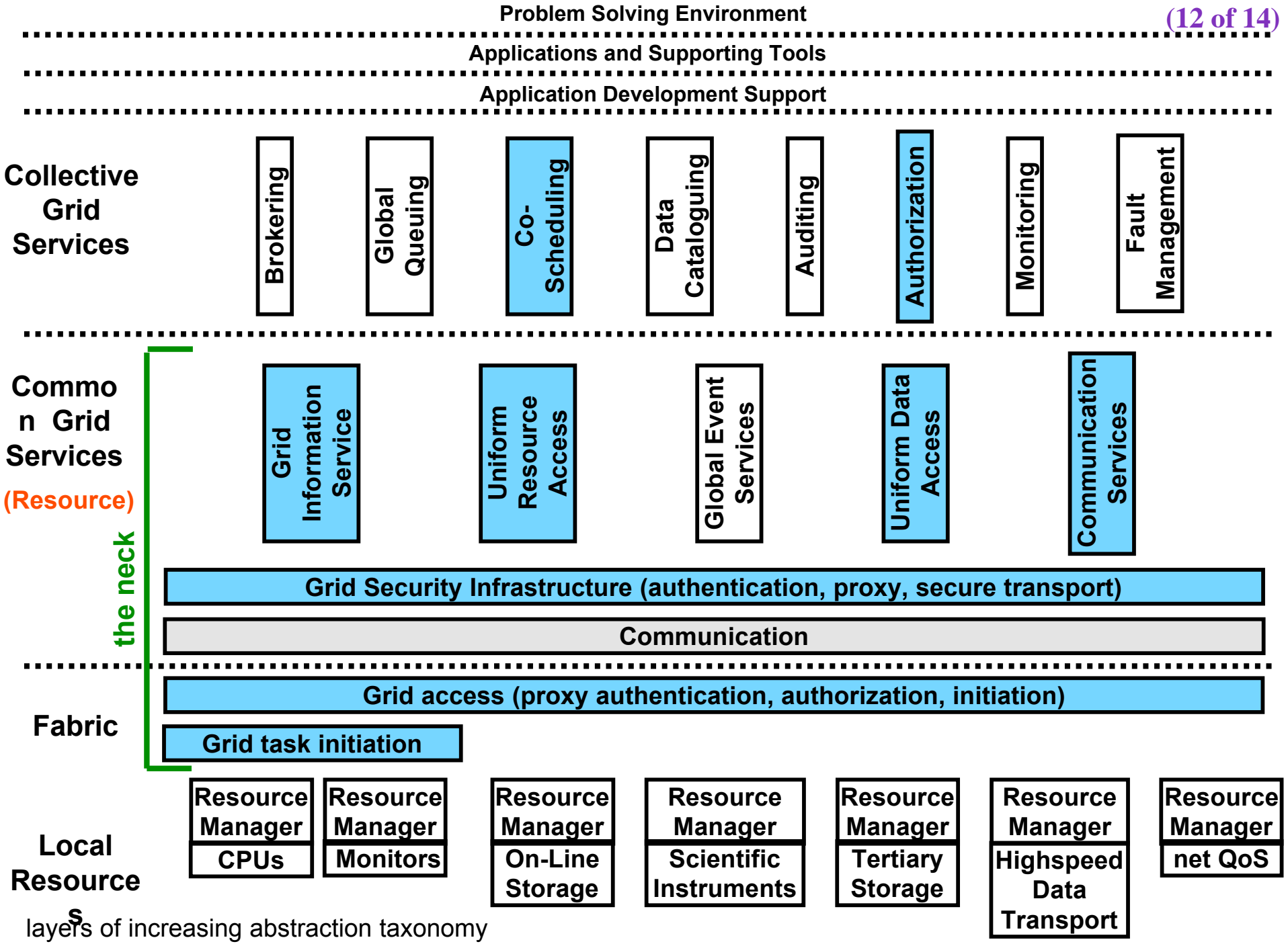


Window = BandWidth * RTT & BW == slow

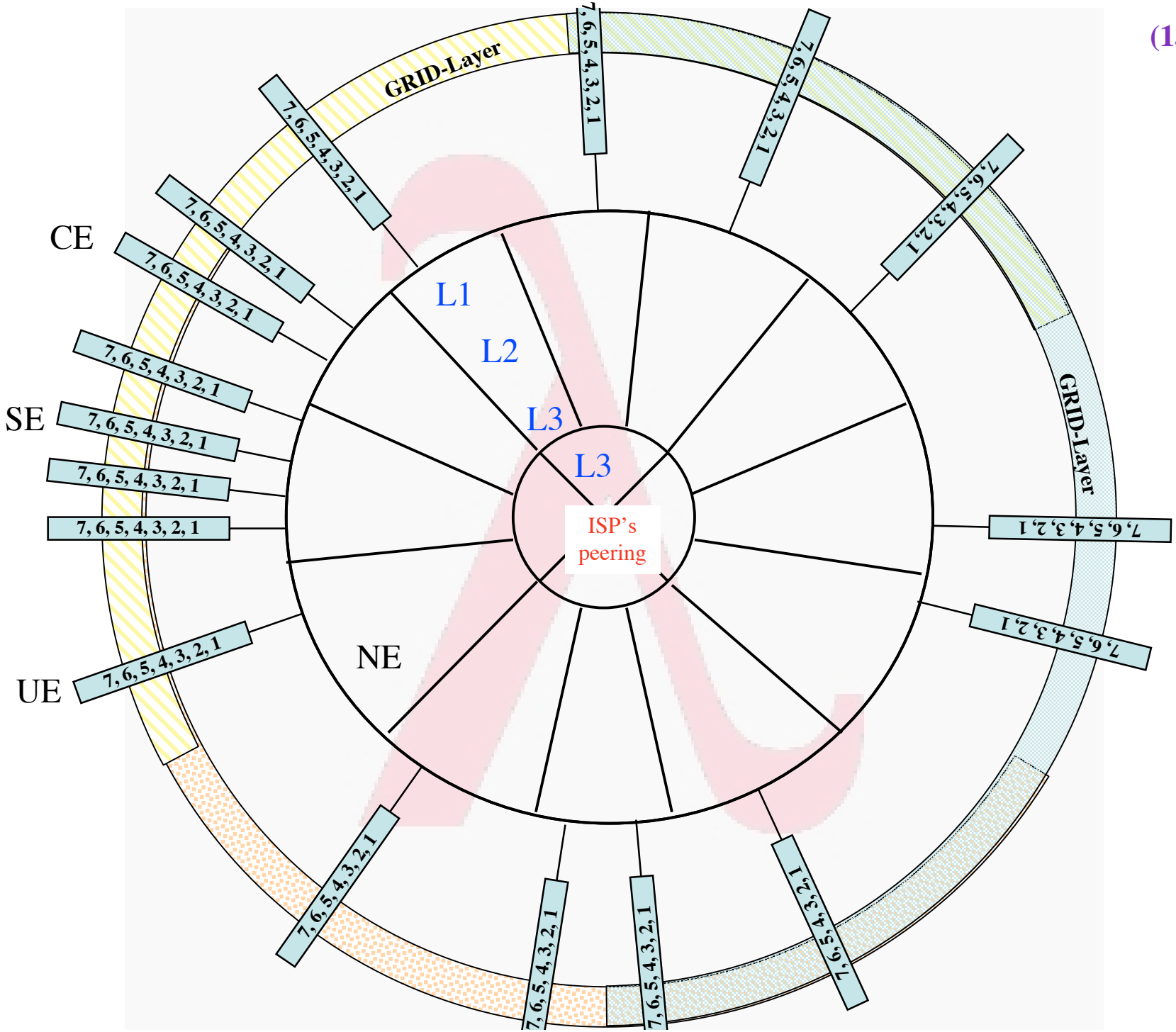
$$\text{Memory-at-bottleneck} = \frac{\text{fast - slow}}{\text{fast}} * \text{slow} * \text{RTT}$$

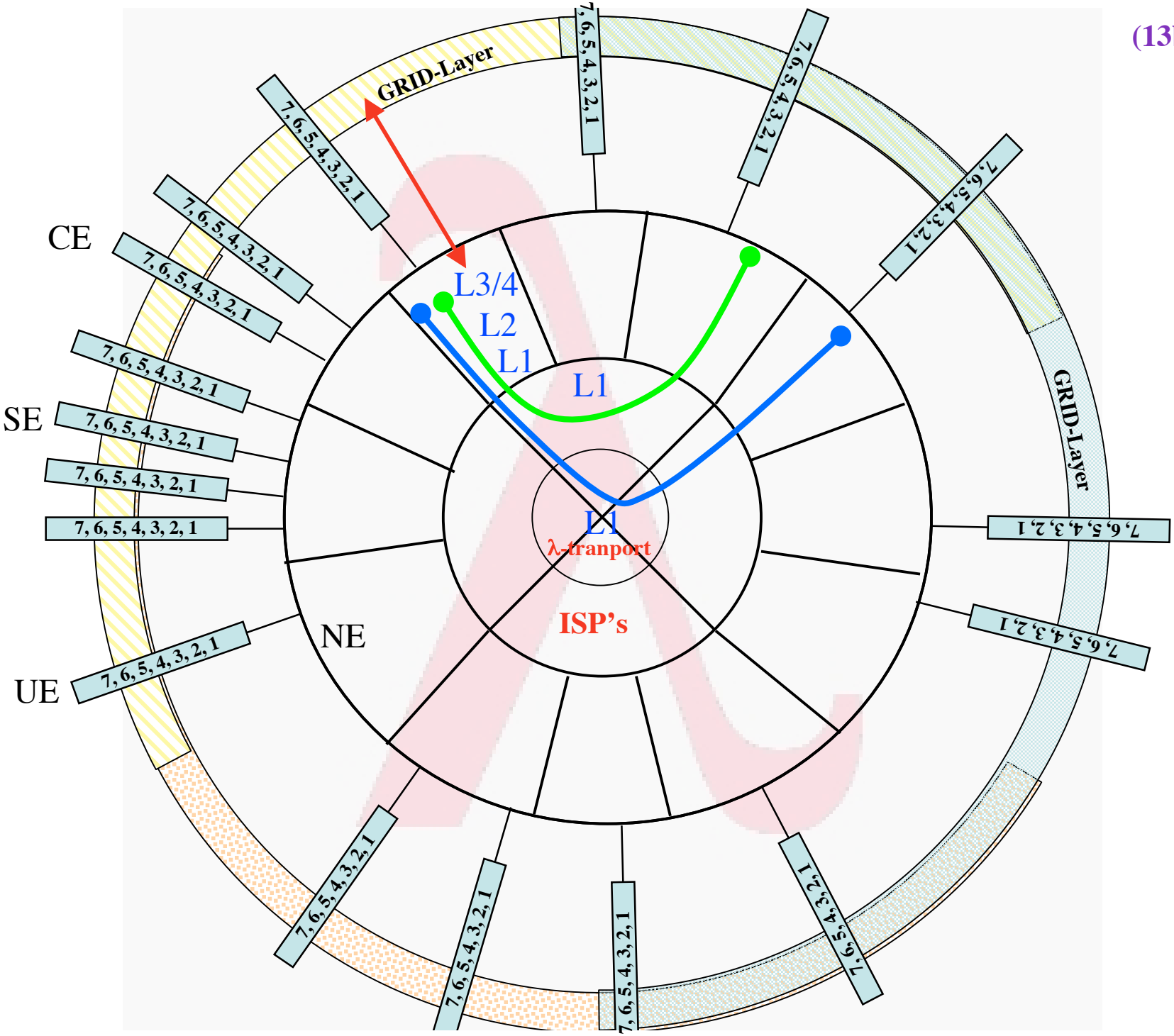
Daisy Chain control model of administrative domains





layers of increasing abstraction taxonomy


GRID-Layer
GRID-Layer
CE
SE
UE
NE
L1
L2
L3
L3
ISP's peering
7, 6, 5, 4, 3, 2, 1


GRID-Layer
7, 6, 5, 4, 3, 2, 1
CE
SE
NE
UE
L3/4
L2
L1
L1
L1
λ-tranport
ISP's
GRID-Layer

Research needed

- Optical devices
- Internet Architecture
- Network Elements as Grid Resources
- Transport protocols get in other corners
- How dynamic must your optical underware be
- Don’t mix trucks and Ferrari’s

Revisiting the truck of tapes

Consider one fiber

- **Current technology allows 320 λ in one of the frequency bands**
- **Each λ has a bandwidth of 40 Gbit/s**
- **Transport: $320 * 40*10^9 / 8 = 1600$ GByte/sec**

- **Take a 10 metric ton truck**
  - **One tape contains 50 Gbyte, weights 100 gr**
  - **Truck contains (10000 / 0.1) * 50 Gbyte = 5 PByte**

- **Truck / fiber = 5 PByte / 1600 GByte/sec = 3125 s ≈ one hour**
- **For distances further away than a truck drives in one hour (50 km) minus loading and handling 100000 tapes the fiber wins!!!**

The END

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