100G Lambda networking in CERNET and IPv4/IPv6 traffic engineering

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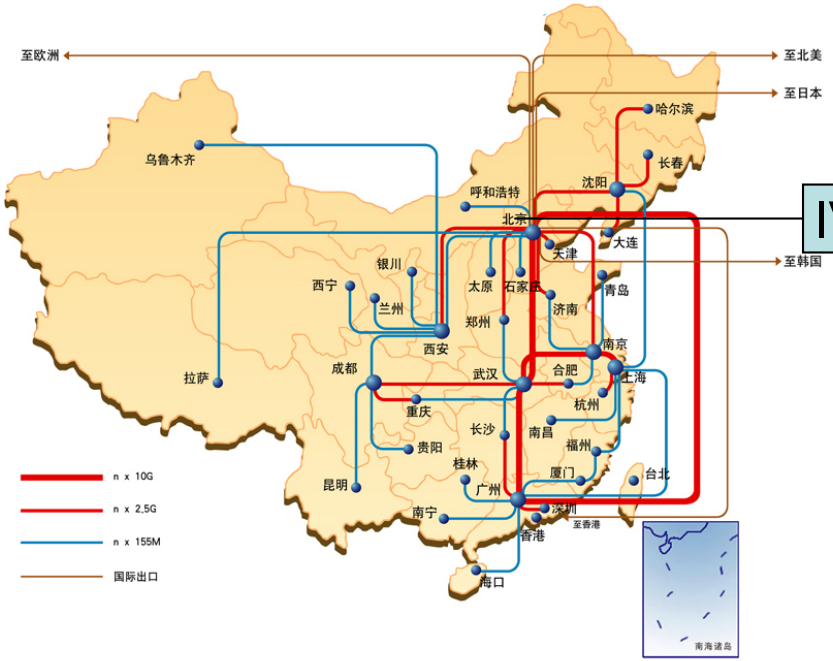
Outline

- CERNET and CERNET2
- 100G experience
- Traffic engineering building blocks
  - Address switching
  - IVI
- Current projects
- Remarks

CERNET Layer 3

CERNET (IPv4)



IVI

CERNET2 (IPv6)

- CERNET is the first (1994) nation wide Internet backbone in China.
- CERNET ranks 23 in global CIDR report.
- Over 2,000 universities on CERNET with about 20M subscribers.

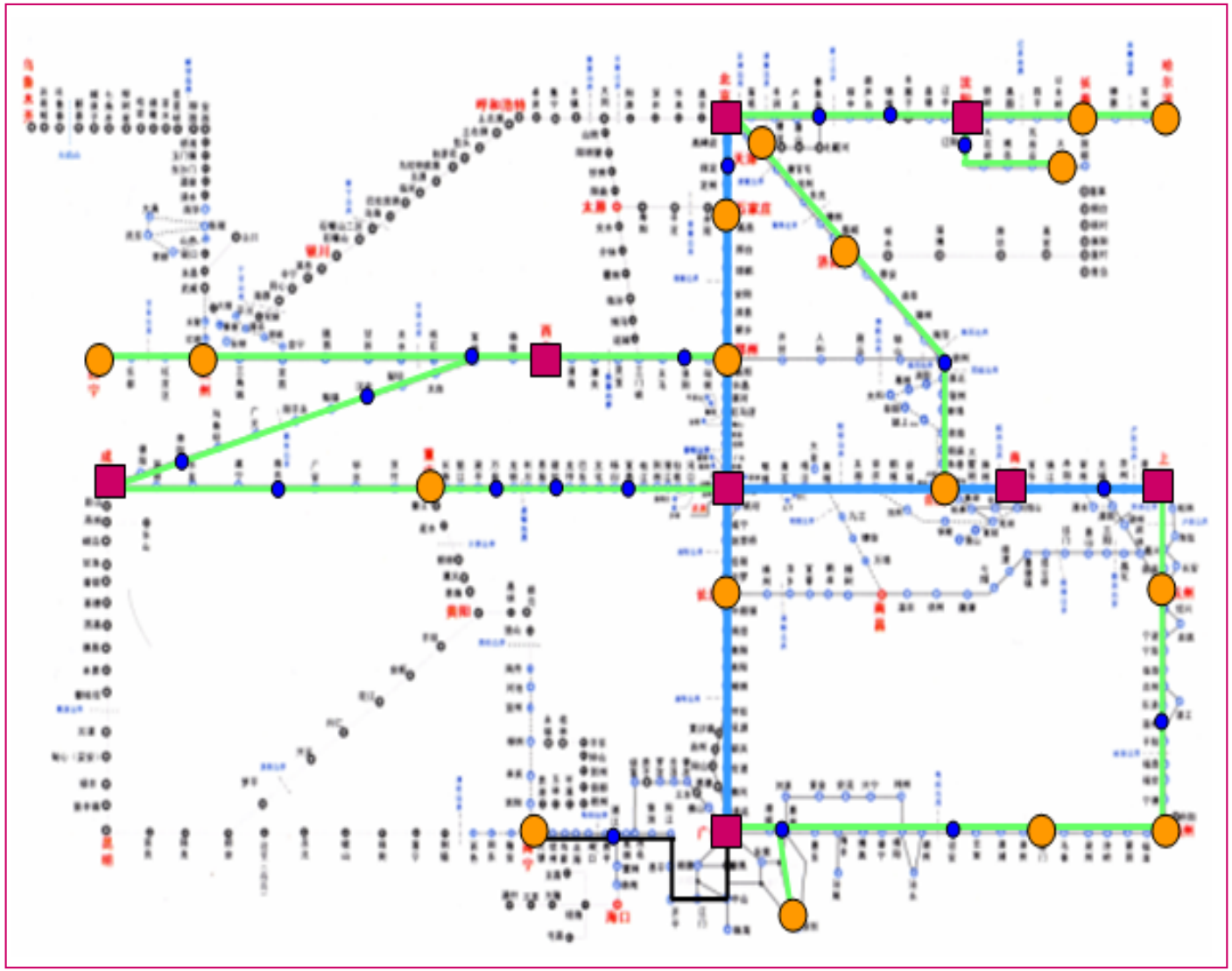
- Built in 2004, with national coverage
- CERNET2 is the largest IPv6 backbone in China.
- About 300 universities connected to CERNET2 with about 3M subscribers.

Peering

- Academic
  - Beijing ←→ Los Angeles 10G
  - Beijing ←→ London 10G
  - Beijing ←→ Hong Kong 10G (100G)

CERNET fiber

CERNET DWDM

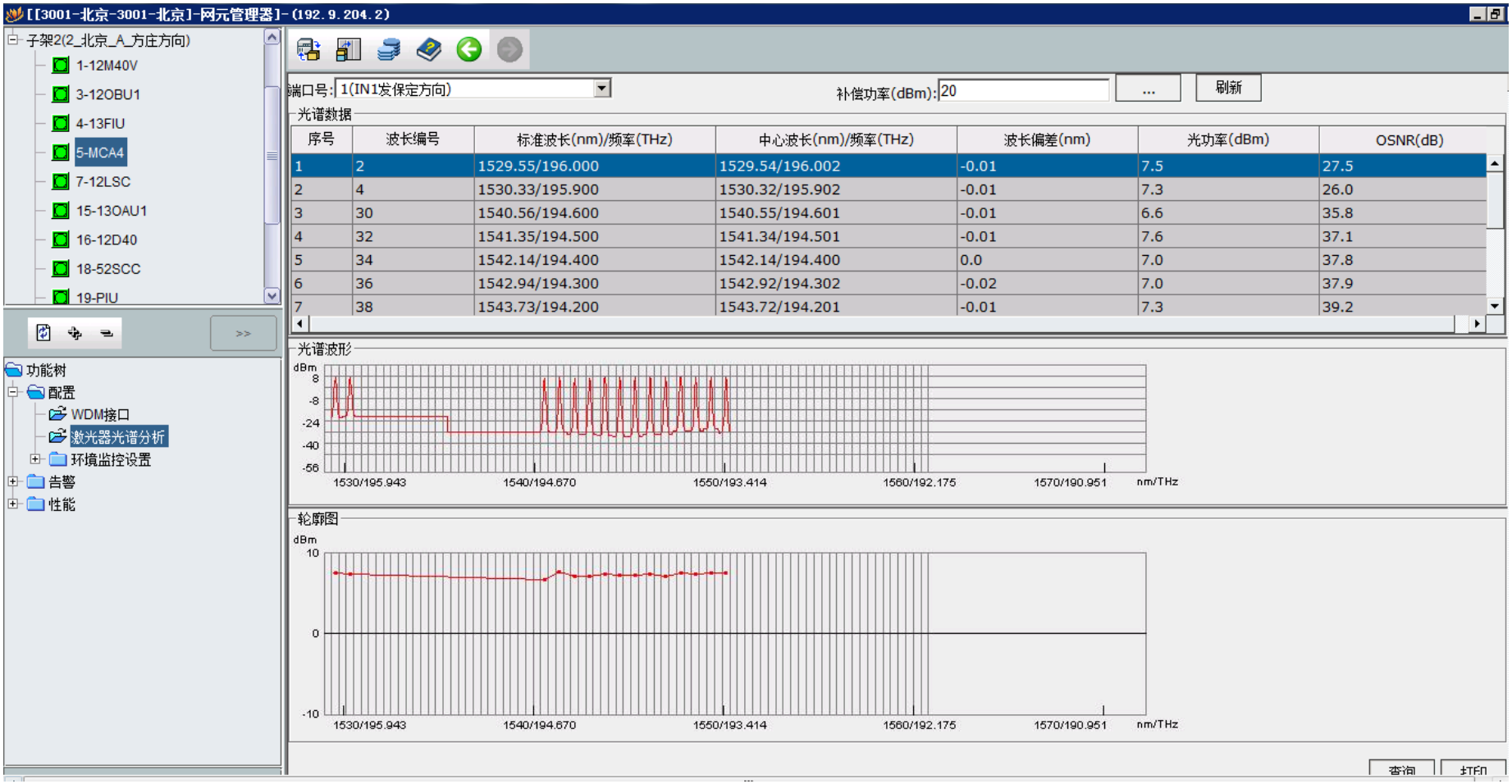


DWDM design considerations

- 100G transport network
  - Point-to-point link
  - No OTN cross-connects

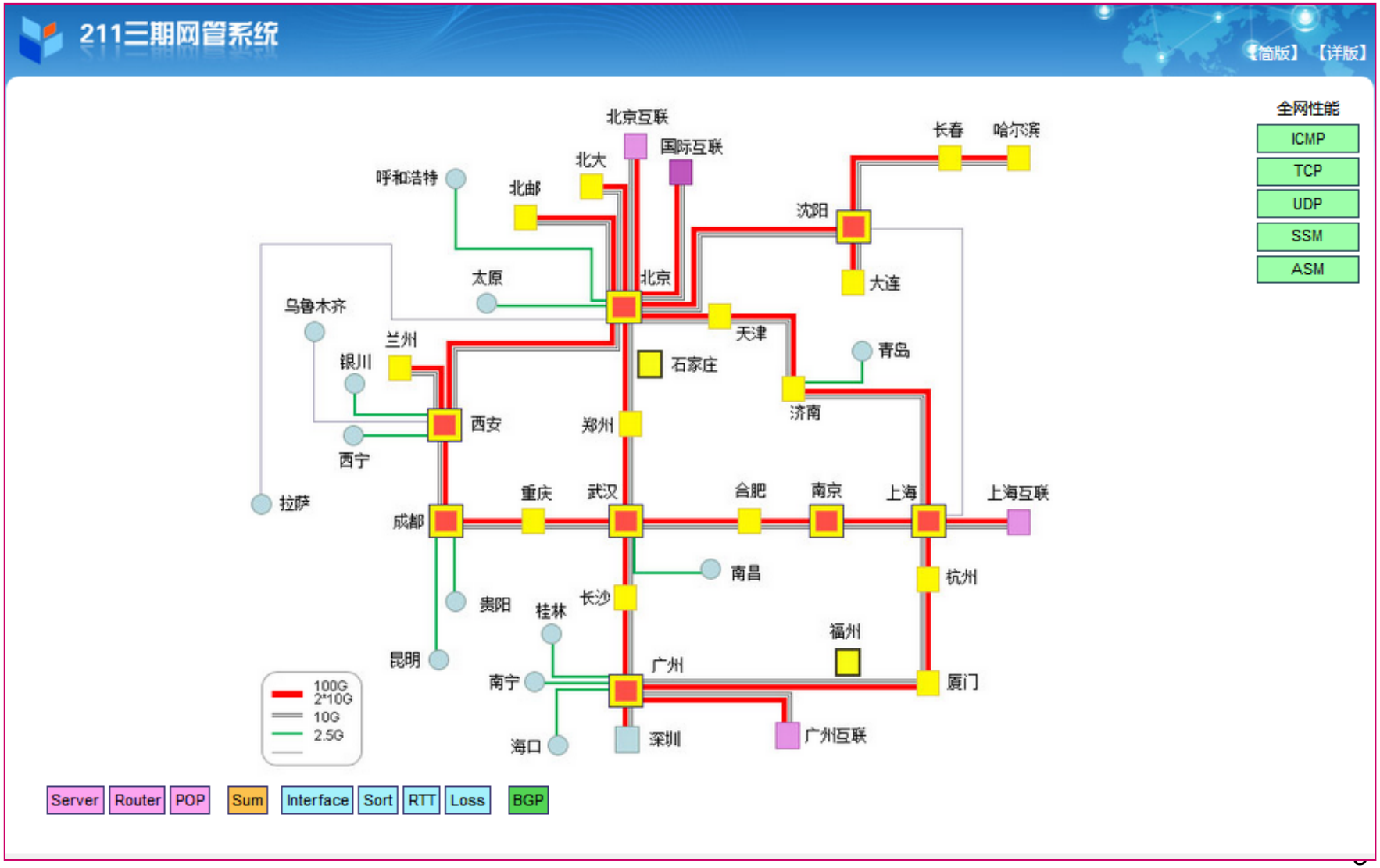
- 100G & 10G mixed system
  - Conservative considerations
    - Not sure 100G is stable at the design time (2012)
  - Economical considerations
    - 100G → TMUX multiple 10Gs
    - Or mixed 100G/10G

DWDM deployment considerations

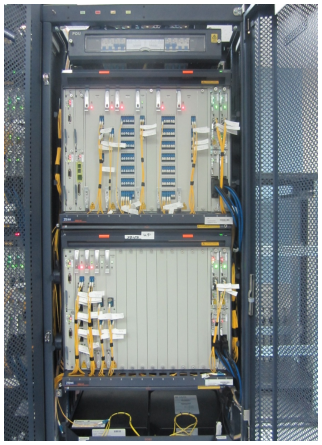


- 10G is sensitive to dispersion
- 100G is sensitive to attenuation

Layer 3 topology



Equipment



Juniper T4000

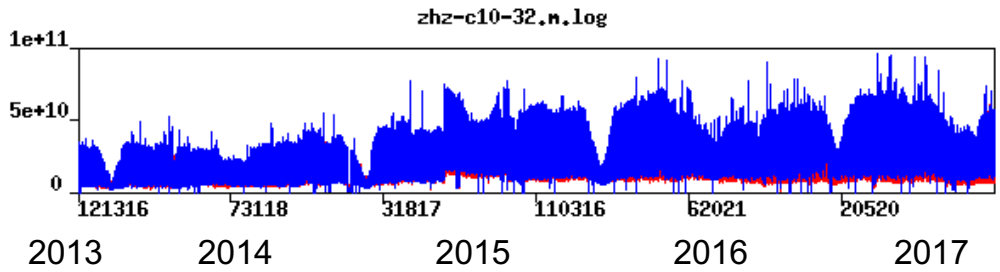
Cisco CRS-3

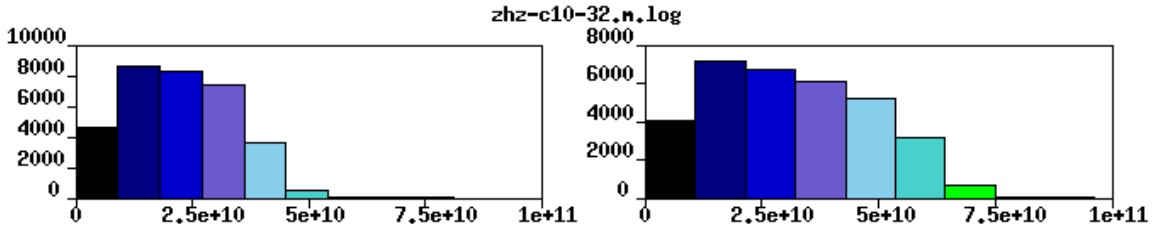
Huawei NE40

IP Traffic examples

111 - 2017092316

zhz-c10-32.m.log in. act= 41.0123G (31458/33114) [max= 81.1666G med= 21.7031G min= 0] {ave= 22.2291G
zhz-c10-32.m.log out act= 59.8893G (31458/33114) [max= 96.3341G med= 30.2292G min= 0] {ave= 31.3001G
data

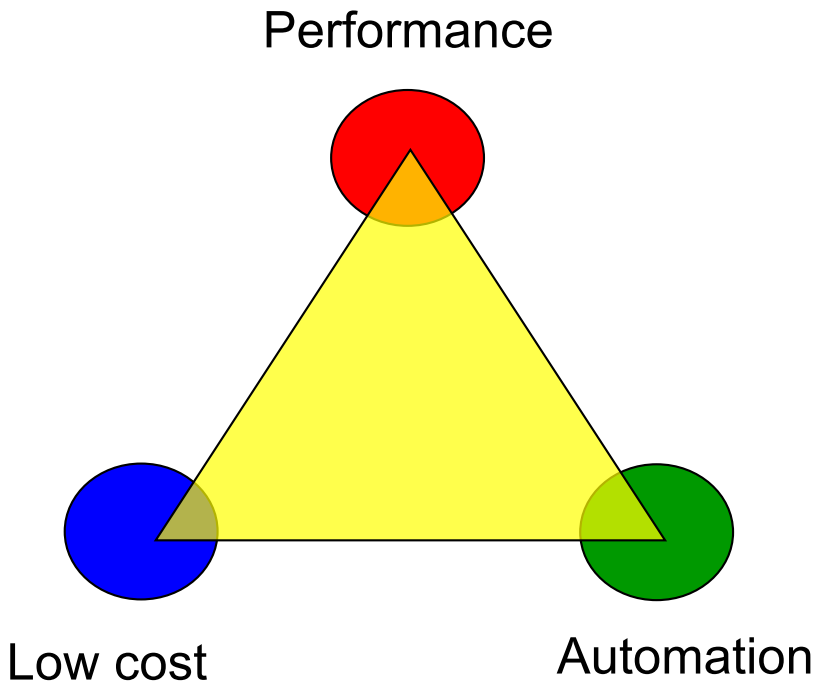




100G to supercomputing center in Wuxi

CERNET user requirements (1)

- Networks
  - QoS Layer 3 path
  - Bandwidth guaranteed Layer 2 Links
  - Measurement
  - Trouble shooting
  - Security
  - Low cost
- Research groups
  - Performance
  - Automation
  - Low cost



CERNET user requirements (2)

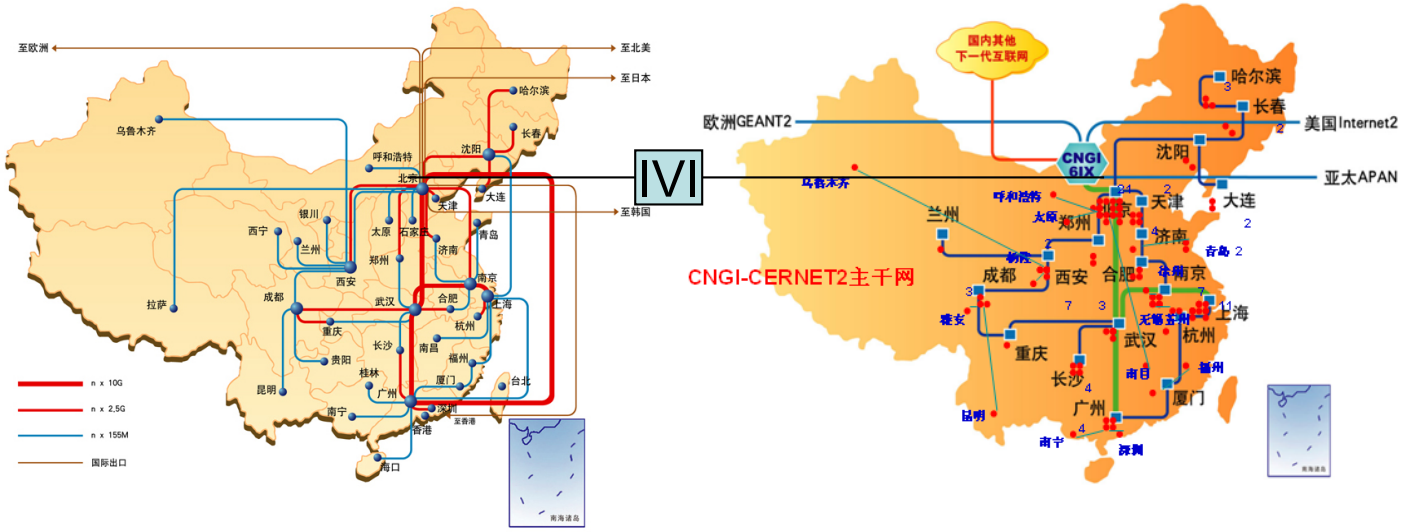
- Layer 3 services
  - IPv4 global, commodity (best effort)
  - IPv4 academic (bandwidth on demand)
  - IPv6 global
  - IPv4 and IPv6 translation
- Layer 3 VPN services
- Layer 2 Point-to-point
- SDN service

Building blocks

- Routing
  - IPv4 BGP
  - IPv6 BGP
  - IPv6 multicast SSM
- Layer 2
  - point-to-point
- Layer 3 VPN
  - BGP VRF
- SDN
- SRv6

- Address switching
- IPv4/IPv6 translation (IVI)
- Scalable Application Specific Measurement (SASM)

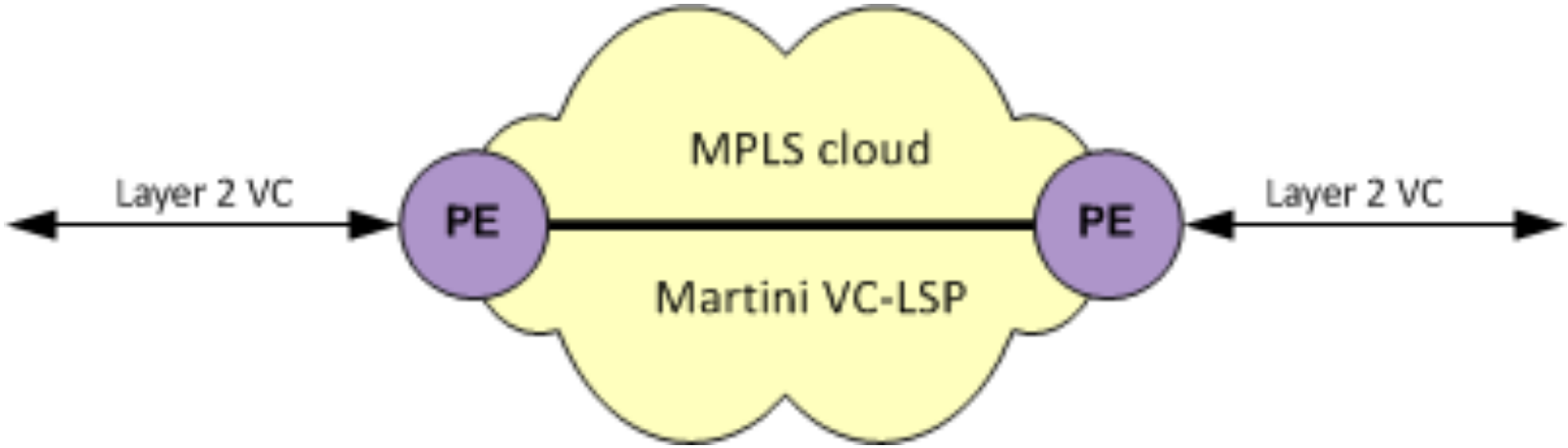
Routing



IPv4 IPv6

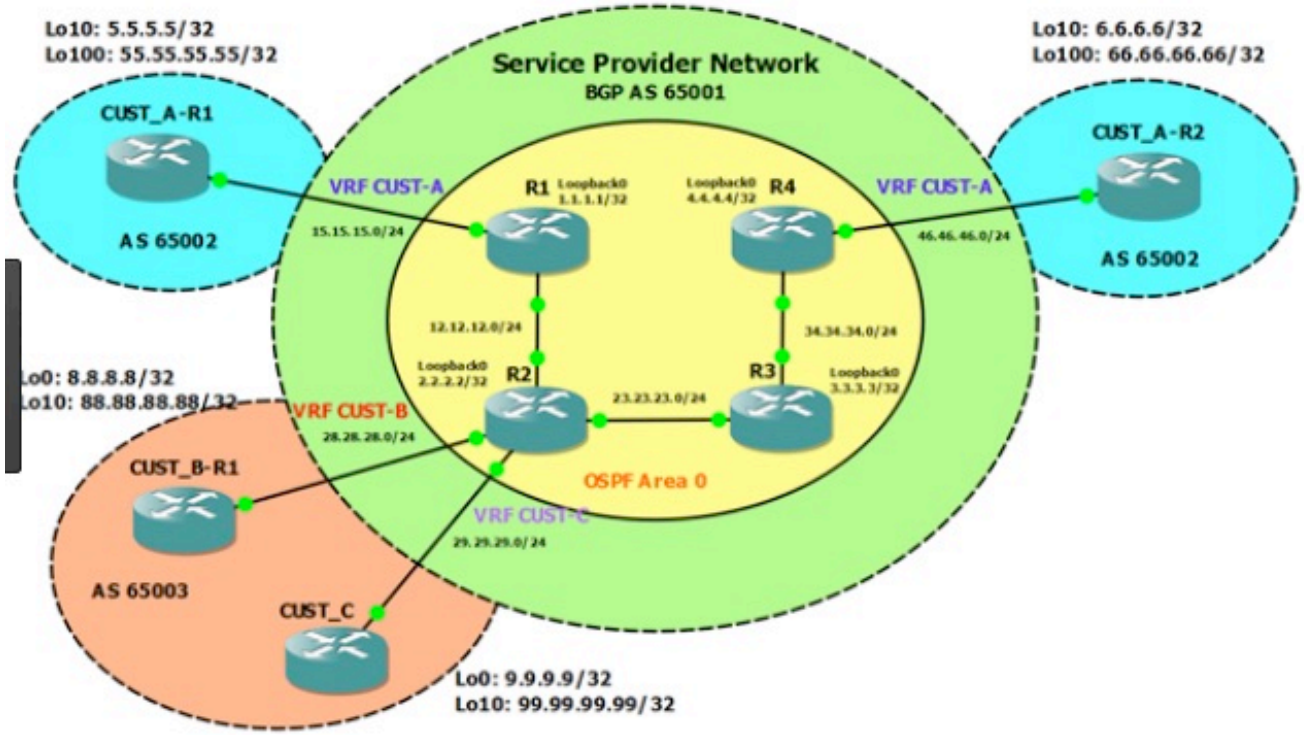
- Providing services already
- Asymmetric routing
- Best effort

Layer 2 point-to-point



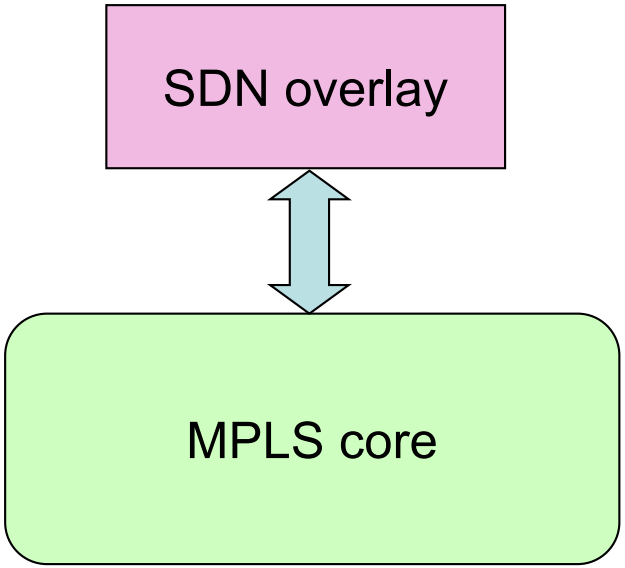
- Providing services already
- Scalability
- Inter domain

Layer 3 VPN



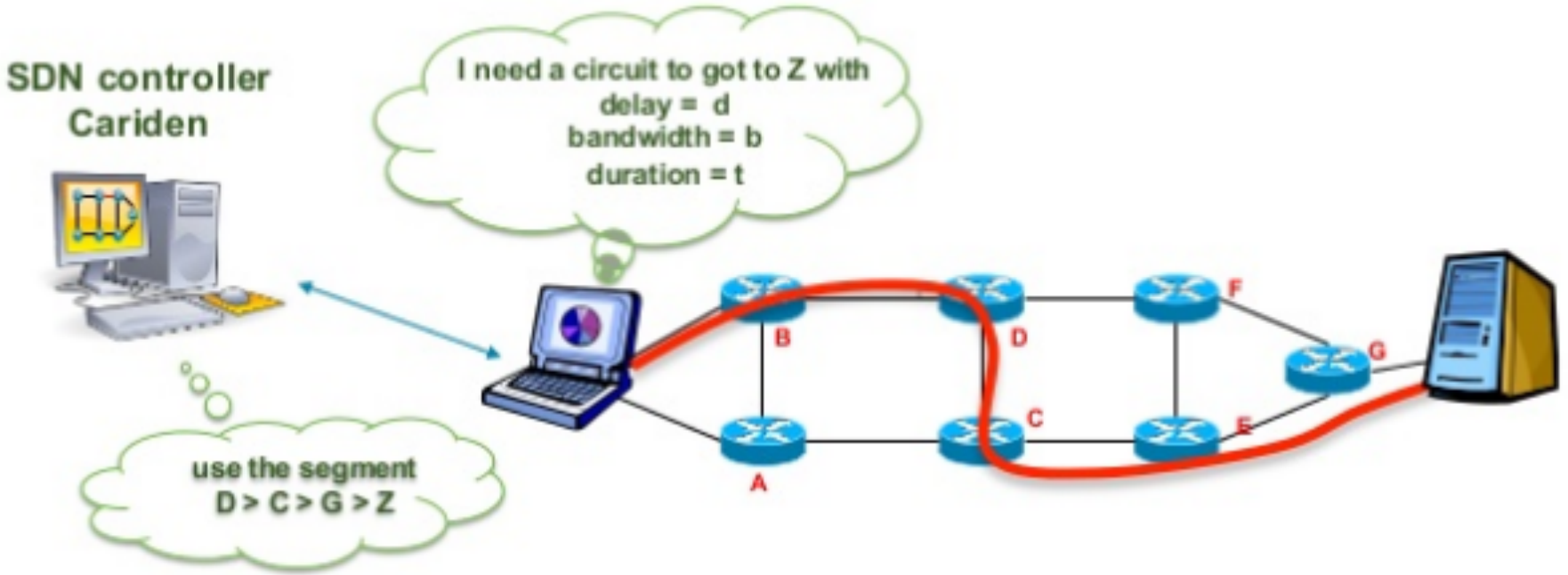
- Provide services soon
- Scalability
- Inter domain

SDN



- Provide services soon (overlay model)
- Production service?

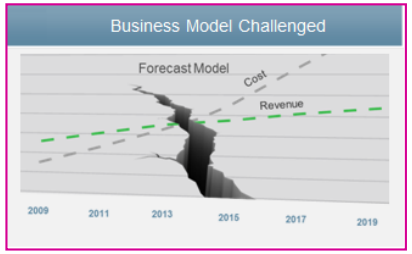
SRv6

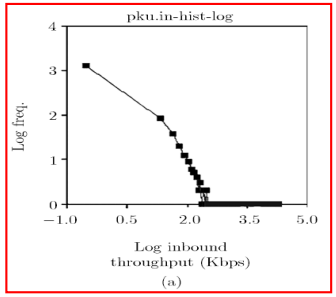


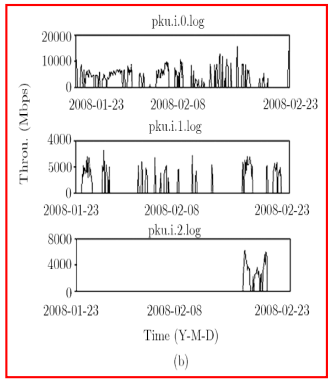
- Keep eyes open

Natures of the Internet

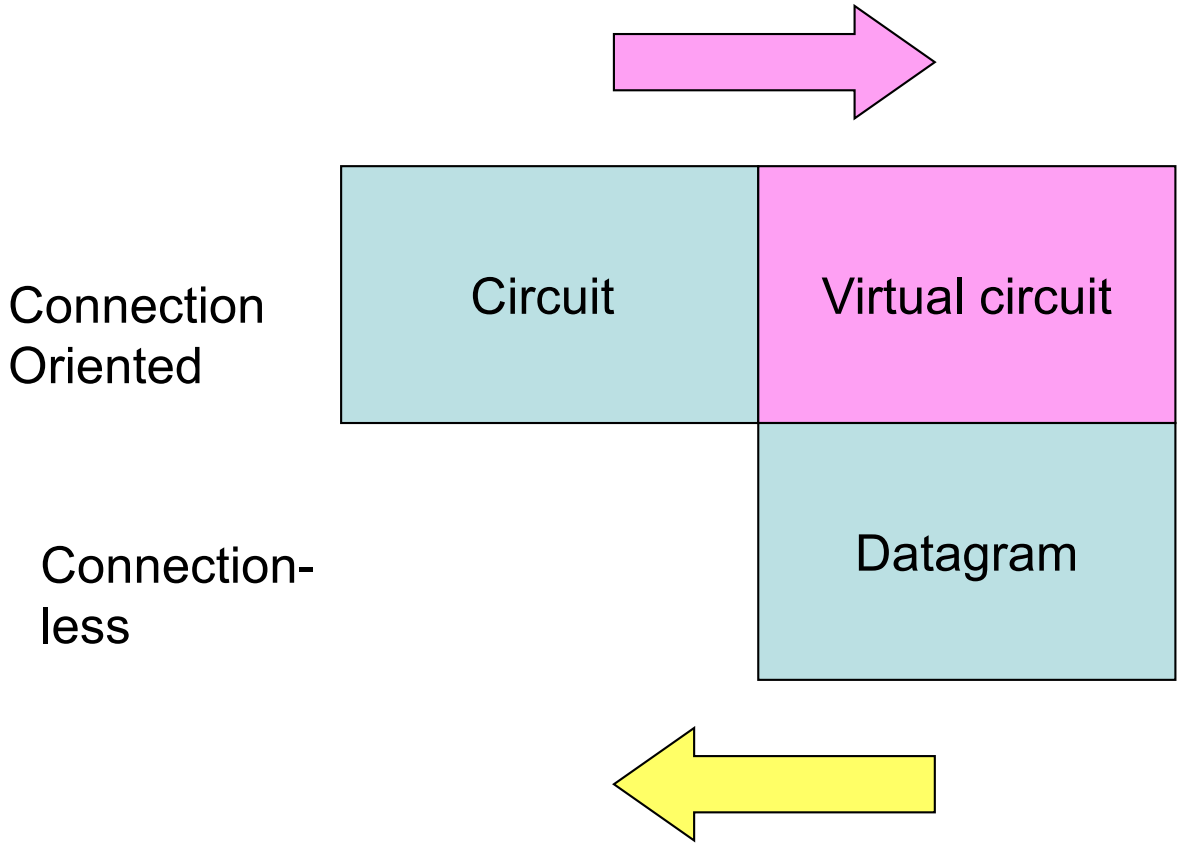
- Bandwidth is limited resource
- The user's behavior follows the power law
- The high performance applications are still Poisson distribution



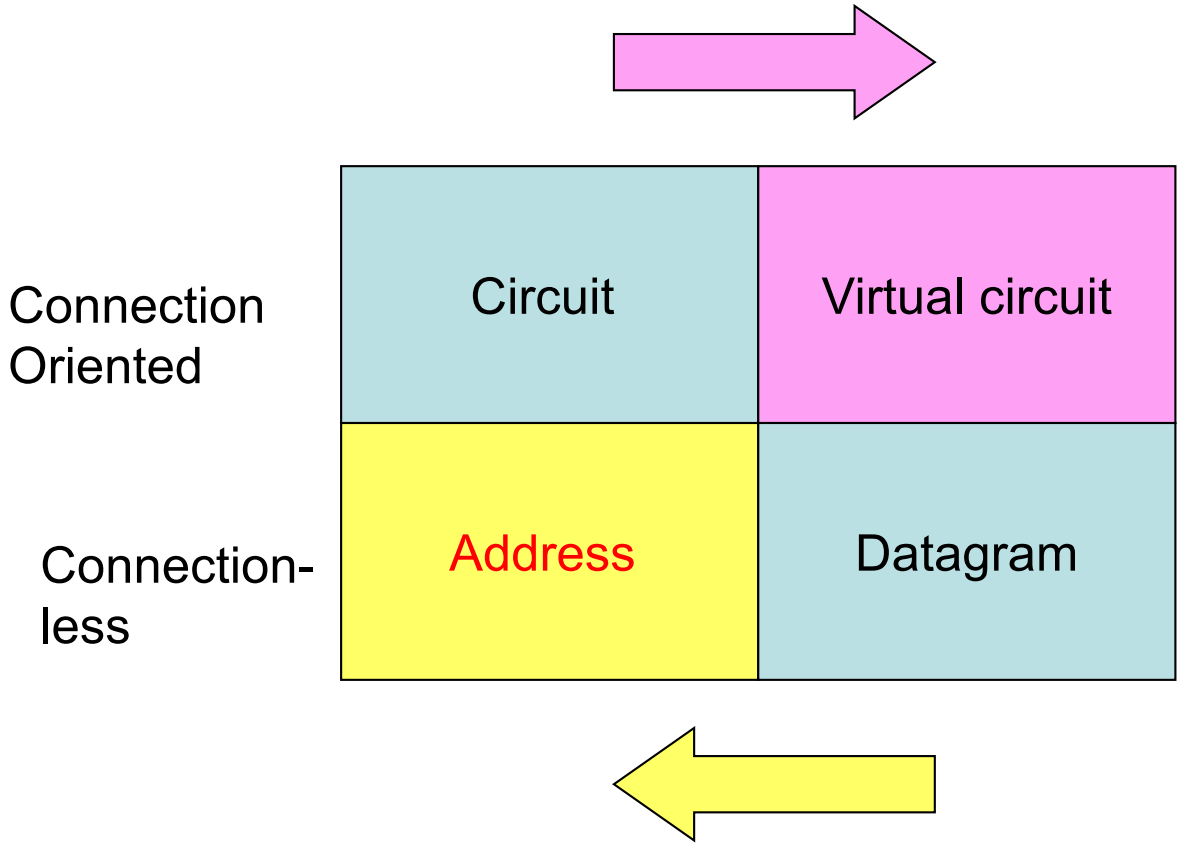




Switching technology

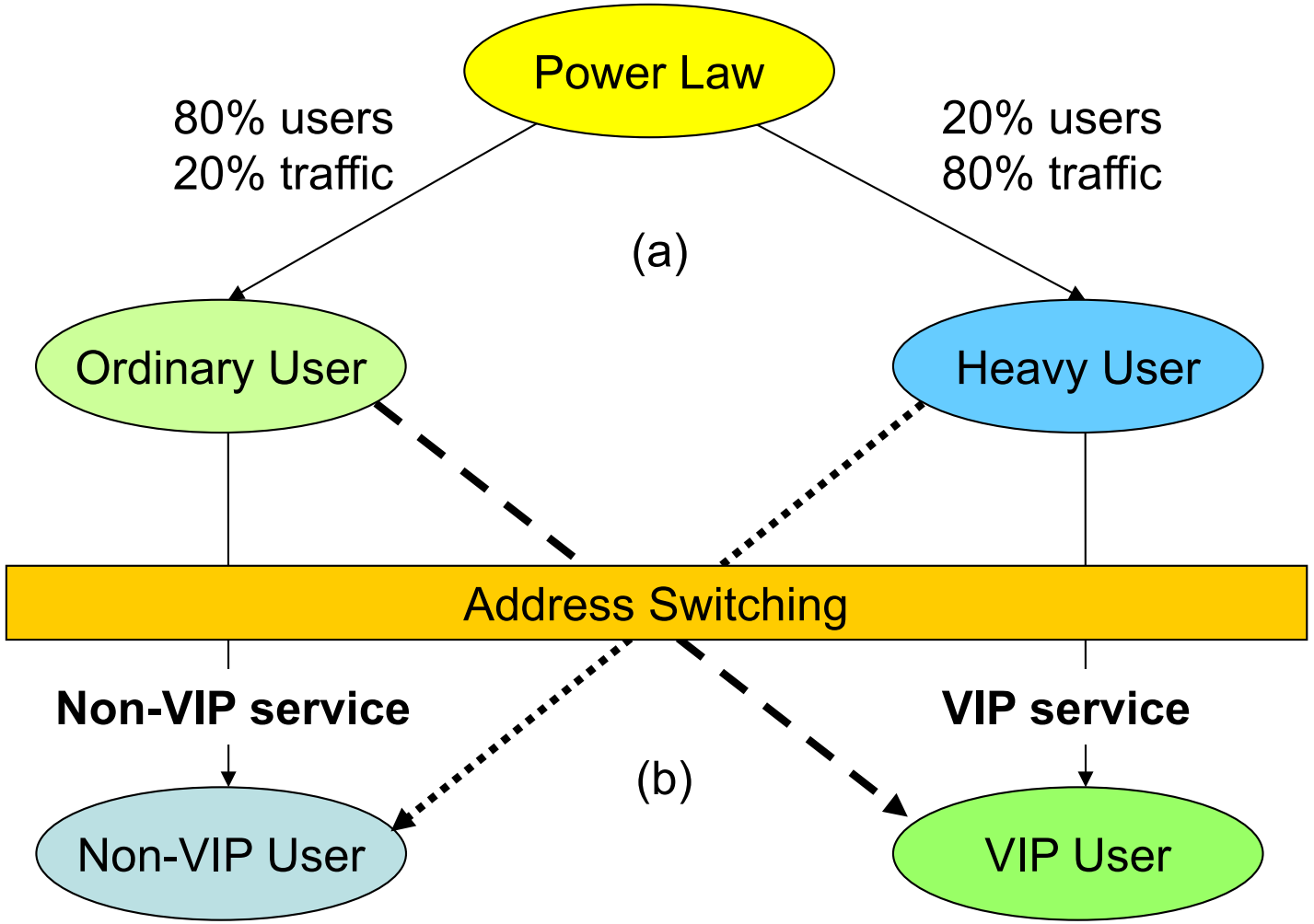


Switching technology

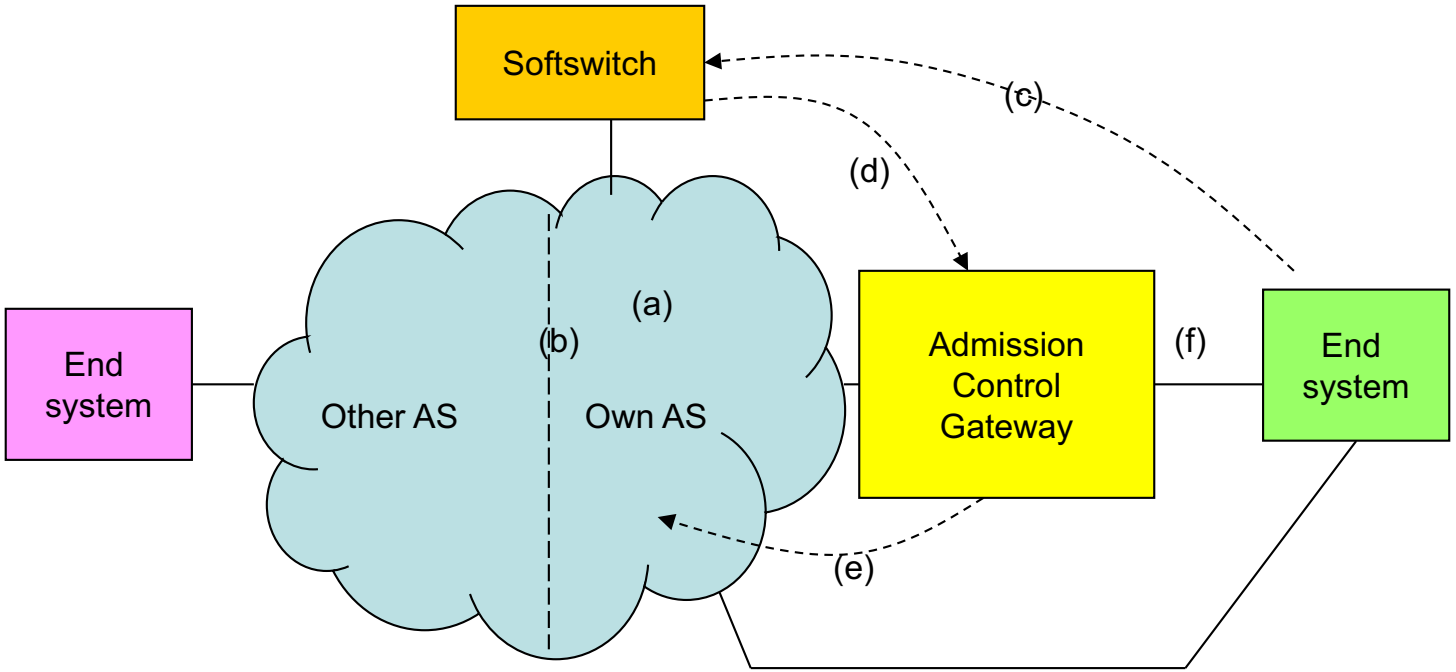


AaaS (Address as Service)

Address-switching concept

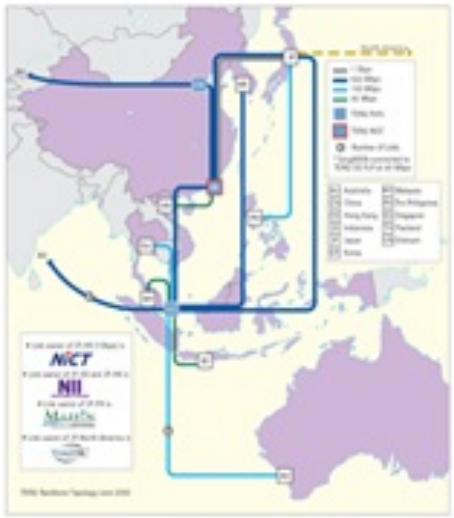


Address switching via BGP RR



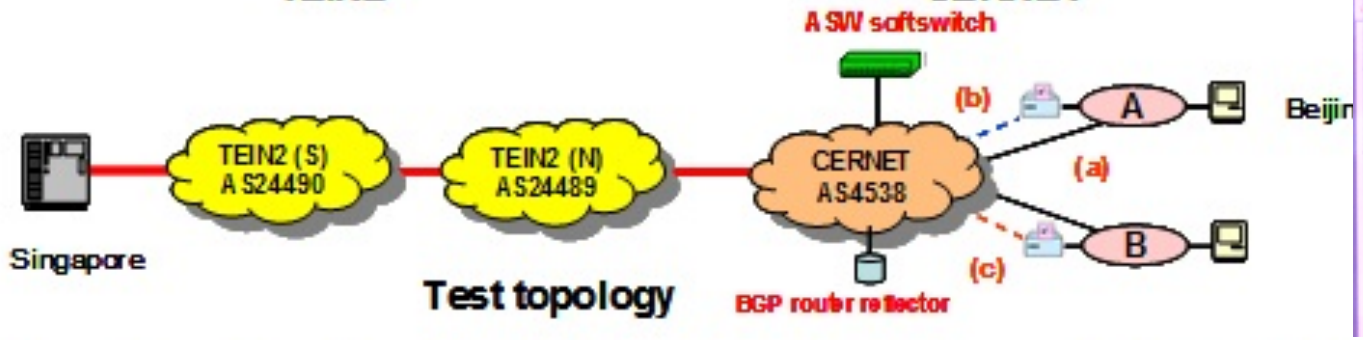
- Bandwidth is limited resource
- Reserve bandwidth per VIP address block
- Dynamic assign VIP address block with admission control

Example



TEIN2

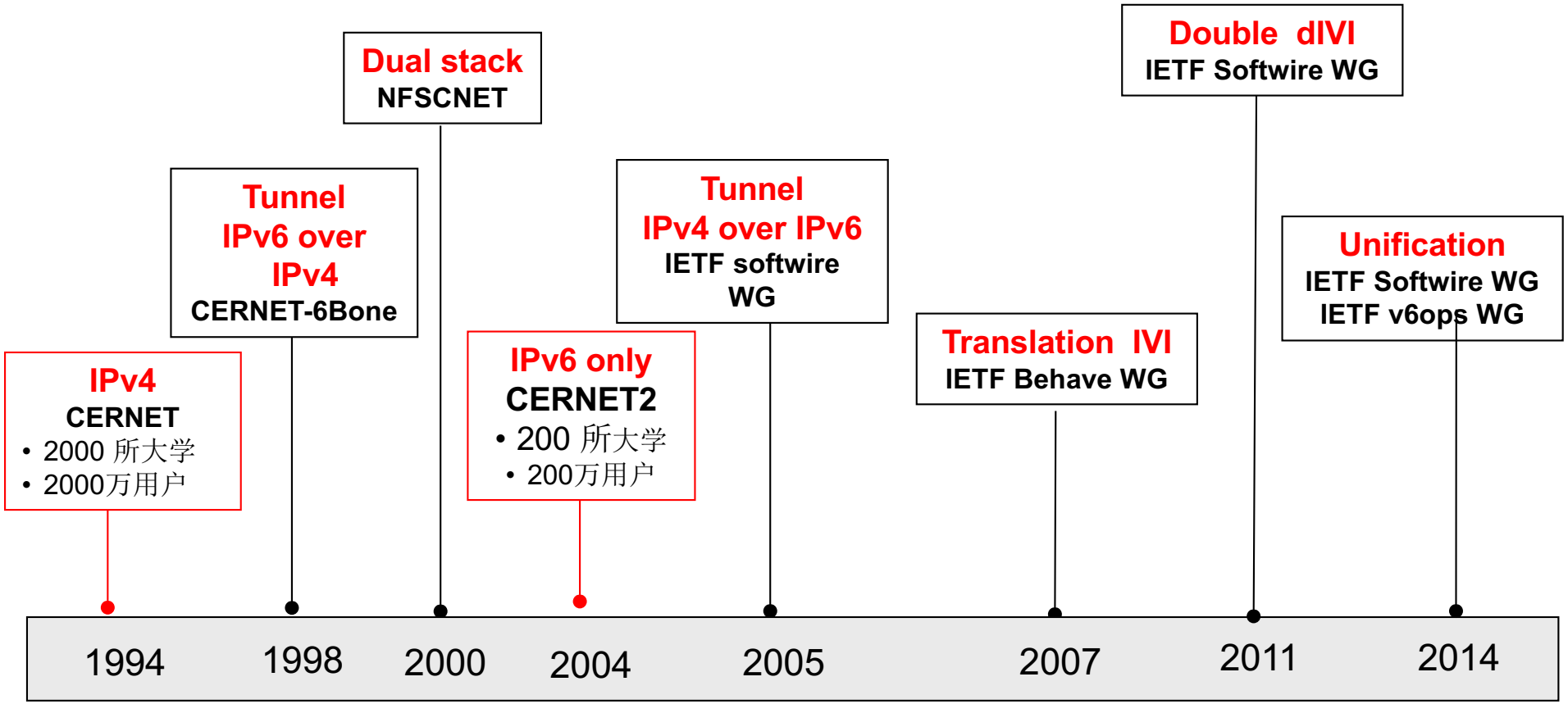
CERNET



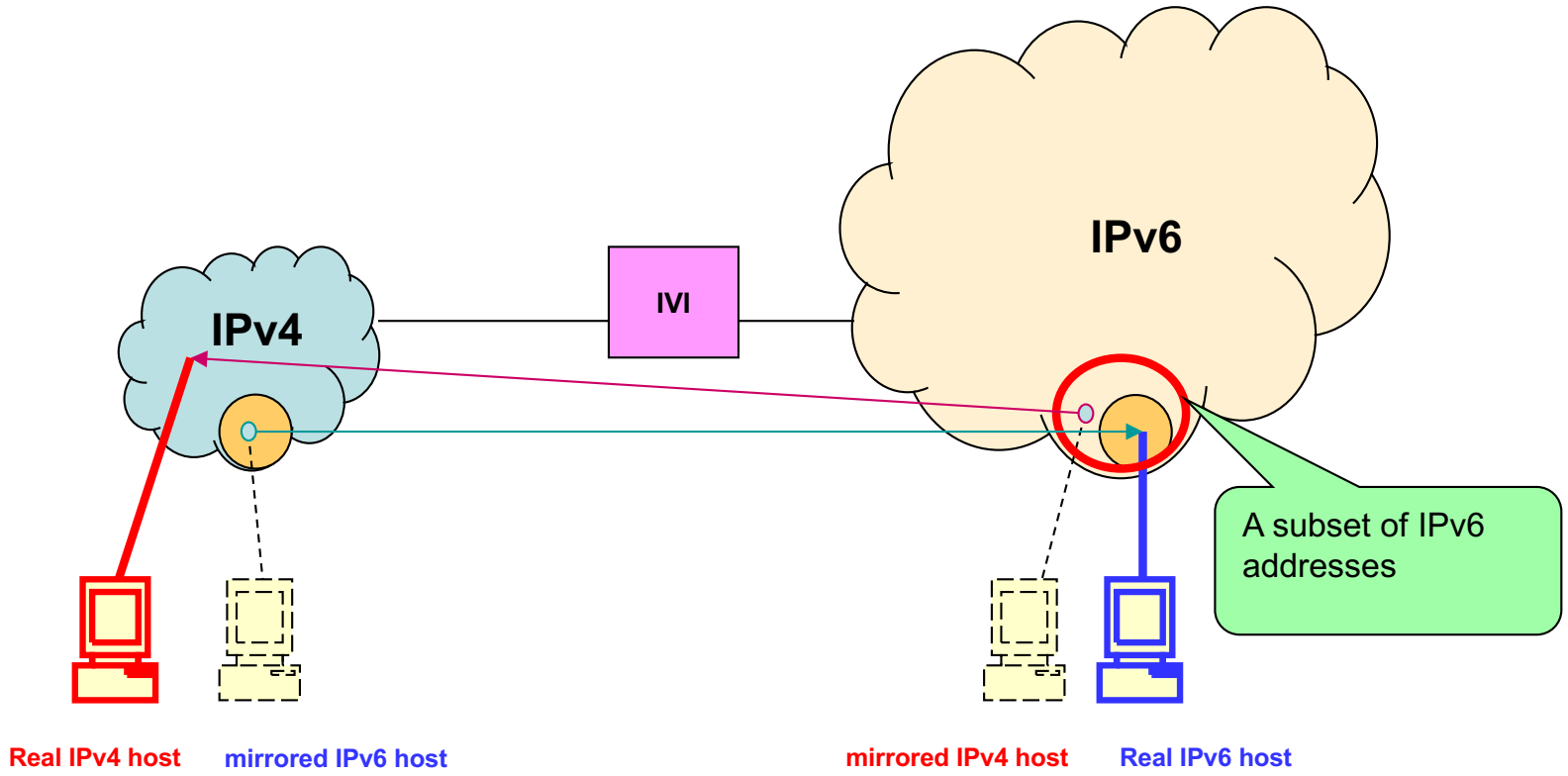
Beijin

http://www.address-switching.org/

CERNET IPv6 transition experience



Stateles translation concept

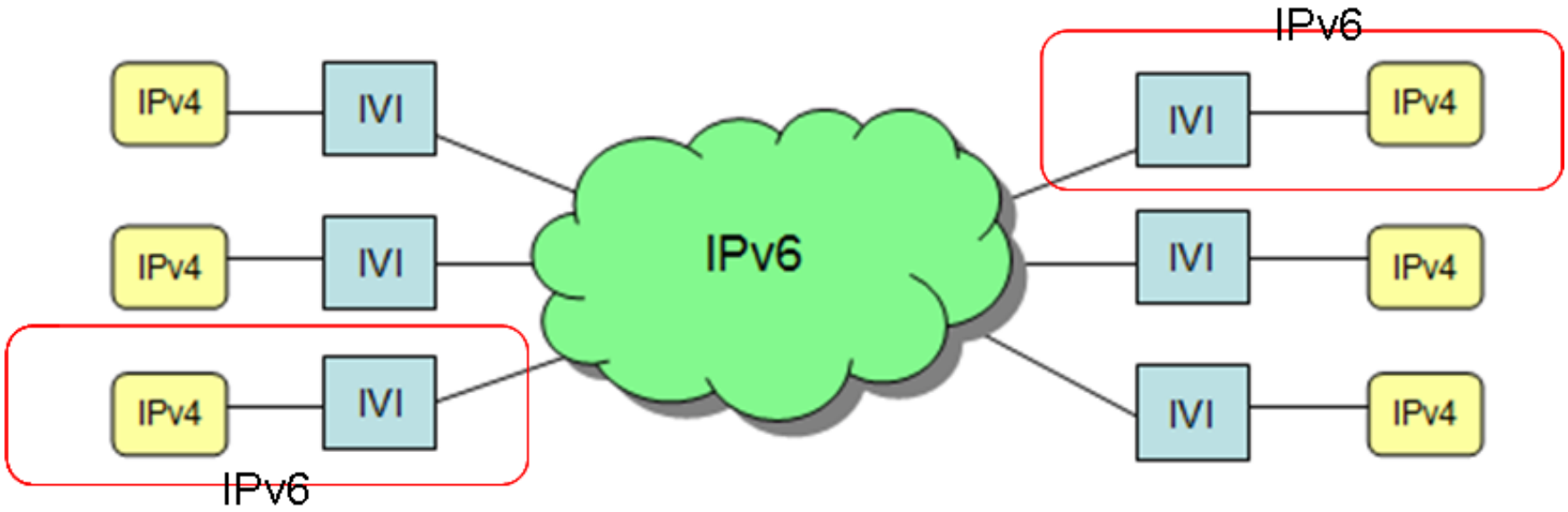


- IPv4/IPv6 translation makes IPv4 and IPv6 can communicate directly

Lessons learned

- The Internet could not have been so successful in the past years if IPv4 had contained any major flaw.
- The value of a network is proportional to the square of the number of connected users of the system (n2)
- Incremental deployment is required.
- Any problem in CS can be solved by adding a layer of indirection.

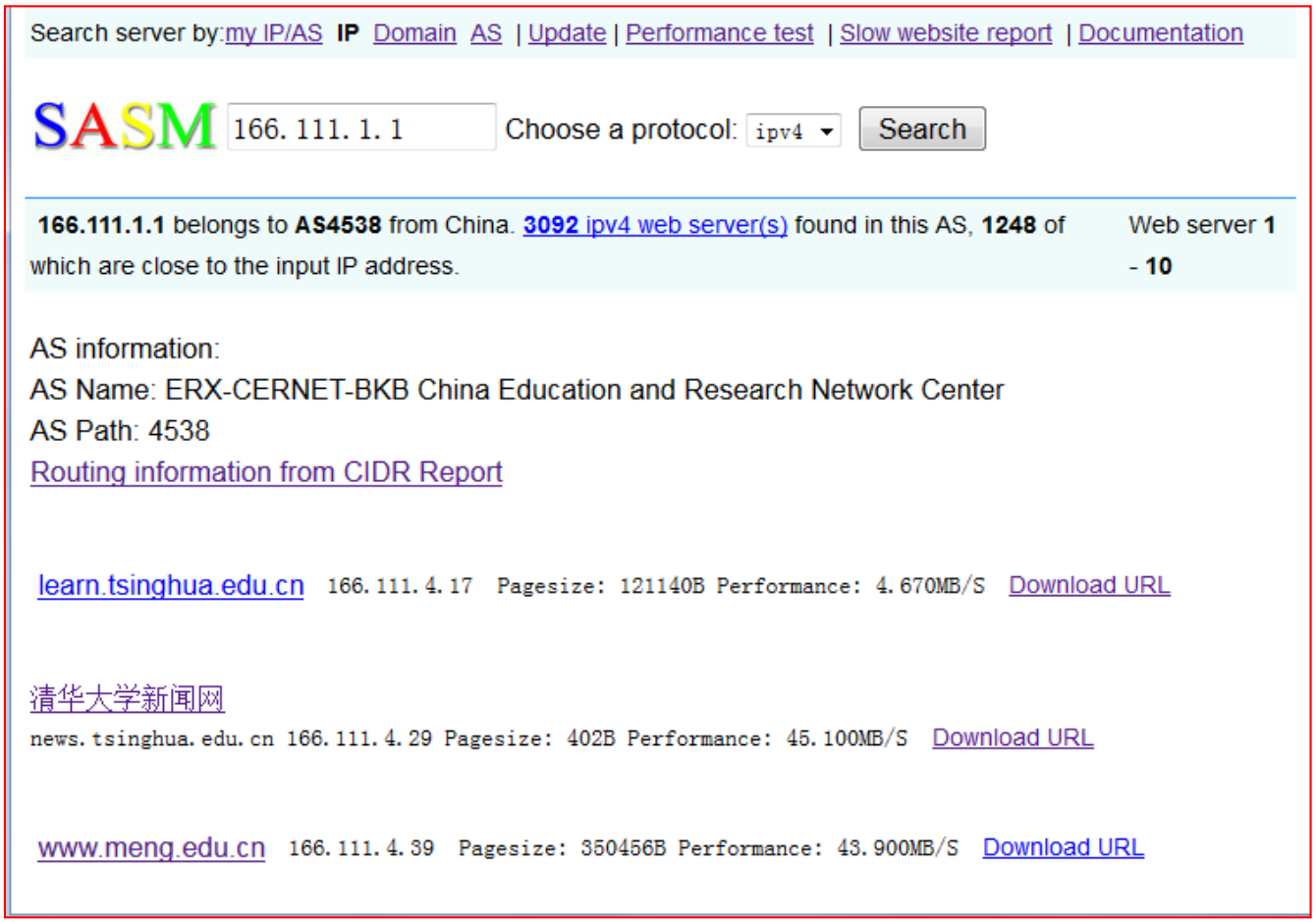
TE via IPv6



4aaS

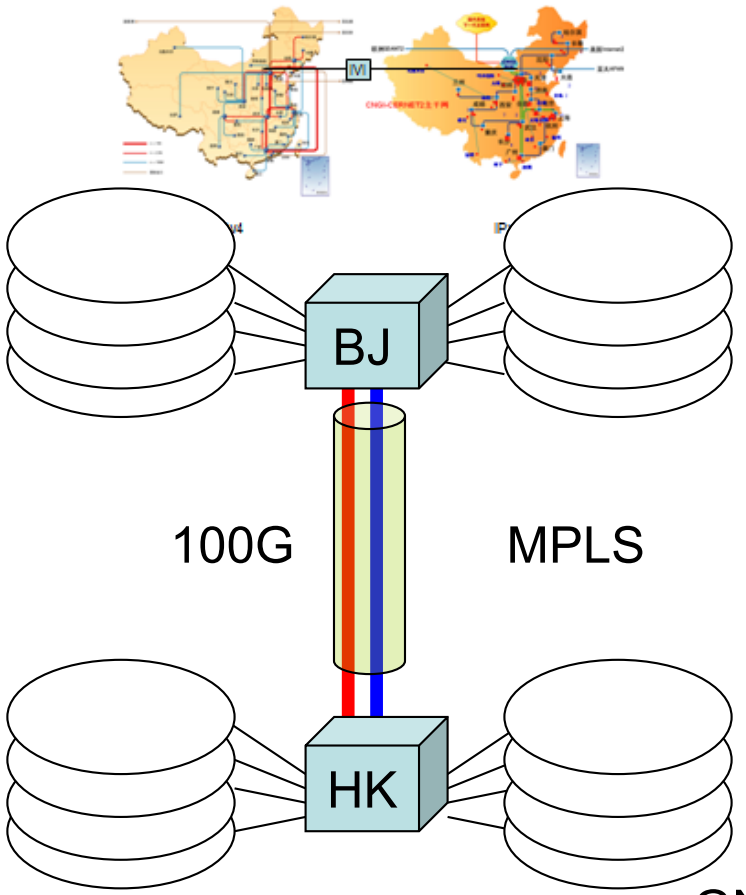
http://www.ivi2.org/

SASM



http://search.sasm3.net/

Beijing-Hong Kong 100G



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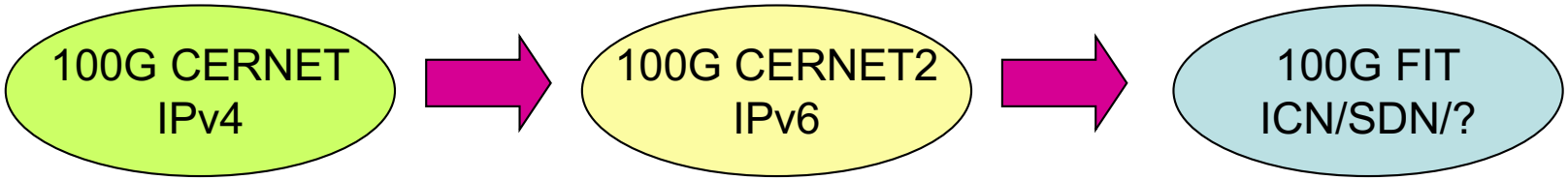
  - IPv6 BGP
  - IPv6 multicast SSM
- Layer 2
  - point-to-point
- Layer 3 VPN
  - BGP VRF
- SDN
- Address switching
- IVI
- SASM

Next steps



2013 2017 2018

Remarks

- 100G
- Keep the stateless nature of the Internet
  - Address switching
- Adding a layer of indirection
  - IPv6 and translation