IPv4/IPv6 transition experience and the features of stateless translation (IVI)

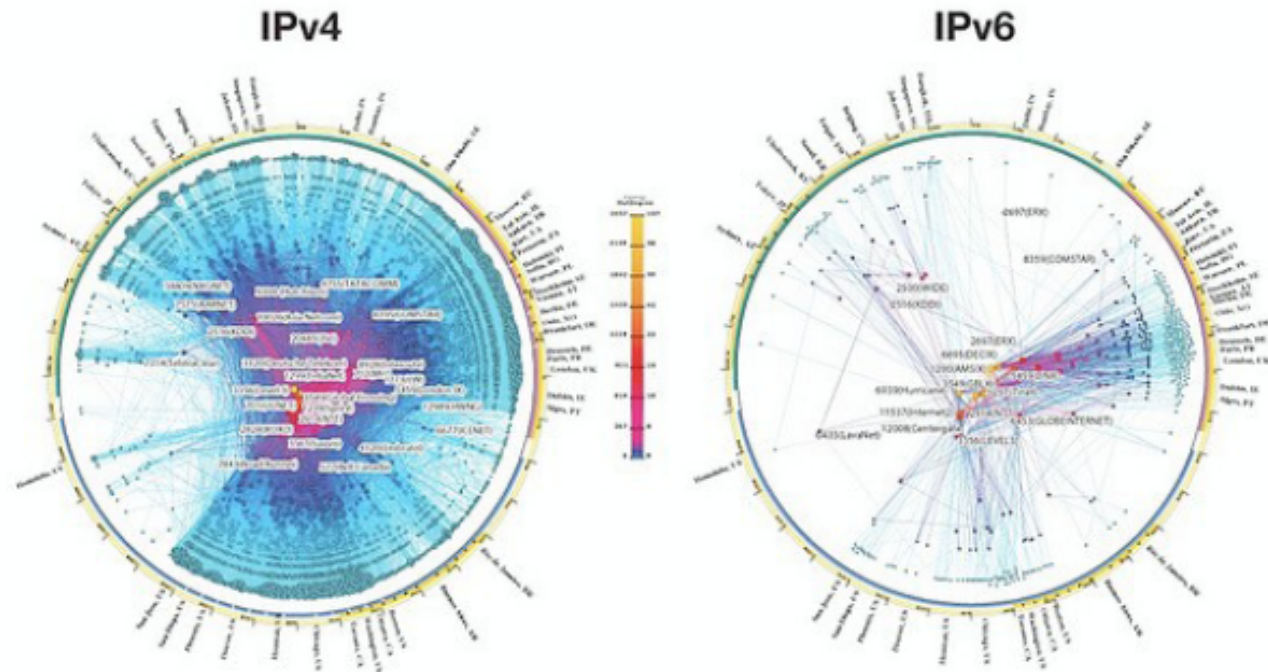Xing Li

2011-02-23

AS-level (1)

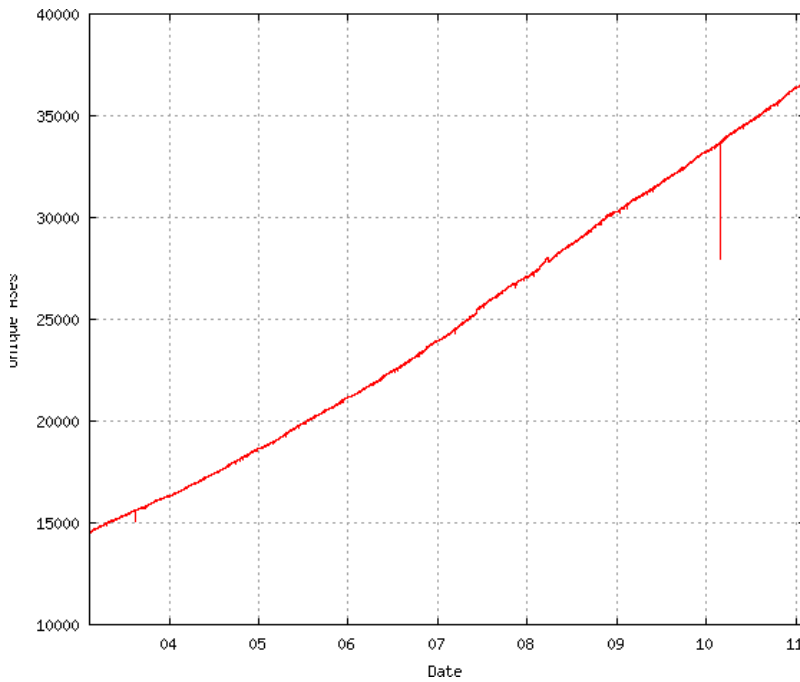IPv4 & IPv6
INTERNET TOPOLOGY MAP
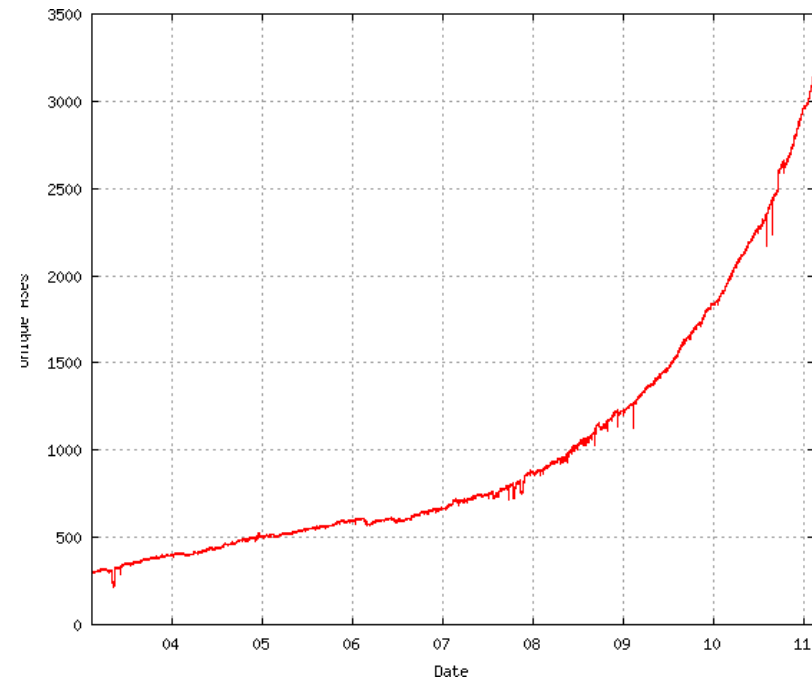JANUARY 2009

AS-level INTERNET GRAPH

IPv4

IPv6
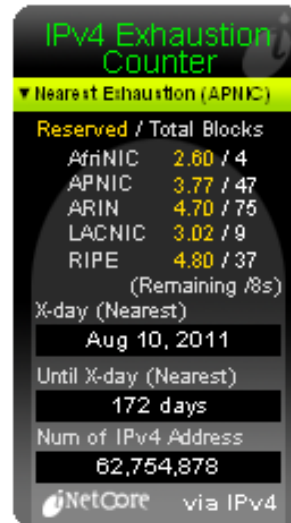
2

AS-level (2)

IPv4 AS count (35k)

IPv6 AS count (3k)

3

After IPv4 exhaustion

- **In 172 days**
  - **Increase AS number from 3K → 35K**
  - **Make 99% of the content IPv6 available**
  - **Mission impossible**

Ready and not ready
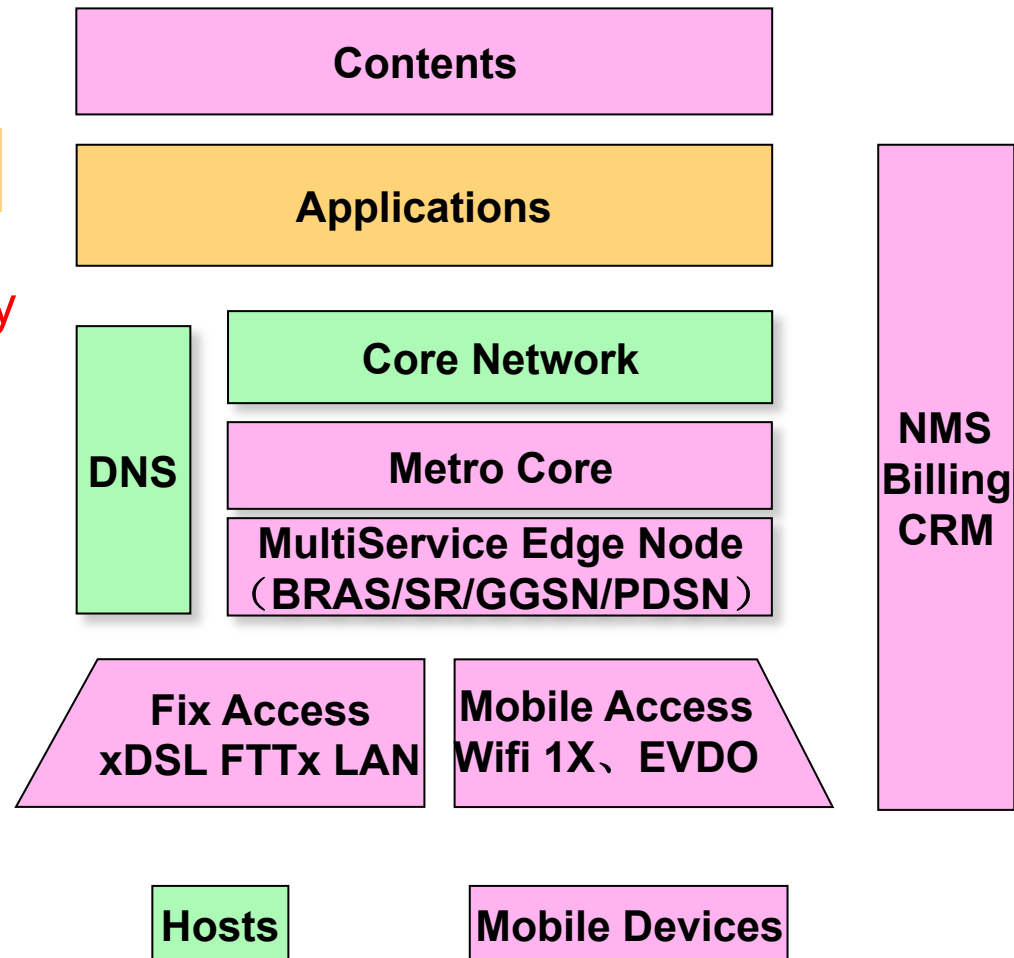
Contents: Not ready

Applications: Some is ready

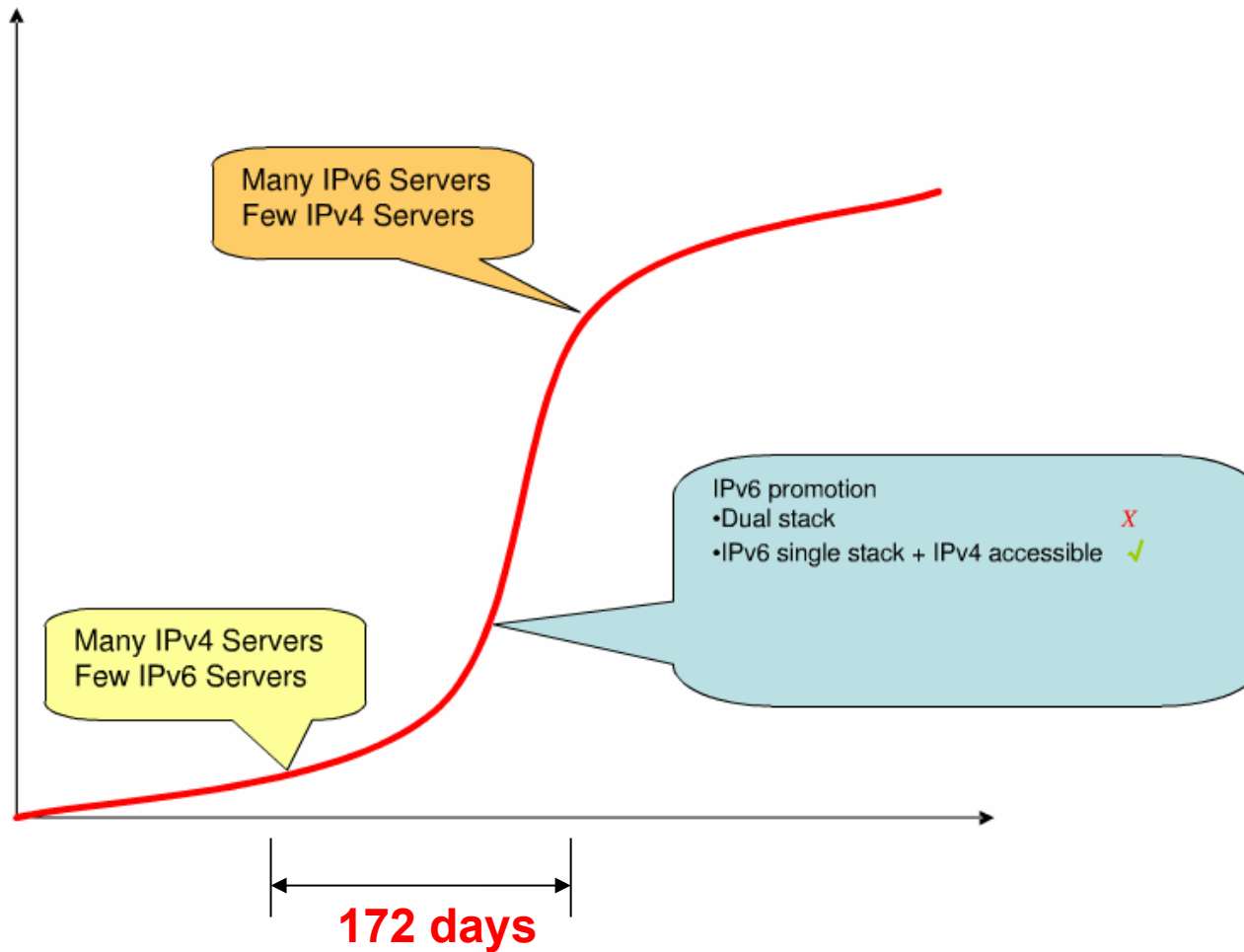NMS/Billing/CRM: Not ready

Core: Ready
DNS: Ready

Access: Not ready

Hosts: Most can be ready

Mobile Devices: Not ready

Contents

Applications

DNS

Core Network

Metro Core

MultiService Edge Node
（BRAS/SR/GGSN/PDSN）

NMS Billing CRM

Fix Access xDSL FTTx LAN

Mobile Access Wifi 1X、EVDO

Hosts

Mobile Devices

5

# IPv6 S curve

Who will be mostly affected

- The existing IPv4-only users
  - They are happy now, until there are IPv6-only content/users
  - Upgrade to dual stack is not very urgent
  - Upgrade to dual stack should not degrade their experience

- The new users
  - They do NOT accept the service if they cannot access the global IPv4 Internet.
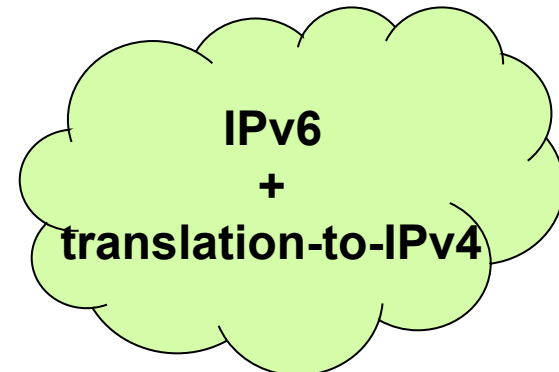
SP should make a decision in 172 days

(IPv4+NAT44)

NAT444

(IPv4+NAT44)
+
IPv6
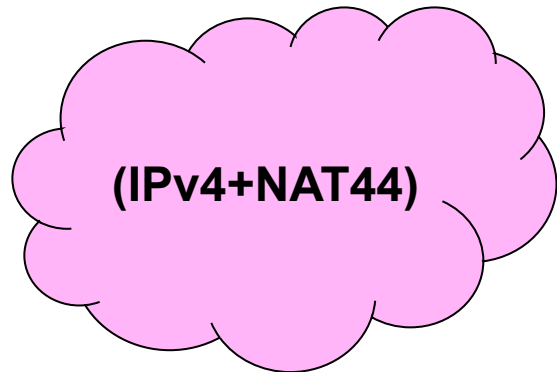
Dual-tack Lite
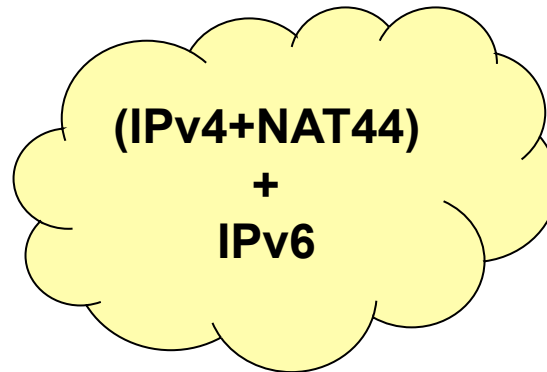
IPv6
+
translation-to-IPv4

IVI, NAT64

IPv4/IPv6 transition standard roadmap

Solution	Standard /Draft	Standard roadmap	note
IVI (stateless)	**RFC6052*** (addr-fmt), **RFC6144*** (framework), **RFC6145*** (xlate), **RFC6147** (dns), ivi*, [in IETF-editor queue]	Est. Mar, 2011	IETF behave WG
NAT64 (stateful)	**RFC6052*** (addr-fmt), **RFC6144*** (framework), **RFC6145*** (xlate), **RFC6146** (stateful), **RFC6147** (dns)	Est. Mar, 2011	IETF behave WG
Dual Stack lite	Dual-stack-lit-06 [AD Evaluation::Revised ID Needed]	Est. Q2, 2011	IETF softwire WG
6RD	**RFC5969**	Aug, 2010	IETF softwire WG
NAT444	nat444-03	Est. Unknown	Not in IETF WG

* CERNET authors/co-authors
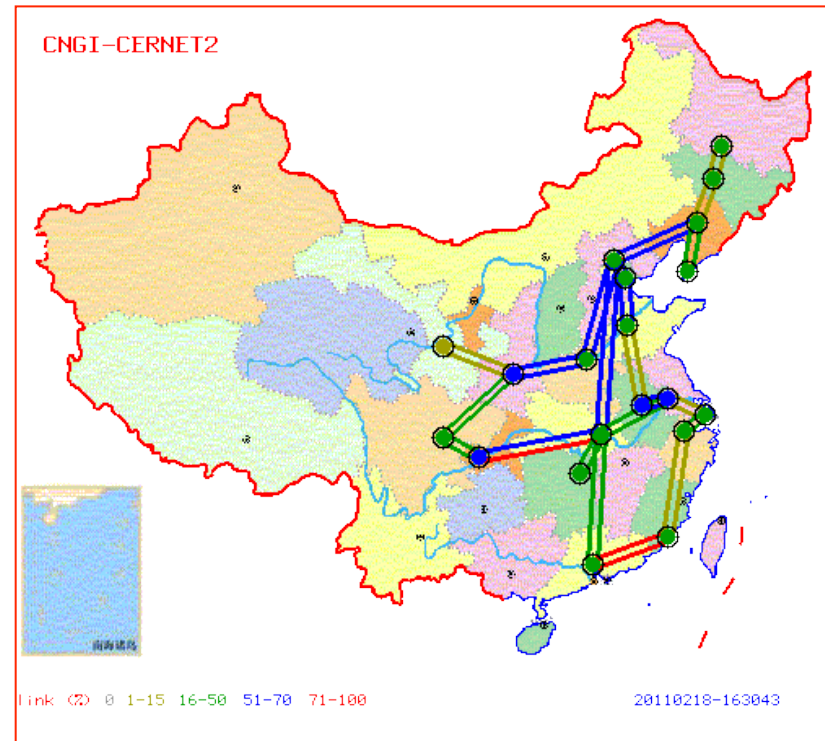
If IPv6 is so great, how come it is not there yet?

- Applications
  - Need upfront investment, stacks, etc.
  - Similar to Y2K, 32 bit vs. "clean address type"
- Network
  - Need to ramp-up investment
  - No "push-button" transition
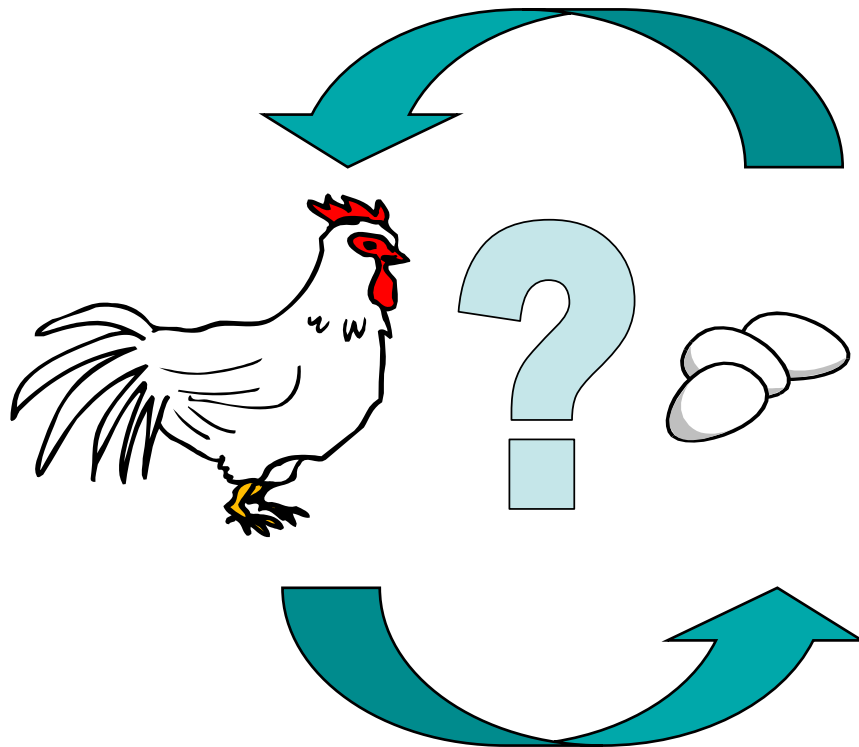
- **IPv4 exhaustion does not change this**
  - **NAT44 vs. IPv6**

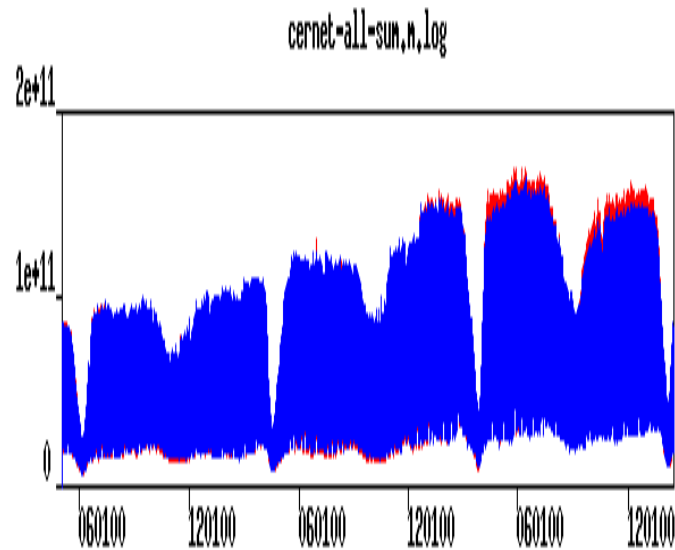# CERNET and CERNER2
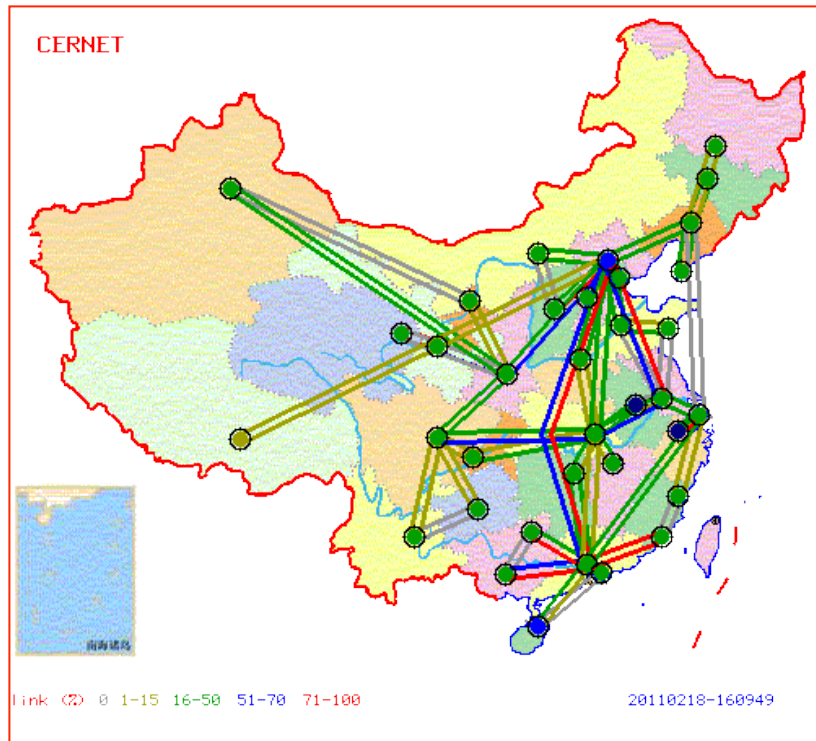
IPv4
2,000 Universities
25,M Users

IPv6-only
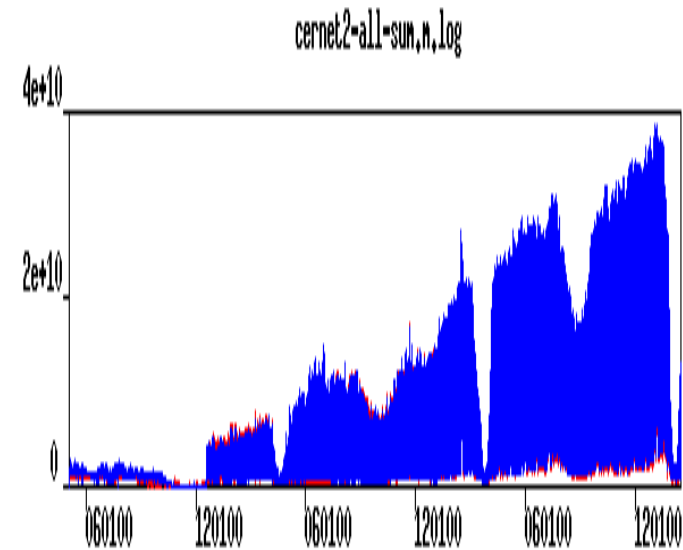200 Universities
2M Users

To encourage transition

- CERNET (IPv4)
  - Congested and charged.
- CERNET2 (IPv6)
  - Light loaded and free of charge.

- So, for using high quality and free network, port your application to IPv6.

IPv4 and IPv6 traffic

IPv4

IPv6

- **CERNET IPv6' traffic is about 20% of IPv4**

So what are IPv6 traffics

- Mostly video

- Anything which cannot be accessed via IPv4

- If both IPv4/IPv6 are available, the users prefer to use IPv4 (better experience)

- Except EE and CS students

When will be the X'-day?

- We have asked our customers
  - Can we turn off CERNET (IPv4) and only provide CERNET2 (IPv6) services?
  - The answer is absolutely NO! If there is a single IPv4-only content in the global Internet, we can not turn off IPv4.
- We have almost reached X-day (IPv4 address depletion)
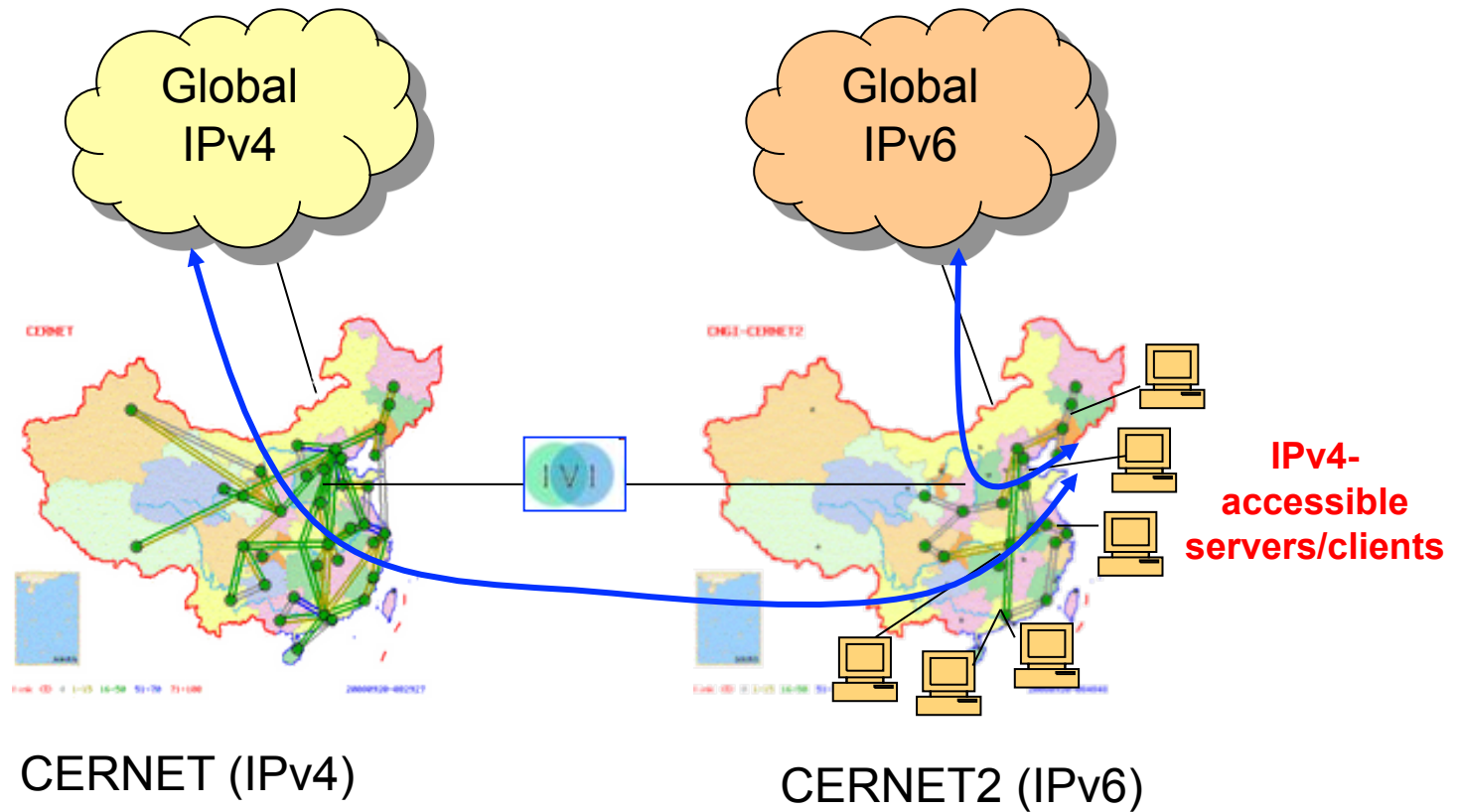- When will be the X'-day (turn off IPv4)?

The killer application

- Video?

- P2P?

- Internet of Things?

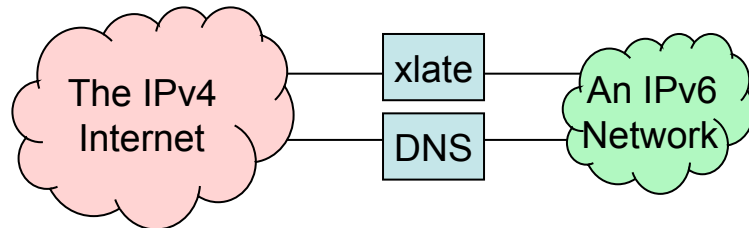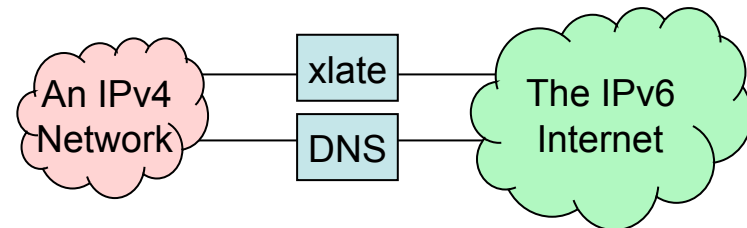- The intercommunication with the IPv4 Internet is the killer application of IPv6.
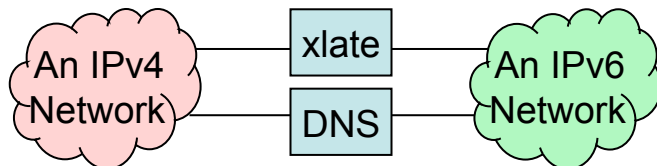
We invented IVI

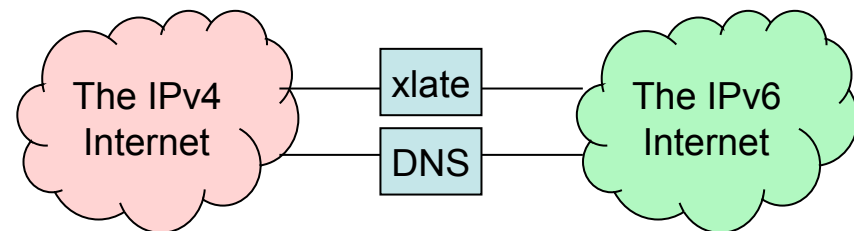CERNET (IPv4)   CERNET2 (IPv6)

Translation scenarios

IVI { Scenario 1 "an IPv6 network to the IPv4 Internet" **< NAT64**
     Scenario 2 "the IPv4 Internet to an IPv6 network"

Scenario 3 "an IPv4 network to the IPv6 Internet" **< NAT64**
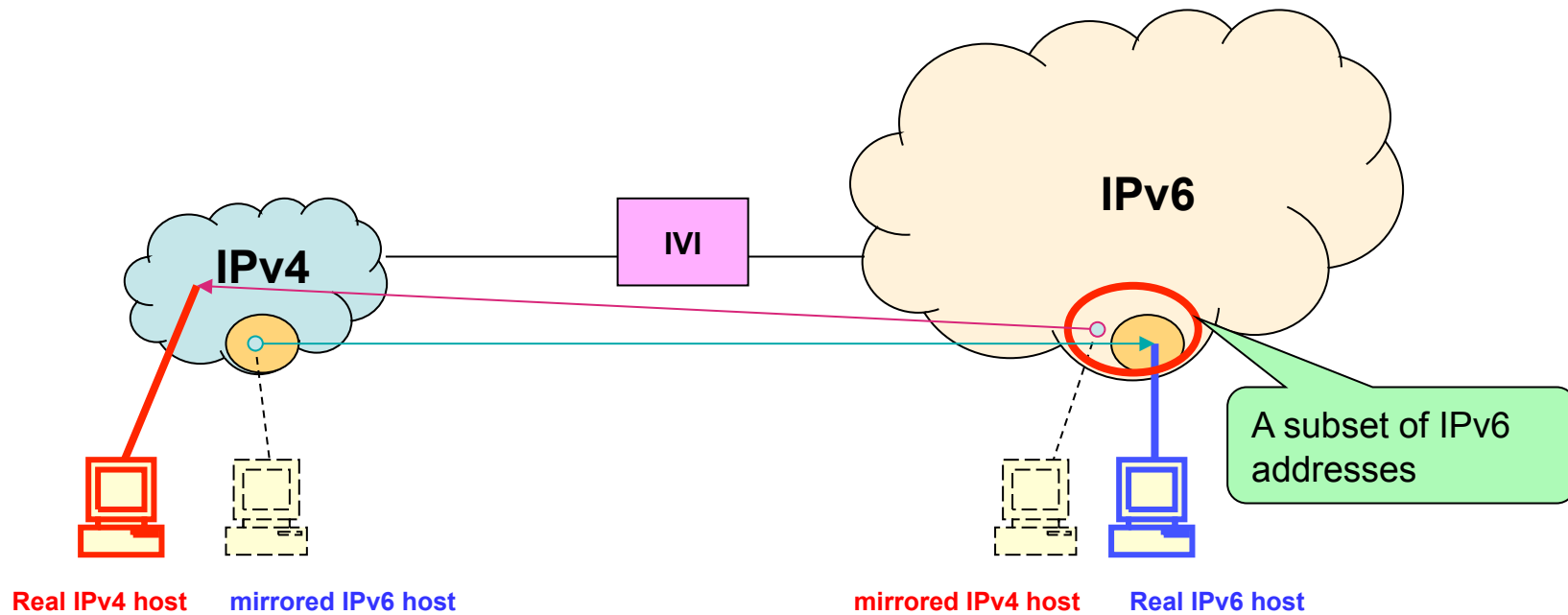Scenario 4 "the IPv6 Internet to an IPv4 network"

IVI { Scenario 5 "an IPv6 network to an IPv4network" **< NAT64**
     Scenario 6 "an IPv4 network to an IPv6 network"

Scenario 7 "the IPv6 Internet to the IPv4 Internet"
Scenario 8 "the IPv4 Internet to the IPv6Internet"

Stateless translation (IVI)

IPv6

IPv4

IVI

A subset of IPv6 addresses

Real IPv4 host   mirrored IPv6 host

mirrored IPv4 host   Real IPv6 host

A subset of IPv6 addresses

www.ivi2.org

1:N IVI

- If R=256
- A /24 is equivalent to a /16

1:N dIVI
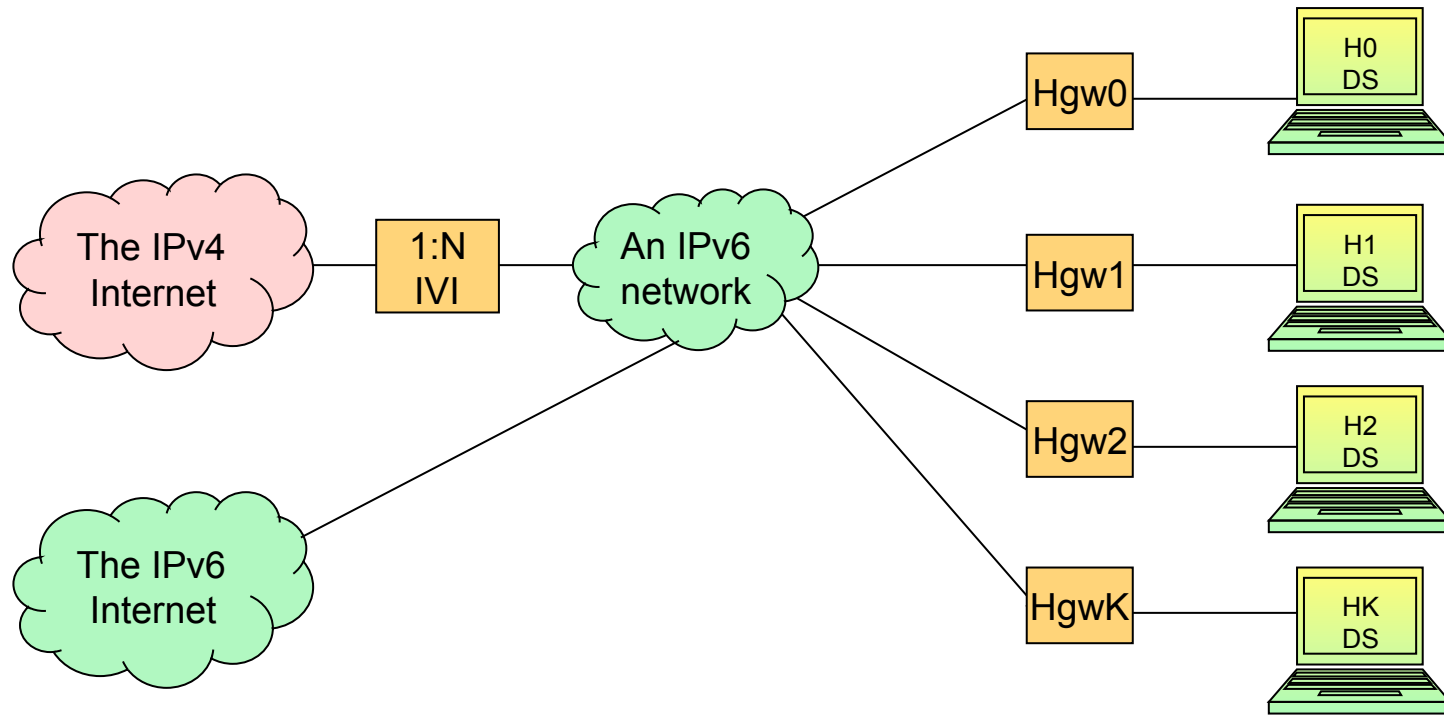
Make things easy and simple

- Service Continuity
  - Only upgrade core network to dual stack
  - Keep the existing IPv4 access network running as usual
- Minimal customer Impact
  - Deploy IPv6-only data center with 1:1 IVI to move content to IPv6 without loosing the IPv4 users
  - Deploying new IPv6-only access network with 1:N double IVI for new customers using shared IPv4 addresses
- Incremental investment
  - Incremental deployment with direct returns.

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Remarks (1)

- Dual stack and tunnel are coexistence technologies
  - 10 year experience indicates that we have not achieved transition via dual stack and tunnel
- Let's try translation now
  - We need a single Internet, not two Internets (IPv4 and IPv6)
  - Due to the long tail, the transition cannot be achieved in short time

Remarks (2)

- The competition is what type of translation technologies we will use

- Translation between
  - IPv4 and RFC1918

- Translation between
  - IPv4 and IPv6

25
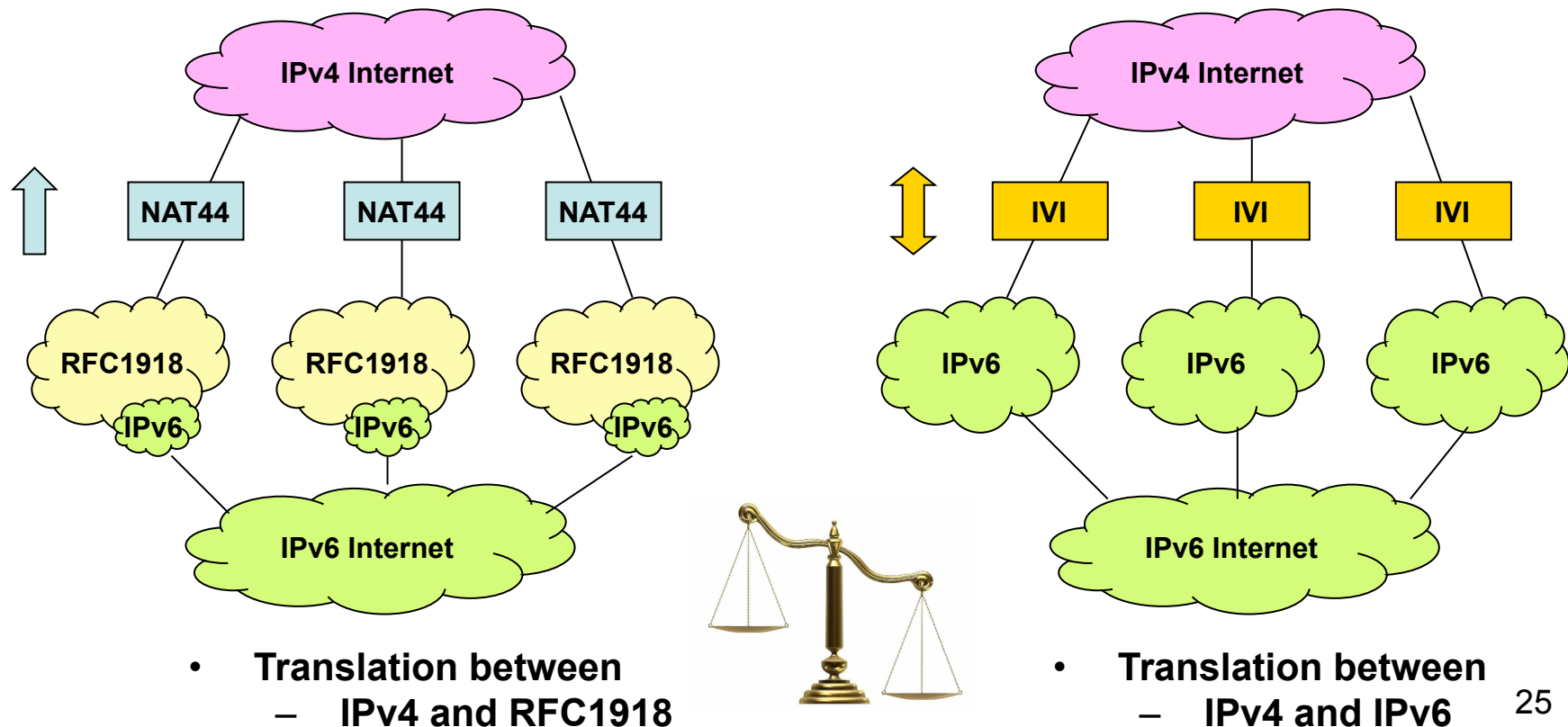
Conclusions

- IPv6 is the right direction and it works
  - A lot of addresses
  - End-to-end address transparency
- IPv6 is not easy – the rest of users and contents may still use IPv4
  - Service Continuity
  - Minimal customer Impact
  - Incremental investment
- The universal connectivity is the fundamental requirement for using Internet
  - Translation

IVI IPv4/IPv6 transition

IPv4 ⟩ Transition ⟩ IPv6

IPv4 area | IPv6 area

Service

| Support IPv4 | → | Support IPv6 (IVI) | Support IPv6 (non-IVI) |

Network

V4 only Network | V6 only Network

IVI

User

| Support IPv4 | → | Support IPv6 (IVI) | Support IPv6 (non-IVI) |