The Transition to IPv6 - the operation experiences and the prospective

Xing Li,

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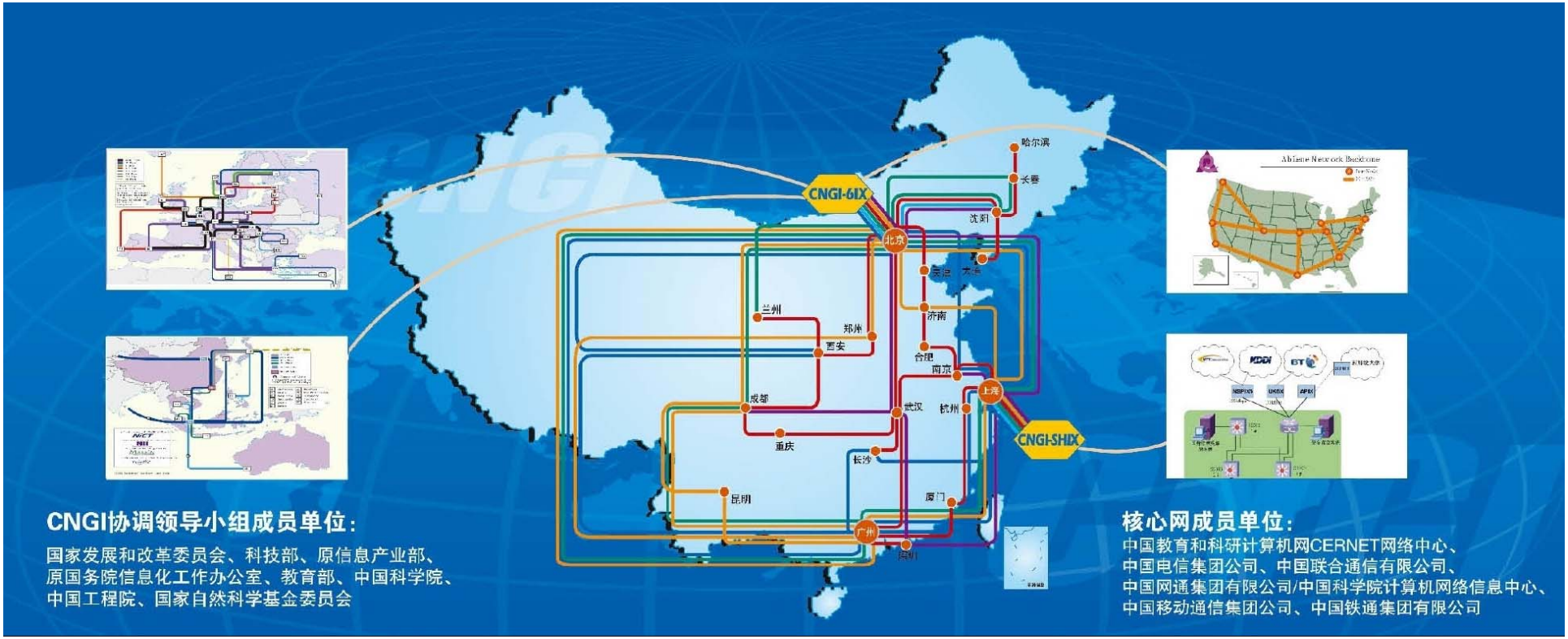
Outline

- Introduction
  - History
  - Operation experiences
- The Transition to IPv6
  - IPv6 only backbone
  - IPv4 over IPv6 transport
  - IVI translation
- Remarks
  - The IPv6 killer application

CERNET IPv6 history

- May 3, 1998, IPv6 on FreeBSD at Tsinghua University
- Sept. 1998 first BGP4+ peer to Sprint (MRTd)
- Nov. 1998, First 6Bone backbone node in China
- Mar., 2000 IPv6 BBS--6th Galaxy opened
- April 26, 2000 obtained sTLA (2001:250::/35) from APNIC
- Aug., 2000《IPv6原理与实践》published
- Sep. 25, 2000 CERNET joined IPv6 Forum
- Jan. 2002 DRAGONTAP IPv6 IX is running
- Jun. 2002 NSFCNET double stack is running
- Sept. 2003 CNGI-CERNET2 test nodes are running

Globe Connectivity of CNGI

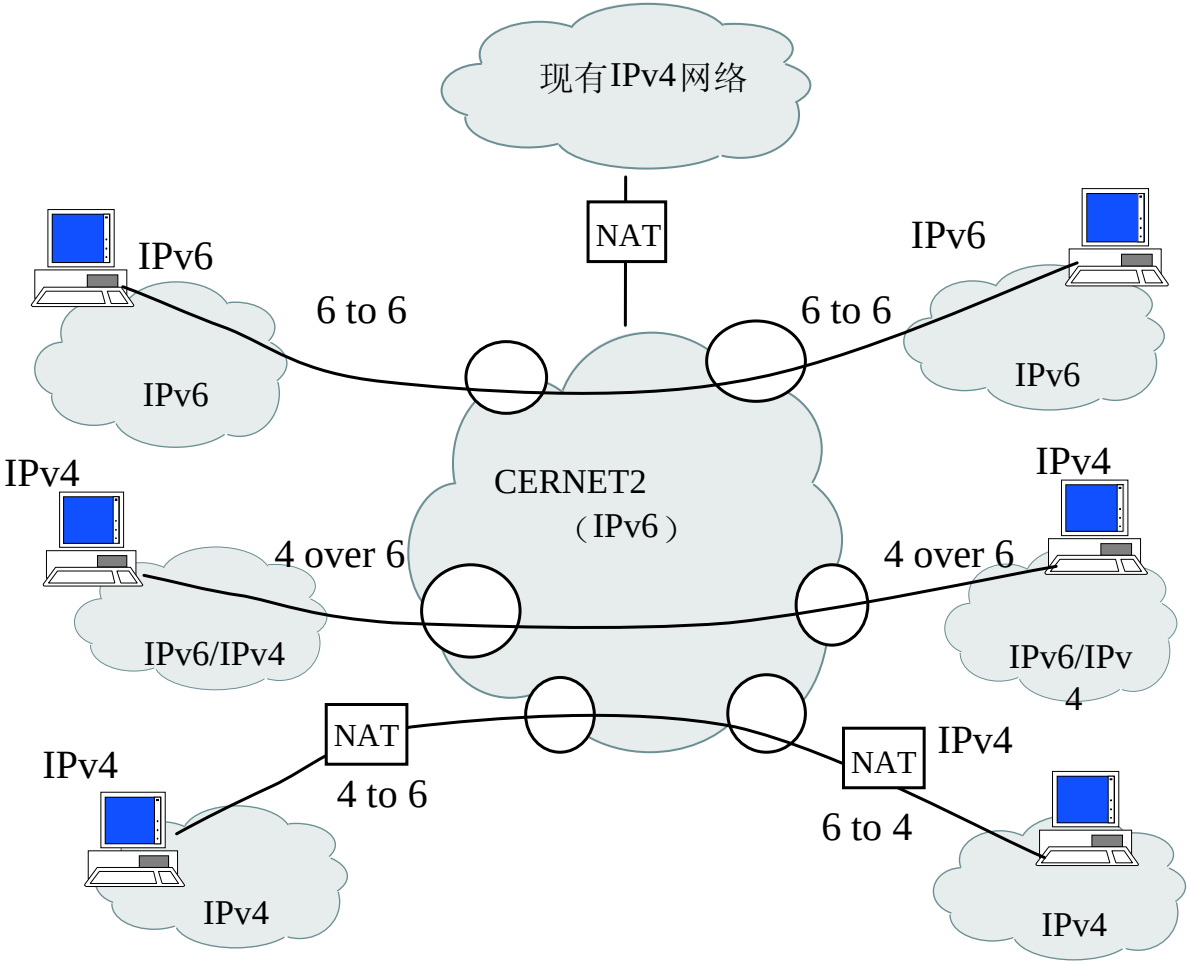


CNGI-CERNET2

Be unique, be different

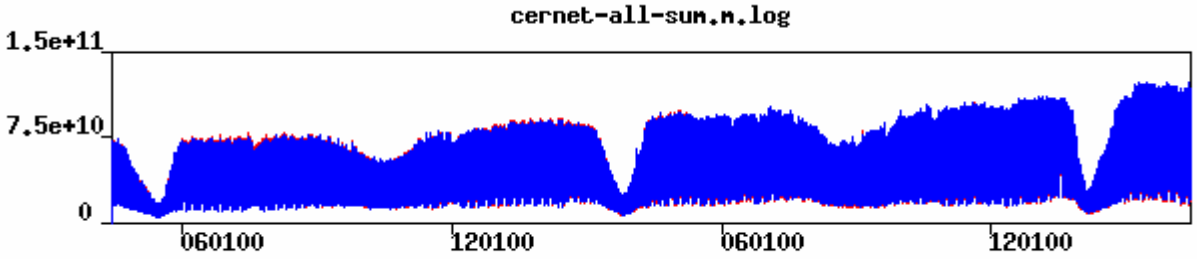
- Protocol selection
  - Rest of the world: Dual stack
  - **CERNET2: Pure IPv6**
- Equipment
  - Rest of the world: Single vendor
  - **CERNET2: Multiple vendors**
- Complexity
  - Rest of the world: Single AS
  - **CERNET2: Multiple AS**
- Transition
  - Rest of the world: IPv6 over IPv4
  - **CERNET2: IPv4 over IPv6 (IETF softwire), IVI (IETF behave)**
- Architecture
  - Rest of the world: HOPI/GENI/etc
  - **CERNET2: Authentic IPv6 address (IETF savi)**

CERNET2 Access

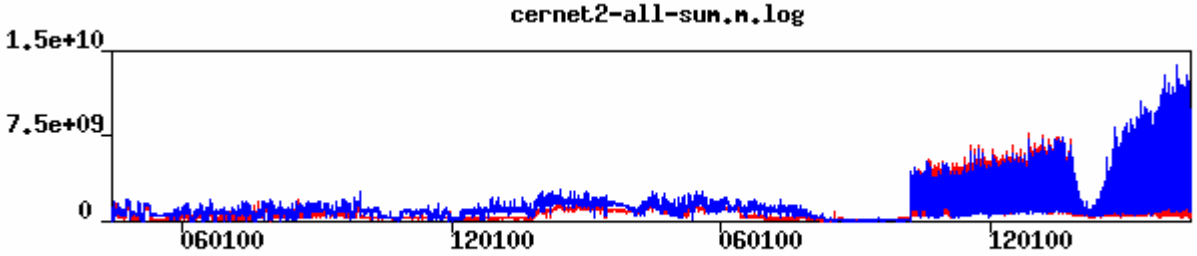


Traffic comparison

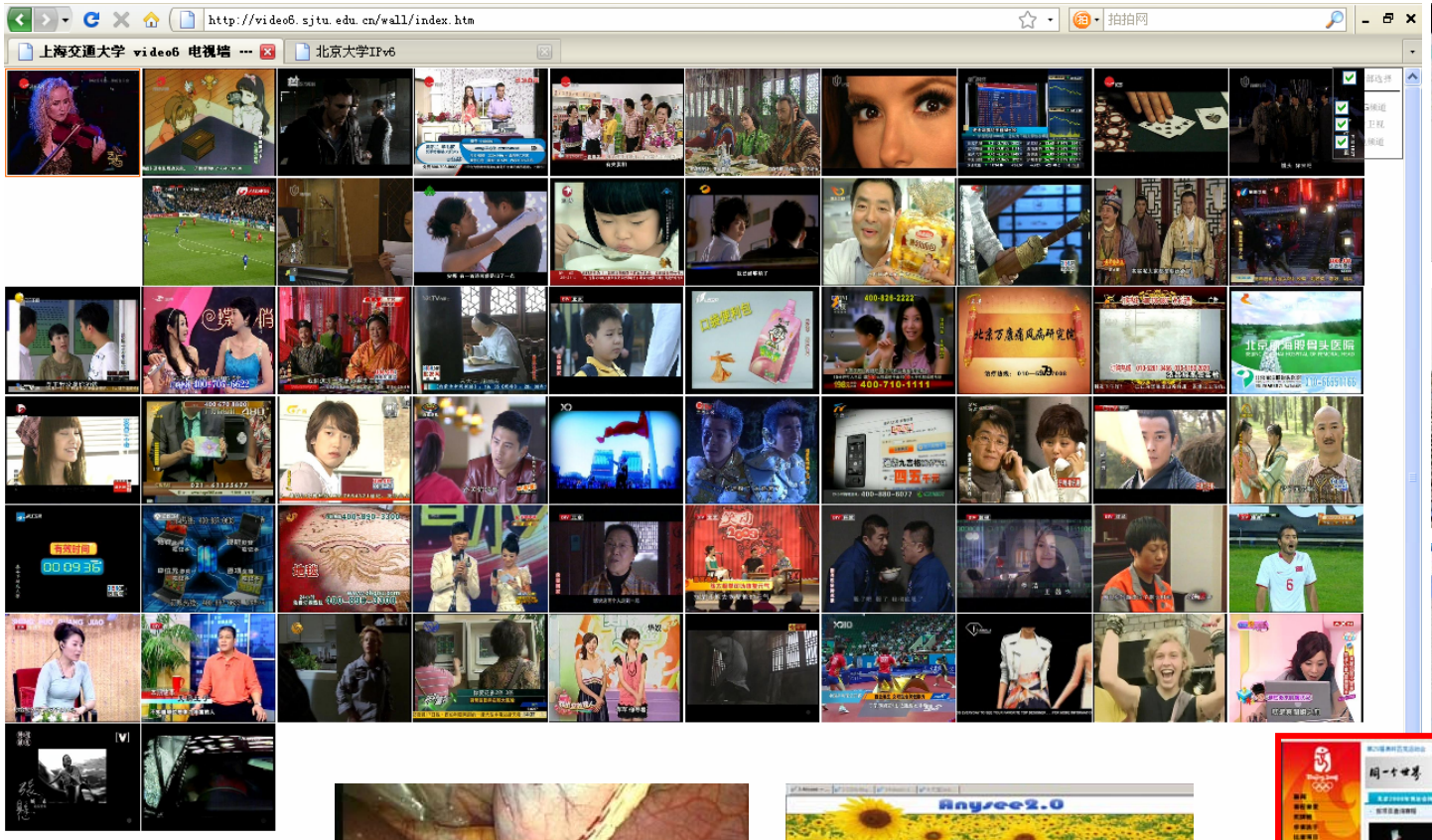
IPv4

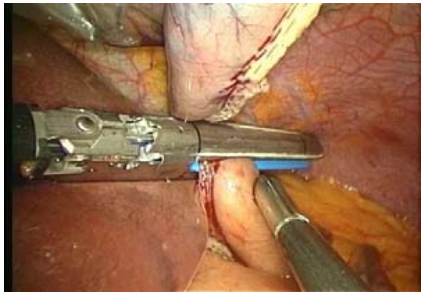


IPv6



IPv6 Applications

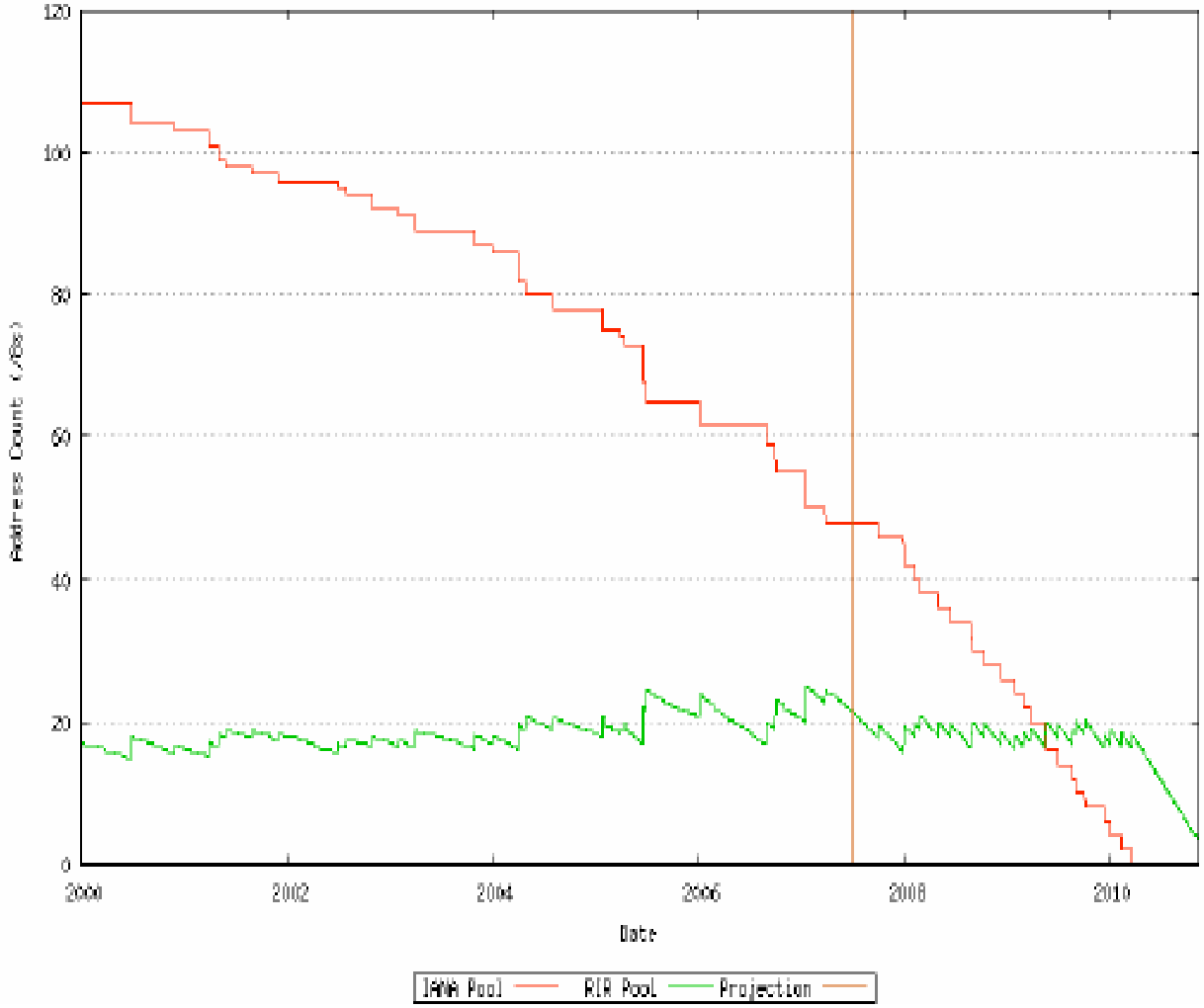




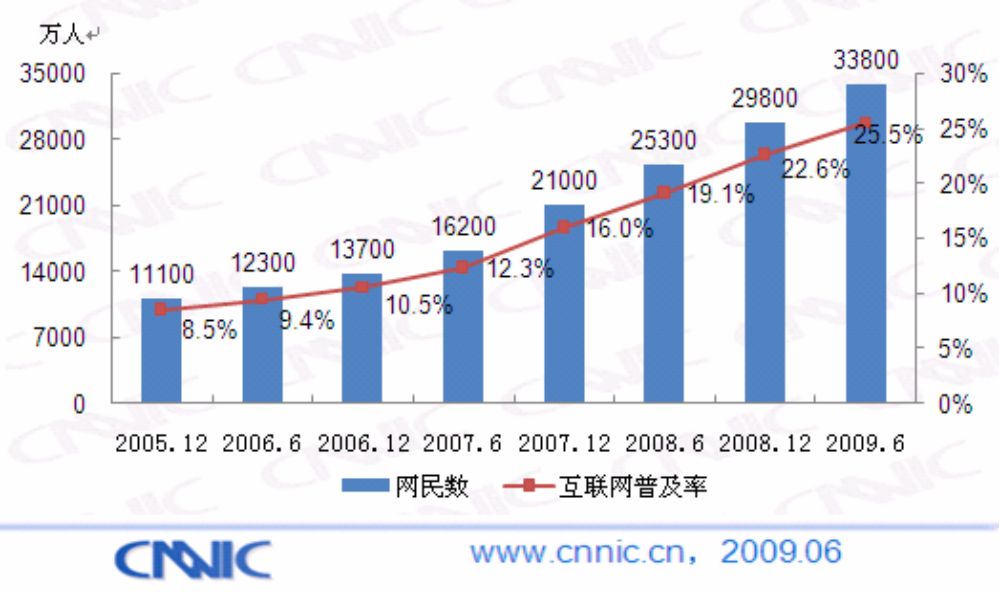
The transition to IPv6

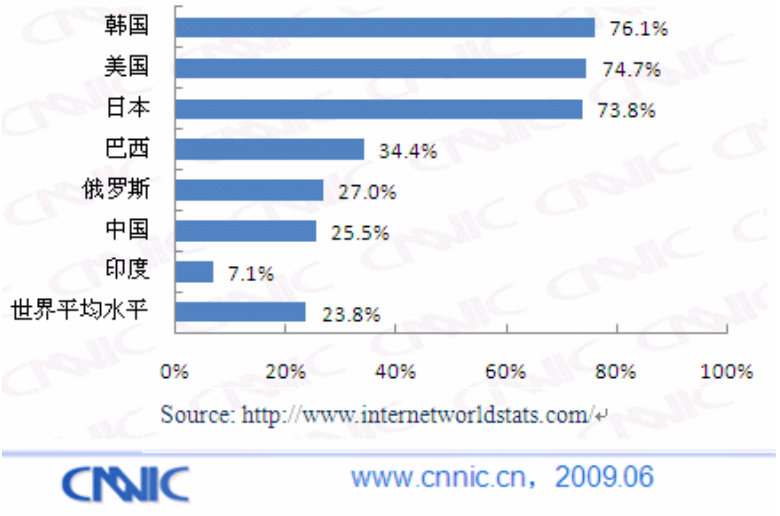
- IPv4 address depletion
  - Dual stack is not practical
- The IPv4 over IPv6
  - Solve part of the transition problem
- The translation between IPv4 and IPv6
  - Difficult, but it is what users really want

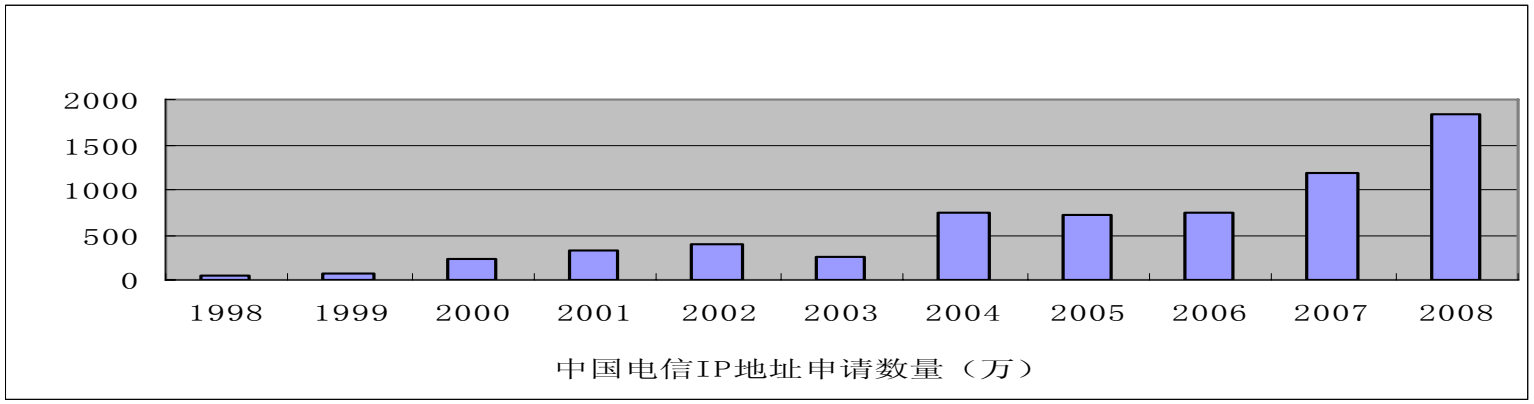
IPv4 address depletion



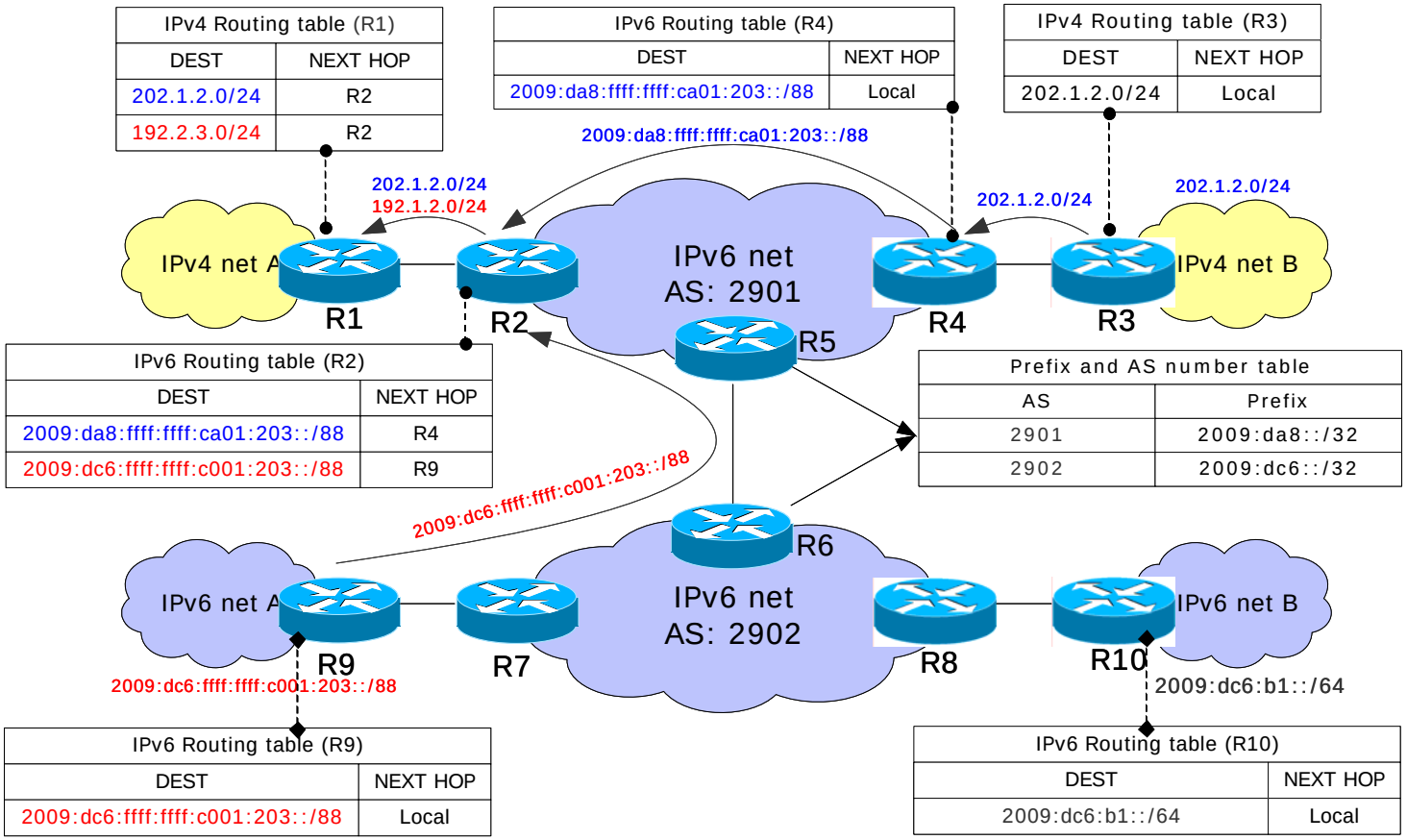
IPv4 address demand



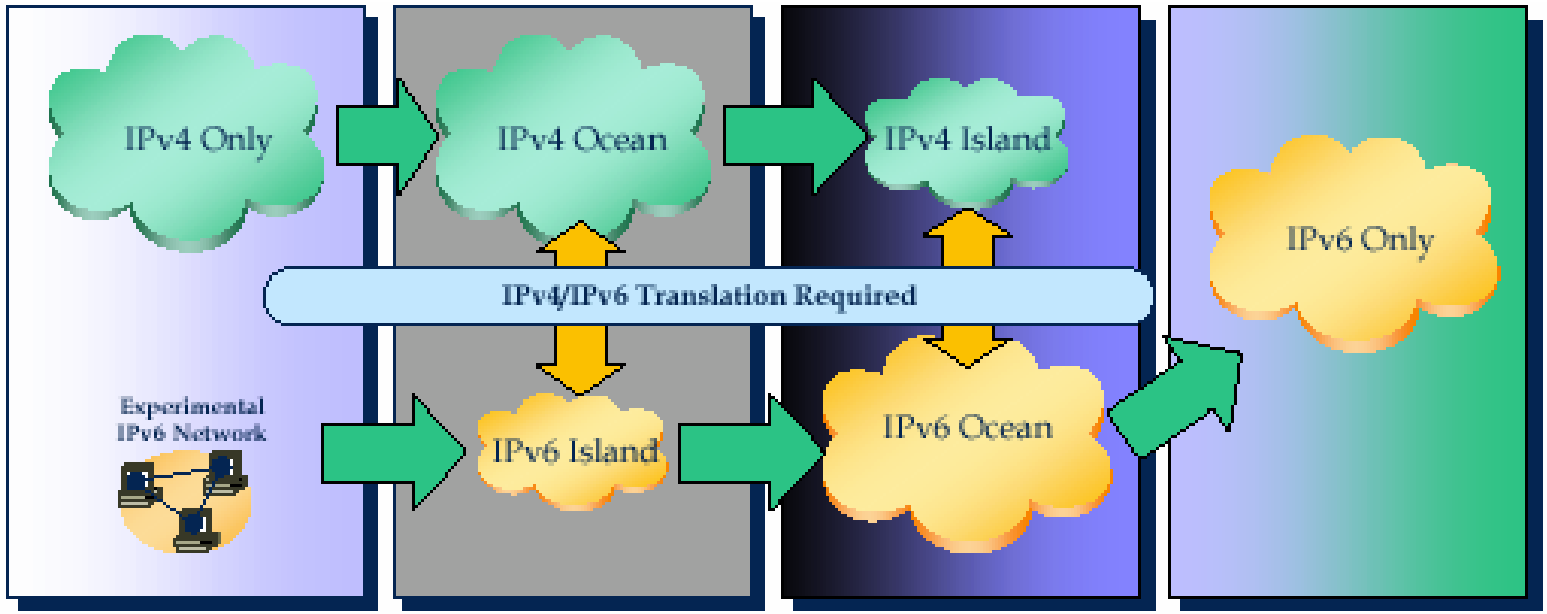




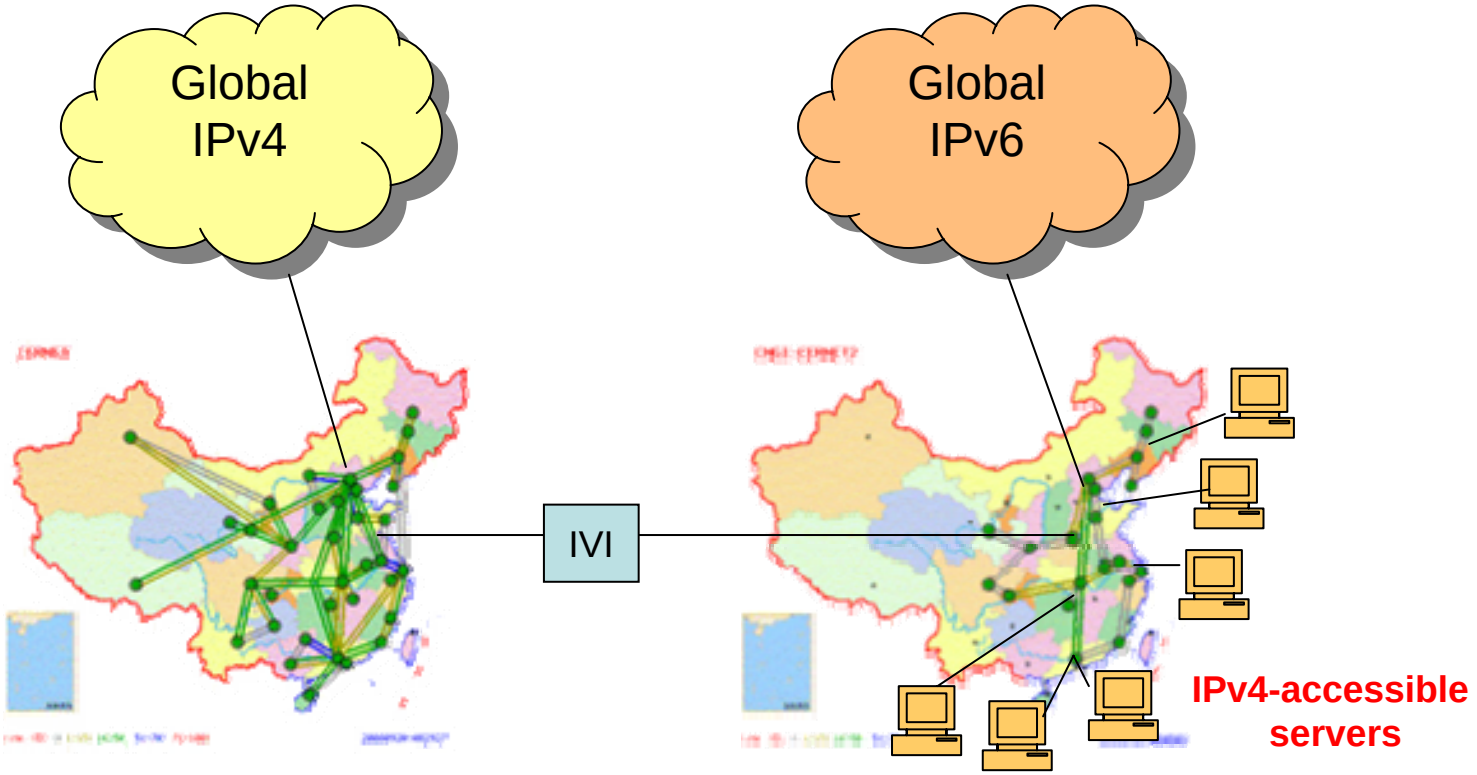
IPv4 over IPv6



IPv6 road map



CNGI-CERNET2 experience



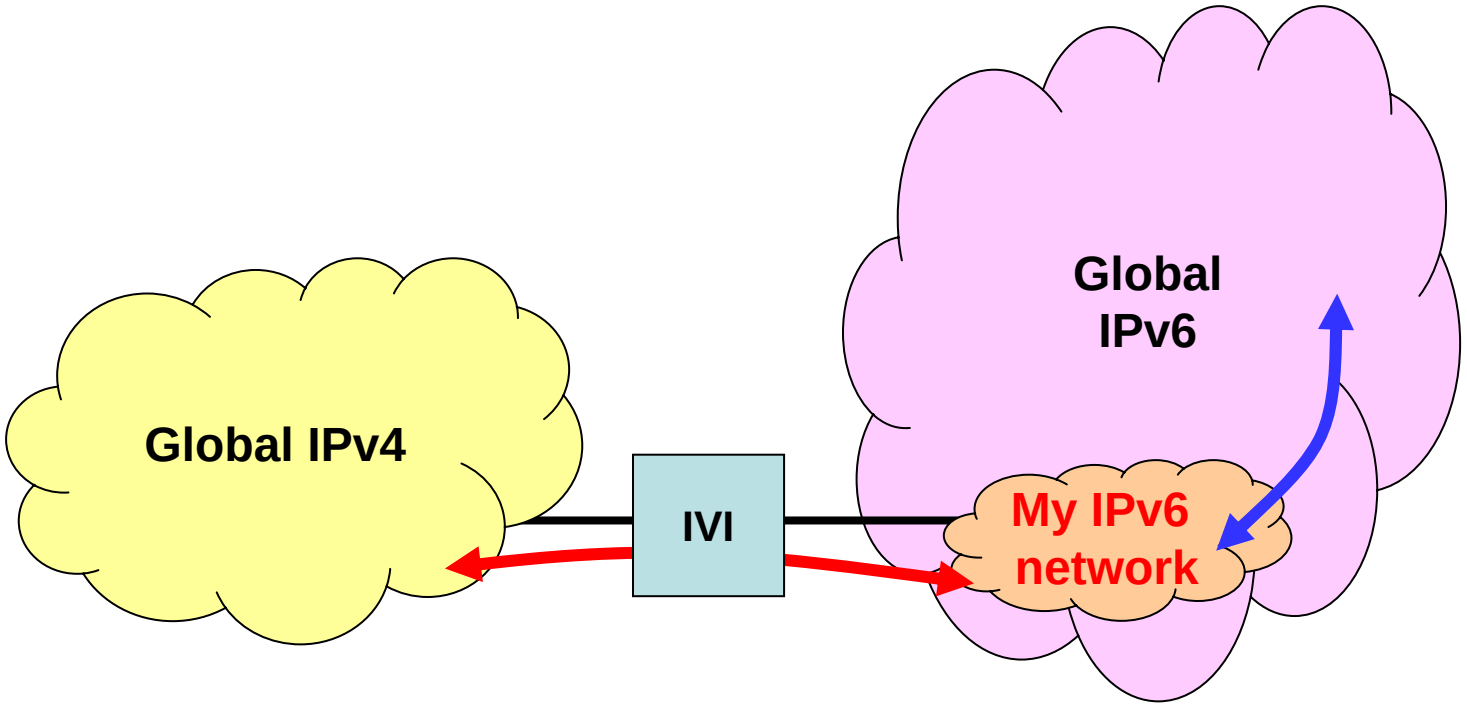
CERNET (IPv4)

2,000 universities
connected
20M users

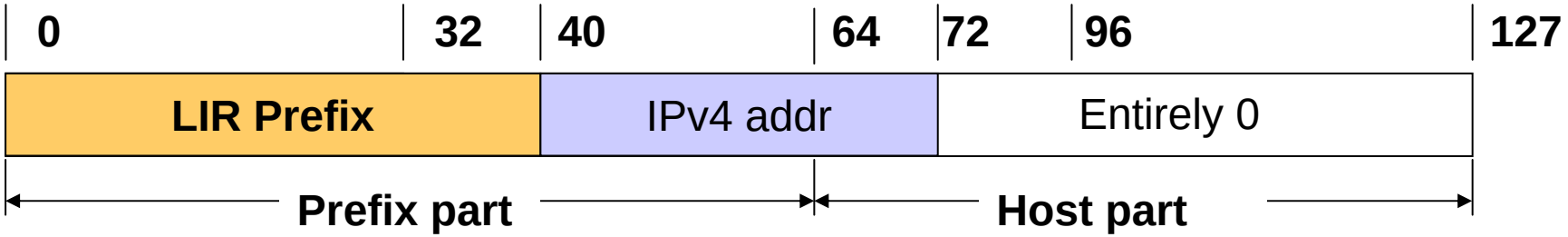
CNGI-CERNET2 (IPv6)

100 universities
connected
400K users

The IVI model



IVI address format



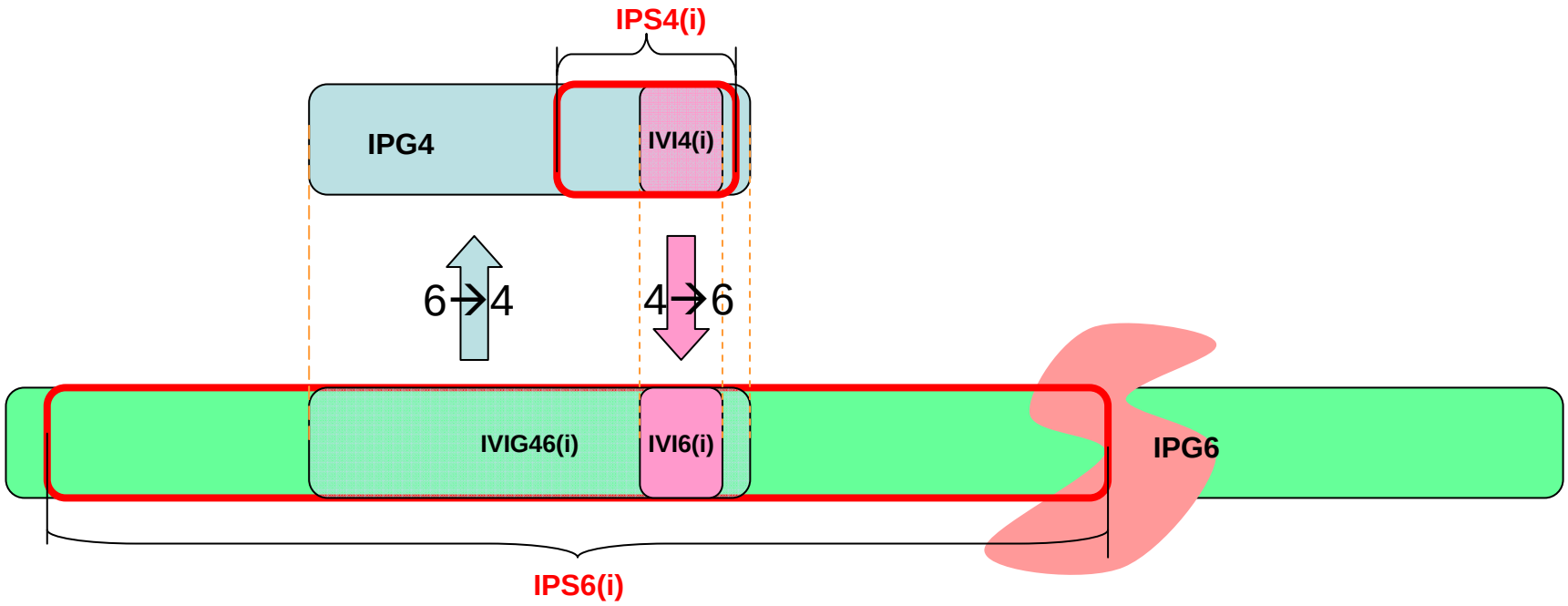
For example

LIR consists of ISP prefix (usually /32) and IVI flag

CERNET/CNGI-CERNET2's selection

- LIR = 2001:da8:ff00::/40
- **ISP's IVI service IPv4 address mapping**
  - **202.38.108.0/24 → 2001:da8:ffca:266c:0000::/64**
- ISP's non-IVI service IPv4 address mapping
  - 202.38.96.0/20 → 2001:da8:ffca:2660:0000::/60
- Other ISP's IPv4 address mapping
  - 0.0.0.0 → 2001:da8:ff00::/40
  - 18.181.0.31/32 → 2001:da8:ff12:b500:1f00::/72

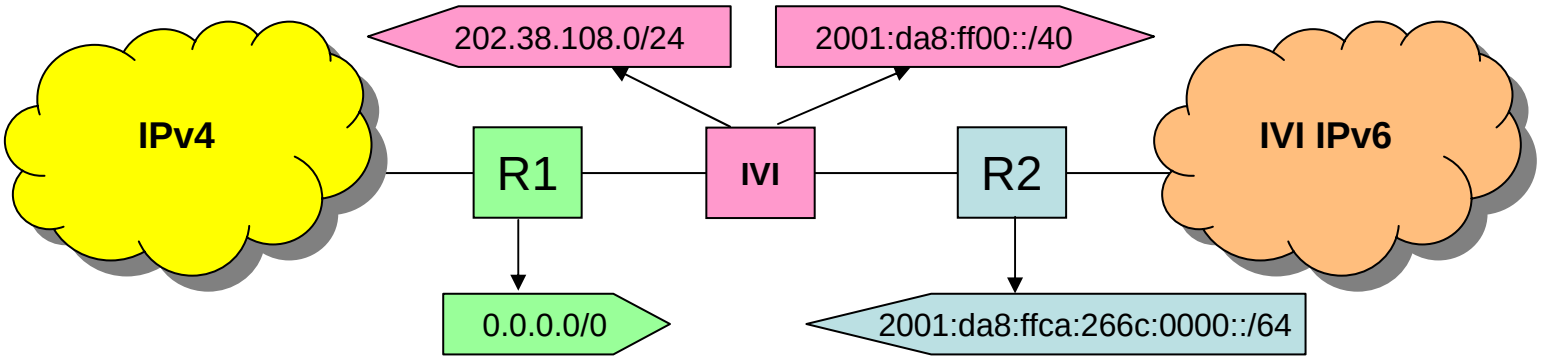
IVI address mapping



IVI protocol translation

- The protocol translation is based on modified SIIT.
- Special issues are related to
  - MTU and fragmentation
  - Checksum recalculation
  - ICMP and ICMP error message handling
  - Etc.

IVI routing



Longest prefix match

DNS46/DNS64

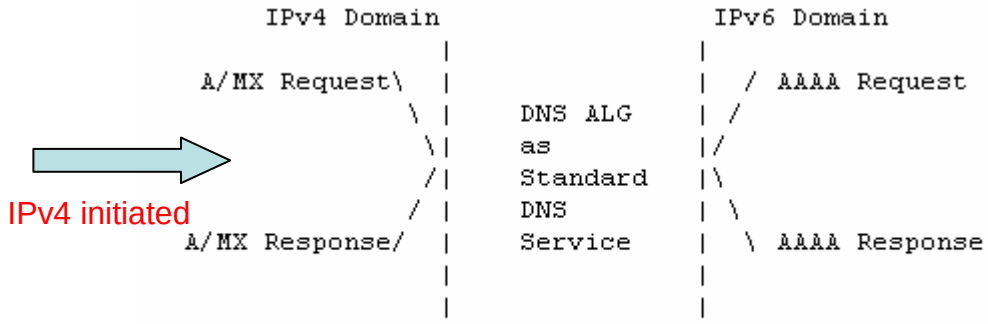


Figure 4: Normal DNS Service

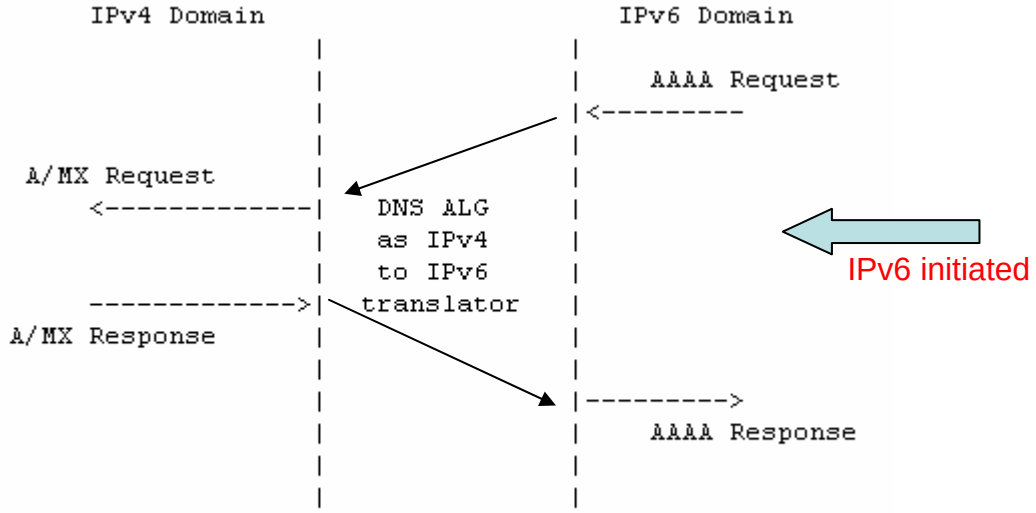


Figure 5: DNS Record Translation Service

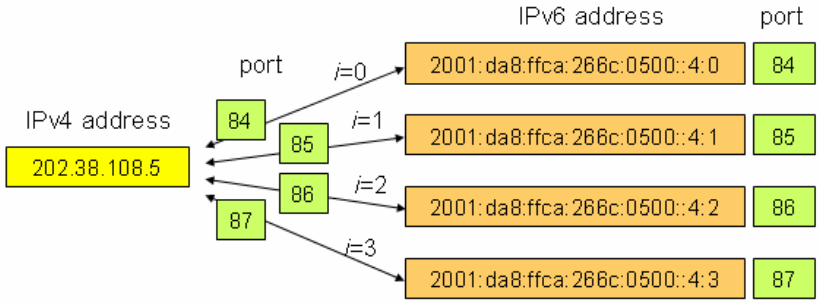
- DNS46
  - Algorithm based
- DNS64
  - Algorithm based

IVI (1:1) operation

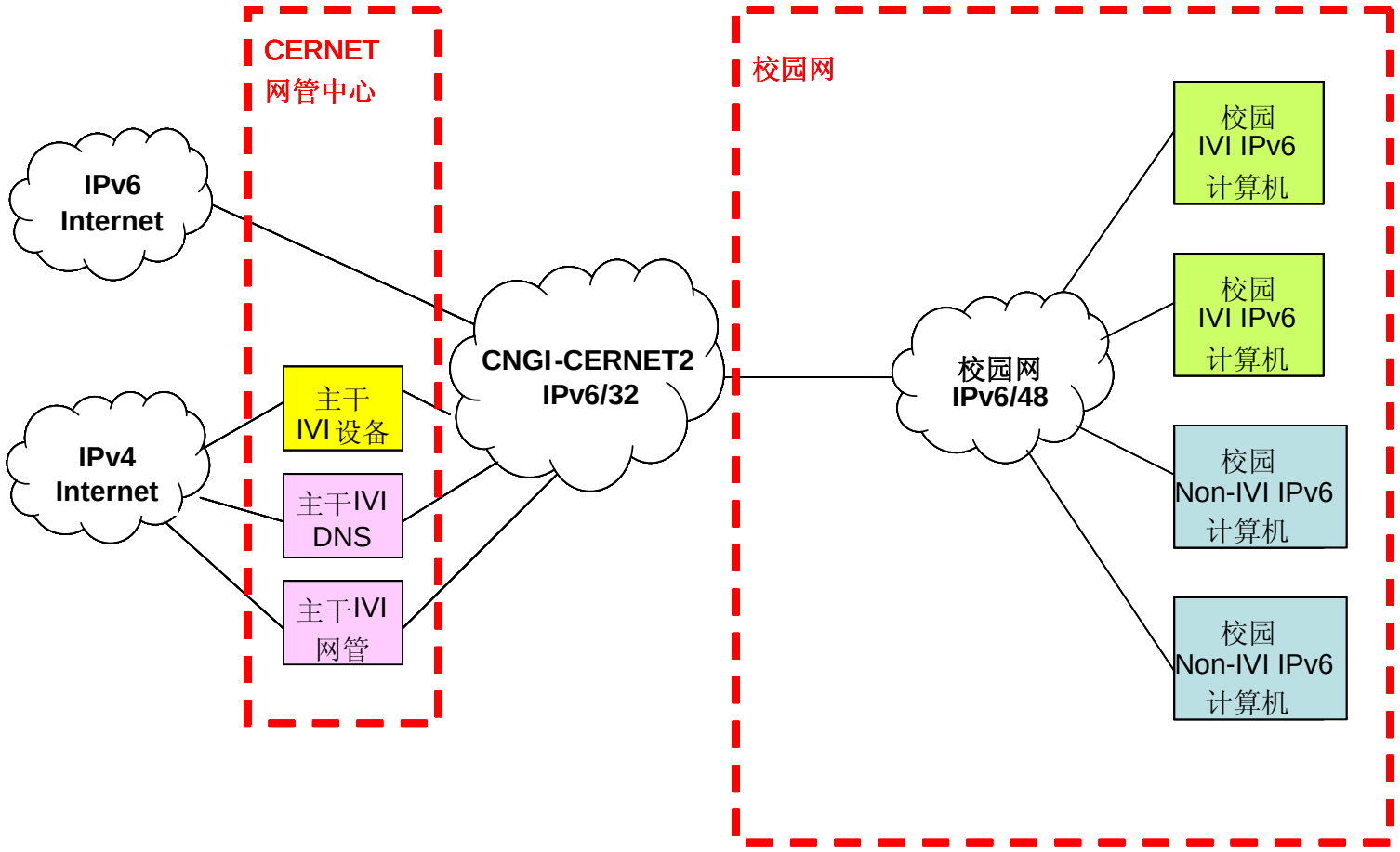
- Stateless
  - Based on ISP's prefix
  - The mapping between IPv4 and IVI IPv6 is based on algorithm
  - Support both IPv6 initiated and IPv4 initiated communications

IVI (1:N) operation

- Stateless
  - Based on ISP's prefix
  - Embed the transport number coding in the IPv6 addresses. If the multiplexing ratio is 256, one IPv4 /8 can support 4.3 billion IPv6 hosts, same as the size of the global IPv4 space
  - The mapping between IPv4 and IVI IPv6 is based on algorithm
  - Support both IPv6 initiated and IPv4 initiated communications



CNGI-2


CERNET
网管中心
IPv6
Internet
IPv4
Internet
主干
IVI 设备
主干IVI
DNS
主干IVI
网管
CNGI-CERNET2
IPv6/32
校园网
校园网
IPv6/48
校园
IVI IPv6
计算机
校园
IVI IPv6
计算机
校园
Non-IVI IPv6
计算机
校园
Non-IVI IPv6
计算机

CNGI-2 IVI address assignment

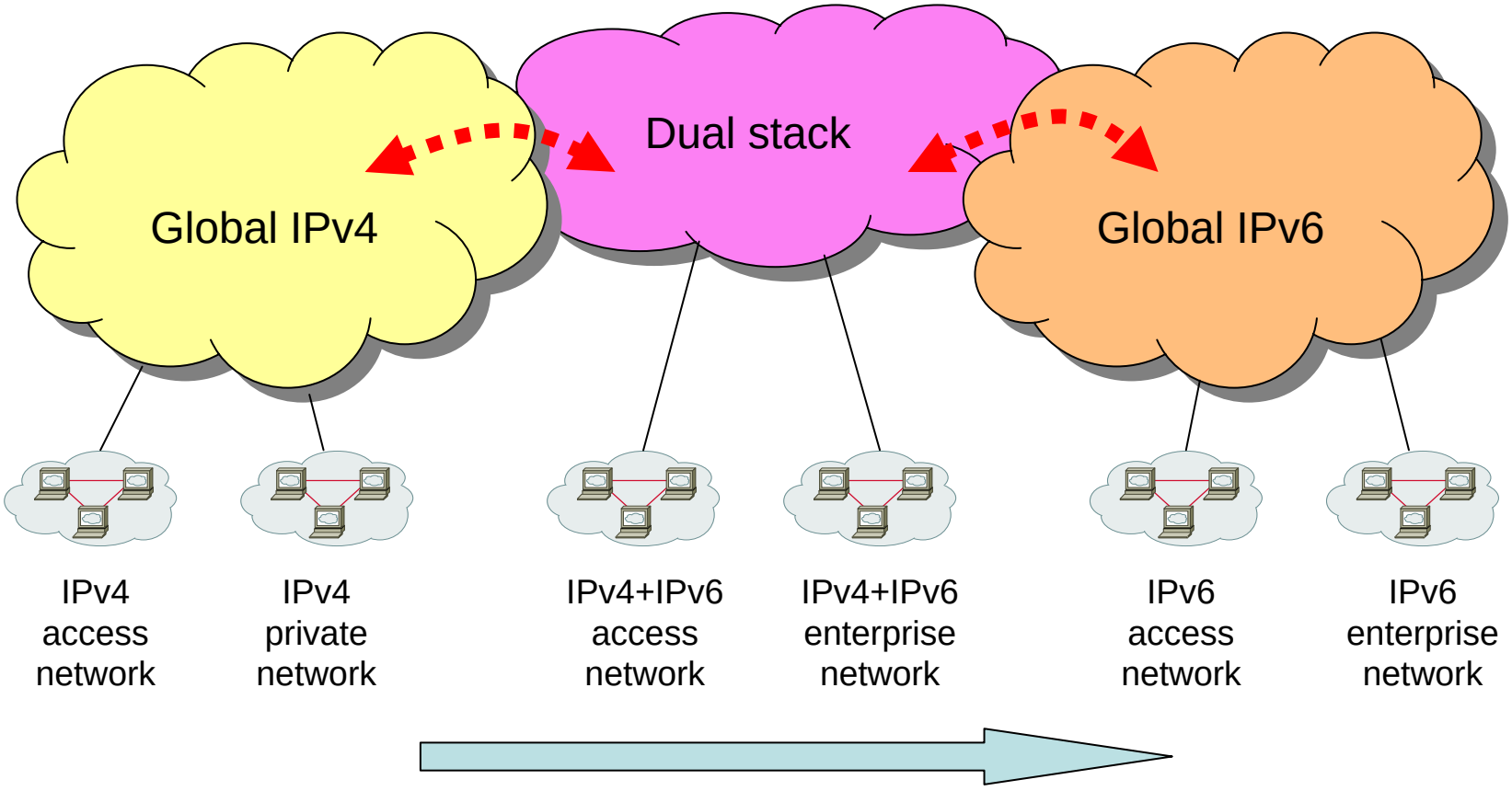
IVI 地址分配方案

	单位名称	城市	IPv4 地址	IPv6 地址
1	北京大学	北京	58.200.128.0/24	2001:da8:ff3a:c880::/64
2	清华大学	北京	58.200.129.0/24	2001:da8:ff3a:c881::/64
3	北京航空航天大学	北京	58.200.130.0/24	2001:da8:ff3a:c882::/64
4	北京邮电大学	北京	58.200.131.0/24	2001:da8:ff3a:c883::/64
5	中国人民大学	北京	58.200.132.0/24	2001:da8:ff3a:c884::/64
6	北京理工大学	北京	58.200.133.0/24	2001:da8:ff3a:c885::/64
7	北京师范大学	北京	58.200.134.0/24	2001:da8:ff3a:c886::/64
8	中央民族大学	北京	58.200.135.0/24	2001:da8:ff3a:c887::/64
9	中国地质大学	北京	58.200.136.0/24	2001:da8:ff3a:c888::/64
10	北京交通大学	北京	58.200.137.0/24	2001:da8:ff3a:c889::/64
11	对外经济贸易大学	北京	58.200.138.0/24	2001:da8:ff3a:c88a::/64
12	北京科技大学	北京	58.200.139.0/24	2001:da8:ff3a:c88b::/64
13	北京工业大学	北京	58.200.140.0/24	2001:da8:ff3a:c88c::/64
14	中国农业大学	北京	58.200.141.0/24	2001:da8:ff3a:c88d::/64
15	北京化工大学	北京	58.200.142.0/24	2001:da8:ff3a:c88e::/64

Transition mechanisms

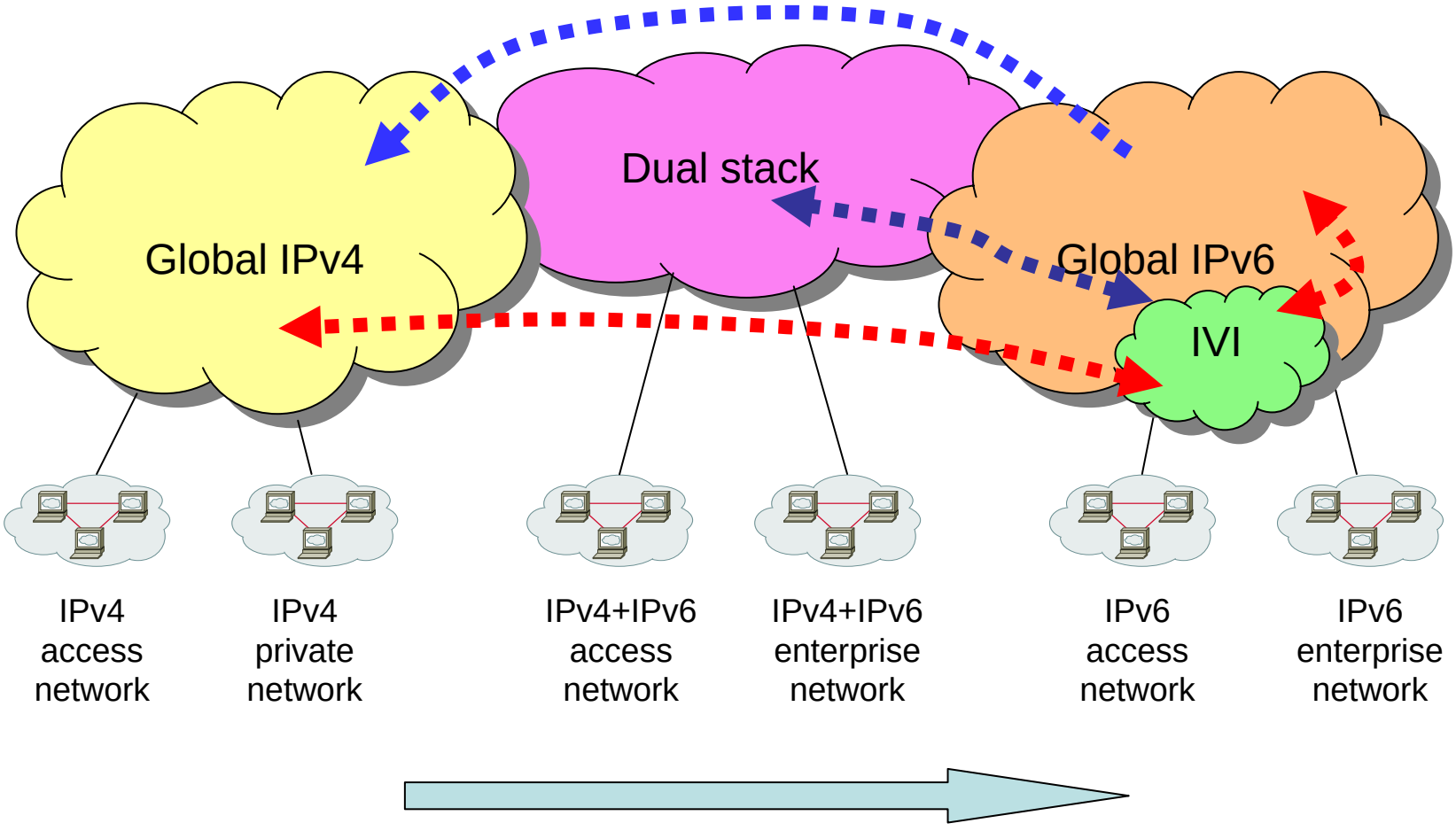
- When IPv4 addresses are running out
  - IPv4 + NAT
    - Short term solution
  - Pure IPv6
    - Cannot reach the global IPv4, unacceptable
  - Dual stack
    - The cost increases, ISPs want others to deploy dual stack
  - IVI IPv6
    - The cost is the same as the single stack, but the IPv6 host can be reached by global IPv4

Dual stack



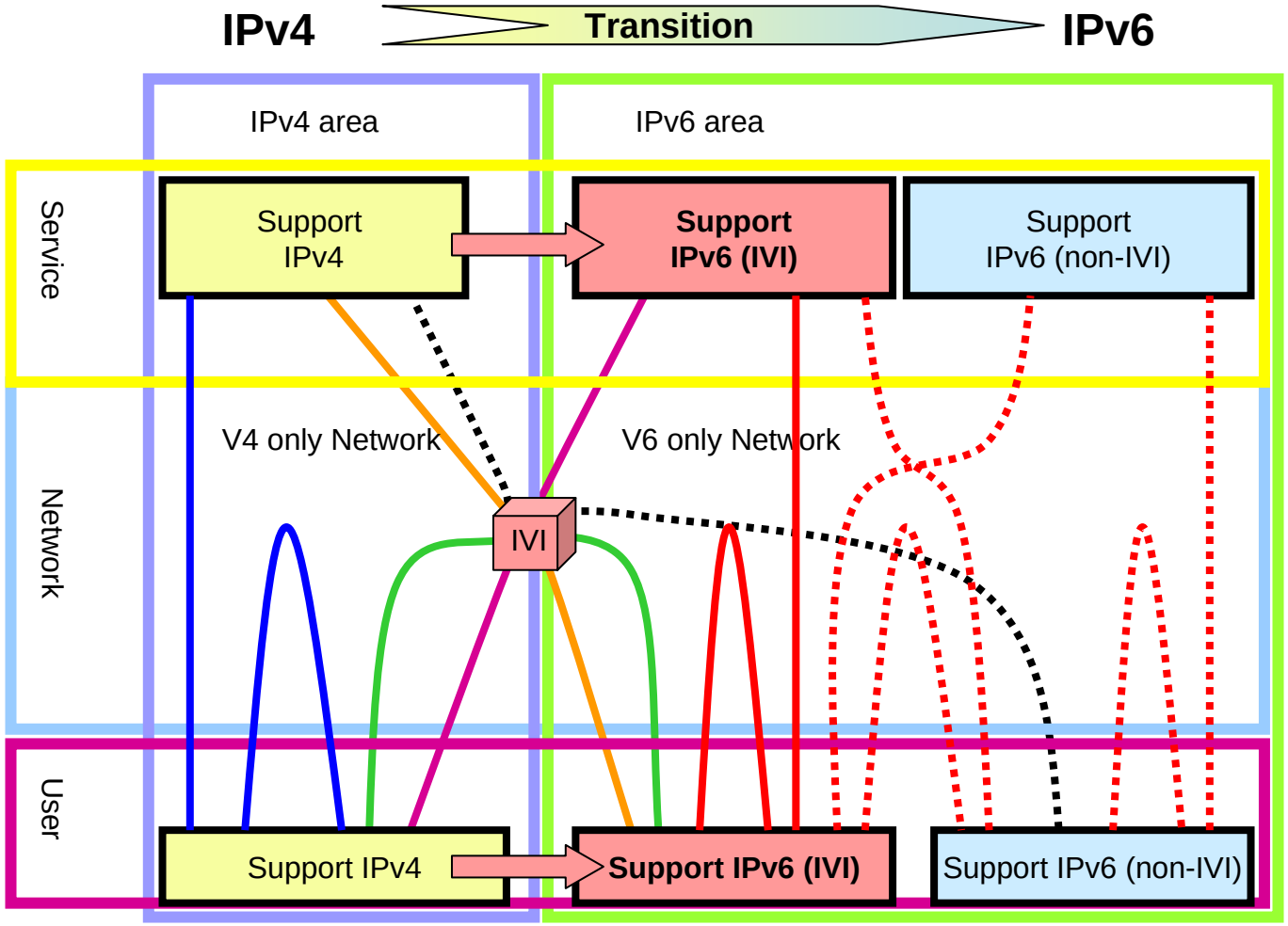
- Not easy

IVI



- Encourage transition

Transition


IPv4
Transition
IPv6
IPv4 area
IPv6 area
Service
Network
User
Support IPv4
Support IPv6 (IVI)
Support IPv6 (non-IVI)
V4 only Network
V6 only Network
IVI
Support IPv4
Support IPv6 (IVI)
Support IPv6 (non-IVI)

IETF behave: Scenarios

- Scenario 1: an IPv6 network to the IPv4 Internet
  - **IVI, NAT64**
- Scenario 2: the IPv4 Internet to an IPv6 network
  - **IVI**
- Scenario 3: the IPv6 Internet to an IPv4 network
  - **NAT64**
- Scenario 4: an IPv4 network to the IPv6 Internet
  - **No solution**
- Scenario 5: an IPv6 network to an IPv4 network
  - **IVI, NAT64**
- Scenario 6: an IPv4 network to an IPv6 network
  - **IVI**
- Scenario 7: the IPv6 Internet to the IPv4 Internet
  - **No solution**
- Scenario 8: the IPv4 Internet to the IPv6 Internet
  - **No solution**

IETF behave: Document Layout

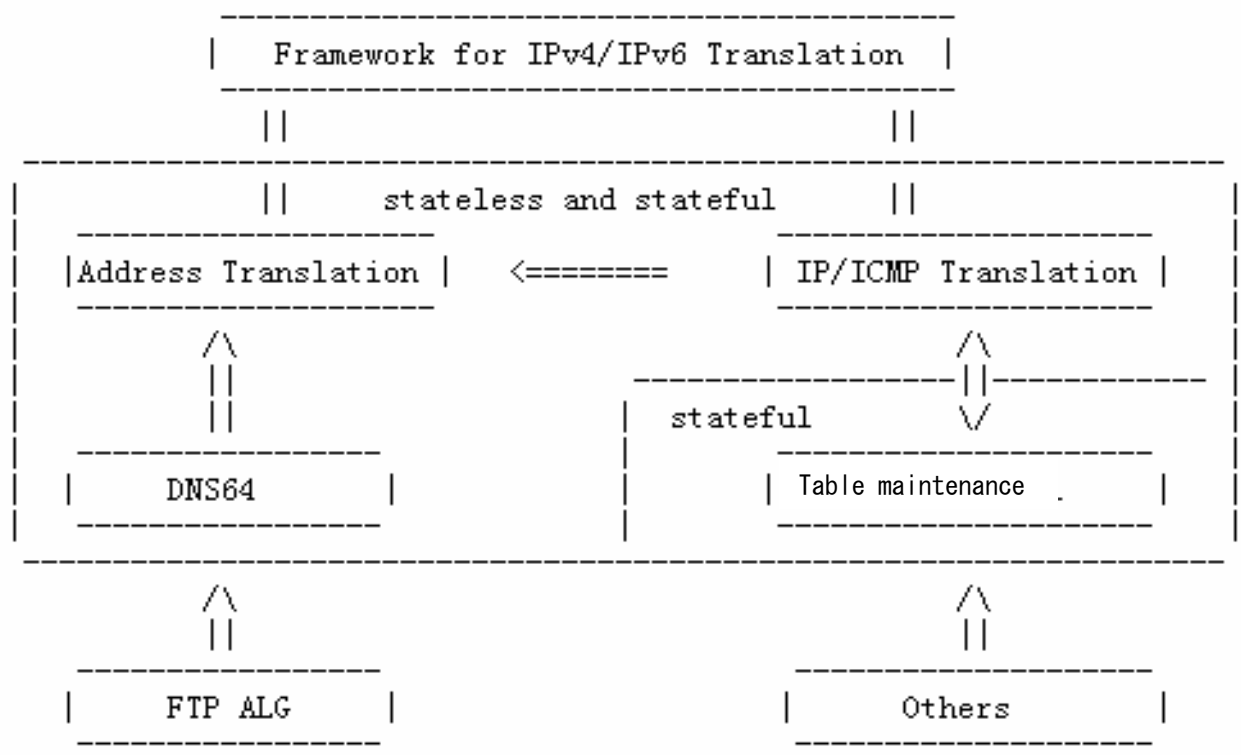
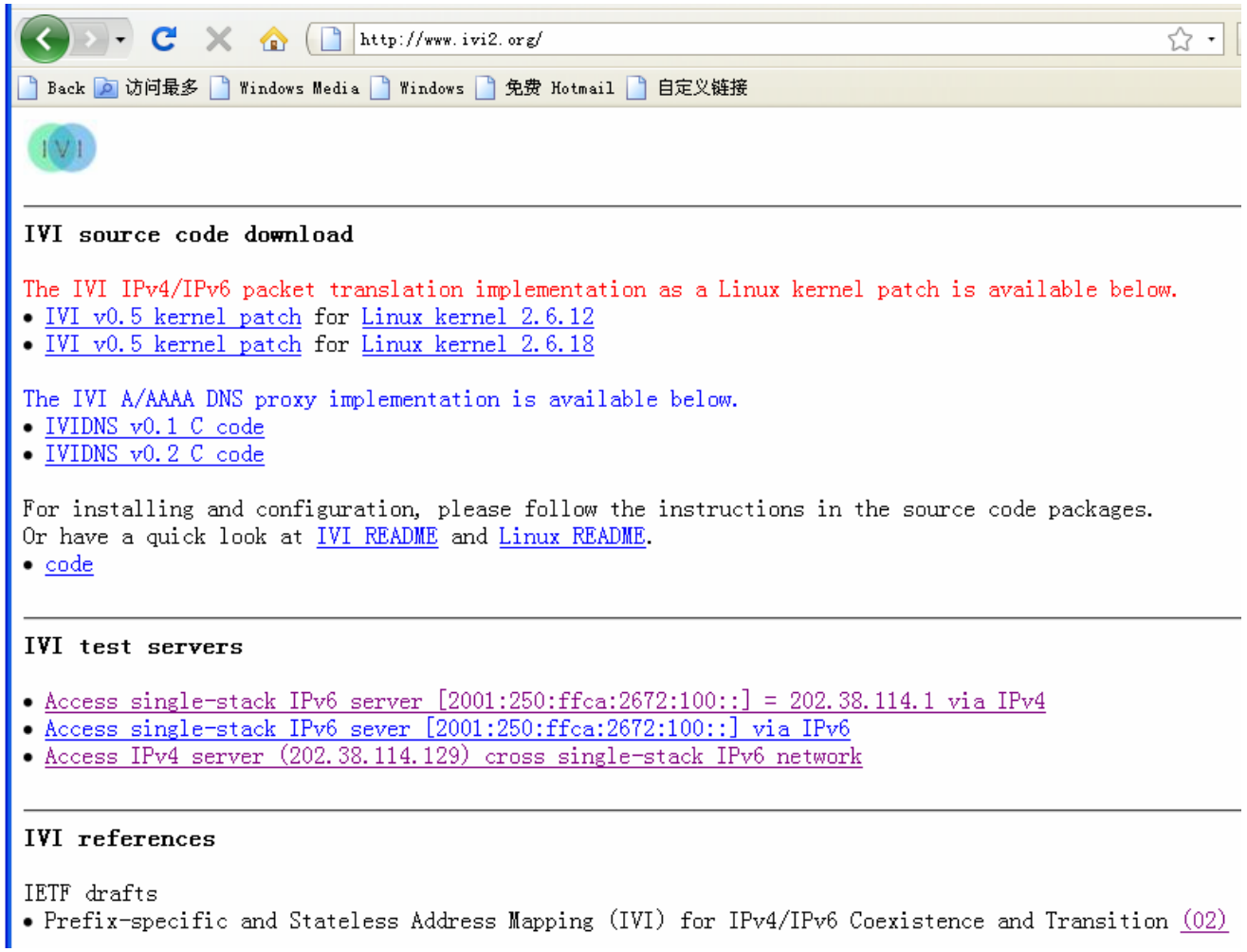


Figure 14: Document Layout

www.ivi2.org


http://www.ivi2.org/
Back
访问最多
Windows Media
Windows
免费 Hotmail
自定义链接
IVI source code download
The IVI IPv4/IPv6 packet translation implementation as a Linux kernel patch is available below.
• IVI v0.5 kernel patch for Linux kernel 2.6.12
• IVI v0.5 kernel patch for Linux kernel 2.6.18
The IVI A/AAAA DNS proxy implementation is available below.
• IVIDNS v0.1 C code
• IVIDNS v0.2 C code
For installing and configuration, please follow the instructions in the source code packages.
Or have a quick look at IVI README and Linux README.
• code
IVI test servers
• Access single-stack IPv6 server [2001:250:ffca:2672:100::] = 202.38.114.1 via IPv4
• Access single-stack IPv6 sever [2001:250:ffca:2672:100::] via IPv6
• Access IPv4 server (202.38.114.129) cross single-stack IPv6 network
IVI references
IETF drafts
• Prefix-specific and Stateless Address Mapping (IVI) for IPv4/IPv6 Coexistence and Transition (02)

Remarks

- The transparent communication with IPv4 is the “killer Application” of IPv6.
- We suggest use the remaining IPv4 blocks for the IPv4/IPv6 translation.