IPv6 Transition Experience

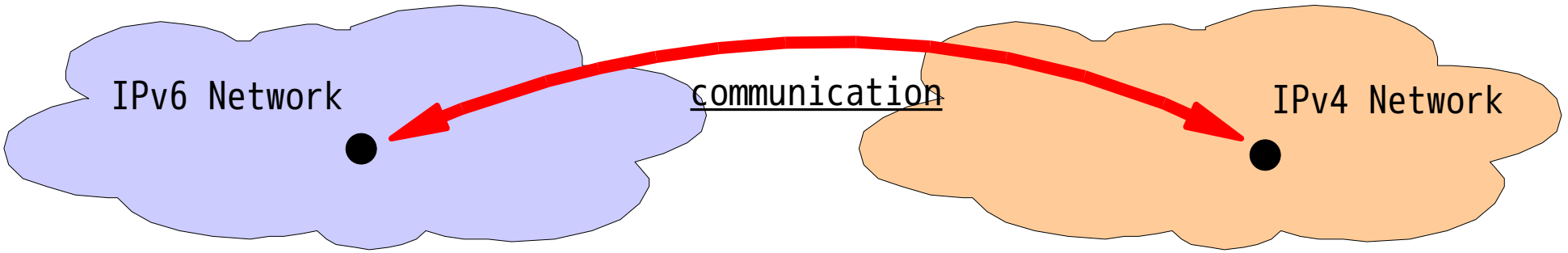
IVI IPv4-IPv6 Translator Service

Feb 4, 2009
Winter 2009 ESCC/Internet2 Joint Techs

Mitsuru Kanda kanda@ISI.EDU
Bill Manning bmanning@ISI.EDU

IPv6 Transition

- Post IPv4 Completion
  - Need “IPv6 Transition”!
  - Coexistence IPv4 and IPv6
- Interoperate IPv4 clouds and IPv6 clouds
  - IPv6 network <-> IPv4 network
  - Translate Packets from IPv6(IPv4) to IPv4(IPv6)



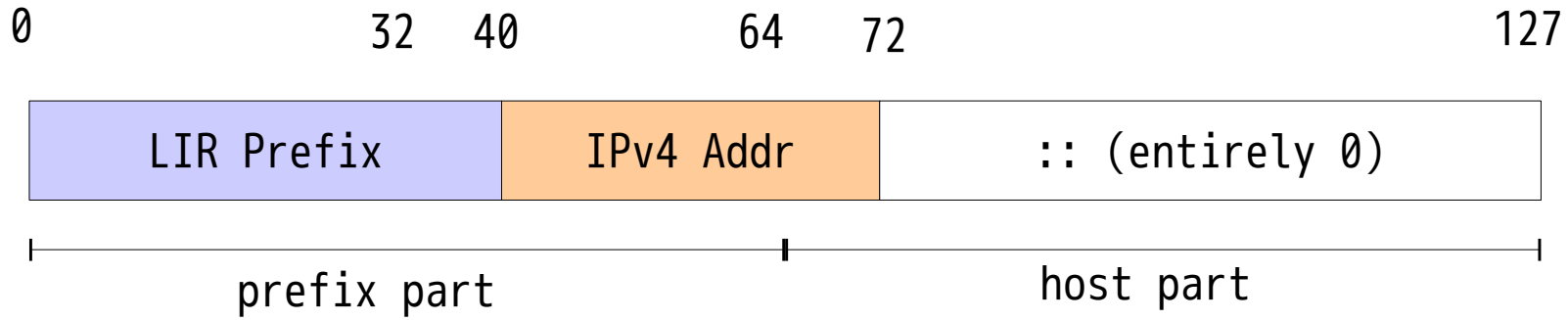
A Short History of IPv6 Translator

- 2000: NA(P)T-PT (RFC2776)
  - IPv4/IPv6 version's NAT
  - Cooperate with DNS-ALG
- 2007: NAT-PT was deprecated to Histric Status
  - Deep depend DNS-ALG (need share state)
- Now: There is no standard...

What's IVI?

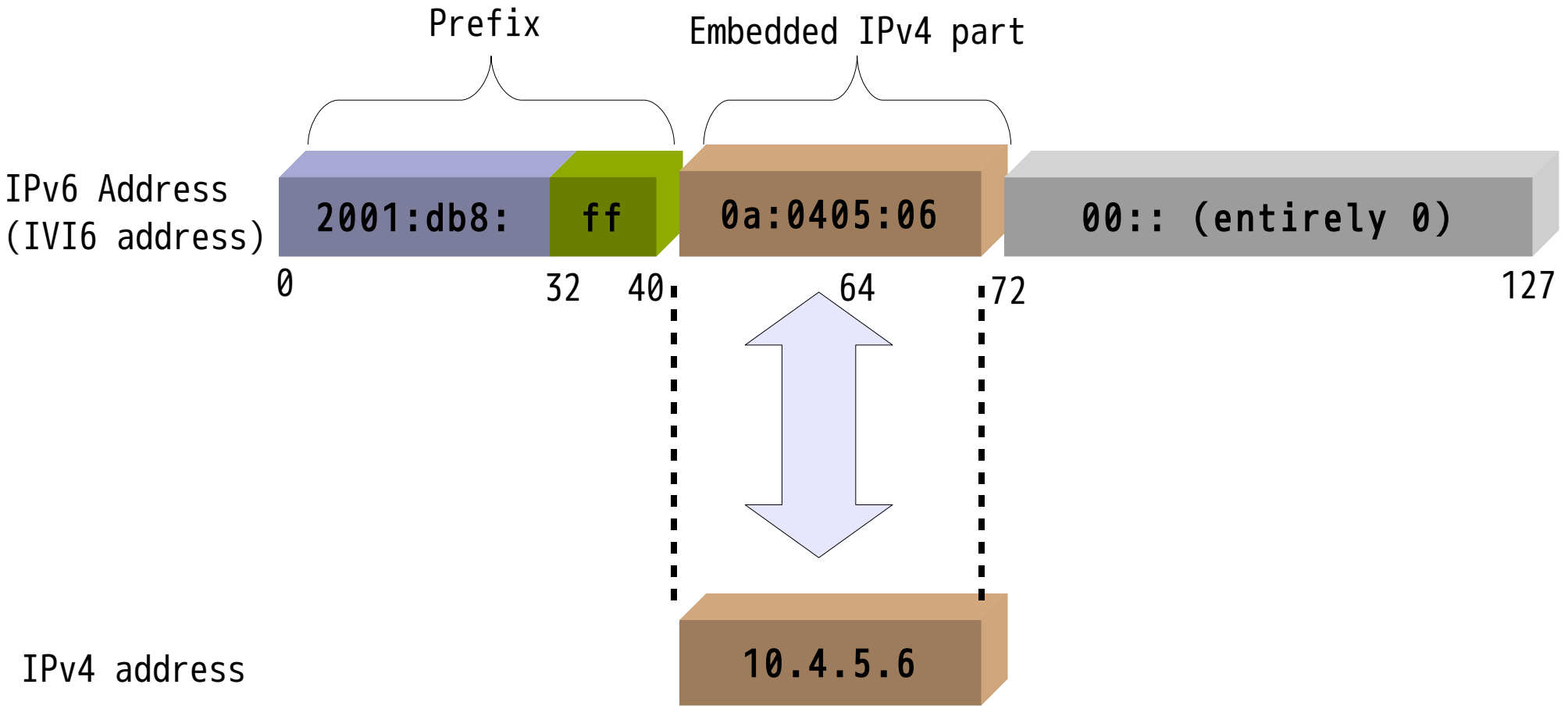
- IVI means **IV**(IPv4) <-> **VI**(IPv6)
- Designed by Xing Li @CERNET, et al.
  - draft-xli-behave-ivi-00, draft-baker-behave-ivi-01
- Based on SIIT(RFC2765) and NAT-PT(RFC2766)
  - But different address format
  - No shared state between NAT and DNS-ALG
- Support **Stateless** Address Translation (1:1)
  - IPv4 hosts can initiate to access a IPv6 host!
  - Also supports stateful address translation (1:N)

IVI Address Format

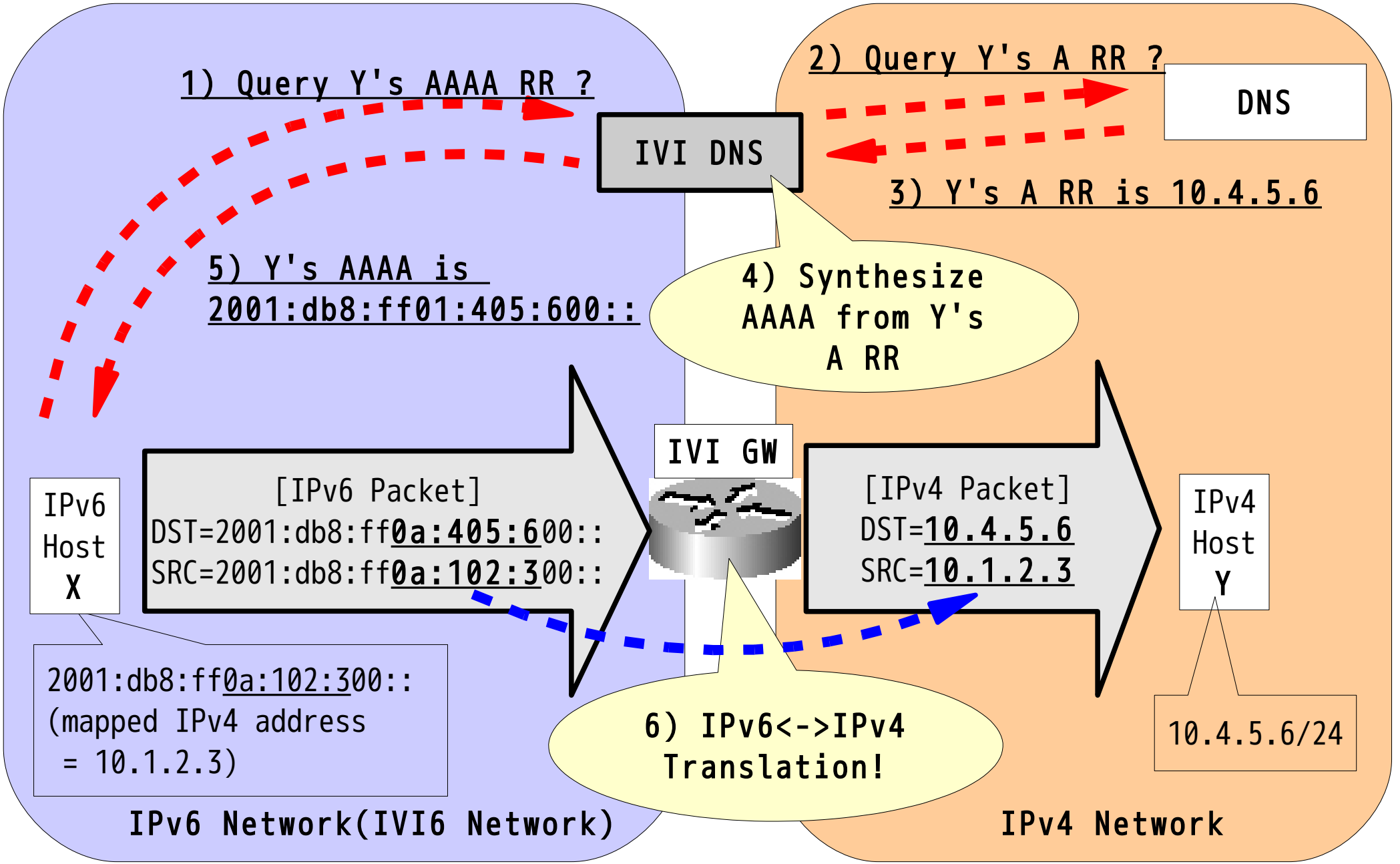


- LIR Prefix consists of two parts
  - ISP's prefix (/32) + IVI marker ('FF')
    - e.g. 2001:db8:ff00::/40
- Embedded 'IPv4 Addr'(ess)
  - IPv4 host address, or
  - IPv6 host's (mapped) IPv4 address

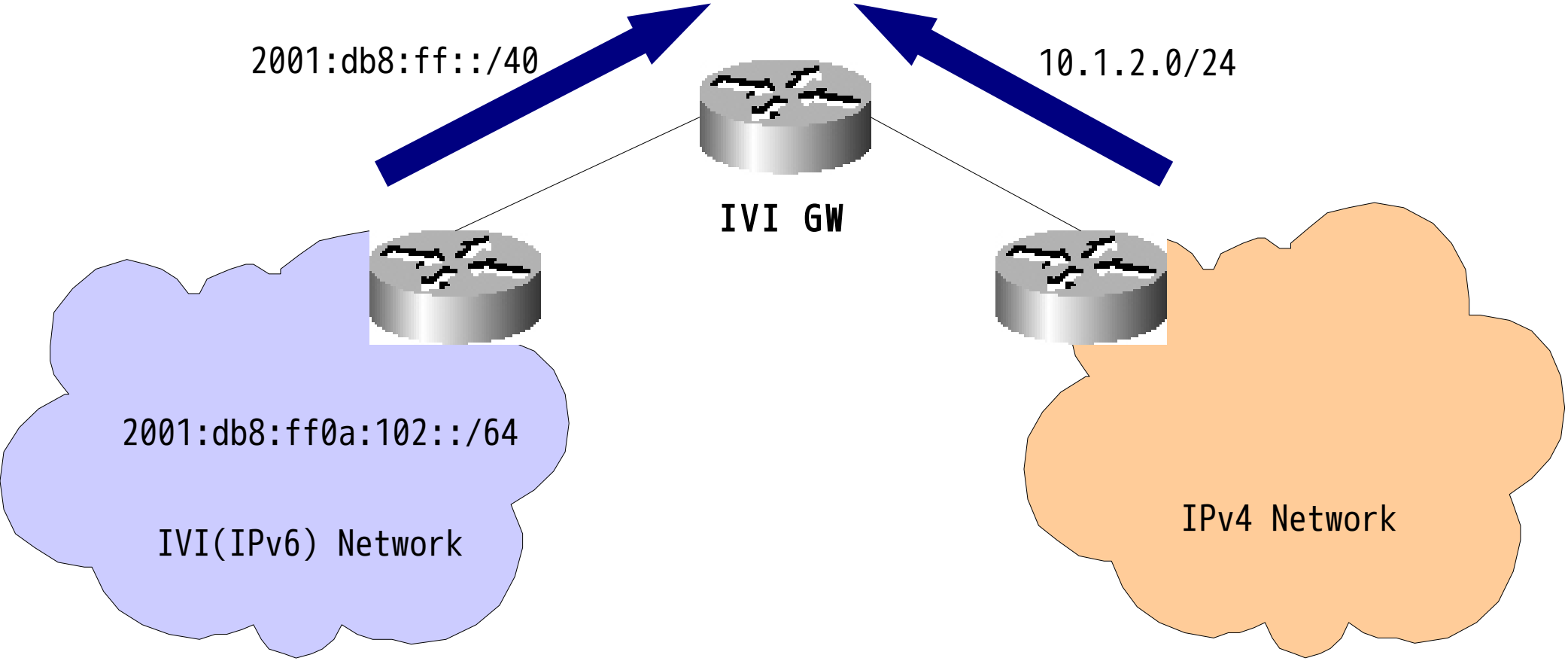
IVI Address Format (cont'd)



How to translate packets



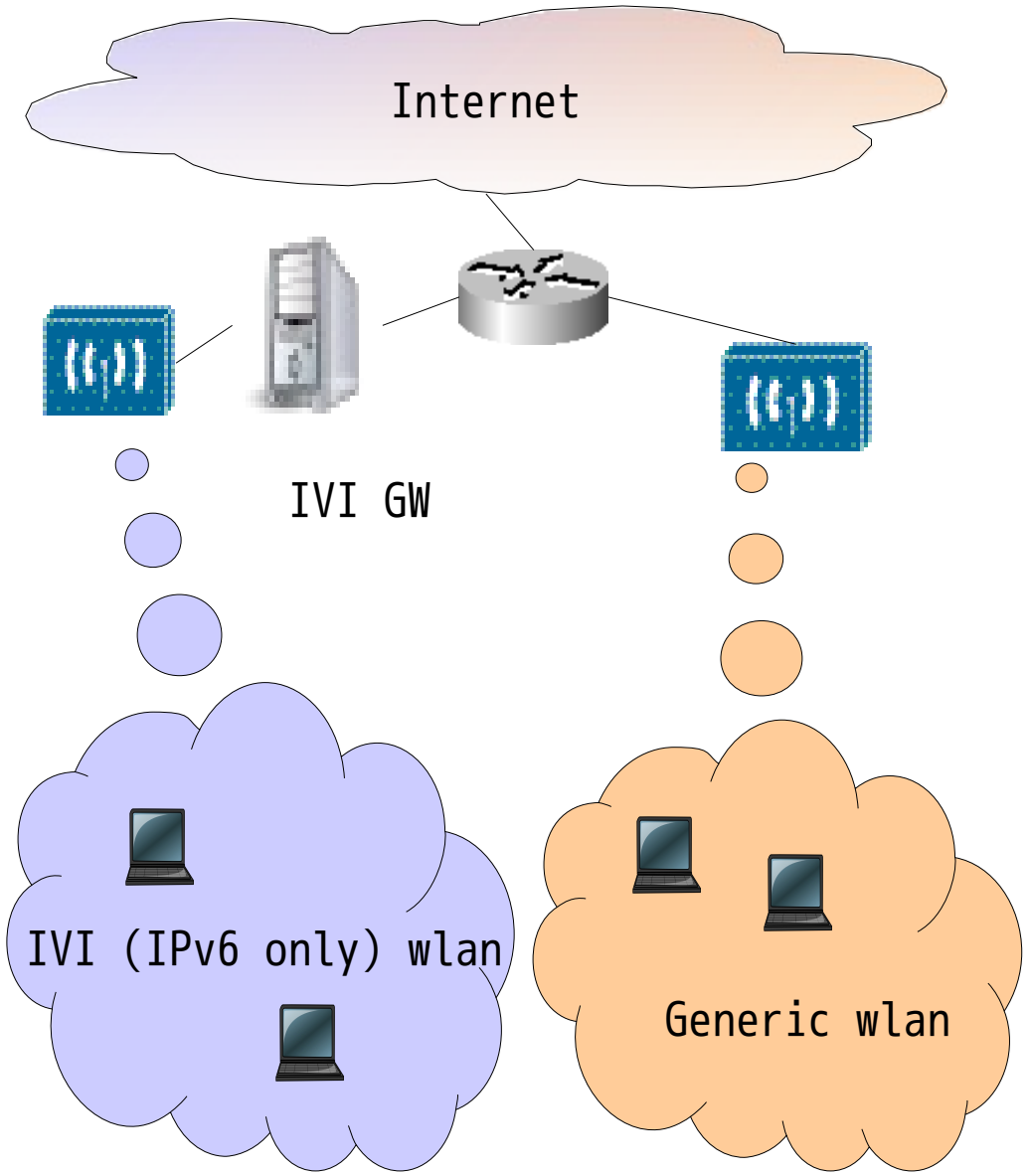
Routing Topology



ARIN/NANOG Demo ARIN XXII meeting 15-17 Oct 2008

- IVI Demo was provided during the meeting period
- Only Stateless Translator (no stateful)
- IVI6 Client Network was separated from the generic wireless network (different SSID)
- Configurations for IVI6 Clients were set by participants manually
  - We passed a slip to each demo participants
    - IPv6(IVI6) address, DNS server's address, SSID

Spec/Topology @ARIN Demo

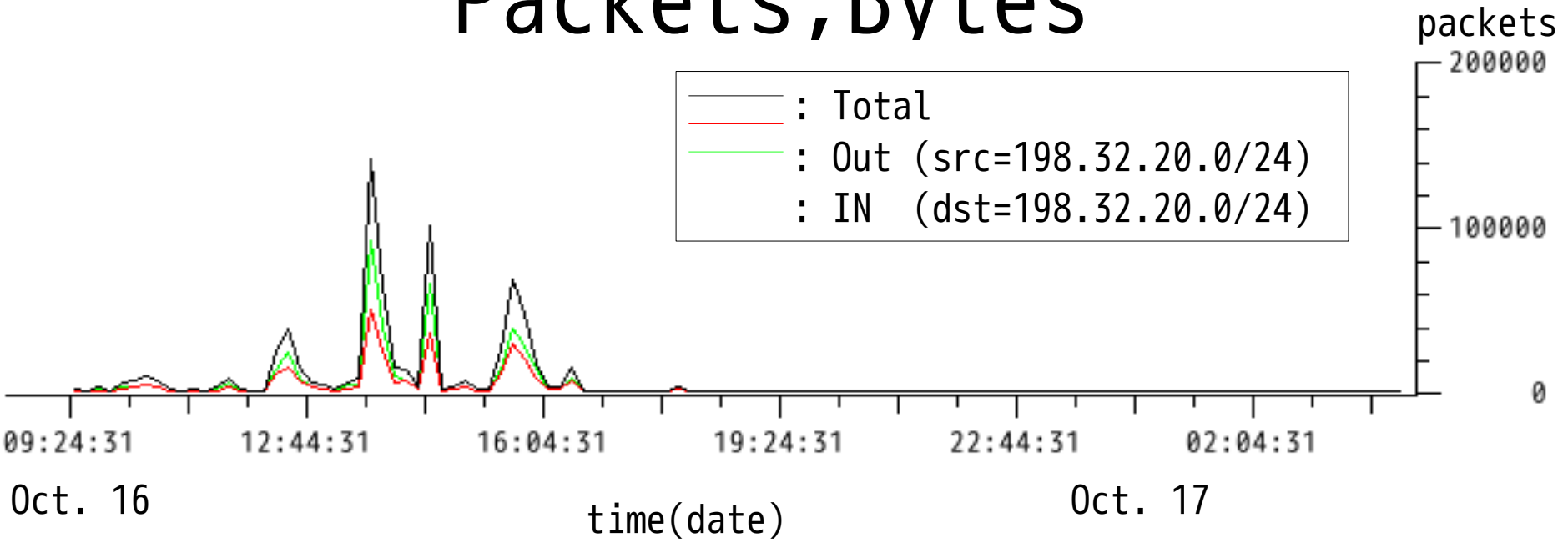


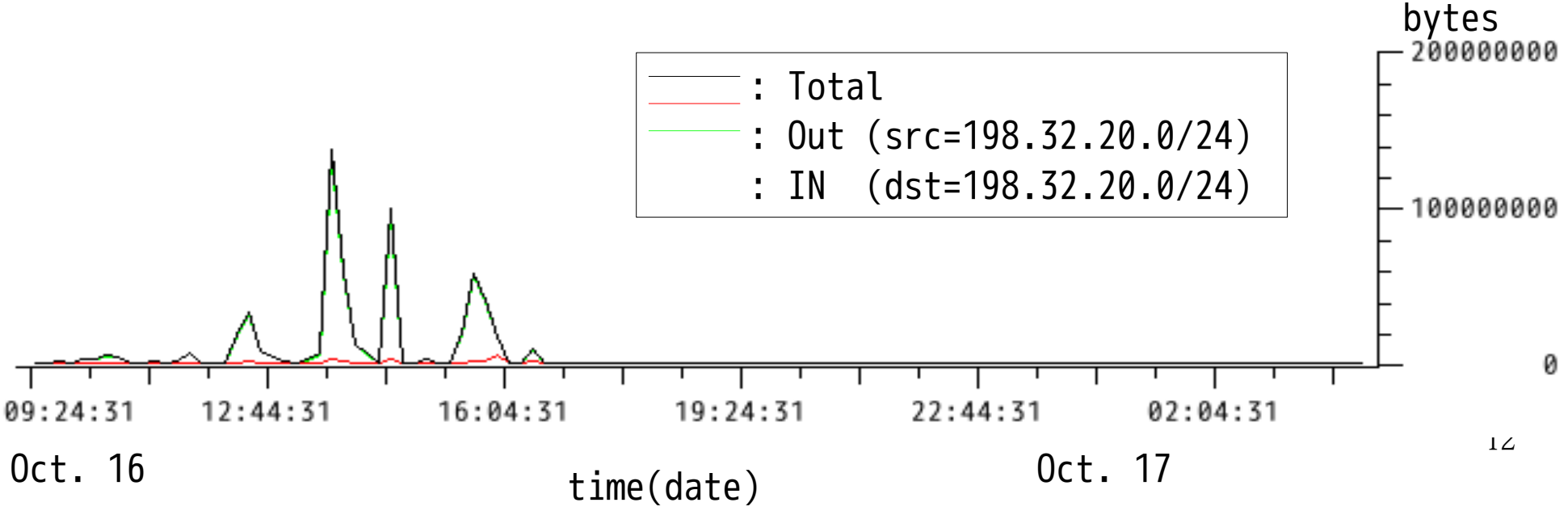
- IVI GW
  - Linux 2.6.12 + IVI patch, Debian
  - totd 1.4 + IVI AAAA synthesizing feature (DNS-ALG)
    - alternatives?
  - Pentium III 1GHz, RAM: 256MB
- IVI6 clients
  - Demo Participants Laptops

Measuring Result

- From 16th morning to 17th morning (one day)
- 6 IVI clients
- 1503 IPv4 addresses were translated
- More than 90% of communication were translated (IPv6<->IPv4)
  - 90.68% (packet-base), 92.66% (byte-base)
  - Native IPv6 communication < 10%
- CPU Load - no data, but very low
  - because of no need to manage states

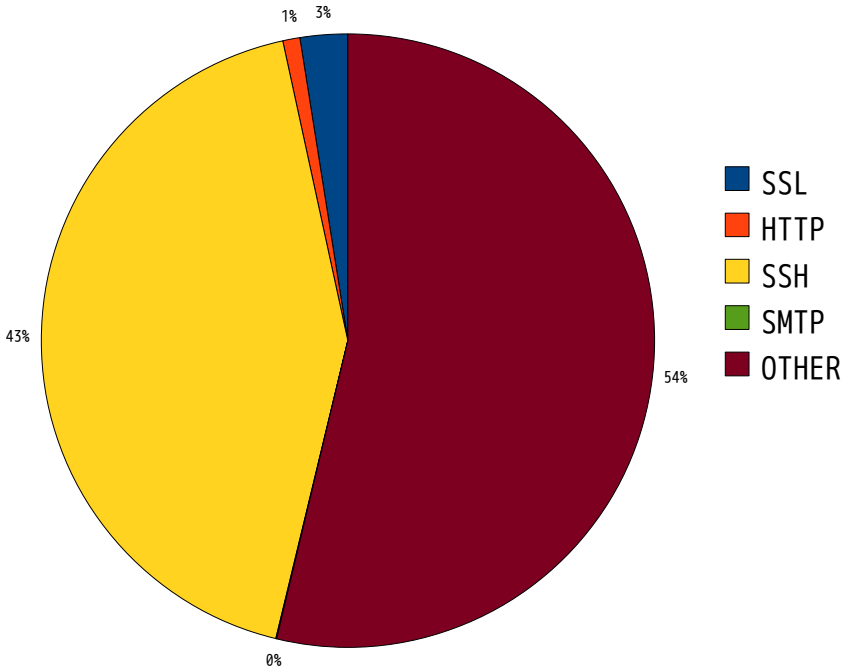
of Translated I/O Packets,Bytes



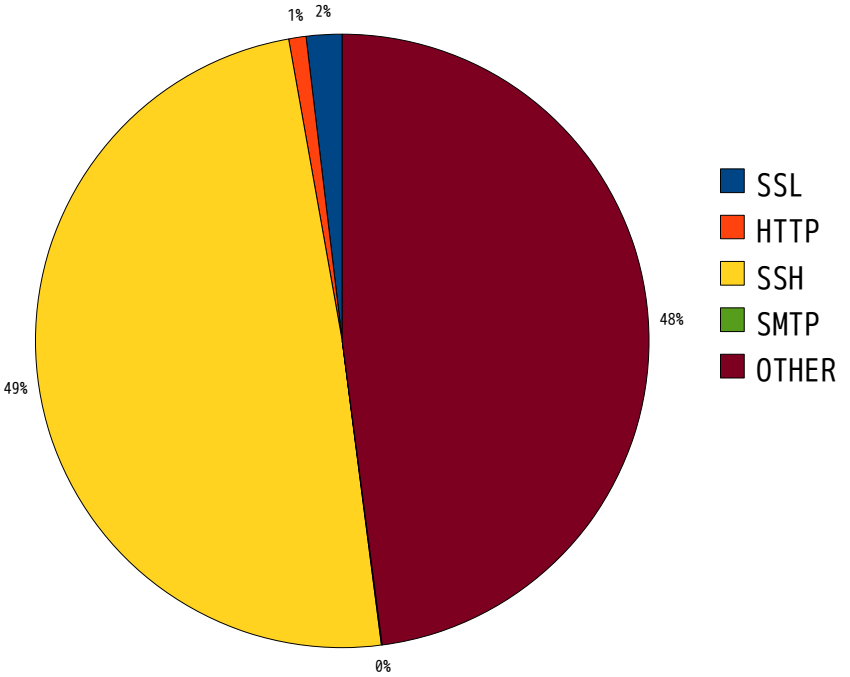


Protocol Breakdown

TCP Protocol Breakdown (packets)



TCP Protocol Breakdown (bytes)

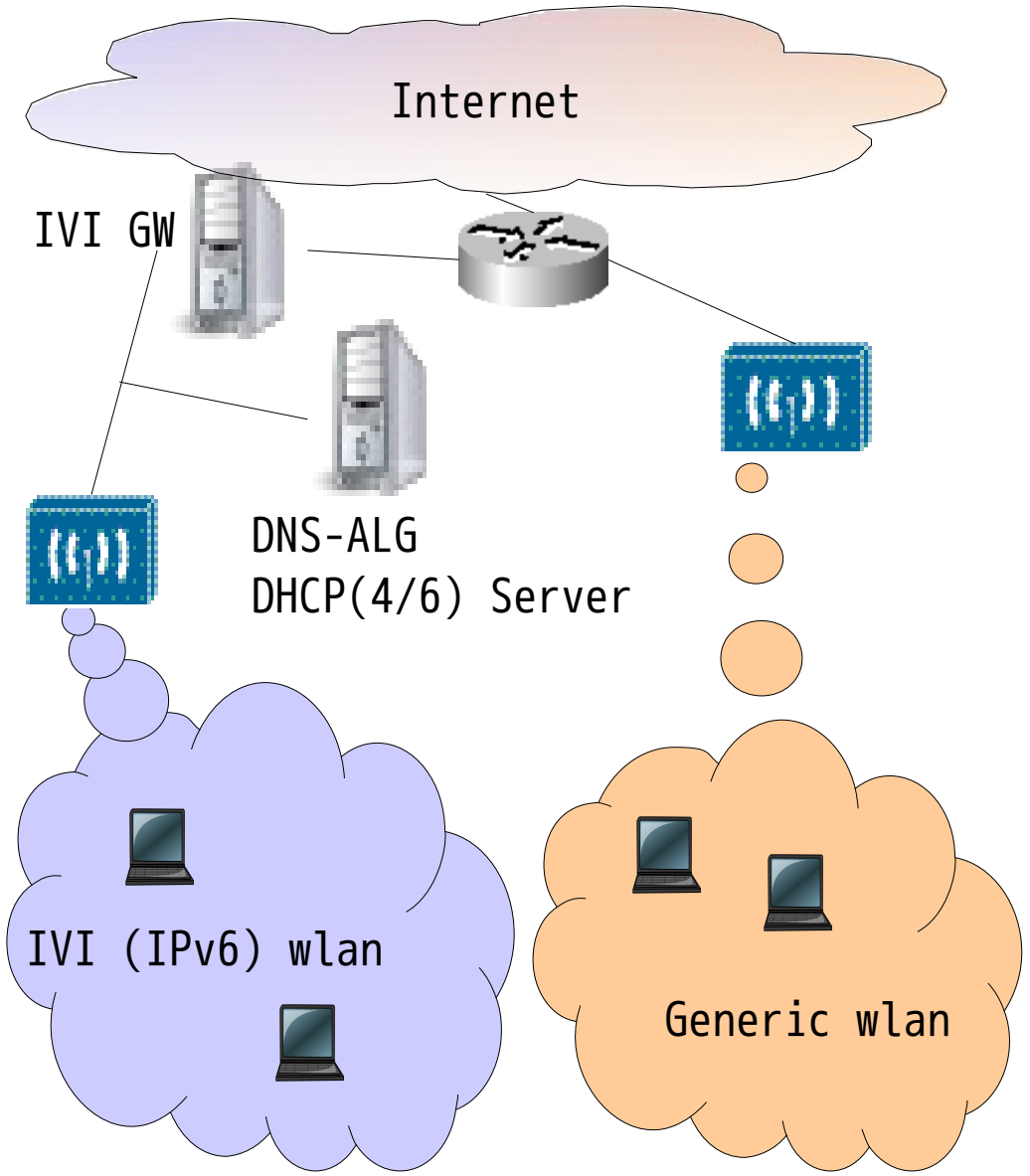


(IVI6 clients' addresses <-> (almost)Mapped IPv6 Addresses)

Demo Issues

- Address Assignment
  - ~~Stateless Address Auto Configuration (RA)~~
    - IPv6 prefixes are different on each clients
  - DHCPv6
    - Need to install DHCPv6 client software
  - Manual (used in the demo)
    - pass out a slip with an address, default gw and DNS server address for attendees. and set by user
- Name resolution (DNS)
  - Windows XP can't resolve DNS over IPv6
    - need some hacks, will be introduced in JTech's demo

Demo @JTechs



- IVI GW
  - Linux 2.6.12 + IVI patch, Debian
  - radvd (sends RA)
    - notify default GW (no prefix)
- DNS-ALG
  - totd 1.4 + IVI AAAA synthesizing feature (DNS-ALG)
- DHCP Server
  - DHCPv6 (dibbler)
  - DHCPv4 (ISC DHCP3),for XP

IETF Standardization Status

- Replace NAT-PT
  - Now a lot of candidates proposed in IETF
    - IVI, NAT64, NAT6, sNAT-PT...
    - discussing in IETF behave WG, etc
  - conclusion: Merge the various proposals
    - @interim meeting, Oct 2008
  - Support both stateless and stateful
    - draft-baker-behave-v4v6-framework-00
    - draft-baker-behave-v4v6-translation-00

Summary

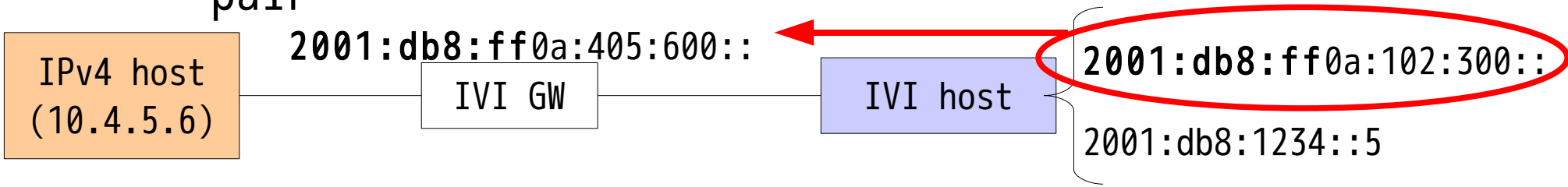
- Address Assignment
  - RA can not distribute 1:1 mapping address
  - DHCPv6 is required
    - But need to install DHCPv6 client software
      - e.g., dibbler, WIDE-DHCPv6, ISC-DHCP-4 for *nix
      - Vista supports DHCPv6 (kicked if RA M&O flags is on)
    - There is no way to recognize the assigned address is as a 1:1 mapping address

Summary (cont'd)

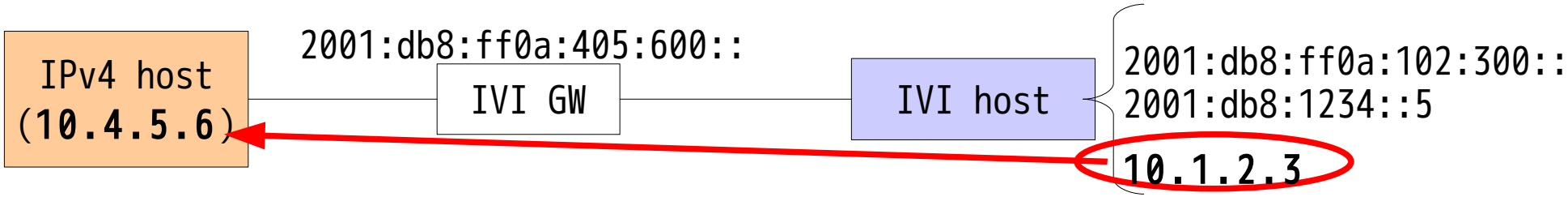
- Protocols that are carrying IP addresses
  - Need ALG (SIP, some web applications,etc)
  - Same problem in IPv4-NAT
    - will be gone after IPv6 deployment
- Using DNSSEC
  - Validating resolver case
    - IVI6 client (stub resolver) CAN NOT validate the synthesized AAAA RR
  - Validating server case
    - IVI-DNS (DNS-ALG) CAN validate the original A RR
  - Other technique? => incremental signing

Summary (cont'd)

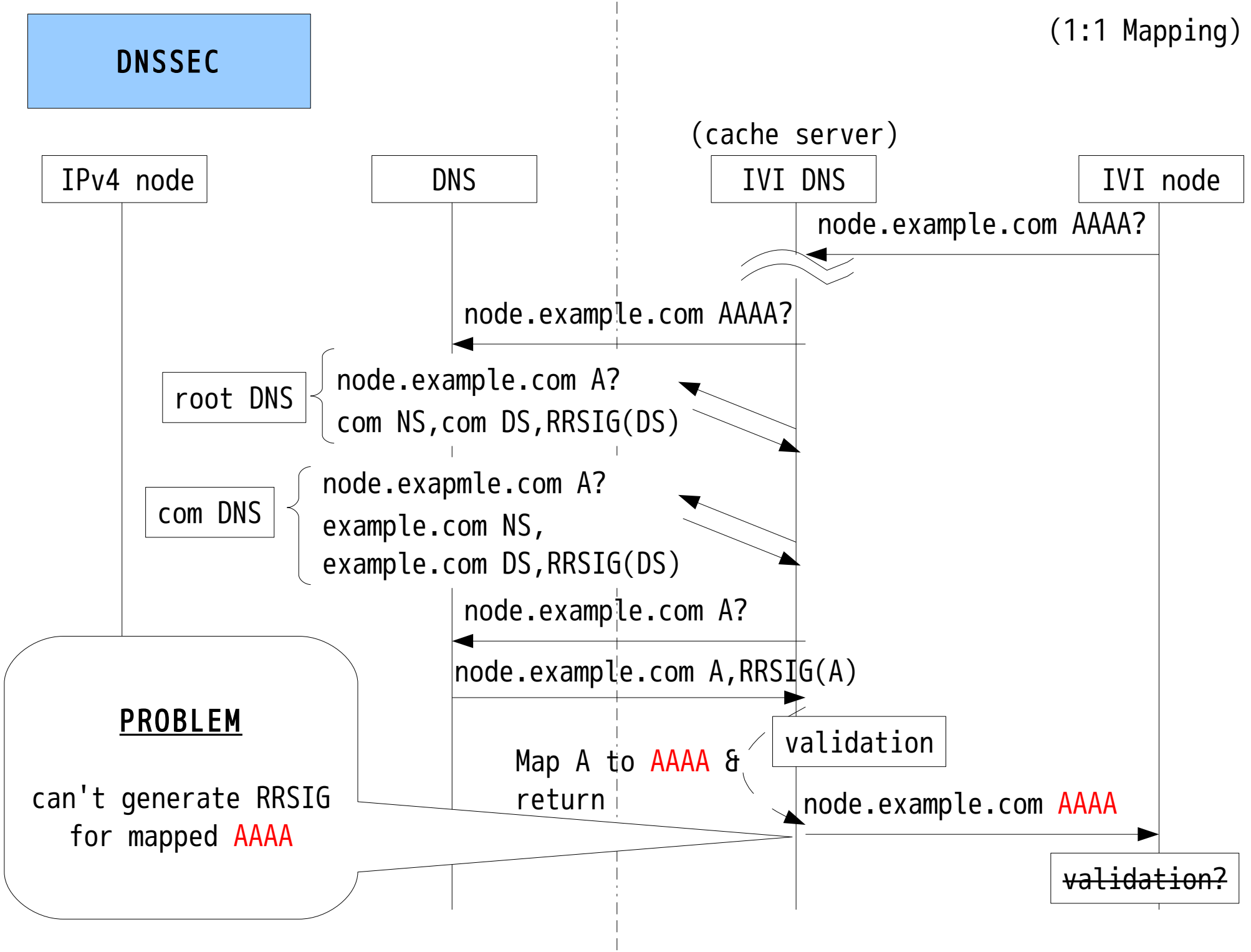
- Address selection
  - In IPv6 only network
    - IPv6 only host must select most similar addresses pair



  - In dual-stack network
    - Host must use/select IPv4 (address) if destination is a synthesized IPv6 address



Appendix


DNSSEC
(1:1 Mapping)
(cache server)
IPv4 node
DNS
IVI DNS
IVI node
node.example.com AAAA?
node.example.com AAAA?
root DNS
node.example.com A?
com NS,com DS,RRSIG(DS)
com DNS
node.exapmle.com A?
example.com NS,
example.com DS,RRSIG(DS)
node.example.com A?
node.example.com A,RRSIG(A)
validation
Map A to AAAA &
return
node.example.com AAAA
validation?
PROBLEM
can't generate RRSIG
for mapped AAAA

IVI Stateful Operation

- Use port multiplexing technique
  - IVI GW need to manage a lot of states