

# The Design and Implementation of a Dual-stack Mobile Network using IPv6 Only Network Infrastructure

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# Background

- NEMO (Network Mobility) protocol for IPv6 (NEMO BS) specification has been specified as RFC3963
- NEMO BS provides IPv6 NEMO, and it can be operated on IPv6
- There is big interest in NEMO technology
  - Vehicles, Personal Area Networks

# IPv6 deployment problem

- Most people do not have a good reason to deploy IPv6 immediately
- We are understanding that IPv6 deployment will take longer period than we initially expected 10 years ago
- We will see a long period which IPv4 and IPv6 coexist and they are operated simultaneously during the transition period
- Many people will need IPv4 connectivity in addition to IPv6 connectivity

# NEMO BS concerns

- NEMO BS can be operated only over IPv6 network, and only provides IPv6 NEMO
- However, many people will need IPv4 support too, especially during the transition period

# Goals

- IPv6 deployment requires a good reason for people to use IPv6
  - Mobility is one of such reasons
- NEMO BS requires IPv4 support to be used by people
- **These two goals can be achieved at the same time**

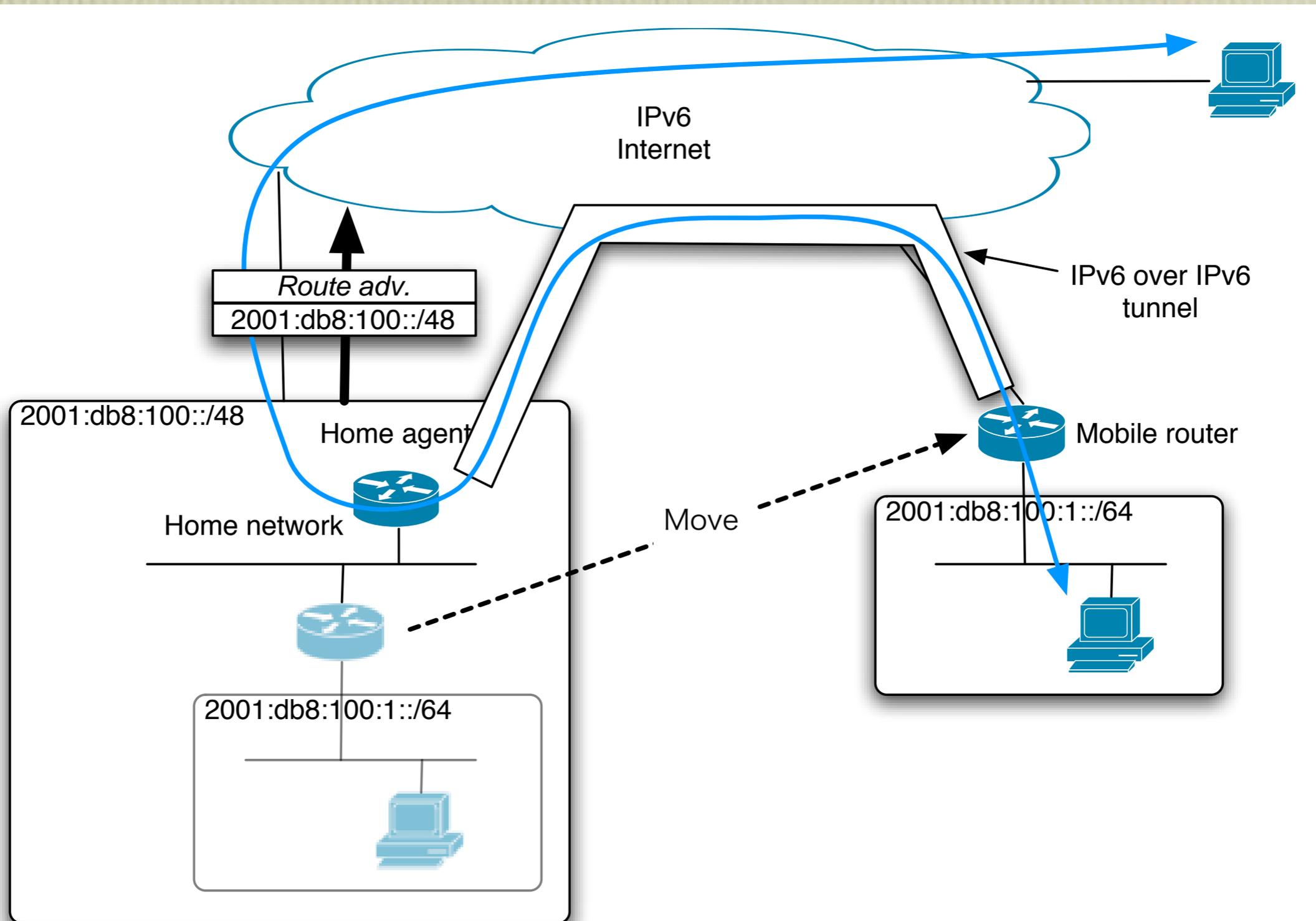
# NEBO BS and IPv4 support

- Users can use the existing IPv4 network even if we introduce NEMO BS to the user's network
- Users will get not only IPv6 NEMO but also IPv4 NEMO
- Once the transition has been completed, what users need to do is only to stop IPv4 operation. They can continue to use IPv6 without any changes

# NEMO BS overview

- A mobile router (MR) carries its mobile network (e.g. 2001:db8:100:1::/64)
- The MR registers binding information between its care-of address and the prefix of the mobile network (MNP)
- An IPv6 over IPv6 tunnel is established between the MR and its home agent (HA)
- All packets destined to the MNP are routed to the HA and tunneled to the mobile router
- All packets from the MNP are tunneled to the HA

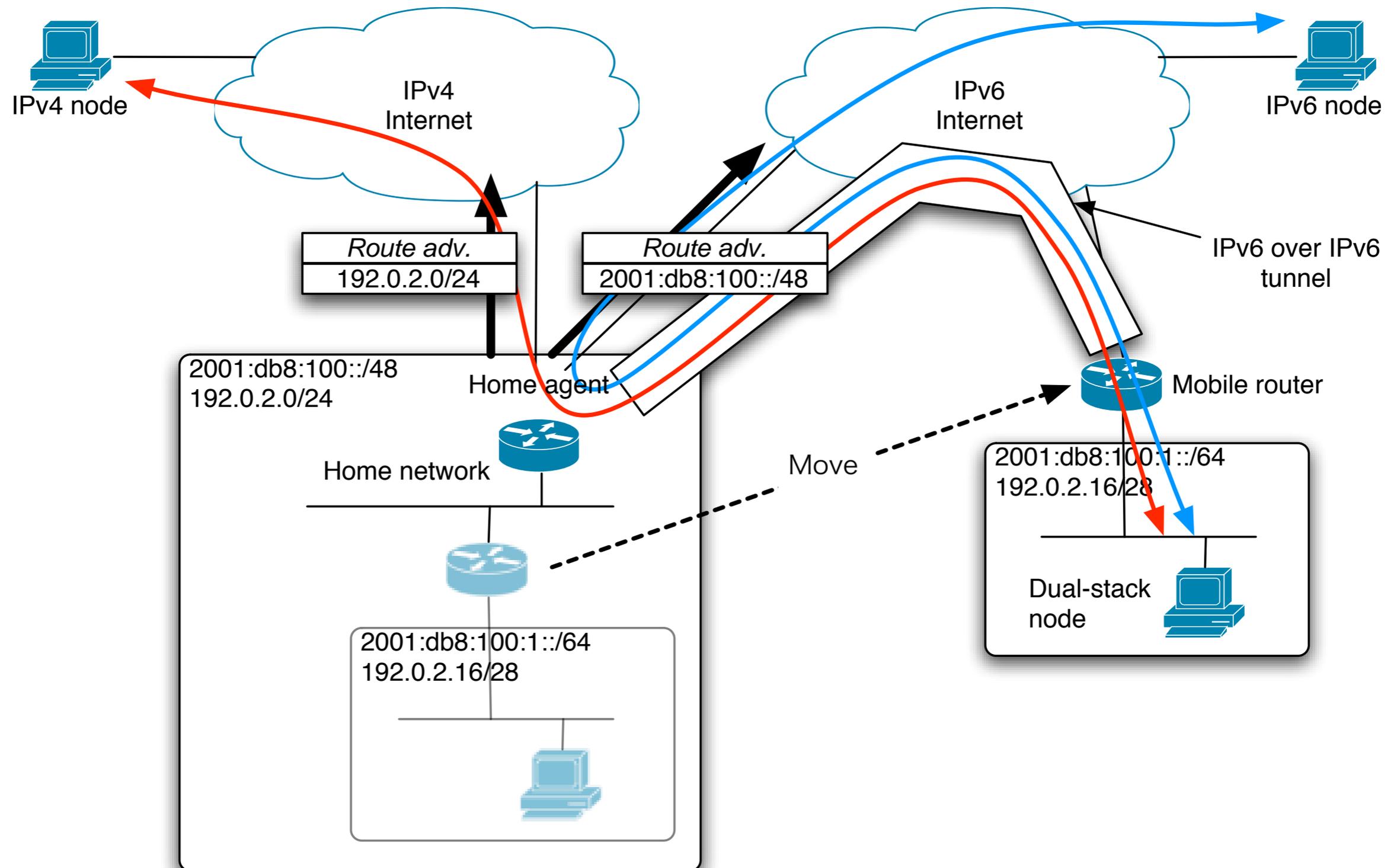
# NEMO BS overview



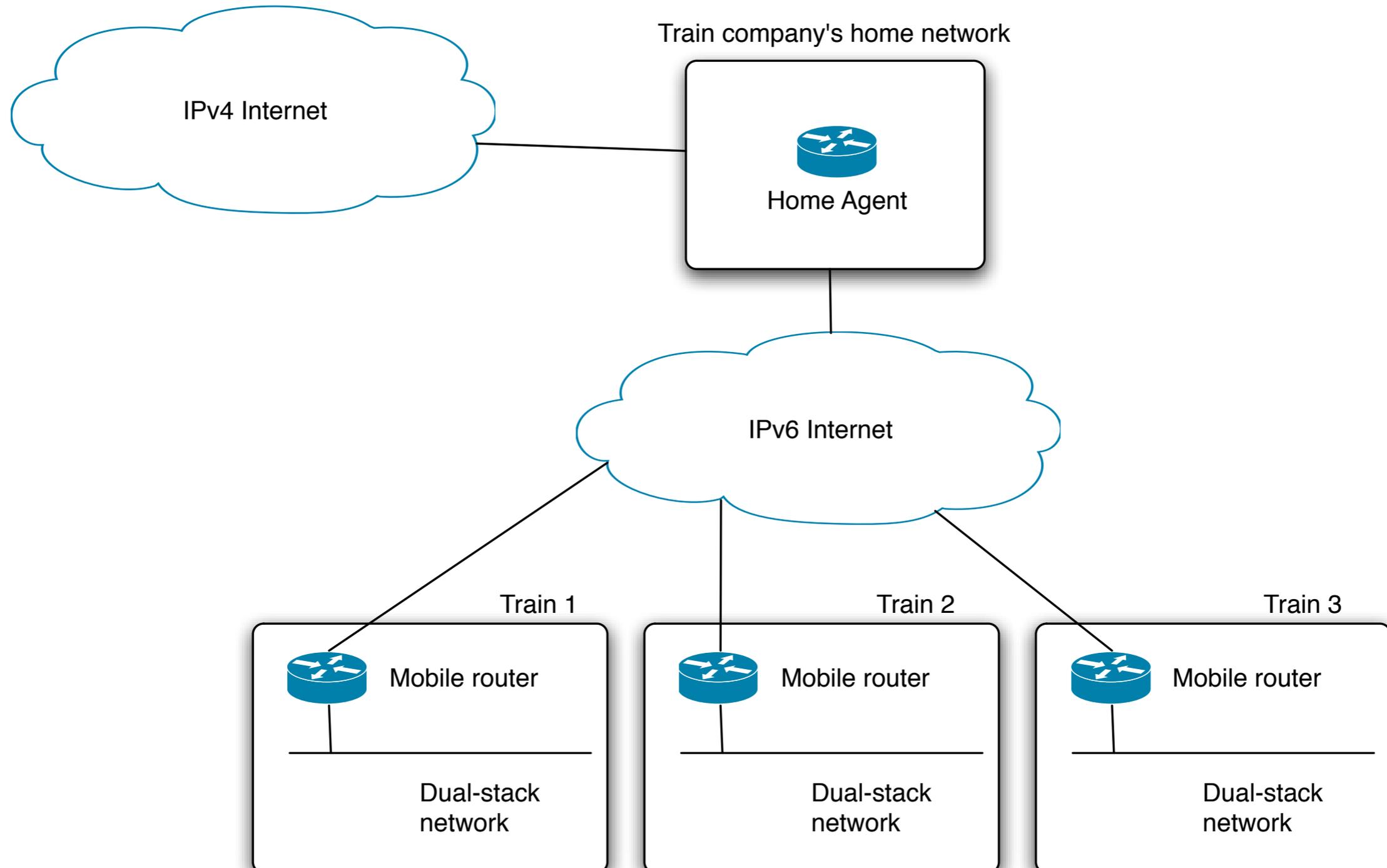
# Proposed mechanism

- A MR registers its care-of address and IPv6 MNP (e.g. 2001:db8:100:1::/64) and IPv4 MNP (e.g. 192.0.2.16/28) simultaneously
- Route information for the MNPs (both IPv4 and IPv6) are advertised from its home network
- Both IPv4 and IPv6 packets from/to the MNPs are tunneled over the IPv6 over IPv6 tunnel established between the MR and the HA

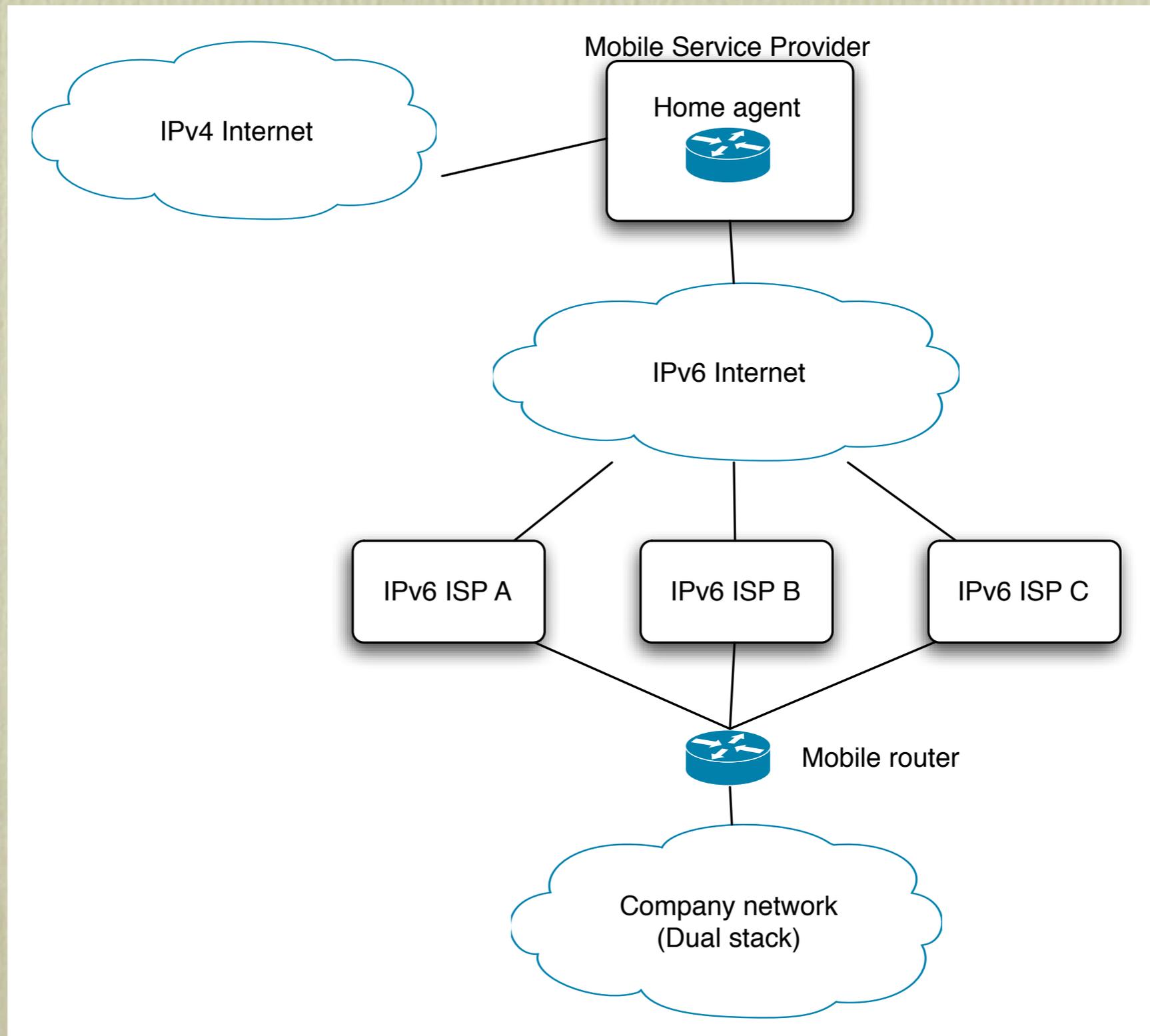
# Proposed mechanism



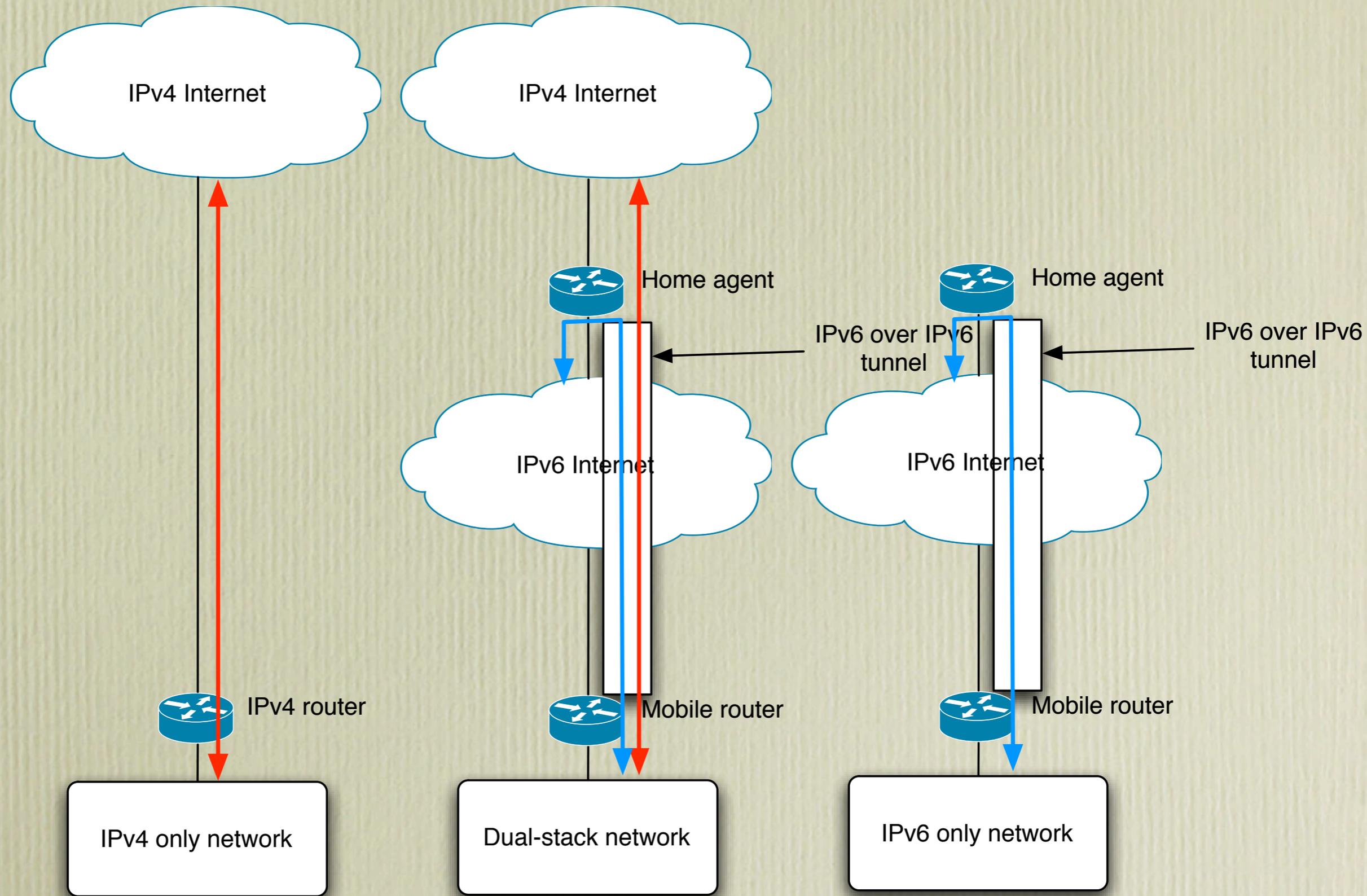
# Usage scenario I (Train company)



# Usage scenario 2 (Multihomed site)



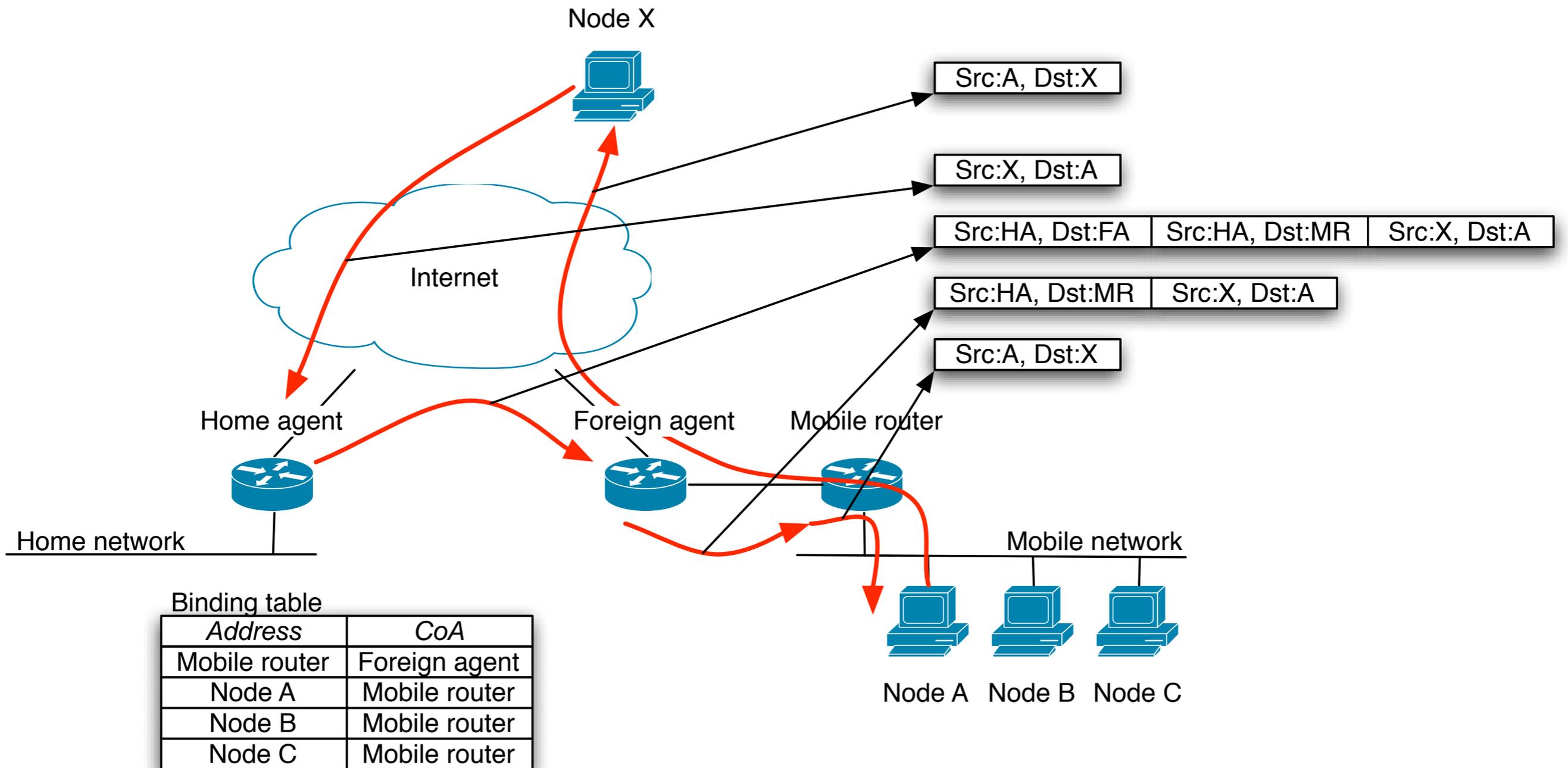
# Transition scenario



# Comparison with other similar mechanisms

- MIPv4 based solution (described in RFC3344, “IP Mobility Support for IPv4”)
- NEMOv4 solution (described in draft-leung-nemov4-base, “IPv4 Network Mobility Basic Support Protocol”)
- Dual-stack solution (described in draft-ietf-mip6-nemo-v4traversal, “Dual Stack Mobile IPv6 for Hosts and Routers”)

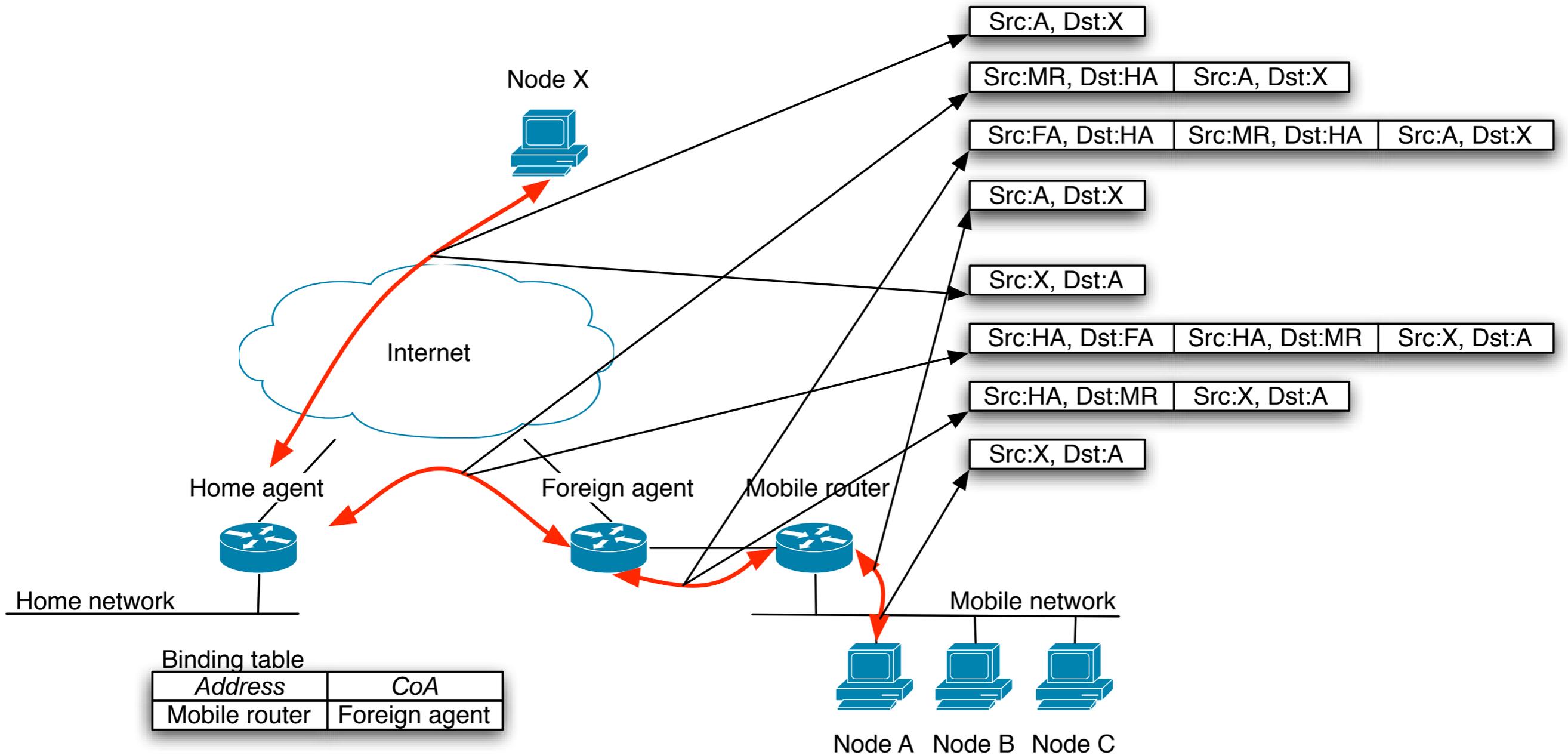
# MIPv4 based solution



# Consideration of MIPv4 based solution

- Sending topologically incorrect packets from nodes inside the mobile network
- Asynchronous behavior when operating NEMO BS and MIPv4 based NEMO for IPv4 mechanism

# NEMOv4 solution



# Consideration of NEMO<sub>v4</sub> solution

- Asynchronous behavior when operating NEMO BS and MIPv<sub>4</sub> based NEMO for IPv<sub>4</sub> mechanism

# Dual-stack solution

- The mechanism proposed in this specification (draft-ietf-mip6-nemo-v4traversal) is similar to our proposal and does not have any significant problems
- We are now focusing on this specification and trying to standardize the specification

# Matrix

Packet source problem      Asynchronous behavior

MIPv4	Yes (Depends on configuration)	Yes
NEMOv4	No (Depends on configuration)	Yes
Dual-stack	No	No
Our mechanism	No	No

# Implementation report

- We have implemented a part of the protocol we proposed
  - IPv4 Mobile Network Prefix registration
  - IPv4 over IPv6 tunnel creation between a mobile router and its home agent
  - Bi-directional communication between IPv4 nodes on the Internet and IPv4 nodes in the Mobile Network
- The code is available for evaluation from <http://www.kame.net/> as a part of the KAME kit

# Conclusion

- IPv6 deployment and NEMO BS deployment problems can be solved when we add IPv4 mobile network support to NEMO BS
- The proposed mechanism will provide seamless transition from IPv4 to IPv6 to existing IPv4 users
- The proposed mechanism does not have problems that similar mechanisms have
- The prototype implementation has been done and proved to work correctly