

# SHISA: The IPv6 Mobility Framework for BSD Operating Systems



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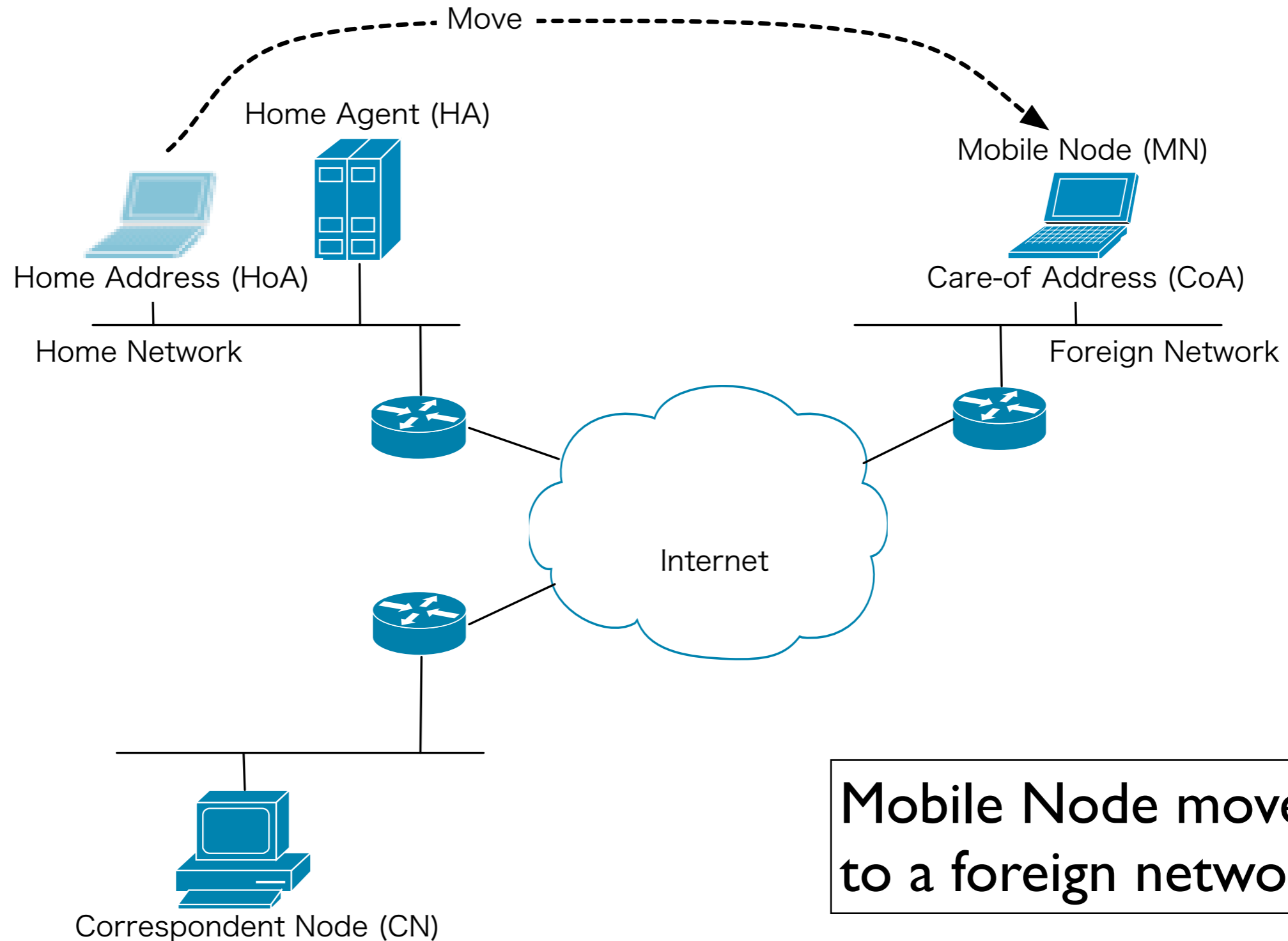
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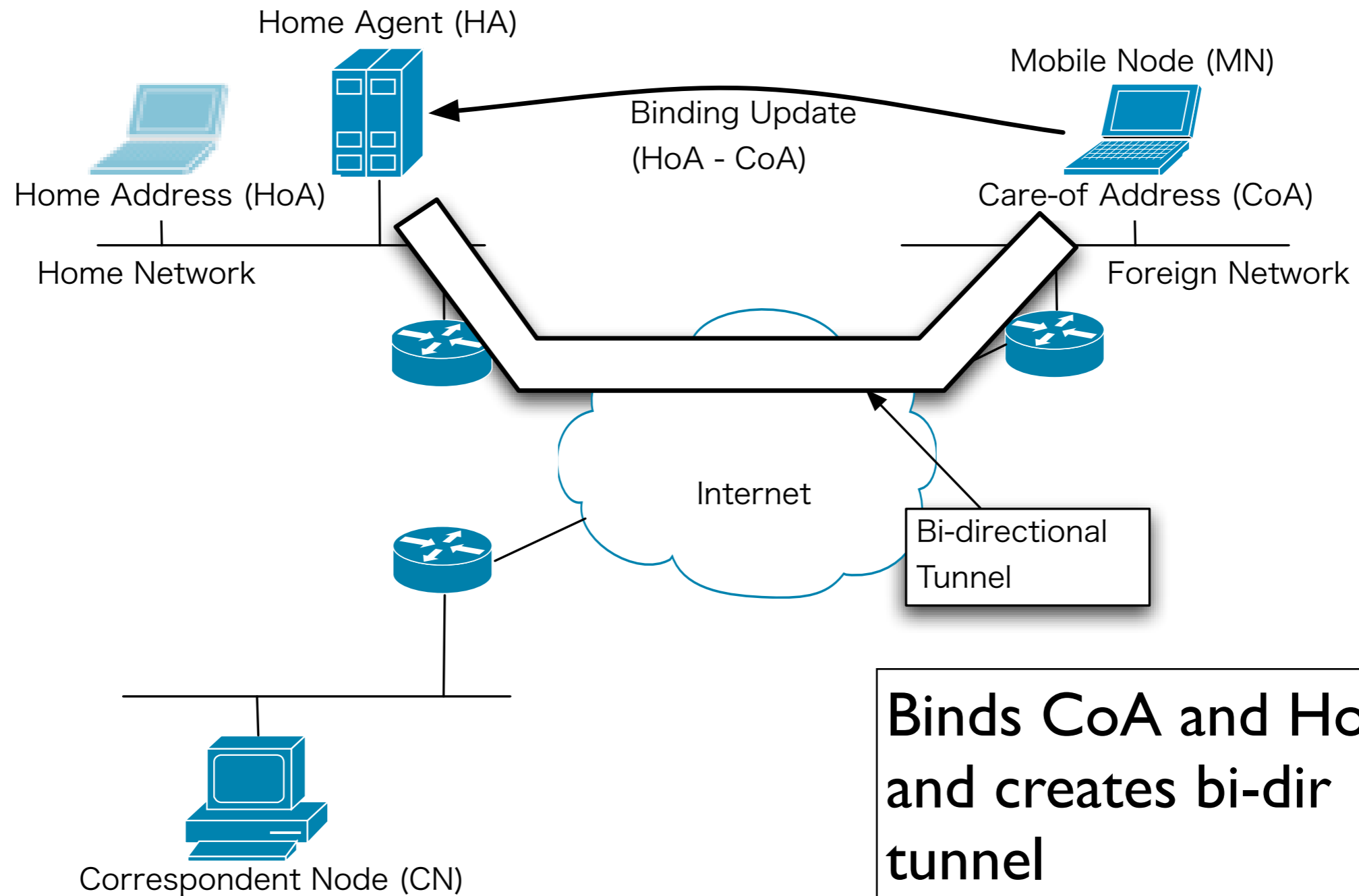
# Objectives

- Deploy IPv6 mobility
  - A free working code as a reference code is important for deployment
    - ex1) the TCP/IP code by UCB
    - ex2) the KAME IPv6 code
- This presentation introduces our implementation and its design

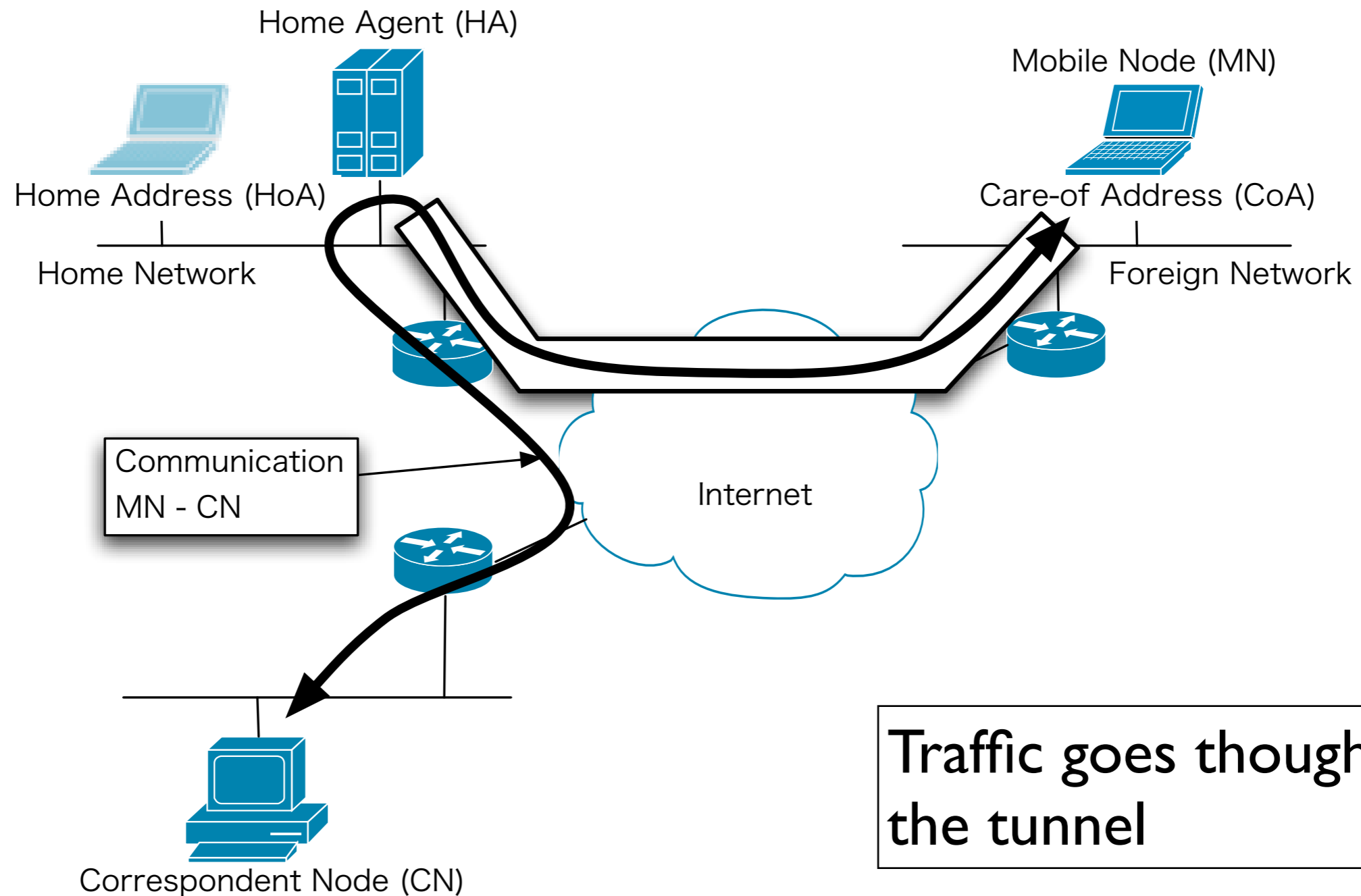
# Mobile IPv6 Overview



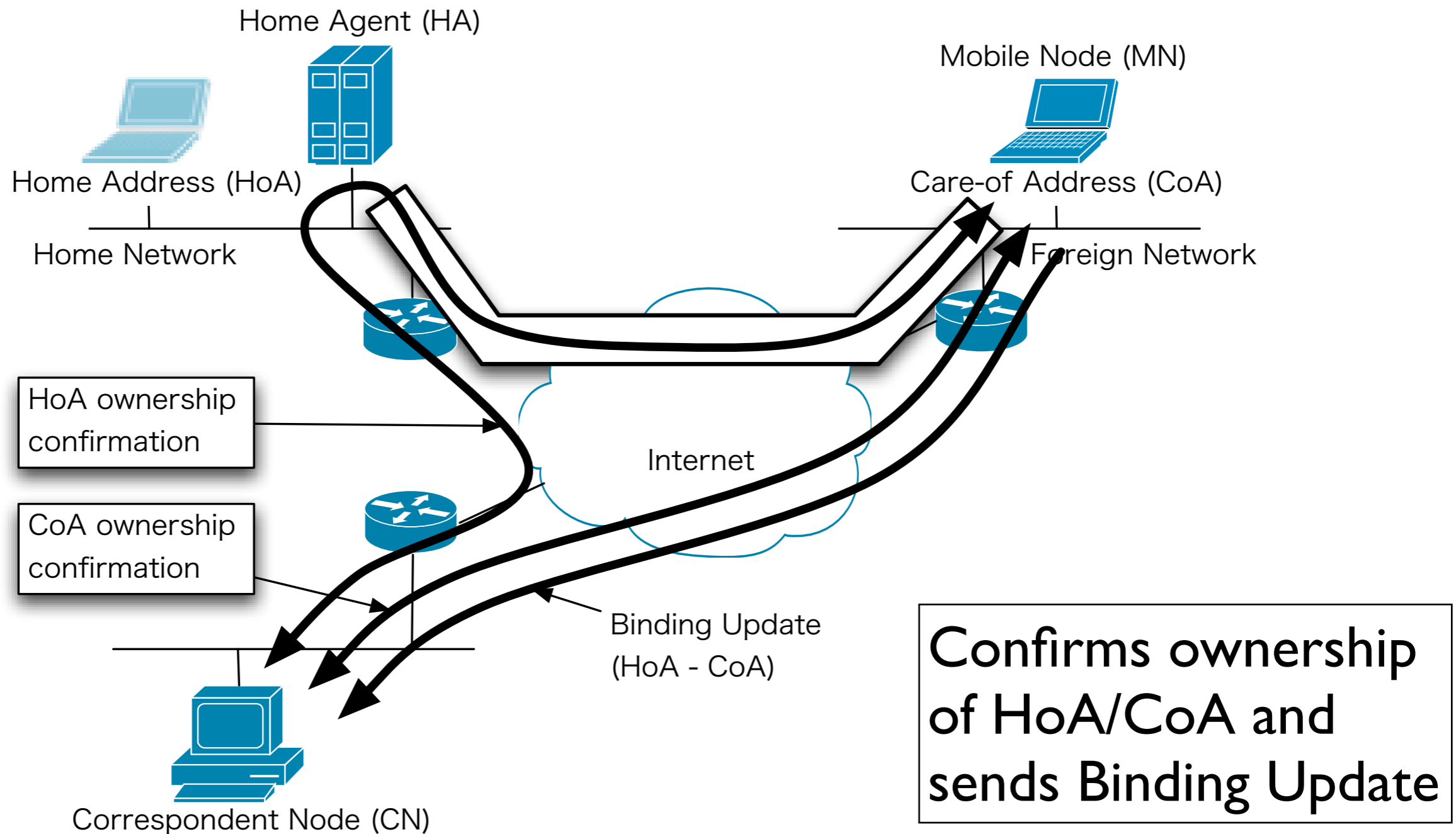
# Mobile IPv6 Overview



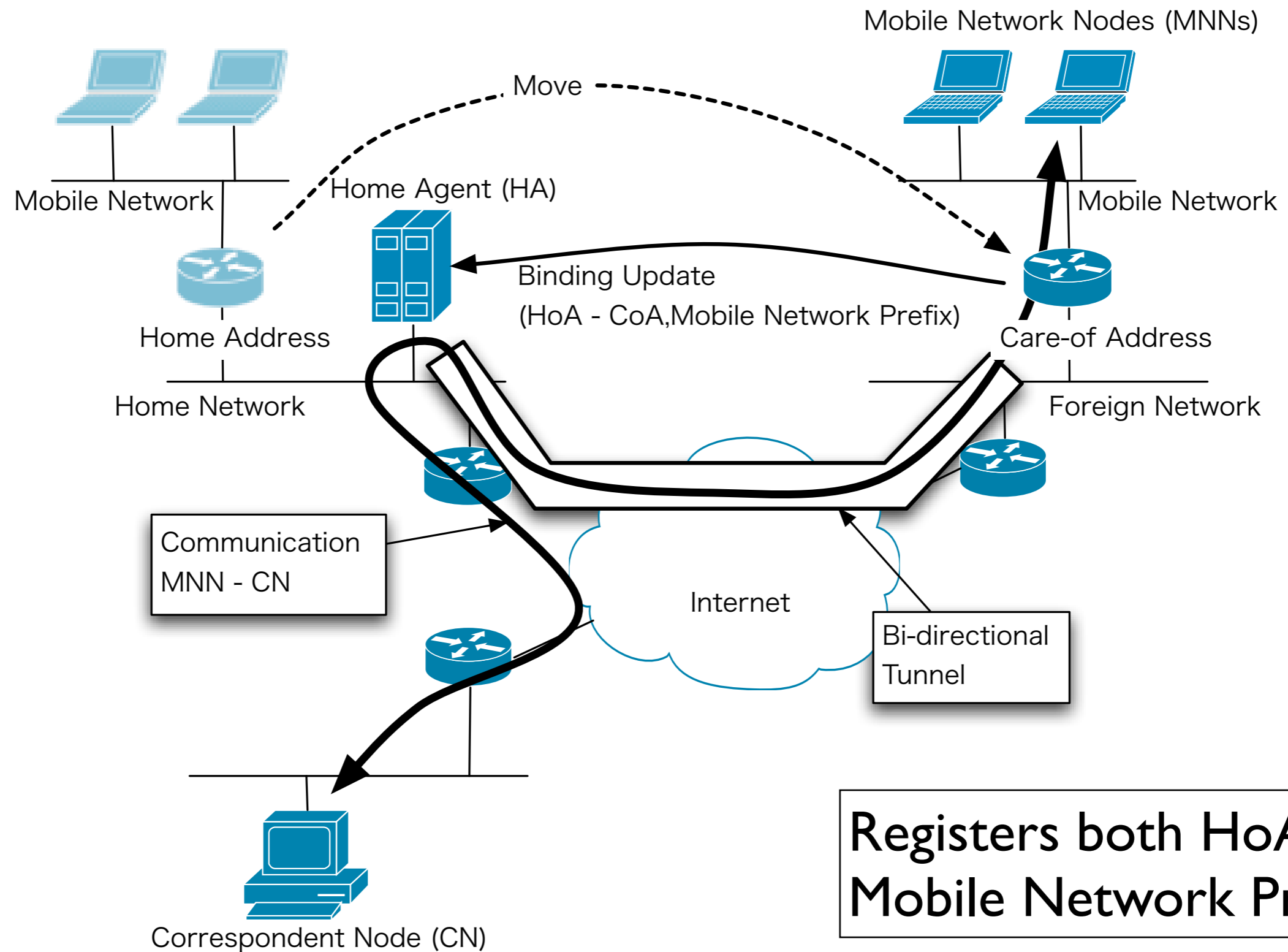
# Mobile IPv6 Overview



# Mobile IPv6 Overview



# NEMO BS Overview



# SHISA Design Goals

- Separation of signaling and data forwarding processing
- Flexibility of network device selection
- Adaptability to various movement scenarios
- Extensibility
- Minimum modification of the kernel

# Implementation

- Supported Features
- System Configuration
- Program Organization, Node Configuration and Module Diagram
- Message Passing System
- Movement Detector
- Extensions

# Supported Features

- Mobile IPv6 (RFC3775 and RFC3776) functions as Mobile Host, Home Agent with Route Optimization
- NEMO BS (RFC3963) functions as Mobile Router and Home Agent
- Multiple Care-of Addresses Registration
- IPv4 Mobile Network Prefix Registration

# Program Organization

- SHISA consists of 6 programs

<b>mnd</b>	Mobile Host Functions
<b>had</b>	Home Agent Functions (for both Mobile IPv6 and NEMO BS)
<b>cnd</b>	Route Optimization Function
<b>babymdd</b>	A simple movement detector
<b>mrd</b>	Mobile Router Functions
<b>nemonetd</b>	Tunnel setup for NEMO BS

# Node Configuration

- Selection of running programs decides the node type
- For Mobile Host
  - **mnd**, **babymdd** and **cnd** (if RO as a CN is required)
- For Home Agent
  - **had**, **cnd** (if RO as a CN is required) and **nemonetd** (if NEMO BS is required)

# Node Configuration

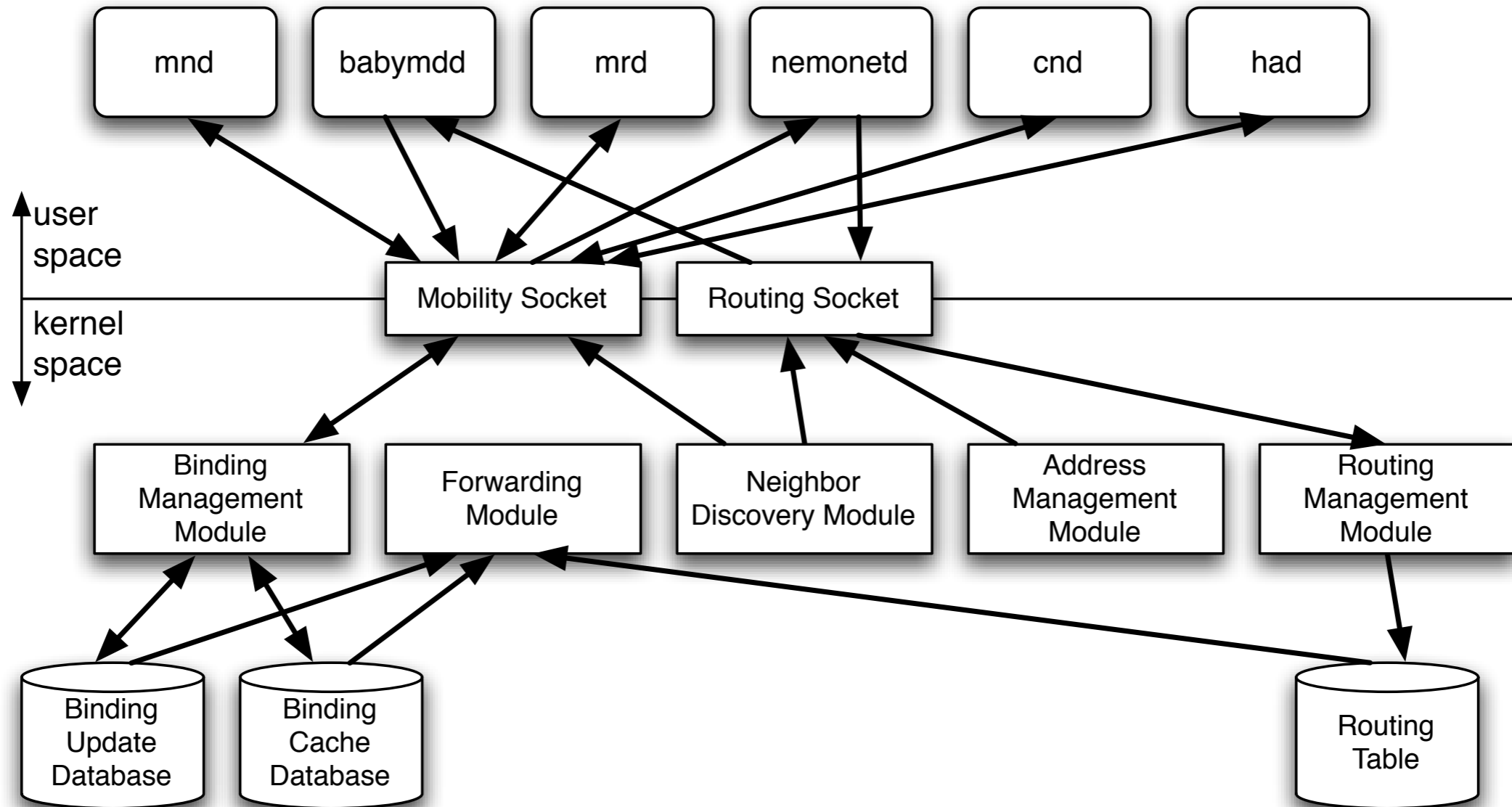
- Required programs

	Mobile Host	Mobile Router	Home Agent	Correspondent Node
<b>mnd</b>	√			
<b>mrdr</b>		√		
<b>babymdd</b>	√	√		
<b>had</b>			√	
<b>nemonetd</b>		√	√	
<b>cnd</b>	√		√	√

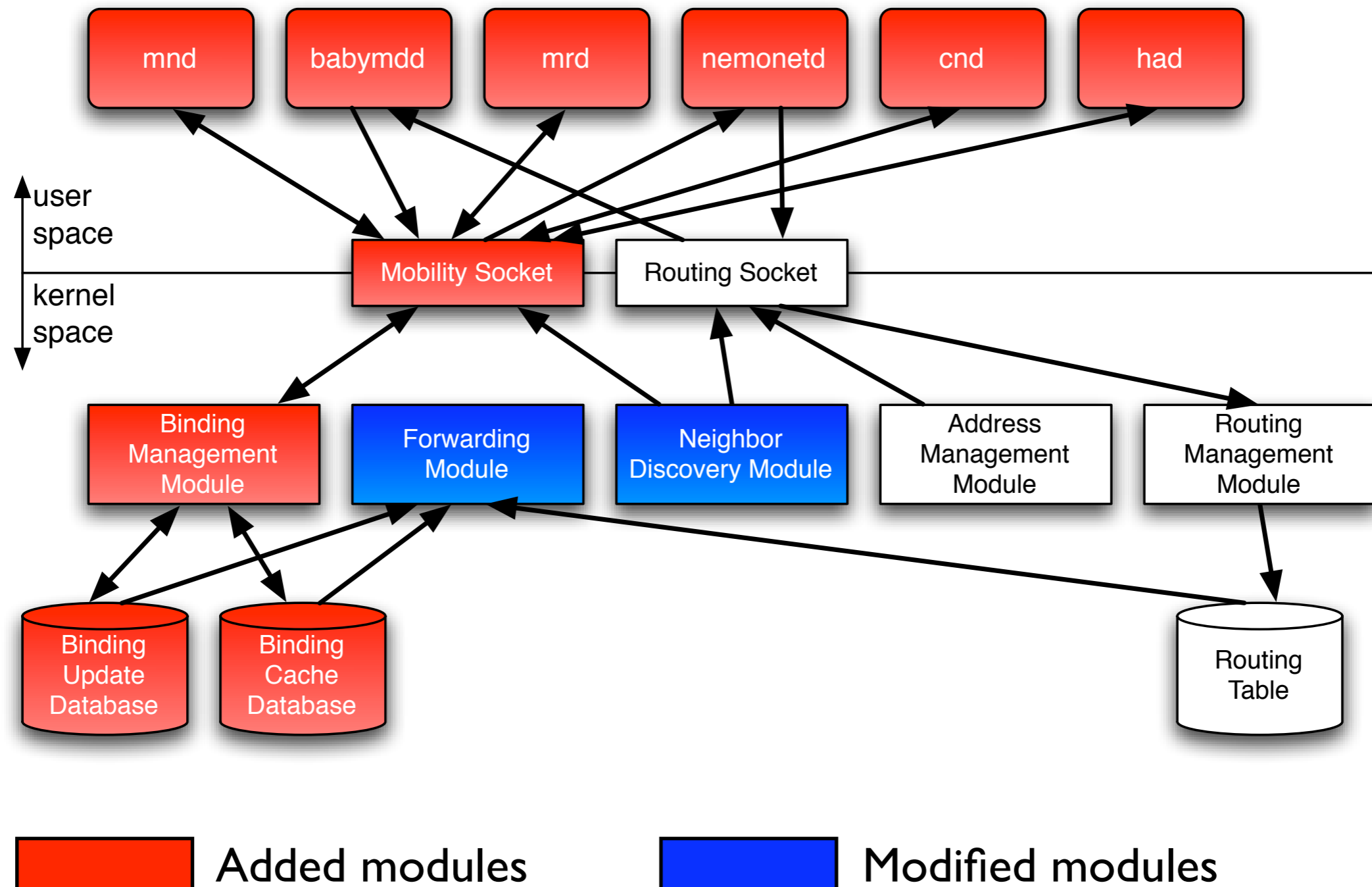
 Required for CN functions

 Required for NEMO functions

# Module Diagram



# Module Diagram

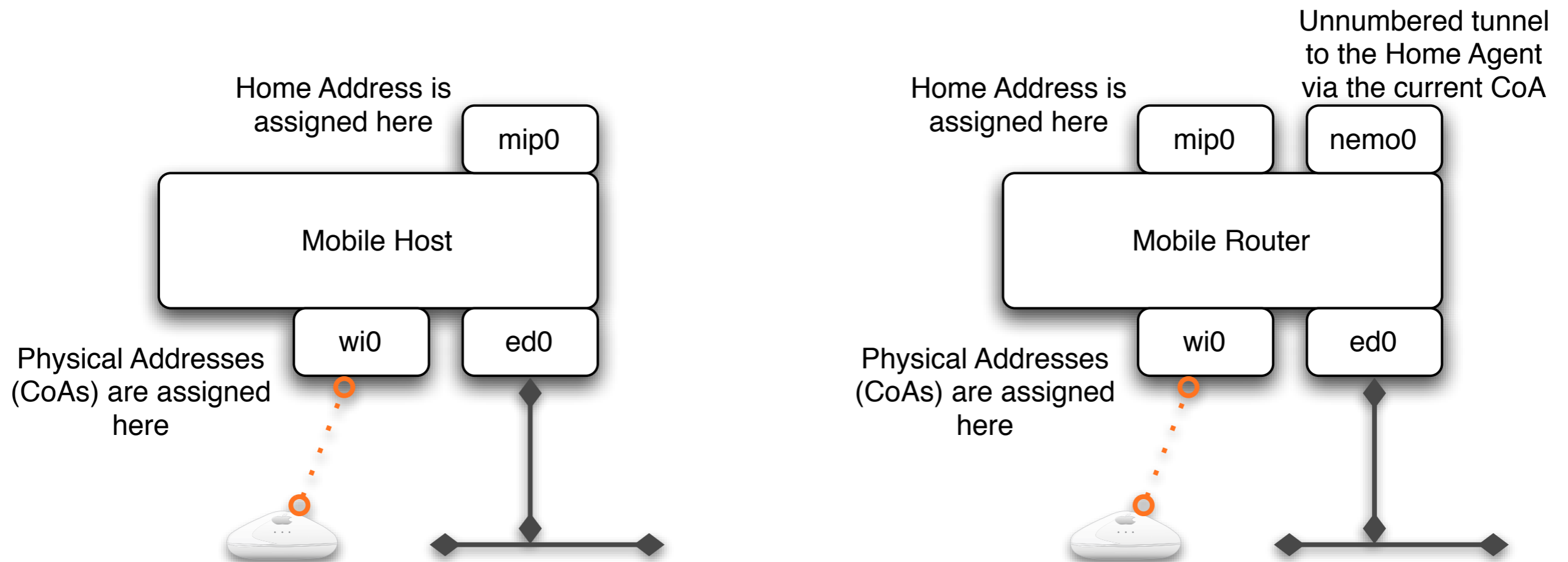


# Virtual Interfaces

- To hide the actual network interface from the mobility stack we introduced the following two virtual interfaces
  - Mobility Interface (`mip` Interface)
    - Represents Home Network
  - NEMO tunnel Interface (`nemo` Interface)
    - Represents NEMO bi-dir tunnel

# Virtual Interfaces

- Mobile Host/Router just binds the logical home address and the current care-of address
- No specific information of the specific network I/F is used
- NEMO BS tunnel interface uses the current care-of address as its end-point address
- Can have multiple nemo I/Fs when multiple CoA is supported



# Message Passing

- A new communication domain socket (Mobility Socket) is designed
  - Similar to the Routing Socket
- Mobility Socket provides
  1. Kernel interface to application programs
  2. Communication method between application programs

# Message Passing

- The benefit of Mobility Socket
  - Simple and Extensible interface using legacy socket interface
  - Common and easy to use in BSD operating systems (and probably in other OSes too)

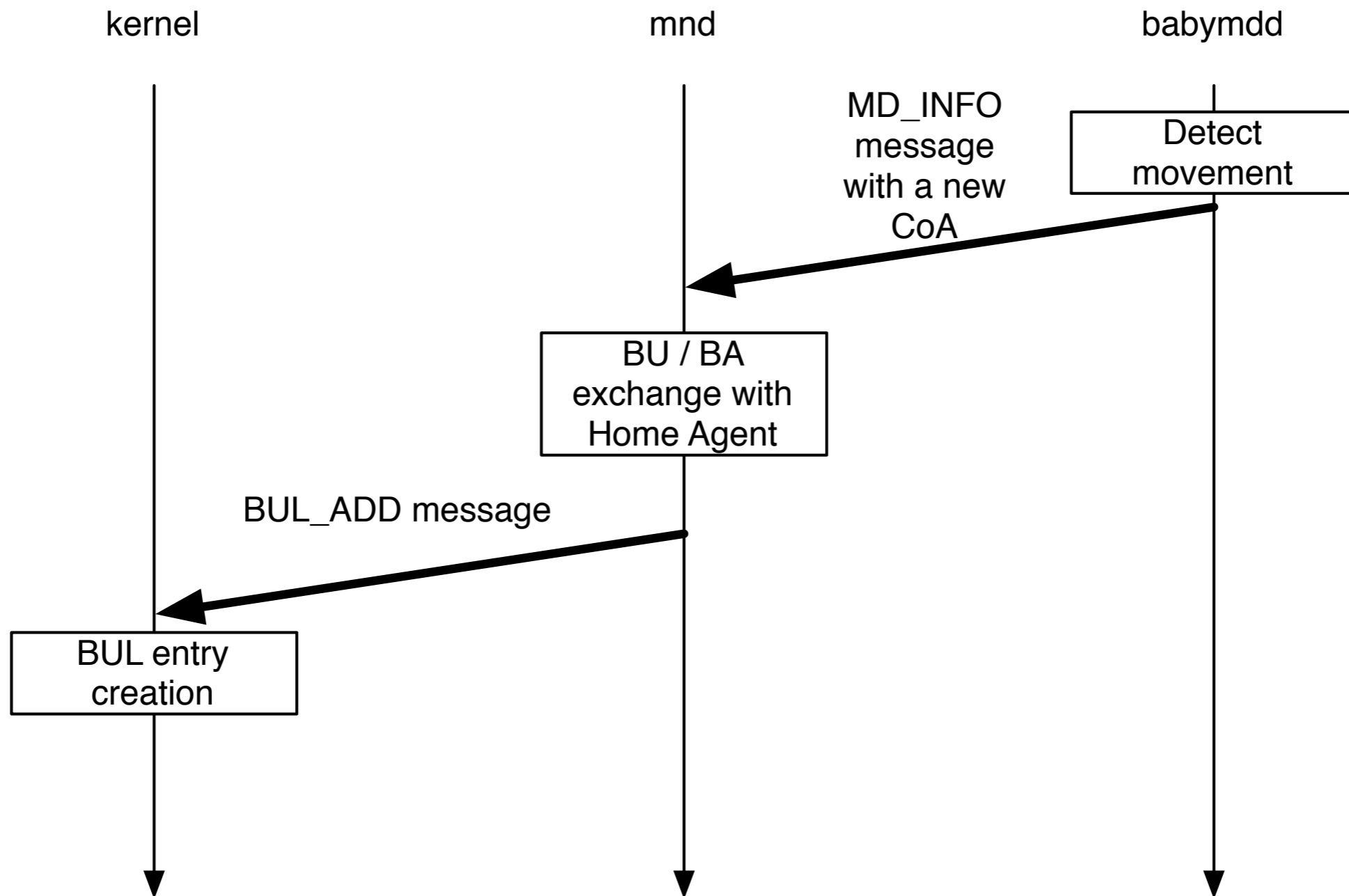
# Message Passing

## Currently defined messages

NODETYPE_INFO	Configure the type of node (MN, MR, HA, CN)
BC_ADD	Add a Binding Cache entry
BC_UPDATE	(same as above)
BC_REMOVE	Remove a Binding Cache entry
BC_FLUSH	Clear all Binding Cache entry
BUL_ADD	Add a Binding Update List entry
BUL_UPDATE	(same as above)
BUL_REMOVE	Remove a Binding Update List entry
BUL_FLUSH	Clear all Binding Update List entry
MD_INFO	Movement information
HOME_HINT	A hint message that a node returns home
RR_HINT	A hint message that a node receives a bi-directional tunneled packet
BE_HINT	A control message from kernel to send a Binding Error message
DAD	A control message to kernel to perform DAD for a specified address

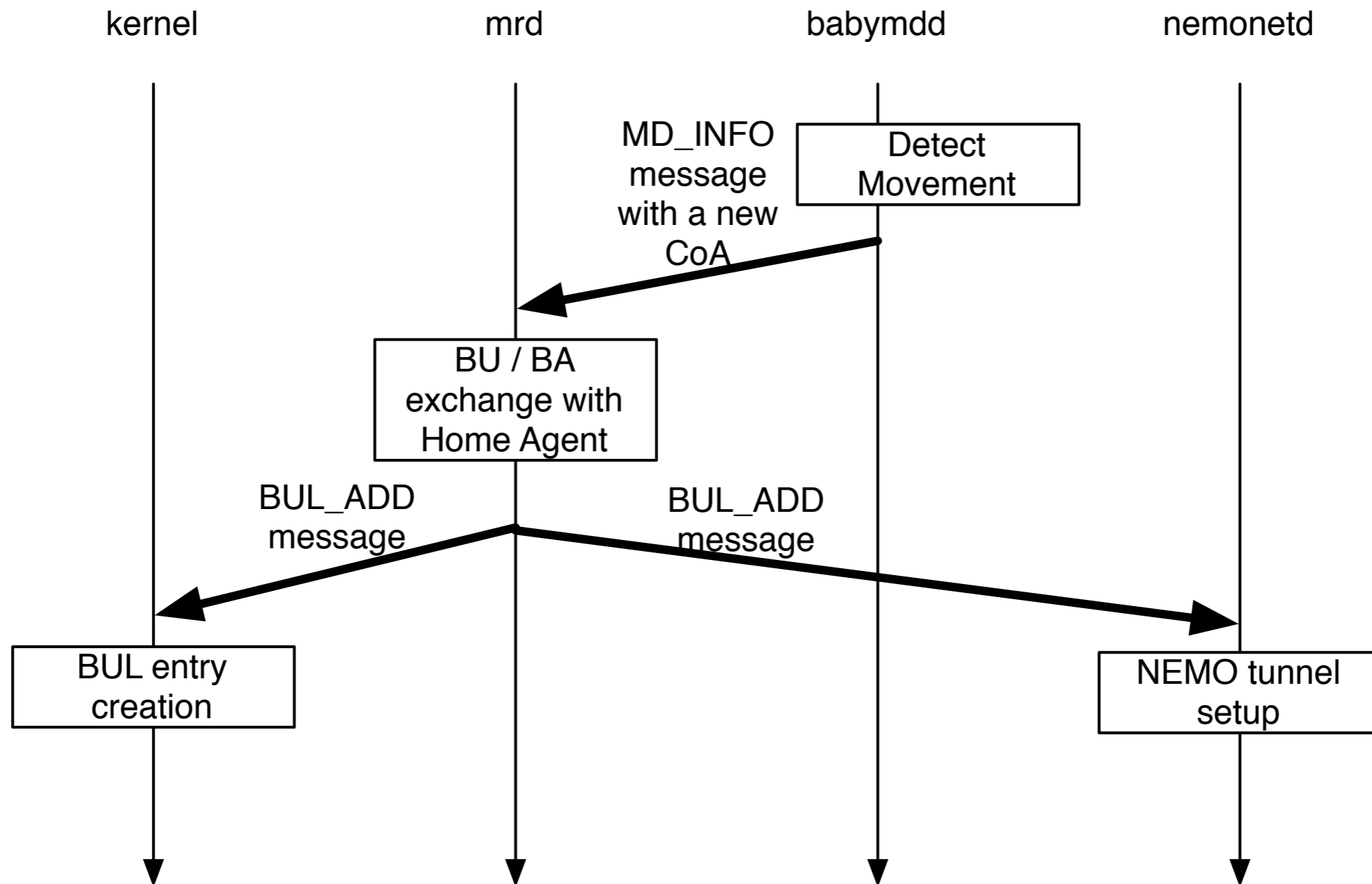
# Message Passing Ex. 1

- Creating a Binding Update List entry



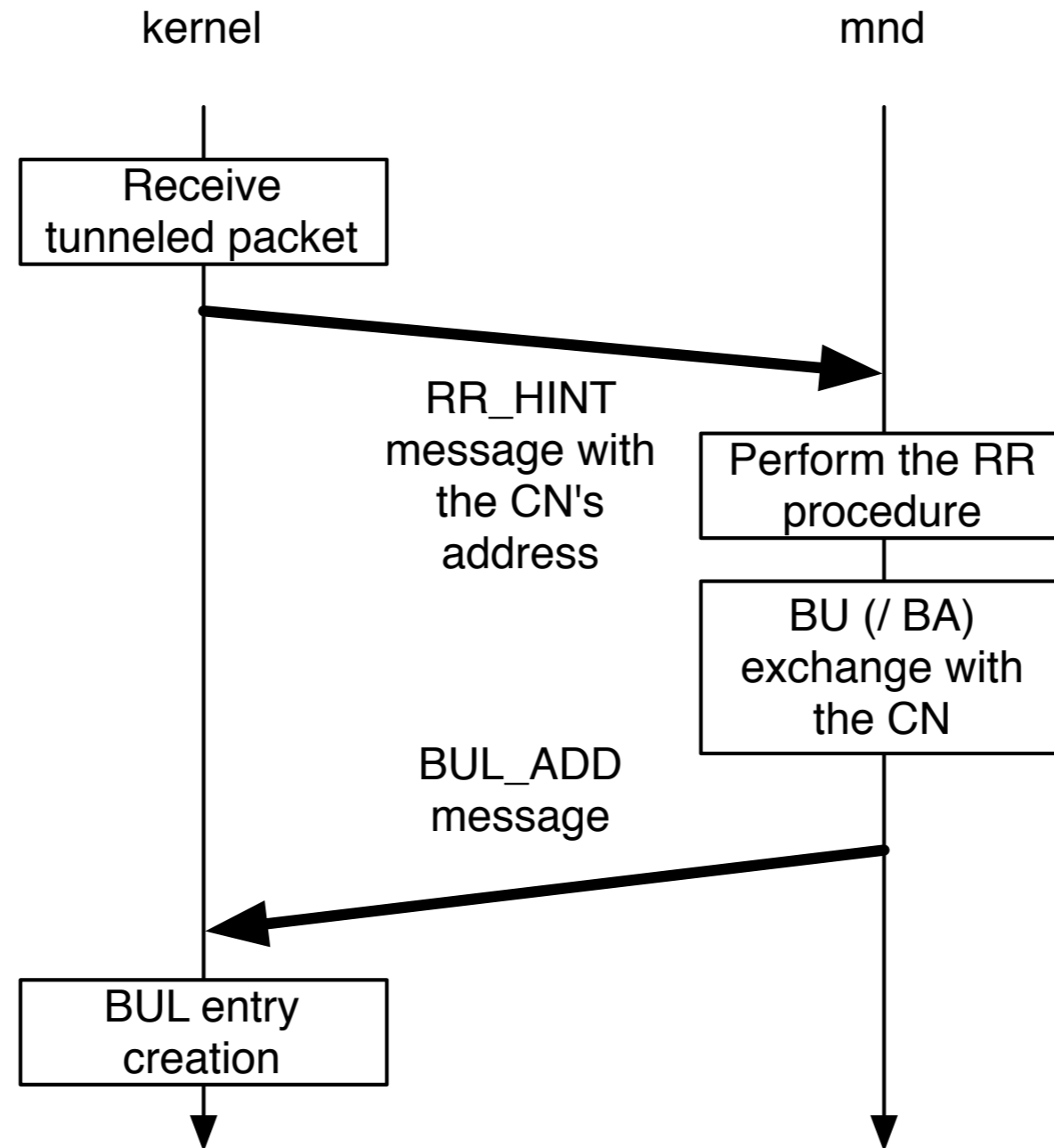
# Message Passing Ex. 2

- Creating a BUL entry in the NEMO BS case

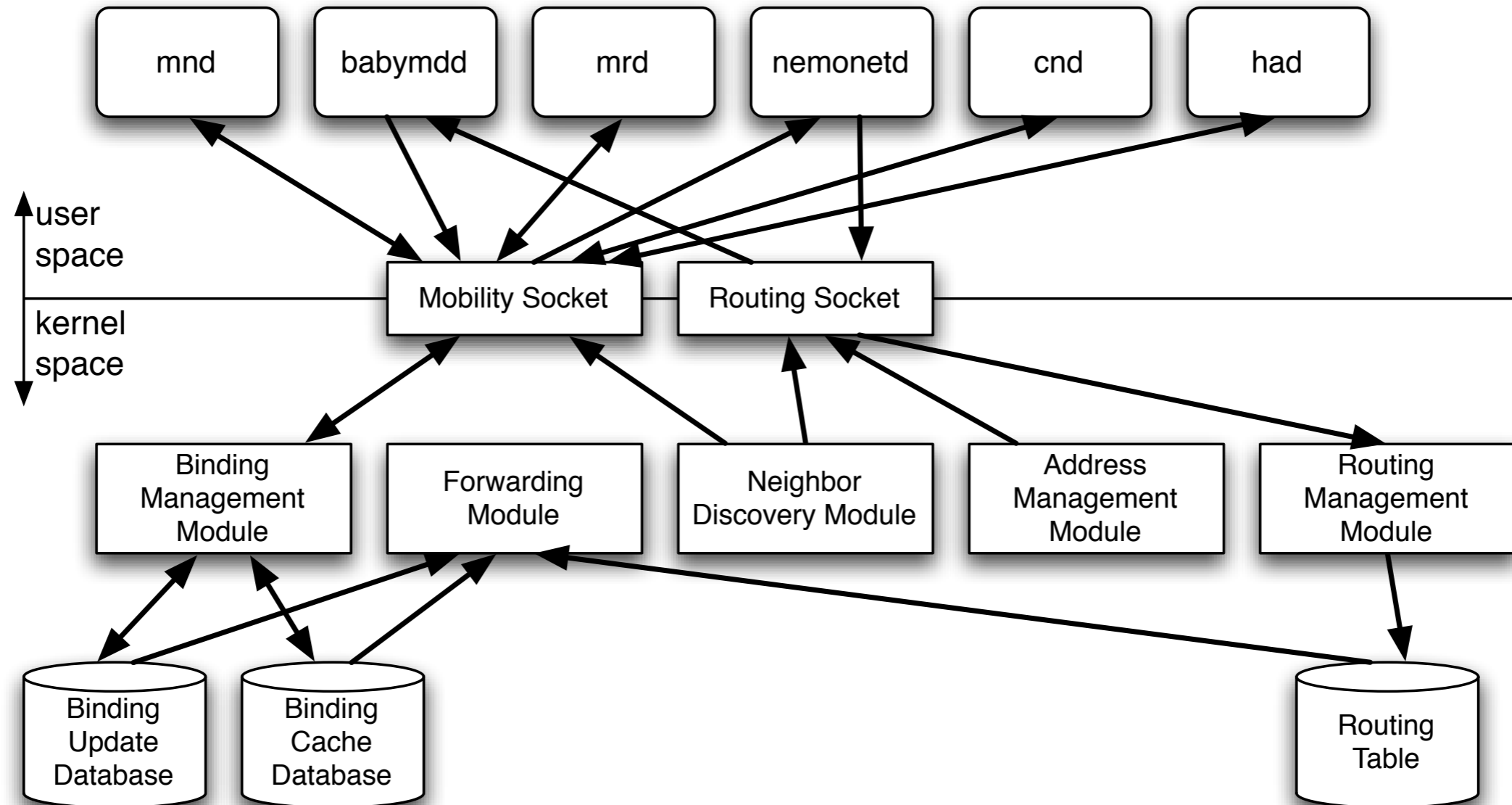


# Message Passing Ex. 3

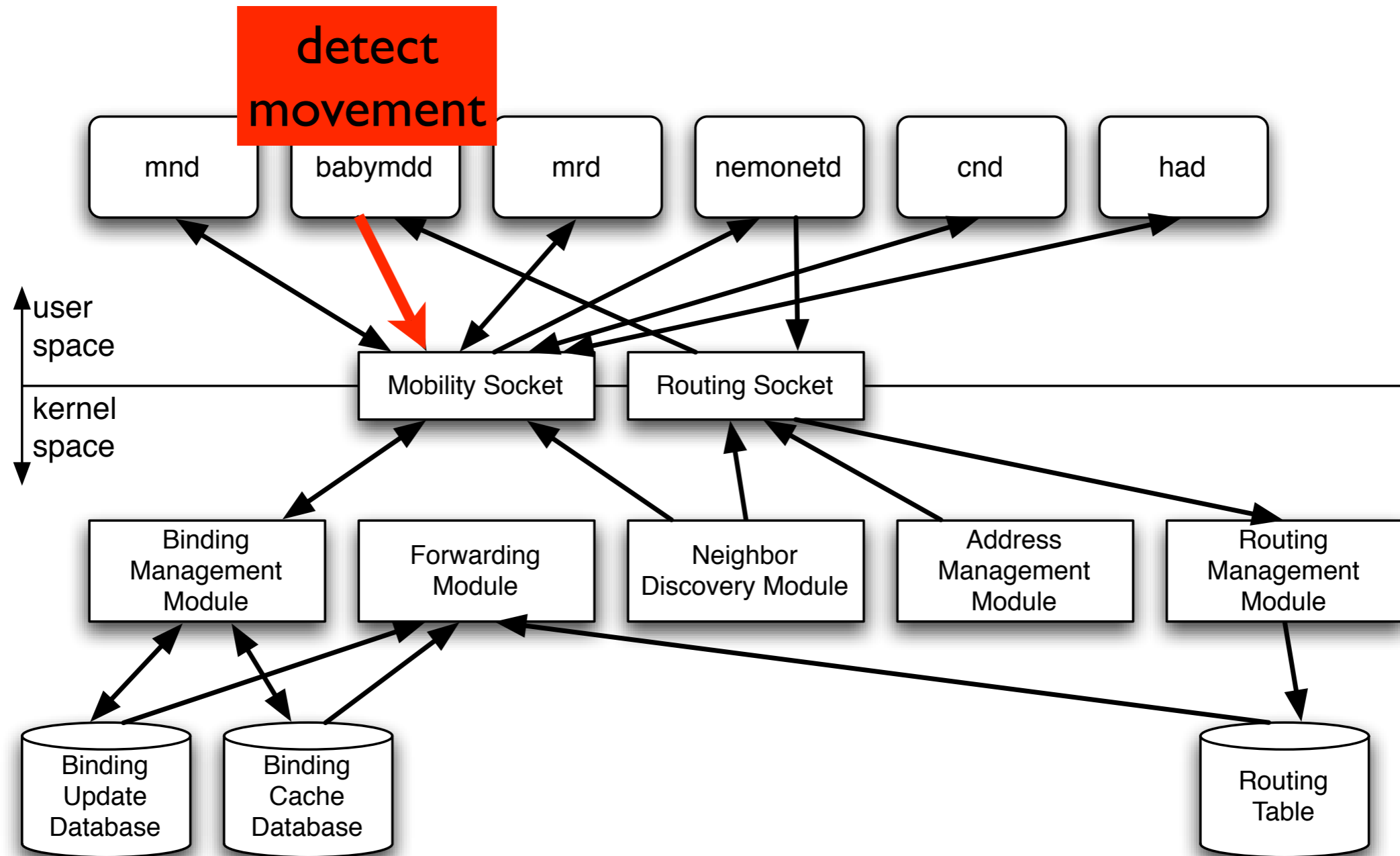
- Notification from the kernel



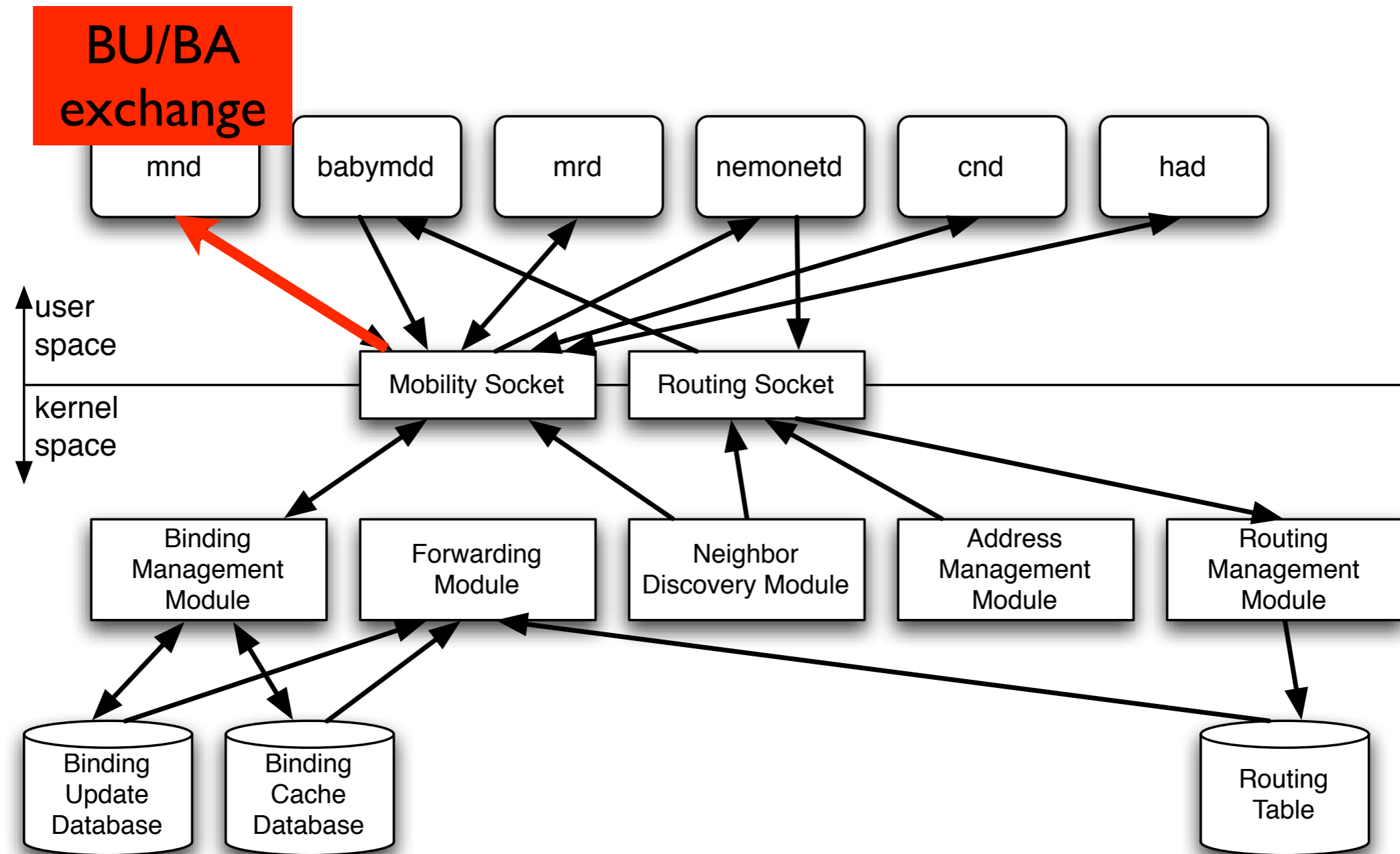
# Message Passing



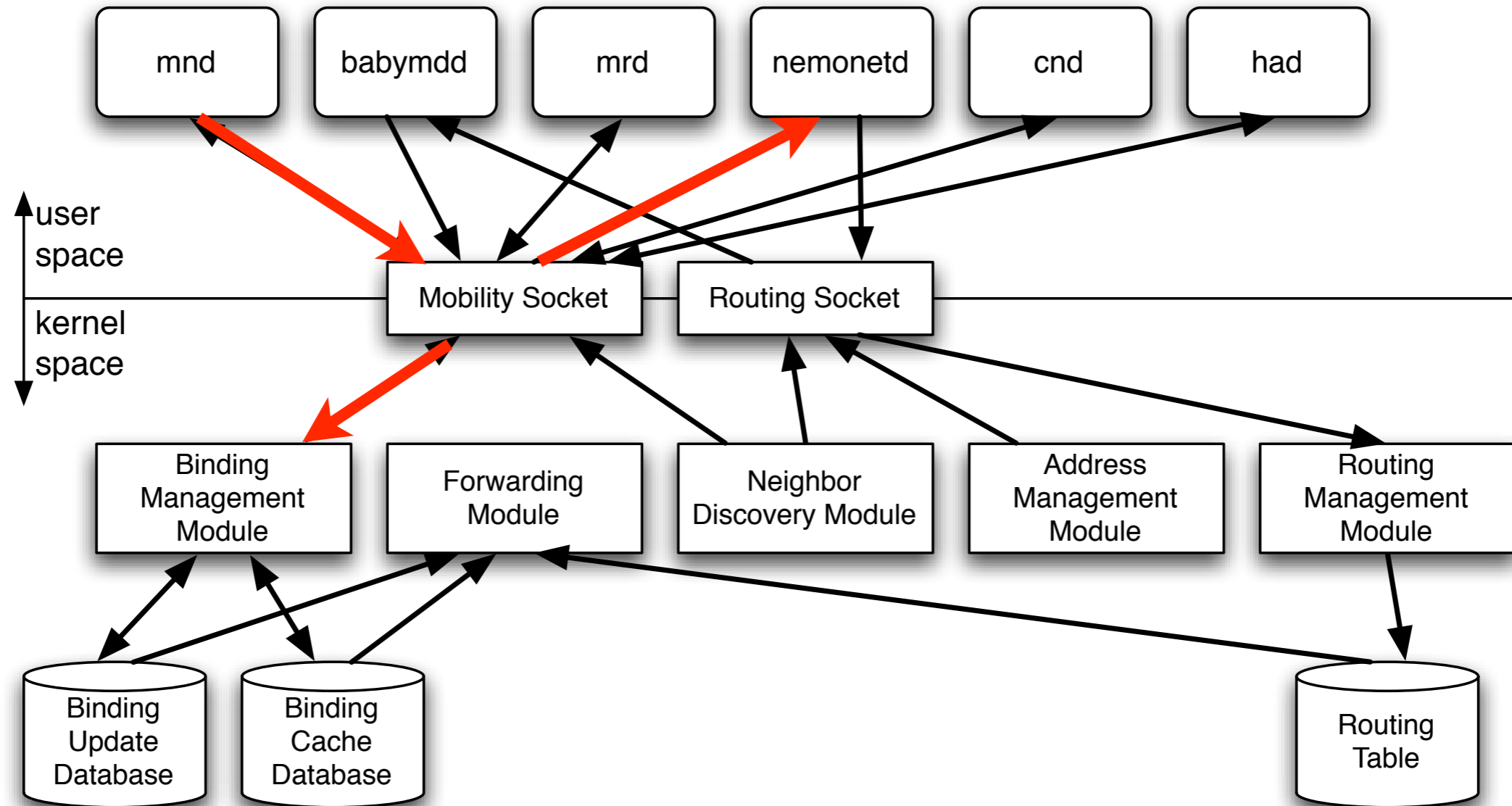
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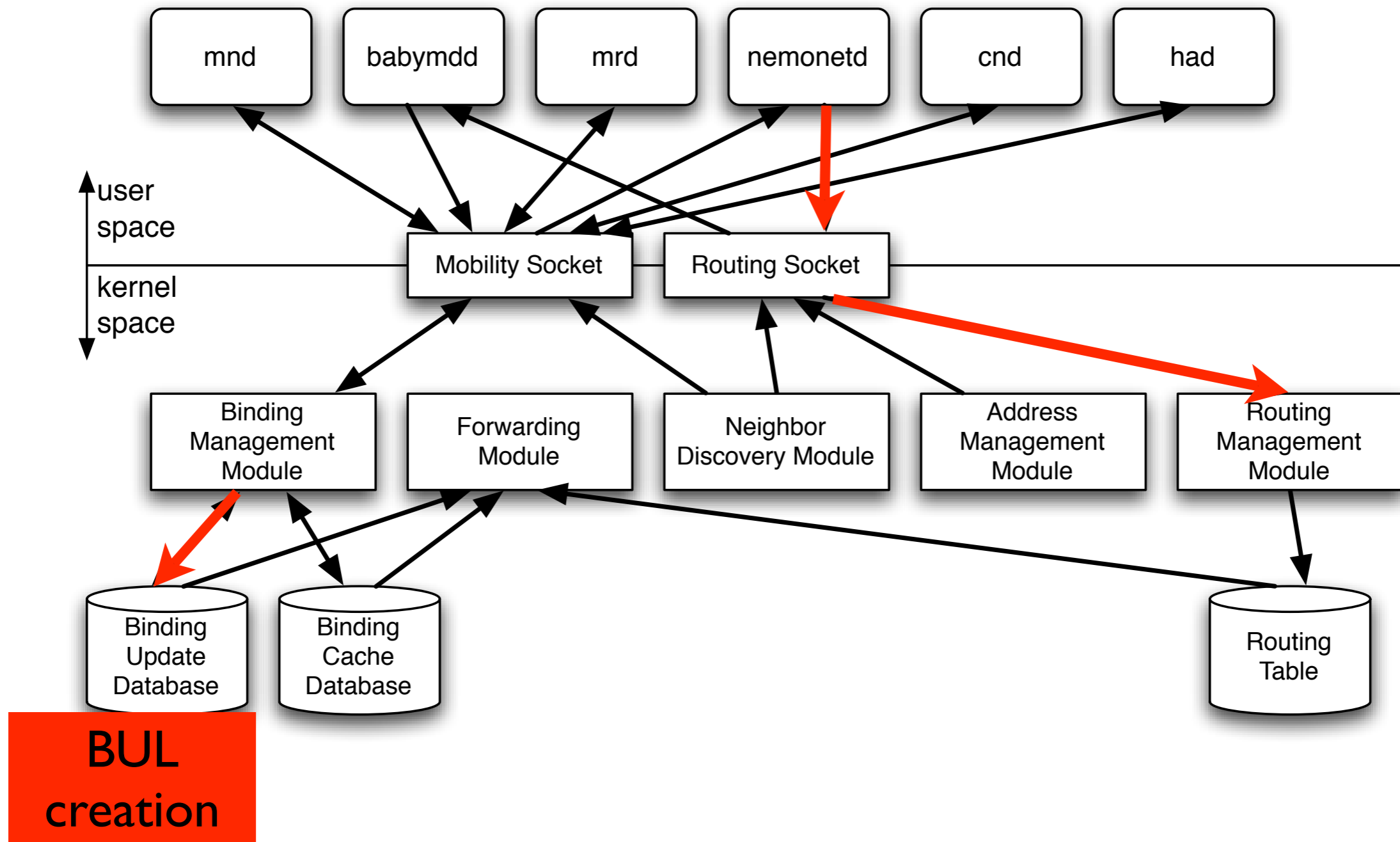
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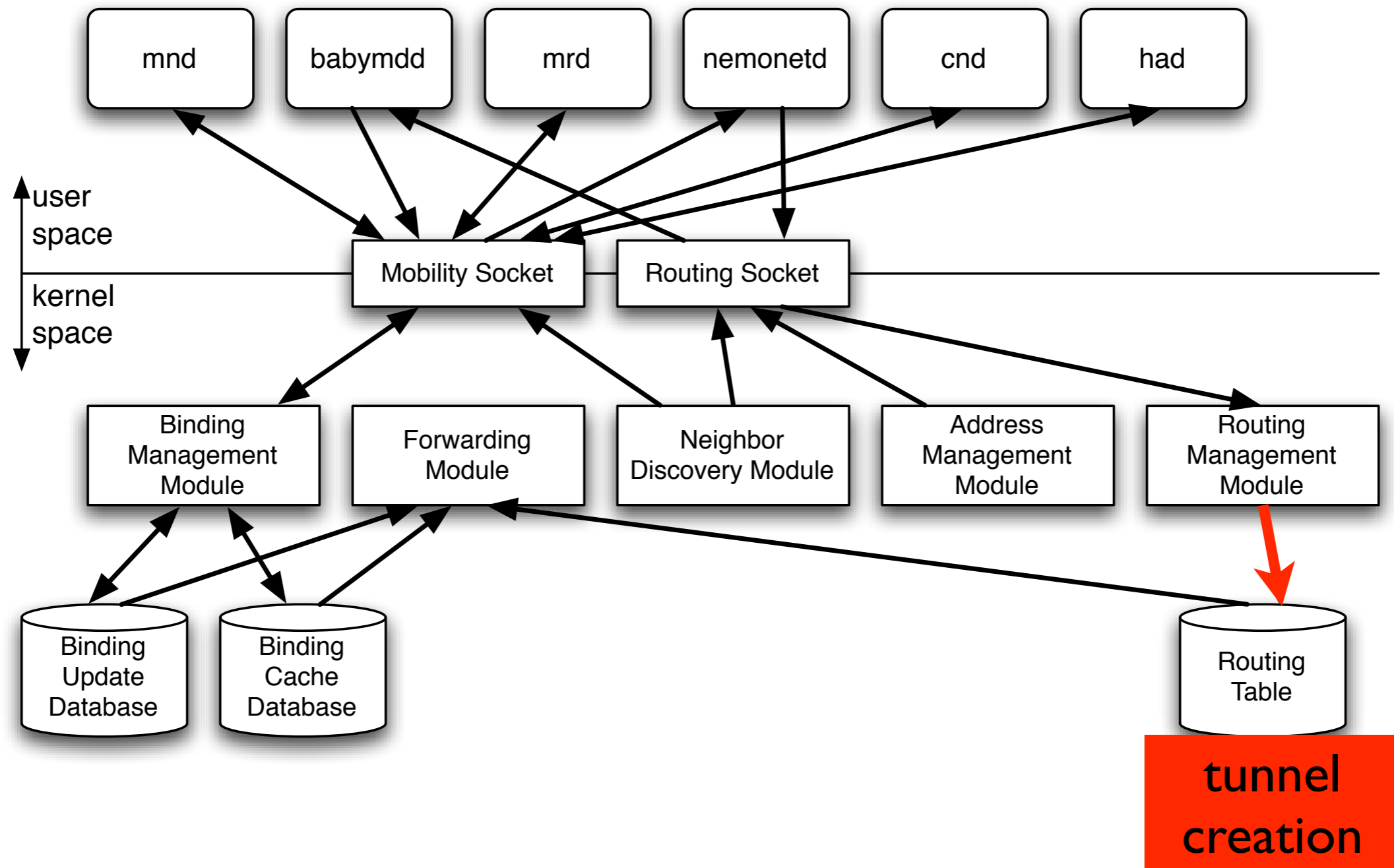
# Message Passing



# Message Passing



# Message Passing



# Movement Detector

- SHISA only provides a simple movement detector implementation as **babymdd**
- Just perform NUD (Neighbor Unreachability Detection) against the router that sent the prefix information of the current care-of address (CoA)
- Sends MD\_INFO message if the router becomes unreachable
- Movement detector can be replaceable based on the requirements of service providers

# Extensions

- Multiple Care-of Addresses Registration
  - based on draft-wakikawa-mobileip-multiplecoa-04
  - Assign a unique identifier to each NEMO tunnel and use multiple NEMO tunnel I/Fs
- IPv4 Network Prefix Registration
  - based on draft-shima-nemo-v4prefix-01
  - Implemented by extending **nemonetd** program

# Conclusion

- Designed the mobility stack as to provide the following characteristics
  - Signal/Data processing separation
  - Flexible network adapter usage using virtual I/Fs
  - Adaptive movement detection mechanism
  - Extensible system design
  - Small kernel modification
- Implemented the stack to satisfy the above requirements
- The code is freely available from the KAME project
  
- Future plans
  - Be compliant with the IPv6 Forum Logo program
  - More advanced features, e.g. DSMIPv6, HA-HA