OLSR for InternetCAR system

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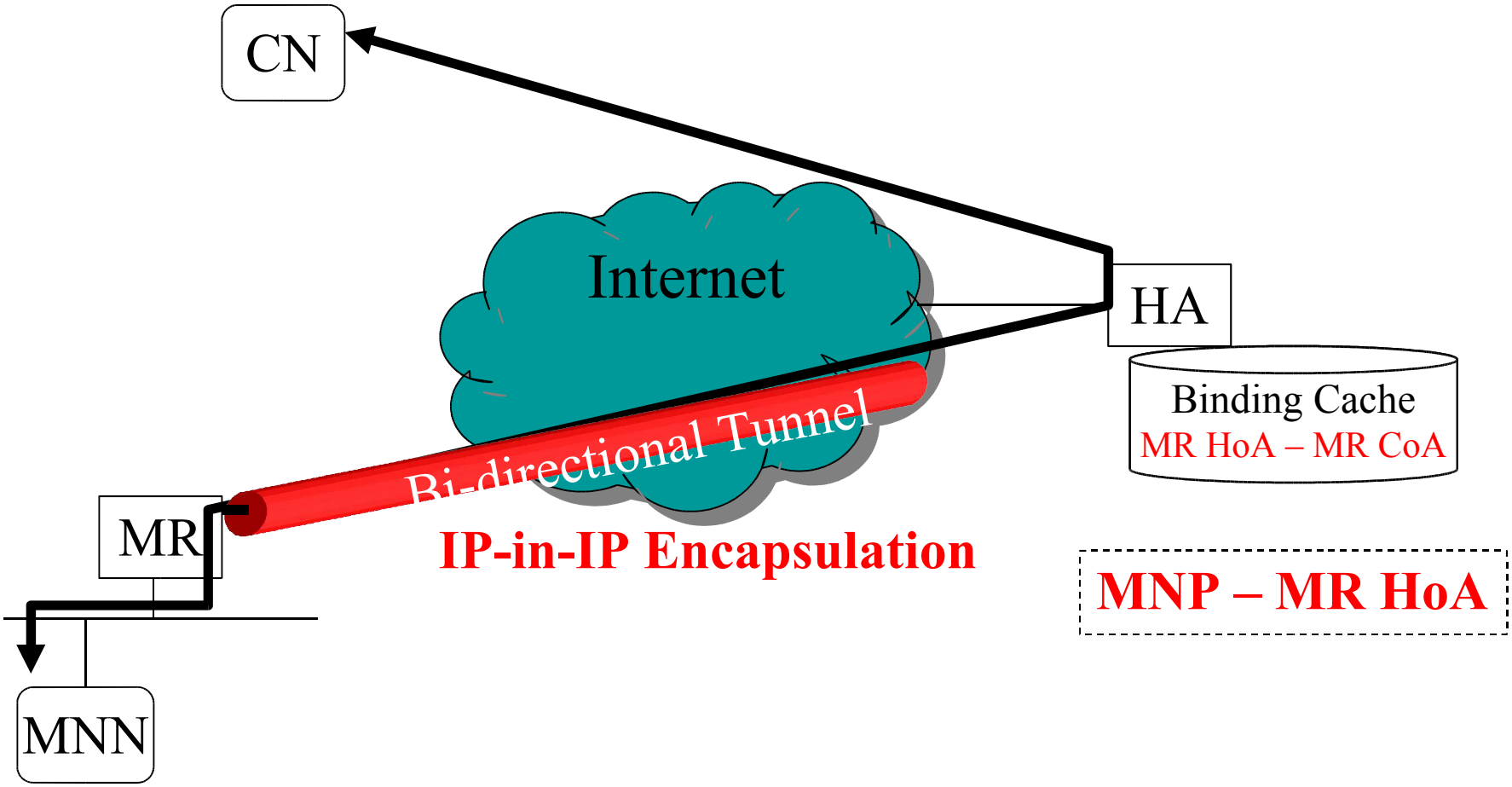
Introduction

- Spread of internet connectivity
  - Non-computer devices have IPv6 protocol stack
- Internet connectivity on automobiles
  - Toyota G-Book
  - Nissan CARWINGS
  - InternetCAR project

InternetCAR project

- Research and deployment of internet connected environment for automobiles
  - Simulations, system development, network construction
  - IPv6 connectivity
  - MIPv6, NEMO, MANET
- The project has large test-bed on automobiles.

NEMO Basic Support Protocol



Signaling

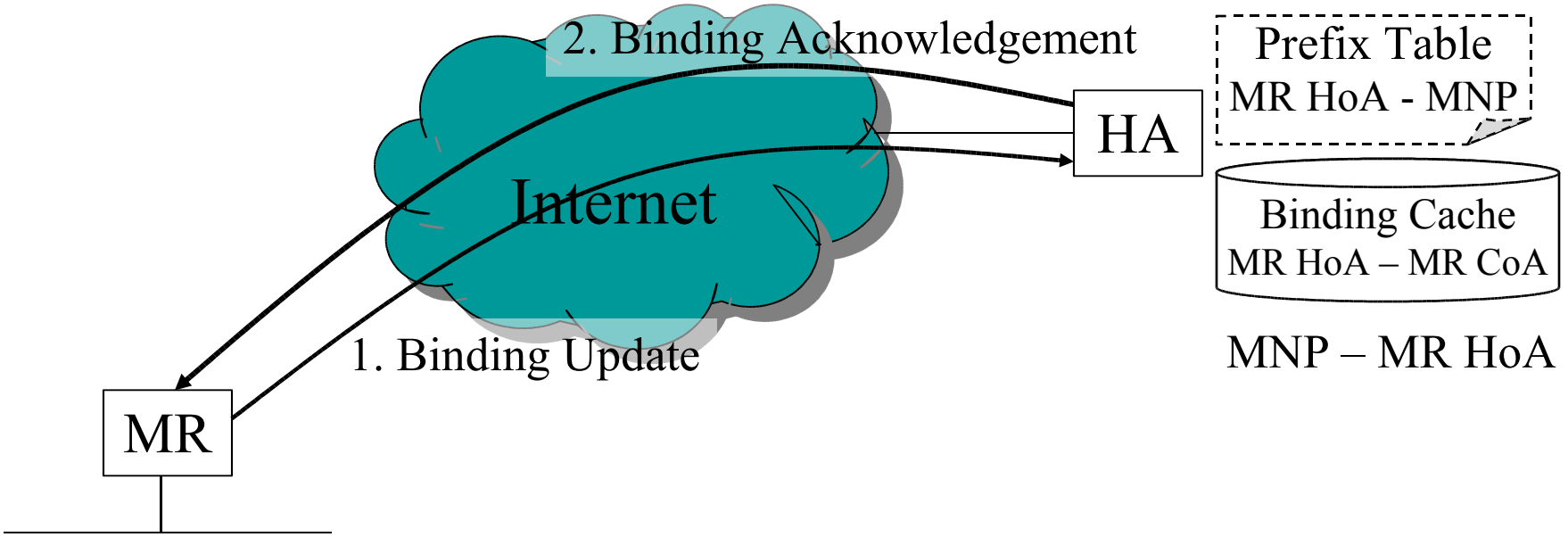
Explicit Binding Update

Mobile Network Prefix Option

IP header	HoA	IPsec	BU (R)	MNP/len

Implicit Binding Update

IP header	HoA	IPsec	BU (R)



VI – Vehicles with the Internet

Automobile environment

- Large space for multiple equipments
  - Communication medias
  - Computers inside automobiles
- high-capacity battery
  - Almost free from the power outage

Network inside automobiles

- Automobiles have about 70 computers
- Three types of network in automobiles
  - Multimedia network(car navigation system, car audio)
  - Body network (headlight, power window)
  - Control network (engine, brake
- Multimedia networks are expected to lead the implementation and the deployment of internet connectivity for automobiles
- Cell-phones, wireless LAN, and DSRC are used for automobiles' connectivity

Out-band connectivity on automobiles

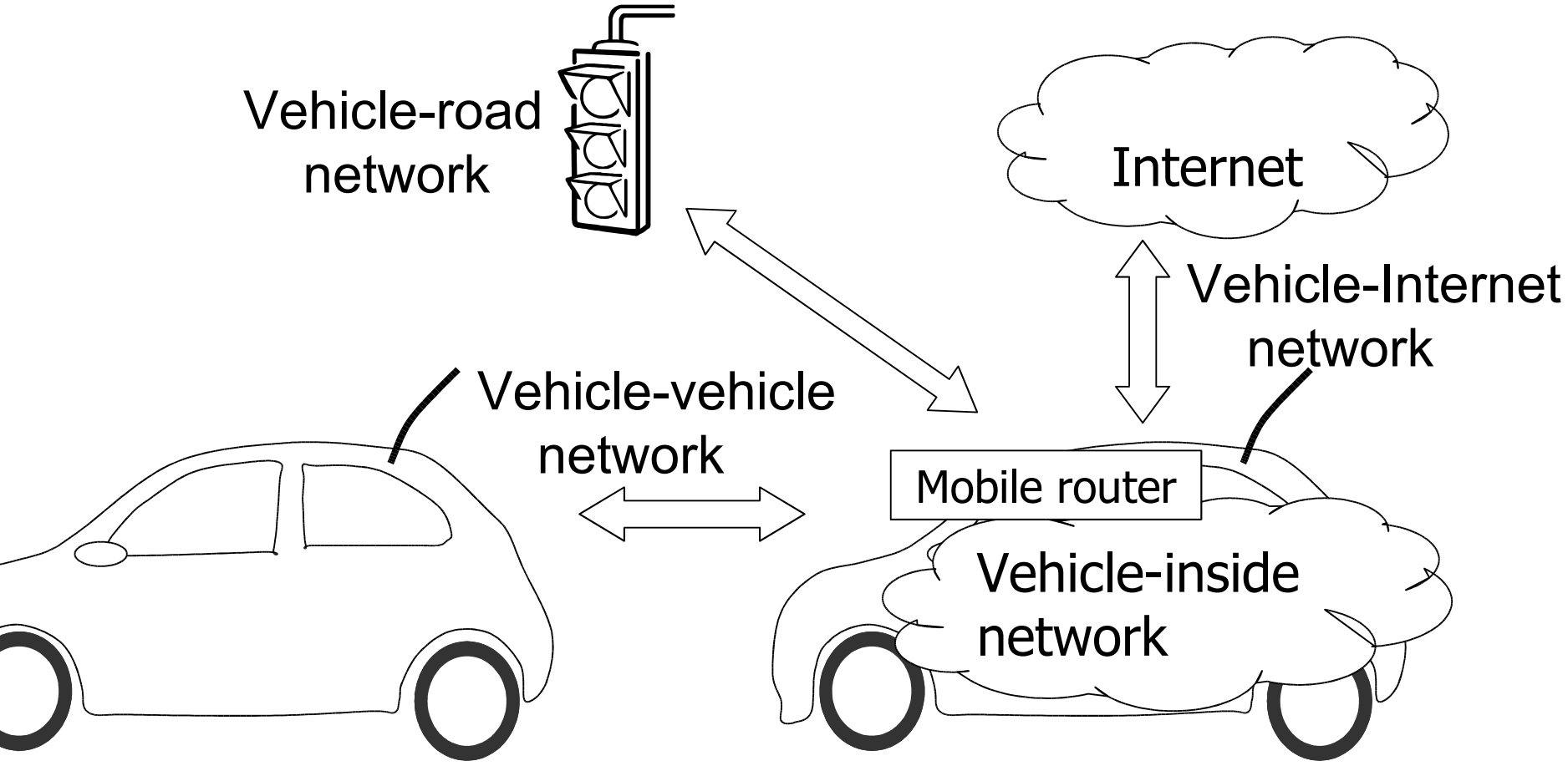
- Wide-range communication
  - Directly connected to the internet with cell-phones
  - Health check services for passengers
- Short-range communication
  - Communication with nodes or networks nearby
  - Vehicle-road communication
    - Traffic jam information
  - Vehicle-vehicle communication
    - Video-chat between people in different cars

Problem Statement

- Existing services utilize cell-phones as the communication media
  - Cell-phones have the narrow band connectivity
    - Not capable to transfer mass volume multimedia data
  - Limitation of the cell-phone link coverage
    - Lost connectivity in tunnels
    - Automobiles move beyond the cell-phone coverage

- The system to utilize both of the wide-range communication with cell-phones and short-range communication with wireless LANs
  - MANET with wireless LANs for short-range communications
  - NEMO with cell-hones for wide-range communications.

Supposed communication environment



System requirement

- Policy based packet forwarding
  - Utilizing multiple links ac cording to pre-set policies
  - Route management for multiple route information from each links.
- Link monitor
  - Detect link trouble and use the active link properly
- MANET edge node selection
  - Internet gateway selection
  - Acquirement of the global routable address

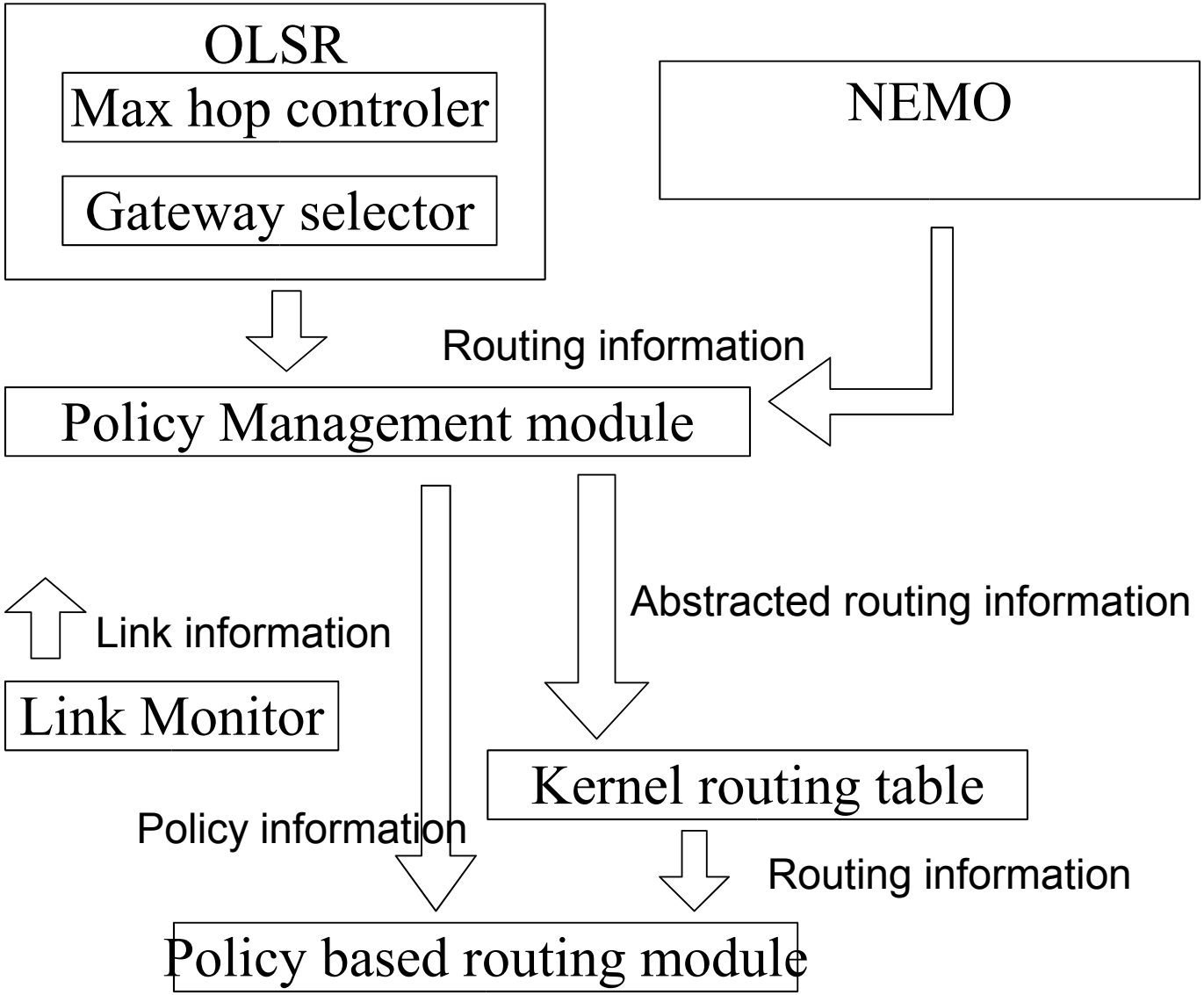
Policy routing

- Link selection with the link monitor
  - Recover from loss connectivity.
- Policy parameters
  - Throughput
  - RTT
  - Link stability
- Node priority
  - Nodes on road-side have higher priority than automobiles because of its stability and bandwidth for internet

OLSR enhancement

- Global connectivity
  - Route acquisition for the Internet gateway
  - Global routable address
  - Select the appropriate internet gateway
- Routing based on geographical information
  - It is not possible to select the “best path” when each mobile router exchanges only hop counts

System overview



System overview(cont.)

- The policy management module acquire routing information from both of OLSR and NEMO
- The policy management module put the policy routing information to the policy routing module
- The link monitor module check the link status information and update policies in the policy management module

OLSR module

- Each routing messages include the geographical information of each node
- When routers get new routes, they examine RTTs for the destinations with that on cell-phones, and ignore the information if the RTT is larger than cell-phones
- Internet gateway selection based on
  - Numbers of nodes connected
  - Upstream bandwidth

Policy routing module

- Policy routing is based on source/destination address and port number
- Policy routing module has three routing tables of throughput, RTT, and link stability
- This module forward data packets according to the appropriate routing table for each traffic

Policy management module

- Link monitor checks the link status of each link
- This module manage the information about appropriate routing tables for each application and put it to policy routing module

Conclusion

- Adapting OLSR for current InternetCAR system realizes rich automobiles communication environment
- We proposed a efficient model to utilize multiple routing modules with the policy routing method