Future Network Architecture for Mobility Control

(= Separating of Control and Forwarding)

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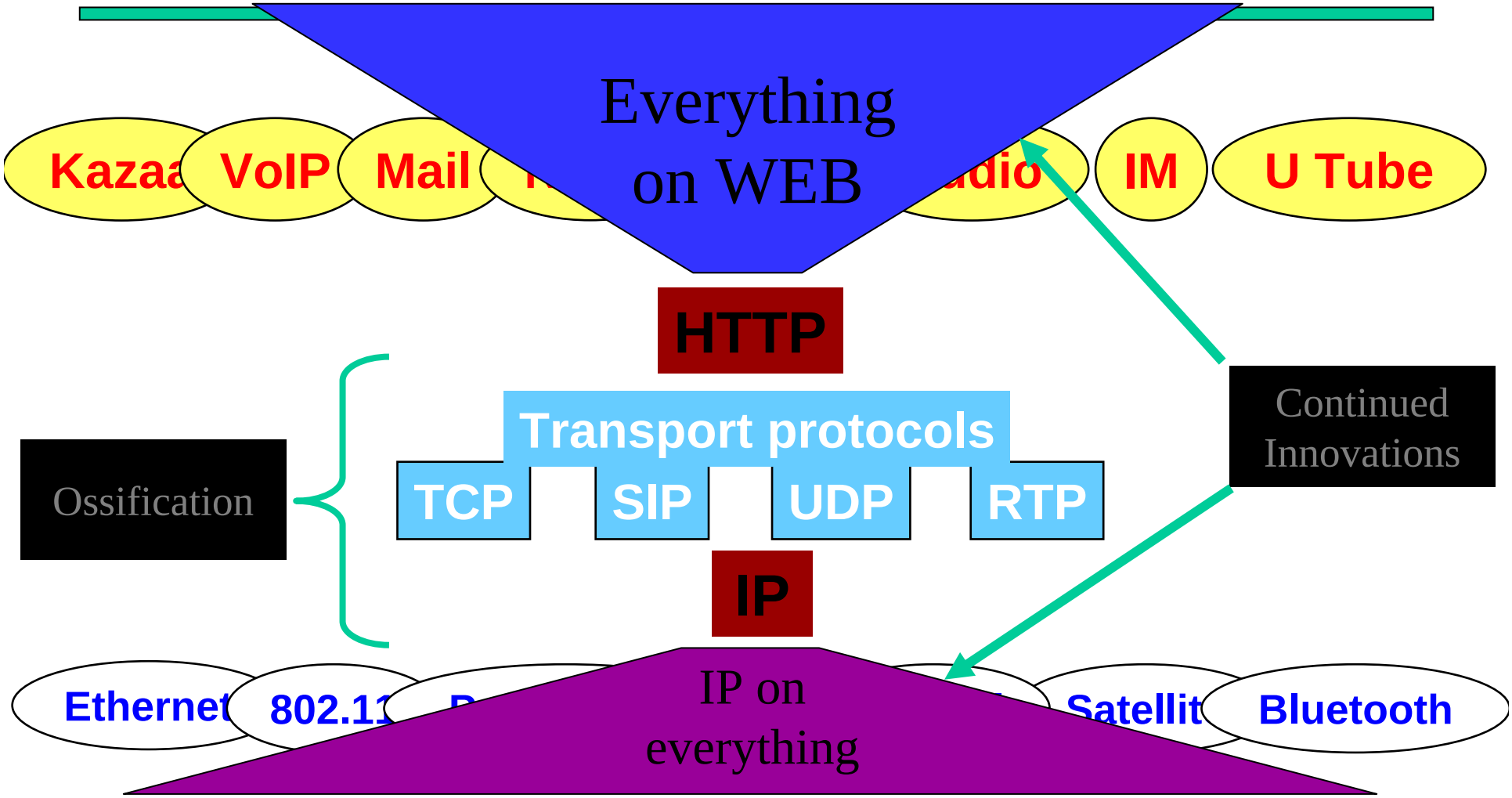
Outline

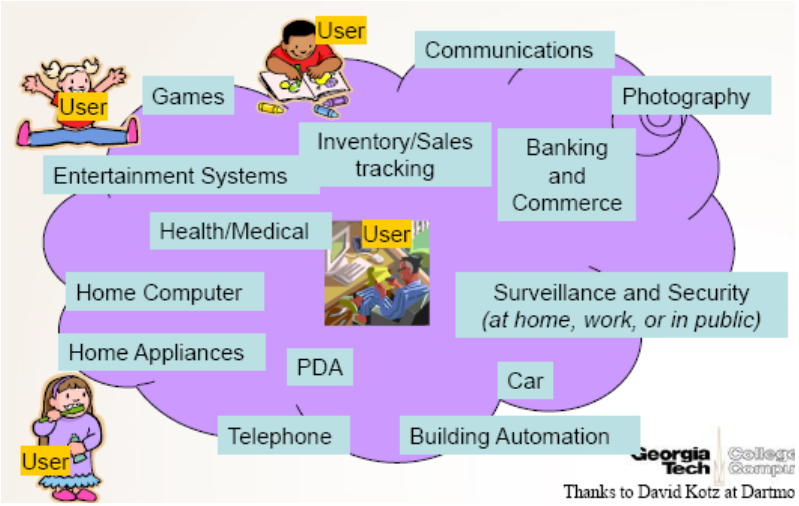
- Background-What is Internet?
  - Internet & Web
  - Future Network can be derived from clean-slate approach.
- Agent based IP (AIP) for Future Network Architecture
  - IP Glue : IP Packet forwarding & IP Global Identifier.
  - Basic Principle in separating of Node ID & Location ID
  - Basic Principle in L2 Forwarding for Transport
- Conclusion
  - Agent based Address Resolution Protocol for Mobility
  - Separating IP control/Forwarding Plane for L2 Transport

Background: Internet & WEB Platform



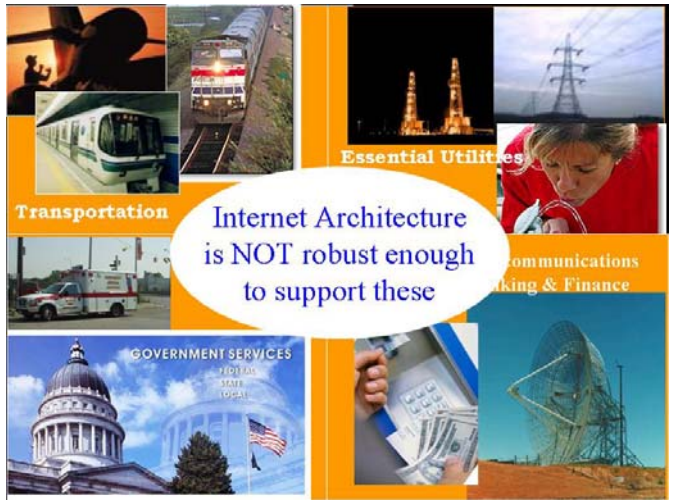
Background: Why need you Future Internet?

- **Internet** is becoming a critical part of an **socio economic infrastructure**
  - Net-delivered services are reshaping the world (search, media, games etc.)
  - Addition of billions of new devices, mobile, machine and sensors.



- **Tomorrow's users** will be surrounded by pervasive devices, embedded sensors and systems… all connected to the Internet.

- Internet is facing several limitations.
  - **Lack of robustness, mobility, security, QoS and Management scheme.**
  - **not economically sustainable & Ill-suited for emerging technologies**



- **Clean Slate approach**
  - Some fundamental issues that cannot be fixed incrementally with patches.

Background: Why **need a clean-slate approach?**

- Internet can support

P1. Packet Multiplexing

P2. Application Transparency

P3. Universal connectivity

P4. End-to-End argument

P5. Subnet heterogeneity

P6. Common Bearer Service

P7. Packet Forwarding context

P8. Global addressing

P9. Stateless Routing

P10. Protocol Layering

Internet → IP (Control: naming & Addressing) + IP(Transport: IP Addressing & Routing)

- Internet not support

P11. Security

P12. Congestion Control

P13. Resource Allocation

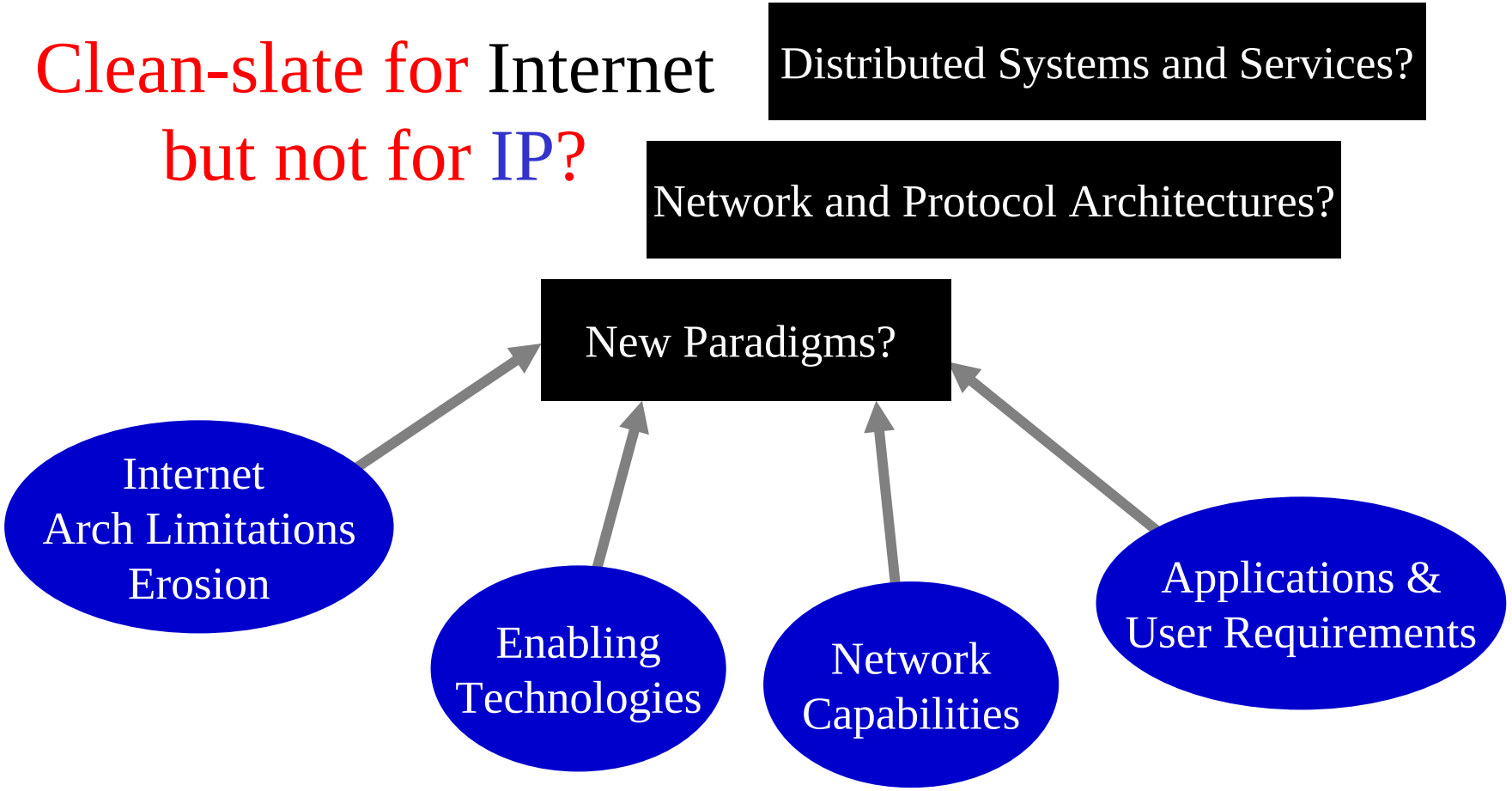
P14. Mobility

Internet → IP (Control: naming & Addressing) + L2(Transport: L2 Packet forwarding)

Background: What is Future Internet?

Clean-slate for Internet

but not for IP?



IP is not Internet! IP is a Protocol!

Agent based IP
for Future Network Architecture

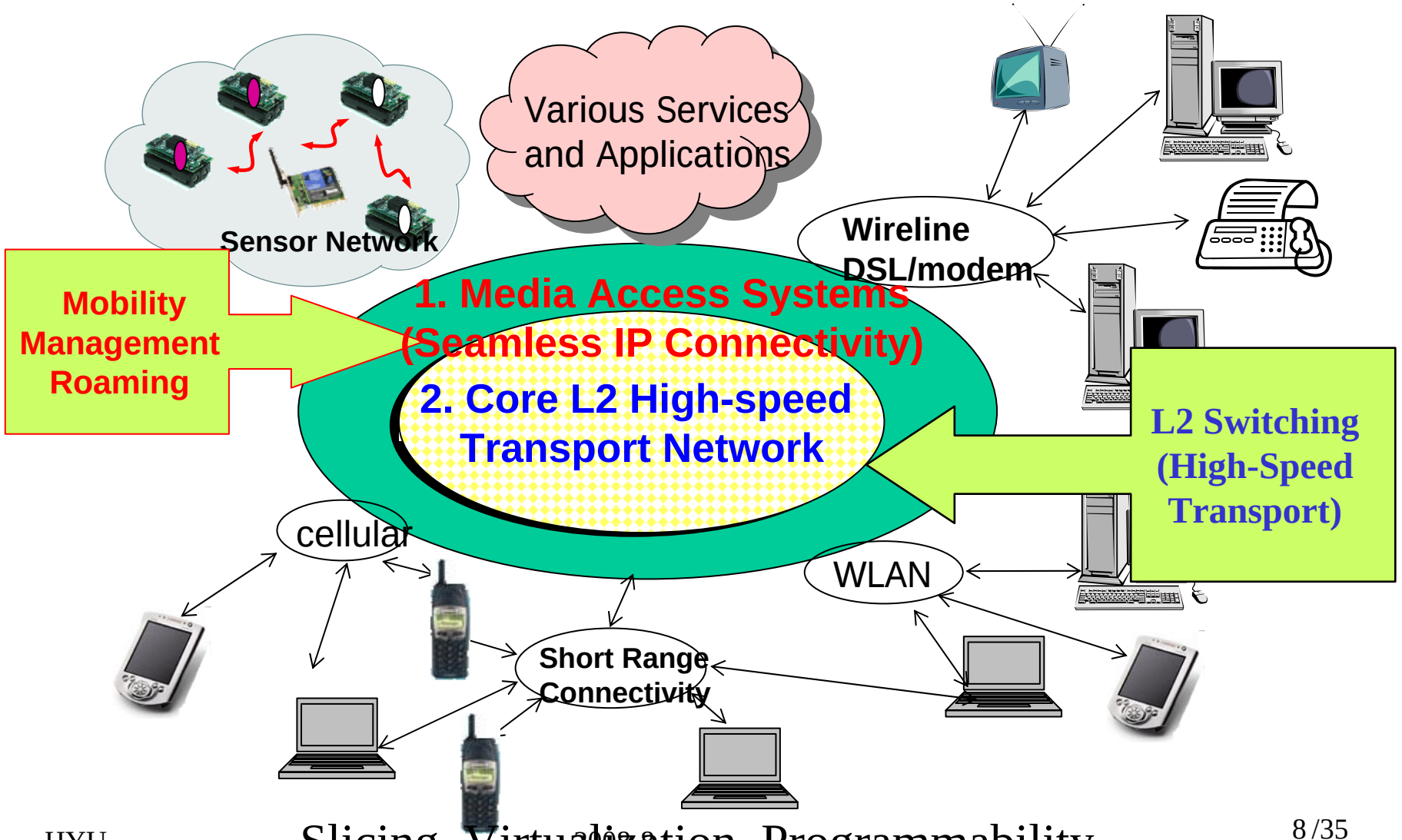
AIP

(w.r.t. Mobility Extension &
L2 Forwarding Extension)

IP becomes a control Protocol!
Ethernet is a high-speed L2 Packet switching!)

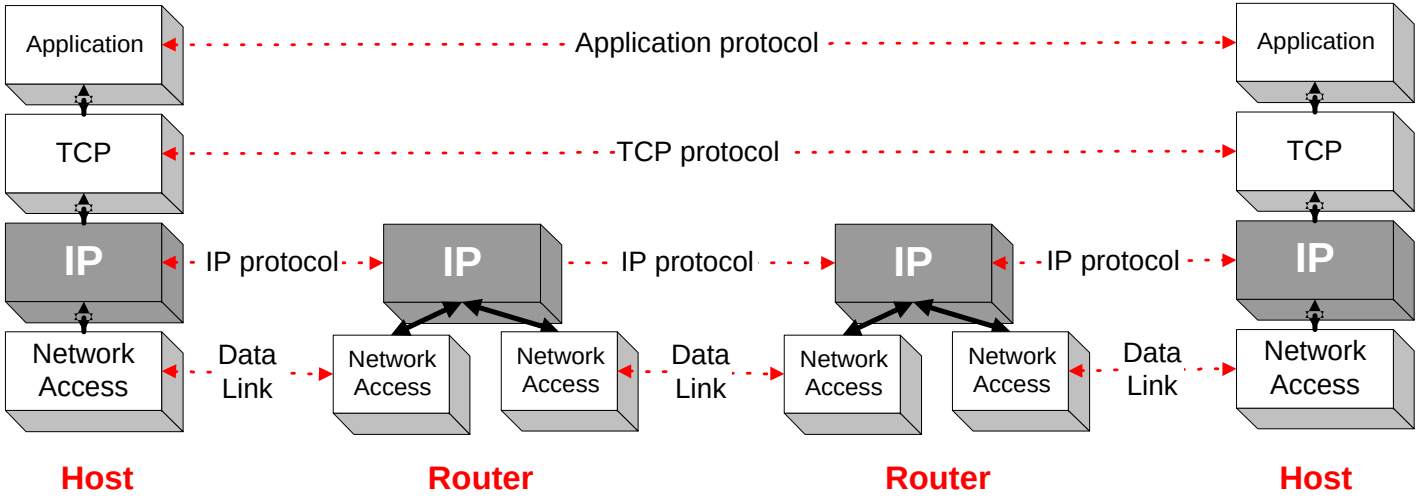
Seamless Future Networks

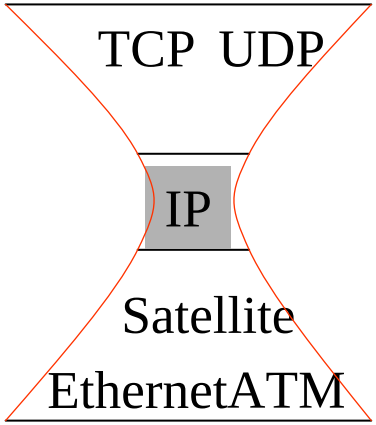
= Interworking with various access networks & Federated Facilities



Why we need IP for Future Network?

- IP is the glue of Internet (All hosts and routers run IP)
  - **Store & Forward datagram**
    - **Packet switched network with global scalability**
  - Stateless architecture
    - no per flow state inside network





Critical Problems in IP Protocol

- IP is the glue of Internet.
  But **(∵ IP (ID) = Location) → IP (ID) ≠ Location**
  need a Mobility Control

- IP is a Packet Switching based on
  Hop-by-hop Routing → high-speed L2 Forwarding
  need a High-Speed L2 Forwarding

Agent Based IP (AIP)

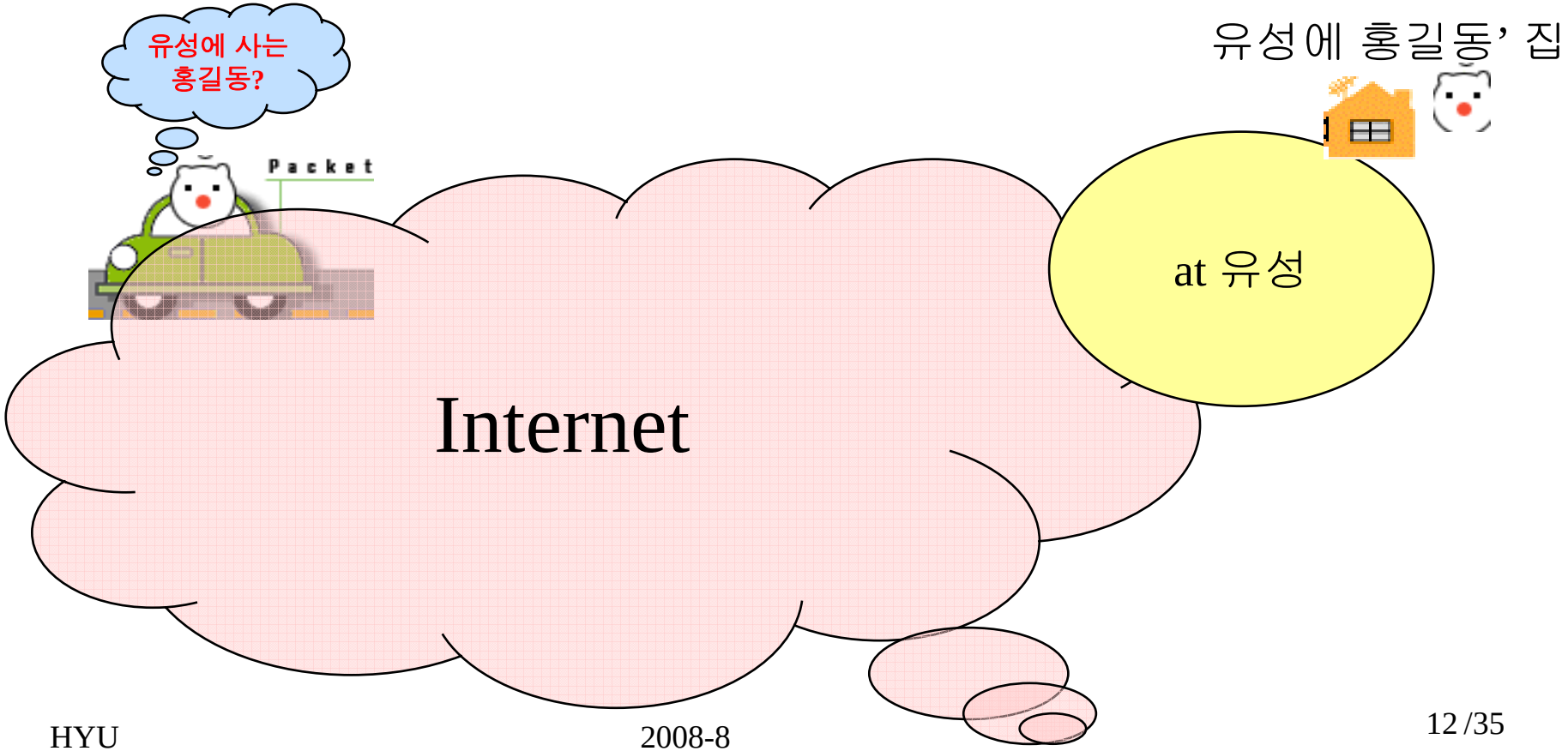
- separating of ID and Location
- Mobility Extension in AIP
- Extension of L2 Forwarding

Agent based Address Translation (or MARP) protocol &

Routing Cache Update & Query

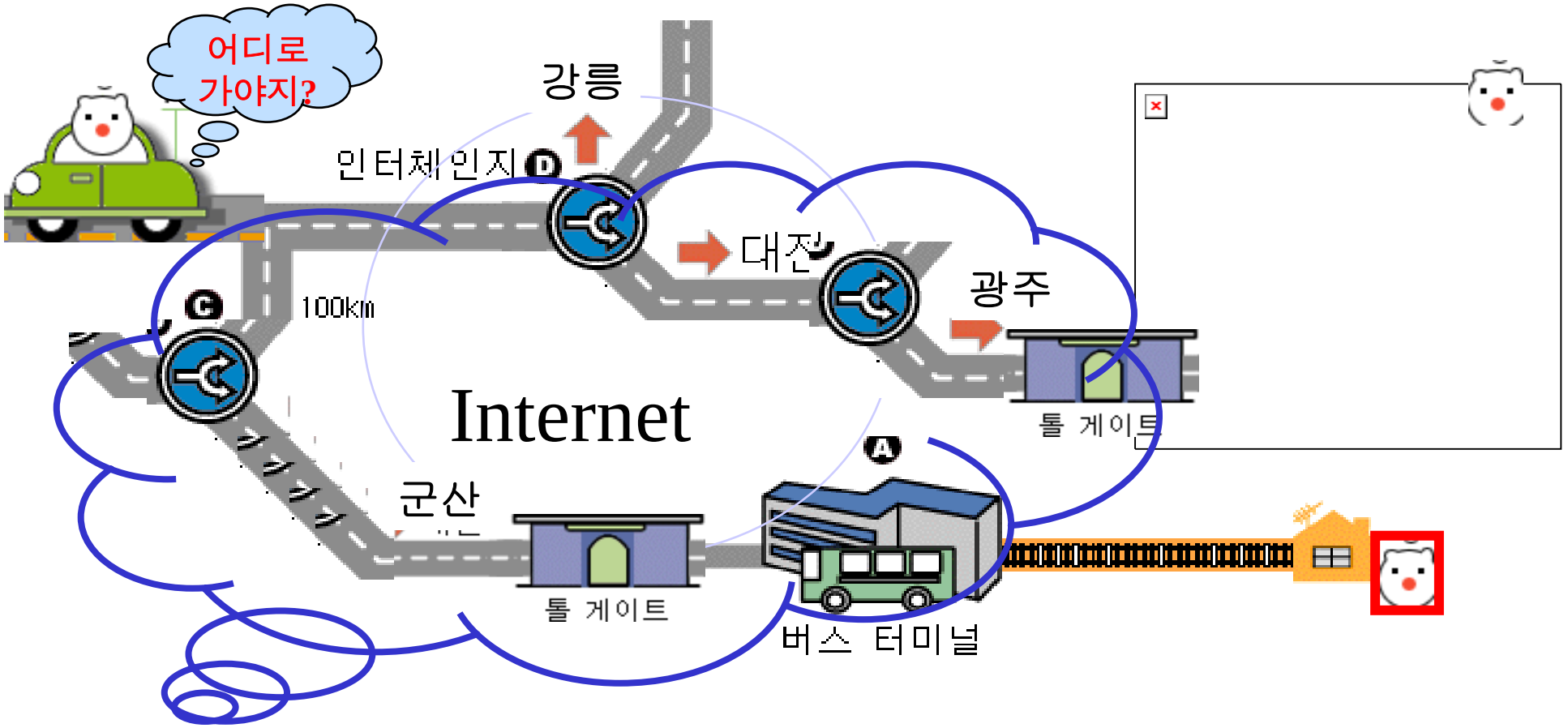
{MN's IP+ISP ID} is an End point identifier for Internet

- {IP+ISP} is an End point identifier for Future Internet
- E.g., ID is "홍길동' at 유성, Korea"



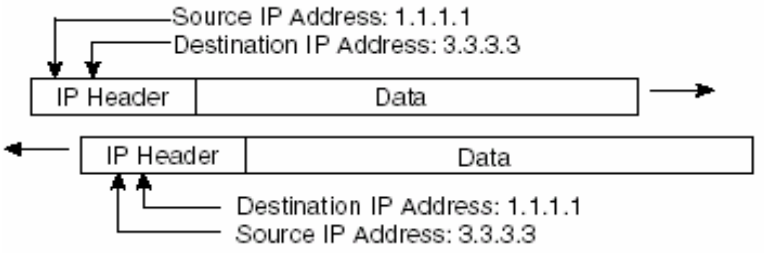
{MN's IP+ISP ID} is a Transport end-point

- {MN's IP+ISP ID} is a **transport end-point**(유성의 홍길동에게 가는 길)



{MN's IP+Location IP} is a Routing directive for Router

- Connectionless datagram (per packet basis)

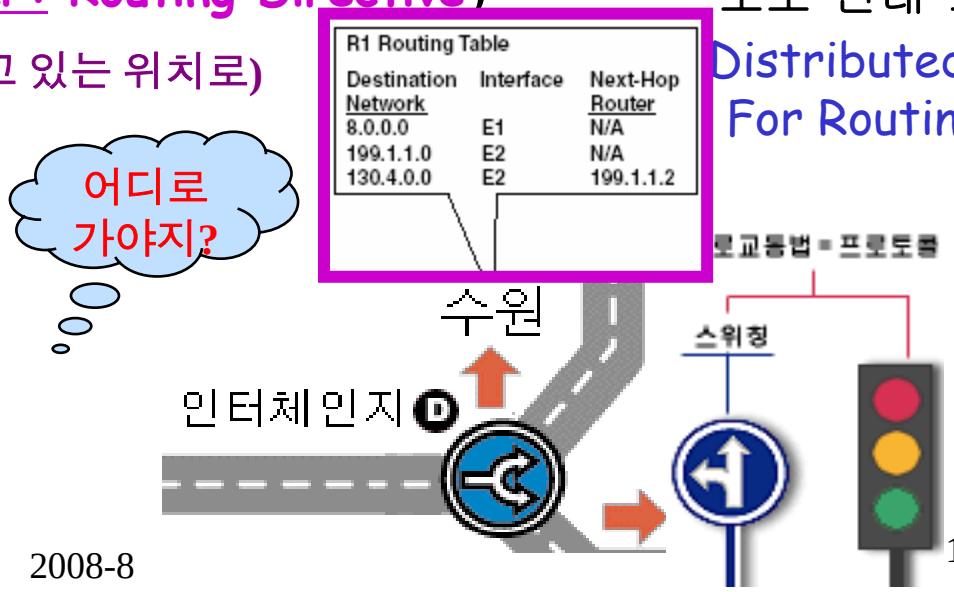


- self-routing (Location IP: Routing Directive)

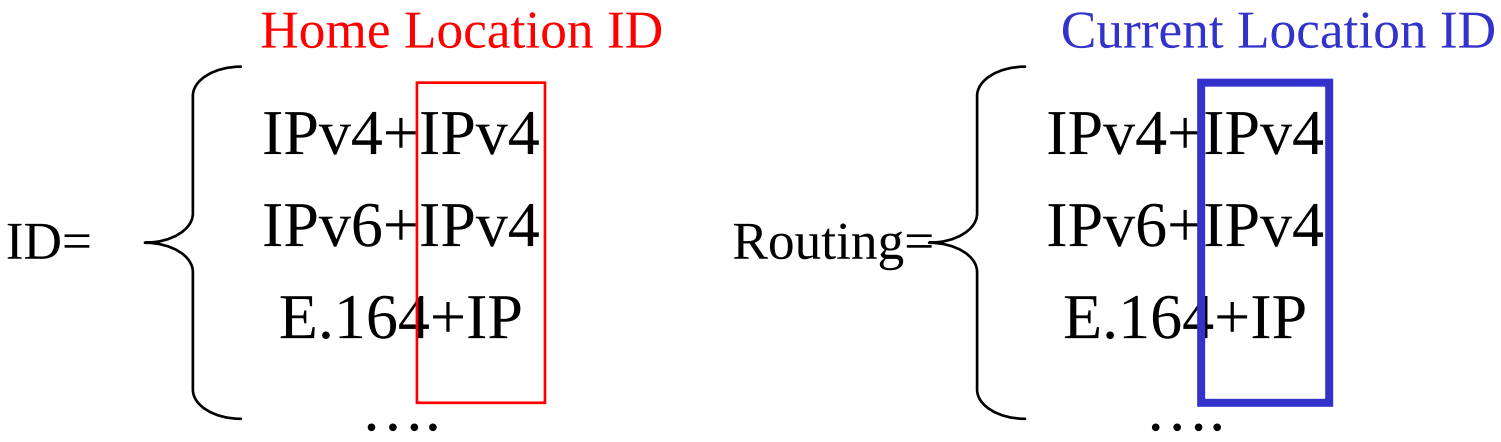
(홍길동이 현재 머물고 있는 위치로)

도로 안내 표지판

Distributed control
For Routing Table

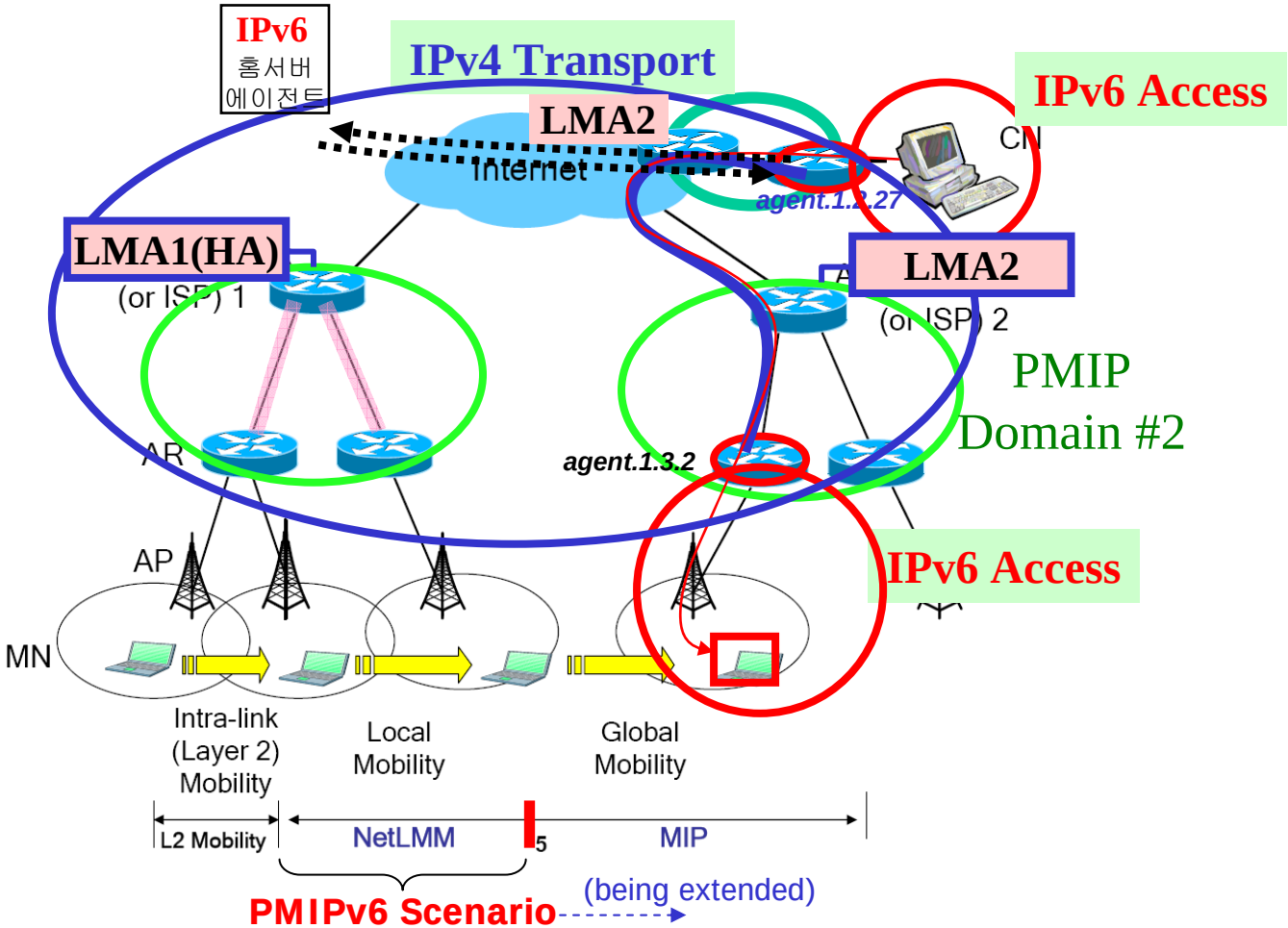


Further Extension in AIP



Design Example1: IPv4 transport & IPv6 Access

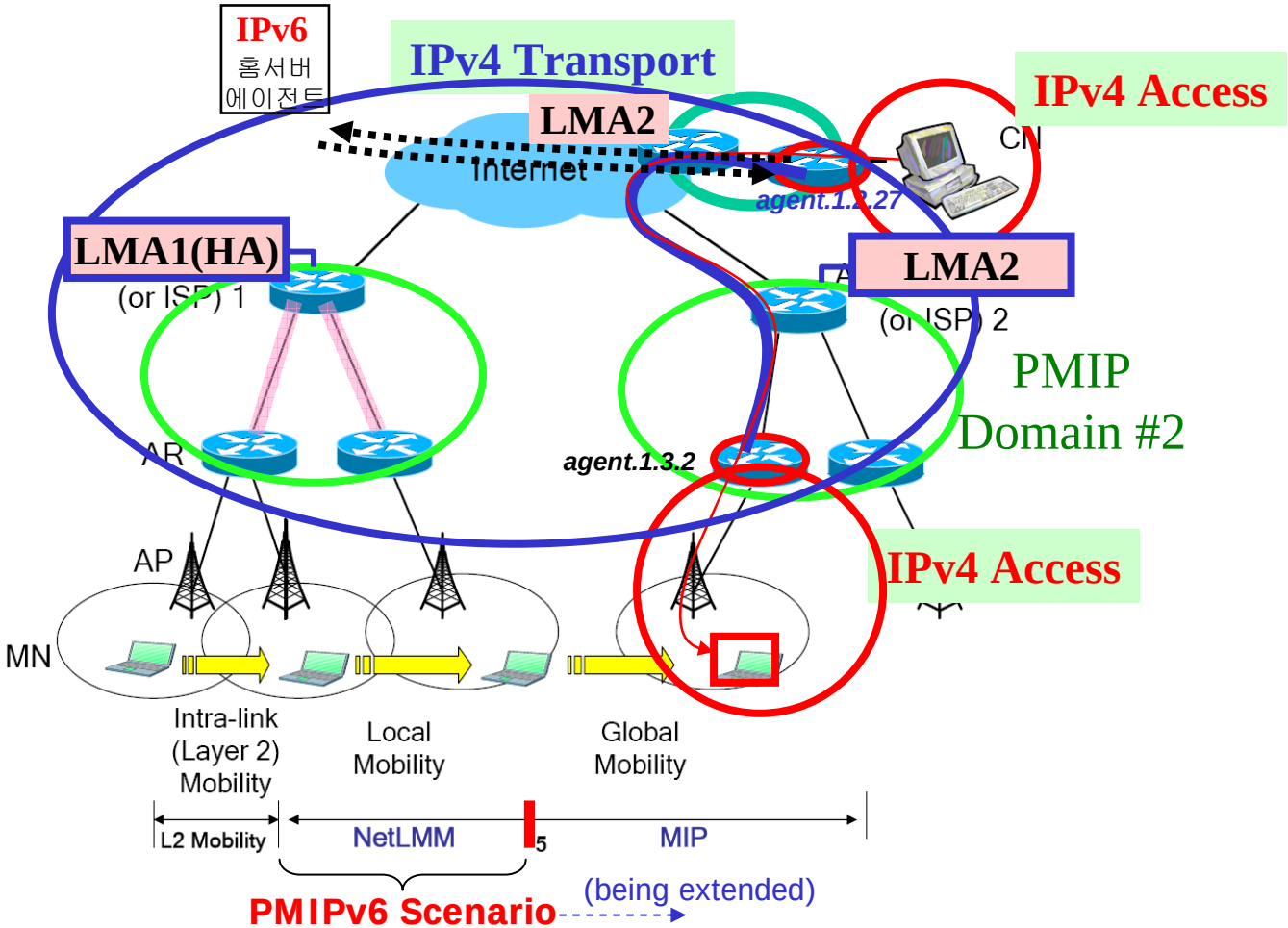
(dynamic mapping between IPv4 & Ipv6



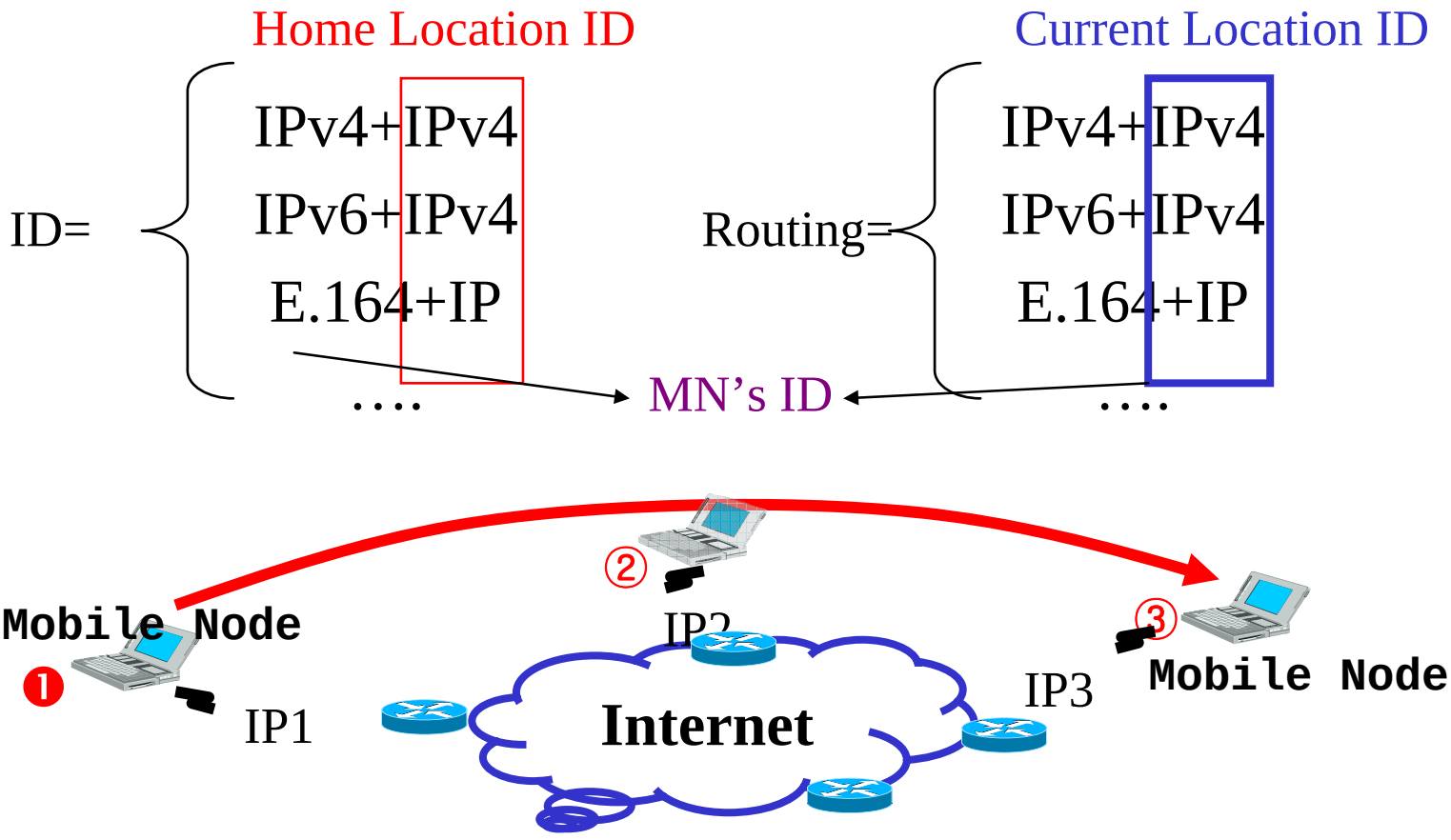
Design Example2: IPv4 transport & IPv4 Access

Home ID of IP1=IP1+ISP1's IPv4

(dynamic mapping between IPv4 & Ipv6

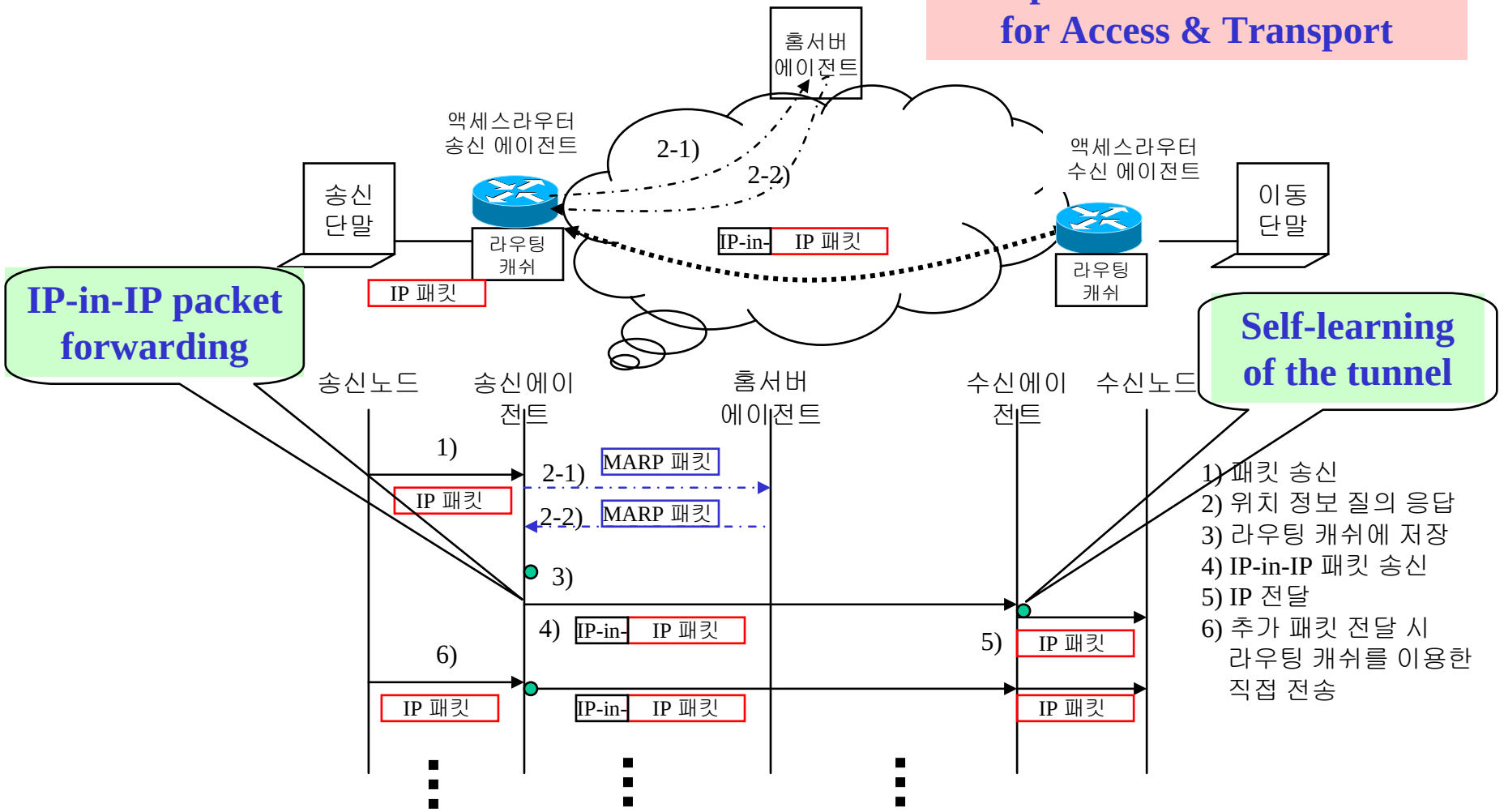


Mobility Extension in AIP

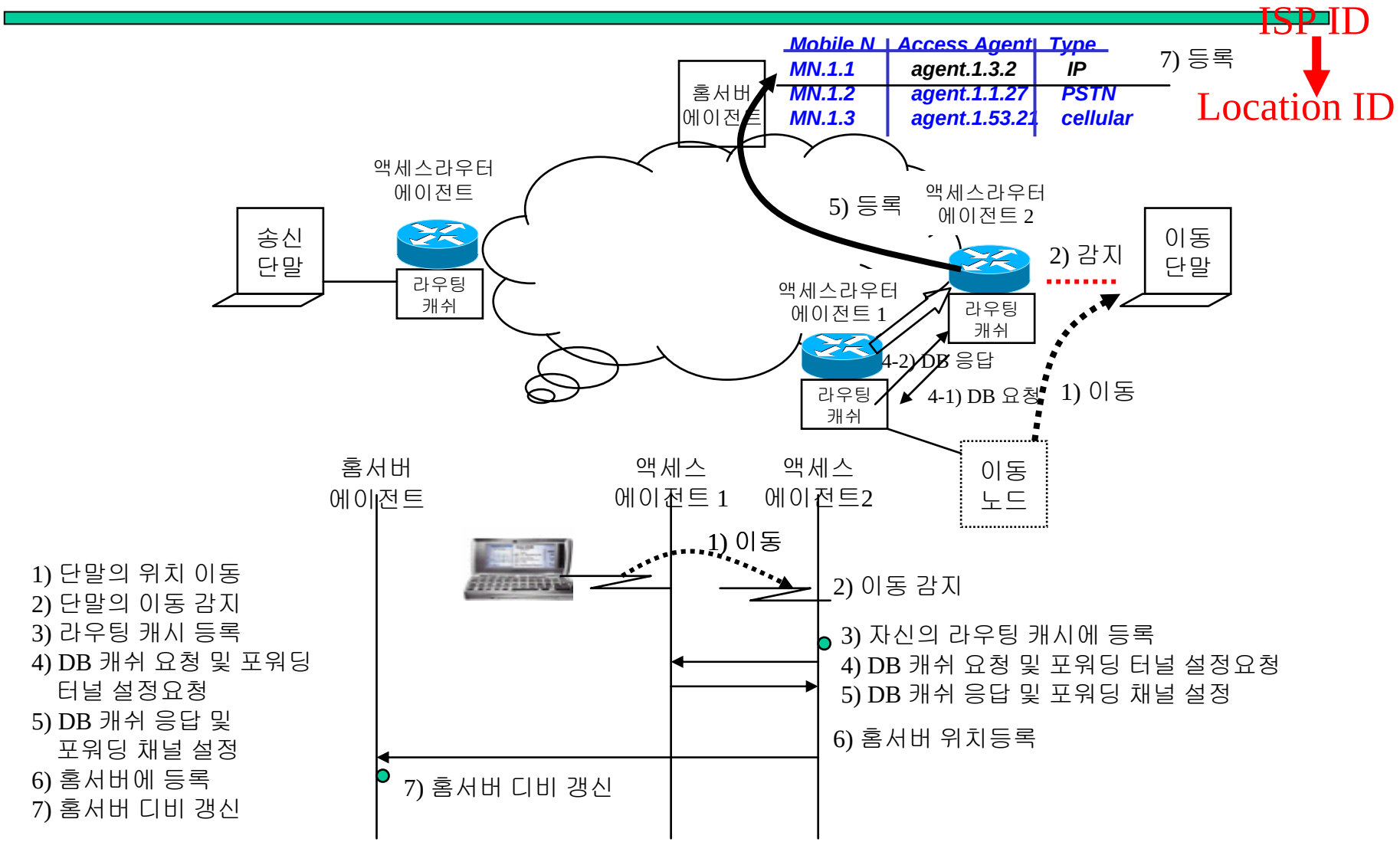


Basic Operation of AIP

Independent Address scheme for Access & Transport



Location Update procedure in AIP

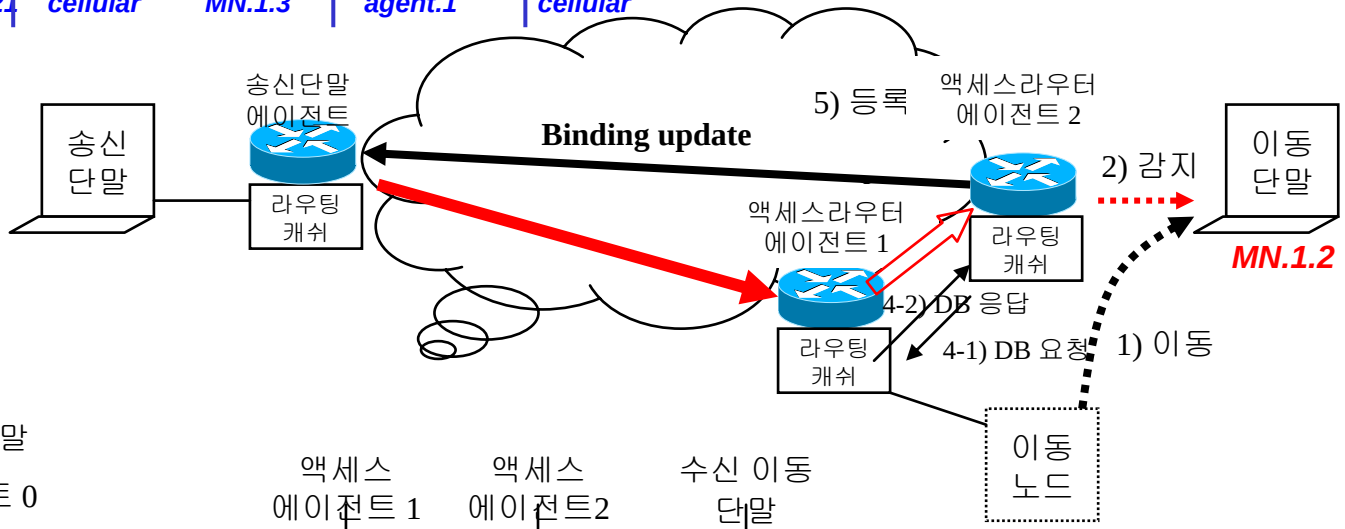


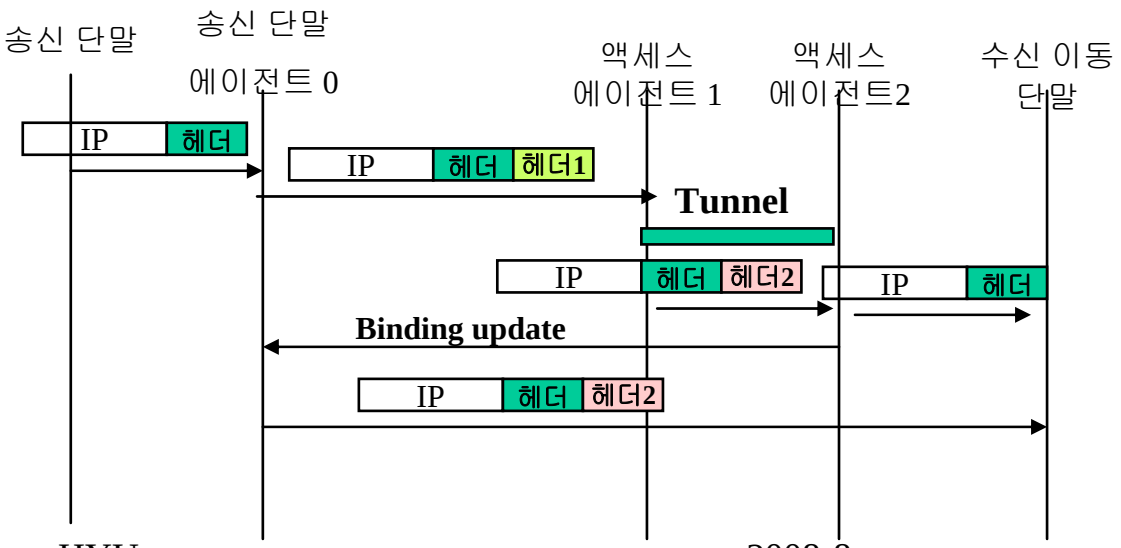
Routing Update procedure in AIP

Mobile N	Access Agent	Type
MN.1.1	agent.1.3.2	IP
MN.1.2	agent.1.1.27	PSTN
MN.1.3	agent.1.53.21	cellular

→

Mobile N	Access Agent	Type
MN.1.1	agent.1.3.2	IP
MN.1.2	agent.2	PSTN
MN.1.3	agent.1	cellular





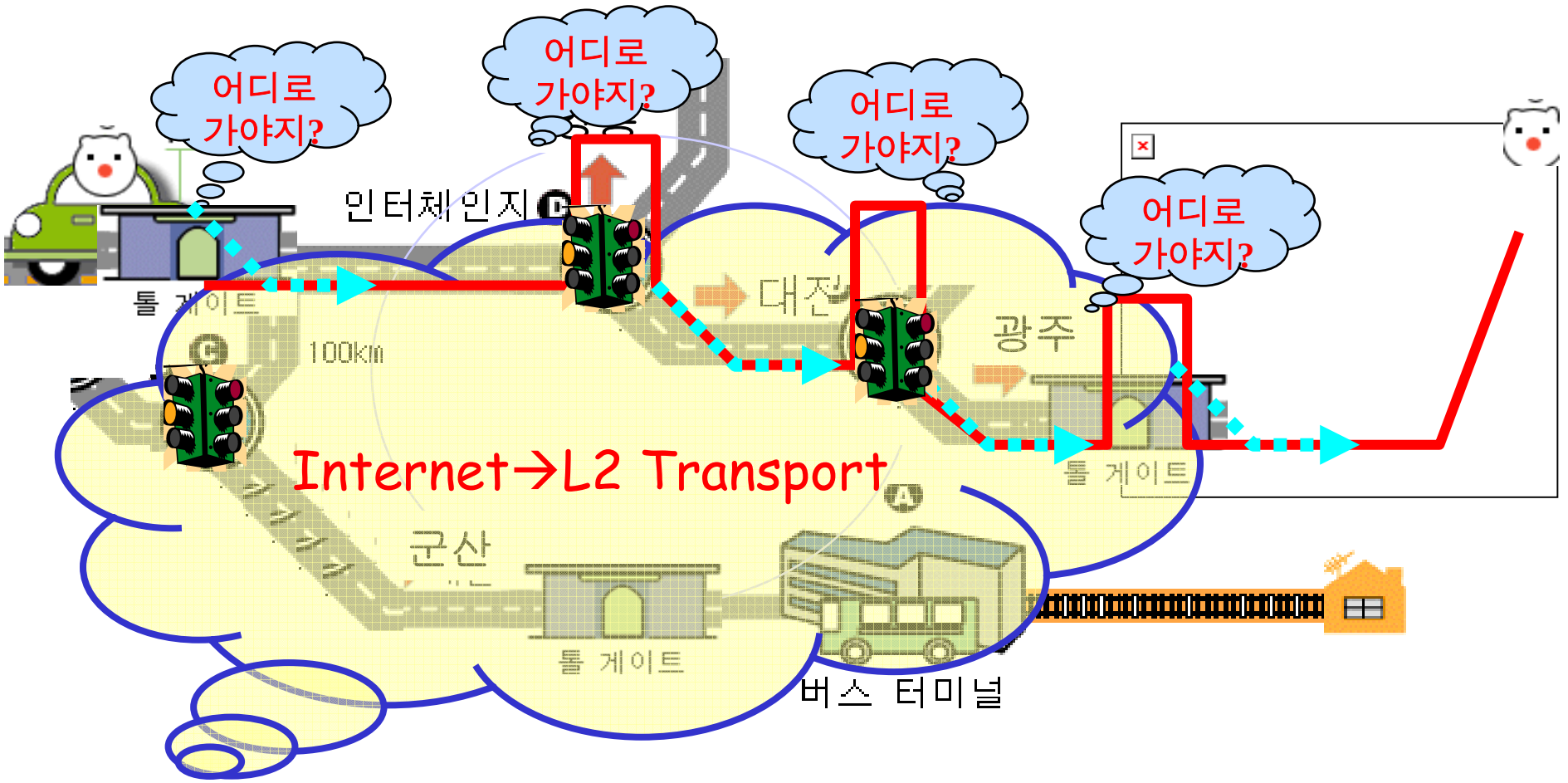
Self-learning from the incoming packet

Agent Based IP (AIP)

Extension of L2 Forwarding

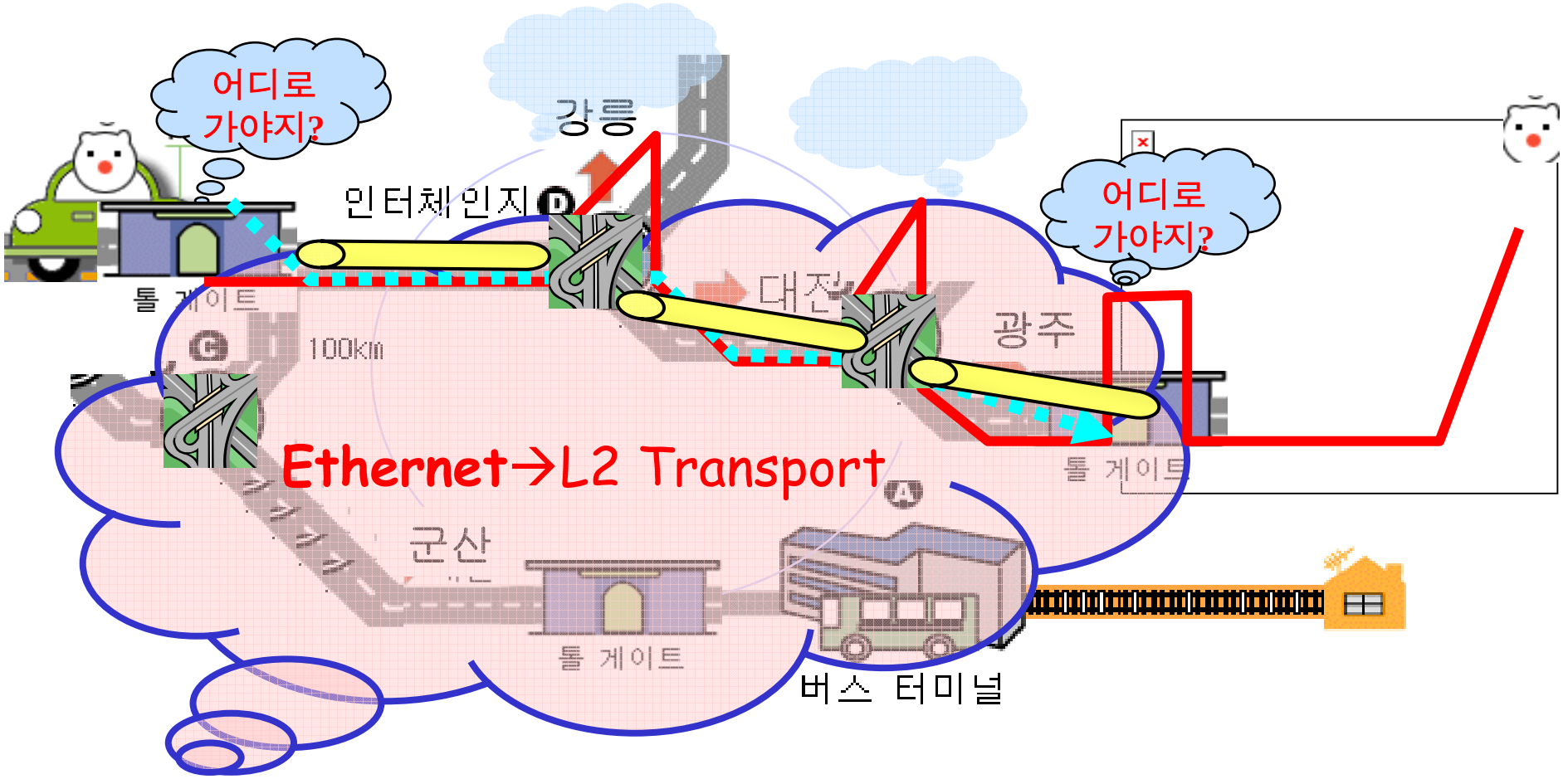
IP is a Routing Directivity but not transport directivity

- {IP} is a Routing Directivity at each Router (홍길동에게 가는 길)



Ethernet can guarantee a transport directivity

- Ethernet can guarantee transport directivity in the network



Critical Problems in Ethernet Protocol

- Ethernet is a self-learning Network,
  So, it is not scalable! (∵every endpoint MAC ID should be studied within the whole network)

- Ethernet is a Packet Switching Network based on end-point MAC → high-speed L2 Forwarding
  but not hierarchical domain &
  need a MAC learning within the network

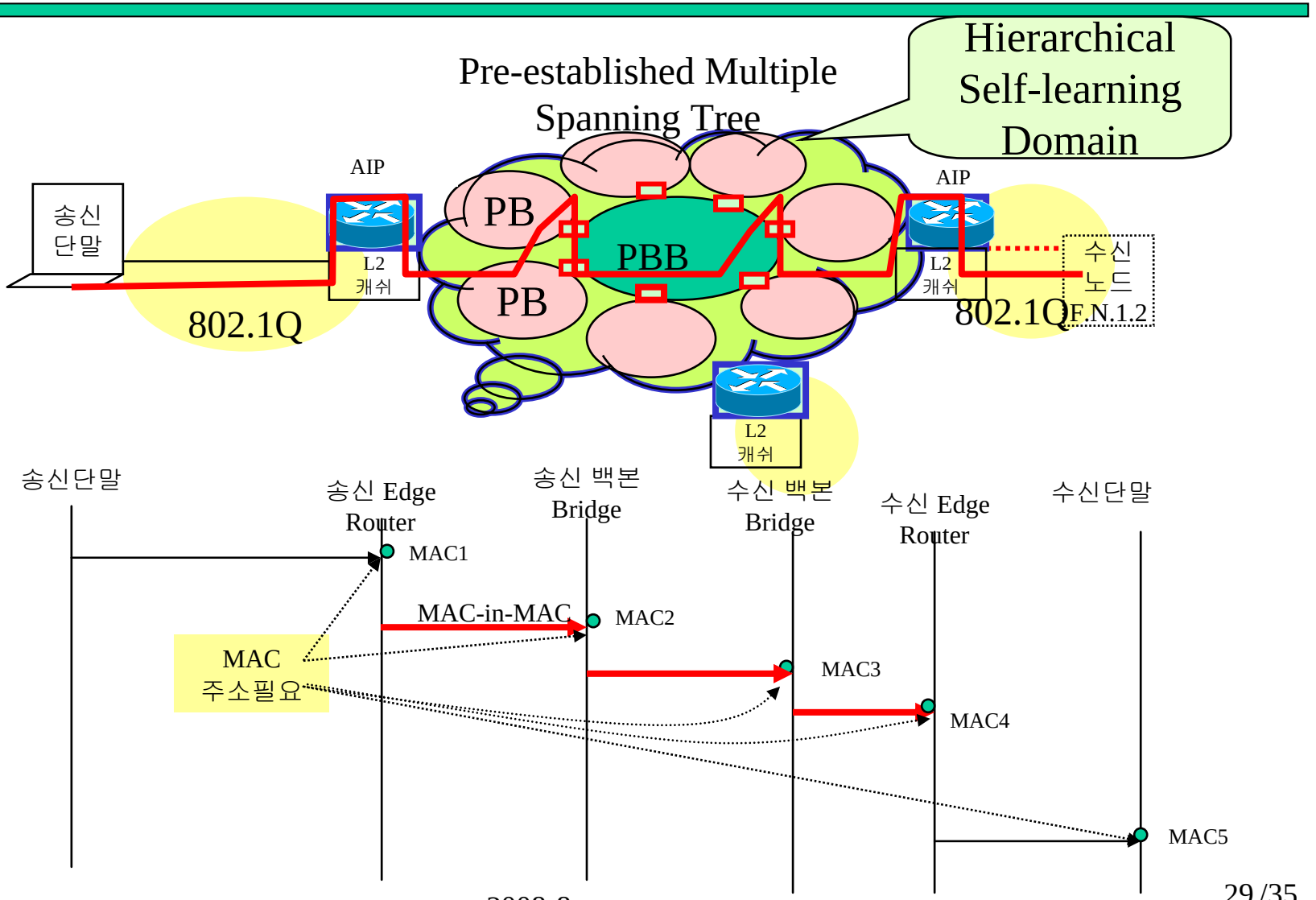
Agent Based IP (AIP)
Extension of L2 Forwarding

Hierarchical Bridge

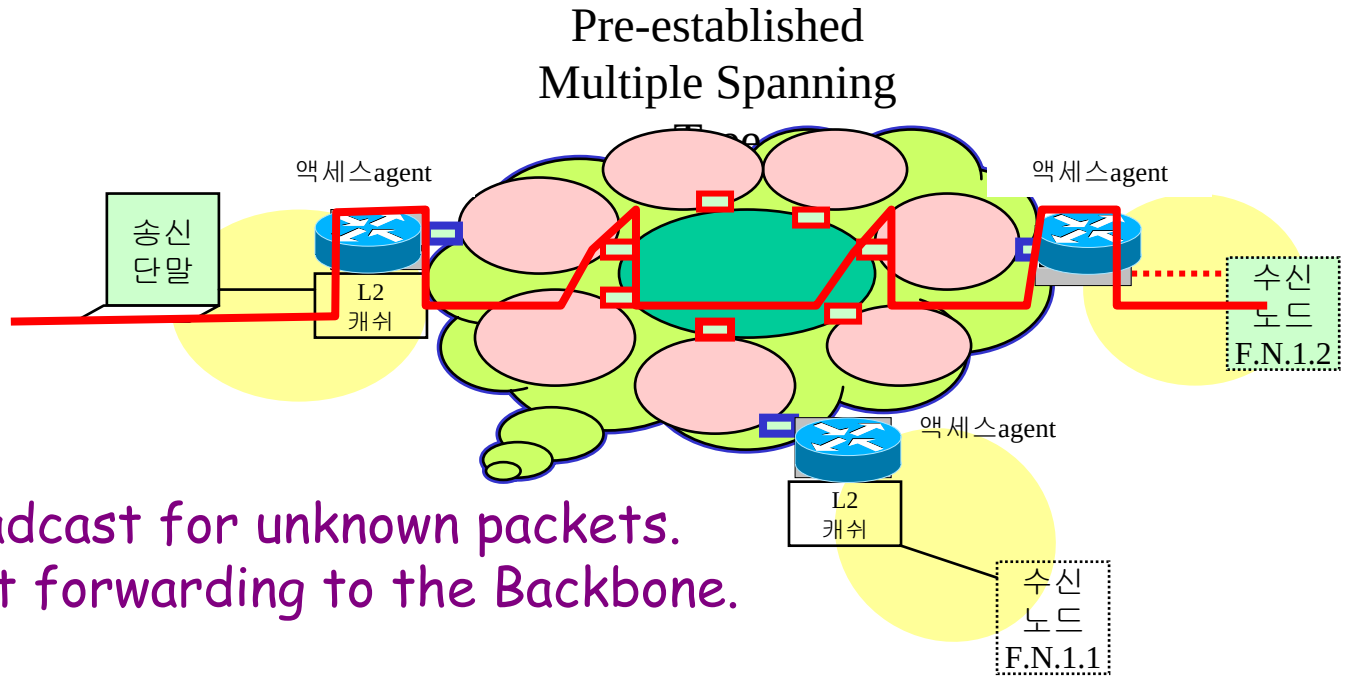
(Provider Bridge+Provider Backbone Bridge)

MAC-in-MAC Address Resolution

L2 Transport in AIP = Hierarchical Bridge



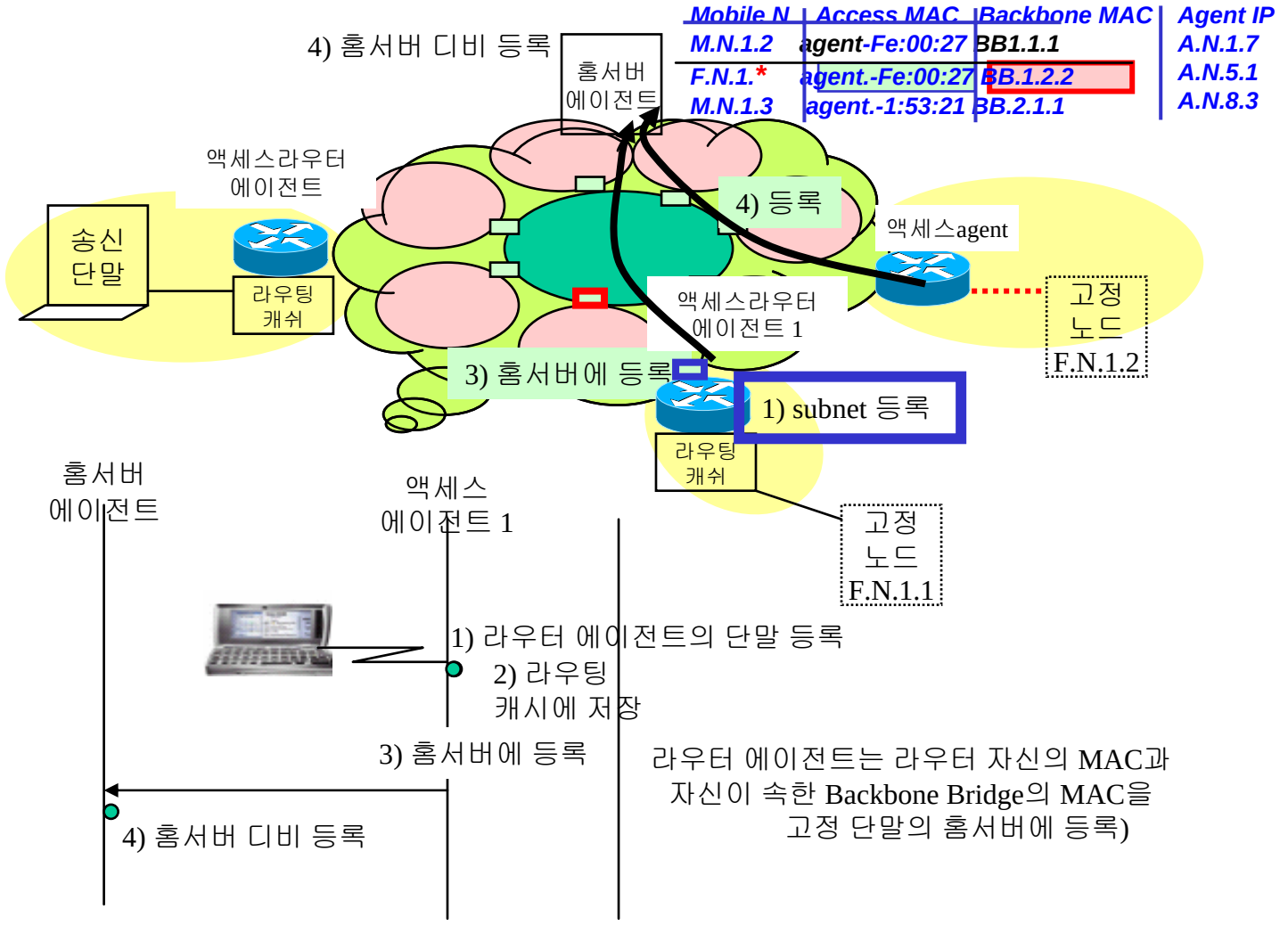
L2 Transport (Self-learning in each segment)



No broadcast for unknown packets.
But packet forwarding to the Backbone.

- Endpoint MAC ID will be studied within the segment.
- Ethernet Packet Switching based on end-point MAC, I.e., only need a MAC learning within the segment
- Access agent forwards packet to the access agent through multiple segments based on MAC-in-MAC addresses.

L2 Transport (MAC-in-MAC Registration)



Candidates for Future Network

- Provide continuous IP connectivity to Future IP device (mobile users as well as Fixed terminal users)
  - Q:What is the meaning of IP address (IP Glue)?
  - A: IP Address is used to manage the node across the Internet
    - An end communication entity (Identifier)
      : (End point identifier for transport and application layer)
    - Reachability for communication entity (Location)
      : IP Routing directive for distributed control in Packet switching

- Ethernet Switching/Forwarding with global Scalability
  - Q:What is the meaning of L2 switching?→ High-speed Packet switching
  - (A: Fast Forwarding)
    - High-speed L2 Switching but not L3 Switching
    - End-to-End Connectivity

Conclusion: Future Network Strategies

- Future Network = IP Network ? [IP+Transport]
  - Internet → IP (transport) + Control IP (MIP, SIP, …)
  - Internet → IP (Control) + Transport IP
    (IP naming & addressing)
- Key Idea (add an control protocol)
  - MARP→IP Mapping to Location of the terminal
  - MARP→enable interworking with IPv4 & IPv6
  - MARP→enable interworking with 4G & IP
  - MARP→ enable interworking with L2 High-speed transport