Researches on connection between WAPL and the Internet

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Abstract

The technology of a mesh network attracts attention these days as the method of making wireless LAN easily. A mesh network makes it easy to set and maintain AP(Access Point)s in wireless LAN by connecting APs with an ad hoc network. In a mesh network, it is need to manage the information of relationships between the AP and terminals under the AP.

We have been proposing WAPL(Wireless Access Point Link)[1] as a mesh network. In this paper, principles of WAPL and its connecting method with the Internet are described.

1. INTRODUCTION

In recent years, there are growing demands that we can easy communicate easily at any time and anywhere ,with the spread of small communication devices. So there has been a focus on the service that uses wireless LAN as communication infrastructure in order to realize low-price and high-speed networks.

The distance of Wireless LAN is limited to a fairy small range , there needs a considerable number of Access Points(APs) to build network infrastructure. However, APs are commonly connected with cables, it takes many costs and much time to set up APs. We have been researching and developing the system that solves the problems , that is called "WAPL"(Wireless Access Point Link)[1] that can expand wireless LAN areas easily connecting APs with an ad-hoc wireless network.

However, WAPL has not yet considered the way of internet connection, its use is limited to internal communication in WAPL. This paper describes the way how to connect WAPL to the Internet. We have implemented the function and confirmed the result.

2. WAPL

WAPL is one of the method of a mesh network that is discussed in IEEE 802.11 committee utilizing infras-
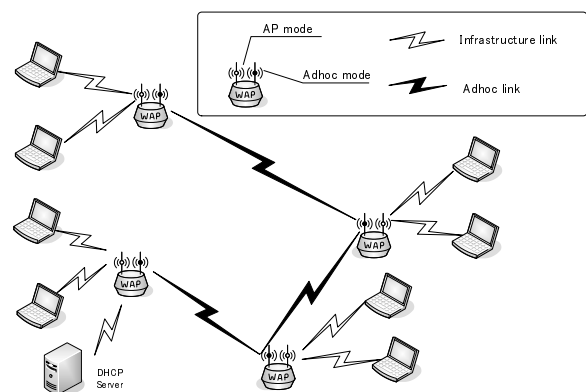

Figure 1: An Example of WAPL structure

tructure mode and ad-hoc mode .In a mesh network, when end terminals communicate among them, AP and terminals are connected with infrastructure mode, and APs are connected with ad-hoc mode.

Fig.1 shows an example of WAPL structure. WAPL uses an unique AP named WAP(Wireless Access Point).WAP has 2 wireless interfaces. One is set for an AP mode and makes connections with terminals in an infrastructure mode , the other one is set for ad-hoc mode and makes connections with other WAPs.

For the connections among WAPs, WAPL uses MANET(Mobile Ad-hoc Network)Routing Protocol, that can make multi-hop communications. By this way internal communication is possible without wired connection.IP addresses of terminals in WAPL system are distributed from a DHCP server.

Fig.2 shows WAP architecture. When WAP receives a wireless packet from a terminal , the packet is encapsulated into IP header in WAP. The encapsulated packet is transmitted to other WAP which is making a connection with the destination terminal, with multi-hop forwarding. When the receiving side WAP receives the above packet, it decapsulates the IP header and transmits it into the destination terminal.
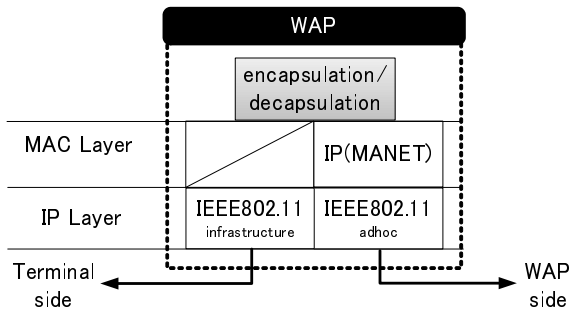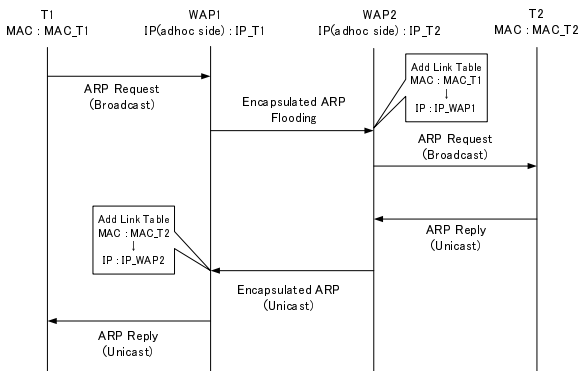
Figure 2: WAP architecture

Figure 4: GWAP architecture

Figure 3: Link Table generating sequence

Figure 5: GWAP architecture

WAP uses so called Link Table when it transmits the encapsulated packet to the destination WAP properly. Link Table is the table which records the relationships between the MAC address of the terminal's infrastructure side and the IP address of WAP's Adhoc side. Link Table is generated on demand with an ARP(Address Resolution Protocol) packet which is regularly executed at the beginning of the communication.

Fig.3 shows Link Table generating sequence. When WAP receives an ARP[3] request packet from the terminal , WAP encapsulates it in multicast header and floods it to all other WAPs. When each WAP receives the above packet ,WAP decapsulates the header and sends the ARP request packet to terminals below and generates Link Table at the same time. Next, when WAP receives an ARP reply packet from the terminal, WAP encapsulates it in unicast header referring its own link table and send back it to the initial WAP.

WAP consists of APF(Access Point Function) which executes outgoing and incoming processes of packets between WAP and terminal , and CAPF(Capsulation Function) which executes encapsulation and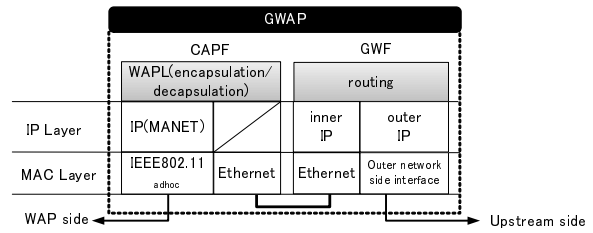 decapsulation processes o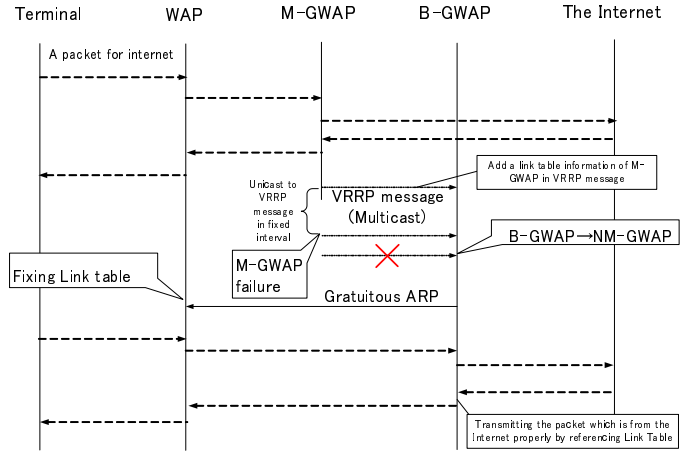f packets, and transmits them among APs. APF is realized with a commercial AP and CAPF is realized with a PC and they are connected with Ethernet. In CAPF, FreeBSD 5.4 kernel is modified and OLSR(Optimized Link State Routing)[2] is applied for the routing protocol.

3. INTERNET CONNECTION

This chapter explains GWAP which applies VRRP. GWAP having the function of MR is called M-GWAP and GWAP having the function of BR is called B-GWAP.M-GWAP sends VRRP messages with a multicast address at the fixed period. When M-GWAP happens to break, B-GWAP becomes a NEW M-GWAP (NM-GWAP) after detecting that M-GWAP is dead. However, there are problems due to the differences of Ethernet and WAPL.

Link Table in each WAP stays the same because it can not detect the M-GWAP failure. Therefore packets from each terminal are sent to old M-GWAP as it stands.

Also, when a NM-GWAP receives a packet from the Internet, it can not send the packet to the proper WAP, because the NM-GWAP does not have the link table that M-GWAP had before. To solve the first

problem, NM-GWAP sends gratuitous ARP (ARP that requests its own IP address) when B-GWAP becomes NM-GWAP. With this function, a link table corresponding to NM-GWAP in each WAP is made, and packets from the terminals are sent to NM-GWAP.

To solve the second problem, the information of the link table in M-GWAP is to be included in VRRP messages. With this function, Link Table in B-GWAP is always the same with M-GWAP. With the method mentioned above, VRRP on WAPL can be achieved.

4. CONCLUSION

We have proposed the installation of GWAP to which a router function is added to WAP in order to connect terminals in WAPL to the Internet. Also, we have proposed VRRP on WAPL in order to make redundancy of the default gateway in WAPL.

Implementation of GWAP is already finished and confirmed the Internet connection. We are going to implement VRRP on WAPL.

References

[1] Shohei Ichikawa,Akira Watanabe: "A realization method of WAPL; Wireless Access Point Link," *Graduate School of Science and Technology. Meijo University. DICOMO 2006 symposium.* , vol.2005, No.6, pp. 225–228,Jul,2005;

[2] T.Clausen, P.jacquet: "Optimized Link State Routing Protocol (OLSR)," *RFC3626 Oct.2003*;

[3] David C. Plummer.: "Ethernet Address Resolution Protocol: Or converting network protocol addresses to 48.bit Ethernet address for transmission on Ethernet hardware," *RFC 826 November 1982*;

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Introduction

➢ Wireless Mesh Network

  ◆ Users can connect to the network with an infrastructure mode

  ◆ APs are connected with an ad-hoc mode

Wireless LAN

Infrastructure mode

Wireless Mesh Network

Ad-hoc mode

Infrastructure mode

▪Easy installation
▪Easy maintenance
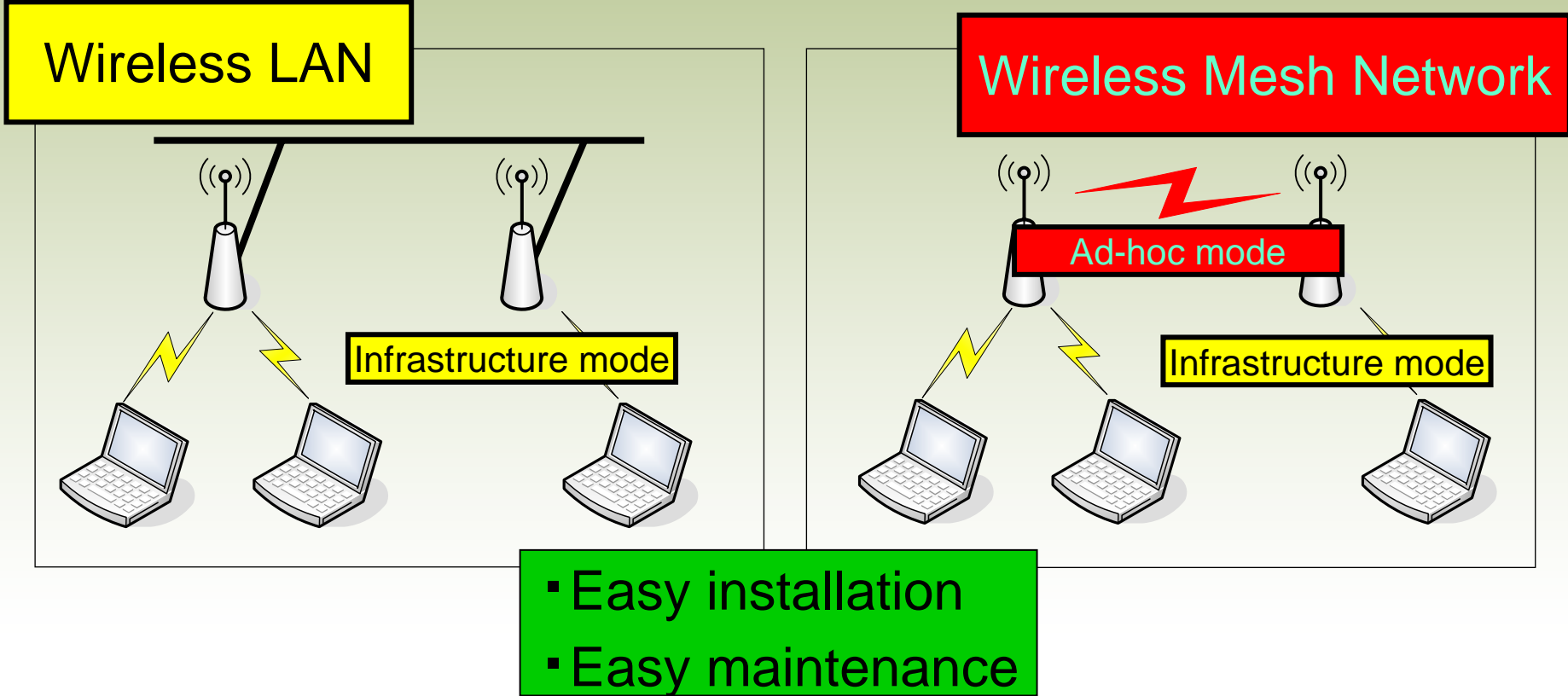
A Related technology

-An existing wireless mesh network technology-

M-WLAN

➢ A wireless mesh network opened to the public

- Ad-hoc
- (Niigata University)
- Infrastructure
- Infrastructure

Adhoc function
+
AP function

➢ The AP for M-WLAN

  ◆ adhoc function + infrastructure function

➢ L2 tunnel

  ◆ To transmit the packet sent from the terminal

encapsulation   decapsulation

Referring Mesh Routing Table

Mesh Routing Table

terminal	AP
T1	AP1
T2	AP2
T3	AP3
T4	AP4
T5	AP5
T6	AP3
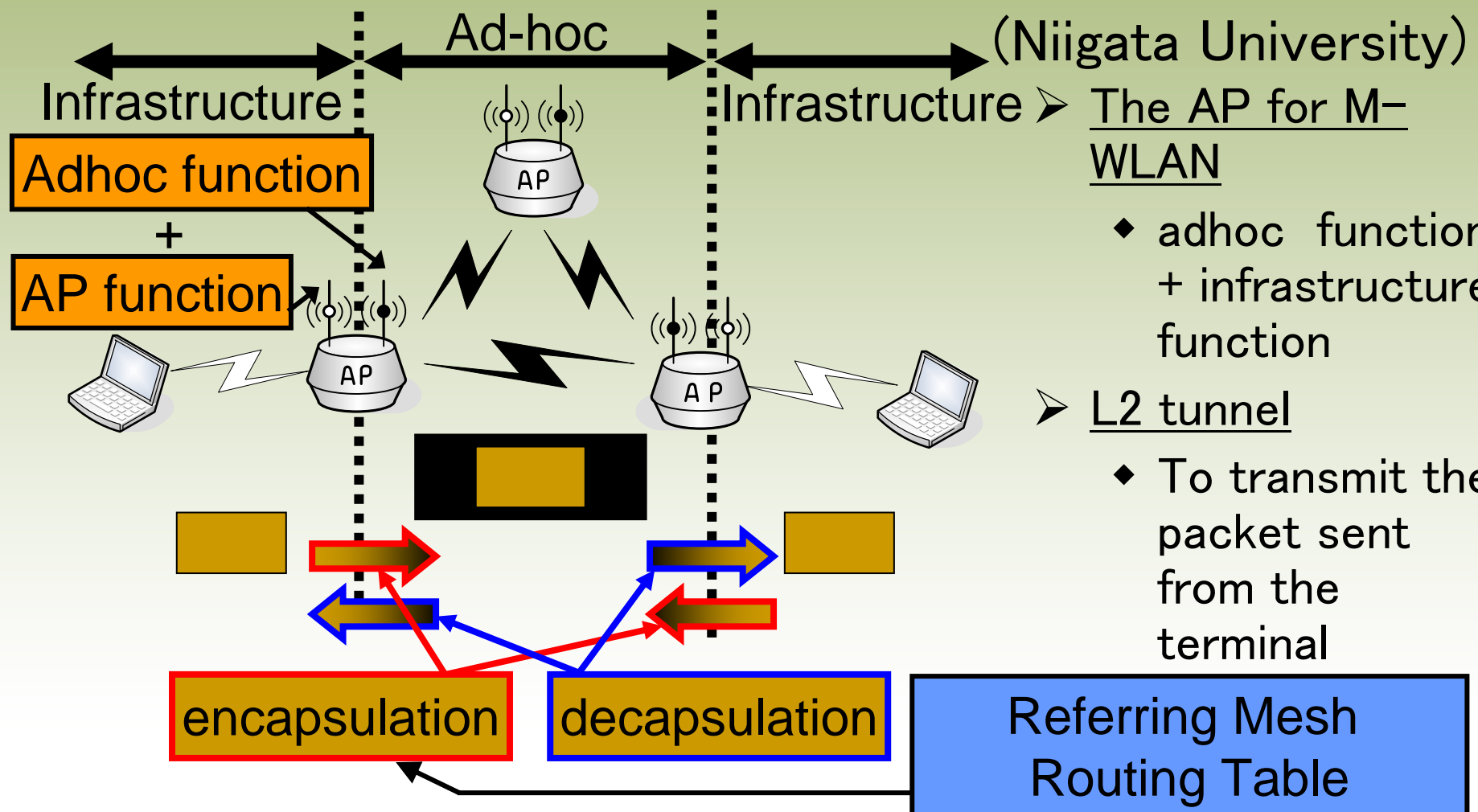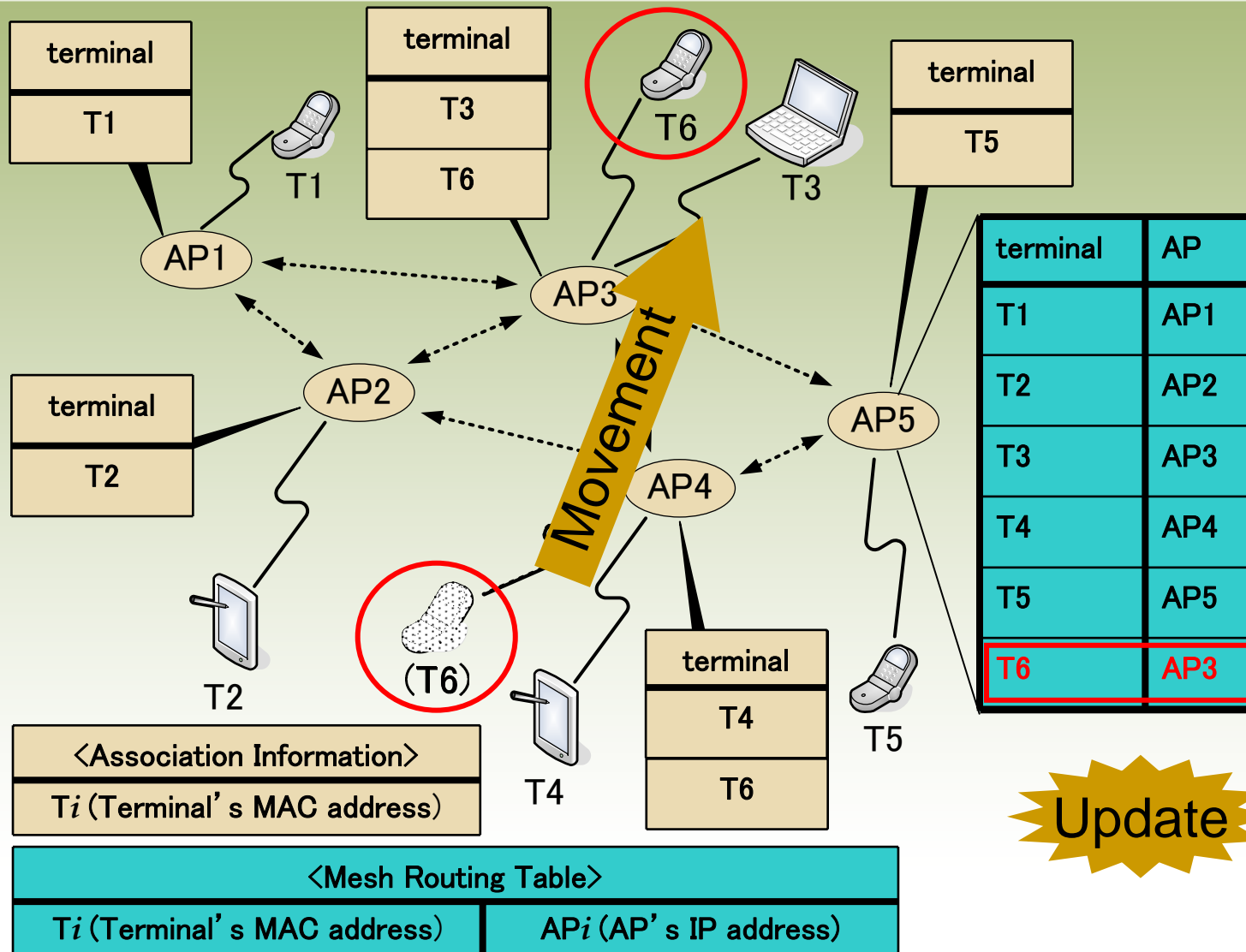
➢ The relationship between Terminals and APs

➢ All APs have the same information

Update

Movement

terminal — T1

terminal — T3 / T6

T6

T3

terminal — T5

AP1 AP3 AP2 AP5 AP4

T2

(T6)

T4

terminal — T4 / T6

T5

\<Association Information\>

T*i*（Terminal's MAC address）

\<Mesh Routing Table\>

T*i*（Terminal's MAC address）	AP*i*（AP's IP address）

Exchanging Mesh Routing Table in M-WLAN

Periodical exchange of the Mesh Routing Table by remodeling OLSR

Occurrence of periodical flooding

Data Packet

Mesh Routing Table Updating Packet

movement

movement

Mesh Routing Table Updating

Packet loss occurrence resulting from the exchanging of periodical Mesh Routing Table
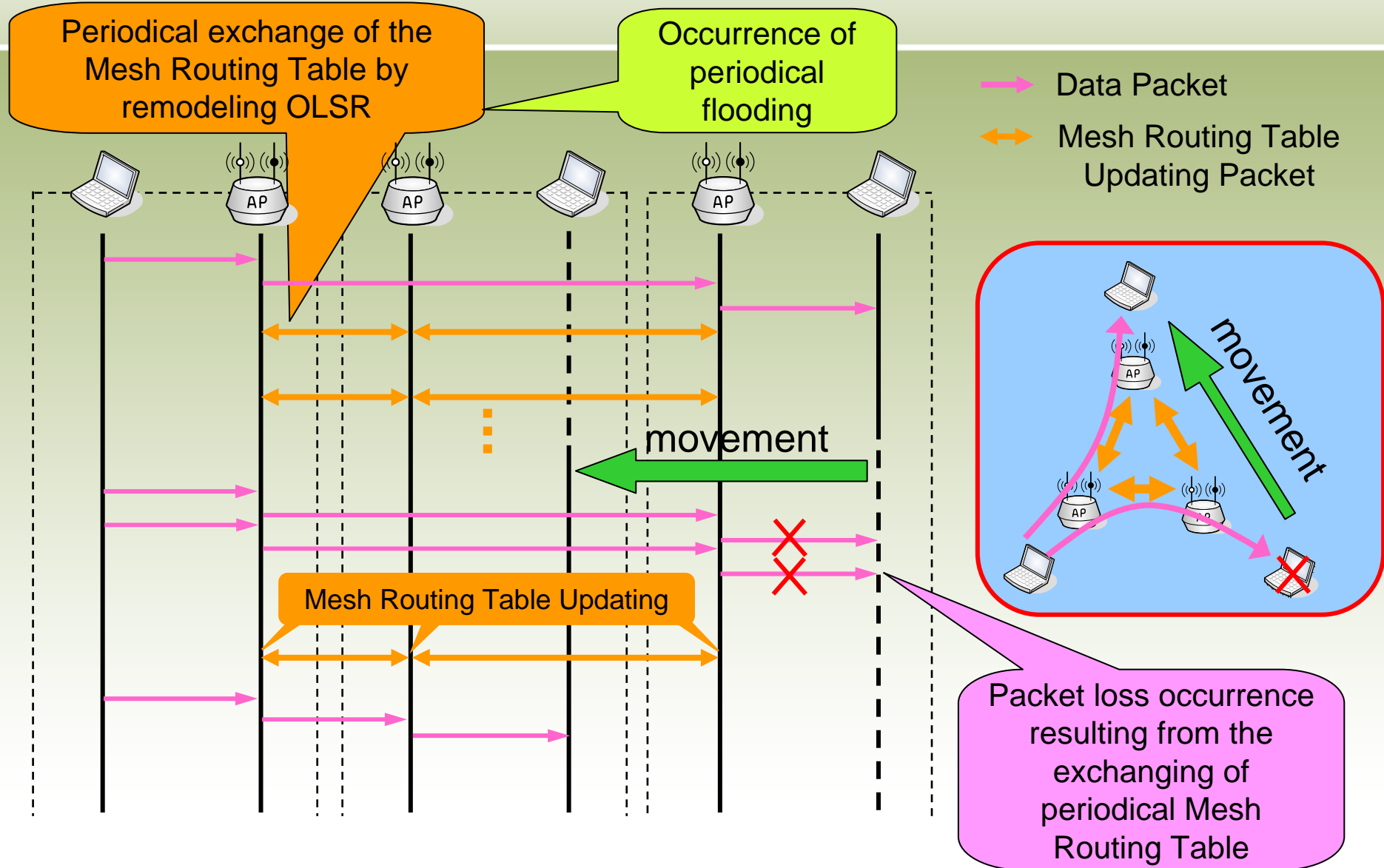
Issues of M-WLAN

➢ Periodical exchange of Mesh Routing Table

◆ Useless flooding occurs

➢ Packet loss occurs when the terminal moves during communication

➢ Remodeled protocol

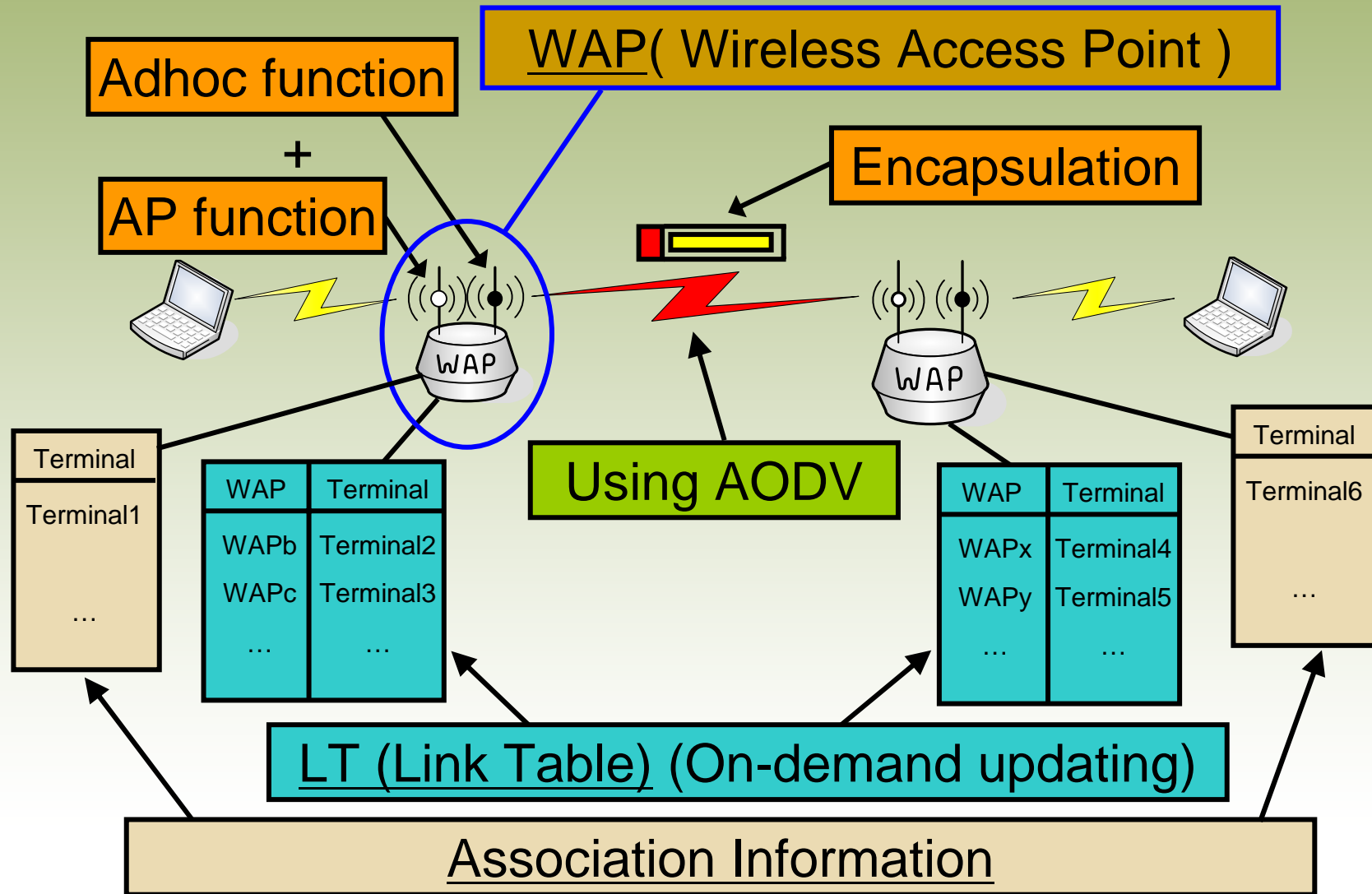◆ It is difficult to change a routing protocol

WAPL

WAPL 〜FEATURE〜

On-demand Link Table updating

Lossless handover

Ad-hoc routing protocol is independent

WAPL ～Summary～

Adhoc function
+
AP function

WAP(Wireless Access Point)

Encapsulation

Using AODV

WAP	Terminal
WAPb	Terminal2
WAPc	Terminal3
...	...

WAP	Terminal
WAPx	Terminal4
WAPy	Terminal5
...	...

Terminal
Terminal1
...

Terminal
Terminal6
...

LT (Link Table) (On-demand updating)

Association Information

Communication of WAPL (LT generation)

St(Source terminal)   S(Source)   N(Other WAP)   D(Destination)   Dt(Destination terminal)

Data Packet

sending

LT confirmation transmitting

LT generation request sending (flood)

LT(D-Dt)un-generating

Checking its own Association Info

LT(S-St) generation ・update

LT(D-Dt) generation

LT generation reply (Unicast)

Referring to LT

・Flooding occurs only at LT generation sequence

・Periodical flooding is not needed

ARP Request

Proxy ARP

Communication of WAPL(terminal movement under communication)

St

S

D' (The connection WAP after movement)

Dt

D

Dt

N

Neighbor

Neighbor

sending

Data Packet

Dt is not exists

Transmitting

LT(D-Dt)

send

movement reporting message

movement

(including data packet)

(Broadcast)

sending

transmitting

sending

LT update message

Data
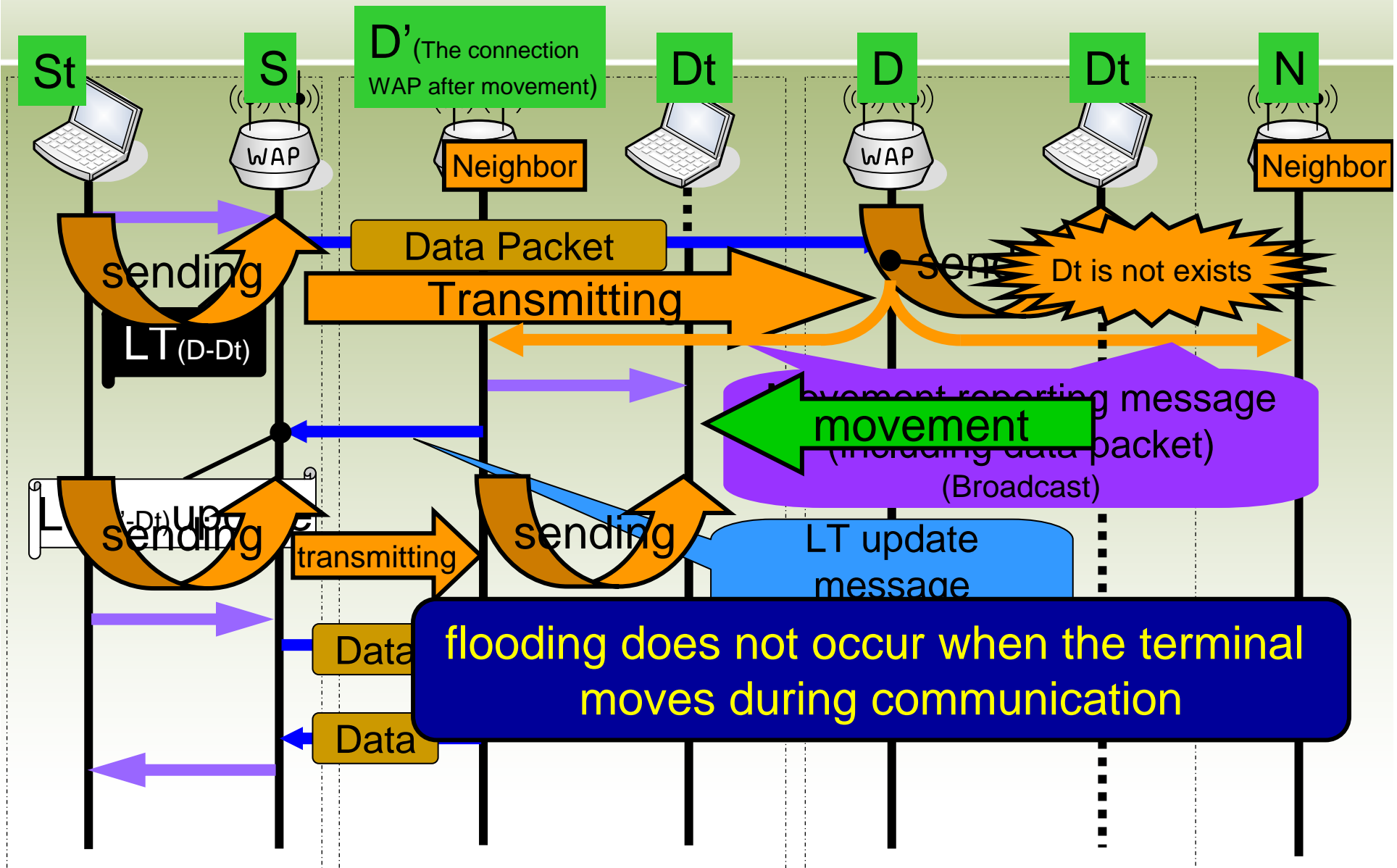
flooding does not occur when the terminal moves during communication

Data

Internet connection
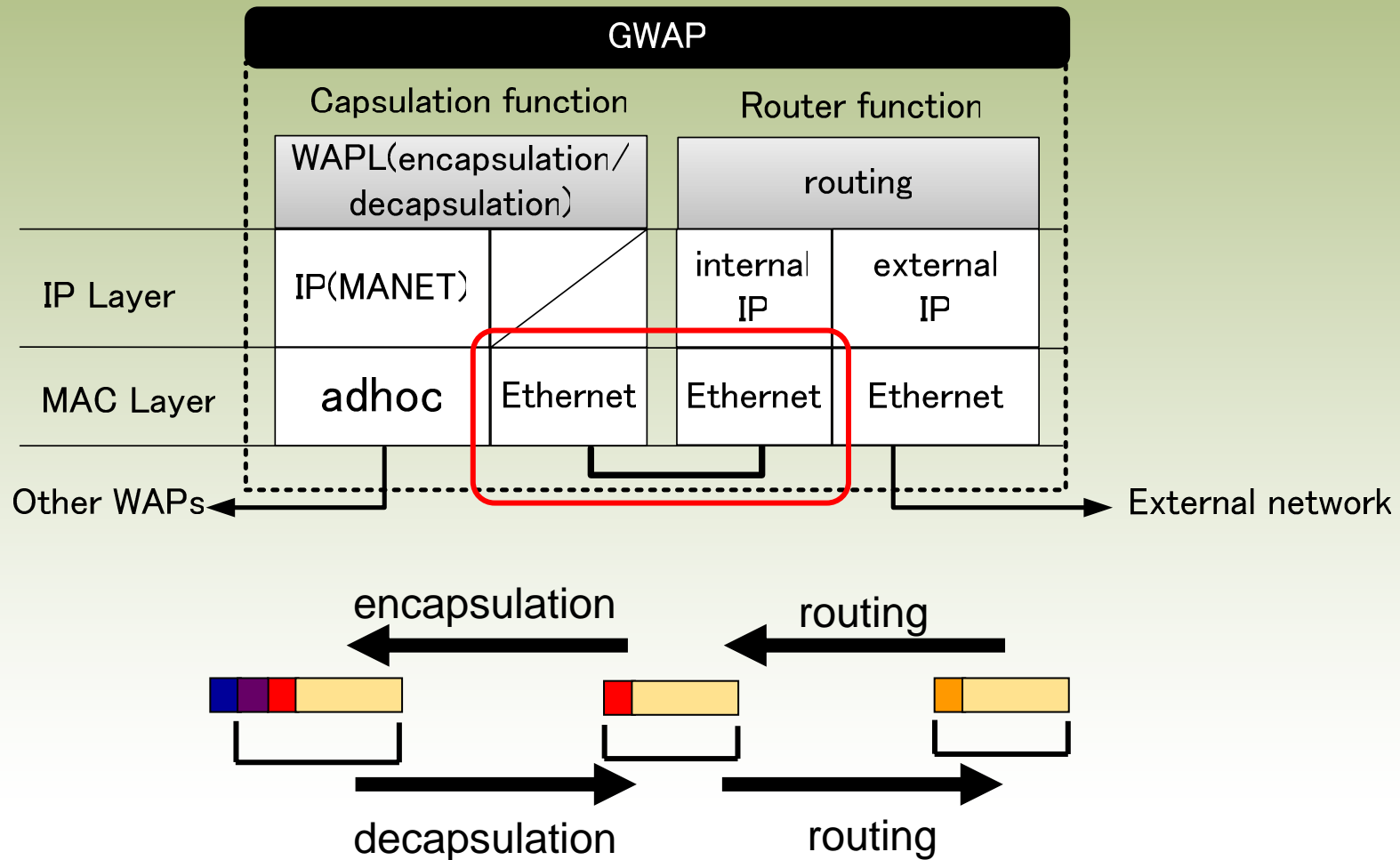
Conclusion

◇**Review of the talk**

> WAPL

  - One of the Wireless Mesh Network technologies
  - On-demand Link Table updating

> Connection between WAPL and the Internet

  - An Internet connectivity is realized by installing a router into WAP

◇**Future work**

> Evaluation with simulation

> Implementing on Linux PCs