

高速シームレスモバイル通信

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Agenda

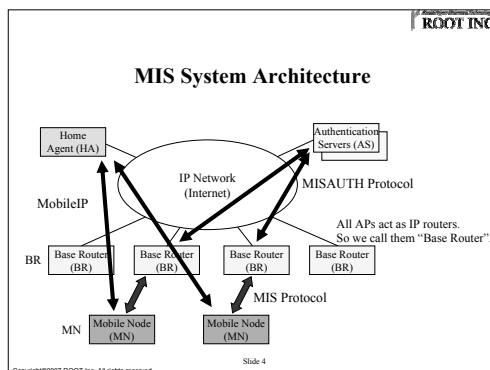
- **MISP protocol (Basic seamless hand over)**
 - Introduce our MIS Protocol (MISP)
 - Comparison with IEEE802.11 and IEEE802.1x from the point of view of handover latency
 - Comparison with IEEE802.11 and IEEE802.1x from the point of view of security
- **PDMA (Make before break hand over)**
 - Handover latency
 - Packet Division Multiple Access (PDMA)
 - Laboratory experiment
 - Field experiment
- **Media hand over (Wireless LAN & PHS)**

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Introduction of MISP (Basic seamless hand over)

- **The combination of Wireless LAN and mobile IP is a fast and low-cost mobile communication method.**
- **But there are some issues.**
 - Security Weakness
 - Handover Latency
- **So we developed a new link layer protocol, MISP.**

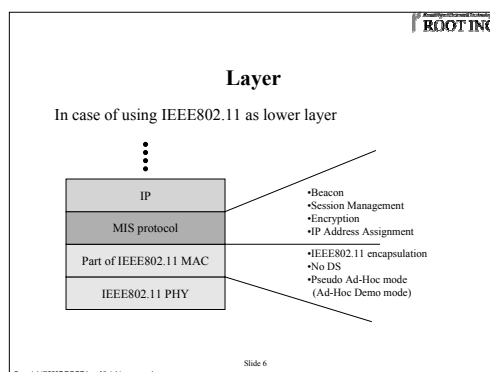
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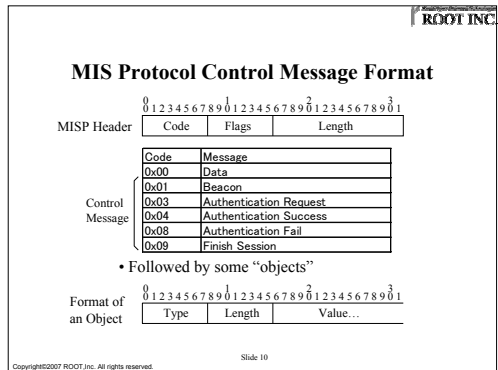
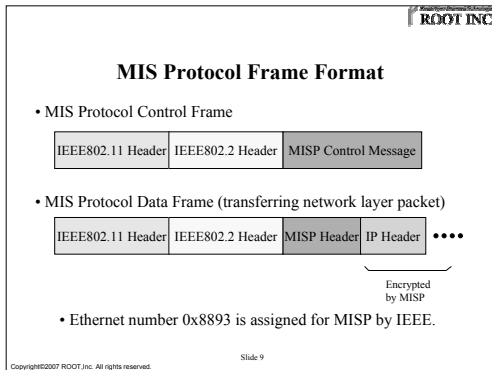
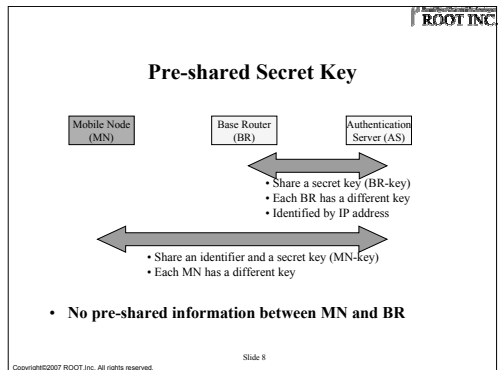
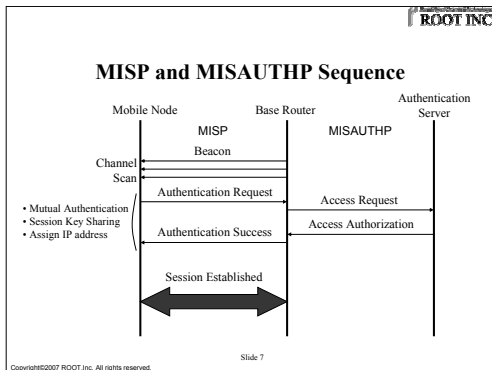


MISP Overview

- **MIS protocol is a layer 2 protocol designed for public mobile internet services.**
- **IPv4 is mainly targeted as upper layer.**
- **Lower layer is IEEE802.3 or part of IEEE802.11.**
- **Features**
 - Mutual authentication, session key exchange and network layer setup between BR and MN by ONE ROUNDTRIP PACKET EXCHANGE
 - Effective for fast handover
 - Encryption between AP and STA with periodic key update
 - Authentication of every frame
 - Multiple Service Providers support
- **It can be used with MISAUTH protocol (MISAUTHP) which enables remote authentication over IP.**

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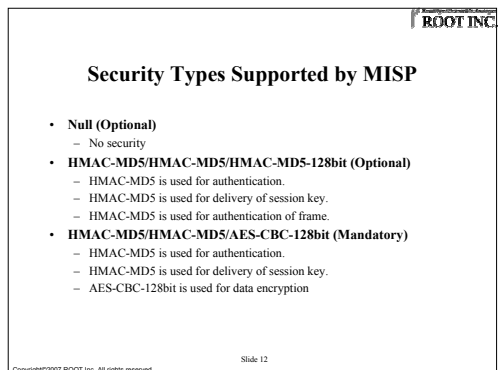
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Objects

Type	Length	Name	Beacon	Auth. Req.	Auth. Suc.	Auth. Fail
0x00	1	Padding	Optional	Optional	Optional	Optional
0x02	10	Beacon Timestamp	Required	Required	Required	Required
0x03	6	IPv4 Local Address		Optional	Optional	
0x04	6	IPv4 Remote Address		Optional	Optional	
0x05	Variable	ICV (Integrity Check Value)		Required	Required	
0x06	Variable	NAL (Network Access Identifier)		Required	Required	
0x08	Variable	Session Key Delivery Data		Required		
0x09	14	Geographical Information		Optional		
0x0a	3	IPv4 available address number		Optional		
0x0b	3	IPv4 Source Address Filter		Optional		
0x0d	4	Error Reason				Required
0x0e	2+4n	BIT Group	Required			
0x0f	4	Session Key Valid Time			Required	
0x10	4	Serial Number	Required			
0x11	4	Beacon Interval	Required			
0x12	2+2n	Security Type	Required	Required		
0x13	8	Link Speed	Optional			
0x14	3	Channel	Optional			
0x15	2+2n	Network Layer Type	Required	Required	Required	

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Beacon

- Beacons are transmitted in 30ms interval.
- Each beacon includes the following information.
 - Timestamp
 - Serial number
 - Beacon interval
 - Group (like SSID)
 - Supported Network layer type
 - Remaining IPv4 addresses
 - Channel
 - Etc

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Behavior of MN

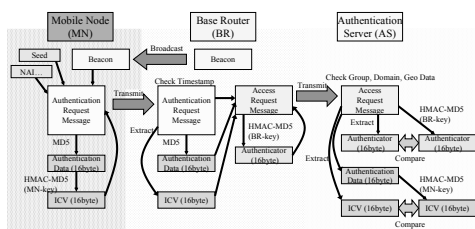
1. An MN makes a list of BRs by scanning channels and receiving beacons. The BRs in the list have corresponding "group (like SSID)".
2. The BR list is sorted by the signal strength of the beacon.
3. The MN try to authenticate to the top of the list of BRs.
4. If the authentication fails, the MN try to authenticate to the next BR in the list until the end of the list.
5. After the authentication succeed, the MN can communicate to the network.
6. The MN makes a registration to the HA.
7. The MN watches the beacon of connected BR. If the MR cannot receive the beacon of the BR for a certain period, or the beacon strength becomes less than the threshold, the MN closes the session and return to 1.

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Authentication

(HMAC-MD5/HMAC-MD5/AES-CBC-128bit)

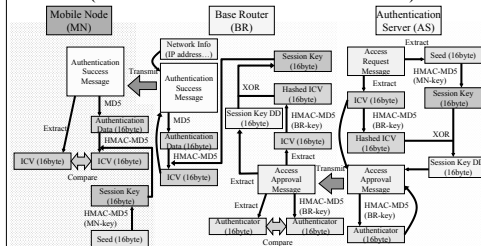


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Authentication (Cont.)

(HMAC-MD5/HMAC-MD5/AES-CBC-128bit)



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Network Layer Setup

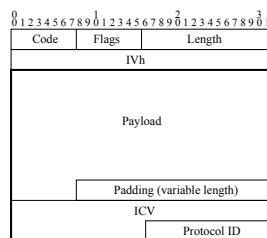
- **IPv4 Configuration**
 - Assign IP address and gateway
 - DNS server, SMTP server, etc. are not assigned because it is premised on mobile IP. In case of using mobile IP, it is enough that fixed servers are installed near the home agent.
 - But it is easy to expand to assign them for non mobile IP users by defining new objects.
- **Other network layer such as IPv6 support is also easy by defining new objects.**

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Data Message Format

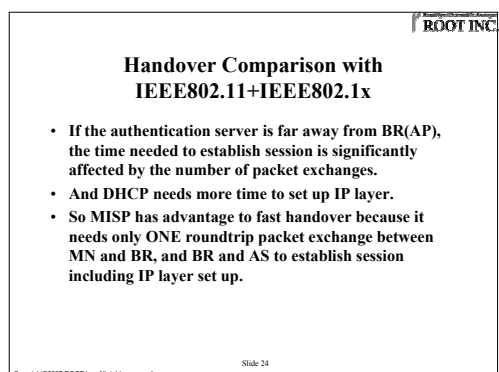
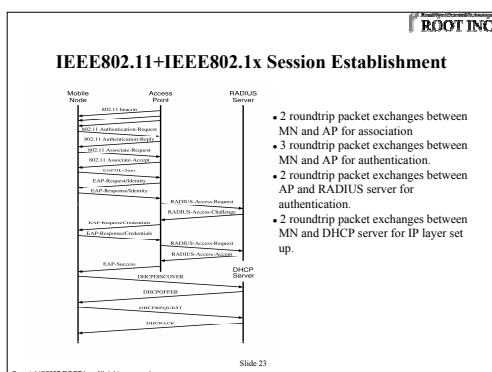
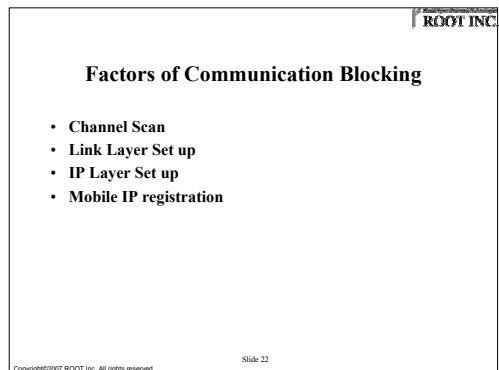
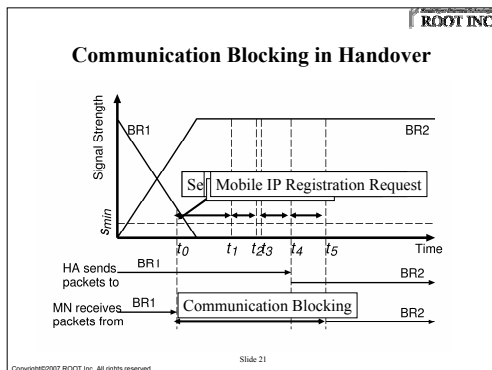
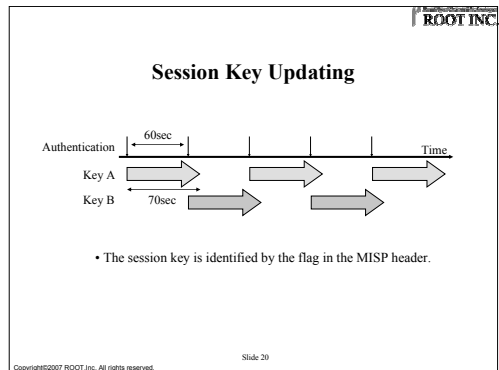
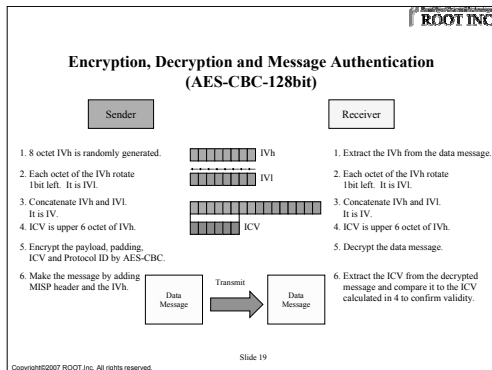
(HMAC-MD5/HMAC-MD5/AES-CBC-128bit)



- IVh: Upper 8 octets of the Initialization Vector for AES-CBC
- Payload: A packet data of the upper protocol
- Padding: It makes the payload multiple of 16 octets
- Protocol ID: Indicates the network layer protocol

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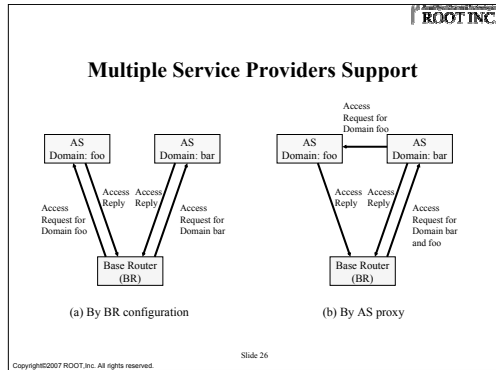
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	IEEE802.11+IEEE802.1x	MISP+MISAUTHP
Man-in-the-middle attack	Available by fake EAP success message	Unavailable (avoided by mutual auth.)
Fake access points	Available	Unavailable (avoided by mutual auth.)
DoS attack by fake management frame	Available	Depends on implementation
Session Hijack	Available by MAC address hijacking	Unavailable (avoided by packet auth.)

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Field experience

- Net meeting over UDP
- Video streaming over TCP/IP

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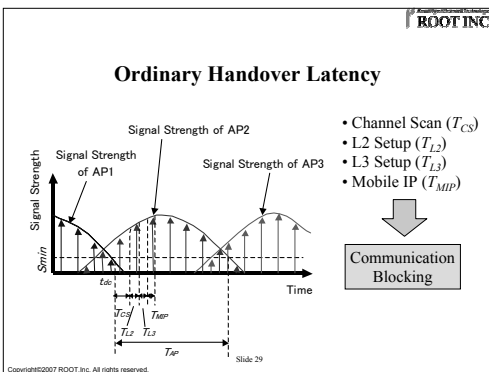
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PDMA (make before break)

- We developed a new link layer protocol MISP and a new multiplexing method PDMA.

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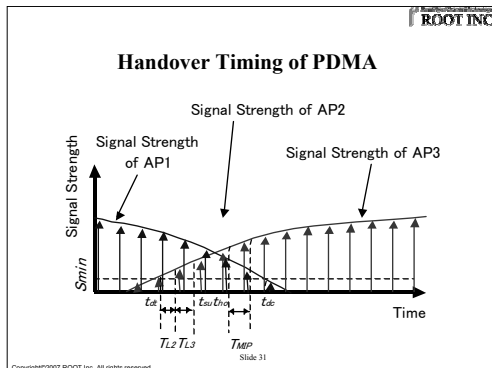


Packet Division Multiple Access (PDMA)

- All cells use same channel.
- All packets share the bandwidth by CSMA/CA fully dynamically and automatically.
- Mobile nodes don't need to scan channels.

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Implementation

- We implemented MISP, PDMA and mobile IP on a mobile router ROOT RMR2400G.
 - CPU: Intel Celeron 400MHz
 - Wireless I/F: Atheros AR5212 (IEEE802.11a/b/g)
 - OS: NetBSD 2.99.10 (-current in Oct. 2004)

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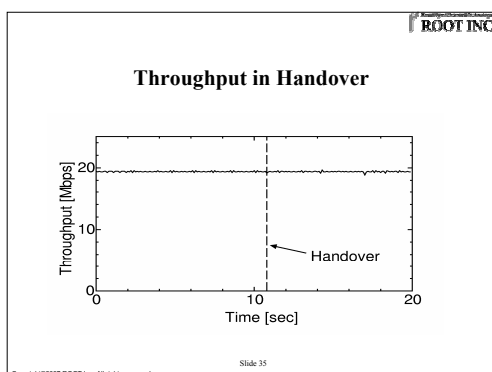
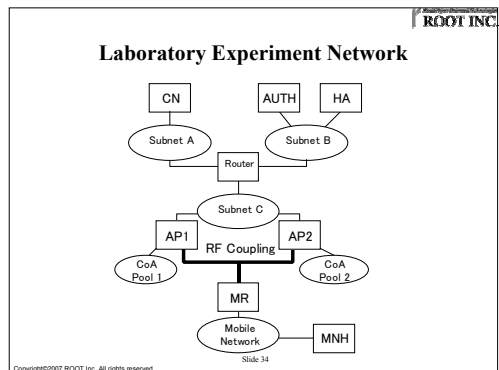
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Laboratory Experiment

- Wireless Interface: 5GHz, OFDM54
- 1200byte UDP packet at 20Mbps
- Observe packet losses and latency at handover
 - No packet losses were observed
 - No significant latency was observed

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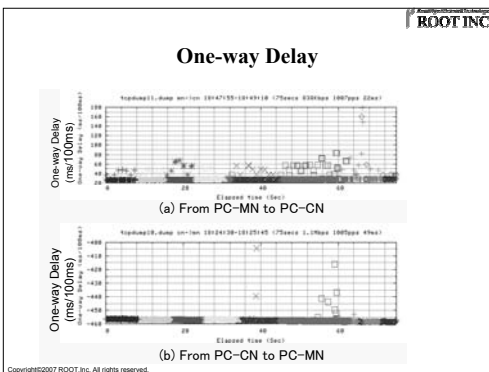
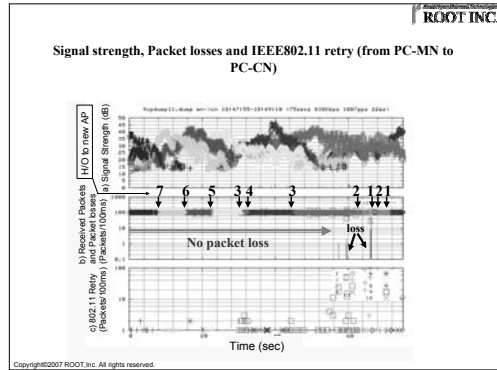
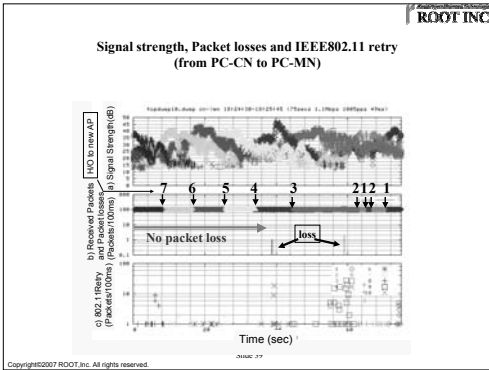
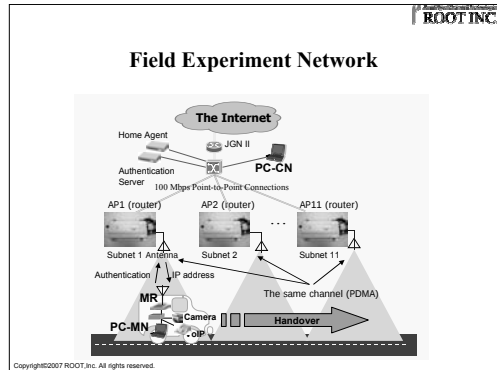
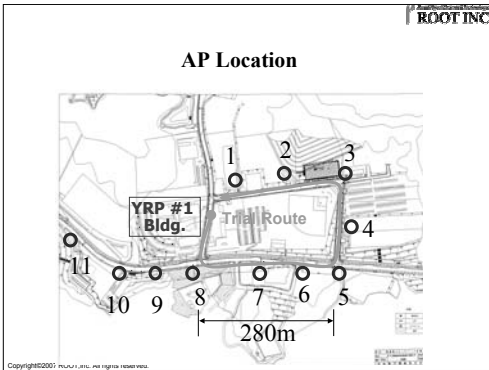
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Field Experiment

- Wireless Interface: 5GHz, 108Mbps (Turbo mode)
- 11 APs are installed along the road
 - 70-150m interval
- MR, PC and camera are installed in a car
 - The car was driven at 30km/h
- Observe signal strength, packet losses and 802.11 retry
 - 58byte UDP packet at 1000packets/sec (1Mbps)
- DVTS (video streaming), Skype (VoIP)

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Media hand over

Media	Data rate	Service cost OPEX	Infrastructure CAPEX	Services area
Cellular	<Mbps	Packet charge High	Operator's property High	Nation wide
PHS	<100kbps	Fixed charge Low	Operator's property High	Nation wide
Wireless Lan	<54Mbps	Free	Low	Limited area



The hybrid system of PHS and Wireless LAN can makes large service area by low OPEX & CAPEX.

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Field Trial

- **Dates** 2006/2/15-2006/3/31
- **Area:** Shuttle bus around Hakata area.
 - Hakata ST→ Gofukumachi →Tenjin →Canal city→Hakata ST
 - Length : 5.4km
 - Round trip time: 30 to 60 min (depends on traffic condition)
- **Number of Mobile (bus):** 10
- **Number of Wireless LAN AP (2.4GHz, OFDM6) :** 9
- **Service Contents:**
 - Operating information (Estimate Arrival time)
 - News (Text, Video)
 - Advertisement (Picture, Video)
 - Emergency information

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Filed Trial Area



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Wireless LAN antenna

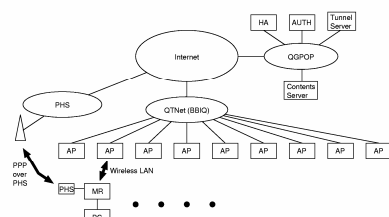


Cardioids Antenna
(140°、6 dBi)

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Network schematics



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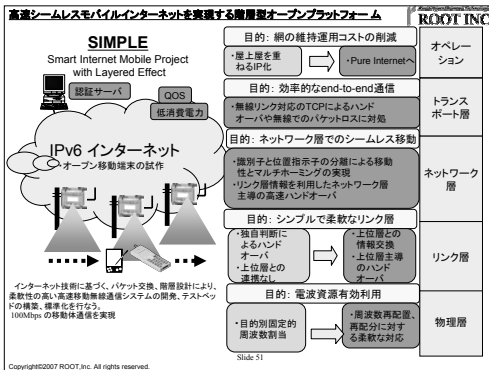
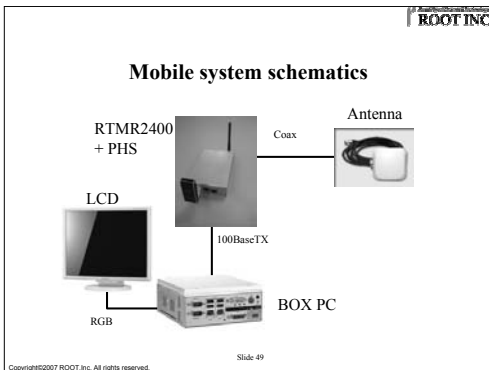
Mobile Router (RTMR2400)

- **CPU:** Intel IXP425
- **OS:** NetBSD
- **Interface**
 - IEEE802.11a/b/g
 - 100BaseTX × 2
 - USB × 2
- **Size:** 95mm × 139.5mm × 33mm
- **Weight:** 500g



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- ### Conclusion
- We implemented MISP, PDMA and mobile IP
 - We did laboratory experiment and field experiment
 - The combination of MISP and PDMA minimize handover latency without packet losses.
 - We deployed media hand over between PHS and Wireless LAN. This hybrid systems makes huge service area immediately with low CAPEX and OPEX.
 - All technologies should be optimized by module architecture.
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