CONNECTATHON2001

The Mobile IPv6 implementation on the InternetCAR projects

Keio University

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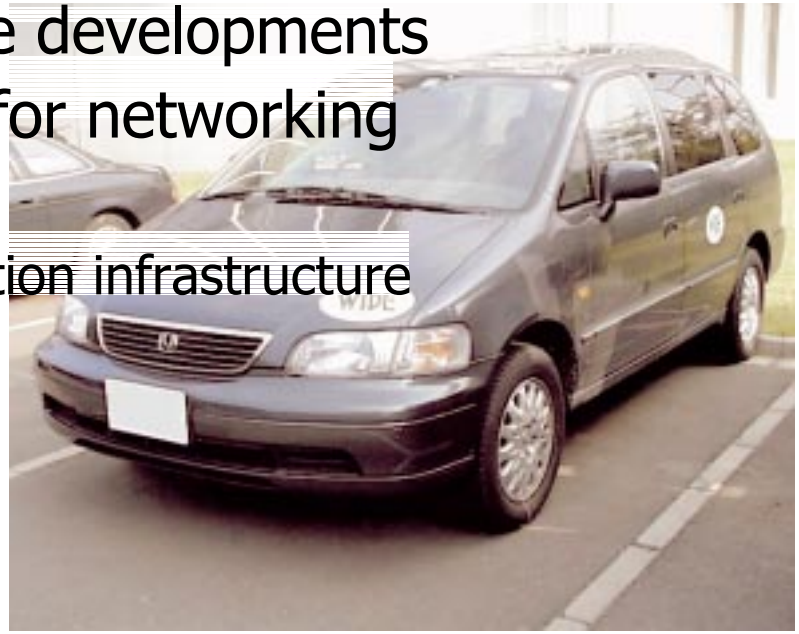
TOC

- Overview of InternetCAR project
- Mobile IPv6 Implementation on InternetCAR
- Evaluation of Mobile IPv6

Internet CAR project

Overview

- *Internet C*onnected *A*utomobiles *R*esearches
  - Connect Automobiles to the Internet
  - Provides a platform to develop applications which deals with information of automobiles
- Research areas
  - On-board computer hardware developments
  - Continuous mobility support for networking
  - Middleware
    - Geographical Location Information infrastructure
    - Dataset and its format
  - Applications



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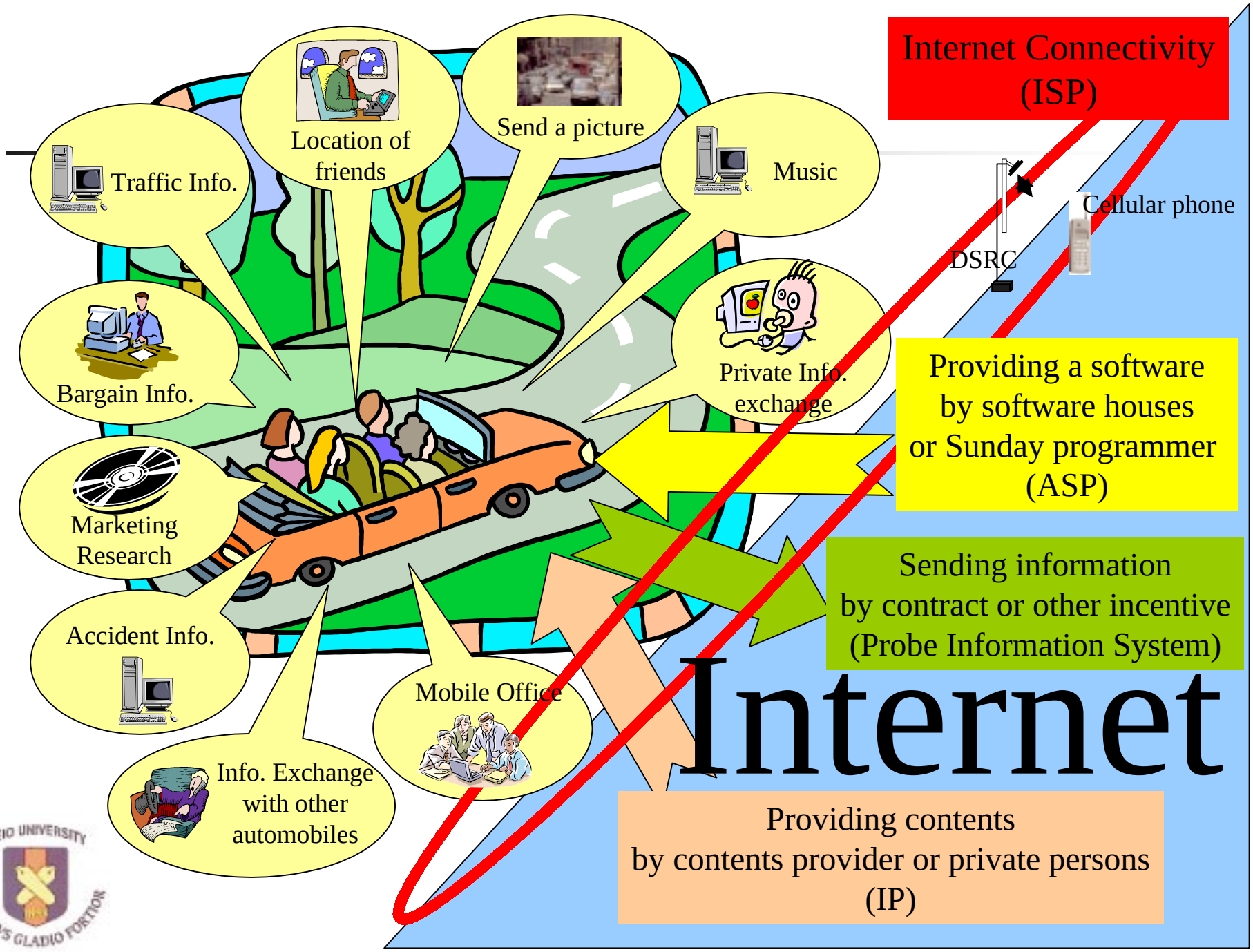
Internet Connectivity
(ISP)
Location of
friends
Send a picture
Traffic Info.
Music
Cellular phone
DSRC
Bargain Info.
Private Info.
exchange
Providing a software
by software houses
or Sunday programmer
(ASP)
Marketing
Research
Sending information
by contract or other incentive
(Probe Information System)
Accident Info.
Mobile Office
Internet
Info. Exchange
with other
automobiles
Providing contents
by contents provider or private persons
(IP)
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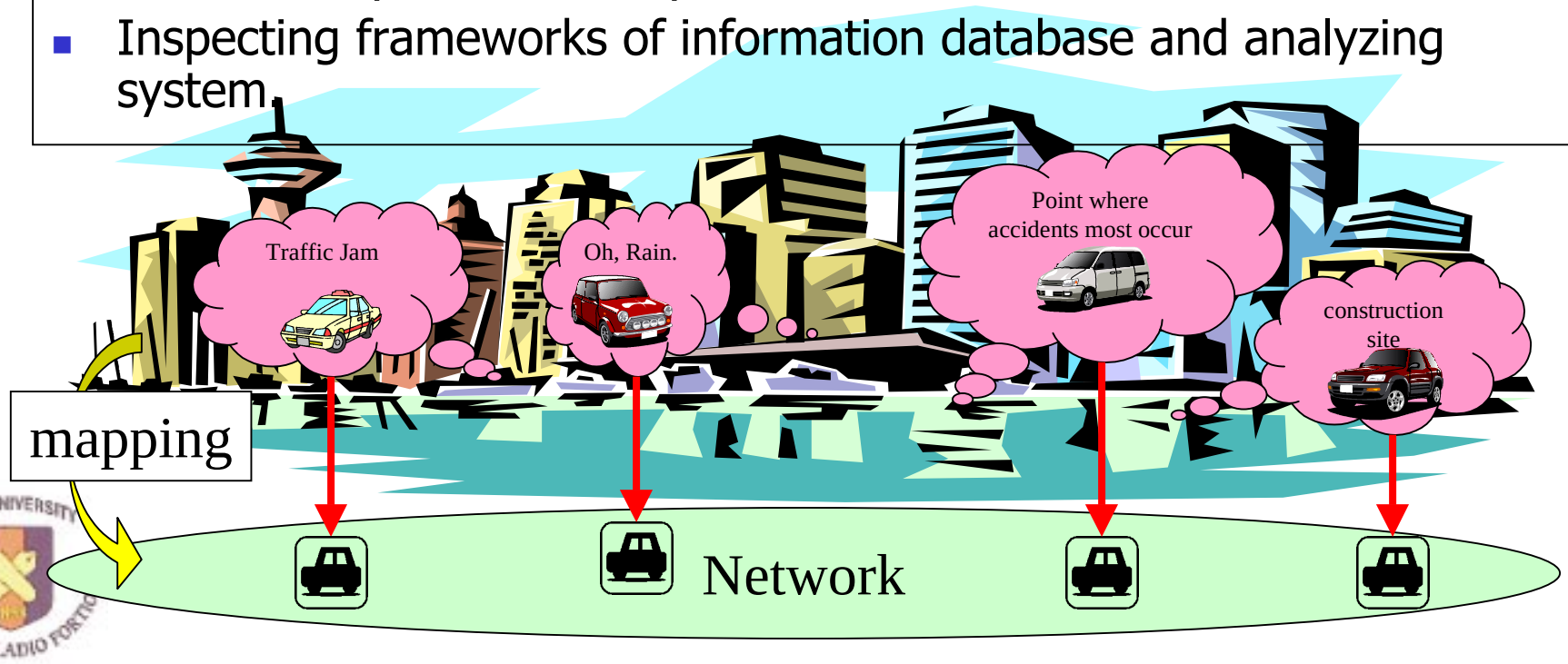
Probe Car: Sharing information

- One of application of the InternetCAR Project
- Probe the real world status using actual cars
- Seek to use the information efficiently by uploading information .
- By collecting information from number of cars, services will ensure the reliability and accuracy.
- Inspecting frameworks of information database and analyzing system.



InternetCAR

- HONDA Odyssey
- 19inch rack is installed

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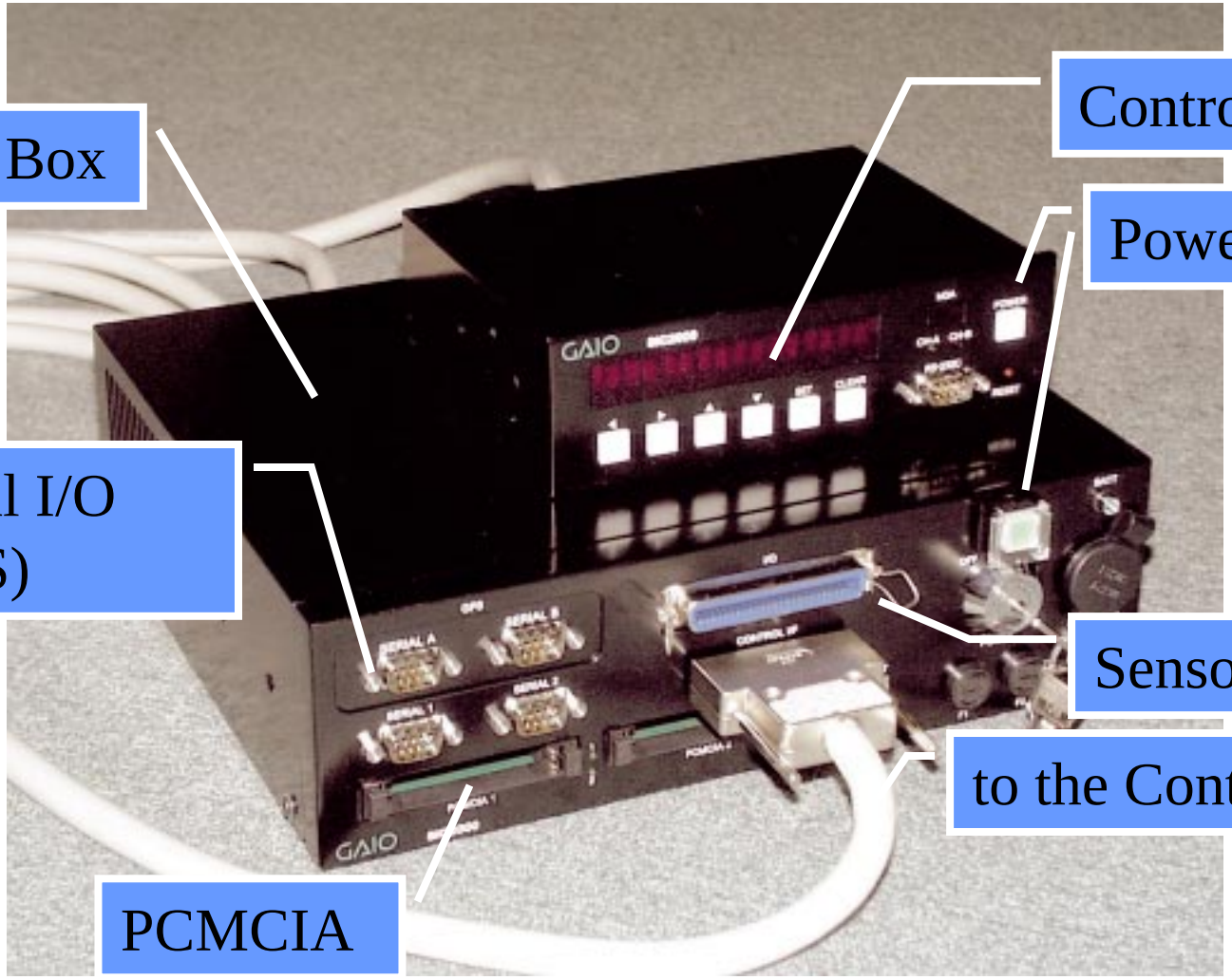
On-board Computer: SIC2000



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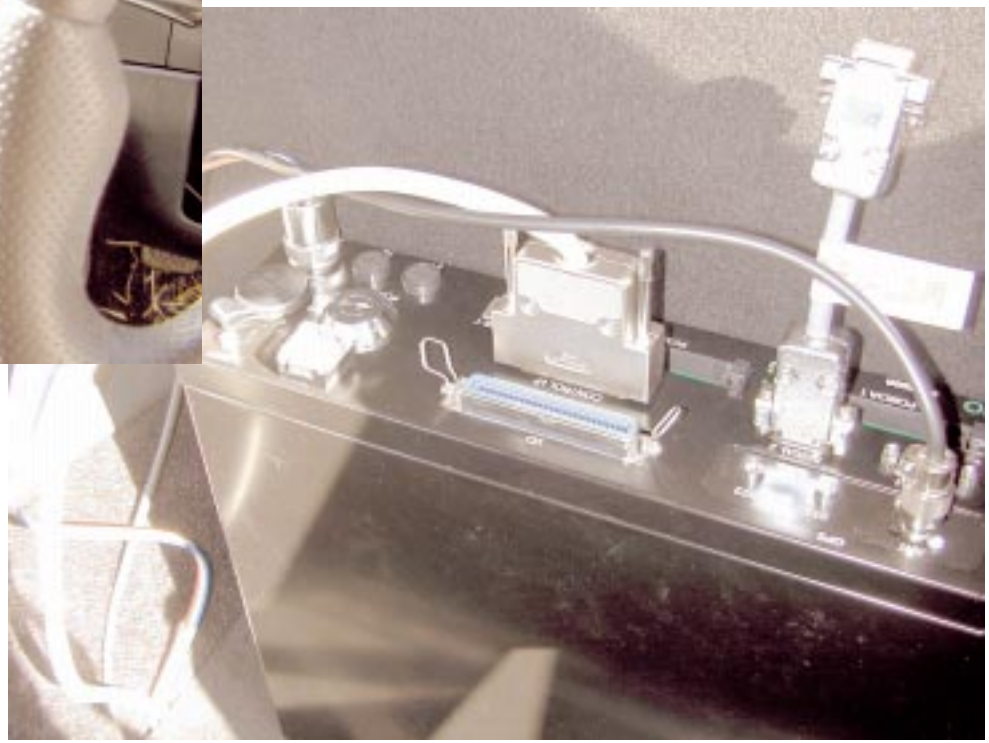
On-board Computer: SIC2000



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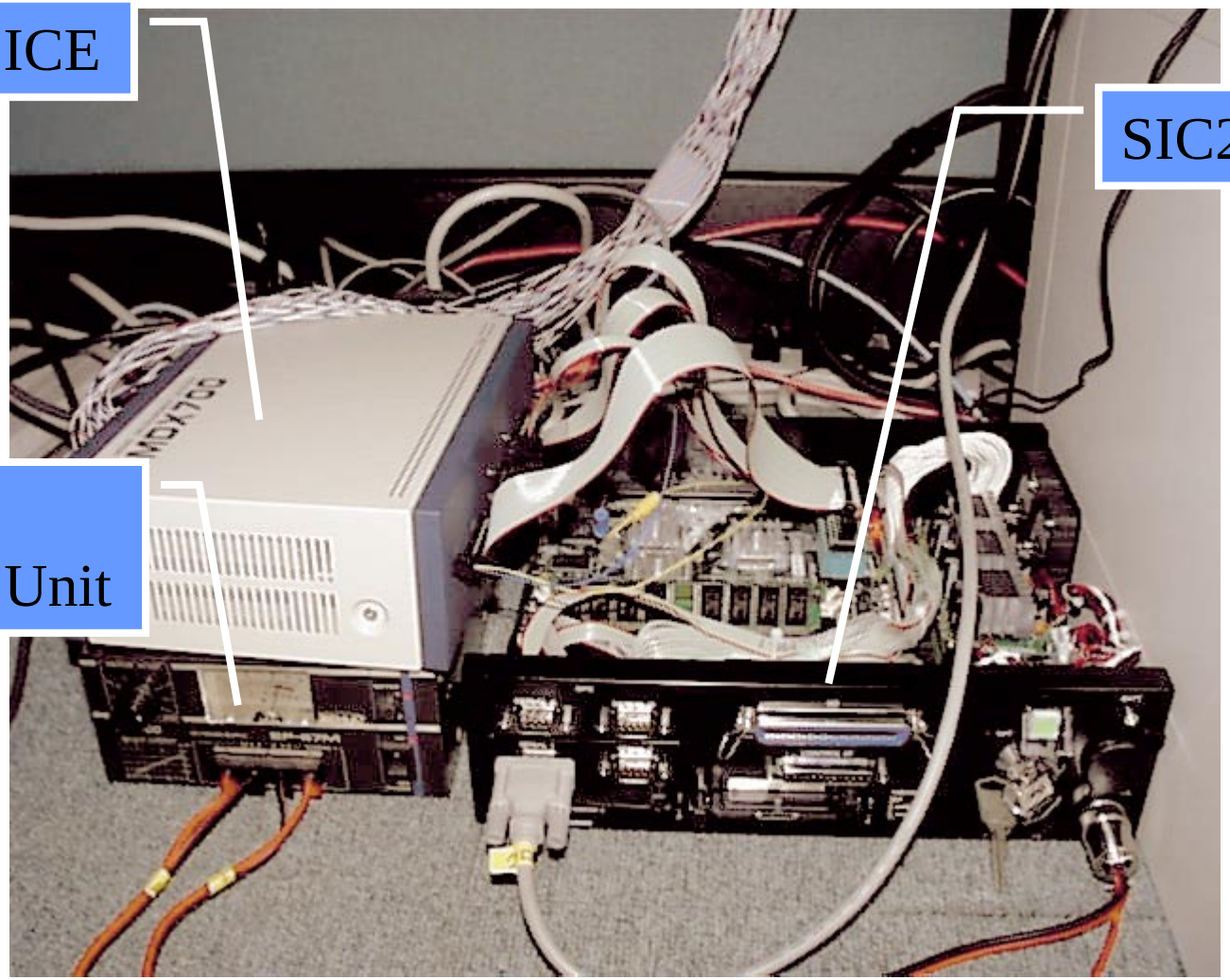
SIC2000 Development Kit



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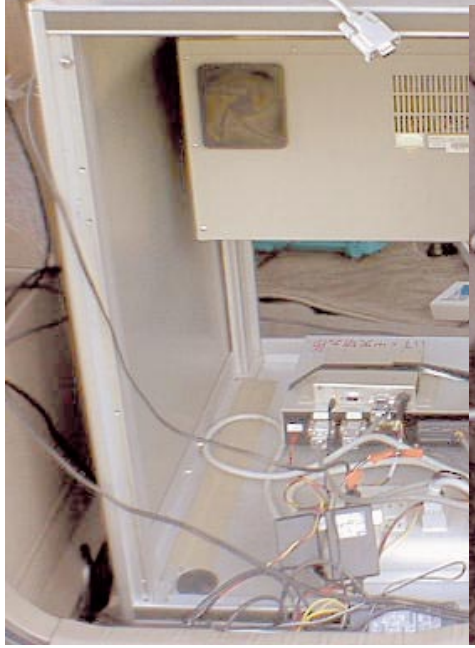
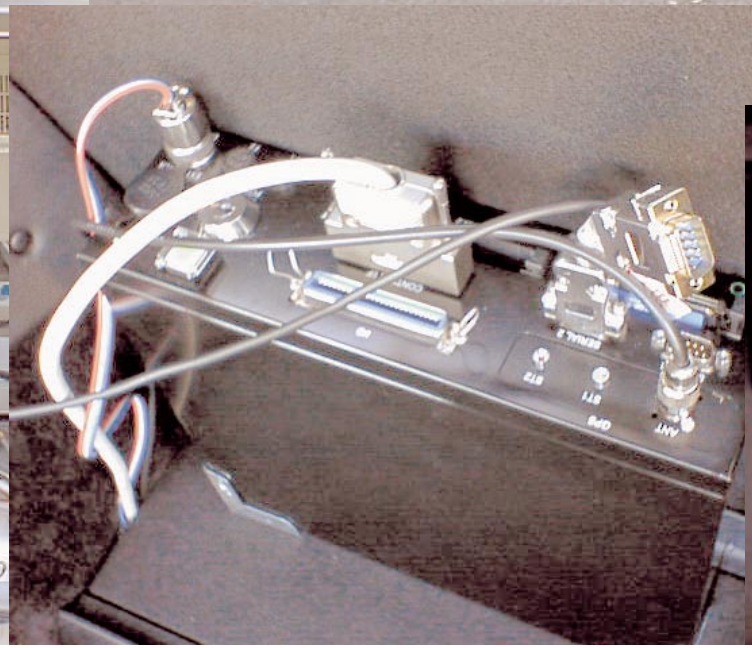
Hardware Specification

Processor	VR4300
Memory	DIMM (64MB) Flash ROM (8MB) PROM (512KB) PBSRAM (1MB)
I/O	RS-232C (x4)
Ethernet	IEEE802.3 (x1)
PCMCIA	Type2 Connector (x4)
GPS	Option(G-12)
D/D	8ch
A/D	2ch


MR2






GAIO
SIC2000

Operating System

- NetBSD is selected as operating system for our research
  - We are familiar with BSD based operating system.
  - NetBSD is one of multi-platform operating system.
- We ported NetBSD to SIC2000
- Some drivers are implemented to it
  - thermometer
  - D/D input
  - …

Network team (Technology)

- Interface switching system
- Mobile IP
- MIBsocket (pass the L2 information to application or other layer)

Technology of connecting vehicles to the Internet

- Use of multiple communication device
- Implementation of the stable connection through the Internet
  - Technologies for vehicle to vehicle communication.
  - UDLR Technology

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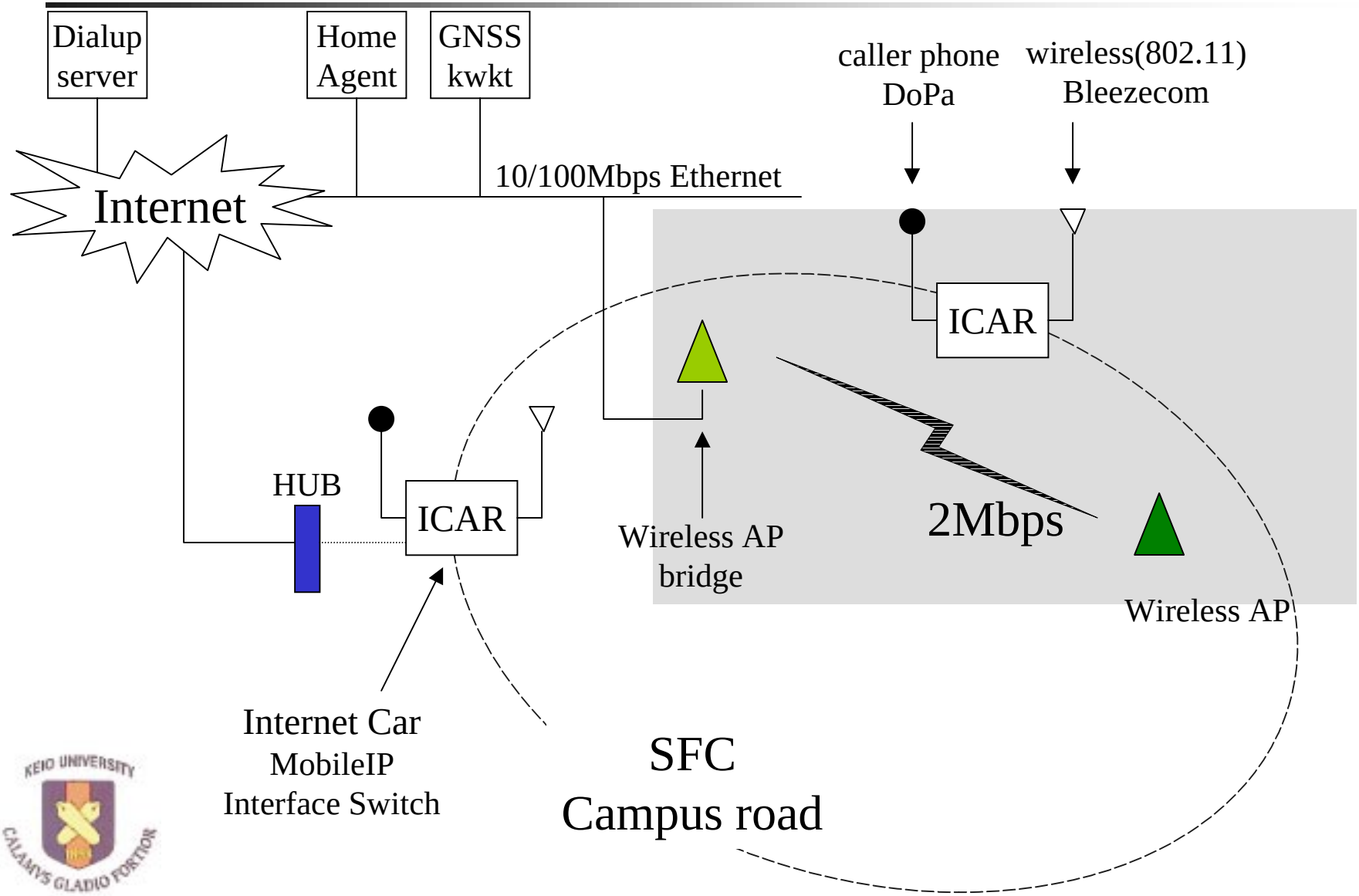
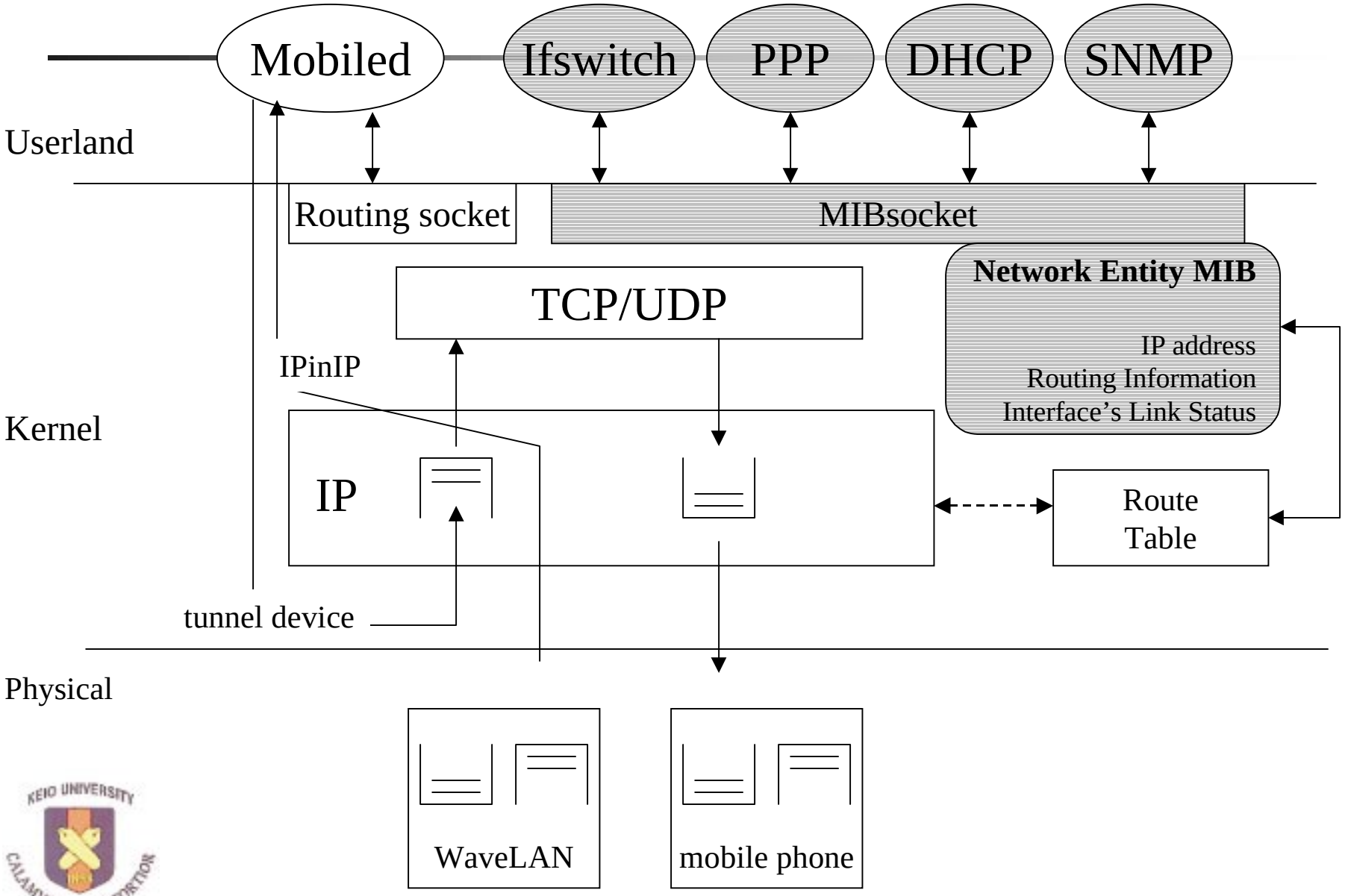
IPv4 Network arch. on ICAR




Mobiled
Ifswitch
PPP
DHCP
SNMP
Userland
Routing socket
MIBsocket
Network Entity MIB
IP address
Routing Information
Interface's Link Status
TCP/UDP
IPinIP
Kernel
IP
Route
Table
tunnel device
Physical
WaveLAN
mobile phone

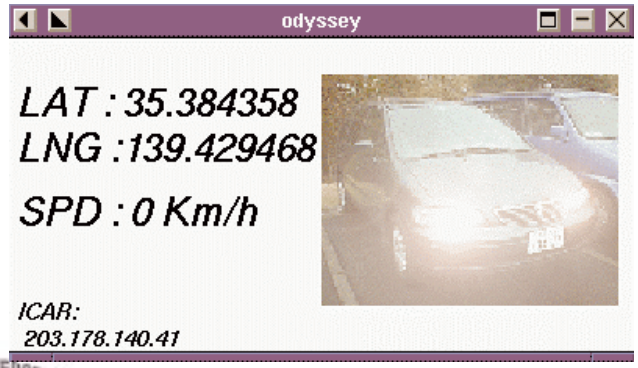
Middleware

- Geographical Information Location System
  - The Internet breaks location barrier.
  - As result, Developing location based application became difficult.
  - We developed GLI system as middleware for location based application.
- GNSS support
  - Correction information distribution
  - VRS system support
- Dataset of automobile
  - An automobile has many digital information.
  - We are standardizing dataset of automobile

Application

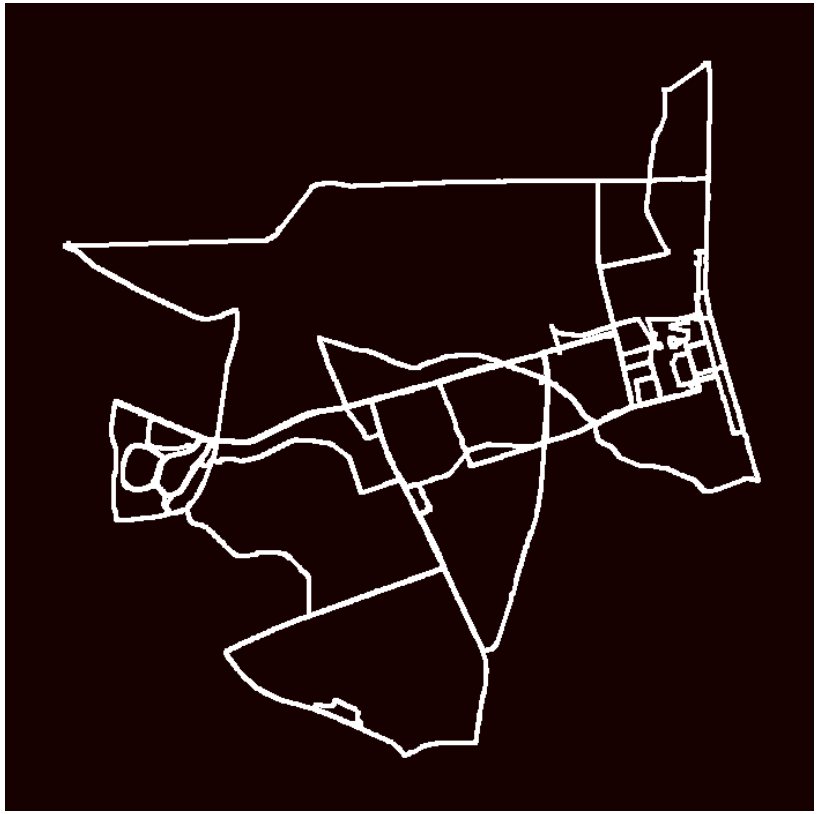
- mapped points by GPS info
- No map mapping
  - with **D-GPS**
  - without **D-GPS**

Window for car status



Light on

Create new map by ICAR



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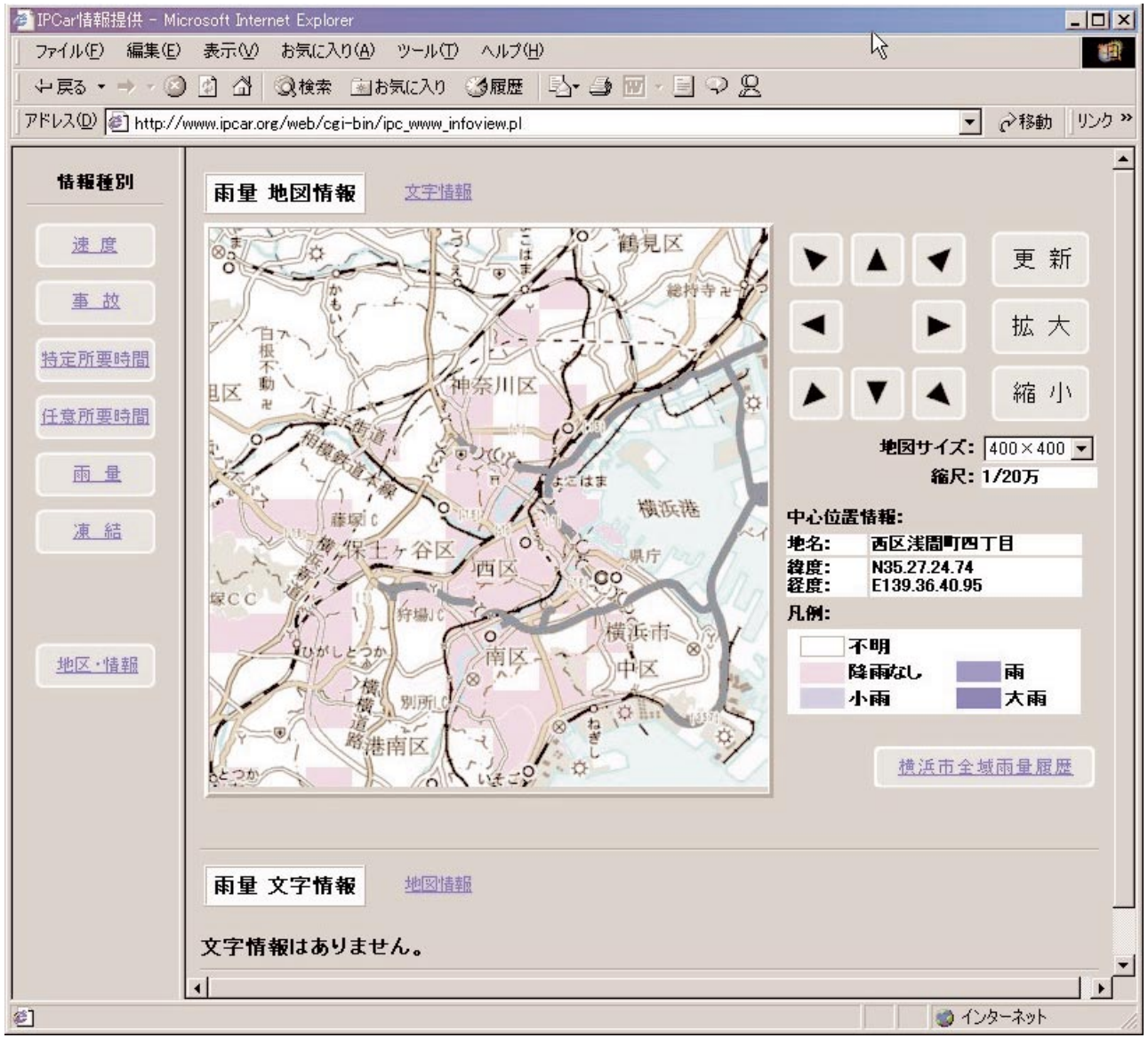
Weather information from ICARS



We work with

- NTT (Nippon Telegraph and Telephone Corp.), Wireless Lab.
- NTT Mobile Comunication Netwrok Inc.
- NTT Central Personal Communication Network Inc.
- Honda R&D Co. LTd.
- Isuzu Advance Engineering Center LTD.
- NOKIA R&D Japan
- A lot of company.

Mobile IPv6

The MobileIPv6 on InternetCAR

- draft-mobileip-ipv6-13.txt based
- KAME
  - Currently only FreeBSD available
  - ToDo: support for all BSD distribution
- IPsec supports
  - The IPsec only for binding packets
  - IKE does not work well
- Multiple Interface support
- Policy setting for mobility support

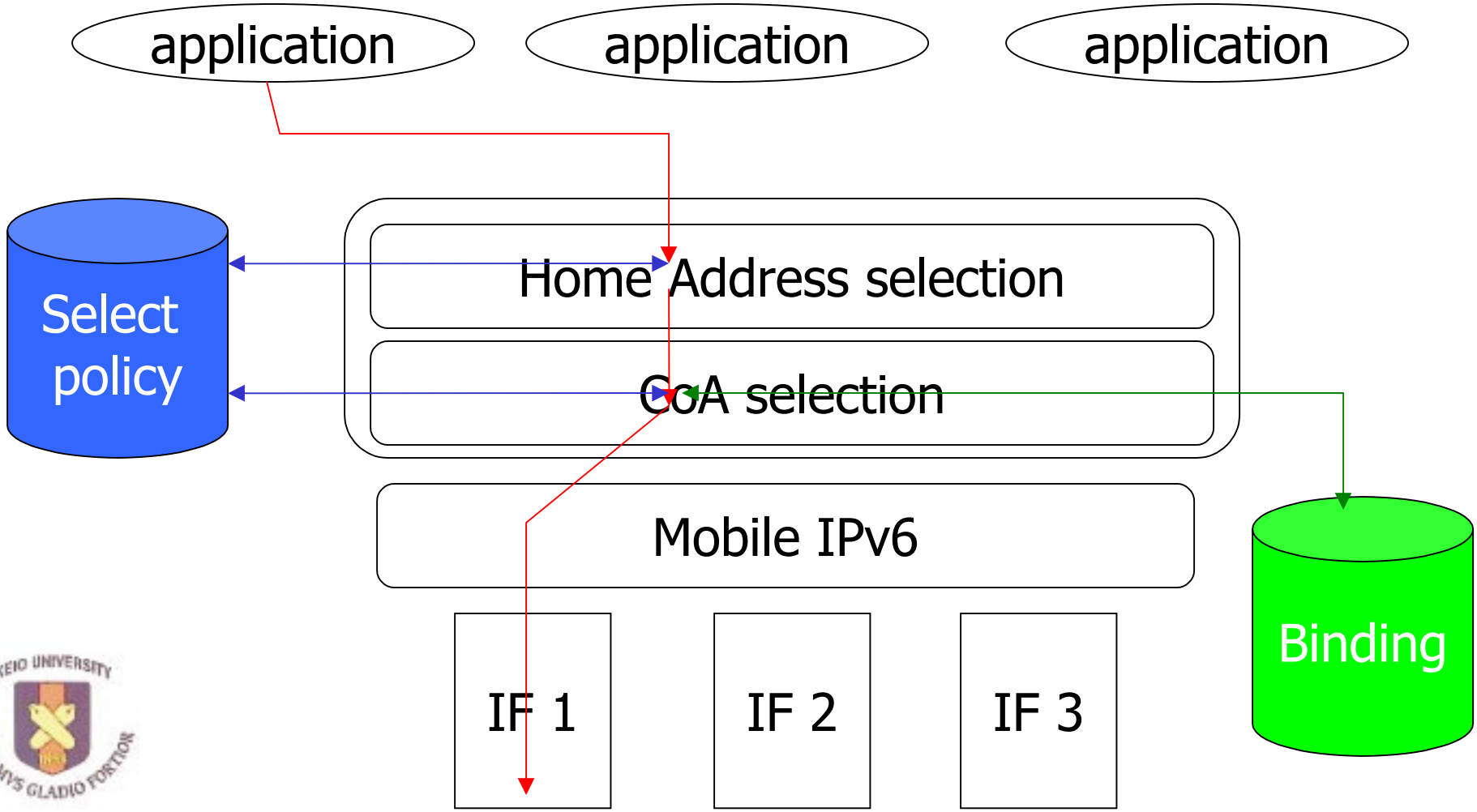
Multiple Network Interface support

- MN communicates with multiple interfaces simultaneously.
- MN selects interfaces by
  - network environment information
  - network configuration
  - policy database(next slide)

Policy setting for mobility support

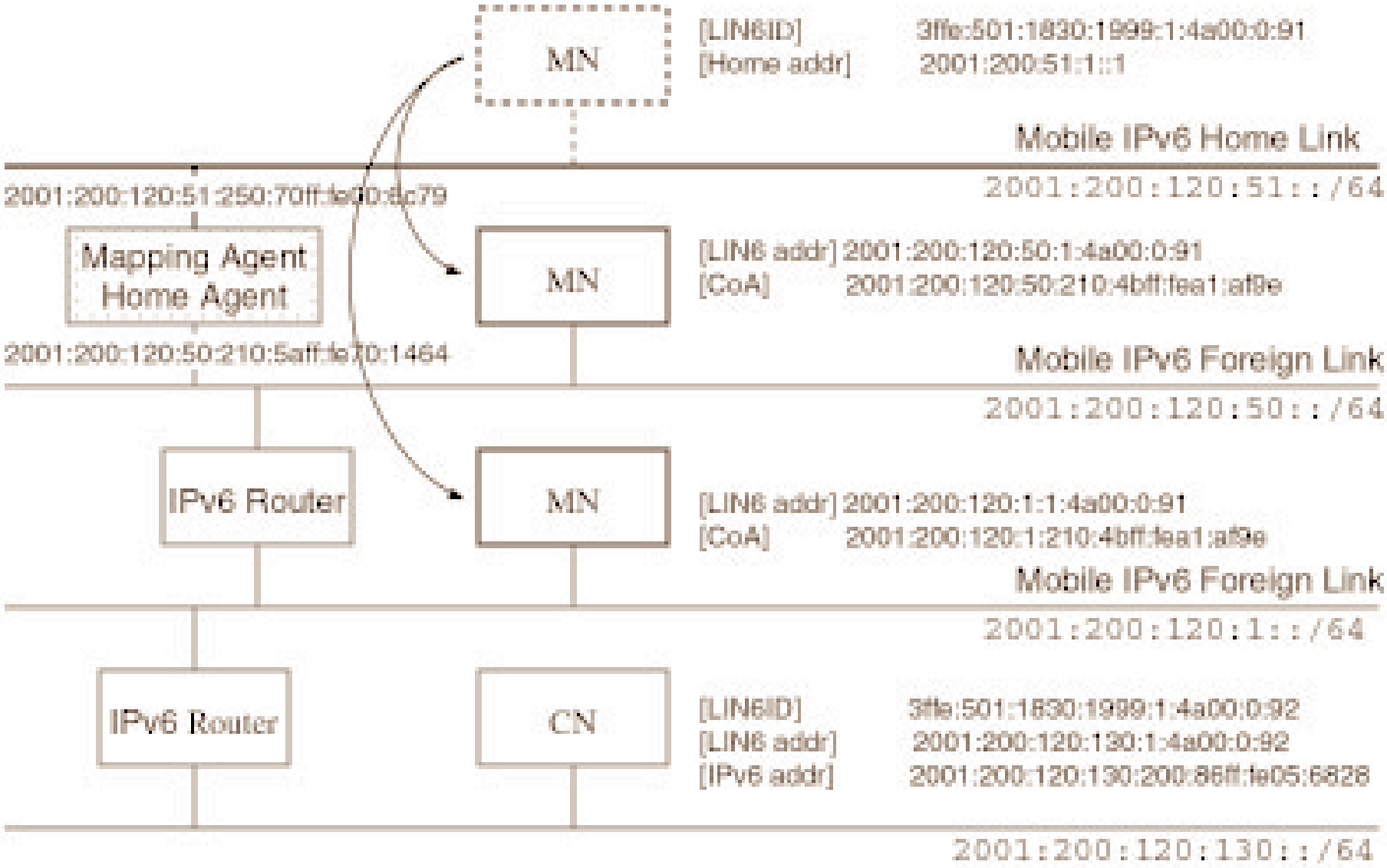
- Which Home Address should MN use?
- Which CoA should MN use?
- available Policy
  - by IP address
  - by protocol
    - telnet, http,
  - by flow
    - currently not implemented
- Policy is useful for DNS query or stream data

The design of Mobile IPv6



Evaluation of Mobile IPv6

Evaluation Environment



Overhead of input/output processing

- The overhead of input/output processing of IPv6
- send 16 byte ICMP Echo each 1 sec
- measured by Pentium Counter
  - MN Pentium Celeron 500 MHz 192M byte
  - CN Pentium MMX 200MHz 96M byte
- Result
  - Send 22% (0.02msec)
    - test on the MN
    - The cost of home address option insert
  - Receive 16% (0.01msec)
    - test on the CN
    - The cost of home address processing

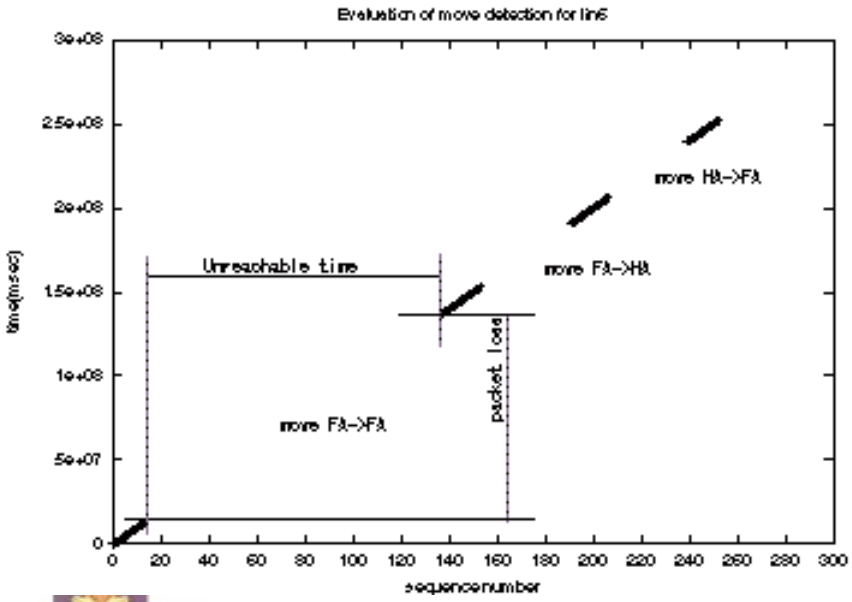
Cost of Binding Update processing

- Comparison between normal and piggyback case.
- To piggyback BU, MN send 16 byte ICMP Echo Req/Rep
- measured by Pentium Counter
  - same as before
- Result
  - About 0.03 msec overhead for piggyback is caused by IPsec processing of data part
  - The increase for piggyback is depends on the data bytes.

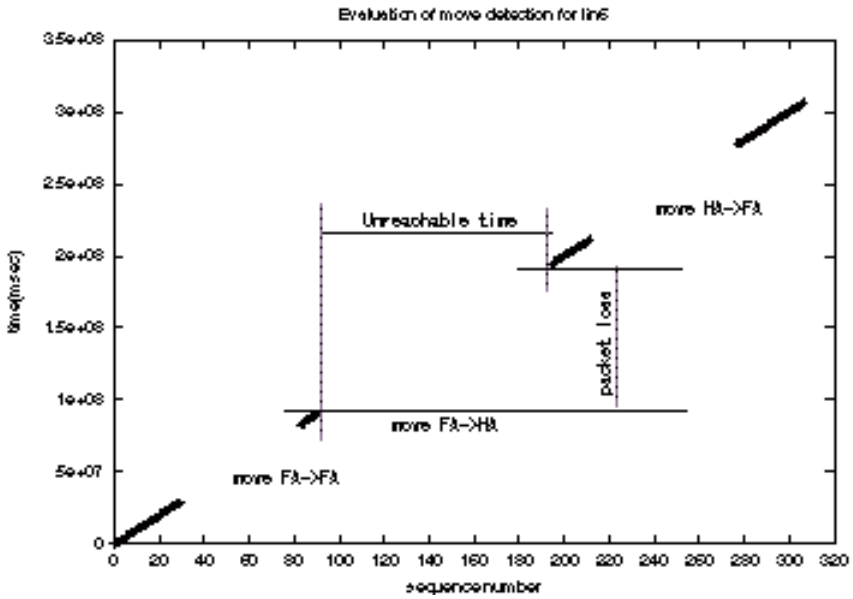
(m sec)	Normal	piggyback
send	0.2	0.231
receive	0.288	0.367

consideration of hand-off

IPv6(kame) cached the old IPv6 address.
MIPv6 should wait untill the old address
is going to be marked as detached address.



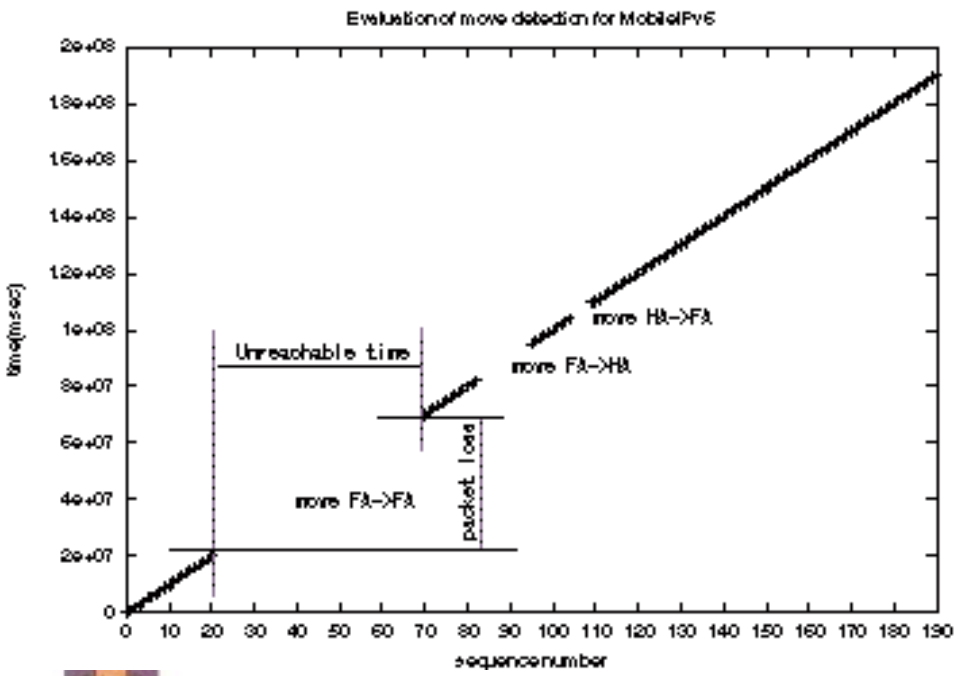
MobileIPv6



LIN6

consideration of hand-off

MIPv6 delete the old address intentionally



- Getting L2 info, MN can hand-off smoothly.

Mobile IPv6

ToDo

- Release
  - http://neo.sfc.wide.ad.jp/~mip6/
- IKE support
- Micro mobility or Smooth Handoff

Contact info

- About InternetCAR
  - nacm@sfc.wide.ad.jp
  - http://www.sfc.wide.ad.jp/InternetCAR/
- About MobileIPv6
  - mip6@sfc.wide.ad.jp
  - http://neo.sfc.wide.ad.jp/~mip6/
- About ProbeCAR
  - http://www.ipcar.org

END