Mobility Activity in WIDE

Keio University/WIDE

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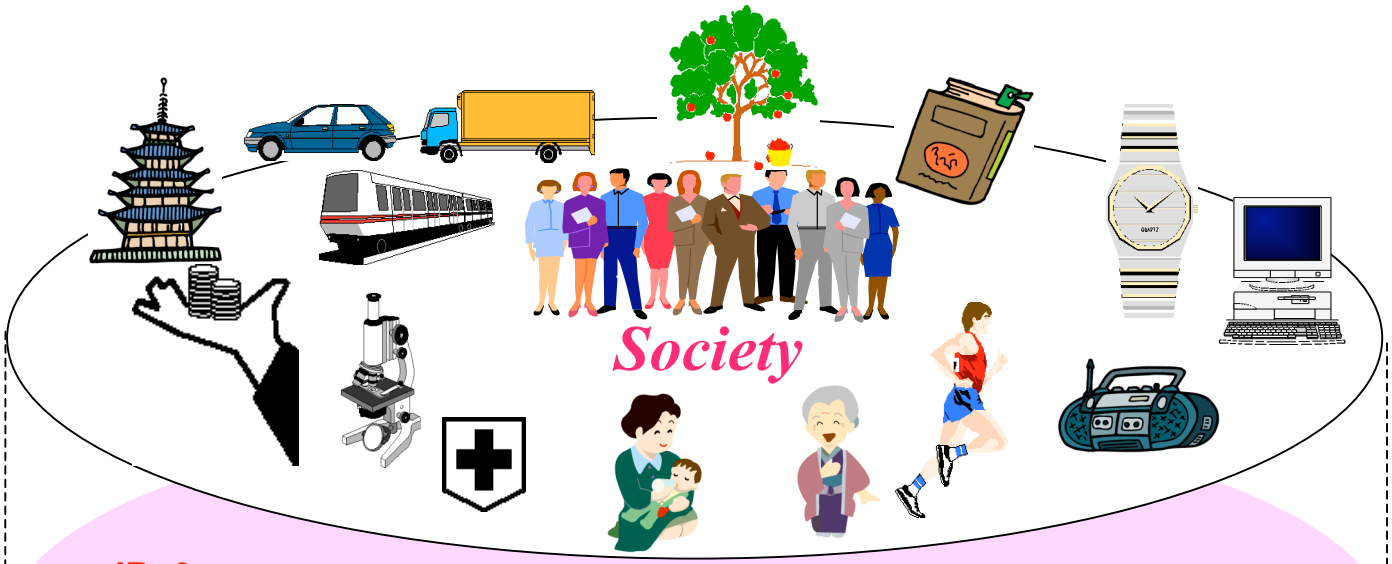
Goal of Mobility



IPv6 AAA IP dynamic network: MANET

IP Telephony: VoIP, SIP, ENUM

Internet Technology

IP Mobility: MIP, NEMO

Satellite

Cell Phone: W-CDMA, CDMA2000, 1x EVDO, HSDPA

Communication Technology

WLAN: 802.11a/b/g
WMAN: 802.16, 802.20
WPAN: 802.15.3, zigbee, bluetooth

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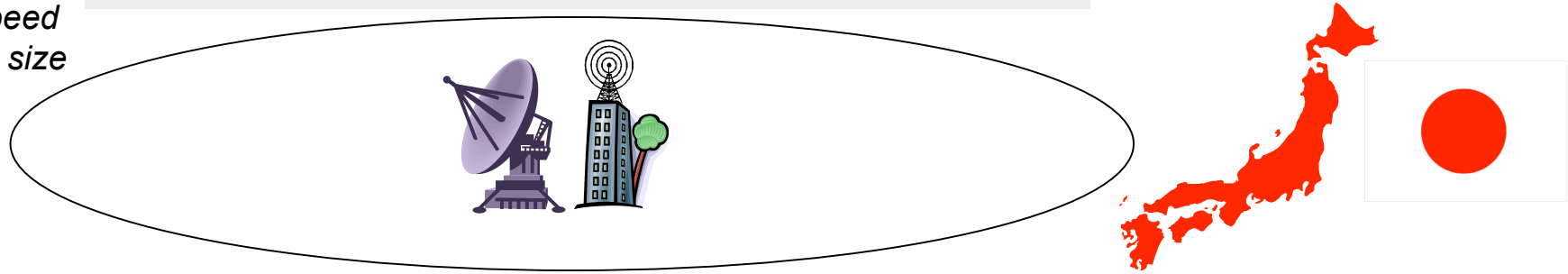
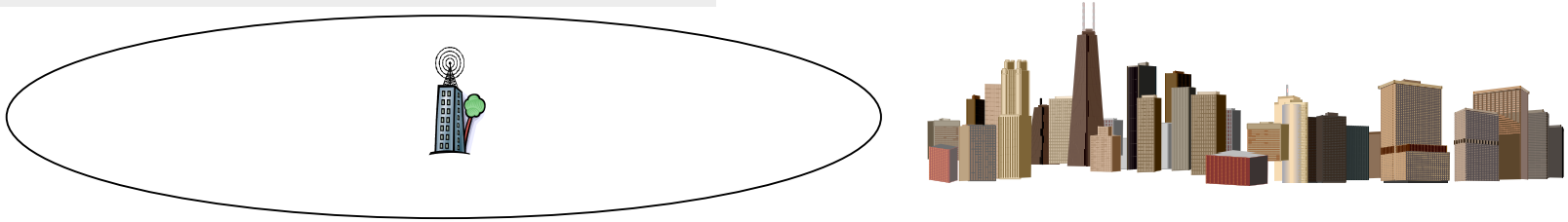
Low Speed
Big Cell size

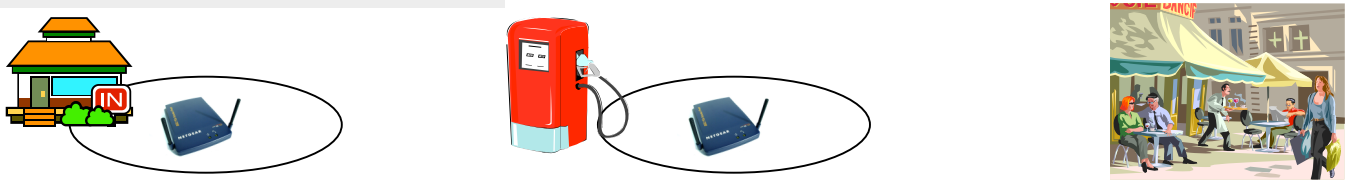
Wireless WAN / Satellite *HSDPA, CDMA2000 1x EvDo*



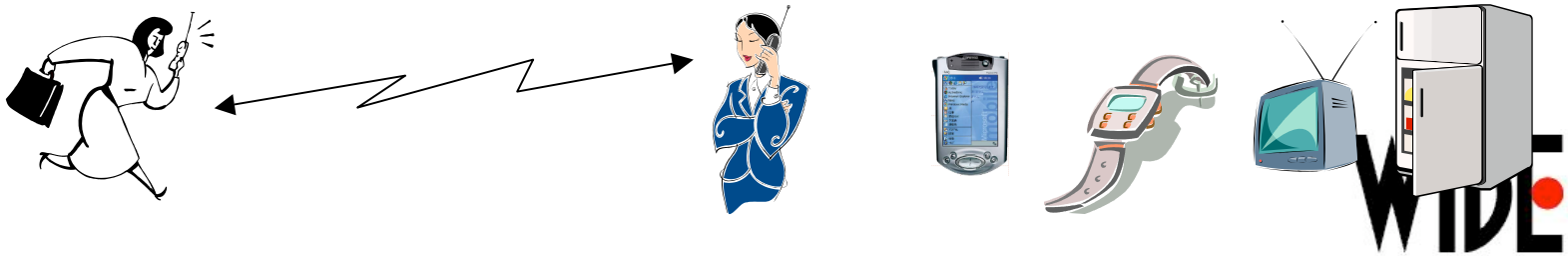
Wireless MAN *802.16e, 802.20, iburst*



Wireless LAN *802.11 a/b/g/n*



Wireless PAN *802.15.1(Bluetooth), 802.15.3a(UWB), 802.15.4(Zigbee)*



High Speed
Small Cell size

IETF/WIDE
Mobility Activity

- Mobility related Working Group @ IETF
  - *Internet Area*: MIP4/6, NEMO, MIPSHOP, PANA, HIP, DNA
  - *Routing Area*: MANET
  - *Operation and Management Area*: MULTI6, AAA
  - *Transport Area*: SIP, ENUM
  - *Security Area:* MOBIKE

- WIDE Working Group
  - InternetCAR: Connecting Vehicles to the Internet
  - Nautilus6： Mobility Deployment
  - KAME/USAGI: IPv6 related protocol implementation

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Mobile IPv6 / Network Mobility

- Movement Transparency is required to move on the Internet
  - Addressing and Routing Problems
- Mobile IPv6 (RFC3775)
  - Host Mobility
  - Mobility Support for IPv6 (RFC3775)
    - Route Optimization Support
  - Cell phone, etc
- Network Mobility (NEMO)
  - Network Mobility
  - NEMO Basic Support Protocol (RFC3963)
    - NO Route Optimization Support
  - Vehicles, etc

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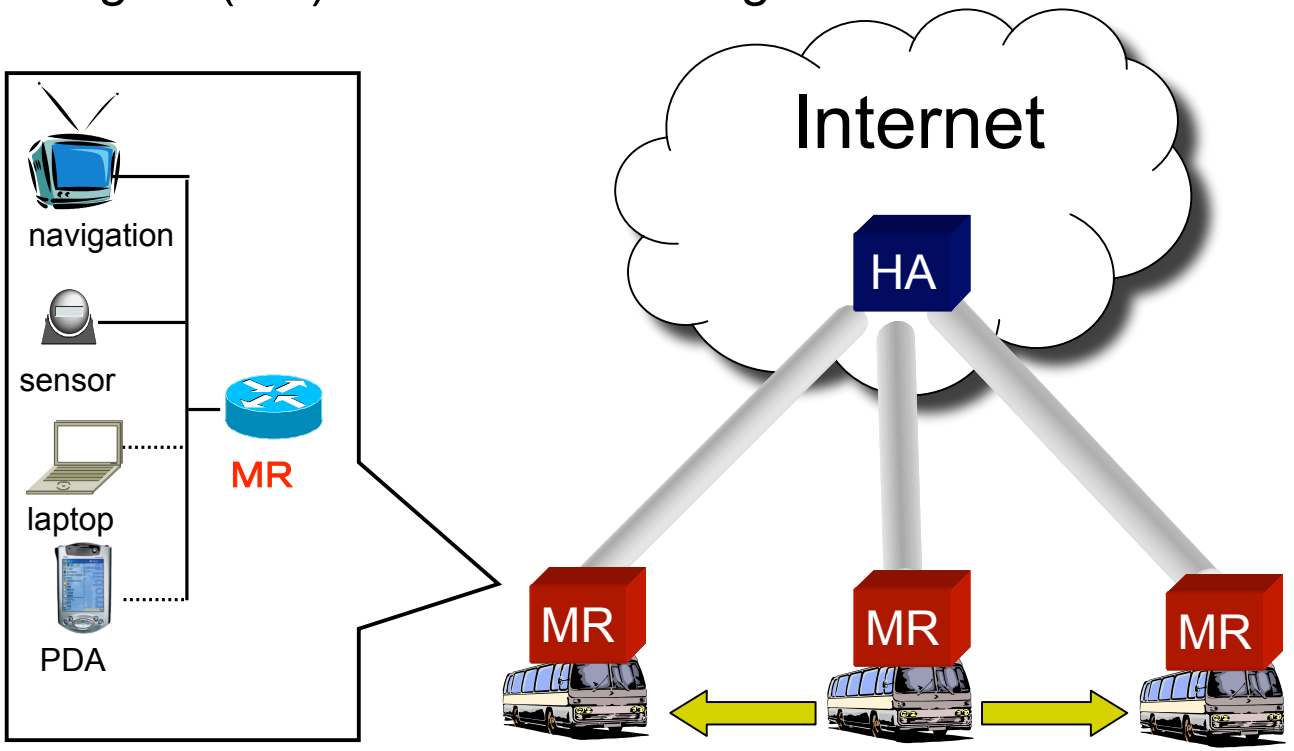
Network Mobility

- The NEMO Basic Support Protocol
  - A bi-directional Tunnel between MR and HA
  - All traffic from a mobile network is routed through a Home Agent
- Mobile Router (MR): a Router connecting a mobile network to the Internet
- Home Agent (HA): A router assisting a Mobile Router



Research Topics in WIDE

- Mobile IPv6/NEMO
  - implementation on BSD/LINUX
- IPv4 Traversal
  - IPv4 Care-of Address Registration
- Route Optimization support for NEMO
  - Virtual Mobility Control Domain (VMCD)
  - Optimizing Route Cache Protocol (ORC)
  - Optimizing NEMO for nested mobility (ONEMO)
- Protocol Redundancy
  - Inter-Home Agents Protocol (HAHA)
  - Multiple Mobile Router managements
- Host Multihoming
  - Multiple Care-of Address Registration
- Fast Handover
  - Fast MIP (implementation)
  - LIES (Inter Layer Control Information Exchange)

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Mobile Ad-hoc Network

- Autonomous Dynamic Ad-hoc Networks
  - No infrastructure
  - Automatically network formulation
  - movements support inside a network
  - sensor networks, robot networks, emergency networks, etc.

- Protocols
  - Proactive Routing Protocols
    - OLSR, TBRPF
  - Reactive Routing Protocols
    - AODV, DSR

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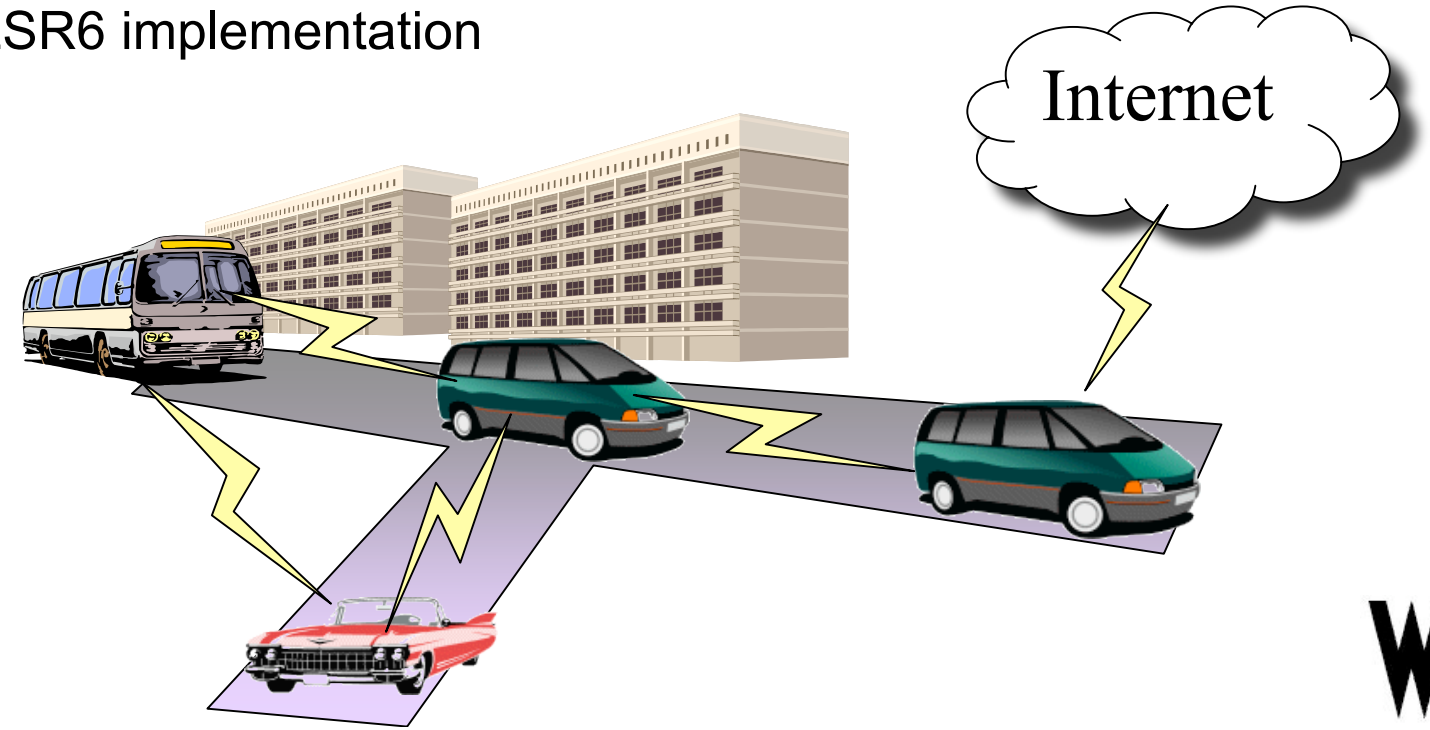
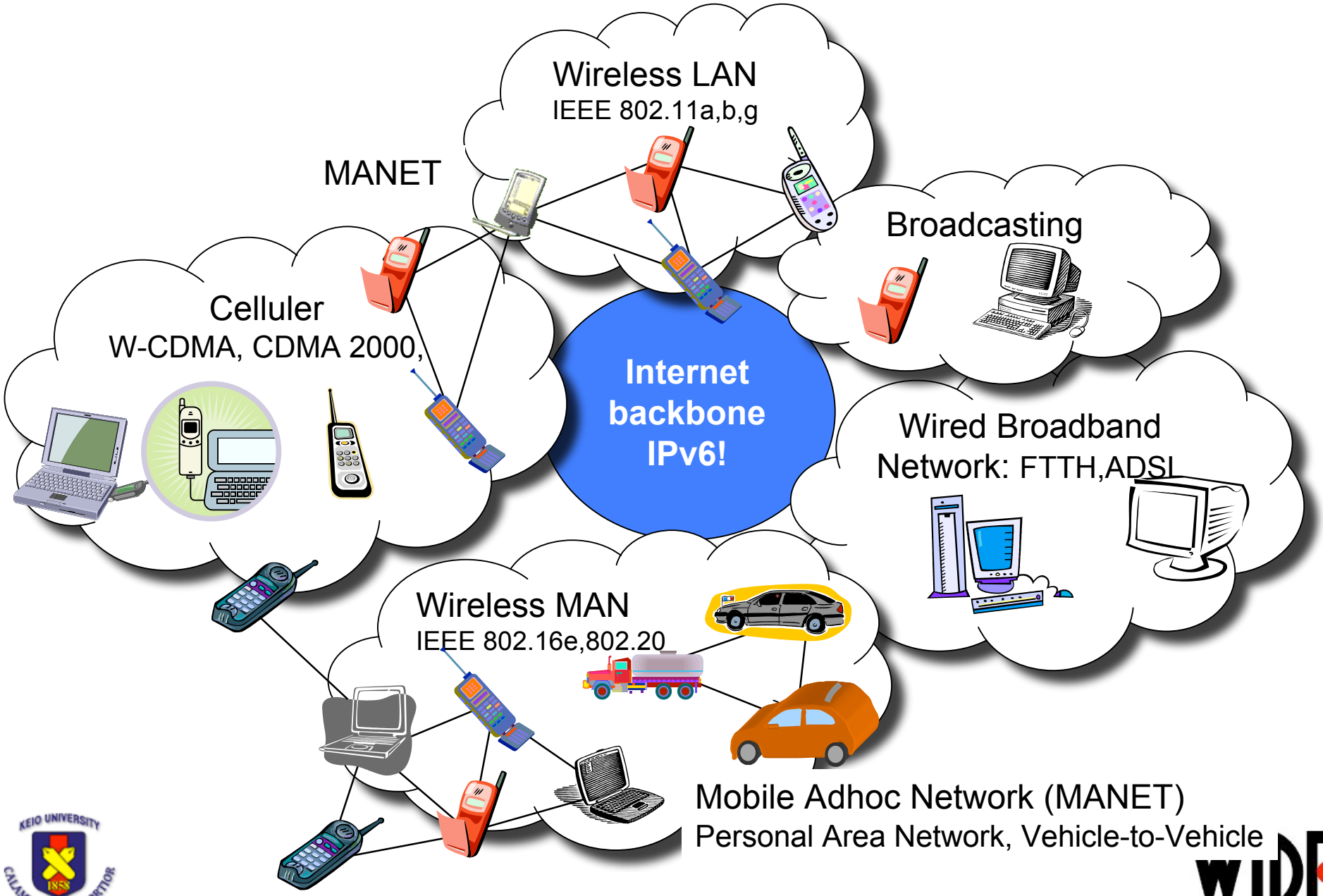
Research Topics in WIDE

- Global Connectivity Support
  - connective MANET to the Internet
  - Combination of MANET and MobileIP/NEMO
- IPv6 Support
  - MANET supporting IPv6
  - OLSR6 implementation



The Ideal Mobile Internet



2004 Nagoya ITS World Congress
IPv6 Mobility Technology for ITS

KEIO Univ. + WIDE

collaboration with

Omnisci Software, Inc.

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Demonstrated Items

- Mobility Support
  - The NEMO Basic Support protocol
- Multihoming
  - Multiple Paths setup
    - Multiple Care-of Address Registration
  - Multiple Paths utilization
    - Policy based routing
- Network aware Application adaptation
  - MR-MNN management

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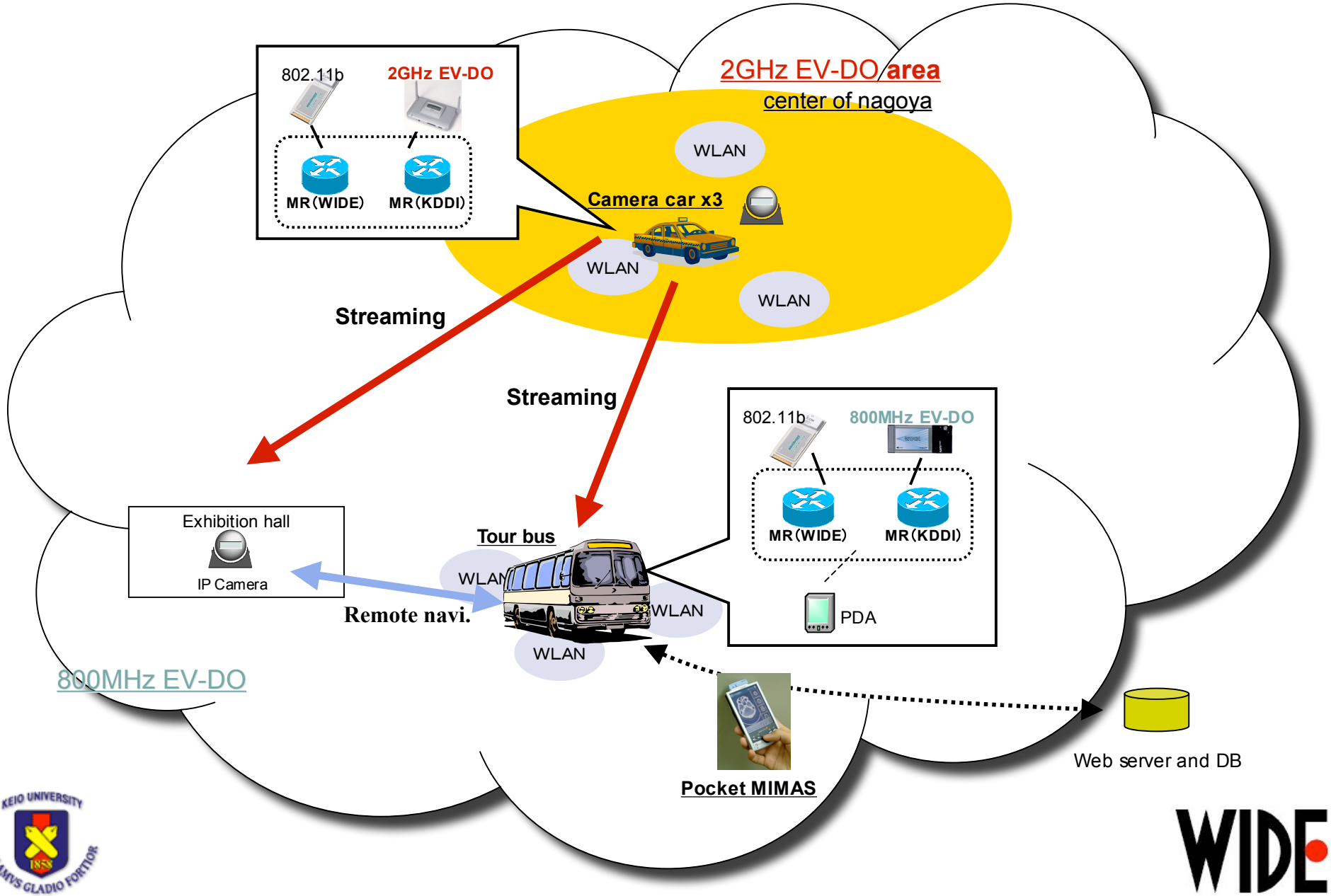
Overview of demonstration



IPv6 Mobility System for Vehicles

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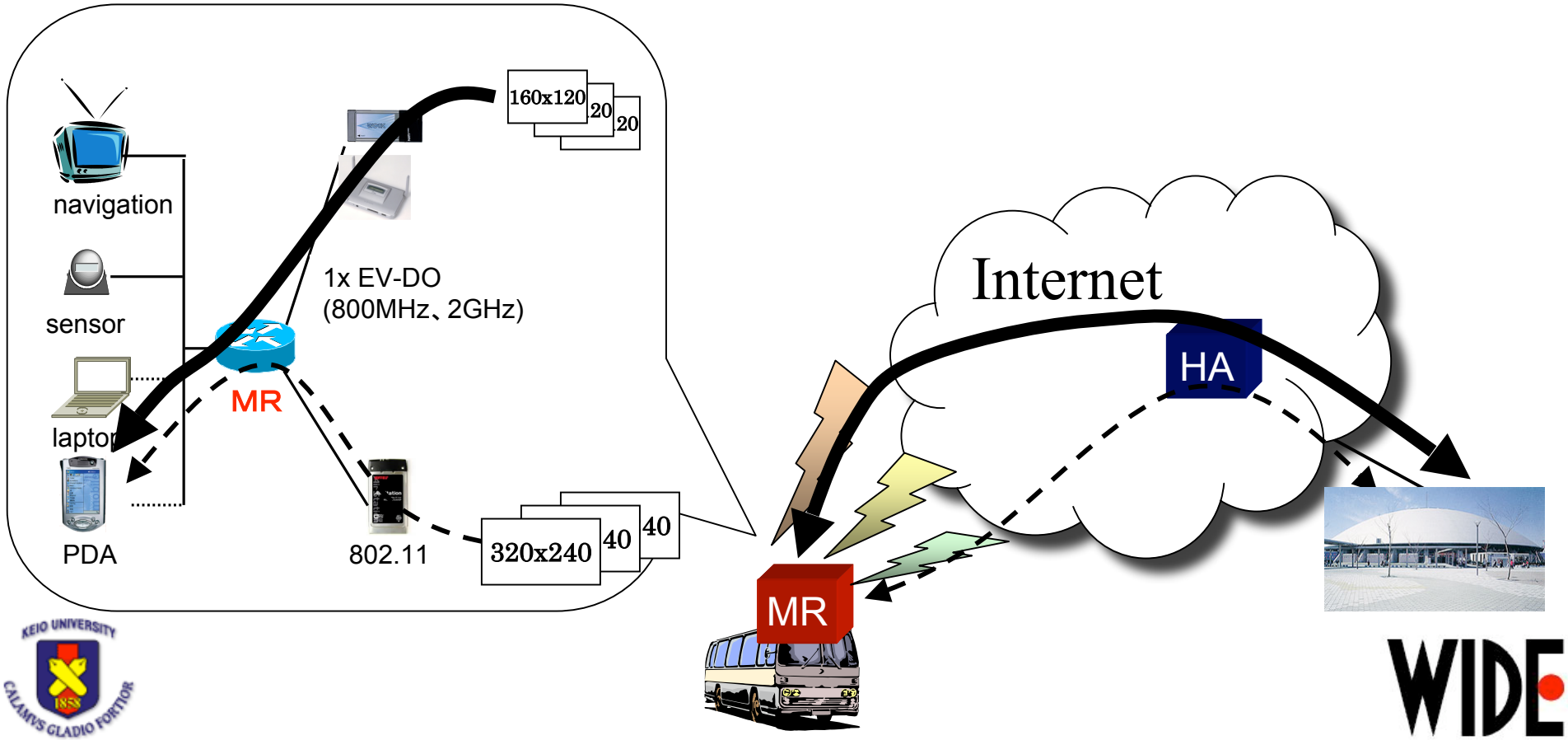
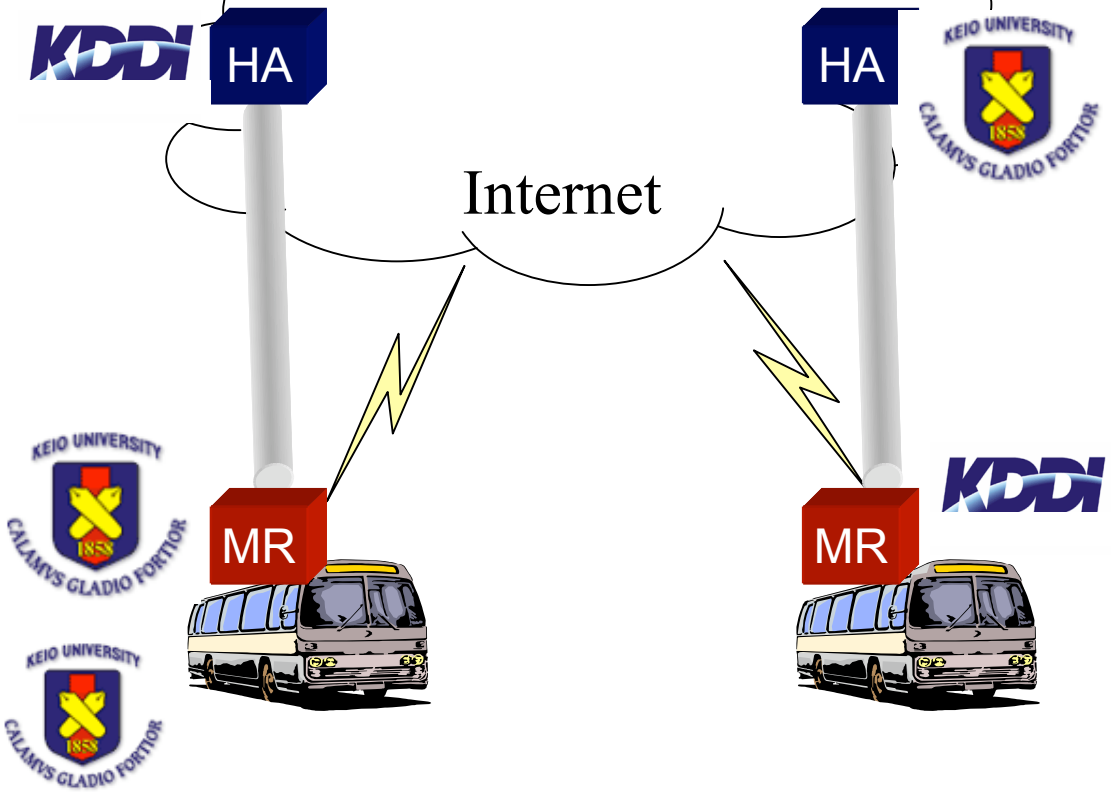
Application Adaptation

Applications are adopt to environment of Mobile Router's Internet connectivity.
Change Frame rate and resolution

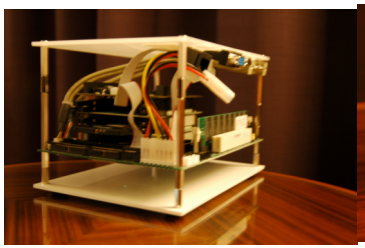
CDMA2000 1x EV-DO:64kbps (4~5fps) for upstream, 98kbps (15fps) for downstream.
160x120 resolution
802.11b: 192kbps (15fps) for upstream and downstream, 320x240 resolution



Interoperability of the NEMO Basic protocol



- NEMO is operated by both KDDI and WIDE on 6-bone
- Supporting Protocols
  - NEMO Basic Support
  - Multiple CoA s registration



keio MR

KDDI MR

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Related References

- URL
  - WIDE project (InternetCAR, Nautilus6)
    - http://www.wide.ad.jp
  - SHISA Mobile IPv6/NEMO Stack implementation
    - http://www.mobileip.jp
- IETF activity
  - “Network Mobility (NEMO) Basic Support Protocol”, RFC3963
  - “Inter Home Agents Protocol”, draft-wakikawa-mip6-nemo-haha-spec-00.txt, draft-thubert-nemo-global-haha-00.txt, draft-wakikawa-mip6-nemo-haha-01.txt
  - “IPv4 Care-of Address Registration”, draft-wakikawa-nemo-v4tunnel-01.txt
  - “Multiple Care-of Address Registration”, draft-wakikawa-mip6-nemo-mcoa-04.txt
  - “Optimized Route Cache Protocol (ORC)”, draft-wakikawa-nemo-orc-01.txt
  - “Global connectivity for IPv6 Mobile Ad Hoc Networks”, draft-wakikawa-manet-globalv6-03.txt
  - “IPv6 Support on Mobile Ad-hoc Network”, draft-wakikawa-manet-ipv6-support-00.txt

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