Mobile IP, its extensions and practical use cases

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Lifix Systems Oy

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Speaker's introduction

- **Tom Weckström**
  - ✓ Mobility management research at HUT since 1998
  - ✓ Dynamics – HUT Mobile IP project manager
  - ✓ M.Sc.(Tech.) from HUT
  - ✓ CTO at Lifix Systems
- **Lifix Systems provides technology for the mobile generation**
  - ✓ Mobility management software provider
  - ✓ Mobile IP product – Lifix^{TM} Go!
  - ✓ Extensions to the standard (e.g., hierarchical MIP)
  - ✓ Integration to the related technolgies (e.g. AAA)

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Mobile IP standardisation

- **Coordinated by IETF**
  - ✓ Mobile IP Working Group (MIP WG)
  - ✓ MIP WG is located in the *Internet Area* of IETF
- **Open standardisation process**
  - ✓ WG mailing list
  - ✓ IETF meetings
- **1996: Mobile IPv4 (RFC 2002)**
- **2002: Mobile IPv4, revised (RFC 3220)**
- **ETA 2002: Mobile IPv6 as an RFC**

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Mobile IPv4 components

- **Home Agent (HA)**
  - ✓ An infrastructure routing component that keeps track of the mobile nodes' locations and forwards traffic to them.
- **Foreign Agent (FA)**
  - ✓ An infrastructure routing component that offers routing services for mobile nodes arriving to foreign networks.
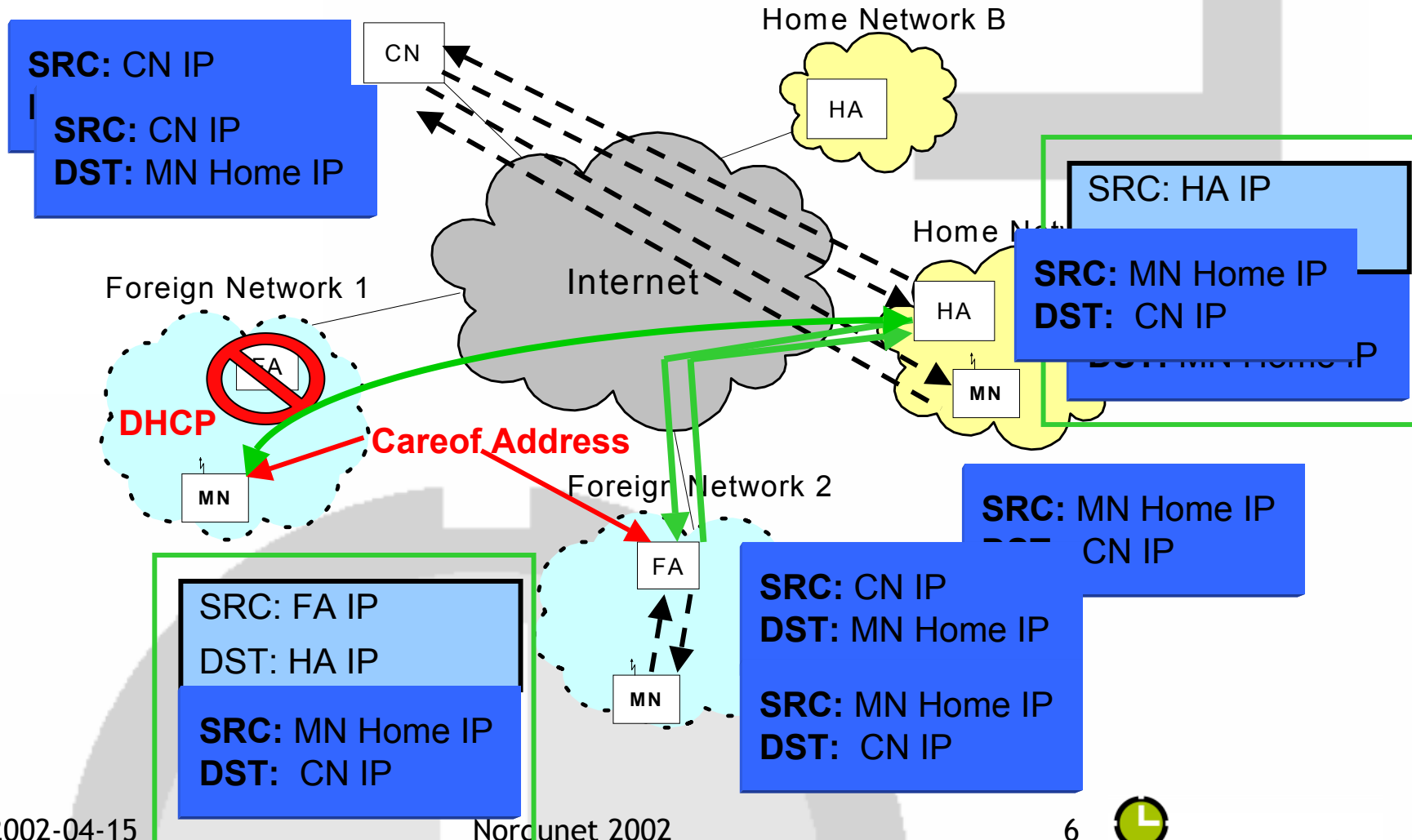- **Mobile Node (MN)**
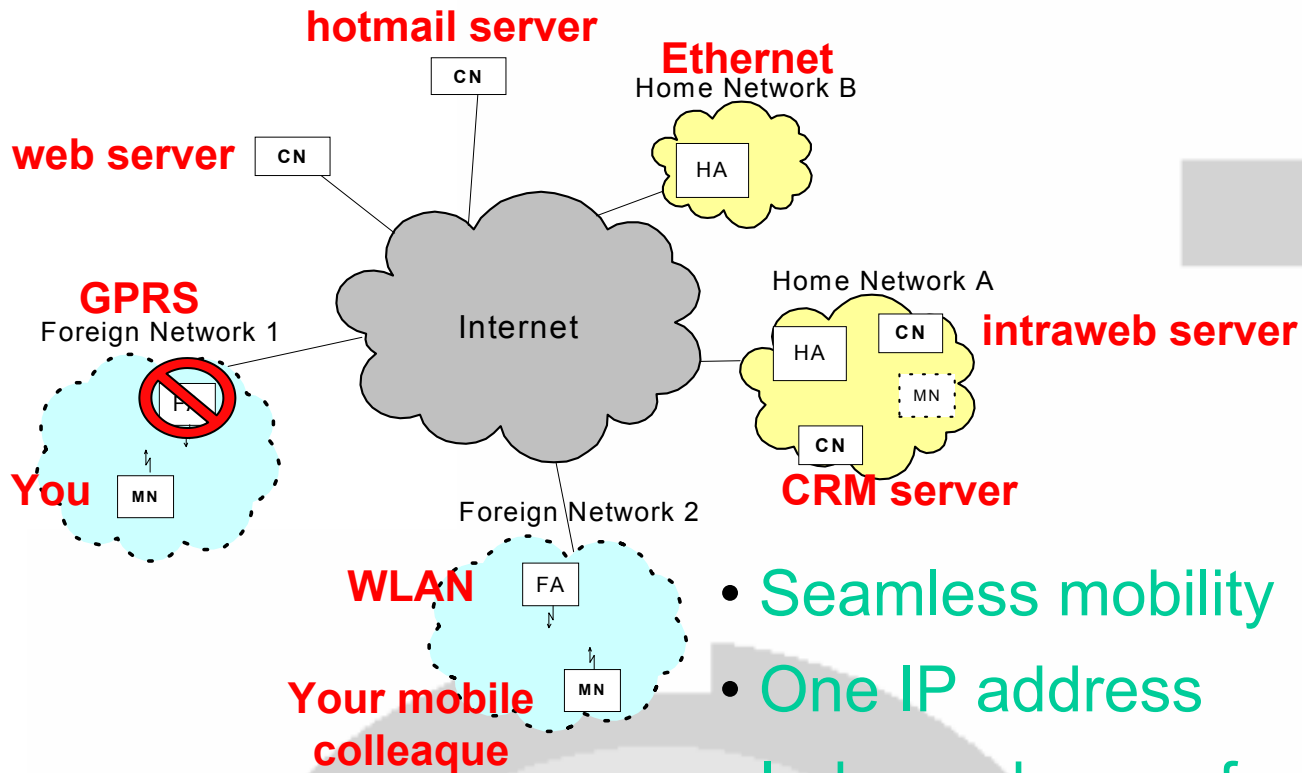 - ✓ A client component installed in the mobile device.
- **Correspondent Node (CN)**
  - ✓ A reference point. Communicates with the MN.

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Mobile IPv4 architecture & protocol

Home Network B

SRC: CN IP

SRC: CN IP
DST: MN Home IP

CN

HA

SRC: HA IP

SRC: MN Home IP
DST: CN IP

Home Net

Internet

HA

DST: MN Home IP

Foreign Network 1

DHCP

FA

Careof Address

MN

MN

Foreign Network 2

SRC: MN Home IP
CN IP

FA

SRC: FA IP

DST: HA IP

SRC: MN Home IP
DST: CN IP

SRC: CN IP
DST: MN Home IP

MN

SRC: MN Home IP
DST: CN IP

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Benefits of Mobile IP

hotmail server

CN

Ethernet
Home Network B

HA

web server

CN

Internet

GPRS
Foreign Network 1

FA

You

MN

Home Network A

HA   CN   **intraweb server**

MN

CN

CRM server

Foreign Network 2

WLAN   FA

Your mobile colleaque   MN

- Seamless mobility

- One IP address

- Independence of access technology

- All IP → Unlimited content

- Global, mature standard

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Benefits for the end user

- **Seamless mobility**
  - ✓ Location privacy
  - ✓ No need for additional intelligence in the communicating peers (CNs)
  - ✓ No need for additions to applications
  - ✓ No need for application restarts/re-logins, OS reboots, manual network access configuration, VPN connection restarts, etc.
- **Global reachability with IP via one home address**
  - ✓ Ideal for a number of applications (messaging, email, VoIP) and security (corporate firewall).

Status of Mobile IP penetration globally

- 🕐 **Mobile IPv4 used in and implemented by, e.g.**
  - ✓ Part of 3GPP2 (1xRTT CDMA2000) specification
  - ✓ HW e.g. from Lucent, Nortel, Cisco, Motorola, 3Com,...
  - ✓ SW e.g. from Lifix Systems, ipUnplugged, Birdstep,...
  - ✓ Growing penetration as a part of companies' Internet solutions

- 🕐 **Mobile IPv6**
  - ✓ Coming to 3GPP (UMTS W-CDMA) specification
  - ✓ HW e.g. from Nokia, Ericsson, Alcatel, Lucent,...
  - ✓ SW mainly for research purposes, e.g. HUT's MIPL
  - ✓ Penetration mainly in lab and demo environments

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Extensions of the base Mobile IP protocol

- **~8 MIP WG RFCs for MIP extensions, e.g.**
  - ✓ Mobile IP NAI Extension for IPv4 (RFC 2794)
  - ✓ Mobile IP Challenge/Response Exts (RFC 3012)
  - ✓ Mobile IP Vendor/Org. -Specific Exts (RFC 3115)
- **~14 MIP WG Internet Drafts for MIP extensions, e.g.**
  - ✓ Mobile IPv4 Regional Registration
  - ✓ Hierarchical MIPv6 mobility management
  - ✓ Fast Handovers for Mobile IPv6
  - ✓ Low latency Handoffs in Mobile IPv4
  - ✓ Requirements of a QoS Solution for Mobile IP
  - ✓ Mobile IP NAT/NAPT Traversal
- **A number of personal Internet Drafts regarding MIP**

Subjective MIP extension
Hot list

- MIPv6 in general, getting it to RFC
- MIPv6 security
- *Hierarchical MIPv4 (and v6)* →*Example 1*
- Fast handoffs, low latency
- AAA (RFC2977 + drafts)
- Ease of use and administration: NAI (RFC2794), Challenge response (RFC3012 +drafts)
- Use of IPv4 private address space with MIP
- MIPv4 NAT, NAPT and VPN traversal
- *Mobile IPv4 Proxy* → *Example 2*

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Example1: Hierarchical MIPv4

- **1998: 2-level hierarchical implementation and draft by NUS**
- **Several drafts since 1999**
- **1999: Dynamics – HUT Mobile IP implementation**
  - ✓ Multi-level FA hierarchy
  - ✓ 2-level HA hierarchy in 2000
- **1999: Regional Registrations draft**
  - ✓ IETF last call 4/2002
- **2002: Hierarchical extensions in Lifix Go!**
- **Benefits of a hierarchical solution**
  - ✓ Fast handoffs, up to 20 handoffs per second (Dynamics 1999)
    - • Ability to support glitchless real-time data
  - ✓ Support for private addresses within the hierarchy
  - ✓ Geographical and topological scalability
  - ✓ Optimised signaling load

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Hierarchical MIPv4 architecture example

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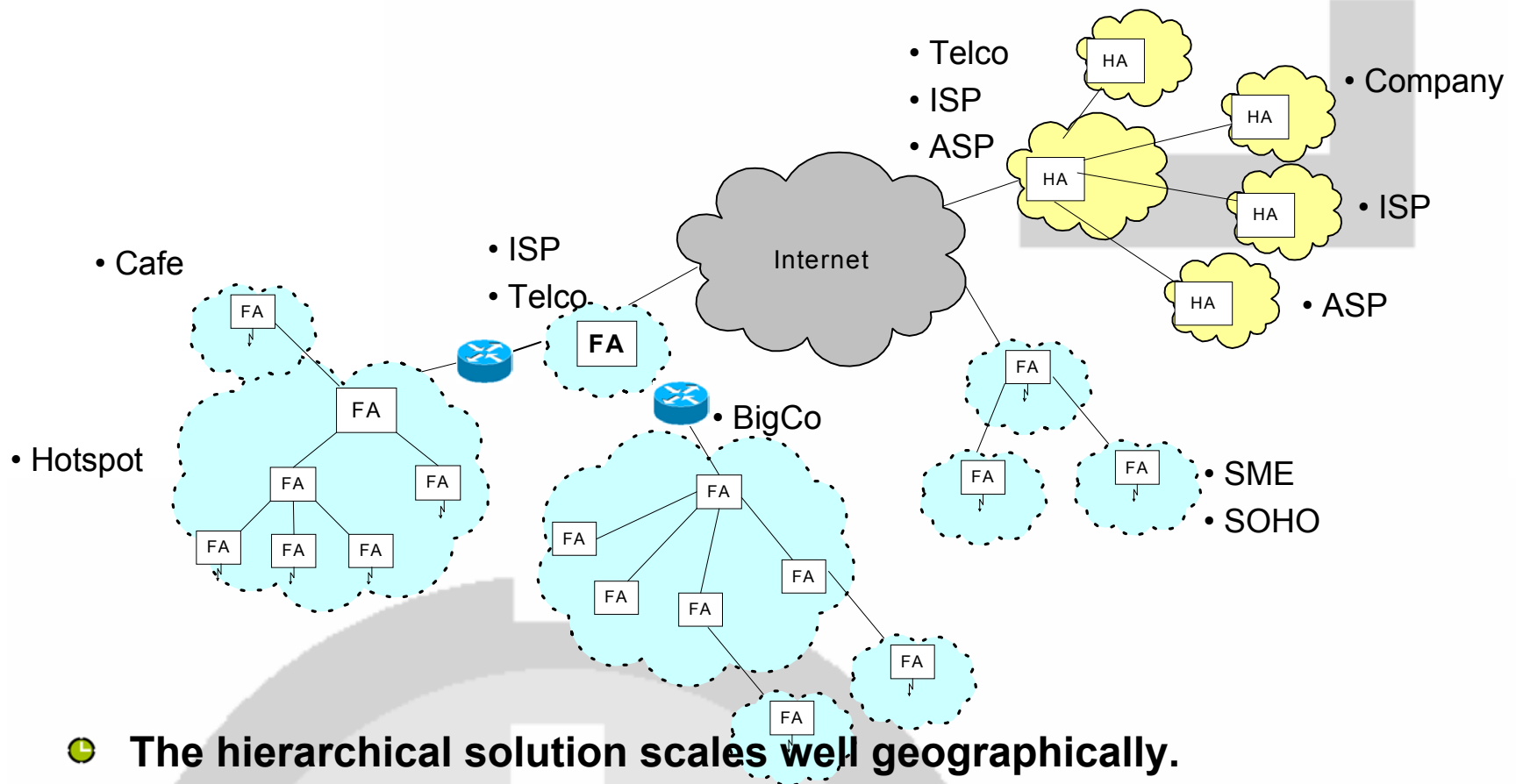Tom Weckström

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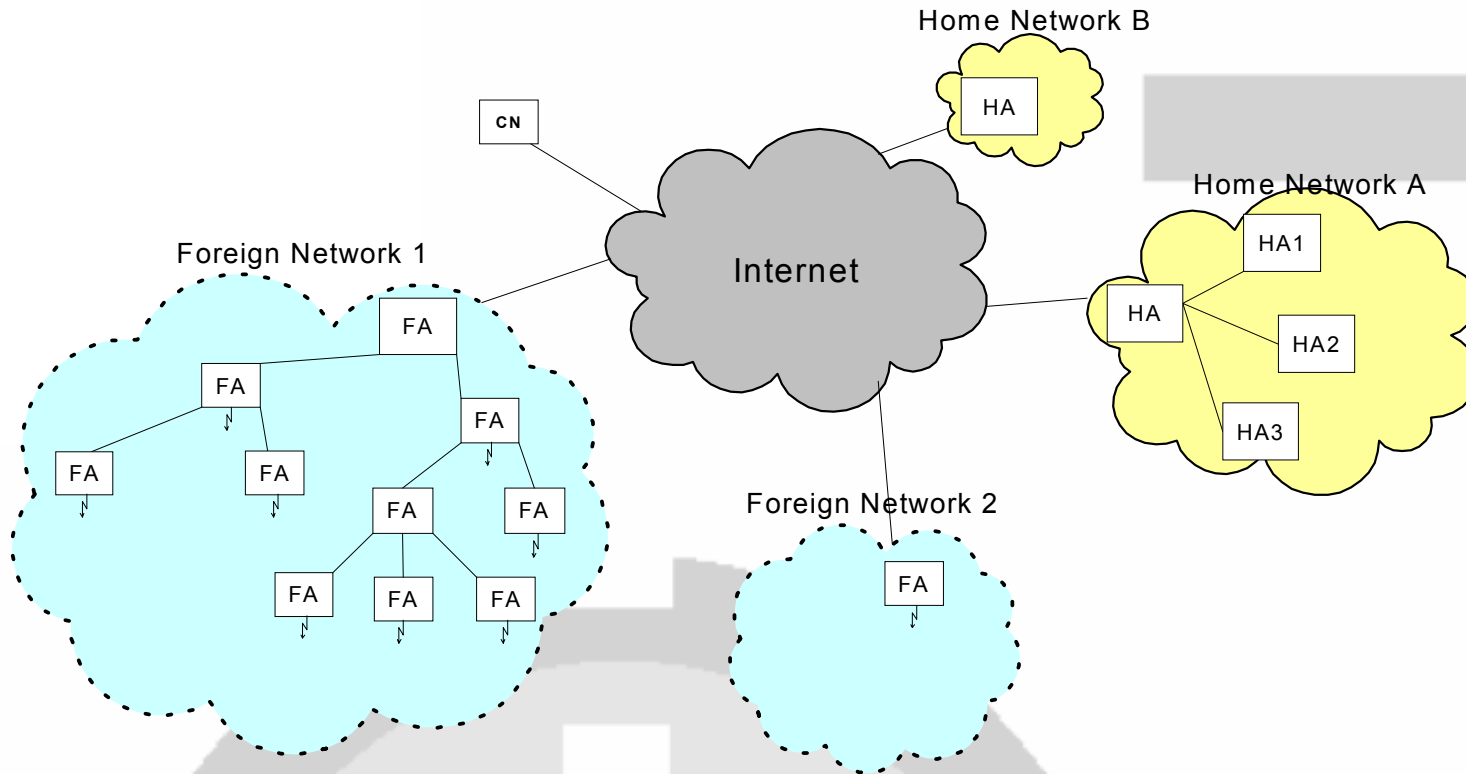
Fast handoffs within the FA hierarchy
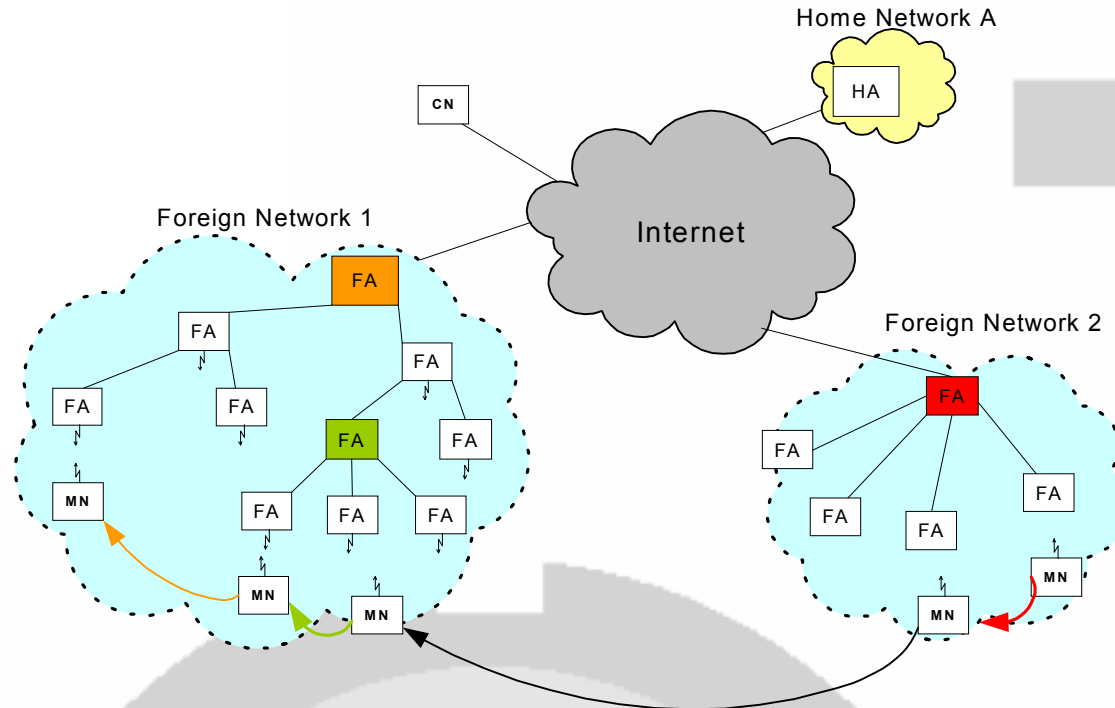
- **The change of routes is localized to the nearest possible FA.**
- **Mobility within a hierarchy does not require slow signaling over the unreliable, possibly slow, global internet.**

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Scalability

- Telco
- ISP
- ASP

- Company
- ISP
- ASP

- Cafe
- ISP
- Telco
- BigCo

- Hotspot
- SME
- SOHO

Internet

- 🕐 **The hierarchical solution scales well geographically.**
- 🕐 **Adding branches to the hierarchy is easy.**
- 🕐 **Scalability enables new operator and service provider business models.**
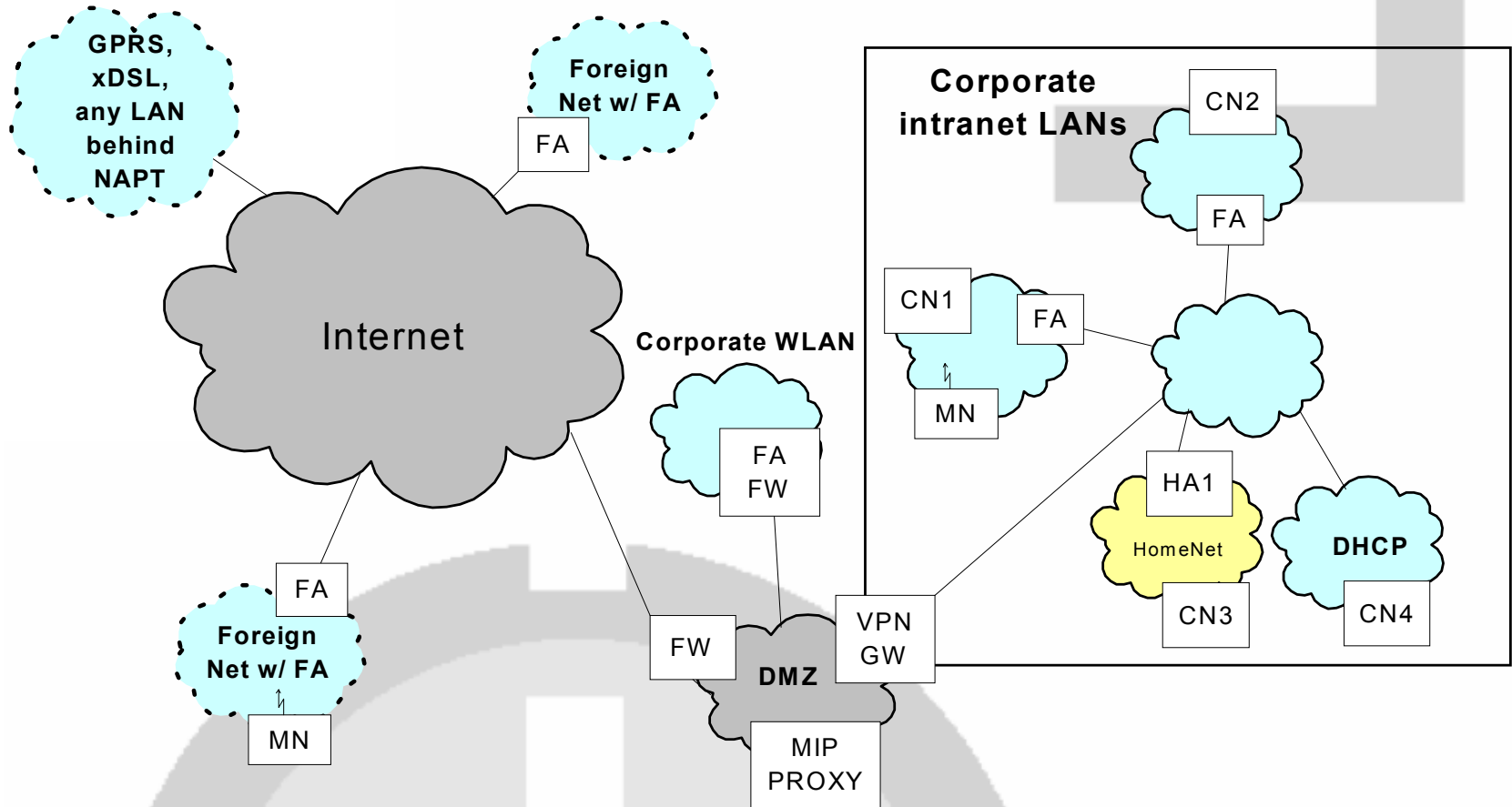
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Support for private addresses
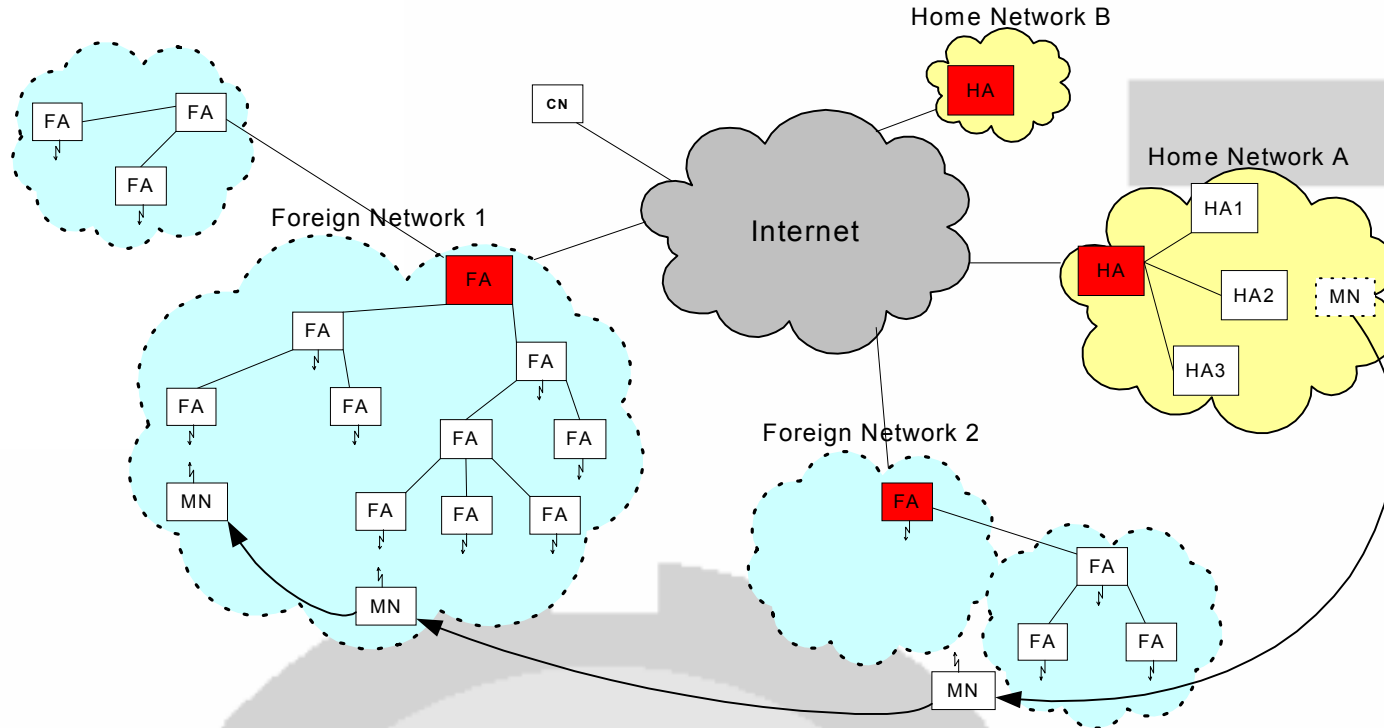
- **Only the hosts marked with red need a public IP address.**
- **Additing a complete sub-hierarchy does not require any more public IP addresses.**

Example2: Mobile IP Proxy

- **Real world requirements / problem statement**
  - ✓ Seamless mobility in the intranet and from the internet
  - ✓ IPSec in MIP tunneling from the Internet
  - ✓ Plain MIP tunneling in the intranet
  - ✓ Minimal changes in the existing MIP
- **Where to place the HA?**
  - ✓ Mobile IP Proxy solves the problem

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MIP Proxy deployed

GPRS, xDSL, any LAN behind NAPT

Foreign Net w/ FA

FA

Internet

Foreign Net w/ FA

FA

MN

Corporate WLAN

FA FW

FW

DMZ

MIP PROXY

VPN GW

Corporate intranet LANs

CN2

FA

CN1

FA

MN

HA1

HomeNet

CN3

DHCP

CN4

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Where can Mobile IP be used?

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LIFIX™ GO!

Home Agent

Foreign Agent

Foreign Agent

Mobile Node

How mobile can you get?

LIFIX™ GO!

Mobile Node

Foreign Agent

Home Agent

Foreign Agent
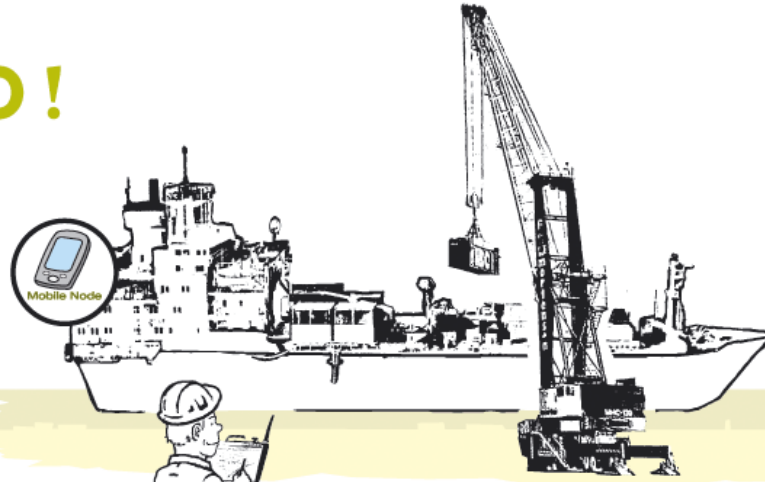
Mobile Node

How mobile can you get?

Visions for the future

- **The networking environment is getting even more heterogeneus**
  - ✓ The number of link layer technologies is growing
- ***"Always connected"* culture**
  - ✓ A completely new wolrd of Internet for businesses and individuals
- **MIP –enabled PDAs**
  - ✓ From off-line calendar to always connected Internet phone or business application toolkit
- **MIP will be there, but you will not notice it**
  - ✓ Mobile IP is enabling 3G IP services

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References

- **IETF**
  - ✓ http://www.ietf.org/
- **MIP WG**
  - ✓ http://www.ietf.org/html.charters/mobileip-charter.html
- **Lifix Systems**
  - ✓ http://www.lifix.fi
- **Dynamics Group**
  - ✓ http://www.cs.hut.fi/Research/Dynamics/
- **3GPP2**
  - ✓ http://www.3gpp2.org/
- **3GPP**
  - ✓ http://www.3gpp.org/
- **National University of Singapore, NUS**
  - ✓ http://www.nus.edu/

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