
Toward a Hierarchical Mobility Management Framework for IPv6

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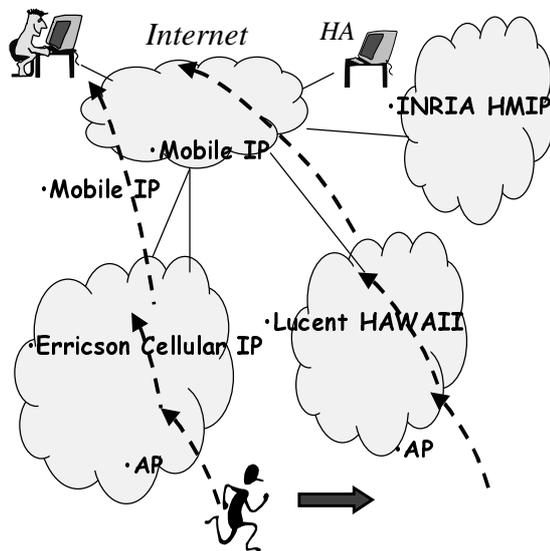
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Motivations

- Current state-of the art:*
 - ◆ Most people agree that *Mobile IP* is great for supporting *macro-mobility* but *something else* is needed for *micro-mobility*
 - ◆ Several *micro-mobility protocols* have been proposed recently: *Erricson Cellular IP, Lucent HAWAII...*
- Problem: Inter-operability and Scalability Problems if the MHs have to understand all possible micro-protocols...*
- Our goal: propose a hierarchical mobility management framework for IPv6 that allows the deployment of different micro-mobility protocols and provides seamless roaming to the MH*

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Hierarchical Mobility Management Framework

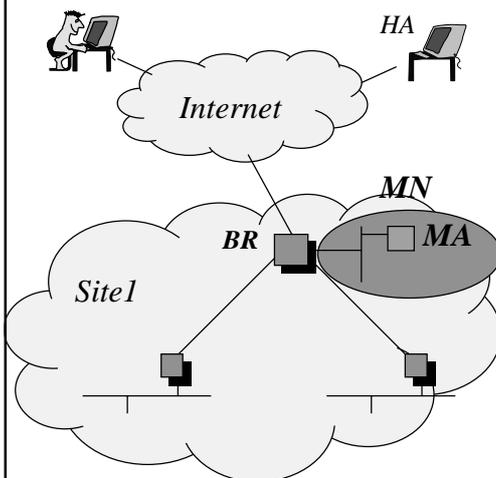


The mobility management protocol is divided in 3 components:

- Access Protocol:** used by the MH to register with its point-of attachment. This protocol needs to be *standard!*
- Micro Protocol:** manages intra-domain mobility: e.g. HAWAII, CellularIP, ... Different proto. can be used!
- Macro Protocol:** manages inter-domain mobility: Mobile IPv6.

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The Mobility Network Concept



We define the concepts of:

- MN (Mobility Network)**
 - ◆ a LAN connected to the BR
 - ◆ defines an address space for Mobile Hosts
 - ◆ contains one or several MAs
- MA (Mobility Agent):**
 - ◆ Routers very similar to HA

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The Registration Phase

We proposed 2 solutions:

□ *Solution1:*

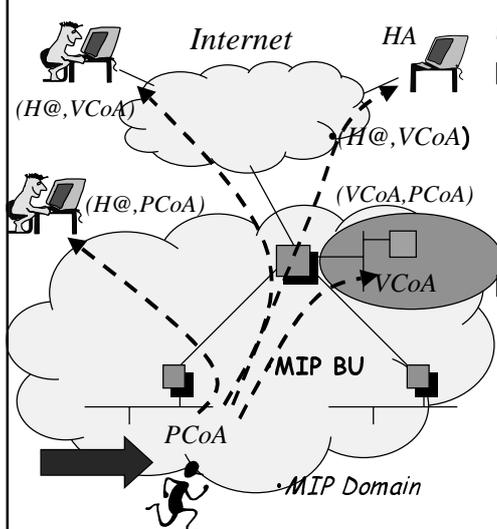
- ◆ Mobile IPv6 (+some extensions) is used as access protocol
- ◆ most of the intelligence is in the MHs
- ◆ MA is only used to route packets to MHs within a domain

□ *Solution2:*

- ◆ The intelligence is moved in the MA
 - ❖ it is responsible of sending BUs on behalf of the MHs
 - ❖ it routes packets to MHs within the domain
- ◆ The access protocol (and MH) is very simple

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Solution1: MIP/MIP Inter-Domain Mobility Registration



MH moves into a domain, it:

□ gets 2 CoAs

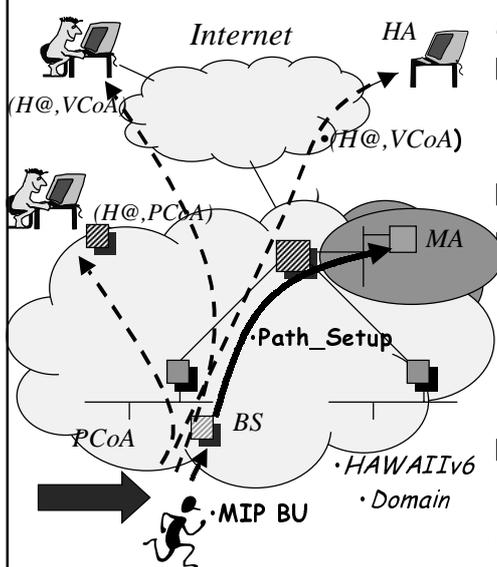
- ◆ VCoA (Virtual CoA) in the MN (stays constant as long as MH is roaming within the site)
- ◆ PCoA (Private CoA) in the visited LAN (changes at each movement of MH)

□ sends

- ◆ external BUs
 - ❖ (H@, VCoA) to ext. CHs + HA
- ◆ local BUs
 - ❖ (H@, PCoA) to local CHs
 - ❖ (VCoA, PCoA) to MA

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Solution1: MIP/HAWAIIv6-like : Inter-Domain Mobility Registration



MH moves into a new site, it:

□ gets 2 CoAs

- ◆ VCoA (Virtual CoA)
- ◆ PCoA (Private CoA)

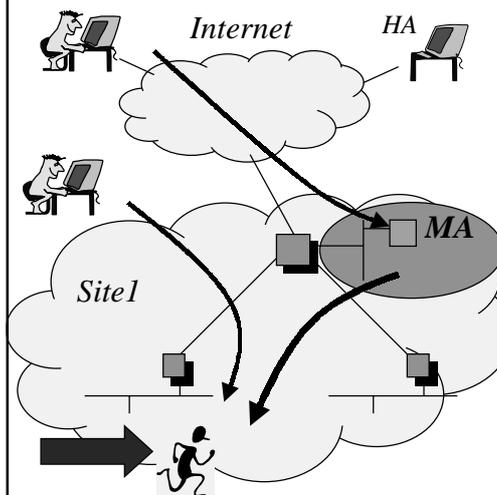
□ sends local + external BUs
□ the BU to MA

- ◆ is intercepted by the BS
- ◆ is encapsulated in a Path Setup message to MA
- ◆ intermediate routers add an entry for the MH

□ some mobile IP extensions might be required

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Packet Delivery



□ When an external CH sends a Packet to the MH:

- ◆ it uses the MH's VCoA.
- ◆ The packet is then :
 - ❖ routed to the MN,
 - ❖ intercepted by the MA,
 - ❖ encapsulated or forwarded to the PCoA.

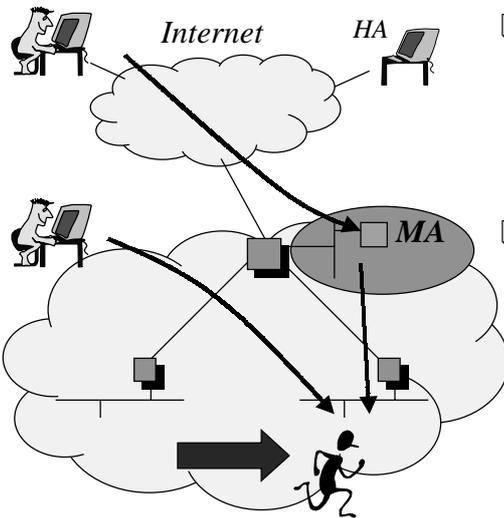
=> Mobility Network should be close to the domain Border Router

□ When a local CH sends a Packet to the MH:

- ◆ it uses the MH's PCoA
- ◆ the packet is directly delivered to the MH

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Packet Delivery

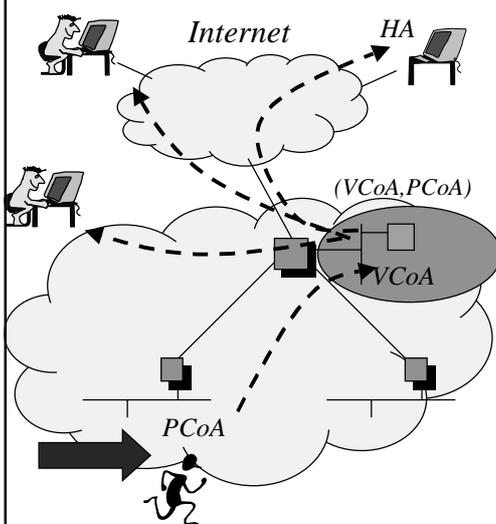


- When an external CH sends a packet to MH:
 - ◆ it uses the MH's VCoA
 - ◆ the packet is routed to MA and redirected to the MH's current location
- When a local CH sends a packet to MH:
 - ◆ it uses the MH's PCoA
 - ◆ the packet is delivered to MH

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Solution2:

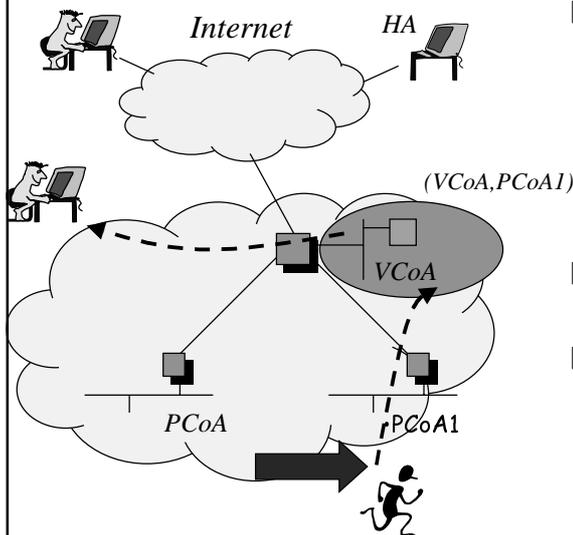
Inter-Domain Mobility Registration



- Intelligence is moved from MH to MA..
- MH moves into a new domain, it:
 - ◆ gets a PCoA and
 - ◆ registers it with the MA using a simple registration protocol
- The MA:
 - ◆ gets a VCoA and
 - ◆ send BUs on behalf of the MH
- more details in the ID

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Solution2: Intra-Domain Mobility Registration



- MH moves within the domain, it :
 - ◆ gets a new PCoA, PCoA1, and
 - ◆ registers it with the MA using a simple registration protocol
- MA sends (H@,PCoA1) BU to local CHs
- The MA is responsible of sending the refresh BUs to the MH's HA...

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Comparisons/Conclusion

- *Solution 1: the intelligence is in the MHs*
 - ◆ simple Mobile IPv6 modifications
 - ❖ MH must differentiate intra-domain and inter-domain movements
 - ❖ MH must differentiate local CHs from external CHs
 - ❖ MH must send 3 types of BU
 - ◆ (PCoA, H@) to local CHs, (PCoA, VCoA) to MA, (VCoA, H@) to external CHs
 - ◆ the burden is on the MHs
- *Solution 2: intelligence is in the network (MA)*
 - ❖ more complex to deploy... but the MH is simpler
 - ❖ less signaling on the wireless link (MH-BS link)
 - ❖ better for very small mobile devices (simpler, less mem.)?
- *Question: Solution1 or Solution2? Both??*

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Status of our work

Solution 1:

- ◆ *there is a INRIA technical report*
- ◆ *implementation soon!*

Solution 2:

- ◆ *implementation under FreeBSD on its way using F.Dupont's Mobile IPv6*
- ◆ *specification should be ready by the next IETF*

Future work:

- ◆ *integrate paging...*
- ◆ *Look more carefully at security issues..*

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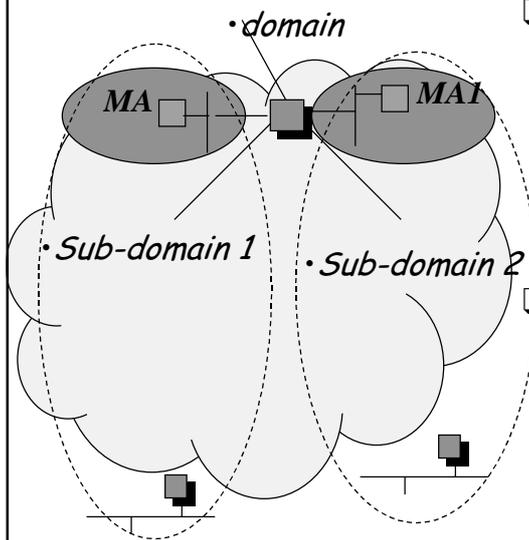
A Hierarchical Mobile IPv6 Framework

QUESTIONS?

- ◆ *Solution 1: technical report*
(<http://www.inrialpes.fr/planete>)
- ◆ *Solution 2: Internet Draft*
(<http://www.inrialpes.fr/planete>)
- ◆ *Claude.Castelluccia@inria.fr*

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Scalability Issues



□ Problem:

The MA

- ◆ receives BUs from local MHs
- ◆ routes packets to MHs
- ◆ sends BUs on behalf of MHs (sol.2)

=> potential Scalability Problem

□ Solution:

- ◆ deploy several MA per MN
- ◆ deploy several MNs per domain
- ◆ load sharing on a geographical basis or dynamically

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Security Issues

□ Solution 1:

- ◆ (MH -> MA) BUs must be authenticated
- ◆ (MH -> CHs, MH->HA) BUs must be authenticated as in Mobile IPv6

=> should not be too difficult!

□ Solution 2:

- ◆ (MH -> MA) BUs must be authenticated
- ◆ (MA -> HA) BUs must be authenticated
- ◆ (MA -> CHs) BUs must be authenticated

=> more tricky?

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Solution1: What is needed?

- ❑ the MA runs the standard HA code
 - ◆ *The MH is seen as a host on its network with VCoA as home address and PCoA as CoA.*

- ❑ The MH runs Standard Mobile IPv6 with some small modifications. It must be able to:
 - ◆ *differentiate intra-domain and inter-domain movements*
 - ◆ *differentiate local CHs from external CHs*
 - ◆ *sends 3 types of BU*
 - ❖ *(PCoA,H@) to local CHs*
 - ❖ *(PCoA, VCoA) to MA*
 - ❖ *(VCoA,H@) to external CHs*

- ❑ CHs and HA runs Standard Mobile IPv6

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Solution2: What is needed?

- ❑ MH considerations:
 - ◆ *MH runs a subset of Mobile IPv6 (CHs' handling is not necessary) + some extensions*

- ❑ MA considerations:
 - ◆ *most complex components*
 - ◆ *it is a HA that generates BU s !*

- ❑ HA and CHs run standard MIPv6

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