

Towards seamless mobility using enhanced Hierarchical Mobile IPv6

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15. Treffen der VDE/ITG-FG 5.2.4 „Mobilität in IP-basierten Netzen“
„Vertical Handover – Providing Intersystem Mobility for heterogeneous Networks“

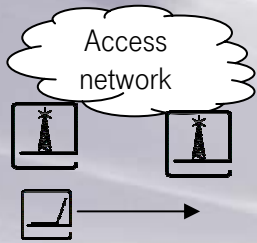
September 29 – 30, 2005, Aachen

Towards seamless mobility using enhanced Hierarchical Mobile IPv6

Outline

- Mobility support on the Network layer
- Hierarchical Mobile IPv6
- Drawbacks of existing Hierarchical Mobile IPv6
- Proposed enhancement and solutions
- Simulation results
- Conclusions

Network-layer Mobility Support



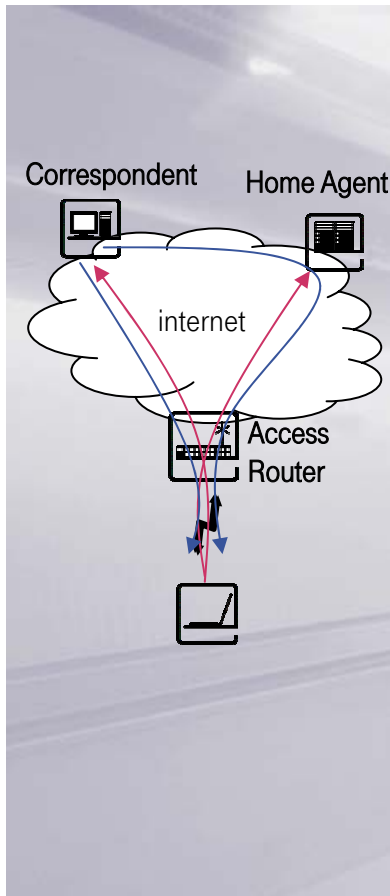
L3 Handover	IPv6 address registration
	IPv6 address configuration
L2 Handover	association
	scanning

- Mobile Node may need to change the access point while moving within a wireless network
 - Handover process is initiated

Handover types

- Data Link Control layer (layer 2) handover
 - Mobile Node does not change the IP address of network accessing interface
 - No IP re-routing is required
- Network layer (layer 3) handover
 - Carried out after a layer 2 handover
 - IP address of accessing interface changes
 - Data packets to the Mobile Node have to be re-routed
 - IETF proposal: Mobile IP protocol family

Mobile IPv6

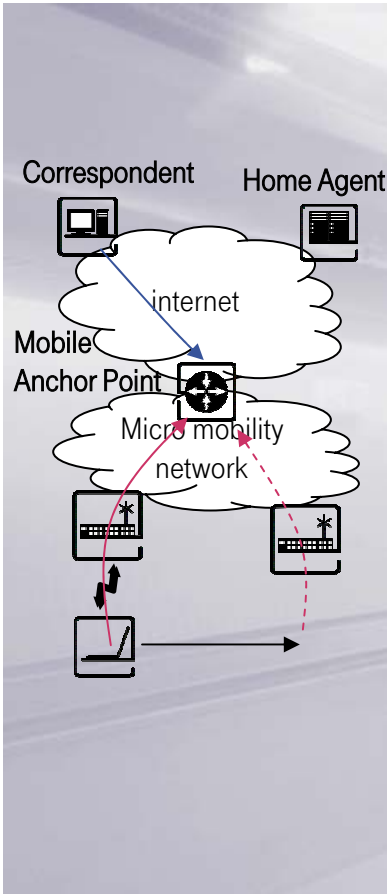


- Basic mobility solution in IPv6
- Registration of the new IP addresses at the Home Agent and corresponding nodes
- Data transfer to the Mobile Node using either tunnelling or IPv6 source routing

Problems

- Too large transport delay between the Mobile Node and the Home Agent if the Home Agent is far away from the visited network
- Too large handover delays
- Insufficient quality for Mobile Nodes managing time-critical sessions

Hierarchical Mobile IPv6



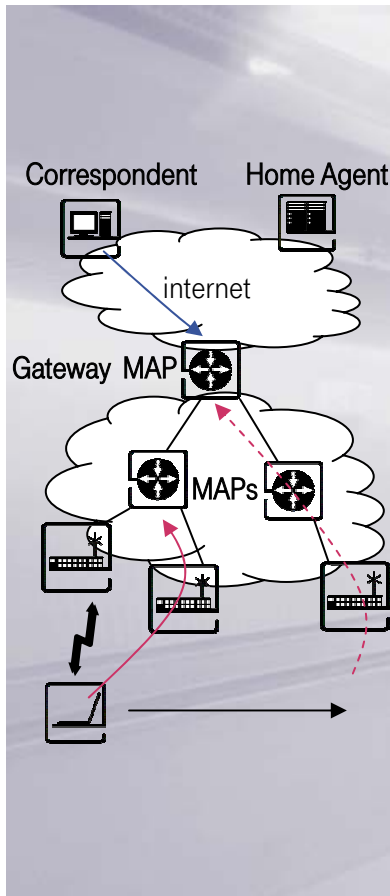
- Extension of Mobile IPv6 and IPv6 neighbour discovery
- Introducing a new node called Mobile Anchor Point (MAP)
 - Essentially acts as a local Home Agent
 - Allows local mobility handling
- A MAP is placed much closer to the Mobile Node
 - Defines a micro mobility network
 - Mobile Node re-registers rather at the Mobile Anchor Point not at its Home Agent
 - Handover delay decreases

Problems

- Transport delay between the Mobile Node and Mobile Anchor Point can still be too large to satisfy mobile users managing time-critical applications
 - High-speed mobile nodes
- Global and permanent mobility

Enhanced Hierarchical Mobile IPv6

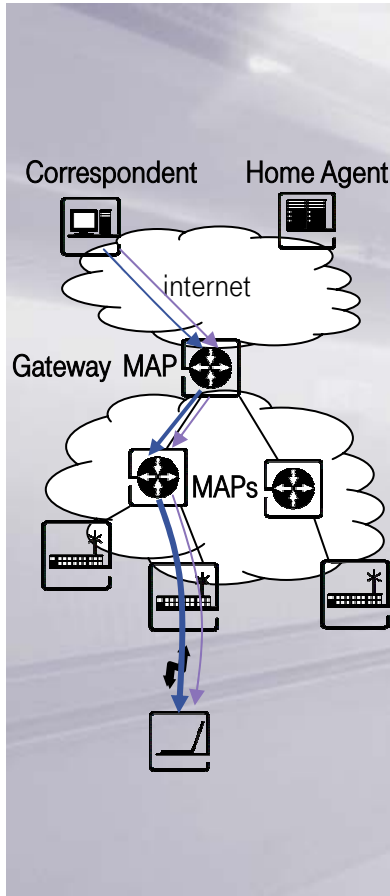
Multi-hierarchy of Mobile Anchor Points



- Introduction of a MAP hierarchy expands the boundaries of the micro mobility network
 - Achieving global and permanent mobility
 - Mobile Node always selects an optimal crossover MAP to re-register its IP address
 - Transport delay for delivery of the registration messages to the accordant MAP is reduced
 - Registration phase of the handover process is reduced
 - Hierarchical Mobile IPv6 allows multiple MAPs within a micro mobility network
 - Adaptation for different mobility scenarios
 - No multi-hierarchical functionality
- Problems using a hierarchy of MAPs**
- Routing of data packets to the Mobile Node
 - Too large overhead because of IPv6-in-IPv6 encapsulation
 - Registration mechanism
 - Too large registration delays because of increased number of MAPs in the route

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Improved routing mechanism



- MAP tunnels intercepted packets to the IPv6 address registered by the Mobile Node
 - IPv6-in-IPv6 encapsulation is used
- Additional tunnelling overhead is added to the packet at each level of MAP hierarchy
 - Packet becomes to large according to the number of MAPs in the route

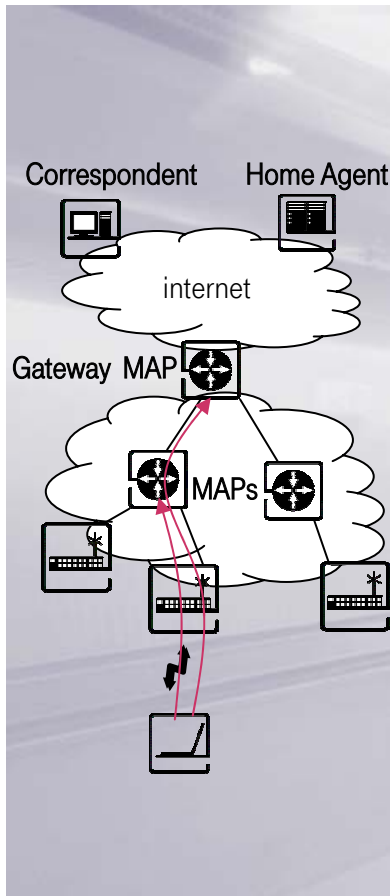
Solution: modified function to process the data packets in MAPs

- Modify in flight destination field of IPv6 header if there is a Routing Header Type 2 in the packet
 - No payload corruption
 - No encapsulation
 - No additional overhead
- Home Agent additionally adds a Routing Header to a packet to invoke this mechanism

IPv6 Hdr	RtgHdr 2	IP _{DEST} = MN	Payload
IP _{DEST} = MAP _{GW}	IP = MN	IP _{SRC} = CN	

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New registration mechanism



- Mobile Node has to wait for an acknowledgement from the closest MAP before registering with a further one
- If any MAP declines the registration request of the Mobile Node, the route to the Mobile is not established
 - Mobile Node has to generate new registration requests instead of declined
 - Registration process is delayed significantly

Solution: new registration signalling message (multi Binding Update)

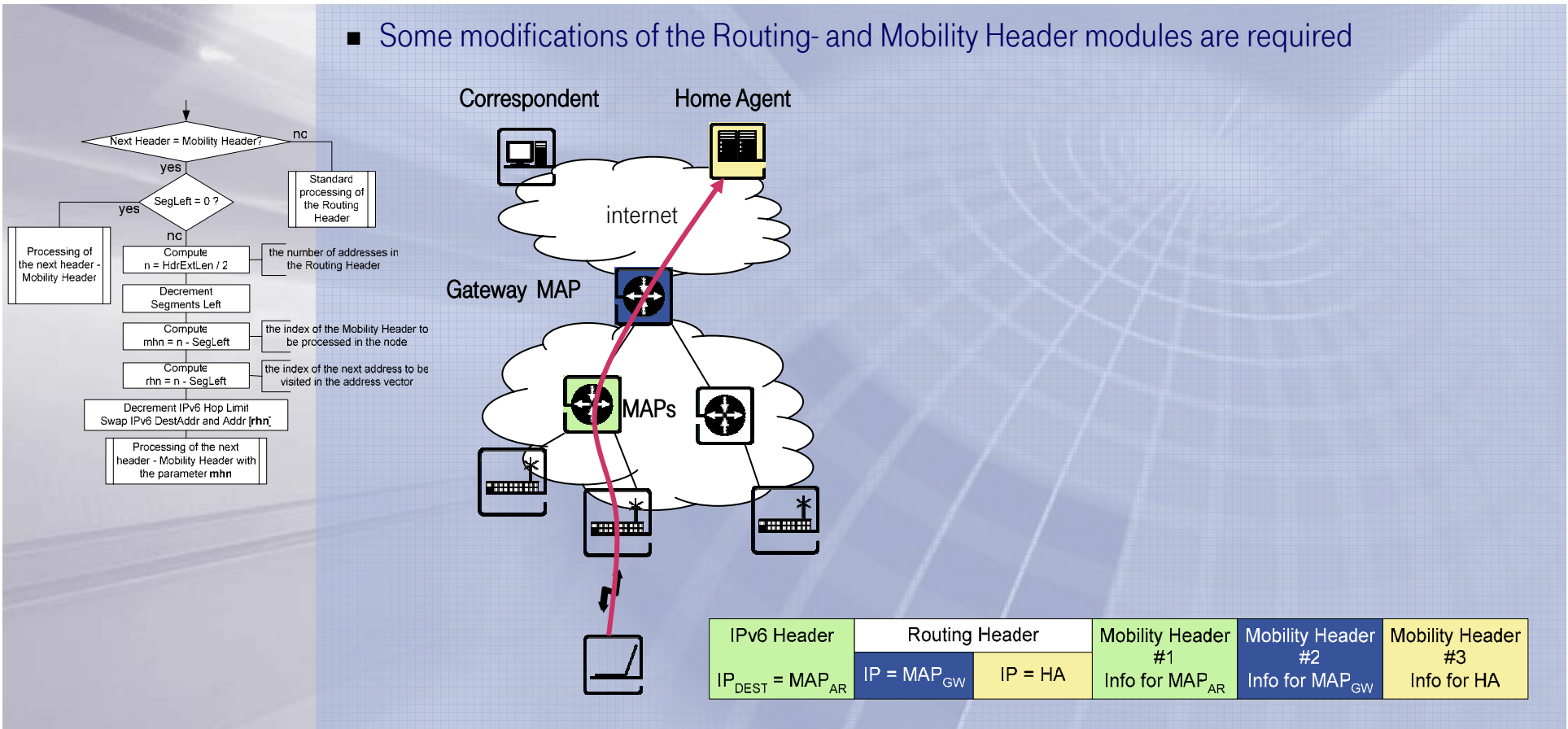
- New multi Binding Update signalling message
 - Carries registration information for all MAP levels and Home Agent

IPv6 Header	Routing Header		Mobility Header #1	Mobility Header #2	Mobility Header #3
IP _{DEST} = MAP _{AR}	IP = MAP _{GW}	IP = HA	Info for MAP _{AR}	Info for MAP _{GW}	Info for HA

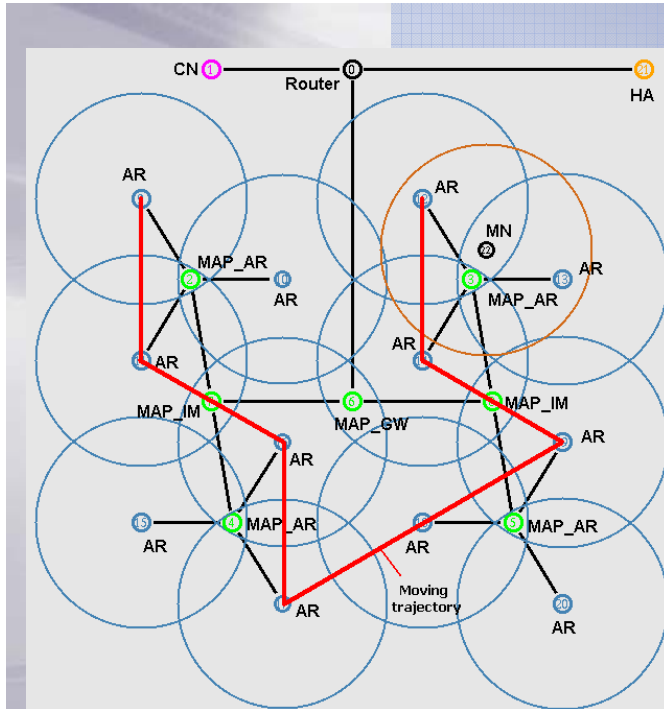
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Functionality of the new registration mechanism

- Some modifications of the Routing- and Mobility Header modules are required



Enhanced Hierarchical Mobile IPv6 Reference scenario

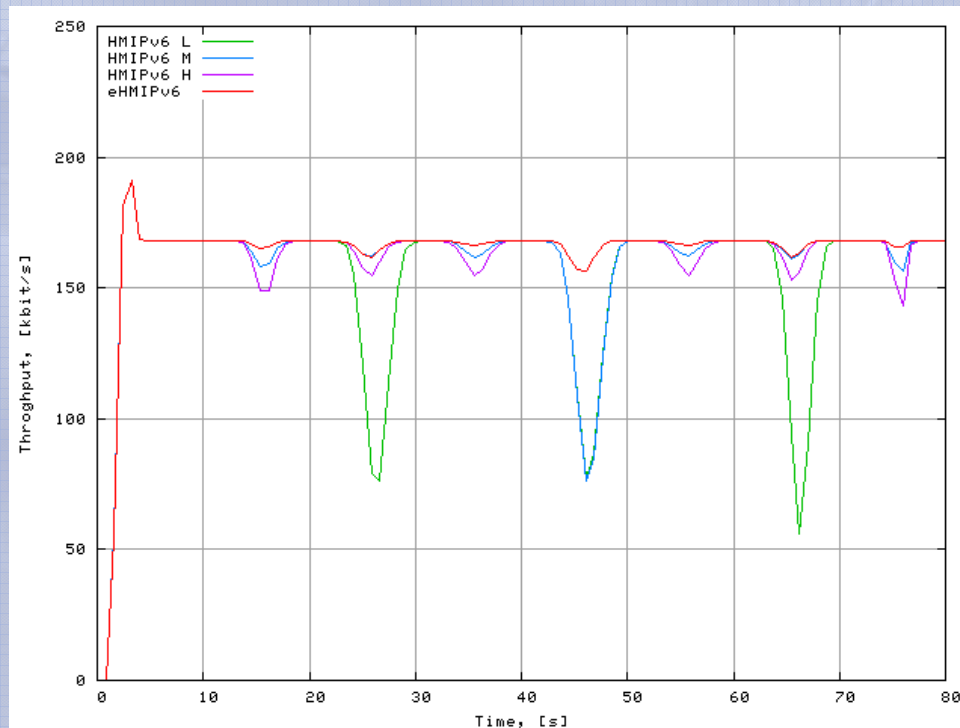
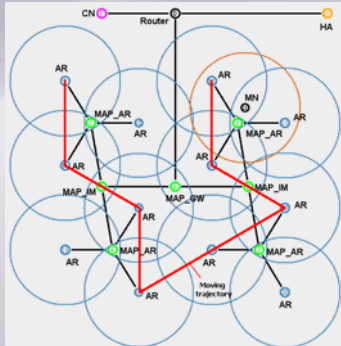


- Wireless LAN based on IEEE 802.11
- Built using three wireless channels (Nr. 1, 6, 11) to prevent interferences
- Four protocol behaviours are compared
 - Three HMIPv6 variations where the Mobile Node registers with MAP:
 - MAP_AR, closest to access routers (AR)
 - MAP_IM, placed intermediately
 - MAP_GW, gateway, most distanced from ARs
 - eHMIPv6, Mobile Node registers at all MAP levels
- Mobile Nodes moves
 - according to the depicted trajectory
 - randomly

Enhanced Hierarchical Mobile IPv6

Simulation results

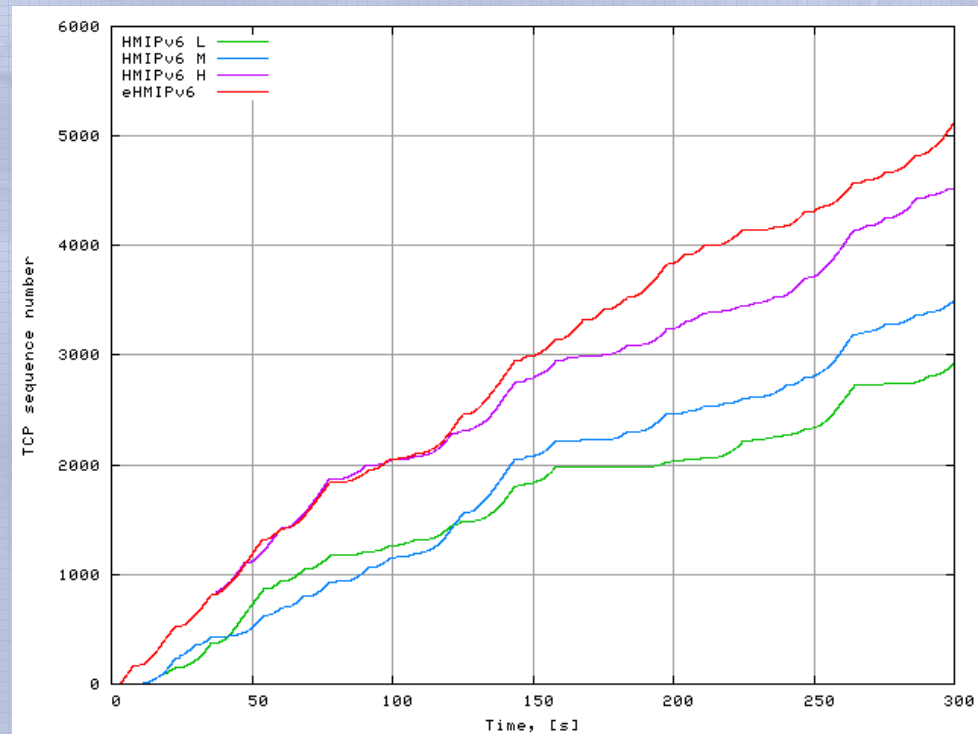
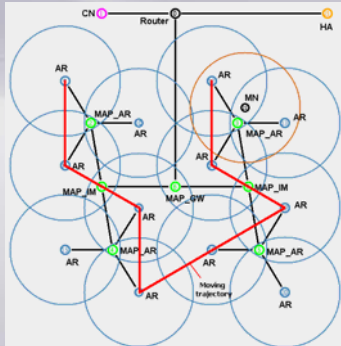
- Mobile Node moves along the shown moving trajectory
- Incoming CBR traffic



Enhanced Hierarchical Mobile IPv6

Simulation results

- Mobile Node moves randomly
- Incoming FTP traffic



Conclusions

- Defined multi-hierarchical architecture of Mobile Anchor Points enhances the performance of the Hierarchical Mobile IPv6 protocol
 - Handover latency is reduced
 - Traffic performance during handovers is improved
 - Support for high speed mobile nodes
 - Permanent and global mobility
- New implemented mechanisms solve the problems of proposed architecture
 - Modified function for processing of data packets in MAPs
 - Avoid forwarding overhead
 - New registration mechanism with a set of hierarchical MAPs
 - New multi Binding Update signalling message
 - Accelerate registration process during handovers
- Obtained simulation results prove the described improvements

Contact

Thank you for your attention

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