

# Mobility in IPv6

Thomas Liske

Dresden University of Technology

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# Outline

## Introduction

Mobility Support  
Overview of IPv6

## Mobility Support

## Handover Management

## What means Mobility Support?

- ▶ allow transparent routing of IPv6 packets to *mobile nodes*
- ▶ mobile nodes always identified by its *home address*
- ▶ regardless the *mobile node's* current point of attachment

## Why Mobility Support?

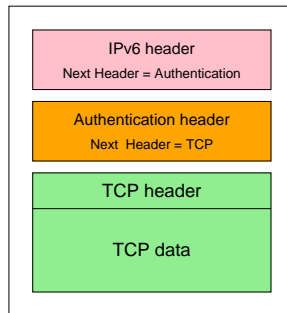
- ▶ w/o mobility support:
  - ▶ *mobile nodes* not reachable by its *home address* while away from their *home subnet*
  - ▶ changing their IP address while changing point of attachment → maintaining higher-level connections not possible
- ▶ mobility support important, since mobile computers becomes more popular these days

# IPv6 address space

- ▶ 128bits long IP addresses
- ▶ reserved parts for
  - ▶ old IPv4 address space
  - ▶ Link-Local addresses
  - ▶ unicast addresses
  - ▶ multicast addresses
- ▶ prefix based routing

# IPv6 headers

- ▶ fixed size, 64bits aligned
- ▶ extension headers:
  - ▶ Authentication header
  - ▶ Routing header



IPv6 packet including TCP payload

# Outline

## Introduction

## Mobility Support

Introduction

Mobile Node Operation

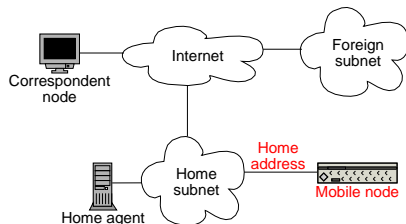
Correspondent Node Operation

Home Agent Operation

## Handover Management

# Terms

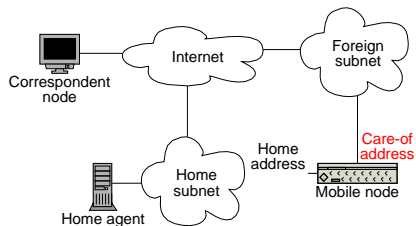
- ▶ *mobile node*
  - ▶ any node which may change its point of attachment
- ▶ *home address*
  - ▶ assigned as normal IP addresses
  - ▶ remains unchanged, regardless the node's point of attachment
- ▶ *care-of address*
  - ▶ IP address acquired by a *mobile node* in *foreign subnets*





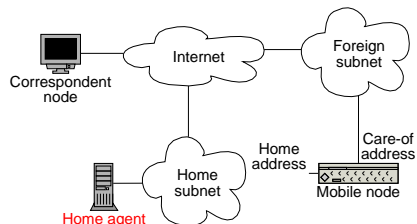
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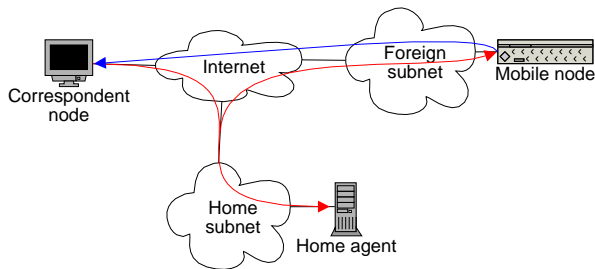


# Terms

- ▶ *binding*
  - ▶ association between *home address* and *care-of address*
- ▶ *home agent*
  - ▶ maintains current *bindings*
  - ▶ intercepts and tunnels packets addressed to *home addresses* to their *care-of address*
- ▶ *correspondent nodes*
  - ▶ any node communicating with a *mobile node*
  - ▶ itself either mobile or stationary



## Triangle routing



→ any IPv6 node must support mobility-related functions for *correspondent nodes* to prevent all-time triangle routing

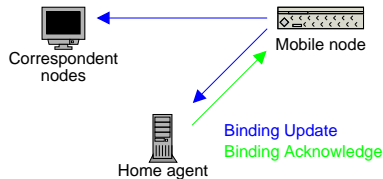
# Mobile Node Overview

any IPv6 *mobile node* must be able to

- ▶ perform IPv6 decapsulation
- ▶ keep track of *Correspondent Nodes*
- ▶ send *Binding Updates*
- ▶ receive *Binding Acknowledgements*

## Binding updates

- ▶ when encapsulated packet arrives
  - ▶ send *binding update* to *correspondent node*
- ▶ after changing point of attachment
  - ▶ configure new *care-of address*
  - ▶ send *binding update* to the *home agent*
  - ▶ send *binding updates* to *correspondent nodes*



# Correspondent Node Overview

- ▶ every IPv6 node may become a *correspondent node*
- ▶ thus, every IPv6 node must be able to
  - ▶ receive *Binding Updates*
  - ▶ send *Binding Acknowledgements*
  - ▶ maintain a *Binding Cache*

## Delivering packets to a mobile node

- ▶ before sending packet, check *Binding Cache*
- ▶ if entry is found, send to *care-of address* using IPv6 Routing Header

# Home Agent Overview

- ▶ same requirements as for *correspondent nodes* and
- ▶ must be able to perform IPv6 encapsulation



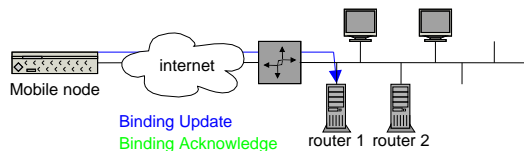
## Forwarding packets to a mobile node

- ▶ could not use IPv6 Routing header
- ▶ instead uses IPv6 encapsulation
- ▶ should only be involved for a few packages

# Home Agent Discovery

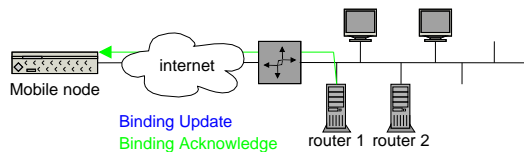
- ▶ while the *mobile node* is away the *home agent's* IP address might change due
  - ▶ failure / replacement of the old *home agent* or
  - ▶ reconfiguration of the *home subnet*
- ▶ thus dynamic discovery of a *home agent* needed

# Home Agent Discovery (1/4)



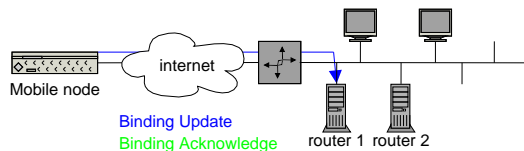
- ▶ *mobile node sends Binding Update to ANYCAST address*

## Home Agent Discovery (2/4)



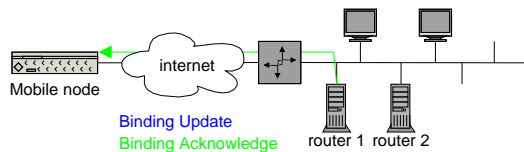
- ▶ possible *home agent* rejects with *Binding Acknowledge*

## Home Agent Discovery (3/4)



- ▶ *mobile node sends Binding Update to home agent*

## Home Agent Discovery (4/4)



- ▶ *home agent accepts with Binding Acknowledge*

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Introduction

Mobility Support

Handover Management

Mobile IPv6

Hierarchical Mobile IPv6

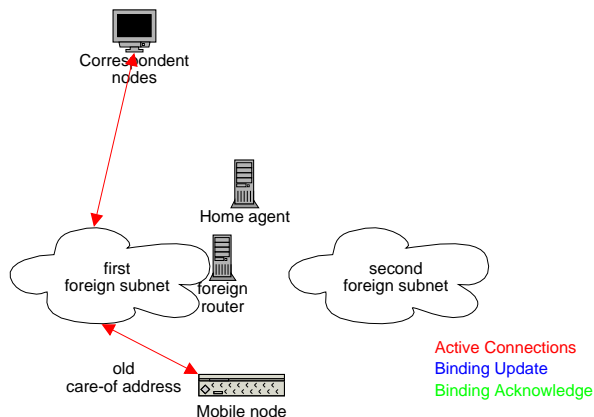
Fast Handover

# The Handover Procedure

1. *mobile node* detects movement by *Router Advertisements*
2. create a new *care-of address*:
  - ▶ *Local-Link address*, do *DAD*
  - ▶ autoconfigure new *care-of address*
3. send *Binding Updates*

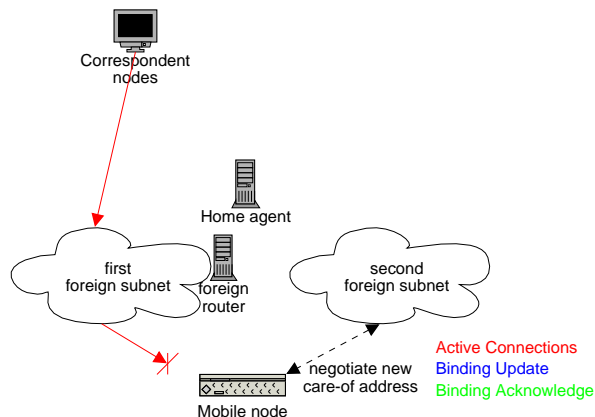


## Router-assisted smooth handoffs (1/5)



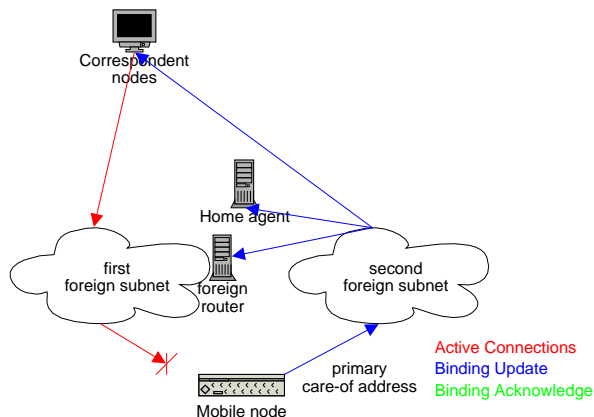
- ▶ only one simultaneously connection possible

## Router-assisted smooth handoffs (2/5)



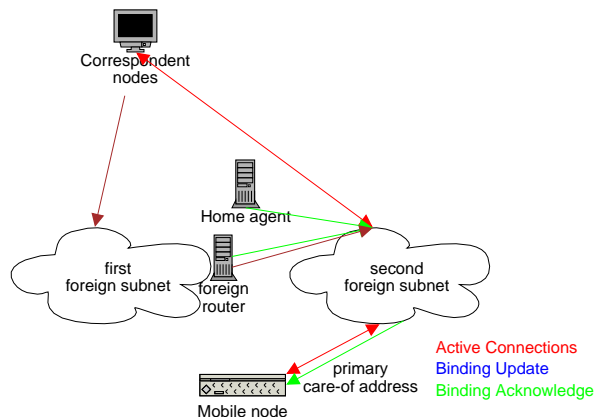
- ▶ disconnect from old network, packets are lost

## Router-assistend smooth handoffs (3/5)



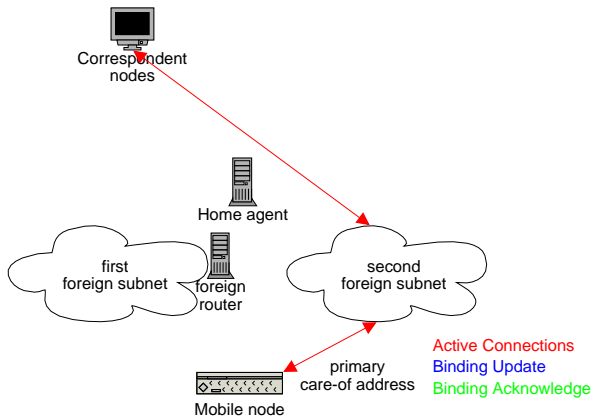
► update *Binding Caches*

## Router-assisted smooth handoffs (4/5)



- ▶ foreign router acts as *temporary home agent*

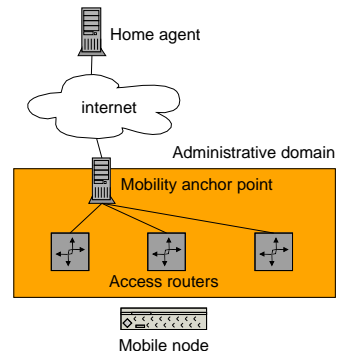
## Router-assisted smooth handoffs (5/5)



▶ handoff complete

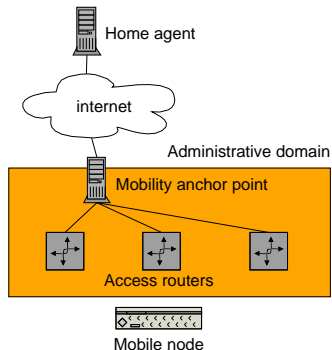
# Overview

- ▶ Internet divided in regions of local mobility
  - ▶ independent from subnets
  - ▶ managed by one administrative authority
- ▶ connected to the internet by a *mobility anchor point*



# Operation

- ▶ *mobile node detects agent advertisement*
- ▶ *regional registration to home agent*
- ▶ *local registration to mobility anchor point.*
  - ▶ *basic mode*
  - ▶ *extended mode*



## Basic mode

- ▶ each *mobile node* acquires two addresses:
  - ▶ *regional care-of address*
  - ▶ *on-link care-of address*
- ▶ *mobility anchor point* acts as *home agent* for *regional care-of address*
- ▶ problem: no scalability for *regional care-of addresses*



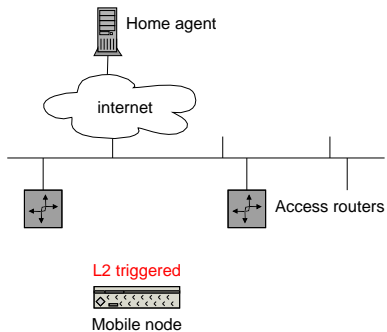
## Extended mode

- ▶ *mobile node acquires on-link care-of address*
- ▶ *mobility anchor point keeps binding b/w home address and on-link care-of address*
- ▶ *all packets must be encapsulated at the mobility anchor point*

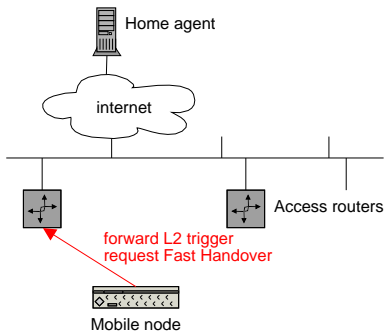
# Overview

- ▶ movement anticipation based on *L2 triggers*
- ▶ *L2 trigger* types:
  - ▶ Link Up
  - ▶ Link Down
  - ▶ L2 Handover Start
- ▶ two possible methods
  - ▶ *Anticipated Handover*
  - ▶ *Tunnel Based Handover*

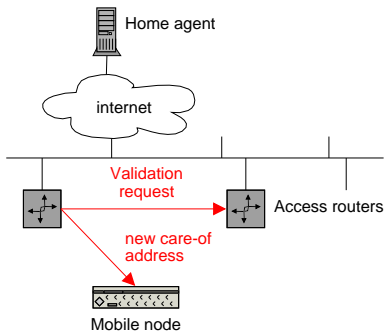
# Anticipated Handover



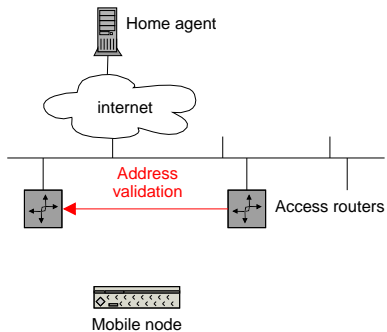
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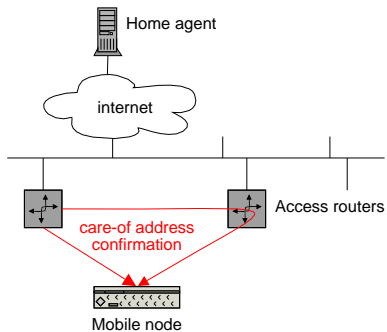
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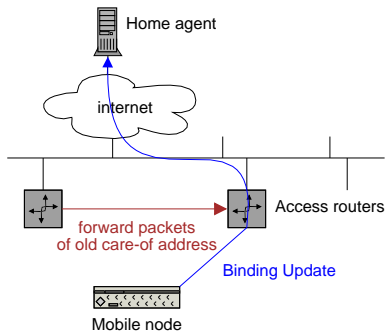
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# Anticipated Handover





## Tunnel Based Handover

- ▶ access routers detect movement only by *L2 triggers*
- ▶ old *access router* tunnels packets for the *mobile node* to the new *access router* and vice versa
- ▶ new *care-of address* is registered later

# Conclusions

The *Mobility in IPv6* Protocol is

- ▶ lightweight as possible
- ▶ minimized in control traffic
- ▶ needed to be deployed in all IPv6 nodes

but handover latency too long for real-time applications, thus using

- ▶ *Hierarchical Mobile IPv6* inside administrative domains
- ▶ otherwise *Fast Handover*

to reduce handover latency.

## References



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*Network Working Group*, RFC 3775, Jun 2004



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