



# Multihoming in Mobile IPv6

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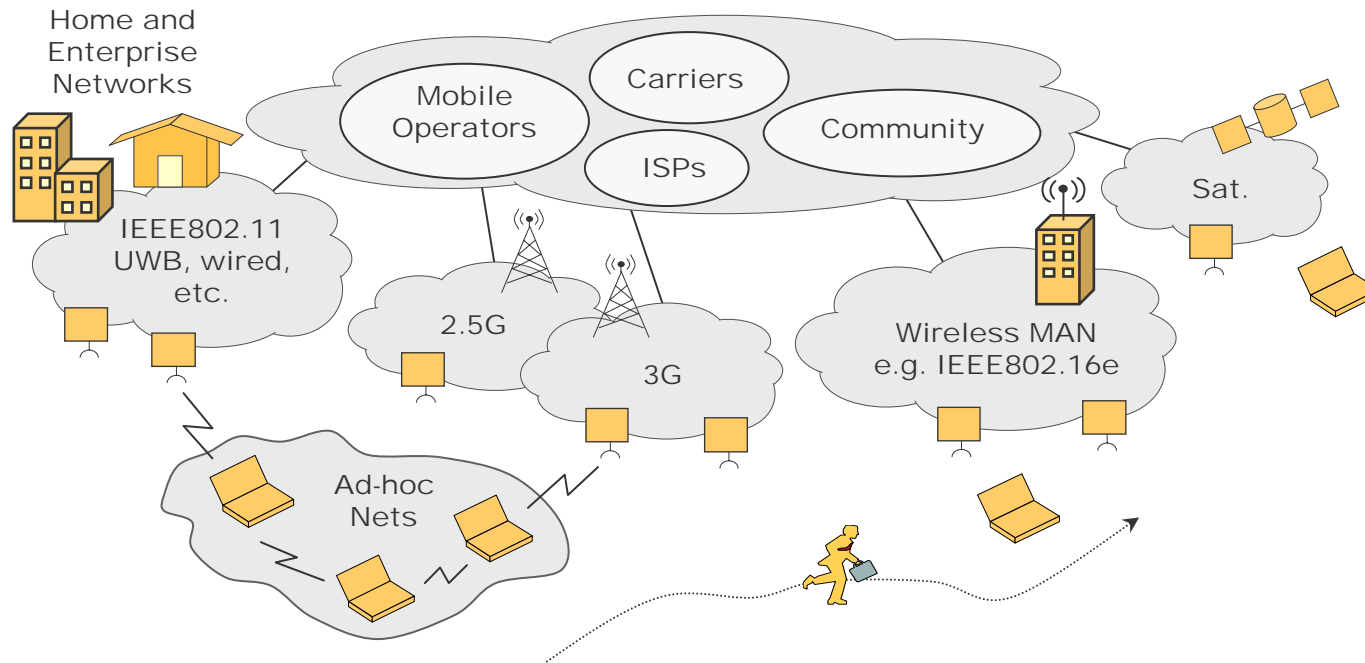
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**Daidalos**

**WP2 - Integration of Heterogeneous Networks**



# Reference Scenario



- IPv6 Networks
- Heterogeneous accesses
- Seamless Mobility (Mobile IPv6)
- Multi-mode Terminals





# Mobile IPv6

## IETF solution (RFC3775) to manage mobility in IPv6 networks

### Pros:

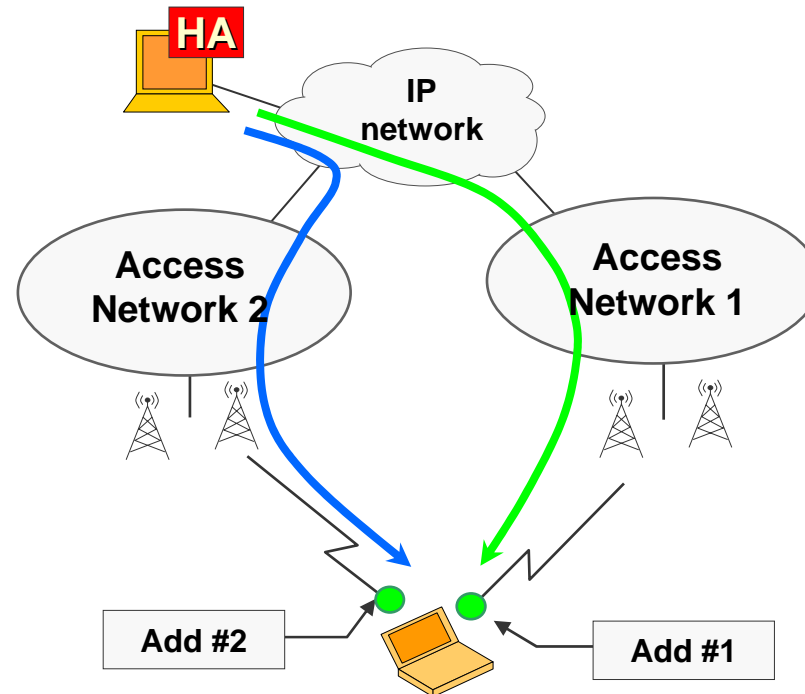
- Session continuity
- Global reachability

### Cons:

- Mobility active on only one interface in a certain moment → The Mobile Node (MN) can register only one interface in the Home Agent (HA)



# Multihoming in MIPv6



- Multimode terminal
- Concurrent IPv6 Mobility on more than one interface
- **Need to enhance Mobile IPv6**





# Multihoming Benefits

- Ubiquitous access
- Redundancy/fault recovery
- Load balancing
- Bicasting
- Preferences settings



# Multihoming & IETF



## ✓ MIP6 wg

- “Analysis of Multihoming in Mobile IPv6”  
(draft-montavont-mobileip-multihoming-pb-statement-03)
- “Goals and Benefits of Multihoming”  
(draft-ernst-generic-goals-and-benefits-00)
- “Multiple Care-of Addresses Registration”  
(draft-wakikawa-mobileip-multiplecoa-03)
- “Mobile IPv6 for multiple interfaces”  
(draft-montavont-mobileip-mmi-01)

## ✓ NEMO wg

## ✓ MULTI6 wg





# Possible solutions for Multihoming issue



# Multiple Care of address and single Home Address



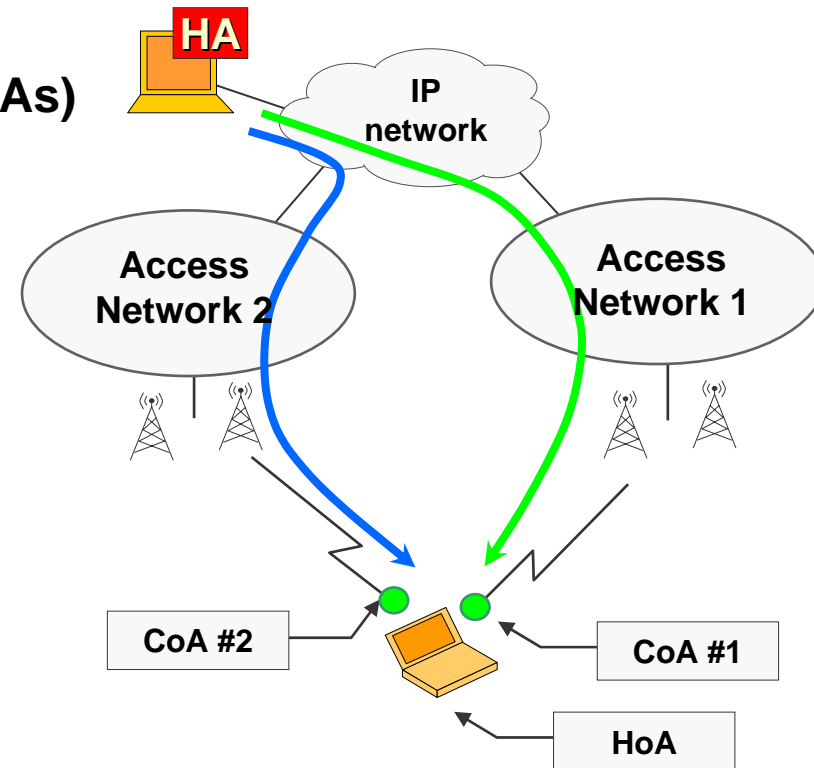
## Multiple Care of Address Addresses (CoAs)

- One (or more) for each interface
- Used to identify a single interface
- Interface Location

## Single Home Address (HoA)

- Node Identity
- Global reachability

- **MIPv6 needs to be modified**
- **Routing policies in the Home Agent**



# Multiple Home Addresses and multiple Care of Addresses



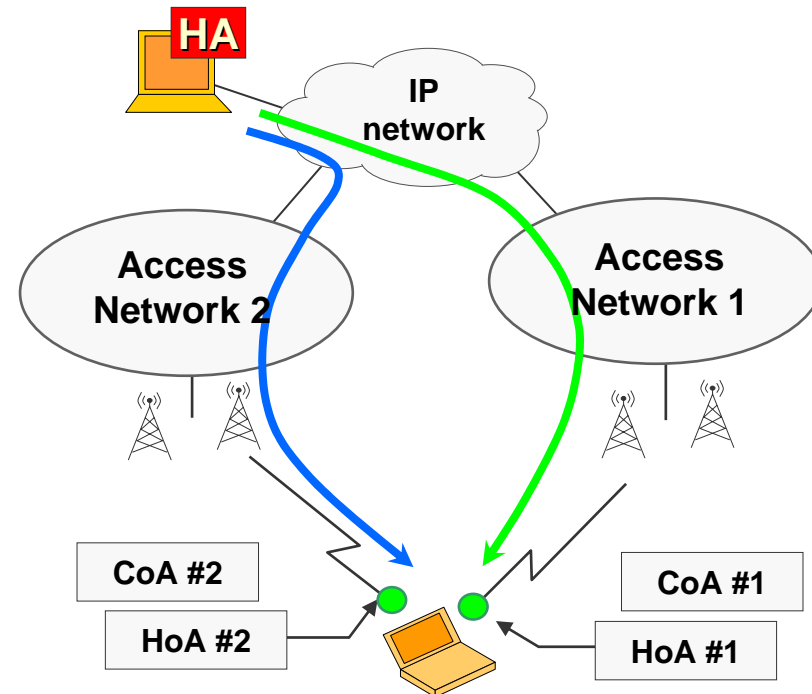
## Multiple Home Addresses (HoAs)

- One for each interface
- Interface Identity
- Global interface reachability
- One or more HAs

## Multiple Care of Addresses (CoAs)

- Interface Location
- Registered with one or more HAs

**MIPv6 doesn't need to be modified**

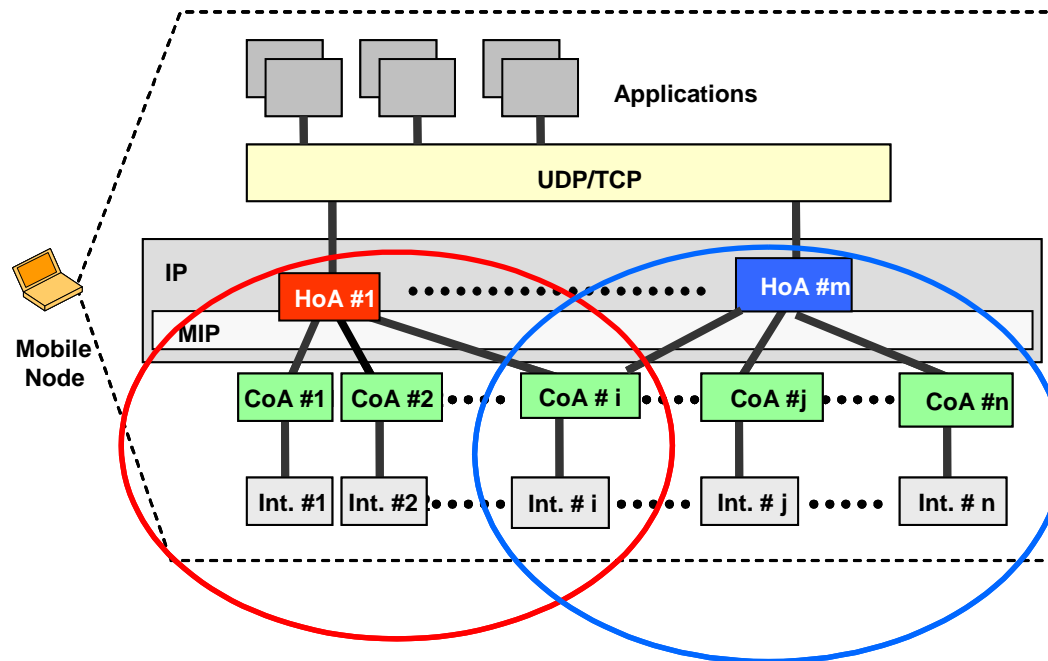


# Mixed approach



## Merging of the two previous proposed solutions:

- Multiple interfaces with similar characteristics can be grouped under the same HoA
- Different interfaces can be linked to different HoAs
- Groups can overlap





# Daidalos' proposed solution : **Single HoA and Multiple CoAs**





# View on solution

## ✓ **Requirements**

- MN with several physical interfaces connected to an IPv6 network
- At least one IPv6 address configured on each interface
- MN has only one HoA and only one HA

## ✓ **Benefit for Mobile Node**

- Efficient usage of network bandwidth (load balancing)
- Intelligent Interface Selection: best interface per application/service

## ✓ **Benefit for the Network**

- Selection of the most suitable network path





# View on solution

## ✓ **Objective**

- development of solutions to allow the mobile node to use multiple access networks at the same time

## ✓ **Approach**

- extension of Mobile IPv6 nodes and Home Agents to support registration of multiple Care-of Addresses

## ✓ **Daidalos aims at**

- defining a solution
- developing a prototype based on MIPL 2.0 (new code in HA and MN modules)





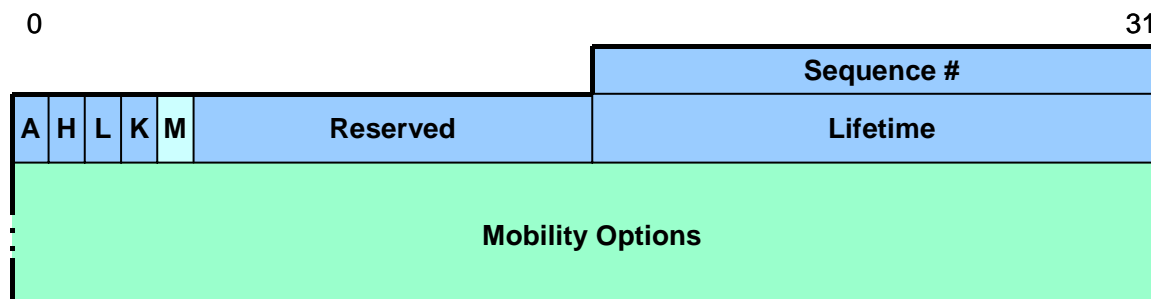
# Required enhancement to MIPv6

- To modify the Binding Update (BU) message
- To define a New Mobility Option called Binding Identifier (BID)
- To modify the Binding Cache in the Home Agent
- To modify the (Multiple) registration procedure
- To define a New De-registration procedure (cross de-registration)





# Binding Update message



- Insertion of a new flag M used to communicate to the HA if the MN supports multiple registration





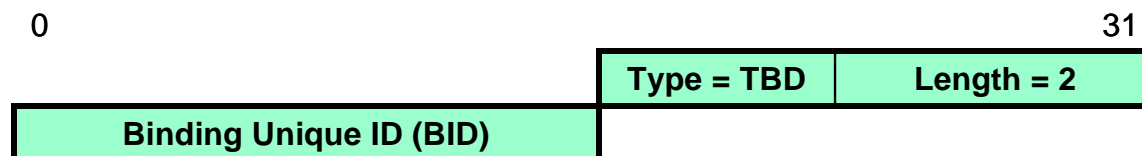
# Binding Identifier (BID) option

- Used to identify univocally the interface of the MN from which a Binding Management message is originated
- the BID sub-option is inserted in all binding management messages
- The value of this option creates the mapping between the originating interface and the related Binding Cache entry in the HA





# Binding Identifier (BID) (cont'd)



**Type** (8 bit): identifies the option type. The values are still to be defined

**Length** (8 bit): length of the BID sub-option; it includes the Length and BID fields (the first byte (Type field) is excluded)

**Binding unique Identifier (BID)** (16 bit): identifies an interface of the MN. The possible values are [1, 2<sup>16</sup>-1]





# Binding Cache (BC)

The BC needs to be modified to permit the MN to register more than one interface in the Home Agent:

BID	HOA	COA	Lifetime	flag	Sequence #	Notes
bid1	HoA <sub>1</sub>	CoA <sub>1</sub>	10	H=1	Seq <sub>1</sub>	...
bid2	HoA <sub>1</sub>	CoA <sub>2</sub>	20	H=1	Seq <sub>2</sub>	...
bid1	HoA <sub>2</sub>	CoA <sub>1</sub>	10	H=1	Seq <sub>1</sub>	...





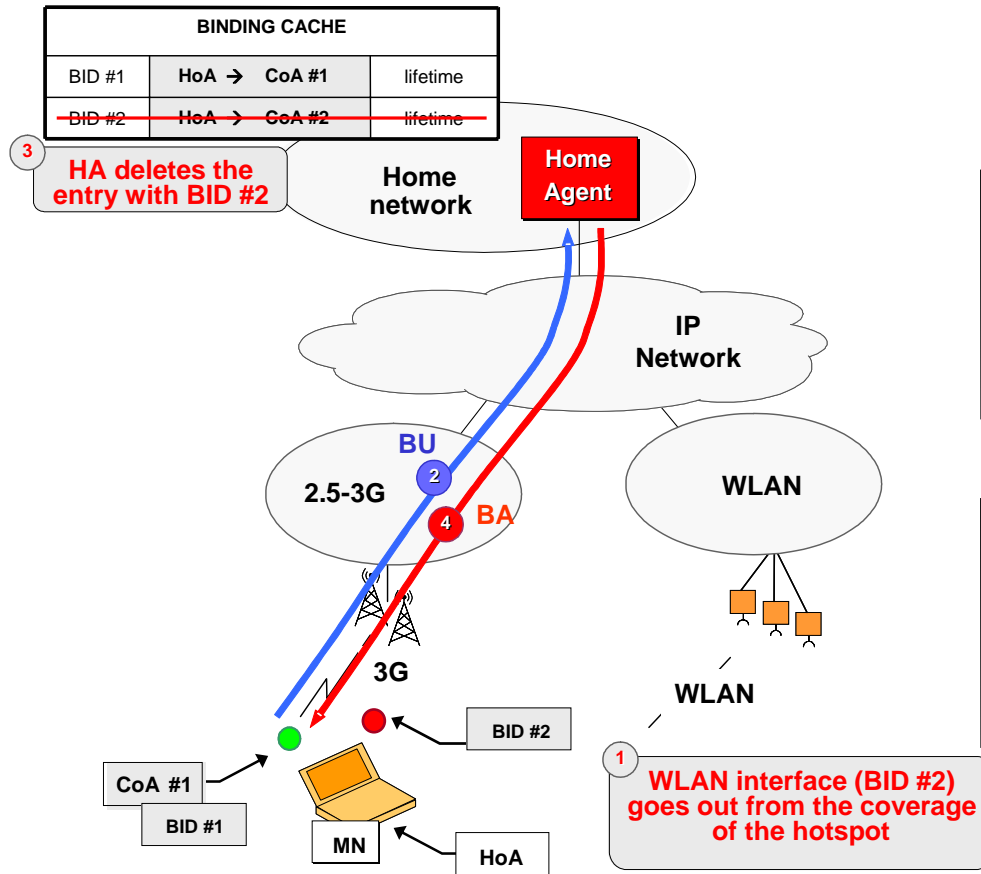


# Cross De-registration

- One interface is no more reachable (turned off, out of coverage)
- The MN sends a Binding Update message to the HA through one of the other active interfaces in order to de-register the interface that is no more reachable
  - The BU message contains the BID of the interface that has to be de-registered
- The HA replies with a Binding Acknowledge message
  - The BA message contains the BID of the interface just de-registered



# Cross De-registration (cont'd)



## BU

Source address	CoA #1
Destination address	HA
Home Address Destination Opt.	HoA
Lifetime	0
Bid Sub Option	BID #2

## BA

Source address	HA
Destination address	CoA #1
Home Address Destination Opt.	HoA
Lifetime	0
Bid Sub Option	BID #2





# Load Balancing





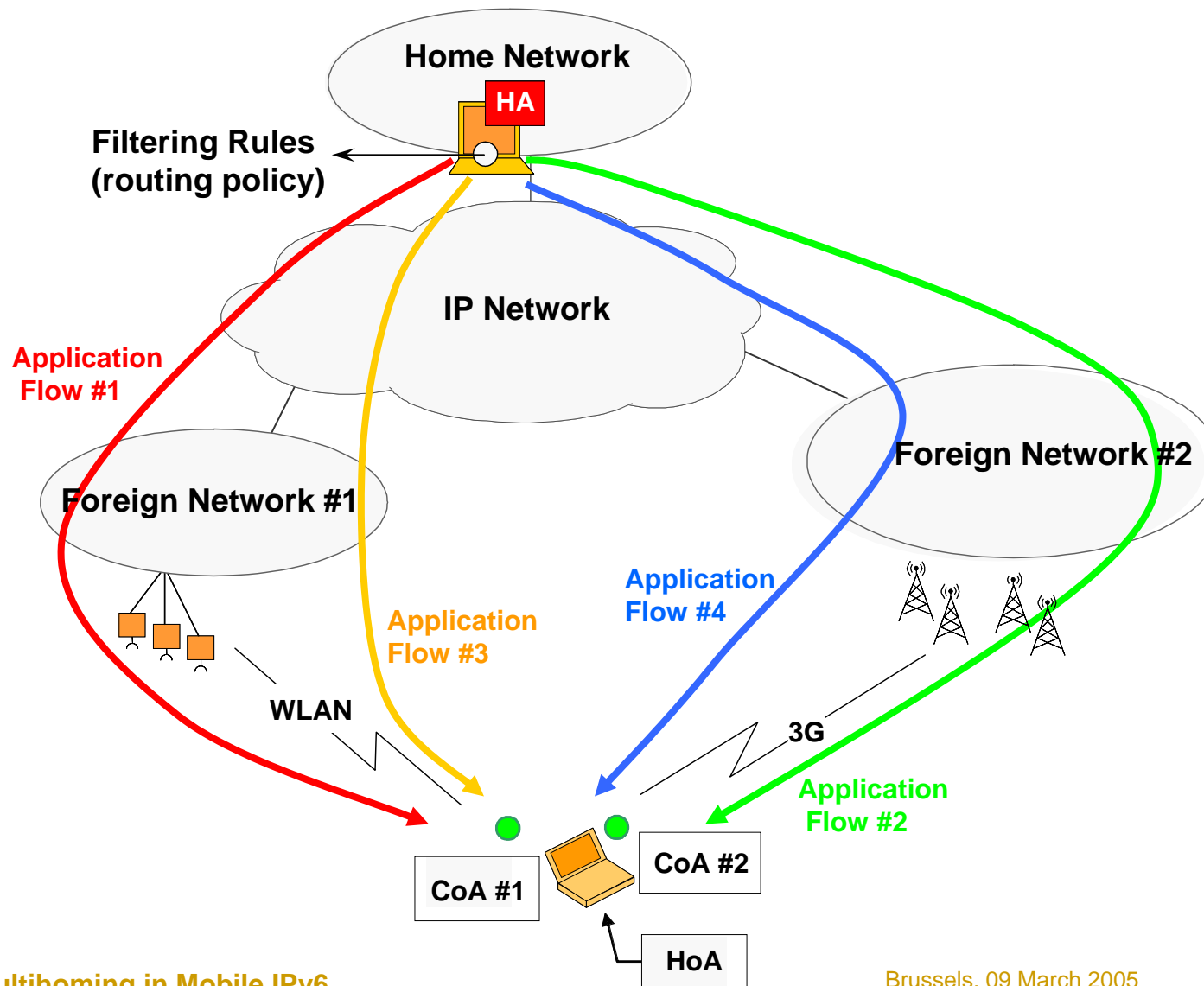
# Load Balancing mechanism

- Only for **Bidirectional Tunnelling (BT)** traffic
- Used to balance the traffic on the different active interfaces on a MN
- Based on the number of application sessions (the number of active communications is equally distributed on the different active interfaces)
- **Need of filtering rules in the Home Agent** to forward the data packets to the right interface. Based on:
  - ✓ IP source address
  - ✓ IP destination address
  - ✓ Source port
  - ✓ Destination port





# Load Balancing (cont'd)



# Load Balancing (cont'd)

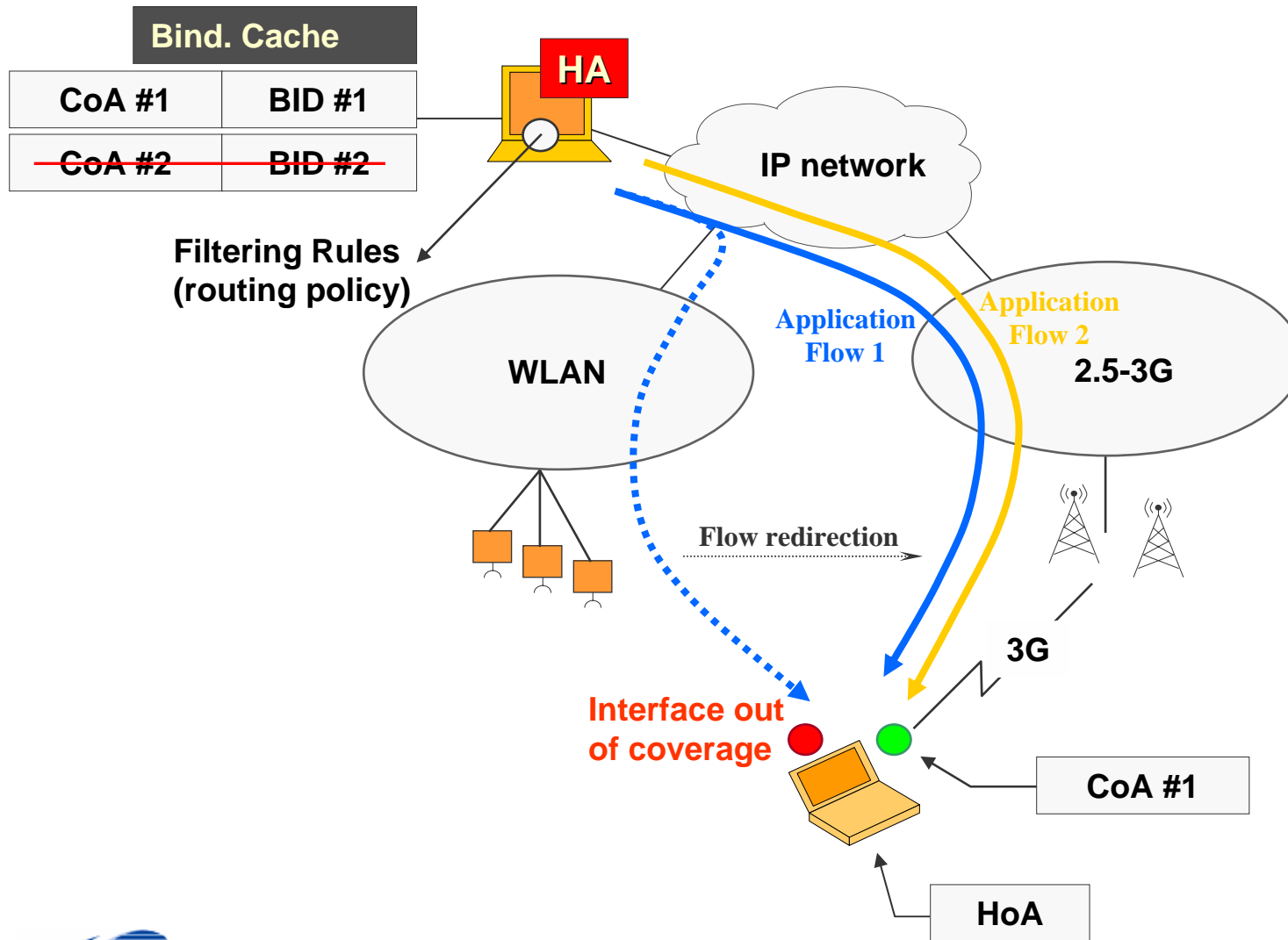


- **Dynamic reconfiguration of data flow distribution:**
  - Out of coverage of an interface (back-up interface feature)
  - Entering into coverage area of a new access network
  - Turn on/off of a new interface
  - Return to home network (standard de-registration procedure)





# Load Balancing (cont'd)





# Software Implementation

- **Based on MIPL 2.0**
- **Modifications to HA module**
- **Modifications to MN module**
- **To be integrated in the Daidalos project architecture**





# Future steps

## ✓ ***To enhance MCoA solution***

- **Multiple HoA support**
- **To merge the two different approaches**
- **To enhance the load balancing mechanism: new filtering rules**

## ✓ ***Integration with other Daidalos modules***

- **Intelligent Interface Selection**
- **Handover procedures (e.g. Fast HO, Duplicate&Merging)**
- **QoS framework**
- **.....**

## ✓ ***Full integration in Daidalos architecture***

