batman-adv: distributed handling of non-mesh clients in a layer 2 mesh

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B.A.T.M.A.N.-Advanced
www.open-mesh.org

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Overview

- How the clients get into the mesh
- Locating non-mesh clients - old mechanism
- Locating non-mesh clients - improving the mechanism

Where the mesh begins

Mesh participants:

- mesh nodes
- non-mesh clients

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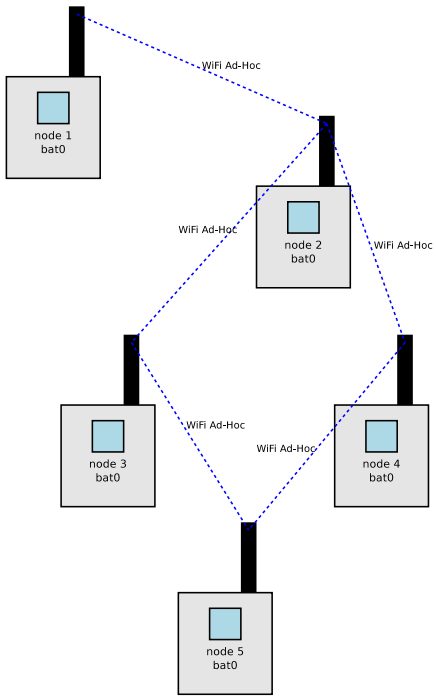

Single interface setup

- give control of the interface to B.A.T.M.A.N.-Adv
- B.A.T.M.A.N.-Adv creates “an access to the mesh” interface (bat0)

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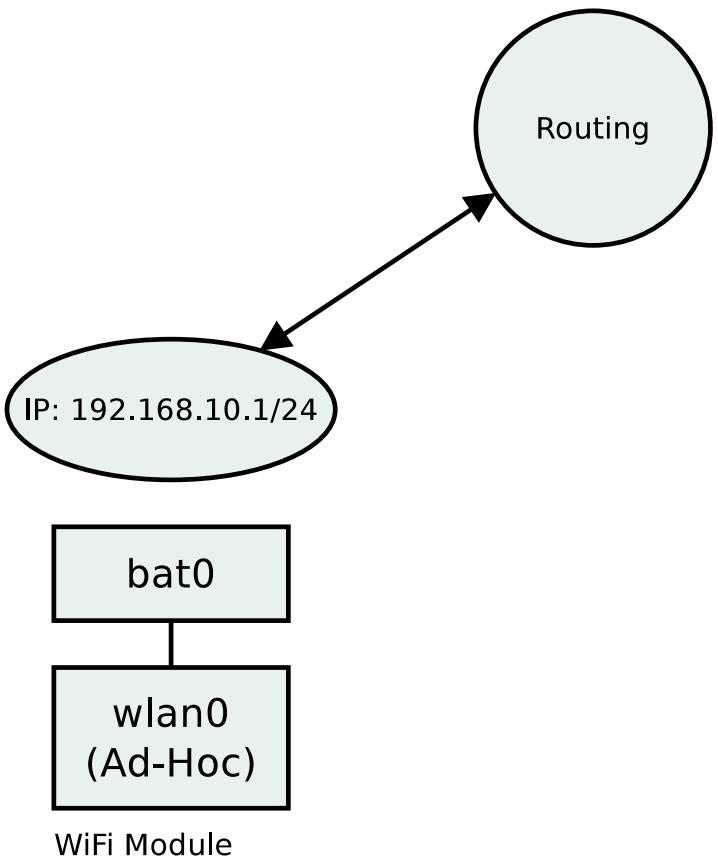
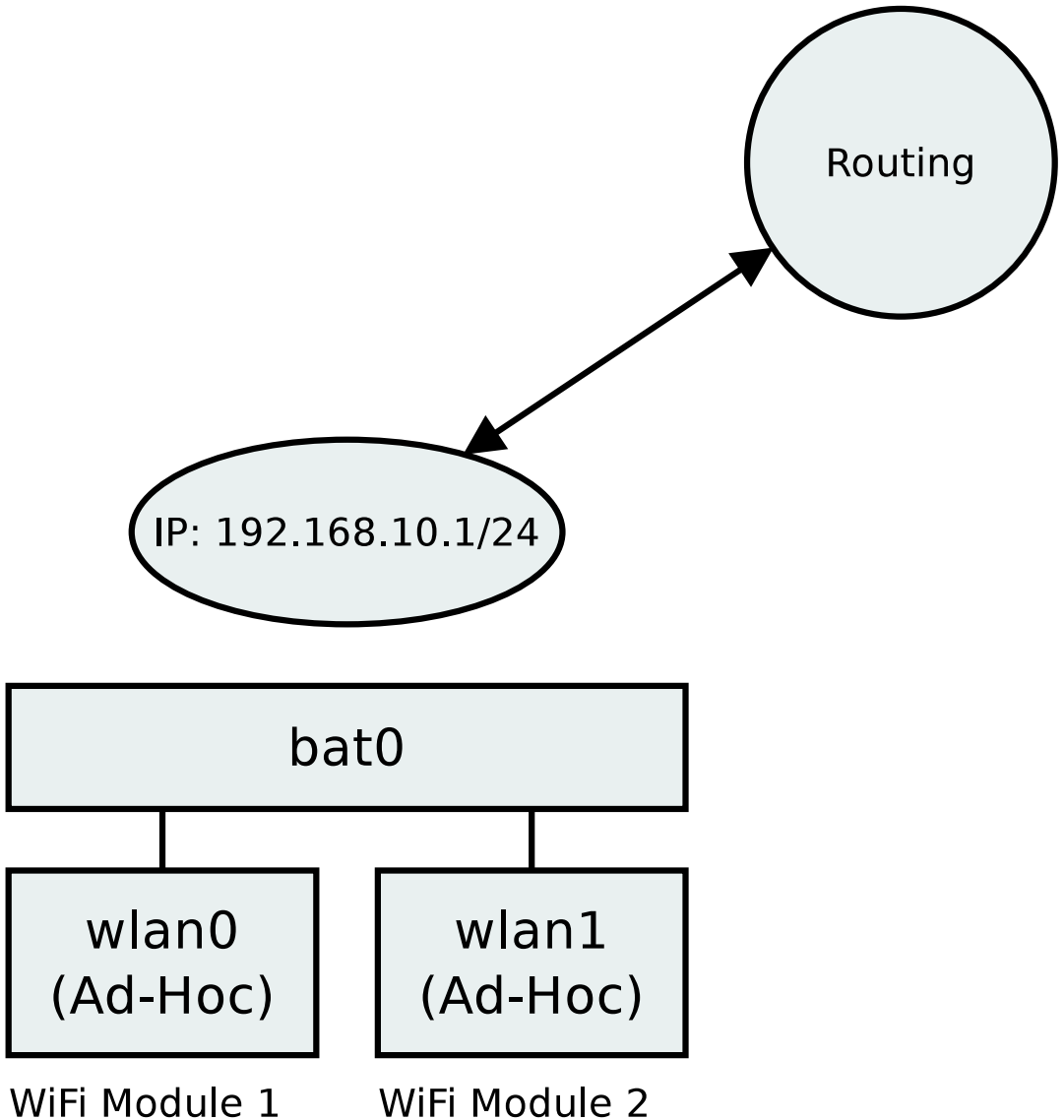
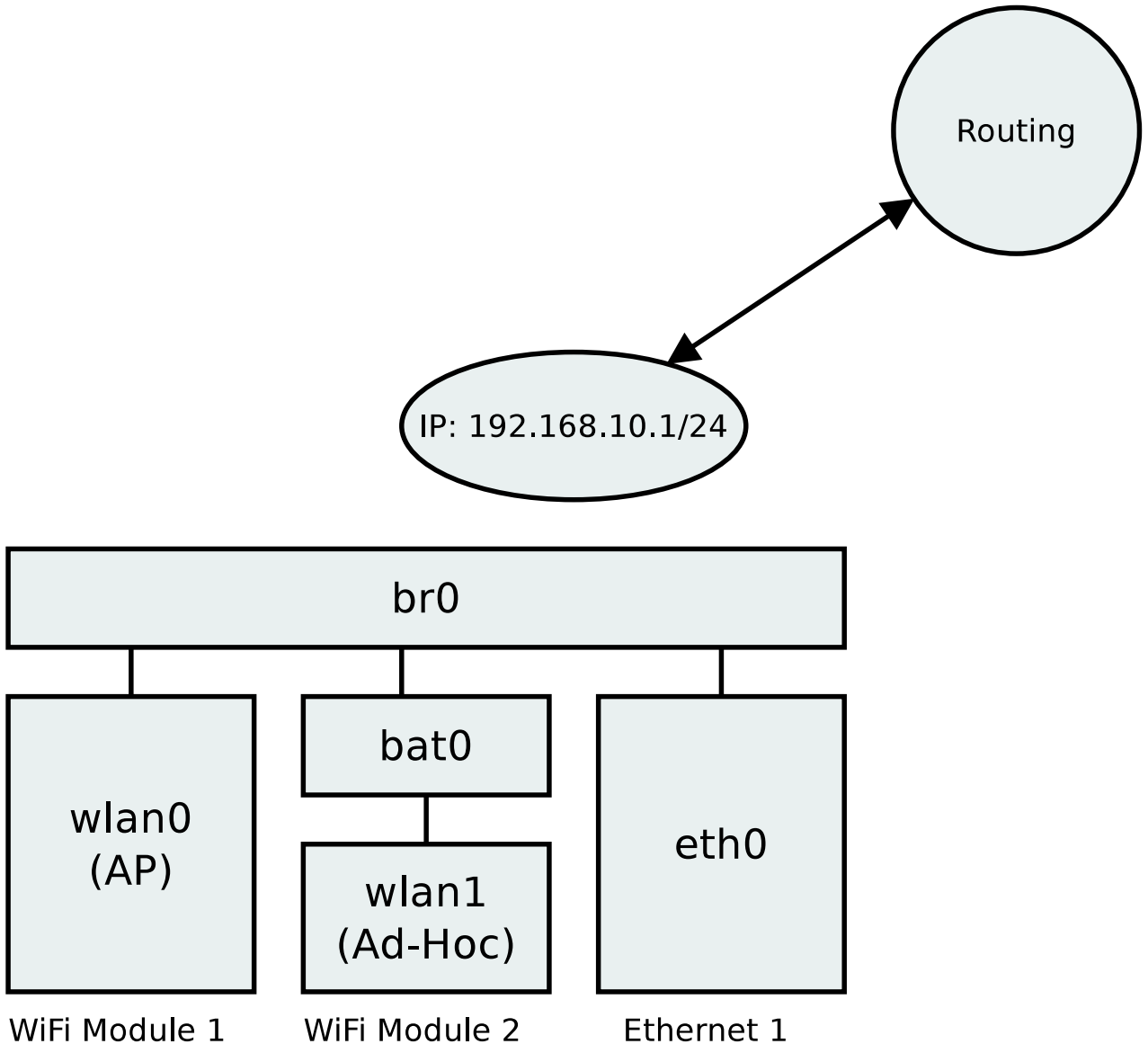


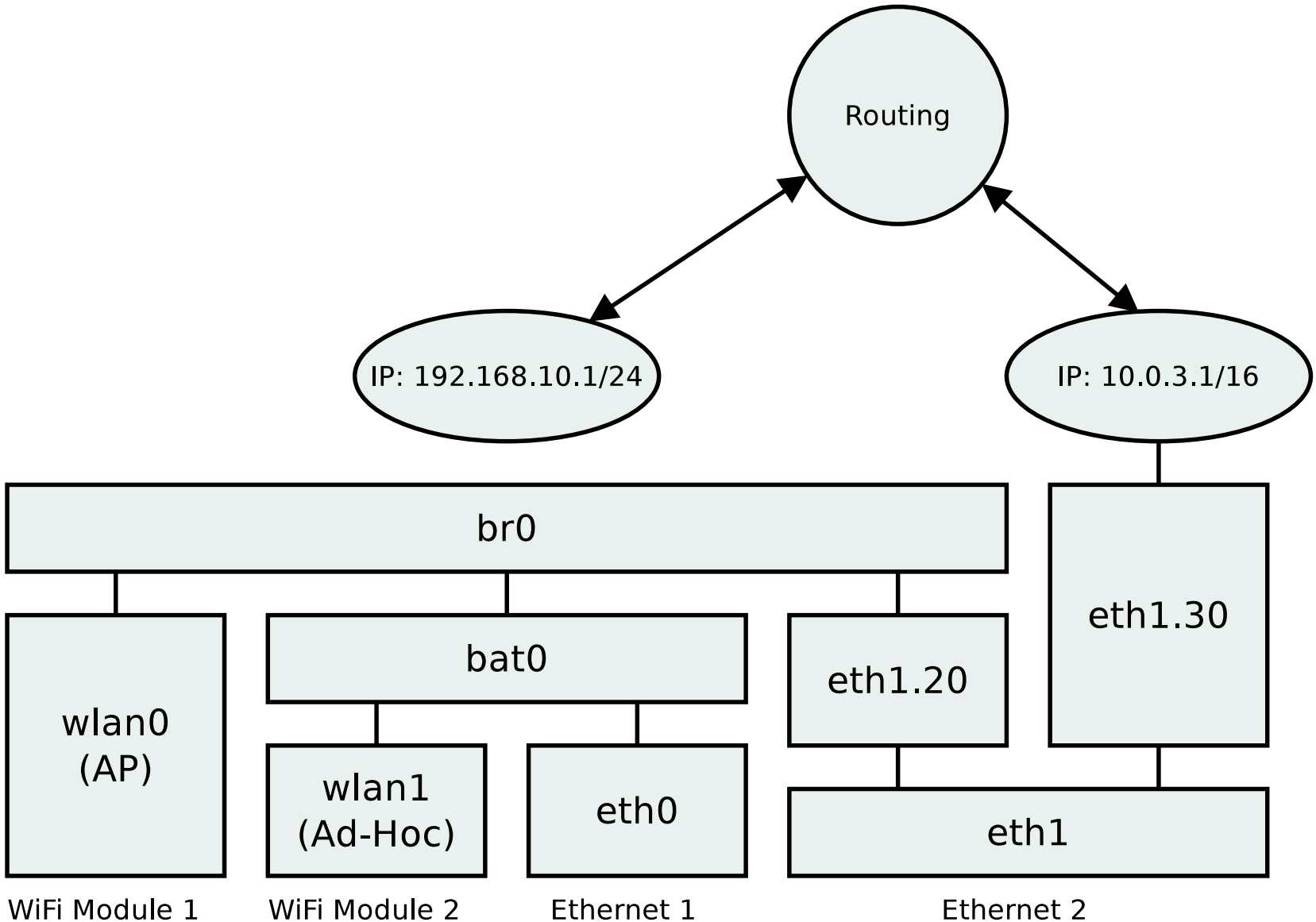
Multi-interface setup



Bridging


Routing
IP: 192.168.10.1/24
br0
wlan0
(AP)
bat0
wlan1
(Ad-Hoc)
eth0
WiFi Module 1
WiFi Module 2
Ethernet 1

Make your live harder



Locating non-mesh clients - old mechanism

Local Translation Table:

- Stores the MAC address of each of the clients "bridged" with the local B.A.T.M.A.N. soft-interface
- A client is added when its first packet goes through the soft-interface

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Global Translation Table:

- Stores the addresses of clients announced by other nodes in the network
- For each client it keeps the originator announcing it

Syncing the global table - old mechanism

- Each node attaches its local translation table to its own OGMs
- Nodes receiving the messages extract the table and store it by overwriting the previous one

Pros and cons

Pros:

- very simple
- it works!

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- it works!

Cons:

- overhead (OGM size)
- roaming works, but leaves room for improvement
- not extensible

New mechanism

- We discussed the topic (non-mesh clients) at WBMv3 (in Rome)
- A couple of weeks later it was decided to start a research project with the University of Trento (Italy) in order to develop a new mechanism
- The project aimed to produce a theoretical basis on top of which we developed a working implementation
- After several review cycles the code has been merged and released

Local translation table versioning

We introduced a new concept: **the versioning**

Each node:

- has a number associated to its local table that identifies its "version": the **Translation Table Version Number (TTVN)**
- increases its TTVN by 1 each time changes happened on its local translation table within the last originator interval
- floods the network with its TTVN (within the OGMs)

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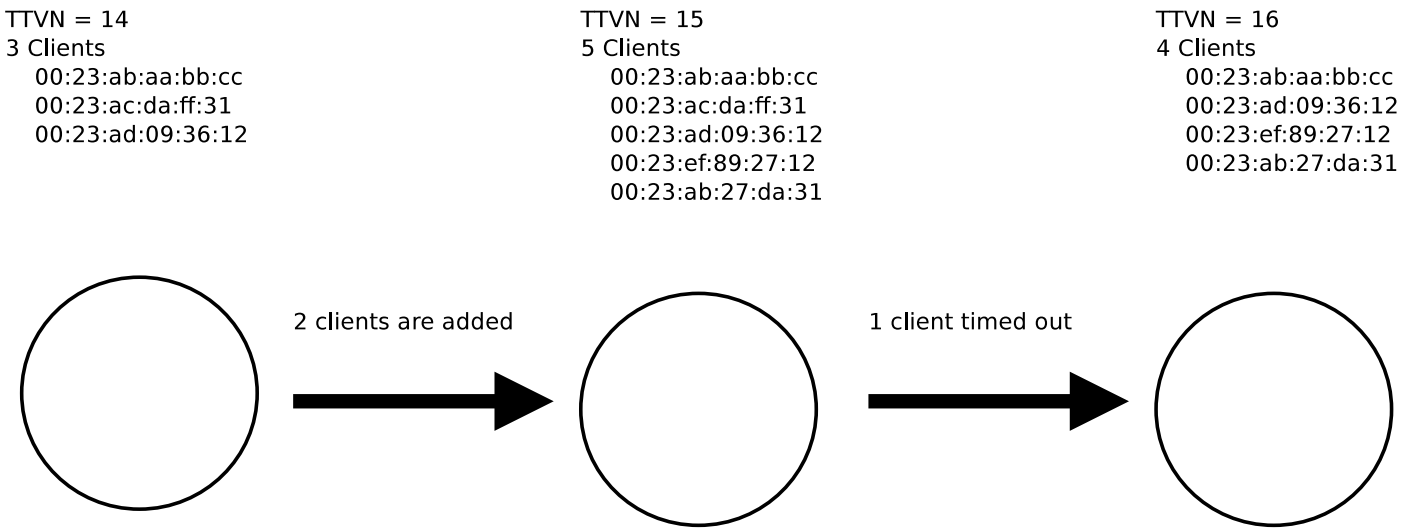

Local table updates exchange

Given the versioning concept it is now possible to exchange **changes** only instead of the whole local translation table.

Therefore, each time a change (or more) happens, the next OGM will be in charge of carrying **the TTVN increased by one 1** and the set of changes that brought to this new version.

- With this information, nodes can so easily update their Global Translation Table accordingly

Inconsistency detection

Of course, something can go wrong. . .

1. OGMs can get lost
2. wrong updates can get in

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Inconsistency can be detected by:

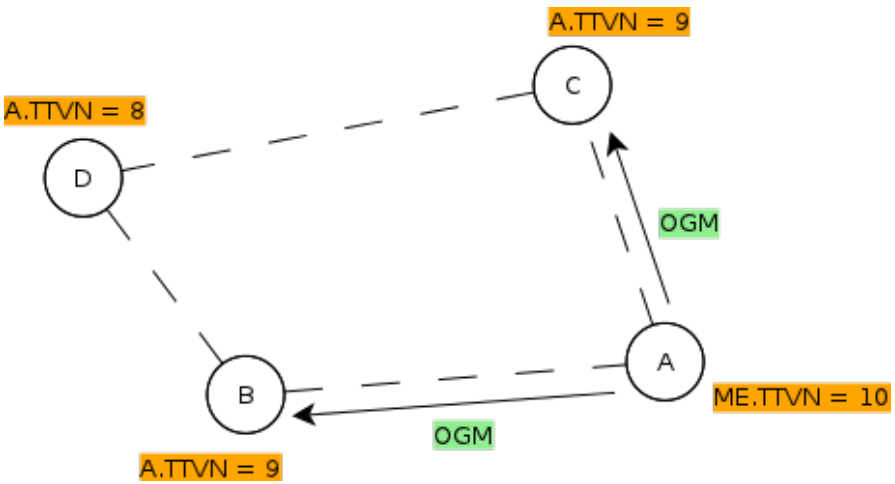
1. receiving an unexpected TTVN within an OGM
2. computing a CRC that doesn't match the one received within the OGM

Table recovery: TT Request / Response

A node can recover its global table state by means of the **TT Request/Response** messages

- It is possible to recover the last changes set only or the full table

An example



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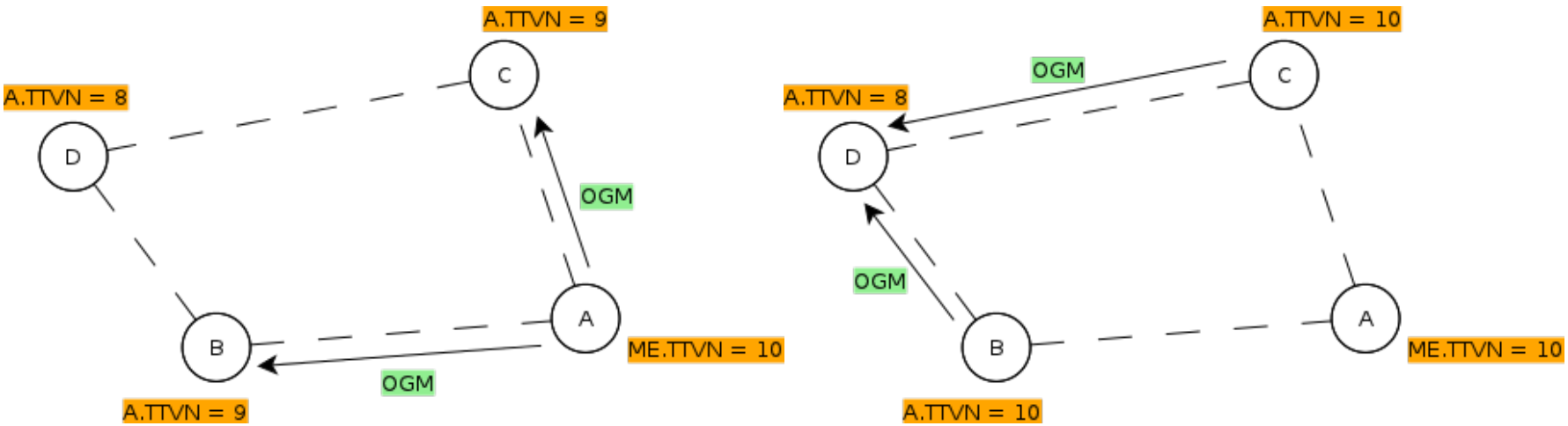
A.TTVN = 9
C
A.TTVN = 8
D
OGM
A
B
ME.TTVN = 10
OGM
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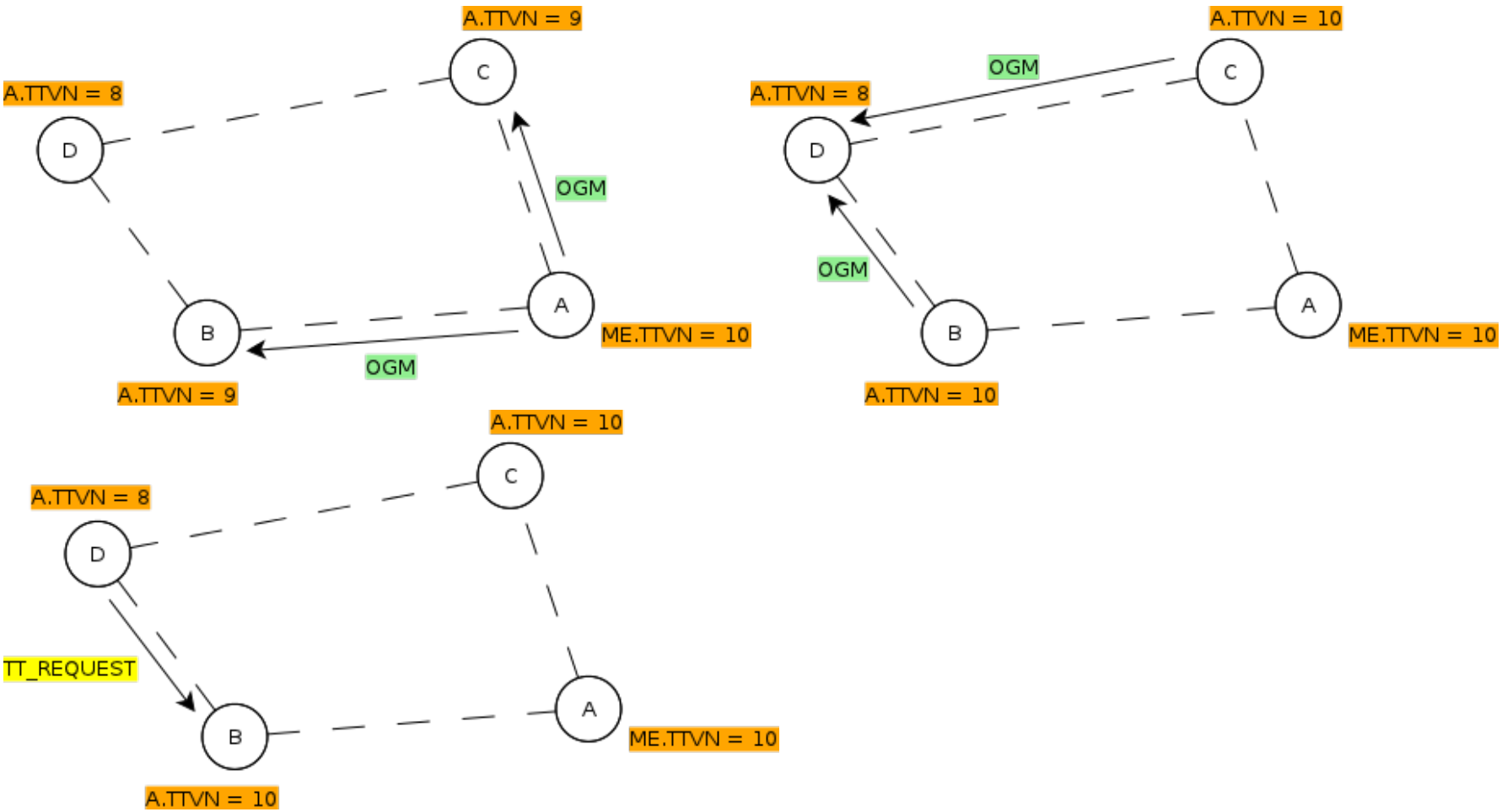
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TT_REQUEST
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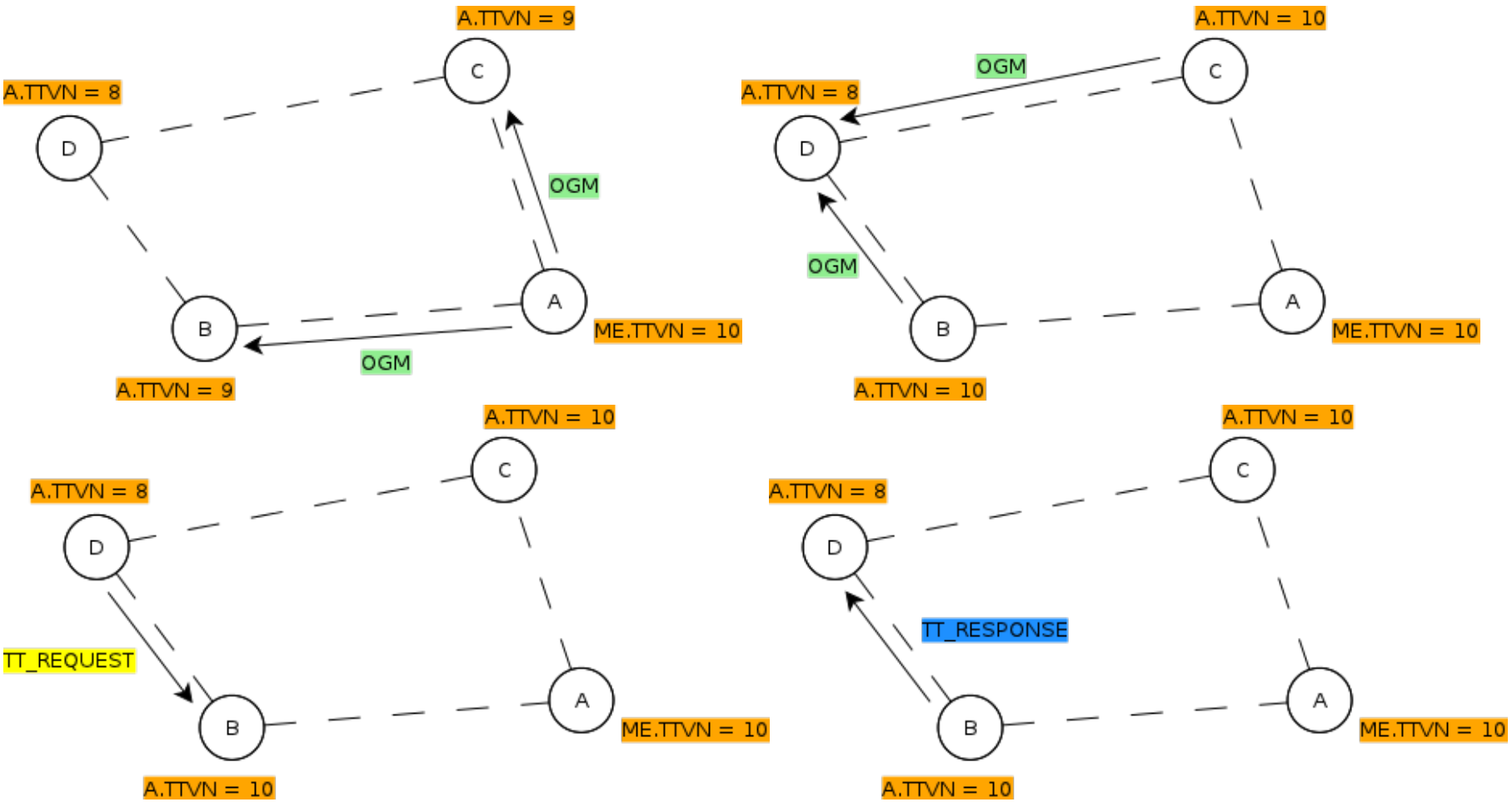
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C
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D
TT_REQUEST
A
B
ME.TTVN = 10
A.TTVN = 10
A.TTVN = 10
C
A.TTVN = 8
D
TT_RESPONSE
A
B
ME.TTVN = 10
A.TTVN = 10

Benefits

- Reduced overhead
  - OGM are smaller
  - Local recovery mode
  - Updating the network only when needed
  - Support for very large LANs
- Extensible: we have a new framework on top of which we can build new (cool!) features

New features

Something we have already developed:

- AP-Isolation
- Seamless Roaming

Scenario: batman-adv is a layer2 routing protocol. Our use case is a mesh network where each node acts either as node and as bridge to allow mesh un-aware clients to get connected

AP-Isolation

Objective:

- Distributed AP-Isolation feature
- If enabled, different WiFi clients, connected to different mesh nodes should not be able to communicate

How:

- Thanks to the new mechanism, batman-adv nodes can exchange meta information about the clients

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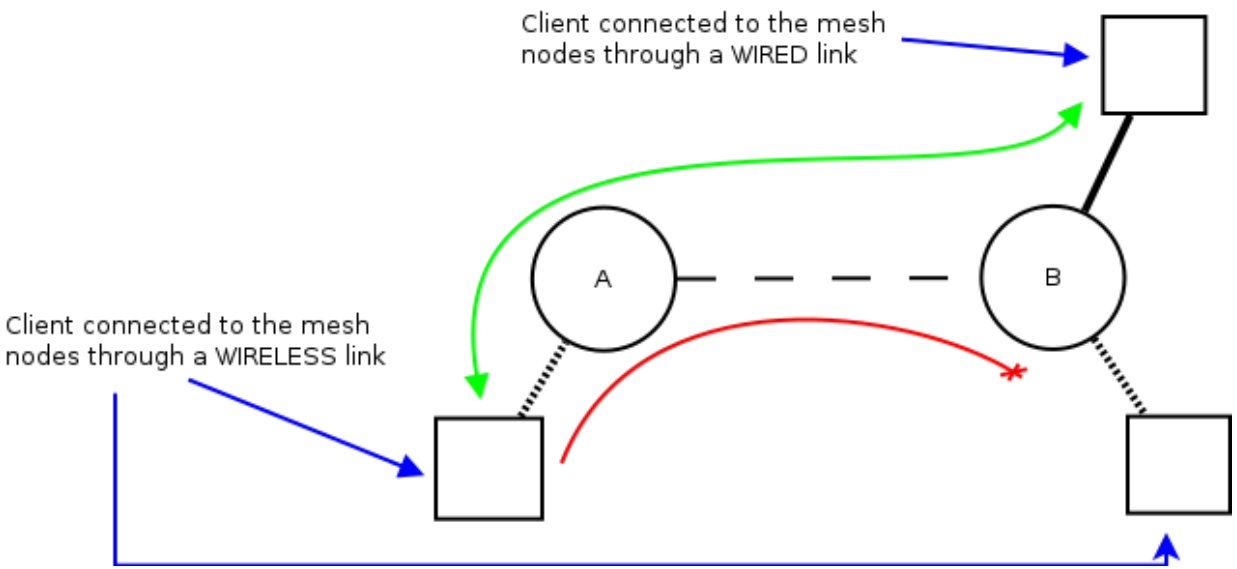

Seamless Roaming

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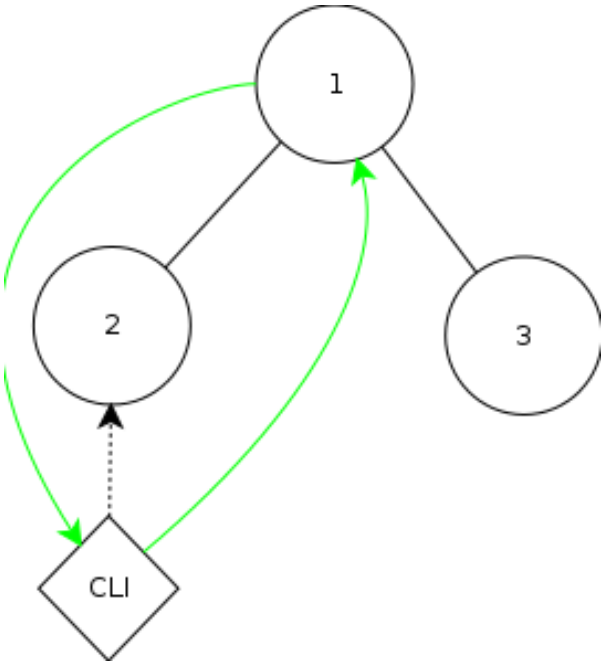

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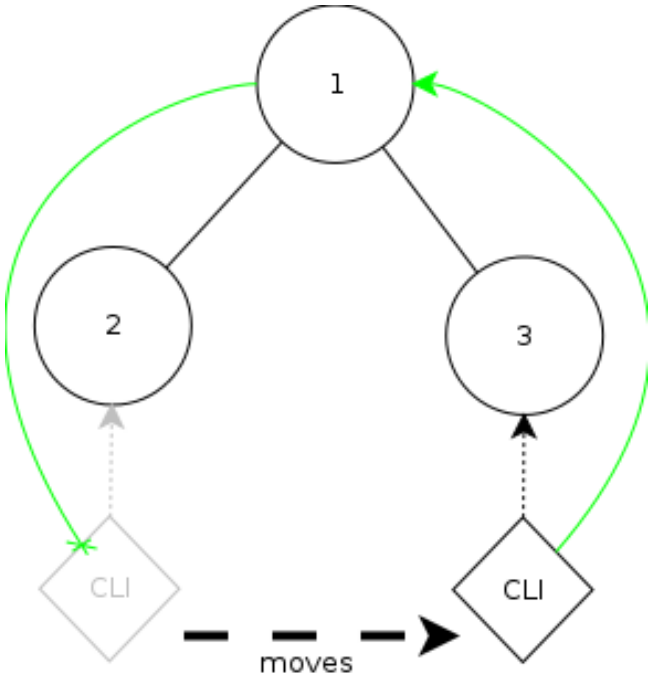

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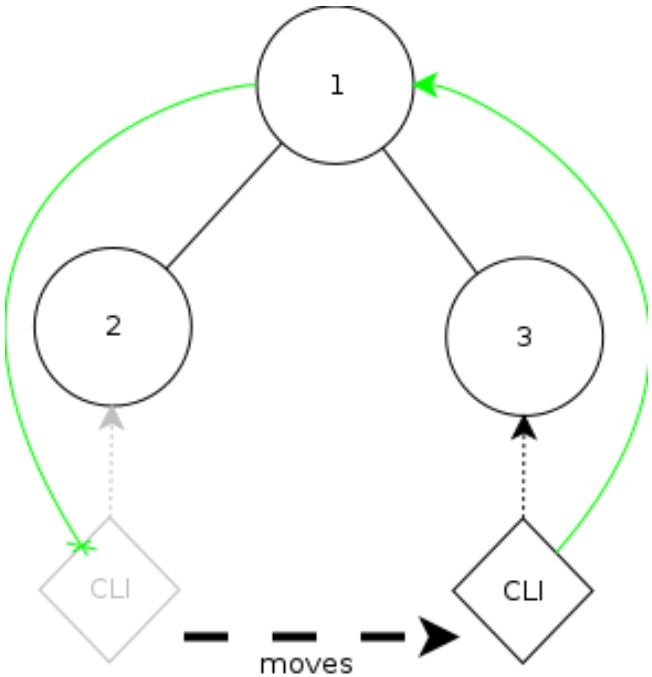


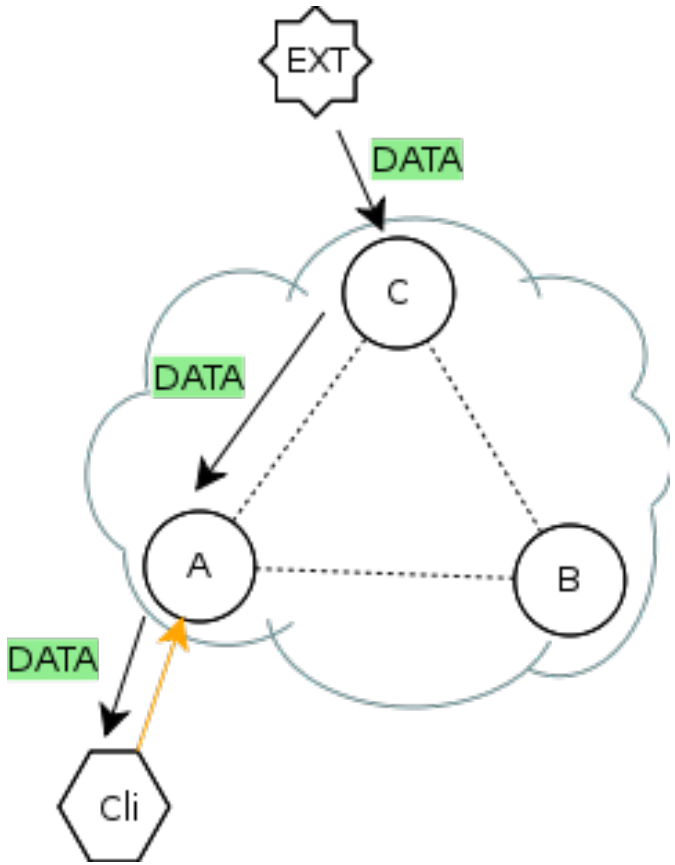
Objective:

- Enable clients to roam and keep connections alive

How:

- The new mechanism provides a way to “inject” a single change

How does it really works? (High level concept)



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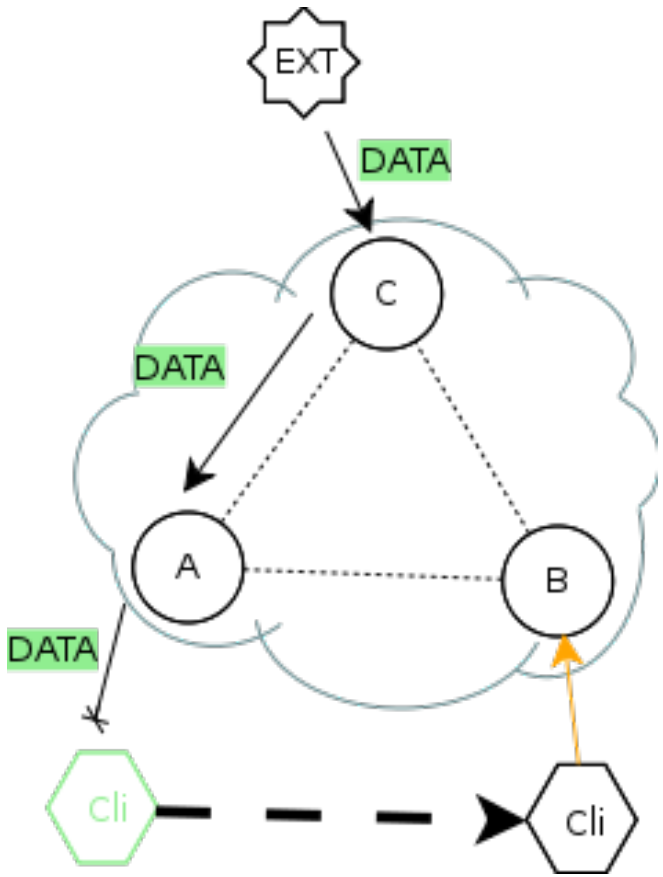

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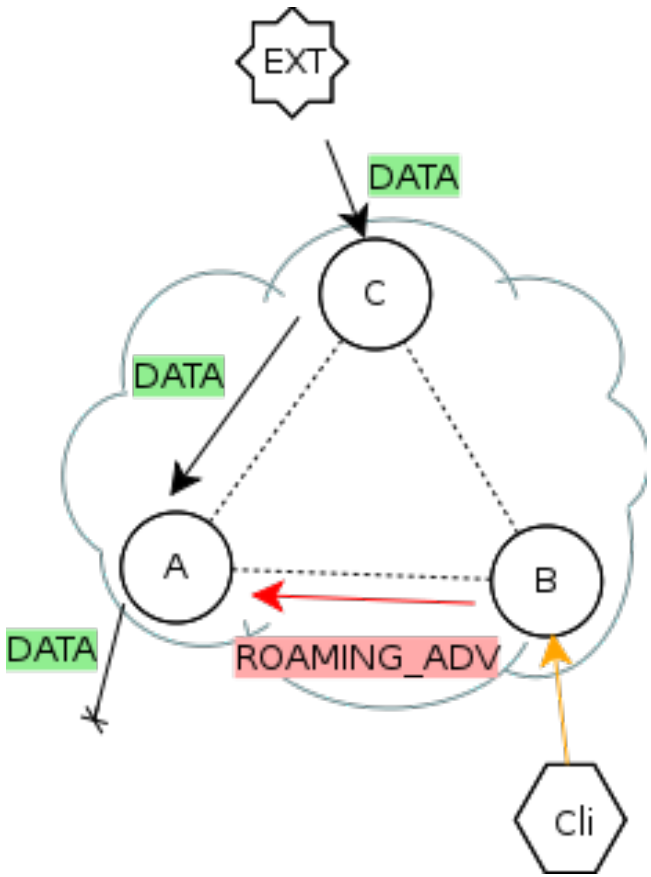

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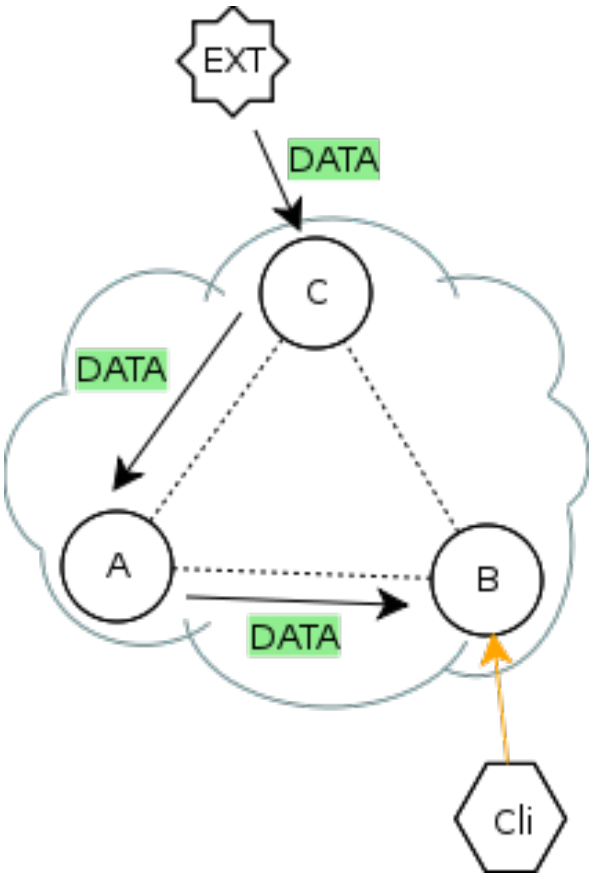

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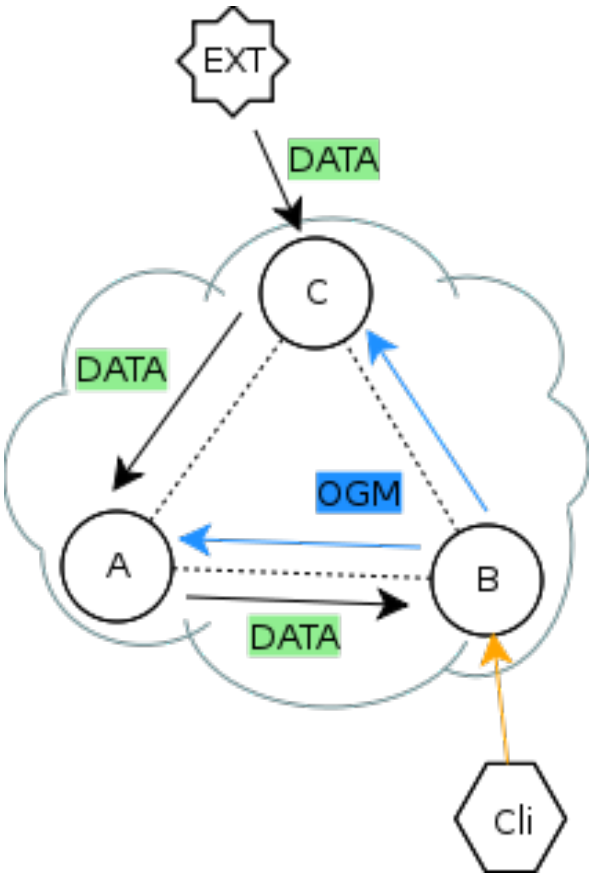

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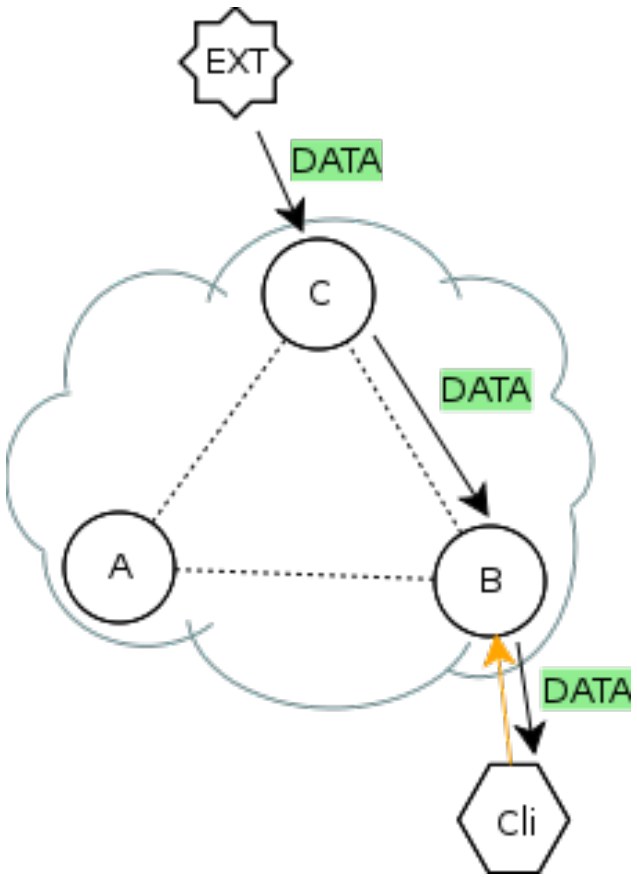
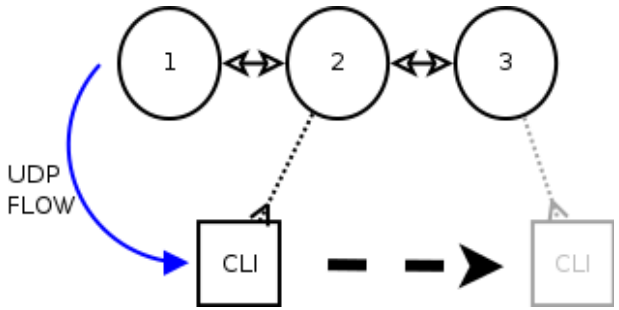


Tests description

Testbed: made up by a bunch of VMs interconnected using vde_switch/wirefilter.
Topology: We chose to recreate a chain topology in order to point out the problems of the old implementation.
Parameters:

- Originator Interval (amount of time between two different OGM sendings): 1sec and 5secs
- OGM loss probability per link: 0% and 25%
- Number of nodes into the chain (we will see why it is interesting): 3 and 10

Short chain - 0% OGM loss prob - 1s orig.int.



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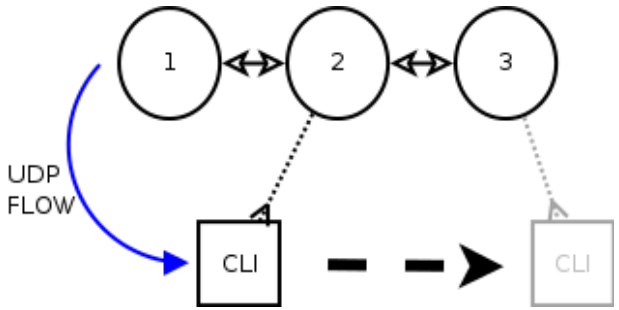

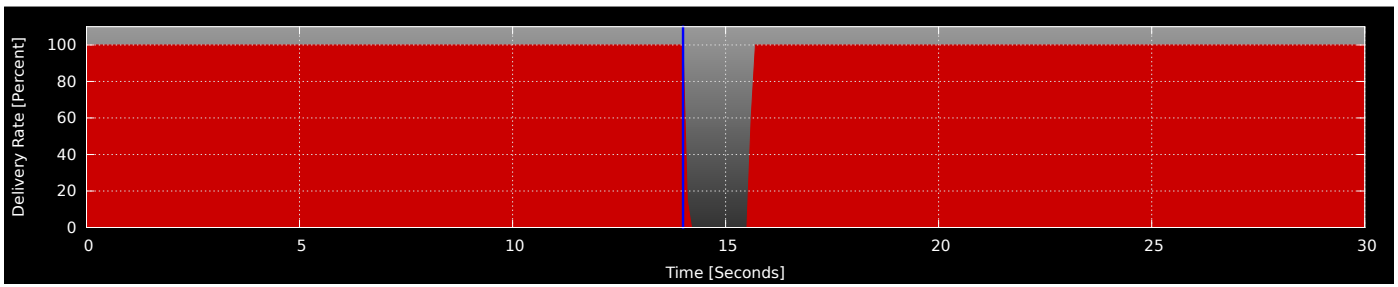

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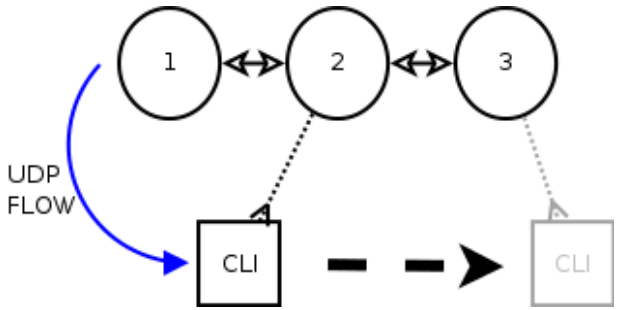
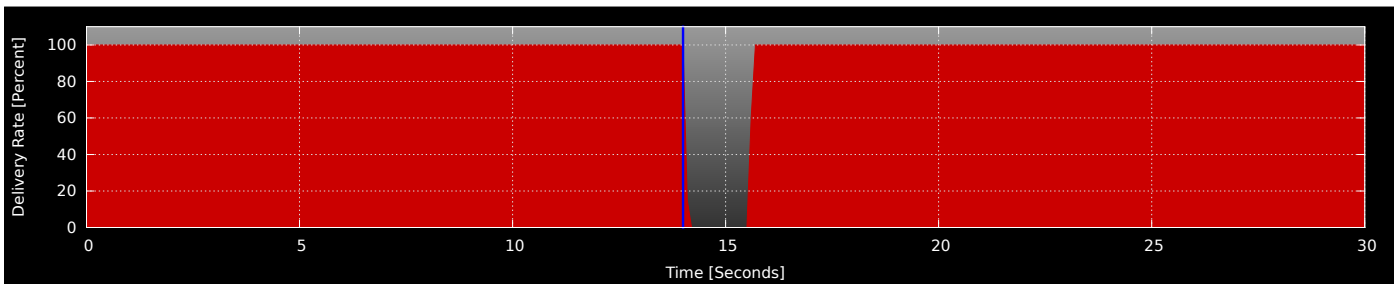
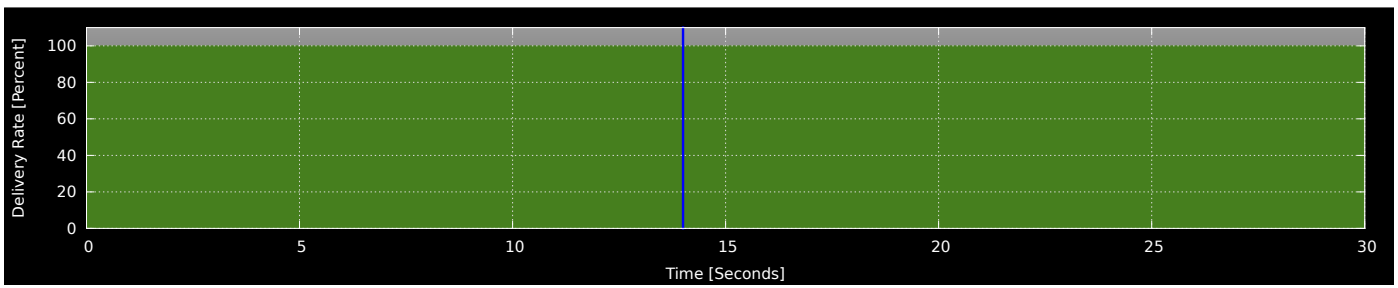
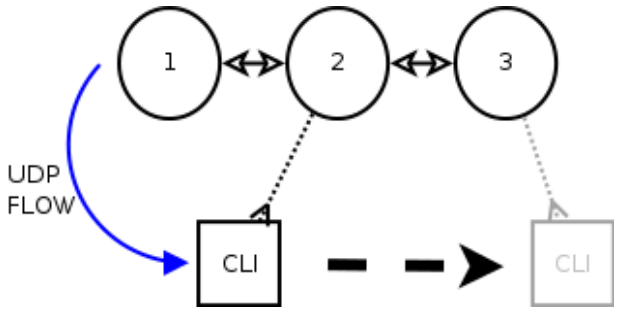






Short chain - 0% OGM loss prob - 5s orig.int.



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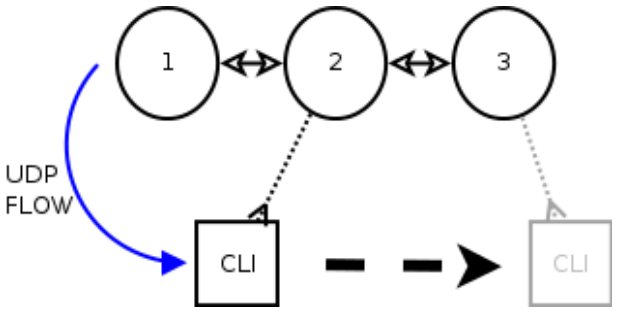

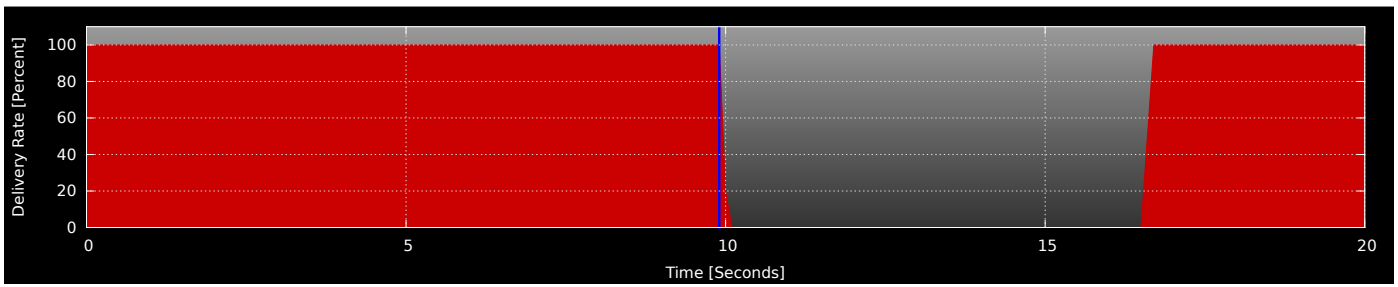

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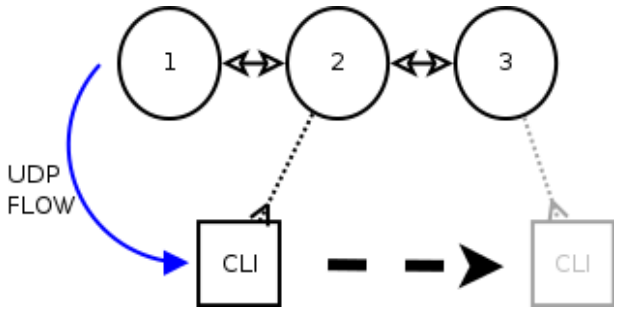

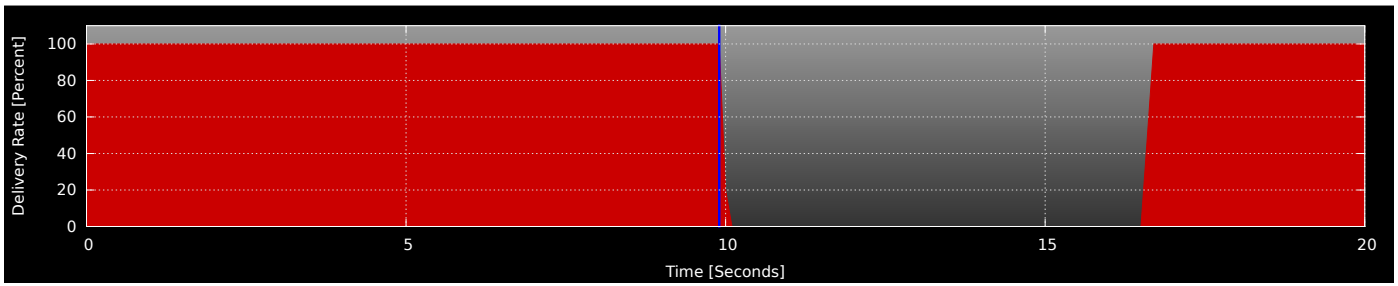

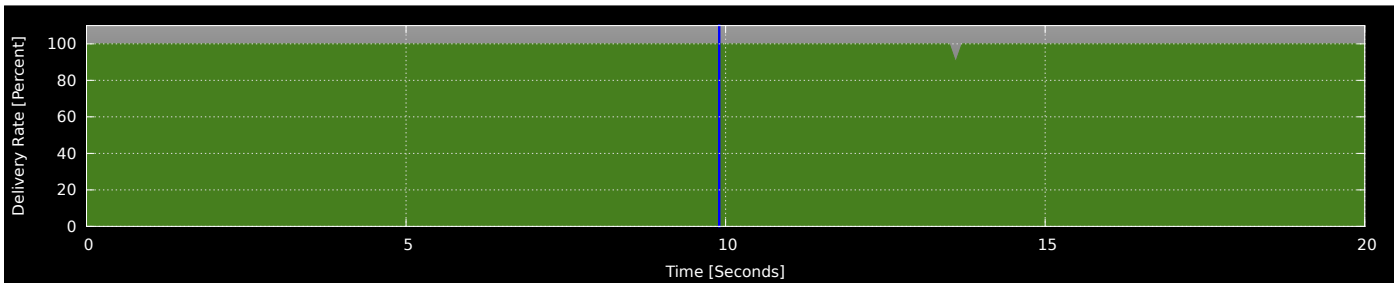

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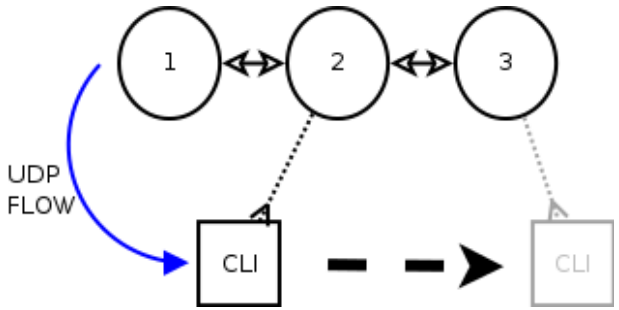

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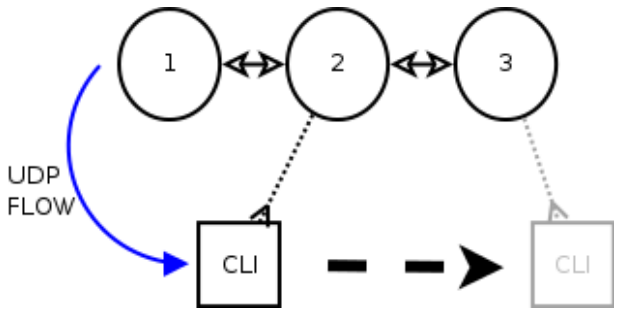

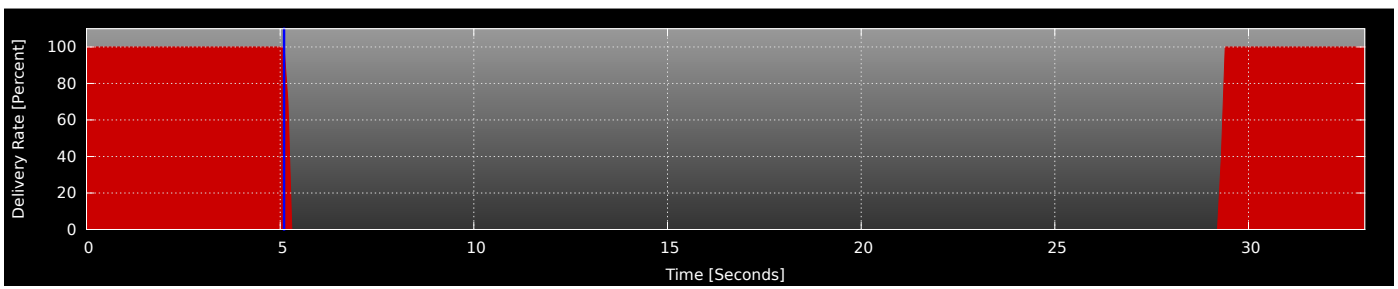

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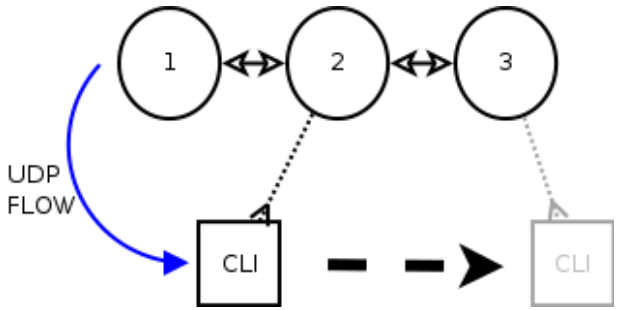

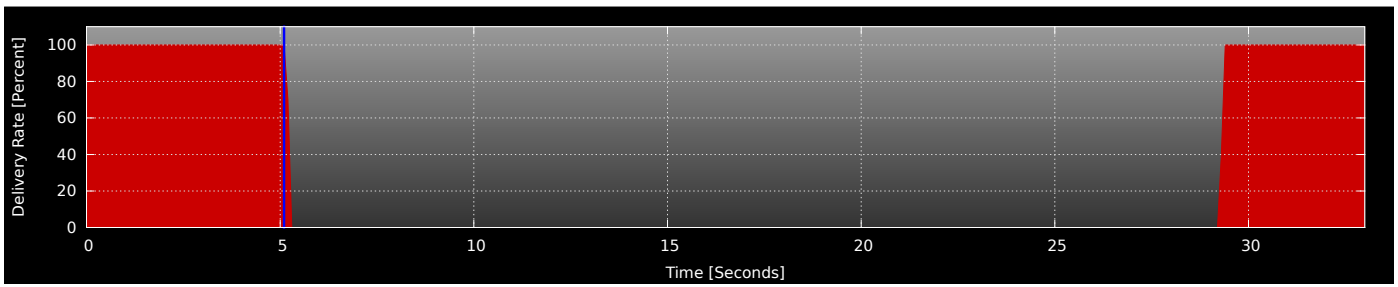

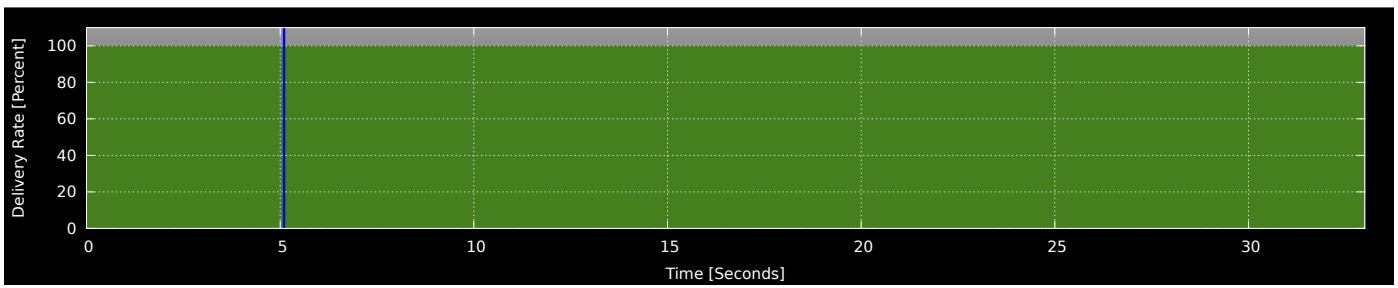

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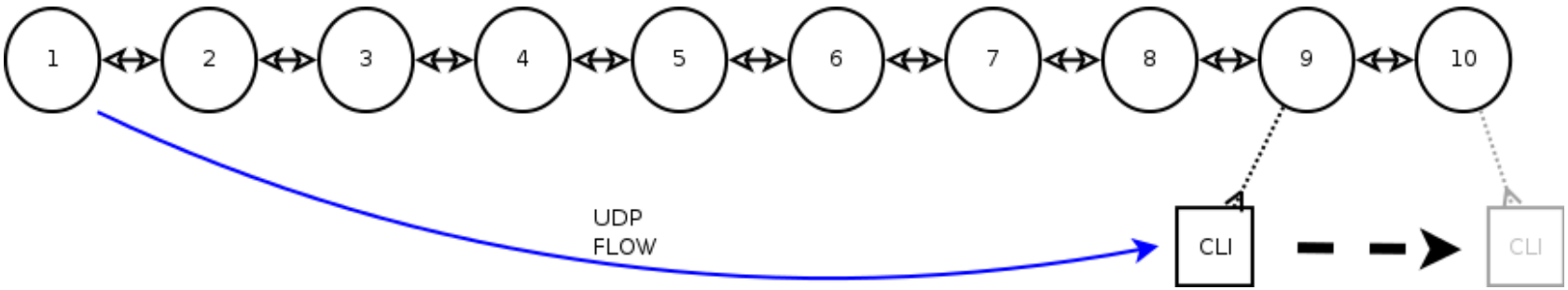

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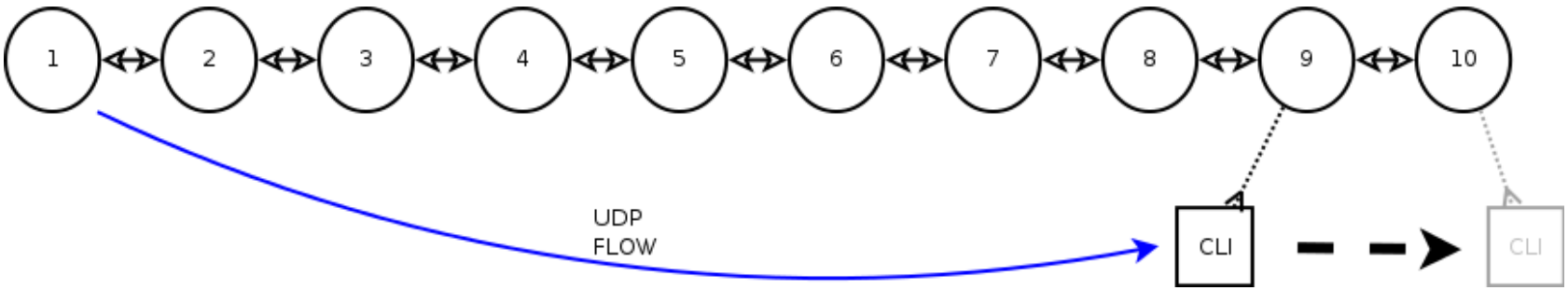

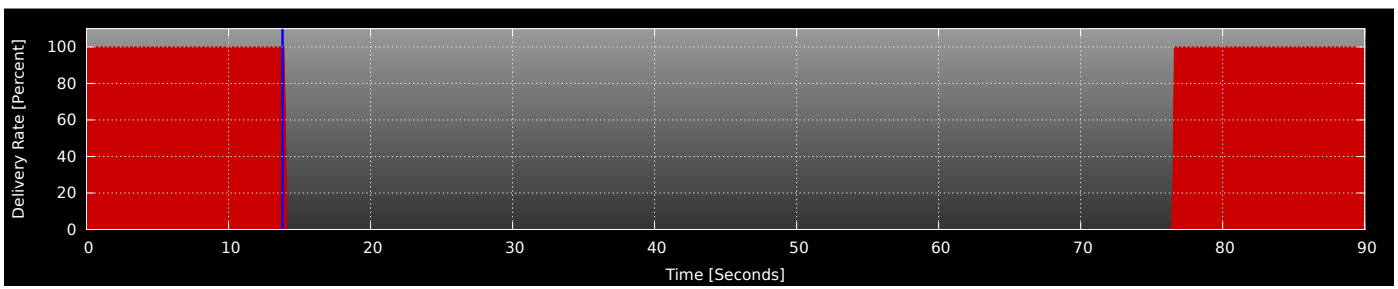

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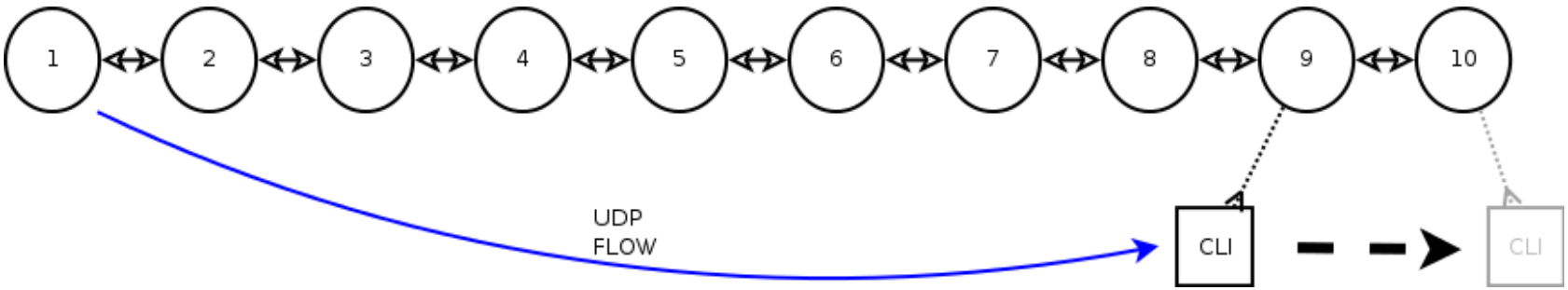

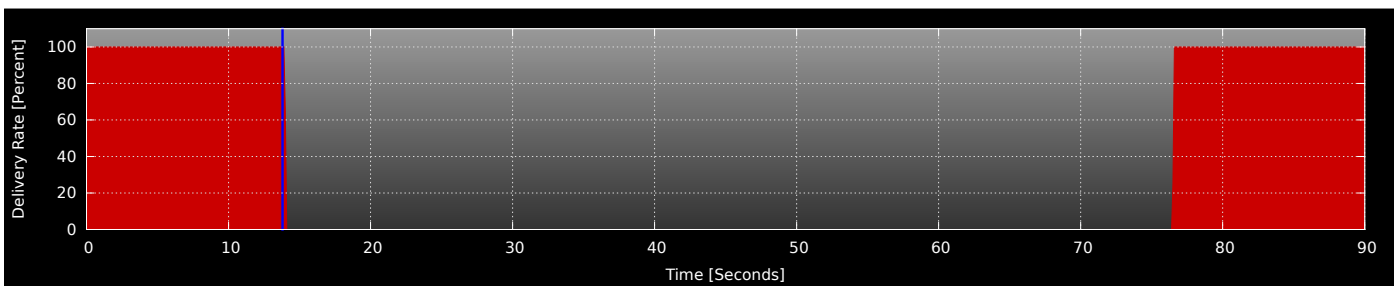

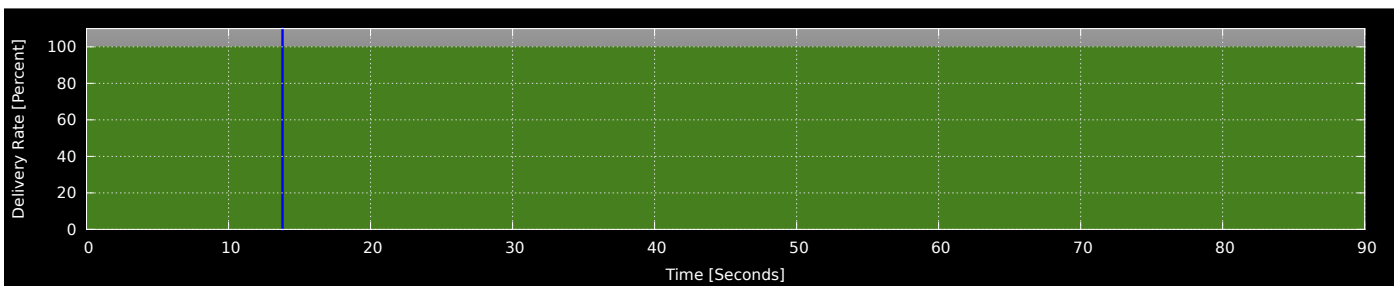

References

The new client handling code and the roaming mechanism code have been written during a one-year **Research Project** at the University of Trento (Italy)

A technical report has been written out and is freely available online (not really updated):
http://eprints.biblio.unitn.it/2269/1/report.pdf

Wiki:
http://www.open-mesh.org

Thank you for your attention

Question?