

IEEE 802.11 and wireless simulations in ns2

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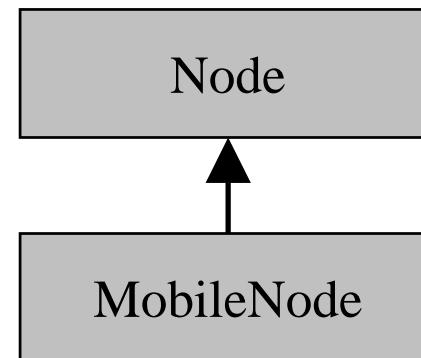
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Contents

- Mobile nodes in ns2
- IEEE 802.11 in ns2
- Wireless simulations in ns2:
 - Mobile IP
 - Hierarchical routing
- Tracing wireless simulations
- Summary

Split nature of mobile nodes in ns2

- Features in C++:
 - Ability to move (periodic position updates)
 - Ability to receive and transmit signals to/from wireless channel
- Features in Otcl:
 - LL
 - MAC
 - Channel
 - ...



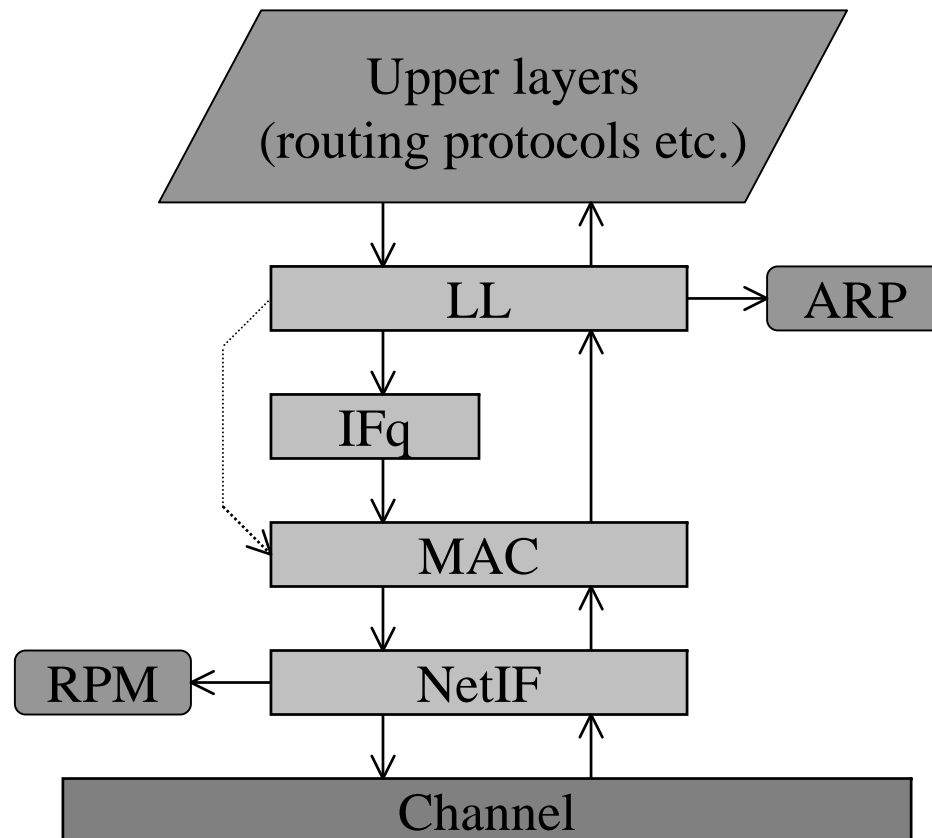
Mobile node implementation in ns2

- C++ files:
 - ~/ns-2.28/common/mobilenode.cc [605 loc]
 - ~/ns-2.28/common/mobilenode.h [254 loc]
- Otcl file:
 - ~/ns-2.28/tcl/lib/ns-mobilenode.tcl [858 loc]

```
# I don't care about address classifier; it's not my business  
# All I do is to setup port classifier so we can do broadcast,  
# and to set up interface stuff.
```

```
// XXX Must supply the first parameter in the macro otherwise  
// msvc is unhappy.
```

Schematic of a mobile node



Creating a mobile node

```
set opt(ahr)      DSDV                ;# Routing protocol
set opt(ll)       LL                  ;# Link layer type
set opt(mac)      Mac/802_11          ;# MAC type
set opt(ifq)      Queue/Droptail/PriQueue ;# Interface queue type
set opt(phy)      Phy/WirelessPhy     ;# Network interface type
set opt(ant)      Antenna/OmniAntenna ;# Antenna model
set opt(cha)      Channel/WirelessChannel ;# Channel type
# ...

$ns node-config -adhocRouting $opt(ahr) \
                -llType       $opt(ll) \
                -macType      $opt(mac) \
                -ifqType      $opt(ifq) \
                -antType      $opt(ant) \
                -phyType      $opt(phy) \
                -channel       $opt(cha) \
                # ...

set foonode [$ns node] ;# Hierarchy info can also be added
```

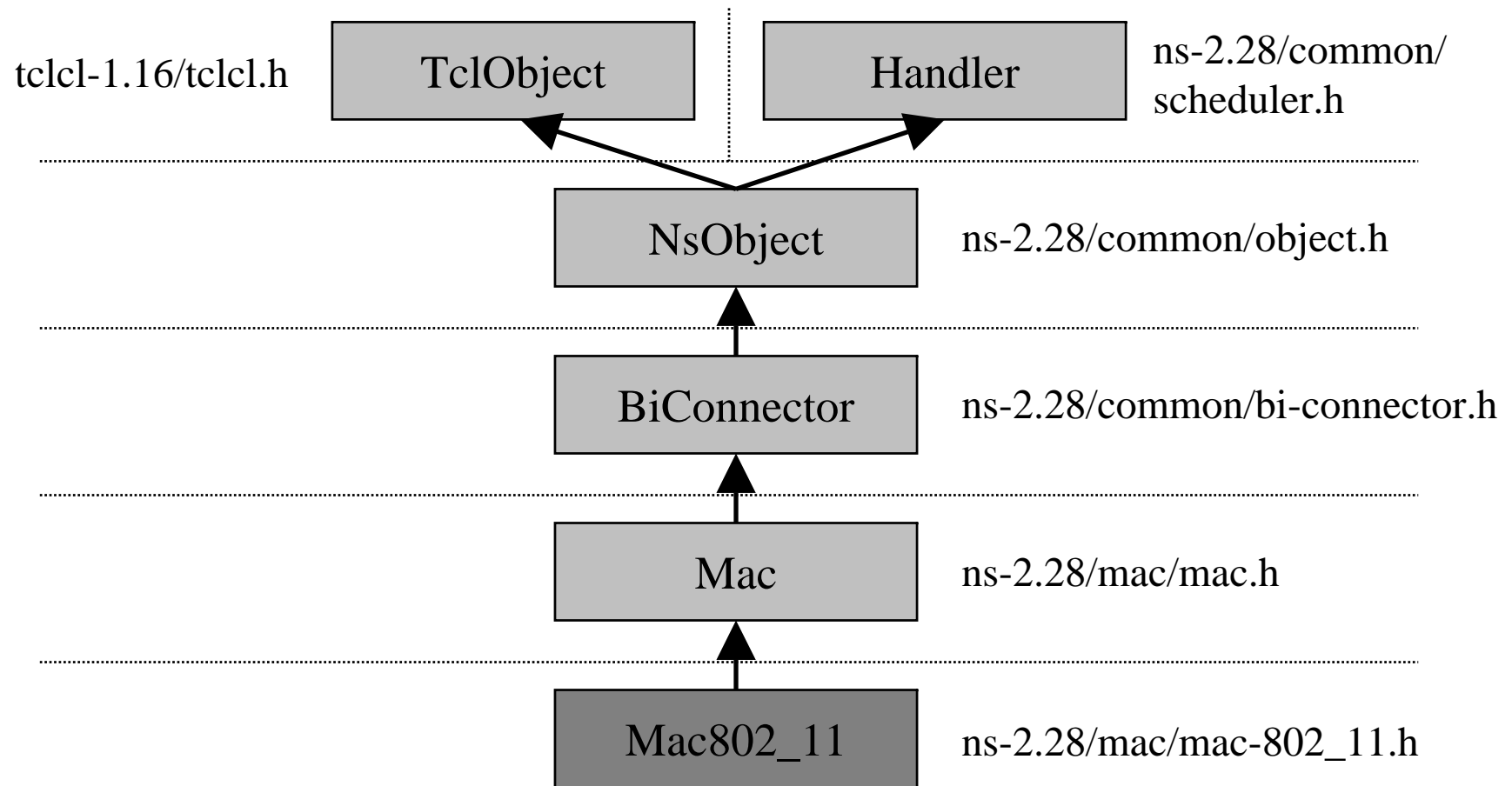
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802.11 in ns2

- 802.11 is a MAC layer protocol in ns2
- It's implemented in:
 - ~/ns-2.28/mac/mac-802_11.cc [1596 loc]
 - ~/ns-2.28/mac/mac-802_11.h [410 loc]
- Only the DCF is implemented
- No extensions (e.g. 802.1x and 802.11i) implemented
- 802.11 implementation in ns2 is poorly documented
- There is also an alternative, which is TDMA

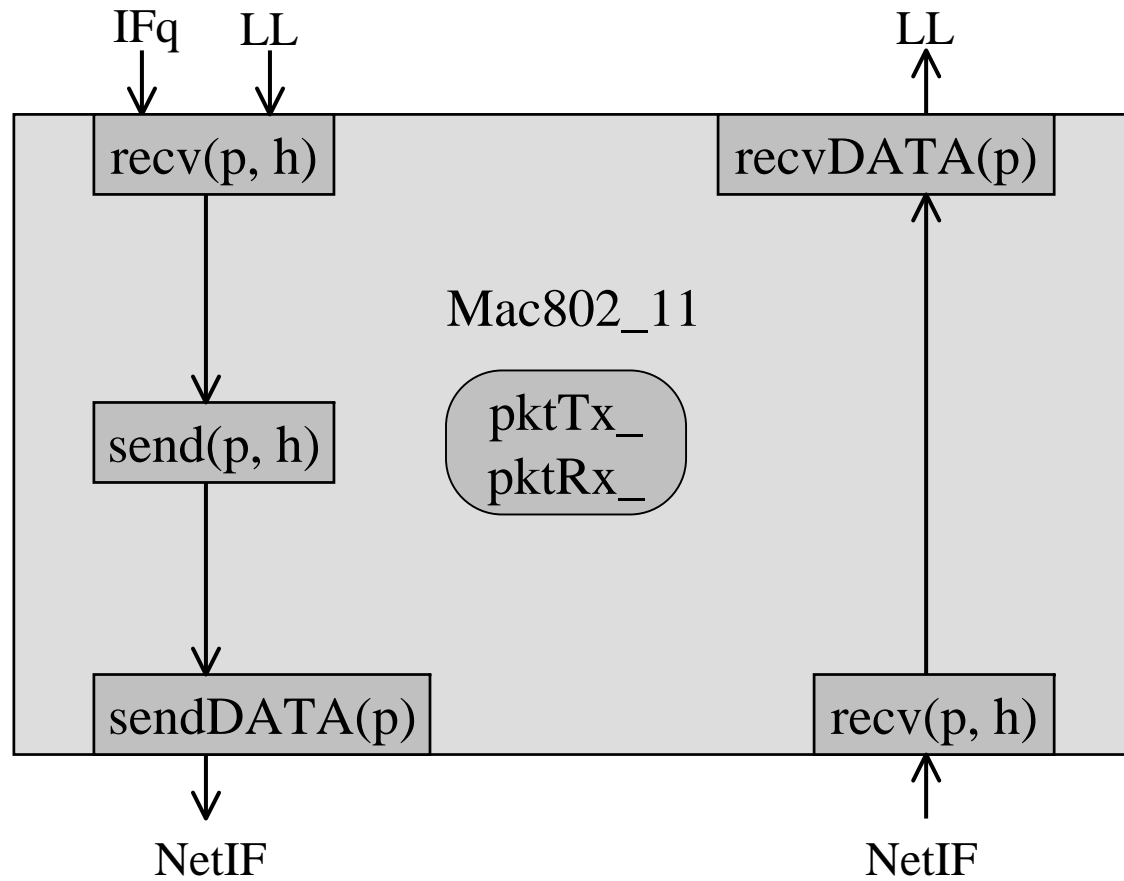
Class hierarchy of 802.11



Overview of *Mac802_11* class

Mac802_11
phymib_ : class PHY_MIB # macmib_ : class MAC_MIB - rx_state : MacState - tx_state : MacState ...
+ recv(p : Packet*, h : Handler*) - backoffHandler() - recvHandler() - sendRTS(dst : int) - sendData(p : Packet*) - recvRTS(p : Packet*) ...

Functions in *Mac802_11* class



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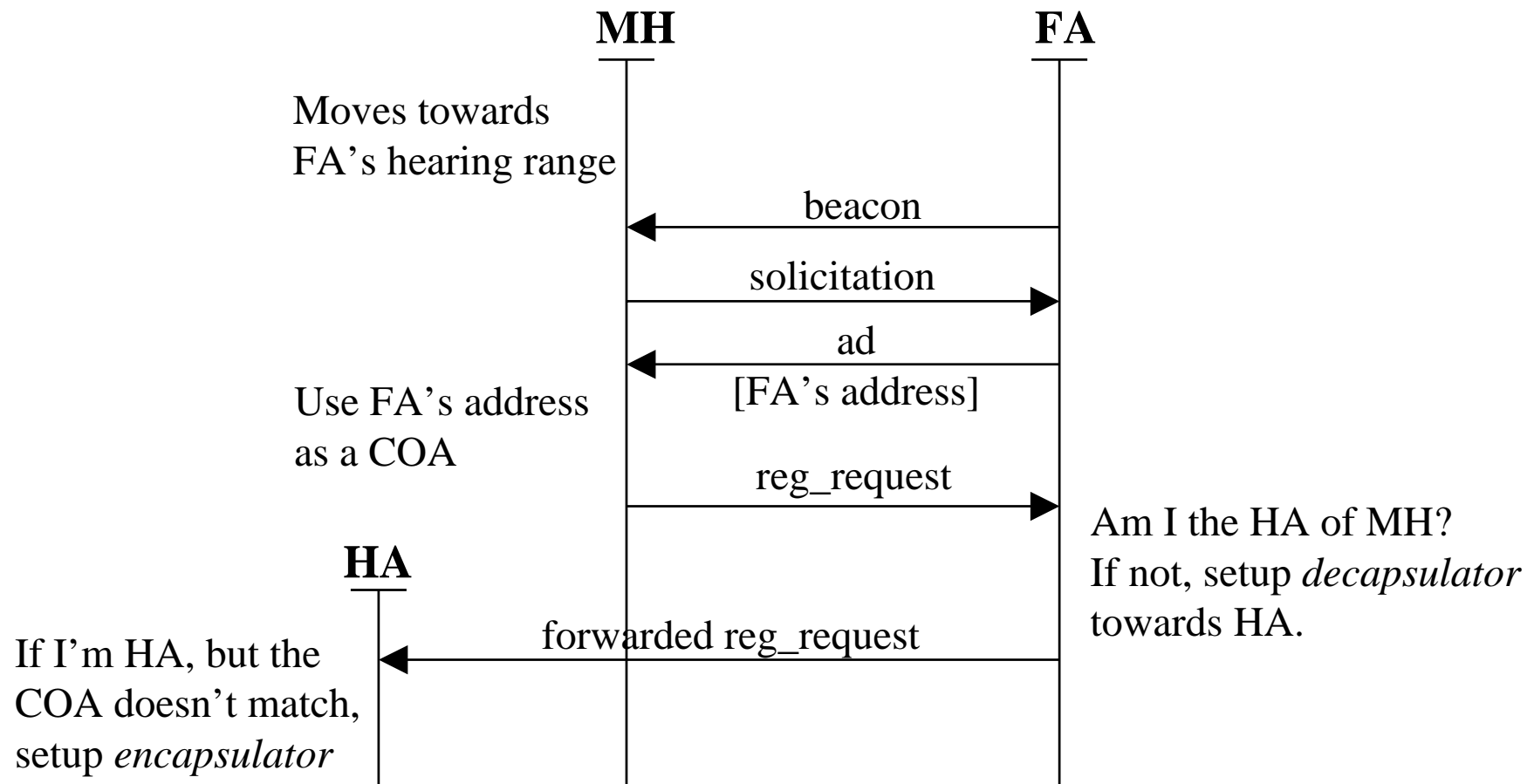
Wireless simulations in ns2

- Original CMU wireless model:
 - Basic WLAN simulations
 - Only wireless nodes
- Extensions to the previous:
 - Wireless/wired simulations
 - Integration of Sun's Mobile IP

Mobile IP for wireless (1/3)

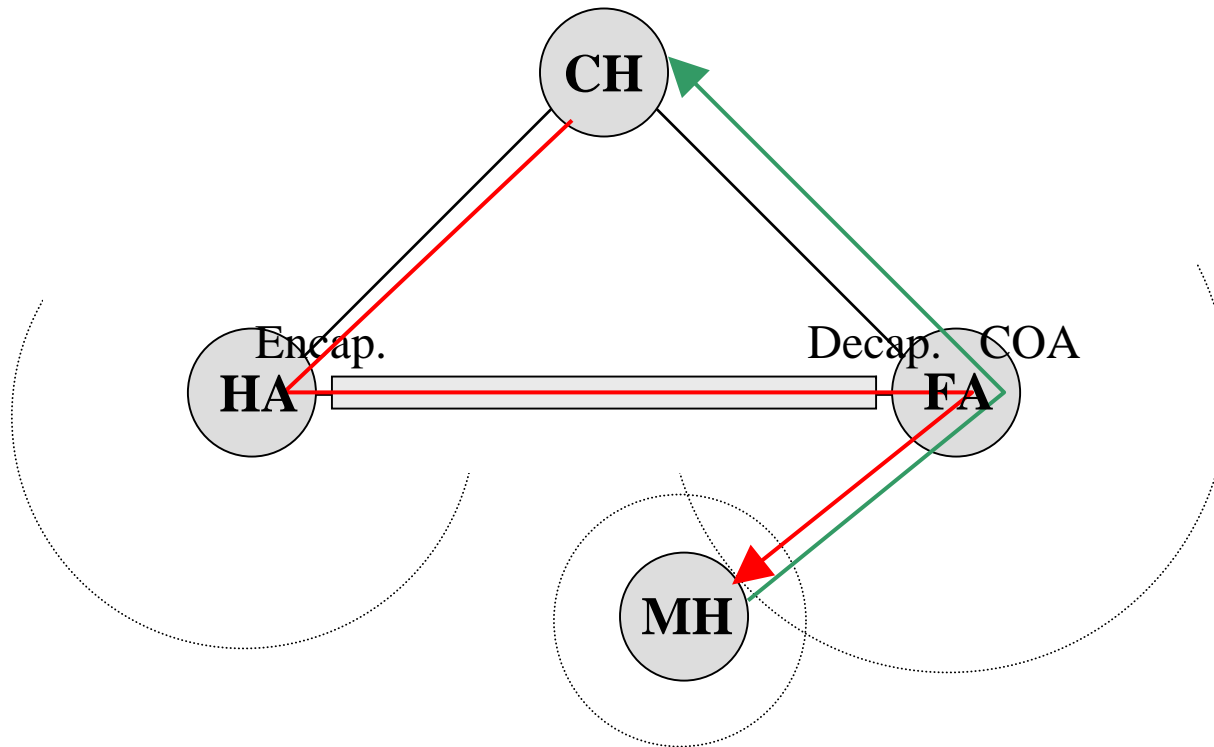
- Three entities: HA, FA and MH
- HA and FA:
 - These are base-station nodes
 - Send *beacons*, and *ads* to mobile nodes
 - Includes *encapsulator* and *decapsulator*
- MH:
 - These are mobile nodes
 - Sends *solicitations* and *reg_requests*

Mobile IP for wireless (2/3)



Mobile IP for wireless (3/3)

Triangular routing



Hierarchical routing in ns2 (1/3)

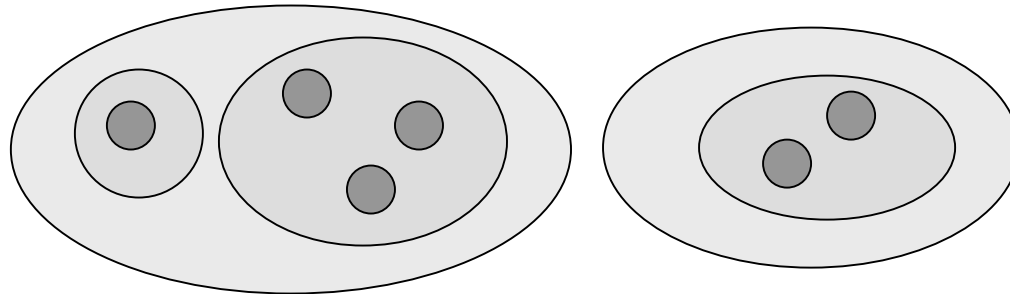
- **No hier. routing:** Every node in the simulation knows all the other nodes
- **Hier. routing:** Nodes in the simulation know only nodes that are in the same level
 - A lot smaller routing tables
 - Max. 3 hierarchy levels (domain.cluster.node)
 - Less memory and computational power required during simulations

Hierarchical routing in ns2 (2/3)

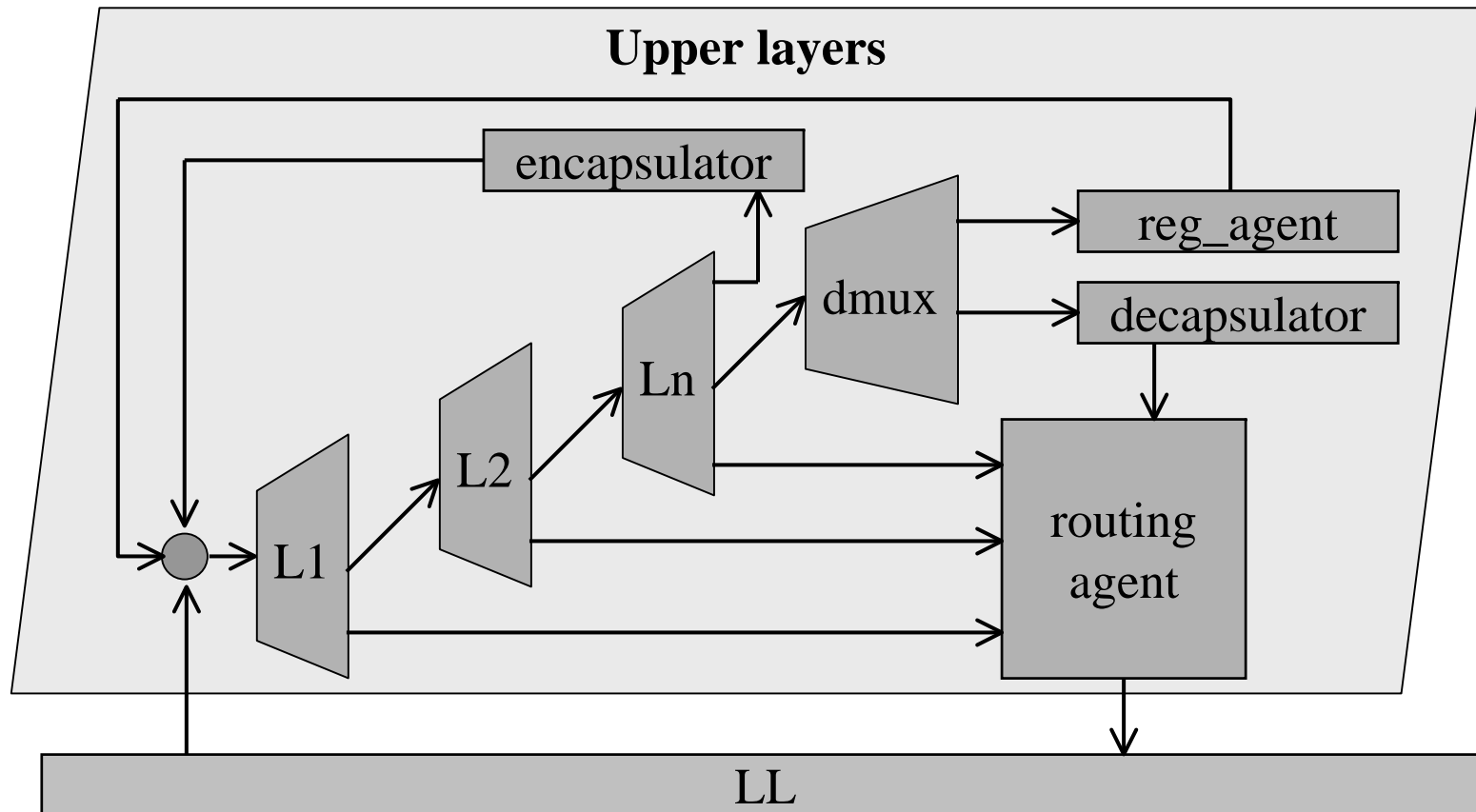
```
# Take the hierarchical routing in use
$ns node-config -addressType hierarchical

# Create a hierarchical framework
AddrParams set domain_num_ 2    ;# number of domains
lappend cluster_num 2 1          ;# number of clusters domains
AddrParams set cluster_num_ $cluster_num
lappend nodes_num 1 3 2          ;# number of nodes in clusters
AddrParams set nodes_num_ $nodes_num

# Create a node
set some_node [$ns node 1.0.1]
```



Nodes that route hierarchically (3/3)



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Tracing wireless simulations

- Traditional trace file format:

```
r 160.093884945 _6_ RTR --- 5 tcp 1492 [a2 4 6 800] ----- [655  
36:0 16777984:0 31 16777984] [1 0] 2 0
```

- There is a new trace file format for wireless traces:

```
s -t 10.000000000 -Hs 0 -Hd -2 -Ni 0 -Nx 5.00 -Ny 2.00 -Nz 0.00  
-Ne -1.000000 -Nl AGT -Nw --- -Ma 0 -Md 0 -Ms 0 -Mt 0  
-Is 0.0 -Id 1.0 -It tcp -Il 1000 -If
```

- New trace file format can't be used with wired nodes

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Summary

- Basic IEEE 802.11 is implemented to ns2 without extensions
- There are extensions to wireless model:
 - Mixed wireless/wired simulations are possible
 - Integrated Mobile IP(v4)
- There are two (old & new) trace file formats

Questions, comments?