A practical experience in designing an OpenFlow controller

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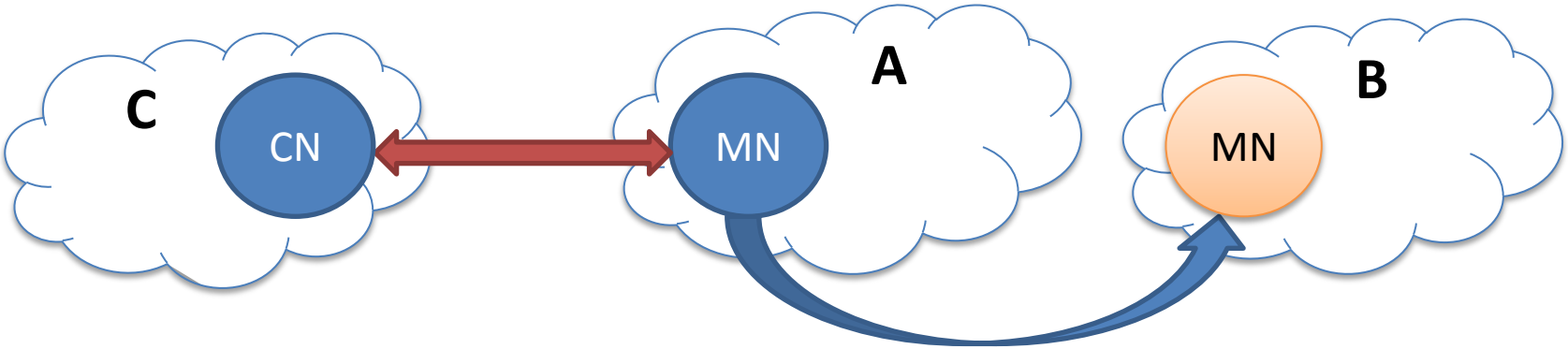
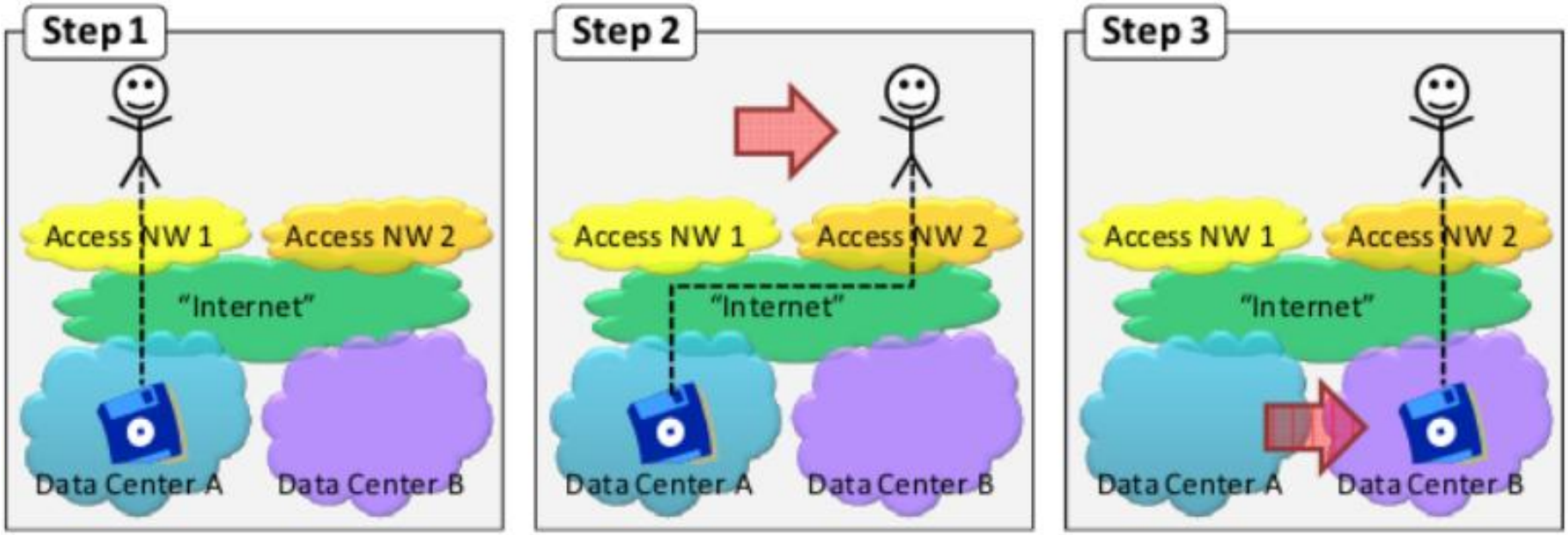
tcp mobility limitation

- TCP/IP networks were originally designed for communications between fixed devices.
- when a Mobile Node (MN) moves from one link to another without changing its IP address, it cannot receive packets in its new address
- when MN changes its IP address when it moves, it must terminate and restart any communications



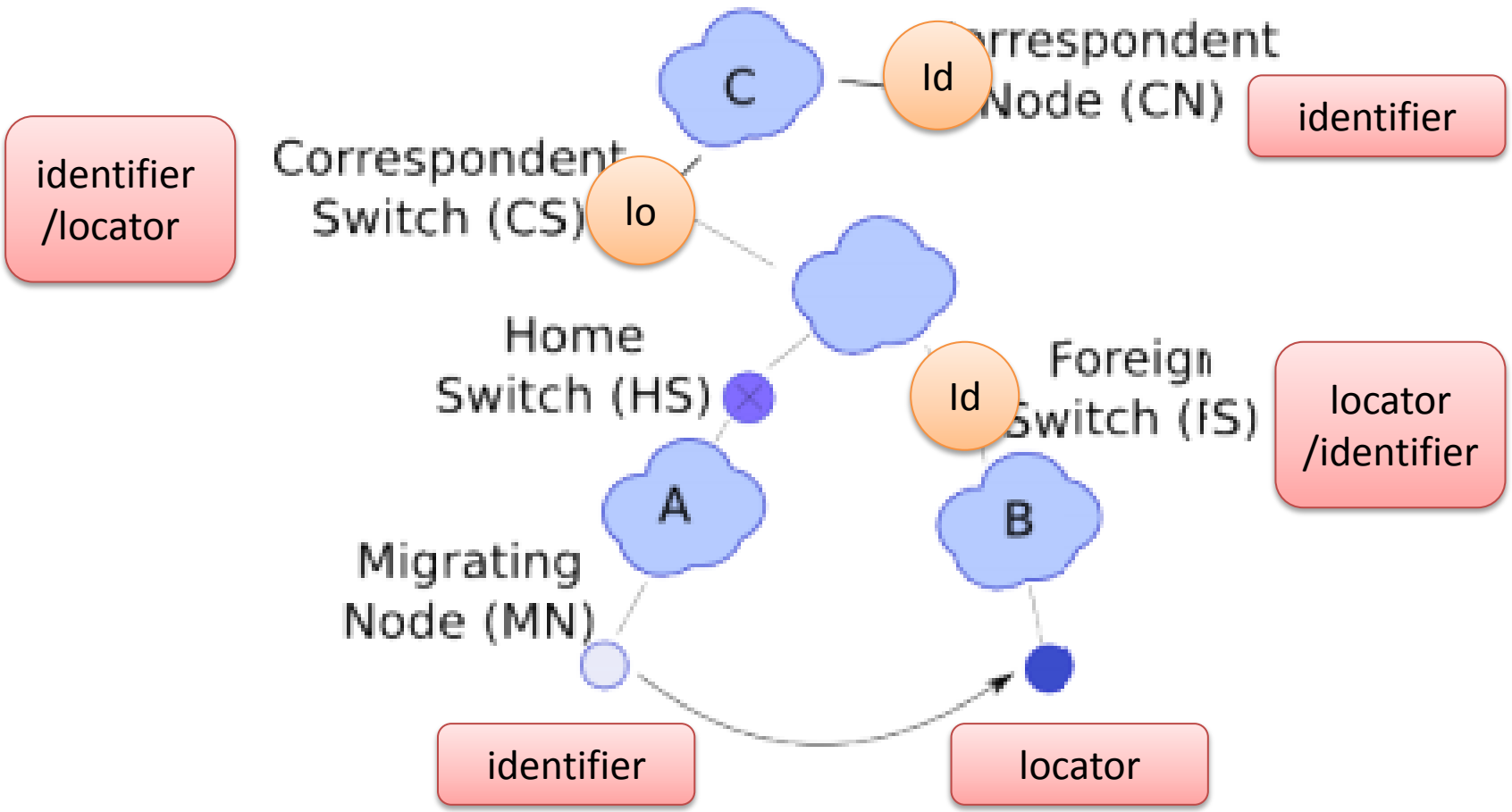
Migrating Service



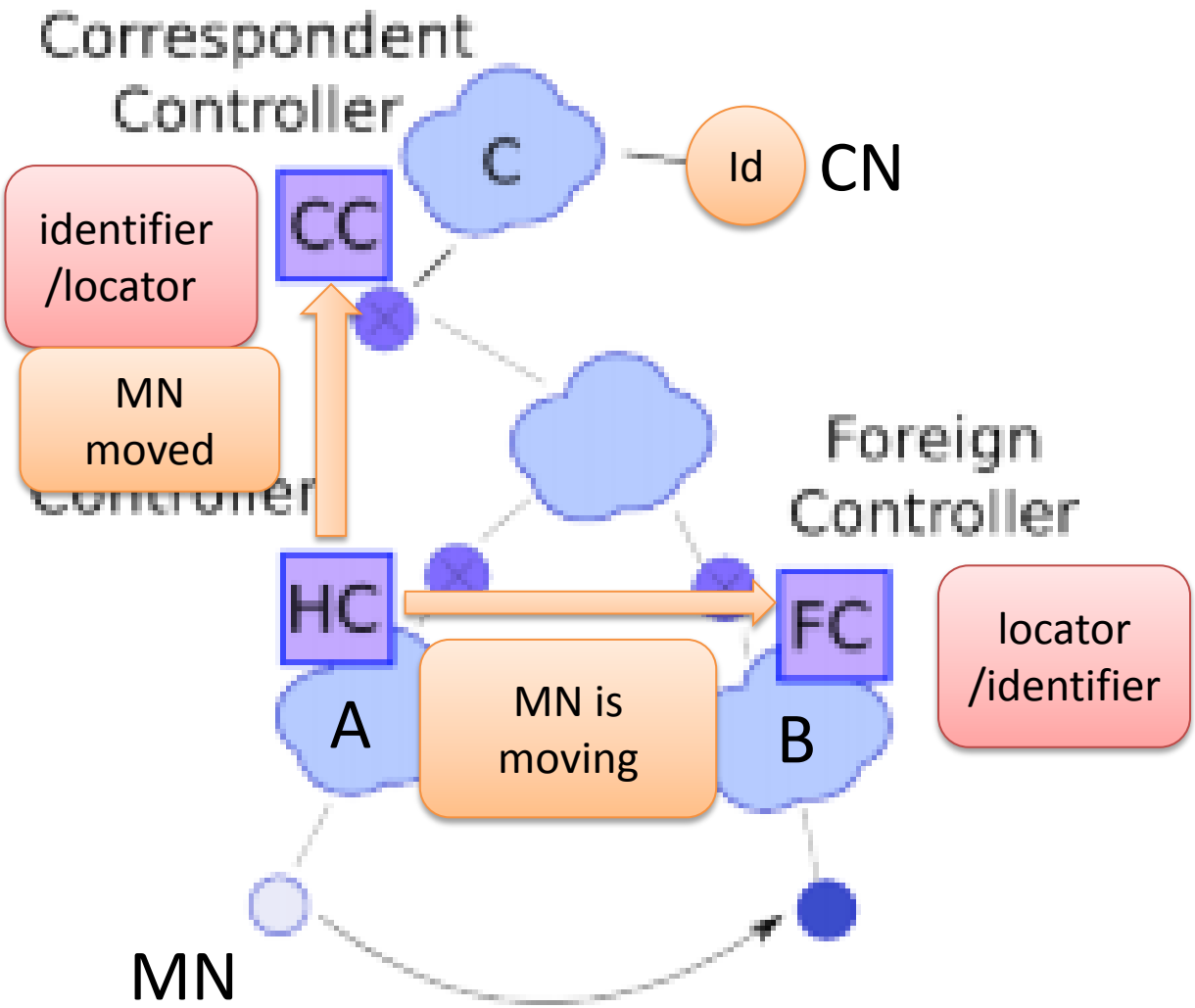
FOLLOW-ME CLOUD

- Overcome TCP/IP architecture mobility limitations
  - ability to migrate network end-points
  - reactively relocate network services depending on users' locations
- performance for the client-server communication

FMC example scenario



FMC distributed architecture



How To Make FMC Usable

- FMC must scale with the number of users and migrations
- must be easily deployable in traditional networks

CONTROLLER DESIGN

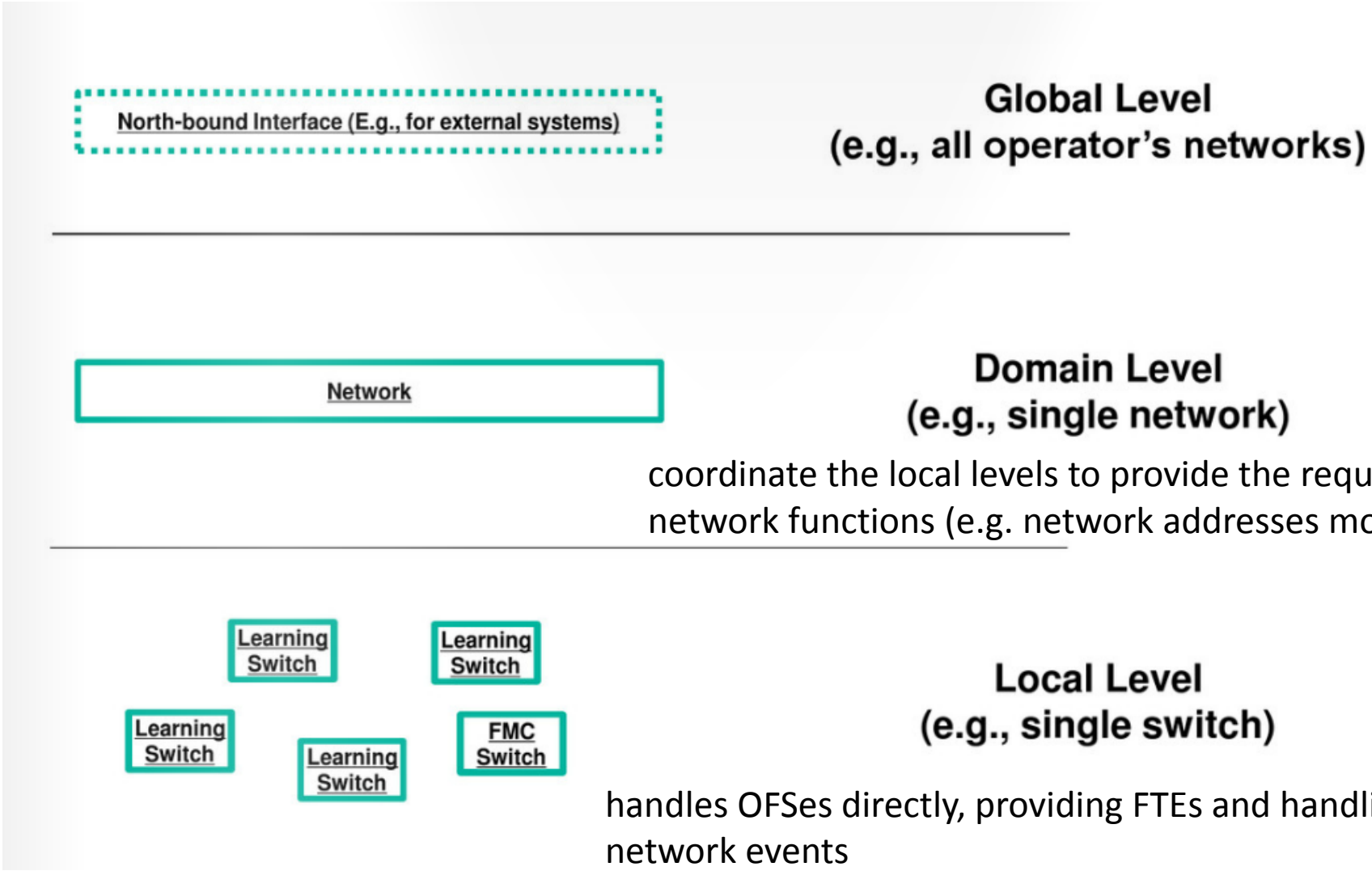
- Data model to describe the network and its state
- Control logic programming model to interact with such data model

- Distributed
  - different parts of the controller should be able to be moved to different computing nodes
- Extensible
  - providing the ability to combine different network functions
- Performance
- Scalability

Data model

- Network contains a globally unique identifier and a set of OFSwitch objects
- OFSwitch is the base class used to represent and manage an OpenFlow switch

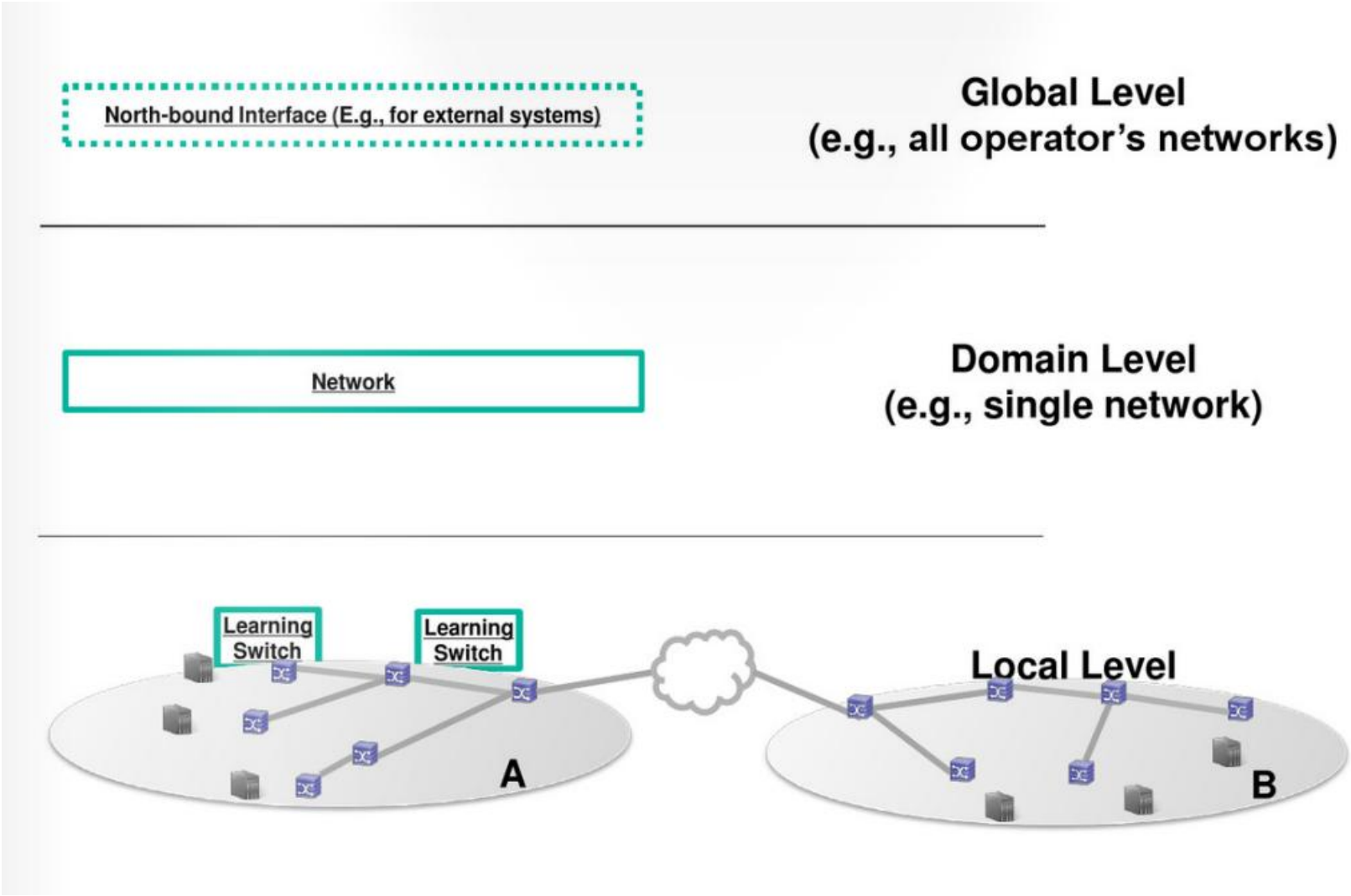
Hierarchical control



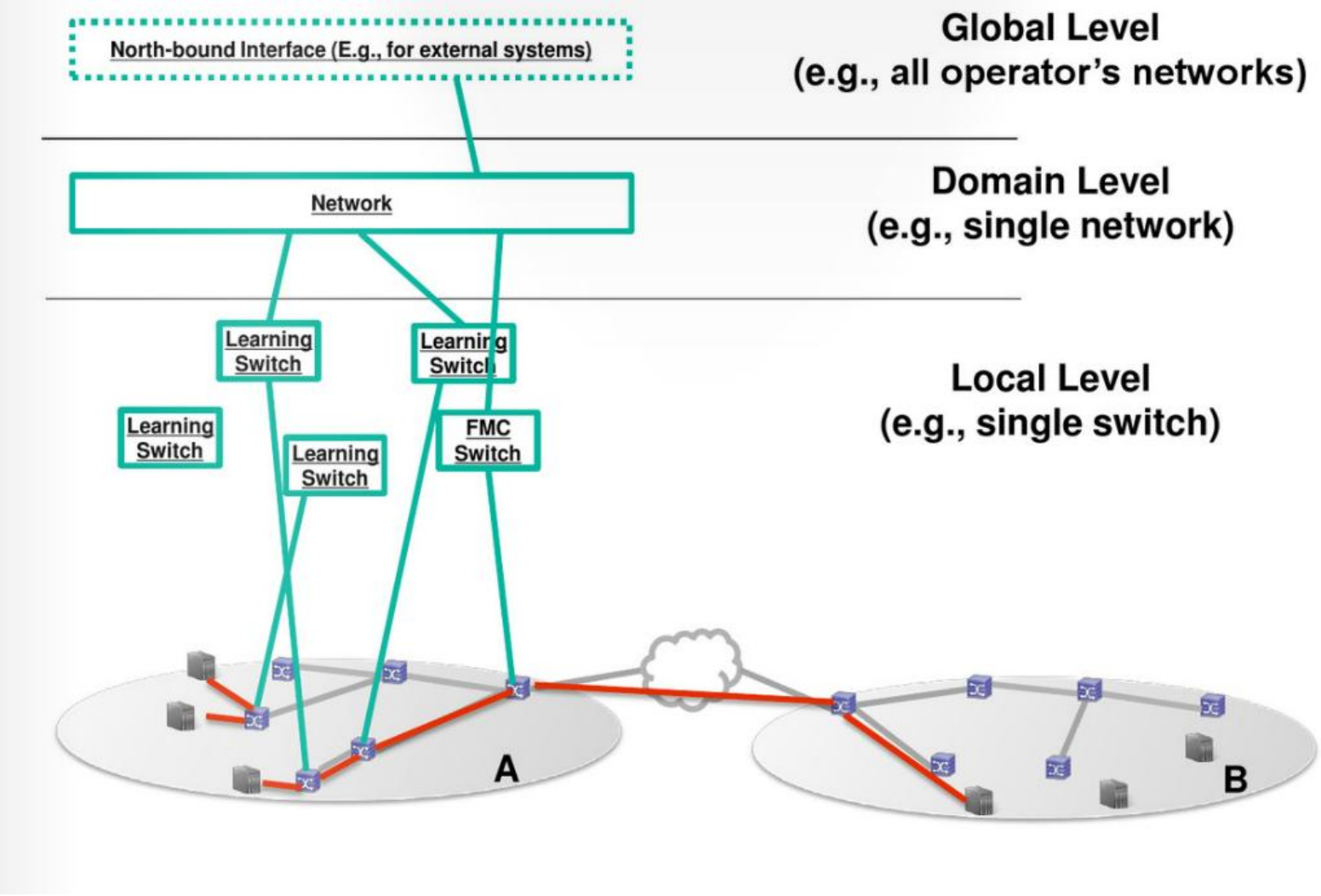
coordinate the local levels to provide the required network functions (e.g. network addresses mobility)

handles OFSes directly, providing FTEs and handling network events

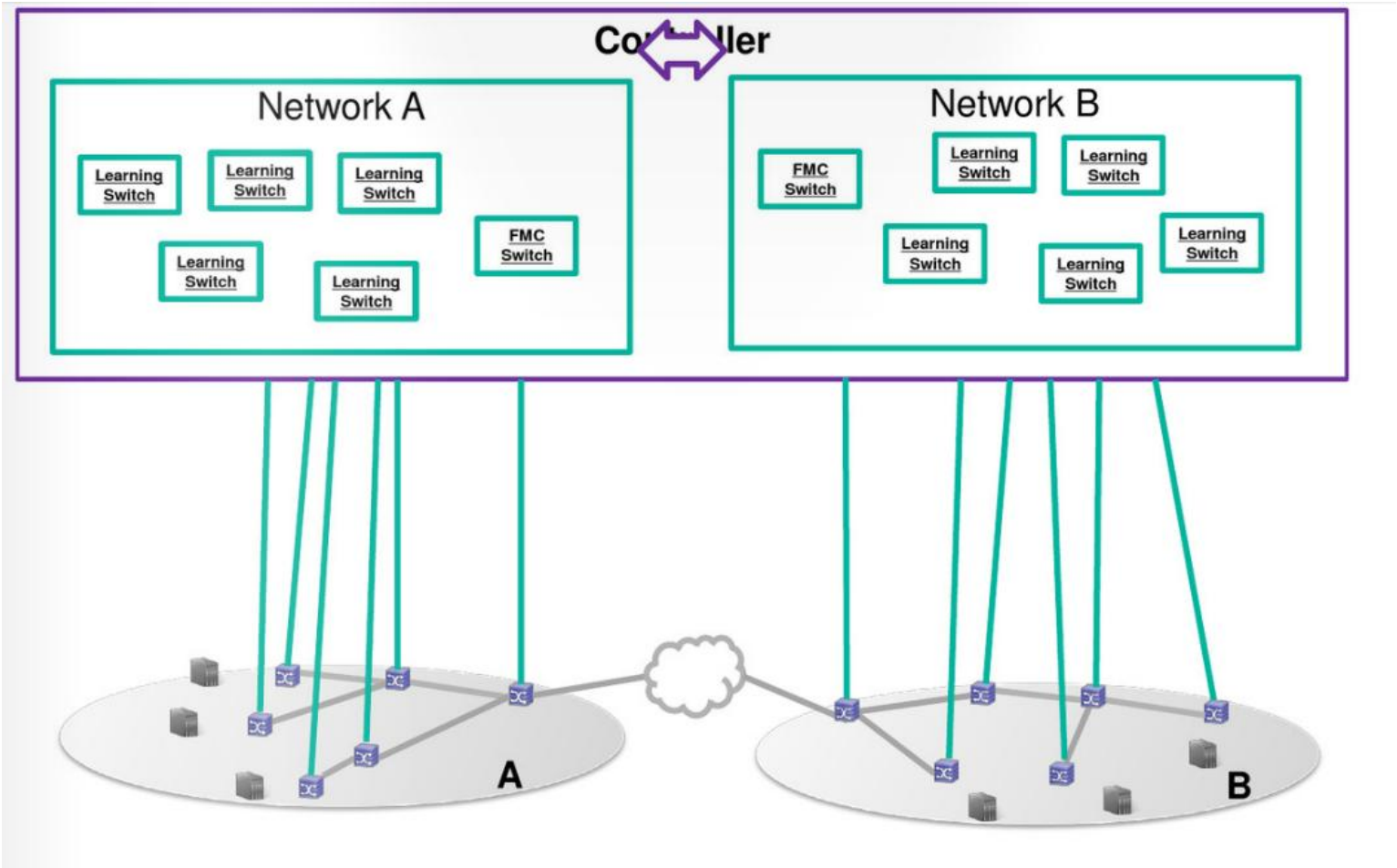
Hierarchical control



Hierarchical control



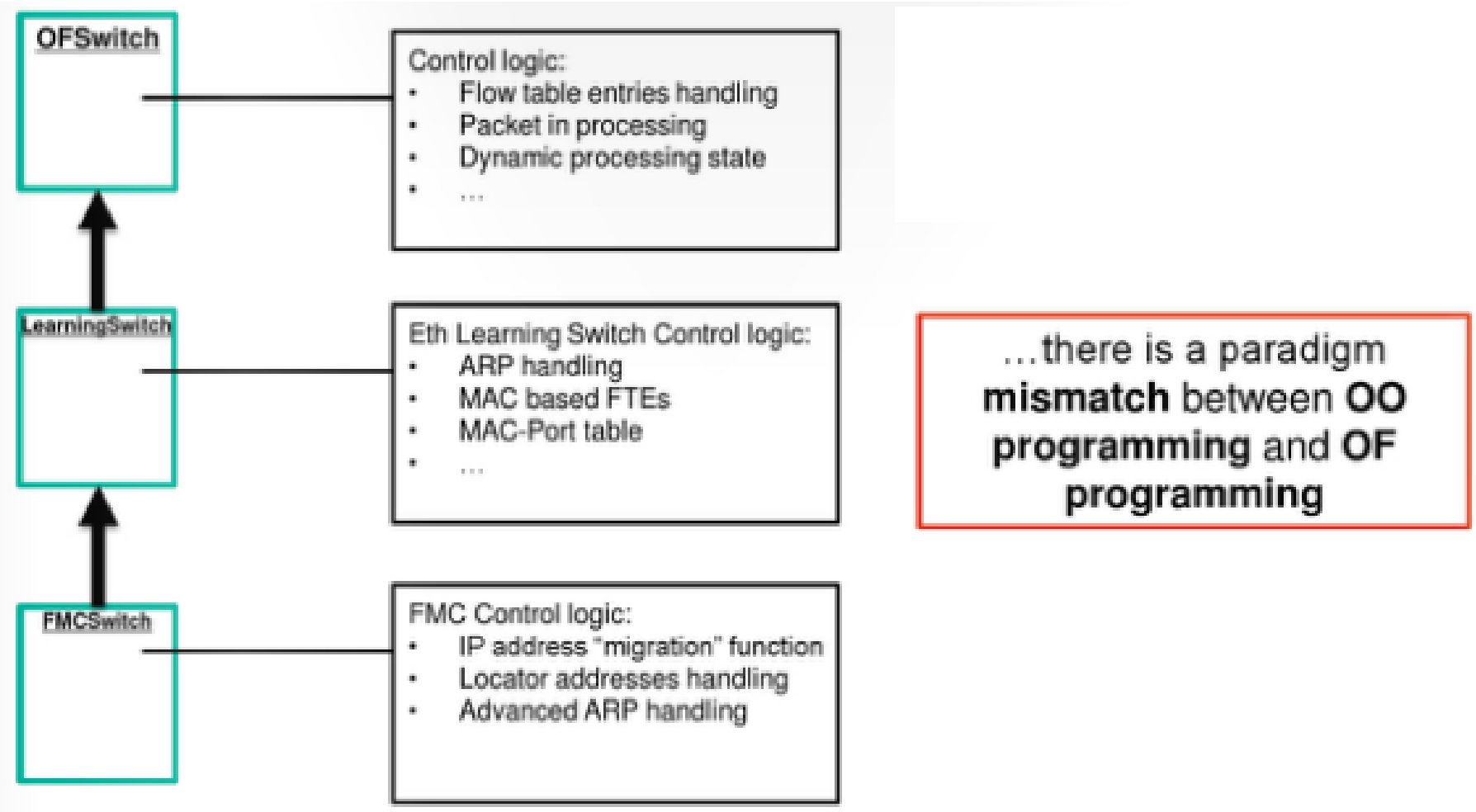
Hierarchical control



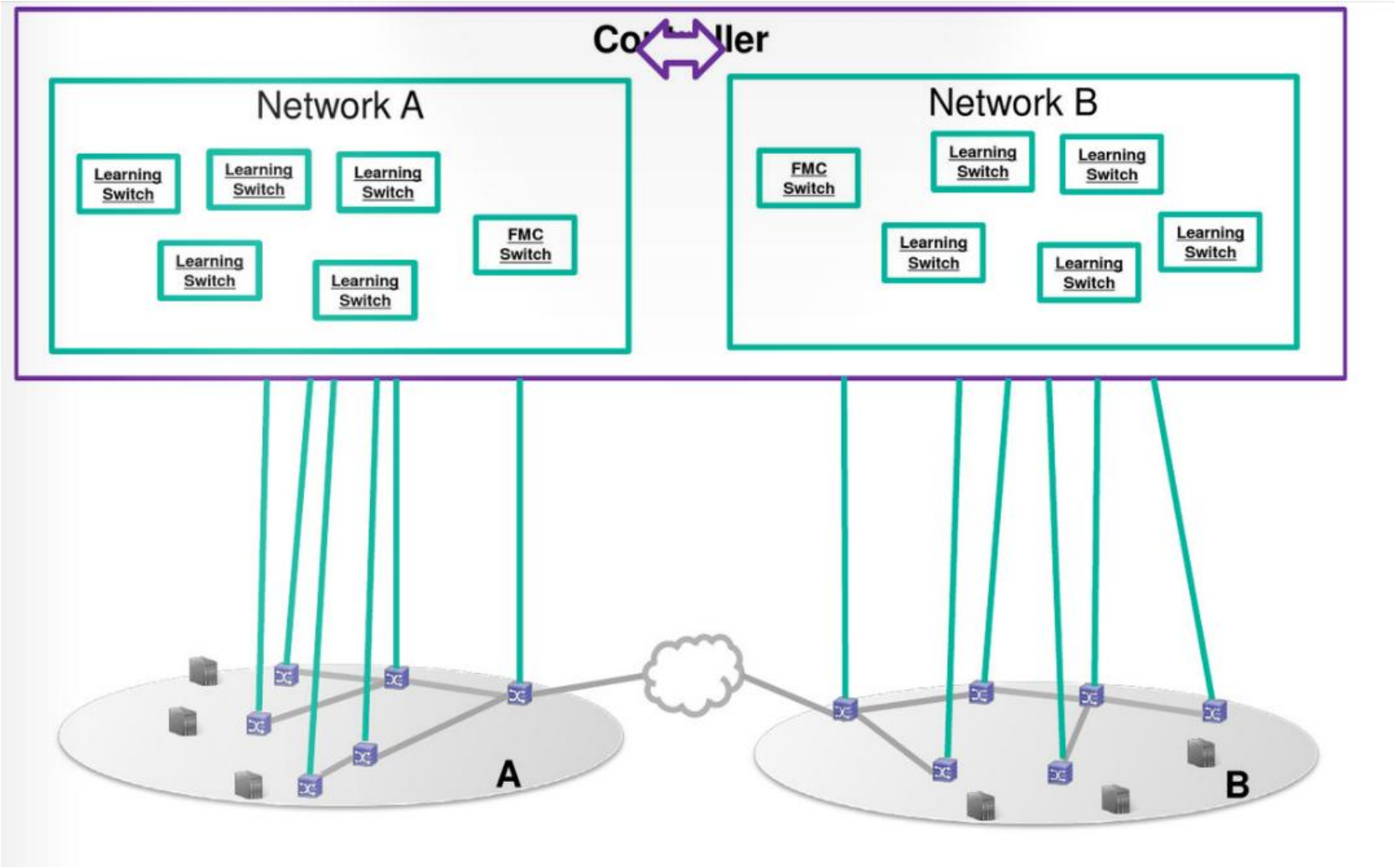
Extensibility

- provided using OO paradigm
- OFSwitch class can be extended to provide new functions
- But… the addition of a FTE can have unexpected effects on the behavior of the switch
- a subclass that inherits from the OFSwitch can use the methods from the superclass

Extensibility using inheritance



Scalability: distribution of networks



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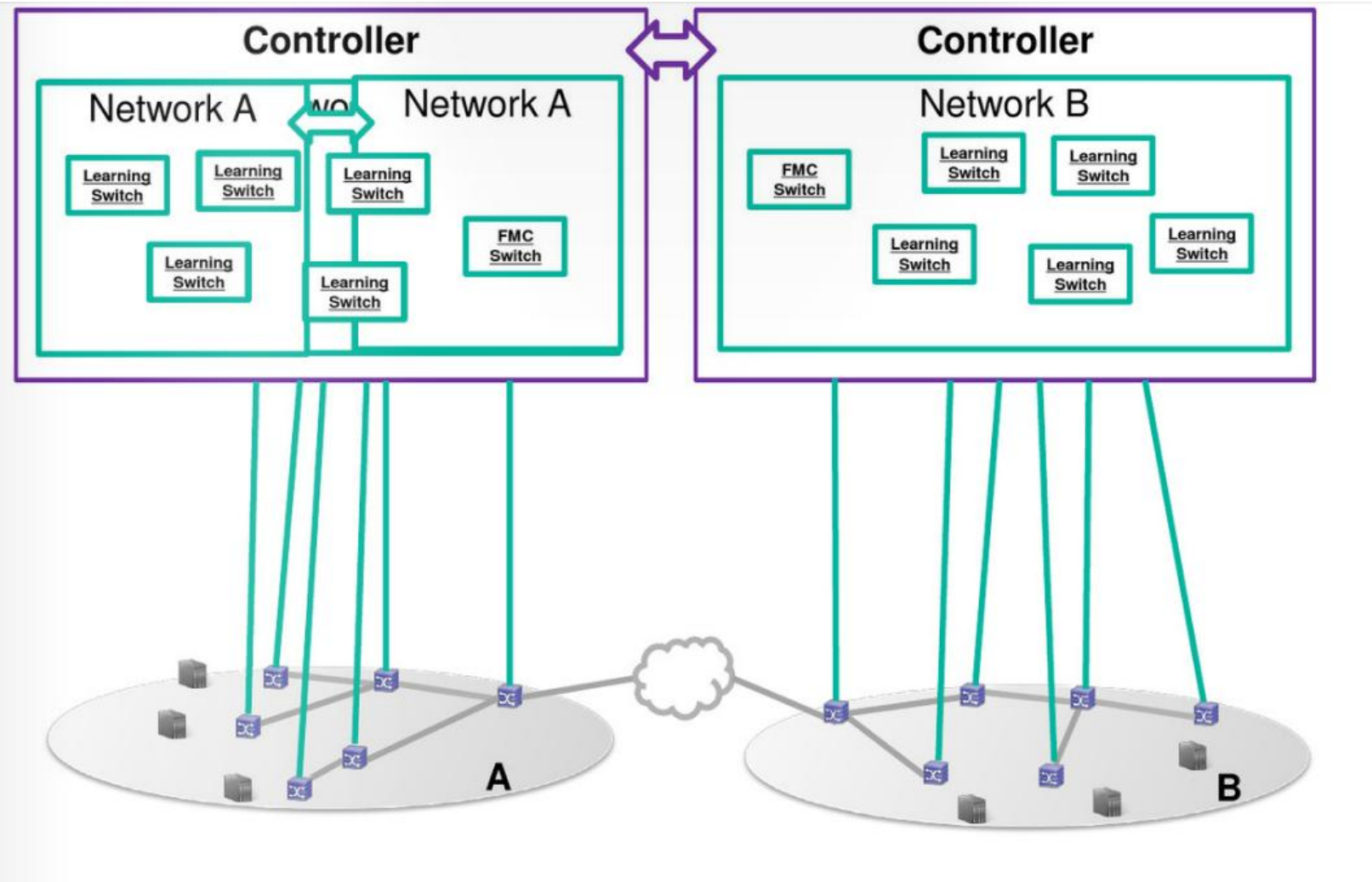
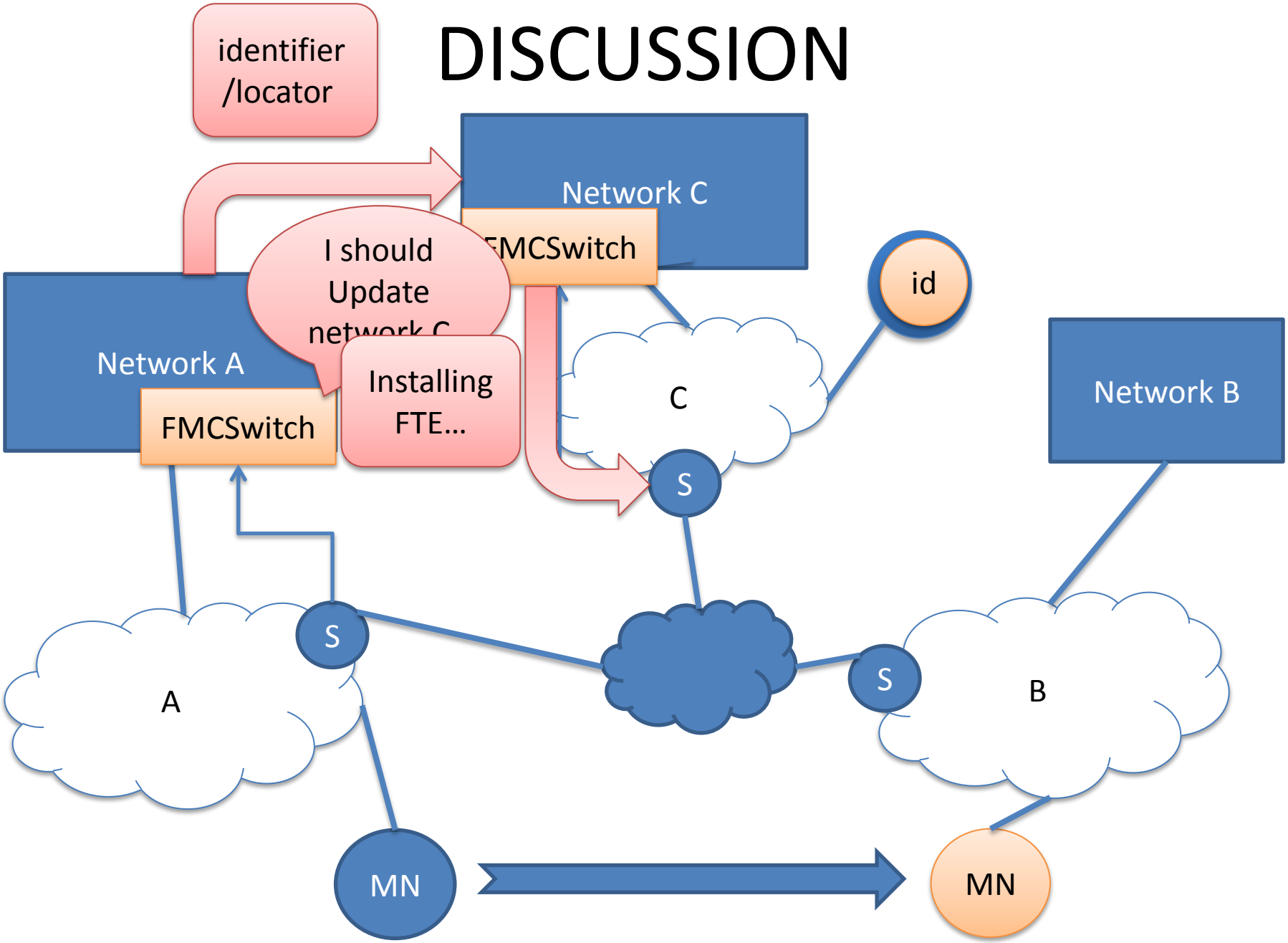


DISCUSSION

- Network class implement global control logic
- OFSwitch objects are in charge of handling the local control logic
- all the local events are kept local, requiring no interactions among different Controller nodes
- separating the development of low level FTEs programming from the development of high-level network functions

DISCUSSION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Update
Network A
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CONCLUSIONS

- Appling OO modeling for an OpenFlow controller design is good to organize the network data and to structure the application for scalability
- it does not help in providing extensibility, that still requires a direct handling of FTEs
  - the function that is going to be extended must be well known by the programmer

What is missing?

- Security issues
- Migrating service
- Implementation
- Actual results

Questions?