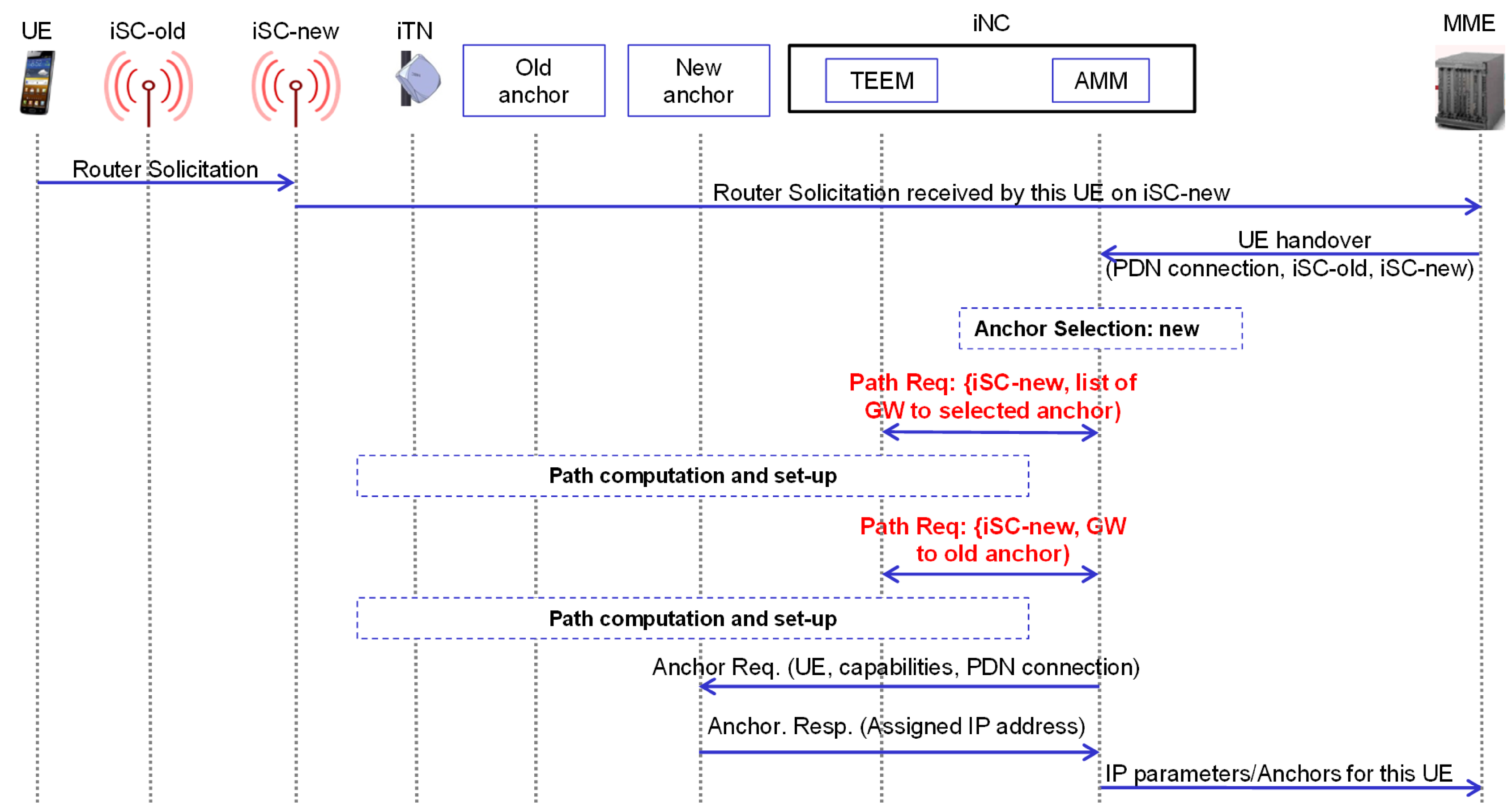
SDN-based Mobility in iJOIN

Background and Motivation

- Traffic demand is expected to be ever-increasing in future years.
- Mobile data revenue is falling fast.
- Impacts on the dimensioning and planning:
  - I. Spectrum is limited and expensive;
  - II. Deployed mobile core networks are highly hierarchical and centralised.
- iJOIN increases the overall bandwidth available to users by using smaller cells.
- iJOIN moves the complexity to the cloud introducing the RANaaS concept.
- This approach raises challenges in network selection and mobility management.

Proposed mobility solution

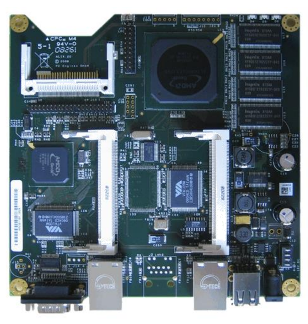
- IP based solution following an SDN-focused approach.
- Distributed IP anchoring with flow-level granularity.
- Support for IP local breakout.
- IP flows may not traverse the BH and network operator's core.
- Key role played by the iJOIN network controller (iNC):
  - I. Centralised and joint optimization of RAN and BH;
  - II. Anchor selection and mobility management.



SDN-Testbed deployment

Hardware platform

- Alix boards: single board computers with two 100BASE-TX Ethernet interfaces and one 802.11g wireless card.
- Dlink DGS-122T: 24 ports 100BASE-TX Ethernet switch, 802.1Q capable.
- Two commodity laptops.



Software platform

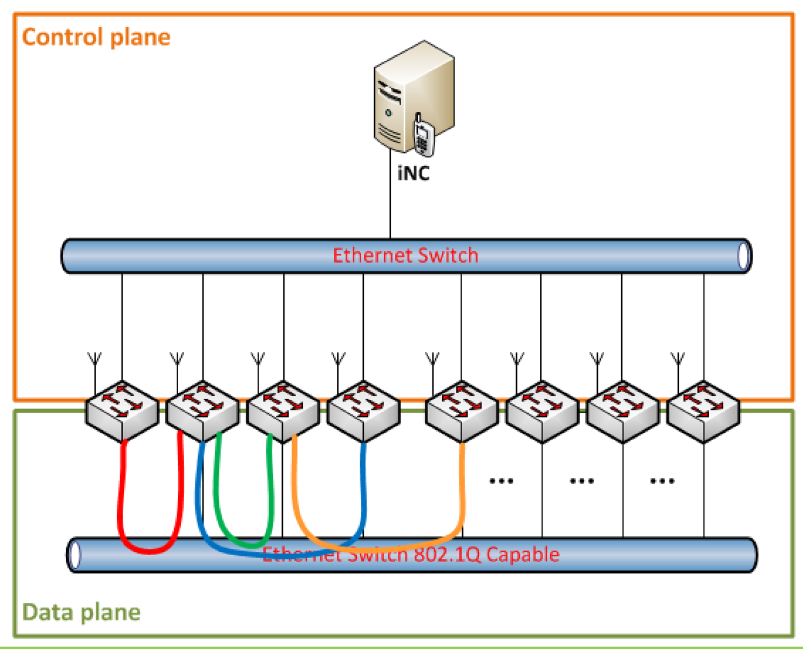
- GNU/Linux (Voyage Linux) running kernel 3.10 installed on Alix boards.
- GNU/Linux without any modification installed on both laptops.
- Open vSwitch 2.0.1 with OpenFlow 1.3 support used on Alix boards.
- RYU as SDN controller installed on one laptop.

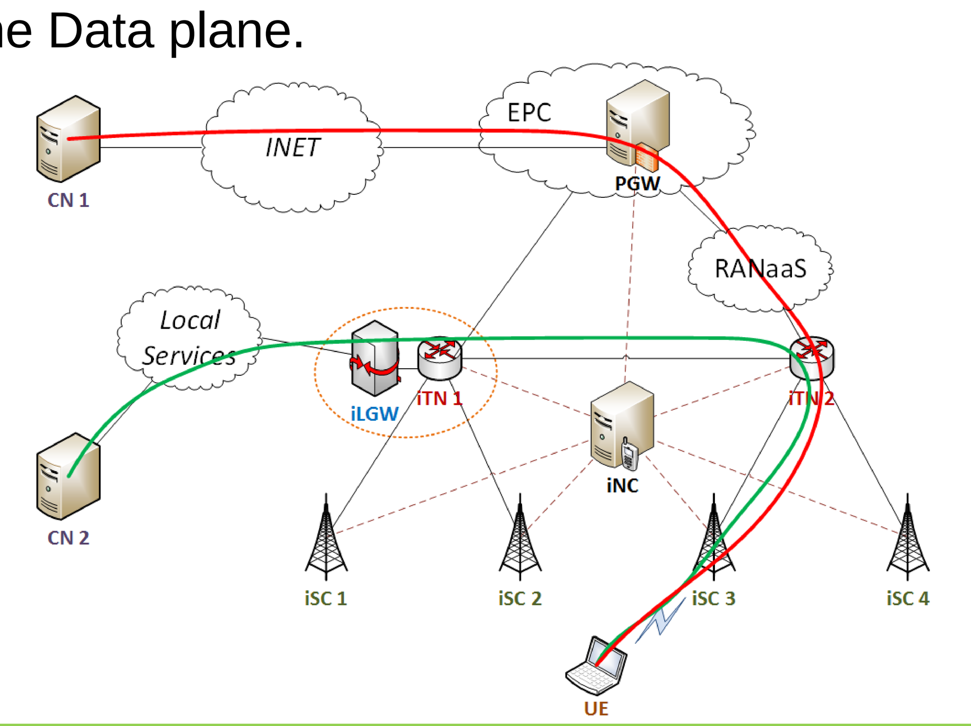
Physical topology

- Alix boards are connected with both Ethernet interfaces to the same switch.
- On Alix boards 1 Ethernet interface is used for Data plane while 1 Ethernet interface is used for Control plane performing out-of-band signaling.

Logical topology

- 802.1Q capable Ethernet switch used for emulating network topology.
- Topology is emulated only for Data plane, Control plane topology is flat.
- Multiple Linux virtual VLAN interfaces on Alix Data plane's Ethernet interface.
- By properly configuring VLANs on the switch and on the Alix boards, we can emulate any desired topology for the Data plane.



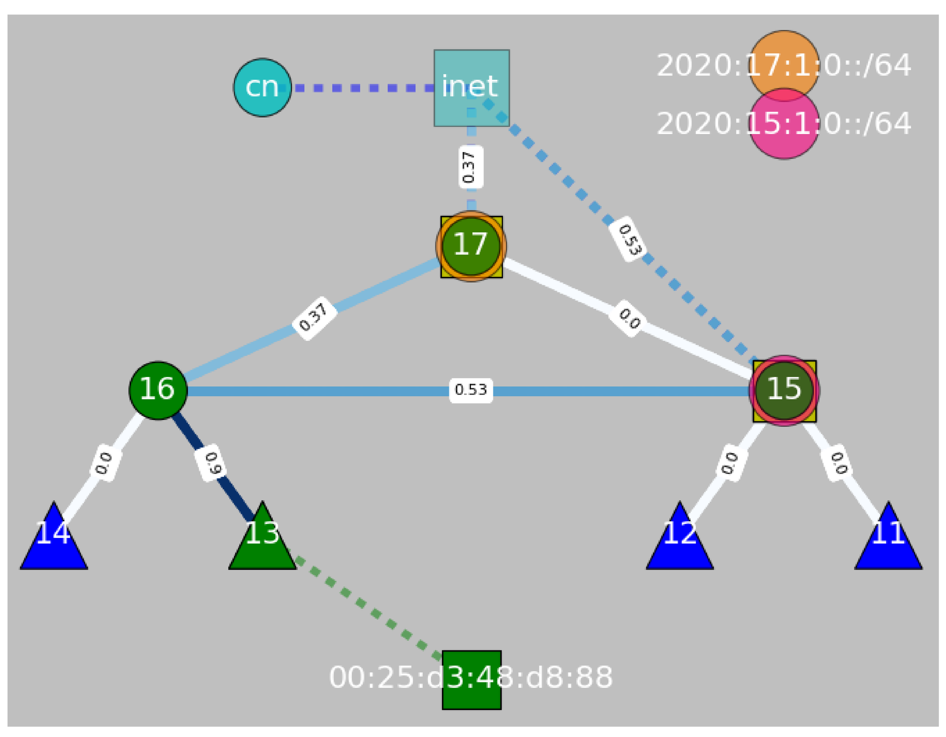


Demo description

SDN-Testbed configuration

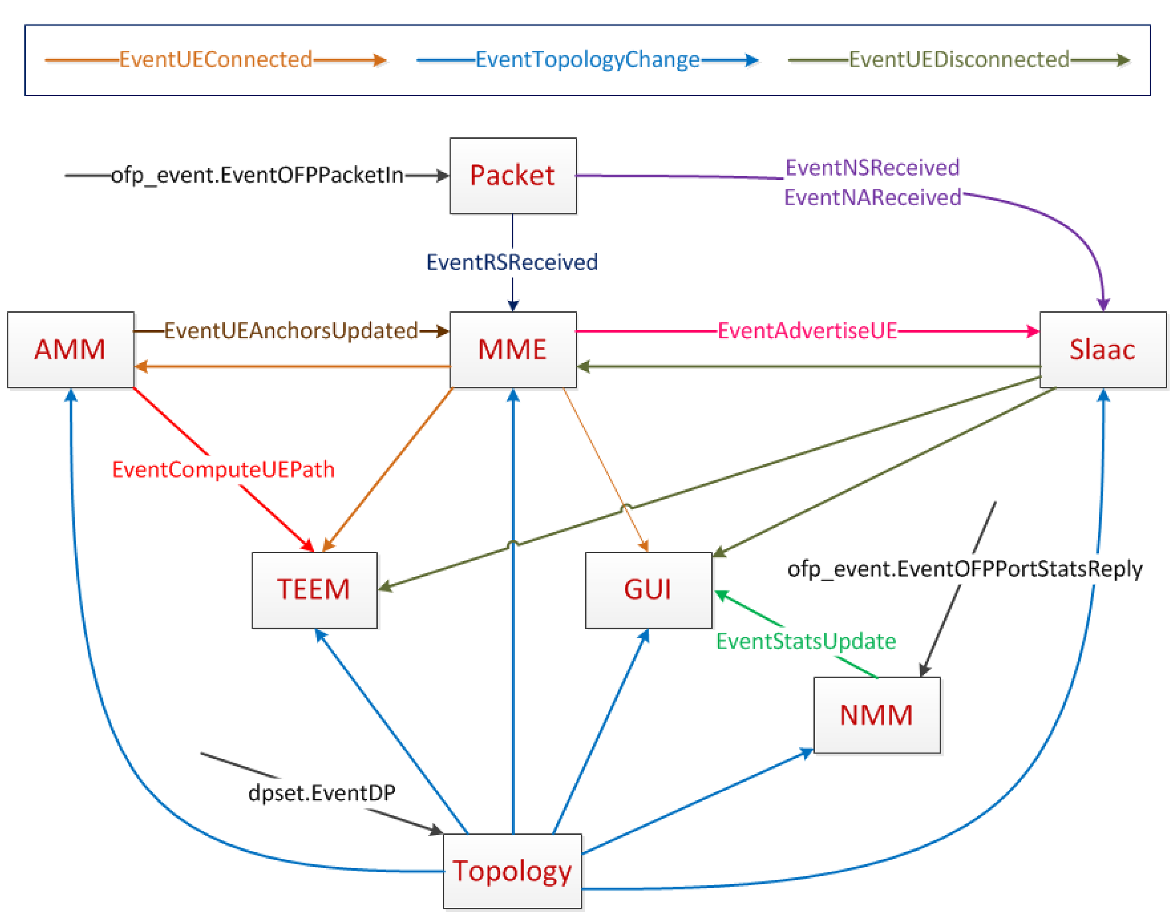
OpenFlow enabled nodes:
- 4 Alix boards act as iSC.
- 1 Alix board acts as iTN.
- 1 Alix board acts as iTN and iLGW.
- 1 Alix board acts as PGW.

Legacy nodes:
- 1 laptop acts as SDN controller.
- 1 laptop acts as Mobile Node.
- 1 Alix board acts as Correspondent Node.



Functional architecture

- SDN-based functional architecture in the iNC.
- Reduced iJOIN functional architecture.
- 8 modules implemented as Ryu applications.
- Event-driven communication between modules.



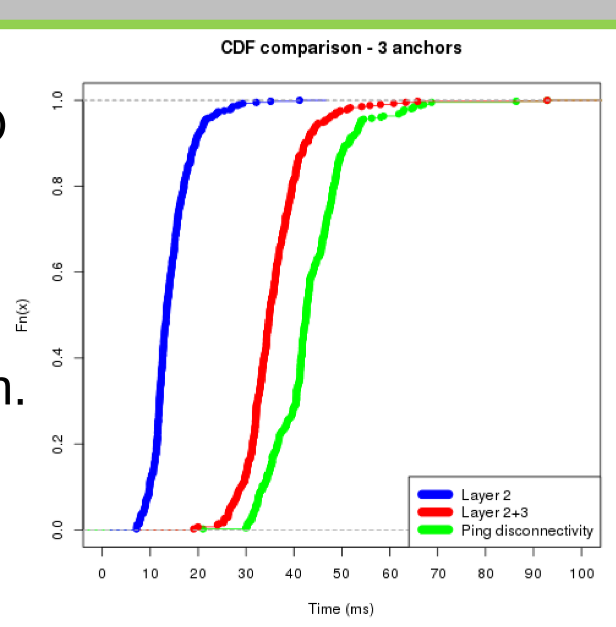
Demonstration walkthrough

- The CN streams two videos over IPv6;
- The UE attaches to the first iSC;
- iNC detects the attachment (iNC internal procedure):
  - I. AMM selects anchor and gateway for the UE;
  - II. AMM asks TEEM to setup a path for the UE;
  - III. TEEM computes the optimal path;
  - IV. TEEM writes the OpenFlow rules on the nodes along the computed path;
  - V. SLAAC sends a Router Advertisement to the UE;
- The UE autoconfigures the IPv6 addresses;
- The UE connects to the CN and starts receiving the first video streaming;
- The UE attaches to a new iSC;
- iNC performs the same internal procedure as before;
- The UE connects to the CN and starts a second video streaming without breaking the first video flow;
- A different path is selected for each video flow;

Results

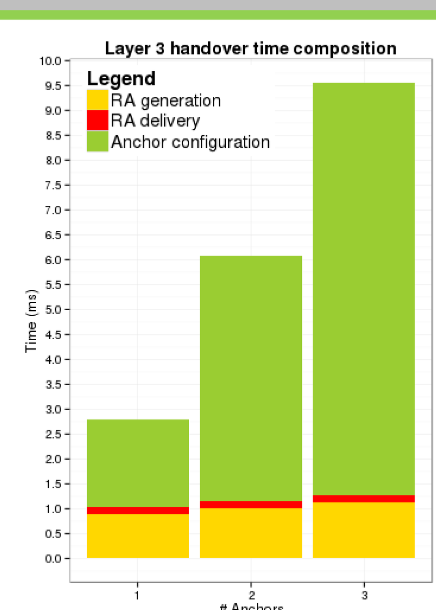
Total HO time

- 95% pctl Layer 2 HO time: 21ms.
- 95% pctl Layer 2+3 HO time: 46ms.
- 95% pctl for ping dcn. time: 54ms.



HO time composition

- Processing time in the iNC
- Configuration time increase linearly with # of anchors.
- Majority of the time spent on configuring the anchors.



HO impact on TCP

- TCP stream generated with *iperf*.
- TCP seq. numbers tends to increase linearly despite the handovers.