EMMA Implementation in ONOS

The EMMA application is an ONOS application that makes energy efficient routing decisions. It is developed based on the ONOS Reactive Forwarding application.

1. It is contained in the folder emma-app

2. EMMA has to be built with the command “make clean install” from its directory.

3. Then it should be installed to a running ONOS instance or cluster using the command “onos-app localhost install! target/emma-app-1.0-SNAPSHOT.oar” or “onos-app localhost reinstall! target/emma-app-1.0-SNAPSHOT.oar” if it is not the first time.
   Note:- “localhost” in the above commands must be replaced with the ip address of the machine where ONOS is running.

4. The application org.onosproject.fwd has to be deactivated in ONOS using the command “app deactivate org.onosproject.fwd” to route traffic using only EMMA decisions.

In the process of creating the application there are lots of files that are generated automatically by maven. The files we wrote are the ones located in “emma-app/src/main/java/org/emma/app/” folder. The description of these files are given below.

1. Routing.java,
   makes the routing decision and updates the active topology whenever new links and/or switches has to be used to route a new flow.

2. FlowListener.java,
   - listens for FLOW_ADDED and FLOW_REMOVED events from devices and computes the energy in the network,
   - reroutes flows which have started half the flow duration time ago whenever a topology changes due to the addition of new links and/or switches into the active topology and when a flow is terminated and resources are freed.
   - removes links and/or nodes that are idle due to termination of flows.

   The energy computed at each event (either FLOW_ADDED or FLOW_REMOVED) and time of the event occurrence is saved to a file called Energy.txt in the apache-karaf folder which is being used for ONOS.

3. AppCommand.java is a cli that is used to see if there are data flows in the switches. The name of the command is dataFlows.

We have also modified the emma-app/pom.xml file to include the necessary dependency “org.osgi.compendium”.

To test the application we have created a topology using Mininet as a forwarding plane. The file used to construct the topology and to generate traffic is emma-topolology.py. It can be run from a mininet virtual machine using the command,

“sudo python emma-topology.py”.

Before running the topology for the next time it is needed to wait till all flows are terminated so that we don't miss any data and clean mininet using the command, “sudo mn -c” .

Whether or not all flows are terminated can be checked using the dataFlows command in ONOS console.

Table 1: Experiment Parameters

Parameter	Value
Flow arrival rate	0.1 flows/s
Average flow duration	20 s
Number of core switches	12
Number of edge switches	Half the number of core switches
Link capacity	10 MB/s
Hysteresis	Half the flow duration
Experiment duration	500 s

The values in Table 1 can be set in the emma-topology.py file except for the hysteresis which has to be set in EMMA in the file “emma-app/src/main/java/org/emma/app/FlowListener.java”.

The ip address and port number of ONOS has to be provided in the emma-topology.py file as the controller address.

Note : data.sh file is used to compute the average power consumption.