OSHI - Open Source Hybrid IP/SDN networking
(and its emulation on Mininet and on distributed SDN testbeds)

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DREAMER Project
http://netgroup.uniroma2.it/DREAMER

Distributed REsilient sdn Architecture MEeting carrier grade Requirements

- Partners:
  - cnit
  - Consortium GARR
  - CREATE-NET

- Main goal:
  - Design a “carrier grade” IP backbone based on OpenFlow/SDN and experiment with its prototype on GÉANT SDN testbed

The DREAMER Project is one of the beneficiary projects of the GÉANT Open Call research initiative running from October 2013 to March 2015, see www.geant.net

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Objectives of this work

- Introduce the Software Defined Networking paradigm in IP backbones
  - replicating the services of IP/MPLS networks
  - ... and their non-functional properties (“carrier grade”)

- Do it in an **open way** !!
  - Open source components
  - **Simple** tools for setting up and performing experiments
Outline

1. Open Source Hybrid IP/SDN (OSHI) data plane
2. An example service: Ethernet VLL
3. OSHI emulation tools (and short video demo)
4. Performance evaluation
1. Open Source Hybrid IP/SDN

Open Source Hybrid IP/SDN (OSHI)

http://netgroup.uniroma2.it/OSHI

Hybrid IP/SDN resilient data plane

Open Source Hybrid IP/SDN (OSHI) nodes

IP routing & forwarding

SDN/OpenFlow switch
OSHI Node architecture

IP Routing Daemon (Quagga)

IP Forwarding Engine (Linux networking)

SDN Capable Switch - SCS (Open vSwitch)

Virtual ports

Physical interfaces

1. Open Source Hybrid IP/SDN

OSHI - Open Source Hybrid IP/SDN networking (and its emulation on Mininet and on distributed SDN testbeds)
1. Coexistence mechanisms for IP traffic and SDN traffic
2. Ingress classification functions / tunneling mechanisms

Hybrid IP/SDN data plane
Hybrid IP/SDN data plane

1. Coexistence mechanisms for IP traffic and SDN traffic
2. Ingress classification functions / tunneling mechanisms

Current prototype: VLAN tags for coexistence, classification & tunneling mechanisms
Ethernet Virtual Leased Line

- VLL is provided through a SDN Based Path (SBP)
  - we use VLAN tags switching (in current prototype)
Virtual Leased Line Pusher

2. An example service (VLL)

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3. Emulation tools

Design & deployment workflow

Graphical Topology and Service Designer

networkx (automatic topology generator)

Topology representation file (JSON)

Topology to testbed mapping

Topology Deployer

Topology Parser

Mininet Deployer

OFELIA Deployer

Measurement Tools

OFELIA Setup scripts

OFELIA config scripts

Management Console

OSHI - Open Source Hybrid IP/SDN networking (and its emulation on Mininet and on distributed SDN testbeds)
Emulation on OCF testbeds

(OCF : OFELIA Control Framework)

3. Emulation tools

Overlay Experimental Topology

VMs and Tunneling

Physical OFELIA testbed

How to map an arbitrary topology on a set of VM servers and links, with minimal configuration effort?
Emulation on the OCF testbeds (2)

(OCF : OFELIA Control Framework)

3. Emulation tools

- VXLAN (or OpenVPN) for making tunnels
- Bash and Python scripts to automate VMs setup
- DSH for distributed setup and maintenance

Our toolset:

- VXLAN (or OpenVPN) for making tunnels
- Bash and Python scripts to automate VMs setup
- DSH for distributed setup and maintenance

Overlay Nodes ➔ VMs
Overlay Links ➔ Ethernet over UDP tunnels
Short demo

1. Topology and Service Designer
2. Topology Deployer (on OFELIA)
3. Virtual Leased Lines operation
Demo Video is available at:
https://www.dropbox.com/s/5ahmuiqlcr3wnue/oshi-v5.wmv

You may want to download the oshi-v5.wmv file locally,
save it in the same folder of the .pptx file,
then you may click on the link below while in pptx presentation mode

Enjoy watching!

OSHIVideo-demo-v5.wmv
3. Emulation tools

Performance evaluation
Measurements tools

- **iperf tool for traffic sources/sinks**
- **A client-server measurement tool to gather CPU load info of VMs**

```
iperf -c
```

```
iperf -s
```

**xentop on the XEN server**

OSH! - Open Source Hybrid IP/SDN networking (and its emulation on Mininet and on distributed SDN testbeds)
4. Performance evaluation

OSHI vs. Plain Router

(no tunnels in both cases)

No tunnels, comparison between routing with OSHI and a plain router

% CPU Load vs. Packet Rate

Packet Rate (p/s)

OSHI IP

ROUTER IP
Tunneling comparisons

OpenVPN tunnels vs. VXLAN tunnels vs. No tunnels

4. Performance evaluation

OSHI IP

Packet Rate (p/s)

%CPU

OpenVPN
VXLAN
No Tun.
References

• DREAMER project home page:
  http://netgroup.uniroma2.it/DREAMER

• Home page of OSHI
  http://netgroup.uniroma2.it/OSHI
  – Code from GitHub see Software download section
Conclusions

• We designed and implemented an Open Source Hybrid IP/SDN solution (OSHI) ... it works well!

• The VXLAN tunneling solution is very effective to map overlay topology over distributed testbeds

• The proposed deployment workflow is a key element to ease innovation in IP/SDN networks
Next steps (work in progress)

- Designing a full Ethernet “pseudo-wire” service... using MPLS for tunneling rather than VLAN
- Using ONOS controller clusters to replace Floodlight
- Designing a solution with multiple controller clusters, each one controlling a portion of a wide area SDN based IP/SDN backbone
Thank you! (questions)
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