OFELIA

The EU FP7 Project
and
The European OpenFlow Experimental Facility
Outline

• OFELIA – the EU FP7 project

• OFELIA – the European OpenFlow experimental facility

• How to experiment on OFELIA
OFELIA
OpenFlow in Europe – Linking Infrastructure and Applications

• EU FP7 project
• Started September 2010
  Duration: 3 years
• Total budget 6.3M€, funding 4.45M€

• 10 partners
  + 2 after the first Open Call
  + 6 after the second Open Call
  – Academic institutions
  – Industry partners:
    • Deutsche Telekom, NEC, ADVA Optical
  – Stanford university official partner
    • Nick McKeown, Guru Parulkar
    • Control framework, architecture, experience

• 10 OpenFlow-enabled islands at academic institutions

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Scientific challenges and objectives
OFELIA builds the first OpenFlow switching testbed in Europe. Essential for Future Internet experimentation.

**Future Internet research needs large-scale flexible environments supporting virtualization, allowing new control and routing algorithms**
- Poor support for experiments in today’s routers & switches
- Large OpenFlow testbeds in the US (GENI) & Japan

**OFELIA creates real-world experimental networking substrate**
- Allows flexible control down to individual flows
- Is protocol agnostic, programmable, scalable
- Allows deployment & test of new controllers & control apps

**Main objective is the creation of a research facility including**
- Virtualization: automatic creation of slices
- Multi-domain extensions of controllers (for federation of islands)
- Extension into optical and wireless technologies

**OF extensions needed for multi-layer, multi-domain experiments**
- Any domain or layer borders require flow processing; Interface between controller and processing plug-ins needs to be developed & tested
- Extend filter format description to generic labels (CarrierEther, IPv6, opt. circuits)
- non-IP experiments such as content-based addressing
OFELIA facility operation and phased extension
From isolated islands to centralized resource management.

Operation of the individual islands, one partner per island has the lead
- Phase i: OF controllers and switches in place, first local experiments concluded
- Phase ii: Connect islands and extend OF experimentation to wireless and optics
- Phase iii: Automate resource assignment and provide connections to other FIRE and non-European research facilities

Open Calls to extend facility & consortium will be published after M5 & M17
Total budget €830,000 max. 200 K€ funding per experiment
- First call closed end of March 2011
- Second call closed end of March 2012
- Open Calls were promoted through www.fp7-ofelia.eu and
  — FIRE Station
  — Standard communication channels (mailing lists, IEEE ComMag)
  — Industry fora: Optical Internetworking Forum, Open Grid Forum

i: Create islands on L2
ii: Connect islands and extend to wireless/optics
iii: Resource assignment automation and connection to other facilities

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• Control Framework based on eGENI’s **expedient**
  – SFA-based (SFA-inspired...)
  – **Expedient** is a web interface
  – VT Plug-in: Expedient’s logic to communicate with VT AM.
  – OF Plug-in: Expedients’s logic to communicate with Opt-in
• VT AM: Manage Virt. Servers
• Opt-in: Manage OpenFlow resources
• Agent: controls virtualization servers
<table>
<thead>
<tr>
<th>Island</th>
<th>OF-capable Ethernet Switches</th>
<th>Servers</th>
<th>NetFPGA cards, optics, wireless</th>
</tr>
</thead>
<tbody>
<tr>
<td>i2CAT</td>
<td>5x NEC IP8800/S3640-24T2XW, 3x HP E3500-48G-PoE+yl</td>
<td>5x SuperMicro SYS-6010T-T</td>
<td></td>
</tr>
<tr>
<td>IBBT</td>
<td>1 NEC IP8800 /S364 0-48T2XVV-LW w/ XFP</td>
<td>Virtual Wall (100 server emulab instance)</td>
<td>WiLab facility, 10 NetFPGA cards</td>
</tr>
<tr>
<td>UBristol</td>
<td>4x NEC, 3x Extreme Networks, 3 ADVA FSP 3000 ROADMs, Calient optical switch</td>
<td>5x Dell PowerEdge servers</td>
<td>ultra HD video streaming, 10TB storage, 2x Virtex-4 FPGA boards</td>
</tr>
<tr>
<td>ETHZ</td>
<td>3x OpenFlow switches NEC IP8800/S3640-24T2XW with two optical 10GBase interfaces</td>
<td>3 servers w/ 36 GByte RAM</td>
<td></td>
</tr>
<tr>
<td>TUB</td>
<td>5x NEC IP8800/S3640-48TWLW</td>
<td>3 servers</td>
<td>2 NetFPGA, BOWL testbed</td>
</tr>
<tr>
<td>Create-Net</td>
<td>3xNEC, 2xHP ProCurve 3500</td>
<td>5 servers (2 control framework, 3 exper.)</td>
<td>4 NetFPGA cards</td>
</tr>
</tbody>
</table>
Example Island:
OFELIA-TUB-Island

Inventory of OpenFlow switches in the testbed

<table>
<thead>
<tr>
<th>Name</th>
<th>Model</th>
<th>Datapath ID</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEC1</td>
<td>NEC IP8800/S3640-48TW</td>
<td>00:00:00:00:00:00:00:04:01</td>
<td>Up and running</td>
</tr>
<tr>
<td>NEC2</td>
<td>NEC IP8800/S3640-48TW</td>
<td>00:00:00:00:00:00:00:04:02</td>
<td>Up and running</td>
</tr>
<tr>
<td>NEC3</td>
<td>NEC IP8800/S3640-48TW</td>
<td>00:00:00:00:00:00:00:04:03</td>
<td>Up and running</td>
</tr>
<tr>
<td>HP1</td>
<td>HP5400</td>
<td>00:00:00:00:00:00:00:04:04</td>
<td>Not deployed</td>
</tr>
<tr>
<td>CIT-NEC</td>
<td>NEC IP8800/S3640-48TW</td>
<td>00:00:00:00:00:00:00:04:05</td>
<td>Only productive</td>
</tr>
</tbody>
</table>

Patch Table

<table>
<thead>
<tr>
<th>Experimental Network (OF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch\Port ...</td>
</tr>
<tr>
<td>NECl</td>
</tr>
<tr>
<td>NEC2</td>
</tr>
<tr>
<td>NEC3</td>
</tr>
</tbody>
</table>
Example Experiment: Virtual Topologies Creation

- AdVisor: extension to FlowVisor, introduces topology virtualisation layer
- Developed by Create-Net, Trento
- Integrated into OFELIA Control Framework in phase 2
OFELIA is Available And Free For Use

• The OFELIA facility is open as a best-effort service
  – Any user accepting the usage policy is welcome
  – Connection to the facility through OpenVPN via the central hub at IBBT in Ghent
  – Through a graphical user interface, a user can create and run experiments

• An experiment/slice consists of
  – A number of end points (Xen-based virtual machines, currently)
  – OpenFlow access to a set of switches that connect the end points
    • The user’s OpenFlow controller can be deployed on one of the VMs
  – Links between end points and switch ports
    • Best effort (shared), mostly
    • Dedicated capacity will be available at least on some lines

• Instructions, Wiki, Videos, Open Calls, press releases, contact
  http://fp7-ofelia.eu

Facility is publicly available for experiments
Feedback is very much appreciated

The control framework software is free
Build your own OFELIA islands, connect over to us, develop further
Create & Run your Experiment!

1. Have an idea!

2. Log on to OFELIA!

3. Configure your network slice!

4. Run your experiment!!!
The OFELIA Offer

• Use the facility
  – Be gentle, this facility is a free offer to be used by researchers all over the world, accept our usage policy (similar to PlanetLab)

• The control framework software is free
  – Build your own OFELIA islands, connect over to us, develop further

• Instructions, Wiki, Videos, Open Calls, press releases, contact

  http://fp7-ofelia.eu