Using Kytos SDN platform to enhance international big data transfers

Beraldo Leal
beraldo.leal@cern.ch
Sao Paulo State University - Unesp
Brazil

CHEP2018 - Sofia, Bulgaria
About Sprace

The São Paulo Research and Analysis Center (SPRACE) develops fundamental and applied research in areas such as High Energy Physics (HEP), scientific instrumentation, high performance computing (HPC) and digital innovation.

SPRACE operates the **BR-SP-SPRACE** cluster, which is a Tier 2 of the WLCG.

Fundamental Research: Our research team is dedicated to the search of new physics beyond the standard model, including the search for dark matter and for heavy resonances decaying into dibosons.

Scientific Instrumentation: Our engineering team is participating in electronics development activities for the Phase-2 upgrade on the CMS experiment.

SPRACE also collaborates with private companies in digital innovation projects, with emphasis on HPC, Machine Learning and Software Defined Networks (SDN).
Since 2004, we have been breaking records in data transfer between hemispheres...

- We reached 2 Gbps from São Paulo to Pittsburgh
- The Bandwidth Challenge Demo reached ~100 Gbps at the showfloor

- We reached 16 Gbps from São Paulo to Pittsburgh
- The Bandwidth Challenge Demo reached ~120 Gbps at the showfloor

- We reached 1 Tbps at the showfloor

*SC (SuperComputing) is The International Conference for High Performance Computing, Networking, Storage and Analysis
...with partners like Caltech and...

We reached **97 Gbps** from São Paulo to Miami
1st production test with Kytos

Kytos was used to manage data flow and orchestrate network equipments connecting São Paulo and Denver
... distributed Academic Networks:

- Internet2 (USA)
- Amlight (USA, Brazil and Chile)
- RNP (Brazil)
- ANSP (Sao Paulo, Brazil)
Lessons learned

- Complex Inter-Domain Orchestration
  - Slow Circuit Provisioning Time
  - Complex coordination for provisioning
    - Large distances, multiple domains are involved
    - Phone calls + emails + tickets > weeks or months
- Quality of Service no guaranteed
  - No Bandwidth reservation (> 10Gbps)
  - Slow circuit reprovisioning (failover)
- Lack of programmability
- Lack of visibility
  - Topology and bottlenecks

*We need fast, flexible and programmable networks!*
What is Kytos?

- Kytos is an open source SDN platform born to stress WAN for data-intensive science and to make programmable networks accessible, friendly, and easy to use.
- An SDN Platform at early, but heavy stage of development since Jan/2016
  - Event Handler with "Pub&Sub" methods and decorators
  - High Level Language API to write Network applications
  - Ecosystem with Plug&Play Network Applications repository
  - User friendly with a Nice and Responsive web UI
  - 100% Open Source (MIT License)
  - Always with "keep it simple" paradigm in mind
  - Designed to be vendor and protocol agnostic

**Definition:** Cyto-: Prefix denoting a cell. 'Cyto-' is derived from the Greek 'kytos', meaning 'hollow, as a cell or container.'
Kytos’ flexibility allows third-parties to build on top of its platform with custom NApps
Our NApps repository is growing and you can use the community power to reuse code.
Using Kytos Platform is easy as pie

# Install
$ pip install kytos

# Explore our NApp Repository
$ kytos napps search router
$ kytos napps install john/router

# Enjoy ;)
# Access: https://your.controller.domain/
Using Kytos Platform is easy as pie

Welcome to Kytos SDN Platform!

We are doing a huge effort to make sure that this console will work fine. But for now is still experimental.

Kytos website.: https://kytos.io/
Documentation.: https://docs.kytos.io/
OF Address....: tcp://0.0.0.0:6633
WEB UI........: http://0.0.0.0:8181/
kytos $>
As an Open Source project, Kytos is continually working to build a strong community

**Partners**
Contribution with tests, bug reports, and code

**Sponsors**
Contribution with space, hardware, and FTEs

https://kytos.io/membership/
Kytos has 2 summits & 2 stable releases / year

- Kytos summit (~1 week)
- b1, b2, b3 (~6 weeks each)
- Release Candidate (~3 weeks)
- Official Stable Release

**Kytos Summit**

Discussions, planning, fun

~1 week

**Development Period**

Milestones

(year).b1
(year).b2
(year).b3

~5 months

**Release Candidate Period**

Milestones

(year).rc1

3 weeks

**Official Stable Release**

Create the stable branch and release the stable version

Kytos SDN Platform
Kytos most recent NApp: MEF E-Line

- A Kytos Network Application for provisioning point-point circuit (E-Line)
  - Uses Metro Ethernet Forum (MEF) Carrier Ethernet E-Line specification
  - Blueprint EP012 (kytos/docs/blueprints/EP012.rst)
  - github.com/kytos/mef_eline
  - napps.kytos.io/kytos/mef_eline
How Kytos MEF E-Line works

- User submits an EVC request via E-Line NApp's REST

- For EVPL: E-Line NApp verifies if UNI_A's requested C-VID and UNI_Z's requested C-VID are available from the interfaces' pools.

- E-Line NApp requests a primary and a backup path to the **Pathfinder NApp** using the attributes `primary_links` and `backup_links` submitted via REST

- For each link composing paths in #3:
  - E-Line NApp requests a S-VID available from the link VLAN pool.
  - Using the S-VID obtained, generate abstract flow entries to be sent to **FlowManager NApp**
How Kytos MEF E-Line works

- Push abstract flow entries to FlowManager and FlowManager pushes OpenFlow entries to datapaths
- E-Line NApp generates an event to notify all Kytos NApps of a new EVC creation
- Notify user of the status of its request

More details:
https://napps.kytos.io/kytos/mef_eline
Kytos MEF E-Line on the field: SC18 use case

- **Sustained bandwidth**: 370 Gbps (800 TB transferred in one day)
- **Transfers from Sao Paulo/Brazil to Denver/USA**
- **9 SDN Switches (6 productions switches)**: Brocade, Corsa, Dell, etc.
Possible Use case: Kytos MEF-Eline & FTS

- A **GFAL2** plugin can be used to create a circuit (with QoS) before transfer starts
  - [https://github.com/kytos/kytos-gfal-plugin](https://github.com/kytos/kytos-gfal-plugin)
    - Forked from: [https://github.com/cern-it-sdc-id/gfal2-sdn](https://github.com/cern-it-sdc-id/gfal2-sdn)
Join us! Learn more about Kytos Platform

Main Site
kytos.io

Documentation
docs.kytos.io

Tutorials
tutorials.kytos.io

GitHub
/kytos

Slack
Kytos @ Channel

Mailing List
lists.kytos.io

Linkedin
/company/kytos

Twitter
/KytosProject
Questions?

Beraldo Leal
beraldo.leal@cern.ch
Sao Paulo State University - Unesp
Brazil

CHEP2018 - Sofia, Bulgaria
$ kytos napps search l2ls

<table>
<thead>
<tr>
<th>Status</th>
<th>NApp ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[--]</td>
<td>jab1982/l2ls</td>
<td>My L2LS implementation</td>
</tr>
<tr>
<td>[--]</td>
<td>kytos/of_l2ls</td>
<td>A L2 learning switch ap...</td>
</tr>
<tr>
<td>[--]</td>
<td>kytos/of_l2lsloop</td>
<td>A L2 learning switch app...</td>
</tr>
</tbody>
</table>

Status: (i)nstalled, (e)nabled