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Europe's Brazil connection

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Although complex, today’s internet still has its roots anchored in the original TCP/IP architecture and protocol foundations. Over the last decade, networks, servers, storage, and applications have all undergone significant changes with the introduction of virtualisation, network overlays and orchestration. Infrastructure innovation is generally risky and will definitely benefit from experimental test beds, where innovative and disruptive future internet solutions can be validated before being used in production networks.

The FIBRE project, co-funded by the Brazilian Council for Scientific and Technological Development (CNPq) and the European Union, has created an intercontinental test bed for large-scale experimentation involving distributed network applications relying on Software Defined Networking (SDN) and network programmability via OpenFlow.

Using Slice-based Federation Architecture (SFA) FIBRE has created a federation of IT and networking devices bringing together independent resources located in remote test beds around Europe and Brazil. Interfaces and data types aggregate resources, allowing the slice-based network substrates to work together.

The physical devices deployed in FIBRE are virtualised so that they may be shared between different users/experiments. This virtualisation and slicing of both servers and network switches is made possible through third-party software tools like XENserver (for IT resources) and Flowvisor (for network resources).

A dedicated 'per-slice' SDN controller then allows the experimenter to test and validate new network applications and routing strategies in an isolated environment.

Federation is not only available at device level –the entire test beds (in Europe and Brazil) are also federated; federation interfaces allow their different control monitoring frameworks (CMFs) to share data.

This has been made possible by incorporating results from previous EU-funded projects, such as OFELIA, OMF and ProtoGENI. The FIBRE team enhanced its software tools to create a more powerful, northbound interface.

The experimentation facilities are showcased in a selection of use cases. For example, users can access OpenFlowcontrolled network resources located in the laboratories of CPqD (Campinas, Brazil) and i2CAT (Barcelona, Spain), through a VLAN-based L2 connection provided by GEANT, Internet2 and RedCLARA.

Particularly innovative in this use case is an enhanced NOX (OpenFlow) controller, integrated with a Flow-aware Path Computation Element, allowing the computation of network flow routes to be installed dynamically in the federated test bed.

The NOX controller communicates with a Web client that receives information about the virtual network topology, calculates flows, installs them in the switches, and schedules the routing paths taking into account bandwidth, time and VLAN constraints.

FIBRE chose OSCARS, a Bandwidth on Demand (BoD) system, to act as a Web user interface for this use case. This will make it possible to explore the full interoperability of OpenFlow-based islands with BoD systems and related control technologies.

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