A Monitoring Framework for the FIBRE project

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Abstract. Performance is a key instrument in today's networks. It allows to diagnose problems in an end to end basis, helping IT staff to reduce costs, downtime and also improving the end user experience. In network research and development, measurement is a key point to guarantee more efficient, correct and accurate results, especially when dealing with Future Internet experimentations. FIBRE (Future Internet testbeds/experimentation between Brazil and Europe) –is a cooperation project which intends to implement and validate a shared research infrastructure between Brazilian and European universities and institutes. This paper elaborates on a proposal for a Monitoring Framework for the FIBRE project which will be a federated management tool, using perfSONAR services. This tool will provide information about slices, queues, response time, flow aggregation, and flow setup time at FIBRE facilities.

Introduction

Future Internet testbeds are being widely deployed all over the world. These experimental networks, such as GENI, Emulab, PlanetLab/OneLab, PanLab, Federica and AKARI, allow the development of new protocols, services, algorithms of any kind in a real network without disrupting the production environment. For more information on these testbeds please refer to [Abelém et al., 2010]. Aligned with this goal, FIBRE is a cooperation project that is intended to implement and validate a shared research infrastructure between Brazilian and European universities and institutes. FIBRE, in a nutshell, aims at building a shared large-scale experimental network based on OpenFlow, federate Brazilian and European resources and also augment collaboration among Brazilian and European researchers. FIBRE, not differently from any other major Future Internet Experimental project, will rely on the Sliced-base Facility Architecture (SFA) [Peterson et al., 2009] and OpenFlow (OF) [McKeown 2008].

Monitoring is a crucial component of any testbed in order to collect all relevant data for each experiment, including not only network related measurements but also operational data which can help operations personnel on monitoring and troubleshooting the infrastructure itself, as pointed out in [Monteiro, 2010].

Several monitoring frameworks have been proposed and/or implemented on these large-scale experimental Future Internet networks such as GENI Instrumentation and Measurement System (GIMS), Leveraging and Abstracting Measurements with perfSONAR (LAMP), Instrumentation Tools (INSTOOLS), TopHat, etc. [Monteiro 2010].

This paper proposes a Monitoring Framework for the FIBRE project that will use perfSONAR services to provide a federated monitoring solution. It will be built upon the work started by GENI's LAMP Project[1] which exactly aims at leveraging and abstracting measurements with perfSONAR.

Monitoring Framework proposals and ideas

perfSONAR is a multi-domain performance monitoring framework, which defines a set of protocols standards for sharing data between measurement and monitoring systems [Tierney, 2009]. Among the defined services we find: Measurement Point (MP) Service: active and passive measurements monitoring information creation and publication; Measurement Archive (MA) Service: measurement data retrieval; Lookup Service: registration process for all participating services; Authentication and Authorization (AA) Service: domain-level access management; Transformation Service (TS): custom data manipulation of existing archived measurements; and Topology Service (TopS): topological information on networks [Hanemann 2005].

As mentioned before, we plan on building upon LAMP's results and experience which is based on ProtoGENI's control framework to support the proposed monitoring framework. Besides making available network related data, the LAMP tool also collects host monitoring data using Ganglia[2], and uses perfSONAR API and schemas to export them through a new Ganglia MA service. Based on the expected results of LAMP's activities, we plan on adapting its prototype to the FIBRE Control Framework.

Since the experimental facilities both in Europe and in Brazil will use OpenFlow switches, the proposed Monitoring Framework will aggregate some OpenFlow information to the existing perfSONAR services, including information about slices, queues, response time, flow aggregation and flow setup time, not limiting the monitoring framework to these parameters. OpenFlow switch table and port statistics can be collected at its controller, e.g., NOX [NOX, 2009]. The collected data will be made available through a measurement archive (MA) and shared to other monitoring tools.

Besides OpenFlow's data, FlowVisor's data should also be taken into account in the proposed monitoring framework. Since FlowVisor is considered an OpenFlow proxy that acts between an OF switch and an OF controller [Sherwood et al., 2009], it

[1] http://groups.geni.net/geni/wiki/LAMP
[2] http://ganglia.sourceforge.net/

adds an extra layer of processing and overhead [Yap 2009], which impacts response time, delays and flow setup time, for example.

Another possibility is to integrate QuagFlow monitored data to the proposed monitoring framework. QuagFlow is a transparent combination of the popular and mature Quagga[3] routing software suite and OpenFlow-enabled hardware [Nascimento, 2010]. This integration may be achieved by installing an SNMP agent using SMUX protocol on Quagga boxes and retrieving some routing and flow information that could be used to help to infer some interesting information about routing changes impact on flow setup time for instance. It would be relevant to monitor the very same behavior using OpenFlow with FlowVisor. This could lead to interesting results, especially when considering the integration and operation of OpenFlow, FlowVisor, NOX Controller, and QuagFlow. The later tool was recently released by CPqD [Nascimento, 2010].

Another approach is to consider a possible integration of the Orbit Measurement Library (OML) to perfSONAR. OML is a part of cOntrol and Management Framework (OMF). OML has been developed by the WinLab and NICTA, which is an Australian ICT institute that is also a FIBRE partner. OML main feature is the possibility to add Measurement Points (MP) to applications or services and it is a researcher's decision to enable it at run-time [White, 2010]. OML focuses mainly on mobile networks and FIBRE proposed monitoring framework could benefit from this expertise and could integrate this service to perfSONAR, at least through a MA interface to OML's server. It is also interesting to analyze and monitor the communication between the client and the server in FIBRE's federated environment.

Conclusion

Despite the ideas and proposals that were presented in this paper, there are still a lot of decisions to be made in FIBRE that can affect many of them. These will be quite challenging due to the federated model that Brazilians and Europeans researchers will define for the FIBRE project. The proposed Monitoring Framework will eventually evolve from the discussion points that were presented in this paper.

Clearly, there are several unsolved problems and new challenges to overcome. FIBRE's monitoring framework proposed in this paper will endeavor to solve at least some of these challenges.

[3] http://www.quagga.net/docs/docs-info.php

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