

\$SDN

Software Defined
Networking

Benchmarking Methodology for

SDN Controller Performance

draft-bhuvan-bmwg-of-controller-benchmarking-00

90th IETF, Toronto

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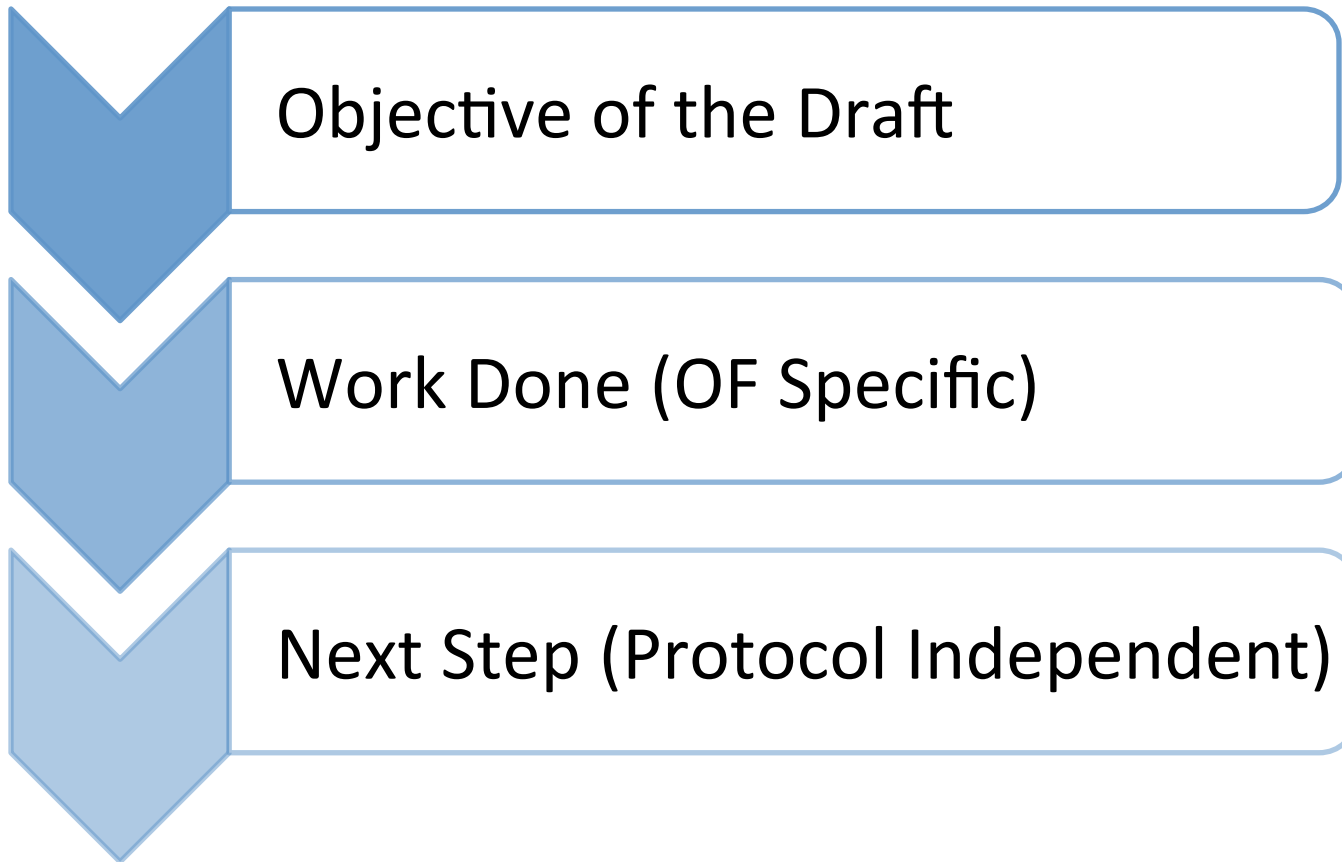
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Agenda



Objective

- Develop comprehensive set of tests for benchmarking SDN controllers for
 - ✓ Performance
 - ✓ Scalability and
 - ✓ Reliability
- Define a **generic** metrics and methodology to assess/evaluate SDN controllers.

Work Done



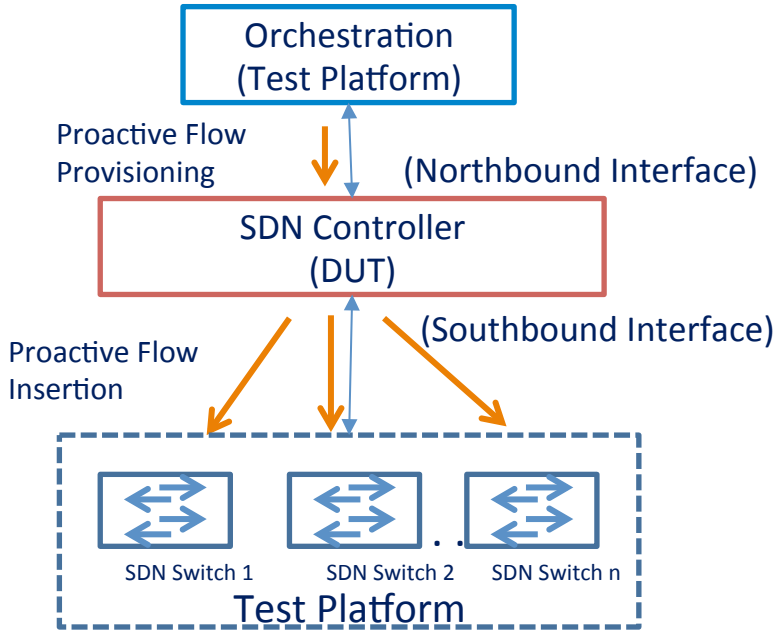
Draft 00
Submitted in March 2014

Draft 00 - Overview

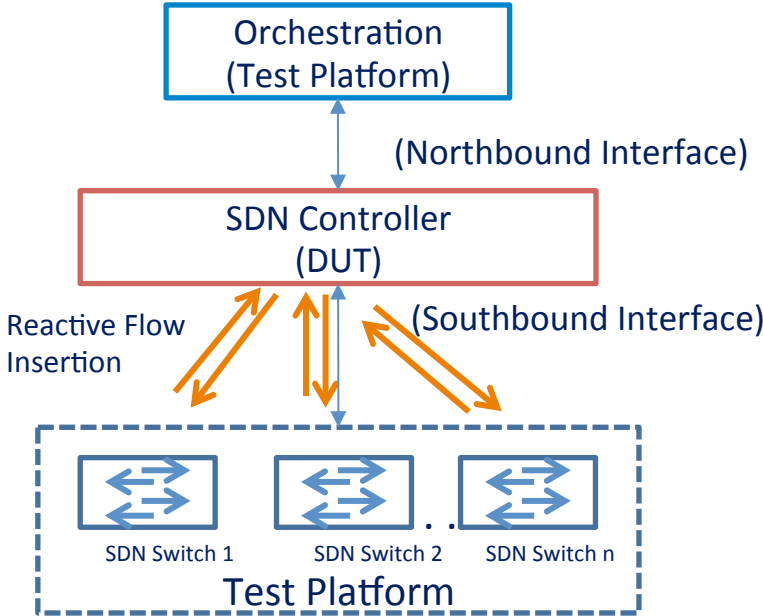
- Discuss metrics and methodologies for benchmarking **OpenFlow based SDN** Controller
- Covers various test scenarios
 - ✓ Proactive/Reactive Flow setup
 - ✓ Standalone/Controller Teaming
- Considers following test parameters
 - ✓ Number of switches
 - ✓ Number of flows
 - ✓ OpenFlow version
 - ✓ Channel Type (TCP/SSL)
 - ✓ Test Duration
 - ✓ Test Iteration

Draft 00 – Test Setup 1

- Controller Standalone Mode



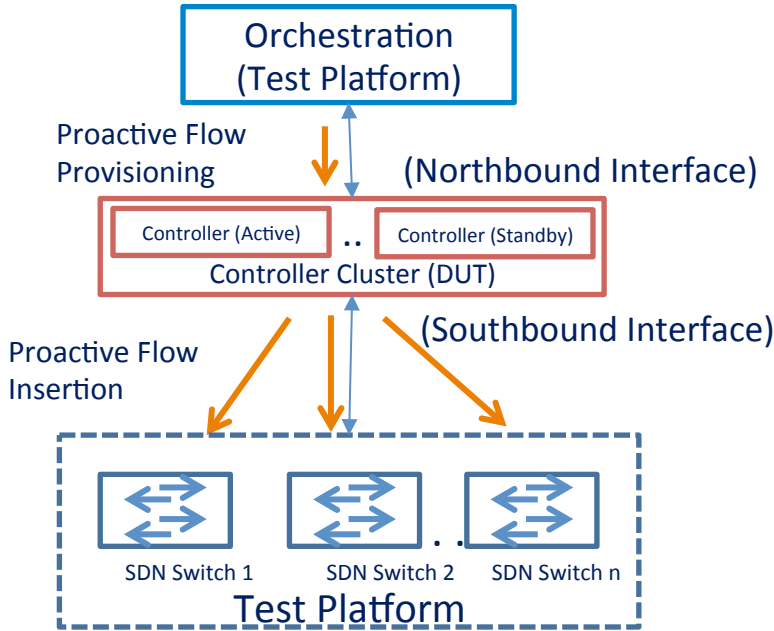
Proactive Flow Setup



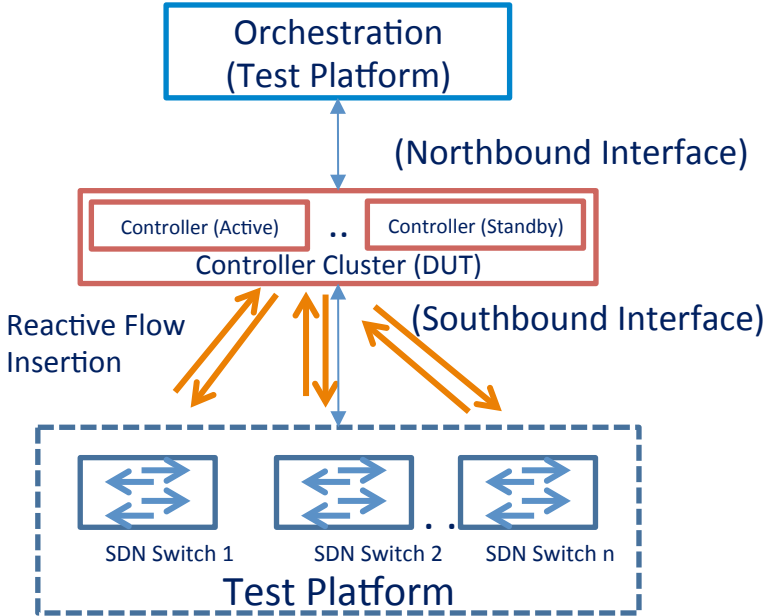
Reactive Flow Setup

Draft 00 – Test Setup 2

- Controller Cluster Mode



Proactive Flow Setup



Reactive Flow Setup

Draft 00 – Benchmarking Metrics

Benchmarking Categories	Metrics	Description
Performance	Flow setup rate	Maximum number of flows setup by a controller, expressed in flows per second
	Flow setup delay	Time taken by the controller to setup a flow, expressed in milliseconds.
	End-End flow setup duration	Time taken by the controller to setup a flow between a source to a destination, expressed in milliseconds.
Scalability	OpenFlow connections capacity	Maximum number of concurrent OpenFlow connections supported by a controller
	Switch scalable limit	Number of switches a controller can optimally manage
	Flow scalable limit	Controller OpenFlow table capacity

Draft 00 – Benchmarking Metrics

Benchmarking Categories	Metrics	Description
Reliability	Errored OpenFlow connections handling	Characterize the behavior of the controller when presented with a combination of both legal and illegal OpenFlow messages.
	Denial of service handling	Determine the effect of a denial of service attack on a controller OpenFlow connection establishment rates
	Controller failover time	Time taken to switch from one controller to another when the controllers are teamed and the master controller fails.
	Data path re-convergence time	Time taken to re-route a flow by the controller when there is a failure in the existing flow path.

Next Step



Draft 01
Work in Progress

Draft 01 – What is New?

- Define **generic metrics and methodologies** for benchmarking different SDN controller designs performing same tasks
- Change in test scenarios
 - No change
- Change in test parameters

Draft – 00	Draft – 01
Number of switches	Number of network nodes
Number of flows	Number of triggers
OpenFlow version	Protocol
Channel Type (TCP/SSL)	Deprecated??
Test Duration	No change
Test Iteration	No change

Draft 01 – Benchmarking Metrics Changes

Categories	Metrics Draft 00	Metrics Draft 01	Description
Performance	Flow setup rate	Forwarding entry programming rate	Maximum number of forwarding entries programmed by a controller, expressed in forwarding entries per second
	Flow setup delay	Forwarding entry programming delay	Time taken by the controller to program a forwarding entry, expressed in milliseconds.
	End-End flow setup duration	Path programming time	Time taken by the controller to setup a path between a source to a destination, expressed in milliseconds.
	-	Path programming rate	Maximum number of paths a controller can setup between any sources and destinations, expressed in paths per second
Scalability	OpenFlow connections capacity	Node discovery rate	Controller's rate of discovery of nodes
	Switch scalable limit	Network scalable limit	Number of nodes a controller can optimally manage
	Flow scalable limit	Max forwarding entries	Controller forwarding table capacity (dynamic/static)

Draft 01 – Benchmarking Metrics Changes

Categories	Metrics Draft 00	Metrics Draft 01	Description
Reliability	Errored OpenFlow connections handling	Exception handling	Characterize the behavior of the controller under exceptional conditions
	Denial of service handling	No Change	Determine the effect of DOS attacks on Forwarding entry programming rate/delay, Path programming rate/time, and Node discovery rate
	Controller failover time	No Change	Time taken to switch from one controller to another when the controllers are teamed and the active controller fails.
	Data path re-convergence time	No Change	Time taken to re-route the traffic by the controller when there is a failure in the existing traffic path.

Draft 01 – Other Changes

- Other Changes
 - Add missing/additional definitions in Terminology
 - Provide more clarity about the Testbed
 - Add recommended values for test parameters (e.g., Test Iterations)
 - Update Security Consideration section for specific issues
 - Appendix sections to be removed
 - Address editorial comments
- Thanks to Al Morton(AT&T), Brian Castelli(Spirent), Mark Tassinari(HP), Sarah Banks (Akamai) for sharing valuable feedback on the mailing list.



Thank You!!!

The authors of
draft-bhuvan-bmwg-of-controller-benchmarking-00