Project 2: VIRO Simulation Performance Report

Jacob Dison, Roman Dovgopol, Vikram Reddy, Tyler Schloesser, and Seth West
University of Minnesota — Twin Cities

I. Abstract

With the increased proliferation of network components, cloud services and mobile devices appearing on the Internet today, a faster, more efficient and robust networking architecture is needed. To address the matter, researchers at the University of Minnesota created **VIRO** (Virtual ID Routing), a namespace-independent networking paradigm intended to address the technical limitations of traditional layer-2 technologies like Ethernet while retaining a plug-and-play feature. A complete description of VIRO can be found in "VIRO: A Scalable, Robust and Namespace Independent Virtual Id ROuting for Future Networks" [1]. The aim of this project is to extend VIRO to support multi-path routing and fast re-routing, and to document performance measurements for our new implementation. This report distills and synthesizes our findings on control plane performance and data plane performance from testing our simulation on two network topologies: 1) *fat-tree-k2*, and 2) *isp-level3*.

II. Topology 1: fat-tree-k2

The fat-tree-k2 topology was designed to simulate a network topology featuring Map/Reduce-style workloads. We conducted simulations on three sets of sample workload data for this topology. Each test was run for approximate *35 seconds*. Our findings are presented below.

III. Control Plane Performance

When analyzing performance for fat-tree topology, we took note of the total packets sent and lost at both the data level and control level. We also noted the convergence times as a metric for our fast-rerouting scheme. For the control plane, we measured a total of *1018* control packets successfully sent through fat-tree and *1055* packets lost. With a total of *3165* data packets sent and *10365* data packets lost (which is also detailed further in the next section), the total number of packets transactions on the fat-tree network topology was *15603*. This means that *1018* out of *15603*, or slightly more than *6.5%* of packets, were considered lost control packets. *We measured an average of 2.656707382 seconds in convergence time on fat-tree*. This is close to par for where we should be, as the average

convergence rate should be close to *[time between rounds]/2*, which is around *5* in our case.

IV. Data Plane Performance

Below are detailed stats for data packets sent and lost on the data level through fat-tree.

Set	Number	Sent	Dropped/Lost
1	3001	1194	Dropped: 0
1	3004	1189	Dropped: 0
1	3005	1195	Dropped: 0
1	3008	1186	Dropped: 0
2	3001	822	Lost: 337
2	3007	0	Lost: 295
2	3003	0	Lost: 0
2	3005	1242	Lost: 0
3	3001	442	Dropped: 374
3	3002	1968	Dropped: 140
3	3003	0	Dropped: 450
3	3004	0	Dropped: 0
3	3005	0	Dropped: 594
3	3006	4	Dropped: 444
3	3007	897	Dropped: 531
3	3008	186	Dropped: 0

The total number of data packets sent is equal to *10365*, and the total number of data packets lost is *3165*. The percentage of data packets lost is equal to *3165/13530*, or about *23.3%*.

Figure 1: *Load Distribution for fat-tree-k2*

Using figures for packets sent, the load is fairly equally distributed in set *1*, while set *2* and set *3* show varying degrees of leftward skew. Many switches failed in sets *2* and *3*.

V. Topology 2: isp-level3

The isp-level3 topology simulates a real network topology, which, in this case, is congruent with the actual network topology maintained by Level 3 Communications in the western United States. Tests were run on this set for about 45 seconds. Due to space constraints, we are presenting our findings for the first data set only.

VI. Control plane performance

For isp-level3, we calculated that a total of 35264 control packets were sent through the topology, and 2183 control packets were lost. Our total data packet stats included 27400 sent and 3498 lost, giving a total of 68,435 packet transactions in isp-level3. This gives a control plane packet loss percentage of around 3.2 percent.

Also, we measured an average convergence time of 1.785805464 seconds, which is better than half of the time between rounds for packets, or 2.5 seconds (denoting an excellent convergence time for fast re-routing).

VII. Data plane performance

Set	**Number**	**Sent**	**Dropped/Lost**
1	8001	0	Lost: 1157
1	8004	2304	Lost: 279
1	8006	0	Lost: 385
1	8010	1554	Lost: 0
1	8012	7092	Lost: 274
1	8018	4534	Lost: 48
1	8023	6138	Lost: 474
1	8026	1834	Lost: 471
1	8032	3944	Lost: 410

With a total of 27400 data packets sent and 3498 data packets lost, the rate for data packet loss was equal to 3498 out of 30,898 data packet transactions, or slightly above 11.3 percent.

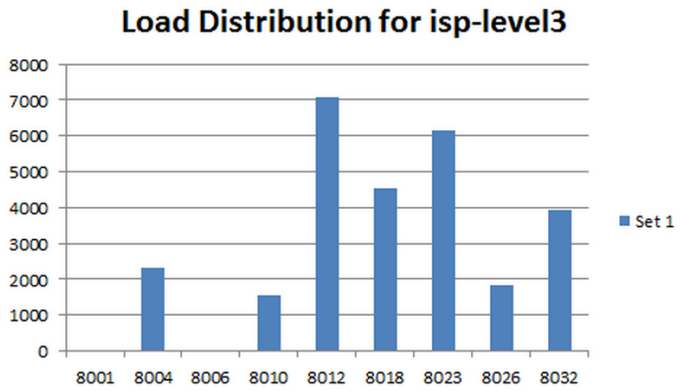

Figure 2: *Load Distribution for fat-tree-k2*

The load distribution for isp-level3 exhibits a skewed-right load with a third of the total load to the immediate right of the center.

VIII. Summary/Conclusion

1. Fat-tree-k2 topology
    - Data plane performance
        - The percentage of data packets lost was 23.3%.
        - In set 1, the load distribution is equal amongst all nodes. Set 2 and 3 show leftward skew.
    - Control plane performance
        - Around 6.5% of the total control packets were lost.
        - The convergence time was an average of 2.656707382 seconds.
2. ISP topology
    - Data plane performance
        - Around 11.3% of the total data packets were lost.
        - The load distribution is a skewed-right load.
    - Control plane performance
        - Around 3.2% of the total control packets were lost.
        - The average convergence time was around 1.785805464 seconds.

References

[1] Jain, Sourabh, Yingying Chen, and Zhi-Li Zhang. "Viro: A scalable, robust and namespace independent virtual id routing for future networks." *INFOCOM, 2011 Proceedings IEEE. IEEE, 2011.*