#214127

July 2014

Commissioned by
Ruijie Networks Co., Ltd.

Ruijie Networks Next-Gen Data Center Infrastructure Solution

Feature Validation - N18000 & S6220 Series Data Center Switches

EXECUTIVE SUMMARY

Nowadays, the realities of enterprise and cloud computing place ever-greater demands on data center infrastructure. Geographically separate data centers need to be able to function as one. They need to be able to handle integrated storage protocols and advanced virtualization functions.

Ruijie Networks Co., Ltd. commissioned Tolly to evaluate its Next-Gen Data Center Infrastructure Solution built around its RG-N18000 and RG-S6220 Series data center switches.

Tolly engineers found that the Ruijie solution could successfully provision a layer 2 network across multiple physical data centers, leverage virtual machine (VM) live migration to migrate switch profiles across data centers and provide unified, simultaneous support for both Fibre Channel (FC) and Fibre Channel over Ethernet (FCoE). See Table 1.

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THE BOTTOM LINE

The Ruijie Next-Gen Data Center Infrastructure Solution:

1. Illustrated the formation of a big Layer 2 network between two data centers using L2GRE & TRILL technologies by Ruijie Newton 18000 and S6220 series switches
2. Migrated the switch network profile with VM live migration between two data centers via the integration between Ruijie SDC (Smart Datacenter Commander) and VMware vCenter
3. Illustrated the unified storage feature in RG-S6220 data center switch, allowing the inter-connection with NetApp storage via both FC & FCoE storage protocols at the same time

Ruijie Network Next-Gen Data Center Infrastructure Solution Features

Tolly Certified Features		
✔	Layer 2 over Generic Routing Encapsulation (L2GRE)	
✔	Transparent Interconnection of Lots of Links (TRILL)	Multipath
✔		Convergence Time - average 142ms
✔	Switch network profile (ACL and QoS policies) follows with the Virtual Machine (VM) live migration - Ruijie Smart Datacenter Commander (SDC) interoperates with VMware vCenter	
✔	Fibre Channel (FC) connectivity to NetApp storage	
✔	Fibre Channel over Ethernet (FCoE)	
✔	Data Center Bridging (DCB)	Data Center Bridging Capability Exchange (DCBX)
✔		Priority-based Flow Control (PFC)
✔		Enhanced Transmission Selection (ETS)
✔	High Availability - FCoE using Link Aggregation Group (LAG)	

Source: Tolly, May 2014

Table 1

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Test Results

Overview

The Next-Gen data center needs to provide a range of sophisticated capabilities that remove networking restrictions previously dictated by geography, leverage the benefits of virtualization, provide multi-protocol storage support and support other advanced networking functions like those that provide for layer 2 communication across layer 3 IP networks.

To illustrate these capabilities, Tolly engineers built a lab environment using Ruijie Networks RG-N18000 and RG-S6220 switches representing two, geographically separate data centers. Tolly engineers then configured and benchmarked a series of key Next-Gen data center functionality. While the specific functions will be covered individually below, an overview of the multiple data center environment can be seen in Figure 1.

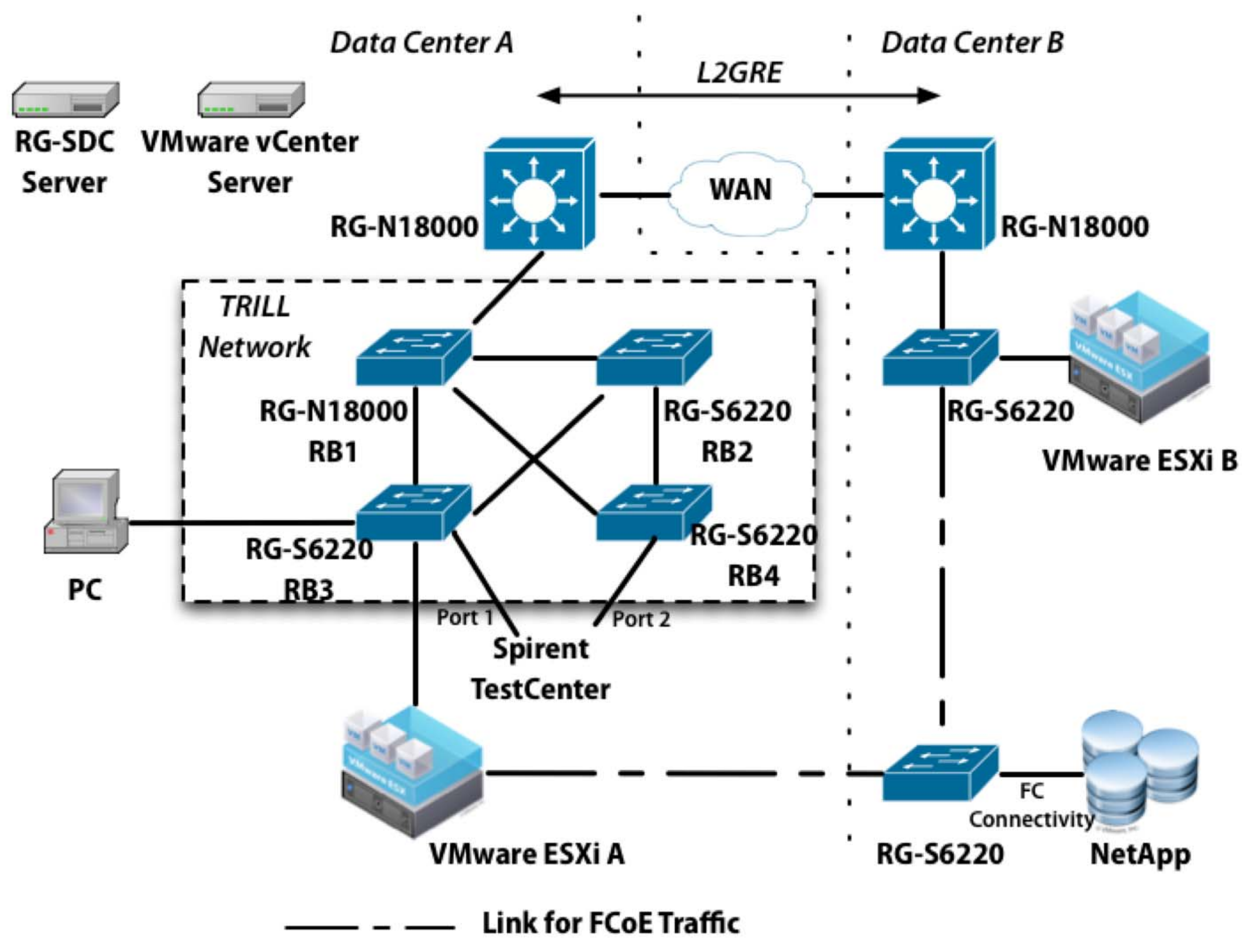
Ruijie Networks Co., Ltd.

Next-Gen Data Center Infrastructure Solution

Features

Tested May 2014

Ruijie Next-Gen Data Center Infrastructure Solution Validation Test Bed



Source: Tolly, May 2014

Figure 1

Test Results

Device Networking

Layer 2 Connectivity Across IP L3 WAN - L2GRE

The simplest way for networking devices to communicate is at layer 2, the layer at which Ethernet operates. To communicate via Ethernet with devices located across an IP (layer 3) network, network traffic must be tunneled between the two locations. This can be accomplished using the layer 2 encapsulated using Generic Routing Encapsulation or L2GRE.

Engineers configured an L2GRE connection between the two test data centers and then verified that layer 2 known unicast, unknown unicast and broadcast traffic could pass through the link between data centers. See Figure 1.

Large Layer 2 Network - TRILL

Transparent Interconnection of Lots of Links (TRILL) uses Layer 3 routing techniques to provide a large Layer 2 network with shortest paths and multipath.

Tolly engineers built a TRILL network using three RG-S6220 switches and one RG-N18000 switch. See Figure 1

Engineers then sent test traffic from one port of the Spirent TestCenter to another port of the TestCenter - each port connecting to a different member of the TRILL network. Engineers verified that traffic was automatically load balanced and traversing multiple links between the origin and destination TRILL switches.

To validate the redundancy aspect of the environment, engineers initiated a bidirectional stream of traffic (8Gbps) across the environment. Then, with the traffic stream running, disconnected one of the active connections between two of the switches.

Engineers verified that the remaining links were unaffected and that the traffic traversing the interrupted link required an average of 142ms to fail over to another link.

Switch Network Profile Follows VM Live Migration of Server

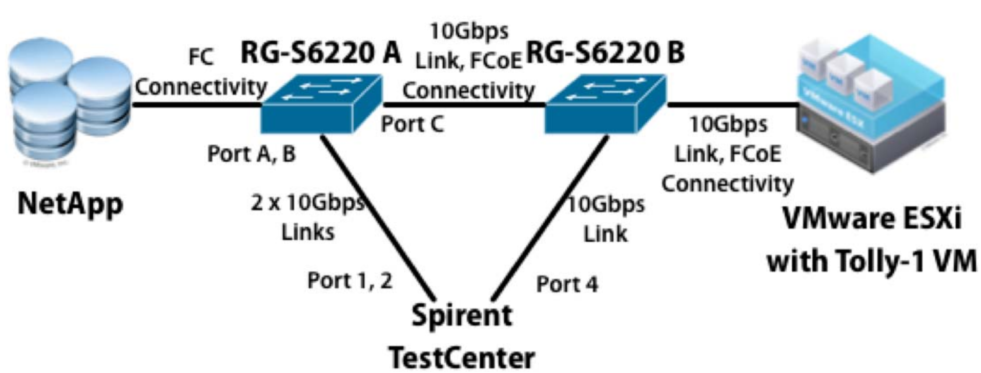
A key element of deploying virtual servers is the capability of moving virtual servers from one physical host to another host while running. In VMware systems, this is known as Live Migration.

It is equally important that switch profiles related to these VMs are also migrated when the servers migrate.

Engineers used Ruijie SDC (Smart Datacenter Commander) to connect to a VMware vCenter Server 5.1.0 which managed two VMware ESXi 5.1.0 hosts and verified that SDC was able to display the hosts, virtual machines and virtual network information managed by the vCenter instance.

One QoS policy and one ACL policy were assigned to the VM group which contains one VM on the ESXi A host. Engineers live migrated the VM from the ESXi A host to the ESXi B host which are in two different simulated data centers across the TRILL network and L2GRE network.

Ruijie RG-S6220 Data Center Bridging Validation Test Bed



Source: Tolly, May 2014

Figure 2

The VM was accessible all the time on the network with the traffic not matching the ACL (deny policies). Tolly engineers verified that the QoS and ACL policies were migrated and enforced to the proper different switch with the VM's migration. See Figure 1.

Storage Networking

Fibre Channel (FC) and Fibre Channel over Ethernet (FCoE)

Tolly engineers verified native FC support as well as FCoE support of the RG-S6220 switch by mounting the NetApp storage to the VMware system with FC connectivity between the storage and one RG-S6220 switch and FCoE connectivity at other places. See Figure 2.

FCoE and Data Center Bridging (DCB)

The functionality defined within the DCB standards provide for the lossless networks essential for running FC storage protocols over Ethernet networks (FCoE).

Specifically, Tolly engineers configured a test environment to test three key functions: Data Center Bridging Capability Exchange (DCBX), Priority-based Flow Control (PFC) and Enhanced Transmission Selection (ETS).

Test engineers devised traffic flows to exercise each of these functions and verified that the RG-S6220 switches provided these functions. See Figure 2 for the test bed and the test methodology section for the details of the data flows.

FCoE on Link Aggregation Group

Finally, engineers validated that FCoE could run successfully across a link aggregation group (LAG). Two links were made between the RG-S6220 switches and configured as a LAG.

Tolly used the Iometer benchmarking application to read storage data across the LAG from the NetApp storage device and verified that even when one of the LAG links was deliberately disconnected, the storage continued to be delivered across the remaining link of the LAG.

Ruijie Networks Systems Under Test

Model	Version
RG-N18010 Switch	RGOS11.0(1)B2
M18010-CM Control Module	
M18010-FE-DIII Fabric Module	
M18000-48XS-DB Line Card	
RG-S6220-24XS	RGOS 10.4(5b2)p1
RG-S6220-48XS4QXS	

Source: Tolly, May 2014

Table 2

About Ruijie Networks

Ruijie Networks (stock code: SZ: 002396) is a leading network solution supplier of China. We focus on customer benefits and strive to improve the network application experience of our customers through continuous technological innovation. Ruijie Networks provides end-to-end network solutions for telecom carriers, financial services, government agencies, education and enterprises to create values for customer networks.

Ruijie Networks has over 38 branch offices with sales and service covering Asia, Europe, North America, and South America. Ruijie Networks is the only data communication company certified as an innovative enterprise in China. With continuous improvement on the innovative road of independent R&D, Ruijie Networks leads and promotes the development of cutting-edge network technologies worldwide.

For more information on Ruijie Networks enterprise switches solution, please visit our company website, or scan the QR code below:

Learn more about Ruijie Switches

Source: Ruijie Networks, July 2014

Test Environment and Methodology

Three Ruijie RG-N18000 series switches and five Ruijie RG-S6220 series switches created the test bed with two simulated data centers. See Figure 1.

Device Networking

L2GRE

Two RG-N18000 switches were in different subnets and connected with WAN (layer 3 connection). A L2GRE tunnel was created between them to give the two data centers Layer 2 connectivity. Known unicast, unknown unicast and broadcast traffic all passed between the two data center networks.

TRILL Network

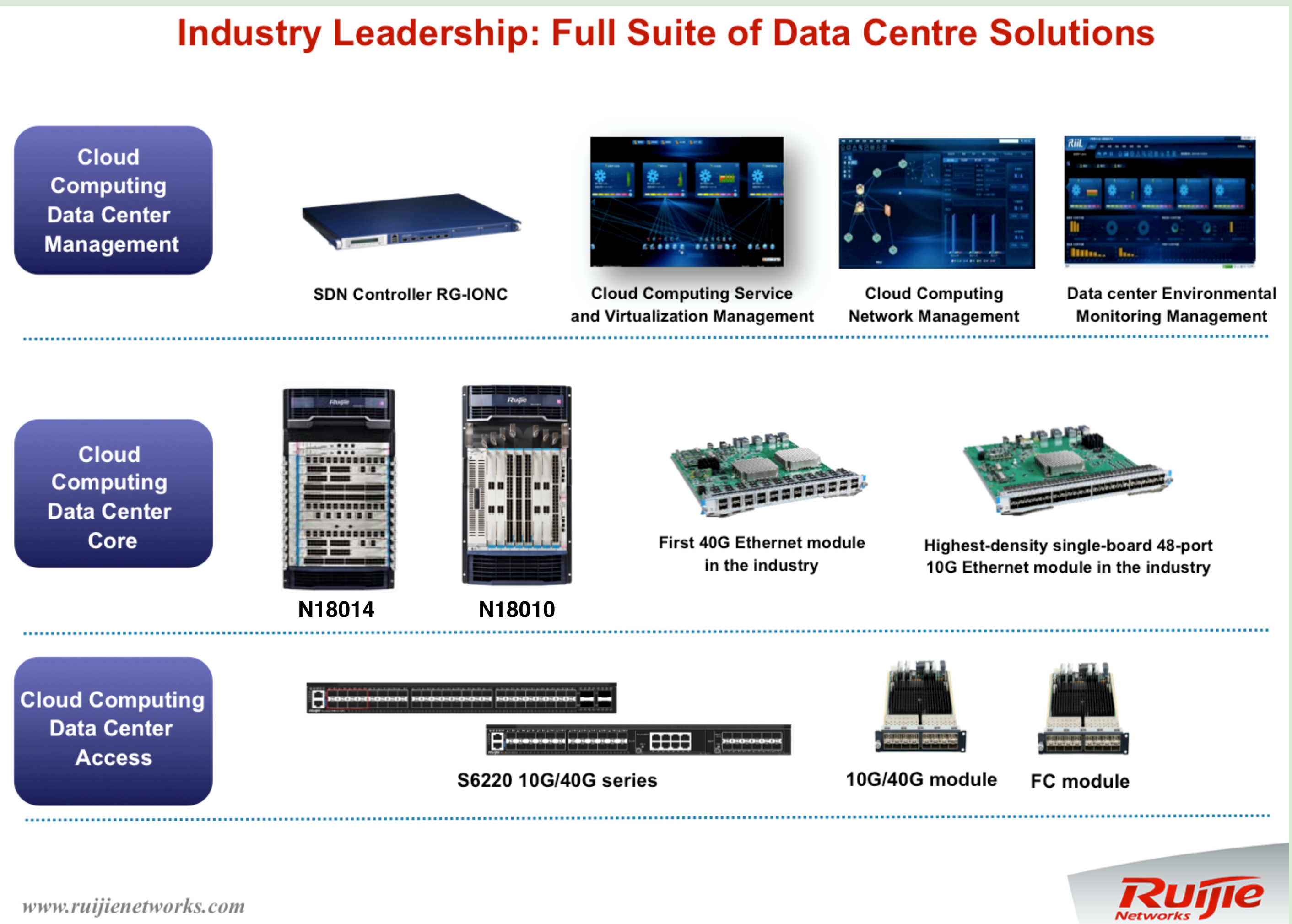
Three RG-S6220 switches and one RG-N18000 switch were configured to be in a TRILL network. The TRILL neighborhood relationships between the four switches were verified.

Multipath

Traffic was sent between TestCenter port 1 and port 2. Tolly engineers verified the traffic was load balanced to two paths in

Ruijie Networks Data Center Solutions Overview

Information provided by Ruijie Networks, not necessarily tested by Tolly



Source: Ruijie Networks, July 2014

the TRILL network (RB3 - RB2 - RB4 and RB3 - RB1 - RB4).

Convergence Time

Engineers configured the SPF and LSP interval for TRILL on the switches to the minimum values. 8Gbps bidirectional test traffic was sent between the two TestCenter ports with 128-byte frames (6,756,756 frames/second). The traffic was load balanced to two paths (RB3 - RB2 - RB4 and RB3 - RB1 - RB4). So on each path, the frame rate was 3,378,378 frames/second.

The link between RB2 and RB3 was then pulled off from the switch ports. The traffic on path RB3 - RB1 - RB4 was not affected by the failure. The traffic on path RB3 - RB2 - RB4 took an average of 142ms to failover to path RB3 - RB1 - RB4. The test traffic was bidirectional. The results for the direction with larger convergence time are reported here.

Switch Network Profile Follows with the VM Live Migration

Ruijie SDC (Smart Datacenter Commander) ver2.26 was configured to connect to the VMware vCenter Server 5.1.0 build 799731 which managed two VMware ESXi 5.1.0 build 799733 hosts.

One QoS policy (rate limit) and one ACL policy (denying source IP as an outbound policy) were assigned to the VM group which contains one VM on the ESXi A host. Engineers live migrated the VM from the ESXi A host to the ESXi B host which are in two simulated data centers across the TRILL network and L2GRE network and checked the connectivities. See Figure 1.

Storage Networking

FC and FCoE

The test bed in Figure 2 was used to validate FC and FCoE features.

One LUN on the NetApp SAN was mounted to the ESXi server. Tolly engineers verified that the WWN of the storage and the ESXi host matched the FC NS database on two RG-S6220 switches as the initiator and target.

DCBX

RG-S6220's ports were set into PFC willing mode. Tolly engineers verified that RG-S6220 ports were then able to learn the PFC settings (enabling PFC for which priorities) from TestCenter ports using DCBX.

PFC

Port 1 and port 2 of the TestCenter each sent 9Gbps traffic with VLAN priority cos 3 to Port 4 to saturate the link between RG-S6220 A and RG-S6220 B. When PFC was enabled on port A and B of the RG-S6220 A for priority 3, the sending rate of port 1 and 2 reduced to a little less than 5Gbps each. There was zero frame loss for stream port 1-port 4 and port 2 - port 4.

ETS

ETS was enabled on Port C of the RG-S6220 A. ETS settings were configured as priority value (cos) 0, 1, 2 in PG 0, priority value 3 in PG 1, priority value 4, 5, 6 and 7 in PG 2. Bandwidth ratio was configured as PG 0 with 1%, PG 1 with 10% and PG 2 with 89%.

Tolly-1 VM with Windows 7 used the disk mounted from the NetApp SAN using FCoE. Engineers ran Iometer sequential read test on Tolly-1 to constantly read data from the disk. Spirent TestCenter was configured to send 10Gbps traffic with cos value 6 from port 1 and 2 to port 4 and saturate the link between RG-S6220 A and RG-S6220 B. The sequential read rate dropped to about 120MBps (~960Mbps) in Iometer. As FCoE traffic's priority value is 3. So the rate is 10% of the line-rate which matches to the ETS setting (PG 1 with 10%).

FCoE on Link Aggregation Group

Engineers then connected two links between RG-S6220 A and RG-S6220 B and configured them as a Link Aggregation Group (LAG). Iometer sequential read test was running on Tolly-1 to read data from the NetApp SAN. When one link in the LAG was disconnected, the failure did not affect the Iometer results which were refreshed every second.

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About Tolly

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http://www.tolly.com

Test Equipment Summary

The Tolly Group gratefully acknowledges the providers of test equipment/software used in this project.

Vendor	Product	Web
Spirent	**TestCenter v4.33**	TESTED WITH SPIRENT http://www.spirent.com

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