SERVIR-Mekong Geospatial Information Technology (GIT) Infrastructure

1 Introduction

The SERVIR-Mekong cluster configuration supports an expanding range of capacity for both SERVIR-Mekong and ADPC with an initial emphasis on hosting SERVIR-Mekong's website and geospatial software and data management systems to support SERVIR's goal of making geospatial data available to decision makers in formats optimized for their needs.

Connected, redundant clusters, one in Thailand and one in California, provide robust, uninterrupted service with numerous security features.

Supporting the development of geospatial information systems (GIS) and the deployment of spatial data infrastructures (SDI) is Geonode, an open source geospatial content management platform that facilitates the creation, sharing, and collaborative use of geospatial data locally and over the internet.

2 Redundancy and Service Stability

Redundancy is achieved via two VMware based clusters, one housed in a temperature-controlled room at ADPC (Asian Disaster Preparedness Center) in Bangkok and the other at the purpose-built Internap Data Center in Santa Clara California. The systems (see below) on both sites have identical specifications in order to allow the mirroring of feature and data sets while achieving HA (high availability), to ensure continuity of service.

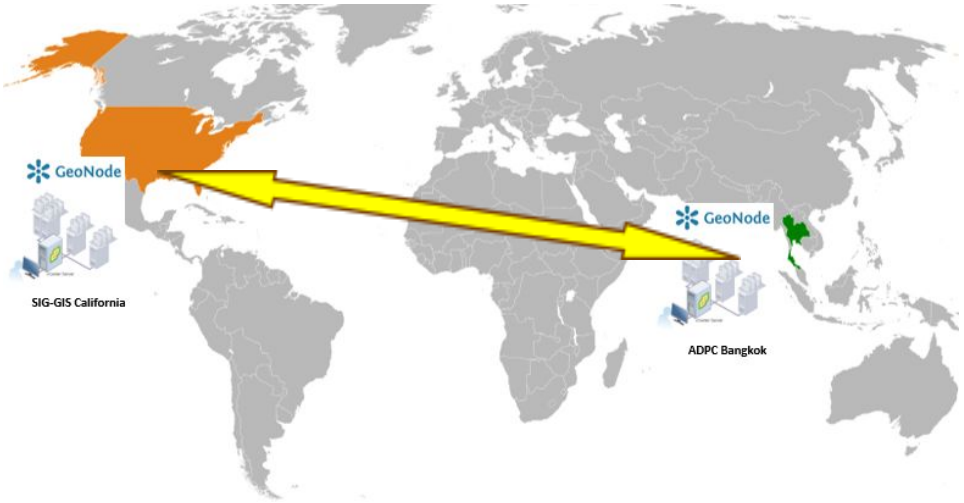

Figure 2-1. *SERVIR-Mekong's duel cluster configuration.*

Figure 2-2. *Asian Disaster Preparedness Center (ADPC), SM Tower, 24th Floor 979/69 Paholyothin Road, Samsen Nai, Phayathai, Bangkok 10400 Thailand.*

Figure 2-3. *Spatial Informatics Group (SIG) leases a private, secure cabinet at the Internap Data Center SJE011, 2151 Mission College Blvd, Santa Clara, CA 95054.*

Ultimately, the vision for the mirrored systems is to have software and data on either server be updated to mirror the structure/content of the other via one or more automated approaches.

3 HARDWARE

All of the components for both locations were ordered and assembled during the fiscal year of 2015. At each location, the completed installation consists of the following:

- 1U Supermicro SuperServers (3)
- 4U Supermicro SuperStorage Server

- SonicWall NSA 220 Firewall
- Cisco Gigabit Managed Switch
- Tripp Lite Rackmount Console KVM

3.1 The Servers

There were two kinds of servers used to create the HA (high availability) clusters. The first is a 1U diskless client that runs an embedded version of VMware's ESXi and from here on out will be referred to as a 'host'. The second is a larger 4U server that provides NAS (network attached storage) and so therefore will be labeled as the 'NAS'.

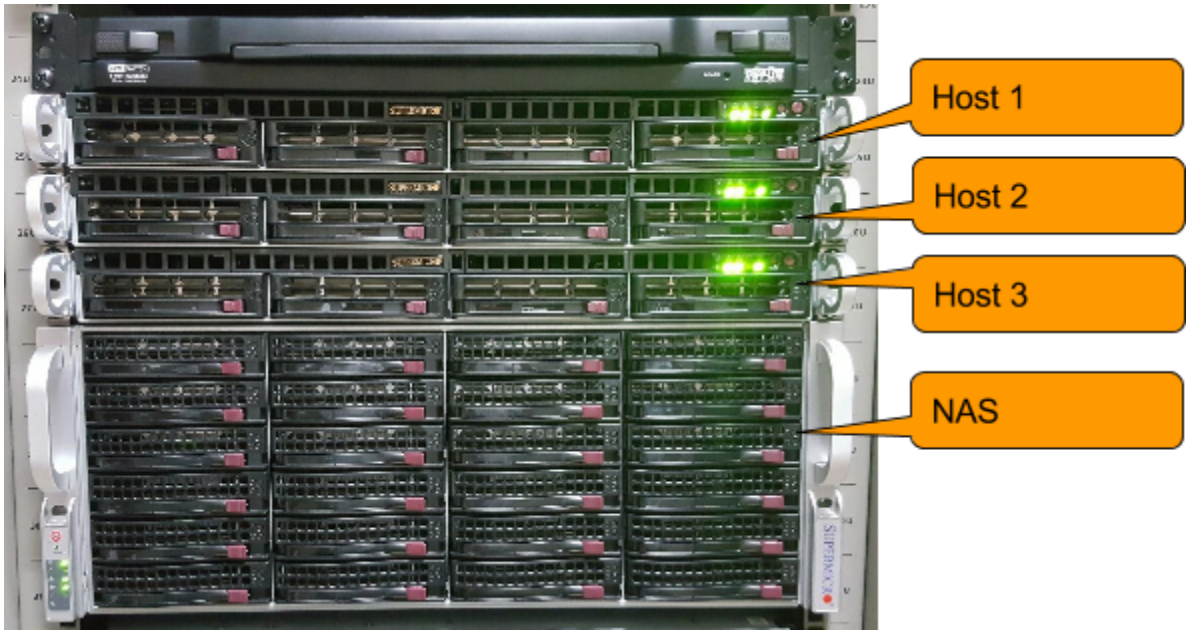

Figure 3-1. *A close-up of one of SERVIR-Mekong's connected clusters.*

The hosts were designed to run multiple virtual machines while providing optimal speed and availability. By utilizing large amounts of RAM in the system configurations, increase performance is achieved while minimizing the need to swapping data to and from hard drives. Xeon octa-core CPUs provide up to 19.2GHz of processing power per host, not including hyper-threading. Each of the 1U chassis that serve as hosts contain the following components:

- Supermicro X10 UP Serverboard
- Intel Xeon E5-2630 v3 Haswell-EP 2.4GHz
- 128GB Samsung DDR4 2133MHz ECC Registered SDRAM
- Supermicro RSC-RR1U-E16 Riser Card
- Intel Gigabit ET Dual-Port Server Adapter
- Kingston DataTraveler Micro 8GB USB 2.0 Flash Drive

The large NAS that supports each cluster is running NAS4Free, an open source distribution based on FreeBSD. This software runs as an imbedded installation and provides iSCSI targets to the VMware hosts as well as S.M.A.R.T (Self-Monitoring, Analysis and Reporting Technology) services and UPS connectivity. Each NAS has forty terabytes available from twenty-four hard drives operating in a RAID 60 configuration that not only offer fast read/write

speeds, but also can withstand up to two disk failures in each sub-array. The LSI MegaRAID cards are augmented with Cachecade Pro licenses that allow use of up to half a terabyte of high speed SSD drives as as a read/write cache to facilitate rapid data transfers. Each of the 4U chassis that serve as a NAS contain the following components:

- Supermicro X9 DP Serverboard
- Intel Xeon E5-2609 v2 Ivy Bridge-EP 2.5GHz
- 16GB Kingston DDR3 1600 ECC Registered SDRAM
- SUPERMICRO Rear side 2x 2.5" HDD kit
- 24 WD Red Pro 2 TB NAS Hard Drive
- 2 Intel 730 Series 240GB SSD
- LSI MegaRAID 9270-8i RAID Controller
- LSI MegaRAID Cachecade Pro 2.0 Software Pack
- LSI MegaRAID CacheVault Flash Cache Protection Module
- LSI Logic LSI00256 SAS Cable
- Kingston DataTraveler Micro 8GB USB 2.0 Flash Drive

3.2 The Network

Each site has a SonicWall NSA 220 hardware firewall that manages all network segments (i.e. LAN, DMZ, Guest, etc.). While minimizing cost and complexity, the NSA 220 offers intrusion prevention, malware protection, and application intelligence, control and visualization. With advanced routing, stateful high-availability and high-speed IPSec and SSL VPN technology, the NSA 220 brings security, reliability, functionality and productivity to the networks. These devices are licensed with SonicWall's CGSS (Comprehensive Gateway Security Suite) that secures the network at the gateway against threats such as intrusions, viruses, spyware, worms, Trojans, adware, key loggers, malicious mobile code (MMC), and other dangerous applications.

Figure 3-2. *A photo of one of the SonicWall NSA 220 units.*

Internet services at the ADPC office in Bangkok is provided by CS Loxinfo. Services have recently been upgraded with 20 Mbps local speeds (within Thailand) and 12 Mbps for international connections. As part of the current service, burst speeds of up to 40 Mbps locally and 20 Mbps for international connections will be provided temporarily upon request to CS Loxinfo.

The California cluster is connected to the grid via an unmetered 100 Mbps network connection. The uplink is provided by multi-homed carrier blend, featuring Level 3 and Cogent Communications. Power to the site is fed by dual power grids and has N+1 redundancies for backup generators, UPS, and cooling.

3.3 The Peripherals

Each site has a Tripp Lite rack mount console for local management and a Cisco switch for interconnectivity. The NetDirector KVM (Keyboard, Video, and Mouse) with integrated console by Tripp Lite, provides secure, centralized on-site system control. All four servers in each cluster are connected to this with an integrated VGA and USB cable also made by Tripp Lite. Connecting the cluster to itself is a Cisco 300 series layer 3 switch. This network device has a switching capacity of 104 gigabits per second and can support configuration of layer 3 interface on physical port, LAG, VLAN or loopback interfaces. A web user interface and QoS (quality of service) or packet prioritizing, can also be utilized with this series of business call switches.

4 Virtualization

Virtualization is a proven software technology that makes it possible to run multiple operating systems and applications on the same server at the same time. All SERVIR-Mekong host servers are running VMware vSphere 6 Standard, to facilitate the creation and configuration of virtualization machines. VMware resources are further managed by VMware vCenter Server Foundation.

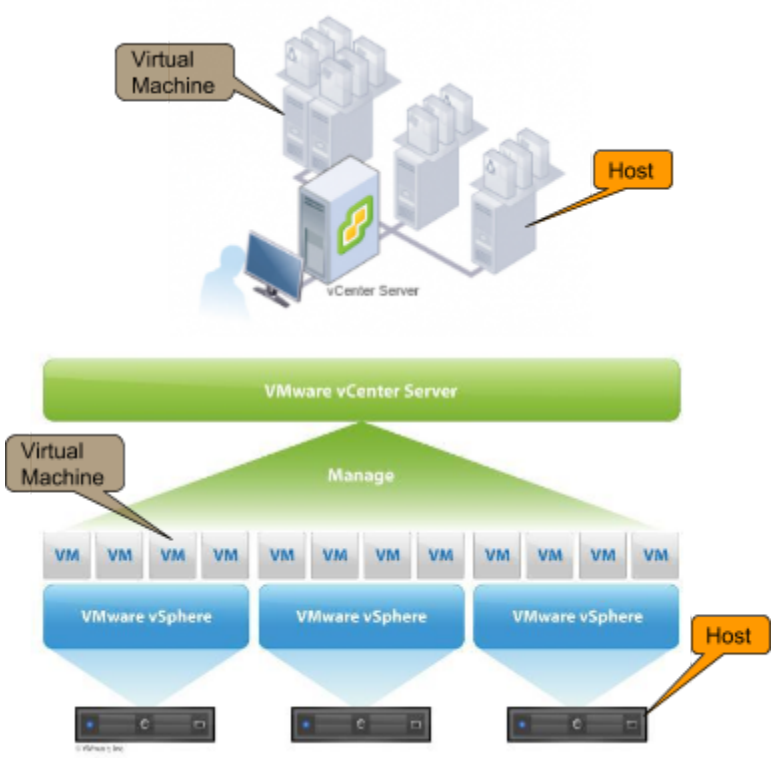

Figure 4-1. *VMware virtualization architecture.*

VMware components:

A **Cluster** is a group of hosts that share resources and a management interface. When adding a host to a cluster, the host's resources become part of the cluster's resources. The cluster manages the resources of all hosts within it.

A **Host** is a physical computer or server that uses virtualization software to run virtual machines. Typically, a host is a computer or server running VMWare ESX or VMWare ESXi software. Hosts provide the CPU and memory resources that the virtual machines use and give the virtual machines access to storage and networks. Multiple virtual machines can operate on the same host at the same time.

A **Virtual Machine** or virtual sever is a software defined computer that, like a physical computer, runs an operating system and applications. An operating system installed on a virtual machine is called a guest operating system. Every virtual machine has virtual devices that provide the same functionality as physical hardware. Virtual machines get CPU and memory capacity, video cards, access to storage, and network connectivity from the hosts they run on.

A **VCenter** server appliance is used to manage the virtual machines and connect to multiple VMware hosts at once. This virtual appliance enables EVC (Enhanced vMotion Compatibility) within SERVIR-Mekong clusters providing maximum vMotion compatibility with Haswell generation CPUs. These servers facilitate:

- Transferring virtual machines between host servers on the fly, while they are running, with zero downtime (vMotion)
- Transfer virtual machines between Shared Storage LUNs on the fly, with zero downtime (svMotion)
- Simultaneous vMotion and svMotion
- Restart Virtual Machine Guest Operating Systems in the event of a physical ESX Host failure (HA or High Availability)
- Recovery from faults with almost instant stateful fail-over of a VM in the event of a physical host failure

5 GeoNode and GeoNetwork

GeoNode and GeoNetwork are run as virtual machines that can adaptively adjust to consume more or less resources (CPU and Memory) based on the volume of processing needed at any given time. Their storage devices can also be change to accommodate future needs.

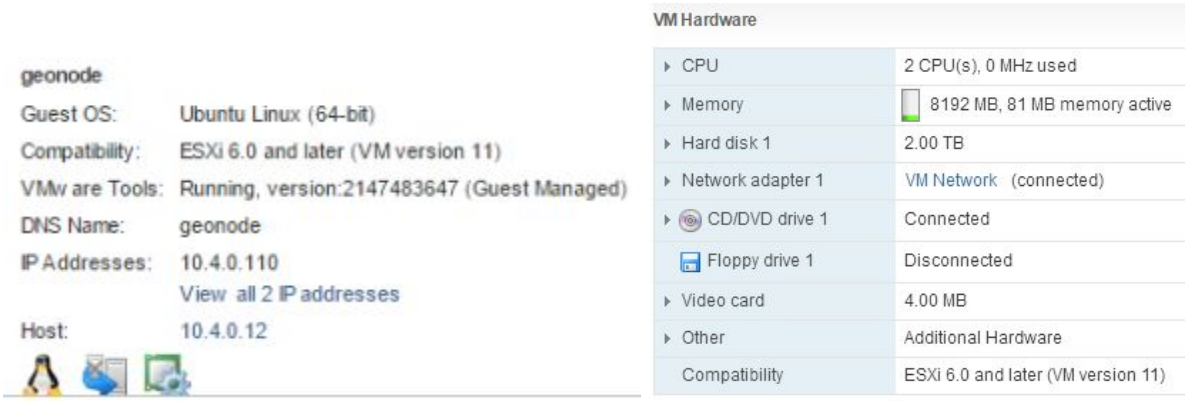

Figure 5-1. *GeoNode Virtual Machine (Server) specification.*

Figure 5-2. *GeoNetwork Virtual Machine (Server) specification.*