ADARA Software Defined Networking

Executive Summary

Challenge
SDN faces tremendous challenges to be considered production ready. SDN solutions need to eliminate vendor lock-in, protect current investments in IT infrastructure, eliminate costs from operations, enable an enterprise to increase revenues and revenue streams, install seamlessly using open standards and open APIs, operate in fully dynamic manner, be complete solutions; with modular and integrated solutions for Intra-Data Center Virtual Computing and LAN/VLAN Networking, WAN and Inter-Domain Cloud Virtual Computing and Networking and include Management Applications.

• SDN Benefits
• Common SDN
• SDN and SLA’s

A Use Case
• SDN SLA’s A New Class of SLA’s

Solution
• ADARA SDN

Key Products
• ADARA Horizon
• ADARA Hercules

Production Quality, Guaranteed Performance, Ease of Implementation Dynamic Management

A Summary of SDN

Introduction
Software Defined Networking (SDN) is an incredibly valuable tool for creating business profitability; it is likely the most valuable Information Technology (IT) development in the last generation. SDN holds the promise that has escaped every other advance in IT. The browser allowed a virtualization of information resources, a common way of accessing those resources, a way to improve productivity, and the ability to create new business models. SDN is a way to virtualize compute network and storage resources and in the process transform businesses by increasing profits and creating new business models. SDN holds the promise to impact the global economy to a greater degree than any other development including the browser.

SDN Benefits
SDN is able to tangibly enable businesses to increase revenues and profits; more importantly it can enable an enterprise to return to profitability, even during a recessionary environment; something Information Technology is rarely able to deliver.

The simple facts are that SDN can positively impact enterprises in all verticals when properly employed.

There are 3 basic facts about SDN that every stakeholder and user needs to understand:
1. SDN has the power to eliminate vendor lock-in while protecting their current investments in the IT infrastructure.

2. SDN provides the means to eliminate costs from operations.

3. SDN enables an enterprise to increase revenues and revenue streams; SDN’s intent is the capability to make IT and infrastructure more flexible. SDN: It’s All about Visibility, Granularity, Flexibility, Ease of Manageability = Increased Revenues and Net Income

Common SDN

Common SDN is predominantly marketed for use in “Intra-Datacenter” scenarios. This stems from 2 factors:

1. Analysis has shown that 85% of this switching is “East-West”, meaning that it does not leave the data center through the gateway

2. Common SDN has significant limitations. Once Common SDN is applied to multi-domain routed infrastructures; infrastructure beyond the control of System Administrator and Service Providers, Common SDN loses its ability to deliver value-added service.

SDN and Service Level Agreements (SLAs)

SDN brings a number of important benefits to the enterprise datacenter; performance is often missed in both traditional computing and networking, and it is commonly missed in SDN.

Traditional Service Level Agreements

Traditional Service Level Agreements (SLAs) offered by service providers or internal enterprise IT staffs teams are usually limited; they revolve around already deployed workloads that are typical in traditional computing and networking such as:

• Mean Time Between Failure (MTBF)
• Mean Time To Repair/ Mean Time To Recovery (MTTR)

In modern/cloud computing and networking, workloads need to be dynamically created, deployed, provisioned and scaled as services are dynamically spun up/spun down or burst on-premise to cloud based. Dynamic service creation, velocity and scaling are key requirements. Traditional data center SLAs cover “five 9’s availability”; five minutes of downtime per year; in SDN, this SLA is not sufficient, and is already provided through SDN.

SDN SLAs: a New Class of Service Level Agreements

There is a capability gap between what customers want and need from service providers, and what providers can currently deliver; there needs to be a new class of SLA. This new kind of SLA doesn’t just focus on uptime, but supports the dynamic requirements of the new dynamic datacenter.

In SDN the SLA needs to cover already deployed workloads, or dynamically created services; for example, the SLA needs to be the number of concurrent sessions before spinning up another service instance, or the cost of a transaction, or the time to deploy a new portal accessible service; requiring deployment in minutes, if not seconds.

ADARA SDN
ADARA Horizon

ADARA Horizon is a complete SDN solution for the virtual environment. ADARA Horizon features the ADARA Axis; the highest performing virtual switch, uniquely capable of Multi-path in the LAN. These are managed by the ADARA Ecliptic and ADARA Sky; the most flexible and scalable controllers in the industry. The ADARA Control Plane (ACP) enables the dynamic management of any environment, from Layer 1 to Layer 7, End-to-End, with dynamic rules creation simply by defining policies. The ADARA Control Plane operates at hyperscale; capable of dynamically and statefully managing hundreds of millions even billions of Virtual and Physical Hosts, Applications and Services. ADARA Horizon is implemented in 2 form factors:

1. Software for Virtual Environments
2. Hardware for Physical Environments

Virtual Environments

ADARA Horizon implemented in Virtual environments enables virtual switching and virtual computing via virtual machines that are dynamically spun up, managed, migrated, and spun down autonomically via any policy, and dynamic network provisioning, as well as choreographing any desired service from Firewalling and Encryption, to Quality of Service, and Multipath Forwarding and Load Balancing. ADARA’s SDN Controller enables both financial and operational policy management. Instead of simple VM management by CPU or RAM, Horizon enables dynamic re-configuration via session state or any parameter. Horizon uniquely enables dynamic re-configuration using $ Cost/Byte of compute or $ Cost/bit of networking.

Physical Environments

ADARA Horizon implemented in Physical Environments enables policy based control of ADARA and any 3rd party hardware device. ADARA Horizon is a Meta Controller; it interfaces Application Data in real time to dynamically re-configure hardware. Horizon is a Network Hypervisor with Network Operating System functionality. Horizon is fully distributed and eliminates the time and performance limitations that restrict conventional SDN controllers to managing virtual switches within a physical host, rack, or data center.

ADARA Horizon operates hardware via processor and Network Interface Card (NIC). As the industry advances merchant silicon to support management of micro flows; this also enables bare metal workloads to be deployed in a compute environment.

ADARA Horizon Service Level Agreement Manager (SLAM)

The goal of SDN is to interface Application needs with configuration/re-configuration of Network Infrastructure. Simply interfacing applications with network infrastructure has consequences however, particularly if applications are unaware of network resource constraints, and resource reservations made by other applications. Simply unintelligently pushing reservation, network configuration and management capabilities onto the application layer, can and will cause applications to contest for network resources, and in doing so slow down applications themselves, or introduce configurations that cause overall network operations to decline or fail. Attempting to push intelligence capable of preventing over subscription of network resources into Applications will cause excessive analysis, and introduce excessive latency into the system.

SLAM is a more than the traditional network monitoring/management tools by providing a much improved control plane with the following unique features.

• Ability to not just monitor the SLAs but also to enforce the SLAs by performing well defined automated actions. SLAM enforces policies based upon SLA conditions. If a particular SLA is not met, SLAM can be configured to execute a policy and bring back the SLA on track. SLAM has the ability to execute an automated custom action when the SLA hits some specific thresholds. It provides the ability for just-in time resource provisioning. SLAM has knowledge of highly dynamic network path properties. SLAM monitors and enforces not just performance SLAs, it also manages security, availability, cost and other business specific SLAs.
• Ability to support multi-vendor products through standard management protocols such as SNMP.

• Ability to configure OpenFlow enabled switches through OpenFlow supported controller. SLAM can monitor and enforce policies on other network devices like third party network routers and switches (e.g. Cisco), UNIX servers, clients etc.

• Ability to provide financial dashboard along side of the operational dashboard. The dashboard can demonstrate the capability of SLAM to display SLAs in hierarchical fashion with filtering capabilities. The dashboard can show real-time values with SLA MET / NOT MET status. SLAM provides real-time charts and dials for SLAs that are being monitored.

• Ability to map the cost to operational parameters to monitor the OPEX. (For example: Mapping the USDs to the Number of Bits transferred through specific interface). The cost can be associated with a particular node, subsystem or the entire system.

• Ability to manage the network using an easy to use web interface. SLAM can calculate performance values not just for single nodes or subsystems. It can monitor SLAs for the entire system as well.

• The network user experience can be measured in a number of ways: access and response times, availability, and reliability, all of which will likely see steady improvement as enterprises deploy new physical and virtual architectures. But probably the most profound change affecting users will be the ability to tailor the network to their own purposes, fostering both a heightened experience and more efficient use of resources.

ADARA Horizon Features

• Network Virtualization - Compute Virtualization - Execution Virtualization

• Every Level of Virtualization, from Machine, Application, Session, State

• End-to-End Virtualization; Data Center-Network-Client

• Most Advanced Fabric - ADARA Dynamic Virtual Overlay Network (VON)

• Data Center Virtualization; L2, L2/L3 and L3

• Multipath Layer 2 (LAN), Layer 3 (WAN), Layer 7 (Application)(Layer1 / *Bundled with Optical)

• Integrated Layer2 / Layer 3 (layer 2 over Layer 3)

• Exponential VLAN Scalability Unified Data Center/Network

• Scalable to Dynamically Statefully Managing Millions/Billions of Virtual Physical Hosts, Applications’, Services

• Network- as- Execution Environment

• OpenFlow API’s

• Web APIs

• Enhanced Cloud Controllers

• Dynamic Network Overlays and Dynamic Control Planes
Manageability

Dynamic Policy Programming - Universal Policy Engine --Any Policies

Out-Of-the-Box Autonomic Operations - Automated Management

LAN/WAN/Intra Inter Domain

Operational and Financial Engineering – Business Intelligence

Guaranteed SLAs

Single Pane of Glass Management for all 3rd Party Infrastructure/Services

Dynamic Topology Creation and Management

Performance

Affirmative Service Guarantees – with Abstraction

Layer 2/7 Load and Flow Balancing of Virtual/ Physical Machines and Networks

Flow Control

Every Soft Appliance in a single integrated platform: Network Functions Virtualization (NFV)

Dynamic Run Time Synchronization Layer 2-7

Continuous Dynamic Optimization

Dynamic Real Time Service Velocity, Service Creation, and Service Elasticity

Security

Ultra Secure SDN

Ultra Secure Compute Virtualization

Any Service, Any Level, Any Time, Any Where

ADARA Hercules

ADARA Hercules enables complete dynamic Service Choreography and Network Orchestration. Services visibility is absolutely critical for SDN, yet the limitation of hypervisors is not commonly well known or understood. On a virtual machine level, you can allocate and prioritize the CPU, Memory, Storage, and Network resources but that doesn't mean the intended resources are going to be used for the actual service that it was intended. A hypervisor does not lend visibility into what is running inside the virtual machine. Often times, there is overhead running on an Operating System that may consume one or many of these resources. A primitive automation system can mistakenly spin up another virtual machine to offset the load on enterprise applications that are presumed to be over-loaded. A typical hypervisor configuration is based upon CPU and RAM; however often those have little to nothing to do with the workload. Often sessions, or throughput or network latency are more important yet there is no configuration capability for many of those metrics. A typical hypervisor configuration requires you to set some priority for the hypervisor to know what to do when CPU and RAM resources
are under contention between other VMs. If there is no priority configured, the hypervisor will act in a “first-come-first-served” method, with VMs already using resources taking precedence over VMs with new resource requests, with only static settings to override all priorities as a fall back option, otherwise VMs will literally “fight” over memory. Hypervisor’s are blind to what is going on inside the VMs; when a guest configured to use dynamic memory asks for more RAM at the same time another one does, the hypervisor doesn’t know that one is a SQL Server processing the CEO’s dashboard while the other is a customer service rep requesting a large file copy.

Networking resources are often all but forgotten in a virtualized environment. Conventional SDN presents limited options; if you’ve only used one physical NIC in each host for virtual switches, you have no good options, if you have multiple physical NICs in each host for virtual switches, you can (a) team the NICs together at the host level (using the NIC manufacturer’s driver settings), creating the virtual switch on that, causing all of your VMs to share one large pipeline, or (b) keep the physical NICs un-teamed and create multiple virtual switches. All this does is set which VMs utilize which virtual switch, enabling some limited ability to shape traffic.

In SDN, visibility into the services is essential, Services Choreography and Network Orchestration all dynamically managed in coordination are absolutely critical. For example, it is common to be able to migrate a VM; however there are few, if any, dynamic intelligent capabilities to provision the network or granularly re-configure firewalls and invoke other services to manage VM’s and services securely. ADARA Hercules can dynamically deliver these capabilities and additionally move the execution to anywhere in the End-to-End infrastructure without moving the VM or the OS; reducing the data to be moved by a million times, increasing the speed of execution by a corresponding amount.

As a result, ADARA SDN enables the new dynamic nature of the data center and network, along with a new class of SLAs, and the ability to reduce the time and costs to deploy new compute and network resources.

ADARA SDN: Key Differenciatiors

• ADARA’s SDN focuses on increasing the performance of existing infrastructures by enabling the applications and services to utilize multiple routed/switched paths that are available. ADARA’s SDN includes the TCP acceleration engine which maximizes the efficiency of end-to-end network links by customizing the traditional TCP protocol. ADARA’s SDN provides data de-duplication as a standard network function that provides further WAN optimization and bandwidth savings.

• ADARA’s SDN enables better overall control by providing affirmative service guarantees for the monitoring and enforcement of Service Level Agreements. ADARA’s SDN allows applications to specify the network resource requirements and provide the best suitable paths which meet the bandwidth, responsiveness (latency tolerance) and reliability (packet loss tolerance) requirements.

• Along with the operational management of infrastructure, ADARA’s SDN performs Financial Engineering using a Policy Engine component that enables System Administrators to set the network policies based on OPEX or budget goals. An application’s path selection could be driven or influenced by the cost-per-bit of a dedicated Internet Service Provider (ISP) connection or the hourly rate of running a Virtual Machine.

• ADARA’s SDN provides infrastructure visibility into the actual applications through its standards-based Northbound APIs. ADARA enables any application to utilize network visibility and make a session or traffic level decision to effectively compute all network resources. It enables dynamic programmability of the entire network.

• ADARA’s SDN provides an intuitive management interface that displays a real-time view of applications that are in use from an operational and financial perspective.

• ADARA’s SDN products adhere to these definitions while extending our benefits for customers to capitalize on their investments within their infrastructure and core business. ADARAs SDN has evolved over a period of many years to create the best intelligent system of control for the entire IT infrastructure which comprises the network, the servers, and the associated applications. It is designed to work on an OpenFlow Full Stack architecture (from Layer-1 through Layer-7) bridging the gap between the Application and Network worlds.
ADARA SDN: Meaningful Dynamic Operational and Financial SLA’s

ADARA’s SDN utilizes this intelligence to enforce Service Level Agreements by managing:

• VMs in order to enable, disable, migrate and re-configure resources.

• Networks in order to change forwarding and routing policies.

• Dynamically Re-configurable IDS and Firewalls create dynamic ACL and NAT rules.

• Dynamic WAN Optimization with Dynamic QoS policies, Data de-duplication, more.

• Layer (1*), 2, 3, 4, 7 MultiPath Sessions that are transparently moved to preferred paths.

• Applications to increase thread counts, CPU allotments, and resource re-allocations.

*Bundled with Optical

ADARA SDN: Layer 0 to Layer 7

ADARA’s SDN extends the common OpenFlow filtering capability that works from Layer 2 to Layer 4 by supporting application, user and session level classification and filtering. ADARA’s SDN supports vendor neutral configuration management for Layer 0 and Layer 1 physical layer devices such as ROADM and HVAC, Layer 2 and Layer 3 switches, routers, accelerators, firewalls, WAN optimizers, load balancers, server hardware (IPMI, CIM, SNMP, etc.), operating systems, to Layer 7 applications, and services.

ADARA SDN: Enhances Physical Wired / Wireless Infrastructure

• Wired - The wired network has challenges that are well known; best efforts delivery and limited tools for troubleshooting. The average enterprise employee is given only 41 kbps on the enterprise network, while at home 1 Mbps is not uncommon, many users seeing 10 Mbps or more; based upon data recently released by Cisco.

✓ ADARA Horizon integrated with ADARA Comet, Sirius and Orion multiplies the bandwidth available to any end user by 100 times or more.

• Wireless - The wireless network has even greater challenges than the wired network. In increasing numbers, users are gravitating away from the desktop toward the laptop and Smartphone. Wireless connectivity will need to rise to the level of the wired network; this is why in the wireless network, bandwidth concerns still dominate. Enterprises need to enable parity between wired and wireless networks. The latest WLAN standard is the 7 Gbps 802.11ad “WiGig” approach that operates in the still-unlicensed 60 GHz range. This “small cell” approach appears to be on track for volume shipments of WiGig systems.

✓ ADARA Horizon and ADARA Polaris, Comet, Sirius and Orion utilize the ADARA Transport Protocol to transparently solve the issues that limit wireless networking.

ADARA SDN: Combined Operational and Financial Engineering

ADARA’s SDN is not another system that is intended only for Network or IT Administrators; it is in fact designed to provide intelligence and visibility to business administrators as well so that they may understand how their investment on infrastructure cost is working for them. It also provides them a platform to perform financial engineering to prioritize resources for their most critical systems and services.

For example, if the cost of running Service-A exceeds the cost of running Service-B, ADARA’s SDN can enforce Policy X. The cost can
be determined by the following factors.

- The cost of the link utilization (with different ISP CAP levels).
- The cost of running VM (based on cloud operator’s cap).

Policy X consists of the following factors:

- Reducing the CPUs on VMs.
- Reducing the number of VMs.
- Moving the VMs closer to the users.
- Redirecting traffic through a different ISP link.

ADARA’s SDN allows the users to specify the policy at service level and provides visibility to the financial audience.

**ADARA SDN: End-to-End Complete Solution**

ADARA SDN provides a complete solution set rather than piece-meal elements. Common SDN stops at the VM layer --their actual services run inside the VMs.

ADARA’s SDN contains interfaces for monitoring and configuration at the application and service levels through industry standard protocols. It provides the necessary granularity for System Administrators to manage their network based on situational needs instead of stopping the entire VM. It virtualizes the Web Services execution around its built-in Enterprise Service Bus (ESB) layer to allow the Web Service’s request to be deployed from the best possible server. It controls the VMs, physical machines, and also HVACs based on any conditions (such as load) to dynamically save power.

It allows the various components of ADARA’s SDN to execute as an orchestrated and choreographed workflow. It allows System Administrators to use their existing management tools and scripts using one single window view to manage their entire infrastructure. It is designed to scale and support any large network. ADARA’s SDN is further designed to collaborate with existing systems instead of removing and replacing them. ADARA SDN provides innovative methodologies to dynamically scale up or scale down the applications and services running on the virtual machines based on operational and financial Service Level Agreements. While VLAN is designed for isolation in a trusted environment, common SDN solutions use them as firewalls on un-trusted multi-tenant data centers. ADARA’s SDN provides a real firewall for virtual environments to ensure the isolation of each tenant. ADARA’s SDN allows tenants to specify business policies to securely run the VMs on hybrid cloud data centers and service providers.

For more information, [www.adaranetworks.com](http://www.adaranetworks.com)