HP ASE FlexNetwork Solutions Architect
OFFICIAL CERTIFICATION STUDY GUIDE
(Exam HP0-Y50)

First Edition

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About the Author

Miriam Allred has spent the last nine years configuring, testing, and troubleshooting HP wired and wireless networks. Miriam combines this wide range of technical expertise with pedagogy and instructional design training, allowing her to create technical training courses for both advanced and entry-level networking professionals. Miriam Allred has a Master's degree from Cleveland State University and a Bachelor's degree from Brigham Young University.

Introduction

This study guide is based on the Architecting HP FlexNetwork Solutions course. Although this guide is designed to help you study for the related exam (HP0-Y50), you can also use it to learn best practices and principles for designing an enterprise-level network based on customer requirements. The book covers topics like LAN, WAN, and WLAN designs in Campus and Datacenter solutions. The focus is on designing a future-ready network capable of endless IT innovations, comprising cloud services, security, OpenFlow, and BYOD (Bring Your Own Device) with integrated wired and wireless solutions for seamless access.

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Audience

This study guide is designed for networking and IT professionals who want to build on their experience implementing networking protocols and learn how to design network solutions that meet specific customer needs. It helps qualified candidates prepare to take the Y50 exam, which tests their ability to design and architect an enterprise-level network based on open network industry standards.

Assumed Knowledge

To get the best use of this study guide, you should understand the networking protocols and technologies that underlie HP FlexNetwork solutions. To take the *HP ASE – FlexNetwork Architect V2* HP0-Y50 exam, candidates should have "on-the-job" experience designing and implementing networking solutions.

Relevant Certifications

After you pass these exams, your achievement may be applicable toward more than one certification. To determine which certifications can be credited with this achievement, log in to The Learning Center and view the certifications listed on the exam's More Details tab. You might be on your way to achieving additional HP certifications.

Preparing for Exam HP0-Y50

This self-study guide does not guarantee that you will have all the knowledge you need to pass the exam. It is expected that you will also draw on real-world experience and would benefit from completing the hands-on lab activities provided in the instructor-led training.

To pass the certification exam, you should be able to answer scenario-based questions, in which you evaluate the information provided about a specific network environment and identify the best possible solution to achieve the desired outcome. The practice test at the end of this study guide will help you determine if you are prepared to take the actual exam.

Recommended HP Training

Recommended training to prepare for each exam is accessible from the exam's page in The Learning Center. See the exam attachment, "Supporting courses," to view and register for the courses.

Obtain Hands-on Experience

You are not required to take the recommended supported courses, and completion of training does not guarantee that you will pass the exams. HP strongly recommends a combination of training, thorough review of courseware and additional study references, and sufficient on-the-job experience prior to taking an exam.

Exam Registration

To register for an exam, go to hp.com/certification/learn_more_about_exams.html.

CONTENTS

1 Networking Trends and the HP FlexNetwork Architecture

EXAM OBJECTIVES

In this chapter you learn to:

- ✓ Recognize and explain networking architectures and technologies.
- ✓ Explain how today's networking trends have changed the way architects must design networks.
- ✓ Explain how the HP FlexNetwork architecture addresses modern networking needs.

INTRODUCTION

This chapter introduces you to the trends in modern networking and the challenges these pose to legacy network infrastructures. You will then examine the FlexNetwork architecture, which offers businesses a way to scale their networks effectively to leverage today's trends and compete effectively in the marketplace.

HP networking architect

In this study guide, you will learn how to become a trusted adviser for customers, architecting HP networking solutions that are based on open standards. To advise customers, you must understand the challenges that enterprises today face and be able to help customers understand the benefits their network resources offer in meeting those challenges.

Most legacy networks were architected to accommodate services, tools, and traffic patterns that were common years ago. But network services and networking environments are changing, promising more efficient use of resources, better performance, better scalability, better resiliency, greater employee productivity, and a better user experience—but also straining outdated and sometimes fragile architectures to the breaking point.

You will take a look now at these trends, as well as the issues that they can introduce for customers. You will help customers devise migration strategies to ensure their network environments are optimized to handle these trends. You will also begin to examine some of the ways that you can help customers to avoid the issues and find the benefits that they are seeking—an examination that you will continue in detail throughout this study guide.

Data center trends

You will examine trends in the data center first and then move on to campus LAN and branch office networks.

New technologies in the consolidated data center

Exploiting server virtualization and low-cost computing power, organizations are deploying more and more sophisticated applications on a larger scale. Figure 1-1 shows just a few of the many proliferating applications. And—with the rise of ubiquitous mobility and social applications—users are accessing these services at unprecedented rates. To reduce complexity and improve the operation of their services, companies are also consolidating fragmented, dispersed facilities into fewer, centralized locations.

A company's data center infrastructure is more crucial to its success than ever before; it represents satisfied customers, productive employees, and valuable intellectual property. Companies stand to gain a great deal from a high-speed, well-designed, resilient network.

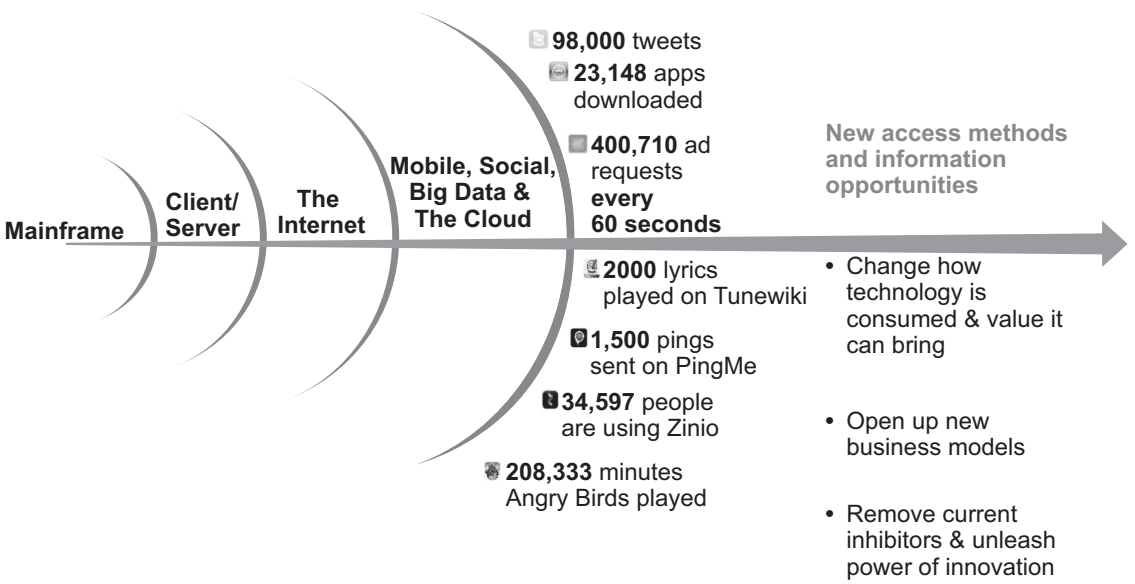

Figure 1-1: Evolution of technologies

Today's networks must be designed to deliver much higher levels of performance, scalability, and availability than before to meet service-level agreements and maintain continuity of operations. And the data center must quickly recover from hardware- or software-related faults and protect against server, storage, network, and application vulnerabilities to ensure continued performance and minimize service disruptions.

On the other hand, a poorly performing network can stand in the way of the company achieving business value from its investments. Legacy networks, which were not built for the modern data center and these new technologies, can degrade application performance, impose excessive management burdens, lengthen network outages, and impede the timely rollout of new services.

To properly design and propose FlexNetwork solutions, you must understand both what customers are trying to gain and what pain points you must help them avoid.

Trends affecting data centers

You will now look at some of the primary trends that pose concerns for legacy data center networks.

In the past several years, server virtualization has taken over the data center. As of 2013, about two-thirds of x86 server workloads are virtualized, and the number of virtual servers is still rising (as estimated by Gartner in its magic quadrant for x86 Server Virtualization Infrastructure). As you will see, this change, coupled with other changes in applications and application delivery models, has shifted traffic patterns. Now in 2014 over 80% of traffic within the data center actually flows *between* servers (as estimated by Gartner analyst Bjarne Murch in "Your Data Center Network Is Heading for Traffic Chaos," 27 April 2011). Legacy networks were never designed to handle this type of flow.

The virtualized data center is a highly scalable and flexible data center—from the server administrator's viewpoint. Virtualization helps companies achieve cloud computing, which transforms network applications into services ordered on demand. This trend too places burdens on legacy networks, which are not so flexible. Network administrators struggle to keep up, and mistakes inevitably occur (an estimated 70% of downtime is caused by CLI misconfiguration).

You will now look at each of these trends and explore the benefits that companies are seeking by embracing them, as well as the challenges that they impose on legacy networks.

New application and delivery models

Modern application architectures are challenging the design of the conventional three-tier data center network, which is illustrated in Figure 1-2.

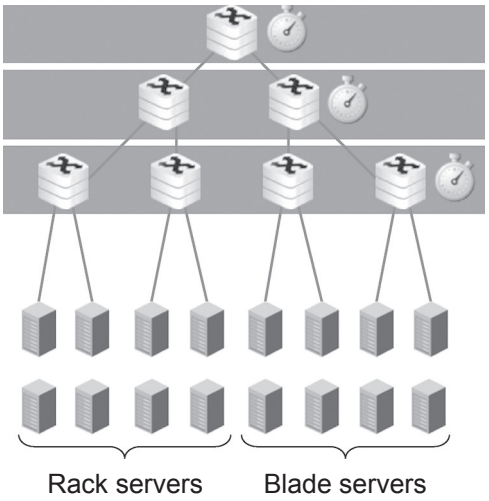

Figure 1-2: Legacy architecture

These networks were designed to support client–server applications and single-purpose application servers—where the traffic flows primarily in north–south patterns: from the server up to the data center core, to the campus core, and out to the campus-wide network or the Internet.

Today, applications rely on data and procedures available on other servers. In service-oriented architecture (SOA) solutions, for example, applications are composed dynamically of components that can be distributed and run on multiple servers or assembled in various ways to share the workload. SOA solutions, Web 2.0 mash-ups, and other federated applications deliver integrated, content-correlated, context-specific information. These deployments drive their own bandwidth-intensive traffic flows within the data center and demand low-latency, high-performance server-to-server and intraserver virtual machine (VM)-to-virtual machine connections.

When you consider the move to federated applications, you should not be surprised that more than 80% of traffic in the data center to be between servers.

Conventional data center networks are not well suited for high-volume server-to-server communications, because server-to-server traffic must traverse these multiple layers of switches, and each switch adds latency to the connection. You can help your customer realize the full benefits of the HP networking solutions by avoiding three-tier topologies and instead designing the two-tier topologies detailed in Chapter 11 of this study guide.

Server virtualization

At the same time that applications are changing, the servers that host those applications have become virtualized.

Companies have embraced server virtualization to achieve a wide array of benefits. With virtualization, software IT staff can convert one physical server into multiple virtual servers or virtual machines (VMs). Each VM acts like a unique physical device capable of running its own OS and application.

Virtualization enables businesses to reduce hardware costs by consolidating server resources while obtaining more value from their remaining servers by utilizing the RAM and processing power more fully. The software automatically adjusts processing power and storage as the needs of each VM change.

Virtualization also simplifies backup and disaster recovery, enabling a high degree of business continuity. And virtual environments are ideal for testing new operating systems, service packs, applications, and configurations before rolling them out on a production network.

For all its benefits, however, server virtualization introduces challenges for a network infrastructure not designed to support virtualized servers.

First, virtualization tends to increase bandwidth and port density demands at the data center server edge. Multiple VMs on a single server drive more traffic in and out of that server.

In addition, with potentially thousands of virtualized applications in play across multiple, consolidated data centers, network resiliency and high availability are more important than ever. Companies need data center networks that recover from failed links in milliseconds.

A key benefit of virtualization involves the portability of VMs. The VMs can migrate to a new location on the fly, enabling companies to optimize their services. But VM migration (VMware vMotion/ Hyper-V Live Migration) introduces several challenges for network design. It adds still more to the east–west traffic flow, for which legacy topologies area not designed. The migrating VM requires low latency to avoid disrupting the services hosted on the VM, so the traditional design simply does not work well for it. VM migration is also driving the requirement for large Layer 2 domains so administrators can move VMs seamlessly across servers without impacting applications or users. In conventional data centers, however, Layer 2 virtual LANs (VLANs) are typically implemented across the access and aggregation tiers, and Layer 3 routing is implemented in the core.

Need for "virtualization-aware" security

Virtualization can also introduce security concerns.

In conventional data centers, distinct workloads—application services, database services, web hosting, and so on—are carried out on discrete physical servers. Workload-to-workload communications always occurs over physical connections and can be secured using conventional intrusion prevention tools.

With server virtualization, workloads can communicate over virtual connections within the same server—in a manner transparent to existing network-based intrusion prevention systems, as shown in Figure 1-3. And because multiple VMs are hosted on a single physical server, a security breach on one can impact all the others on that server.

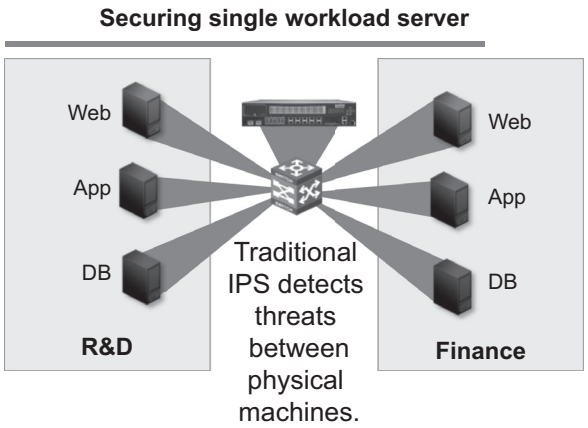

Figure 1-3: Traditional IPS: security between physical servers

Enterprises must implement new "virtualization-aware" security solutions to police intraserver communications flows and protect virtual resources. For example, HP TippingPoint Secure Virtualized Framework (SVF) enables the monitoring of traffic that passes between VMs but not over the physical network wiring, as shown in Figure 1-4.

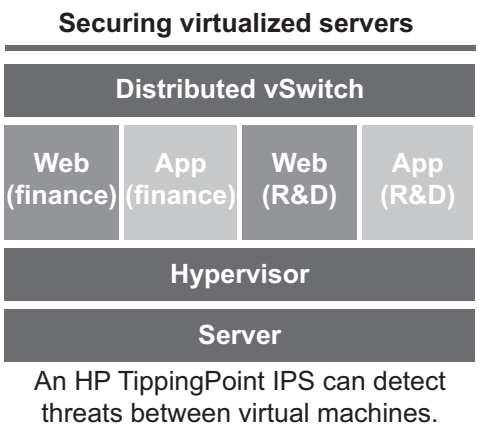

Figure 1-4: HP TippingPoint: security between *and* within virtualized servers

Need to adapt to accelerating changes

Server virtualization and sophisticated policy-based tools have dramatically simplified deploying and adjusting services. Data centers are evolving toward cloud computing environments, in which IT or compute capabilities (such as applications or infrastructure) are delivered over a network to users, who consume the capabilities as a service. A cloud allows administrators or users to self-provision the services that they require. It requires a high degree of scalability to accommodate changing demands.

Server virtualization helps to meet these demands. Software solutions can provision VMs and bring them up on the proper physical device. As you saw, VMs can even move across the network in real time.

But, for the deployment to succeed, the network infrastructure must be configured with the correct settings and policies for the new or migrating VM. Legacy networks can stand in the way.

While server administrators are using automation and policy-based solutions, network administrators are often still using manual processes and CLI commands. A typical data center, according to Cindy Borovick from IDC, could have 500 servers, each with about 20 virtualized workloads. All 10,000 of those workloads require, on an average, five network attributes. The data center has 50,000 network attributes that administrators must configure on a port-by-port basis across dozens of switches—possibly 250,000 command-line entries across those dozens of switches.

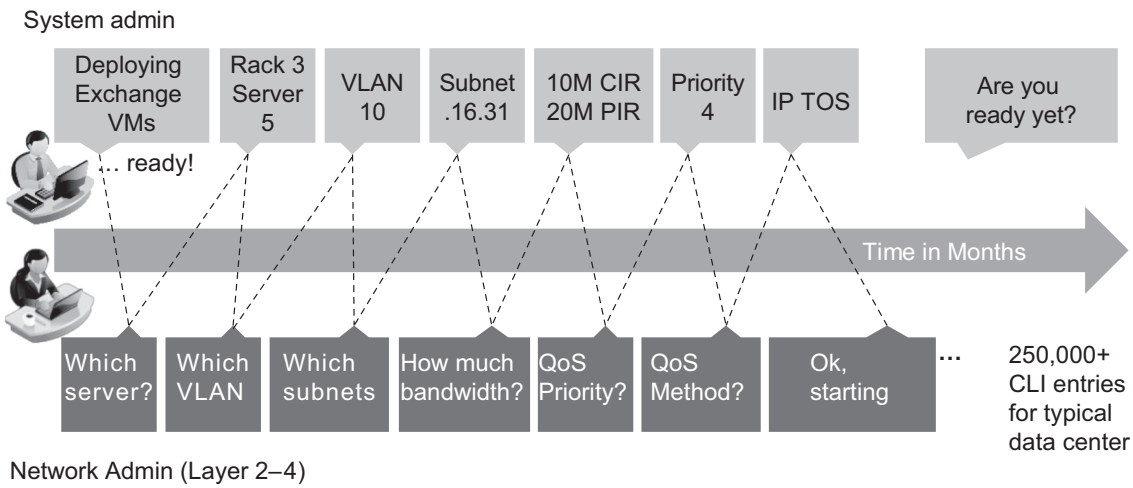

Figure 1-5: Traditional network provisioning process

Clearly, as Figure 1-5 illustrates, even very talented and dedicated network administrators struggle to keep up with the demands of highly virtualized and cloud computing environments. In addition, conventional data center server and networking infrastructures are administered independently, by separate teams using distinct toolsets. Every time a new blade, for example, is added or swapped out of a chassis, the system administrator and LAN and SAN network administrators have to be involved to hook up the blade to the external LAN or SAN.

These manual processes can delay projects for weeks as they configure the network. Worse, the more complex that network management gets, the more likely it becomes that issues will be overlooked. Even if network administrators make only a very small number of mistakes—perhaps, one mistake in 1000 commands—they might introduce hundreds of errors. These errors can have serious repercussions such as public disclosure of intellectual property, an inability to access critical data, a potential disruption to critical manufacturing applications, delayed billing cycles, or worse.

To avoid these problems, companies need to automate the network infrastructure with policy-based solutions that interoperate with the solutions that automate server and application workloads.

Network virtualization: SDN

To make the network as flexible as other infrastructure resources, software-defined networking (SDN) seeks to transform the network into a transparent resource, which can be provisioned and controlled automatically by policy-based solutions.

The Open Networking Foundation (ONF) outlines the basic SDN architecture, which includes the application layer, the control layer, and the infrastructure layer as shown in Figure 1-6. An SDN controller operates at the control layer. Providing the intelligence that controls the network, the SDN controller takes over as the network control plane. This software interfaces with a variety of applications to make the best decisions about handling traffic, from how to forward traffic to how to apply security policies. The network devices, operating at the infrastructure layer, provide the data plane and actually forward traffic. They accept instructions from the SDN controllers and handle traffic accordingly.

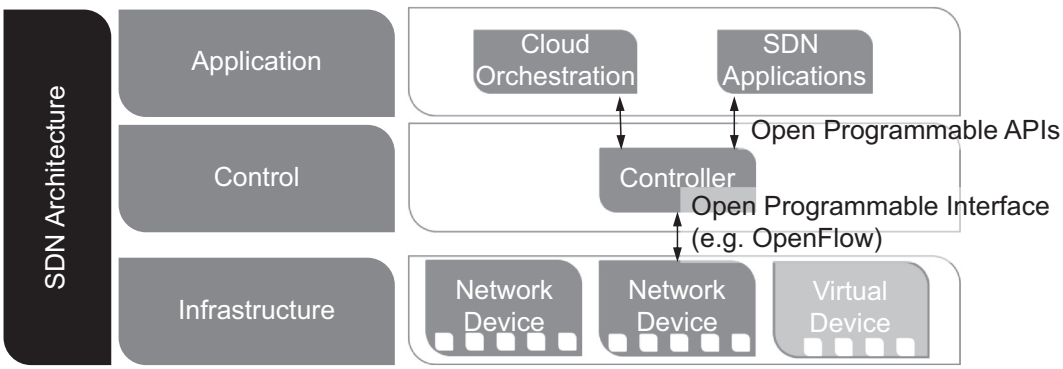

Figure 1-6: SDN architecture

The SDN controller can use a variety of technologies to communicate with network devices, but OpenFlow is one of the most important. OpenFlow decouples the control plane and data plane in Ethernet switches. When a switch implements OpenFlow, rather than use its MAC forwarding and routing tables to decide how to traffic, it uses an OpenFlow table. The switch receives this table from an OpenFlow controller, which is part of the SDN controller.

SDN promises to dramatically simplify networking.

Network abstraction allows IT to separate the logical provisioning and physical management of network resources, enabling vendors to automate the orchestration of the network. Orchestrating the network speeds up the delivery of applications and ensures that all aspects of a policy are aligned with the application so it meets the users' expected service level.

With virtual networking, the network can gracefully adapt to the needs of different tenants, users, applications, and devices. IT no longer has to build and manage inflexible overlay networks to accommodate the need for wired, wireless, and secure remote connectivity. Employees, contractors, and partners have easy access to the information they need, while security risks are more effectively mitigated.

HP has been at the forefront of OpenFlow and SDN development and has introduced support for these technologies across its product portfolio, as you will see.

Infrastructure convergence of data and storage

In a virtual data center, data storage has also become virtualized, and VMs often read and write to arrays of storage disks in complex storage area networks (SANs). The company benefits with more flexible and scalable data solutions, but servers require a second set of connections. With the escalating demand for communications and storage, the typical rack in a data center has as many as 73 networking components and 144 cables, as shown in Figure 1-7. This I/O sprawl has IT at the breaking point and costs companies enormous amounts in capital and operating expenditures.

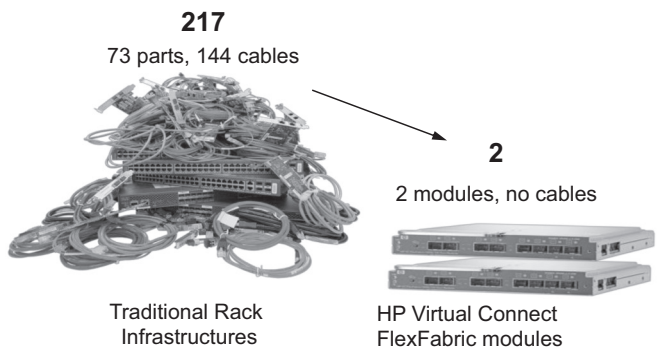

Figure 1-7: Minimizing sprawl with HP Virtual Connect FlexFabric solutions

The solution is to break down technology silos and bring all compute, storage, and networking resources together as a common pool so that resources can be dynamically provisioned and shared.

LAN/SAN convergence is part of this trend. Enterprises are looking to consolidate server and storage connectivity to reduce equipment and operations expenses, eliminate clutter and complexity, and make more efficient use of shared networking resources while ensuring continuity of service. The traditional model of completely parallel, autonomous data and storage networks with dedicated interface cards, switches and cabling plants can be costly and inefficient.

HP offers a simple strategy for eliminating sprawl and complex storage solutions:

- Converge storage and data traffic on the server connection
- Converge the storage and data uplinks on the same server access layer device
- Replace SANs with hyperscalable and efficient federated storage solutions