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Vulnerability Management

FOR DUMMIES®

Qualys Limited Edition

Control the security risks affecting your network

A Reference for the Rest of Us!®

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Vulnerability Management FOR DUMMIES®

by Qualys

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Vulnerability Management For Dummies®

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Introduction

Welcome to *Vulnerability Management For Dummies*! Most of the successful attacks through a business network could be prevented with vulnerability management. This book is all about what you can do to automatically manage vulnerabilities and keep your network safe from attack.

About This Book

This book simply explains the essential steps of vulnerability management and shows you how to select the right tools.

Foolish Assumptions

In writing this book, we assume that you:

- Are somewhat familiar with information technology and networking.
- Want to understand the risks of networking and buggy software.
- Are thinking about using a vulnerability management application to improve your network security.

After reading this book you'll know more about how to do network vulnerability management.

How to Use This Book

This book is divided into five succinct parts:

- **Part I: Understanding the Need for Vulnerability Management.** Start here if you need a primer.
- **Part II: Doing Vulnerability Management.** A guide to the essential best-practice steps of successful vulnerability management.

- **Part III: Considering Your Options for Vulnerability Management.** Understand the pros and cons of different options for automating vulnerability management.
- **Part IV: QualysGuard: Vulnerability Management On Demand.** Introducing QualysGuard, the effective Software-as-a-Service way to automate the vulnerability management process.
- **Part V: Ten Best Practices for Doing Vulnerability Management.** A ten-point checklist for removing vulnerabilities in your key resources.

Dip in and out of this book as you like – go to any part that interests you immediately; or read it from cover to cover.

Icons Used in This Book

We highlight crucial text for you with the following icons:

This icon targets hints and shortcuts to help you get the best from vulnerability management solutions.

Memorize these pearls of wisdom – and remember how much better it is to read them here than to have your boss give a know-it-all lecture.

The bomb means 'whoops'. It signals common errors that happen all the time. Avoid these at all cost.

You can skip information next to this icon if you're not into it. Don't worry – you don't have to be a security whiz or hot-rod programmer to do vulnerability management.

Where to Go from Here

Check out the headings and start reading wherever it makes sense. This book is written with a sequential logic, but if you feel a need to express your inner Spock you can start anywhere to extract good stuff. If you want a hands-on demo or trial version of QualysGuard – our featured vulnerability management solution – visit `www.qualys.com`.

Part I

Understanding the Need for Vulnerability Management

In This Part

- Understanding the risks posed by cyber criminals
- Reviewing the sources of software vulnerabilities
- Surveying international trends in vulnerabilities
- Defining vulnerability management as the way to remove risks

To a cyber criminal, vulnerabilities on a network are hidden, high-value assets. When exposed, these vulnerabilities can be targeted for exploitation, which may result in unauthorized entry into a network, can expose confidential information, provide fuel for stolen identities, trigger theft of business secrets, violate privacy provisions of laws and regulations, or paralyze business operations.

New vulnerabilities appear every day due to flaws in software, faulty configuration of applications and IT gear, and (dare we say it?) good old human error. Whatever their source, vulnerabilities don't go away by themselves. Their detection, removal, and control require vulnerability management. VM, as vulnerability management is called, is the regulated, continuous use of specialized security tools and workflow that actively help to eliminate exploitable risks.

Who's at Risk?

The challenge for every business is to maintain a safe, open, and interconnected network – making it easy to exchange information with customers, suppliers, and business partners around the world.

Unfortunately, making this information both highly available and secure is hard work. Worms, viruses, and other security risks constantly threaten the theft of information and disruption of business operations. Moreover, the dramatic increase in new vulnerabilities discovered each day – and the speed with which new threats are created – make this challenge even steeper.

Every single business with an Internet connection is at risk due to network vulnerabilities. Whether you're a small business, a multinational corporation, or a government – it makes no difference, you're at risk.

The solution is to immunize your network from these security threats by eliminating their origin: network vulnerabilities.

How Vulnerabilities Expose Your Network to Danger

Vulnerabilities have plagued operating systems and software applications from the earliest days of computing. They used to be rare but now you read about successful attacks via the Internet almost every day. Universal connectivity provided by this global pathway gives hackers and criminals easy access to your network and its computing resources. When your network-attached devices are running without current security updates, these unpatched devices are immediately vulnerable to a variety of exploits. Any business is susceptible if vulnerabilities aren't identified and fixed.

Where do vulnerabilities come from?

Programming mistakes cause most vulnerabilities in software. A common mistake is failing to check the size of *data buffers* – a kind of storage bin of memory where a computer process executes its functions. When a buffer overflows, it overwrites data in adjacent memory buffers. This corrupts the stack or heap areas of memory, which may allow the execution of an attacker's code on that machine via a virus, worm, or other unpleasant exploit.

Computer scientists estimate that about 5 to 20 bugs are present in every thousand lines of software code, so it's no surprise to see regular announcements of new vulnerabilities with related patches and workarounds. Your risk of vulnerabilities grows with use of General Public License software, particularly because implementers plug in untested modules of object-oriented programming code. When the quality of code is marginal, bad, or just plain wrong, experts call it 'non-robust'. Modules of code placed in the public domain may include non-robust implementations of Internet protocol standards, making them easy targets for attack when used in a real-world network.

Vulnerabilities must be identified and eliminated on a regular basis because new vulnerabilities are discovered every day. For example, Microsoft releases advisories and patches on the second Tuesday of each month – commonly called 'Patch Tuesday'.

Careless programmers aren't the only source of vulnerabilities. For example, improperly configuring security applications such as a firewall may allow attackers to slip through ports that should be closed. People using mobile devices may use an unauthorized or even a malware-infested website without going through the corporate virtual private network (VPN), perhaps because the official VPN is a bother when people want to surf MySpace, eBay, or the local online personal ads.

Letting your security guard down like this exposes devices and the network to attacks. You can even trigger an attack just by clicking on an email attachment infected with malware.

The exploitation of vulnerabilities via the Internet is a huge problem requiring immediate proactive control and management. That's why companies need to use VM – to detect and eliminate vulnerabilities in order to reduce overall security risk and prevent exposure.

Looking more closely at attack trends

Endless public disclosures in the news of data breaches reveal the unauthorized exposure of millions of confidential consumer records worldwide. This is adequate proof why organizations must do more to protect networks from attack. But a dramatic change in the security threat landscape is raising the bar for organizations large and small that want to actively minimize successful attacks on their vulnerabilities.

Recent data show that exploits are no longer restricted to traditional risks of generic viruses, worms, Trojans, and other single-vector attacks. According to global research conducted by Symantec Corporation, a fundamental change in threats reveals movement 'away from nuisance and destructive attacks towards activity motivated by financial gain'. The report characterizes five new trends (you can read the details at `www.symantec.com`), including:

- Increased professionalism and commercialization of malicious activities.
- Threats that are increasingly tailored for specific regions.
- Increasing numbers of multistaged attacks.
- Attackers targeting victims by first exploiting trusted entities.
- Convergence of attack methods.

Respondents to the Computer Security Institute's *Computer Crime and Security Survey* report that financial fraud causes the highest dollar amount of losses (31 per cent of total), compared to viruses/worms/spyware (12 per cent), system penetration by an outsider (10 per cent), or theft of confidential data (8 per cent). Discover more from this 12-year series of computer crime reports at `www.gocsi.com`.

The fallout from cyber attacks now poses serious financial risk, so your organization needs to stop malware and other attacks by deploying layers of security technology such as anti-virus/anti-spyware software, firewall, intrusion detection/prevention, VPN, and encryption. Technologies like these are essential components of network security, yet while they're effective in their own spheres of purpose, none perform the most fundamental of all security measures: vulnerability management.

Detecting and Removing Vulnerabilities

Vulnerability management has evolved from simply running a scanner on an application, computer, or network to detect common weaknesses. Scanning is an essential element of vulnerability management, but VM includes other technologies and workflow that contribute to a bigger picture required for controlling and removing vulnerabilities. The primary objectives of VM are to:

- Identify and fix faults in the software that affect security, performance, or functionality.
- Alter functionality or address a new security threat, such as updating an antivirus signature.
- Change a software configuration to make it less susceptible to attack, run faster, or improve functionality.
- Use the most effective means to thwart automated attacks (such as worms, bots, and so on).
- Enable the effective improvement and management of security risks.
- Document the state of security for audit and compliance with laws, regulations, and business policy.

Consistent, ongoing vulnerability management is difficult, if not impossible to do on a manual basis. You have simply too many moving parts to juggle and act on in a timely and cost-effective manner. Repetitive tasks that regularly cycle through all devices are enormously time consuming – and an inefficient use of IT and network staff time. For this reason, organizations

VM can automatically document regulatory compliance

A major benefit of vulnerability management is the built-in reports provided by VM software. Some of these reports are good enough for documentation demanded by auditors checking for regulatory compliance. Security is a growing requirement for financial transactions, health care information, and information used in many other forms of business automation solutions.

Legal network security requirements are seen in a growing number of government and industry-specific regulations for safeguarding the confidentiality, integrity, and availability of electronic data from information security breaches. Organizations that don't fully comply and stay up-to-date with security regulations face serious potential consequences – including fines and civil (sometimes criminal) penalties. Part III tells you more about VM and compliance.

As you find out more about VM in this book, keep related regulations for compliance in the back of your mind – especially as they relate to your company. The regulations may specify use of certain VM-related processes or technologies. VM-related technologies provide reports such as those from scanning and patch management systems. The network and IT department use these reports to document network security audits and remediation, including detailed, prioritized lists of existing vulnerabilities related to severity of risk, and verification of vulnerabilities that were fixed with patches or workarounds.

The most important idea about compliance is that VM can automate much of what used to be an expensive, time-consuming, manual process. Getting the right VM solution can not only *protect* your network and data – it can also *save you money* by automating daily chores for VM! Any business can easily automate VM.

need to automate and simplify as much as they can for each element of VM, which we cover in Part II.

Getting Organized to Do VM

As you get ready to do vulnerability management, be sure to organize priorities for security. The fancy term for this step is *policy management*. Policy management determines the controls required to ensure security, such as standard

configurations for all security devices and applications including antivirus, firewall, and intrusion detection/prevention. Policies and controls should include servers, network services, applications, and endpoints.

Policy management used to be a manual, cumbersome process. New software tools can automate policy management and enforce configurations on endpoint devices. Automation saves time, improves accuracy, and lowers the total cost of ownership.

Part II

Doing Vulnerability Management

In This Part

- Ensuring security policies work with VM
- Tracking inventory and categorizing assets
- Scanning systems for vulnerabilities
- Verifying vulnerabilities against inventory
- Classifying and ranking risks
- Pre-testing and applying patches, fixes, and workarounds
- Rescanning to verify compliance

Vulnerability management (VM) means systematically finding and eliminating network vulnerabilities. Many of the steps or processes for VM use technology. Other steps need IT staff for implementation and follow-up. Integrating these processes produces stronger network security and protection of your organization's systems and data. To focus efforts for successful VM, your organization needs to govern all activity with clear security policies.

Putting Security Policies to Work with VM

'Policy' is one of those buzz-terms that can make an IT expert's eyes glaze over. But mastering the idea of policies for vulnerability management does more than make an IT person feel as important as a CEO or a politician. Security policies for

VM make it easier to define actions that guide decision-making about setting up your VM program. The result of good policies makes it easier and faster for you and the IT security team to discover vulnerabilities, remediate those security holes, and produce documentation to satisfy audit requirements for compliance.

Policy creation and management for an enterprise starts at the top of an organization and requires executive oversight to ensure systematic implementation. Here are some key considerations:

- Policies determine the nature of controls used to ensure security, such as standard configurations for all security devices and applications including antivirus, firewall, and intrusion detection and prevention. IT security experts should create a matrix with a short list of configurations and features so that policy makers can understand their options for security controls.
- Policies and controls apply to servers, network services, applications, and endpoints.
- Policy makers need to determine the business impact of vulnerability on each asset (or asset group). For example, a system that hosts the lunch menu probably isn't as important as the system that maintains customer information or financial data. Prioritization weighs the business risks and importance of each asset, which affects the urgency and completion order of vulnerability remediation.

Some organizations already use software for policy management, risk correlation, and enterprise security management. Look for VM solutions that include an *application programming interface* (API) to allow automatic integration of existing security policies with vulnerability management.

Step 1: Track Inventory and Categorize Assets

In order to fix vulnerabilities, you must first understand what assets (such as servers, desktops, and devices) you have in your network and then test to find any vulnerability that may exist.

Tracking inventory and categorizing assets establishes an evaluation baseline. In this step, you create and continuously maintain a database of all Internet Protocol (IP) devices attached to the network. Here is where you connect the actual assets in your network with the policies determining relative business value for these assets.

Identifying your inventory

Vulnerability scanning is usually done by directing the scanner at a particular IP address or range of addresses, so it's useful to organize your database by IPs. Figure 2-1 provides an example:

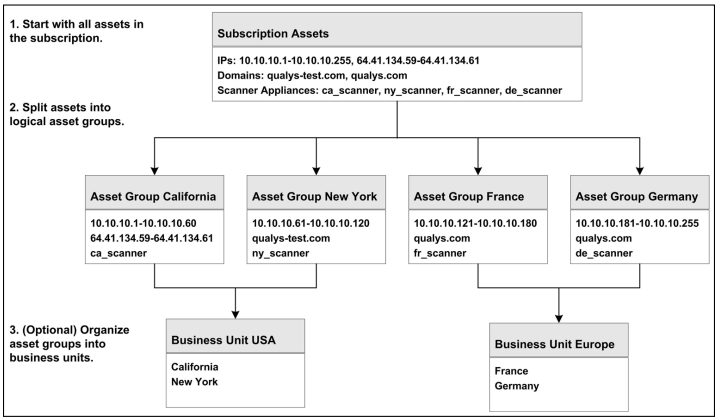


Figure 2-1: Creating the network asset database.

Elements in the asset groups include all hardware, software, applications, services, and configurations. Tracking this level of detail provides the following benefits:

- The data enables your organization to identify which vulnerabilities affect particular subsets of the IT infrastructure.
- The tracking inventory helps speed the scanning process because it enables you to scan multiple asset groups in parallel. You can track this data manually, but VM is much more effective by automating the entire inventory process for discovery and tracking. Figure 2-2 shows a

map of the network devices discovered during the VM discovery process.

- An accurate inventory ensures that the correct patches are selected and applied during remediation.

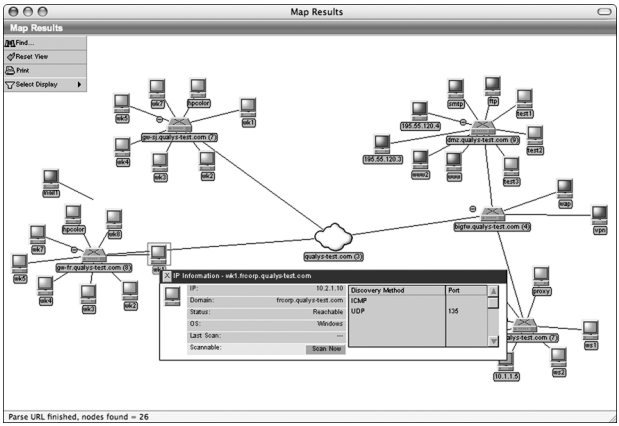


Figure 2-2: Automated mapping and tracking of each network asset.

Prioritizing assets by business risk

An automated VM system provides the ability to assign priorities of business risk to each network asset. It's much easier to leave the correlation of vulnerabilities, policies, and procedures for remediation to computers – and far more accurate than using a notebook. An input control screen for a VM database, such as the one shown in Figure 2-3, automatically clarifies assignment of business risk to specific network assets in relation to security risks.

The VM asset tracking system incorporates these business risks when you manage and use the system. Figure 2-3 shows automatic assignment of these values to classes of assets in particular sections of an organization.

The result enables an automated system that tracks all network assets by business risk and correlates them against known vulnerabilities.

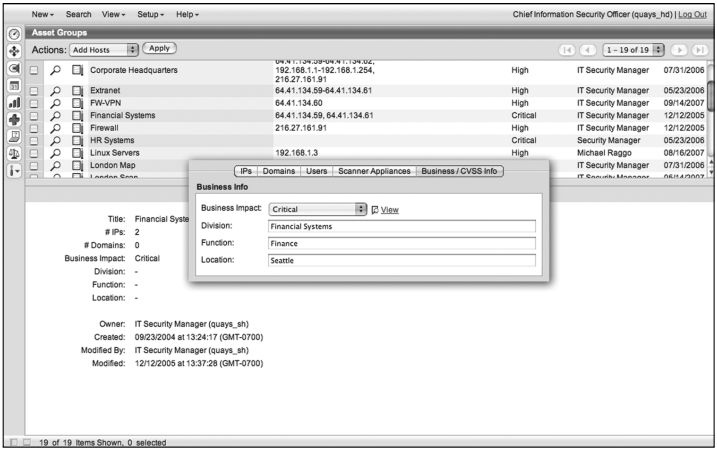


Figure 2-3: Assigning priorities to network assets by business risk.

Step 2: Scan Systems for Vulnerabilities

Vulnerability management has many steps, but scanning is the foundational process for finding and fixing network vulnerabilities. Your choice of scanning technology is the most important element of an effective system for VM.

A vulnerability scan tests the effectiveness of security policy and controls by examining the network infrastructure for vulnerabilities. A scan provides two benefits:

1. The scan systematically tests and analyses IP devices, services, and applications for known security holes.
2. A post-scan report reveals actual vulnerabilities and states what you need to fix in order of priority.

Launching a scan

A vulnerability scan is initiated by a VM application. You can usually schedule a scan to run automatically or run one on

eBay case study

Industry: Technology

Headquarters: San Jose, California

Locations: Worldwide

Major Brands: eBay, Skype, PayPal, Shopping.com, Rent.com

Employees: 13,000+

Annual Revenue: $5.9+ billion

Stock Symbol: EBAY (NASD)

'QualysGuard has made the job of auditing our network much easier. We used to have to dig through results and do a lot of manual analysis to get meaningful reports, and those were inconsistent. Qualys takes care of that nightmare.' – Senior Manager, Information Security

Objectives:

- Reliably identify network vulnerabilities across the global network.
- Audit the network security of business partners and help those partners quickly remediate vulnerabilities and eliminate risks.
- Rollout an automated solution that finds the most recent vulnerabilities without requiring constant and time-consuming staff research.
- Provide senior management with the ability to audit and review the security *posture* (the industry term for status) at any time.

Results:

- After a careful market evaluation, eBay selected QualysGuard for both network-perimeter scanning and auditing vulnerabilities on the network within the corporate firewall, and on partner networks.
- eBay now has a default vulnerability management standard to evaluate security throughout both eBay's and partner networks.
- Simplified reporting gives senior executives a concise, real-time view into the company's security risks. QualysGuard enables eBay execs to measure the changes in those risks as they implement security measures.

See `www.qualys.com/customers/success/` for more info and other case studies.

request. The scan request needs to indicate the particular hosts you want to check for vulnerabilities, specified as any combination of IP numbers, ranges of IPs, and asset groups. Figure 2-4 shows a scan launching automatically.

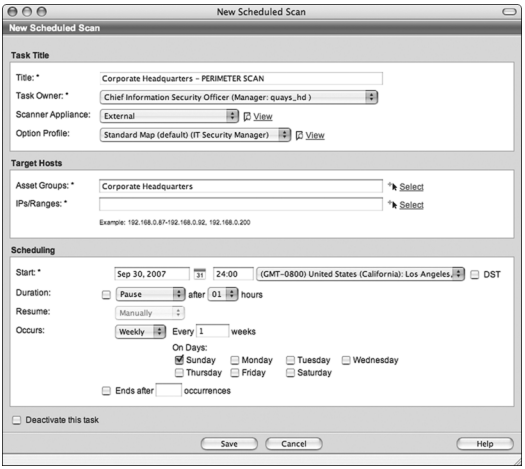


Figure 2-4: Launching a scan automatically.

Here's what you need to gather before the launch:

- At a minimum, you need the IPs (or IP ranges) for your organization's domains and sub-networks.
- If you want to scan specific devices, you need to identify them by IP before launching the scan.
- You need to ready IPs for your organization's business partners whose networks integrate business functions shared with applications on your network. Some business regulations require scans for business partners to ensure the confidentiality, integrity, and availability of personally identifiable information – whether for customers, employees, or partners. Alert these partners if your organization needs to scan their IPs that integrate with your network.

Options for scanning tools

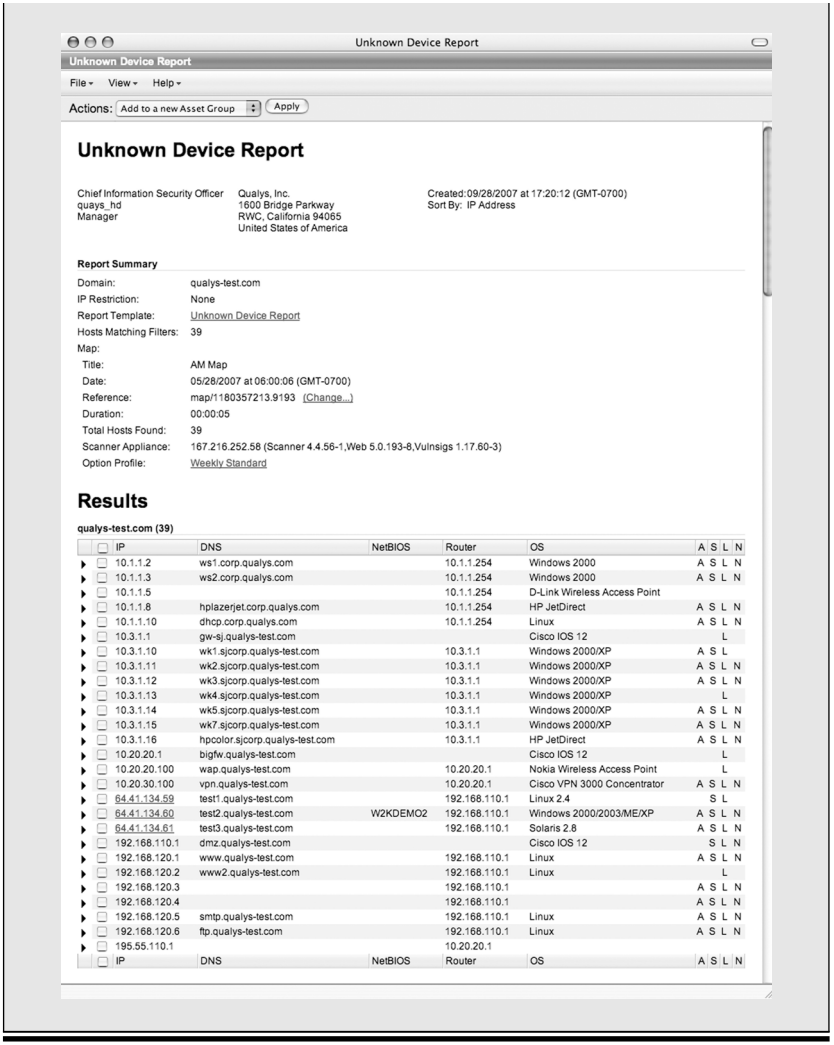
You have many options for scanning tools. All use a vulnerability database of known risks, but these databases vary in coverage and effective quality. Some require software applications that you install and maintain, such as the Nessus public domain scanner. These can require significant time and resources – plus they carry typical operational overhead.

By contrast, software applications may also be hosted by a vendor and used by businesses with a Web browser over the Internet. This delivery model is called *Software-as-a-Service* (SaaS), and businesses are beginning to use SaaS for a variety of applications – including VM. A VM solution with SaaS provides the capability to perform the scans on demand over the Internet. You simply log in to your account and manage everything online. A SaaS service works without special software and is always up-to-date with the most recent and comprehensive set of vulnerability signatures. As a result, you don't have to worry about updates to scanning technology because they're automatically applied in the VM system. We talk about the benefits of using SaaS for VM in more detail in Part III.

Public enemy #1: Threats from rogue wireless devices

Organizations of all sizes use wireless access points, and doing so has un-tethered computing and provided huge benefits of mobility. But mobility has also accelerated the *de-perimeterization* of corporate networks. This means that rogue devices can easily bypass traditional network security controls like firewalls and intrusion prevention. A common problem occurs when a department installs an unauthorized wireless access point for the convenience of its staff – and inadvertently exposes the entire organization's network and assets to worms, viruses, and other risks via unprotected endpoints.

Network mapping capability included with some vulnerability management solutions can identify rogue devices and scan them for vulnerabilities. Scanning your network for rogue systems is a key step to preventing attacks. The figure below shows a VM report identifying unknown 'rogue' devices.



Unknown Device Report

Unknown Device Report

File ▾ View ▾ Help ▾

Actions: Add to a new Asset Group ▾ Apply

Unknown Device Report

Chief Information Security Officer
quays_hd
Manager

Qualys, Inc.
1600 Bridge Parkway
RWC, California 94065
United States of America

Created:09/28/2007 at 17:20:12 (GMT-0700)
Sort By: IP Address

Report Summary

Domain:	qualys-test.com
IP Restriction:	None
Report Template:	Unknown Device Report
Hosts Matching Filters:	39
Map:	
Title:	AM Map
Date:	05/28/2007 at 06:00:06 (GMT-0700)
Reference:	map/1180357213.9193 (Change...)
Duration:	00:00:05
Total Hosts Found:	39
Scanner Appliance:	167.216.252.58 (Scanner 4.4.56-1,Web 5.0.193-8,Vulnsigs 1.17.60-3)
Option Profile:	Weekly Standard

Results

qualys-test.com (39)

IP	DNS	NetBIOS	Router	OS	A	S	L	N
10.1.1.2	ws1.corp.qualys.com		10.1.1.254	Windows 2000	A	S	L	N
10.1.1.3	ws2.corp.qualys.com		10.1.1.254	Windows 2000	A	S	L	N
10.1.1.5			10.1.1.254	D-Link Wireless Access Point				
10.1.1.8	hplazerjet.corp.qualys.com		10.1.1.254	HP JetDirect	A	S	L	N
10.1.1.10	dhcp.corp.qualys.com		10.1.1.254	Linux	A	S	L	N
10.3.1.1	gw-sj.qualys-test.com			Cisco IOS 12			L	
10.3.1.10	wk1.sjcorp.qualys-test.com		10.3.1.1	Windows 2000/XP	A	S	L	
10.3.1.11	wk2.sjcorp.qualys-test.com		10.3.1.1	Windows 2000/XP	A	S	L	N
10.3.1.12	wk3.sjcorp.qualys-test.com		10.3.1.1	Windows 2000/XP	A	S	L	N
10.3.1.13	wk4.sjcorp.qualys-test.com		10.3.1.1	Windows 2000/XP			L	
10.3.1.14	wk5.sjcorp.qualys-test.com		10.3.1.1	Windows 2000/XP	A	S	L	N
10.3.1.15	wk7.sjcorp.qualys-test.com		10.3.1.1	Windows 2000/XP	A	S	L	N
10.3.1.16	hpcolor.sjcorp.qualys-test.com		10.3.1.1	HP JetDirect	A	S	L	N
10.20.20.1	bigfw.qualys-test.com			Cisco IOS 12			L	
10.20.20.100	wap.qualys-test.com		10.20.20.1	Nokia Wireless Access Point			L	
10.20.30.100	vpn.qualys-test.com		10.20.20.1	Cisco VPN 3000 Concentrator	A	S	L	N
64.41.134.59	test1.qualys-test.com		192.168.110.1	Linux 2.4		S	L	
64.41.134.60	test2.qualys-test.com	W2KDEMO2	192.168.110.1	Windows 2000/2003/ME/XP	A	S	L	N
64.41.134.61	test3.qualys-test.com		192.168.110.1	Solaris 2.8	A	S	L	N
192.168.110.1	dmz.qualys-test.com			Cisco IOS 12		S	L	N
192.168.120.1	www.qualys-test.com		192.168.110.1	Linux	A	S	L	N
192.168.120.2	www2.qualys-test.com		192.168.110.1	Linux			L	
192.168.120.3			192.168.110.1		A	S	L	N
192.168.120.4			192.168.110.1		A	S	L	N
192.168.120.5	smtp.qualys-test.com		192.168.110.1	Linux	A	S	L	N
192.168.120.6	ftp.qualys-test.com		192.168.110.1	Linux	A	S	L	N
195.55.110.1			10.20.20.1					
IP	DNS	NetBIOS	Router	OS	A	S	L	N

What to scan?

The simple answer to what to scan is this: pretty much anything that's connected to your organization's network. Here's a list of what to scan:

- **Operating Systems:** Microsoft Windows Vista XP, CE, NT, 2003, 2000; Linux; BSD; MacOS X; Solaris; HP-UX; Irix; AIX; SCO; Novell.

- **Web Servers:** Apache, Microsoft ISS; iPlanet; Lotus Domino; IpSwitch; Zeus; full support for virtual hosting.
- **SMTP/POP Servers:** Sendmail; Microsoft Exchange; Lotus Domino; Netscape Messaging Server; QMail.
- **FTP Servers:** IIS FTP Server; WuFTPd; WarFTPd.
- **Firewalls:** Check Point Firewall-1/VPN-1 and NG; Cisco PIX; Juniper NetScreen; Gauntlet; CyberGuard; Raptor.
- **Databases:** Oracle; Sybase; MS SQL; PostgreSQL; MySQL.
- **eCommerce:** Icat; EZShopper; Shopping Cart; PDGSoft; Hassan Consulting Shopping; Perishop.
- **LDAP Servers:** Netscape; IIS; Domino; Open LDAP.
- **Load Balancing Servers:** Cisco CSS, Alteon, F5 BIG IP; IBM Network Dispatcher; Intel Routers; Administrable.
- **Switches and Hubs:** Cisco; 3Com; Nortel Networks; Cabletron; Lucent; Alcatel.
- **Wireless Access Points:** Cisco; 3Com; Symbol; Linksys; D-Link; Netgear; Avaya; Apple Airport; Nokia; Siemens.

Identifying the vulnerability shortlist

The VM solution you select needs to provide the capability to scan for and fix vulnerabilities in a broad range of categories, including:

- Back Doors and Trojan Horses (bypass authentication systems).
- Brute force attacks (defies cryptography by systematically trying different keys).
- CGI (exploits the Common Gateway Interface).
- Databases.
- DNS and Bind (exploits Domain Name Services).
- E-commerce applications.
- File sharing.
- File Transfer Protocol.
- Firewalls.

- General Remote Services.
- Hardware and network appliances.
- Information/Directory Services.
- SMB/Netbios Windows (exploits application-layer protocols for sharing network services).
- SMTP and e-mail applications.
- SNMP (exploits Simple Network Management Protocol).
- TCP/IP (exploits Transmission Control Protocol and Internet Protocol).
- VoIP (exploits Voice-over-IP protocol).
- Web servers.
- Wireless access points.
- X-Windows (exploits display protocol).

Step 3: Verify Vulnerabilities Against Inventory

You can use the results of a vulnerability scan to verify that vulnerabilities match the actual devices, software, and configurations in your network. The value of this step is to minimize efforts spent investigating risks that don't apply to your network configuration. Obviously, this is another task that's best done automatically. Intelligent scanning applications, such as QualysGuard, are designed to accurately identify risks pertinent to the devices and applications on your network – eliminating common errors known as 'false positives' and 'false negatives' that can lead to inefficiencies in the VM process.

What to look for in scan results

Scan results need to be:

- Comprehensive.
- Specific, especially with vulnerability data and remediation instructions.

- Free of excessive false positive or false negative scan results.
- Easy to understand.

False positives inhibit some vulnerability scanning by drowning the scan results with vulnerabilities that don't match what's in your inventory. Chasing down false positives is a waste of IT staff time and an inefficient way to do VM. Likewise, a false negative may occur when the VM solution fails to detect a vulnerability that actually exists in your network. Not knowing about the vulnerability places your network at serious risk of exploitation by hackers.

Improving the odds for good scan results

Substantial industry- and government-driven efforts are aimed at collating data about network vulnerabilities. The VM solution you choose should incorporate as many of the findings as possible to tap the collective wisdom of vulnerability researchers. Take a look at:

- The Common Vulnerabilities and Exposures website at `www.cve.mitre.org`.
- The National Institute of Standards and Technology's National Vulnerability Database at `http://nvd.nist.gov`. The NIST database takes CVE to the next level with detailed information for each of its vulnerabilities.
- SANS (SysAdmin, Audit, Network, Security) Top 20 at `www.sans.org/top20`.
- The United States Computer Emergency Readiness Team (CERT) Vulnerability Notes Database at `www.kb.cert.org/vuls/`.
- A particular vulnerability management vendor's own knowledgebase gleaned from its ongoing research and development efforts.

The VM solution you choose needs to include functionality to search for vulnerabilities on a specific class of equipment, running a specific operating system and specific applications. Figure 2-5 shows such a search for IPs called 'New York Asset

Group,' and within that group, all Linux hosts running the HTTP service.

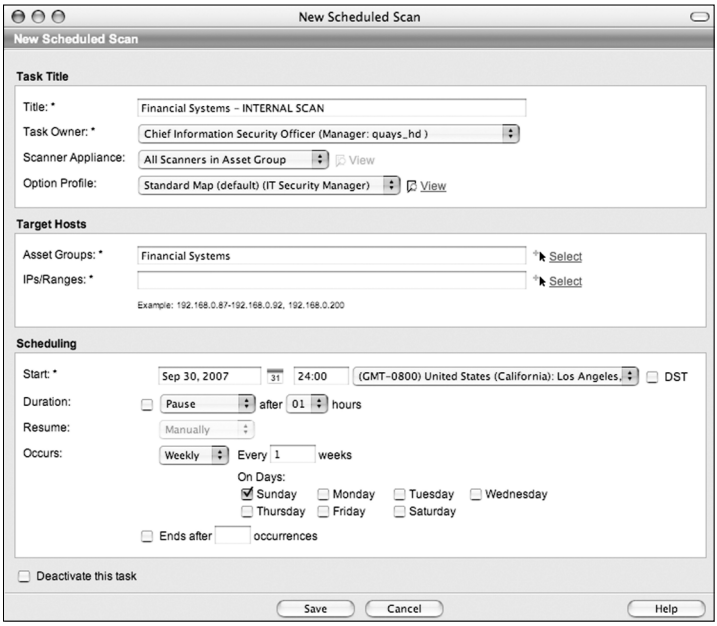


Figure 2-5: Scan report of vulnerabilities identified on the network.

The result of good scanning is accurate, up-to-date, and concise vulnerability information that you can trust and apply to assets on your organization's network.

Employing technologies to improve scanning

Look for scanners that use a variety of active operating system (OS) discovery techniques such as banner grabbing and binary grabbing, OS-specific protocols, and TCP (transmission control protocol)/IP stack fingerprinting (determining the operating system used by a remote target), and passive techniques such as packet spoofing (concealing or forging identity with a fake source IP address). Fingerprinting entails careful inspection for subtle variations in implementation of RFC (request for comments) standards. A service discovery engine detects backdoors, Trojans, and worms by checking

TCP and UDP (user datagram protocol) services, including those on non-default ports and with fake banners. A similar discovery process is used to fingerprint HTTP applications by leveraging software's version ID, service pack ID, and installed patches. A good scanner correlates OS and HTTP fingerprint tests to quickly find true vulnerabilities and minimize false positives.

Step 4: Classify and Rank Risks

Fixing everything at once is practically impossible. In fact, in large organizations, the amount of vulnerability data can be overwhelming if it's not properly categorized, segmented, and prioritized in a meaningful fashion. VM workflow allows you to automatically rank vulnerabilities to define the most critical issues that could impact the most critical systems – all the way down to the least critical issues that could impact devices of less importance. In a nutshell, you need to decide what to fix first.

Devising a categorization scheme

You can devise your own category scheme or adopt rating scales from other sources. Microsoft, for example, publishes four categories of risk (see `www.microsoft.com/technet/community/columns/secmgmt/sm0404.mspx?pf=true`):

- **Critical:** Exploitation could allow the propagation of an Internet worm without user action.
- **Important:** Exploitation could result in compromise of confidentiality, integrity, or availability of user data or in the integrity or availability of processing resources.
- **Moderate:** Exploitation is serious, but mitigated by factors such as default configuration, auditing, need for user action, or difficulty of exploitation.
- **Low:** Exploitation is extremely difficult or impact is minimal.

Thinking like a hacker

The VM solution you select needs to allow your security team to think like a hacker because it uses the scanning technology to identify and fix vulnerabilities inside and outside the firewall.

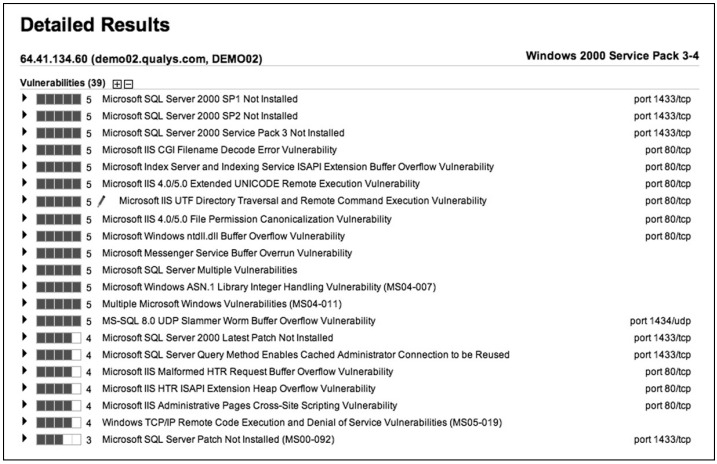
To duplicate a hacker's workflow, each scan should work from the outside looking in. The implication for a scanner is that it's deployed outside the firewall and audits all of an organization's hosts facing the Internet. Naturally, the scanner's platform also needs protection from attacks via the Internet, so be sure to account for this safety factor as you choose a solution.

The VM solution needs to operate by the same steps used as a hacker, including:

1. **Information Gathering:** Finding out as much about a host as possible without visiting or connecting to it, with techniques such as whois, DNS, and IP assignments.
2. **Discovery:** Identifying hosts in the target subnet, including topology, firewalls, and other devices.
3. **Scanning:** Finding out the potential targets and vulnerabilities associated with hardware, software, and their open ports via network scanning and port scanning.
4. **Verification:** Confirming the vulnerabilities to achieve the goal of a successful exploit.

Elements for scan reports

A solution for VM should automatically assign a category and a severity level for each vulnerability detected, such as in the sample scan report in Figure 2-6. The system should indicate vulnerabilities, potential vulnerabilities, and information data such as services running on a particular device. A severity level indicates the security risk posed by exploitation of the vulnerability and its degree of difficulty. Results of a successful exploitation of vulnerability can vary from disclosure of information about the host to a complete compromise of the host.



Detailed Results

64.41.134.60 (demo02.qualys.com, DEMO02) — Windows 2000 Service Pack 3-4

Vulnerabilities (39)

5	Microsoft SQL Server 2000 SP1 Not Installed	port 1433/tcp
5	Microsoft SQL Server 2000 SP2 Not Installed	port 1433/tcp
5	Microsoft SQL Server 2000 Service Pack 3 Not Installed	port 1433/tcp
5	Microsoft IIS CGI Filename Decode Error Vulnerability	port 80/tcp
5	Microsoft Index Server and Indexing Service ISAPI Extension Buffer Overflow Vulnerability	port 80/tcp
5	Microsoft IIS 4.0/5.0 Extended UNICODE Remote Execution Vulnerability	port 80/tcp
5	Microsoft IIS UTF Directory Traversal and Remote Command Execution Vulnerability	port 80/tcp
5	Microsoft IIS 4.0/5.0 File Permission Canonicalization Vulnerability	port 80/tcp
5	Microsoft Windows ntdll.dll Buffer Overflow Vulnerability	port 80/tcp
5	Microsoft Messenger Service Buffer Overrun Vulnerability	
5	Microsoft SQL Server Multiple Vulnerabilities	
5	Microsoft Windows ASN.1 Library Integer Handling Vulnerability (MS04-007)	
5	Multiple Microsoft Windows Vulnerabilities (MS04-011)	
5	MS-SQL 8.0 UDP Slammer Worm Buffer Overflow Vulnerability	port 1434/udp
4	Microsoft SQL Server 2000 Latest Patch Not Installed	port 1433/tcp
4	Microsoft SQL Server Query Method Enables Cached Administrator Connection to be Reused	port 1433/tcp
4	Microsoft IIS Malformed HTR Request Buffer Overflow Vulnerability	port 80/tcp
4	Microsoft IIS HTR ISAPI Extension Heap Overflow Vulnerability	port 80/tcp
4	Microsoft IIS Administrative Pages Cross-Site Scripting Vulnerability	port 80/tcp
4	Windows TCP/IP Remote Code Execution and Denial of Service Vulnerabilities (MS05-019)	
3	Microsoft SQL Server Patch Not Installed (MS00-092)	port 1433/tcp

Figure 2-6: Scan report of vulnerabilities identified on the network.

Step 5: Pre-test Patches, Fixes, and Workarounds

After software vendors rewrite pieces of an application, the resulting 'healed' software compilation (or *patch*) can still be vulnerable to other bugs. Software vendors are often pressured to release a patch quickly, and this patch could potentially cause a conflict with other applications on your network. As a result, you need to pre-test patches before applying them to live systems. Some faulty patches have inadvertently crashed business processes.

Guidelines for pre-testing

Follow these tips for pre-testing:

- Ensure the testing takes place in your organization's unique environment. Most problems with patches are due to third-party applications or modifications to default configuration settings.

Jelly Belly case study

Industry: Manufacturing

Headquarters: Fairfield, California

Locations: Worldwide

Employees: 670+

'We don't want the hassles of maintaining this type of software. It's pretty much hands-off to get the benefits with QualysGuard. We have not had any successful attacks since we installed QualysGuard.' – Network Administrator and Security Specialist

Objectives:

- As Jelly Belly brought many of its web operations in-house, the company sought a way to enhance network security to protect its e-commerce business. This required its small IT staff to be able to conduct timely and comprehensive security analysis, scanning, and remediation.

Results:

- QualysGuard provides vulnerability and risk management monitoring for all of Jelly Belly's external-facing servers and IT devices, including routers, firewall, website, and e-mail.
- Jelly Belly doesn't need to dedicate staff to keep up with new vulnerabilities or update the on-demand QualysGuard solution.

See `www.qualys.com/customers/success/` for more info and other case studies.

- Organizations need to verify cryptographic checksums (a redundancy check to preserve integrity of data), Pretty Good Privacy signatures, and digital certificates to confirm the authenticity of any patches being deployed. You can further verify this by getting patches directly from the vendor.

- Check that the patch corrects the vulnerability without affecting applications and operations of the business process.

Using a VM solution that includes patching instructions

Choose a comprehensive VM solution that includes information for patching vulnerabilities with links to recommended solutions, such as patches and workarounds from the vendors. Preferably, these solutions should be tested and validated by the VM solution provider to save you time and help you further streamline the remediation process in your organization. Figure 2-7 shows how built-in hotlinks can enable you to click on a particular vulnerability and immediately see background technical details about the vulnerability and how to fix it.

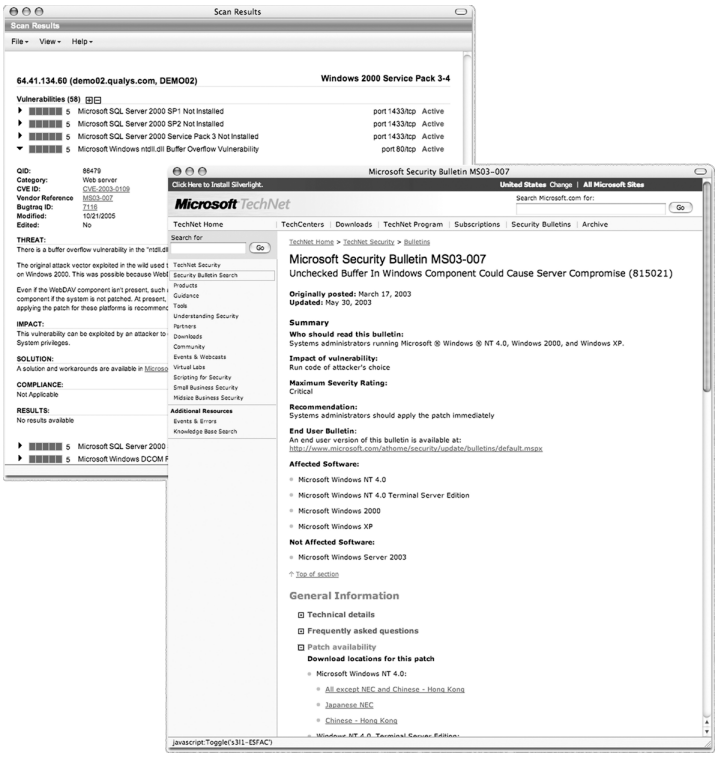


Figure 2-7: One-click link to verified vulnerability solutions.

Step 6: Apply Patches, Fixes, and Workarounds

Finding and fixing security problems is the core of vulnerability management. Traditional manual processes for finding flaws, and suggesting patches and other remediation actions are far too slow, error-prone, and expensive. Sometimes the high cost of patching coupled with the high volume of flaws detected in vendor applications encourages organizations to delay remediation. Organizations may delay updates – even for critical patches – until multiple patches, service packs, or a regular monthly, quarterly, or annual update process is available. Unfortunately, delay can be a fatal strategy because attackers quickly detect potential threats. The window between flaw and exploit is constantly shrinking.

Guidelines for patching

Follow these tips for patching:

- Remediate vulnerabilities as quickly as possible and minimize risk – giving first priority to the most critical issues facing your most critical systems.
- Automated patch management and software distribution solutions can help speed this process and keep costs to a minimum. Rollback capability can restore software to a previous state and ensures organizations use appropriate software versions efficiently.
- Integrating patch management with other automated VM processes is beneficial. For example, QualysGuard provides one-click links to vulnerability patches, fixes, and workarounds to use during this phase of workflow.

Built-in trouble ticketing

As you examine initial vulnerability reports, it's useful for the VM system to let you instantly assign a *trouble ticket* – a kind of tracking system for problems – to a particular vulnerability to help speed remediation workflow.

Trouble ticketing enables organizations – especially larger organizations – to automatically distribute and assign vulnerability remediation actions to certain individuals or groups. For example, you can have all critically-rated web server risks directed to the web IT security manager, and all lower level risks assigned to other personnel.

An example of trouble ticketing assignment is shown in Figure 2-8.

Ensure your VM solution enables the IT security team to analyze remediation trends, including long-term trends in 'open' and 'closed' ticket status (unsolved and solved problems). This facilitates progress tracking and easy analysis of other security metrics you may have in place.

Figure 2-9 shows an example of ticket status tracking and reporting.

Fifth Third Bank case study

FIFTH THIRD BANK

Industry: Financial Services

Headquarters: Cincinnati, Ohio

Business: Diversified financial services company

Locations: Operates 18 affiliates with 1,167 full-service banking centers throughout the United States

Employees: 21,000+

Annual Revenue: $8.5+ billion

Total Assets: $220 billion in managed assets

'It's not about being secure the day the auditors show up. It's about being secure and compliant every month, week, day, and hour. And QualysGuard helps us to achieve and demonstrate that continuous level of security and compliance.' – Manager of Information Security Vulnerability Management Team

Objectives:

- Fifth Third's vulnerability management team, dedicated to keeping 5,000 servers and 30,000 desktops secure, needed to move away from

manual-based scanners that only allowed the team to run ad-hoc scans, and lacked the ability to centrally manage vulnerability data or trend the bank's risk management progress over time.

- The organization wanted to attain more accurate scan results and organize data by business units, system platforms, and any other way needed.

Results:

- Fifth Third has 20 QualysGuard appliances deployed that continuously audit more than 30,000 specific IP addresses automatically throughout the bank's infrastructure.
- Via QualysGuard's ability to assign highly-specific asset tags (which quantify the monetary value of an asset based on business purpose), the bank can now examine and report its vulnerability information in any way it needs. The bank can break down its reporting by machine types, business units, and many other ways.
- Fifth Third has improved efficiency via the use of QualysGuard's API to automate report distribution to all IT managers, systems administrators, and others.

See `www.qualys.com/customers/success/` for more info and other case studies.

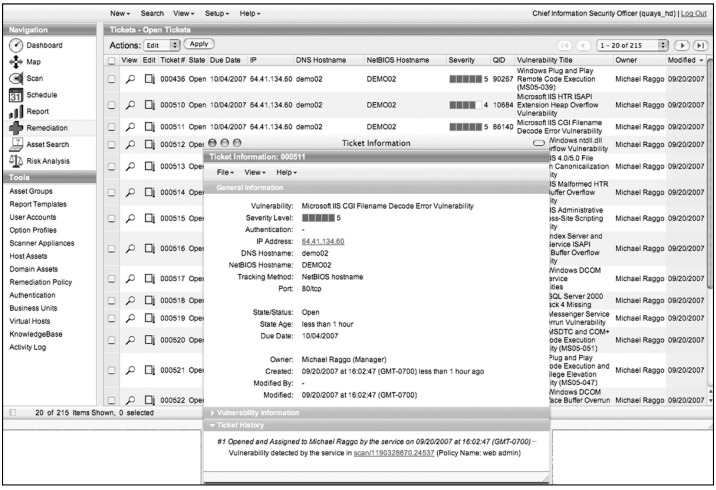


Figure 2-8: One-click assignment of a vulnerability trouble ticket.

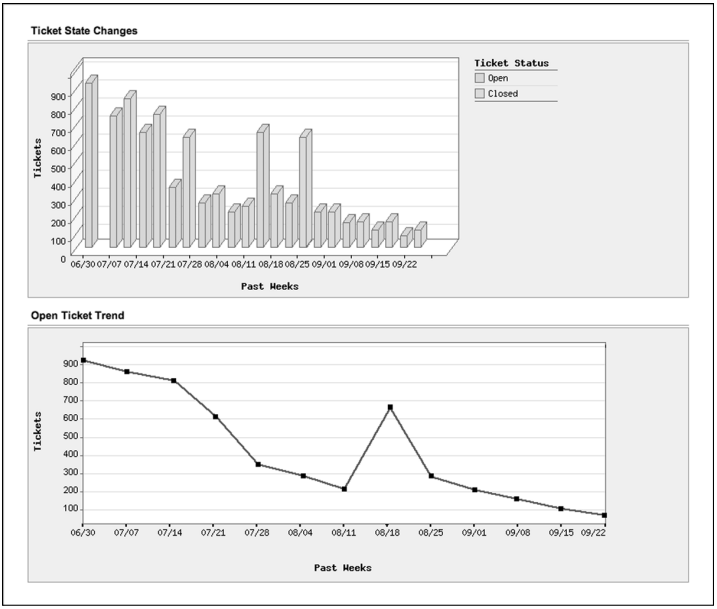


Figure 2-9: Long-term trends in trouble ticket workflow.

Step 7: Rescan to Verify Patching

After applying a patch or completing the remediation process, be sure to rescan IP-connected assets – especially critical assets – as shown in Figure 2-10. This step verifies that the fix worked and that it doesn't cause other network devices, services, or applications to malfunction or be exposed to other vulnerabilities.

Business risk and security risk are two indicators you can use to prioritize remediation efforts. For example, extremely valuable assets may have a much higher priority rating for remediation efforts even though the vulnerabilities detected on these systems have a lower security risk. A lower-priority asset (such as the server hosting the lunch menu for the company) may have a more critical vulnerability, but the business risk (and priority to fix the vulnerability) wouldn't outweigh the more important business-critical system.

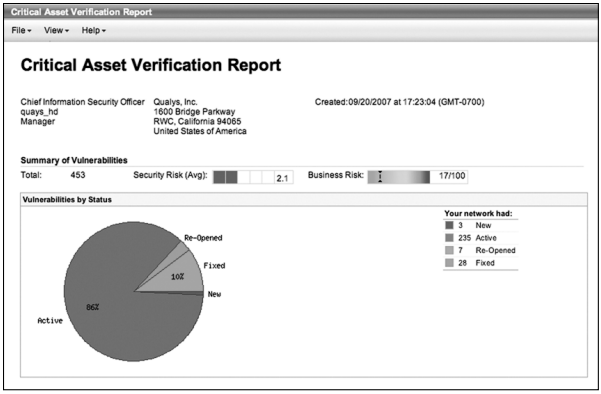


Figure 2-10: VM report on vulnerabilities for critical assets.

Reporting compliance with laws and regulations

Verifying fixes with resulting scan reports may provide adequate documentation for auditors checking for compliance with security provisions of laws and regulations such as PCI DSS (the Payment Card Industry Data Security Standard), HIPAA (the Health Insurance Portability and Accountability Act), Basel II, Gramm-Leach-Bliley, and Sarbanes-Oxley. Some VM solutions provide custom templates for specific regulations. Figure 2-11 shows an example of compliance documentation.

Reporting compliance with internal policies

Your VM solution needs to provide the capability to create custom reports that confirm compliance with internal operating policies. QualysGuard automates the creation of reports for many laws and regulations, and provides simple customization features for documenting compliance with any business policy, as shown in Figure 2-12.

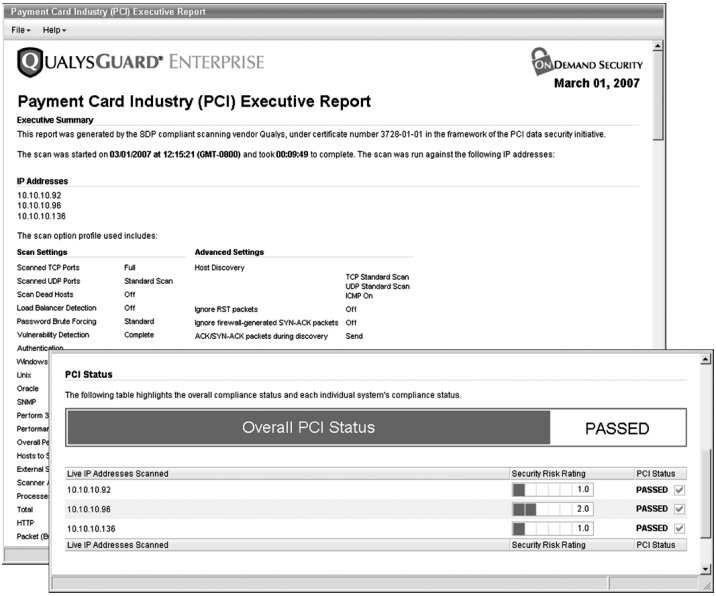


Figure 2-11: VM report documenting compliance with PCI DSS standard.

Time to Choose a Solution for VM

In this part you reviewed the steps to VM. Now it's time to choose a solution that can:

- Map your network and its devices.
- Accurately and efficiently scan for the largest potential number of vulnerabilities.
- Clearly and comprehensively report scanning results.
- Shepherd the remediation process.
- Test and confirm that vulnerabilities are fixed.
- Automatically produce accurate, comprehensive, and detailed reports to verify compliance with internal policies and legally mandated regulations for security.

Part III discusses the various options for VM. Part IV provides details about QualysGuard, the industry's first and leading Software-as-a-Service (SaaS) solution for vulnerability management.

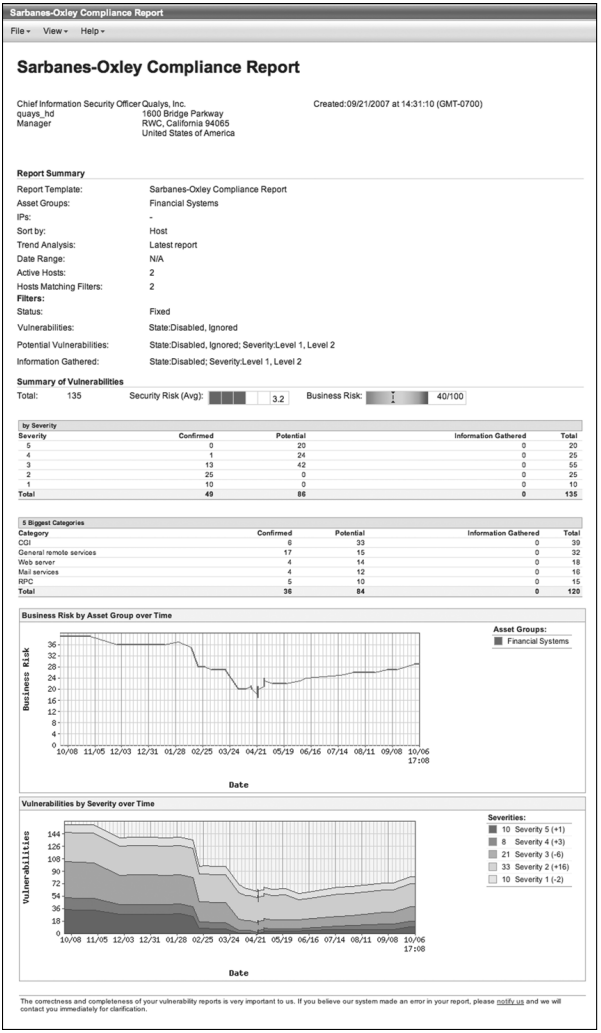


Figure 2-12: Security compliance report for financial systems.

Using VM reports to ease compliance

You've heard all the acronyms: PCI DSS, HIPAA, GLBA, SB 1386, SOX, FISMA, Basel II, CobIT, and many more. These are laws, regulations, and frameworks that tell a broad range of organizations and disciplines that they must secure personally identifiable information stored in or transferred out of their IT systems. Diverse requirements have one thing in common for IT people: work!

Business processes that use data with personally identifiable information are, by nature, IT-intensive. So be prepared for the auditors who'll want documentation describing security policies and controls. The auditors will also want to examine documentation that verifies compliance with specific requirements of all relevant laws and regulations. Preparing reports customized to those requirements is where you could spend a substantial amount of time. But guess what? This is where your VM solution can pay off in a big way.

Data used in standard VM reports, such as listing vulnerabilities, severity levels, assets affected, remediation status and history can also be used to satisfy many reporting requirements for security provisions of laws and regulations. Existing reports may suffice. But check with your VM solution provider about custom report templates. Some providers offer templates for major laws and regulations that completely automate the process of creating documentation for compliance.

As a bonus, some VM solutions also provide customization features for reports that verify unique internal policy requirements for an organization. Either way, a robust reporting capability will reward your efforts at VM with accessible evidence of security and protection. The customization, scope, and precision of VM reports also helps to make your IT security department look good to executives running the company.

Part III

Considering Your Options for Vulnerability Management

In This Part

- Choosing the best path for eliminating network vulnerabilities
- Paying a consultant for penetration testing
- Running open source or commercial VM software yourself
- Using VM Software-as-a-Service
- Comparing SaaS to traditional software for VM

Vulnerability management (VM) is critical for every business to simplify security compliance requirements and to prevent mass and targeted attacks that take advantage of network weaknesses.

The steps of VM are fundamental, but so are the ways you implement solutions to meet operational requirements. This part provides preparatory ideas for choosing and implementing VM solutions.

Choosing the Best Path to Eliminate Network Vulnerabilities

The choice of what solution you implement for VM will directly affect your company's actual state of security and overall compliance. As you weigh options for each step of VM, consider these tips:

- **Automate as much as you can.** Many of the steps to vulnerability management are repetitive and applied to all networked devices in the enterprise. Manually doing these tasks consumes an enormous amount of time and resources. Regulatory requirements may require your company to extend VM to suppliers, business partners, and channel representatives. There's no way you'll have enough budget and people on staff to do all these steps manually. Automation is a must – and not only for affordability and economies of scale, but also to ensure that VM is done in a rapid, systematic, and comprehensive manner. It's one of those cases where machines are better than people!
- **Use solid, safe technology.** With VM, we're talking about preserving the safety and security of your network, applications, and data. Don't skimp on the technology required to do the job right. And be especially careful about implementing experimental, unproven solutions into your VM system. When it comes to your business network, systems, and data, safer is better than sorry. Stick with VM technology that has a solid track record and wide use in the user community.
- **Chose a solution that grows with your business.** Change is the only certain aspect of business, so check out a proposed VM solution's ability to scale as your organization's requirements grow more complex and demanding. It's one thing to secure a few machines or a small department; it's another to coordinate VM with multiple departments, divisions, business units, and independent business partners – domestic and global.

With that, the following sections look at a few options for implementing a VM solution.

Option: Pay a Consultant

Consultants are a great resource to assist you in protecting your network and are experts in identifying weaknesses.

However, there's a big difference between VM and simply identifying issues or proving there are weaknesses. Many consultants perform what's called *penetration testing* or '*pen testing*', which means they try to find vulnerabilities and crack your network. A couple of comprehensive pen tests each year might cost tens or even hundreds of thousands of dollars. A penetration test captures in-depth vulnerability information at a single point in time. The results of this test might be adequate for specific compliance instances with a regulation – but providing ongoing, reliable security is a different matter.

The shelf life of a penetration test is fleeting:

- Results are valid only until the environment changes or until new threats arise – which is daily!
- Results are good for a few hours at best. In typical companies, administrators reconfigure networks and devices every day. Also, new vulnerabilities are found daily and point-in-time penetration tests are quickly outdated. If you want vulnerability management to help strengthen security, it's more appropriate to do consistent, daily scans.
- Regular assessments quickly become too expensive to outsource for manual processing by penetration testing consultants.

VM is relatively easy when you use an automated solution, so you may want to aim additional resources at fixing any issues detected. Remediation of vulnerabilities can often be time consuming, so consultants can provide great value in assisting you in this complex task.

Option: Run Software Yourself

Software-based solutions enable you to install software for vulnerability management on your internal network and run them yourself. Software can automate many processes for VM.

However, having the control over VM software carries the usual price tag of having to manage it (and secure it). You have to successfully operate and maintain everything – in between everything else on the usual IT and security person's daily list of things to do.

Tasks for running and maintaining VM software include:

- Buying and maintaining the servers and infrastructure to reliably run the VM software applications.
- Ensuring the VM applications and infrastructure are always 100 per cent secure and performing at peak operational efficiency.
- Integrating the required data exchange between component software used for VM solutions.
- Keeping software maintenance up-to-date with the latest updates and patches from each vendor.
- And, of course, responding to alerts and managing the vulnerabilities spotted by your system.

Do-it-yourselfers have two choices. You can download Open Source software or buy commercial solutions.

Open Source software: Free, but not cheap

Open Source software is usually developed in an open, collaborative manner. The software is typically free, and users are able to use, change, improve, or share it. However, three considerations about Open Source software don't bode well for use with VM:

- **Questionable code.** Open Source code is developed by the public, and you can't be assured of its quality like you can with a commercial vendor. A reputable vendor follows industry standard processes for software code assurance and security, and submits the code to scrutiny by independent testers and validation regimes such as those used for FIPS (Federal Information Processing Standards) or Common Criteria.

  The issue of implementing untested Open Source modules of code into any software application also poses the

risk of non-robustness after the application is deployed into an enterprise's production environment. And there's a risk of inadvertently integrating vulnerabilities into the VM system via the untested module. In fact, many instances of modules (or vulnerability checks) have provided false positive and false negative results. Some checks have even disabled systems. If you use Open Source solutions for VM, proceed at your own risk!

- **Open Source software may be free but it's not inexpensive.** Open Source software carries the same operational costs as commercial software. Be ready to pay for equipment space, rack and air conditioning, system administration, deployment and configuration, maintenance and patching (if and when they arrive from community developers), backup and restore, redundancy, failover and uninterrupted power, audit logs, provision for VM application security and maintenance, capacity planning, and event monitoring. The list goes on!
- **Training and support is skimpy.** Your security staff must know how to operate tools and capabilities of VM – and how to quickly eradicate vulnerabilities found on the network. With Open Source software, it's rare to find packaged training and support information together from Open Source forums on the Internet. While many experts collaborate on sharing their tips, it helps to know the people who program the software because they're often the only source of information – especially for Open Source modules or plug-ins that may not work as described. When you rely on Open Source for VM, gurus are essential for handling technical aspects of the job.

Commercial software: Not cheap, but has maintenance

The other option for running VM software yourself is to use commercial software. Most people automatically think of commercial software as a 'safe' option, and it usually constitutes the bulk of installed applications. But commercial software has drawbacks, so consider these points:

- **Commercial software costs real money.** You have to buy it, and that requires budget, process, and paperwork to convince the boss to sign the purchase order.

- **You must pay every year for the right to continue using commercial software.** Technically, buyers don't actually own anything except a license granting them 'entitlements' to using the software.
- **Maintenance brings higher assurance.** Well, maybe. A commercial venture is hopefully developing the VM software with industry standards for software assurance and security. Ask your vendors about how they do this. On the other hand, mistakes are virtually assured in any software application so you must regularly and rapidly install updates and new patches. Find out how that process works and how you'll have to integrate it with your internal process for updates and patching. Check on the provider's training and support programs to ensure that your security staff will be able to deploy and use the solution.
- **Commercial software costs the same to run as Open Source solutions.** Be ready to pay for the same long list of things that you'd have to pay for with Open Source.

Option: Use Software-as-a-Service (SaaS)

Software-as-a-Service is an application delivery model offering organizations a low-cost, efficient way to use software applications. With SaaS, third-party developers run their applications on a secure Internet web server, which users operate and control on demand with a web browser. Users save money by paying a periodic subscription fee, instead of paying for software, regular updates, and ongoing maintenance.

A variety of applications delivered with SaaS include customer relations management, office productivity, human resources, videoconferencing, and accounting. A SaaS provider handles all the technical 'heavy lifting' of infrastructure behind the application – you can use it right away without requiring special technical expertise or training to deploy and use it. No gurus needed either!

Qualys was the first company to offer vulnerability management via SaaS and is the global leader in providing on-demand security with its web-based service called

QualysGuard. The QualysGuard vulnerability management and policy compliance platform performs more than 150 million IP audits per year for thousands of customers around the globe.

Comparing SaaS to Traditional Software for VM

Organizations can deploy vulnerability management in several ways. Some do it themselves by purchasing, deploying, and managing software-based vulnerability management products. Some hire consultants to do penetration testing, who often use the same software-based products that hiring organizations could run themselves. A growing number are turning to a proven alternative: doing vulnerability management on demand with SaaS.

As you choose a solution for VM, it's useful to weigh the pros and cons of each against four key factors: Design, Deployment, Management, and Compliance. Each of these plays a crucial role in determining successful deployment of VM.

Design: Assessing risk from the outside, looking in

Software-based solutions are installed by users on their enterprise network and operated manually. This is a familiar process but using software-based solutions for vulnerability management has huge drawbacks:

- Software-based solutions don't provide an outsider's view of network vulnerabilities, especially for devices on the perimeter.
- Installation options are either on the non-routable private side of the network or on the public-facing Internet side. Behind-the-firewall deployments are unable to process exploits such as transmission of incorrectly formatted data packets so their scans generate many false positives and false negatives. Products deployed outside the firewall are subject to attacks and compromise. Secure communications of scan assessments are questionable.

With SaaS, the application is installed and operated by a trusted third party and may be hosted on a user's network or on secure external facilities. The latter option enables the SaaS vulnerability management solution to mimic the perspective of a hacker during the network audit process – from the outside, looking in. An externally-hosted SaaS vulnerability management solution can also assess security inside the firewall perimeter using a 'hardened appliance' (which contains integrated security protection) that can communicate internal audit results to a central secure repository hosted and managed by the trusted third party.

Deployment: Keeping operational burdens to a minimum

When users deploy software-based solutions, they need to provide servers to run the vulnerability management application. For large enterprises, this may require servers in multiple data centers worldwide so deployment can consume a lot of time as network and security staff roll out the required infrastructure. Smooth integration of these resources with enterprise management platforms is often challenging if not impossible.

A SaaS solution has many operational advantages:

- SaaS is already 'up and running' so deployment is instant, no matter how many sites need vulnerability management, and no matter where they are in the world.
- There are no software agents to install that might conflict with other applications.
- SaaS is inherently scalable and immediately begins working for the largest enterprise.
- The solution should provide an API allowing for simple integration with enterprise network management platforms.

Figure 3-1 shows the main reasons why people adopt SaaS.

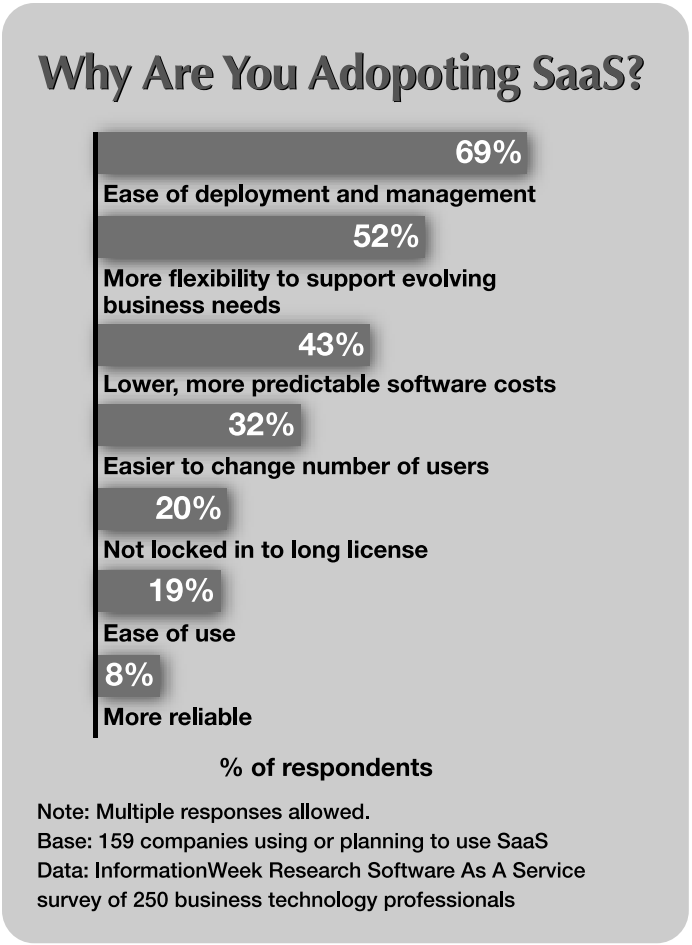


Figure 3-1: Why people adopt SaaS.

Management: For an effective, low-cost solution

Software-based solutions require substantial overheads for vulnerability management. In large-scale deployments, scan results are dispersed across multiple network segments and devices, so collating for an enterprise-wide view of vulnerabilities is a long manual process. Software updates and patches

must be applied on every distributed node, which also require hardware maintenance and backup. Moreover, nodes hosting the software are susceptible to attack.

Vulnerability management with SaaS eliminates all these issues:

- Secure SaaS hosting means that updates are automatic and instant for the entire enterprise.
- Enterprise-wide collation of vulnerability data is automatic.
- The total cost of ownership (TCO) is lower with SaaS due to the elimination of manual deployment, management, and reporting.

Compliance: Audits and reports for a variety of policies and regulations

Demonstrating compliance with software-based solutions is difficult. In addition to manually collating reports, the data is 'owned' by the user and so is subject to extra scrutiny and skepticism by auditors. By contrast, fully automated SaaS vulnerability reporting is trusted by auditors because it's collected and held by a secure third party. SaaS provides tamper-proof capability by enforcing access to VM functionality and reporting based on a user's operational role in an organization. This role-based capability further protects the integrity of VM results for verification of compliance.

Part IV

QualysGuard: Vulnerability Management On Demand

In This Part

- Providing VM on demand
- Using a secure SaaS infrastructure for reliable VM
- Speeding follow-through with prioritized remediation
- Automating document compliance
- Trying QualysGuard for free

QualysGuard is an on demand vulnerability management solution. It plays a vital role in network security and compliance management. The prospect of malicious intrusion via a network has spurred considerable innovation in network security. Virtually all industry analysts agree that network security should be a product of multiple interventions and layers – virus detection, firewalls, and vulnerability management. Most analysts also agree that VM is a critical intervention, without which virus detection and firewalls may offer a false sense of security.

Discovering VM On Demand

On demand Software-as-a-Service (SaaS) vulnerability management involves a trusted third party as opposed to acquiring, installing, supporting, and maintaining a software-based solution. QualysGuard is an on demand, service-based VM solution.

Industry experts define VM to include the following criteria. VM should:

- Identify both perimeter and internal weaknesses.
- Automatically scan using a continually updated database of known attacks.
- Be highly accurate, essentially eliminating false positives and false negatives – and be non-intrusive.
- Use inference-based scanning to ensure that only applicable vulnerabilities are tested for each scan.
- Generate concise, actionable, customizable reports, including vulnerability prioritization using severity levels and trend analysis.
- Provide tested remedies and workarounds for cases where no remedy as yet exists.
- Provide distributed scanning capabilities with consolidated reporting and centralized management capabilities.
- Offer both trusted (credential-based) and simple password-based authorization techniques for scanning.
- Provide user access management to restrict users' roles and privileges to their function in the organization and network responsibility.
- Supply workflow capabilities for prioritizing and tracking remediation efforts.
- Enable customers to build compliance reporting.
- Integrate seamlessly with customers' Security Information Management (SIM), Intrusion Detection System (IDS), patch management, and help desk systems.

That's a lot of requirements, but QualysGuard meets every one of them with its SaaS architecture and easy-to-use user interface.

Accessing QualysGuard

Users access QualysGuard by simply logging in via a web browser. Through this authorized access to its web service-based delivery architecture, QualysGuard users can immediately use the service and audit the security of their external

and internal network. VM services with QualysGuard are available on demand 24x7 to all subscribers worldwide.

With QualysGuard you can schedule scans to occur automatically, including selected scan targets, start time, duration, and occurrence frequency.

VM features in QualysGuard provide a broad array of capabilities for finding and eliminating network vulnerabilities. QualysGuard:

- Discovers all systems attached to your network.
- Identifies and analyses vulnerabilities on all discovered systems.
- Reports findings of discovery and vulnerability analysis.
- Shepherds the vulnerability remediation process.
- Confirms that remedies or workarounds have been applied.
- Provides documentation to verify security compliance.

Elements of QualysGuard's architecture (seen in Figure 4-1) include a KnowledgeBase, security operations centers, Internet scanners, scanner appliances, and a secure web interface, which we explain in the following sections.

KnowledgeBase

The core of QualysGuard is its KnowledgeBase. KnowledgeBase contains the intelligence that powers the QualysGuard vulnerability management service. It's updated daily with signatures for new vulnerabilities, validated patches, fixes for false positives, and other data that continuously improves its effectiveness.

Security Operations Centers

The KnowledgeBase resides inside Qualys' Security Operations Centers (SOCs), which provide secure storage and processing of vulnerability data on an n-tiered architecture of load-balanced application servers. That's computer-speak for the ability to expand processing power to meet customer demand

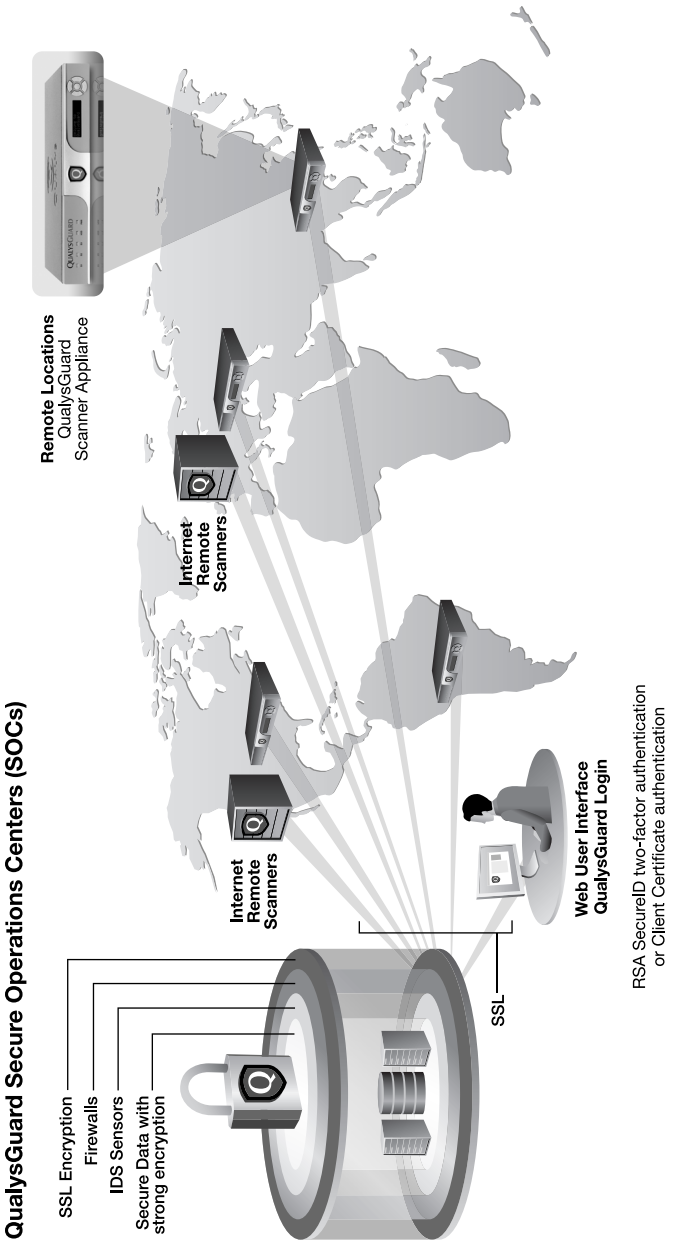


Figure 4-1: QualysGuard's SaaS architecture.

simply by adding more servers. All computers and racked equipment are isolated from other systems in a locked vault.

Internet scanners

QualysGuard Internet scanners carry out perimeter scanning for customers. These remote scanners begin by building an inventory of protocols found on each machine undergoing an audit. After discovering the protocols, the scanner detects which ports are attached to services, such as web servers, databases, and email servers. At that point, the scanners initiate an *inference-based* vulnerability assessment, based on vulnerabilities that could actually be present (due to operating system and configurations) to quickly identify true vulnerabilities and minimize false positives.

Scanner Appliances

QualysGuard Scanner Appliances are installed by customers to map domains and scan IPs behind the firewall. These are plug-in devices that install within a matter of minutes, gather security audit data inside the firewall, and provide secure communications with Qualys SOCs. These appliances use a hardened operating-system kernel designed to prevent any attacks. In addition, they contain no services or daemons (background software processes) that are exposed to the network. These devices poll the SOCs for software updates and new vulnerability signatures, and process job requests.

Secure web interface

Users interact with QualysGuard through its secure web interface. Any standard web browser permits users to navigate the QualysGuard user interface, launch scans, examine audit report data, and manage the account. Secure communications are assured via HTTPS (SSLv3) encryption. All vulnerability information, as well as report data, is encrypted with unique customer keys to guarantee that your information remains confidential and make it unreadable by anyone other than those with proper customer authorization.

Prioritizing Remediation to Guide and Speed Up Staff Follow-Through

QualysGuard provides a remediation ticketing capability similar to trouble tickets created by a support call center. As the security manager, you can control the priority-driven policies for these tickets and automatically assign responsibility for fixing them. QualysGuard notes when tickets have been created and tracks all remediation changes in subsequent scans. The automation of these processes can dramatically speed remediation of vulnerabilities.

Reports from QualysGuard automatically identify and rank vulnerabilities with the QualysGuard Scanning Engine, which assigns one of five severity levels to define the urgency associated with remediation of each vulnerability. Rankings are based on a variety of industry standards such as CVE and NIST. These levels are:

- **Level 1 (minimal):** Information can be collected.
- **Level 2 (medium):** Sensitive information can be collected, such as precise version and release numbers of software running on the target machine.
- **Level 3 (serious):** Indications of threats such as directory browsing, denial of service, or partial read of limited files have been detected.
- **Level 4 (critical):** Red-flag indications of file theft, potential backdoors, or readable user lists present on target machines have been discovered.
- **Level 5 (urgent):** Backdoor software has been detected, or read and write access on files, remote execution, or other activities are present.

Details for each vulnerability are displayed in a report, as shown in Figure 4-2.

QualysGuard also provides an Executive Report, which summarizes the status of repair for all vulnerabilities.

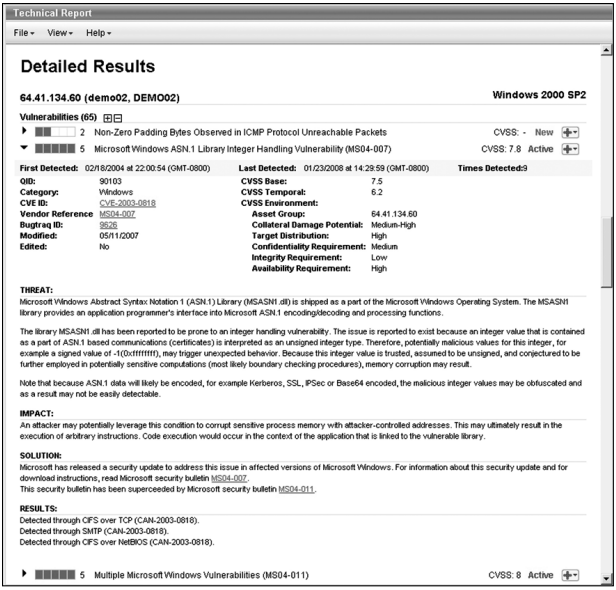


Figure 4-2: QualysGuard individual vulnerability report.

Automating Compliance Documents for Auditors

One area that distinguishes QualysGuard from other VM solutions is its very flexible, comprehensive, and intelligent reporting capability. Most other solutions produce rigid reports that reflect, one-for-one, whatever data they gathered during a scan. Few, if any, mechanisms can filter, regroup, or synthesize the data into higher levels of information abstraction. QualysGuard reports, however, are like quality business intelligence reporting – with filtering and sorting that enables you to view data any way you want.

Components of QualysGuard reporting are:

- **Network assets** (IPs and/or asset groups) included in the report.
- **Graphs and charts** showing overall summaries and network security status.

- **Trending analysis** for a given network.
- **Vulnerability data** with detailed specificity.
- **Filtering and sorting options** to provide other flexible ways to view your network's data.

The QualysGuard Dashboard provides an instant one-page snapshot of your network's overall security position, as shown in Figure 4-3.

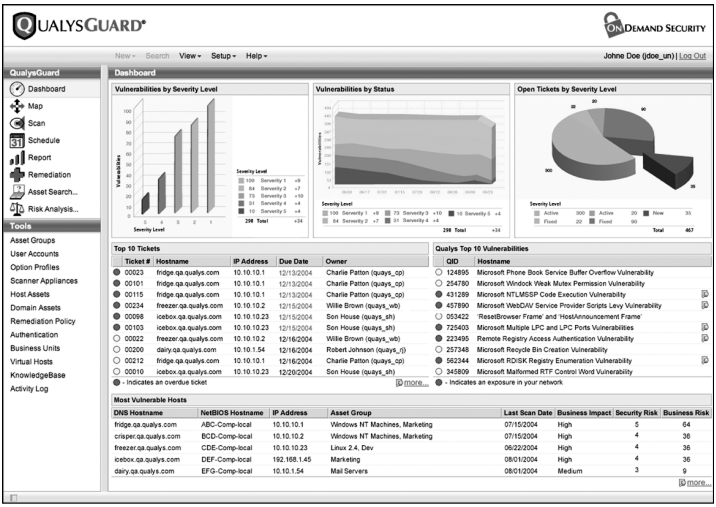


Figure 4-3: QualysGuard Dashboard.

The Dashboard is a portal to more detailed reports that describe each aspect of vulnerability management processes. QualysGuard provides a range of report templates that automatically present VM data and information synthesis typically required by an IT organization for vulnerability remediation. You can easily customize the templates to display specialized reports, formats (such as HTML, XML, PDF), and associated distribution to appropriate staff members, executives, and auditors.

For example, customizable templates automatically generate reports such as:

- Unremediated vulnerabilities with the highest level of severity.

- Rogue devices discovered on the network.
- Technical compliance with a specific regulation, such as PCI DSS, HIPAA, Gramm-Leach-Bliley, or Sarbanes-Oxley.
- Trouble-ticket status for a particular department or business process, such as a financial reporting system or an order processing system.
- Trend analysis for use in job performance appraisals of network security staff.

Keeping the Costs Down

QualysGuard is cost-effective thanks to automation, which saves both smaller businesses and large multinational organizations a huge amount of time compared to the manual execution of continuous processes for VM. QualysGuard's secure architecture is updated daily with new vulnerability audits, and quarterly with new product features. All updates are done seamlessly to subscribers. The costs of ownership are assumed by Qualys and distributed across a large subscriber base. This enables users to benefit from an immediately deployable VM capability at a far lower cost than using an internal, software-based solution.

On demand audits versus costly penetration testing

As described in Part III, penetration testing is the term for network security auditing performed by outside consultants that consists of simulating an attack by a malicious user. Essentially, the 'attacker' tries to identify vulnerabilities and exploit them. While penetration testing captures some vulnerability information at a single point in time, its shelf life is fleeting and results are valid only until the environment changes or until new threats arise. In short, penetration tests aren't always comprehensive and are valid for just hours. With network administrators reconfiguring networks and devices daily, and vulnerabilities emerging at the rate of 25+ per week, network security requires frequent, continual assessment.

On-demand security audits are the ideal supplement to or replacement for penetration tests. QualysGuard provides subscribers with unlimited assessments – daily if required – at a fraction of the cost of one penetration test. Differential reporting and trend analysis is automatically included so you can measure your security improvements over time.

Counting the QualysGuard subscriber benefits

QualysGuard is designed to operate effectively on diverse networks of any size. It's the first scalable, cost-effective web service providing proactive on-demand security audits inside and outside the firewall.

QualysGuard enables total control over the security audit and vulnerability management process, including:

- Easy deployment with the QualysGuard SaaS architecture.
- The ability to easily manage vulnerability management no matter how large your network is.
- A fully-automated solution that eliminates traditional labor-intensive operations, saving time and simplifying large-scale vulnerability management.
- The rapid identification and visualization of network assets.
- Accurate vulnerability detection that eliminates the time-consuming manual work of verifying results and consolidating data.
- Accessible VM service to authorized users from anywhere on the globe.

Sampling Your Free Trial and Four-Step Program for VM

Now that you're familiar with the basics of vulnerability management, it's time to do it for real. You can benefit from a free

two-week trial of QualysGuard. All you need to use it is a web browser. Go to `www.qualys.com/freetrial` and get started!

After registration, you receive an e-mail with a secure link to your user name, password, and initial login URL. After checking the terms and conditions, you see a welcome screen that looks like Figure 4-4.

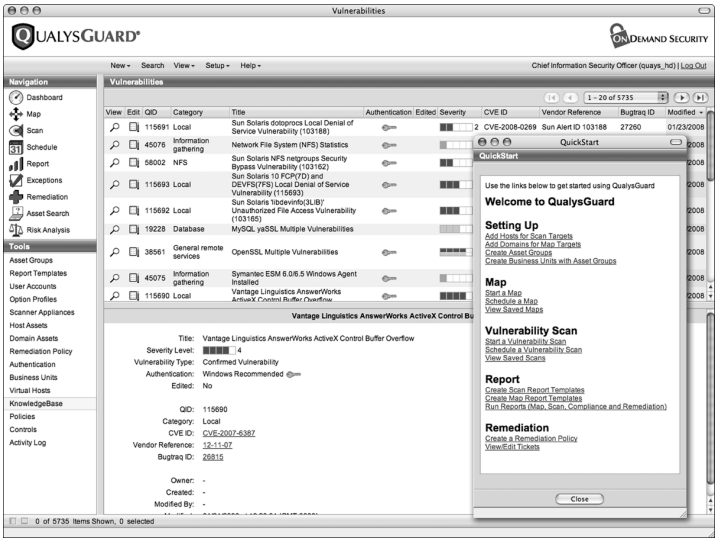


Figure 4-4: The QualysGuard welcome screen.

The welcome window guides you through the essential VM steps for auditing your external network (perimeter). You need a brief set-up to use QualysGuard. First time through, keep it simple and enter your network's top-level domain ID. Later, you may want to try domains, asset groups, and related business units to experience the full power of QualysGuard.

Step 1: Map your network

After you've set up QualysGuard, go to the section called Map, click on 'Start a Map' and do it! This automatically analyses your network and generates data for all devices attached to the IP or range of IPs that you stated in set-up.

Step 2: Scan your network

After the map is created, you can scan all devices on your entire network or a designated subset of those devices. To do this, go to the section called Scan, click on 'Start a Scan' and do it!

Step 3: Read scan reports

Reports are the key deliverable of QualysGuard – and are the best and most comprehensive in the industry. To automatically generate reports, go to the section called Report. First tell QualysGuard what kind of reports you want for Scans and Maps. Next, click on 'Run Reports'. That's it.

Step 4: Remediate risks

This is where your work begins because you need to implement fixes for the issues detected. Don't worry, QualysGuard can guide you through the remediation process. When it tells you about vulnerabilities, QualysGuard also provides hotlinks to remediation patches, fixes, and workarounds. It tells you what to fix first based on business priorities and severity levels. And, by rescanning, QualysGuard can verify that these vulnerabilities have been properly corrected.

Use QualysGuard on a regular basis to help ensure maximum safety and security of your network, applications, and data. As you familiarize yourself with the easy-to-use interface of QualysGuard, you may want to explore generating various reports and trying more comprehensive QualysGuard functionality.

Congratulations! You're now ready to reap the benefits of VM for a secure, protected network. If you have other questions, contact Qualys at `www.qualys.com` and we'll be happy to respond.

Part V

Ten Best Practices for Doing Vulnerability Management

In This Part

- Checking everything to ensure you're protected
- Producing technical, management, and compliance reports
- Patching and tracking

You can use this chapter as a ten-point checklist for doing vulnerability management. These best practices reflect the variety of security measures required to effectively identify and eliminate weaknesses on your network. The checklist is an aggressive plan for removing vulnerabilities in key resources before attackers can exploit your network.

Discover Network Assets

You can't measure risk if you don't know what you have on your network. Discovering your assets helps you determine the areas that are most susceptible to attacks. Network mapping automatically detects all networked devices. VM gives you the capability to do a full network discovery of your network assets on a global scale.

Classify Assets

Most organizations have 5 to 20 categories of network assets whose classification is determined by value to the overall business. Tier the hierarchy of assets by value to the business. For example, you can rank critical databases, financial systems, and other important business assets in a higher category than clerical desktops, non-production servers, and remote laptops. Classify asset priority based on the value to the business and don't give critical assets a lower categorization due to presumptions about their safety.

Check Inside and Outside the DMZ

You want to be comprehensive about your network auditing. So perform VM on your 'demilitarized zone' (DMZ, or the external network boundary) and internal systems. That's the only way to achieve optimal security protection. Hackers' exploits are crafty and can otherwise breach your network, so make sure you're guarding and checking everything.

Run Comprehensive Scans

Run comprehensive and accurate scans on your assets starting with the most important ones. Doing so gives you full visibility on the level of risk associated with your assets. Intelligent scanning rapidly finds vulnerabilities on your network – automatically or on demand. You can scan lower categories of assets less frequently.

Generate Reports for the Technical Staff

Vulnerability reports need to be comprehensive, with full instructions on how to remediate vulnerabilities. Customizable reports are really useful, enabling technical staff to view data in the desired context while reducing information overload.

Generate Management Reports

Use gathered metrics from scans to communicate the status of network security to senior management so that they can understand the trend of vulnerabilities and the efforts of the security team to minimize risks to the enterprise. Use actual performance measurements to educate your executive management team and show the value of VM in maintaining business continuity, reducing risks, and maintaining a secure infrastructure.

Prioritize Patching Efforts

Prioritize patch application starting with the most critical vulnerabilities on the most important assets, and proceed to the less critical ones. Get in the habit of setting (and exceeding!) performance goals to reduce the level of critical vulnerabilities in the network.

Track Remediation Progress

Automatically generated trouble tickets enable you to track each step of remediation and to measure progress over time. If you have a larger organization, using a ticketing system speeds remediation. It also saves you time, enables you to compare the performance of distributed teams, and provides recognition to leaders and followers. Peer pressure encourages security teams to share experiences of actions leading to a more rapid reduction in vulnerabilities.

Generate Policy Compliance Reports

VM delivers trusted third-party auditing and reporting which meets the compliance needs of HIPAA, GLBA, SB 1386, Sarbanes-Oxley, Basel II, and PCI DSS. You can use reports from VM solutions to document the state of security over time on systems in scope for compliance.

Repeat the VM Process on a Regular Basis

Vulnerability management isn't a one-time effort. Best practices of VM suggest regular, on-going scanning and remediation to proactively guard against internal and external threats and ensure compliance. Scan critical systems at least weekly and less critical assets bi-weekly. Microsoft's Patch Tuesday (the second Tuesday of each month) is a good reminder to run system-wide VM audits to detect the latest vulnerabilities.

Vulnerability Management needn't be scary!

Discover:

Why organizations need VM

Options for VM

How to get the best VM solution for your business

A four-step program for VM

Successfully discover how to manage vulnerabilities and protect your network!

Vulnerability Management may seem like a daunting task. This minibook is a quick guide to understanding how to protect your network and data with VM – from finding out about network threats, to selecting a solution that helps you quickly discover and fix vulnerabilities. This book also tells you about the industry's leading VM solution – QualysGuard.

An electronic version of this book is available at **www.qualys.com/dummies**.

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