DRAFT

NETWORK INFRASTRUCTURE SECURITY TECHNICAL IMPLEMENTATION GUIDE Version 6, Release 0

29 OCTOBER 2004

Developed by DISA for the DOD

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APPENDICES

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SUMMARY OF CHANGES

General Changes:

The previous release was Version 5, Release 2, dated 29 September 2003.

Section Changes:

SECTION 1 – ENCLAVE ARCHITECTURE OVERVIEW

Updated with template.

SECTION 2 – ENCLAVE ARCHITECTURE OVERVIEW

No changes

SECTION 3 – NETWORK INFRASTRUCTURE

3.1 External Connections

NET0135 - Changed the audit to become more specific. A review on semi-annual basis is now required.

NET0150 – Deleted, Redundant check. NET0130 accomplishes the requirement.

3.1.2 AG/ISP Connections

NET0162 - Added AG ingress ACL requirement to only permit packets with a destination address belonging to the site's address block.

NET0164 - Ensure there is no routing protocol session with a peer router belonging to an AS (Autonomous System) of the AG service provider.

NET0166 - Restricting AG network service provider IP addresses so they are not redistributed into or advertised to the NIPRNet.

NET0175 – Changed requirement to be allowed if approved by DAA.

3.2.1 IANA Reserved Addresses

Added URL references: www.iana.org/assignments/ipv4-address-space and http://www.iana.org/

3.2.3 DHCP

NET0195 – Deleted do to lack of vulnerability and is common practice.

NET0198 – Modified requirement to include retention period.

NET0199 – Modified for clarity objective.

3.3 General Standards for Communications Devices

NET0200 - Removed requirement for maintaining listing of MAC addresses for all workstations.

3.3.1 Passwords

NET0240 – Modified to remove backdoor accounts do to unachievable objective.

NET0260 – Modified to reference current Instruction 8500.2. Outdated Appendix C removed.

3.3.2 Device Management

NET0290 – Deleted. Do to conflicts with other STIGs this PDI was removed. The image file can be loaded from a console (i.e., XMODEM) or via the FTP or SCP—not TFTP. The IAO will ensure that if FTP or SCP is being used, connectivity between devices and the FTP or SCP server is secured. At a minimum, this will be accomplished by restricting communication to known authorized IP addresses.

3.3.2.1 Out-of-band Management

NET310 – Modified for clarity.

Referred Router and Switch review to section 3.4.3 and 3.7.3 respectively.

3.3.2.2 In-band Management

Referred Router and Switch review to section 3.4.3 and 3.7.3 respectively.

NET0324 - Modified requirement verbiage to become more specific to the environment.

NET0326 – Modified to meet appropriate guidance. “or IAW FIPS 140-2 validated encryption”

3.3.3 Warning Banners

NET0340 - Modified to meet appropriate guidance. “access in accordance with DODI 8500.2 Enclosure C Appendix C”. Outdated Appendix C of this document was removed.

3.4.1 Route Table Integrity

NET0400 – Modified for clarity.

NET0420 - Modified requirement to specify keys need to be changed every 90 days.

3.4.2 Router Accounts and Passwords

NET0560 – Combined with NET0600.

NET0620 – Deleted, determined PDI was not capable of reviewing.

3.4.3.1 Out-of-Band Router Management

NET0630, Modified PDI for out-of-band criteria.

NET0640, originally NET0310 to cover OoB in it's entirety for routers in this section.

NET0650 - Modified timeout requirements from 15 minutes to 10 minutes on console port.

NET0652, originally NET0640.

NET0655, originally NET0630.

3.4.3.2 In-Band Router Management

NET0664, originally NET0320 to cover In-band in it's entirety for routers in this section.

NET0681 – New PDI requiring Secure Shell timeout of 60 seconds reducing the broken telnet session.

NET0682 – New PDI restricting Secure Shell invalid logon attempts to 3.

NET0685 - Modified timeout requirements from 15 minutes to 10 minutes on vty ports.

3.4.4 Securing Router Services and Features

NET0705 - Deleted. It has been determined there isn't a vulnerability in leaving router interfaces in an up/down status.

NET0710 - Modified requirement to restrict on external interfaces only

NET0722 – Require PAD services to be disabled.

NET0724 – Require TCP Keepalives to be enabled.

NET0726 – Require Identification support be disabled.

NET0728 – Require DHCP service to be disabled.

NET0781 – Require Gratuitous ARP to be disabled.

NET0790 – Modified to specify all interfaces.

NET0800 – Modified for clarity.

NET0811 – Require NTP Servers provide services for internal clients only.

NET0812 – Require NTP clients to peer with local NTP servers.

Modified for clarity. (NET… 0710, 0720, 0730, 0740, 0750, 0760, 0770, 0780, 0820).

NET0892 – renamed from NET0900

NET0894 – renamed from NET0925

NET0900- renamed from NET0830

NET0910- renamed from NET0840

NET0920- renamed from NET0845 and modified for clarity.

NET0900- renamed from NET0830

NET0900- renamed from NET0830

3.4.5.2 Exploits Protection

NET0960 - Modified PDI and included information and method to block the later version of traceroute IAW RFC1913.

NET0965- Require TCP wait time interval and Rate limiting on CISCO and JUNOS respectively to prevent TCP SYN Flood Attack.

NET0966 – Require CISCO Express Forwarding (CEF) on all CISCO routers to help router perform better when under SYN Flood Attack.

NET0980 – Modified, new requirement denies ICMP destination unreachable inbound to support the Ports and Protocols category of being a Red Service.

NET0990 – Modified to allow ICMP type 3 code 4, packet fragmentation.

3.4.5.3 Logging

NET1020 - renamed from NET0850

NET1021 – renamed from NET0860

NET1025 – renamed from NET1120

NET1027 – renamed from NET1130

NET1028 – renamed from NET1150

3.4.6 Router Configuration Management

Added clarification for secured alternative methods for uploading and downloading router configurations and images.

3.5.1 Firewall Architecture

Updated Drawing

NET1190 – Modified PDI to reference application-level gateways or firewalls to proxy traffic.

Deleted NET1192. It duplicates NET1190 procedure.

3.5.2 Firewall Placement

NET1200 – Modified PDI for clarity.

3.5.3 Identification & Authentication

NET1228 – Modified PDI for clarity.

3.5.4 Configuration

NET1254 – Modified PDI for clarity.

Deleted NET1262 and NET1270

NET1316 – Modified PDI for clarity, “encryption via SSH, SSL or IAW FIPS 140-2 validated encryption”.

3.6 Network Intrusion Detection (NID)\Real Secure

Added guidance indicating Host Intrusion Detection (HID) isn’t required on a OS-based NID.
NET1325 / NET1326 – Split the PDI (originally NET0100) into two PDIs.

NET1327 – renamed from NET0110

NET1328 – renamed from NET0120

NET1342 – Modified PDI for clarity.

NET1350 – Modified PDI for clarity.

3.7 Switches and VLANS

3.7.1 Horizontal Wiring IDF

Collapsed Data Outlets and Switch & Intelligent Hub section renaming it to Switches and VLANS. Expanded section significantly.

Deleted - (NET1360: CAT II) The IAO will ensure that all LAN outlets not in use are detached in the communications closet and the switch port is disabled.

NET1362 – Require Switch equipment to be in a secured area.

3.7.2 Switch Accounts and Passwords

NET1364 – Require an Authentication Server for Switch equipment.

NET1365 – Only one Local Account can be defined on the Switch.

NET1366 – Require users to have their own account and password to the Switch.

NET1367 – Ensure the lowest security level is assigned to the user-ids.

NET1368 – Expired Switch user's logons are removed form the Authentication Server.

NET1369 – Require type 5 encryption on passwords to the switch.

NET1370 - Deleted. Split NET1370 into 6 PDIs (1364, 1365, 1366, 1367, 1368, 1370)

3.7.3 Switch Administrative Access

NET1380 – Require passwords on all out-of-band switch connections.

NET1381 – Ensure Switch console port times out after 10 minutes.

NET1382 – Ensure modems are not connected to console or auxiliary ports.

NET1383 – Ensure the Switch's Auxiliary port is disabled.

NET1385 – Require passwords on all Switch In-band ports.

NET1386 – Require Switch In-band to be performed on only authorized IP addresses.

NET1387 – Require SSH for all In-band Switch connections.

NET1388 – Require the Switch SSH timeout value is set at 60 seconds or less.

NET1389 – Limit the amount of unsuccessful logons to the switch to three or less.

NET1390 – Set the timeout value on the Switch console port to 10 minutes or less.

NET1391 – Log all In-band Management attempts.

3.7.4.1 Management VLAN & VLAN1

NET1410 - Previously Net1375. Split PDI into two PDIs. Rewrote for clarity.

NET1411 - Previously Net1375. Split PDI into two PDIs. Rewrote for clarity.

NET1412 – Renamed from 1376 and modified PDI for clarity.

NET1413 – Renamed from 1377 and modified PDI for clarity.

3.7.4.2 VLAN Trunking

NET1416 – renamed from 1378. Split PDI into three PDIs. Rewrote for clarity.

NET1417 – renamed from 1378. Split PDI into three PDIs. Rewrote for clarity.

NET1418 – renamed from 1378. Split PDI into three PDIs. Rewrote for clarity.

3.7.4.3 VLAN Access Port Authentication

NET1435 – Renamed from 1379 and modified PDI for clarity.

NET1436 – Port Security or 802.1x Authentication must be used.

NET1437 – If Port security is used, require static MAC addresses to be coded.

NET1438 – If Port Authentication is used require ports to come up in an unauthorized state.

NET1439 – If Port Authentication is used require re-authentication every 60 minutes.

SECTION 4 –REMOTE ACCESS

4.1 VLAN Access Port Authentication

NET1440 – Renamed PDI from NET1380 and modified PDI for clarity.

NET1441 – Renamed PDI from NET1400 and modified PDI for clarity.

NET1446 – Renamed PDI from NET1415 and modified PDI for clarity.

4.2 Remote Access Agreemant

NET1410 - Deleted PDI.

4.3 Authentication, Authorization, and Accounting (AAA)

Deleted following PDIs (NET … 1418, 1435, 1438)

NET1451 – Renamed PDI from NET1420

NET1452 – Renamed PDI from NET1425

NET1453 – Renamed PDI from NET1430

NET1455 – Renamed PDI from NET1436

NET1456 – Renamed PDI from NET1420 and changed requirement from daily to weekly.

4.4.1 Modems

NET1470 – Modified PDI as conditional, if back up services aren't used.

4.4.2 Remote Access Server/Network Access Server

NET1530 – Modified PDI for clarity and changed requirements.

NET1540 – Deleted.

NET1550 – Deleted.

NET1590 – Deleted.
NET1606 – Modified PDI to meet more current standards.

4.5 Remote Client to VPN Gateway

NET1620 – Deleted.

NET1635 – Deleted.

5.1.2 Network Management Security Implications

NET1665 – Split NET1665 into two PDIs (NET1665 & NET1666). Modified to meet current standards.

NET1670 – Modified PDI for clarity.

NET1635 – Deleted.

5.1.3 Network Management Station

NET1762 – Modified PDI to meet current standards.

5.2.1 Site to Site VPN

NET1800 – Modified PDI for clarity.

5.2.2 Contractor to Company Site VPN

NET1840 – Modified PDI, adjusting requirements.

APPENDIX A – RELATED PUBLICATIONS

No changes

APPENDIX B – CJCSM AND DISA COMPUTING SERVICES HANDBOOK REFERENCES

No changes

APPENDIX G – REQUIRED FILTERING RULES

Removed. New policy: The DOD Instruction 8551.1 is now real, dated, published, and available at http://www.dtic.mil/whs/directives/corres/html/85511.htm.

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1. INTRODUCTION

A core mission for the Defense Information Systems Agency (DISA) Field Security Operations (FSO) is to secure DOD Networks. The processes and procedures outlined is this Security Technical Information Guide (STIG) when applied, will decrease the vulnerability of security information. Network Security is clearly still one of the biggest concerns for our Department of Defense (DOD) customers (i.e. the warfighter).

The intent of this Network Infrastructure STIG is to include security considerations at the network level needed to provide an acceptable level of risk for information as it is transmitted throughout an enclave.

1.1 Background

The Network Infrastructure Security Guide has been developed to enhance the confidentiality, integrity, and availability of sensitive Department of Defense (DOD) Automated Information Systems (AISs).

Each site network/communications infrastructure must provide secure, available, and reliable data for all customers. This document is designed to supplement the security guidance provided by DOD-specific requirements. This document will assist sites in meeting the minimum requirements, standards, controls, and options that must be in place for secure network operations.

It should be noted that FSO Support the STIGs, Checklists, and Tools is only available to DOD Customers.

1.2 Authority

DOD Directive 8500.1 requires that “all IA and IA-enabled IT products incorporated into DOD information systems shall be configured in accordance with DOD-approved security configuration guidelines” and tasks DISA to “develop and provide security configuration guidance for IA and IA-enabled IT products in coordination with Director, NSA.” This document is provided under the authority of DOD Directive 8500.1.

The use of the principles and guidelines in this STIG will provide an environment that meets or exceeds the security requirements of DOD systems operating at the MAC II Sensitive level, containing unclassified but sensitive information.

1.3 Scope

The requirements set forth in this document will assist Information Assurance Managers (IAMs), Information Assurance Officers, and System Administrators (SAs) in support of protecting DOD network infrastructures.

The requirements in this document will be employed at the boundary between DOD private LANs and all WAN connections such as the Non-classified (but Sensitive) Internet Protocol Routing Network (NIPRNet), Secret Internet Protocol Router Network (SIPRNet) and the Internet. The

document will also assist in identifying external security exposures created when the site is connected to at least one Information System (IS) outside the site's control.

1.4 Writing Conventions

Throughout this document, statements are written using words such as "**will**" and "**should**." The following paragraphs are intended to clarify how these STIG statements are to be interpreted.

A reference that uses "**will**" implies mandatory compliance. All requirements of this kind will also be documented in the italicized policy statements in bullet format, which follow the topic paragraph. This will make all "**will**" statements easier to locate and interpret from the context of the topic. The IAO will adhere to the instruction as written. Only an extension issued by the Designated Approving Authority (DAA) will table this requirement. The extension will normally have an expiration date, and does not relieve the IAO from continuing their efforts to satisfy the requirement.

A reference to "**should**" is considered a recommendation that further enhances the security posture of the site. These recommended actions will be documented in the text paragraphs but not in the italicized policy bullets. Nevertheless, all reasonable attempts to meet this criterion will be made.

For each italicized policy bullet, the text will be preceded by parentheses containing the italicized Short Description Identifier (SDID), which corresponds to an item on the checklist and the severity code of the bulleted item. An example of this will be as follows "(*G111: CAT II*). "If the item presently has no Potential Discrepancy Item (PDI), or the PDI is being developed, it will contain a preliminary severity code and "N/A" for the SDID (i.e., "(*N/A: CAT III)*".

1.5 Vulnerability Severity Code Definitions

Category I	Vulnerabilities that allow an attacker immediate access into a machine, allow superuser access, or bypass a firewall.
Category II	Vulnerabilities that provide information that have a high potential of giving access to an intruder.
Category III	Vulnerabilities that provide information that potentially could lead to compromise.
Category IV	Vulnerabilities, when resolved, will prevent the possibility of degraded security.

1.6 DISA Information Assurance Vulnerability Management (IAVM)

The DOD has mandated that all IAVMs are received and acted on by all commands, agencies, and organizations within the DOD. The IAVM process provides notification of these vulnerability alerts and requires that each of these organizations take appropriate actions in accordance with the issued alert. IAVM notifications can be accessed at the Joint Task Force - Global Network Operations (JTF-GNO) web site, http://www.cert.mil.

1.7 STIG Distribution

Parties within the DOD and Federal Government's computing environments can obtain the applicable STIG from the Information Assurance Support Environment (IASE) web site. This site contains the latest copies of any STIG, as well as checklists, scripts, and other related security information.

The NIPRNet URL for the IASE site is http://iase.disa.mil/. The National Institute of Standards and Technology (NIST) site is http://csrc.nist.gov/pcig/cig.html. Access to the STIGs on the IASE web server requires a network connection that originates from a **.mil** or **.gov** address. The STIGs are available to users that do not originate from a **.mil** or **.gov** address by contacting the FSO Support Desk at DSN 570-9264, commercial 717-267-9264, or e-mail to fso_spt@ritchie.disa.mil.

1.8 Document Revisions

Comments or proposed revisions to this document should be sent via e-mail to fso_spt@ritchie.disa.mil. DISA FSO will coordinate all change requests with the relevant DOD organizations before inclusion in this document.

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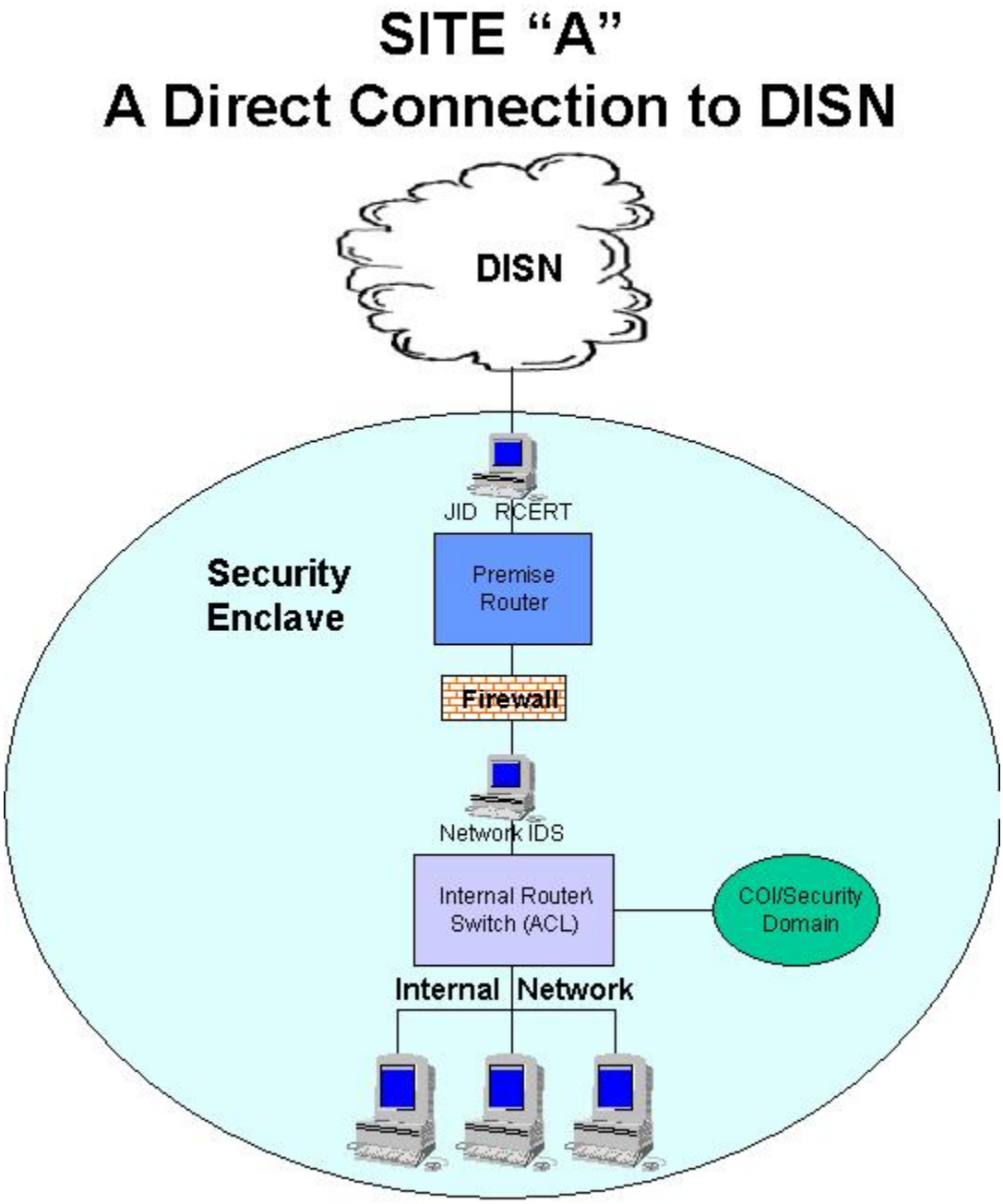
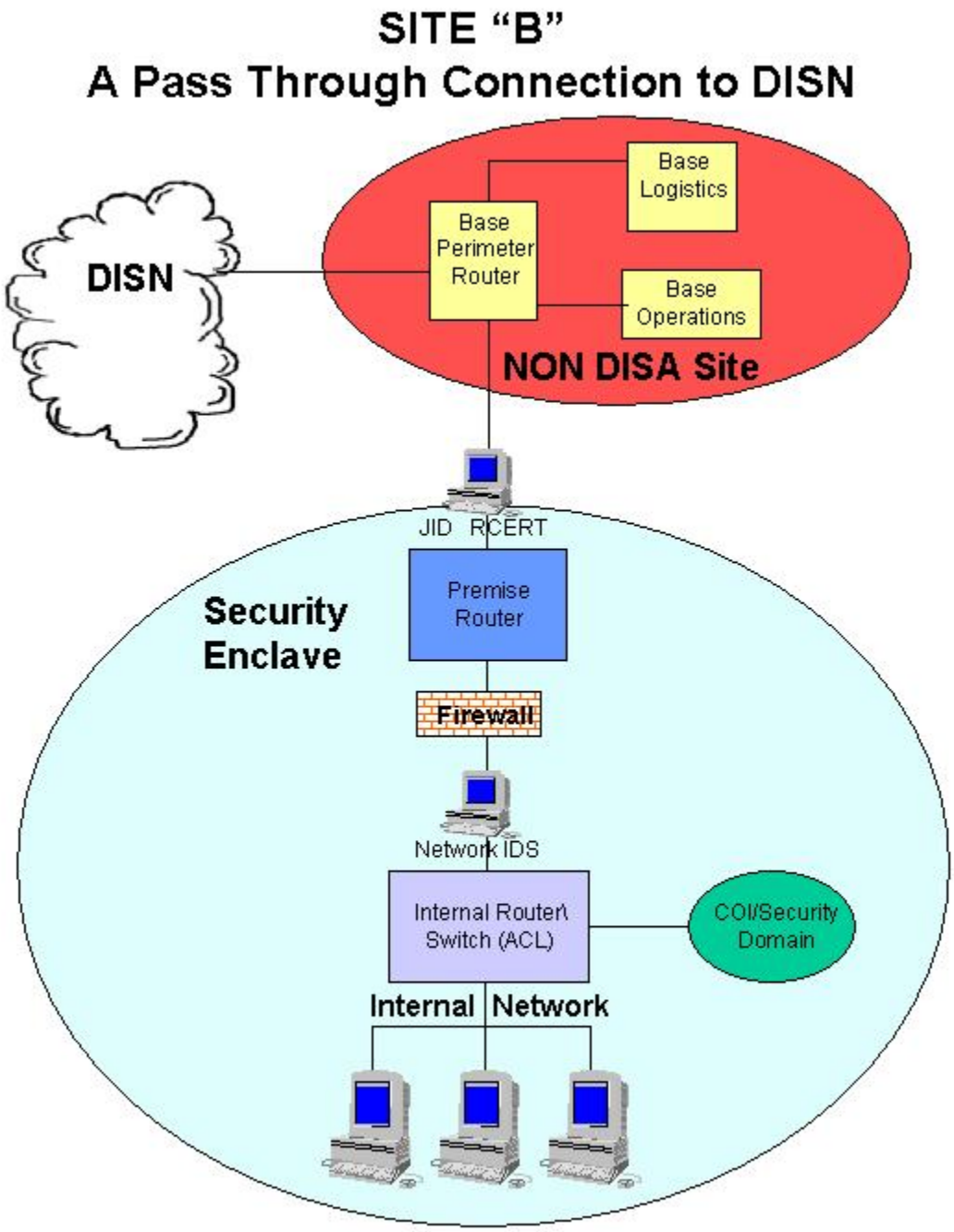
2. ENCLAVE ARCHITECTURE OVERVIEW

Enclave Perimeter Security mechanisms are employed at the boundary between a DOD private LAN and a WAN (e.g., Internet, NIPRNet, SIPRNet). These connections are discussed in this document as **LAN to WAN** connections.




SITE "B"
A Pass Through Connection to DISN
DISN
Base Logistics
Base Perimeter Router
Base Operations
NON DISA Site
JID RCERT
Security Enclave
Premise Router
Firewall
Network IDS
Internal Router\ Switch (ACL)
COI/Security Domain
Internal Network

2.1 Enclave Protection Mechanisms

Enclave protection mechanisms are also used to provide security within specific security domains. In general, enclave protection mechanisms are installed as part of an Intranet used to connect networks that have similar security requirements and have a common security domain. A site may have multiple security domains with protection mechanisms tailored to the security requirements of specific customers. There might also be technology-driven security domains for OS/390, Unisys, Tandem, etc. Smaller locations may have a single enclave with a single security domain supporting the entire organization. The enclave or system owner will identify security domain requirements in the System Security Authorization Agreement (SSAA).

Procedures outlined in the *DOD Instruction 5200.40, DOD Information Technology Security Certification and Accreditation Process (DITSCAP), 30 Dec 97*, lay out the process for the Enclave Security Architecture as they are applied to specific requirements. Each SSAA will include a description of the architectural implementation of the security requirements identified in this STIG.

STIGs and the review process provide the specifications, standards, and inspections for each of the key enclave components. In order to comply with the Enclave Architecture the minimum requirements include the following devices or systems:

- External Network Intrusion Detection System
- Router with ACLs
- Application-level Firewall
- Internal Network Intrusion Detection System
- Demilitarized Zone (DMZ)
- Split-DNS

The only approved variance to the Enclave Architecture would be a site that adheres to the Deny by Default rule, does not require access into the Enclave to any user services, or host publicly accessible data (e.g., web servers, ftp servers, etc.). Therefore, the requirement for a DMZ and Split-DNS would not apply to these sites. This does not negate the need for DNS services; therefore, if the site utilizes an internal DNS server it must be configured In Accordance With (IAW) the Domain Name System (DNS) STIG, otherwise the use of host files to handle the internal resolution may be an acceptable solution. Either solution would require the utilization of a primary or secondary DNS server, hosted on the NIPRNet, for all external resolution.

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3. NETWORK INFRASTRUCTURE

Without current and accurate documentation the change control processes don't have adequate information to make changes that will not jeopardize the network's integrity. To assist in the management, auditing, and security of the network infrastructure facility drawings and topology maps are a necessity. Topology maps are important because they show the overall layout of the network infrastructure and where devices are physically located. They also show the relationship and inter-connectivity between devices and where possible intrusive attacks (wire taps) could take place.

- *(NET0090: CAT II) The IAO will maintain a current drawing of the site's network topology that includes all external and internal links, subnets, and all network equipment.*

3.1 External Connections

Connecting to external networks is one of the most complex areas of designing, implementing, and managing a network. An external network can be the NIPRNet or SIPRNet, as well as a network belonging to another DOD activity, a contractor, or even the Internet. An external network is connected to the site's internal network via an external connection that can include but not limited to a dedicated circuit (i.e., DISN Data Services), dial-on-demand Integrated Services Digital Network (ISDN), or an Ethernet upstream link to a neighboring service or activity's network on the same base.

Regardless of technology used, each external connection to the site's internal network must be secured such that it does not introduce any risk to the network. Every site should have a security policy addressing filtering of the traffic from those connections. This documentation along with diagrams of the network topology are required to be submitted to the Connection Approval Process (CAP) for approval to connect to the NIPRNet or SIPRNet. Depending on the command, service, or activity, additional approval may be required. SIPRNet connections must also comply with the documentation provided to the SIPRNet Connection Approval Office (SCAO) to receive the SIPRNet Interim Approval to Connect (IATC) or final Approval to Connect (ATC) or as documented in the Interim Approval to Operate (IATO) or Approval to Operate (ATO) signed by the Designated Approving Authority (DAA).

Prior to establishing a connection with another activity, the site's policy should require that a Memorandum of Understanding (MOU) or Memorandums of Agreement (MOA) be established between the two sites prior to connecting with each other. This documentation along with diagrams of the network topology is required to be submitted to the CAP for approval to connect to the NIPRNet or SIPRNet. The policy must insure that all connections to external networks should conform equally. A connection to a trusted DOD activity must be treated the same as a connection to the NIPRNet. The security posture of a network is only as good as its weakest link.

- *(NET0130: CAT III) The IAO will ensure that all external connections are validated and approved prior to connection.*

- *(NET0135: CAT II) The IAO will review all connection requirements on a semi-annual basis to ensure the need remains current, as well as investigate all undocumented network connections discovered during inspections.*

NOTE: Unjustified and unapproved connections will be disconnected.

3.1.1 Leased/Dedicated Lines

DOD leased lines carry an aggregate of sensitive and non-sensitive data; therefore unauthorized access must be restricted. Security guidelines concerning leased/dedicated circuits are as follows:

- (*NET0140: CAT III) The IAO will ensure the connection between the CSU/DSU and the local exchange carrier's (LEC) data service jack (i.e., demarc) is in a secured environment.*

- *(NET0140: CAT III) The IAO will ensure the network management modems connected to all Channel Service Units (CSUs)/Data Service Units (DSUs) are disabled or disconnected when not in use.*

3.1.2 AG/ISP Connections

Direct ISP connections are prohibited unless written approval is obtained from the GIG Waiver Panel or the Assistant Secretary of Defense for Networks & Information Integration (NII) who acts as the DOD CIO as well as the chair for the GIG Panel. NIPRNet enclave connections to contractor or non-DOD Federal Agency networks must be approved by the OSD. Henceforth, an Approved Gateway (AG) is any external connection from a DOD NIPRNet enclave to an ISP or network owned by a contractor or non-DOD Federal Agency that has been approved.

Any enclave with one or more AG connections will have to take additional steps to insure that neither their network nor the NIPRNet is compromised. Without verifying destination address of traffic coming from the site's AG, the premise router could be routing transit data from the Internet into the NIPRNet. This could also make the premise router vulnerable to a DoS attack as well as provide a backdoor into the NIPRNet. The site must insure that the premise router's ingress packet filter for any interface connected to an AG is configured to only permit packets with a destination address belonging to the site's address block.

The premise router will not use a routing protocol to advertise NIPRNet addresses to the AG. All ISPs use Boarder Gateway Protocol (BGP) to share route information with other autonomous systems (AS)—that is, any network under a different administrative control and policy than that of the local site. If BGP is configured on the premise router, no BGP neighbors will be defined as peer routers from an AS belonging to any AG. The only method to be used to reach the AG will be through a static default route. It would also not be feasible to implement Message Digest (MD5) authentication with any BGP neighbors belonging to an AG. Thus, this restriction will ensure that routing information shared by the BGP peers across the NIPRNet will not be corrupted through route updates sent from untrusted routers. Furthermore, by not redistributing NIPRNet routes into the AG, unsolicited traffic that may inadvertently attempt to enter the NIPRNet by traversing the enclave's premise router will be avoided.

- *(NET0160: CAT I) The IAM will ensure that written approval is obtained from the GIG Waiver Panel or the Assistant Secretary of Defense (NII) prior to establishing a direct ISP connection.*

- *(NET0162: CAT I) The IAO will ensure router interfaces that connect to an AG (i.e. ISP) are configured with an ingress ACL that only permits packets with destination addresses within the site's address space.*

- *(NET0164: CAT I) The IAO will ensure the premise router does not have a routing protocol session with a peer router belonging to an AS (Autonomous System) of the AG service provider.*

- *(NET0166: CAT III) The IAO will ensure the AG network service provider IP addresses are not redistributed into or advertised to the NIPRNet.*

NOTE: The normal enclave requirement for filtering and monitoring traffic will still be enforced for any traffic from the AG. All traffic entering the enclave from the AG must enter through the firewall and be monitored by an internal IDS. All traffic leaving the enclave, regardless of the destination--AG or NIPRNet addresses, will be filtered by the premise router's egress filtering to verify that the source IP address belongs to the enclave.

3.1.3 Backdoor Connections

The term "backdoor link" is used to refer to a link between two customer sites that does not traverse the provider's network (RFC 2764) –in this case, the provider network would be NIPRNet or SIPRNet. Routes over this link are called "backdoor routes". Without taking the proper safeguard steps, this connection could impose security risks to either site. For example, as a result of link availability or routing protocol administrative distances (i.e. the backdoor route is more favorable), it is possible that traffic destined for other networks from site B's network and vise versa could just be passing through Site A's premise router. It is also possible that traffic from Site B's network could be destined for Site A's network. In either case, the premise router external interface providing the backdoor link must have the same ingress filtering applied as an external interface providing a connection to the NIPRNet, SIPRNet, or ISP.

An even greater risk would be a backdoor link established between two sites' internal routers or layer-3 switches. In this case, the traffic between the two sites is bypassing the perimeter that has been established for each network for defense against an attack. Though both networks consider each other a trusted network, the risk becomes evident when one of the networks has been breached leaving the other in a vulnerable position. Backdoor connections bypassing the networks perimeter (i.e., premise or screening router, firewall, IDS, etc) are prohibited unless the connection is mission critical and approved by the DAA or CIO. This unprotected connection could also be to the Internet, NIPRNet, SIPRNet, or any other DOD or contractor network.

- *(NET0170: CAT II) The IAO will ensure that no backdoor connections exist between the site's secured private network and the Internet, NIPRNet, SIPRNet, or other external networks unless approved by the DAA or CIO.*

3.2 Network Layer Addressing

IPv6 is the next generation network layer protocol for the Internet as well as the Global Information Grid (GIG) including the NIPRNet and SIPRNet. Implementation of IPv6 is necessary due to the fundamental constraints of IPv4 that renders it incapable of meeting long-term requirements of both the commercial community and the DOD. As part of the GIG integrated architecture strategy, the migration to IPv6 across DOD networks will consider operational requirements, risks, and costs, while maintaining interoperability within the DOD, across the Federal Government, and among business partners in the commercial sector. Henceforth, as of the memo from the ASD (NII) dated June 9, 2003, IPv4 will continue to be the mandated internetworking protocol for DOD. In addition, all references in this document relating to addressing, address blocks, subnets, prefixing, multicasting, and broadcasting will be exclusively within the IPv4 framework.

The first part of an IP address identifies the network on which the host resides, while the second part identifies the particular host on the given network. This creates the two-level addressing hierarchy—subnetting supports a three-level hierarchy. The network-number field has been referred to as the "network-prefix" because the leading portion of each IP address identifies the network number. All hosts on a given network share the same network-prefix but must have a unique host-number.

The DOD Network Information Center (NIC) assigns blocks of network addressees, to local administrators. The local network administrator then assigns individual IP addresses to hosts, servers, printers and workstations on their LAN.

- *(NET0175: CAT I) The IAO will ensure that IPv6 has not been implemented on any DOD network that transports production or operations traffic unless approved by DAA.*

3.2.1 IANA Reserved Addresses

In the past, it has been typical to assign globally unique addresses to all hosts that use IP. In order to extend the life of the IPv4 address space, address registries are requiring more justification than ever before, making it harder for organizations to acquire additional address space blocks. It is the intent of RFC 1918 to promote a strategy that will provide constraint relief to the available globally unique address space that is rapidly diminishing.

Sites may incorporate the use of private network addresses into the site's NIPRNet architecture using the address spaces defined in this section. A site that uses any of these private addresses can do so without any coordination with IANA or the NIC. Since these addresses are never injected into the global NIPRNet, SIPRNet, or Internet routing system, the address space can simultaneously be used by every organization.

As documented in RFC 1918 The Internet Assigned Numbers Authority (IANA) has reserved the following three blocks of the IP address space that can be used for private networks:

10.0.0.0	- 10.255.255.255 (10/8 prefix)	Class A
172.16.0.0	- 172.31.255.255 (172.16/12 prefix)	Class B
192.168.0.0	- 192.168.255.255 (192.168/16 prefix)	Class C

The appropriate ACLs need to be applied to filter this traffic. These address blocks are subject to change. To ensure that you have the latest ACLs, refer to the following URL: http://www.iana.org/assignments/ipv4-address-space. To reference the central coordination site for the assignment of unique parameter values for Internet protocols use the following url: http://www.iana.org/

- *(NET0180: CAT II) The IAO will ensure all network IP address ranges are properly registered with the .MIL Network Information Center (NIC).*

- *(NET0185: CAT II) The IAO will ensure that all addresses used within the site's SIPRNet infrastructure are authorized .mil addresses that have been registered and assigned to the activity.*

3.2.2 Network Address Translation

Using the private addressing scheme in accordance with RFC 1918 will require an organization to also use Network Address Translation (NAT) for global access. Though NAT works well with the implementation of RFC 1918 addressing scheme, it also has the security benefit of hiding real internal addresses. A sites network address infrastructure should be considered proprietary information and should not be advertised. If potential attackers were able to map the network infrastructure by discovering real client addresses, they would be able to identify resources on the network to attack. The external IP address of the firewall or routable addresses from a NAT pool should be the only address visible to the public.

- *(NET0190: CAT III) The IAO will ensure that workstation clients' real addresses are not revealed to the public by implementing NAT on the firewall or the router.*

NOTE: If the site has implemented an application-level firewall, hiding of the clients' real address can also be done by enabling the proxies. Verify the clients' real source address is replaced with that of the firewall's external IP.

The first scenario would be a site that has configured the firewall with one external IP address and has configured the internal network to use RFC 1918 addresses. It may work for a site that does not allow for external connections into the network, but is the least deployed configuration.

The second scenario would be a site that has multiple external IP addresses configured on the firewall, one primary for the site (workstations, printers, etc.), and the others redirected to individual servers. This is common with sites that host Web and FTP sites. The internal network is configured with the RFC 1918 addresses, including the Web or FTP server, but the server's IP address is mapped one to one with a different external IP.

The last scenario would be a system that requires that its real address be used. For these instances, the site will implement RFC 1918 addresses for the entire network with the exception of those hosts. The site will provide written justification for the exclusion of these hosts from the requirement.

In all of the situations above, the intent is to restrict the source and destination range to the smallest range possible. For servers that are open to the public, or an unmanageable subset of the public range (e.g., .mil, .gov, and .com), the site is configured similar to the second scenario, except the source address for these connections would be "any". If the .com users were only a few users, then you could restrict to .mil and .gov and then configure the small amount of .com addresses. The destination IP should be restricted to a single IP or in the case of a cluster or server "farm" it could be restricted to a subnet, yet would still implement port restriction.

3.2.3 DHCP

With an increase in TCP/IP networks, the ability to assign IP client configurations automatically for a specific time period (called a lease period) has alleviated the time consuming process of IP address management. Network administrators can now automate and control from a central position the assignment of IP address configurations using the Dynamic Host Control Protocol (DHCP).

When connected to a network, every computer must be assigned a unique address. However, when adding a machine to a network, the assignment and configuration of network IP addresses has required administrator action. The user had to request an IP address, and then the administrator would manually configure the machine. Mistakes in the configuration process are easy to make, and can cause difficulties for both the administrator making the error, as well as users on the network. In order to simplify the process of adding machines to the network and assigning unique IP addresses manually, the site may decide to deploy DHCP.

If DHCP is used to allocate IP addresses for internal devices, a portion of the network IP addresses needs to be excluded or reserved from the DHCP scope for devices that require manual configuration of IP addresses (e.g., servers, routers, firewalls, and administrator workstations, etc.). The DHCP server is required, at a minimum, to log hostnames or MAC addresses for all clients. In order to trace, audit, and investigate suspicious activity, DHCP servers within the SIPRNet infrastructure must have the minimum duration of the lease time configured to 30 days or more.

- *(NET0198: CAT III) The IAO will ensure that the DHCP server is configured to log hostnames or MAC addresses for all clients and all logs are stored online for 30 days and offsite for one year.*

- *(NET0199: CAT III) The IAO will ensure that any DHCP server used within SIPRNet infrastructure is configured with a lease duration time of 30 days or more.*

3.3 General Standards for Communications Devices

The following subsections set security guidance applicable to all communications devices (e.g., routers, switches, firewalls, RAS, NAS, IDS, etc.). This guidance will be adhered to in addition to the requirements set forth in the individual sections that provide detailed security requirements for each device.

NOTE: For the purpose of this document the term "remote" applies to anything other than direct console access, unless stated otherwise in the following section.

- *(NET0210: CAT II) The IAO will ensure that all network devices (i.e., IDS, routers, RAS, NAS, firewalls, etc) is located in a secure room with limited access.*

NOTE: The IAO will have ultimate authority to determine who has access both physically and administratively.

3.3.1 Passwords

- *(NET0230: CAT I) The IAO will ensure all communications devices are password protected.*

- *(NET0240: CAT I) The IAO will ensure all default manufacturer passwords are changed.*

- *(NET0260: CAT II) The IAO will ensure that all passwords are created and maintained in accordance with the rules outlined in DODI 8500.2, IAIA-1 and IAIA-2. http://www.dtic.mil/whs/directives/corres/html/85002.htm.*

- *(NET0270: CAT II) The IAO will record the locally configured passwords used on communications devices and store them in a secured manner.*

3.3.2 Device Management

- *(NET0280: CAT III) The IAO will ensure that image files loaded via the File Transfer Protocol (FTP) process are checked on a monthly basis to ensure the file has not been corrupted or altered.*

- *(NET0300: CAT II) The IAO will disable all network management ports except those needed to support the operational commitments of the sites.*

3.3.2.1 Out-of-band Management

Out-of-band management consists of accessing the communications device via a dial-up circuit, directly connected terminal device, or local area networks dedicated to managing traffic. With the dial-up method, a modem is attached to the console service port and the administrator connects via a standard phone line. This connection is relatively private, since connect times are random and the circuit is disconnected when not in use. The most secure out-of-band management is directly connecting a computer or terminal to the service port. This precludes any intentional or accidental reception of information. Section 3.4.3 Router Administration and

3.7.3 Switch Administration covers and expands these requirements. Disregard this section for routers and switches.

- *(NET0310: CAT II) The IAO will ensure that the out-of-band or direct connection method for communications device management is used.*

- *(NET0310: CAT II) To ensure the proper authorized network administrator is the only one who can access the device, the IAO will ensure out-of-band access enforces the following security restrictions:*

  - *Strong two-factor authentication (e.g., Secure ID)*
  - *Encryption of management session*
  - *Auditing*

3.3.2.2 In-band Management

In-band management is accomplished by establishing a SSH session with the device. This method is fast and convenient, but presents some security risks. Accessing the communications device in-band makes the session susceptible to all the monitoring and line sniffing vulnerabilities associated with a distributed LAN. For example, the login or privileged password could be intercepted, providing an attacker the capability to exploit a network device.

In-band management is only to be used in situations where out-of-band management will hinder operational commitments, and the IAO has approved in writing the use for that specific purpose. If remote access is used to connect to a network component for administrative access, the most stringent security controls will be implemented as specified in Section 4.1 Levels of Remote Access. Section 3.4.3 Router Administration and 3.7.3 Switch Administration covers and expands these requirements. Disregard this section for routers and switches.

- *(NET0320: CAT II) The network administrator will limit the use of in-band management to situations where the use of out-of-band management would hinder operational commitments or when emergency situations arise. IAO will approve the use of in-band management on a case-by-case documented basis.*

- *(NET0322: CAT II) For in-band management, the IAO will implement the use of strong two-factor authentication for all access to all communications devices.*

- *(NET0324: CAT II) The IAO will ensure that the use of in-band management is restricted to a limited number of authorized IP addresses. The number of IP addresses must be equal to or less than the number of network administrators.*

- *(NET0326: CAT II) For in-band management, the IAO will insure that the currently supported version of SSH with all security-related patches applied is utilized.*

3.3.3 Warning Banners

- *(NET0340: CAT II) The IAO will ensure that warning banners are deployed on all network devices allowing SSH, Telnet, File Transfer Protocol (FTP), or Hyper-Text Transfer Protocol (HTTP) access in accordance with DODI 8500.2 Enclosure C Appendix C.*

  http://www.dtic.mil/whs/directives/corres/html/85002.htm.

3.4 Routers

Routers process information at the third layer of the OSI model, the Network Layer. They provide a seamless path for the forwarding of data from a node on one network to a node on another network. The networks may be collocated or separated by thousands of miles and when combined they create the openness upon which information sharing is based.

3.4.1 Route Table Integrity

A rogue router could send a fictitious routing update to convince a site's premise router to send traffic to an incorrect or even a rogue destination. This diverted traffic could be analyzed to learn confidential information of the site's network, or merely used to disrupt the network's ability to effectively communicate with other networks.

There are two approaches that can be used to safeguard the integrity of a route table: static routes and neighbor router authentication. For obvious reasons, defining static routes is the most secure method and is ideal for small stable networks. When using routing protocols to make route table updates due to changes in network topology and connection states, neighbor router authentication must be used to prevent fraudulent route updates from being received. Authentication occurs when routing updates are exchanged between neighbor routers; thereby, ensuring that a router receives routing information only from a trusted source. Neighbor router authentication is supported by all routing protocols except RIP Version 1.

There are two types of neighbor router authentication that can be used: plain text authentication and MD5 authentication. The message digest is created using the key and a message, but the key itself is not sent, preventing it from being read while it is being transmitted. Plain text authentication sends the authenticating key itself over the network. All of the routing protocols support MD5 authentication except RIP Version 1 and IGRP.

NOTE: MD5 for IS-IS was introduced in Cisco IOS software version 12.2(13) T and is only supported on limited number platforms.

As with all secret keys and passwords, it is imperative that one closely guards the authentication keys used in neighbor router authentication. The security benefits of this feature are reliant upon keeping all authentication keys confident by using controlled methods for exchanging the keys as well as changing the keys on a regular basis.

NOTE: As of this writing, neighbor router authentication will not be required between the site's premise router and a NIPRNet or SIPRNet hub router.

- *(NET0400: CAT II) The router administrators will ensure neighbor authentication with MD5 is implemented for all routing protocols with all peer routers within same or between autonomous systems (AS).*

- *(NET0410: CAT II) The router administrators will restrict BGP connections to known IP addresses of neighbor routers from a trusted AS.*

- *(NET0420: CAT III) The IAO will ensure there are written procedures for MD5 key management to include: key exchange, storage, and expiration. Keys will be changed every 90 days.*

3.4.2 Router Accounts & Passwords

Restricting access to all routers is critical in safeguarding the network. In order to control and authorize access, an authentication server that provides extended user authentication and authority levels will be implemented.

Individual user accounts with passwords will be set up and maintained in accordance with the guidance contained in *Appendix B, CJCSM.* There are two password protection types provided by Cisco Internetworking Operating System (IOS): Type 7 and Type 5. Type 7 uses the Cisco defined encryption algorithm, which is regarded as weak in the commercial security community. Type 7 encryption can be applied to the enable password, username, and line password commands using the service password-encryption command. Type 5 encryption, which uses a Message Digest Algorithm Version 5 (MD5), is considered a stronger mechanism and is used by the enable secret command.

Juniper routers do not have enable or privilege mode passwords—and there is no password prompt to enter edit mode. There is simply a one-time login to access the Command Line Interface (CLI). All privileges are based on the administrator's account or the class the account belongs to. In addition, all passwords defined in JUNOS are always encrypted when the configuration is displayed.

- *(NET0430: CAT II) The IAO will ensure that an authentication server is used to gain administrative access to all routers.*

- *(NET0440: CAT II) The IAO will ensure that when an authentication server is used for administrative access to the router, only one account is defined locally for use in an emergency (i.e., authentication server or connection to the server is down).*

- *(NET0460: CAT I) The router administrators will ensure that each user has their own account to access the router with username and password.*

- *(NET0465: CAT II) The router administrators will ensure that all user accounts are assigned the lowest privilege level that allows them to perform their duties.*

- *(NET0470: CAT II) The router administrator will immediately remove accounts from the authentication server or router that are no longer required.*

- *(NET0580: CAT III) The router administrator will ensure that a password is required to gain access to the router's diagnostics port.*

- *(NET0590: CAT III) The router administrators will ensure the enable secret password does not match any other username password, enable password, or any other enable secret password.*

- *(NET0600: CAT I) The router administrators will ensure that passwords are not viewable when displaying the router configuration. Type 5 encryption must be used for the enable mode password (i.e., enable secret password).*

3.4.3 Router Administrative Access

3.4.3.1 Out-of-band Router Management

From an architectural point of view, providing Out-Of-Band (OOB) management of network systems is the best first step in any management strategy. No production traffic resides on an out-of-band network. Devices should have a direct local connection to such a network.

The console port will be configured to time out, so that if an administrator forgets to log out, the router will log the administrator out automatically. Users should never connect a modem to the aux port as a backup or remote access method to the device.

- *(NET0630: CAT II) The IAO will ensure that the out-of-band or direct connection method for communications device management is used.*

- *(NET0640: CAT II) To ensure the proper authorized network administrator is the only one who can access the device, the IAO will ensure out-of-band access enforces the following security restrictions:*

  - *Strong two-factor authentication (e.g., Secure ID)*
  - *Encryption of management session*
  - *Auditing*

- *(NET0645: CAT I) The IAO will ensure that all out-of-band management connections to the router require passwords.*

- *(NET0650: CAT II) The router administrators will ensure the router console port is configured to time out after 10 minutes or less of inactivity.*

- *(NET0652: CAT II) The IAO will ensure modems are not connected to the console or auxiliary ports.*

- *(NET0655: CAT III) The router administrators will ensure that the router's aux port is disabled.*

3.4.3.2 In-band Router Management

In-band management administration with telnet is dangerous because anyone with a network sniffer and access to the right LAN segment can acquire the router account and password information. Security centers on protecting the paths and sessions used to access the device.

Access lists or filters must be used to limit which hosts may connect to the device using any in-band management application. Additionally, the IP addresses, which will be restricted to administrators only and must be from the internal network.

NOTE: In-band management is only to be used in situations where out-of–band management has been deemed to hinder operational commitments, and the IAO has approved in writing the use for that specific purpose.

- *(NET0664: CAT II) The network administrator will limit the use of in-band management to situations where the use of out-of-band management would hinder operational commitments or when emergency situations arise. IAO will approve the use of in-band management on a case-by-case documented basis.*

- *(NET0665: CAT I) The IAO will ensure that all in-band management connections to the router require passwords.*

- *(NET0670: CAT II) The router administrators will ensure that the router only allows in-band management sessions from authorized IP addresses from the internal network.*

- *(NET0680: CAT II) The router administrators will ensure in-band management access to the router is restricted to SSH.*

- *(NET0681: CAT II) The router administrators will ensure SSH timeout value is set to 60 seconds or less, causing incomplete SSH connections to shut down after 60 seconds or less.*

- *(NET0682: CAT II) The router administrators will ensure the maximum number of unsuccessful SSH login attempts is set to three, locking access to the router.*

- *(NET0685: CAT II) The router administrators will ensure the timeout for in-band management access is set for no longer than 10 minutes.*

- *(NET0690: CAT IV) The router administrators will configure the ACL that is bound to the VTY ports to log permitted and denied access attempts.*

3.4.4 Securing Router Services & Features

Ensuring each device on the network is as secure as possible dictates that the features and services activated, all need to be reviewed from a mindset of security. Simple security principles

like – "if you are not using it, do not turn it on" – can be applied. The best security practice is to only support the services and protocols needed by the network to meet operation commitments. In most cases the industry recommends turning the service off, and as new operating systems are released they have become turned off by default. If a particular portion of a network needs a service but the rest does not, then the restriction features should be employed to limit the scope of the service.

Operating System

To guard against security weaknesses identified in older versions of the Operating System a current operating system is required.

- *(NET0700: CAT II) The router administrator will implement the minimum operating system release level for all routers IAW the current Network Infrastructure Security Checklist.*

Cisco Discovery Protocol

Cisco Discovery Protocol (CDP) is used for some network management functions, but is dangerous in that it allows any system on a directly connected segment to learn that the router is a Cisco device, determine the model number and the Cisco IOS software version being run. This information may in turn be used to design attacks against the router. CDP information is accessible only to directly connected systems.

- *(NET0710: CAT III) The router administrators will ensure Cisco Discovery Protocol (CDP) is disabled on all external interfaces on all Cisco premise routers.*

Trivial Services

By default, Cisco devices up through IOS version 11.3 offer the "small services": echo, chargen, and discard. These services, especially their UDP versions, are infrequently used for legitimate purposes, but can be used to launch denial of service and other attacks that would otherwise be prevented by packet filtering.

For example, an attacker might send a DNS packet, falsifying the source address to be a DNS server that would otherwise be unreachable, and falsifying the source port to be the DNS service port (port 53). If such a packet were sent to the Cisco's UDP echo port, the result would be the Cisco sending a DNS packet to the server in question. No outgoing access list checks would be applied to this packet, since it would be considered locally generated by the router itself.

The small services are disabled by default in Cisco IOS 12.0 and later software. In earlier software, they may be disabled using the commands no service tcp-small-servers and no service udp-small-servers. In Juniper the defaults have them turned off.

Packet Assembler Disassembler (PAD) is a X.25 component seldom used. It collects the data transmissions from the terminals and gathers them into a X.25 data stream and vice versa. PAD

acts like a multiplexer for the terminals. If enabled, it can leave your device vulnerable to attacks.

Enabling TCP keepalives on incoming connections can help guard against both malicious attacks and "orphaned" sessions caused by remote system crashes. Enabling the TCP keepalives causes the router to generate periodic keepalive messages, letting it detect and drop broken Telnet connections.

Identification support allows you to query a TCP port for identification. This feature enables an unsecured protocol to report the identity of a client initiating a TCP connection and a host responding to the connection. With identification support, you can connect a TCP port on a host, issue a simple text string to request information, and receive a simple text-string reply. This is another mechanism to learn the router vendor, model number, and software version being run.

By sending a large packet to the Dynamic Host Configuration Protocol (DHCP) port it is possible to freeze the router's processing engine. Service DHCP is enabled by default.

The "finger" service is used to find out which users are logged into a network device. "Finger" is a known security risk in the Internet, due to its divulgence of detailed information of people logged into a system. This is a "need to know" category and an attacker could use the information as a social engineering practice to try to elicit classified DOD information.

Most recent software versions support remote configuration and monitoring using the World Wide Web's HTTP protocol. In general, HTTP access is equivalent to interactive access to the router. The authentication protocol used for HTTP is equivalent to sending a clear-text password across the network, and, unfortunately, there is no effective provision in HTTP for challenge-based or one-time passwords. This makes HTTP a relatively risky choice for use across the public Internet. The additional services that the router is enabled for increases the risk for an attack since the router will listen for these services.

- *(NET0720: CAT III) The router administrators will ensure TCP & UDP small servers are disabled.*
- *(NET0722: CAT III) The router administrators will ensure PAD services are disabled.*
- *(NET0724: CAT III) The router administrators will ensure TCP Keep-Alives for Telnet Session are enabled.*
- *(NET0726: CAT III) The router administrators will ensure Identification support is disabled.*
- *(NET0728: CAT III) The router administrators will ensure DHCP Services are disabled.*
- *(NET0730: CAT III) The router administrators will ensure Finger is disabled.*

- *(NET0740: CAT II) The router administrators will ensure HTTP, FTP, and all BSD r-commands servers are disabled.*

Configuration and Image Integrity

Bootp is a user datagram protocol (UDP) that can be used by routers to access copies of Software on another router running the Bootp service. In this scenario, one router acts as a Software server that can download the software to other routers acting as Bootp clients. In reality, this service is rarely used and can allow an attacker to download a copy of a router's software to obtain its passwords and IP addresses.

The routers can find their startup configuration either in their own NVRAM, or load it over the network via TFTP or Remote Copy (RCP). Obviously, loading in from the network is taking a security risk. If an attacker intercepted the startup configuration it could be used to gain access to the router.

- *(NET0750: CAT III) The router administrators will ensure Bootp server is disabled.*

- *(NET0760: CAT II) The router administrators will ensure Configuration auto-loading is disabled.*

IP Source Routing

Source routing is a feature of IP, whereby individual packets can specify routes. This feature is used in several different network attacks.

- *(NET0770: CAT II) The router administrators will ensure IP source routing is disabled.*

Proxy & Gratuitous ARPs

When proxy ARP is enabled on a Cisco router, it allows that router to extend the network (at Layer 2) across multiple interfaces (LAN segments). Because proxy ARP allows hosts from different LAN segments to look like they are on the same segment, proxy ARP is only safe when used between trusted LAN segments. Attackers can leverage the trusting nature of proxy ARP by spoofing a trusted host and then intercepting packets. You should always disable proxy ARP on router interfaces that do not require it, unless the router is being used as a LAN bridge.

A gratuitous ARP is an ARP broadcast in which the source and destination MAC addresses are the same. It is used to inform the network about a host’s IP address. A spoofed gratuitous ARP message can cause network-mapping information to be stored incorrectly, causing network malfunction.

- *(NET0780: CAT II) The router administrators will ensure Proxy ARP is disabled.*

- *(NET0781: CAT II) The router administrators will ensure Gratuitous ARP is disabled.*

Directed Broadcasts

IP directed broadcasts are used in the extremely common and popular smurf, or Denial of Service (DoS), attacks. In a smurf attack, the attacker sends ICMP echo requests from a falsified source address to a subnet broadcast address, causing all the hosts on the target subnet to send replies to the falsified source. By sending a continuous stream of such requests, the attacker can create a much larger stream of replies, which can completely inundate the host whose address is being falsified.

IP directed broadcast is a datagram sent to the broadcast address of a subnet that is not directly attached to the sending machine. The directed broadcast is routed through the network as a unicast packet until it arrives at the target subnet, where it is converted into a link-layer broadcast. Because of the nature of the IP addressing architecture, only the router connected directly to the target subnet can conclusively identify a directed broadcast. Consequently, directed broadcasts must be disabled on all router interfaces.

- *(NET0790: CAT III) The router administrators will ensure IP directed broadcast is disabled on all router interfaces.*

ICMP Exploits

The Internet Control Message Protocol (ICMP) supports IP traffic by relaying information about paths, routes, and network conditions. Routers automatically send ICMP messages under a wide variety of conditions. Attackers for network mapping and diagnosis commonly use three ICMP messages: Host unreachable, Redirect, and Mask Reply.

An ICMP redirect message instructs an end node to use a specific router as its path to a particular destination. In a properly functioning IP network, a router will send redirects only to hosts on its own local subnets, no end node will ever send a redirect, and no redirect will ever be traversed more than one network hop. However, an attacker may violate these rules; some attacks are based on this. Note that this filtering prevents only redirect attacks launched by remote attackers. It's still possible for attackers to cause significant trouble using redirects if their host is directly connected to the same segment as a host that's under attack.

The ICMP Address mask request and mask reply pair can be used to determine the subnet mask on the network allowing ease to network mapping information. When the requesting system issues the Address Mask Request bound for a destination, the destination system responds with an Address Mask Reply message. This condition can sometimes be a part of normal network traffic, but is uncommon on most networks. Suspicion should be aroused when a large number of these packets are found on the network.

Whenever a packet is dropped the router must send an ICMP unreachable packet back to the source. That is mandated by the Internet Standards. The unreachable message can be used to gain network-mapping information. To silently drop denied packets in hardware on the input interface, you must disable ICMP unreachables.

- *(NET0800: CAT II) The router administrators will ensure ICMP unreachable notifications, mask replies, and redirects are disabled on all external interfaces of the premise router.*

Logging Integrity - NTP

Without synchronized time, accurately correlating information between devices becomes difficult, if not impossible. If you cannot successfully compare logs between routers within a network, it will be almost impossible to determine the series of events that resulted in compromising a host or network.

An NTP client is configured to set its clock and stay synchronized with an NTP server. NTP clients can be configured to use multiple servers to set their time and are also able to set preference to the most accurate time sources. An NTP server is configured to synchronize NTP clients, they will not let clients update or affect its time settings. NTP peers can provide time synchronization to each other.

NOTE: Preferred NTP timeservers are provided by the US Naval Observatory. The NIPRNet and SIPRNet accessible NTP servers are identified at http://tycho.usno.navy.mil/ntp.html

Once a premise router is synchronized with a trusted external timeserver, that router is then capable of providing time synchronization for other NTP clients. Internal routers must be configured to use the premise router as their NTP server, thereby enabling all of the enclave's routers to be in synch. However, it is imperative that the premise router does not act as an NTP server for external clients and the internal clients are restricted by IP addresses.

- *(NET0810: CAT III) The IAO will ensure that two Network Time Protocol (NTP) servers are defined on the premise router to synchronize its time.*

- *(NET0811: CAT II) The IAO will ensure that the premise router is acting only as an NTP server for internal clients.*

- *(NET0812: CAT III) The IAO will ensure that all internal routers are configured to use the premise router to synchronize time.*

Connection Integrity

A router administrator can use a router to establish a Telnet connection with a destination router, switch, or other host using a host name. If the local router is configured as a name resolver and the host name is not in its host lookup table, it will attempt to query a DNS server if one is defined. If there is no DNS server defined, the router will broadcast the DNS query out all interfaces. If the response to this query is the IP address of a host operated by an attacker, the local router will establish a connection with the attackers host, rather than the intended target.

- *(NET0820: CAT III) The IAO will ensure that the DNS servers must be defined if the router is configured as a client resolver.*

SNMP Service

A router can be configured to act as a client for SNMP. When SNMP service is enabled on a router, network management tools can use it to gather information about the router configuration, route table, traffic load, and more. SNMP will only be used on the internal network interfaces.

- *(NET0890: CAT II) The router administrator will restrict SNMP access to the router from only authorized IP addresses.*

- *(NET0892: CAT II) The router administrator will ensure IP addresses of the hosts that are permitted SNMP access to the routers belong to the internal network.*

- *(NET0894: CAT II) The router administrators will ensure SNMP will be enabled in the read only mode; Read/Write is not enabled unless approved by the IAO.*

3.4.5 Packet Filtering & Logging

Access lists are used to separate data traffic into that which it will route (permitted packets) and that which it will not route (denied packets). Secure configuration of routers makes use of access lists for restricting access to services on the router itself as well as for filtering traffic passing through the router.

Sites will implement router ingress and egress filtering based on a policy of **Deny by Default.** All services and protocols required by the site for operational commitments and thus permitted by the ACLs will be in accordance with the guidelines contained in DoD Instruction 8551.1. http://www.dtic.mil/whs/directives/corres/html/85511.htm

NOTE: Those ports and services that are noted as conditional are permitted as long as they meet the specific condition. Several of these must be restricted by source or destination address. Connections initiated by clients from external networks for services such as http, dns, smtp, and ftp must be restricted to only those servers residing in the DMZ or service network.

The site will enable logging on all statements used to deny any traffic. This feature will provide valuable information about what types of packets are being denied and can be used to enhance the sites intrusion detection capabilities.

- *(NET0900: CAT I) The router administrator will implement ingress and egress filtering on all premise routers based on a policy of Deny by Default.*

NOTE: If the site has implemented a firewall on the perimeter based on a policy of Deny by Default, this finding can be downgraded to a Category II. If the site has implemented a firewall on the perimeter based on a policy of Deny by Default and has a documented plan to implement router ACLs based on a policy of Deny by Default, this can be downgraded to a Category III.

NOTE: When verifying compliance with the Deny-by-Default requirement, first verify that the filter ends with the deny rule (implied or explicit). Then verify that what is permitted by the filtering rules is IAW DOD Instruction 8551.1. http://www.dtic.mil/whs/directives/corres/html/85511.htm. This requirement applies to all internal and external interfaces.

If the router is in a Deny-by-Default posture, and what is allowed through the routers filtering is IAW DOD Instruction 8551.1 http://www.dtic.mil/whs/directives/corres/html/85511.htm, then all requirements related to ports being blocked would be satisfied. These ports would be covered under the Deny-by-Default rule as long as a permit rule was not created for them.

When the site is in an allow-all posture, all filter statements need to be verified for compliance with DOD Instruction 8551.1. http://www.dtic.mil/whs/directives/corres/html/85511.htm, and all ports that are mandated to be blocked will have to have a rule created to block these ports. Furthermore, the router will still be given a finding for not being in the Deny-by-Default posture.

- *(NET0910: CAT II) The router administrator will utilize ingress and egress ACLs to restrict traffic in accordance with the guidelines contained in* DOD Instruction 8551.1*, Required Filtering Rules, for all services and protocols required for operational commitments.*

- *(NET0920: CAT II) The router administrator will bind the ingress ACL filtering packets entering the network to the external interface, and bind the egress ACL filtering packets leaving the network to the internal interface—both on an inbound direction.*

3.4.5.1 IP Address Spoof Protection

Inbound Traffic

In Software Release 11.1, Cisco introduced the ability to assign inbound access lists to an interface. This allows a network administrator to filter packets before they enter the router instead of as they leave the router. Inbound access lists can be used to prevent some types of IP address spoofing, whereas outbound access lists alone will not provide sufficient security. For background information on anti-spoofing, refer to the Joint Task Force Computer Network Operations (JTFCNO) 0101.

- *(NET0940: CAT I) The router administrators will restrict the premise router from accepting any inbound IP packets with a source address that contain an IP address from the internal network, any local host loop back address (127.0.0.0/8), the link-local IP address range (169.254.0.0/16), or any reserved private addresses in the source field.*

Outbound Traffic

Egress filtering rules will be applied denying all outbound traffic with an illegitimate address in the source address field. This is to prevent the network from being part of a Distributed Denial of Service (DDoS) attack.

Unicast Reverse Path Forwarding (uRPF) provides another mechanism for IP address spoof protection. When uRPF is enabled on an interface, the router examines all packets received as input on that interface to make sure that the source address and source interface appear in the routing table and match the interface on which the packet was received. If the packet was received from one of the best reverse path routes, the packet is forwarded as normal. If there is no reverse path route on the same interface from which the packet was received, it might mean that the source address was modified. If Unicast RPF does not find a reverse path for the packet, the packet is dropped.

- *(NET0950: CAT I) The router administrators will restrict the router from accepting any outbound IP packet that contains an illegitimate address in the source address field via egress ACL or enabling Unicast Reverse Path Forwarding.*

3.4.5.2 Exploits Protection

SYN Flood Attack – Protecting the Network

The first packet in the TCP three-way handshake sets the SYN bit. When a host receives an initial SYN packet requesting a provided service, the host responds with a packet setting the SYN and ACK bits, and waits for an ACK from the initiator of the connection request. If the initiator never responds to the host, the host will eventually time out the connection. However, while the host is still waiting for the ACK to complete the connection, the half-open connection consumes resources on the host—that is, entries in the connection table.

If there is an attack, the source address in these SYN packets is forged and probably unreachable. In most cases, the source address will either be an unregistered address or the address of a host the attacker knows does not exist. Therefore, the attacked host will never receive a response to its request to complete the initial three-way handshake and must wait to time out thousands of connections. During the wait, the server must ignore legitimate requests since its connection table is full.

In intercept mode, the router responds to the incoming SYN request on the server's behalf with a SYN-ACK and waits for an ACK from the client. If an ACK is received, the original SYN packet is sent to the server, and the router completes the three-way handshake with the server on behalf of the client and joins the two half-connections together transparently. In the case of illegitimate requests, the software's aggressive timeouts on half-open connections and its thresholds on TCP connection requests protect destination servers while still allowing valid requests.

In watch mode, the router allows the SYN requests through to the server. If the session fails to establish itself during specified period of time, the router sends a reset (RST) to the server to clear the connection. The amount of time the router waits is configurable with the ip tcp intercept watch-timeout command.

By default, the software waits for 30 seconds for a watched connection to reach established state before sending a Reset. To optimize router resources, it is recommended to reduce this to 10 seconds using the following command:

ip tcp intercept watch-timeout 10

By default, the software still manages a connection for 24 hours after no activity. It is recommended to change this to 60 seconds using the following command:

ip tcp intercept connection-timeout 60

TCP intercept is available on all Cisco Routers with IOS Version 11.3 or greater. Most firewalls can also provide protection against SYN flood attacks using the similar concept of "proxying" or "watching" the connection until the three-way handshake is complete. SYN flood protection must be implemented on either the premise router or the firewall located on the sites' network perimeter. If the router will be providing the SYN flood protection using the TCP intercept software, it is the site's option to implement this feature in either intercept or watch mode.

JUNOS does not have a similar method to proxy or watch over TCP connection attempts. However, it does have rate limiting mechanisms that can be used to mitigate a SYN flood attack against a network or targeted hosts. Rate limiting TCP SYN packets with JUNOS can be performed by including rate limiting on the ingress firewall filter assigned to external facing interfaces. Rate limiting can be configured to limit the amount of bandwidth consumed as well as the maximum burst size of the TCP SYN traffic. A firewall counter could also be established to sample and count the number of SYN packets and the total number of TCP packets directed towards the network or servers you want to protect. The counters can be viewed using a *show firewall* command. If a SYN flood is underway, the number of SYN packets will be very high, perhaps 50 percent or greater of the total TCP packets.

- *(NET0960: CAT II) The IAO will implement features provided by the router to protect servers from any TCP SYN flood attacks from an outside network.*

NOTE: If the site has implemented SYN flood protection for the network using the perimeter firewall, there is not an additional requirement to implement it on the router.

SYN Flood Attack – Protecting the Router

Upon responding to the initial SYN packet that requested a connection to the router for a specific service (i.e., Telnet, SSH, BGP, etc) with a SYN ACK, a Cisco router will wait 30 seconds for the ACK from the requesting host that will establish the TCP connection. A more aggressive interval for waiting for the TCP connection to be established will reduce the risk of putting the router out of service during a SYN flood attack directed at a Cisco router. The wait time can be adjusted using the *ip tcp synwait-time* command that should be set to 10 seconds or less. If the router does not have any BGP connections with BGP neighbors across WAN links, this value could be set to an even more aggressive interval.

JUNOS does not have a similar method to control the SYN wait-time interval. However, it does have rate limiting mechanisms that can be used to mitigate a SYN flood attack and prevent a DoS on the Routing Engine. Rate limiting TCP SYN packets with JUNOS can be performed using either of the following two techniques:

1. Specify the number of allowable connection attempts per minute for each service (i.e., ssh, telnet, ftp) enabled on the router

2. Create a firewall filter protecting the routing engine that rate limits TCP SYN traffic based on its bandwidth utilization and the maximum burst size.

The Cisco Express Forwarding (CEF) switching mode replaces the traditional Cisco routing cache with a data structure that mirrors the entire system routing table. Because there is no need to build cache entries when traffic starts arriving for new destinations, CEF behaves more predictably when presented with large volumes of traffic addressed to many destinations—such as a SYN flood attacks that. Because many SYN flood attacks use randomized source addresses to which the hosts under attack will reply to, there can be a substantial amount of traffic for a large number of destinations that the router will have to handle. Consequently, routers configured for CEF will perform better under SYN floods directed at hosts inside the network than routers using the traditional cache.

Juniper's FPC (Flexible PIC Concentrator) architecture with the integrated Packet Forwarding Engine provides similar functionality and capabilities and is far superior than the traditional routing cache vulnerable to a DoS attack described above. The forwarding plane on all Juniper M and T Series platforms are built around this architecture and therefore is not configurable.

NOTE: Enabling CEF is required to utilize the Unicast RPF feature previously discussed.

- (*NET0965: CAT II) The router administrator will set the maximum wait interval for establishing a TCP connection request to the router at 10 seconds or less, or implement a feature to rate-limit TCP SYN traffic destined to the router.*

- *(NET0966: CAT II) The router administrator will enable CEF to improve router stability during a SYN flood attack to the network.*

ICMP Message Types and Traceroute

There are a variety of ICMP message types. Some are associated with programs (e.g., the ping program works with message types Echo Request and Echo Reply). Others are used for network management and are automatically generated and interpreted by network devices.

With Echo packets an attacker can create a map of the subnets and hosts behind the router. Also, an attacker can perform a denial of service attack by flooding the router or internal hosts with Echo packets. With ICMP Redirect packets, the attacker can cause changes to a host's routing tables. Otherwise, the other ICMP message types should be allowed inbound except message types Echo Request and Redirect.

- *(NET0980: CAT II) The router administrator will block all inbound ICMP messages with the exception of Echo Reply (type 0), and Time Exceeded (type 11). ICMP message number 3 code 4 are permitted inbound with the following exception: Must be denied from external AG addresses, otherwise permitted.*

For outbound ICMP traffic, the router administrator should allow the message types Echo Request, Parameter Problem, and Source Quench, and block all other message types unless needed for operational commitments. With Echo packets, users will be able to ping external hosts. Parameter Problem packets and Source Quench packets improve connections by informing about problems with packet headers and by slowing down traffic when it is necessary.

- *(NET0990: CAT II) The router administrator will block outbound ICMP traffic message types except Echo Request (type 8), Parameter Problem (type 12), and Source Quench (type 4) Destination Unreachable - Fragmentation Needed and Don't Fragment was Set (type3 – code 4).*

Traceroute is a utility that prints the IP addresses of the routers that handle a packet as the packet hops along the network from source to destination. An attacker can use traceroute response to create a map of the subnets and hosts behind the router, just as they could do with pings ICMP Echo Reply messages. The traditional traceroute uses UDP ports 33400 through 34400 and is dependent on receiving several TTL-expired responses from routers along the path and an ICMP port-unreachable response from the target host. Therefore, block inbound traceroute by including a rule in the inbound interface access list to block ports 33400 through 34400 that are the UDP ports commonly used by traceroute.

The later version of traceroute IAW RFC1913 initiates a traceroute with the originator sending a packet with a value of 82 in the IP Options field. Each router along the path will respond to the originator with an ICMP traceroute (type 30) message. The premise router will need to block any packets with a value of 82 in the IP Options field.

NOTE: All premise routers will need to be configured to ensure both methods are being blocked.

- *(NET1000: CAT III) The router administrators will block all inbound traceroutes to prevent network discovery by unauthorized users.*

Distributed Denial of Service (DDoS) Attacks

Several high-profile DDoS attacks have been observed on the Internet. While routers cannot prevent DDoS attacks in general, it is usually sound security practice to discourage the activities of specific DDoS agents (a.k.a. zombies) by adding access list rules that block their particular ports. Sites will utilize automated scanning for DDoS tools on all servers, routers, and other communications devices.

- *(NET1010: CAT I) The router administrators will block known DDoS attack ports in accordance with DoD Instruction 8551.1, Required Filtering Rules.*

The example below shows access list rules for blocking several popular DDoS attack tools.

TRINOO DDoS systems
```
access-list 170 deny tcp any any eq 27665 log
access-list 170 deny udp any any eq 31335 log
access-list 170 deny udp any any eq 27444 log
```

Back Orifice systemb
```
access-list 170 deny udp any any eq 31337 log
```

Stacheldraht DDoS system
```
access-list 170 deny tcp any any eq 16660 log
access-list 170 deny tcp any any eq 65000 log
```

TrinityV3 system
```
access-list 170 deny tcp any any eq 33270 log
access-list 170 deny tcp any any eq 39168 log
```

T0rn rootkit system
```
access-list 170 deny tcp any any eq 47017 log
```

Subseven DDoS system and some variants
```
access-list 170 deny tcp any any range 6711 6712 log
access-list 170 deny tcp any any eq 6776 log
access-list 170 deny tcp any any eq 6669 log
access-list 170 deny tcp any any eq 2222 log
access-list 170 deny tcp any any eq 7000 log
```

3.4.5.3 Logging

Logging is a key component of any security architecture and is a critical part of router security. It is essential security personnel know what is being done, attempted to be done, and by whom in order to compile an accurate risk assessment. Maintaining an audit trail of system activity logs can help identify configuration errors, understand past intrusions, troubleshoot service disruptions, and react to probes and scans of the network. A syslog server provides the network administrator the ability to send log messages from all of the communication devices on a network to a central host for examination and storage. Syslog levels 0-6 are the levels required to collect the necessary information to help in the recovery process.

Level	Level Name	Description	Example
0	Emergencies	Router becoming unusable	IOS could not load
1	Alerts	Immediate action needed	Temperature too high
2	Critical	Critical condition	Unable to allocate memory
3	Errors	Error condition	Invalid memory size
4	Warnings	Warning condition	Crypto operation failed
5	Notifications	Normal but important event	Interface changed state, up or down
6	Informational	Information message	Packet denied by access list
7	Debugging	Debug message	Appears only when debugging is enabled

- *(NET1020: CAT III) The router administrator will ensure that all attempts to any port, protocol, or service that is denied are logged.*

- *(NET1021: CAT III) The router administrator will configure all routers to log severity levels 0 through 6 events and send log data to a syslog server.*

- *(NET1025: CAT III) The IAO will ensure a centralized syslog server is deployed and configured by the syslog administrator to store all syslog messages for a minimum of 30 days and then stored offline for one year.*

- *(NET1027: CAT III) The syslog administrator will configure the syslog sever to collect syslog messages from levels 0 through 6.*

- *(NET1028: CAT III) The syslog administrator will configure the syslog server to accept messages from only authorized devices (restricting access via source and destination IP address).*

3.4.6 Router Configuration Management

3.4.6.1 Logistics for Configuration Loading and Maintenance

There are two basic approaches for configuration loading and maintenance—online editing and offline editing. Each has its advantages and disadvantages. Online editing provides for syntax checking but provides limited editing capability and no comments. Offline editing provides the ability to add comments, allows for the use of better editors, and guarantees all settings will be visible, but provides no syntax checking. It is important to keep the running configuration and the startup configuration synchronized, so that if there is a power failure or some other problem, the router will restart with the correct configuration. If there is a need for old or alternative configurations, they should be stored offline. In this situation, it is only necessary to manage the startup configuration since the running configuration is identical.

If you set passwords in an offline configuration file, then they will be stored in the clear and transferred in the clear. Instead, it is best to type the passwords while online and then copy the encrypted strings to the offline configuration. This is especially true for the enable secret password. You can obtain the encrypted string by setting the password manually on the router command line interface, then displaying the running configuration, and then copying and pasting the encrypted string into your offline configuration file.

With the configuration files offline, the files must be transferred to the router in a secure method—TFTP is prohibited while FTP is allowed provided that a username and password are required. Following are some alternative approaches that are actually more secured than using FTP:

1. If the router is equipped with PCMCIA Flash Memory Cards, you can copy images as well as configurations to these cards.

2. Copy and paste output of a displayed configuration while in a SSH session or HyperTerminal (i.e., Capture Text) console connection. The file can then be saved onto a floppy disk and stored in a secured location.

NOTE: For Cisco IOS, defaults will not be included since most of the IOS defaults are not displayed on a *show run* command.

3. Secure Copy Protocol (SCP)

NOTE: The JUNOS software can use SCP with the file copy operational mode command. Before enabling SCP on a Cisco router, one must correctly configure SSH, authentication, and authorization. SCP requires that authentication, authorization, and accounting (AAA) authorization be configured so the router can determine whether the user has the correct privilege level. SCP allows a user who has appropriate authorization to copy any file that exists in the Cisco IOS File System (IFS) to and from a router by using the *copy* command.

- *(NET1030: CAT III) The router administrator, when saving and loading configurations will ensure that the running and startup configurations are synchronized.*

- *(NET1040: CAT IV) The router administrator will ensure at least the current and previous router configurations are stored in a secured location to ensure a proper recovery path.*

- *(NET1050: CAT III) The IAO will ensure that on the system where the configuration files are stored, the router administrators use the local operating system's security mechanisms for restricting access to the files (i.e., password restricted file access).*

- *(NET1050: CAT III) The IAO will ensure only authorized router administrators are given access to the stored configuration files.*

- (*NET1060: CAT I) The router administrators will not store unencrypted router passwords in an offline configuration file.*

- *(NET1070: CAT II) The router administrators will not use the TFTP protocol to transfer configuration or image files to and from the router*.

- *(NET1080: CAT II) The router administrators will ensure that the FTP username and password are configured.*

3.4.6.2 Router Change Management

People and organizations are forever moving and changing work locations. This sometimes requires updates to router tables. The point-of-contact (POC) for each router is usually recorded with the domain registration authority for troubleshooting purposes. However, this can open up the change request process to possible spoofing. A person can impersonate the authorized POC and request updates that can deny or stop services altogether.

- *(NET1110: CAT II) The IAO will ensure all router changes and updates are documented in a manner suitable for review.*

- *(NET1110: CAT II) The IAO will ensure request forms are used to aid in recording the audit trail of router changes requested.*

- *(NET1110: CAT II) The IAO will ensure changes and modifications to routers are audited so that they can be reviewed.*

- *(NET1110: CAT II) The router administrator will ensure current paper or electronic copies of router configurations are maintained in a secure location.*

- *(NET1110: CAT II) The IAO will ensure only authorized personnel, with proper verifiable credentials, are allowed to request changes to routing tables or service parameters.*

3.5 Firewalls

Perimeter filtering rules can be applied to any internal firewall device or router and should be implemented to the fullest extent possible. This is necessary in order to minimize the internal threat and protect the enclaves. Allowing only approved IP addresses through the perimeter router will control access to required ports and services. The Enclave firewall rules should be based on applications being used within internal Enclave; all non-required ports and services will be blocked to the most restrictive rules possible and what is allowed through the firewall needs to be configured IAW DoD Instruction 8551.1 (*"that which is not expressly allowed is denied"*).

- *(NET1160: CAT I) The IAM will ensure that a firewall has been implemented to protect the entire facility and has been configured with a deny-by-default policy.*

- *(NET1162: CAT II) The IAM will ensure that the firewall policy is in accordance with DOD Instruction 8551.1. http://www.dtic.mil/whs/directives/corres/html/85511.htm*

3.5.1 Firewall Architecture

The Screened Subnet Firewall Architecture will be used (see *Figure 1* below). This firewall is set up as a gateway with multiple network interface cards (NICs)—one connected to the external network through a router, one to the internal network, and one to the DMZ (if applicable). Packet forwarding is disabled on the gateway and information is passed at the application level or the network layer, depending on the type of firewall used. The firewall/gateway can be reached from all sides, but traffic cannot directly flow across it unless that particular traffic is allowed to pass to the requested destination.

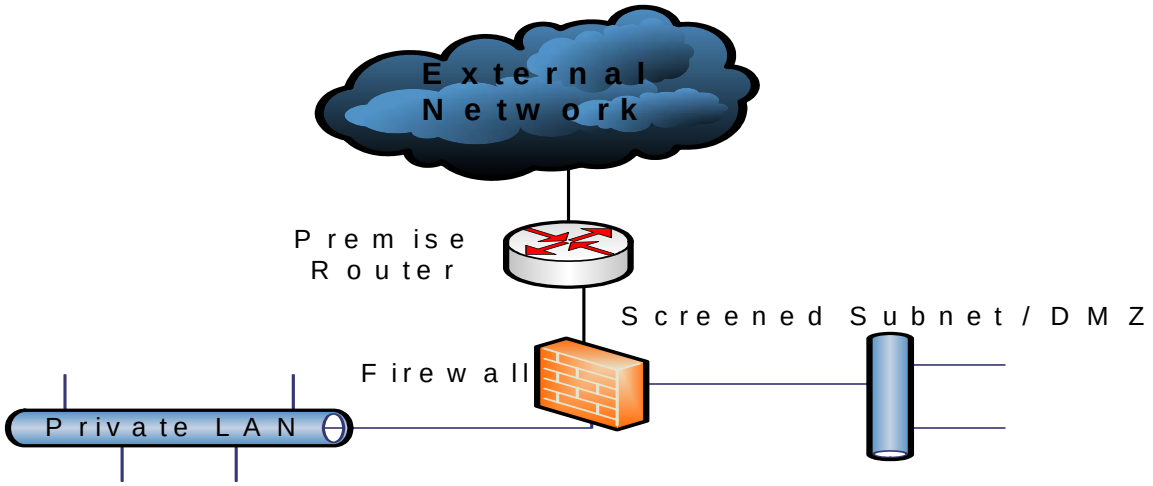

FIGURE 1. SCREENED SUBNET (DMZ)

- *(NET1170: CAT II) The IAM will ensure that only firewalls that have a Common Criteria Protection Profile evaluation of EAL4 or greater are placed in the network infrastructure.*

- *(NET1180: CAT II) The IAO will ensure that a Screened Subnet (DMZ) Firewall Architecture is implemented.*

- *(NET1190: CAT II) The IAO will ensure that all networks use application-level gateways or firewalls to proxy all traffic to external networks.*

3.5.2 Firewall Placement

A firewall can be placed at several locations to provide protection from attacks. Each implementation will differ depending on several key factors, including the sensitivity of the networks, the network infrastructure, and the type of network traffic. Usually firewalls are used to protect the boundaries of a network, although at times they can be used to separate an internal security domain from the rest of an enclave. There are three main points at which a firewall can be implemented within a network—at LAN-to-WAN connections, at LAN-to-LAN connections, and at WAN-to-WAN connections.

The Enclave requirement to place an application-level firewall at the perimeter can be accomplished by multiple scenarios to include the following:

- An application-level firewall at the perimeter to protect the whole Enclave to include the Security Domains

- A non application-level firewall at the perimeter (e.g., stateful inspection, hybrid, packet-filter) with an application-level firewall protecting every Security Domain (including the DMZ) with no IP addressable systems or devices operating in the area between the non application-level firewall and the Security Domain's firewall

- *(NET1200: CAT II) The IAO will ensure, when protecting the boundaries of a network, the firewall is placed between the private network and the perimeter router and the DMZ.*

3.5.3 Identification & Authentication

Identification and authentication is one of the major functions provided by the firewall. While users on the inside of a firewall are often considered trusted, external users who require access to the internal network must be authenticated. At a minimum, the firewall must support a secure, strong user authentication system (e.g., SecureID, Radius, or TACACS+).

NOTE: In-band management is only to be used in situations where Out-of–band management has been deemed to hinder operational commitments, and the IAO has approved in writing the use for that specific purpose.

- *(NET1220: CAT II) The IAO will ensure the firewall authenticates all administrators using individual accounts before granting access to the firewall's administration interface.*

- *(NET1222: CAT II) The IAO will ensure all user and administrator accounts are assigned the lowest privilege level that allows them to perform their duties.*

- *(NET1224: CAT II) The IAO will ensure the firewall is set to lock out accounts after three unsuccessful logon attempts.*

- *(NET1226: CAT II) The IAO will ensure that only the FA is allowed to remotely access the firewall administration interface.*

- *(NET1228: CAT II) The IAO will ensure only authorized personnel have permission to change security settings on the firewall.*

3.5.4 Configuration

The firewall must protect the private network from external attacks. The firewall will be maintained with the currently supported version of the firewall software and the Operating System (OS) with all security-related patches applied. The FA will subscribe to the vendor's vulnerability mailing list to be made aware of required upgrades and patches. Content Vector Protocol (CVP) compliant applications run AntiVirus software and scanning products that block hostile code (i.e., viruses, malicious code, Java applets) from entering the network. Transactions from the Internet are sent by the firewall directly to this server where they are scanned for hostile code, then returned to the firewall for delivery to your users.

- *(NET1240: CAT II) The IAO will ensure that the firewall is configured to protect the network against denial of service attacks such as Ping of Death, TCP SYN floods, etc.*

NOTE: If the site has implemented SYN flood protection for the network using the premise router, it is not an additional requirement to implement this on the firewall.

- *(NET1250: CAT II) The FA will ensure the firewall does not utilize or enable any services (DNS, HTTP, etc.) not required by the firewall engine.*

- *(NET1252: CAT II) The FA will use a supported version of the firewall software with all security-related patches applied.*

- *(NET1254: CAT II) The FA will ensure that if the firewall product operates on an OS platform, the host must be made STIG compliant prior to the installation of the firewall product.*

NOTE: If an IAVA is issued against the OS any time after the firewall installation and implementation, the FA must contact the firewall vendor, or FSO if deployed by FSO, to determine if the firewall is vulnerable and if there is a patch to be applied to the OS. If the vendor does not recommend installing a patch or upgrade, and has stated that the firewall is not vulnerable, the FA must retain this documentation.

- *(NET1260: CAT III) The FA will subscribe to the vendor's vulnerability mailing list to be made aware of required upgrades and patches.*

3.5.5 Auditing and Administration

Qualified personnel who are specifically trained in the operation and administration of the firewall must administer the firewall. At least two firewall administrators will be identified for each managed firewall. Follow the auditing and administration rules below:

- *(NET1280: CAT III) The IAO will ensure there is a review on a daily basis, of the firewall log data by the firewall administrator (FA), or other qualified personnel, to determine if attacks or inappropriate activity has occurred.*

- *(NET1282: CAT III) The FA will ensure the firewall logs are retained online for a minimum of 30 days and then stored offline for one year.*

- *(NET1284: CAT III) The IAO will ensure the firewall configuration data are backed up weekly and whenever configuration changes occur.*

- *(NET1286: CAT III) The IAO will ensure the firewall log data is backed up weekly.*

- *(NET1290: CAT II) The IAO will ensure the firewall is configured to alert the administrator of a potential attack or system failure.*

- *(NET1300: CAT III) The FA will ensure the following capabilities will be enabled on the firewall:*

- *Log unsuccessful authentication attempts.*
- *Stamp audit trail data with the date and time when recorded.*
- *Record the Source IP, Destination IP, protocol used, and the action taken.*
- *Log administrator logons, changes to the administrator group, and account lockouts.*
- *Protect audit logs from deletion and modification.*
- *The firewall will provide the ability to record a readable audit log of security-related events, with accurate dates and times, with the capability to search and sort the audit log based on relevant attributes.*

- *(NET1310: CAT II) The FA will limit the use of in-band management to situations where the use of out-of-band management would hinder operational commitments or when emergency situations arise.*

NOTE: *IAO will approve the use of in-band management on a case-by-case documented basis.*

- *(NET1312: CAT II) For in-band management, the IAO will implement the use of strong two-factor authentication.*

- *(NET1314: CAT II) The FA will ensure that the use of in-band management is restricted to a limited number of authorized IP addresses.*

NOTE: *The number must be equal to or less than the number of firewall administrators.*

- *(NET1316: CAT II) The FA will ensure that all in-band management access to all firewalls is encryption via SSH or SSL,* IAW *FIPS 140-2 validated encryption.*

3.6 Network Intrusion Detection (NID)\Real Secure

Network intrusion detection systems (NIDS) provide an additional level of control and visibility into the network infrastructure. Implementing a NIDS on the network's exterior can expose unauthorized or malicious traffic that will most likely be blocked by the premise router and firewall as well as traffic from hackers who may be able to thwart the enclave perimeter protection mechanisms. Network intrusion detection systems can also be used to block suspect attacks that are easily recognized. Perhaps the greatest value that network intrusion detection systems provide is the information about the use and usage of the network. This information provides decision support data, can increase the value and efficiency of existing enclave protection mechanisms, and can produce hard evidence and justification for altering the enterprise's security policy.

3.6.1 External Network Intrusion Detection System

As depicted in Section 2 ENCLAVE ARCHITECTURE OVERVIEW, an external NIDS must be installed and implemented in front of the premise or border router and must be monitored by the RCERT or a certified CND Service Provider. Placing the external NIDS on the exterior—that is, between the premise router and the node router—will enable the RCERT or CND Service Provider to detect attempted attacks that may otherwise be blocked by the premise router or firewall. A signature-based, anomaly-based, or rules-based NIDS that has been customized to specific NIPRNet or SIPRNet traffic can alert the RCERT or CND Service Provider of suspected threats at the enclave's gateway. The external NIDS can be a JID or any other DISA approved intrusion detection system.

The JID is a suite of software tools that supports the detection, analysis, and gathering of evidence of intrusive behavior occurring on Ethernet or Fiber Distributed Data Interface (FDDI) based networks using IP. In support of these services, JID provides four common operating models:

- Retrospective intrusion analysis
- Near Real-time intrusion detection
- Evidence gathering
- Statistics gathering

- *(NET1325: CAT II) The IAO will ensure that an external NIDS has been installed and implemented so that all external connections can be monitored if directed by their CND Service Provider.*

- *(NET1326: CAT II) The IAO will ensure that the RCERT or a certified CND Service Provider is continuously monitoring the data from the external NIDS.*

NOTE: If a site does not have a direct link to a NIPRNet or SIPRNet node router—that is, its connection to the NIPRNet or SIPRNet is through an upstream link to another activity's premise router, then this site would not be required to have its own external NIDS if the upstream activity has an external NIDS that is being monitored by the RCERT or a certified CND Service Provider. However, if this site has other external connections such as an Internet Service Provider, this traffic would need to be monitored by a CND Service Provider using an external NIDS.

- *(NET1327: CAT II) The IAO will ensure that the external NIDS is located between the site's NIPRNet or SIPRNet Point of Presence (POP) and the their premise router.*

- *(NET1328: CAT III) The IAO will ensure that the data from the external NIDS is restricted to the RCERT or certified CND Service Provider personnel only.*

3.6.2 Internal Network Intrusion Detection System

DISA has dedicated funding, equipment, applications, and training to complement the Global Information Grid IA security initiative. The use of the Internet Security Systems, Inc. (ISS),

RealSecure Network Intrusion Detection System (IDS), or other NID is a layer of security that can be used to support the GIG.

All DOD locations will install, maintain, and operate a Network IDS inside of their network enclaves. The Enclave Network IDS will monitor internal network traffic and provide near real-time alarms for network-based attacks. A host intrusion detection (HID) application is not required on a OS-based NID.

Either the RCERT or the local staff may control the enclave Network IDS rules and attack signatures; however, OP7 will provide second-level technical support and configuration management. The site may establish a support agreement with the RCERT for monitoring. The local staff is responsible for initial response to real-time alarms. Significant incidents are reported to the site's RCERT. The Enclave Management Control Board (EMCB) on a case-by-case basis will grant extensions.

If monitoring is being performed using a switch SPAN port, it is recommended that the IDS is configured in Stealth Mode—the NIC connected to the SPAN port would not have any network protocol stacks bound to it. A second NIC would then be connected to an out-of-band network. Stealth mode will eliminate the risk of the IDS itself being attacked. Stealth mode would not be applicable if the IDS is monitoring from a network tap solution.

- *(NET1330: CAT I) The Network IDS administrator will ensure a Network IDS is installed and operational with all external connections (e.g., LAN and WAN) being monitored.*

- *(NET1340: CAT II) The IAO will establish policies outlining procedures to notify DOD-CERT or the respective RCERT when suspicious activity is observed.*

- *(NET1342: CAT II) The IAO will ensure that authorized reviewers of Network IDS data are identified in writing by the site's IAM.*

- *(NET1344: CAT II) The IAO will ensure that any unauthorized traffic is logged for further investigation.*

- *(NET1346: CAT II) The IAO will establish weekly data backup procedures for the Network IDS.*

- *(NET1348: CAT II) The IAO will establish anti-virus update procedures for the Network IDS.*

- *(NET1350: CAT III) The Network IDS administrator will subscribe to the vendor's vulnerability mailing list.*

- *(NET1350: CAT III) The Network IDS administrator will update the Network IDS when software is provided by Field Security Operations for the RealSecure distribution, and for all other Network IDS software distributions when a security-related update is provided by the vendor.*

3.7 Switches and VLANs

3.7.1 Horizontal Wiring - IDF

Poor design of horizontal wiring within the physical network infrastructure can invite the connection to the private network by an unauthorized host or even a rogue wireless Access Point. The horizontal wiring extends from the work area wall plate or LAN outlet to the Telecommunications Closet (TC) or Intermediate Distribution Frames (IDF)—commonly referred to as the "wiring closet". The path of all horizontal wiring includes the wall plate, the horizontal cable that runs from the wall plate to the IDF, as well as any patch cables used between any cross-connect hardware (i.e., patch panel, distribution frame) and the switch.

Since it would be virtually impossible to monitor all work area wallplates to insure that only authorized devices are attached, physical LAN access control and security must be maintained within the IDF. This end of the horizontal wirng must be disconnected at the switchport or patch panel if there is no authorized host connected to it in the work area.

Since the IDF includes all hardware required to connect horizontal wiring to the backbone wiring, it is imperative that all switches and associated cross-connect hardware are kept in a secured IDF or an enclosed cabinet that is kept locked. This will also prevent an attacker from gaining privilege mode access to the switch. Several switch products only require a reboot of the switch in order to reset or recover the password.

- *(NET1362: CAT II) The IAO will ensure that all switches and associated cross-connect hardware are kept in a secured IDF or an enclosed cabinet that is kept locked.*

3.7.2 Switch Accounts & Passwords

Securing adminsitrative access to all switches is critical to maintaining stability and integrity within the network infrastructure. Administrative access to any switch by unauthorized personnel provides a mechanism to not only disrupt service at the core or access layers, but also break down the security provided between VLANs—including the access to the network's out-of-band management VLAN. In order to control and authorize administrative access, an authentication server that provides user authentication as well as authority level validation will be implemented. Individual user accounts with passwords will be set up and maintained in accordance with the guidance contained in *Appendix B, CJCSM.*

- *(NET1364: CAT II) The IAO will ensure that an authentication server is used to gain administrative access to all switches.*

- *(NET1365: CAT II) The IAO will ensure that when an authentication server is used for administrative access to the switch, only one account can be defined locally for use in an emergency (i.e., authentication server or connection to the server is down).*

- *(NET1366: CAT I) The IAO will ensure that each user has their own account to access the switch with username and password.*

- *(NET1367: CAT II) The IAO will ensure that all user accounts are assigned the lowest privilege level that allows them to perform their duties.*

- *(NET1368: CAT II) The switch administrator will immediately remove accounts from the authentication server or switch that are no longer required.*

- *(NET1369: CAT II) The IAO will ensure that passwords are not viewable when displaying the switch configuration.*

- *(NET1374: CAT II) The NSO will ensure that all accounts are assigned the lowest privilege level that allows them to perform their duty.*

3.7.3 Switch Administrative Access

3.7.3.1 Out-of-band Switch Management

Management must be performed out-of-band via the console port or an out-of-band management network. The console port will be configured to time out, so that if an administrator forgets to log out, the device will log the administrator out automatically. The auxiliary port will be disabled. Users should never connect a modem to the aux port as a backup or remote access method to the device.

- *(NET1380: CAT I) The IAO will ensure that all out-of-band management connections to the switch require passwords.*

- *(NET1381: CAT II) The switch administrators will ensure the switch console port is configured to time out after 10 minutes or less of inactivity.*

- *(NET1382: CAT II) The IAO will ensure modems are not connected to the console or auxiliary ports.*

- *(NET1383: CAT III) The switch administrators will ensure that the switch's aux port is disabled.*

3.7.3.2 In-band Switch Management

In-band management administration with telnet is dangerous because anyone with a network sniffer and access to the right LAN segment can acquire the device account and password information. Network device security centers on protecting the paths and sessions used to access the device.

Access lists or filters must be used to limit which hosts may connect to the network device using any in-band management application. Additionally, the IP addresses, which will be restricted to administrators only and must be from the internal network.

NOTE: In-band management is only to be used in situations where Out-of –band management has been deemed to hinder operational commitments, and the IAO has approved in writing the use for that specific purpose.

- *(NET1385: CAT I) The IAO will ensure that all in-band management connections to the switch require passwords.*

- *(NET1386: CAT II) The switch administrators will ensure that the switch only allows in-band management sessions from authorized IP addresses from the internal network.*

- *(NET1387: CAT II) The switch administrators will ensure in-band management access to the switch restricted to SSH or any FIPS 140-2 algorithm.*

- *(NET1388: CAT II) The switch administrator will set the SSH timeout value to 60 seconds, causing incomplete SSH connections to shut down after 60 seconds or less.*

- *(NET1389: CAT II) The switch administrator will set the maximum number of unsuccessful SSH login attempts to three before locking access to the switch.*

- *(NET1390: CAT II) The IAO will ensure the timeout for in-band management access is set for no longer than 10 minutes.*

- *(NET1391: CAT IV) The switch administrators will configure the ACL that is bound to the VTY ports to log permitted and denied access attempts.*

3.7.4 Virtual Local Area Networks (VLANs)

VLAN technology is an efficient way of grouping users into workgroups to share the same network address space regardless of their physical location on the network. Users can be organized into separate VLANs according to their department, location, function, application, physical address, logical address, or protocol. Regardless of organization method used, the goal with any VLAN is to group users into separate communities that share the same resources; thereby, enabling the majority of their traffic to stay within the boundaries of the VLAN.

Network nodes of the same VLAN can communicate with other nodes in the same VLAN using layer-2 switching. In order to communicate with other VLANs, the nodes in one VLAN need to go through a layer 3 device. Broadcast frames are switched only between nodes within the same VLAN. This logical separation of users and traffic results in better performance management (i.e., broadcast and bandwidth utilization control) as well as a reduction in configuration management overhead enabling networks to scale at ease.

3.7.4.1 Management VLAN & VLAN1

By default, all ports—including the internal sc0 interface, are configured to be members of VLAN 1. In a VLAN-based network, switches use VLAN1 as the default VLAN for in-band management and to transport Layer-2 control plane traffic such as Spanning-Tree Protocol

(STP), Cisco Discovery Protocol (CDP), Dynamic Trunking Protocol (DTP), VLAN Trunking Protocol (VTP), Uni-Directional Link Detection (UDLD) and Port Aggregation Protocol (PAgP)—all as untagged traffic. As a consequence, VLAN 1 may unwisely span the entire network if not appropriately pruned. If its scope is large enough, the risk of compromise can increase significantly. The risk is even greater if VLAN1 is also used for user VLANs or the management VLAN. In addition, it is unwise to mix management traffic with user traffic making the management VLAN an easier target for exploitation.

- *(NET1410: CAT I) The IAO will ensure VLAN 1 is not used for in-band management traffic. Assign a dedicated management VLAN to keep management traffic separate from user data and control plane traffic.*

- *(NET1411: CAT III) The IAO will ensure the management VLAN is not configured on any trunk or access port that doesn't require it.*

- *(NET1412: CAT II) The IAO will ensure VLAN 1 is not used for user VLANs.*

- *(NET1413: CAT III) The IAO will ensure VLAN 1 is pruned from all trunk and access ports that do not require it.*

3.7.4.2 VLAN Trunking

There can be several VLANs defined on a single switch, while on the other hand a VLAN can span across multiple switches. VLAN spanning is enabled by trunked links connecting the switches and frame tagging such as IEEE 802.1q or Cisco's Inter-Switch Link (ISL) protocol. Trunk links can carry the traffic of multiple VLANs simultaneously. Therein lies a potential security exposure. Trunk links have a native or default VLAN that is used to negotiate trunk status and exchange VLAN configuration information. Trunking also enables a single port to become part of multiple VLANs—another potential security exposure. Within the switch fabric, switches use frame tagging to direct frames to the appropriate switch and port. Frame tagging assigns a VLAN ID to each frame prior to traversing a trunked link. Each switch the frame traverses must identify the VLAN ID and then determine what to do with the frame based on its filter table. Once the frame reaches the exit to the access link, the VLAN ID is removed and the end device receives the frame. The frame tagging is another technology that can be exploited as a result of a poor VLAN implementation design.

VLAN "hopping" occurs when a tagged frame destined for one VLAN is redirected to a different VLAN, threatening network security. The redirection can be initiated using two methods: "tagging attack" and "double encapsulation". Frame tagging attacks allow a malicious user on a VLAN to get unauthorized access to another VLAN. For example, if a switch port's trunk mode were configured as *auto* (enables a port to become a trunk if the connected switch it is negotiating trunking with has its state set to *on* or *desirable*) and were to receive a fake DTP packet specifying *trunk on* or *desirable*, it would become a trunk port and it could then start accepting traffic destined for all VLANs that belong to that trunk group. The attacker could start communicating with other VLANs through that compromised port—including the management VLAN. Insuring that trunk mode for any non-trunking port is configured as *off* can prevent this type of attack.

Double encapsulation can be initiated by an attacker who has access to a switch port belonging to the native VLAN of the trunk port. Knowing the victim's MAC address and with the victim attached to a different switch belonging to the same trunk group, thereby requiring the trunk link and frame tagging, the malicious user can begin the attack by sending frames with two sets of tags. The outer tag that is the attacker's VLAN ID (probably the well known and omnipresent VLAN1) is stripped off by the switch, and the inner tag that will have the victim's VLAN ID is used by the switch as the next hop and sent out the trunk port. To insure the integrity of the trunk link and prevent unauthorized access, the native VLAN of the trunk port should be changed from the default VLAN1 to its own unique VLAN.

- *(NET1416: CAT II) The IAO will ensure trunking is disabled on all access ports (do not configure trunk on, desirable, nonegotiate, or auto—only off).*

- *(NET1417 CAT III) The IAO will ensure when trunking is necessary; a dedicated VLAN is configured for all trunk ports.*

- *(NET1418 CAT III) The IAO will ensure access ports are not assigned to the dedicated trunk VLAN.*

3.7.4.3 VLAN Access – Port Authentication

Eliminating unauthorized access to the network from inside the enclave is vital to keeping a network secure. Unauthorized internal access leads to the possibility of hackers or disgruntled employees gaining control of network resources, eavesdropping, or inflicting denial-of-service on the network. Simply connecting a workstation or laptop to a wall plate or access point located in the work area enables internal access to the private network.

An initial security best practice for a VLAN-based network is to place all disabled ports into an unused VLAN; thereby thwarting unauthorized VLAN access using both physical and logical barriers.

Once a user has connected to the network, services that the client has access to should be based on individual need—and only if that individual or workstation is authorized. First determining if the individual or workstation is authorized to connect to the network and then insuring that it is assigned to the appropriate VLAN can only restrict this. Restricting VLAN access and authenticating switch port connections can be done using and one of the following methods:

1. Port security
2. VLAN Management Policy Server (VMPS)
3. Port authentication with 802.1X

Port Security

The port security feature provided by most switch vendors can be used to block input to access port when the MAC address of the station attempting to access the port does not match any of the MAC addresses specified for that port—that is, those addresses statically configured or auto-

configured (i.e., "learned). The maximum number of MAC addresses that can be configured or learned (or combination of both) is also configurable.

In the event of a security violation, the Link LED for that port turns orange. You can also configure the port to shut down permanently, shut down for a specified time interval, or drop incoming packets from the insecure host if a violation occurs. If either of the first two methods is used, a link-down trap is also sent to the Simple Network Management Protocol (SNMP) manager.

If port security is implemented, every switch at the access layer must have port security enabled on every access port that is in use—that is, a switchport configured as enabled and as an access port. Furthermore, the MAC addresses must be statically configured for each port.

Port Authentication with 802.1x

While technologies such as MAC filtering and ACLs are used to enhance overall network security, the IEEE 802.1x specification provides another level of network protection. Authentication through IEEE 802.1x provides the ability to limit network access based on a client profile. A client profile typically contains the client identification and access privileges. Data cannot be passed through the switch and onto the LAN until the client's identification has been verified. There are several benefits gained by implementing 802.1x on all edge or access layer switches. The secure authentication allows a client to be recognized and granted access privileges from wherever he or she logs on. It can also account for a client's activity while they are connected to the network.

The authentication server authenticates each client connected to a switch port and assigns the port to a VLAN before allowing connectivity. The switch port state determines whether or not the client is granted access to the network. The port starts in the *unauthorized state*. While in this state, 802.1x access control allows only Extensible Authentication Protocol over LAN (EAPOL) traffic through the port to which the client is connected. This would be authentication challenges and data passing between the client and the authentication server. When a client is successfully authenticated, the port transitions to the *authorized state* allowing all traffic for the client to flow normally. Only one client can be connected to the 802.1x-enabled switch port. The switch detects the client when the port link state changes to the up state. If a client leaves or is replaced with another client, the switch changes the port link state to down, and the port returns to the unauthorized state.

If port authentication is implemented, every switch at the access layer must have 802.1.x enabled on every access port that is in use. Furthermore, the ports must be configured to start in the *unauthorized state* and they must re-authenticate the client on a regular interval.

VLAN Management Policy Server (VMPS)

VMPS allows a switch to dynamically assign VLANs to users based on the workstation's MAC address or the user's identity when used with the User Registration Tool. A switch is configured and designated as the VMPS server while the remainder of the switches on the segment act as

VMPS clients. The VMPS server opens a UDP socket to communicate and listen to client requests using VMPS Query Protocol (VQP). When the VMPS server receives a valid request from a client, it searches its database for a MAC address-to-VLAN mapping. If the assigned VLAN is restricted to a group of ports, VMPS verifies the requesting port against this group. If the VLAN is allowed on the port, the VLAN name is returned to the client. If the VLAN is not allowed on the port, the host receives an "access denied" response when VMPS is not configured in secure mode or the port is shut down if in secure mode.

VQP is a UDP-based protocol that does not support any form of authentication and the data is in clear text. This makes its use in security-sensitive environments inadvisable. An attacker who is able to spoof VQP could prevent network logins with a DoS attack to the VMPS server or even join an unauthorized VLAN. Furthermore, a VMPS database configuration file is nothing more than an ASCII text file that is stored on a TFTP server and downloaded to the VMPS server at startup or when VMPS server is first enabled on the switch. As noted in previous sections, a network component must never use TFTP to upload or download configuration files. For these reasons, VMPS must not be used to provide port authentication or dynamic VLAN assignment.

- *(NET1435: CAT III) The IAO will ensure disabled ports are placed in an unused VLAN (do not use VLAN1).*

- *(NET1436: CAT I) The IAO will ensure Port Security or 802.1x Port Authentication is used on all access ports.*

- *(NET1437: CAT II) The IAO will ensure if Port Security has been implemented; the MAC addresses are statically configured on all access ports.*

- *(NET1438: CAT I) The IAO will ensure if 802.1x Port Authentication has been implemented, all access ports must start in the unauthorized state.*

- *(NET1439: CAT II) The IAO will ensure if 802.1x Port Authentication has been implemented, re-authentication must occur every 60 minutes.*

4. REMOTE USER ACCESS

Information security vulnerabilities are inherent in all forms of computer systems, software, architectures, and devices. The goal of information security is to provide data integrity, confidentiality, and availability. In order to provide these services to the DOD community, general security standards for any form of remote access to a DOD network must be in place. These standards are set forth for ease of configuration management and to aid in developing a secure, standardized remote access environment. This section sets the security guidance applicable to all remote access communications methods and access levels. This guidance will be adhered to, in addition to the requirements set forth in the individual sections that provide detailed security requirements for remote access.

4.1 Levels of Remote User Access

There are varying sensitivity levels when initiating remote access to a Department of Defense network and the resources it contains. The following levels are defined to differentiate the types of remote access users. These definitions are used to clarify differing requirements based on the type of access required by the user. If the site so chooses, Administrative and End-User access may be treated the same for configuration management purposes; however, systems will be secured at the Administrative Access Level. If the site allows Administrative or End-User access to a system, the remote device must be controlled or owned by a Government entity to allow for confiscation and review at any time. This requirement allows for the review of security vulnerabilities and STIG requirements, as well as determination of possible spillage or harm to the network infrastructure. These requirements pertain to any system within an Enclave, excluding those resources specifically designed for public access (e.g., resources residing in a DMZ such as a web server).

Administrative Access – Remote users who will be connecting to a DOD core network to perform any system administration duties to include troubleshooting, configuration changes, and reviewing any system or configuration data, regardless of system type. This type of access will require the most stringent security controls and users must use government owned or controlled devices. Administrative access will employ encryption.

End-User Access – Remote users who will be accessing, downloading, or uploading data. The "end-user" remote access level requires that users do not make any system configuration changes or view system configuration information. This type of access will require medium security controls on the remote system and users must use government owned or controlled devices. End-User access includes customers who access, change, or download Government data via Telnet and other clear-text terminal emulators. It is strongly suggested that End-User access employs the use of encryption.

Limited (General) Access – Remote users who are viewing content or sending e-mail, but are not altering or entering official Government data (e.g., viewing e-mail via a webmail application such as Outlook for Web Access [OWA] or accessing a DOD web site). This type of access will require minimum-security controls and users may use personal computers or devices if approved by the local DAA.

As System Administrators perform duties such as configuration changes, troubleshooting application and communications issues, and logging in to a system with privileges to perform maintenance functions, rigorous security measures must be in place to protect the data and communication to and from the system. Administrative access will require the use of encryption on all communication channels between the remote user and the system being accessed. If the system requires the use of a clear-text based terminal emulator such as Telnet or TN3270, which accesses 3270 and 5250 based applications over TCP/IP, the only acceptable methods of connectivity will be an encrypted session, the employment of VPNs, Secure Web Access (SWA) with Secure Socket Layer (SSL), IPSEC, or SSH. Encryption should be used to protect the End-User access level. However, as of this writing, it is not required, but rather it is a suggested practice.

Limited access does not preclude the remote user from using their personal PCs to access services such as a webmail application (e.g., OWA) to send and receive e-mail. Limited Access users are not prohibited from accessing publicly accessible services that reside in a DMZ. While the intent at this time is to allow users to access a Government webmail application from a personal PC, the preferred method is to access e-mail from Government owned or controlled devices via dial-up or VPNs in order to limit the Government's exposure to malicious threats.

To ensure security within a classified environment, strict controls must be in place prior to any remote access to the classified network or resource. DOD has stringent policies on the access, storage, location, and containment of all classified data and processing. Furthermore, it is prohibited to allow non-DOD personnel to obtain remote access capability to any DOD network.

- *(NET1440: CAT III) The IAO will ensure that End user access is limited and the use of clear text Telnet, TN3270, and other terminal emulator TCP/IP sessions should employ encryption to the fullest extent possible.*

- *(NET1441: CAT I) The IAO will ensure that an NSA Certified remote access security solution is in place for remote access to a classified network and will only be used from an approved location.*

    - *The solution will be used in accordance with all NSA and DOD policy and guidelines.*
    - *The secure solution will support Key Exchange Algorithm (KEA).*
    - *The secure solution will support Palladium Fortezza Modems.*
    - *Each modem will have a valid X.509 V1 Certificate issued.*
    - *The Fortezza card will be kept in the user's possession at all times or stored in accordance with policy applicable to classified storage.*
    - *The modem will be stored separately from the computer when not in use.*

4.2 Remote User Access Agreement

There are numerous places from which a remote user can access a network, such as General Services Administration (GSA) telework centers, hotel rooms, homes airports other DOD sites, etc. To remotely access a DOD network or resource, a remote user must complete and sign a computer security checklist and a remote access agreement that is developed by the site. This STIG is intended to secure the site's network regardless of the location the remote user.

- *(NET1446: CAT II) The IAM will develop a policy for secure remote access to the site and an agreement between the site and remote user, to include, but not limited to, the following:*

  - *The signed agreement will contain the type of access required by the user.*

  - *The signed agreement will contain the responsibilities, liabilities, and security measures (e.g., malicious code detection training) involved in the use of their remote access device.*

  - *Incident handling and reporting procedures will be identified along with a designated point of contact.*

  - *The remote user can be held responsible for damage caused to a Government system or data through negligence or a willful act.*

  - *The policy will contain general security requirements and practices and will be acknowledged and signed by the remote user.*

  - *If classified devices are used for remote access from an alternative work site, the remote user will adhere to DOD policy in regard to facility clearances, protection, storage, distributing, etc.*

  - *Government owned hardware and software will be used for official duties only. The employee is the only individual authorized to use this equipment.*

4.3 Authentication, Authorization, and Accounting (AAA)

An Authentication, Authorization, and Accounting (AAA) server manages user requests for access to network resources. Restricting access to all network components is critical in safeguarding the enclave. In order to control and authorize access, an authentication server (e.g., Radius, TACACS+, or Kerberos) that provides extended user authentication and authority levels will be implemented.

- *(NET1451: CAT II) The IAO will ensure that all remote users are required to use a form of two-factor authentication to access the network.*

- *(NET1452: CAT III) The IAO will ensure that the remote access infrastructure (i.e. authentication server, RAS/NAS device, VPN gateway) logs session connectivity and termination, userid, assigned IP address, and success or failure of all session events.*

Logging is a key component of any security architecture and is a critical part of AAA server security. It is essential security personnel know what is being done, attempted to be done, and by whom in order to compile an accurate risk assessment. Maintaining an audit trail of system activity logs can help identify configuration errors, understand past intrusions, troubleshoot service disruptions, and react to probes and scans of the network.

- *(NET1453: CAT III) The IAO will ensure that a session that exceeds 30 minutes of inactivity is disconnected.*

- *(NET1455: CAT III) The IAO will ensure that the audit logs for any remote access server authentication mechanism are maintained for no less than a period of 30 days on-line, and one year off-line.*

- *(NET1456: CAT III) The IAO will ensure that the audit logs are viewed on a weekly basis.*

4.4 Dial-up Communications

Using either PSTN (public switched telephone network) or ISDN (Integrated Services Digital Network) lines, dial-up remote access is still one of the most cost effective and flexible solutions available today. With boosts in data throughput through increases in modem speeds and gains in data compression algorithms, as well as effective resource sharing though modem pooling, there are a number of applications that are well suited for dial-up communications. This section will focus on opportunities along with the risks associated with the dial-in remote access application that can be implemented within a site's network infrastructure enabling personnel at remote locations to gain access to its resources.

4.4.1 Modems

Implementing a dial-up technology—whether dialing out or dialing in—introduces additional security concerns for the network infrastructure. Each modem is a potential gateway for uninvited users, either by chance or malicious intent, to gain access to the attached network. Modems can provide an unchecked gateway to sensitive data within the DOD's computing boundaries. Keeping accurate records of all authorized modems used for both dial-in and dial-out is a good practice that promotes sound configuration management and an awareness of all network access points.

- (*NET1460: CAT III) The IAO will ensure all modems are physically protected.*

- *(NET1462: CAT III) The IAO will maintain a listing of all modems, associated phone number, and location.*

- *(NET1470: CAT III) The IAO will ensure that all modem phone lines will be restricted to single-line operation if dial back services aren't used (inward dial only or outward dial only) without any special features (e.g., call forwarding).*

4.4.2 Remote Access Server/Network Access Server

A Remote Access Server (RAS) or Network Access Server (NAS) is a device that provides for the initial entry point into a network. The NAS provides all the services that are normally available to a locally connected user (e.g., file and printer sharing, database and web server access, etc.) Permission to dial in to the local network is controlled by the NAS and can be granted to single users, groups, or all users. NAS servers such as Windows RAS, Shiva LanRover, and CISCO AS5200 have interfaces both to the network backbone and to the switched telephone service provider. These servers receive calls from remote clients or hosts that want to access the network using analog dial-up services that can support connections up to 56 Kbps. Access servers (e.g., Ascend Pipeline 4004 and Cisco AS5200) with an ISDN interface, as well as remote access servers with ISDN cards, support connections up to 128 Kbps. NAS and RAS devices can also interface with authentication servers such as RADIUS and TACACS.

Multi-modem adapter cards that plug into Windows servers can provide a low-cost analog alternative to a dedicated remote access server. These cards fit into any Intel-based server and support up to 24 communication ports bound to Windows RAS services. Some multi-modem cards support RSA SecurID for user authentication, which can be used with a RADIUS server to provide user management, session management, and accounting services. Because server cards can be installed on primary or backup domain controllers, a network administrator may inadvertently give all dial-in clients "log on locally" rights to the network. If a few permissions were to be configured improperly, a security breach could be created. Furthermore, some multi-modem cards rely solely on Windows RAS for user authentication, and do not allow for the use of the approved authentication servers.

Callback features are an attempt to protect the network by providing a service that disconnects an incoming call and reestablishes the call, dialing back to a predetermined number. Upon establishment of the callback connection, the communications device will require the user to authenticate to the system.

Configuring a focal point of access is vital to the overall security of a remote access infrastructure. In addition, only services that are absolutely needed for end users to conduct business should be allowed through the firewall from this access point. Hence, a sound approach would be to place dial-in users under the same access policy as those connecting via VPN. This can easily be accomplished by placing the remote access server either in the DMZ or within a screened subnet where the VPN gateway resides. The screened subnet architecture provides a layered defense ensuring only authorized users are permitted access to the internal network while still providing protection for the remote access server.

- *(NET1530: CAT III) The IAO will maintain ANI logs to provide a call audit trail.*

- *(NET1535: CAT III) The Network Administrator (NA) will ensure that if callback procedures are used, upon establishment of the callback connection, the communications device requires the user to authenticate to the system.*

- *(NET1595: CAT II) The IAO will ensure that the RAS/NAS device is located in a DMZ or screened subnet, thereby providing protection to the server while enforcing remote user access under the same remote access policy as those connecting by VPN.*

- *(NET1600: CAT II) The IAO will limit the use of in-band management to situations where the use of out-of-band management would hinder operational commitments or when emergency situations arise. IAO approves the use of in-band management on a case-by-case documented basis.*

- *(NET1602: CAT II) The IAO will ensure for in-band management, that the site implements the use of strong two-factor authentication.*

- *(NET1604: CAT II) The IAO will ensure that the use of in-band management is restricted to a limited number of authorized IP addresses. The number of IP addresses must be equal or less than the number of network engineers.*

- *(NET1606: CAT II) The IAO will ensure that all in-band management access to all remote access servers is via SSH or IAW FIPS 140-2.*

4.4.3 Dial-in Connectivity: SLIP and PPP

Serial Line Internet Protocol (SLIP) and Point-to-Point Protocol (PPP) are the two communication protocols that enable a remote computer to connect to a network over standard asynchronous serial lines using a modem. Both SLIP and PPP provide the ability to transport TCP/IP traffic over the serial lines; however, PPP can support additional protocols such as IPX and AppleTalk.

The most significant advantage PPP provides is authentication and configuration negotiation. With SLIP, the remote user must configure communication parameters such as MTU (maximum transmission unit) and MRU (maximum receive unit). In addition, SLIP does not support authentication; hence, chat scripts must be used to provide some form of authentication before SLIP is started. On the other hand, PPP negotiates the configuration parameters at the start of the connection to include which authentication method will be used, as well as all required transmission parameters. PPP provides authentication methods such as PAP (Password Authentication Protocol), CHAP (Challenge-Handshake Authentication Protocol), and Microsoft Challenge Handshake Authentication Protocol (MS-CHAP). These protocols are used for authentication at the Data Link Layer—that is, between the remote client and the remote access server. These methods provide the means for the remote client to send logon userid and password information to the remote access server.

Authentication takes place when the remote node attempts to establish a PPP session with a remote access server. The remote access server can be configured to use PAP, SPAP, or CHAP to authenticate the remote node. After the link is established, the remote node is required to send the username and password pair to the remote access server.

PAP transmits the username and password as plain text. NT RAS server supports SPAP to allow remote access to Shiva clients. Unlike PAP, SPAP does send encrypted passwords over the communication link as opposed to clear-text passwords. CHAP offers additional security by using encrypted keys during communication between the remote access server and the remote node. With CHAP, PPP sends a randomly generated challenge string to the client, along with its hostname. The client uses the hostname to look up an appropriate key, combines this with the challenge, and encrypts it with a one-way hashing algorithm. The resulting string is returned to the server, along with the client's hostname. The server performs the same computation as the client on the challenge string. The server will only allow the client to connect if its computation result is identical to that received from the client. DES or MD5 encryption can be chosen when using CHAP. DES is the default option used by CHAP; however, MD5 is recommended. An additional security feature of CHAP is that client authentication is not only required at initial connect time but the server sends challenge strings to the client at regular intervals to detect if the client has not been replaced by an imposter. These two security features working together help to ensure data transfer security in the PPP network.

MS-CHAP is the most secure encryption algorithm that NT supports and is Microsoft's version of the RSA MD4 standard. MS-CHAP uses a one-way hash function to produce a message-digest algorithm. A hash function takes a variable-sized input and returns a fixed-size 128-bit string. This type of algorithm produces a secure checksum for each message, making it almost impossible to change the message if the checksum is unknown. MS-CHAP V2 provides two-way authentication or mutual authentication. The remote access client receives verification that the remote access server that it is dialing in to has access to the user's password.

- *(NET1610: CAT II) The IAO will ensure that all remote clients and remote access servers are configured to use PPP instead of SLIP to provide the dial-up communication link.*

- *(NET1610: CAT II) The IAO will ensure that CHAP with MD5 or MS-CHAP with MD4 encryption is used to authenticate the remote client.*

4.5 Remote Client to VPN Gateway

DOD activities can out-source dial-up access to their networks using a cost-effective, easy to implement, and protocol-independent solution that requires minimal changes to their network architecture and policy. As discussed in section 5.2, a VPN is a network secured by encryption and authentication and is layered on existing public networks such as the Internet. A remote client uses the Internet and NIPRNet as the backbone for VPN connectivity to a DOD local area network. There are three tunneling protocols that can be used to create connectivity between a remote client and a VPN gateway: Point-to-Point-Tunneling Protocol (PPTP), Layer 2 Tunneling Protocol (L2TP), and IPSec. The later being the most secured and the required method for VPN connectivity between a remote client and a DOD network.

PPTP is Microsoft's solution for remote access VPN using RSA RC4 encryption and CHAP or MS-CHAP authentication. Both encryption and authentication are done within PPP. The PPP packets are then encapsulated within IP packets to create the tunnel. PPTP uses an enhanced Generic Routing Encapsulation (GRE) mechanism to provide a flow- and congestion-controlled encapsulated datagram service for carrying PPP packets within IP. With PPTP, a remote user

makes a dialup connection to an ISP NAS. The ISP provides a connection through its WAN and the Internet to a PPTP server residing in a DOD LAN. All encryption is done on the PPTP client and the decryption is done on the PPTP server creating a secured tunnel between the PPTP client and the PPTP server. The NAS can act as a PPTP client if the remote client is not PPTP aware; thereby, only providing a PPP session between the remote client and the NAS device at the ISP point of presence. For the obvious reason, the most secured implementation is to use a PPTP-enabled remote client to insure that there is a secured tunnel between the remote client and the DOD LAN.

Based on Microsoft's PPTP and Cisco's Layer 2 Forwarding Protocol (L2F), an L2TP VPN implementation model is similar to PPTP with one major difference—there is no encryption of the PPP packets so it must depend on IPSec or some other technology for encryption. Authentication is performed within PPP using PAP, CHAP, or Extensible Authentication Protocol (EAP).

IPSec provides two main facilities for creating VPN connections: an authentication-only function referred to as an Authentication Header (AH) and a combined authentication/encryption function called Encapsulating Security Payload (ESP) which can operate either in transport mode or tunnel mode.

In transport mode, IPSec encrypts only the data component of the IP packet to be transported: application headers, TCP/UDP headers and data are encrypted, the IP headers are readable. The authentication data is calculated on the basis of values in the IP header (and some other things). The original IP header is therefore maintained and an additional IPSec header is appended. The advantage of this mode of operation is that only a few bytes are added to each packet. On the other hand, it is possible for attackers to analyse the data traffic in VPN, since the the IP headers are not modified. The data itself however is encrypted, so one can only determine how much data is being exchanged by which stations, but not what data.

In tunnel mode, the entire IP packet is encrypted and provided with a new IP header and IPSec header. The advantage lies in that, in those LANs that should be connected to a VPN, a gateway can be configured such that it accepts IP packets, changes them into IPSec packets and then sends them over the Internet to the gateway on the target network, which restores and forwards the original packet. Moreover, attackers can thereby only determine the start- and end point of an IPSec tunnel.

- *(NET1625: CAT II) The IAO will ensure that VPN gateways terminate on or outside of the firewall.*

- *(NET1630: CAT II) The IAO will ensure that remote access via VPN will use IPSec ESP in tunnel mode. For legacy support, L2TP may be used if IPSec provides encryption or another technology that utilizes at a minimum a FIPS 140-2 approved data encryption algorithm such as AES or 3DES.*

5. NETWORK MANAGEMENT AND SUPPORT SERVICES

5.1 NETWORK MANAGEMENT

Managing a network with automated tools is becoming a necessity as networks become more complex. These automated processes can be used to monitor network performance and activity as well as to provide reports about the network. Network management models are built around network elements and are configured to monitor the attributes and functions associated with them. A network management configuration generally involves a managing process that runs on a management workstation. The managing process collects performance and other relevant data about the network or about particular nodes on the network.

Network management is generally implemented as a high-level application, so that the management software uses well-established protocol suites, such as the TCP/IP and the seven-layer OSI Reference Model, to move its information around.

5.1.1 The IP Management Model

The major components within the TCP/IP based model are Structure of Management Information (SMI), Management Information Base (MIB), and SNMP. The SMI specifies how information about managed objects is to be represented. The MIB contains the definitions and values for the managed objects relevant to a particular network. The information for the MIB component is acquired and updated by a management agent, a program whose task is to determine and report the information desired by a management program. Continued expansion of a generic MIB has been abandoned in favor of a scheme that allows extensions for specific networking products to be defined as separate nodes. SNMP is the protocol used to transmit management information.

5.1.2 Network Management Security Implications

This document focuses on the IP management service. SNMP, by virtue of what it is designed to do, can be a large security risk. Because SNMP can obtain device information and set device parameters, unauthorized users can cause damage rather easily.

SNMP has three basic commands that can supply potentially network-damaging information to individuals:

- *GET* *For MIB variable polling, used by the management station to create threshold alarms, provide system settings, and show other device information.*

- *SET* *For altering a variable's value from the management station, possibly triggering an intended side effect such as causing the managed device to reset a counter or to reboot.*

- *TRAP* *For agents to asynchronously notify the management station of a significant event, such as a change in the availability status of a communication link.*

SNMPv2 and later releases support the use of Message-Digest 5 (MD5) protocol to ensure sender authenticity and message integrity by creating a hash value of the Protocol Data Unit

(PDU). It can also incorporate a time stamp to avoid possible replay attacks. To achieve confidentiality of the PDU transmission, SNMPv2 and later uses Symmetric Privacy Protocol, which currently calls for the messages to be encrypted using the Digital Encryption Standard (DES). The communicating SNMP devices know the same symmetric DES key and can communicate freely across the network.

A would-be attacker can send SNMP GET sequences to routers, bridges, printers, or other devices polling for information. This individual could flood a particular device with so many GETs that all the processing time is used up, causing a denial of service. Using the TRAP, an unauthorized user could send an erroneous PDU to the router signaling that a circuit is down, thus causing packets to be rerouted or not delivered. A router's table or ACL could be overwritten by the SET command, allowing an unauthorized workstation access past the ACL router. On hosts using SNMP to communicate with the management station, commands can be sent to change an ARP cache table or even reboot the machine.

- *(NET1650: CAT II) The IAO will ensure IPSec is used to secure traffic between the network management workstation on DOD-managed LANs and all monitored devices sent via the Internet, NIPRNet, SIPRNet, or other external network.*

- *(NET1660: CAT I) The IAO will ensure that the SNMP Version 3 Security Model (both MD5 packet authentication and DES encryption of the PDU) is used across the entire network infrastructure.*

NOTE: If the site is using Version 1 or Version 2 with all of the appropriate patches to mitigate the known security vulnerabilities, this finding can be downgraded to a Category II. If the site is using Version 1 or Version 2 with all of the appropriate patches and has developed a migration plan to implement the Version 3 Security Model, this finding can be downgraded to a Category III.

- (*NET1665: CAT I) The IAO will ensure that all SNMP community strings are changed from the default values.*

- (*NET1666: CAT II) The IAO will ensure that all SNMP community strings and usernames are protected via* technology that utilizes at a minimum a FIPS 140-2 approved data encryption.

- *(NET1670: CAT III) The IAO will establish and maintain a standard operating procedure managing SNMP community strings and usernames to include the following:*

  - *Community string and username expiration period.*
  - *SNMP community string and username distribution including determination of membership*

- *(NET1675: CAT II) The IAO will ensure that both privileged and non-privileged modes are used on all devices. Different community names will be used for read-only access and read-write access.*

- *(NET1710: CAT III) The IAO will ensure that security alarms are set up within the managed network's framework. At a minimum, these will include the following:*

  – *Integrity Violation: Indicates that network contents or objects have been illegally modified, deleted, or added.*

  – *Operational Violation: Indicates that a desired object or service could not be used.*

  – *Physical Violation: Indicates that a physical part of the network (such as a cable) has been damaged or modified without authorization.*

  – *Security Mechanism Violation: Indicates that the network's security system has been compromised or breached.*

  – *Time Domain Violation: Indicates that an event has happened outside its allowed or typical time slot.*

- *(NET1720: CAT III) The IAO will ensure that alarms will be categorized by severity using the following guidelines:*

  – *Critical and major alarms are given when a condition that affects service has arisen. For a critical alarm, steps must be taken immediately in order to restore the service that has been lost completely.*

  – *A major alarm indicates that steps must be taken as soon as possible because the affected service has degraded drastically and is in danger of being lost completely.*

  – *A minor alarm indicates a problem that does not yet affect service, but may do so if the problem is not corrected.*

  – *A warning alarm is used to signal a potential problem that may affect service.*

  – *An indeterminate alarm is one that requires human intervention to decide its severity.*

5.1.3 Network Management Station

At the center of the network management structure is the management station. Applications such as HP's OpenView and Cabletron's Spectrum provide the user interface to the various levels of network management mentioned above. All facets of the management umbrella are controlled from here. Without encrypted in-band management connections, unauthorized users may gain access to the NMS enabling them to change device configurations and SNMP variables that can cause disruptions and even denial of service conditions. It is extremely important that this workstation be protected as follows:

- *(NET1730: CAT II) The IAO will ensure that the management workstation is located in a secure environment.*

- *(NET1740: CAT II) The IAO will ensure that only those accounts necessary for the operation of the system and for access logging will be maintained.*

- *(NET1750: CAT III) The IAO will ensure a record is maintained of all logons and transactions processed by the management station.*

NOTE: Include time logged in and out, devices that were accessed and modified, and other activities performed.

- *(NET1760: CAT I) Access to the NMS will be restricted to authorized users with individual userids and passwords.*

- *(NET1762: CAT II) The IAO will ensure that all in-band sessions to the NMS use a minimum FIPS 140-2 approved data encryption.*

- *(NET1770: CAT II) The IAO will ensure connections to the NMS are restricted by IP Address to only the authorized devices being monitored.*

- *(NET1780: CAT II) The IAO will ensure all accounts are assigned the lowest possible level of access/rights necessary to perform their jobs.*

5.2 Virtual Private Networks (VPNs)

5.2.1 Site-to-site VPN

A Virtual Private Network (VPN) is a distributed collection of networks or systems that are interconnected via a public and/or private network (i.e., the Internet or the NIPRNet) but protect their communications using encryption. In effect, a VPN is a private secure distributed network that is *transported* or *tunneled* across a public and/or private network. Typically, VPN encryption is implemented at the local network entry point (i.e., the firewall or Premise Router), thereby freeing the end systems from having to provide the necessary encryption or communications security functions.

- *(NET1800: CAT II) The IAO will ensure VPNs are established as tunnel type VPNs, which terminate outside the firewall (e.g., between the router and the firewall, or connected to an outside interface of the router).*

The placement of the VPN is to maintain the security of the enclave and the requirement that all traffic must pass through the Enclave Security Architecture. This is not to say that encrypted data (e.g., SSL, SSH, TSL) that entered the VPN tunnel must also be unencrypted prior to leaving the tunnel. However, the data would still have to pass through the respective application proxy on the firewall. If a host-to-host VPN is required, it will be established between trusted known hosts.

NOTE: A DOD site that enters into an agreement to establish a VPN with an outside security enclave/domain will retain administrative oversight and control privileges on the IPSEC/VPN device within their security enclave.

- *(NET1810: CAT III) The IAM will ensure that the site retains administrative oversight and control privileges on the IPSEC/VPN device within their security enclave if access is granted to the local network.*

- *(NET1820: CAT II) The IAM will require the customer to provide an Intrusion Detection System (IDS) capability for any VPN established that bypasses the site's current IDS capability.*

A VPN solution can be cheaper than conventional networks that run over WAN connections. VPN devices and software provide not only encryption functions but also network access control to secure Internet tunnels between remote sites. A VPN must provide privacy and integrity of data as it traverses the public network. At a minimum it should provide for the following:

- User Authentication — The solution must verify a user's identity and restrict VPN access to authorized users. In addition, the solution must provide audit and accounting records that reflect who, what, and when information was accessed.

- Address Management — The solution must assign a client's address on the private net, and must ensure that private addresses are kept private.

- Data Encryption — Data carried on the public network must be rendered unreadable to unauthorized users on the network. The VPN solution must also generate and refresh encryption keys for the client and server.

5.2.2 Contractor-to-Company Site VPN

Contractors working at DOD locations that require the ability to connect to their company network, using client-side VPN software installed on their government machine, will adhere to the following guidance:

- *(NET1840: CAT III) The SA and the IAO will ensure that if VPN technology is used to connect to a DOD network, the VPN client and concentrator will be configured to deny the use of split tunneling. The connection established is an exclusive connection between the VPN client and the VPN network device; all other connectivity is blocked after establishment of the VPN session, so there is no chance of IP packets being forwarded between the Internet and the DOD network.*

- *(NET1840: CAT III) The remote user will enter into a written agreement with the DOD site that allows the site to maintain administrative oversight and control privileges of the computer.*

- *(NET1840: CAT III) The remote user will ensure all communication to/from the site network employs at a minimum a FIPS-140-2 approved encryption algorithm (i.e., 3DES, AES).*

APPENDIX A. RELATED PUBLICATIONS

Government Publications

Department of Defense (DOD) Directive 8500.1, "Security Requirements for Automated Information Systems (AISs)," 21 March 1988.

Department of Defense 5200-28-STD, "DOD Trusted Computer System Evaluation Criteria," December 1985.

Department of Defense CSC-STD-002-85, "DOD Password Management Guideline," 12 April 1985.

Department of Defense CM-400-260-01, “Software Requirements Specification (SRS) for the Network Management (NM) Functional Area Of The Defense Information Infrastructure (DII),” 8 July 1997.

DOD Directive Number 3020.26, Continuity of Operations (COOP) Policy and Planning, May 26, 1995.

DOD Instruction Number 3020.39, Integrated Continuity Planning for Defense Intelligence, ASD (C3I), August 3, 2001.

DOD Directive Number O-8530.1, Computer Network Defense (CND), January 8,2001.

Defense Information Systems Agency Instruction (DISAI) 630-230-19, "Security Requirements for Automated Information Systems (AIS)," August 1991, and Supplements 1 and 2, not dated.

National Security Agency (NSA), "Information Systems Security Products and Services Catalog" (Current Edition).

National Security Agency (NSA), “Router Security Configuration Guide” (Current Edition)

ASD (NII) Memo, “Internet Protocol Version 6” (IPv6), June 9, 2003.

Field Security Operations Publications

DISA Computing Services Security Handbook
DNS STIG
NIPRNet STIG
Secure Remote Computing STIG
STIG on Enclave Security
UNIX STIG
Web Application STIG
WIRELESS STIG

Commercial and Other Publications

William R. Cheswick and Steven M. Bellovin. Firewalls and Internet Security, Repelling the Wily Hacker. Addison-Wesley Publishing Company, 1994.

J. Reynolds, and J. Postel, Assigned Numbers, RFC 1700, October 1994.

World-Wide Web References

Network Information Center (NIC) - http://www.internic.net

Electronic Industry Association/ Telecommunications Industry Association (EIA/TIA) - http://www.eia.org

Global Engineering Documents - http://global.ihs.com

TN3270 Server For Channel Interface Processor (CIP)- http://www.cisco.com

Role of Backbone Solutions - http://www.cisco.com

Advanced Peer-to-Peer Networking - http://www.cisco.com

Cisco Channel Interface Processor - http://www.cisco.com

Cisco Field Notices - http://www.cisco.com/warp/public/770/index.shtml

Cisco Security Advisories - http://www.cisco.com/warp/public/707/advisory.html

Cisco White Papers Website - http://www.cisco.com/warp/public/126/index.shtml

CERT Coordination Center - http://www.cert.org

CERT Alerts (from 1988) - http://www.cert.org/nav/alerts.html

DOD-CERT Home Page - http://www.cert.mil

NIPRNet Connection Approval Process - http://cap.nipr.mil

APPENDIX B. CJCSM AND DISA COMPUTING SERVICES SECURITY HANDBOOK REFERENCES

The references below are excerpts from *CJCSM 6510.01* and the *DISA Computing Services Security Handbook,* and are provided for the convenience of the readers/users of this STIG.

- The following is an excerpt from *Section 3.13, Passwords*, in the *Handbook*. The excerpt is provided as an adjunct to *DISA Computing Services Security Handbook* references.

3.13 Passwords

1. General.

a. Passwords provide the identification and authentication (I&A) function required of a C2 trusted level system. However, passwords become a vulnerability rather than a protection if misused or poorly maintained.

b. Ideally, only the user and the system know a password. The IAO will issue a temporary password that the user will change on initial access to the system. Temporary passwords will meet password structure requirements and will be varied. If a user forgets a password, the IAO will have to delete the existing account and reissue a new temporary password.

c. Users must sign a receipt for their initial password. The receipt must contain an acknowledgment that the user understands the responsibility to protect the password and has received guidance on password selection (if user selected). Password receipts must be kept on file for as long as a user has access. The receipt can be combined with access request forms. This requirement is now fulfilled with the DISA Form 41. These forms do not need to be stored at the DECC/Dets. It is recommended that they be filed at the local IAO level.

2. Password Structure.

a. Passwords will generally be a minimum of eight characters. The pertinent STIG will be consulted for the requirement of each operating system.

b. No words found in standard dictionaries will be used.

c. At least one upper case letter, lower case letter, numeric, and special character will be used.

d. Repeating, consecutive characters will not be used.

3. Password Maintenance. The following are minimum standards. Refer to the appropriate STIG for standards specific to the operating system.

a. Passwords must be changed every 90 days.

b. Passwords cannot be reused within 10 password changes.

c. Passwords cannot be changed more than once every 24 hours without the intervention of the IAO.

d. If software allows, set it to enforce the above rules.

e. The password file must be encrypted, if possible, and protected from unauthorized access.

4. Password Classification.

a. Passwords for unclassified but sensitive systems will be marked, "**FOR OFFICIAL USE ONLY**."

b. Passwords for classified systems, operating in the dedicated or systems high mode, will be marked, "**FOR OFFICIAL USE ONLY**."

c. Passwords for classified systems, operating in the multi-level mode, depend on what other security measures are in place. If physical security or COMSEC measures separate the levels of classification, the passwords may be marked, "**FOR OFFICIAL USE ONLY**." However, if the password is the only measure separating the levels of classification, the password must be classified to the level of that user.

5. Password Storage.

a. If it is necessary to maintain a password list, it must be kept under key lock. *Although a list of all passwords for a classified system is FOUO, it is recommended the list be stored as classified.*

b. Users are encouraged not to keep a copy of their written password, but it is often necessary to have it available. It should be protected as follows to prevent loss and to detect a compromise.

(1) Do not store the password where it is easily accessible to your computer.

(2) Do not keep the password and user ID together.

(3) Store the password in a locked drawer or cabinet. However, this is not effective if the same key opens most of the drawers in the office area.

(4) Keep the password in your wallet.

(5) Seal the password in an envelope and sign across the seal to detect tampering.

6. Password Dissemination.

a. Passwords must be given to the user via a secure means. The user ID and password should never be transmitted, together in the clear. There is no one solution, but many possible alternatives. A risk management approach should be used and the less secure the means, the less time the password should remain active before the change. If the user is not able to change passwords, the most secure methods should be employed.

b. The ideal situation would involve the IAO personally giving the user their initial, one-time password and the user immediately changing that password.

c. Other acceptable solutions include:

(1) Sending the user ID and password by mail.

(2) Giving the user ID and password over a secure phone.

(3) Sending the user ID and password by an encrypted E-mail. The password to unencrypt will be sent by a separate message, without referencing what this password is for.

(4) Centrally managed system may predetermine default password, such as the password of the week or a list of 25 different passwords. These can be mailed to local IAOs ahead of time. When an account is established centrally, the local IAO will be notified that the password for the week of the 17th was used or password #12. The local IAO can then personally give the user their one-time password.

d. Other methods of disseminating passwords should be submitted to FSO for approval.

7. Password Vaults.

a. A password vault is a utility program that stores multiple passwords under a master password. This eliminates the problem of users forgetting multiple passwords or having to write them down.

b. The use of a password vault will only be considered if:

(1) Passwords are stored by a minimum of 128-bit encryption.

(2) The vendor provides a Vendor Integrity Statement. *See Section 3.23.*

(3) The IAO or IAM approves the software and use of this product is reflected in the accreditation.

3.26 CJCSM Warning Banners

1. The purpose of the warning banner is two-fold. First, it warns unauthorized users, surfing the net, that unless they are authorized they should not proceed. It is like an electronic **No Trespassing** sign that allows us to prosecute those who do trespass. Secondly, it warns both authorized and unauthorized users that they are subject to monitoring to detect unauthorized use. This provides the informed consent that again allows us to prosecute those who abuse the system.

2. The requirement for a LOGON Warning Banner was disseminated through DoD-CERT Bulletin 93-17, subject: LOGON Warning Banner for DoD Interest Computer Systems. The bulletin referenced guidance from the Deputy Assistant Secretary of Defense for Security Countermeasures and Counterintelligence (DASD/SCM/CI). Other clarifying guidance has also been distributed.

3. The banner should be installed so that it appears before a LOGON screen or before any identification of the system. An escape should also be provided to allow the individual to end the LOGON attempt (e.g., **PRESS ENTER TO LOG ON TO SYSTEM OR ESCAPE TO ABORT SESSION**). If the banner cannot be installed before the LOGON process due to the configuration of the system, install the banner as soon as possible.

4. Below is the latest version of the warning banner provided by CJCSM 6510.01 dated 15 March 2002. Previously approved versions are acceptable, but should be updated when possible.

> This is a Department of Defense computer system. This computer system, including all related equipment, networks, and network devices (specifically including internet access), are provided only for authorized U.S. Government use. DoD computer systems may be monitored for all lawful purposes, including to ensure their use is authorized, for management of the system, to facilitate protection against unauthorized access, and to verify security procedures, survivability, and operational security. Monitoring includes active attacks by authorized DoD entities to test or verify the security of this system. During monitoring, information may be examined, recorded, copied, and used for authorized purposes. All information, including personal information, placed on or sent over this system, may be monitored.
>
> Use of this DoD computer system, authorized or unauthorized, constitutes consent to monitoring of this system. Unauthorized use may subject you to criminal prosecution. Evidence of unauthorized use collected during monitoring may be used for administrative, criminal, or other adverse action. Use of this system constitutes consent to monitoring for these purposes.

APPENDIX C. REQUIRED FILTERING RULES

The DOD Ports and Protocol Technical Guidance is a valuable source that can be utilized in filtering traffic. The publicly accessible data (no FOUO) is at http://www.dtic.mil/whs/directives/corres/html/85511.htm.

The understanding of mutually accepted risk within the NIPRNet community seeks to provide maximum interoperability while maintaining an emphasis on security. The logic is that all participants inside the NIPRNet share a common level of risk to their systems, defined by the protections established at the NIPRNet/Internet boundary, and the minimum level of protection found at all internal enclave boundaries to the NIPRNet backbone. To mitigate this threat, DOD is in the process of establishing a NIPRNet ports and protocols security document. This document, when approved, will establish the DOD community policy for firewall and router implementations for the NIPRNet. It will provide detailed configuration settings for known identified combinations of ports, protocols, and services (PPS). It will recommend security countermeasures for minimizing the vulnerabilities for use of risky ports, protocols, and services that are used by essential applications.