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Various Solutions for Address Resolution Protocol Spoofing Attacks

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Abstract: - Security is at the forefront of most networks, and many companies implement a comprehensive security policy encompassing many of the OSI layers, from application layer all the way down to IP security. However, one area that is often left untouched is hardening Layer 2 and this can open the network to a variety of attacks and compromises. Address resolution protocol is the mapping of IP address to the MAC address (layer 3 to layer2 mapping). ARP provides no authentication mechanism to the incoming request packets this is the reason that any client can forge an ARP message contains malicious information to poison the ARP cache of target host. There are many possible attacks on ARP which can make the communication unsecure such as man-in-the-middle (MITM), Denial of service (DOS), cloning attack, session hijacking and many more attacks.

Keywords: — Address resolution protocol (ARP), ARP Cache, Denial of service (DOS) Attacks, MAC Address, IP Address, man-in-the-middle (MITM)

I. INTRODUCTION

A computer connected to an IP/Ethernet LAN has two addresses, One is the MAC(media access control) address, second is the IP address . ARP spoofing may allow an attacker to intercept data frames on a LAN, modify the traffic, or stop the traffic altogether. Often the attack is used as an opening for other attacks, such as denial of service, man in the middle, or session hijacking attacks. The attack can only be used on networks that make use of the Address Resolution Protocol (ARP) [1], and is limited to local network segments. The network card, called the MAC address.

The MAC, in theory, is a globally unique and unchangeable address which is stored on the network card itself.MAC addresses are necessary so that the Ethernet protocol can send data back and forth, independent of whatever application protocols are used on top of it. Ethernet builds "frames" of data, consisting of 1500 byte blocks. Each frame has an Ethernet header, containing the MAC address of the source and the destination computer. The second address is the IP address. IP is a protocol used by applications, independent of whatever network technology operates underneath it. Each computer on a network must have a unique IP address to communicate. IP addresses are virtual and are assigned via software. IP and Ethernet must work together.IP communicates by constructing "packets" which are similar to frames, but have a different structure. These packets cannot be delivered without the network layer. In this case they are delivered by Ethernet, which splits the packets into frames, adds an Ethernet header for delivery, and sends them down the cable to the switch. The switch then decides which port to send the frame to, by comparing the destination address of the frame to an internal table which maps port numbers to MAC addresses. When an Ethernet frame is constructed, it must be built from an IP packet. However, at the time of construction, Ethernet has no idea what the MAC address of the destination machine is which it needs to create an Ethernet header. The only information it has available is the destination IP from the packet's header. There must be a way for the Ethernet protocol to find the MAC address of the destination machine, given a destination IP. This is where ARP, the Address Resolution Protocol, comes in.

II. ARP OPERATIONS

ARP operates by sending out "ARP request" packets. An ARP request asks the question "Is your IP address x.x.x.x? If so, send your MAC back to me." These packets are broadcast to all computers on the LAN, even on a switched network. Each computer examines the ARP request, checks if it is currently assigned the specified IP, and sends an ARP reply containing its MAC address. To minimize the number of ARP packets being broadcast, operating systems keep a cache of ARP replies. When a computer receives an ARP reply, it will update its ARP cache with the new IP/MAC association. As ARP is a stateless protocol, most operating systems will update their cache if a reply is received, regardless of whether they have sent out an actual request. ARP spoofing [2] involves constructing forged ARP request and reply packets. By sending forged ARP replies, a target computer could be convinced to send frames destined for computer A to instead go to computer B. When done properly, computer A will have no idea that this redirection took place. The process of updating a target computer's ARP cache with a forged entry is referred to as "poisoning". Various attacks on arp are SNIFFING Switches determine which frames go to which ports by comparing the destination MAC on an frame against a table. This table contains a list of ports and the attached MAC address. The table is built when the switch is powered on, by examining the source MAC from the first frame transmitted on each port. Network cards can enter a state called "promiscuous mode" where they are allowed to examine frames that are destined for MAC addresses other than their own. On switched networks this is not a concern, because the switch routes frames based on the table described above. This prevents sniffing of other people's frames. However, using ARP spoofing, there are several ways that sniffing can be performed on a switched network. A "man-in-the-middle" attack is one of these. When a MiM is performed, a malicious user inserts his computer between the communications path of two target computers. Sniffing can then be performed. The malicious computer will forward frames between the two target computers so communications are not interrupted. The attack is performed as follows (where X is the attacking computer, and T1 and T2 are targets):

-X poisons the ARP cache of T1 and T2.

-T1 associates T2's IP with X's MAC.

-T2 associates T1's IP with X's MAC.

-All of T1 and T2's IP traffic will then go to X first, instead of directly to each other.

This is extremely potent when we consider that not only can computers be poisoned, but routers/gateways as well. All Internet traffic for a host could be intercepted with this method by performing a MiM (man in the middle) on a target computer and the LAN's router. Another method of sniffing on a switched network is MAC flooding. By sending spoofed ARP replies to a switch at an extremely rapid rate, the switch's port/MAC table will overflow. Results vary by brand, but some switches will revert to broadcast mode at this point. Sniffing can then be performed. DOS Updating ARP caches with non-existent MAC addresses will cause frames to be dropped. These could be sent out in a sweeping fashion to all clients on the network in order to cause a Denial of Service attack. This is also a side effect of post-MiM attacks, since targeted computers will continue to send frames to the attacker's MAC address even after they remove themselves from the communication path. To perform a clean MiM attack, the target computers would have to have the original ARP entries restored by the attacking computer. HIJACKING Connection hijacking allows an attacker to take control of a connection between two computers, using methods similar to the MiM attack. This transfer of control can result in any type of session being transferred. For example, an attacker could take control of a telnet session after a target computer has logged in to a remote computer as administrator LONING MAC addresses were intended to be globally-unique identifiers for each network interface produced. They were to be burned into the ROM of each interface, and not be changed. Today, however, MAC addresses are easily changed. Linux users can even change their MAC without spoofing software, using a single parameter to "ifconfig", the interface configuration program for the OS .An attacker could DoS a target computer, then assign themselves the IP and MAC of the target computer, receiving all frames intended for the target.

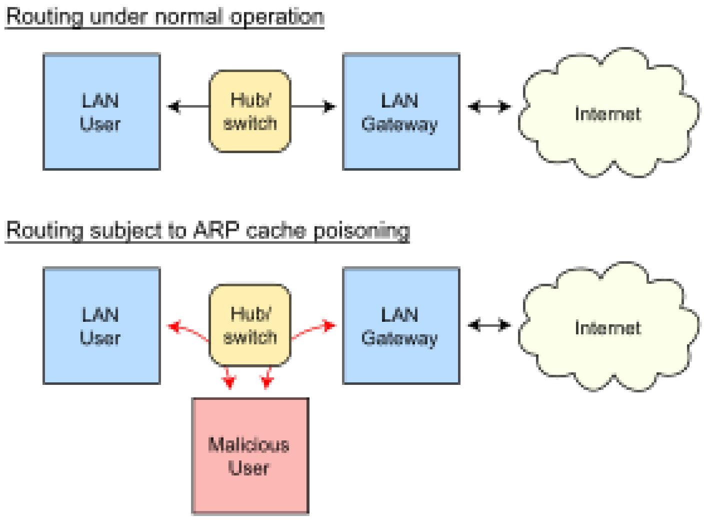


Fig 1: ARP Normal and cache poisoning

III. VULNERABILITIES OF THE ADDRESS RESOLUTION PROTOCOL

The Address Resolution Protocol (ARP) [4] is a widely used protocol for resolving network layer addresses into link layer addresses. When an Internet Protocol (IP) datagram is sent from one host to another on a local area network, the destination IP address must be converted into a MAC address for transmission via the data link layer. When another host's IP address is known, and its MAC address is needed, a broadcast packet is sent out on the local network. This packet is known as an ARP request fig2. The destination machine with the IP in the ARP request then responds with an ARP reply fig2, which contains the MAC address for that IP.

ARP is a stateless protocol. Network hosts will automatically cache any ARP replies they receive, regardless of whether or not they requested them. Even ARP entries which have not yet expired will be overwritten when a new ARP reply packet is received. There is no method in the ARP protocol by which a host can authenticate the peer from which the packet originated. This behavior is the vulnerability which allows ARP spoofing to occur.

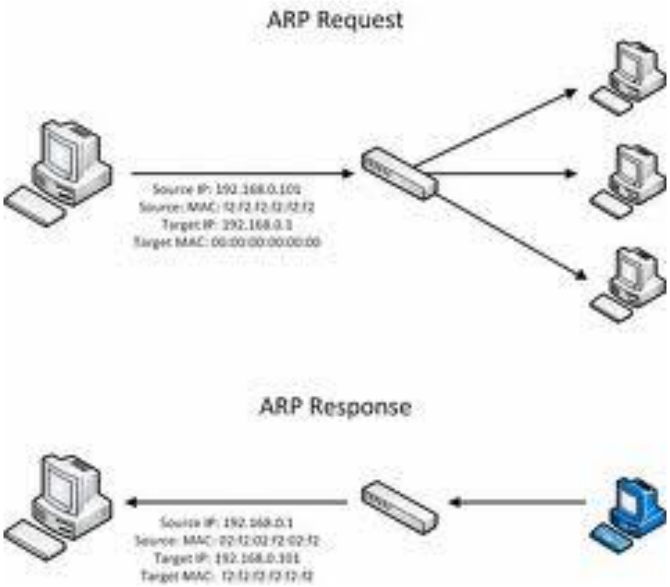

ARP Request
Source IP: 192.168.0.101
Source: MAC: f2:f2:f2:f2:f2:f2
Target IP: 192.168.0.1
Target MAC: 00:00:00:00:00:00
ARP Response
Source IP: 192.168.0.1
Source: MAC: 02:f2:02:f2:02:f2
Target IP: 192.168.0.101
Target MAC: f2:f2:f2:f2:f2:f2

Fig 2: ARP request and response

IV ANATOMY OF AN ARP SPOOFING ATTACK

The basic principle behind ARP spoofing is to exploit the above mentioned vulnerabilities in the ARP protocol by sending spoofed ARP messages onto the LAN. ARP spoofing attacks can be run from a compromised host on the LAN, or from an attacker's machine that is connected directly to the target LAN.

Generally, the goal of the attack is to associate the attacker's MAC address with the IP address of a target host, so that any traffic meant for the target host will be sent to the attacker's MAC instead. The attacker could then choose to:

Inspect the packets, and forward the traffic to the actual default gateway (interception).Modify the data before forwarding it (man-in-the-middle attack).Launch a denial-of-service attack by causing some or all of the packets on the network to be dropped

V. THE ARP ATTACKS

A. Connection Hijacking & Interception

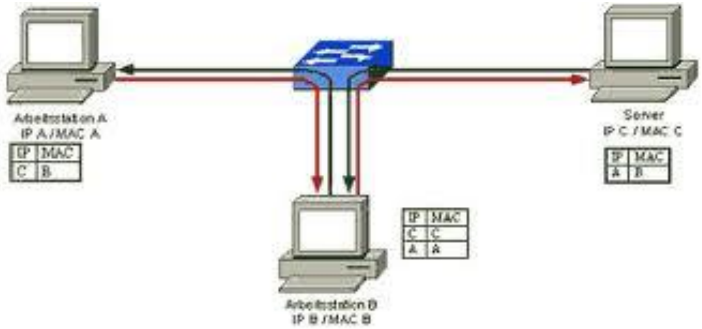
Packet or connection hijacking and interception is the act in which any connected client can be victimized into getting their connection manipulated in a way that it is possible to take complete control over.

B. Connection Resetting

The name explains itself very well. When we are resetting a client's connection, we are cutting their connection to the system. This can be easily done using specially crafted code to do so. Luckily, we have wonderful software that was made to aid us indoingso.

C. Man in the Middle

A hacker can exploit ARP Cache Poisoning to intercept network traffic between two devices in your network. For instance, let's say the hacker wants to see all the traffic between your computer, 192.168.0.12, and your Internet router, 192.168.0.1. The hacker begins by sending a malicious ARP "reply" (for which there was no previous request) to your router, associating his computer's MAC address with 192.168.0.12 Now your router thinks the *hacker's* computer is *your* computer. Next, the hacker sends a malicious ARP reply to *your* computer, associating his MAC Address with 192.168.0.1, now your machine thinks the hacker's *computer* is your *router*. Finally, the hacker turns on an operating system feature called *IP forwarding*. This feature enables the hacker's machine to forward any network traffic it receives from your computer to the router. Whenever you try to go to the Internet, your computer sends the network traffic to the hacker's machine, which it then forwards to the real router. Since the hacker is still forwarding your traffic to the Internet router, you remain unaware that he is intercepting all your network traffic and perhaps also sniffing your clear text passwords or hijacking your secured Internet sessions.



IP	MAC
C	B

IP	MAC
A	B

IP	MAC
C	C
A	A

Fig 3: Man in the middle attack

D. *Packet Sniffing*

Sniffing on a Local Area Network (LAN) is quite easy if the network is segmented via a hub, rather than a switch. It is of course possible to sniff on a switched environment by performing a MAC flood attack. As a result of the MAC flood, the switch will act as a hub, and allow the entire network to be sniffed. This gives you a chance to use any sort of sniffing software available to you to use against the network, and gather packets.

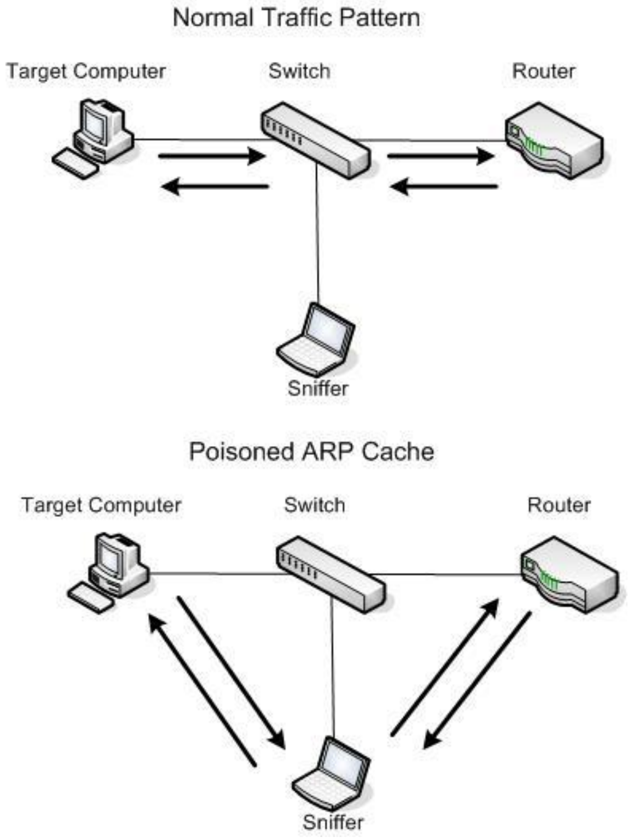


Fig 4: Packet sniffing

E. Denial of Service

A hacker can easily associate an operationally significant IP address to a false MAC address. For instance, a hacker can send an ARP reply associating your network router's IP address with a MAC address that doesn't exist. Your computers believe they know where your default gateway is, but in reality they're sending any packet whose destination is not on the local segment, into the Great Bit Bucket in the Sky. In one move, the hacker has cut off your network from the Internet.

F. MAC Flooding

MAC Flooding is an ARP Cache Poisoning technique aimed at network switches. (If you need a reminder about the difference between a hub and a switch, see this sidebar.) When certain switches are overloaded they often drop into a "hub" mode. In "hub" mode, the switch is too busy to enforce its port security features and just broadcasts all network traffic to every computer in your network. By flooding a switch's ARP table with a ton of spoofed ARP replies, a hacker can overload many vendor's switches and then packet sniff your network while the switch is in "hub" mode.

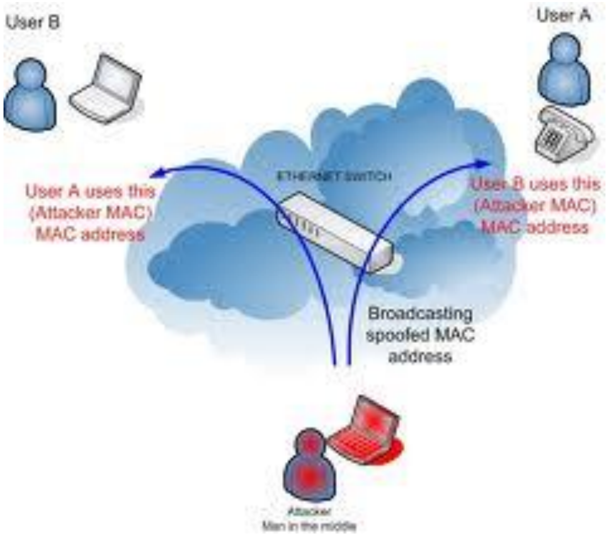

User B
User A
ETHERNET SWITCH
User A uses this (Attacker MAC) MAC address
User B uses this (Attacker MAC) MAC address
Broadcasting spoofed MAC address
Attacker
Man in the middle

Fig 5: MAC flooding attack

Some of the tools [3] that can be used to carry out ARP spoofing attack

- Arpspoof (part of the DSniff suite of tools)
- Arpoison
- Ettercap
- Cain&Abel
- Seringe[13]
- ARP-FILLUP -V0.1
- arp-sk -v0.0.15
- ARPOc -v1.13
- arpalert -v0.3.2
- arping -v2.04
- arpmitm -v0.2
- arpoison -v0.5
- ArpSpyX -v1.1
- ArpToXin -v 1.0

- SwitchSniffer

VI. VARIOUS SOLUTIONS OF ARP

- Recently, there have been several solutions proposed to solve the ARP spoof problem. However, most of them have some critical drawbacks. The previous solutions may be grouped as follows

A. Cryptographic approaches

Bruschi et al. [5] proposed a secure address resolution protocol (SARP), which uses asymmetric key cryptography to authenticate the hosts in a local area network (LAN).In SARP, each host uses an invite–accept protocol to periodically register its IP–MAC pairs in a secure server.IP–MAC pairs are hashed by a message digest algorithm. This approach, however, requires medication of the ARP protocol as the sender needs to sign each ARP message with its private key, and the receiver needs to verify the signature with the sender's public key.Goyal and Tripathy [6] used the combination of digital signatures and one-time password based on hash chains to authenticate a host. Their approach requires substantial overhead to perform signature generation, verification and key management.Limmaneewichid and Lilakiatsakun [7] proposed an ARP authentication scheme based on ARP authentication trailer, named P-ARP, which consists of a magic number, nonce and the authentication data produced by the HMAC hash function. In order to hide the target IP address in an APR request message, additional operation such as hash function must be performed to create nonce and HMAC values. In addition, this approach is ineffective against ARP DoS attacks. Although cryptographic approach is generally an effective mechanism to guarantee integrity of ARP packets themsel

B. Kernel-based patch

Anticap [8] and Antidote [9] are some examples of solutions to ARP spoof that suggest a patch to some specific OS to protect against ARP spoof. However, their patch can be used only with some specific kernel. ARP in that kernel after~ ves, it often slows down the overall network throughput to an unacceptable level in practice. patched may not be compatible and interoperable with the ARPmechanisms in other un-patched kernels.

C. Host-based approaches

Xing et al. [10] used WinPcaP library to capture and filter ARP packets. Whenever ARP response acket is received and the cache needs to be updated, it compares against the correct IP–MAC address pairs and corrects the contents of the local ARP cache if they are different. Ramachandran and Nandi [11, 12] checked inconsistencies of the addresses advertised by ARP request and TCP SYN packets. In order to build reliable IP–MAC pairs, they used the IP–MAC address advertised by ARP messages to build TCP SYN packets. When there are no ARP attacks, the destination MAC and IP in the TCP SYN packet has to be the source MAC and IP address reported in ARP messages. However,this approach would create a heavy traffic on the LAN if ARP DoS attacks are continuously generated to probe the network. Furthermore, this approach only detects an ARP attack but cannot prevent it.Hou et al. [13] used a network intrusion detection system (e.g. Snort [14, 15]) to detect ARP attacks. They expanded the original ARP spoofing plug-ins in Snort by adding an ARP inspection module. The ARP inspection module automatically binds the correct gateway IP–MAC address in static mode. Likewise, Barbhuiya et al. [16] used a host-based intrusion detection system to detect ARP attacks.Their approach checked the integrity and authenticity of ARP replies using a combination of digital signatures and one time passwords based on hash chains. Information included in digital signatures (e.g. IP address to MAC

address mapping, the local clock time and the tip of hash chain etc.) is used to verify the password. the host-based IDS answered ARP requests by sending digital signature as the ARP reply. Unfortunately, s acknowledged by the authors, at present this approach can only detect ARP attacks.Philip [17] proposed a technique to prevent ARP cache poisoning attacks in wireless access point-based networks which may include wired clients. The access point creates a mapping table, which stores the mapping of IP addresses to MAC addresses. Since all the wireless clients registered with the access point have to obtain an IP address using the DHCP protocol, the mapping table contains the correct mapping of all the wireless clients that communicate through this access point. Therefore whenever the access point receives an ARP request or reply, it uses its mapping table to verify whether the mapping in the ARP request or reply is valid. Unfortunately, there are a couple of serious drawbacks to this approach. First, it does not support hosts that have static IP addresses. Second, it is designed to work with only Linksys routers, and this approach requires manufacturers to release device driver source code to update firmware which handles transmission of packets from one wireless client to another. tellectual property issues prevent this approach from becoming widely adapted in practice.Nam et al. [18] proposed man-in-the-middle (MITM)-

resistant address resolution protocol (MR-ARP). Their approach consists of two parts: (i) mapping table (e.g. long-term table) keeps the values of IP–MAC pairs for connected hosts over longer periods; and (ii) conflict resolution mechanism based on voting prevents hosts against MITM attacks being launched. However, their approach was installed and evaluated on a small number of hosts. In addition, if a host is disabled by another type of DoS attack in the worst case, then the MITM attack cannot be valid.Lastly, Trabelsi and El-Hajj [19] proposed a stateful ARP cache management mechanism based on a fuzzy logic. The DHCP protocol, the mapping table contains the correct mapping of all the wireless clients that communicate through this access point. Therefore whenever the access point receives an ARP request or reply, it uses its mapping table to verify whether the mapping in the ARP request or reply is valid. Unfortunately, there are a couple of serious drawbacks to this approach. First, it does not support hosts that have static IP addresses. Second, it is designed to work with only Linksys routers, and this approach requires manufacturers to release evice driver source code to update firmware which handles transmission of packets from one wireless client to another. Intellectual property issues prevent this approach from becoming widely adapted in practice.Nam et al. [18] proposed man-in-the-middle (MITM)-resistant address resolution protocol (MR-ARP). Their approach consists of two parts: (i) mapping table (e.g. long-term table) keeps the values of IP–MAC pairs for connected hosts over longer periods; and (ii) conflict resolution mechanism based on voting prevents hosts against MITM attacks being launched. However, their approach was installed and evaluated on a small number of hosts. In addition, if a host is disabled by another type of DoS attack in the worst case, then the MITM attack cannot be valid.Lastly, Trabelsi and El-Hajj [19] proposed a stateful ARP cache management mechanism based on a fuzzy logic. Thecan be used to block ARP attacks in small office, home office (SOHO) LANs. The scheme consists of two elements, namely a server that updates the ARP cache and a switch that blocks all ARP messages. However, they failed to address how the server collects the correct IP–MAC mappings so that it may generate correct reply to the incoming ARP requests.

D. Port security on switch

This group of solutions suggests using an expensive switch that can support port security (such as Dynamic ARP Inspection (DAI) [20]). This kind of switch can help detect ARP spoof easily. However, the main problem of this solution is cost. For most of organization, it would not be possible to change all LAN switches to the high-end ones (in particular at the access level ofnetwork).

E. Manually configuration of static ARP entries

The most basic way to protect against ARP spoof is manually configuring static ARP entries at every host.However, this solution is not manageable for network administrators of a rather big rganization. Also, it would be rather difficult to educate all end users of any organization to configure static ARP entries properly.

F. ARP spoof detection & protection software

There have been several programs, proposed to detect and protect against ARP spoof. Yet, most of them work ineffectively. Some of them can only detect but not protect, such as XArp [21], ARPWatch [22]. Several programs (such as Anti Netcut [23], NoCut [24], and AntiARP [25]) have been tested in our lab [26] and found an ineffectiveness of protection.AVASS [27] is an ARP spoof detection/protection software,designed and implemented by a team from our lab [26]. From our testing, it demonstrates effectiveness. However, we have also found that the design of AVASS is still not very efficient and easy to manage. In this work, we join with some of the team who has built AVASS to redesign and implement a new and better solution.

G. server-based approaches

Gouda and Huang [28] proposed an architecture in which a secure server is connected to the Ethernet and communications with the server take place using invite-accept and request-reply protocols. All ARP requests and replies occur between a host and the server, and replies are authenticated using shared pair keys. Kwon et al. [29]proposed a similar approach to securely manage IP addresses in a distributed network. This approach uses an agent which retrieves genuine IP–MAC pairs from a host and forwards them to the manager to construct reliable IP–MAC mapping. The manager node onitors if IP addresses of licensed hosts are changed, and unauthorized hosts are disconnected as they are assumed to have suffered spoofing attacks. Ortega et al. [30] proposed a scheme that can be used to block ARP attacks in small office, home office (SOHO) LANs. The scheme consists of two elements, namely a server that updates the ARP cache and a switch that blocks all ARP messages. However, they failed to address how the server collects the correct IP–MAC mappings so that it may generate correct reply to the incoming ARP requests.Lootah et al. [31] implemented a secure IP–MAC address

Lootah et al. [31] implemented a secure IP–MAC address mapping in which an ARP reply is generated with an attached signature when a request is issued. A ticket is appended as a variable length ayload. This approach uses a local ticket agent

(LTA), a key management server, to issue a public key to obtain the IP–MAC from the ticket. This approach is backward compatible with existing ARP, but it is susceptible to replay attacks. Furthermore, addition of cryptographic features in ARP may lead to some performance overhead. Pansa and Chomsiri [32] proposed revision of the dynamic host configuration protocol (DHCP)definition to include authentication of network devices and inclusion of mapping information between IP and MAC addresses. Although flawless in concept, it would cause serious compatibility problems because DHCP is one of the most popular protocols. In general, approaches based on secure server are generally ineffective because the server itself becomes the primary target of DoS attacks and has the potential of becoming a single point of failure.Some high-end Cisco switches provide a feature called dynamic ARP inspection [33] through which the switch may drop ARP packets containing invalid IP/MAC pairs.The switch binds a physical port to a MAC address and maintains valid associations in content addressable memory (CAM) tables. However, if the first sent packet itself is a spoofed MAC address, the whole system fails. Likewise, various network monitoring tools (e.g. such as ARP- GUARD [34], ARPWATCH [31] and ARPDEFENDER [35]) inspect if ARP tables are arbitrarily changed. They maintain IP–MAC addresses of the ARP cache, periodically compare if changes have been made to the ARP cache, and alert administrators if necessary. These tools are cheaper than switches with port security but have slower response time compared to switches .Furthermore, false alarms occur when genuine IP (or MAC) address changes occur.

H. ASA (anti-ARP spoofing agent) software

Address resolution protocol (ARP) is widely used to maintain mapping between data link (e.g.MAC) and network (e.g. IP) layer addresses. Although most hosts rely on automated and dynamic management of ARP cache entries, current implementation is well-known to be vulnerable to spoofing or denial of service (DoS) attacks. There are many tools that exploit vulnerabilities of ARP protocols, and past proposals to address the weaknesses of the 'original' ARP design have been unsatisfactory. Suggestions that ARP protocol definition be modified would cause serious and unacceptable compatibility problems. Other proposals require customized hardware be installed to monitor malicious ARP traffic, and many organisations cannot afford such cost. This study demonstrates that one can effectively eliminate most threats caused by the ARP vulnerabilities by installing anti-ARP spoofing agent (ASA)[36] which intercepts unauthenticated exchange of ARP packets and blocks potentially insecure communications. The proposed approach requires neither medication of kernel ARP software nor installation of traffic monitors. Agent uses user datagram protocol (UDP) packets to enable networking among hosts in a transparent and secure manner. The authors implemented agent software on Windows XP and conducted an experiment. The results showed that ARP hacking tools could not penetrate hosts protected by ASA.

Some of the tools that can be used to defense ARP spoofing attacks

- anti-arpspoof
- Arpwatch
- ArpON: Portable handler daemon for securing ARP against spoofing, cache poisoning or poison routing attacks in static, dynamic and hybrid networks.
- Antidote: Linux daemon, monitors mappings, unusually large number of ARP packets.
- Arp_Antidote Linux Kernel Patch for 2.4.18 - 2.4.20, watches mappings, can define action to take when.
- ArpGuard: ArpGuard protects your Mac by keeping an eye on your Internet network.
- Arpalert: Predefined list of allowed MAC addresses, alert if MAC that is not in list.
- Arpwatch/ArpwatchNG/Winarpwatch: Keep mappings of IP-MAC pairs, report changes via Syslog, Email.
- Prelude IDS: ArpSpoof plugin, basic checks on addresses.
- Snort: Snort preprocessor Arpspoof, performs basic checks on addresses

- XArphttp://en.wikipedia.org/wiki/ARP_spoofing - cite_note-XArp-11: Advanced ARP spoofing detection, active probing and passive checks. Two user interfaces: normal view with predefined security levels, pro view with per-interface configuration of detection modules and active validation. Windows and Linux, GUI-based.

TABLE1: ARP SPOOFING ATTACK DETECTION TOOLS COMPARISON

Name	OS	GUI	Free	Protection	Per interface	Active/passive
Agnitum Outpost Firewall	Windows	Yes	No	Yes	No	passive
AntiARP	Windows	Yes	No	Yes	No	active+passive
Antidote	Linux	No	Yes	No	?	passive
Arp_Antidote	Linux	No	Yes	No	?	passive
Arpalert	Linux	No	Yes	No	Yes	passive
ArpON	Linux/Mac/BSD	No	Yes	Yes	Yes	active+passive
ArpGuard	Mac	Yes	No	Yes	Yes	active+passive
ArpStar	Linux	No	Yes	Yes	?	passive
Arpwatch	Linux	No	Yes	No	?	passive
ArpwatchNG	Linux	No	Yes	No	No	passive
Colasoft Capsa	Windows	Yes	No	No	Yes	no detection, only analysis with manual inspection
Prelude IDS	?	?	?	?	?	?
remarp	Linux	No	Yes	No	No	Passive
Snort	Windows/Linux	No	Yes	No	Yes	Passive
Winarpwatch	Windows	No	Yes	No	No	Passive
XArp	Windows, Linux	Yes	Yes (+pro version)	Yes (Linux, pro)	Yes	active + passive
Seconfig XP	Windows 2000/XP/2003 only	Yes	Yes	Yes	No	only activates protection built-in some versions of Windows

VII. ARP ATTACK PROTECTION

To prevent the above mentioned ARP attacks, H3C launches a comprehensive ARP attack protection solution.

Figure 6: Device roles in an ARP attack protection solution

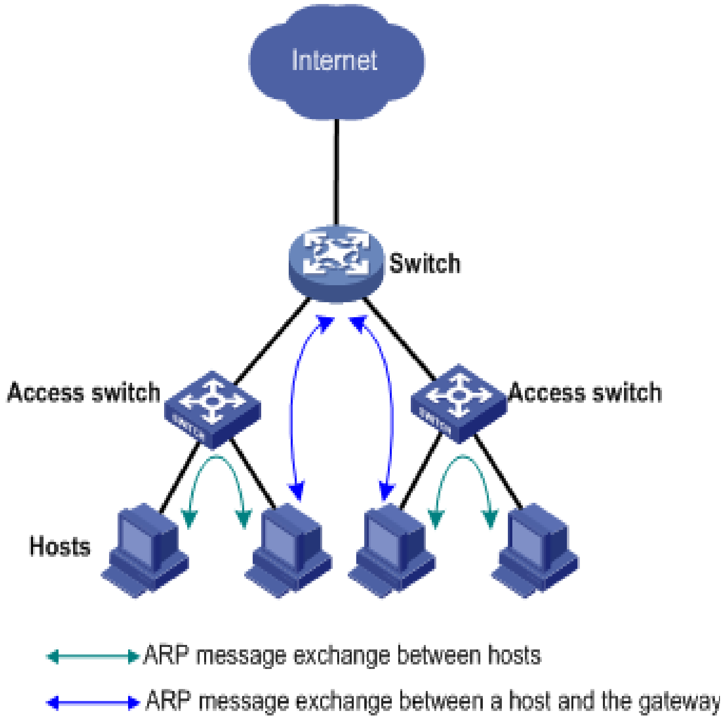

Internet
Switch
Access switch
Access switch
Hosts
ARP message exchange between hosts
ARP message exchange between a host and the gateway

Fig 6

Figure 6 shows the device roles in an ARP attack protection solution. The device roles serve as the basis for analyzing possible ARP attacks that Layer 2 and Layer 3 network devices may encounter, and for providing effective attack protection methods.

An access switch is a critical point to prevent ARP attacks, as ARP attacks generally arise from the host side. To prevent ARP attacks, the access switches must be able to

□ Establish correct ARP entries, detect and filter out forged ARP packets, and ensure the validity of ARP packets it forwards.

□ Suppress the burst impact of ARP packets.

After configuring the access switches properly, you do not need to deploy ARP attack protection configuration on the gateway. This relieves the burden from the gateway.

If the access switches do not support ARP attack protection, or the hosts are connected to a gateway directly, the gateway must be configured to

□ Create correct ARP entries and prevent them from being modified.

□ Suppress the burst impact of ARP packets or the IP packets that will trigger sending of ARP requests.

TABLE 2: COMPARISON OF VARIOUS APPROACHES TO DEFEND HOSTS AGAINST ARP ATTACKS

	Category	Operation mode of ARP cache table	communication Protocol	Types of security assurance against ARP attacks	
				At Host	at Gateway
Bruschi et al. [5]	cryptography, Server-based	dynamic	modified ARP	defeat ARP spoofing attack	N/A
Goyal and Triphyp [6]	cryptographic Server-based	dynamic	modified ARP	defeat ARP Spoofing attack	N/A
Limmaneewichid and Lilakiatsakun [7]	cryptographic	dynamic	ARP	defeat ARP spoofing attack	N/A
Xing et al. [10]	host-based (application)	dynamic	ARP	defeat ARP spoofing attack	N/A

Ramachandran and Nandi [11, 12]	host-based	dynamic	ARP	Detection of ARP spoofing	N/A
Hou et al. [13]	host-based (IDS plug-ins)	dynamic (gateway's IP–MAC pairs in static mode)	ARP	Detection of ARP spoofing	N/A
Barbhuiya et al. [16]	host-based IDS Cryptographic	dynamic	ARP	Detection of ARP spoofing	N/A
Philip [17]	host-based (router)	dynamic	ARP	defeat ARP Spoofing attack	N/A
Nam et al. [18]	host-based	dynamic (ARP table,long-term table)	ARP	defeat ARP Spoofing attack	N/A
Trabelsi and	host-based	dynamic	ARP	defeat ARP Spoofing attack	N/A
Gouda and Huang [28]	server-based Cryptographic	dynamic	ARP	defeat ARP Spoofing attack	N/A
Kwon et al. [29]	server-based (server, agent)	dynamic	ARP	defeat ARP Spoofing attack	N/A
Ortega et al. [30]	server-based	dynamic	ARP	defeat ARP Spoofing attack	N/A
Lootah et al. [31]	server-based cryptographic	dynamic	ARP	only Detection of ARP spoofing	N/A
Pansa and Chomsiri [32]	server-based	dynamic	ARP, Modified DHCP	defeat ARP Spoofing attack	N/A
M. OhY.-G. KimS HongS. Cha[36]	host-based	Static (agent)	UDP among ASA protected hosts	defeat ARP Spoofing attack and DOS attacks	detection of being spoofed or under DoS attacks

VIII. CONCLUSIONS

In conclusion the main aim of this paper is to differentiate between the various solutions of address resolution protocol and also discuss the limitations of these existing solutions. We analyzed several currently available solutions; identify their strengths and limitations and provide comparison among them. Also describe the how to prevent the ARP spoofing attacks. Specified number of tools for carries the ARP spoofing attack and defense ARP spoofing. we can say that this paper may be used as a reference by researchers when deciding how to secure the ARP protocol.

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