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Comparing Context Based Access Control to Zone-based Policy Firewalls

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***Abstract:** This paper will be introducing a comparative study on the choices between two best classical software firewalls one is Context Based Access Control (CBAC) and Zone Based firewall (ZBF). Both of them may deliver a stateful inspection of TCP, UDP and/or ICMP control packets. Through this study, two type of networks were designed one used the CBAC firewall and the other works with a zone based firewall. The result obtained showed that ZBF has several feature which are not available in CBAC. Furthermore, ZBF deals with the security zones the traffic will be dynamically inspected as it passes through the zone.*
In order to monitor the network, GNS3 and Wirshrah tools has been used to configure the required network. Then we have used different scenarios to inspect and evaluate the behavior of the network. In this study firewalls were implemented in software not in hardware as separate devices. That is, they are building functions of the routers. In our project, two networks were designed The first one has two areas LAN and WAN, while the second contains three areas LAN, WAN and DMZ.
***Key Words:** CBAC; ZBF; GNS3; Wirshark; TELNET; SSH; HTTP; Ping.*

I. INTRODUCTION

A firewall act as a packet filter. It can operate as a positive filter, allowing to pass only packets that meet specific criteria, or as a negative filter, rejecting any packet that meets certain criteria. Depending on the type of firewall. In firewall all traffic from inside to outside and vice versa must pass through it.It may examine one or more protocol headers in each packet, the payload of each packet, or the pattern generated by a sequence of packets. Firewalls are an excellent security mechanism and, when appropriately selected and implemented, can establish a relatively secure barrier between a system and the external environment. This paper describes the principal of two types of statefal firewalls that are available and presents the advantages and disadvantages of each type one called Context Based Access Control (CBAC) and other Zone-Based Firewalls (ZBF). Although, this project will not examine them, instead concentrating on the operation and configuration of CBAC. In addition, through this paper we will address the operation of CBAC, its benefits, limitation. Finally work through the steps involved in configuration CBAC.

A. Motivation

A firewall is a dedicated hardware, or software or a combination of both, Because of scalability and ease of configuration Cisco developed, a new approach for router-base d firewalling known as Context Based Access Control (CBAC) and Zone-based policy Firewall (ZFW), rather than using devices will used only software on the routers by using one of those firewalls. Consider zone based firewall better than context based access control list whereas ZFW introduces the concept of security zones, which allow simpler definition of the degree of trustworthiness of a given interface making administrators lives a lot easier when deploying firewall policies. Zone based policy introduces a new firewall configuration model where policies are applied to traffic moving between zones not interfaces. No interference between multiple inspection policies or ACLs.

B. Context Based Access Control (CBAC)

Cisco's original implementation of a router-based stateful firewall called Context Based Access Control (CBAC) or, in other words, the Classic Input/Output System (IOS) Firewall. The basic configuration element of CBAC is the "ip inspect" command, which instructs IOS software to monitor connection initiation requests for a particular (L4 or L7) protocol that arrive on a given router interface, consider robust stateful inspection based firewall solution for those smaller organizations that may be operating on a tight budget .Cisco IOS firewall feature set allow significant flexibility in managing a perimeter Cisco. The CBAC router is configured to inspect traffic generated inside our network and going through the CBAC router. Figure 1 below shows. It does not include any traffic generated by the router itself. Any traffic generated by the router itself will not be inspected and catered for and will instead have to deal with the current access control list configured on the outside interface (namely deny any log).

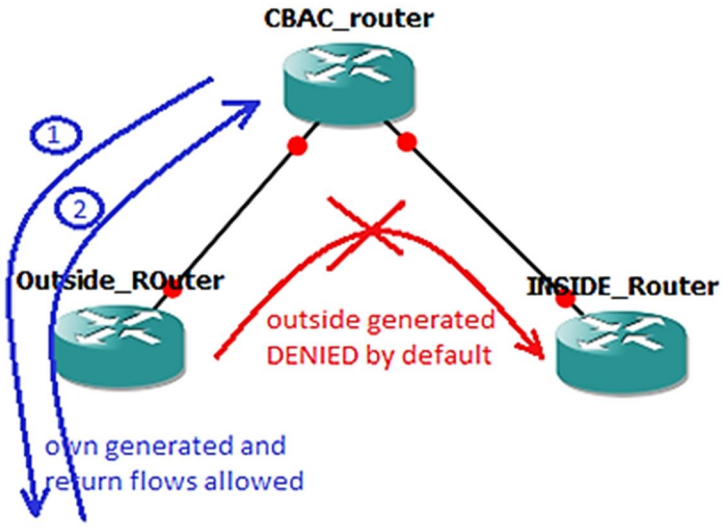


Figure 1 way to work CBAC

CBAC creates temporary openings in access lists at firewall interfaces. These openings are created when specified traffic exits your internal network through the firewall. The openings allow returning traffic, which would normally be blocked, and additional data channels to enter your internal network back through the firewall. The traffic is allowed back through the firewall only if it is part of the same session as the original traffic that triggered CBAC when exiting through the firewall.

C. Traffic Inspection

CBAC inspects traffic that travels through the firewall to discover and manage state information for TCP and UDP sessions. This state information is used to create temporary openings in the firewall's access lists to allow return traffic and additional data connections for permissible sessions. Inspecting packets at the application layer, and maintaining TCP and UDP session information, provides CBAC with the ability to detect and prevent certain types of network attacks such as SYN flooding**.** CBAC inspects packet sequence numbers in TCP connections to see if they are within expected ranges CBAC drops any suspicious packets. You can also configure CBAC to drop half-open connections, which require firewall processing and memory resources to maintain**.** Additionally, CBAC can detect unusually high rates of new connections and issue alert messages. CBAC can provide more protection against certain DoS attacks involving fragmented IP packets.

D. Zone-Based Firewalls (ZBF)

The Cisco IOS Zone Based Firewall is one of the most advanced form of Stateful firewall used in the Cisco IOS devices.ZBF completely changes the way you configure a Cisco IOS Firewall inspection, as compared to the Cisco IOS Classic Firewall The zone based firewall (ZBFW) is the successor of Classic IOS firewall or CBAC (Context-Based Access Control). When the large corporate networks began to be connected to less-secure public networks (for example, the early Internet), security-conscious network administrators immediately started to feel the need to secure their internal networks from potential intruders. The ZBFW mainly deals with the security zones, where we can assign the router interfaces to various security zones and control the traffic between the zones. Also the traffic will be dynamically inspected as it passes through the zones. The zone based firewall came up with many more features that is not available in CBAC

E. Security Zones & Security Zone Firewall Policies

A zone is a group of interfaces that have similar functions or features. They help you specify where a Cisco IOS XE firewall should be applied**.**wheras security zone is a group of interfaces to which a policy can be applied. By default, traffic flows among interfaces that are members of the same zone. In Security Zone Firewall Policies a class identifies a set of packets based on its contents. Normally, you define a class so that you can apply an action on the identified traffic that reflects a policy. A class designed through class maps. An action is a functionality that is typically associated with a traffic class. For example, inspect, drop, and pass are actions.

F. Implementing Zone-Based Designs

Many devices used in firewall implementations are using a concept of packet filters to filter traffic arriving or departing through an interface. For example, Cisco IOS implements packet filters with the ip access-list and ip access-group configuration commands that enable you to specify filtering conditions based on source and destination IP addresses, Layer 4 protocol (for example, TCP, UDP, or ICMP), and Layer 4 port numbers (for example, TCP port 80 for HTTP). The design below show Figure 2 simple firewall with perimeter

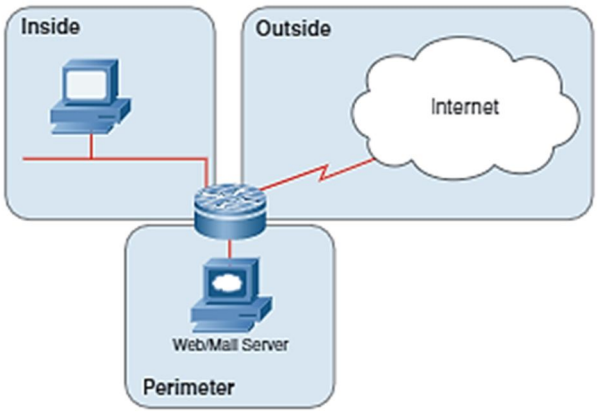


Figure 2 simple firewall with perimeter

However, implementing even a straightforward firewall policy (like the one described in the “Simple Zone-Based Design "Section) with Cisco IOS access lists can lead to a configuration nightmare.

II. SIMULATION TOOLS USED

In our paper work we are using two software programs GNS3 (Graphical Network Simulator) and Wireshark first software using to configuration all commands and other to monitor the traffic packets exchange between different networks. In our work we are designed the network as below in figure 3 to find the differentiation between two firewall and the configuration on the edges router R1 and R4. The network design process for the simple network has taken the following steps:

1) Selecting router devices that support all commands.
2) Design the network connection between LAN and WAN; according to the standard organizational structure.
3) Configuring static routs as the main routing configuration.
4) Implementing the CBAC and ZBF to provide security firewall to the network.

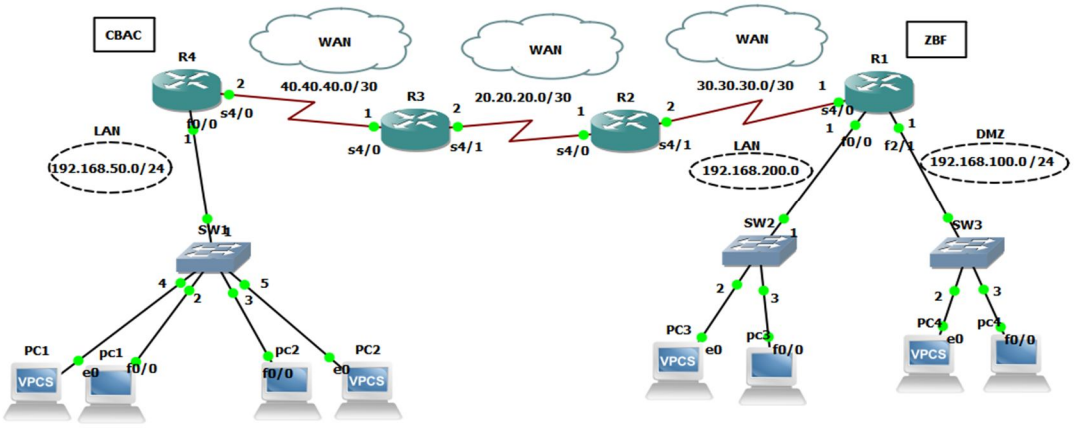


Figure 3 find the differentiation between two firewall

III. DEVICES USED IN THE NETWORK

Table 1 lists the devices selected to implement the sample network, which contain routers, switches, PCs and cloud devices composing the sub-networks of the design.

Table 1 The main devices used to design the sample network

Devices	Devices types
Routers	Emulated CISCO 7200
Switches	Ethernet Switch and always on
Computers	PCs/VPCs devices
Cloud device Internet	Device for external connection

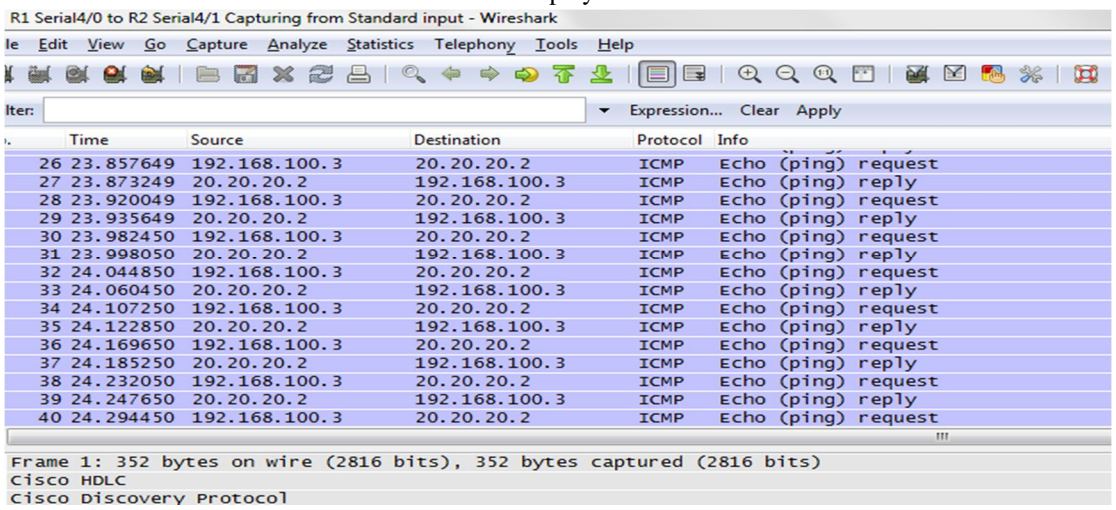
IV. RESULTS AND FINDINGS

This shows the Verification Commands and results of comparison between CBAC and ZBF firewalls. We used Wireshark to get the result and we will use some commands and protocols to test our project for example Ping,SSH protocol, Telnet, HTTP and HTTPs protocol so we apply and enable this commands and protocol in our work we will choose only two results of every connection.

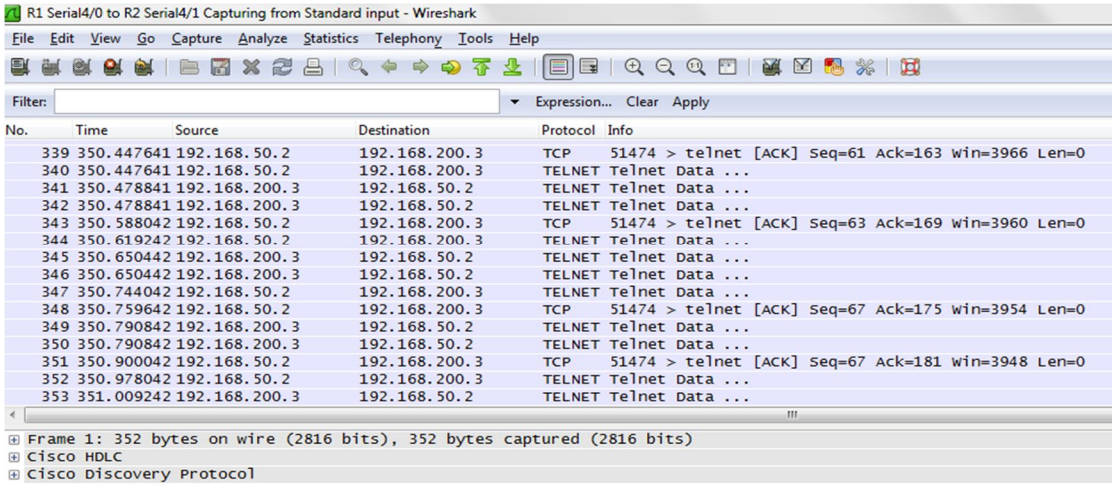
A. Using static Routing Protocol Without Firewall

In all figures when we use the commands to test the result there is always a reply or we can say successful.

1) Test ping command from 192.168.100.3 to 20.20.20.2 the replay is successful



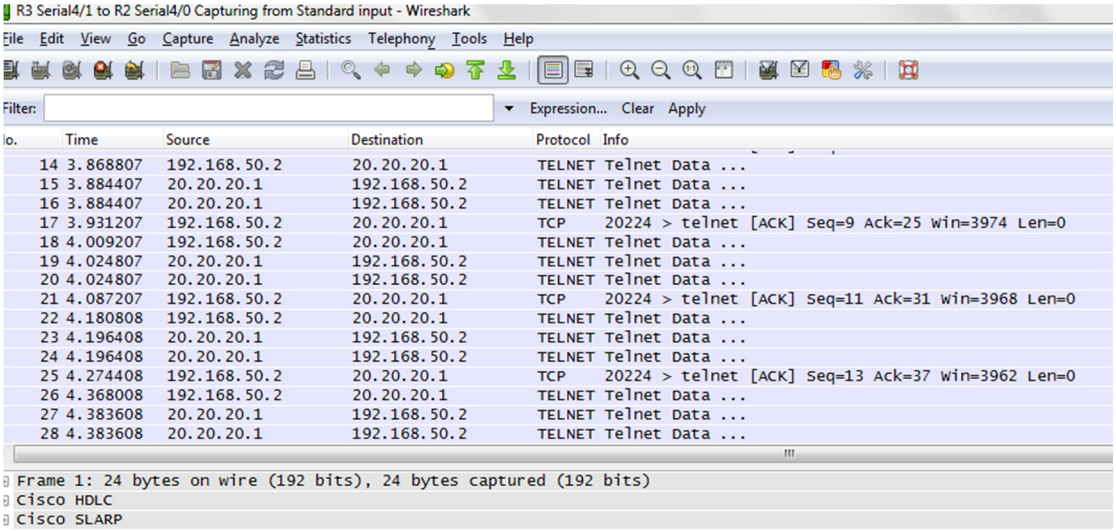
2) Test the telnet command from 192.168.50.2 to 192.168.200.3 the replay is successful



B. Using CBAC firewall from LAN -TO –WAN

In this case all commands and protocols which be sent from LAN to WAN will be successful because the configuration which we have done must be LAN connect to the internet or outside the WAN whereas allow all traffic (TCP , UDP,ICMP) to send ,upload and download any files or messages from WAN areas.

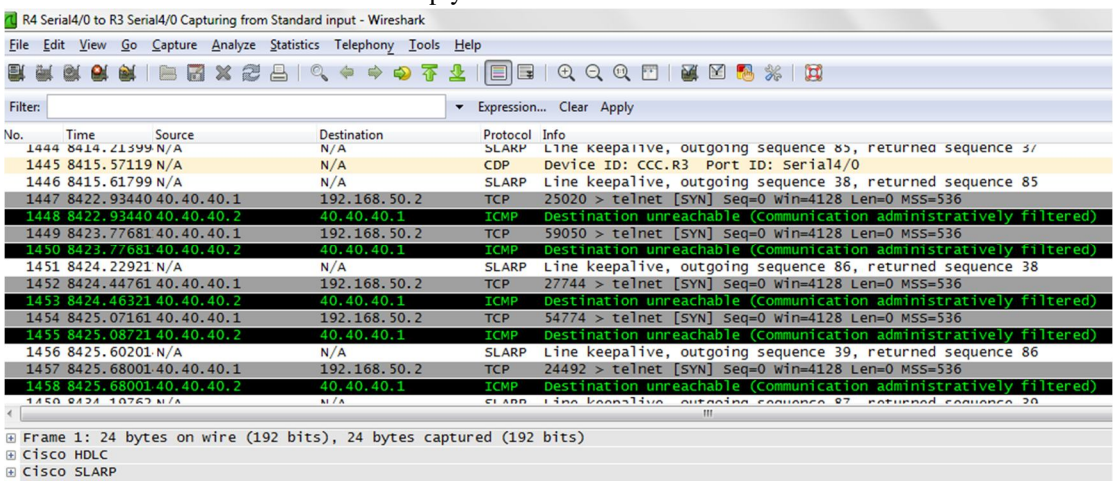
1) Test telnet protocol from 192.168.50.2 to 20.20.20.1 the replay is response**.**



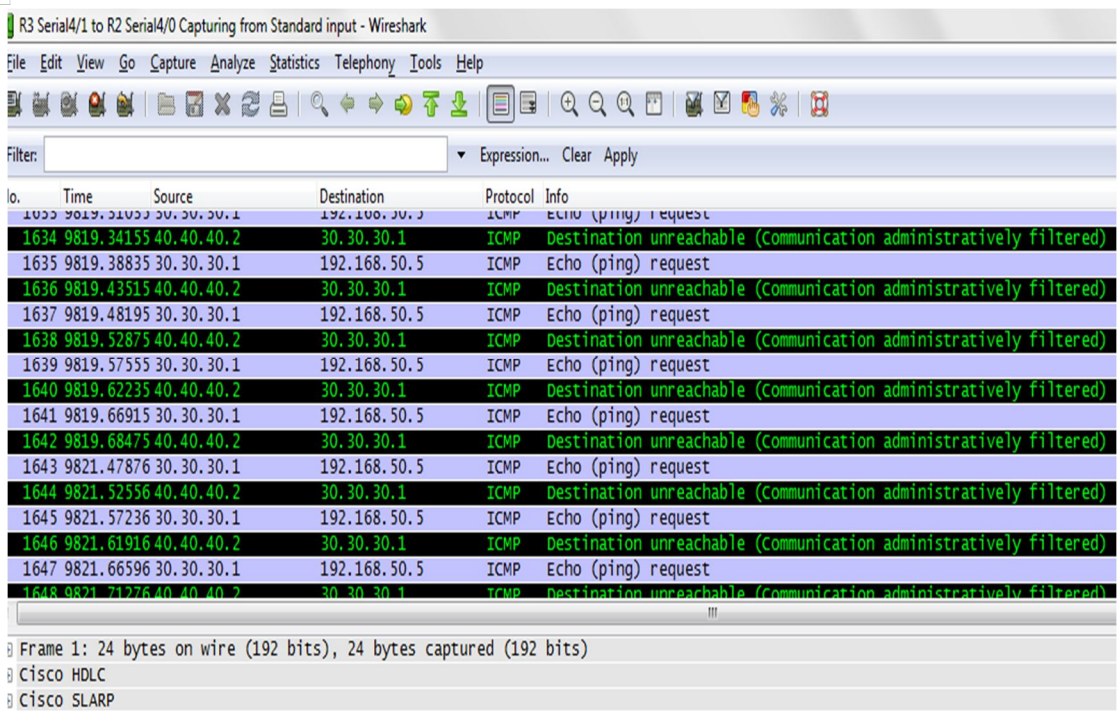
C. From WAN TO LAN in case of using CBAC.

In this case all packet will response unreachable or fail to connect.

1) Test telnet from 40.40.40.1 to 192.168.50.2 the reply is fail to connect from sender to receiver.



2) Test ping command from 30.30.30.1 to 192.168.50.5 the reply is fail to connect from sender to receiver



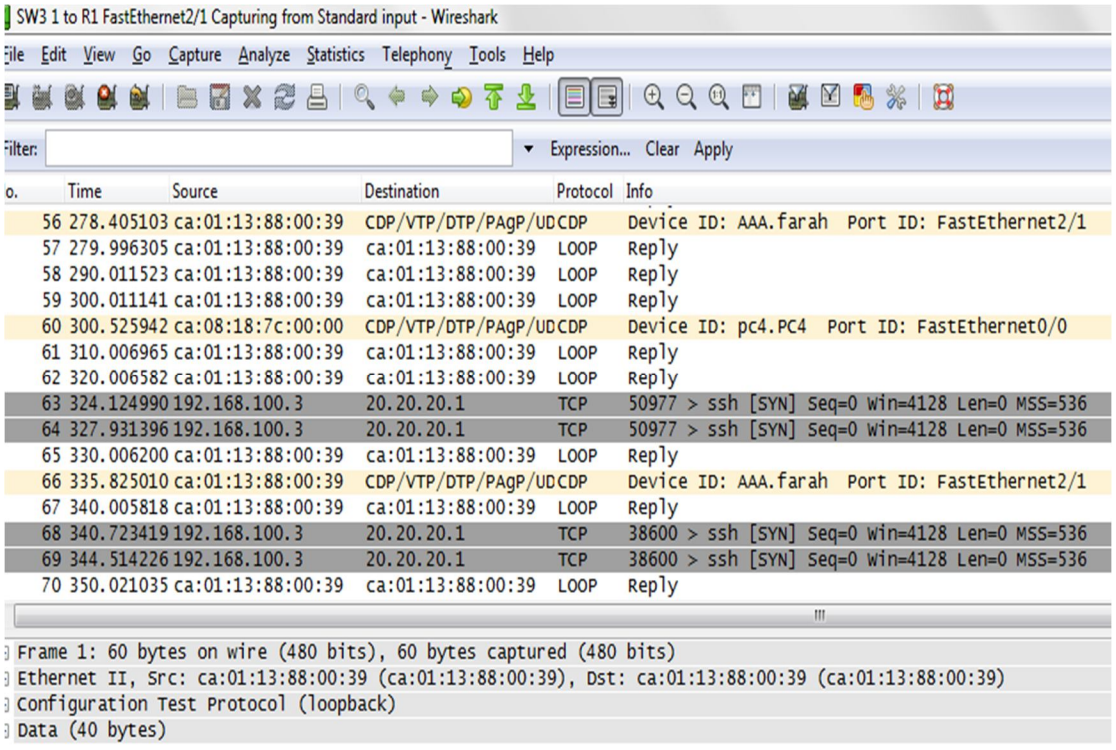
D. Third after using ZONE Based Firewall.

In this case the area of DMZ can't connect with LAN as well as WAN because this area supposed be server's area that's way we can't allow to the any server computer for example to the enter Internet web page.

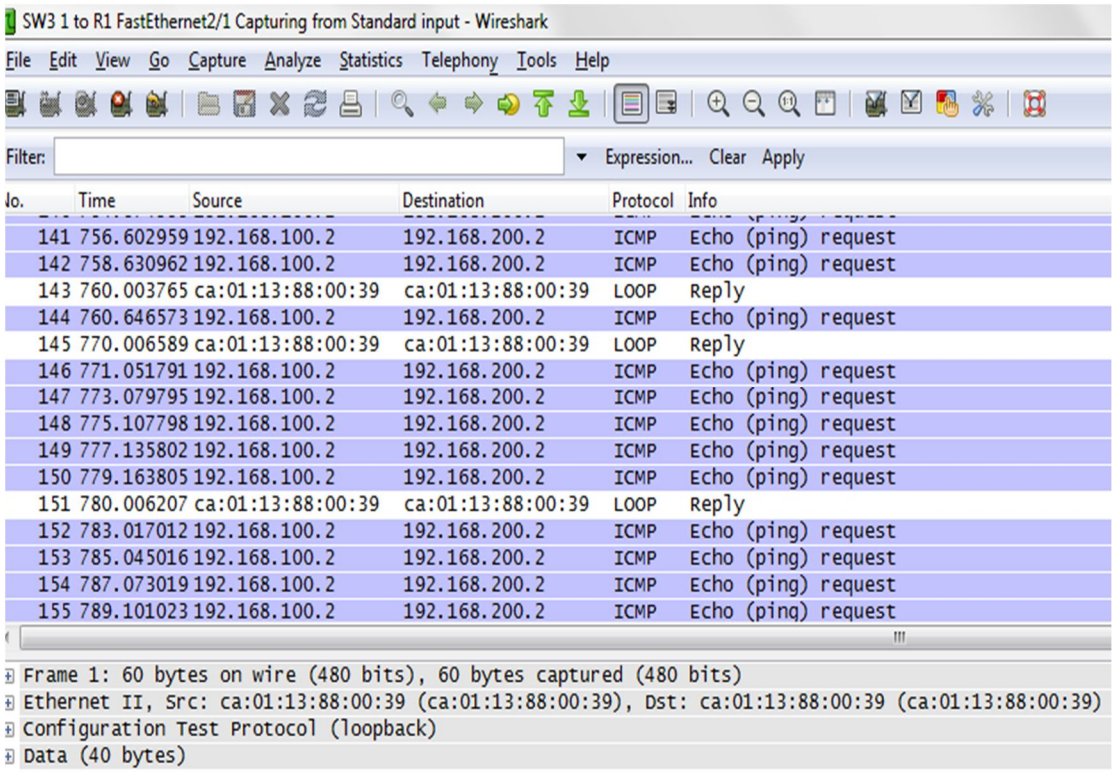
E. Form DMZ to LAN and WAN

In this case all protocols will be deny, and this also applies to from WAN to LAN.

1) Test SSH protocol from 192.168.100.3 to 20.20.20.1 no replay



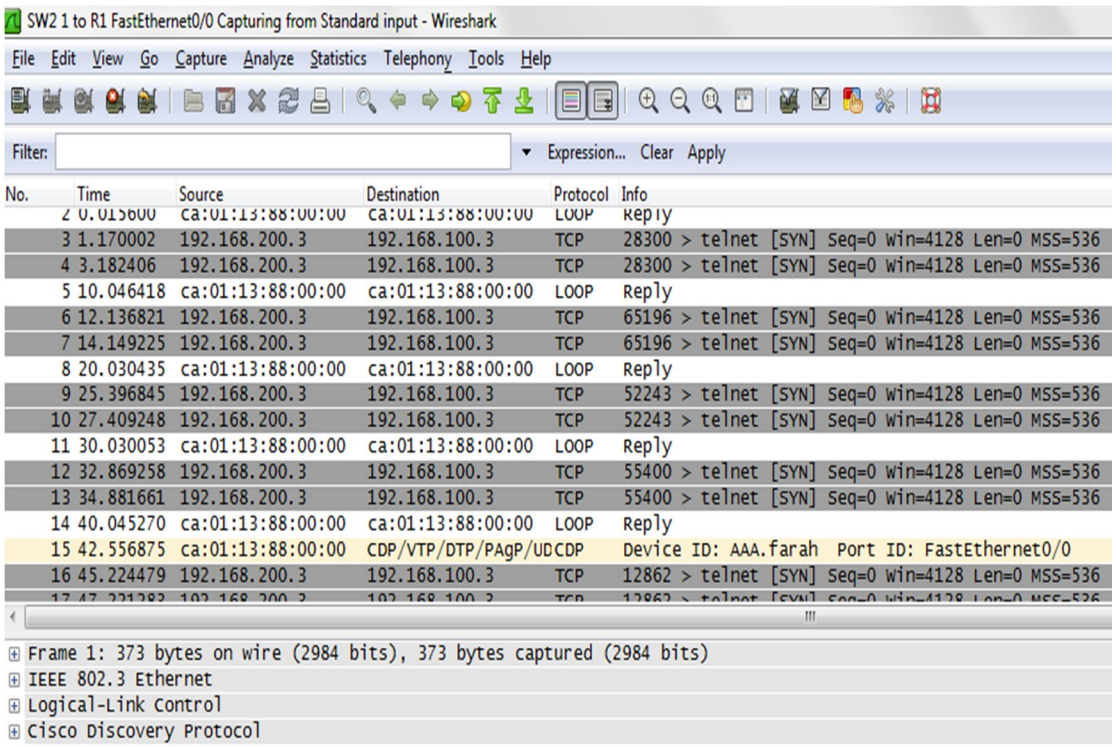
2) Test ping from 192.168.100.2 to 192.168.200.2 no response found



F. From LAN to DMZ in zone based firewall

in this case we will allow just two protocol HTTP and HTTPs to be connect successful and other protocol not allow or no response, this also applies to from **WAN to DMZ.**

1) Test telnet from 192.168.200.3 to 192.168.100.3 the replay is no response found.



2) Test http from 192.168.200.3 to 192.168.100.3 this allow to be connect

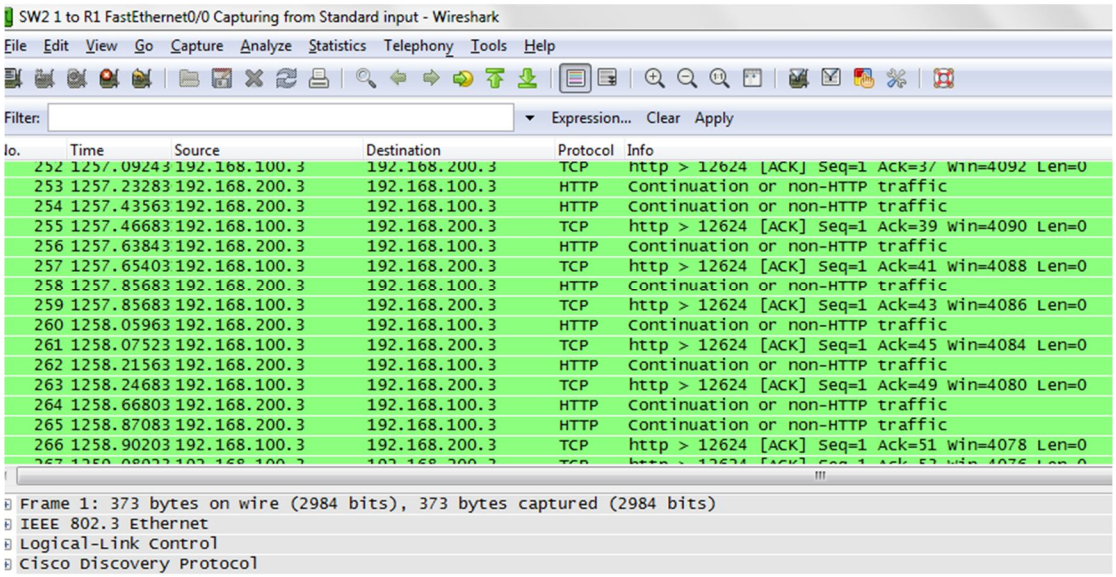


Table (4.1) this table explains the result showed of the comparison between CBAC and ZBF firewalls.

	Protocols		http	https	telnet	SSH	Ping
CBAC	LAN TO WAN		Allow	Allow	Allow	Allow	Allow
	WAN TO LAN		Deny	Deny	Deny	Deny	Deny
ZBF		LAN TO WAN	Allow	Allow	Allow	Allow	Allow
		WAN TO LAN	Deny	Deny	Deny	Deny	Deny
		DMZ TO LAN TO WAN	Deny	Deny	Deny	Deny	Deny
		LAN TO DMZ	Allow	Allow	Deny	Deny	Deny
		WAN TO DMZ	Allow	Allow	Deny	Deny	Deny

V. CONCLUSION AND RECOMMENDATION

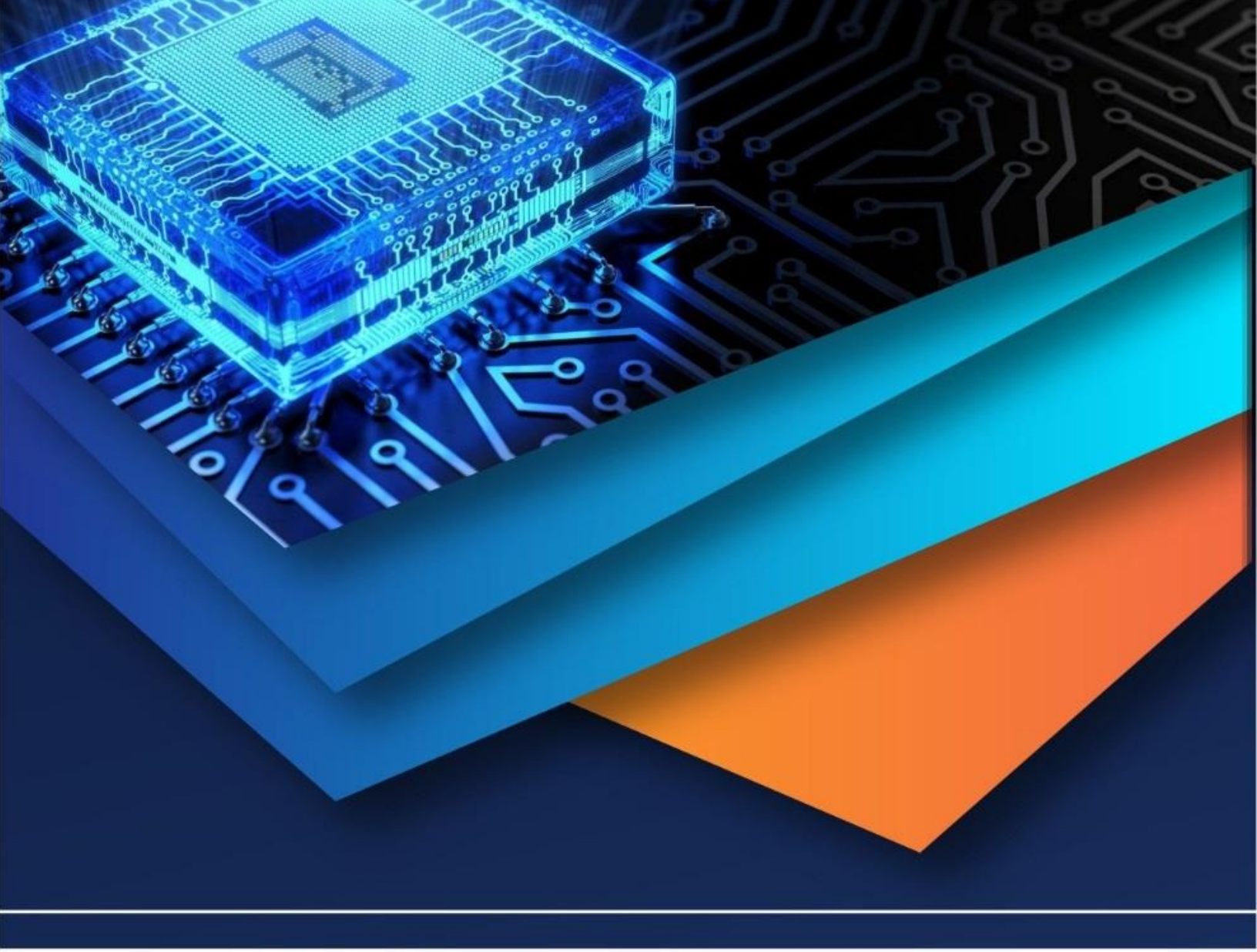
In this paper we apply the Context based access controls and zone based firewall in design using GNS3 and Wireshark tools, through this study we have notes these are vital when used Cisco routers. Although, CBAC and ZBF can be extremely useful in configuring an elementary stateful firewall inspection mechanism on a cisco router. Moreover, the cisco IOS zone based firewall is considered as one of the most advanced form of stateful firewall used in the Cisco IOS devices. The zone based firewall is the successor of the classical IOS firewall or context based access control.

By comparing Zone based to CBAC firewall we came up with many more features that is not available in CBAC. ZBF mainly deals with the security zones, where we can assign the router interfaces to various security zones and control the traffic between the zones. Also the traffic will be dynamically inspected as it passes through the zones.

However, through our practice, we noticed that Context based access depending on Interface Based Configuration and uses inspect statements, while zone based firewall depending on Zone Based Configuration and Uses Class-Based Policy language.

VI. FUTURE WORK

Certainly, developing and invent new approaches in the area of firewalls, whereas software has changed the rules of network security and businesses. Therefore, its necessary to have more confidentiality to protection. Thus, we recommend using hardware firewalls such as ASA CISCO firewall, FORTINET frigate firewall and PALO ALTO firewall etc.; rather than software firewalls because they provide more security to businesses.



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