Controlling and Protecting Wide Broadband Networks Using ACS Server Against Attacks

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ABSTRACT

Networks emerged to meet the need for communication across distances and the exchange of services, enabled by advances in science and technology. They allow organizations to share resources, such as linking company branches into a unified system or connecting multiple devices to a single printer. This fosters a shared work environment and centralized management for geographically dispersed operations.

Networks are classified by geographical scope into local (LANs), metropolitan (MANs), and wide (WANs) networks. LANs, limited to a few kilometers, offer high data speeds (10–1,000 Mbps) using technologies like coaxial cables, twisted pairs, or optical fibers. WANs span vast distances, connecting numerous devices and enabling data exchange across regions.

Access control is crucial for information system security. It prevents unauthorized access, defines user permissions, and protects system resources, ensuring safe and secure operation while blocking illegal intrusions.

1. INTRODUCTION

Server is a computer with high-capacity components, its main task is to manage the information resources available on the network such as computers, printers, phones, etc.

The server has multiple uses that differ according to the types of programs that were previously installed to determine the server working environment, so you must first determine which server is needed to provide the appropriate programs for it[1-10].

1.1 Why Use Cisco ACS?

- Cisco ACS servers can be used as a clearinghouse for user authentication.
- By allowing all your network devices to use the ACS server, an admin can avoid having to create the same user account on each individual router and switch
- One convenient feature of the ACS is that the users do not have do not have to be configured locally on the server

    - ACS servers have the ability to use and review an external database o An example of this type of external database is the Microsoft Active Directory

1.2 On What Platform Does ACS Run?

- There are multiple platforms that an ACS server can run on.
    - Newer versions of the ACS server can be installed on top of previous older versions of it
- The most common option is to install the ACS server in a Vmware environment like ESXi server o This will mean that the ACS server will run as a virtual machine.

1.3 Protocols Used Between the ACS and the Router

- The communication between an ACS server and its client uses two main protocols: TACACS+ and RADIUS.
    - TACACS+: Terminal Access Control Access Control Server
        - TACACS+ is proprietary to Cisco
        - If the ACS server uses this protocol, all AAA packets are encrypted before being sent o RADIUS: Remote Authentication Dial-In User Service
        - Open standard alternative to TACACS+
        - Only encrypts passwords, not the entire packet

1.4 Protocol Choices Between the ACS Server and the Router

- TACACS+ is more granular than RADIUS
    - If an administrator wants to tell the router to check authorization for each individual command before allowing the user to put that command and only give the administrator a select few of commands.
    - RADIUS does not allow for command-by-command authorization
- RADIUS can be used in a scenario in which end users just want their packets to go through a network device where authentication and authorization are required.
- A router can be configured to use both RADIUS and TACACS+ simultaneously [10-20].

The following table compares the two protocols:

	TACACS+	**RADIUS**

Functionality	Separates AAA functions into distinct elements. Authentication is separate from authorization and both are separate from accounting	Combines many of the functions of authentication and authorization together. Has detailed accounting capability when accounting is configured for use.
Standard	Cisco proprietary, but very well known.	Open standard, and supported by nearly all vendors' AAA implementation.
L4 Protocol	TCP	UDP
Confidentiality	***ALL*** packets are encrypted between the ACS server and the router (aka the client)	Only the password is encrypted with regard to packets sent back and forth between the ACS server and the router.
Granular command by command authorization	This is supported, and the rules are defined on the ACS server about which commands are allowed or disallowed.	No explicit command authorization checking rules can be implemented.
Accounting	Provides accounting support.	Provide accounting support, and generally acknowledged as providing more detailed or extensive accounting capability than TACACS+.

2. Context and Preliminary Investigation

2.1 Most important types of hosting servers:

1. Dedicated Server

An integrated unit that works to serve one company or one person, and it is considered one of the most expensive and best types of servers, and institutions, companies and major sites work in it in order to achieve the greatest degree of safety and privacy[21-30] .

2.Virtual Privet Server

Vps, which means dividing the server into more than one virtual server, and each VPS server is sold separately. Therefore, all users will share the capabilities of the server from (storage unit - RAM - data processor.. That is why a virtual server was named for its privileges as a full server .

3. Application Server

It provides a suitable working environment for running applications and games, and there are different types of it for the diversity of applications and the diversity of programming languages such as applications made through Java or PHP, and therefore you must choose an application server compatible with the programming language[31-40] .

4. Web Server

A device that contains software files for websites, so that it receives and processes requests coming from the network (through users' browsers., and provides pages with website content, and the service provided in this type of server is called web hosting .

5. Email Server

A device responsible for receiving and sending e-mails to and from the same domain or any other domain, as well as through which e-mail files are stored .

6. File Transfer Server - FTP Server

It is a server device used for the exchange of computer files through the network and often the Internet, so that it is possible to specify the permissions to access the files and control the users' access to the files on the server [41-50].

7. Database Server

It is a server machine that contains a database management program, and provides database service to other servers or computers connected to a network .

8. DNS Server

It is a server machine that is responsible for translating domain names into two IP addresses and vice versa, and has uses in local networks (LAN. and the Internet .

2.2 THE PROPOSED SERVER-ACS SERVER

The ACS "Cisco Access Control Security" is a server from Cisco that is used to control WANs or large-scale networks, allowing some specific users of it to access these networks .

It is the latest types of servers that have provided:

1. A lot of security and flexibility in dealing between networks and each other .

2. As well as protection from cyber attacks that threaten its work .

3. It provides and supports AAA feature

- It is a feature found in the latest types of Routers and some types of the latest switches, and its main function is to give permissions to access the network in addition to specifying the permissions for everyone who accesses the router .
- Protecting network devices, specifically the router, from any penetration of unauthorized users.
- After connecting the router, two virtual machines will be created, one VM machines, one will be placed on it, a copy of the ACS, which is the server through which the site networks will be controlled, but not by configuration or the usual traditional commands, but by a GUI dedicated to remote control of the devices.

3. Literature survey

R.Molva describes an access control mechanism that enforces at the network level an access control decision that is taken at the application level. The mechanism is based on the precomputation of encrypted counters called tickets. An access enforcement device verifies the existence of a valid ticket in each packet that is subject to access control and kills unauthorized packets. Tickets are not computed as a function of the user data. Due to the timing constraints of shared media LANs the presence of a valid ticket in a packet proves that the operation implied by the user data has been authorized. The access control mechanism is elaborated for Internet protocols over Ethernet and we discuss its properties for internetworking and multicasting *[4].*

David presented RBAC systems define a number of roles and assign each role a set of permissions. Each user is then assigned to one or more roles, and inherits the permissions assigned to the roles (for more on RBAC, see the “Role-Based Access Control Models” sidebar). X.509 supports RBAC by defining role specification ACs that hold the permissions granted to each role, and role assignment ACs that assign various roles to the users. RBAC can significantly simplify access control management for large numbers of users because it allocates permissions to roles rather than individuals, and there are typically far fewer roles than users [5].

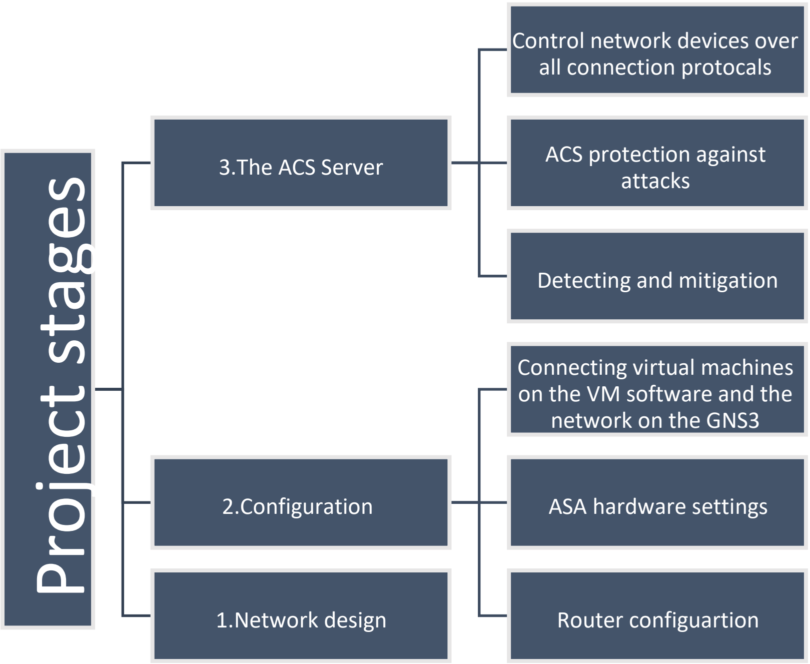
SHI Jiaoli et al. introduced Binding access policies to data, Ciphertext-policy attribute-based encryption (CP-ABE) enables data access control to be independent from a certain application and lets users face data directly. It is regarded as one of the most suitable access control methods in cloud storage system and gets the attention of extensive researches. In those researches, Hierarchical cryptography architecture (HCA) is often applied to improve the efficiency of the system. There exist two open issues: illegal leakage of symmetric keys and low efficiency of revocation of an attribute of a user. We propose an Access control scheme under Hierarchical cryptography architecture (ACS-HCA). In this scheme, key derivation mechanism and forward derivation function are used to avoid the leakage of symmetric keys, All-orNothing transform is used to prevent the illegal reuse of symmetric keys, and attribute revocation is realized without reissuing other users' private keys. Analyses and simulations demonstrate that our scheme sustains less encrypting cost on each owner and less decrypting cost on each user, but gain high efficiency in revocation of an attribute of a user [50-54]].

4. Analysis

Project phases

1. Designing.
2. Implementation.
3. Testing.

Project steps


Project stages
3.The ACS Server
Control network devices over all connection protocals
ACS protection against attacks
Detecting and mitigation
2.Configuration
Connecting virtual machines on the VM software and the network on the GNS3
ASA hardware settings
1.Network design
Router configuartion

Software:

- GNS3.
- VMWARE.

4.1 Designing phase:

In this stage, the shape of the network, how to design it, the types of the router devices used in the network and the switch devices to connect the network devices used by computers, as well as network sources such as printers and .... etc.

Also, at this stage, a general conception of how the ACS server is used, how to manage and control it, as well as a general conception of the addresses used within the network, in addition to creating a structural vision of the network expected to be designed.

4.2 Implementation phase:

In this stage, the network is completely designed and with all its details on the GNS 3 program used to design networks, in addition to that, complete settings for the routers used to connect branches, as well as the switch devices used to connect devices and resources within the network, as well as the address settings used to connect the network.

Also, at this stage, the virtual machines will be added to the VM ware program, which is the program used to create virtual machines from the Windows system used to manage the ACS server or even the ACS server itself, and link the virtual network cards used to connect the virtual machines created on the VM program and link them to the network designed on the GNS3 program. And finally, creating authenticated network users to give them access to the network, or 4.3

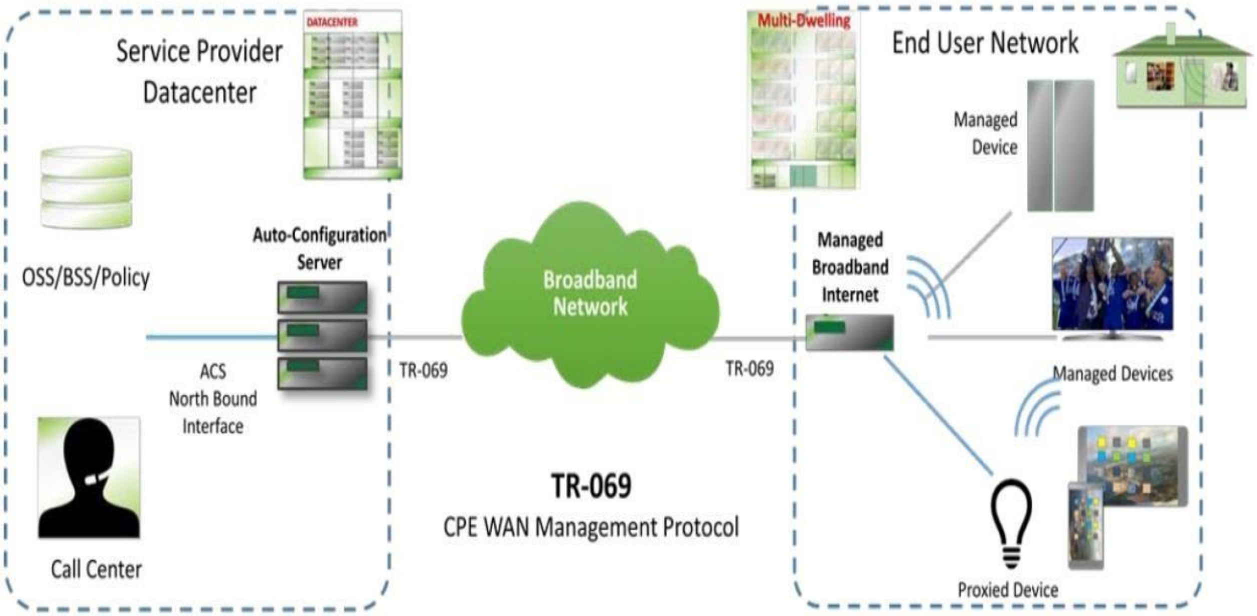
4.3 Testing phase:

In the testing phase, the connection to all the designed branches within the network will be tested and investigated, and their connection between them and some will also be investigated, the ACS will be operated and its connection to all parts of the network will be investigated, and then the network management stage will come through the server.

The network will be managed first through the Cisco Configuration Professional program, which is used to manage Cisco devices from servers and use the graphical interface features to fully control the network devices[55-60].

Then, secondly, controlling the server through the HTTPs browser and managing the services and features provided by this server[60-65] .

5. Design



Network block diagram

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