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Kerberos Protocol: A Review

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***Abstrac*-- Kerberos is a authentication protocol developed by Massachusetts Institute of Technology (MIT) as a part of Athena a project provides authentication over the distributed environment. The Kerberos protocol provides a single sign-in facility for the clients and composed of Ticket generation and Ticket grating services for authentication over the network. Kerberos protocol is widely accepted by many organizations and its latest versions are Version 4 Version 5.The study of this paper will help us to get an overview of the basic working of the Kerberos protocol.**

Keywords---Kerberos protocol; Ticket granting server; Service Ticket; KDC(Key Distribution Centre).

I. INTRODUCTION

As the network is growing day by day it provides many services over the network. So network need to identify its client over the distributed environment to provides its services to its valid client. So password base authentication was not enough to provide the safety of the user personal data over the distributed environment. As user need to enter his or her password again and again and it become very easy task for the attacker to know the client password over the distributed environment. Password base authentication was not enough for providing the client's data security as client need to remember his or her password and intruder can get the clients password by hit and trial method.

The name Kerberos is taken from the Greek methodology which was a three headed dog who guarded the gates of Hades. Here the three heads

denotes Authentication, Authorization, and Accounting. Kerberos protocol verifies the services request and access rights generated by the client. The central authentication server is KDC.So a Kerberos protocol is designed to provide strong authentication over the unsecure network by central authentication and symmetrical key system. Authentication mean no one can access over the network without proving its identity. The central authentication server is Key distribution centre. Kerberos consist of a client server model and it also provide a mutual authentication-both client and the server verifies each other identity. Kerberos protocol does not allow password to pass through the network. The Kerberos protocol messages are keep safe from eavesdropping and replay attacks.

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Paper Outline: The rest of the paper is organized as follows: Section 2 presents the basic overview of the Kerberos protocol Section 3 presents the basic working of the Kerberos protocol Sections 4 finally concludes the reference papers.

II. OVERVIEW OF THE KERBEROS PROTOCOL:-

Kerberos is a network authentication protocol. It access the services over the distributed network. Only a single login is required per request. It is designed to provide strong authentication for client/server applications by using secret-key cryptography. It is a ticket based system in which Kerberos issues a ticket encrypted with users password when the client logs in. The client decrypts the ticket and uses it to obtain further tickets to access the network services.. The basic requirement of the Kerberos protocol are as follows:-

- Work Station:- Place where the client exist
- Client:-issues the request over the network.
- Key distribution center:-Validate the Client request and assign a service ticket.
- Application server:- place where client services actually resides.
- Credential cache:- Client store its password and TGT and other useful information.

Kerberos protocol consist consist of three parties client, server, key distribution center. Where a Key-Distribution center further consist of authentication server and ticket granting server.KDC has given a separate secret key to the different client over the network. A request is sent from the client to the authentication server with certain name and the password. if the match is found the authentication server will generate a (Ticket Granting Ticket) and session key. The TGT and the session key is stored by the client credential cache. And the password is erased from the client credential cache..The client is again requesting for a service ticket to which the Ticket Granting Server will confirm it to the client. The TGS ie Ticket granting server issues a service ticket encrypted with the server secret key to the client. After obtaining the ticket the client can directly communicate to the server. The Kerberos protocol verifies the client identity over the network and then only it allows the client to access the network services. If the client does not verifies by this protocol then it does not allow the client to access the network services. It is strong authentication protocol which require the clients to prove their identity to access the services otherwise they are denied.

III. WORKING OF KERBEROS PROTOCOL

A request is sent from client for accessing the services to authentication sever to obtain the service ticket. Authentication server will verify the client identity in its data base and issues a service ticket As the client gets the

services ticket then it can directly access the services at the application server.

A. TERMINOLOGIES USED IN KERBEROS PROTOCOL :-

- AS= Authenticator server will authenticate a client
- TGS=Ticket Granting ticket will generate a ticket to a client
- C =Client
- AP =Application server
- Client name=Name given to a client in a realm
- Service name = Name of the service needed by a client
- IP_List = IP address of the client

Data Base= Store the essential information of its client to verify them.

B. The client server base authentication protocol consist of the following steps:-

Step1:- C->AS(AS_REQ goes from client to Authenticator server)

Client enter its user id and password and request a service on host on its work station encrypted with its private key(k_{user})..Work station sends a message to a authentication server request for a Ticket granting Ticket.

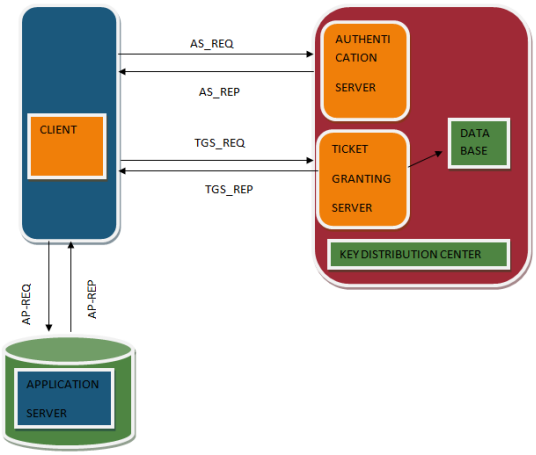

Fig. 1. Kerberos protocol working

AS_REQ:-{client name, service name ,Ip_list,timestamp}k_{user}

Step 2:- AS->C(AS_REP given by Authenticator server to client)

Authentication server decrypts the client request by searching the user key in its data base if a match is found then it generate a session key(S_{tgs}) and TGT(Ticket Granting Ticket) and encrypt it with the key derive from the user password otherwise sends a error message.Session key:- S_{tgs} shared between client client and TGS.

- K_{TGS} :- Private key of the Ticket Granting Server.
- TGT:-{client Name,service name,Ip_list,Timestamp,lifetime,Stgs}
  - Time stamp :- Time stamp of KDC.
  - Life time :- max validity of the Ticket.
- .AS_REP={client name, service name ,Lifetime, S_{tgs}}K_{user} {TGT}K_{TGS}

The workstation will decrypt the incoming message with its key and obtain a session key S_{tgs} and TGT(Ticket Granting Ticket) and stores it in its credential cache.

Step 3:- C->TGS(TGS_REQ goes from client to Ticket Authenticator server)

When the user wants access to a service, the workstation client application prepare a authenticator sends a request to the Ticket Granting Service containing the client name, Life time,and a authenticator encrypted with the session key S_{tgs} and a TGT received in Step 2.

- Authenticator={client name,Timestamp}S_{tgs}
- TGS_REQ={client name,Lifetime, Authenticator}{TGT} K_{TGS}

Step 4:- TGS->C(reply given by Ticket Granting Server to client)

The TGS decrypts the ticket and authenticator, verifies the request, and creates a service ticket and a session key $S_{service}$ for the requested server.

- Session key $S_{service}$ Shared between client and server.
- Create a service ticket Tservice
- Tservice={client name, client, service name,Ip_list,Timestamp ,lifetime,$S_{service}$}
- TGS_REP={clientname, Timestamp,lifetime, $S_{service}$} S_{tgs} { Tservice}$K_{service}$
  - $K_{service}$= server secret key.

Step 5:- C->AP(AP_REQ goes from client to server)

The client application now sends a service request to the server containing the ticket received in Step 4 and an authenticator. The service authenticates the request by decrypting the session key. The server verifies that the ticket and authenticator match, and then grants access to the service.

- Authenticator={ client name,Time stamp} $S_{service}$
- AP_REQ = Authenticator { Tservice}$K_{service}$

Step 6:- AP->C(Reply given by application server)

If mutual authentication is required,.Then the server will reply with a server authentication message. it is optional step.

If all the above steps are successfully executed then a client will use the requested services.

IV. LIMITATION OF KERBEROS PROTOCOL:-

1. Kerberos protocol requires continuous availability of the Key distributed center.
2. If the main server ie KDC is down then whole network may get fail to provide response among the client in the same domain
3. The client clock should be synchronized with the Key distribution center.
4. If a client chooses a poor password then than it becomes very easy for a intruder to steal the network.
5. All secret keys are stored at the key distribution center .If a intruder is able to fetch the data base and may gain access over the data base.
6. No host to host communication is possible with this protocol.
7. Only client to server communication is possible.
8. It becomes a tedious task to store all the secret key of the clients of the same domain at the key distribution center.
9. It is time consuming as it require lots of steps to validate the clients over the network.

V. CONCLUSION

In this paper, a detail working of the Kerberos protocol is described. The Kerberos protocol is a trusted third party authentication protocol which basically authenticates the client with the help of the authentication server and issues a Ticket Granting Ticket to the client. it also issues service ticket to the client. With the help of the service ticket client can directly communicate with the server. It provide the reliable communication over the distributed environment by identifying the clients identities of the same domain. It is authentication protocol which authenticates its client with the help of Ticket system.

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