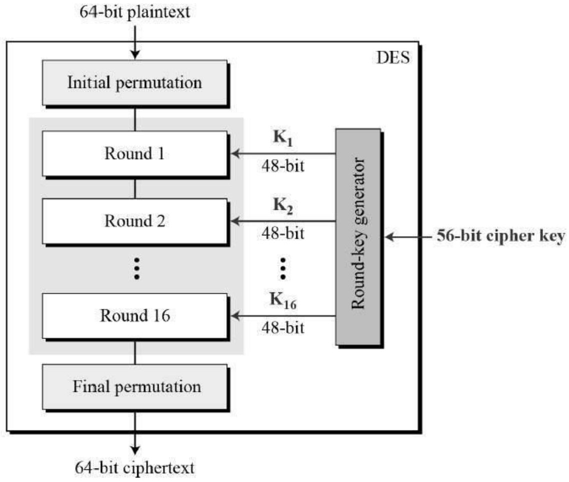
CNS-W-2018

1. Define password. Name the steps for authentication mechanism work.

Ans: A password is a string of characters used for authenticating a user on a computer system. Plain text means that the stored passwords are unencrypted, meaning they are stored as letter and symbols exactly as entered by the user in the database.

a. Explain DES. Explain steps in des

Ans: The Data Encryption Standard (DES) is a symmetric-key block cipher. DES is an implementation of a Feistel Cipher. It uses 16 round Feistel structure. The block size is 64-bit. General Structure of DES is given by

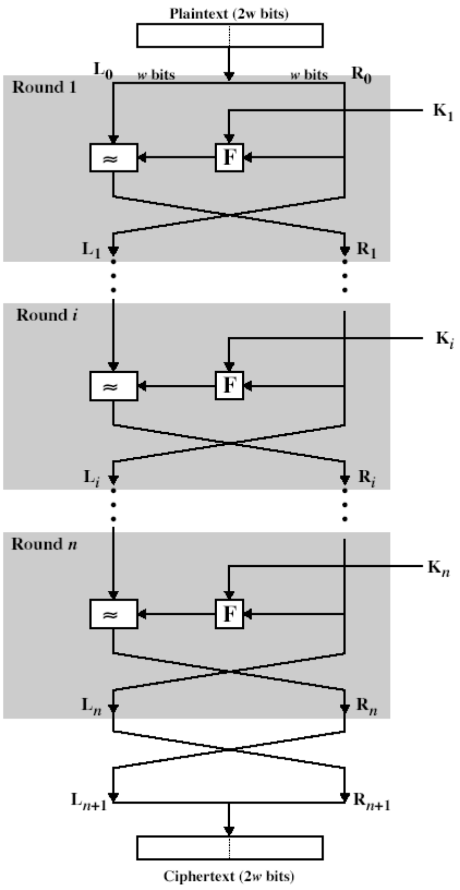


DES has three main phases − Round function, Key schedule, Initial and final permutation.

The input to the encryption algorithm are a plaintext block of length 64bits and a key K. the plaintext block is divided into two halves L_0 and R_0 of 32 bits each. The key K of 56 bits is compressed into 48 bits by discarding the 8th bit of each byte. The two halves of the data pass through 16 rounds of processing and then combine to produce the cipher text block. Each round "i" has inputs L_{i-1} and R_{i-1}, derived from the previous round, as well as the subkey K_i, derived from the overall key K. in general, the subkeys K_i are different from K and from each other. All rounds have the same structure. A substitution is performed on the left half of the data (as similar to S-DES). This is done by applying a round function F to the right half of the data and then taking the XOR of the output of that function and the left half of the data. The round function has the same general structure for each round but is parameterized by the round sub key K_i. Following this substitution, a permutation is performed that consists of the interchange of the two halves of the data. This structure is a particular form of the substitution-permutation network.

The process of decryption is essentially the same as the encryption process. The decryption algorithm will take the cipher text as input along with the subkey K_i in reverse order. At each round, the intermediate value of the decryption process is same (equal) to the corresponding value of the encryption process with two halves of the value swapped.

After the last iteration of the encryption process, the two halves of the output are swapped, so that the cipher text is $R_{16} \| L_{16}$. The output of that round is the cipher text.

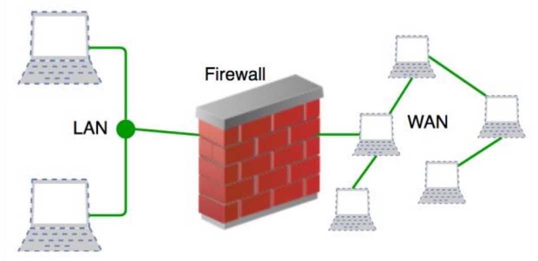


b. what is firewall? Describe different types of firewall.

Ans: Firewall is a network security device, either hardware or software based, which monitors all incoming and outgoing traffic and based on defined set of security rules it accept, reject or drop that specific traffic.

Accept : allow the traffic
Reject : block the traffic but reply with an “unreachable error”
Drop : block the traffic with no reply

Firewall establishes a barrier between secured internal networks and outside untrusted network, such as Internet.



Types of firewall:

Packet Filtering Firewall : Packet filtering firewall is used to control network access by monitoring outgoing and incoming packet and allowing them to pass or stop based on source and destination IP address, protocols and ports. It analyses traffic at the transport protocol layer (but mainly uses first 3 layers).
Packet firewalls treats each packet in Isolation. They have no ability to tell whether a packet is part of an existing stream of traffic. Only It can allow or deny the packets based on unique packet headers.

Stateful Inspection Firewall : Stateful firewalls (performs Stateful Packet Inspection) are able to determine the connection state of packet, unlike Packet filtering firewall, which makes it more efficient. It keeps track of the state of networks connection travelling across it, such as TCP streams. So the filtering decisions would not only be based on defined rules, but also on packet's history in the state table.

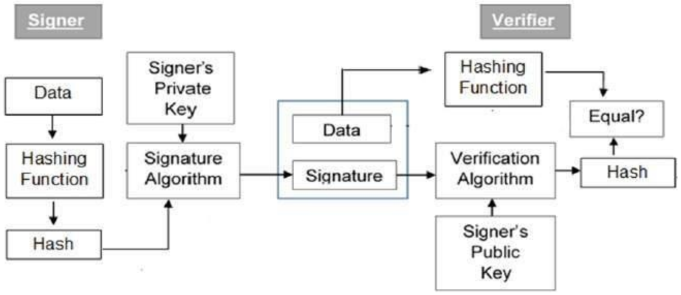
Application Layer Firewall : Application layer firewall can inspect and filter the packets on any OSI layer, up to application layer. It has ability to block specific content, also recognize when certain application and protocols (like HTTP, FTP) are being misused.
In other words, Application layer firewalls are hosts that run proxy servers. A proxy firewall prevents direct connection between either side of firewall, each packet has to pass through the proxy. It can allow or block the traffic based on predefined rules.

Host- based Firewalls : Host-based firewall are installed on each network node which controls each incoming and outgoing packet. It is a software application or suit of applications, comes as a part of operating system. Host-based firewalls are needed because network firewalls cannot provide protection inside a trusted network. Host firewall protects each host from attacks and unauthorized access.

Network-based Firewalls : Network firewall function on network level. In other words, these firewalls filters all incoming and outgoing traffic across the network. It protects the internal network by filtering the traffic using rules defined on firewall. A Network firewall might have two or more network interface cards (NICs). Network-based firewall is usually a dedicated system with proprietary software installed.

2. What is digital signature? Give example

Ans: a digital signature is a technique that binds a person/entity to the digital data. This binding can be independently verified by receiver as well as any third party. It is based on public key cryptography.



- Each person adopting this scheme has a public-private key pair.

- Generally, the key pairs used for encryption/decryption and signing/verifying are different. The private key used for signing is referred to as the signature key and the public key as the verification key.

- Signer feeds data to the hash function and generates hash of data.

- Hash value and signature key are then fed to the signature algorithm which produces the digital signature on given hash. Signature is appended to the data and then both are sent to the verifier.

- Verifier feeds the digital signature and the verification key into the verification algorithm. The verification algorithm gives some value as output.

- Verifier also runs same hash function on received data to generate hash value.

- For verification, this hash value and output of verification algorithm are compared. Based on the comparison result, verifier decides whether the digital signature is valid.

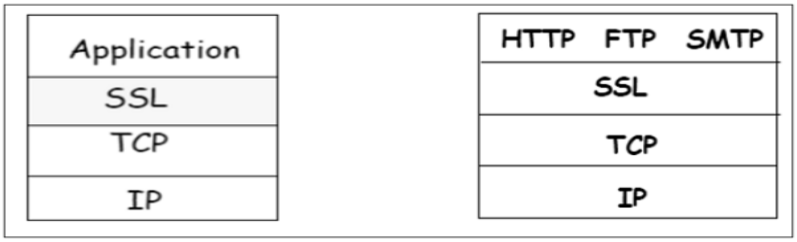
- Since digital signature is created by 'private' key of signer and no one else can have this key; the signer cannot repudiate signing the data in future.

a.**Describe position of SSL in TCP/IP with diagram**.

Ans: The SSL protocol provides

- Confidentiality − Information is exchanged in an encrypted form.
- Authentication − Communication entities identify each other through the use of digital certificates. Web-server authentication is mandatory whereas client authentication is kept optional.
- Reliability − Maintains message integrity checks.

- The position of SSL protocol in TCP/IP protocol is between application and transport layer.

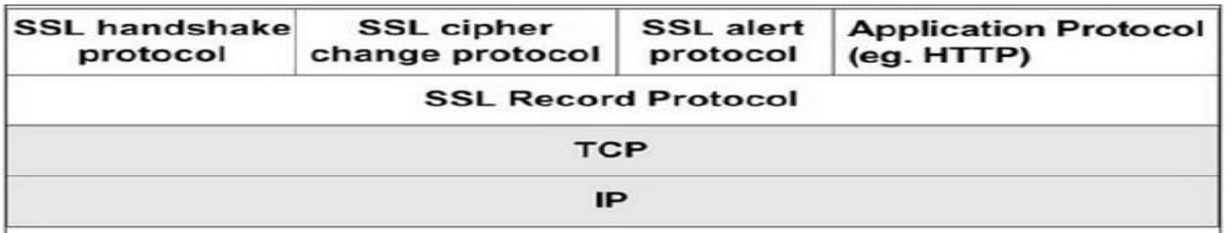


SSL itself is not a single layer protocol rather it is composed of two sub-layers.

- Lower sub-layer comprises of the one component of SSL protocol called as SSL Record Protocol. This component provides integrity and confidentiality services.
- Upper sub-layer comprises of three SSL-related protocol components and an application protocol. Application component provides the information transfer service between client/server interactions.

Technically, it can operate on top of SSL layer as well. Three SSL related protocol components are −

- SSL Handshake Protocol
- Change Cipher Spec Protocol
- Alert Protocol.



SSL Protocol Architecture

b. **Describe transposition techniques**.

Ans: Transposition technique:
In this technique some permutation is performed on the plaintext letters. Examples are Rail fence, row transposition, feistel cipher etc.
Rail fence:
Here the plaintext is written as a sequence of diagonals and then read off as a sequence of rows.
Plaintext = meet at the school house
To encipher this message with a rail fence of depth 2, we write the message as follows:
m e a t e c o l o s
e t t h s h o h u e
The encrypted message is MEATECOLOSETTHSHOHUE
Row Transposition Ciphers-
A more complex scheme is to write the message in a rectangle, row by row, and read the message off, column by column, but permute the order of the columns. The order of columns then becomes the key of the algorithm.
e.g., plaintext = meet at the school house
Key = 3 4 2 1 5 6 7

R/C	1	2	3	4	5	6	7
1	M	E	E	T	A	T	T
2	H	E	S	C	H	O	O
3	L	H	O	U	S	E	

CT = ESOTCUEEHMHLAHSTOETO
Feistel cipher structure

- The input to the encryption algorithm are a plaintext block of length 2w bits and a key K.
- The plaintext block is divided into two halves L0 and R0.
- The two halves of the data pass through „n" rounds of processing and then combine to produce the ciphertext block.
- Each round "I" has inputs L_{i-1} and R_{i-1}, derived from the previous round, as well as the subkey K_i, derived from the overall key K. The subkeys Ki are different from K and from each other.
- All rounds have the same structure. A substitution is performed on the left half of the data. This is done by applying a round function F to the right half of the data and then taking the XOR of the output of that function and the left half of the data.
- Following this substitution, a permutation is performed that consists of the interchange of the two halves of the data. This structure is a particular form of the substitution-permutation network.

3. Define cryptography.

Ans: Cryptography is the practice and study of techniques for secure communication in the presence of third parties called adversaries. That is cryptography is about constructing and analyzing protocols that prevent third parties or the public from reading private messages;

a. **Comparison between symmetric and asymmetric key cryptography**.

Ans: Symmetric Cryptography:

- It is easy to use but less secure.
- It also requires a safe method to transfer the key from one party to another.
- It only requires a single key for both encryption and decryption.
- The size of cipher text is same or smaller than the original plain text.
- The encryption process is very fast.
- It is used when a large amount of data is required to transfer.
- It only provides confidentiality.
- Examples: 3DES, AES, DES and RC4

Asymmetric Cryptography:

- It is more secure than symmetric key encryption technique.
- It requires two key one to encrypt and the other one to decrypt.
- The size of cipher text is same or larger than the original plain text.
- The encryption process is slow.
- It is used to transfer small amount of data.
- It provides confidentiality, authenticity and non-repudiation.
- Examples: Diffie-Hellman, ECC, El Gamal, DSA and RSA

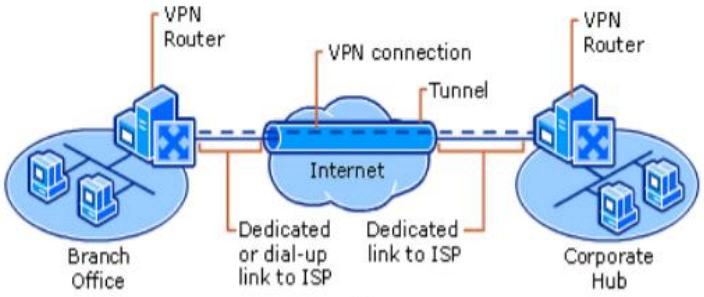
b. Explain VPN. Describe it's architecture.

Ans: : VPN allows private communication through public internet. It is essentially a logical (virtual) network within a conventional network. It makes use of cryptography (IPSec in tunnel mode) to perform private communication through insecure and public internet.

There are two common types of VPNs.

- Remote-Access—Also called a Virtual Private Dial-up Network (VPDN), this is a user-to-LAN connection used by a company that has employees who need to connect to the private network from various remote locations.
- Site-to-Site—Through the use of dedicated equipment and large-scale encryption, a company can connect multiple fixed sites over a public network such as the Internet. Each site needs only a local connection to the same public network, thereby saving money on long private leased-lines.

VPN Architecture:



VPN Architecture

Tunneling is the process of encapsulating an entire packet within another packet and sending it over a network. Data tunneling is helpful in cases where it is desirable to hide the identity of the device originating the traffic. For example, a single device that uses IPsec encapsulates traffic that belongs to a number of hosts behind it and adds its own header on top of the existing packets. By encrypting the original packet and header (and routing the packet based on the additional layer 3 header added on top), the tunneling device effectively hides the actual source of the packet. Only the trusted peer is able to determine the true source, after it strips away the additional header and decrypts the original header. All the encryption protocols listed here also use tunneling as a means to transfer the encrypted data across the public network. It is important to realize that tunneling, by itself, does not provide data security. The original packet is merely encapsulated inside another protocol and might still be visible with a packet-capture device if not encrypted. It is mentioned here, however, since it is an integral part of how VPNs function.

A VPN offers following features.

- Data Confidentiality— Since your private data travels over a public network, data confidentiality can be attained by encrypting the data using IPsec protocol. This is the process of taking all the data that one computer is sending to another and encoding it into a form that only the other computer will be able to decode.

- IPsec— IPsec has two encryption modes: tunnel and transport. Tunnel mode encrypts the header and the payload of each packet while transport mode only encrypts the payload. Only systems that are IPsec-compliant can take advantage of this protocol. Also, all devices must use a common key or certificate and must have very similar security policies set up.

- Data Integrity— IPsec has a mechanism to ensure that the encrypted portion of the packet, or the entire header and data portion of the packet, has not been tampered with. If tampering is detected, the packet is dropped. Data integrity can also involve authenticating the remote peer.

- Data Origin Authentication—The identity of the source of the data that is sent can also verified.

4. **Role of CA in digital certificate**.

Ans: Certificate Authority (CA) is a trusted entity that issues Digital Certificates and public-private key pairs. The role of the Certificate Authority (CA) is to guarantee that the individual granted the unique certificate is who he or she claims to be.

a. Principle of security with example.

Ans: : Data Confidentiality, Data Integrity, Authentication, Availability and Non-repudiation are core principles of modern-day cryptography.

- Confidentiality refers to certain rules and guidelines usually executed under confidentiality agreements which ensure that the information is restricted to certain people or places.

Example: Let there are two people communicating via an encrypted email they know the decryption keys of each other and they read the email by entering these keys into the email program. If someone else can read these decryption keys when they are entered into the program, then the confidentiality of that email is compromised.

- Data integrity refers to maintaining and making sure that the data stays accurate and consistent over its entire life cycle.

Example: Let’s say you are doing an online payment of Rs.500, but your information is tampered without your knowledge in a way by sending to the seller Rs.5000, this would cost you too much.

- Authentication is the process of making sure that the piece of data being claimed by the user belongs to it.
- Availability refers to the ability to access data of a resource when it is needed, as such the information has value only if the authorized people can access at right time. Denying access to data nowadays has become a common attack. Imagine a downtime of a live server how costly it can be.
- Example: Let’s say a hacker has compromised a webserver of a bank and put it down. You as an authenticated user want to do an e-banking transfer but it is impossible to access it, the undone transfer is money lost for the bank.
- Non-repudiation refers to ability to make sure that a person or a party associated with a contract or a communication cannot deny the authenticity of their signature over their document or the sending of a message.

b. Define authentication token. How does this work.

Ans: : A security token is a peripheral device used to gain access to an electronically restricted resource. The token is used in addition to or in place of a password. It acts like an electronic key to access something. Examples include a wireless keycard opening a locked door, or in the case of a customer trying to access their bank account online, the use of a bank-provided token can prove that the customer is who they claim to be.
Working:

A token is a piece of data created by server, and contains information to identify a particular user and token validity. The token will contain the user's information, as well as a special token code that user can pass to the server with every method that supports authentication, instead of passing a username and password directly.

Token-based authentication is a security technique that authenticates the users who attempt to log in to a server, a network, or some other secure system, using a security token provided by the server.

An authentication is successful if a user can prove to a server that he or she is a valid user by passing a security token. The service validates the security token and processes the user request.

After the token is validated by the service, it is used to establish security context for the client, so the service can make authorization decisions or audit activity for successive user requests.

Types of tokens:

Static password token

The device contains a password which is physically hidden (not visible to the possessor), but which is transmitted for each authentication. This type is vulnerable to replay attacks.

Synchronous dynamic password token

A timer is used to rotate through various combinations produced by a cryptographic algorithm. The token and the authentication server must have synchronized clocks.

Asynchronous password token

A one-time password is generated without the use of a clock, either from a one-time pad or cryptographic algorithm.

Challenge response token

Using public key cryptography, it is possible to prove possession of a private key without revealing that key. The authentication server encrypts a challenge (typically a random number, or at least data with some random parts) with a public key; the device proves it possesses a copy of the matching private key by providing the decrypted challenge.

5. What is IP datagram?

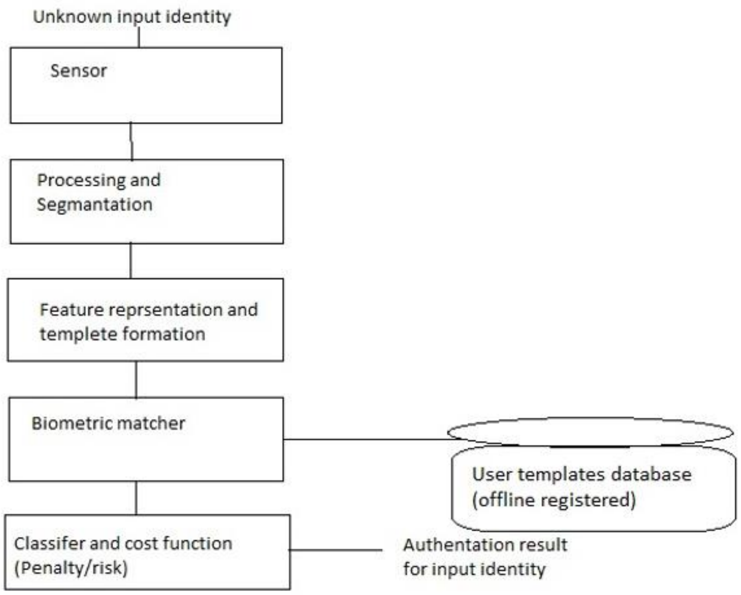
Ans: It is a message containing data that is sent from location to another. ... Datagrams are also called "IP datagrams" which defines how information is sent between systems over the Internet.

a. Explain biometric authontecation. Describe how does it works?

Ans: Biometric authentication is considered the automatic identification or identity verification of an individual using either a biological feature possesses physiological characteristics like a signature.

Biometric can be separated into two main categories:

- Physiological Characteristics: They are related to the shape of the body. The trait that has been


Unknown input identity
Sensor
Processing and Segmantation
Feature reprsentation and templete formation
Biometric matcher
User templates database (offline registered)
Classifer and cost function (Penalty/risk)
Authentation result for input identity

used the longest, for over one hundred years, are fingerprints, other examples are face recognition, hand geometry and iris recognition.

- Behavioural Characteristics: They are related to the behaviour of a person. The first characteristics to be used that is still widely used today is the signature.

- Biometric samples are collected using an appropriate sensor. The samples are then processed to correct the deterministic variations like translational and rotational shifts due to interaction of a sensor with the external world. This leads to set of “discriminatory” attributes that are invariant to irrelevant transformation of the input at the sensor.
- Following this segmentation/identification is performed to extract/recognize the desired attributes from the biometric samples.
- Measurements performed on these attributes give features depending upon the representation method.
- The features so obtained are used to form a biometric template. The biometric template is stored in one of the many encrypted forms so as to avoid spoofing.
- Once the database is ready, a query template needs to be authenticated using a matcher so as to determine its similarity with templates in the database.

The output of the matcher is a matching score which gives the degree of similarity of the query template with various templates. This is used to arrive at a decision using a classifier

b. What is SET? Explain SET process.

Ans: Secure Electronic Transaction (SET) is a standard protocol that is used for securing credit card transactions over insecure networks. SET itself is not a payment system. It is a a set of security protocols and formats that enables users to employ the existing credit card payment infrastructure on an open network in a secure fashion!

SET has following features:

- Maintains confidentiality of information: Information is provided only to the concerned recipient.

- SET takes care of Integrity of data.
- SET employs a particular subset of protocol for carrying out cardholder account authentication.
- SET employs a particular subset of protocol for carrying out Merchant authentication.

SET process: A SET system includes the following participants:
- Cardholder
- Merchant
- Issuer
- Acquirer
- Payment gateway
- Certification authority

Both cardholders and merchants must register with the CA (certificate authority) first, before they can buy or sell on the Internet. Once registration is done, cardholder and merchant can start to do transactions, which involve nine basic steps in this protocol, which is simplified.

- Customer browses the website and decides on what to purchase
- Customer sends order and payment information, which includes two parts in one message:

a. Purchase order – this part is for merchant
b. Card information – this part is for merchant’s bank only.

- Merchant forwards card information (part b) to their bank
- Merchant’s bank checks with the issuer for payment authorization
- Issuer sends authorization to the merchant’s bank
- Merchant’s bank sends authorization to the merchant
- Merchant completes the order and sends confirmation to the customer
- Merchant captures the transaction from their bank
- Issuer prints credit card bill (invoice) to the customer

6. What is biometric authentication?

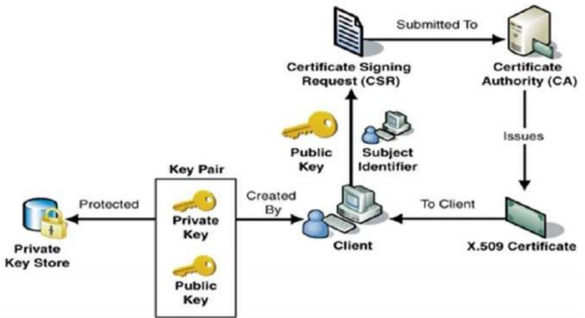
Ans: Biometric authentication is considered the automatic identification or identity verification of an individual using either a biological feature possesses physiological characteristics like a signature

a. Explain PKIX model.

Ans: Public Key Infrastructure X.509 provides assurance of public key. It provides the identification of public keys and their distribution. PKIX has following components.

- Public Key Certificate, commonly referred to as ‘digital certificate’.
- Private Key tokens.
- Certification Authority.
- Registration Authority.
- Certificate Management System.

- Digital certificates are based on the ITU standard X.509 which defines a standard certificate format for public key certificates and certification validation. Hence digital certificates are sometimes also referred to as X.509 certificates.
- Public key pertaining to the user client is stored in digital certificates by The Certification Authority (CA) along with other relevant information such as client information, expiration date, usage, issuer etc.
- CA digitally signs this entire information and includes digital signature in the certificate.
- Anyone who needs the assurance about the public key and associated information of client, he



carries out the signature validation process using CA's public key. Successful validation assures that the public key given in the certificate belongs to the person whose details are given in the certificate.

Certifying Authority (CA)

As discussed above, the CA issues certificate to a client and assist other users to verify the certificate. The CA takes responsibility for identifying correctly the identity of the client asking for a certificate to be issued, and ensures that the information contained within the certificate is correct and digitally signs it.

Registration Authority (RA)

CA may use a third-party Registration Authority (RA) to perform the necessary checks on the person or company requesting the certificate to confirm their identity. The RA may appear to the client as a CA, but they do not actually sign the certificate that is issued.

Private Key Tokens

While the public key of a client is stored on the certificate, the associated secret private key can be stored on the key owner's computer. This method is generally not adopted. If an attacker gains access to the computer, he can easily gain access to private key. For this reason, a private key is stored on secure removable storage token access to which is protected through a password.

The procedure is given below

- A client whose authenticity is being verified supplies his certificate, generally along with the chain of certificates up to Root CA.
- Verifier takes the certificate and validates by using public key of issuer. The issuer's public key is found in the issuer's certificate which is in the chain next to client's certificate.
- Now if the higher CA who has signed the issuer's certificate, is trusted by the verifier, verification is successful and stops here.
- Else, the issuer's certificate is verified in a similar manner as done for client in above steps. This process continues till either trusted CA is found in between or else it continues till Root CA.

b. Explain RSA wth example.

Ans: RSA cryptosystem is a public key cryptosystem which has two aspects. Firstly generation of key pair and secondly encryption-decryption algorithms.

1. Generation of RSA Key Pair

The process of generation of keys pair is described below −

a) Generate the RSA modulus (n)

- Select two large primes, p and q.
- Calculate n=p*q. For strong unbreakable encryption, let n be a large number, typically a minimum of 512 bits.

b) Find Derived Number (e)

- Number e must be greater than 1 and less than (p − 1)(q − 1).
- There must be no common factor for e and (p − 1)(q − 1) except for 1. In other words two numbers e and (p – 1)(q – 1) are co prime.

c) Form the public key

- The pair of numbers (n, e) form the RSA public key and is made public.

d) Generate the private key

- Private Key d is calculated from p, q, and e. For given n and e, there is unique number d.
- Number d is the inverse of e modulo (p - 1)(q – 1). This means that d is the number less than (p - 1)(q - 1) such that when multiplied by e, it is equal to 1 modulo (p - 1)(q - 1).
- This can be written as : ed = 1 mod (p − 1)(q − 1)

The Extended Euclidean Algorithm takes p, q, and e as input and gives d as output.
Example

- Let two primes be p = 7 and q = 13. Thus, modulus n = pq = 7 x 13 = 91.
- Select e = 5, which is a valid choice since there is no number that is common factor of 5 and (p − 1)(q − 1) = 6 × 12 = 72, except for 1.
- The pair of numbers (n, e) = (91, 5) forms the public key.
- Input p = 7, q = 13, and e = 5 to the Extended Euclidean Algorithm. The output will be d = 29.
- Hence, public key is (91, 5) and private keys is (91, 29).

2. Encryption and Decryption

RSA Encryption :
- Suppose the sender wish to send some text message to someone whose public key is (n, e).
- The sender then represents the plaintext as a series of numbers less than n.

- To encrypt the first plaintext P=10 which is a number modulo n, the encryption process is $C = P^e \bmod n$

- plaintext P , we get cipher text $C = 10^5 \bmod 91=82$

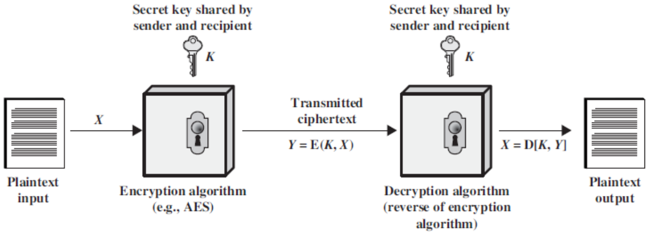
RSA Decryption :
- Receiver after getting C, the plaintext $P = C^d \bmod n$

- Plaintext = $82^{29} \bmod 91 = 10$

7. What is trusted system.

Ans: It is a system used toenhance the ability to defend against intruders and malicious programs.
a.**What is encryption and decryption? Draw block diagrm of encryption and decryption**.

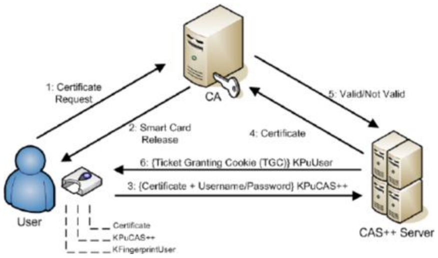
Ans: Encryption is the process of translating plain text data (plaintext) into something that appears to be random and meaningless (ciphertext). Decryption is the process of converting ciphertext back to plaintext.


Secret key shared by sender and recipient
K
Secret key shared by sender and recipient
K
X
Transmitted ciphertext
Y = E(K, X)
X = D[K, Y]
Plaintext input
Encryption algorithm (e.g., AES)
Decryption algorithm (reverse of encryption algorithm)
Plaintext output

The plain text ‘X’ is encrypted with a suitable encryption algorithm ‘E’using the secret key ‘K’ to get cipher text ‘Y=E(K,X)’.This cipher text Y is transmitted to receiver. The receiver decrypt the cipher text ‘Y’ by a suitable decryption algorithm ‘D’ and the key ‘K’ to get the plain text ‘X’.

b. What is certificate based authentication? Describe it’s working.

Ans:



A certificate-based authentication scheme is a scheme that uses a public key cryptography and digital certificate to authenticate a user. A digital certificate is an electronic form that contains identification data, public key, and the digital signature of a certification authority derived from that certification authority’s private key. When a user signs on to the server, he provides his digital certificate that has the public key and signature of the certification authority. The server then confirms the validity of the digital signature and if the certificate has been issued by a trusted certificate authority or not. The server then authenticates the user with public key cryptography to confirm the user is in possession of the private key associated with the certificate