



NIS_Unit 5

Syllabus:

5a. Explain the given component of Kerberos authentication protocol.	5.1 Kerberos : Working, AS, TGS, SS
5b. Explain the given IP Security protocol with modes.	5.2 IP Security- Overview, Protocols- AH, ESP, Modes- transport and Tunnel.
5c. Explain working of the given protocol for Email security.	5.3 Email security- SMTP, PEM, PGP.
5d. Describe the given component of Public Key Infrastructure.	5.4 Public key infrastructure (PKI): Introduction, Certificates, Certificate authority, Registration Authority, X.509/PKIX certificate format.
5e. Classify the given Cyber crime.	5.5 Cyber Crime: Introduction, Hacking , Digital Forgery, Cyber Stalking/Harassment, Cyber Pornography , Identity Theft and Fraud , Cyber terrorism, Cyber Defamation.
	5.6 Cyber Laws: Introduction, need,
5f. Explain the specified Cyber law.	Categories: Crime against Individual, Government, Property.
5g. Describe compliance standards for Information Security.	5.7 Compliance standards: Implementing and Information Security Management System, ISO 27001, ISO 20000, BS 25999, PCI DSS, ITIL framework, COBIT framework.

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5.1 Kerberos

- a **centralized** network authentication protocol
- Provides **strong authentication** for client/server application
- Uses **secret key cryptography**
- **Internet** provides different protocols
- But **internet is insecure**
- Applications using **unencrypted passwords** are **extremely vulnerable**
- Few sites use **firewalls** → **firewalls think attackers are outsiders**
- **Insiders** are more damaging
- **Kerberos**: protocol- created by MIT(Massachusetts Institute of Technology) → as a **solution to network security problems**
- Uses **strong cryptography**

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- **Freely** available from MIT **under copyright permissions**
 - MIT provides **-open-source Kerberos**
 - Anyone can see the code and assure that its **trustworthy**
 - **Kerberos** – also available as a **product** from different vendor
 - It provides tools for authentication and strong cryptography over n/w
-
- **AS, TGS, SS**
 - **Parties /components involved in Kerberos**
 - **User:** client workstation

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- **AS: Authentication Server**
 - verifies user login
 - shares unique password with every user
- **TGS: Ticket Granting Server**
 - issues **tickets** to certify **proof of identity** after authentication
- **SS: Service Server**
 - provide **services** to clients
 - like → n/w printer, file sharing, application program
- **Working**
- **Encrypts** data with symmetric key (same key – client & server)
- **Encryption key details** sent to
 - **Key Distribution Centre (KDC)** → rather than sending to each other
- This whole procedure takes **8** steps

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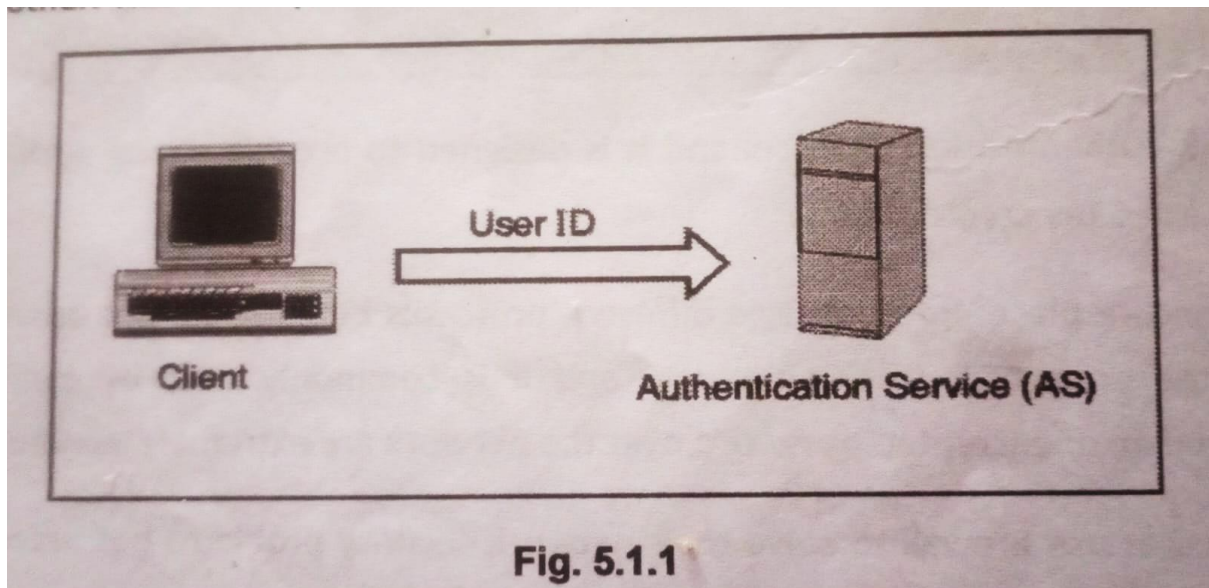
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1. **AS** receives **request** from client → AS **verifies** that client is **indeed** → by looking at **user ID**
2. After verification **timestamp** is created → current time is put on user **session** with expiration date → (**default 8 Hours**) → then **encryption** (which is useless after 8 hours → **hacker doesn't intercept data** → all keys can be **cracked** but **take more than 8 hours**

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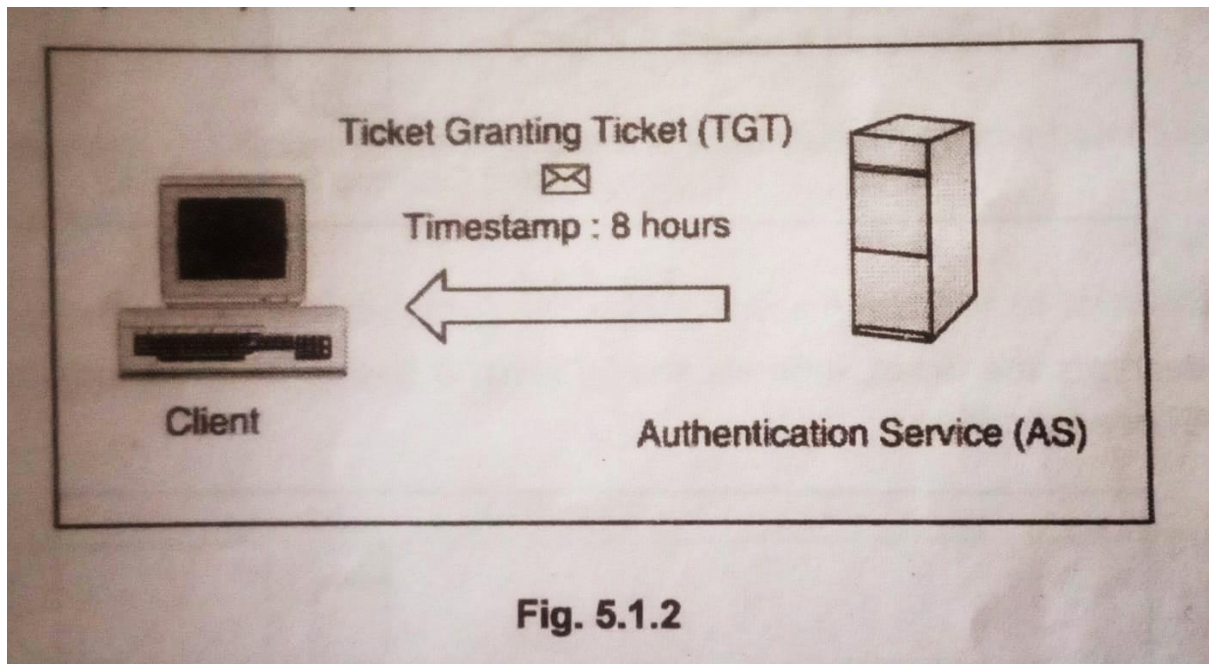
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3. Key is sent **back to client** in the form of TGT → it's a simple ticket issued by AS → it is used for authenticating client for future reference

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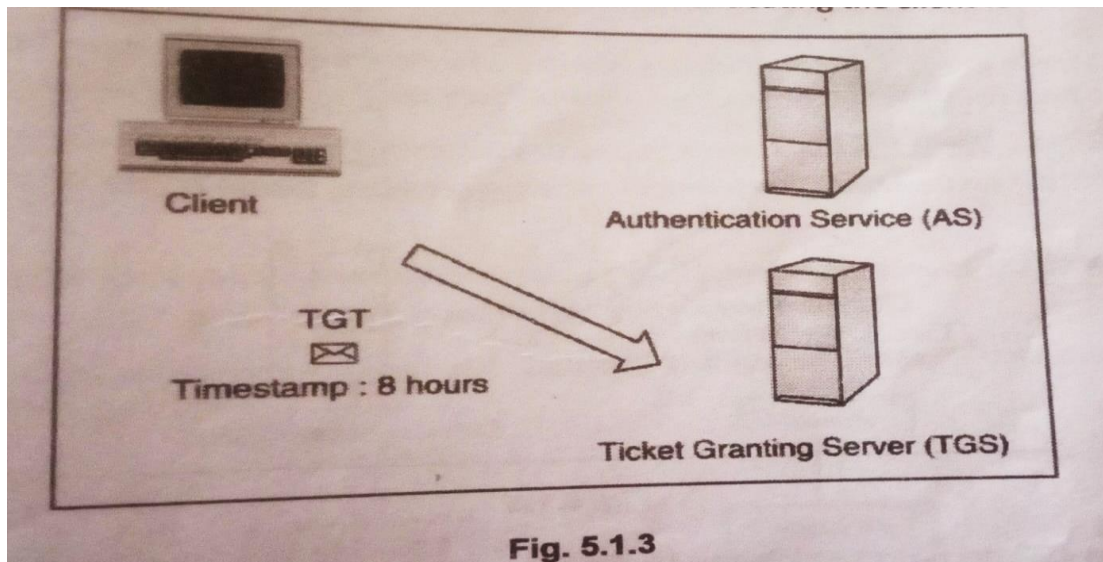
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4. Client submits **TGT to TGS** for authentication
5. **TGT creates encrypted key with timestamp** and grants service ticket to client

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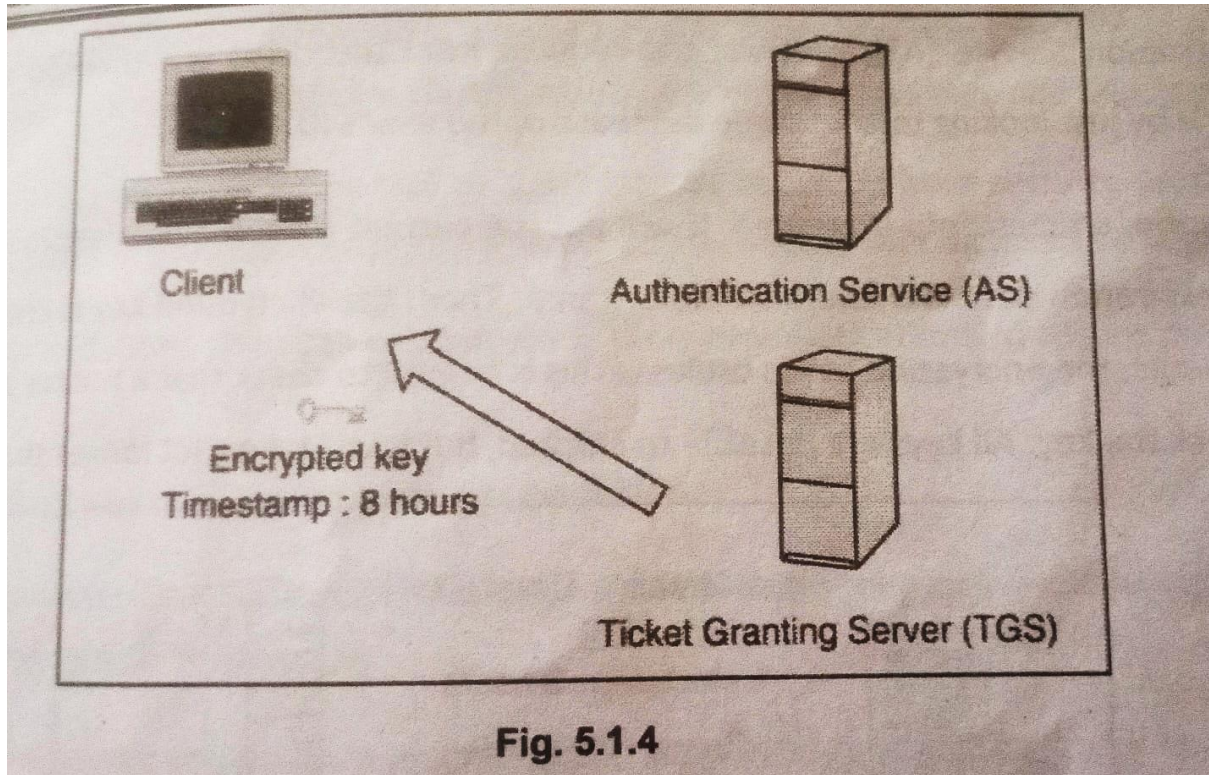
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6. Client decrypts the ticket → informs TGT → sends own encrypted key to SS or application

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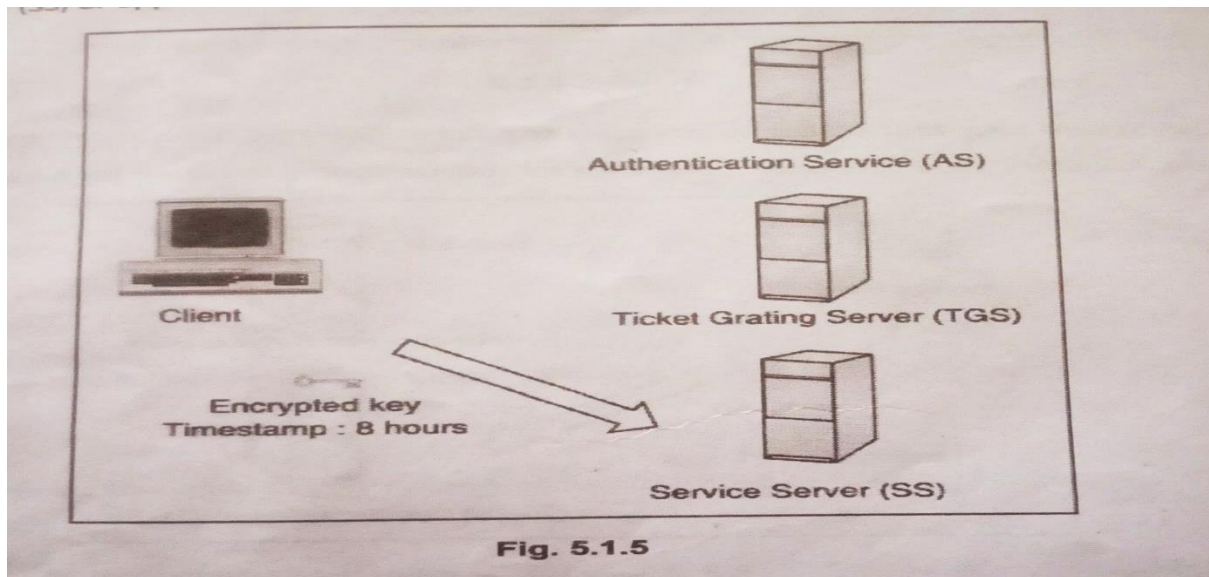
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7. SS decrypts key sent by client → checks **validity** of timestamp → if **valid**- SS **contacts KDC to receive a session** which is returned to the client

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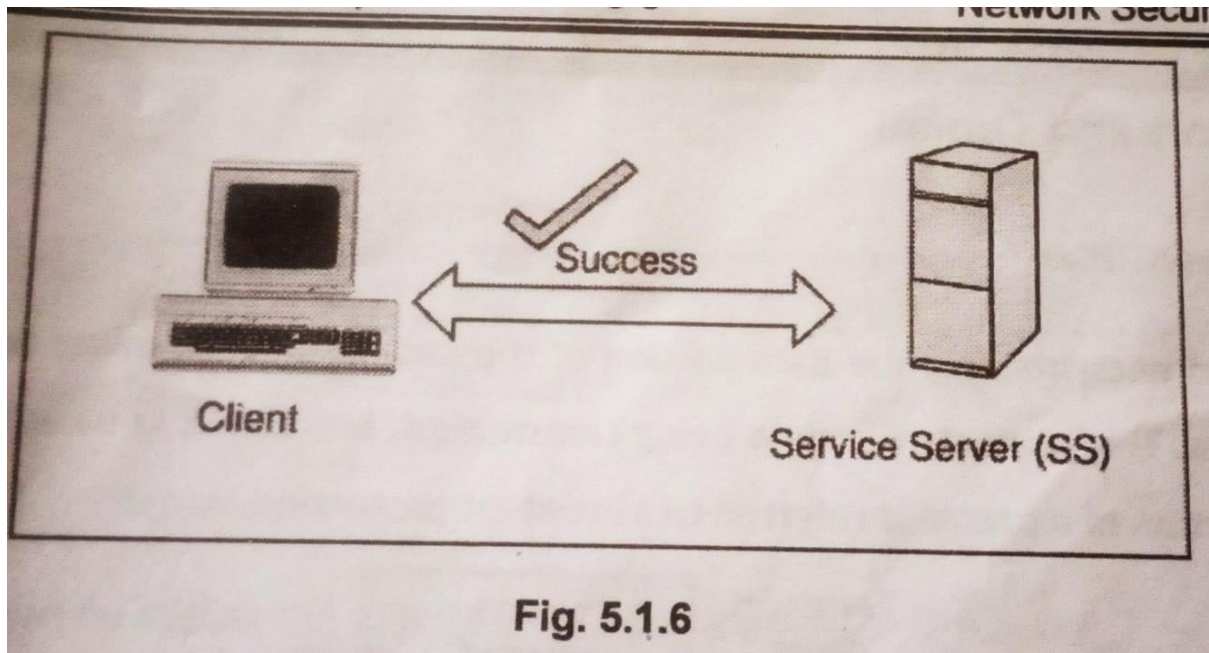
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8. client **decrypts ticket** → if **key is valid** –
communication initiates between client and server
- **after communication** between client and server →
there is **no need to transmit login information** →
because **client is authenticated until session expires**

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- **Limitations of Kerberos**
- Each network service must be **modified individually** for use with Kerberos
- It doesn't work well in a **timeshare environment**
- Requires an **always-on** Kerberos server
- Stores all passwords are encrypted with a single key
- **Assumes** workstations are secure
- May result in cascading loss of trust.
- **Scalability**

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5.2 IP Security

- Overview
- IP packet contains data in **plaintext**
- Anyone can **read and change**

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- Need a **mechanism to protect data**
- To **secure** n/w infrastructure from unauthorized monitoring
- There should be **traffic control** using **authentication and encryption**
- **IPSEC** – protocol developed to support secure exchange of packets at IP layer
- provides secure communication across
 - LAN
 - private and public WAN
 - internet
- **IPSec** → **encrypts and seals transport and application layer data during transmission**

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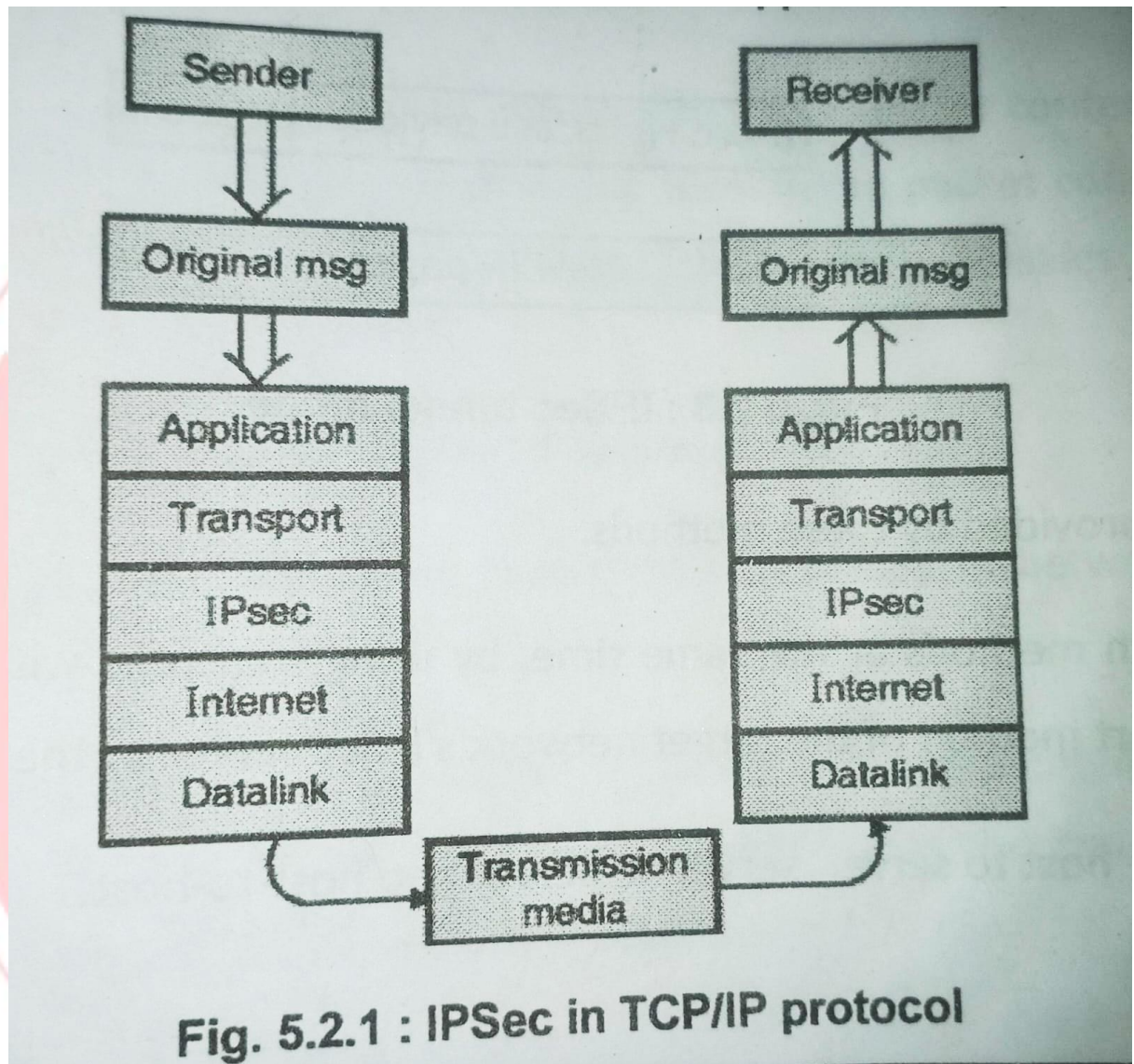
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-
- **Modes- Transport and Tunnel**
- **2 methods of IPsec**

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- **Transport:** encrypts only data portion of packet
- Enables outsider to see source and destination IP address
- Protects data being transmitted
- **But** allows knowledge of transmission
- “Protection of data portion → celled as **content protection**”
- Method
 - → takes transport layer payload
 - → adds IPSec **Header** and **tailer**
 - → **encrypts** whole thing
 - → then adds **IP header**
 - → thus, IP header is **not encrypted**

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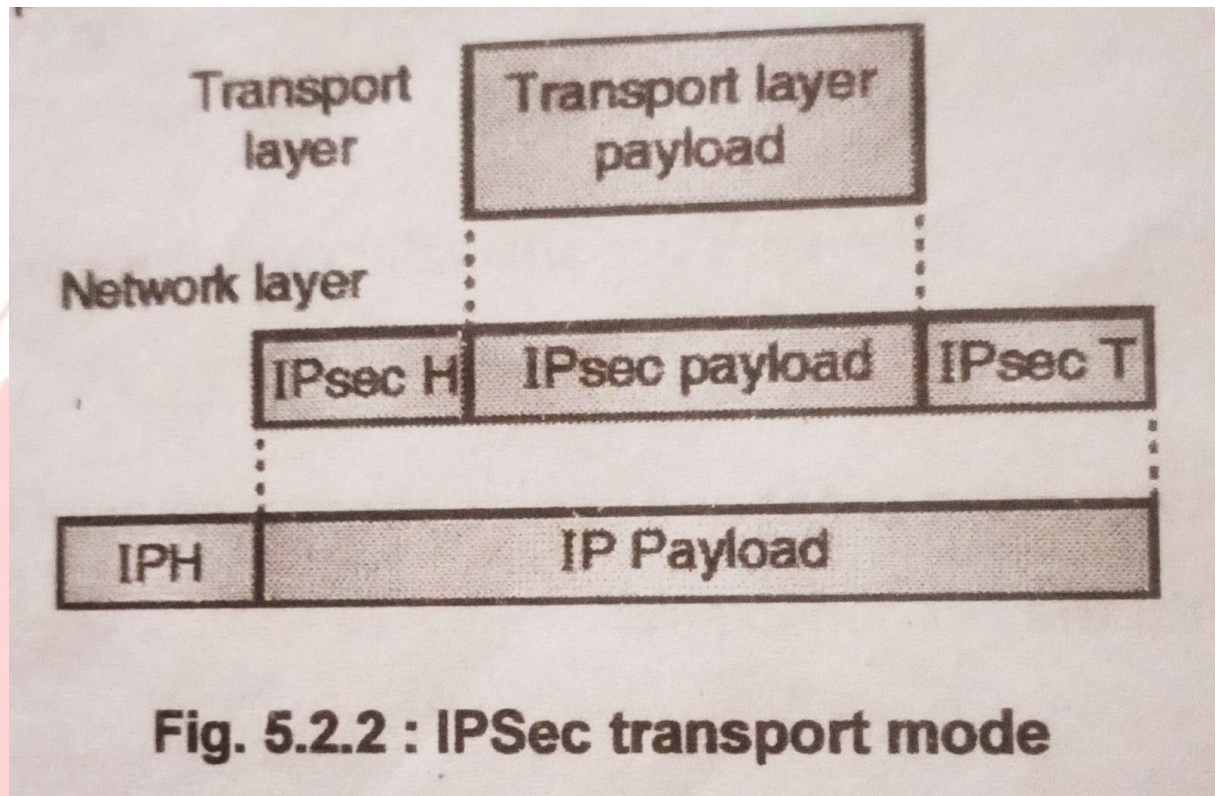
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-
- **Tunneling**
- **Provides encryption of →**
 - source address,
 - destination address,
 - data
- **Provides greatest security**

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- But this is **possible only between IPSec servers**
- As final destination needs to be known for delivery
- “Protection of header information → called as **context protection**”
 - It accepts IP data gram with IP header
 - → adds IPSec header and Tailer to it
 - → encrypts the whole packet
 - → adds **new IP header** to encrypted datagram

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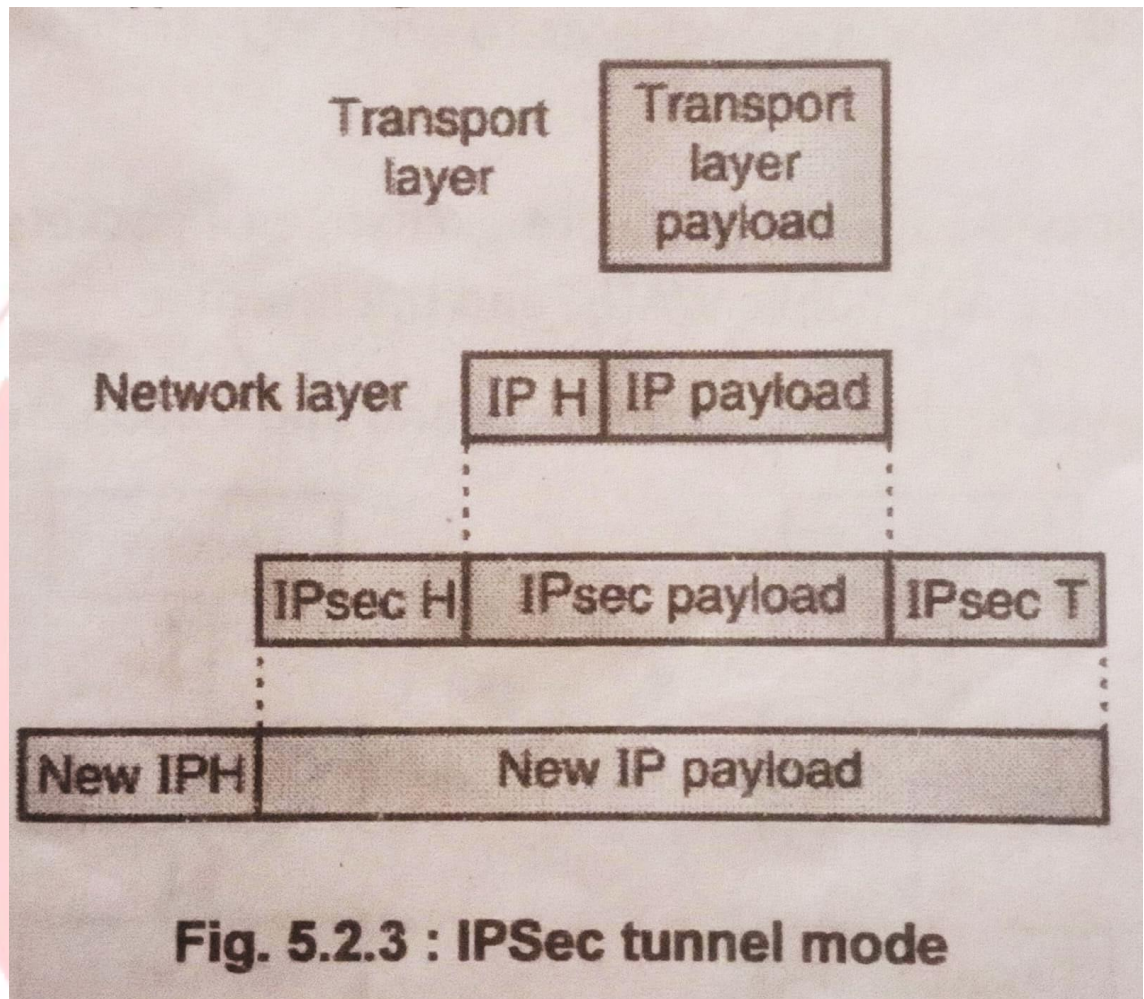
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- Different level of security is provided by both methods

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- Both can be **used at the same time**
 - → By using **transport** within one n/w to reach an IPSec server
 - → Then using transport method to **target n/w** IP server to target Host
- IPSec has **3 connections** →
 - Host to server
 - Server to server
 - Host to host
- **Protocols**- AH and ESP
- IP packet → 2 portions
 - IP Header
 - Actual Data
- **IPSEC** is implemented by adding IP header to standard default IP header

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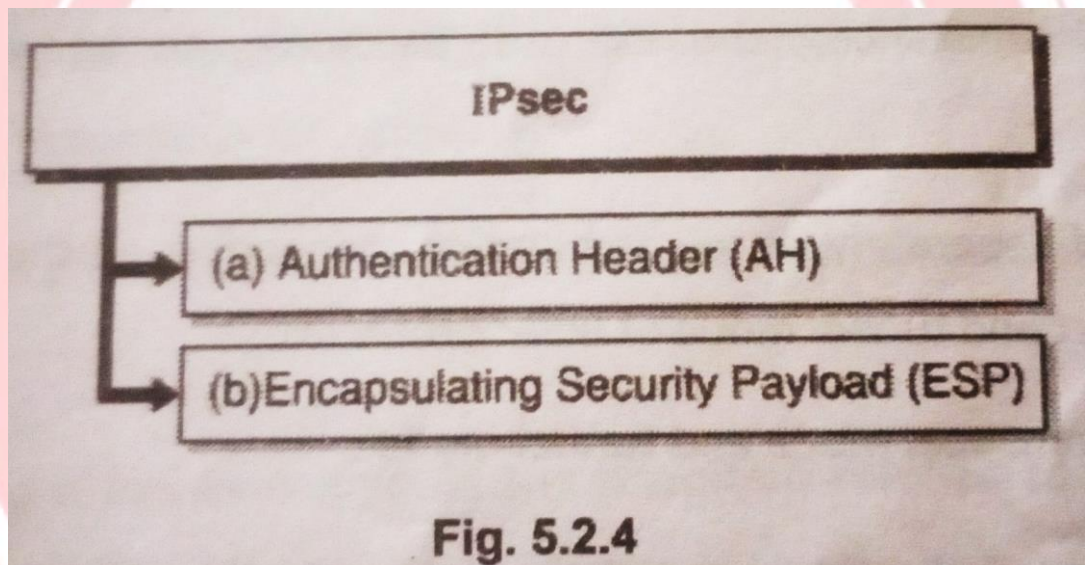
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- This extension of IP header – follows standard IP header
- IPSec offers **2 Services**
 - **Authentication**
 - **Confidentiality**
- **2 main protocols of IPSEC**



- **Authentication Header (AH)**
- When added to IP Datagram-
 - ensures integrity of data
 - Authenticity of data origin

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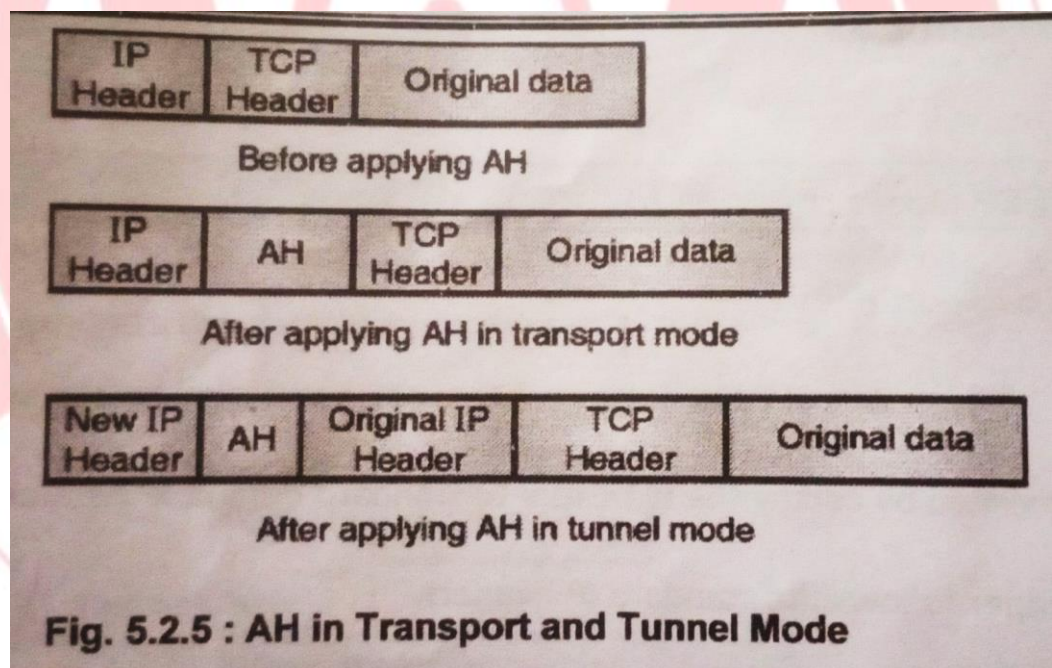
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- Optional anti-reply service
- Protects non changing elements of IP header
- AH protects address
- Enables data origin authentication
- AH works in 2 modes
- **AH transport mode:**
- **AH Tunnel mode:**



- **Encapsulating Security Payload (ESP)**

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- Provides services for higher level protocol portions- not the IP header
- Provides data confidentiality
- Defines a new header to be inserted into IP packet
- ESP process includes- transformation of protected data into an unreadable encrypted form
- Normally ESP will be inside AH → encryption first then authentication
- Ah and Esp can be used separately or together – depending upon level of security desired
- Both work in transport and tunnel mode of IPSec protocol:
 - **ESP Transport Mode:**
 - This mode is used to encrypt data carried by IP

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- Provides optional authentication service
- It is placed into IP packet- before TCP and UDP
- ESP trailer is added – after IP packet
- If authentication needed
→ authentication data field is added after ESP trailer
- Entire transport layer segment and ESP trailer are encrypted

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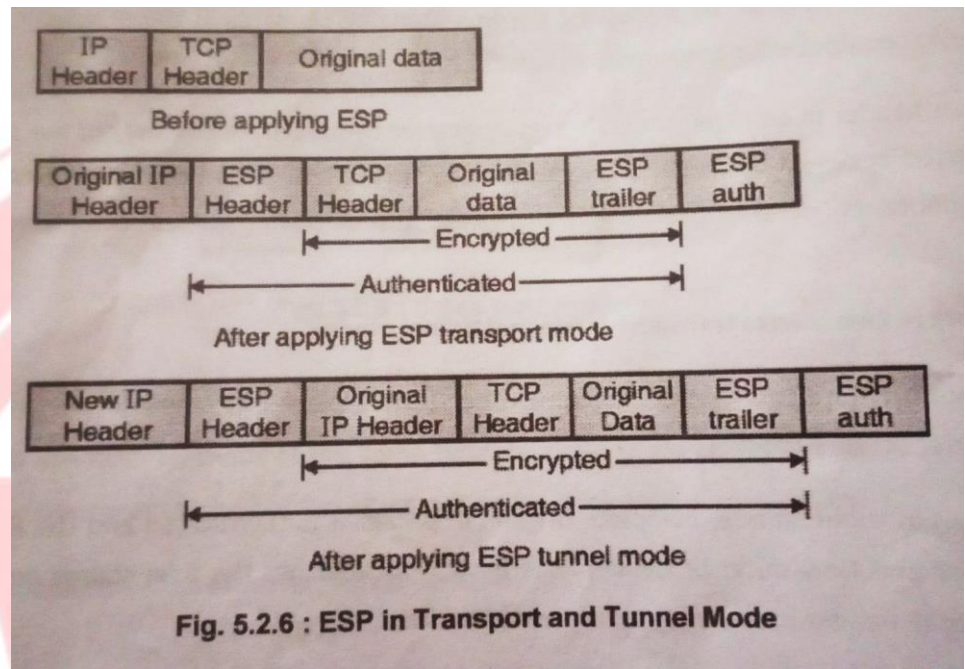
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-
- **ESP Tunnel Mode:**
- Encrypts entire IP packet
- ESP header is prefixed to packet → then packet with trailer is encrypted
- Header contains destination address and intermediate routing information
- This packet cannot be transmitted as it is

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- New IP header is added → containing sufficient information for routing
- For key management and exchange → 3 protocols:
 1. ISAKMP- internet security association and key management protocol
 2. Oakley
 3. SKEMI- secure key exchange mechanism for internet
- IPSec does not require any security algorithm
- It is an open framework
- Vendors can implement existing industry standard algorithm suitable for specific tasks

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5.3 Email Security

- Email- most **widely** used on internet
- Used to send- text, pictures, videos, sounds- **to other internet users (keyword followed by colon)**
- Email security is **extremely important** issue
- Text email message has **2** portions:
 - Content
 - Header
- **Header** lines are followed by **message**
- **Header keywords-** From, To, Subject, Date
- **SMTP (Simple Mail Transfer Protocol)**
- It's a TCP/IP protocol
- Specifies how computer exchange e-mail
- It works with POP (Post Office Protocol)

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- Request/response based
- Email client s/w at sender's end
- Gives email message to SMTP server
- SMTP server transfers message to receiver's SMTP server
- SMTP's duty – to carry email message between sender and receiver
- On same or different computer
- It also supports:
 - Sending single message to one or more recipients
 - Message can include- text, voice, video, or graphics
 - It can send message on networks outside internet
- SMTP uses -TCP port no 25

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- Email delivery happens through TCP connection to port 25
- Email communication:
 - Sender's end- SMTP server takes message sent by user's computer
 - Sender's end – SMTP server at sender's end transfers message to SMTP server at receiver's end
 - Receiver's computer drags the email from SMTP server at receiver's end using other email protocols POP or IMAP

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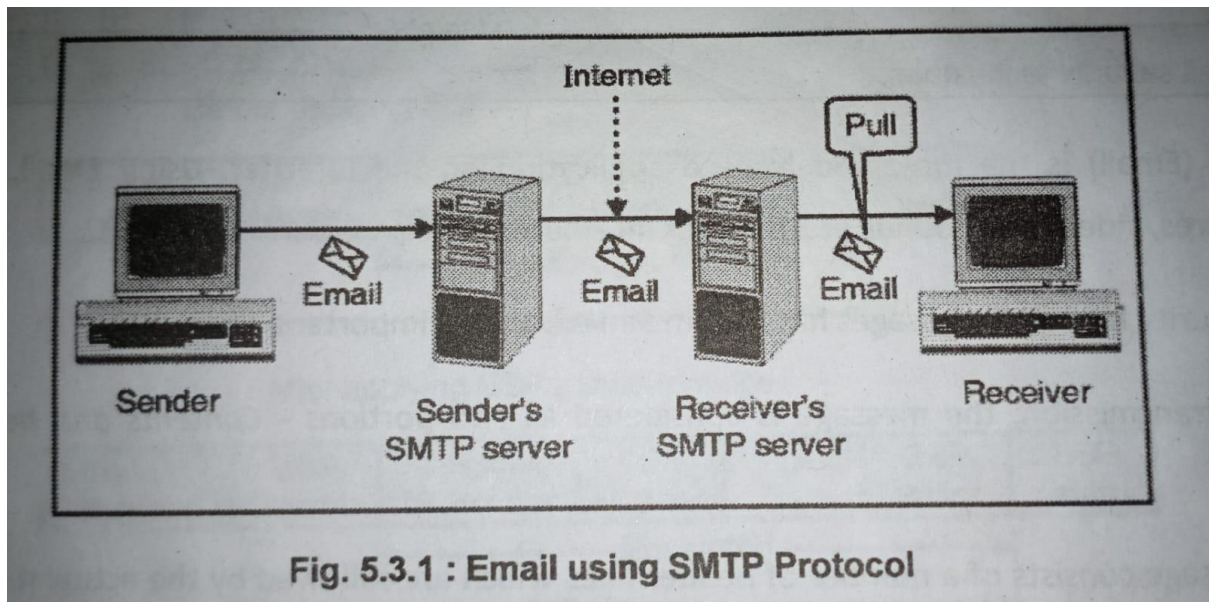
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- **3 phases of SMTP:**
 1. **Connection set up**
 - SMTP server attempt to set up TCP connection with target host when it has one or more mail message to deliver to that host
 - **Step sequence of connection setup:**
 - sender opens TCP connection with receiver
 - receiver identifies itself with “220 service Ready”

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- sender identifies itself with the HELLO command
- receiver accepts senders' identification with "250 OK"
- if mail server on destination is not available-destination host returns a "\$@! Service Not Available" reply in step 2 and process is terminated

2. Mail transfer

- After connection establishment – SMTP sender sends 1 or more messages to SMTP receiver
- 3 logical phases to transfer a message
 - MAIL command identifies originator of the message
 - One or more RCPT commands identify recipients of message

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- A DATA command transfers the message text

3. Connection termination

- Sender closes the connection in following way:
 - Sender sends QUIT command and waits for reply
 - Sender indicates TCP close operation for TCP connection
 - Receiver initiates its TCP close after sending is reply to QUIT command
- **Privacy Enhanced Mail (PEM)**
 - It's an internet standard providing secure exchange of E-mail
 - Uses cryptographic techniques allowing CIA
 - Integrity- allows user to make sure that - message is not modified-during transport
 - Authentication- allows user to verify PEM message is received authenticated person

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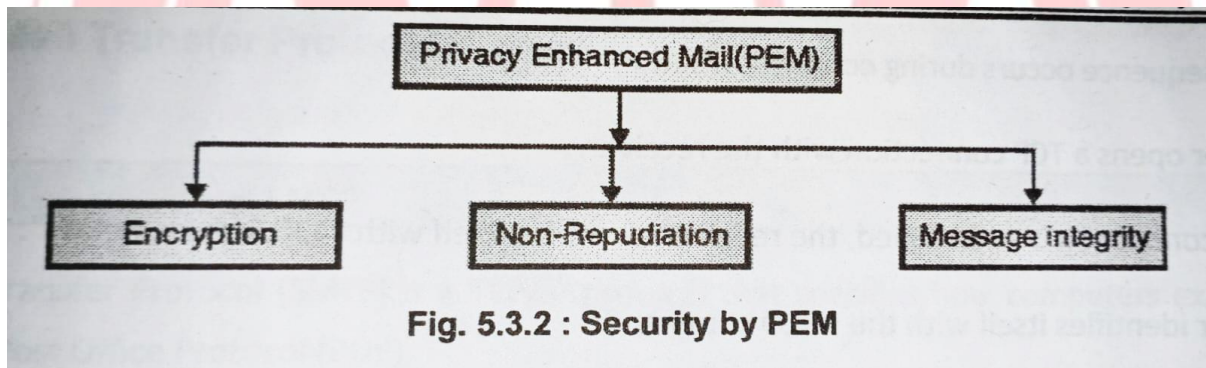
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- Confidentiality- allows message to be kept secret from other people
- PEM supports 3 cryptographic functions:
 - Encryption
 - Non repudiation
 - Message integrity



- **PEM operation**

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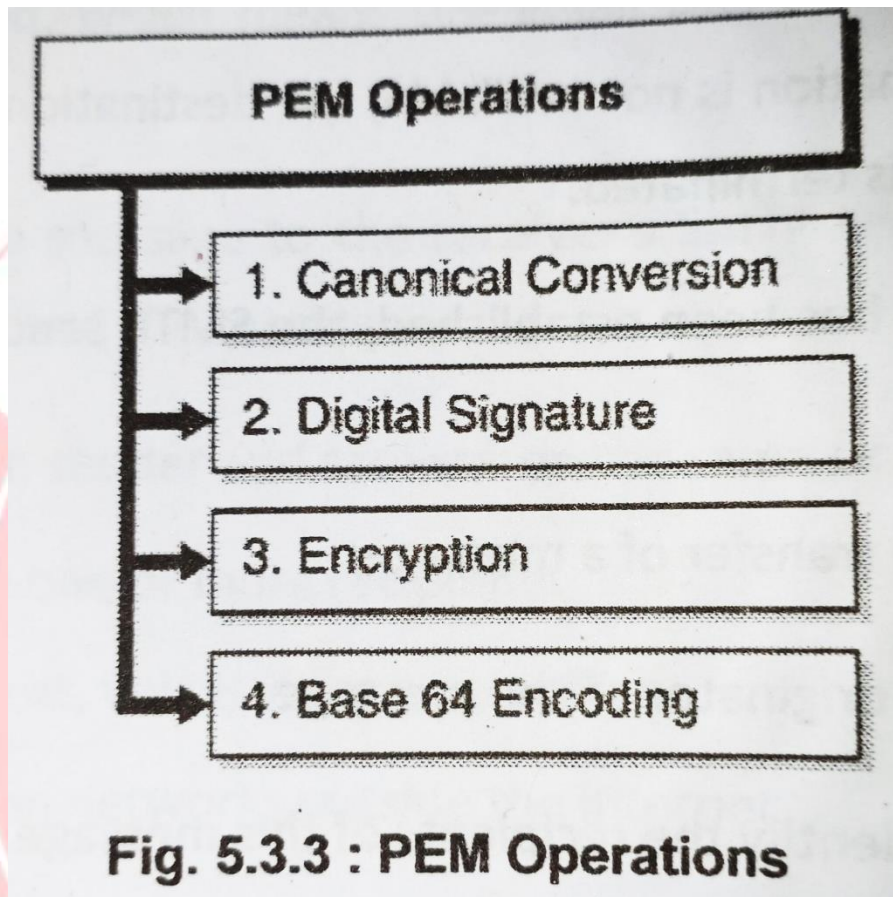
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Step 1: Canonical Conversion

- Internet works on computer having TCP/IP stack
→ regardless of architecture and OS
- So same thing can be represented differently on different computers

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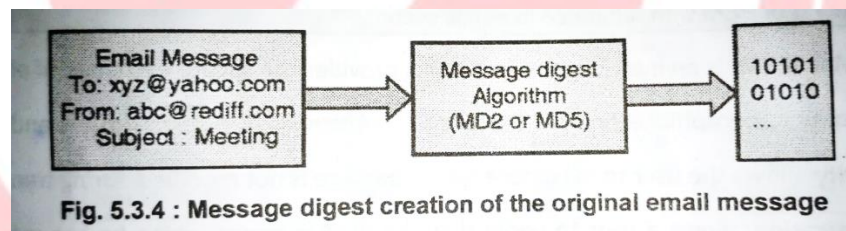
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- It transforms all messages into abstract canonical representation → regardless of architecture and OS of senders and receiver's computer as well
- Email messages will travel in uniform and independent manner

Step 2: Digital Signature

- Starts by creating message digest of email message – using MD2 or MD5 algorithm



- Message digest is encrypted with sender's private key to form sender's digital signature

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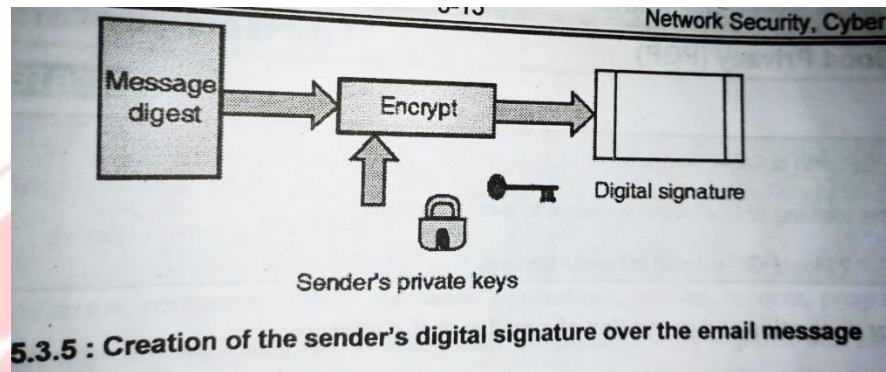
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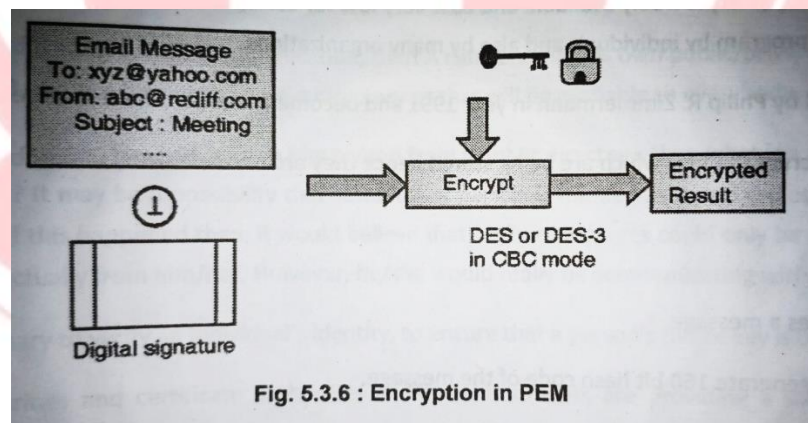
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- **Step 3: Encryption**
- Original email and digital signature are encrypted with symmetric key
- DES or DES3 algorithm in CBC(cipher Block code) mode is used



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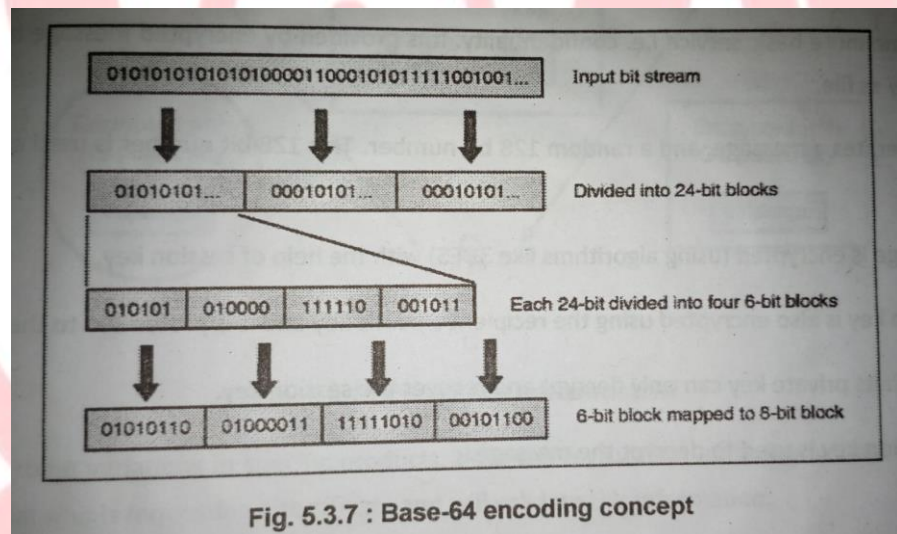
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- **Step 4: Base-64 Encoding**
- This transforms binary input to printable character output
- Here binary input processed in block of 3 octets or 24 bits
- 24 bits are considered in 4 sets of 6 bits
- 6 bits then mapped into 8 bits characters



- **Pretty Good Privacy (PGP)**
- Used for encryption and decryption of email

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- Also uses digital signature to ensure integrity of email
- Freely available/low-cost commercial version
- Widely used
- Ensures privacy
- Developed by – Philip R. Zimmermann in 1991
- Has become a standard for email security
- PGP encrypted files cannot be read by unauthorized users of intruders
- **How it works?**
- **Authentication**
 - Sender creates message
 - SHA-1 is used to generate 10-bit hash code of message
 - Hash code encrypted -using sender's private key → result is pretended message

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- Receiver uses- sender's public key to decrypt → recovers the hash code
- Receiver generates new hash code and compares
- If matches → message accepted

- **Confidentiality**

- PG provides confidentiality by encryption
- Sender generates message – 128-bit number
- This is used as session key of this message only
- Message encrypted using 3DES using session key
- Session key- encrypted using recipient's public key → pretended to be the message
- Receiver decrypts with his private key

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- Receiver can only decrypt and recover session key
- Session key is used for decryption

5.4 PKI (Public Key Infrastructure)

- Provides → essential components for
→ different types of users and entities for
→ **secure communication**
- **Components of PKI-**
 - Hardware, applications, policies, services, programming interfaces, cryptographic algorithms, protocols, users, utilities
 - These components **work together**
 - **Communicate** using -public key cryptography, symmetric key for digital signature, data encryption and integrity

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- No need to construct PKI application – because same functionality is provided by different applications and protocols
 - If A and B want **secure** communication
 - A generates **own public/private key**
 - A **sends** his public key to B or places public key in **dictionary** (so available to everybody)
 - B **receives** A's public key
 - What is guarantee that this is the correct key
 - If key is **changed** with C (may be **attacker**)
 - B **feels** that he is communicating with A
 - But **actually**, he is communicating with C
 - It is necessary to verify individuals' identity

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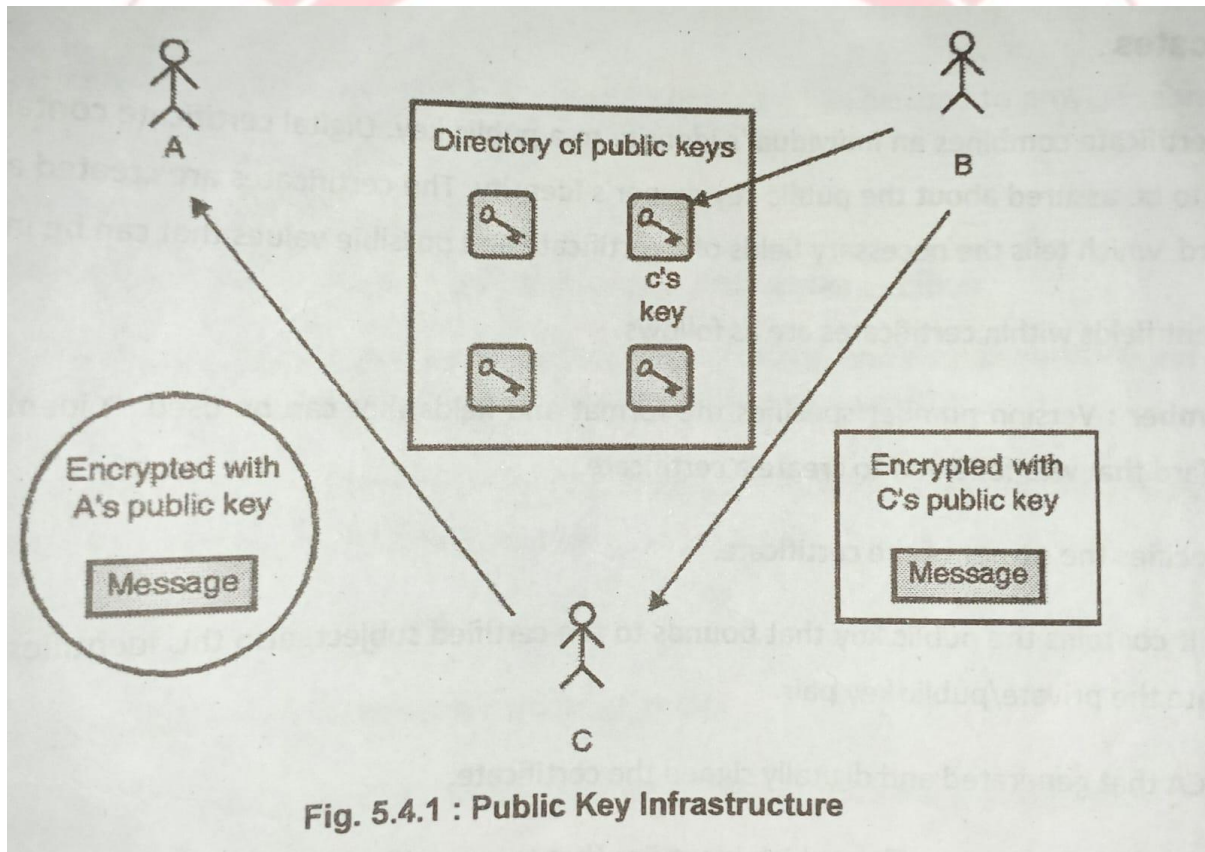
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- Person's **public key** is bound to their identity
- Registration authority and certificate authority → work like **R.T.O.**



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- for **variation** of product → CA will ask for **proof of identity** and will **validate information provided**
- RA will take **advice** of CA → to generate a certificate
- CA will **digitally sign certificate** using private key
- A and B trust CA and hence they trust digitally signed message as well
- A and B both are **authenticated** for communication

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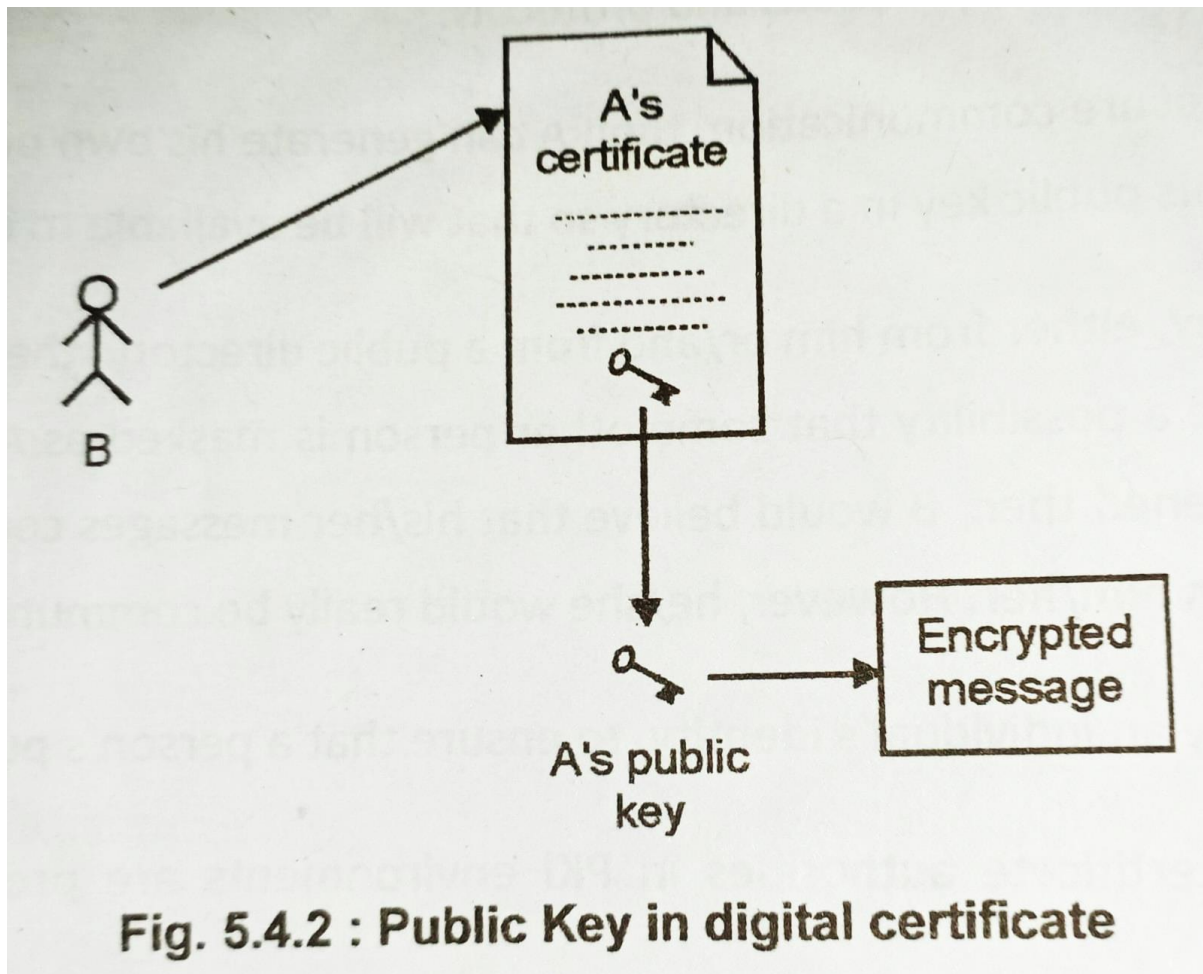
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- **Certificates**
- **Digital certificate** – combines individual's identity to public key

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- Certificates are **created** and **formatted** based on **X.509 standard**
- Standard tells necessary **fields** and possible **values** to be inserted in those fields as follows:
 - **Version number:** version of X.509 standard **followed to create certificate**
 - **Subject:** specific **owner** of certificate
 - **Public key:** public key bound to certified subject – **algorithm** used to create public/private key pair
 - **Issuer:** the **CA** that generated and digitally signed the certificate
 - **Serial Number:** unique number identifying specific certificate issued by particular CA
 - **Validity:** identifies dates through which certificates are valid for use

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- **Certificate Usage:** specifies for what purpose user can use public key
- **Signature Algorithm:** identifies hashing algorithm and digital signature algorithm used
- **Extensions:** additional data which can be encoded into certificate to **expand** certificate's functionality
- **Certificate attributes**
- **4 types of certificates**
 - **End-entity certificates:**
 - Issued by **CA** to specific subject
(*accounting department or firewall*)
 - **CA certificates:**

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- **Standalone** or **Root CA's** – **self signed** or issued by **superior** CA within hierarchical model
- Superior CA gives **authority** to **subordinate** CA → to accept request for certificate and generate individual certificates itself
- Organization with **different departments** need to have their **own CA**
- **Cross-certificates:**
- Independent CA's establish **peer-to-peer trust relationship**
- **One CA can issue certificate allowing its users to trust another CA**
- **Policy Certificate:**
- Used for placing policy information
- CAs used for high security applications

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- A mechanism used to provide **centrally controlled policy** information to PKI clients

- **Certificate Extensions**
- Allows **additional information** within certificate
- Used to provide **more functionality** in PKI implementation
- Extension can be **standard** or **private**:
- **Standard**: implemented for **every** PKI implementation
- **Private**: defined for **specific organization** as per business needs

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- Key examples of certificate extensions
 - **Digital Signature:**
 - Key is used to **verify** digital signature
 - **Key Encipherment:**
 - Key is used to **encrypt** other keys used for **secure** key distribution
 - **Data Encipherment:**
 - Key is used to **encrypt data** and cannot be used to encrypt other keys
 - **CRL (Certificate Revocation List) Sign:**
 - Key is used to **verify** CA signature on a **revocation list**
 - **Key Cert Sign:**
 - Key is used to **verify** CA signature on certificates
 - **Non-Repudiation:**

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- Key is used when **non-repudiation service** is being provided
- **Certificate Lifecycle**
- **Lifetime** is **set** for keys and certificate → user need to register for **new certificate after particular time**
- **Shorter** lifetime → **limits** attacker to crack them
- **Longer** lifetime → have lower system overhead
- PKI performs
- → **automated** and **transparent** key updates
- → saves **time** and **expenses** for new registrations (when old certificate expires)
- Certificate management involves
 - **Administrating** and **managing** each phase → registration, certificate and key generation, renewal, revocation

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- **Certificate Authority**
- CA → create **Digital Certificate** → indicates that individuals are **who they say they are**
- Digital Certificate – **establishes association** between → subject's identity and public key
- Certificate's private and **public** key are stored separately
- **CA** is made up of → **software, hardware, procedures, policies, people** → **validating** individual's **identity** and generating certificates
- If any **component** is **compromised** → **affects CA negatively** → threatens **integrity** of certificates
- Certificate Practices Statement (CPS) **outlines:**
 - How to **verify** identity

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- **Steps** CA should follow to generate, maintain, transmit certificates
- Why CA can be **trusted**
- **CPS describes** complete CA procedure
- Before using public CA – company's authority should **examine** CA's entire CPS- for meeting their needs
- **Trust** between CA and user is **part of PKI**
- **Certificate server**- service which issues certificate depending upon data given during initial registration process
 - Server **constructs certificates** based on information provided
 - It **combines** users public key with resulting certificate
 - Then certificate is **digitally signed** with CA's private key

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- **Registration Authority**
- Accepts request for digital certificate
- Performs **steps** for → **Registration and authentication**
- **3 different types of certificates:**
 - **Class 1**
 - Used to **verify individuals' identity** through **email**
 - Certificate recipient can use their public/private key to **digitally sign e-mail** and **encrypt message content**
 - **Class 2**
 - Used for **software signing**
 - Software vendor will register for this type
 - To get their software digitally signed
 - Provides **integrity** to software
 - Receiver can verify **originality** of software

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- **Class 3**
- Used by **company** to setup own CA
- Allows them to carry own identification verification and generate certificates internally

- **Different classes have different requirements**
- **Class 1:** name, email address, physical address
- **Class 2:** requires additional data like driving license passport and company information
- **Class 3:** requires more information and person may need to visit RA'S office for face-to-face meeting
- **X.509/PKIX Certificate Format**
- Most **widely accepted** format
- **Verifies** that a public key belongs to the user

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- **Used for:** n/w security applications, IP security, Secure Socket Layer (SSL), Secure Electronic Transaction (SET), S/MIME, e-business applications
- **Standard information** in the certificate:
 - **Version:** which version applies to certificate
 - **Serial Number:** that distinguishes certificate from other certificates
 - **Algorithm Information:** algorithm used by issuer to sign the certificate
 - **Issuer Distinguished Name:** name of the entity issuing certificate (CA)
 - **Validity Period of Certificate:** start/end date and time
 - **Subject Distinguished Name:** name of the identity the certificate is issued to

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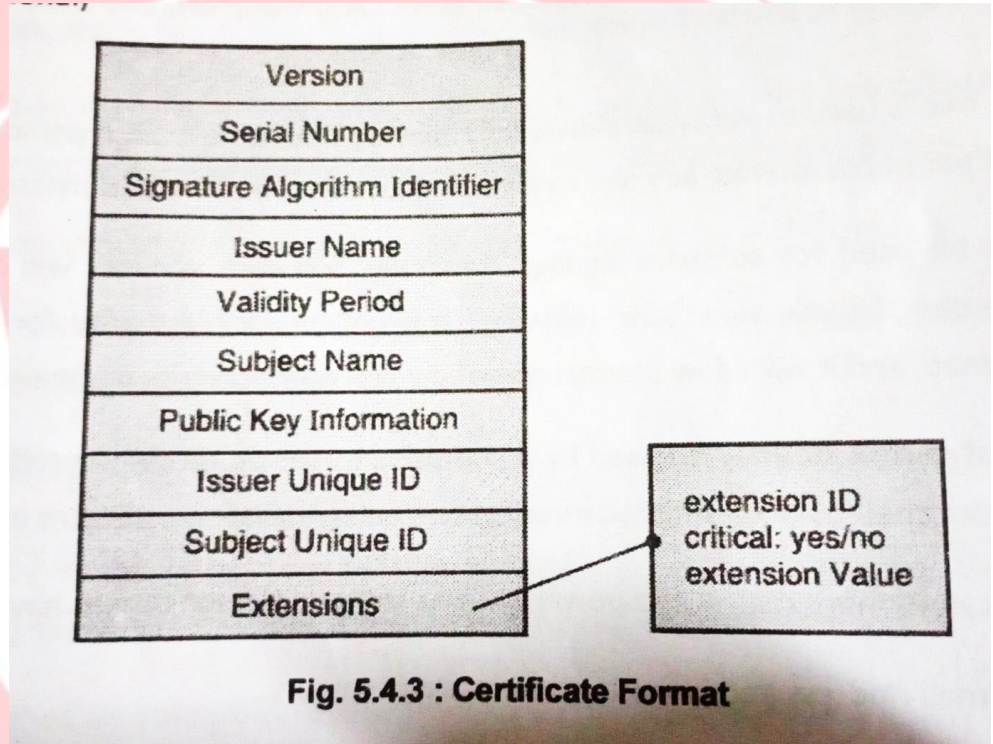
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- **Subject Public Key Information:** public key associated with the identity
- **Extensions:** optional



5.5 Cyber Crime

- Introduction

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- All criminal activities using – computer, internet and world wide web
- Also known as computer crime
- Illegal things performed- committing fraud, trafficking in child pornography and intellectual property, stealing identities, violating properties
- Potential problem to- commerce, entertainment, government
- Attack happens on individual or corporate virtual body
- Cyber crime ranges from-violation of personal or corporate information to using obtained information to blackmail a firm or individual

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- Transaction based crimes: fraud, digital piracy, money laundering , counterfeiting(fraud imitating someone else)
- Within corporation or government organizations: deliberately altering data for profit or political objectives
- Other crimes:
 1. Financial: crime disrupt business ability to conduct 'e-commerce'
 2. Piracy: copying copyright material- new way of old crime-distributing creative work protected by copyright
 3. Hacking: act of illegal access to computer system or network- for fraud or terrorism

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4. Cyber-terrorism: hacking designed to cause terror- E-terrorism cause violence-generate harm or fear
5. Online pornography: strict laws- laws for minors
6. Sabotage: hacking involving hijacking of government or corporation web-site- purposeful destruction of property- slowing down and damaging work

- **Hacking**

- Well known computer crime
- Hacker: who finds and exploits weakness of computer system and network
- This is unauthorized access

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- Purpose: launch malicious programs- virus worms trojan horses → that shut down/destroy entire system/network
- Taking credit card numbers, internet passwords, personal information, accessing commercial database
- Types of hackers:

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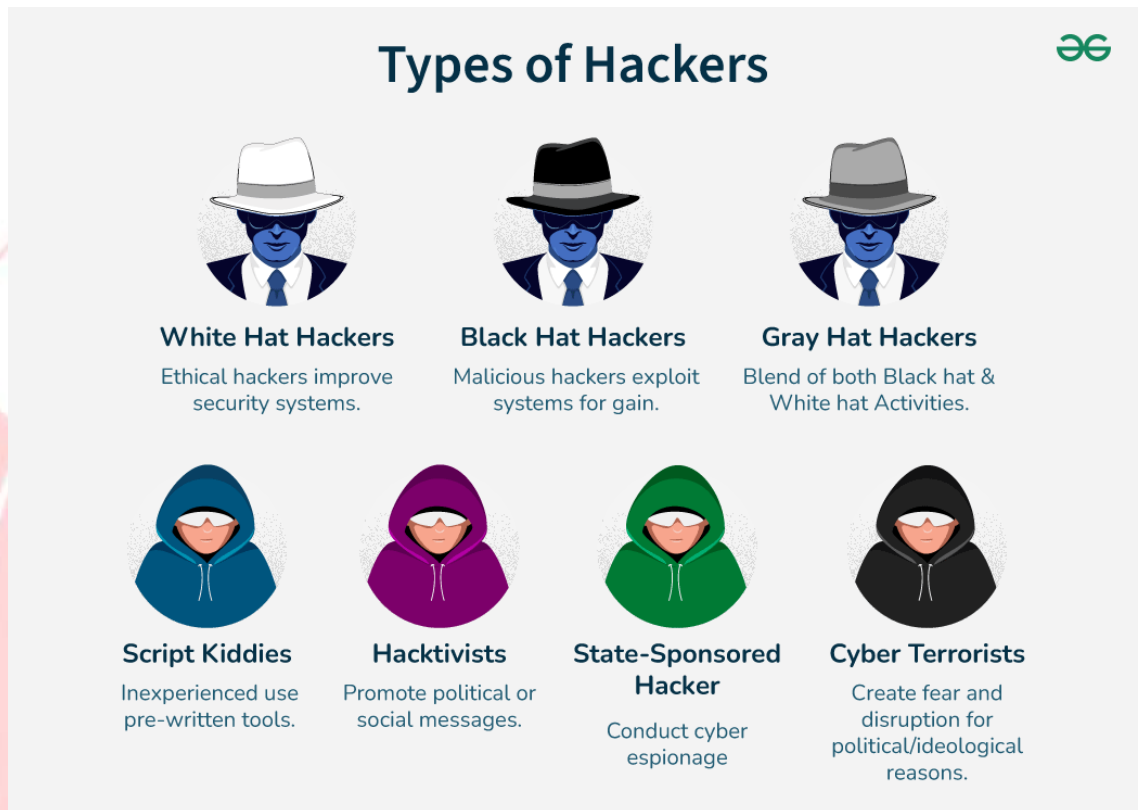
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- **White Hat:**
- Non-malicious purpose
- They are security experts
- Hired to test → how vulnerable a protective setup is
- Perform vulnerability assessment and penetration tests

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- Also called as “Ethical Hackers”
- **Black Hat:**
- Known as crackers
- Has malicious purpose
- Breaks computer security system, n/w system, telecommunication system → without authorization
- Malicious purpose: piracy identity theft, credit card fraud, damage
- May use- worms, malicious sites
- **Grey Hat:**
- Combination of white and black hats
- Not a penetration tester but will go ahead and surf internet for vulnerable system he could exploit

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- He will inform admin of website about vulnerabilities – he found after hacking the site
- Will hack site freely- without any prompting or authorized from owners
- Will offer a repair to vulnerabilities he has exposed for small fees
- **Elite Hacker:**
- Social status among hackers is underground
- ELITE – hackers among hackers
- Masters of deception
- Solid reputation among their groups
- **They are cream of hacker crop**
- **Script Kiddie:**
- Part time /non expert hacker
- He breaks into people's computer

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- Does not have knowledge about IT security
- Uses prepackaged automated script, tools or s/w → written by real hackers

- **Digital Forgery**

- Falsely altering or manipulating documents
- Intension is misleading others
- May produce false documents
- Big problems → today's era we create, process, transmit, and store documents digitally
- They can alter- pictures, images, documents, music for economic gain
- May involve electronic forgery or identity theft
- Digitally forged pictures appeal to viewer's eyes

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- Using picture processing softwares → one can later anything in the photo
- Picture processing software- Adobe Photoshop, Adobe Premier, Corel Draw, GIMP
- Photos are changed pixel by pixel
- These changes are hard to spot with human eyes
- **Cyberstalking or Harassment**
- Following a person online anonymously
- Stalker virtually follows victim and his/her activities
- Involves online harassment
- Cyberstalker uses- social media, websites and search engines to instill fear
- Cyberstalker knows the victim- makes the person feel afraid or concerned for their safety

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- Victims are mostly – women or children
- **Identity Theft and Fraud**
- **Identity theft:**
 - It's a kind of fraud
 - Cybercriminals steal- personal data- passwords, bank account details, credit cards, debit cards, social security, other sensitive information
 - Through identity theft criminal can steal money
- **Fraud:**
 - Cyber crime intends to deceive a person in order to gain important data or information
 - Fraud can be done by → altering, destroying, stealing or suppressing information
- **Cyber Terrorism**

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- Any planned, politically motivated attack against information, computer system, computer programs and data → which results in violence → against non-combatant targets by sub-national groups or clandestine agents
- Cyber terrorist attacks- explicitly designed to- cause physical harm to individuals
- Targets- banking industry, military installations, power plants, air traffic control centers, water systems
- Carried out on private servers
- Hackers can- break into computer system, introduce viruses to vulnerable networks, deface websites, launch denial-of-service, make terroristic threats electronically
- Can endanger the public safety of millions of people

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- Can cause massive panic or fatalities
- **Cyber Defamation**
- Injury caused to reputation of a person in the eyes of a third person
- By word, oral or written, by signs or by visible representations
- Intension → to lower the reputation of a person in the eyes of public
- “Publishing a defamatory material against another person with the help of computer or internet”
- Harm caused to the person is widespread, irreparable → as information is shared with entire world
- This affects welfare of community as a whole
- Impacts economy of a country
- Mediums of cyber defamation:

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- World wide web
- Discussion groups
- Intranets
- Mailing list and bulletin boards
- E-mail
- **OS Fingerprinting**
- Process if identifying OS of target device or system based on analysis of network packets it sends and receives
- OS detection can be- active or passive
- Active OS fingerprinting tools: interacts with target network
- Passive OS fingerprinting tools: does not interact with target system
 - **Passive OS Fingerprinting**
 - Gathers information about target system
 - Without actively interacting with OS

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- Examines network packets- to identify specific characteristics → IP address, active systems, open ports
- **Passive Sniffing**
- Act of observing and capturing network packets without sending any data to the target
- Uses collected information during sniffing → to analyse patterns and features → revealing target system's OS
- Commonly used items:
- **IP TTL Value**
- Different OS assign unique default IP TTL (time-to-live) values to outbound packets
- **TCP Window Size**

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- Initial window size used by TCP varies between OS
- **IP DF Option**
- Operating systems handle Don't Fragment (DF) flag differently → resulting in variations in fragmentation behavior
- **IP TOS Option**
- Type of service (TOS) field- which prioritizes certain packets → implemented differently by various OS vendors
- **Active OS Fingerprinting**
- More powerful than passive
- Eliminates the need to wait for random packets for analysis
- Uses tools to inject packets into n/w
- Analyses difference between → how various vendors implement TCP/IP stack

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- Observing these differences OS version can be identified
- Common methods used:
 - **FIN Probe-**
 - Sends packet with FIN(FINISH) flag set to observe – how system handles such requests
 - **Bogus Flag Probe-**
 - Uses packet with invalid/unexpected flag combination to elicit distinctive responses
 - **Initial Sequence Number (ISN) Sampling-**
 - Analyzes pattern of sequence numbers in TCP connects to determine randomness and predictability
 - **IPID Sampling-**
 - Observes behavior of ID field of IP header to identify patterns unique to specific OS

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- **TCP Initial Window-**
- Examines size of initial TCP window advertised by the system
- **ACK Value-**
- Analyses how system responds to ACK packets under certain conditions
- **Type of Service-**
- Tests how target system handles the type of service field in IP packet
- **TCP Option-**
- Evaluates use and order of TCP options (such as MSS maximum segment size, window scaling)
- **Fragmentation Handling-**
- Examines how system handles fragmented IP packets

5.6 Cyber Law

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○ **Introduction and Need**

- Describes legal issues related to use of communication technology
- Rules that control the conduct of cyber activity and security under cyber space
- Law is related to computers, network, software, data storage devices, internet, websites, emails, electronic devices, cell phones, mobiles, ATM machines etc
- Also includes intellectual property-privacy, freedom of expression, jurisdiction
- Cyber law is an attempt to apply laws designed for physical world to human activities on internet
- IT Act 2000- has been made punishable

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- Objective- create environment where Information Technology can be used safely
- IT Act 2000 is altered by IT Act 2008- known as Cyber Law
- Has separate chapter entitled Offences
- Various cyber crimes have been declared as penal offences punishable with imprisonment and fine
- **Categories**
- 3 major categories
 - **Crime Against Individual**
 - Includes cyber harrasment and stalking
 - Distribution of child pornography
 - Credit card fraud
 - Human trafficking

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- Spoofing
- Identity theft
- Online libel or slander
- **Government**
 - If cyber-crime committed against government
 - Considered as attack on nation's sovereignty
 - It includes- hacking, accessing confidential information, cyber warfare, cyber terrorism, pirated software
- **Property**
 - Online crimes against property
 - Computer or server
 - DDOS Attack, hacking, virus transmission, cyber and typo

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squatting, computer vandalism,
copyright infringement, IPR violation

5.7 Compliance Standard

- **Information security → top concern** in government and business
- Bench marks, standards and legal regulations are set for information security
- Different **frameworks** used: - ITIL, COBIT, SMMI, ISO/IEC 20000, ISO 9000

Implementing and Information Security Management System (ISMS)

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- **Part of management system** dealing with information security
- **ISMS**→
- “Set of **policies** and **procedures** specifying instruments and methods – management should use to- manage the **tasks** and **activities** to achieve **security** → (plan, adopt, implement, supervise, improve)”
- ISIM **provides**- systematic approach towards management of information security
- **4 levels of documentation** in ISIM:

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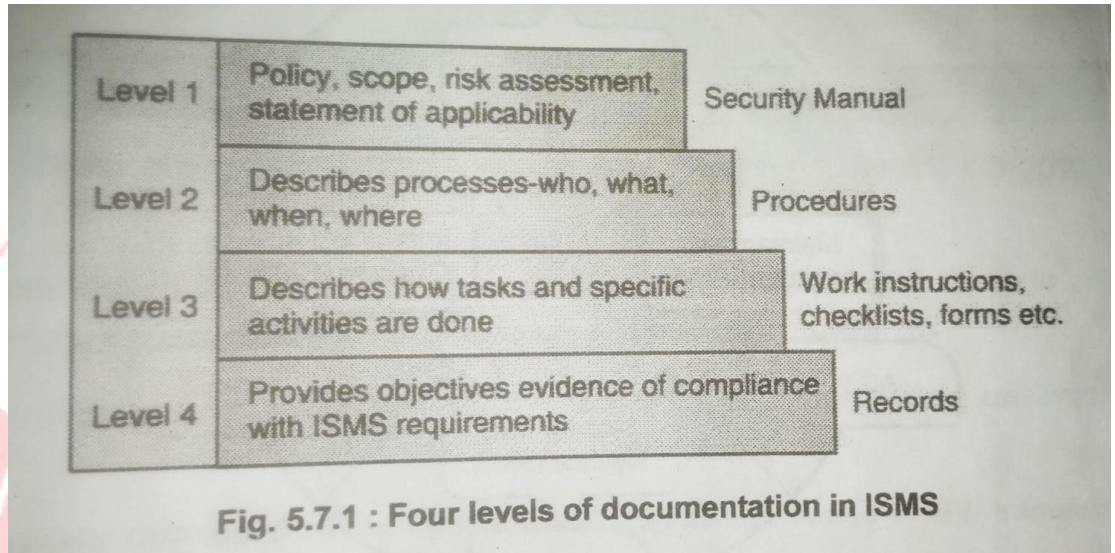
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- Organizations should **identify** the nature of possible threats to information system
- Hence, they can **ensure controls for security**
- Organizations should **continuously audit** and **evaluate** controls to ensure privacy and confidentiality of data
- **ISO 27001**
- International Organization for Standard
- Established in **1997**

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- Non-governmental international body
- **Collaboration** with
- **IEC**- International Electrotechnical Commission
- **ITU**- International Telecommunication Union on Information
- **ICT**- Information and Communication Technology Standard
- ISO 27001 describes following processes:
 1. Definition of information security policy
 2. Definition of scope of ISMS
 3. Security Risk Assessment
 4. Manage the identified risk
 5. Select controls for implementation
 6. Prepare SoA (Statement of Applicability)
- ISO 27001 uses **PDCA(Plan-Do-Check-Act)** approach to improve effectiveness:

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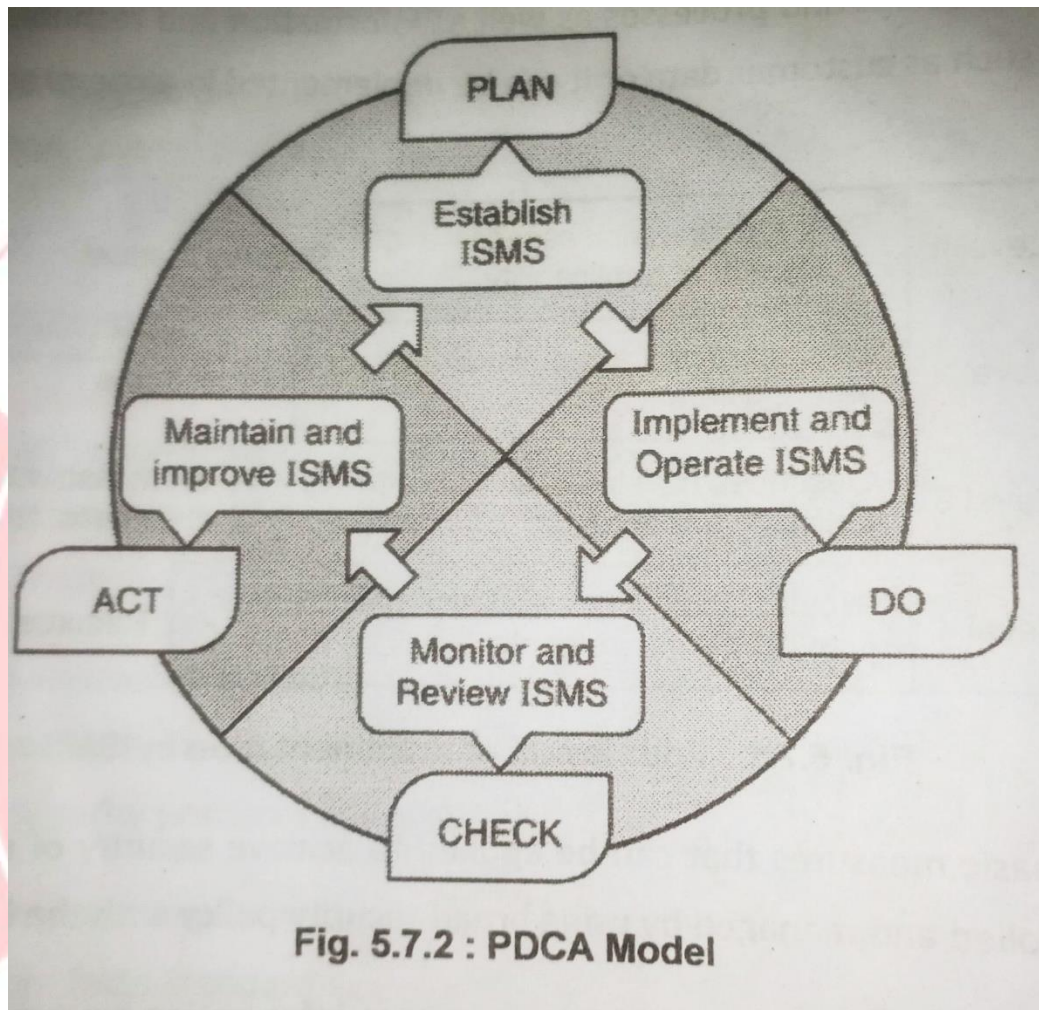
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- **Plan:** plans the **basic organization** of information security, sets objectives for information security and chooses appropriate security controls

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- **Define** the scope and policy of ISMS
- **Identify** the **methodology** for risk assessment and **determine** the criteria for risk acceptance
- **Select controls** for risk treatment
- **Do:** carrying out everything that was planned during previous phase
 - **Write & implement** risk treatment plan
 - **Implement** security controls
- **Check:** **monitor** the functioning of ISMS through various channels and **check** whether the **results meet** the set of objectives

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- **Monitor** different **processes** and take regular **reviews** of effectiveness of ISMS
- Conduct internal **audits**
- **Act:** **improve everything** that was **identified** as non-compliant in the previous phase
 - **Implement** identified **improvements** in ISMS
 - Take **corrective actions** and **preventive actions**
 - **Communicate** with stakeholders about **activities and improvements**
- **ISO 27001** allows→
 - selection of objectives and controls of security

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- which shows the unique security risks and requirements

- **ISO 20000**

- It's an **industry standard**
- It offers **-organizational certification**
- It shows IT- **how to manage and improve IT while establishing audit criteria**
- It also provides **standard for auditors**
- This is an **organizational certificate with international recognition**
- Developed and published in **December 2005**
- It has **2 specifications**
 - **ISO 20000-1:**
 - **for service management → organizational certification uses this section**
 - **sections:**

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- scope
- terms and definition
- requirement for a management system
- planning and implementing service management
- planning and implementing new or changed services
- the service delivery processes
- relationship processes
- resolution processes
- release processes
- control processes
- **ISO 20000-2**
- **Documents a “code of practice”**
- **Explains how to manage IT with regards to ISO 20000-1 audits**

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- Includes **sections** from part 1 → **except requirements for a management system**
- Both 1 & 2 derive directly from the ITIL **best practice**
- It **groups the processes** into 5 core bundles as follows:

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ISO 20000 groups the ITIL processes into following five core bundles .

Table 5.7.1 : ITIL processes

Service Delivery Processes	Relationship Processes	Resolution Processes	Control Processes	Release Process
Service Level Management	Business Relationship Management and Supplier Management	Incident Management Problem Management	Configuration Management Change Management	Release Management
Availability Management				
Capacity Management				
Continuity Management				
Budgeting Management				
Accounting/Financial Management				
Information Security Management				

- ISO 20000 is a **requirement for outsourced IT services** → stated by **government**
- ISO 20000 **includes** →
 - service delivery & service support

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- suppliers' management, business management, security management
- it helps organization in **benchmarking**→
 - IT service management
 - Improving services
 - Demonstrating an ability to meet customer requirement
 - Creating a framework for an independent assessment
- **Benefits** of ISO 20000 certification for service providers:
 - It offers competitive differentiation by demonstrating **reliability** and **high quality of service**
 - It gives access to **key markets**; many organizations and IT service providers

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demonstrate compliance with ISO/IEO 20000

- It provides **assurance** to clients that their service **requirements will be fulfilled**
- It enforces **measurable level of effectiveness**
- It enables service provider to **monitor, measure and review** service management processes
- It helps in **optimizing resources and processes**
- **BS 25999**
- **BCM- Business Community Management** → subject of **British Standard 25999**
- Important for **all types of organizations** and their **members**
- An organization can face many issues-

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- Natural disasters, terrorist activities, unable to respond on time, unable to process transactions etc. → this **impacts organization's effective operations**
- BS 25999 standard has **2 parts**:
- **BS 25999-1**
 - It's a **code of practice** for BCM
 - **Contains-** general **guidance** on the process, principles and terminology recommended for BCM
 - **Published by – British Standard Institution – in December 2006**
- **BS 25999-2**
 - A specification for **Management Scheme**

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- Set of **requirements**- for implementing, operating and improving – BCM system
- Published in **November 2007**
- **Benefits of BCM in the organization**
- **Increased flexibility**→ when faced with organizational threats
- **Improved competence**→ to maintain critical business services through action plan rehearsal
- **Enhanced capability**→ to handle disruption and protect brand reputation when integrated with business planning
- For customers – it provides: - **confidence and trust in organization**
- It helps to **recover quickly from potential risks and reduces such risks**

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- **PCI DSS**
- Payment **Card** Industry Data Security Standard
- Administered by **PCI Security Standard Council**
- **Purpose:** - to decrease payment card fraud across internet and to increase credit card data security
- **Organizations** – processing or transmitting card holder's data – must **comply PCI DSS**
- Compliance is **regulated by** → **acquiring bank** → organization must have **merchant account** there
- PCI DSS –can be applied to -
 - **For Merchant:** have responsibility for ensuring all contracted parties are compliant with standard

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- **For Service Providers:** if dealing with cardholders' data
- Can be applied to **whole organization** or **subset of organization** → **storing and transmitting cardholders' data**
- It **includes** -electronic systems, receipts, mail order forms, phone conversations, data being read by call center operators
- This standard **requires**- **merchants** and **MSPs** (Member Service Providers) to →
 - **Build secure network** - using firewalls and maintain it
 - **Protect stored data**- encrypt transmission across network
 - **Manage vulnerability** - using anti-virus and its security patches
 - **Implement strong access control**

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- **Monitoring and testing** networks regularly
- **Maintain-** detailed and up to date security policy
- **ITIL Framework**
- Successful mechanism- to drive **consistency, efficiency** and **excellence** into business of managing IT services
- ITIL is an **approach to IT Service Management**
- **SERVICE:** - provides value to the customers – customers can **directly utilize or consume** them → known as business services
- **SERVICE MANAGEMENT:** - set of specialized **organizational capabilities for providing value to the customers** in the form of service
- E.g. **payroll** → calculating salaries, compensations, generating cheque etc

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- **Payroll** business services **include** → server administration, database administration, storage administration
- **ITIL** – **used in conjunction with** →
 - **COBIT** (framework for IT Governance and Controls)
 - **Six Sigma** (a quality methodology)
 - **TOGAF** (a framework for IT architecture)
 - **ISO 27000** (a standard for IT security)
 - **ISO/IEC 20000** (a standard for IT service management)
- ITIL is organized around a service lifestyle which **includes**:
 - **Service Strategy**:
 - **Understanding** IT customers
 - **Meeting** customers' needs

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- **Resources** required to execute requirements successfully
- Try to **ensure** cost of delivery is consistent with values delivered to the customer
- **Service Design:**
 - **Ensures** new and changed services are designed effectively
 - **Technology** and **architecture** should meet customers' needs cost effectively
 - **Monitor** and **support** new or modified services
 - **Measure** service levels, technology an efficiency and effectiveness of processes
- **Service Transition:**

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- Design is **built, tested and moved** into production to **enable customers to achieve desired value**
- **Service Operation:**
 - After transition service operation delivers services
 - Manages **disruption** to services through **rapid restoration**
 - **Determining** root cause of problem
 - **Detecting** trends associated with recurring issues
 - **Handling** daily routine
 - **Managing** service access
- **Continual Service Improvement (CSI)**
 - It's a **mechanism** for IT organization to measure and improve service levels

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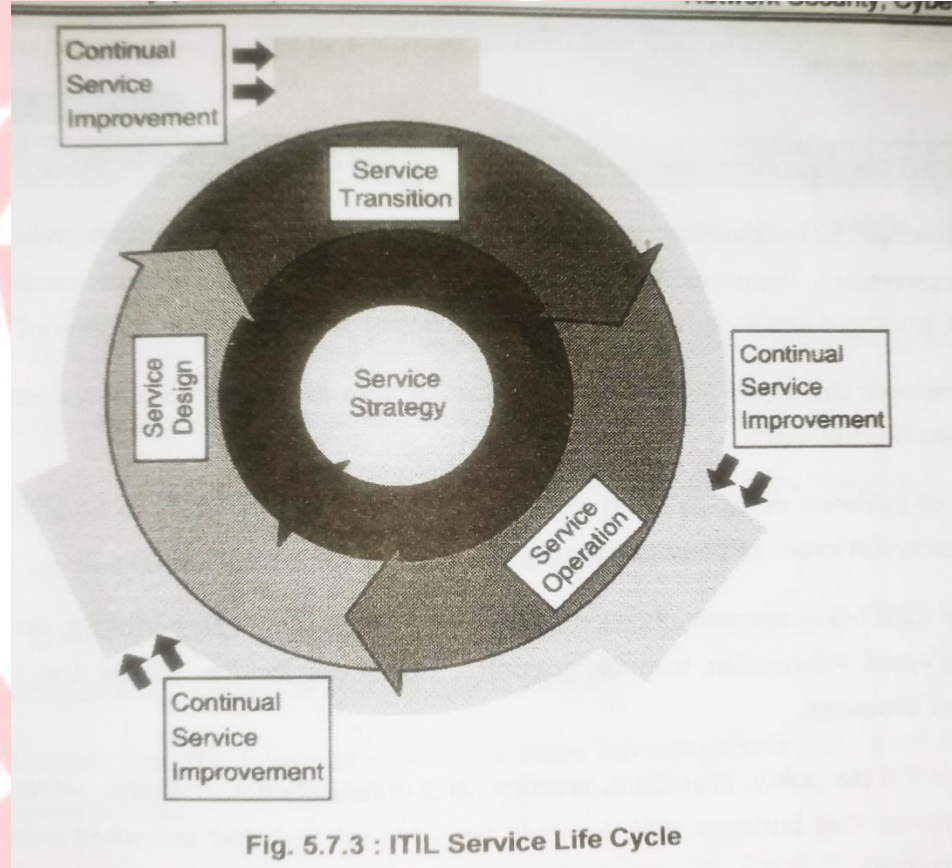
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- **Improve technology**
- **Effectiveness** of process in overall management of services



-
- **Benefits to organization with ITIL framework**
- **Improve resource utilization**

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- Be more competitive
 - Reduce re-work
 - Eliminate redundant work
 - Improve availability, reliability and security of business-critical IT services
 - Improve project deliverables and time-scales
 - Justify the cost-of-service quality
 - Provide services that meet or exceed business demands
- **ITIL framework can be adopted by many companies like:-**
 - Large technological companies
 - Retailers
 - Financial services organizations
 - Entertainment
 - Manufacturing

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- Life sciences companies

- **COBIT Framework**

- **Control OBjectives** for Information and related Technology → “A control framework that **links** IT initiatives to business requirements, **organizes** IT activities into a generally accepted process model, **identifies** the major IT resources to be leveraged and **defines** the management control objectives to be considered”
- **Developed** by **ISACA**- Information System Audit and Control Association
- IN the year **1996**- for IT management and IT governance
- It's a **set of materials for IT governance**

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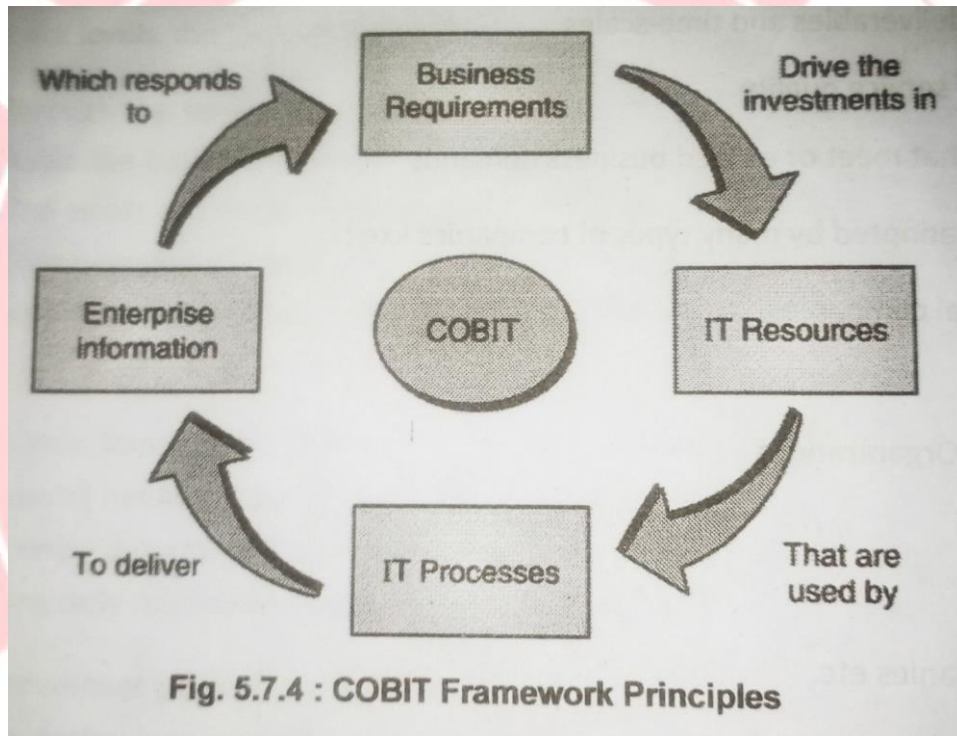
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- It allows managers to bridge the gap between control requirements, technical issues and business risks
- COBIT framework principles:



- COBIT Criteria:

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- **Effectiveness:** means- **information** is – relevant, timely, correct, consistent and applicable to business process
- **Efficiency:** means- **information** is optimal for productive as well as economical use of resources
- **Confidentiality:** means- **information** is protected from unauthorized use
- **Integrity:** means- **information** is accurate, complete and valid for business
- **Availability:** means- **information** will be available whenever required by business process
- **Compliance:** means- **information** has fulfilled all laws, regulations and contractual agreements externally

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imposed business criteria and internal policies

- **Reliability:** means- information is appropriate for management to operate the entity and apply governance responsibilities

- **Control objectives of COBIT:**

- **Quality control** components show- quality and delivery of facility
- **Fiduciary control** component show- efficiency, effectiveness and consistency of information and compliance
- **Security control** component shows- security goals (CIA)

- **COBIT defines IT activities – in generic process model in -4 domains**

1. Plan and Organize (PO)

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- Provides direction to **solution delivery** and **direction delivery**
- Addresses following **questions**:
 - **Definition** of strategic IT plan, information architecture, IT organization and relationship
 - **Decide** technology directions, assess the risk
 - **Make sure** compliance with external requirements

2. **Acquire and Implement (AI)**

- **Provides solutions** and **turns** them into **services**
 - **Recognize** automated solutions
 - **Acquire** and **maintain** application software and technology infrastructure

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- **Develop** and **maintain** procedures and manage changes
- **Install** and **credit** the system

3. Deliver and Support (DS)

- **Receives solutions** and **make them usable** for end users
 - **Define** service levels
 - **Manage** service levels, third party services, performance, capacity, configuration, data, facilities, operations, problems and incidents
 - **Ensure** security of system
 - **Educate** and **train** users, provide assistance and advice to users
 - **Recognize** and **allocate** the cost

4. Monitor and Evaluate (ME)

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- **Monitor processes** to ensure that the direction provided is followed
 - **Monitor** the process, assess internal control capability
 - **Find** independent assurance
 - **Provide** independent audit
- COBIT framework **ensures** that:
 - IT is aligned with the business
 - IT enables the business and maximizes benefits
 - IT resources are used responsibly
 - IT risks are managed appropriately

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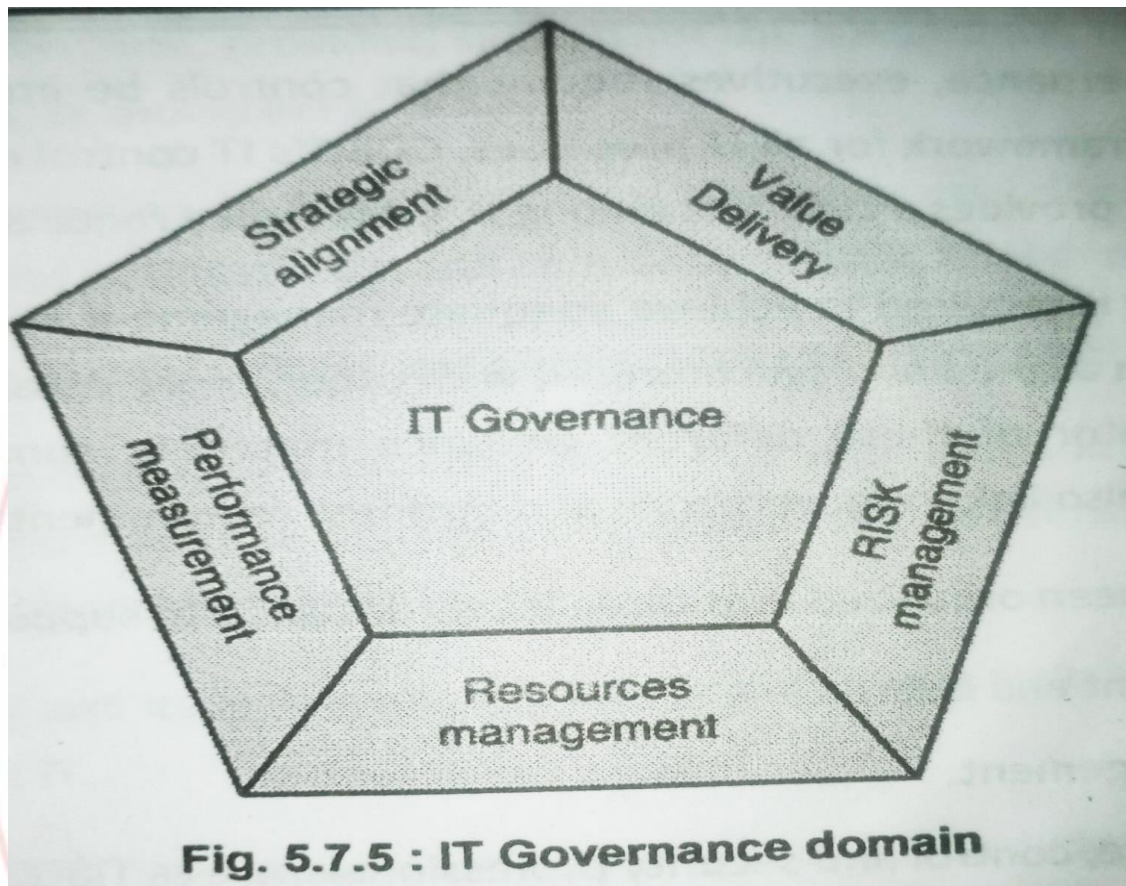
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i) **Strategic Alignment**

- Focuses on ensuring **connection** of business and IT plans
- **Defining, maintaining and validating** value of IT plans

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- **Aligning** operations between IT and enterprise
- ii) **Value Delivery**
- **Execution** of the **value plan** during delivery cycle
 - It **ensures** that IT delivers assured benefits against the strategy
 - Concentrates on **optimizing costs** and providing intrinsic IT value
- iii) **Resource Management**
- **Focuses** on **best possible investments and the correct management** for **critical** IT resources like → applications, information, infrastructure and people
- iv) **Risk Management**
- **Focuses** on risk **awareness** by senior management officers
 - Gives clear **understanding** of risk

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- **Focuses** on - compliance requirements, transparency of major risks and implementation of risk management

v) Performance Management

- Takes **follow up** and **monitors** strategic implementation, project completion, resource usage , process performance and service delivery
- **COBIT products – organized into 3 levels: -**
 - Executive management and boards
 - Business and IT management
 - Governance, assurance, control and security professionals
- **Effective IT governance covers following key aspects:**
 - **What** type of decisions should be taken for effective management and use of It?

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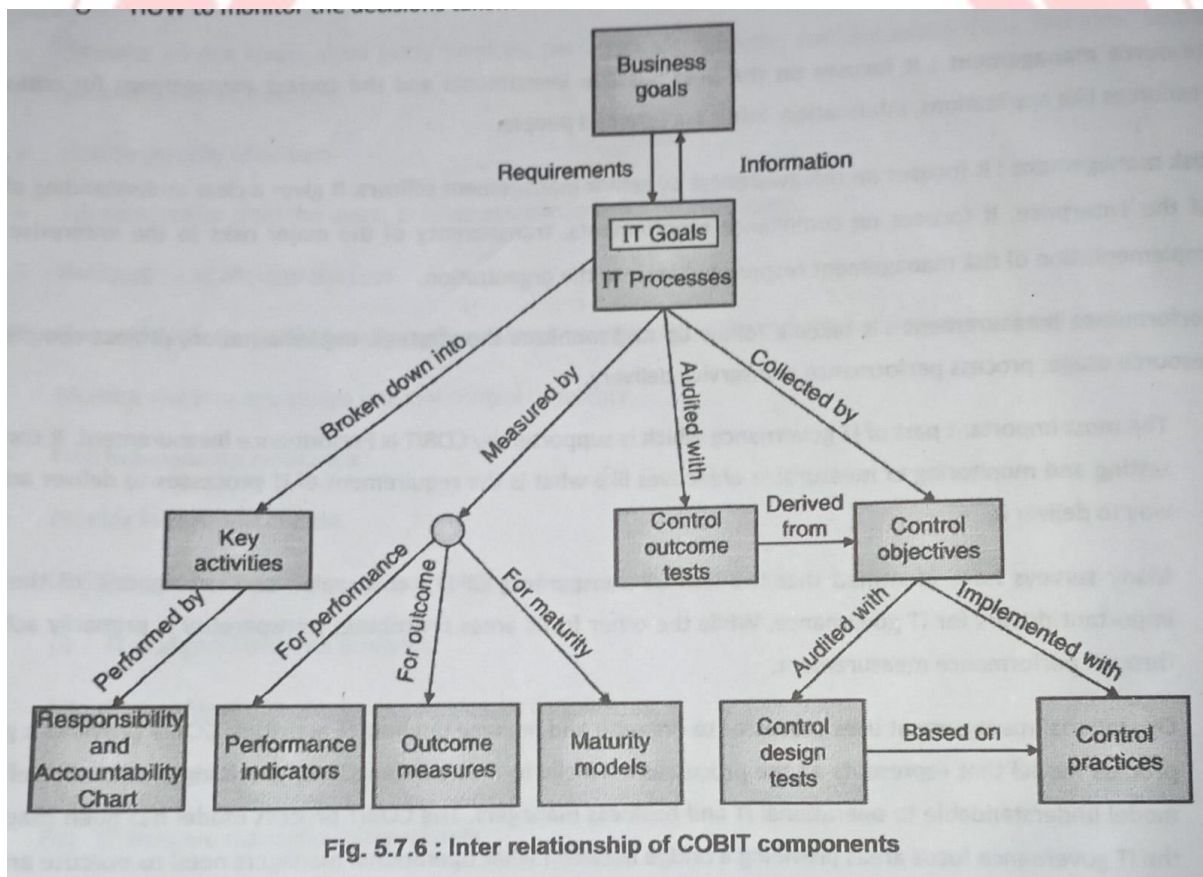
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- **Who** should take such type of decisions?
- **How** to monitor the decisions taken?



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- **Benefits** of implementing COBIT
- Better alignment based on **business focus**
- **Understandable** to management
- **Clear ownership and responsibilities**- based on orientation
- General **acceptability with third parties and regulators**
- Shared **understanding** among all **stakeholders** -based on **common language**
- Fulfillment of **COSO** (**Committee of Sponsoring Organizations of the Treadway Commission**) requirements for IT control environment

---XXX---end of unit 5---XXX---

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