DSP Unit I

Security Architecture (Introduction):

→ Security means avoiding unauthorized access.
→ Security breaches include: virus alerts, email spamming, identity theft, data theft, etc.
→ Database security is the degree to which all the data is fully protected from tampering or unauthorized acts.

Information Systems: (Security Architecture):

→ Wise decisions cannot be made without accurate and timely information. At the same time, integrity of information is important.
→ The integrity depends on the source and reliable processing of the data.
→ Data is processed and transformed by a collection of components working together to produce and generate accurate information. These components are known as Information System.
→ Information system can be a backbone of day to day operations of a company.
→ Information Systems can be categorized based on usage.
→ Information System can be classified into three categories:
① Transaction Processing System (TPS)
② Decision Support System (DSS)
③ Expert System (ES)

(*) Transaction Processing System (TPS): Characteristics.
→ Also known as online Transaction Processing.
→ Used for operational task.
→ Provides solution for structured Problems.
→ Includes business transactions.
Typical Application System:
Order tracking, Customer Service, Payroll, accounting, Student Registration, sales.

(*) Decision Support System (DSS): Characteristics:
→ Deals with nanostructured Problems.
→ Provides recommendations or answer to solve these problems
→ Capable of what-if? Analysis.
→ Contains collection of business models.
Typical Application System:
Risk Management, Fraud Detection, Sales forecasting, etc.

(*) Expert System (ES): Characteristics:
→ Captures reasoning of Human Experts.
→ Used by top level management.
→ Branch of Artificial Intelligence.
→ Consists of Knowledge Base, Inference Engine, Rules.
→ People consist of Domain Experts, Knowledge Engineers, Power users.
Typical Application System:
Virtual University simulation, Loan Expert, Market Analysis Statistical trading, Financial Enterprise.

Components of Information System:

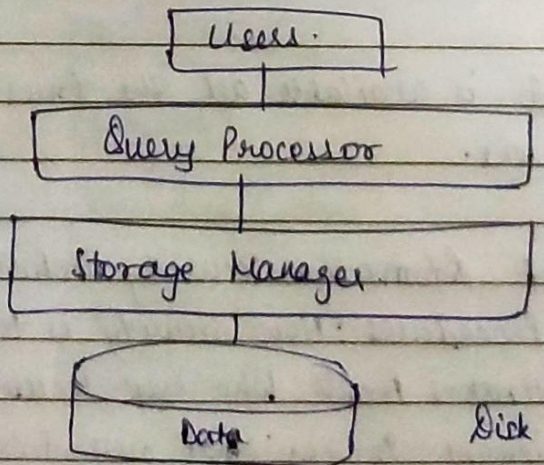
1. Data
2. Procedures
3. Hardware
4. Software tools
5. Network
6. People. (Users, System Analysts, Business Analysts, etc.)

(*) Database Management System:

→ A collection of meaningful Integrated Information System.
→ Both Physical and logical.
→ Represents logical information in physical device.
→ Mainly used for storing and Retrieving data for processing.
→ Uses Client / server architecture.
→ There is a set of programs to access the database.

Purpose of DBMS:

1. Data redundancy & inconsistency.
2. Difficulty in accessing data.
3. Data Isolation
4. Integrity Problems.
5. Atomicity
6. Concurrent access.
7. Security Problems.



(M). Information Security Architecture:

→ Information is one of the most valuable asset in an organization.

→ Many companies have Information security Department.

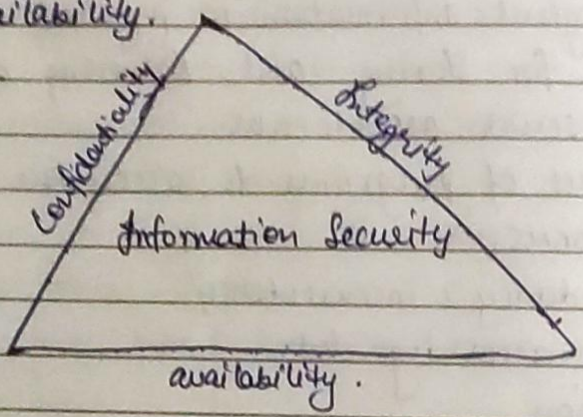
→ It consists of the procedures and measures taken to protect each component of Information Systems.

→ CIA triangle:

C → Confidentiality

I → Integrity.

A → Availability.



→ Confidentiality: Info is classified into different levels of confidentiality to ensure only authorised users access the info.

→ Integrity: Info is accurate and protected from tampering.

→ Availability: Info is available all the times only for authorized users.

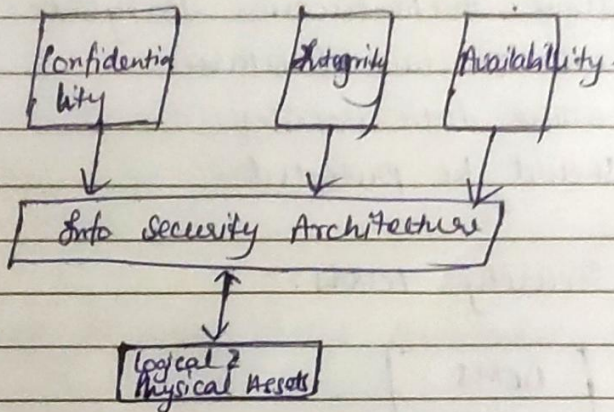
Components of Information Security Architecture:

① Policies and Procedures: How security is to be carried out.

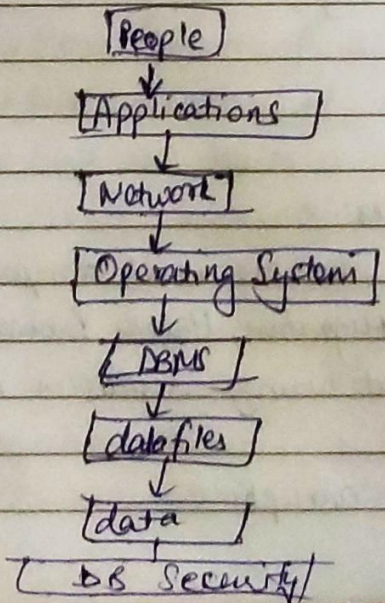
② Security Administrators: People who keep security in order.

③ Detection equipment: Devices that authenticate users.

④. Security Programs: Tools to protect computer systems & servers.
⑤. Monitoring Equipments: To monitor physical properties, employees, etc
⑥. Monitoring Applications: Applications used to monitor n/w traffic.
⑦. Auditing Procedures and tools: Ensures that security measures are working.



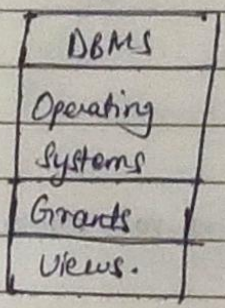
(*). Database Security:
→ One of the functions of DBMS is to empower DBA to implement security at all levels.
→ Security access point: A place where database security must be applied.
→ Database security Access points:



Database Security Access Points:

① People: Individuals who have been granted privileges and permissions.
② Applications: Application design and implementation
③ Network: Protect the N/ow. Most one of sensitive. Sec. APIs
④ Operating systems: Authentication to system.
⑤ DBMS: logical structure of database.
⑥ Data files: where data resides.
⑦ Data: should be protected.

(*). Database Security levels:



Menaces to databases.

① Security Vulnerability
② Security Threat
③ Security Risk.

Examples of Risk Types:

① People: loss of people who are vital components.
Eg: loss of key person(Migration, Health problems).
② Hardware: A risk that mainly results in hardware unavailability.
② Data: Data loss or data corruption.

④ Confidence: loss of procedural data, frauds, etc.

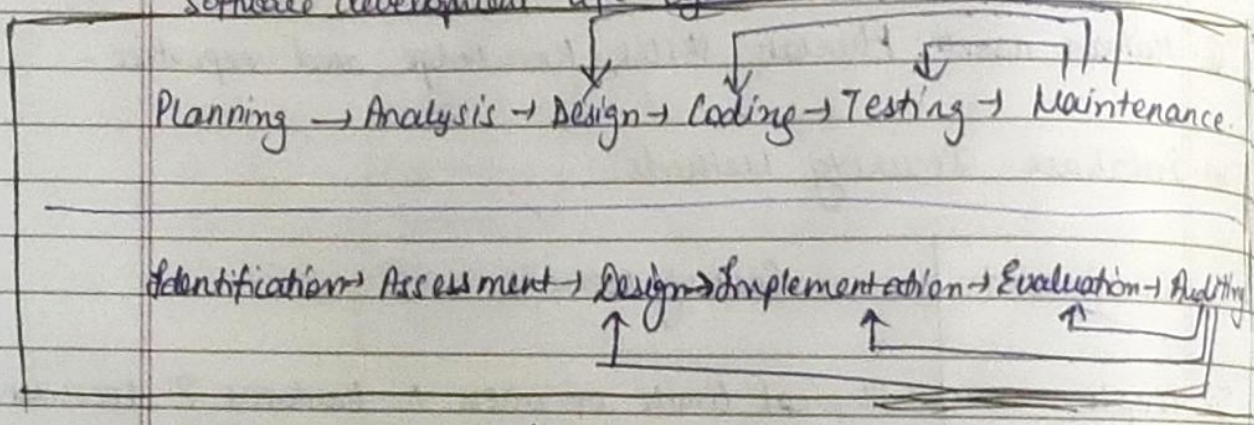
(iii) Asset Types and their values:
→ Infrastructure of company operation.
→ 4 main types: Also called tangible assets.
ⓐ Physical Assets: Include buildings, cars, hardware, etc.
ⓑ Logical Assets: Logical aspects of Information System such as business applications, in-house programs, purchased softwares, OS, data bases, data, etc.
ⓒ Intangible assets: Business reputation, quality, public confidence.
ⓓ Human assets: Human skills, knowledge and expertise.

(iv) Database Security Methods:

Component	Security Methods
① People	→ Physical limits on access to hardware & documents. → Thorough process of identification & authentication. eg: ID cards, eye scans, passwords, etc. → Training courses on importance of security. → Establishment of security policies and procedures.
② Application.	→ Authentication of users who access applications. → Business rules. → Single sign-on.
③ Network	→ Fire walls to block n/w intruders. → Use of VPN (Virtual Private N/w). → Authentication.
④ OS	→ Authentication, → Intrusion detection. → Password Policies → User accounts.

Components	Security Methods.
⑤. DBMS	→ Authentication → Audit Mechanism → Database Resource Limits → Password Policy.
⑥. Data files	→ File permission. → Access Monitoring.
⑦. Data	→ Data validation → Data constraints. → Data Encryption → Data Access.

Software development life Cycle



Database security Implementation Methodology.

→ Identification: Identification and investigation of resources required and policies to be adopted.
→ Assessment: Analysis of vulnerabilities, threats, etc for both Physical and logical DB security.
→ Design: results in a blueprint of the adopted security model.
→ Implementation: Code is developed or tools are purchased to implement the blueprint.
→ Evaluation: Evaluate by testing the system against attacks hardware failures, natural disasters & human errors.

→ Auditing: After production, security audits should be performed periodically to ensure security of the system.

(*) Operating System Security Fundamentals:

→ Operating System is a collection of programs that allows the user to operate the computer hardware.

→ OS is also known as "Resource Manager".

→ OS is one of the main access points in DBMS.

→ Computer System has 3 layers → ① Inner layer represent the hardware.
② Middle layer is the OS.
③ Outer layer is all different softwares.

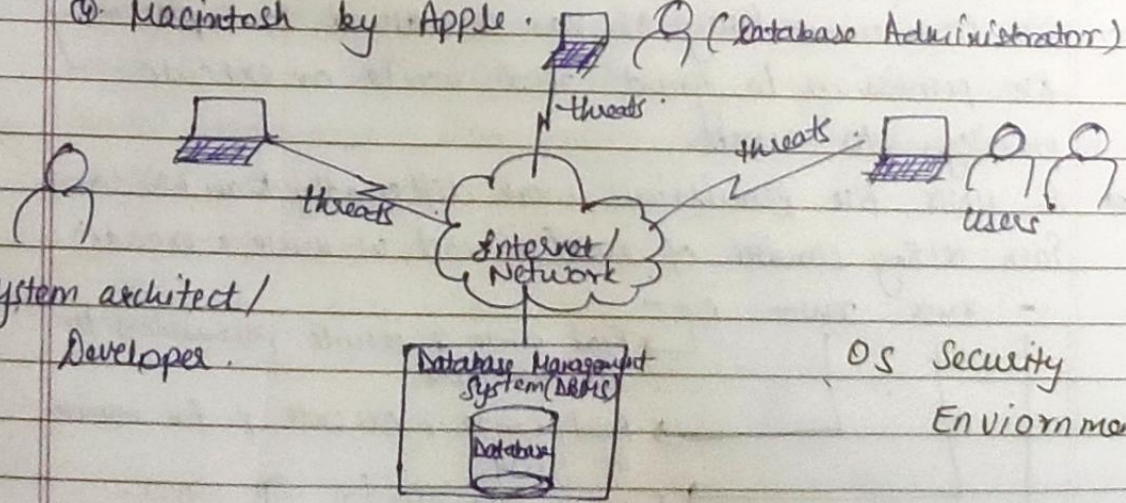
→ Key functions and capabilities of operating system:

① Multitasking
② Multi sharing
③ Managing Computer resources.
④ Controls the flow of activities
⑤ Provides a user interface.
⑥ Administers user Actions.
⑦ Schedules jobs and tasks
⑧ Provides tools to configure OS & Hardware.

→ It also provides functionalities to enforce security.

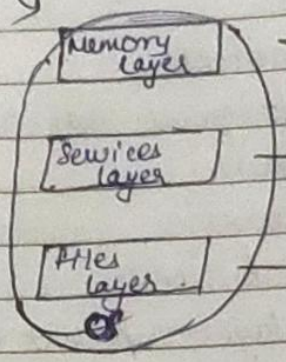
→ Different vendors of OS include:

① Windows by Microsoft.
② UNIX by Sun Microsystems, HP & IBM.
③ LINUX
④ Macintosh by Apple.



OS Security Environment.

(a) 3 layer architecture: Component of OS Security Environment.



① → Hardware memory available on the system.

→ OS features and functions such as N/W services, File Management, web services

→ Files stored on the disk.

② Services:
→ Main component of OS security Environment.
→ Consists of functionalities that OS offers.
→ Users employ these utilities to gain access to OS.
→ If services are not secured and configured properly, each service becomes a vulnerability.

③ Files: Actions: ① File Permission
② File transfer
③ File Sharing.

→ File Permissions: Every OS has a method of implementing file permission to grant read, write or execute privileges to users.

→ In UNIX, file permission work differently than Windows. Each setting consists of rwx (r-read, w-write, x-execute)

- rwx rw- r--
- r-- → Read, write & execute permissions for all the users.
- rw- → Read, write & execute p. for members of group.
- rwx → R, W, X permission for file owner.
- - → file type. "-" means a file, "d" means a director

→ File transfer: ①. Moving the files from one location to another in a disk / web / cloud.

②. FTP is an internet service that allows transferring of files.

③. FTP clients and servers transmit username & passwords in plain text format (Not Encrypted).

④. Any Hacker can sniff the traffic & get the login info.

⑤ Some best practices for file transferring include:

→ Using the secure FTP utility.

→ Allow only authorized operators to have FTP privileges.

→ File sharing ①. Sharing files naturally leads to security threats and risks.

②. Peer to Peer programs allow users to share files over internet.

④. Memory: → Memory is an access point to security violations.

→ There are many badly written programs that could change the content of the memory.

→ These programs do not perform deliberate destruction acts.

→ Programs that intentionally damage or scan data in the memory are the type that not only can harm the data integrity, but may also exploit data for illegal usage.

(*) Authentication Methods:

→ Authentication is fundamental service of OS.

→ Process to verify the user identity.

→ Two types:

ⓐ Physical Authentication: Using Magnetic cards and card readers to control entry in a building office, laboratory or data center.

ⓑ Digital Authentication: Process of verifying the identity of user by means of digital mechanism or software.

(*) Digital Authentication Methods:

① Digital Certificates: Widely used in e-commerce.

→ File issued by a trusted party that verifies the identity of the holder.

② Digital token (Security Token):

→ Small electronic device that users keep with them to be used for authentication.

→ It displays a unique number to the token holder which is used as a pin (Personal Identification Number).

③ Digital Card: → Also known as security card or smart card.

→ Similar to credit card without magnetic strip.

→ It has electronic circuit that stores identification info.

④ Kerberos: Enables two parties to exchange info. over the network by assigning a unique key. This key is used to encrypt communicated messages.

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⑤. LDAP (Lightweight Directory Access Protocol).
→ developed by University of Michigan, USA
→ uses centralized directory database.
→ It is OS Independent, it can be used across all platforms.
→ LDAP architecture is client / server based.

⑥. NTLM (Network LAN Manager):
→ developed by microsoft.
→ Employs authentication protocol.

⑦. Public Key Infrastructure (PKI):
→ Also known as Public Key Encryption.
→ A method in which user keeps a private key and authentication firm holds the public key.

⑧. RADIUS (Remote Authentication Dial-In-User services).
→ Provides centralized authentication mechanism.
→ Client / server based, uses a dial-up server, a VPN or a wireless Access Point.

⑨. SSL (Secure Socket layers):
→ Developed by Netscape Communications.
→ To provide secure communication b/w client & server.

⑩. SRP (Secure Remote Password):
→ Developed by Stanford University, USA.
→ Easy to install, does not require client server configuration.

(*) Authorization:

→ Process that decides whether users are permitted to perform the functions for which they request.

→ Authorization is not performed until the user is authenticated.

→ Deals with privileges and rights that have been granted to the user.

(*) User Administration:

→ Authentication and authorization are essential services that every OS provides in order to secure access to computer's logical and physical resources.

→ Another related service is User Administration.

→ Administrators use this functionality to:

① Create User Accounts.

② Set Password Policies

③ Grant Privileges to users.

→ Improper use of this feature can lead to security risks and threats.

→ Best practices for user Administration:

① Use a consistent naming convention.

② Always provide a password to user and force them to change it on first logon.

③ Make sure that all the passwords are encrypted.

④ Do not use default passwords.

⑤ If a machine is compromised, change all the password of all existing accounts.

⑥ Create a specific file system.

⑦ Lock accounts that are not used for a specific time period.

⑧ Perform random auditing procedures.

⑨ Do not grant privileges to all the machines, but only to those who are actually in need.
⑩ When a computer system is compromised, isolate the system from other systems.

(*) Password Policies:

→ Usually hackers try to access the system using an account and a password. If this method fails, they try other methods.
→ Most hackers utilise the tools that use dictionary method to crack passwords. These tools use permutations of the words in dictionary to guess the password.
→ There are many different practices and policies that you can adopt for your company:

① Password aging: Tells a system how many days a password can be effective before it must be changed. Many companies practice 3 month policy.
② Password reuse: Tells the system how many times you can reuse a password or indicates the no. of days that must pass before you reuse a password. Also tells if you can reuse the password or not.
③ Password history: Related to password reuse. Tells the system how many passwords it should maintain for an account.
④ Password encryption: A method that encrypts a password and stores it in a way that it cannot be read directly.
⑤ Password storage: The place where password is stored and kept hidden from the public.
⑥ Password complexity: Complex passwords are the ones that are made up of a combination of upper case, lower case letters, symbols and numbers. The password must have a minimum length of 6 characters.

⑦ Logon retries: A good practice is to allow a user to try 3 times before the account is locked and administrator is contacted.

⑧ Password Protection: This practice is hard to enforce. If you record a password, use an encrypted file that can only be accessed by you.

⑨ Single sign-on: Allows you to sign on once to a server and not have to sign in again on a different server if you have an account.

(*) Vulnerabilities of Operating Systems:

→ Vulnerability means Susceptible to Attacks.

→ Hackers usually explore the weak points of the system until they get an entry.

→ Types of Vulnerabilities:

(a) Installation and Configuration: Results from default installation Configuration that is known publically. Does not enforce any safety measures.

(b) User mistakes: Carelessness in implementing procedures, accidental errors, failures to follow through, etc.

(c) Lack of auditing controls, untested recovery plan, lack of activity monitoring, lack of protection against malicious codes, etc.

(c) Software: Software contains bugs, etc.

(d) Design and Implementation: Related to improper designs, coding problems, Input data not validated, etc.

→ Vulnerabilities of OS:

① IIS (Internet Information server)

② MSSQL (Microsoft SQL Server)

⑤. Windows Authentication
④. IE (Internet Explorer)
⑤. Microsoft Outlook & Outlook Express.
⑥. Windows Peer to peer file sharing (P2P)

→ Top vulnerabilities to UNIX Systems:
①. BIND domain Name.
②. RPC (Remote Procedure Call)
③. Apache Web Server.
④. Clear text services.
⑤. Sendmail
⑥ Open SSL (Secure Socket Layer).

(x). E-mail Security:
→ E-mail is the tool that is most widely used by public and private organizations as a means of communication.
→ It may be the tool most frequently used by hackers to exploit viruses, worms and other computer system invaders.
→ In past years, email was the medium used in many of the most famous worm and virus attacks.
→ Some common attacks include:
    ⓐ. Love Bug worm.
    ⓑ. I Love You worm.
    ⓒ. Mydoom worm
    ⓓ. Melissa virus.
→ Email is not only used to send worms and viruses, but also to send spam emails, private and confidential data as well as offensive messages.
→ To prevent such activities:
①. Do not configure e-mail Server to a machine in which

sensitive data resides.
② Do not disclose the e-mail server technical details.
③ Auditing and monitoring controls should be installed to detect any suspicious activities.
④ In case a suspicious activity is detected, the management should be immediately informed.

(*) Internet Security:
→ Central aspect of cybersecurity. It includes managing cyber threats and risks associated with internet.
→ Primary purpose of Internet security is to protect users and corporate IT assets from attacks that travel over the Internet.
→ Internet security threats include:
① Malware: Can be embedded in websites or attached to emails. Once malware has access, it can steal data.
② Phishing: targets the person behind the computer attempting to trick them into doing the attackers bidding.
③ Data Loss: Data can be stolen from an organization over the Internet in many ways.
④ Credential Compromise: Cyber Criminals collect user credentials to gain access to corporate systems.
⑤ Malicious websites: Many sites on the internet are malicious or inappropriate for business use.

→ To ensure Internet security, solutions should be provided against these Internet-borne cyber threats.