

Module 5

Protection and Security

- Protection and security requires that computer resources such as CPU, softwares, memory etc. are protected.
- This extends to the operating system as well as the data in the system.
- This can be done by ensuring integrity, confidentiality and availability in the operating system.
- The system must be protect against unauthorized access, viruses, worms etc.
- A threat is a program that is malicious in nature and leads to harmful effects for the system.
 - Some of the common threats that occur in a system are –

Virus

- Viruses are generally small snippets of code embedded in a system.
- They are very dangerous and can corrupt files, destroy data, crash systems etc. They can also spread further by replicating themselves as required.

Trojan Horse

- A trojan horse can secretly access the login details of a system. Then a malicious user can use these to enter the system as a harmless being and wreak havoc.

Trap Door

- A trap door is a security breach that may be present in a system without the knowledge of the users. It can be exploited to harm the data or files in a system by malicious people.

Worm

- A worm can destroy a system by using its resources to extreme levels. It can generate multiple copies which claim all the resources and don't allow any other processes to access them. A worm can shut down a whole network in this way.

Denial of Service

- These type of attacks do not allow the legitimate users to access a system. It overwhelms the system with requests so it is overwhelmed and cannot work properly for other user.

Protection and Security Methods

The different methods that may provide protect and security for different computer systems is

Authentication

This deals with identifying each user in the system and making sure they are who they claim to be. The operating system makes sure that all the users are authenticated before they access the system. The different ways to make sure that the users are authentic are:

- **Username/ Password**

Each user has a distinct username and password combination and they need to enter it correctly before they can access the system.

- **User Key/ User Card**

The users need to punch a card into the card slot or use their individual key on a keypad to access the system.

- **User Attribute Identification**

Different user attribute identifications that can be used are fingerprint, eye retina etc. These are unique for each user and are compared with the existing samples in the database. The user can only access the system if there is a match.

One Time Password

These passwords provide a lot of security for authentication purposes. A one time password can be generated exclusively for a login every time a user wants to enter the system. It cannot be used more than once. The various ways a one time password can be implemented are –

- **Random Numbers**

The system can ask for numbers that correspond to alphabets that are pre arranged. This combination can be changed each time a login is required.

- **Secret Key**

A hardware device can create a secret key related to the user id for login. This key can change each time.

Authorization

- Authorization is the process of giving someone permission to do or have something.
- In multi-user computer systems, a system administrator defines for the system which users are allowed [access](#) to the system and what privileges of use (such as access to which file directories, hours of access, amount of allocated storage space, and so forth).
- Authorization is normally preceded by authentication for user identity verification.
- During authorization, a system verifies an authenticated user's access rules and either grants or refuses resource access.
- *Authentication* means determining the identity of a user, server, or client. *Authorization* means determining whether that user, server, or client has permission to do something.

Every file in Unix has the following attributes –

- **Owner permissions** – The owner's permissions determine what actions the owner of the file can perform on the file.
- **Group permissions** – The group's permissions determine what actions a user, who is a member of the group that a file belongs to, can perform on the file.
- **Other (world) permissions** – The permissions for others indicate what action all other users can perform on the file.
- The basic building blocks of Unix permissions are the **read**, **write**, and **execute** permissions, which have been described below –

Read

- Grants the capability to read, i.e., view the contents of the file.

Write

- Grants the capability to modify, or remove the content of the file.

Execute

- User with execute permissions can run a file as a program.

MOBILE OS

A mobile operating system (OS) is software that allows smartphones, tablet PCs and other devices to run applications and programs.

A mobile OS typically starts up when a device powers on, presenting a screen with icons or tiles that present information and provide application access. Mobile operating systems also manage cellular and wireless network connectivity, as well as phone access.

Examples of mobile device operating systems include Apple iOS, Google Android, Research in Motion's BlackBerry OS, Nokia's Symbian, Hewlett-Packard's webOS (formerly Palm OS) and Microsoft's Windows Phone OS. Some, such as Microsoft's Windows 8, function as both a traditional desktop OS and a mobile operating system.

Most mobile operating systems are tied to specific hardware, with little flexibility. Users can jailbreak or root some devices, however, which allows them to install another mobile OS or unlock restricted applications.

TYPES OF MOBILE OS

iOS

Apple's very own operating system, iOS runs the company's iPod, iPad, iPhone and Apple Watch devices. It is only available on Apple products and responds to commands from the user's fingertips. iOS features iTunes for music and the App Store for everything else. One of the benefits of the Apple operating system is its built-in video chatting and Apple Music capabilities.

Android

Android's OS is owned by Google and is considered **open-source** to Apple's closed system. With an open-source system, software developers can build applications and programs until their heart's content and users reap the benefits of tons of free software.

Most Android lovers cite the operating system's openness, which leads to more personalization options, as the reason they're hardcore devotees.

Windows

Microsoft is no stranger to computer operating systems, but is a relative newcomer to mobile OS. Its latest version uses the tiled layout common to its most recent computer OS. These tiles can be rearranged and moved to the user's preferences.

BlackBerry OS

A lesser known, but still used OS is the one designed for BlackBerry devices, common among business users. The BlackBerry operating system is well-liked for its enhanced security and safety measures. It was the phone of choice for former President Barack Obama! BlackBerry has been far more successful with an operating system that requires a trackball and a physical keyboard than a touch screen device like iPhone.

POPULAR MOBILE OPERATING SYSTEMS

1. Android OS (Google Inc.)

The Android mobile operating system is Google's open and free software stack that includes an operating system, middleware and also key applications for use on mobile devices, including smartphones. Updates for the open source Android mobile operating system have been developed under "dessert-inspired" version names (Cupcake, Donut, Eclair, Gingerbread, Honeycomb, Ice Cream Sandwich) with each new version arriving in alphabetical order with new enhancements and improvements.

2. Bada (Samsung Electronics)

Bada is a proprietary Samsung mobile OS that was first launched in 2010. The Samsung Wave was the first smartphone to use this mobile OS. Bada provides mobile features such as multipoint-touch, 3D graphics and of course, application downloads and installation.

3. BlackBerry OS (Research In Motion)

The BlackBerry OS is a proprietary mobile operating system developed by Research In Motion for use on the company's popular BlackBerry handheld devices. The BlackBerry platform is popular with corporate users as it offers synchronization with Microsoft Exchange, Lotus Domino, Novell GroupWise email and other business software, when used with the BlackBerry Enterprise Server.

4. iPhone OS / iOS (Apple)

Apple's iPhone OS was originally developed for use on its iPhone devices. Now, the mobile operating system is referred to as iOS and is supported on a number of Apple devices including the iPhone, iPad, iPad 2 and iPod Touch. The iOS mobile operating system is available only on Apple's own manufactured devices as the company does not license the OS for third-party hardware. Apple iOS is derived from Apple's Mac OS X operating system.

5. MeeGo OS (Nokia and Intel)

A joint open source mobile operating system which is the result of merging two products based on open source technologies: Maemo (Nokia) and Moblin (Intel). MeeGo is a mobile OS designed to work on a number of devices including smartphones, netbooks, tablets, in-vehicle information systems and various devices using Intel Atom and ARMv7 architectures.

6. Palm OS (Garnet OS)

The Palm OS is a proprietary mobile operating system (PDA operating system) that was originally released in 1996 on the Pilot 1000 handheld. Newer versions of the Palm OS have added support for expansion ports, new processors, external memory cards, improved security and support for ARM processors and smartphones. Palm OS 5 was extended to provide support for a broad range of screen resolutions, wireless connections and enhanced multimedia capabilities and is called Garnet OS.

7. Symbian OS (Nokia)

Symbian is a mobile operating system (OS) targeted at mobile phones that offers a high-level of integration with communication and personal information management (PIM) functionality. Symbian OS combines middleware with wireless communications through an integrated mailbox and the integration of Java and PIM functionality (agenda and contacts). Nokia has made the Symbian platform available under an alternative, open and direct model, to work with some OEMs and the small community of platform development collaborators. Nokia does not maintain Symbian as an open source development project.

8. webOS (Palm/HP)

WebOS is a mobile operating system that runs on the Linux kernel. WebOS was initially developed by Palm as the successor to its Palm OS mobile operating system. It is a proprietary Mobile OS which was eventually acquired by HP and now referred to as webOS (lower-case w) in HP literature. HP uses webOS in a number of devices including several smartphones and HP TouchPads. HP has pushed its webOS into the enterprise mobile market by focusing on improving security features and management with the release of webOS 3.x. HP has also announced plans for a version of webOS to run within the Microsoft Windows operating system and to be installed on all HP desktop and notebook computers in 2012.

9. Windows Mobile (Windows Phone)

Windows Mobile is Microsoft's mobile operating system used in smartphones and mobile devices – with or without touchscreens. The Mobile OS is based on the Windows CE 5.2 kernel. In 2010 Microsoft announced a new smartphone platform called Windows Phone 7.

FEATURES OF MOBILE OS

- **Userfriendly design:**

any os should focus on giving a powerful platform that is eye catching and easy to use.

- **Speed of Ease:**

Menus and buttons are about as vital to a mobile experience as much as what the user can do with them.

- **Power to the User:**

Most operating systems allow for a breadth of customisation options, it's best to just shop around and try out as many in phone stores as you can as each one may be differently suited to your customisation taste.

- **Apps**

apps are so advanced that you can even download a brand new browser to access the Internet on.

- **Multi-Tasking**

The hardware of a device covers how well and how fast each app or process on the device runs

- **Robustness:**

A user expects a mobile operating system to be robust. This means it should be strong and unlikely to fail or crash.

- **Resource-limited hardware:**

Smartphones should be able to support various applications. It should also provide facility to access Internet. But to meet these requirements, Smartphones have limited memory and processing power when compared to the desktop PCs and Laptops.

- **User interface for limited user hardware:**

The operating system should implement a user interface environment that is efficient and intuitive to use, despite the smaller screen and limited user input capabilities of the Smartphone

- **Library support:**

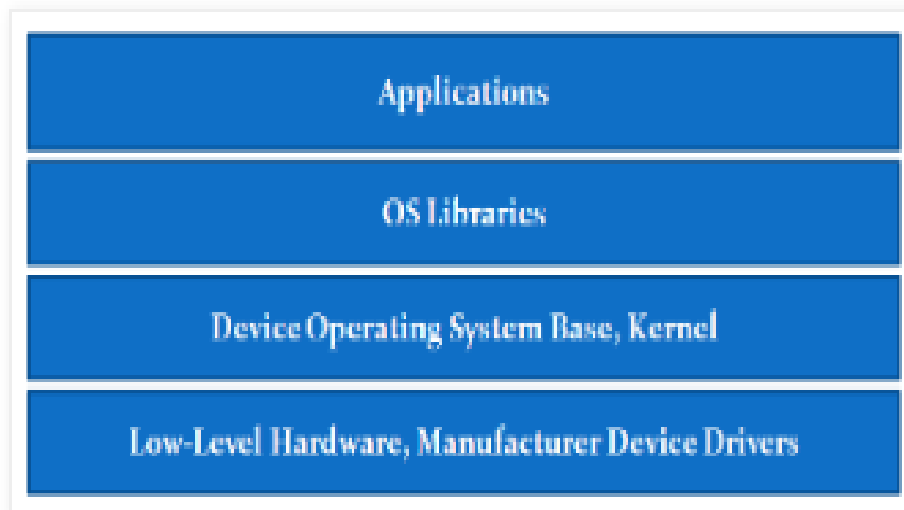
Smartphone operating systems should contain middleware libraries and frameworks with APIs that implement and abstract the functionality of the features of the Smartphone. The purpose is to provide functional consistency and to ease the software development.

- **Personal Information Management**

Personal information management includes notes, calendar, to-do lists, alarms and reminders. A Mobile OS needs to have the right information in the right place, in the right form, and quality to meet users needs.

ARCHITECTURE OF MOBILE OS

A mobile OS is a software platform on top of which other programs called application programs, can run on mobile devices such as PDA, cellular phones, smartphone and etc.



Low Level Hardware

- **Mobile Processors:** Processors use RISC architecture

Mainly two types

1. ARM Processors

It is a 32-bit RISC processor architecture

Low power consumption

2. MIPS - Microprocessor without Interlocked Pipeline Stages

mainly used in embedded systems

•Mobile Memory

The better the memory management offered by the OS, the wider the options available to applications developers

Mobile devices have two types of memories

ROM - For operating system and preinstalled programs

RAM - For user information

Types of RAMs

DRAM (Dynamic RAM): cheapest, used in mobile devices

EDO (Enhanced Data Output): more expensive but offers a speed increase over DRAM (WindowsCE)

SDRAM (Synchronous Dynamic RAM): a further 50% speed (iPAQ)

DDR (Double Data Rate) SDRAM is twice as fast as SDRAM

OUM (Ovonic Unified Memory): experimental

Kernal

Responsible for services such as

Security

Memory Management

Process Management

It include the following components

I/O Components

File Systems

Networking Components

Libraries & Application Framework

Libraries

Media Libraries

3D Libraries, etc.

Application Framework

These Libraries are exposed to developers through the application framework.

CASE STUDIES:

1. Android

Android is an open source and Linux-based **Operating System** for mobile devices such as smartphones and tablet computers. Android was developed by the *Open Handset Alliance*, led by Google, and other companies.

Android offers a unified approach to application development for mobile devices which means developers need only develop for Android, and their applications should be able to run on different devices powered by Android.

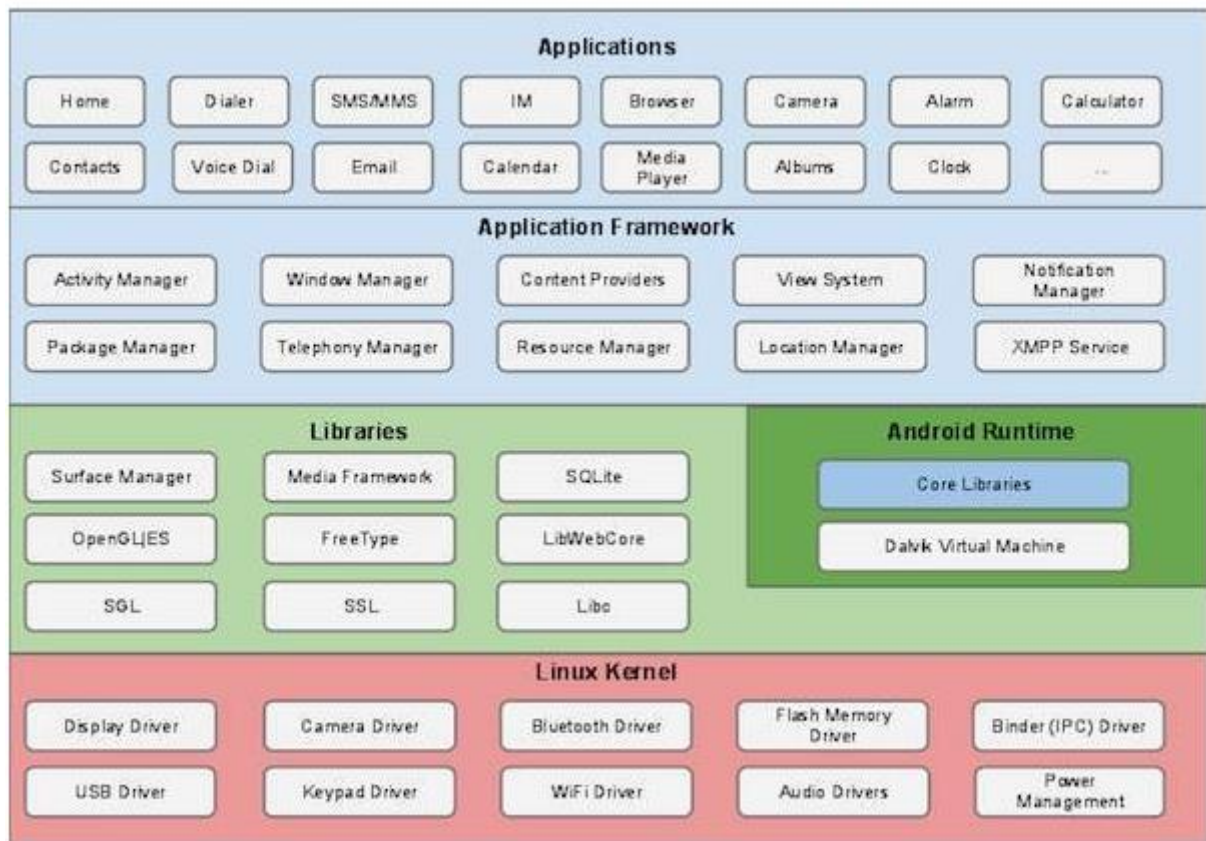
The first beta version of the Android Software Development Kit (SDK) was released by Google in 2007 where as the first commercial version, Android 1.0, was released in September 2008.

Features:

- Head set layout
- Storage
- Connectivity: GSM/EDGE, IDEN, CDMA, Bluetooth, WI-FI, EDGE,3G,NFC, LTE,GPS.
- Messaging: SMS, MMS, C2DM (could to device messaging), GCM (Google could messaging)
- Multilanguage support
- Multi touch
- Video calling
- Screen capture
- External storage
- Streaming media support
- Optimized graphics

Android architecture

Android operating system is a stack of software components which is roughly divided into five sections and four main layers as shown below in the architecture diagram.



1. Linux kernel

At the bottom of the layers is Linux - Linux 3.6 with approximately 115 patches. This provides a level of abstraction between the device hardware and it contains all the essential hardware drivers like camera, keypad, display etc

2. Libraries

On top of Linux kernel there is a set of libraries including open-source Web browser engine WebKit, well known library libc, SQLite database which is a useful repository for storage and sharing of application data, libraries to play and record audio and video, SSL libraries responsible for Internet security etc.

3. Android Runtime

This is the third section of the architecture and available on the second layer from the bottom. This section provides a key component called **Dalvik Virtual Machine** which is a kind of Java Virtual Machine specially designed and optimized for Android.

4. Application Framework

The Application Framework layer provides many higher-level services to applications in the form of Java classes. Application developers are allowed to make use of these services in their applications.

5. Applications

You will find all the Android application at the top layer. You will write your application to be installed on this layer only. Examples of such applications are Contacts Books, Browser, Games etc.

2. UNIX

The Unix operating system is a set of programs that act as a link between the computer and the user.

The computer programs that allocate the system resources and coordinate all the details of the computer's internals is called the **operating system** or the **kernel**.

Users communicate with the kernel through a program known as the **shell**. The shell is a command line interpreter; it translates commands entered by the user and converts them into a language that is understood by the kernel.

- Unix was originally developed in 1969 by a group of AT&T employees Ken Thompson, Dennis Ritchie, Douglas McIlroy, and Joe Ossanna at Bell Labs.
- There are various Unix variants available in the market. Solaris Unix, AIX, HP Unix and BSD are a few examples. Linux is also a flavor of Unix which is freely available.
- Several people can use a Unix computer at the same time; hence Unix is called a multiuser system.
- A user can also run multiple programs at the same time; hence Unix is a multitasking environment.

Features of unix

A). Multiuser: A multi-user Operating system allows more than one user to share the same computer system at the same time.

B). Multi Tasking: More than one program can be run at a time. The main concept of multitasking is maximum utilizing CPU resources

C). Open System: The UNIX is open source code i.e Any user can modified Unix open source code according there ideas and requirements

D). Security: One of the most valued advantages of linux over the other plat forms lies with the high security levels it ensures. Every linux user is happy to work in a virus-Free environment and use the regular virus – prevention time needed when working with other operating systems for other more important task.

E). Portability: Portability means Independent of hardware & processors

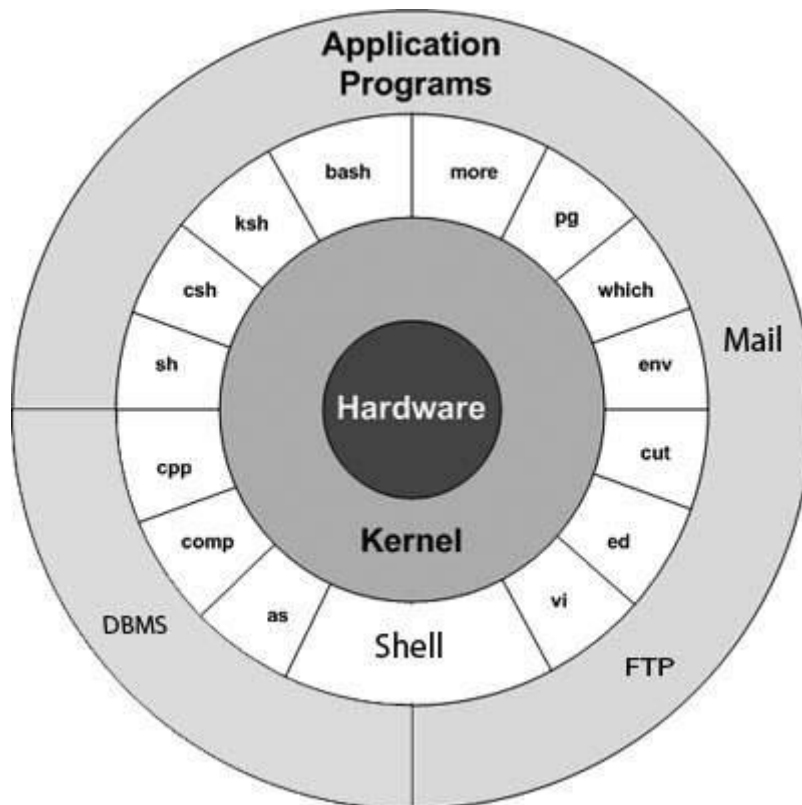
F). Communication: The main concept of communication facility Exchanging of information or files form one user account to other user account.

G). Programming Facility: UNIX o/s provides shell. Shell works like a programming language. It provides commands and keywords.

H). Help facility : It is the beautiful feature of UNIX/ LINUX Operating systems. Don't know the information about given command just go through the help line.

Unix Architecture

Here is a basic block diagram of a Unix system –



The main concept that unites all the versions of Unix is the following four basics –

- **Kernel** – The kernel is the heart of the operating system. It interacts with the hardware and most of the tasks like memory management, task scheduling and file management.
- **Shell** – The shell is the utility that processes your requests. When you type in a command at your terminal, the shell interprets the command and calls the program that you want. The shell uses standard syntax for all commands. C Shell, Bourne Shell and Korn Shell are the most famous shells which are available with most of the Unix variants.
- **Commands and Utilities** – There are various commands and utilities which you can make use of in your day to day activities. **cp**, **mv**, **cat** and **grep**, etc. are few examples of commands and utilities. There are over 250 standard commands plus numerous others provided through 3rd party software. All the commands come along with various options.
- **Files and Directories** – All the data of Unix is organized into files. All files are then organized into directories. These directories are further organized into a tree-like structure called the **filesystem**.

System Bootup

If you have a computer which has the Unix operating system installed in it, then you simply need to turn on the system to make it live.

As soon as you turn on the system, it starts booting up and finally it prompts you to log into the system, which is an activity to log into the system and use it for your day-to-day activities.

3. Windows NT

Introduction To Windows NT Operating System

Microsoft introduced Windows NT (New Technology) as a series of Windows Operating system. The first version of Windows NT i.e. 3.1 was released in 1993. Windows NT was a 32-bit operating system having default file system NTFS. This Windows NT series supports preemptive multitasking.

Windows NT versions

There are 4 versions of Windows operating system that were released with the name Windows NT. After Windows NT 4.0, the next versions of Windows NT were being released with other marketing names such as Windows 2000, Win XP. The 4 versions of Windows NT operating system are listed below:

- Windows NT 3.1 (July, 1993) – Workstation, Advanced server
- Windows NT 3.5 (September, 1994) - Workstation, Server
- Windows NT 3.51 (May, 1995) - Workstation, Server
- Windows NT 4.0 (July, 1996) - Workstation, Server, Server Enterprise Edition, Terminal Server, Embedded

Windows NT Editions- Workstation And Server

All versions of Windows NT Operating System were available in two editions- Windows NT Workstation and Windows NT Server. Windows NT Workstation simply called Windows NT was designed to act as a client workstation whereas Windows NT server was developed to work as a server over the network.

Noticeable features of windows NT

- **NTFS File System**

Windows NT family introduced default file system NTFS which is capable of recovering from disk errors automatically, support large sized hard disk, provide security like permission and encryption.

- **Hardware Abstraction Layer**

Microsoft included HAL feature i.e. hardware abstraction layer in Windows NT. HAL layer provides the interface between hardware and software, OS access hardware via HAL. This feature enables Windows to run regardless of the hardware platform.

- **Preemptive Multitasking**

Windows NT supports preemptive multitasking feature so that all computer programs share operating system and hardware resources.

- **Remotely access**

Windows NT 4.0 Terminal Server Edition was designed to provide the feature to log on the system remotely.

Data Loss Problems In Windows NT

Windows NT 3.1, 3.5, 3.51, 4.0 are susceptible to virus attack since Microsoft stopped providing security essentials and updates to Windows NT. Moreover, Windows NT has become too old to overcome any issues. Data loss situation can occur frequently due to either virus attack or windows crash. To restore data back to the system, one can **use a tool i.e. Windows data recovery** which can help in getting back lost, deleted or corrupt data from all versions of Windows NT.

Architecture

Windows NT consists of nine basic modules

Hardware Abstraction Layer

HAL hides the specifics of the hardware platform from the rest of the operating system and represents the lowest level of Windows NT. Thus, HAL provides true hardware platform independence for the operating system.

Kernel

The kernel represents the core of the Windows NT operating system

The NT Executive

The NT Executive can be considered a common service provider because it is responsible for providing a set of services to all other operating system components

Object Manager

The object manager names, retains, and provides security for objects used by the operating system

Process Manager

In a Windows NT environment, a process represents an address space, a group of objects defined as a resource, or a set of threads. Thus, each of these entities is managed by the process manager.

Virtual Memory Manager

Windows NT uses a special file on the hardware platform's hard disk for additional memory beyond available RAM

I/O Manager

The Input/Output (I/O) Manager is responsible for managing all input and output to and from storage and the network

The Security Module

Windows NT includes a comprehensive security facility built into the operating system.

Windows NT Networking

One of the biggest advantages associated with the use of Windows NT is its built-in support of many transport protocols. The Windows NT networking architecture was established in a layered design that follows the seven-layer ISO Open System Interconnection (OSI) Reference Model