Krishna Chanra College, Department of Commerce

3.1 Introduction

Internet Applications can be described as the type of applications that use the internet for operating successfully, that is, by using the internet for fetching, sharing and displaying the information from the respective server systems. It can be accessed only with the help of the internet facility, and it cannot be functional without the internet. These applications can be classified as electronic devices based, automated digital technology, industrial internet, smartphones based, smart home-based, smart grids, smart city, and other major applications.

3.2 Meaning of Internet

The internet is a global network of interconnected computers, servers, phones, and smart appliances that communicate with each other using the transmission control protocol (TCP) standard to enable a fast exchange of information and files, along with other types of services.

3.3 Evolution of Internet

The evolution of the internet has been a dynamic and transformative process that has unfolded over several decades. Here's a brief overview of key milestones in the evolution of the internet:

1960s: The Birth of ARPANET
The precursor to the modern internet, ARPANET (Advanced Research Projects Agency Network), was developed by the U.S. Department of Defense. It was designed to connect computers at different research institutions.

1970s: TCP/IP Protocol
The development of the Transmission Control Protocol (TCP) and the Internet Protocol (IP) laid the foundation for a standardized communication protocol that would enable diverse networks to interconnect, leading to the formation of the internet.

1980s: Domain Name System (DNS)
The Domain Name System was introduced, providing a hierarchical naming system for computers, services, or resources connected to the internet. This made it easier for users to navigate the growing network.

1989: World Wide Web (WWW)
Tim Berners-Lee invented the World Wide Web, introducing the concept of URLs, HTML, and HTTP. This marked a significant shift from text-based communication to a more user-friendly, multimedia experience.

1990s: Commercialization and the Dot-Com Boom
The internet became more accessible to the public, and commercial interests started investing heavily in online ventures. The dot-com boom saw the rise of numerous internet-based companies, though it was followed by a market crash in the early 2000s.

Late 1990s: Broadband and High-Speed Internet
High-speed internet access became more widely available, replacing slower dial-up connections. This facilitated faster data transfer and improved the overall internet experience.

2000s: Web 2.0 and Social Media
The term "Web 2.0" emerged to describe a shift in the use of the internet from static websites to dynamic and user-generated content. Social media platforms, such as Facebook, Twitter,

and YouTube, gained popularity, transforming the internet into a more interactive and collaborative space.

2007: Mobile Internet and Smartphones

The introduction of smartphones, particularly the iPhone, revolutionized internet usage by making it more accessible on mobile devices. Mobile internet usage soared, leading to the development of mobile apps and responsive web design.

2010s: Cloud Computing and Internet of Things (IoT)

Cloud computing services became prevalent, allowing users to store and access data remotely. The Internet of Things (IoT) gained momentum as more devices became connected to the internet, enabling data exchange and automation.

2020s: 5G Technology and Emerging Technologies

The rollout of 5G technology promised even faster and more reliable internet connectivity. Emerging technologies like artificial intelligence, virtual reality, and augmented reality continued to shape and enhance online experiences.

3.4 Key Features of the Internet

The internet is a vast, interconnected network of computers and other network-enabled devices, which is:

- **Globally available**: The internet is an international service with universal access. People living in isolated areas of an archipelago or even in the depths of Africa can now access the internet.
- **Easy to use**: The software used to connect to the internet (web browser) is user-friendly and easy to understand. It's also relatively easy to create.
- **Compatible with other types of media**: The internet provides a high level of engagement with photos and videos, among other media.
- **Affordable**: Internet service development, as well as maintenance costs, are modest.
- **Flexible**: Internet-based communication is highly adaptable. It supports text, audio, and video communication. These services are available at both individual and organizational levels.

3.5 Uses of the Internet

Some of the important usages of the internet are:

- **Online Businesses (E-commerce):** Online shopping websites have made our life easier, e-commerce sites like Amazon, Flipkart, and Myntra are providing very spectacular services with just one click and this is a great use of the Internet.
- **Cashless Transactions:** All the merchandising companies are offering services to their customers to pay the bills of the products online via various digital payment apps like Paytm, Google Pay, etc. UPI payment gateway is also increasing day by day. Digital payment industries are growing at a rate of 50% every year too because of the INTERNET.
- **Education:** It is the internet facility that provides a whole bunch of educational material to everyone through any server across the web. Those who are unable to attend physical classes can choose any course from the internet and can have point-to-point knowledge of it just by sitting at home. High-class faculties are teaching online on digital platforms and providing quality education to students with the help of the Internet.
- **Social Networking:** The purpose of social networking sites and apps is to connect people all over the world. With the help of social networking sites, we can talk, and

share videos, and images with our loved ones when they are far away from us. Also, we can create groups for discussion or for meetings.

- **Entertainment:** The Internet is also used for entertainment. There are numerous entertainment options available on the internet like watching movies, playing games, listening to music, etc. You can also download movies, games, songs, TV Serial, etc., easily from the internet.

3.6 Advantages of the Internet

- **Online Banking and Transaction:** The Internet allows us to transfer money online through the net banking system. Money can be credited or debited from one account to the other.
- **Education, Online Jobs, Freelancing:** Through the Internet, we are able to get more jobs via online platforms like Linkedin and to reach more job providers. Freelancing on the other hand has helped the youth to earn a side income and the best part is all this can be done via the INTERNET.
- **Entertainment:** There are numerous options for entertainment online we can listen to music, play games can watch movies, and web series, and listen to podcasts, youtube itself is a hub of knowledge as well as entertainment.
- **New Job Roles:** The Internet has given us access to social media, and digital products so we are having numerous new job opportunities like digital marketing and social media marketing online businesses are earning huge amounts of money just because the Internet is the medium to help us to do so.
- **Best Communication Medium:** The communication barrier has been removed from the Internet. You can send messages via email, Whatsapp, and Facebook. Voice chatting and video conferencing are also available to help you to do important meetings online.
- **Comfort to humans:** Without putting any physical effort you can do so many things like shopping online it can be anything from stationeries to clothes, books to personal items, etc. You can books train and plane tickets online.
- **GPS Tracking and google maps:** Yet another advantage of the internet is that you are able to find any road in any direction, and areas with less traffic with the help of GPS on your mobile.

3.7 Disadvantages of the Internet

- **Time Wastage:** Wasting too much time on the internet surfing social media apps and doing nothing decreases your productivity rather than wasting time on scrolling social media apps one should utilize that time in doing something skillful and even more productive.
- **Bad Impacts on Health**: Spending too much time on the internet causes bad impacts on your health physical body needs some outdoor games exercise and many more things. Looking at the screen for a longer duration causes serious impacts on the eyes.
- **Cyber Crimes:** Cyberbullying, spam, viruses, hacking, and stealing data are some of the crimes which are on the verge these days. Your system which contains all the confidential data can be easily hacked by cybercriminals.
- **Effects on Children:** Small children are heavily addicted to the Internet watching movies, and games all the time is not good for their overall personality as well as social development.

- **Bullying and Spreading Negativity:** The Internet has given a free tool in the form of social media apps to all those people who always try to spread negativity with very revolting and shameful messages and try to bully each other which is wrong.

3.8 What Is an IP Address?

IP address stands for internet protocol address; it is an identifying number that is associated with a specific computer or computer network. When connected to the internet, the IP address allows the computers to send and receive information.

3.9 How are IP Addresses Generated?

IP addresses are generated automatically using an integrated algorithm by the Internet of Assigned Numbers Authority (IANA). IANA then allocates IP address blocks to regional internet registries (RIRs) who in turn geographically distribute these blocks to internet service providers (ISPs). To generate individual IP addresses for their customers, ISPs typically use a technique called Dynamic Host Configuration Protocol (DHCP). DHCP allows devices to have an IP address assigned automatically when they connect to a network.

At a more technical level, IP addresses are generated using two main versions of Internet Protocol (IP): IPv4 and IPv6. IPv4 addresses are 32-bit numbers, represented in a dotted-decimal format (e.g., 192.168.0.1), while IPv6 addresses are 128-bit numbers, represented in a hexadecimal format (e.g., 2001:0000:130F:0000:0000:09C0:876A:130B.)

3.10   Classification of IP Address

An IP address is classified into the following types:

1. Public IP Address: This address is available publicly and it is assigned by your network provider to your router, which further divides it to your devices. Public IP Addresses are of two types,

- **Dynamic IP Address:** When you connect a smartphone or computer to the internet, your Internet Service Provider provides you an IP Address from the range of available IP Addresses. Now, your device has an IP Address and you can simply connect your device to the Internet and send and receive data to and from your device. The very next time when you try to connect to the internet with the same device, your provider provides you with different IP Addresses to the same device and also from the same available range. Since IP Address keeps on changing every time when you connect to the internet, it is called a Dynamic IP Address.
- **Static IP Address:** Static address never changes. They serve as a permanent internet address. These are used by DNS servers. What are DNS servers? Actually, these are computers that help you to open a website on your computer. Static IP Address provides information such as device is located on which continent, which country, which city, and which Internet Service Provider provides internet connection to that particular device. Once, we know who is the ISP, we can trace the location of the device connected to the internet. Static IP Addresses provide less security than Dynamic IP Addresses because they are easier to track.

2. Private IP Address: This is an internal address of your device which are not routed to the internet and no exchange of data can take place between a private address and the internet.

3. Shared IP addresses: Many websites use shared IP addresses where the traffic is not huge and very much controllable, they decide to rent it to other similar websites so to make it cost-friendly. Several companies and email sending servers use the same IP address (within a single mail server) to cut down the cost so that they could save for the time the server is idle.

4. Dedicated IP addresses: A dedicated IP Address is an address used by a single company or an individual which gives them certain benefits using a private Secure Sockets Layer (SSL) certificate which is not in the case of a shared IP address. It allows to access the website or log in via File Transfer Protocol (FTP) by IP address instead of its domain name. It increases the performance of the website when the traffic is high. It also protects from a shared IP address that is black-listed due to spam.

3.11   Internet Protocols

Internet Protocols are a set of rules that governs the communication and exchange of data over the internet. Both the sender and receiver should follow the same protocols in order to communicate the data.

3.12   Types of Internet Protocol

Internet Protocols are of different types having different uses. These are mentioned below:

1. TCP/IP (Transmission Control Protocol/ Internet Protocol)

These are a set of standard rules that allows different types of computers to communicate with each other. The IP protocol ensures that each computer that is connected to the Internet is having a specific serial number called the IP address. TCP specifies how data is exchanged over the internet and how it should be broken into IP packets. It also makes sure that the packets have information about the source of the message data, the destination of the message data, the sequence in which the message data should be re-assembled, and checks if the message has been sent correctly to the specific destination. The TCP is also known as a connection-oriented protocol.

2. SMTP (Simple Mail Transfer Protocol)

These protocols are important for sending and distributing outgoing emails. This protocol uses the header of the mail to get the email id of the receiver and enters the mail into the queue of outgoing mail. And as soon as it delivers the mail to the receiving email id, it removes the email from the outgoing list. The message or the electronic mail may consider the text, video, image, etc. It helps in setting up some communication server rules.

3. PPP (Point-to-Point Protocol)

It is a communication protocol that is used to create a direct connection between two communicating devices. This protocol defines the rules using which two devices will authenticate with each other and exchange information with each other. For example, A user connects his PC to the server of an Internet Service Provider and also uses PPP. Similarly, for connecting two routers for direct communication it uses PPP.

4. FTP (File Transfer Protocol)

This protocol is used for transferring files from one system to the other. This works on a client-server model. When a machine requests for file transfer from another machine, the FTO sets up a connection between the two and authenticates each other using their ID and Password. And, the desired file transfer takes place between the machines.

5. SFTP (Secure File Transfer Protocol)

SFTP which is also known as SSH FTP refers to File Transfer Protocol (FTP) over Secure Shell (SSH) as it encrypts both commands and data while in transmission. SFTP acts as an extension to SSH and encrypts files and data then sends them over a secure shell data stream. This protocol is used to remotely connect to other systems while executing commands from the command line.

6. HTTP (Hyper Text Transfer Protocol)

This protocol is used to transfer hypertexts over the internet and it is defined by the www (world wide web) for information transfer. This protocol defines how the information needs to be formatted and transmitted. And, it also defines the various actions the web browsers should take in response to the calls made to access a particular web page. Whenever a user opens their web browser, the user will indirectly use HTTP as this is the protocol that is being used to share text, images, and other multimedia files on the World Wide Web.

7. HTTPS (Hyper Text Transfer Protocol Secure)

HTTPS is an extension of the Hypertext Transfer Protocol (HTTP). It is used for secure communication over a computer network with the SSL/TLS protocol for encryption and authentication. So, generally, a website has an HTTP protocol but if the website is such that it receives some sensitive information such as credit card details, debit card details, OTP, etc then it requires an SSL certificate installed to make the website more secure. So, before entering any sensitive information on a website, we should check if the link is HTTPS or not. If it is not HTTPS then it may not be secure enough to enter sensitive information.

8. TELNET (Terminal Network)

TELNET is a standard TCP/IP protocol used for virtual terminal service given by ISO. This enables one local machine to connect with another. The computer which is being connected is called a remote computer and which is connecting is called the local computer. TELNET operation lets us display anything being performed on the remote computer in the local computer. This operates on the client/server principle. The local computer uses the telnet client program whereas the remote computer uses the telnet server program.

9. POP3 (Post Office Protocol 3)

POP3 stands for Post Office Protocol version 3. It has two Message Access Agents (MAAs) where one is client MAA (Message Access Agent) and another is server MAA(Message Access Agent) for accessing the messages from the mailbox. This protocol helps us to retrieve and manage emails from the mailbox on the receiver mail server to the receiver's computer. This is implied between the receiver and the receiver mail server. It can also be called a one-way client-server protocol. The POP3 WORKS ON THE 2 PORTS I.E. PORT 110 AND PORT 995.

10. IPv4

The fourth and initially widely used version of the Internet Protocol is called IPv4 (Internet Protocol version 4). It is the most popular version of the Internet Protocol and is in charge of distributing data packets throughout the network. Maximum unique addresses for IPv4 are 4,294,967,296 (232), which are possible due to the use of 32-bit addresses. The network address and the host address are the two components of each address. The host address identifies a particular device within the network, whereas the network address identifies the network to which the host belongs. In the "dotted decimal" notation, which is the standard for IPv4 addresses, each octet (8 bits) of the address is represented by its decimal value and separated by a dot (e.g. 192.168.1.1).

11. IPv6

The most recent version of the Internet Protocol, IPv6, was created to address the IPv4 protocol's drawbacks. A maximum of 4.3 billion unique addresses are possible with IPv4's 32-bit addresses. Contrarily, IPv6 uses 128-bit addresses, which enable a significantly greater number of unique addresses. This is significant because IPv4 addresses were running out and there are an increasing number of devices that require internet access. Additionally, IPv6 offers enhanced security features like integrated authentication and encryption as well as better support for mobile devices. IPv6 support has spread among websites and internet service providers, and it is anticipated to gradually displace IPv4 as the main internet protocol.

12. ICMP

ICMP (Internet Control Message Protocol) is a network protocol that is used to send error messages and operational information about network conditions. It is an integral part of the Internet Protocol (IP) suite and is used to help diagnose and troubleshoot issues with network connectivity. ICMP messages are typically generated by network devices, such as routers, in response to errors or exceptional conditions encountered in forwarding a datagram. Some examples of ICMP messages include:

- Echo Request and Echo Reply (ping)
- Destination Unreachable
- Time Exceeded
- Redirect

ICMP can also be used by network management tools to test the reachability of a host and measure the round-trip time for packets to travel from the source to the destination and back. It should be noted that ICMP is not a secure protocol, it can be used in some types of network attacks like DDO Samplification.

13. UDP

UDP (User Datagram Protocol) is a connectionless, unreliable transport layer protocol. Unlike TCP, it does not establish a reliable connection between devices before transmitting data, and it does not guarantee that data packets will be received in the order they were sent or that they will be received at all. Instead, UDP simply sends packets of data to a destination without any error checking or flow control. UDP is typically used for real-time

applications such as streaming video and audio, online gaming, and VoIP (Voice over Internet Protocol) where a small amount of lost data is acceptable and low latency is important. UDP is faster than TCP because it has less overhead. It doesn't need to establish a connection, so it can send data packets immediately. It also doesn't need to wait for confirmation that the data was received before sending more, so it can transmit data at a higher rate.

14. IMAP

IMAP (Internet Message Access Protocol) is a protocol used for retrieving emails from a mail server. It allows users to access and manage their emails on the server, rather than downloading them to a local device. This means that the user can access their emails from multiple devices and the emails will be synced across all devices. IMAP is more flexible than POP3 (Post Office Protocol version 3) as it allows users to access and organize their emails on the server, and also allows multiple users to access the same mailbox.

15. SSH

SSH (Secure Shell) is a protocol used for secure remote login and other secure network services. It provides a secure and encrypted way to remotely access and manage servers, network devices, and other computer systems. SSH uses public-key cryptography to authenticate the user and encrypt the data being transmitted, making it much more secure than traditional remote login protocols such as Telnet. SSH also allows for secure file transfers using the SCP (Secure Copy) and SFTP (Secure File Transfer Protocol) protocols. It is widely used in Unix-based operating systems and is also available for Windows. It is commonly used by system administrators, developers, and other technical users to remotely access and manage servers and other network devices.

16. Gopher

Gopher is a type of file retrieval protocol that provides downloadable files with some description for easy management, retrieving, and searching of files. All the files are arranged on a remote computer in a stratified manner. It is an old protocol and it is not much used nowadays.

3.13 Hyper Text Markup Language (HTML)

HTML, or **HyperText Markup Language**, is the standard markup language used to create web pages. It's a combination of Hypertext, which defines the link between web pages, and Markup language, which is used to define the text document within tags to structure web pages. This language is used to annotate text so that machines can understand and manipulate it accordingly. HTML is human-readable and uses tags to define what manipulation has to be done on the text.

3.14 Dynamic HTML

DHTML, or Dynamic HTML, is a technology that differs from traditional HTML. DHTML combines HTML, CSS, JavaScript, and the Document Object Model (DOM) to

create dynamic content. It uses the Dynamic Object Model to modify settings, properties, and methods. Scripting is also an essential component of DHTML, which was part of earlier computing trends. It is supported by some versions of Netscape Navigator and Internet Explorer 4.0 and higher.

3.15   Extensible Markup Language (XML)

Extensible Markup Language (XML) is a type of markup language that establishes a set of guidelines for encoding texts in a way that is both machine- and human-readable. For storing and transferring data on the web and in many other applications, XML is widely used. XML steps in as a versatile tool for encoding and organizing data in a way that both humans and machines can comprehend.

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Suggested Readings:
1. ITLESL, Introduction to Computer Science, Pearson Education.
2. ITLESL, Introduction to Information Technology, Pearson Education.
3. Sinha&Sinha, Fundamentals of Computers, BPB Publication.
4. Rajaraman, Fundamentals of Computers, PHI.

Prepared by Shyamal Garai, Assistant Professor, Dept of Commerce, Krishna Chandra College