

Information and Communication Technology, ICT, Types

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Information and Communication Technologies (ICTs) refer to any communication device or application that allows users to access, retrieve, store, transmit, and manipulate information in a digital format, such as mobile phones, network hardware, software, the Internet, **satellite systems**, and other media applications. The ICT sector combines manufacturing and **service industries** whose products primarily perform or enable the function of information processing and **communication via electronic means**, such as transmission and display.

Over the past decade, ICT has helped create the most rapidly growing industry sectors, driven efficiency in government and business operations, and developed the essential building blocks of a knowledge-based economy.

About Information and Communication Technology

Information and communication technology (ICT) is a broad term that encompasses all **technical tools** needed to manage information and facilitate communication, such as computer and network hardware, communication middleware, and essential software.

- **Information:** It is knowledge derived from data/ data placed within a context. It is a message that the sender intends to communicate to the **receiver**.

- It is produced and stored by individual minds, or implicitly encoded and documented in organisational processes, services and systems.
- **Communication:** It is the process of information, usually via a common system of symbols. Communication can be **participatory**, **transactive**, deliberate, or unintended; verbal or nonverbal.
- **ICT:** Information and Communication Technology (ICT) is about the use of technology in information processing and communication.
 - Various technologies have been developed over the years in terms of information and communication such as telephone, radio, computer hardware and software, local area networks (LAN), wide area networks (WAN), satellite etc.
- **Objectives of ICT:** To improve information access and make human-to-human, human-to-machine, and machine-to-machine (M2M) communication more efficient and convenient.

Types of Technologies in ICT

ICT engineers are creating a virtual world that offers new services and applications for daily life, combining traditional technologies like landline telephones and radio broadcasts with modern advancements like artificial intelligence and **robotics**.

- **Cellular Network:** The creation of technology and the evolution of the mobile industry have been initiated by the **mobile industry** since the early 1970s.
 - Cellular networks have evolved through various generations from the first version of mobile connectivity 1G in the 1980s to the more recent 5G Technology (fifth generation).
 - 6G Technology is the sixth generation of cellular networks, with truly **omnipresent wireless intelligence** expected to be available in the early 2030s.
- **Wi-Fi:** Wi-Fi is a networking technology that uses radio waves to transmit data at high speeds over short distances. It enables **local area networks (LANs)** to function without cables and wiring.
 - **Wi-Fi Direct** is a Wi-Fi version that allows devices to connect without the need for a **LAN**.
- **LiFi:** LiFi Technology is a wireless optical networking technology that transmits data via **light-emitting diodes (LEDs)**. It provides better bandwidth, efficiency, connectivity, and security than Wi-Fi.
- **Supercomputers:** Supercomputer is a system with high-performance computing capability to execute computationally intensive tasks in different scientific fields such as **molecular modelling**, climate research, and **quantum mechanics**.
- **Space Internet:** Space Internet is an internet connection powered by satellites orbiting the Earth.
 - For instance, **Starlink** (by SpaceX) is providing high-speed internet access anywhere on the planet using a **constellation** of thousands of satellites.
- **Near-field communication (NFC):** It is a **short-range wireless** connectivity technology that uses **electromagnetic radio fields** to communicate between two devices.
 - NFC-enabled devices must be either physically touching or within a few centimetres of each other for data transfer to occur.
- **Radio Frequency Identification (RFID):** It refers to a wireless system that uses **radio waves** at several different frequencies to transfer data. It is comprised of two **components: tags and readers**.

- The reader is a device with one or more antennas that emit radio waves and receive signals from the **RFID tag**.
- Tags, which communicate their identity and other information to nearby readers via radio waves, can be either passive or active.
- **Other Technologies in ICT:** The Internet, the Internet of Things, **metaverse**, virtual reality, and social media are also part of ICT, as are cloud computing **services**, video conferencing and collaboration tools, and mobile communication networks.
 - Emerging or work-in-progress technologies, like **5G/6G**, **Web3**, and quantum computing are also in the ICT universe.

Application of Information and Communication Technology

Information and communication technology are used in a wide range of fields, including education, agriculture, medicine, defence, and **e-governance**. With the advances in technology, **computing infrastructure**, and the need to automate and reduce cycle times, ICT plays a vital role.

- **Education:** ICTs can increase access to and improve the quality of education. Many types of ICTs are commonly used in education like open and distance learning (access to a large number of e-books, and e-journals) and **E-learning** which makes use of the internet, **LAN**, **WAN**, partially or completely, for proper communication or interaction.
- **Agriculture:** ICT benefits agriculture by providing up-to-date information on issues such as new variety releases, new threats, weather forecasts, pricing control, warning alerts, and so on.
- **Medicine:** The use of ICT has helped to develop new cures and treatments for illnesses. Most diseases are detected by computerized equipment refers as **MRI**, CT scanners, and **ECG machines**. **E-channeling** also plays a vital role in medicine, e-channeling refers to channelling doctors over the internet.
- **Defence:** ICT has transformed the defence industry from producing smart weapons to **network-centric battlefield** management and from aftermath combat review to **real-time combat surveillance**.
- **E-governance:** It utilizes ICT for government services, information exchange, communication transactions, and integration of systems and services between government to citizens, businesses, employees, and others.
- **E-Commerce:** It is a business model that enables the buying and selling of goods and services over the Internet.

ICT in India

India's ICT sector is growing rapidly and contributing to the economy overall. The success is hard-earned via deploying multiple government initiatives, development of adequate digital infrastructure, bolstering policy, legal and regulatory framework, and fostering public-private partnerships, etc.

- The **ICT sector** contributes to around **13% of the country's GDP**. It intends to increase to **\$1 trillion** or **20%** of projected GDP **by 2025**.

Regulatory Framework

- **The Digital Personal Data Protection Act, 2023:** The act seeks to protect Indian citizens' **privacy** and personal data in the context of a globally interconnected digital economy.
- **Telecommunications Bill:** Telecommunications Bill 2023 aims to consolidate and amend existing laws governing the provision, development, expansion, and operation of telecommunications services, telecom networks, and infrastructure, as well as spectrum allocation.
 - It consolidates three separate acts that govern the telecommunications sector — the **Indian Telegraph Act of 1885**, the **Indian Wireless Telegraphy Act of 1933**, and The **Telegraph Wires, (Unlawful Protection) Act of 1950**.
- **IT Amendment Rules, 2023:** It gives the union government the authority to remove any online content related to its business that it considers false or misleading.
- The amendment contains a provision that repeals the legal protection granted to social media platforms and intermediaries under Section 79 of the **Information Technology (IT) Act, 2000**, if they fail to comply with the union government's orders.

Government Initiatives to Accelerate ICT

- **Digital India Program:** The Government of India's **flagship programme**, launched in **2015** to transform India into a digitally empowered society and knowledge economy.
 - The policy aimed to achieve **three vision areas**: infrastructure as a utility for all citizens, governance, and services on demand, and digital empowerment through nine 'pillars' or focus areas.
- **National Policy on Electronics:** It establishes a strategic framework for India's **Electronic System Design and Manufacturing (ESDM)** sector.
 - The policy actively promotes a comprehensive startup ecosystem, with a focus on emerging technologies such as artificial intelligence, **5G**, IoT, machine learning, robotics, optics, and more.
- **National Broadband Mission:** It enables fast-track growth of digital communications infrastructure, bridges the **digital divide** for digital empowerment and inclusion, and provides affordable and **universal access** to broadband for all.
- **National Mission on Education through ICT (NMEICT):** It aims to make high-quality content available to all learners in the country at no cost. The various initiatives are implemented under this program:
 - **SWAYAM:** The 'Study Webs of Active Learning for Young Aspiring Minds' (SWAYAM) is an integrated platform that provides online courses from the ninth to the twelfth grades to the postgraduate level.
 - **National Digital Library (NDL):** To create a framework for a virtual repository of learning resources that include a single-window search facility.

Challenges Associated with ICT in India

- **Digital divide:** There exists a grave digital divide in India wherein gaps exist in the usage of the internet and access to digital infrastructure.
 - According to the '**India Inequality Report 2022: Digital Divide**' by Oxfam, only 38% of households are digitally literate; additionally, only 31% of the rural population uses the internet as compared to 67% of the urban population.

- **Privacy concern:** Recent advances in information technology threaten privacy and have reduced the amount of control over personal data and open up the possibility of a range of negative consequences as a result of access to personal data.
- **Cybersecurity threats:** With advancements in ICT, cybersecurity threats also continue to grow and evolve in frequency, vector, and complexity. The most common information security threats are **malware attacks** (eg. Ransomware), **social engineering attacks**, etc.
- **Telecom sector:** The telecom sector is facing many challenges with service providers having to incur huge initial fixed costs to enter semi-rural and rural areas due to lack of infrastructure, rapidly falling **ARPU (Average Revenue Per User)**, **low broadband penetration** in the country, etc.

Information and Communication Technology UPSC PYQs

Question 1: Consider the following communication technologies: **(UPSC Prelims 2022)**

1. Closed-circuit Television
2. Radio Frequency Identification
3. Wireless Local Area Network

Which of the above are considered Short-Range devices/technologies?

1. 1 and 2 only
2. 2 and 3 only
3. 1 and 3 only
4. 1, 2 and 3

Answer: (d)

Question 2: With reference to communication technologies, what is/are the difference/differences between LTE (Long-Term Evolution) and VoLTE (Voice over Long-Term Evolution)?

1. LTE is commonly marketed as 3G and VoLTE is commonly marketed as advanced 3G.
2. LTE is data-only technology and VoLTE is voice-only technology.

Select the correct answer using the code given below.

1. 1 only
2. 2 only
3. Both 1 and 2
4. Neither 1 nor 2

Answer: (d)

Question 3: With reference to 'Near Field Communication (NFC) Technology', which of the following is/are correct? **(UPSC Prelims 2013)**

1. It is a contactless communication technology that uses electromagnetic radio fields.
2. NFC is designed for use by devices which can be at a distance of even a metre from each other.

3. NFC can use encryption when sending sensitive information.

Select the correct answer using the codes given below.

1. 1 and 2 only
2. 3 only
3. 1 and 3 only
4. 1, 2 and 3

Answer: (c)

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