

Unit 12:Internet of Things

- Definitions and Functional Requirements - Motivation - Architecture - Web 3.0 View of IoT - Ubiquitous IoT Applications - Four Pillars of IoT - DNA of IoT -The Toolkit Approach for End-user Participation in the Internet of Things. Middleware for IoT: Overview -Communication middleware for IoT - IoT Information Security.
- Protocol Standardization for IoT - Efforts - M2M and WSN Protocols - SCADA and RFID Protocols- Issues with IoT Standardization - Unified Data Standards -Protocols -IEEE 802.15.4 - BACNet Protocol Modbus - KNX - Zigbee- Network layer - APS layer –Security.
- Web of Things versus Internet of Things - Two Pillars of the Web - Architecture standardization for WoT Platform Middleware for WoT - Unified Multitier WoT Architecture - WoT Portals and Business Intelligence. Cloud of Things:

Grid/SOA and Cloud Computing - Cloud Middleware - Cloud Standards - Cloud Providers and Systems - Mobile cloud Computing - The Cloud of Things Architecture.

- Industrial Internet of Things - Introduction to Industrial Internet of Things - Industrie 4.0 - Industrial Internet of Things (IIoT) - IIoT Architecture - Basic Technologies - Applications and Challenges - Security and Safety - Introduction to Security and Safety - Systems Security - Network Security - Generic Application Security - Application Process Security and Safety - Reliable-and-Secure-by-Design IoT Applications - Run-Time Monitoring - The ARMET Approach - Privacy and Dependability
- The Role of the Internet of Things for Increased Autonomy and Agility in Collaborative Production Environments -Resource Management in the Internet of Things: Clustering, Synchronization and Software Agents. Applications - Smart Grid -Electrical Vehicle charging

4 Pillars of Internet of Things (IoT)

1. Device

- The Internet of Things (IoT), is a technology that links gadgets to the internet so they may share and exchange data.
- The device is the first pillar of IoT. Your smartphone, hospital medical equipment, a vehicle, or any other electronic item that can transport data over the internet can be this device.
- These gadgets have sensors that capture and send data from one location to another.
- IoT devices need wireless networks that enable several devices to function on a same network in order to stay connected. For IoT devices to operate without interruption, a wireless solution is necessary. Mobile devices, medical equipment, cars, and electronic appliances are all examples of IoT devices.



4 Pillars of Internet of Things (IoT)

2. Data

- The prior aim of IoT is to collect & store data.
- This data is processed to enhance the functionality of various devices and software. Data plays a crucial role in the system.
- One example of this is exercise applications that monitor user movement to generate relevant data for tracking fitness goals.
- The primary function of IoT is to gather a large amount of data to improve application functionality and process information.



4 Pillars of Internet of Things (IoT)

3. Analytics

- The proper analysis and efficient processing of data are crucial for the effectiveness of IoT applications in daily life.
- The use of data analysis tools and procedures is employed to analyze the various types of generated data.
- This analysis helps in obtaining valuable information, which can then be used to optimize and enhance the benefits of IoT for the user.
- The third pillar of IoT is analytics, which is responsible for the efficient and accurate analysis of collected data.



4 Pillars of Internet of Things (IoT)

4. Connectivity

- The fourth and final pillar of IoT is connectivity, it allows the previous three pillars to coexist peacefully.
- It is crucial to maintain uninterrupted connectivity to ensure the smooth flow of real-time data processing and analysis.
- Without connectivity, it is impossible to optimize the processing and use of data in different systems and software.
- Poor connectivity can also cause inaccuracies and data loss during data analysis.
- Connectivity is essential for the three previously mentioned pillars to work in conjunction with each other.





Pillars of the Internet of Everything (IoE)



People

Connecting people in more relevant, valuable ways.



Data

Converting data into intelligence to make better decisions.



Process

Delivering the right information to the right person at the right time.



Things

Physical devices & objects connected to the Internet & each other for intelligent decision making; often called Internet of Things (IoT).

What is the Web of Things (WoT)?

- Enter the Web of Things (WoT), a novel evolution advancing beyond IoT.
- The World Wide Web Consortium or W3C has put in place a set of standards, referred to as WoT.
- It facilitates the fragmentation, interoperability, and usability of IoT.
- Basically, it is a subset of IoT that simplifies the connection of devices.
- It is created around software standards including HTTP, REST, and URIs.



What is the Web of Things (WoT)?

- **The Web of Things (WoT) extends IoT by integrating devices and data into the web. WoT makes seamless device interaction possible.**
- **This way, it enables data sharing and interoperability. It makes IoT more accessible, scalable, and user-friendly for a wide range of applications and users.**



IoT vs WoT: The Difference

- While both technologies serve the same purpose of enabling connectivity, there is a difference in the layer they work on. Some key differences between the two are mentioned below.
- The IoT connects physical devices and sensors to the Internet. On the other hand, WoT connects IoT to web architecture.
- While IoT primarily focuses on data collection and device communication, WoT ensures device interoperability and access to the web.



IoT vs WoT: The Difference

- **IoT operates independently of the web. However, WoT leverages existing web standards for device communication and control.**
- **IoT devices have different protocols. On the other hand, WoT uses a single protocol for multiple IoT devices.**



IoT	WoT
Devices can be connected with any form of internet	WoT is made to handle and use the potential of IoT
It deals with actuators, sensors, computation, communication Interfaces. Digitally Augmented objects make IoT	It deals with web servers and Protocols. WoT is made up of the applications that are made for IoT Devices.
Every IoT devices have a different Protocol	A single protocol is used for multiple/various IoT devices.
Programing is difficult because of multiple protocols	Programming is easy so it doesn't have multiple protocols.
All the protocols and standard are private and it cannot be accessed publicly	WoT can be accessed freely by anyone, anytime.





Network Security

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RANSOMWARE



Blackmails you

SPYWARE



Steals your data

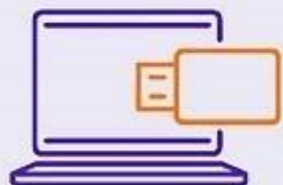
ADWARE



Spams you with ads

Types of Malware

WORMS



Spread
across computers

TROJANS



Sneak malware
onto your PC

BOTNETS



Turn your PC
into a zombie



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Brute force

- **It is a type of attack which uses a trial and error method.**
- **This attack generates a large number of guesses and validates them to obtain actual data like user password and personal identification number.**
- **This attack may be used by criminals to crack encrypted data, or by security, analysts to test an organization's network security.**



SPAMMING : the sending of multiple unsolicited emails or text messages, usually for marketing purposes

VIRUS : it's a computer program that can self-replicate, infect other programs, and spread to other computers

Virus	Worm
<ul style="list-style-type: none">• The virus is the malicious code which will destroy the functioning of the computer system and transfer from one to another system.	<ul style="list-style-type: none">• The malicious program that will copy itself and spread from one system of the computer to another through a network is called a worm.
<ul style="list-style-type: none">• The virus is created by human action.	<ul style="list-style-type: none">• The creation of a worm doesn't need human action.
<ul style="list-style-type: none">• The speed of spreading the virus is slow.	<ul style="list-style-type: none">• The speed of spreading of worms is fast.
<ul style="list-style-type: none">• The host is needed for spreading the virus.	<ul style="list-style-type: none">• No host is needed for spreading the virus.



Phishing

- **Phishing is a type of attack which attempts to steal sensitive information like user login credentials and credit card number.**
- **It occurs when an attacker is masquerading as a trustworthy entity in electronic communication.**





Phishing

Phishing is the fraudulent practice of sending emails claiming to be from reputable companies (including RBI, income tax department) in order to induce individuals to reveal personal information such as passwords and card details, online.



Vishing

Vishing is the act of using the telephone (Mobile/Landline/IVR) in an attempt to scam the user into surrendering private information that will be used for identity theft such as income tax refund, card activation or upgrade, rewards redemption etc.



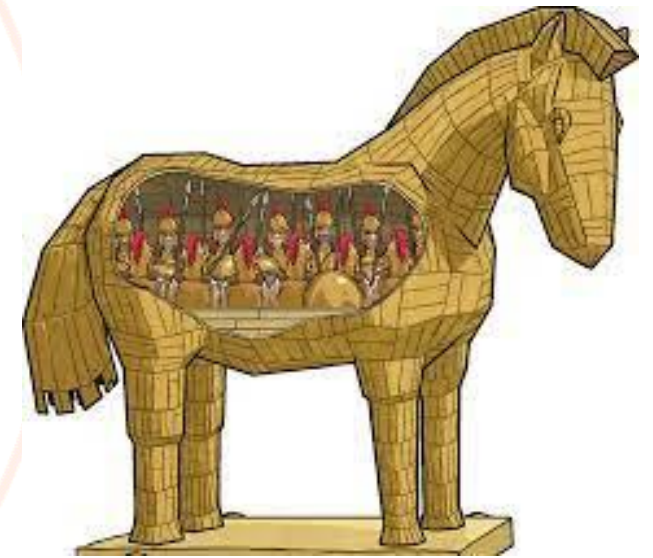
Smishing

Smishing is type of phishing attack where mobile phone users receive text / multimedia (MMS) messages containing a web site hyperlink, which if clicked would download a Trojan horse (spread viruses) to the mobile phone.



Trojan Horse:

- It is a malicious program that occurs unexpected changes to computer setting and unusual activity, even when the computer should be idle. It misleads the user of its true intent.
- It appears to be a normal application but when opened/executed some malicious code will run in the background.
- For example, Trojan horse software observe the e-mail ID and password while entering in web browser for logging.



Man-in-the-middle (MitM) attacks:



Also known as eavesdropping attacks, occur when attackers insert themselves into a two-party transaction. Once the attackers interrupt the traffic, they can filter and steal data.

Denial of Service attacks:

Service Unavailable

HTTP Error 503. The service is unavailable.

- A Denial-of-Service (DoS) attack is an attack meant to shut down a machine or network, making it inaccessible to its intended users.
- DoS attacks accomplish this by flooding the target with traffic, or sending it information that triggers a crash.

Intrusion Detection System (IDS)

- **An Intrusion Detection System (IDS) is a system that monitors network traffic for suspicious activity and issues alerts when such activity is discovered.**
- **It is a software application that scans a network or a system for the harmful activity or policy breaching.**
- **Any malicious venture or violation is normally reported either to an administrator or collected centrally using a security information and event management (SIEM) system.**

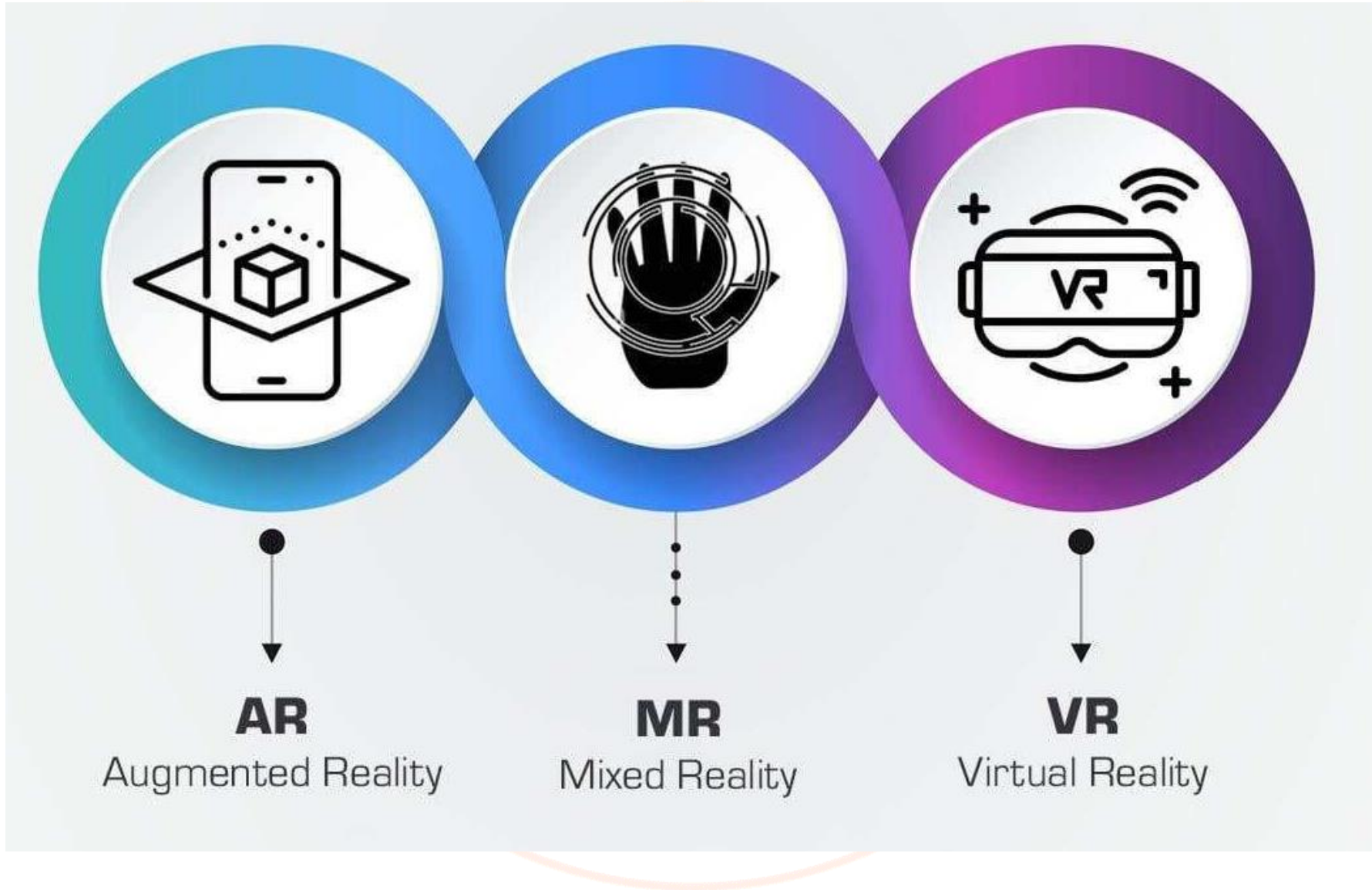




IMMERSIVE TECHNOLOGY

Immersive technology is an integration of virtual content with the physical environment in a way that allows the user to engage naturally with the blended reality.







Virtual reality

- **Virtual reality (VR) refers to a computer-generated simulation in which a person can interact within an artificial three-dimensional environment using electronic devices, such as special goggles with a screen or gloves fitted with sensors.**
- **In this simulated artificial environment, the user is able to have a realistic-feeling experience.**





Augmented Reality

- **Augmented reality (AR for short) is defined as "the real-time use of information in the form of text, graphics, audio, or other virtual enhancements integrated with real-world objects."**
- **It involves overlaying visual, auditory, or other sensory information onto the world in order to enhance one's experience.**





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Mixed Reality

- MR brings together real world and digital elements.
- In mixed reality, you interact with and manipulate both physical and virtual items and environments, using next-generation sensing and imaging technologies.







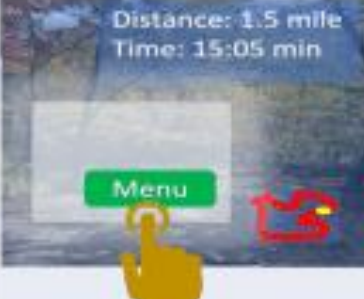





Mixed Reality





		Extended Reality (XR)		
	Reality	Augmented Reality (AR)	Mixed Reality (MR)	Virtual Reality (VR)
Display	Naked eye/optical glasses	Translucent display	Translucent display	Occlusion display
Display example				
Example				
	Real view of a trail	Augmented virtual map and direction	Interactive virtual contents	Virtual gaming





Blockchain technology

- **Blockchain technology is a decentralized, digital ledger that records transactions across a network of computers.**
- **Each block in the chain contains a number of transactions, and every time a new transaction occurs on the blockchain, a record of that transaction is added to every participant's ledger.**





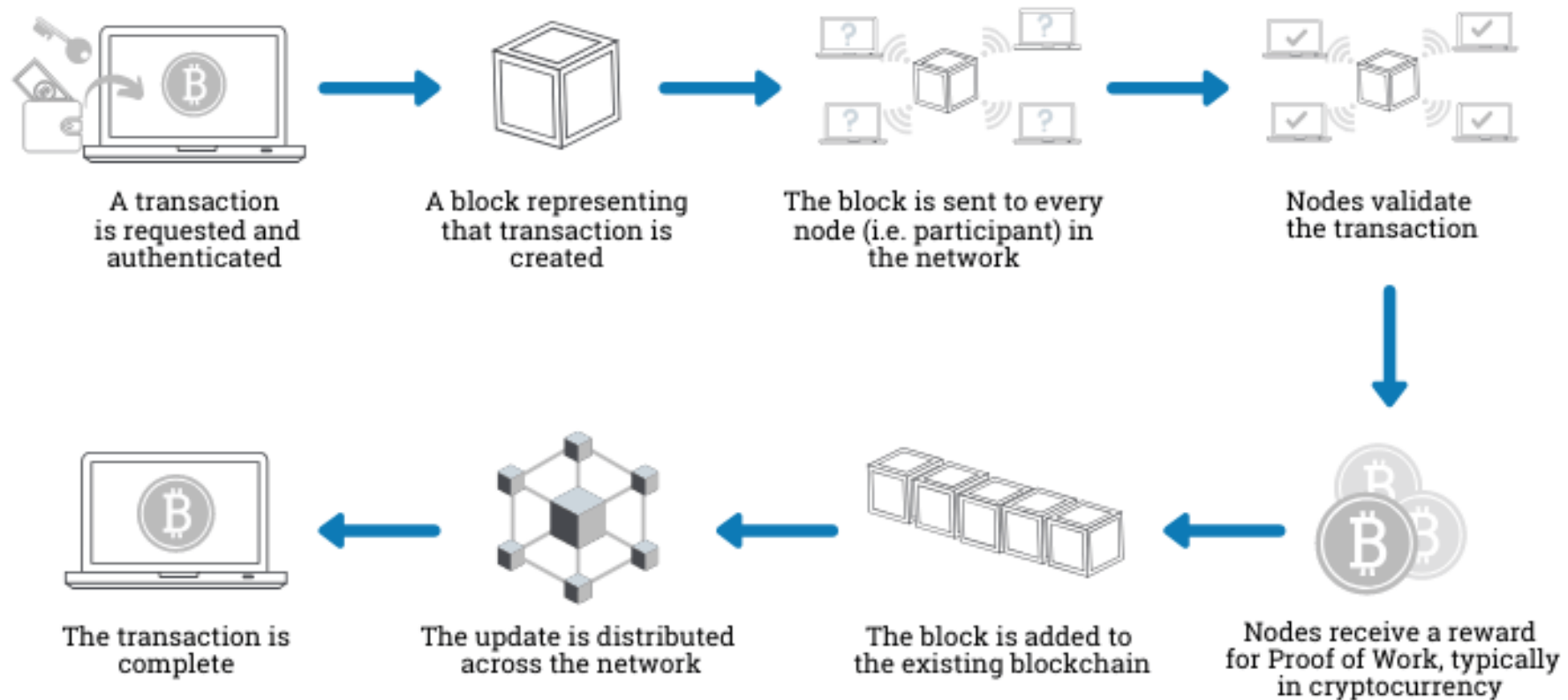
Blockchain technology

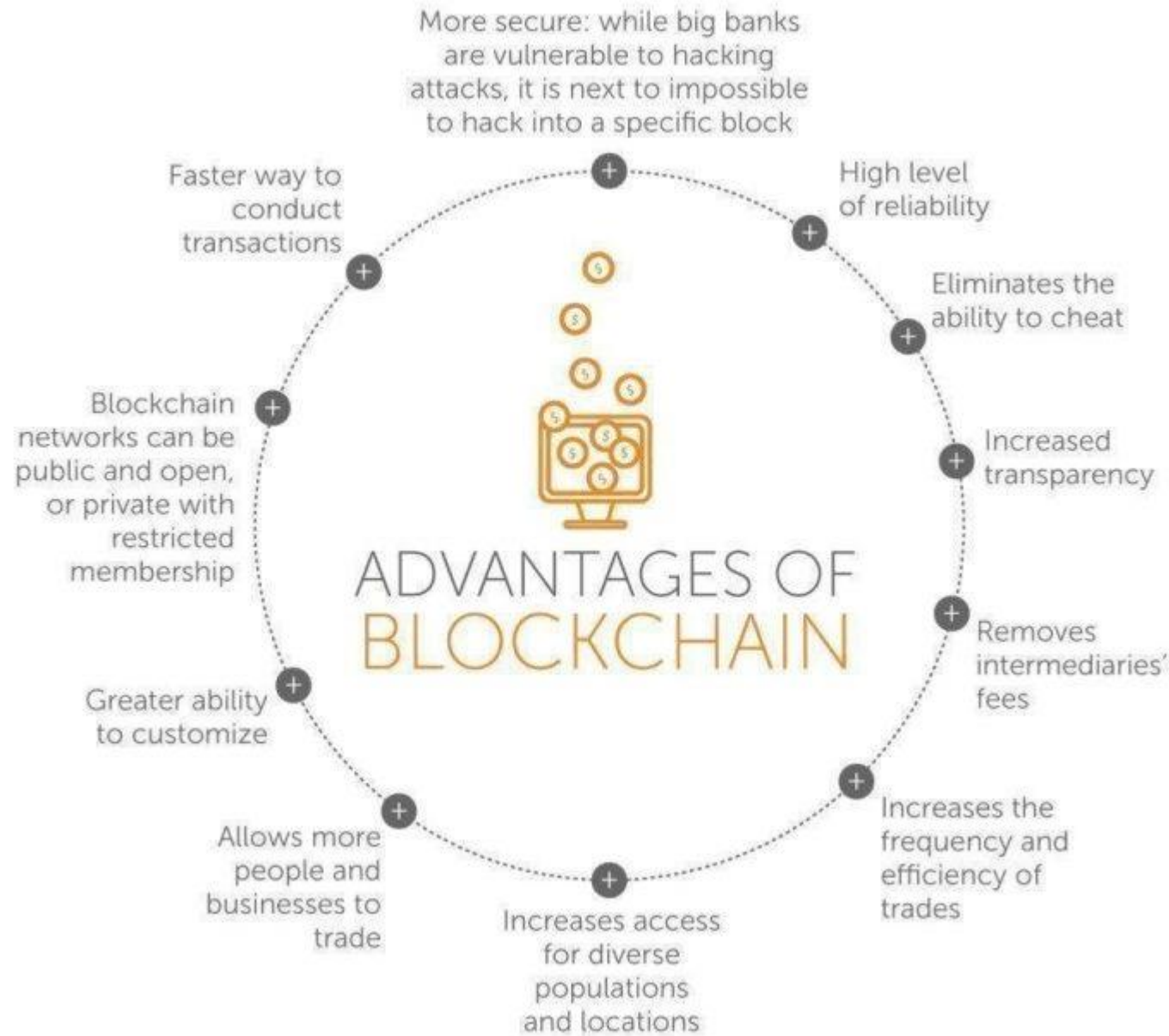
- **The decentralized nature of technology ensures that no single entity can alter or delete previous transactions, providing a high degree of security and transparency.**





How does a transaction get into the blockchain?







➤ Radio Frequency Identification (RFID)

- **Radio Frequency Identification (RFID)** is a form of wireless communication that incorporates the use of electromagnetic or electrostatic coupling in the radio frequency portion of the electromagnetic spectrum to uniquely identify an object, animal or person. It uses radio frequency to search ,identify, track and communicate with items and people. it is a method that is used to track or identify an object by radio transmission uses over the web. Data digitally encoded in an RFID tag which might be read by the reader.

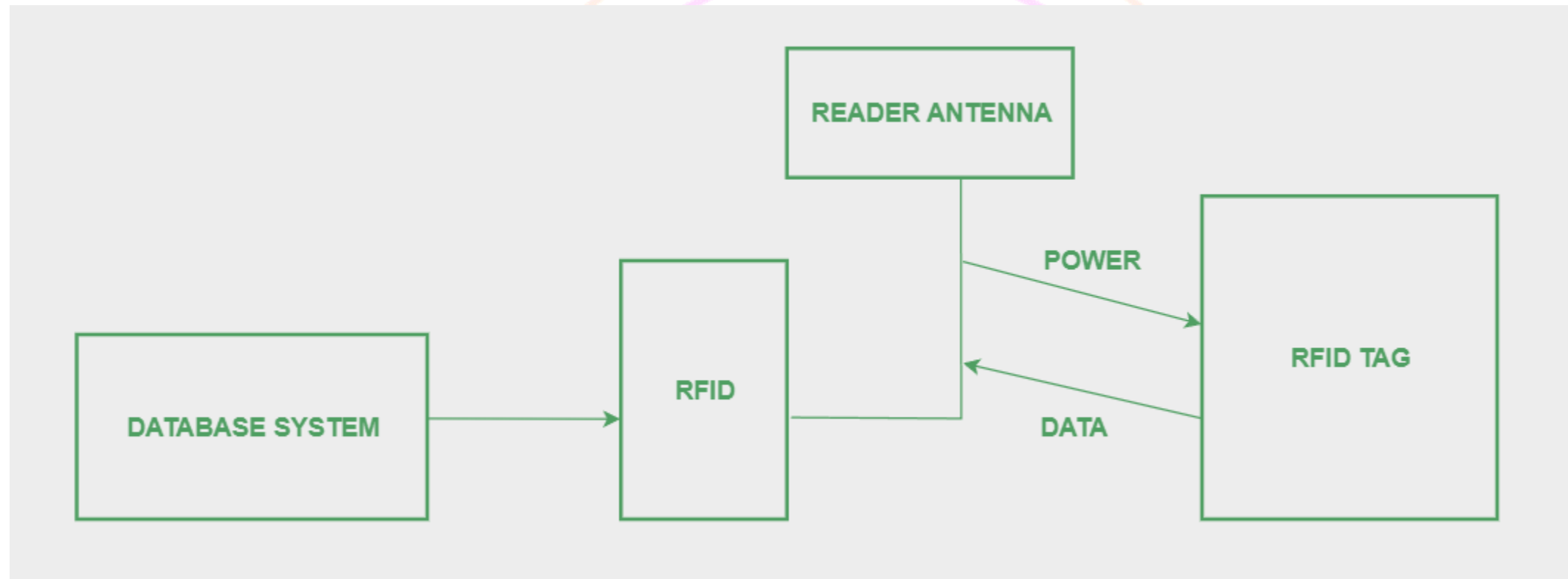




➤ Radio Frequency Identification (RFID)

- This device work as a tag or label during which data read from tags that are stored in the database through the reader as compared to traditional barcodes and QR codes. It is often read outside the road of sight either passive or active RFID.







NATURAL LANGUAGE PROCESSING (NLP)



Chatbots



Autocomplete



Search results



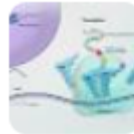
Sentiment analysis



Email classification



Predictive text



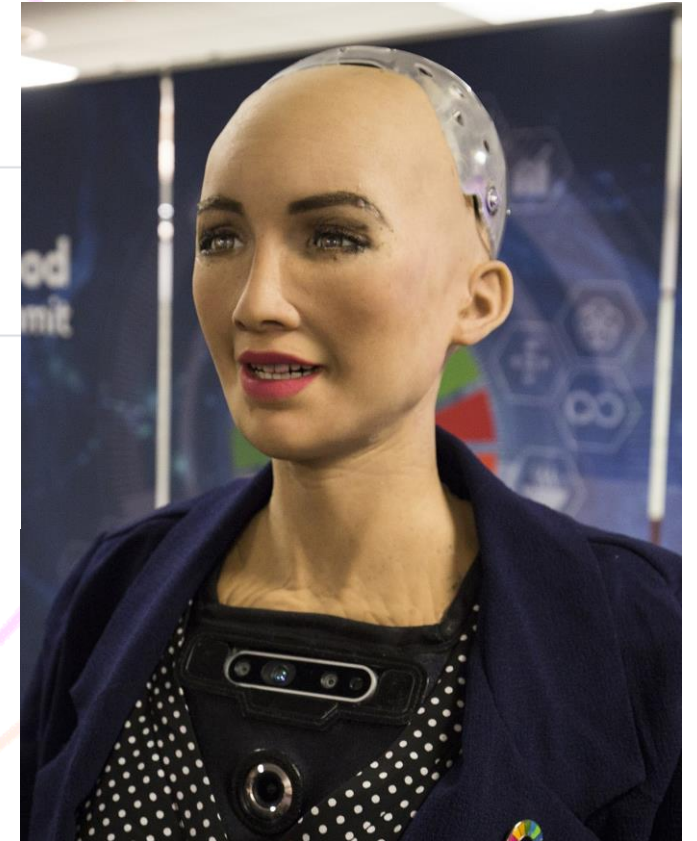
Language translation



Autocorrect



Smart assistants



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NATURAL LANGUAGE PROCESSING (NLP)

- **Natural language processing (NLP) is a subfield of Artificial Intelligence (AI) that deals with the interaction between computers and humans in natural language.**
- **This technology works on the speech provided by the user breaks it down for proper understanding and processes it accordingly.**
- **It involves the use of computational techniques to process and analyze natural language data, such as text and speech, with the goal of understanding the meaning behind the language.**





NATURAL LANGUAGE PROCESSING (NLP)

Natural Language Processing Pipeline





CLOUD COMPUTING

- **Cloud computing means storing and accessing the data and programs on remote servers that are hosted on the internet instead of the computer's hard drive or local server.**
- **Cloud computing is also referred to as Internet-based computing.**
- **Cloud computing is the on-demand delivery of IT resources through the internet with pay-to-use charges.**





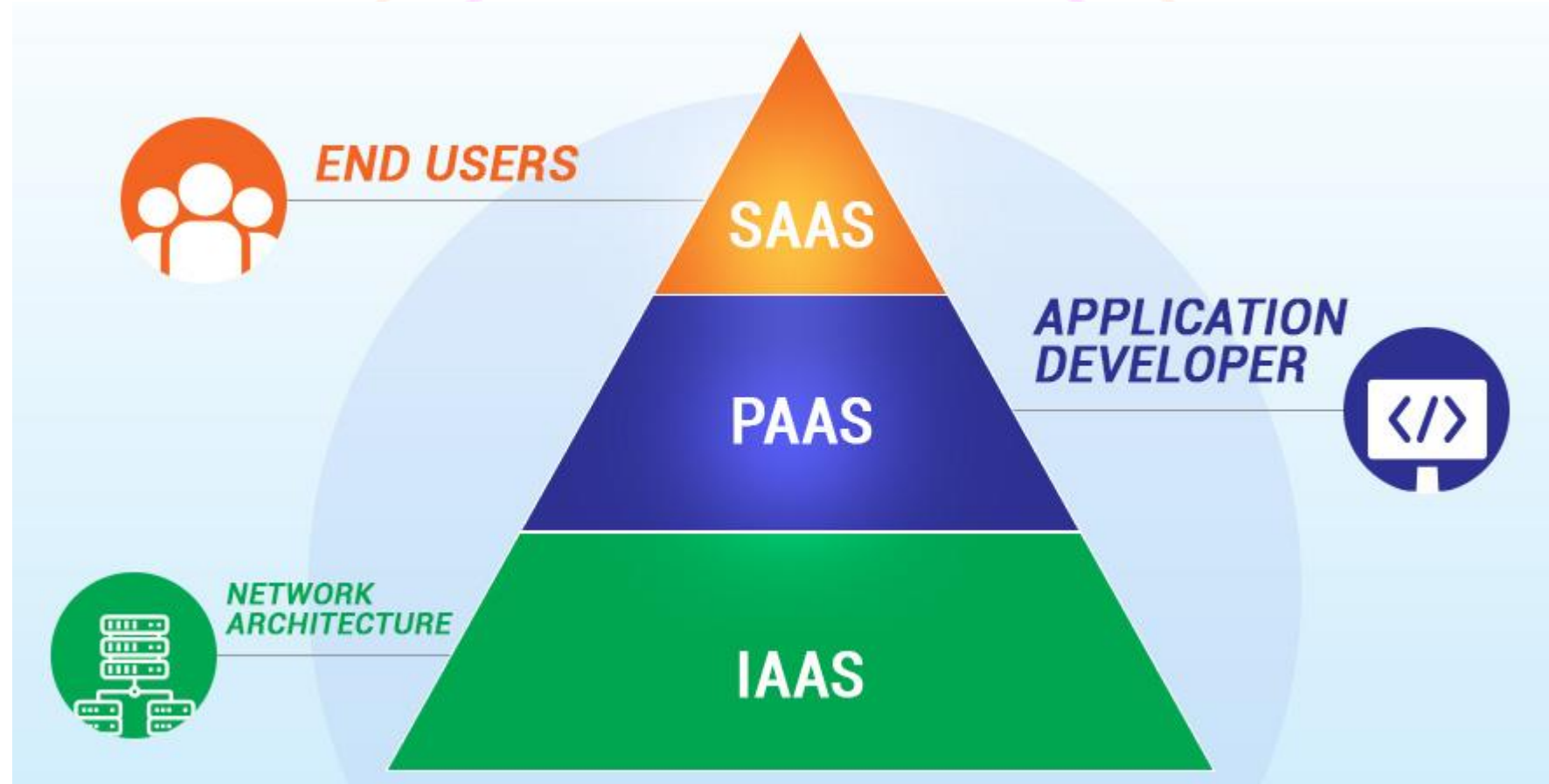
THREE MAJOR CLOUD SERVICE MODELS

- **Cloud computing services can be broken down into three models**
- 1. Software as a Service (SaaS)**
- 2. Platform as a Service (PaaS)**
- 3. Infrastructure as a Service (IaaS)**





CLOUD COMPUTING





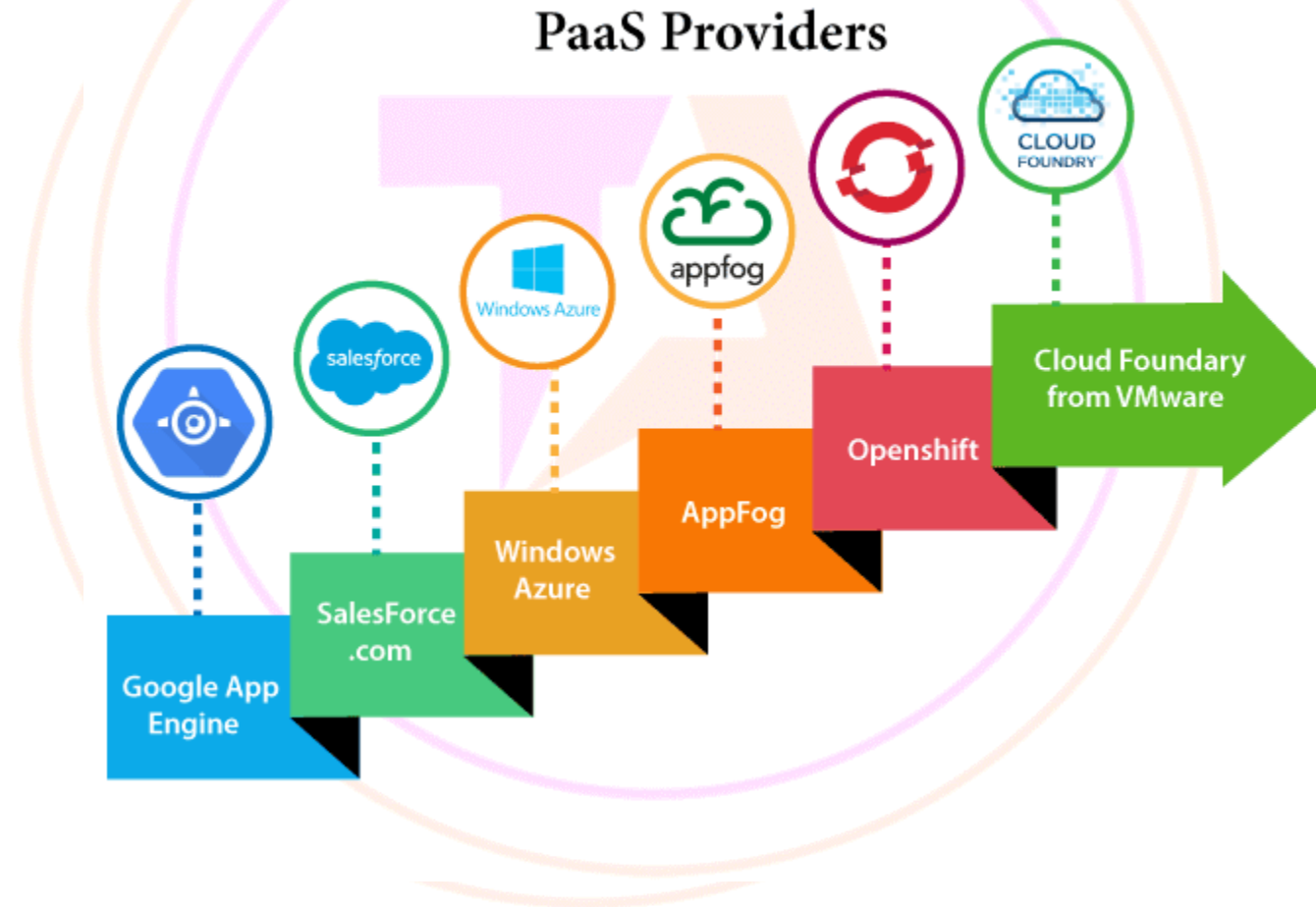
CLOUD COMPUTING

- Software services are offered under a platform.



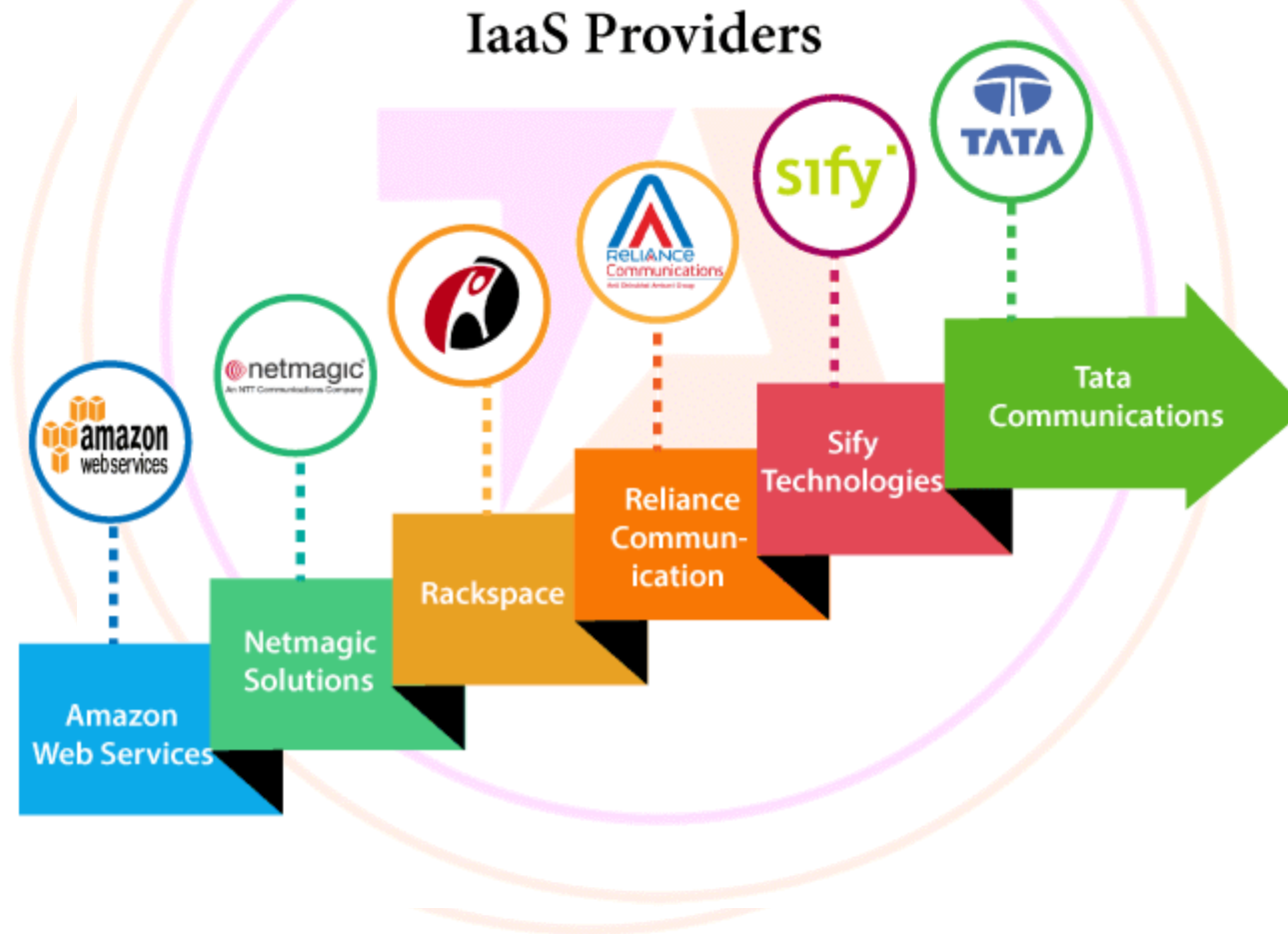


CLOUD COMPUTING





CLOUD COMPUTING





Q. What is the main purpose of virtual reality technology?

- a) To create realistic simulations of real-world environments**
- b) To enhance the gaming experience**
- c) To improve communication and collaboration in remote teams**
- d) To enhance the visual effects of movies and television shows**





Q. In immersive technology, what does MR stand for?

- a) Mixed Reality**
- b) Measured Reality**
- c) More Reality**
- d) Mirrored Reality**





Q. What is a blockchain?

- 1. A blockchain is a centralized digital ledger consisting of records called blocks.**
- 2. A blockchain is a decentralized, distributed, digital ledger consisting of records called blocks.**
- 3. A blockchain is a digital database consisting of records called class.**
- 4. It is a private ledger that no one can inspect.**





Q. What is Machine learning?

- a) The autonomous acquisition of knowledge through the use of computer programs**
- b) The autonomous acquisition of knowledge through the use of manual programs**
- c) The selective acquisition of knowledge through the use of computer programs**
- d) The selective acquisition of knowledge through the use of manual programs**





Q. What is Cloud Computing?

- a) Cloud Computing means providing services like storage, servers, database, networking, etc**
- b) Cloud Computing means storing data in a database**
- c) Cloud Computing is a tool used to create an application**
- d) None of the mentioned**





Q. An IoT network is a collection of _____ devices.

- A. Signal**
- B. Machine to Machine**
- C. Interconnected**
- D. Network to Network**





Q. What is the main purpose of WoT (Web of Things) in the IoT?

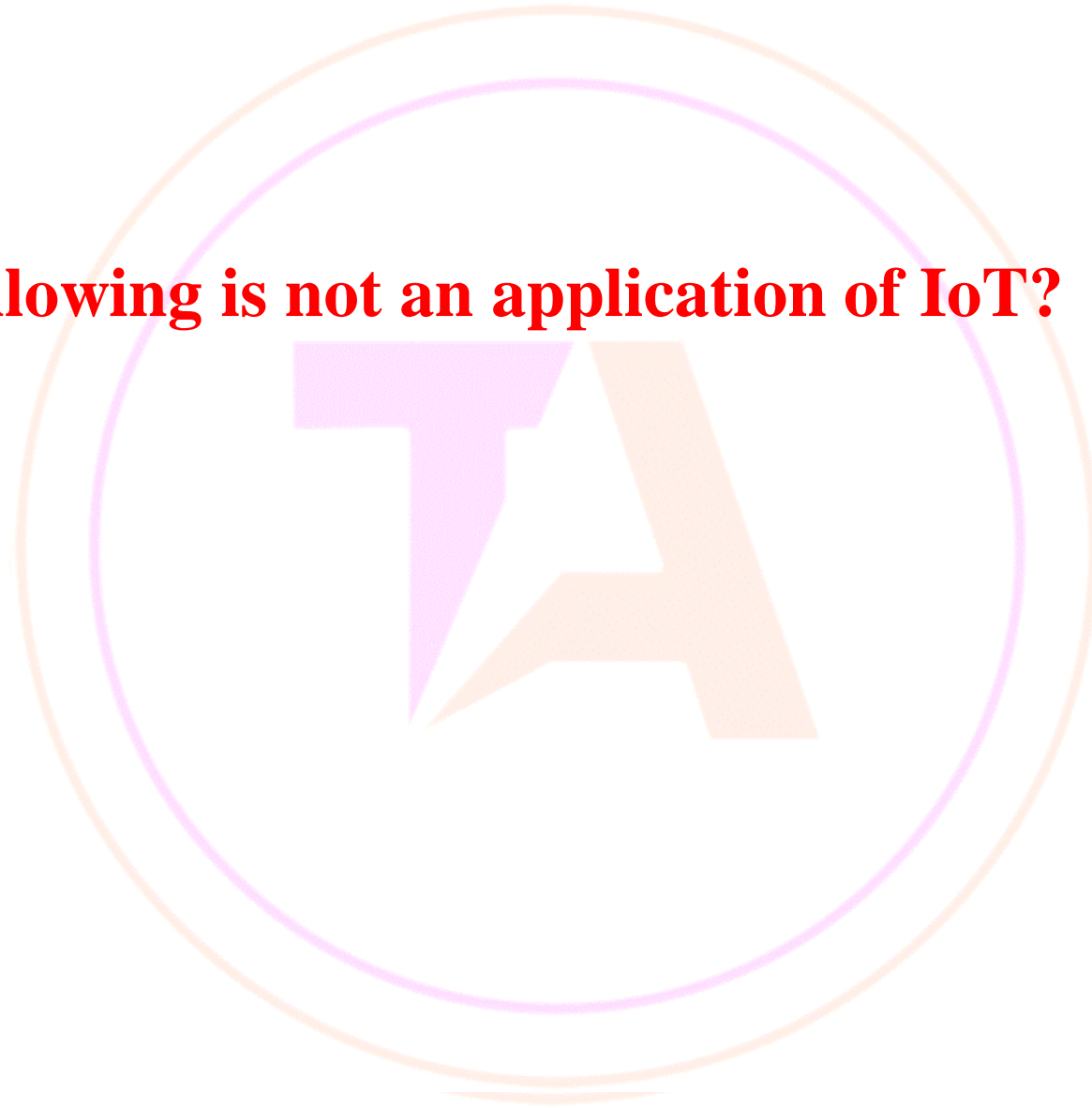
- A. Improve the usability and interoperability**
- B. Reduce the security**
- C. Complex the development**
- D. Increase the cost**





Q. Which of the following is not an application of IoT?

- A. Wearables**
- B. Smart Grid**
- C. Arduino**
- D. Smart City**





Q. What is IoT?

- a) network of physical objects embedded with sensors**
- b) network of virtual objects**
- c) network of objects in the ring structure**
- d) network of sensors**





Q. Which of the following is false about IoT devices?

- a) IoT devices use the internet for collecting and sharing data**
- b) IoT devices need microcontrollers**
- c) IoT devices use wireless technology**
- d) IoT devices are completely safe**





Q. Which of the following is used to capture data from the physical world in IoT devices?

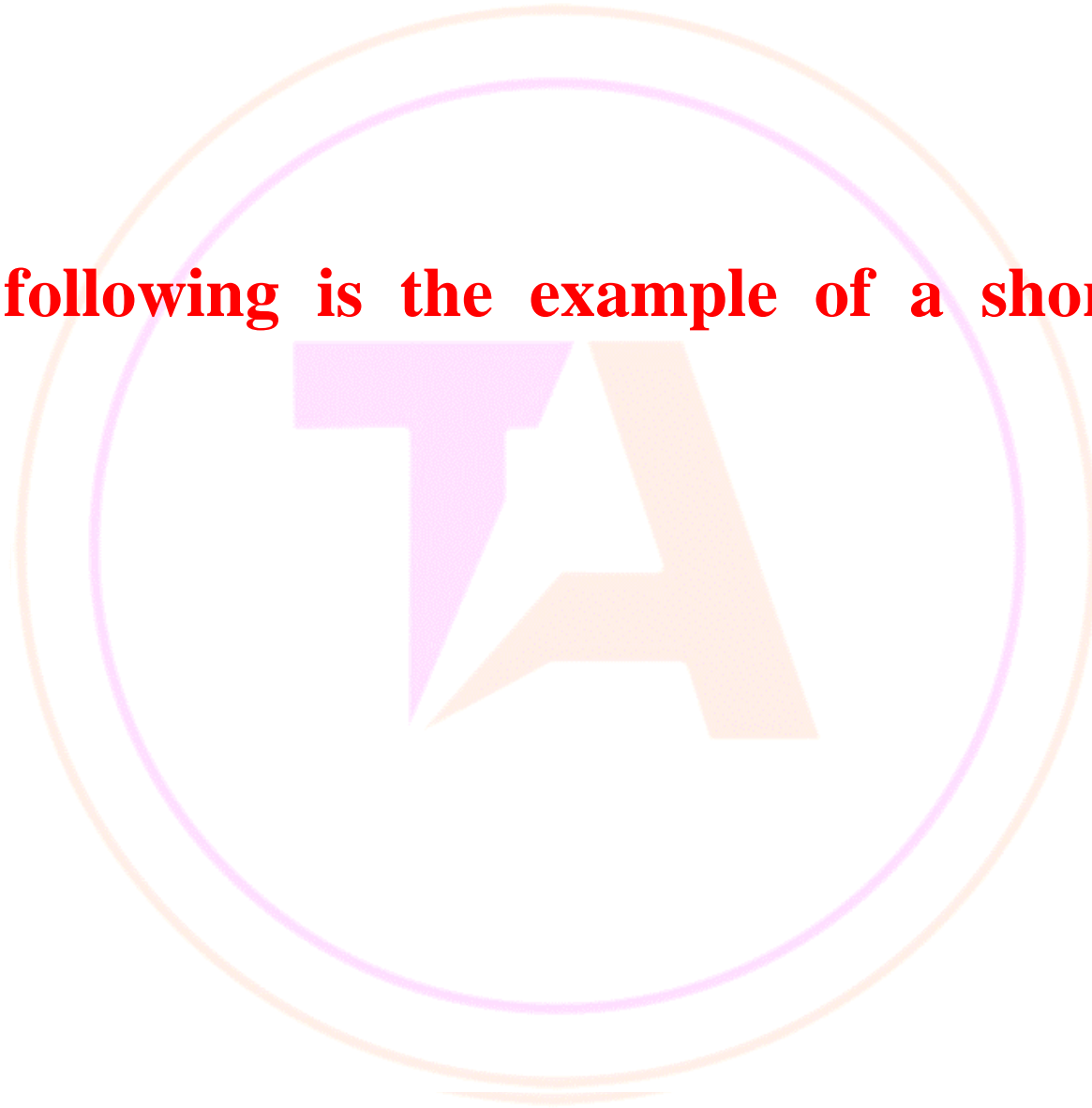
- a) Sensors**
- b) Actuators**
- c) Microprocessors**
- d) Microcontrollers**





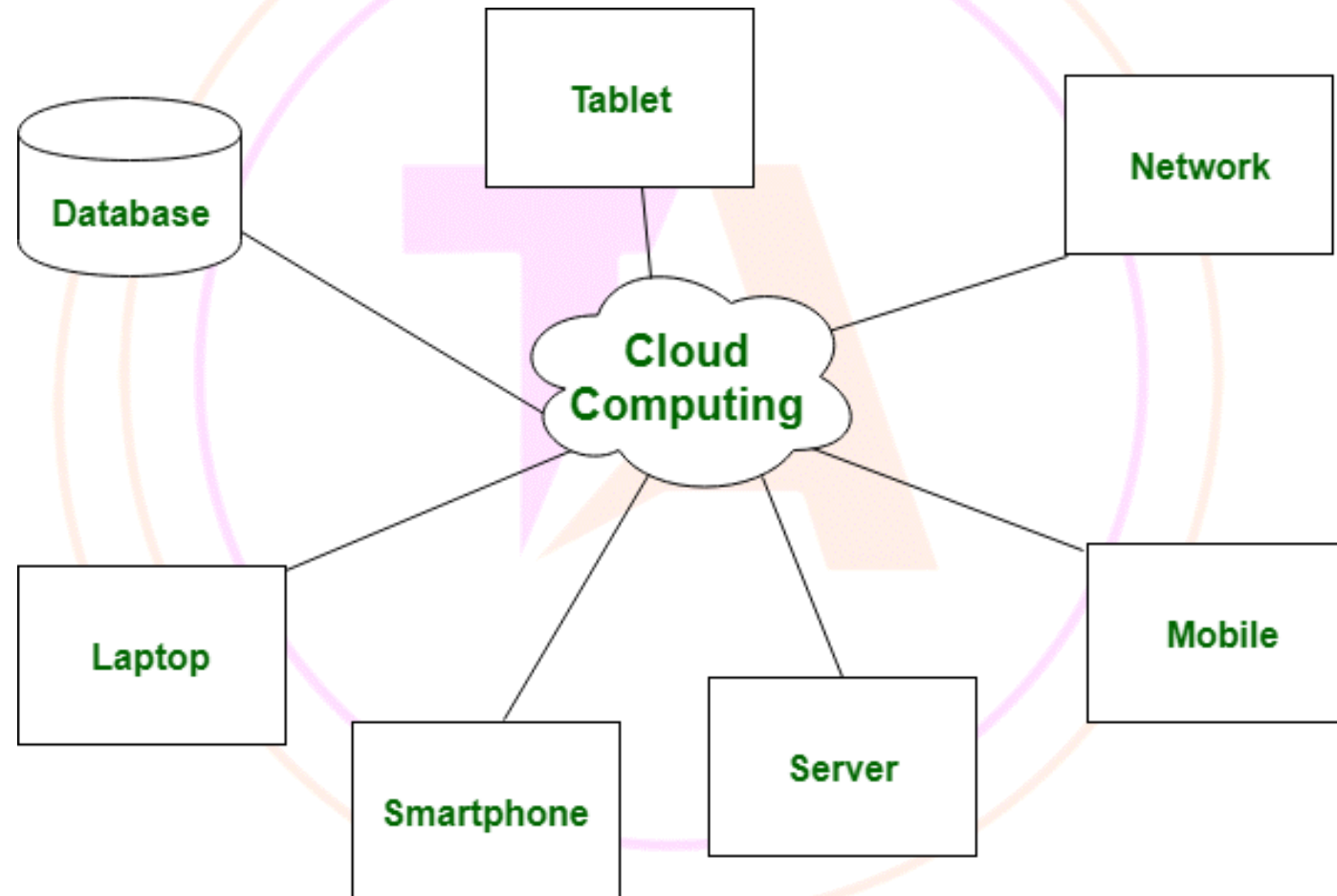
Q. Which of the following is the example of a short-range wireless network?

- A. VPN**
- B. Wi-Fi**
- C. Internet**
- D. WWW**





CLOUD COMPUTING





Grid Computing

- Grid Computing can be defined as a network of computers working together to perform a task that would rather be difficult for a single machine.
- consists of a large number of computers which are connected parallel and forms a computer cluster. This combination of connected computers uses to solve a complex problem.





Grid Computing

- The task that they work on may include analyzing huge datasets or simulating situations that require high computing power.
- Computers on the network contribute resources like processing power and storage capacity to the network.

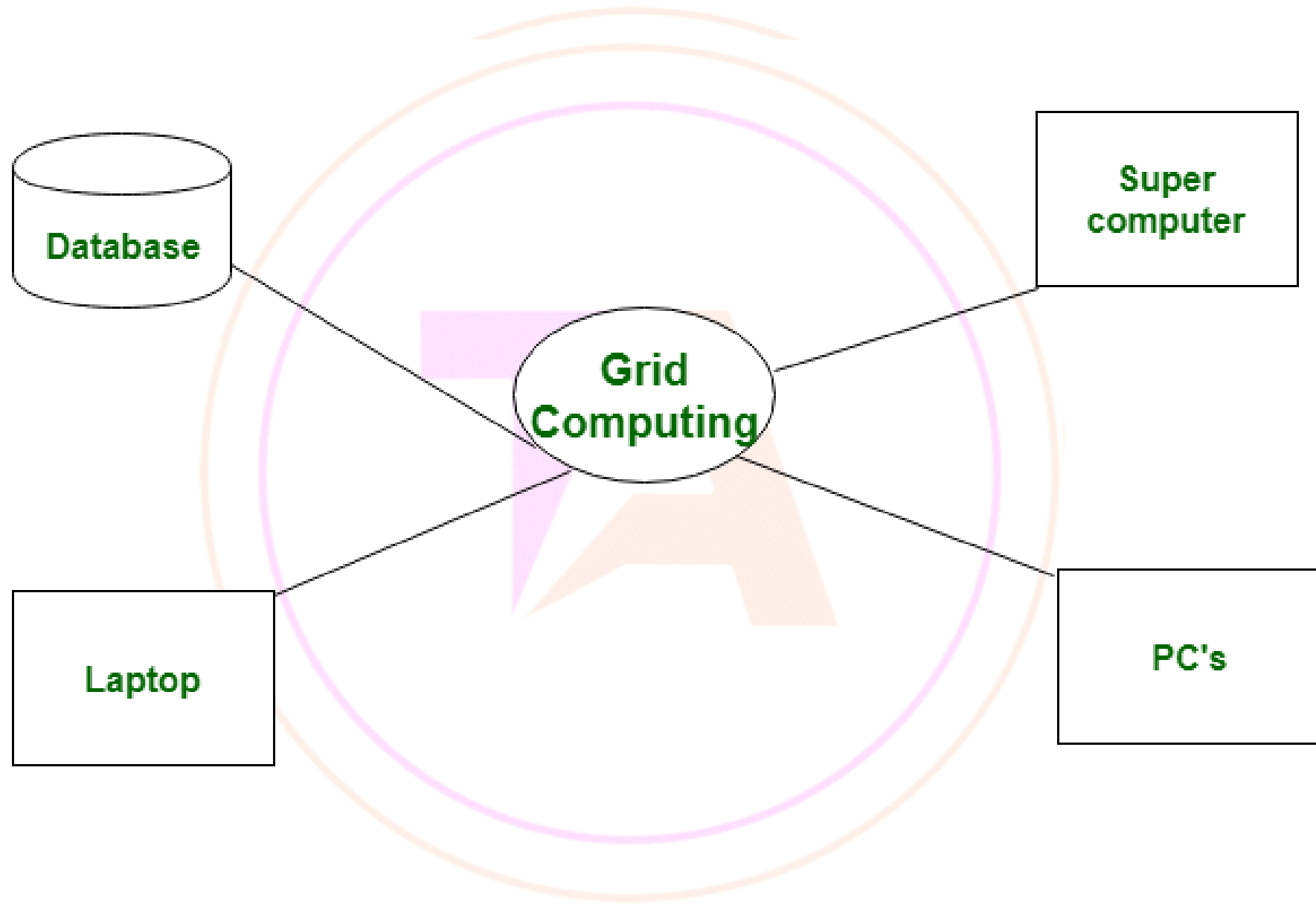




Grid Computing

- A Grid computing network mainly consists of these three types of machines
- **Control Node:** A computer, usually a server or a group of servers which administrates the whole network and keeps the account of the resources in the network pool.
- **Provider:** The computer contributes its resources to the network resource pool.
- **User:** The computer that uses the resources on the network.







What is Big Data Analytics?

- **Big data analytics describes the process of uncovering trends, patterns, and correlations in large amounts of raw data to help make data-informed decisions.**
- **These processes use familiar statistical analysis techniques—like clustering and regression—and apply them to more extensive datasets with the help of newer tools.**





What is Big Data Analytics?

- **On a broad scale, data analytics technologies and techniques give organizations a way to analyze data sets and gather new information.**
- **Business intelligence (BI) queries answer basic questions about business operations and performance.**





Big data analytics tools and technology

- **Big data analytics cannot be narrowed down to a single tool or technology. Instead, several types of tools work together to help you collect, process, cleanse, and analyze big data. Some of the major players in big data ecosystems are listed below.**
- **Hadoop is an open-source framework that efficiently stores and processes big datasets on clusters of commodity hardware.**
- **NoSQL databases are non-relational data management systems that do not require a fixed scheme, making them a great option for big, raw, unstructured data.**





Big data analytics tools and technology

- **MapReduce is an essential component to the Hadoop framework serving two functions. The first is mapping, which filters data to various nodes within the cluster.**
- **YARN stands for “Yet Another Resource Negotiator.” It is another component of second-generation Hadoop.**





Big data analytics tools and technology

- **Spark** is an open source cluster computing framework that uses implicit data parallelism and fault tolerance to provide an interface for programming entire clusters.
- **Tableau** is an end-to-end data analytics platform that allows you to prep, analyze, collaborate, and share your big data insights. Tableau excels in self-service visual analysis, allowing people to ask new questions of governed big data and easily share those insights across the organization.

