

UNIT VI-Future of Cloud Computing

How the Cloud Will Change Operating Systems, Location-Aware Applications, Intelligent Fabrics, Paints, and More, The Future of Cloud TV, Future of Cloud-Based Smart Devices, Faster Time to Market for Software Applications, Home-Based Cloud Computing, Mobile Cloud, Autonomic Cloud Engine, Multimedia Cloud, Energy Aware Cloud Computing, Jungle Computing.

Docker at a Glance: Process Simplification, Broad Support and Adoption, Architecture, Getting the Most from Docker, The Docker Workflow

Advantages of Cloud

- ▶ One of the greatest advantages is accessibility of resources. Users can access their data from anyplace, at any time, and from any type of device as long as they are connected to internet.
- ▶ Services become completely flexible (pay-per-use model) and can be adjusted at any time which is referred to as scalability in terms of Cloud Computing.
- ▶ Cloud Service Provider (CSP) takes care of all maintenance works, which allows us to concentrate more efficiently on our tasks, which in turn helps us in optimizing productivity.
- ▶ Cloud Computing provides increased security when compared with traditional and internal infrastructures in company. It guarantees safety by providing the best security systems and services with proper auditing, passwords, and encryptions.

Cloud with OS

- ▶ Operating systems allow users to run programs, store and retrieve data from one user session to next.
- ▶ Through virtualization, most server operating systems now support and will continue to support hypervisors that allow multiple (and possibly different) operating systems to run simultaneously.
- ▶ Virtualized servers will continue to play huge role in driving operations of cloud.

Cloud with OS

- ▶ Many organizations are opting for on-demand model operating systems.
- ▶ allows users to access their personalized OS environment from any device, as long as they have internet connectivity.
- ▶ Technologies like Windows 365, Amazon WorkSpaces, and Citrix Virtual Apps and Desktops allow users to access a fully functional desktop remotely.
- ▶ These systems run on virtual machines (VMs) hosted on cloud servers, delivering an OS experience without local installation.
- ▶ With the advent of more programs that run within browser, there may be much less need for powerful desktop operating systems, such as Windows and Mac OS.

Cloud with OS

- ▶ **Shift from Traditional OS to Cloud-based OS**
- ▶ Traditional OSs like Windows, macOS, and Linux were designed to manage local resources. Cloud-based OSs, like Chrome OS and Windows 365, rely on cloud computing for storage, processing, and applications.
- ▶ Many traditional desktop applications now have **web-based alternatives** (e.g., Google Docs replacing Microsoft Office, Canva replacing Photoshop for basic tasks, and Figma replacing traditional design tools).
- ▶ Progressive Web Apps (PWAs) allow users to **install** web apps that work offline, making them behave like native applications.

Chrome OS: A Cloud-First Operating System

- ▶ **Chrome OS** is a lightweight, cloud-centric operating system developed by Google.
- ▶ Primarily for web-based applications, making it **fast, secure, and easy to use.**
- ▶ **Features:**
 - Cloud-Centric Design
 - Lightweight and Fast Performance
 - Android and Linux App Support
 - Security and Automatic Updates
 - Multiple Form Factors
- ▶ **Limitations of Chrome OS**
 - Limited Offline Functionality
 - Not Ideal for High-End Software
 - Gaming Limitations

Cloud-based location-tracking applications

- ▶ location-tracking applications use cloud computing to collect, store, process, and analyze real-time location data. These apps are widely used in navigation, fleet management, employee tracking, personal safety, and IoT applications.

Cloud-based location-tracking applications

- ▶ How Cloud-Based Location Tracking Works
- ▶ Data Collection:
 - GPS, Wi-Fi, cellular networks, and Bluetooth collect real-time location data.
- ▶ Cloud Processing:
 - Data is sent to cloud servers where it's processed and analyzed.
- ▶ User Access & Analytics:
 - Users access location data via web apps, mobile apps, or APIs.
 - Advanced analytics, geofencing, and alerts provide insights.

Features of Cloud-Based Location-Tracking Apps

- ▶ Real-time Tracking – Continuous monitoring of location updates.
- ▶ Geofencing – Alerts when a user or asset enters/exits a defined area.
- ▶ Cloud Storage & Analytics – Secure storage of location history and AI-driven insights.
- ▶ Multi-Device Access – Use on smartphones, tablets, and desktops.
- ▶ Integration with APIs & IoT – Connect with business software, smart devices, and wearables.

Types of Cloud-Based Location-Tracking Apps

- ▶ **1 Navigation & Mapping Apps**
 - ✓ Google Maps, Apple Maps, Waze – Real-time navigation, traffic updates, and business locations.
 - ✓ HERE Maps, Mapbox – Custom mapping solutions for businesses and developers.
- ▶ **2 Fleet & Asset Tracking**
 - ✓ Samsara, Verizon Connect, Geotab – Track vehicle fleets for logistics and delivery companies.
 - ✓ GPS Insight, Fleet Complete – Fuel management, driver monitoring, and geofencing.
- ▶ **3 Employee & Workforce Tracking**
 - ✓ Hubstaff, Time Doctor, TSheets – Track remote employees' locations for fieldwork and attendance.
 - ✓ Jibble, Clockify – Geolocation-based time tracking for businesses.
- ▶ **4 Personal Safety & Family Tracking**
 - ✓ Life360, Find My iPhone, Google Family Link – Track family members for safety.
 - ✓ bSafe, Noonlight – Emergency SOS and location sharing for personal safety.
- ▶ **5 IoT & Smart Device Tracking**
 - ✓ Tile, Apple AirTag, Samsung SmartThings Find – Track lost or stolen items.
 - ✓ Spytec GPS, Tracki – Real-time GPS tracking for valuables, pets, and vehicles.
- ▶ **6 Emergency & Disaster Management**
 - ✓ RapidSOS, FEMA Alerts, Google Crisis Map – Provide real-time disaster alerts and emergency response coordination.

Cloud-based smart fabrics and paints

- ▶ Ability to connect devices to cloud from any place, at any time will open door to wide range of cutting-edge applications.
- ▶ Devices that once had to be read by utility or city employees, such as electric meters and parking meters, will connect to web and create report.
- ▶ Intelligence will be built into fabrics of our clothes, bedding, and furniture.

Cloud-based smart fabrics and paints

- ▶ Intelligent fabrics and smart paints, integrating AI, IoT, and big data to create self-adjusting, responsive, and functional materials.
- ▶ Used in healthcare, fashion, military, infrastructure, and sustainability.
- ▶ Intelligent fabrics (or smart textiles) use sensors, conductive threads, and cloud connectivity to collect and analyze data in real time.
- ▶ These textiles can monitor health, adjust temperature, and even change color.

Cloud-based smart fabrics and paints

▶ How They Work

1 Embedded Sensors & IoT – Fabrics include nano-sensors that track temperature, movement, or biometrics.

2 Cloud Connectivity – Data is sent to cloud servers for AI-powered analysis.

3 Smart Responses – The fabric heats up, cools down, or alerts users based on real-time data.

▶ Applications of Intelligent Fabrics

✓ Wearable Health Tech – Monitors heart rate, hydration, or muscle strain (E.g., Hexoskin, Owlet Smart Socks).

✓ Sports & Fitness – Tracks performance and recovery (E.g., Sensoria Smart Socks).

✓ Adaptive Fashion – Changes color or texture based on temperature or mood.

✓ Military & Defense – Bulletproof, climate-adaptive uniforms with built-in communication.

✓ IoT-Connected Clothing – Smart jackets with GPS, music control (E.g., Levi's Jacquard).

Cloud-based smart fabrics and paints

- ▶ Automatically adjust room temperature when body temperature becomes too warm or too cold.
- ▶ Notify rooms when we enter or leave so that lights, music, and other devices are automatically controlled.
- ▶ Monitor body functions such as blood pressure, blood sugar levels, stress, and more, and notify person and adjust environment to affect those functions.
- ▶ Notify others when elderly person has fallen.
- ▶ Provide deterrence against mosquitoes and other insects.

Cloud TV

- ▶ Cloud TV is a **cloud-based streaming platform** that delivers TV shows, movies, and live broadcasts **over the internet** instead of traditional cable or satellite. It uses **cloud computing, AI, and content delivery networks (CDNs)** to provide **on-demand and live streaming** across multiple devices.
- ▶ **Key Features of Cloud TV**
 - **On-Demand Streaming** – Access movies, series, and live TV anytime.
 - **Multi-Device Compatibility** – Works on **smart TVs, smartphones, tablets, and laptops**.
 - **Cloud DVR** – Record and store shows on the cloud instead of a physical device.
 - **AI-Powered Recommendations** – Suggests content based on viewing habits.
 - **No Need for Set-Top Boxes** – Eliminates traditional cable or satellite hardware.

Cloud TV

▶ Popular Cloud TV Services

✓ Netflix, Disney+, Amazon Prime Video – On-demand cloud-based entertainment.

✓ YouTube TV, Hulu Live TV, Sling TV – Cloud TV for live channels & sports.

✓ Apple TV+, Google TV, Roku – Streaming platforms with cloud integration.

✓ Plex, Kodi – Cloud-based media servers for personal content storage.

Cloud Based Smart Devices

- ▶ Cloud-based smart devices use **internet connectivity and cloud computing** to provide **remote access, automation, and AI-driven intelligence**.
- ▶ These devices connect to cloud platforms to **store data, process commands, and deliver real-time insights**.
- ▶ **Key Features**
 - **Remote Access & Control** – Manage devices from anywhere via mobile apps.
 - **AI & Machine Learning Integration** – Devices learn user preferences and optimize performance.
 - **Cloud Storage & Data Analysis** – Sensor data is stored, processed, and analyzed in the cloud.
 - **Multi-Device Syncing** – Works across smartphones, tablets, and voice assistants.
 - **Automatic Updates & Enhancements** – Devices receive firmware updates from the cloud.

Cloud Based Smart Devices

- ▶ 1 Smart Home Devices
 - ✓ Amazon Echo & Google Nest Hub – AI-powered voice assistants (Alexa, Google Assistant).
 - ✓ Ring & Arlo Smart Cameras – Cloud-connected security cameras with motion detection.
 - ✓ Nest Thermostat – AI-driven temperature control that adapts to habits.
 - ✓ Philips Hue & LIFX Smart Lights – Cloud-enabled smart lighting with automation.
- ▶ 2 Wearable Smart Devices
 - ✓ Apple Watch & Fitbit – Cloud-connected health tracking & fitness insights.
 - ✓ Whoop & Oura Ring – AI-driven sleep & activity monitoring.
 - ✓ Hexoskin Smart Shirts – Cloud-based biometric tracking for athletes.
- ▶ Smart Healthcare & Baby Monitoring
 - ✓ Owlet Smart Socks – Cloud-based infant health monitoring.
 - ✓ Medtronic Smart Insulin Pumps – Cloud-powered diabetes management.
 - ✓ Withings Smart Scales – AI-driven body composition tracking.

Home Based Cloud Computing

- ▶ Today most households have wireless network capabilities that allow family members to connect to Web and access sites and contents they desire.
- ▶ With arrival of smart devices, intelligent fabrics, and greater use of frequency identification devices (RFID), relations will expect on-demand personalized technology solutions.
- ▶ Families will use cloud devices to customize their environments and experiences.

Home Based Cloud Computing

- ▶ Within such environment, families will want to restrict processing to within home, meaning that they will not want neighbors to receive signals generated by their devices and clothing.
- ▶ That implies ability to encrypt wide range of signals within home. To that end, you should expect to see cloud-based in-home devices that store family files, maintain appliance settings. download and store movies and TV shows, and more.

Modular Software

- ▶ With cloud computing, companies no longer have to raise capital required to fund large data center. Instead, they can leverage PaaS solution.
- ▶ Furthermore, companies no longer have to pay expensive licensing fees for various software tools such as database management systems. Instead, they can leverage pay-on-demand solutions. Hence developers will release software solutions at faster rate, bringing solutions to market that expects high functionality and demands lower cost.

Modular Software

- ▶ 85% Software developed since 2012 is cloud-enabled and increase in future data requirements will enable more services through Cloud. All-State and Center will have its own Cloud Platform for providing basic services in health, agriculture and social, etc.
- ▶ Aadhar Card is major example of Cloud Computing projects and all banking platforms are moving towards serving 7 billion people in world. All Stock exchanges have to move towards cloud computing to provide efficient and real-time stock details.

Conclusion

- ▶ Cloud computing is beginning to transform way enterprises buy and use technology resources and will become even more prominent in coming years.
- ▶ In the next-generation, cloud computing technology role is going to be integral element in life of each human being because Cloud is only place where all software and hardware and all devices can connect at single place.



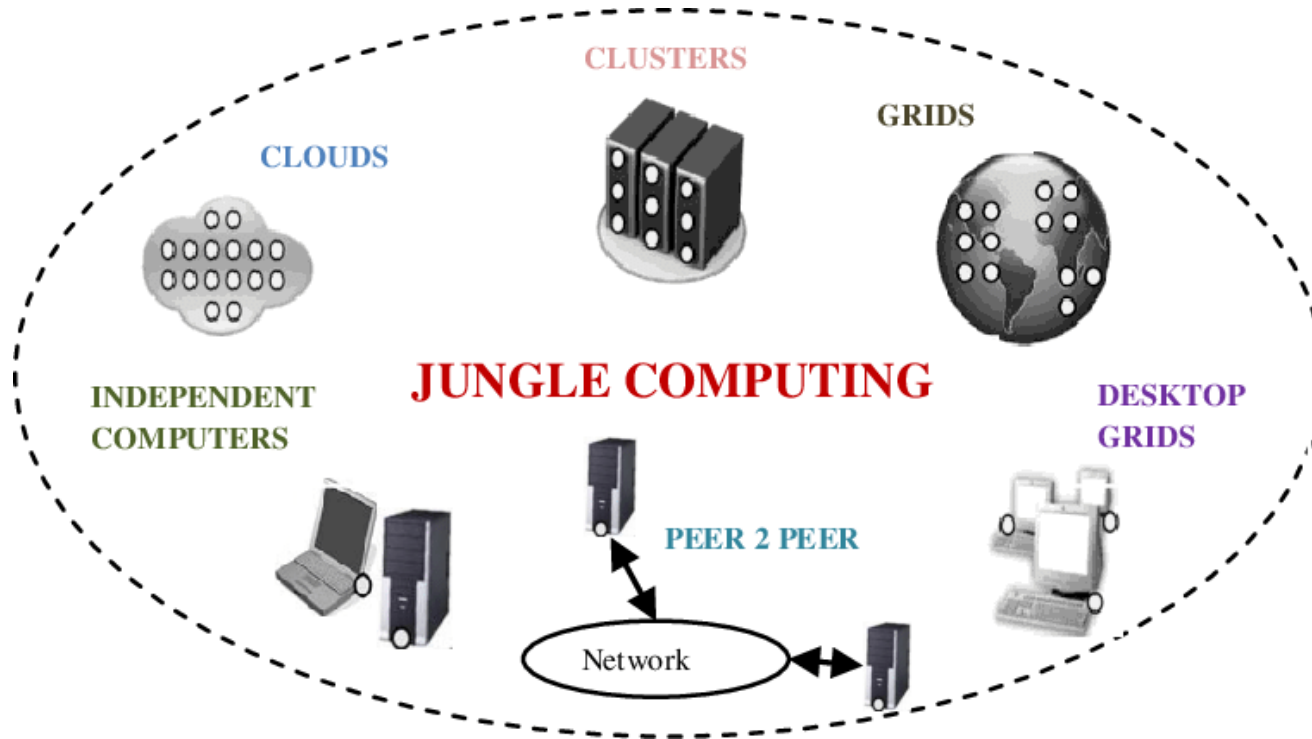
Jungle Computing

- ▶ Jungle computing is a simultaneous combination of heterogeneous, hierarchical, and distributed computing resources.
- ▶ In many realistic scientific research areas, domain experts are being forced into concurrent use of multiple clusters, grids, clouds, desktop grids, independent computers, and more.
- ▶ Jungle computing refers to the use of diverse, distributed and highly non-uniform high performance computer systems to achieve peak performance.
- ▶ These new distributed computing paradigms have led to a diverse collection of resources available to research scientists, including stand-alone machines, cluster systems, grids, clouds, desktop grids, etc. as shown in the Figure and this varied collection is named as jungle computing

Jungle Computing

- ▶ **Key Characteristics of Jungle Computing**
 - **Heterogeneous Resources** – Uses a mix of **supercomputers, clusters, cloud, and grid computing**.
 - **Decentralization** – No single point of control; resources are spread across **multiple locations**.
 - **High Scalability** – Handles **large-scale computational tasks** across different architectures.
 - **Dynamic Resource Allocation** – Adapts **workloads to available resources** in real time.
 - **Cross-Platform Integration** – Combines **public/private clouds, high-performance clusters, and edge devices**.

Jungle Computing



Applications of Jungle Computing

▶ **Scientific Research & Big Data Processing**

- ✓ Genomic Sequencing – Massive computations for DNA analysis.
- ✓ Climate Modeling – Simulates weather patterns and global climate changes.
- ✓ Physics Simulations – Used in Large Hadron Collider (LHC) experiments.

▶ **AI & Machine Learning**

- ✓ Deep Learning Model Training – Uses multiple GPU clusters, cloud AI services, and edge devices.
- ✓ AI for Medical Imaging – Processes massive datasets for disease detection.

▶ **High-Performance Computing (HPC) & Supercomputing**

- ✓ Weather Forecasting – Requires huge computational power across multiple systems.
- ✓ Cryptography & Blockchain – Secure, large-scale decentralized transactions.

Multimedia Cloud

- ▶ Cloud-based platform that provides storage, processing, and distribution of multimedia content such as videos, images, music, and interactive applications. It enables seamless access, real-time streaming, and efficient content management for users across devices.

- ▶ **Key Features**

- ▶ Scalable Storage – Unlimited cloud storage for high-resolution images, videos, and audio.

On-Demand Streaming – Netflix, YouTube, Spotify use multimedia clouds to deliver real-time video & music streaming.

AI-Powered Processing – Automatic image recognition, video indexing, and speech-to-text conversion.

Cross-Device Access – Users can upload, edit, and view content from any device.

Content Delivery Networks (CDNs) – Ensures fast, buffer-free streaming worldwide.

Cloud-Based Editing & Rendering – Supports video editing, animation, and 3D rendering in the cloud.

Multimedia Cloud

- ▶ Due to the invention of cloud computing, nowadays users can easily access the multimedia content over the internet at any time.
- ▶ Here the user can efficiently store the multimedia content of any type and of any size in the cloud after subscribing it with no difficulties
- ▶ Not only storing the media content like Audio, Video and Image, but can process them within the cloud since the computation time for processing media data is more in complex hardware

Multimedia Cloud

- ▶ **Applications of Multimedia Cloud**
- ▶ **Streaming Services & Cloud TV**
 - ✓ **Netflix, Amazon Prime, Disney+** – Cloud-based on-demand video streaming.
 - ✓ **Spotify, Apple Music** – Music streaming with cloud-based AI recommendations.
 - ✓ **YouTube, Twitch** – Video-sharing and live streaming services.
- ▶ **Cloud Gaming & Interactive Media**
 - ✓ **Google Stadia, NVIDIA GeForce Now, Xbox Cloud Gaming** – Stream games from the cloud.
 - ✓ **Metaverse & VR Applications** – Delivers 3D experiences using **cloud computing & AI**.
- ▶ **Cloud-Based Multimedia Editing & Production**
 - ✓ **Adobe Creative Cloud (Photoshop, Premiere Pro)** – Cloud-based photo & video editing.
 - ✓ **Canva, Figma** – Online design tools for real-time collaboration.
 - ✓ **Blender & Autodesk Maya** – Cloud-based **3D rendering & animation**.
- ▶ **Smart Surveillance & AI-Powered Analytics**
 - ✓ **Cloud-Based CCTV (Google Nest, Ring, Arlo)** – Stores & processes surveillance footage.
 - ✓ **AI-Powered Image & Video Recognition** – Used in **security, retail, and healthcare**.
- ▶ **Social Media & Content Sharing**
 - ✓ **Instagram, TikTok, Facebook** – Store & process billions of images & videos daily.
 - ✓ **Google Photos, iCloud** – AI-enhanced **photo storage & automatic backups**.

Energy Aware Cloud Computing

- Emerging cloud computing has caused data centers consume more energy and therefore there is more CO2 emission.
- Using resources more efficiently can help reducing energy consumption in data centers.
- refers to the optimization of energy consumption in cloud data centers while maintaining high performance. It focuses on reducing carbon footprints, minimizing costs, and improving sustainability through AI-driven resource management, virtualization, and renewable energy integration.
- There are different hardware and software solutions and technologies such as virtualization, using hardware with lower energy consumption, and implementing efficient software algorithms to optimize energy consumption.

Energy Aware Cloud Computing

- ▶ **Key Strategies for Energy Efficiency in Cloud Computing**
- ▶ **Virtualization & Resource Consolidation**
- ▶ ✓ Server Virtualization ,Containerization (Docker, Kubernetes) – Uses lightweight containers instead of full VMs to save power.
Benefit: Lowers power consumption by improving hardware utilization.
- ▶ **Dynamic Power Management (DPM)**
- ▶ ✓ AI-Powered Load Balancing – Shifts workloads to low-power servers when demand is low.
- ▶ ✓ Auto Scaling – Increases or decreases cloud resources based on real-time usage.
- ▶ ✓ Server Sleep Modes – Powers down idle or underutilized servers.
- ▶ Benefit: Reduces wasted energy and cooling costs.
- ▶ **Green Data Centers & Renewable Energy Integration**
- ▶ ✓ Solar, Wind, & Hydro-Powered Data Centers – Google, AWS, and Microsoft invest in renewable energy.
- ▶ ✓ Energy-Efficient Cooling (Liquid Cooling, Free Air Cooling) – Reduces AC power usage.
- ▶ ✓ Carbon-Neutral Cloud Computing – Offsets carbon footprints by using sustainable energy sources.
- ▶ Benefit: Lowers environmental impact and long-term energy costs.
- ▶ **AI & Machine Learning for Energy Optimization**
- ▶ ✓ AI-Based Energy Forecasting – Predicts peak loads & optimizes energy distribution.
- ▶ ✓ Smart Workload Scheduling – AI shifts workloads to low-energy periods or renewable-

Autonomic Cloud Engine: A Self-Managing Cloud System

- ▶ An Autonomic Cloud Engine is a self-managing cloud system that can automatically monitor, analyze, optimize, and adjust cloud resources without human intervention.
- ▶ Inspired by the autonomic nervous system in the human body,
- ▶ this cloud engine ensures efficient performance, minimal energy consumption, and high availability.

Key Features

- ▶ Self-Configuration (Automated Setup & Deployment)
- ▶ Self-Optimization (Performance & Cost Efficiency)– **Google Cloud AI** predicts workloads and **optimizes resource usage automatically.**
- ▶ Self-Healing (Fault Detection & Recovery)
- ▶ Self-Protection (Cybersecurity & Threat Management)

Key Features

Self-Configuration (Automated Setup & Deployment)

- ▶ ♦ What it does:
 - ✓ Automatically provisions **servers, networks, and storage** as needed.
 - ✓ Deploys cloud applications **without manual intervention**.
 - ✓ Adjusts settings dynamically for **optimal performance**.

Self-Optimization (Performance & Cost Efficiency)

- ▶ ♦ What it does:
 - ✓ Monitors system performance in **real-time**.
 - ✓ Adjusts computing power to **balance workload and energy efficiency**.
 - ✓ Optimizes costs by **allocating the most efficient cloud resources**.

Self-Healing (Fault Detection & Recovery)






- ▶ ♦ What it does:
 - ✓ Detects **server failures, crashes, or slowdowns**.
 - ✓ Automatically restarts failed services or **shifts workloads to healthy servers**.
 - ✓ Reduces downtime by **proactively fixing errors**.

Self-Protection (Cybersecurity & Threat Management)

- ▶ ♦ What it does:
 - ✓ Detects and prevents **cyberattacks, malware, and DDoS threats**.
 - ✓ Implements **real-time security policies** based on threat levels.
 - ✓ Encrypts sensitive data and ensures **compliance with security regulations**.

Benefits

Benefits of Autonomic Cloud Engines

- ▶  **Less Human Effort:** Reduces the need for manual cloud management.
-  **Improved Efficiency:** Dynamically adjusts computing power, saving costs.
-  **High Availability:** Prevents downtime with self-healing capabilities.
-  **Stronger Security:** Protects against cyber threats with real-time monitoring.
-  **Sustainability:** Optimizes energy use, reducing cloud carbon footprint.