

NARUMALAR ACADEMY – ONLINE COACHING CENTRE
DHARMAPURI – 8122190917, 9988404061
TRB – Computer Science / Computer Applications
Unit 10 - Cloud Computing and Internet of Things

1. Roots of Cloud Computing

Historical Evolution

- **1960s - Time-sharing concept:** John McCarthy proposed computation as a public utility, similar to electricity
- **1969 - ARPANET:** Foundation for networked computing and resource sharing
- **1990s - Telecommunications:** Companies began offering Virtual Private Network (VPN) services
- **1997 - Term "Cloud Computing":** Professor Ramnath Chellappa first used the term
- **1999 - Salesforce.com:** Pioneer in delivering enterprise applications via internet
- **2002 - Amazon Web Services (AWS):** Amazon launched web services platform
- **2006 - Elastic Compute Cloud (EC2):** AWS introduced commercial cloud computing services
- **2008 - Google App Engine:** Google entered cloud computing market
- **2010 - Microsoft Azure:** Microsoft launched its cloud platform

Key Technological Enablers

- **Virtualization technology:** Ability to create virtual machines and abstract hardware
- **Grid computing:** Distributed computing for complex calculations
- **Utility computing:** Pay-per-use model for computing resources
- **Distributed computing:** Processing across multiple computers
- **High-speed internet:** Broadband connectivity made cloud access feasible
- **Service-oriented architecture (SOA):** Modular approach to software development

2. Layers of Cloud

Infrastructure Layer (IaaS)

- Provides virtualized computing resources over internet
- Includes servers, storage, networking equipment
- Users manage operating systems, applications, and middleware

NARUMALAR ACADEMY – ONLINE COACHING CENTRE
DHARMAPURI – 8122190917, 9988404061
TRB – Computer Science / Computer Applications
Unit 10 - Cloud Computing and Internet of Things

- Examples: Amazon EC2, Google Compute Engine, Microsoft Azure VMs
- Characteristics: scalable, flexible, cost-effective hardware replacement

Platform Layer (PaaS)

- Provides platform for developing, testing, and deploying applications
- Includes development tools, databases, operating systems
- Developers focus on application logic without managing infrastructure
- Examples: Google App Engine, Heroku, AWS Elastic Beanstalk
- Features: built-in scalability, integrated development environments, middleware services

Application Layer (SaaS)

- Delivers complete software applications over internet
- End-users access via web browsers without installation
- Provider manages all infrastructure and platform components
- Examples: Gmail, Salesforce, Microsoft Office 365, Dropbox
- Advantages: no maintenance, automatic updates, accessible anywhere

Additional Conceptual Layers

- **Hardware/Datacenter Layer:** Physical infrastructure including servers, cooling, power
- **Network Layer:** Connectivity infrastructure enabling communication between resources
- **Management Layer:** Tools for monitoring, provisioning, and orchestrating cloud resources

3. Types of Cloud

Based on Deployment Model

Public Cloud

- Services offered over public internet to multiple customers
- Infrastructure owned by cloud service provider
- Cost-effective due to shared resources

NARUMALAR ACADEMY – ONLINE COACHING CENTRE
DHARMAPURI – 8122190917, 9988404061
TRB – Computer Science / Computer Applications
Unit 10 - Cloud Computing and Internet of Things

- Examples: AWS, Google Cloud Platform, Microsoft Azure
- **Advantages:** low cost, no maintenance, scalability, reliability
- **Disadvantages:** less control, security concerns, potential compliance issues

Private Cloud

- Dedicated infrastructure for single organization
- Can be hosted on-premises or by third-party provider
- Greater control over security and customization
- Examples: VMware vCloud, OpenStack private deployments
- **Advantages:** enhanced security, compliance control, customization
- **Disadvantages:** higher costs, requires IT expertise, limited scalability

Hybrid Cloud

- Combination of public and private clouds
- Allows data and applications to move between environments
- Provides flexibility and optimization of existing infrastructure
- Examples: Azure Stack, AWS Outposts, Google Anthos
- **Advantages:** flexibility, cost optimization, business continuity
- **Disadvantages:** complex management, integration challenges, security risks

Community Cloud

- Shared infrastructure for specific community with common concerns
- Used by organizations with similar requirements (security, compliance)
- Cost shared among community members
- Examples: Government clouds, healthcare industry clouds
- **Advantages:** cost-sharing, tailored compliance, collaborative environment
- **Disadvantages:** limited to community, shared control issues

Based on Service Model

- Already covered in Layers section (IaaS, PaaS, SaaS)

NARUMALAR ACADEMY – ONLINE COACHING CENTRE
DHARMAPURI – 8122190917, 9988404061
TRB – Computer Science / Computer Applications
Unit 10 - Cloud Computing and Internet of Things

- Additional models: FaaS (Function as a Service), DBaaS (Database as a Service), STaaS (Storage as a Service)

4. Features of Cloud Computing

Essential Characteristics (NIST Definition)

On-Demand Self-Service

- Users can provision resources automatically without human interaction
- Access computing capabilities as needed (storage, processing, networks)
- No need to contact service provider for resource allocation
- Real-time provisioning through web interfaces or APIs

Broad Network Access

- Services available over network through standard mechanisms
- Accessible via heterogeneous platforms (laptops, mobile phones, tablets)
- Location-independent access through internet connectivity
- Supports thin or thick client platforms

Resource Pooling

- Provider's resources pooled to serve multiple consumers (multi-tenant model)
- Physical and virtual resources dynamically assigned based on demand
- Location independence - users don't know exact location of resources
- Resources include storage, processing, memory, bandwidth
- Economies of scale achieved through shared infrastructure

Rapid Elasticity

- Capabilities can be rapidly scaled up or down based on demand
- Appears unlimited from consumer perspective
- Automatic or manual scaling options available
- Pay only for resources actually used

NARUMALAR ACADEMY – ONLINE COACHING CENTRE
DHARMAPURI – 8122190917, 9988404061
TRB – Computer Science / Computer Applications
Unit 10 - Cloud Computing and Internet of Things

- Handles workload fluctuations efficiently

Measured Service

- Resource usage monitored, controlled, and reported automatically
- Metering capability at appropriate abstraction level
- Transparency for both provider and consumer
- Pay-per-use or subscription-based billing models
- Detailed usage reports and analytics

Additional Important Features

Reliability and Availability

- High uptime percentages (typically 99.9% or higher SLAs)
- Redundancy and failover mechanisms
- Disaster recovery capabilities
- Multiple data center locations

Cost-Effectiveness

- Eliminates capital expenditure on hardware
- Reduces operational costs
- Converts fixed costs to variable costs
- No costs for unused capacity

Flexibility and Scalability

- Easy to scale resources vertically or horizontally
- Adapt quickly to changing business needs
- Support for various operating systems and applications

Automation

- Automated deployment and configuration
- Self-healing capabilities
- Automated backup and recovery