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"Advanced Techniques in Cloud Computing"

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SYLLABUS

- Future Tends in cloud Computing, Mobile Cloud, **Automatic Cloud Computing:** Comet Cloud.
- **Multimedia Cloud :** IPTV, Energy Aware Cloud Computing, Jungle Computing, Distributed Cloud Computing Vs Edge Computing, Containers, Docker, and Kubernetes, Introduction to DevOps. IOT and **Cloud Convergence:** The Cloud and IoT in your Home, The IOT and cloud in your Automobile, **PERSONAL:** IoT in Healthcare.

Future of Cloud Computing

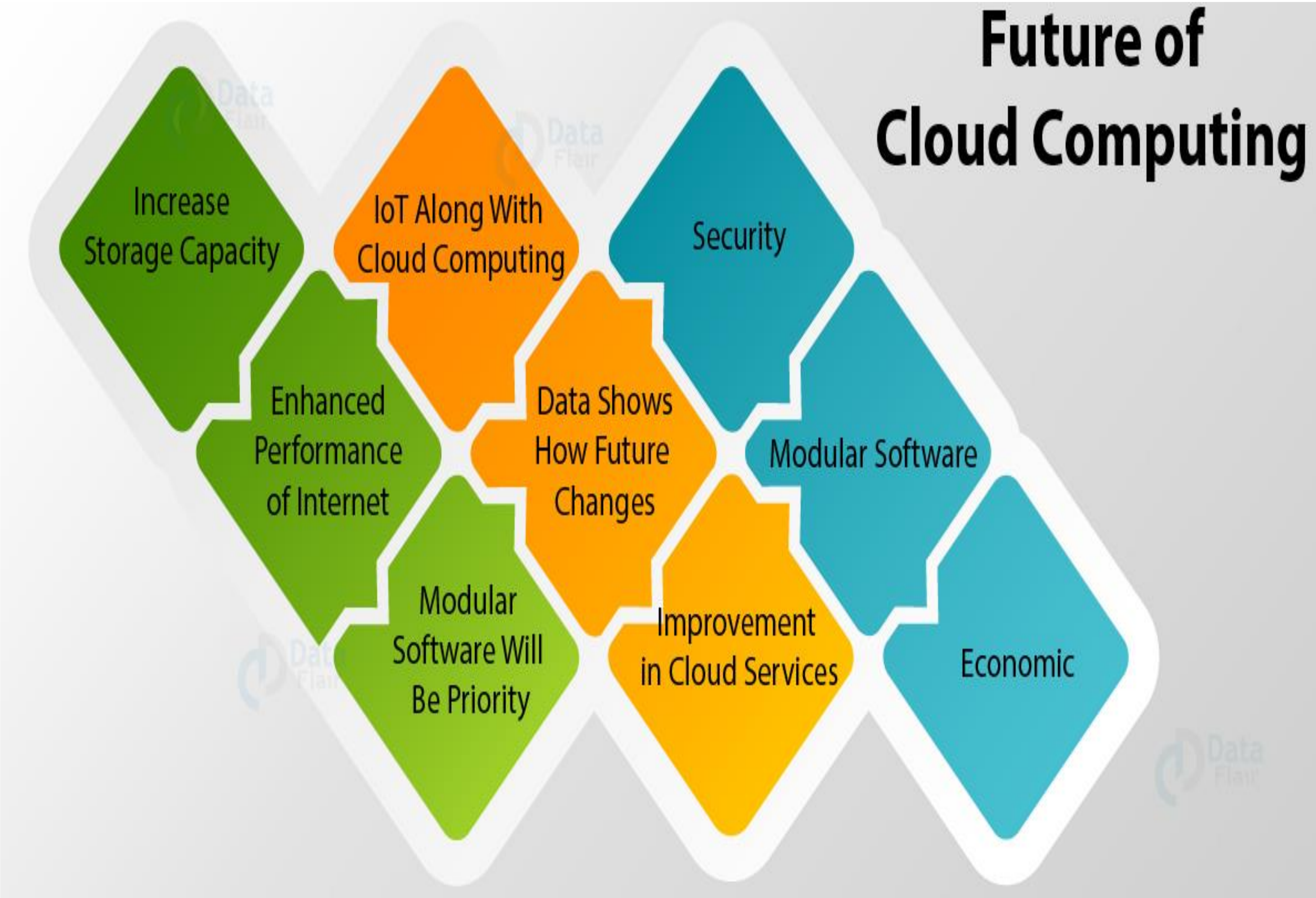
Future Trends in Cloud Computing

1. Increase Storage Capacity

Today, data is generating in a high volume and it's difficult to store it with security. Most of the companies require a place where they can securely store their data.

So many businesses are adopting cloud computing and it has been predicted that the Cloud providers will provide more data centers at a lower price as there is a large competition between them. With the help of the more in your company will be able to store the data.

Risk in Cloud Computing



Future Trends in Cloud Computing

2. Enhanced Performance of Internet

With the help of the Internet of Things, the quality of the internet can be increased. With the help of the IoT and Cloud Computing, we can store data in the cloud, for further analyze & provide enhanced performance.

The users expect high-quality fast-loading services and application. The network provided will be faster and the ability to receive and deliver that data will be quick.

Future Trends in Cloud Computing

3. Modular Software Will Be Priority :

The size of an individual program along with the complexity is increasing regularly. This leads to the fact that Cloud technology will soon require advance system thinking.

We can see software development from many angles because in the future applications will store in places other than the cloud. This application will store on different modules, on servers of different Cloud Service.

This can also reduce the cost of software as placing components of the program on different storage is economical.

Future Trends in Cloud Computing

4. Internet of Things Along With Cloud Computing

The internet of things is also one of the leading Technology is it comes with continuous innovation in real time Data Analytics and cloud computing. There are many machine-to-machine communication, data, and process occurring. We can do it easily with the help of cloud computing.

5. Data Shows How Future Changes

The cloud computing market is growing at 22.8 percent and will exceed $127.5 after 2018. By 2018, 62% of all CRM software will be cloud-based. Moreover, 30% of all application spending is for software as a service based applications.

Future Trends in Cloud Computing

6. Improvement in Cloud Services

Cloud Computing includes:

Infrastructure as a service

Platform as a service

Software as a service

With this service, we can achieve our desired goals. There are many researchers which have proved that Cloud Computing will be one of the leading technologies in the future as the software as a service solution will account for more than 60% of the workload.

It also has been predicted that the platform as a service and infrastructure as a service will increase gradually as it has been used in most of the organizations. Cloud Computing is user-friendly and is compatible for both new as well as old organizations.

7. Security

The data which are stored in the cloud is secure but not fully. The small companies which are providing cloud services may or may not provide proper security to the data.

So in the future, we can prevent from cyber attacks by providing better security. The cloud providers provide better security measures opening balance ways to prevent cyber attacks.

8. Modular Software

Companies are using much software, which is yet to modify. This leads to the fact that cloud computing requires modified software, which will provide better security and facilities. This software will be more user-friendly and flexible to use.

One of the major advantages of this software will be that it will save the overall cost as well as time. We can see from the below graph, companies providing services and software are also improving.

Mobile Cloud

MCC stands for Mobile Cloud Computing which is defined as a combination of mobile computing, cloud computing, and wireless network that come up together purpose such as rich computational resources to mobile users, network operators, as well as to cloud computing providers. Mobile Cloud Computing is meant to make it possible for rich mobile applications to be executed on a different number of mobile devices. In this technology, data processing, and data storage happen outside of mobile devices.

Mobile Cloud Computing applications leverage this IT architecture to generate the following advantages:

1. Extended battery life.
2. Improvement in data storage capacity and processing power.
3. Improved synchronization of data due to "store in one place, accessible from anywhere " platform theme.
4. Improved reliability and scalability.
5. Ease of integration.

Mobile Cloud

Factors Fostering Adoption Of Mobile Cloud Computing :

- **Trends and demands:** Customers expect convenience in using companies' websites or applications from anywhere and at any time. Mobile Cloud computing is meant for this purpose. Users always want to access business applications from anywhere, so that they can increase their productivity, even when they are on the commute.
- **Improved and increased broadband coverage:** 3G and 4G along with WiFi, femtocells, are providing better connectivity for mobile devices cloud computing.
- **Enabling technologies:** HTML5, CSS3, a hypervisor for mobile devices, cloudlets and Web 4.0 are enabling technologies that will drive adoption of mobile cloud computing.

Mobile Cloud

Characteristics Of Mobile Cloud Computing Application

1. **Cloud infrastructure:** Cloud infrastructure is a specific form of information architecture that is used to store data.
2. **Data cache:** In this, the data can be locally cached.
3. **User Accommodation:** Scope of accommodating different user requirements in cloud app development is available in mobile Cloud Computing.
4. **Easy Access:** It is easily accessed from desktop or mobile devices alike.
5. **Cloud Apps** facilitate to provide access to a whole new range of services.

Mobile Cloud

Mobile Cloud Computing Working :

On a remote data center, Mobile Cloud Applications are operated generally by a third-party, data is stored, and compute cycles are carried out. The uptime, integration, and security aspects are taken care of, by a backend, which also enables support to a multitude of access methods. These apps can function online quite well, however, they need timely updating. These need not be permanently stored on the device but they do not always occupy any storage space on a computer or communications device.

Moreover, it offers the same experience as that of a desktop application, while offering the portability of a web application.

Applications of Mobile Cloud

- **Email.** This is a common example that many people use. Gmail, Outlook, and Yahoo Mail are examples of mobile email. When you check your emails via your mobile phone, you're using mobile cloud technology.

- **Social Media.** Be it via Twitter, Instagram, or Facebook, mobile social networking allows real-time data sharing. For example, a mobile user can store data and share videos with other users.

- **Commerce.** Do you use a banking app or eshop on your mobile? If the answer is yes, you use mobile cloud computing. MCC in mobile commerce uses scalable processing power.

Applications of Mobile Cloud

- **Healthcare.** With mobile healthcare, MCC allows massive amounts of instantaneous data storage in the cloud, accessible via a mobile device. For example, it's quick and easy to access patient records on the go.

Benefits of Mobile Cloud Computing

1. Mobile Cloud Computing saves Business money.
2. Because of the portability which makes their work easy and efficient.
3. Cloud consumers explore more features on their mobile phones.
4. Developers reach greater markets through mobile cloud web services.
5. More network providers can join up in this field.

Challenges of Mobile Cloud Computing

1. **Low bandwidth:** This is one of the big issues in mobile cloud computing. Mobile cloud use radio waves which are limited as compared to wired networks. Available wavelength is distributed in different mobile devices. Therefore, it has been three times slower in accessing speed as compared to a wired network.
2. **Security and Privacy:** It is difficult to identify ad manage threats on mobile devices as compared to desktop devices because in a wireless network there are more chances of the absence of the information from the network.
3. **Service Availability:** Users often find complaints like a breakdown of the network, transportation crowding, out of coverage, etc. Sometimes customers get a low-frequency signal, which affects the access speed and storage facility.

Challenges of Mobile Cloud Computing

4. Alteration of Networks: Mobile cloud computing is used in a different operating system driven platforms like Apple iOS, Android, and Windows Phone. So it has to be compatible with different platforms. The performance of different mobile platform network is managed by the IRNA (Intelligent Radio Network Access) technique.

5. Limited Energy source: Mobile devices consume more energy and are less powerful. Mobile cloud computing increases battery usage of mobile devices which becomes an important issue. Devices should have a long-life battery to access applications and other operations. When the size of the altered code is small, the offloading consumes more energy than local processing.

Architecture of Mobile Cloud Computing

Cloud Computing offers such smartphones that have rich Internet media support, require less processing and consume less power. In terms of Mobile Cloud Computing (MCC), processing is done in cloud, data is stored in cloud, and the mobile devices serve as media for display.

Today smartphones are employed with rich cloud services by integrating applications that consume web services. These web services are deployed in cloud.

There are several Smartphone operating systems available such as Google's Android, Apple's iOS, RIM BlackBerry, Symbian, and Windows Mobile Phone. Each of these platforms support third-party applications that are deployed in cloud.

Architecture of Mobile Cloud Computing

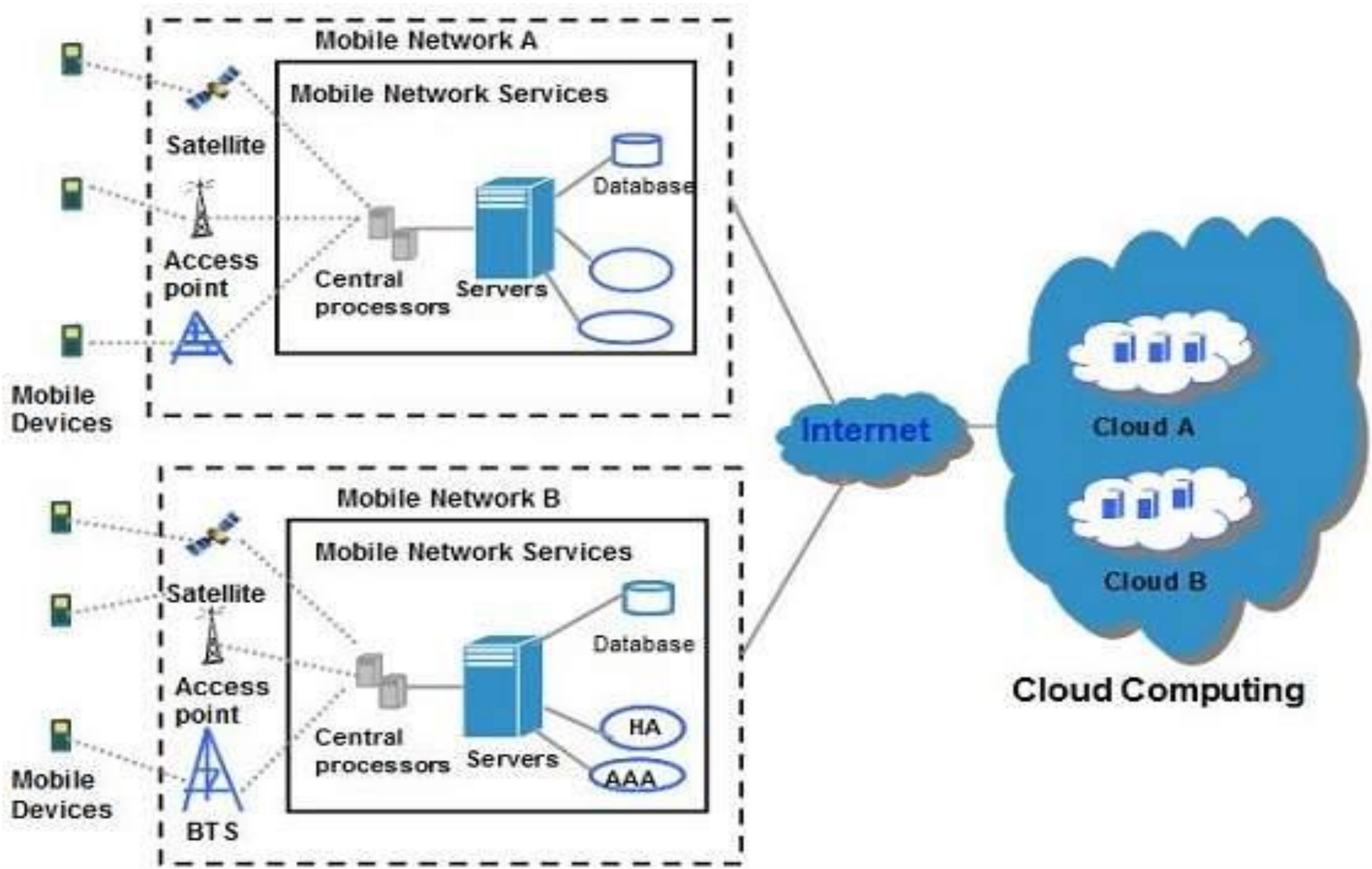
Architecture

MCC includes four types of cloud resources:

1. Distant mobile cloud
2. Distant immobile cloud
3. Proximate mobile computing entities
4. Proximate immobile computing entities
5. Hybrid

Architecture of Mobile Cloud Computing

The following diagram shows the framework for mobile cloud computing architecture:



Architecture of Mobile Cloud Computing

Issues

Despite of having significant development in field of mobile cloud computing, still many issues remain unsorted such as:

Emergency Efficient Transmission

There should be a frequent transmission of information between cloud and the mobile devices.

Architectural Issues

Mobile cloud computing is required to make architectural neutral because of heterogeneous environment.

Architecture of Mobile Cloud Computing

Live VM Migration

It is challenging to migrate an application, which is resource-intensive to cloud and to execute it via Virtual Machine.

Mobile Communication Congestion

Due to continuous increase in demand for mobile cloud services, the workload to enable smooth communication between cloud and mobile devices has been increased.

Security and Privacy

This is one of the major issues because mobile users share their personal information over the cloud.

Automatic Cloud Computing

Comet Cloud in Cloud Computing

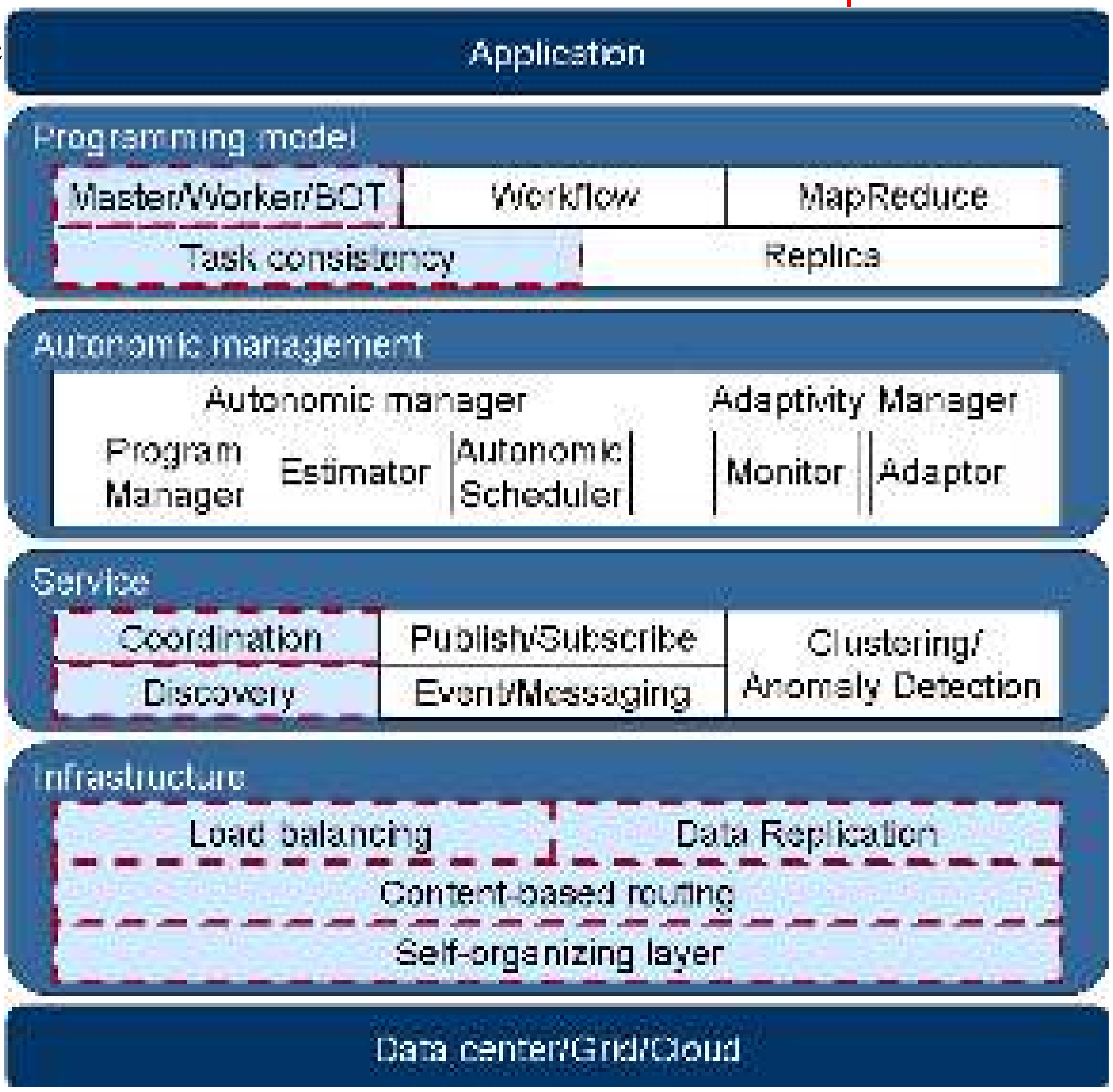
COMET Cloud is an Internet data storage designed for recording measured values from selected COMET measuring instruments. The data is accessible after the user's connection to the Internet and is displayed in a web browser in the form of a table or graph. Users can be notified by e-mail of all alarm conditions reported by the device.

After purchasing a device that supports connection to the COMET Cloud, you can register the device in the COMET Cloud. Each user has access only to their account, which is password protected. If you run a large number of devices in the COMET Cloud, you can clearly organize them into groups and assign new users to them, who can have an overview of the group of devices. Different rights for data display and administration can be set for individual users.

CometCloud (www.cometcloud.org)

- **Application/Programming layer autonomics:** Dynamics workflows; Policy based component/service adaptations and compositions
- **Autonomics layer:** Resource provisioning based on user objectives; estimation of resource requirement initially, monitor application performance, and adjust resource provisioning.
- **Service layer autonomics:** Robust monitoring and proactive self-management; dynamic application/system/context-sensitive adaptations
- **Infrastructure layer autonomics:** On-demand scale-out; resilient to failure and data loss; handle dynamic joins/departures; support "trust" boundaries

Redbox denotes open source.

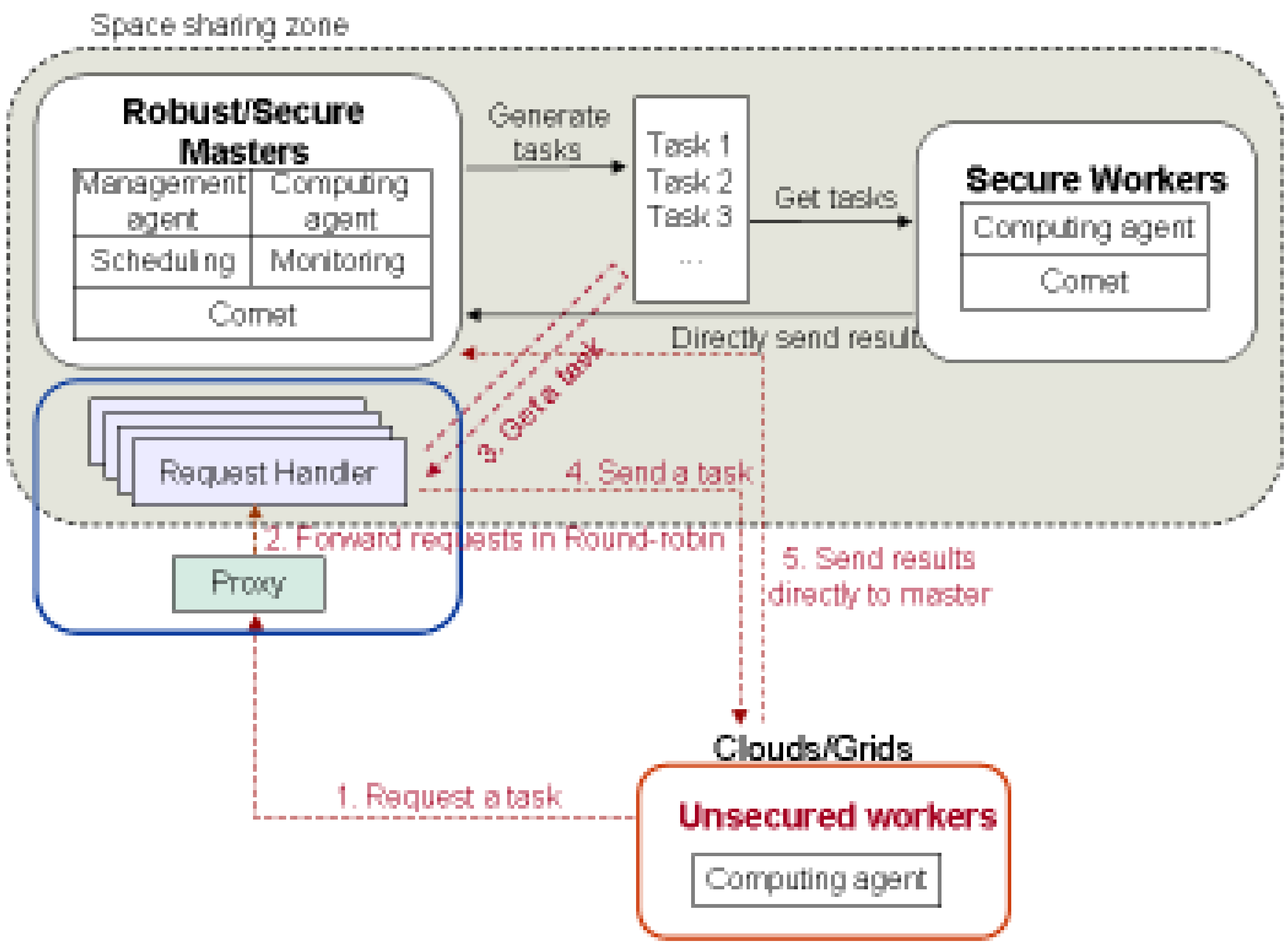


CometCloud space management

- A virtual semantically--specialized shared space
  - Constructed from a application define multi--dimensional information space, which is deterministically mapped onto the dynamic system of peer nodes
- The space is associatively accessible by all system nodes.
  - Access is independent of the physical locations of data tuples or hosts
- Dynamically constructed transient spaces enable application to exploit context locality

Programming models – Master/Worker

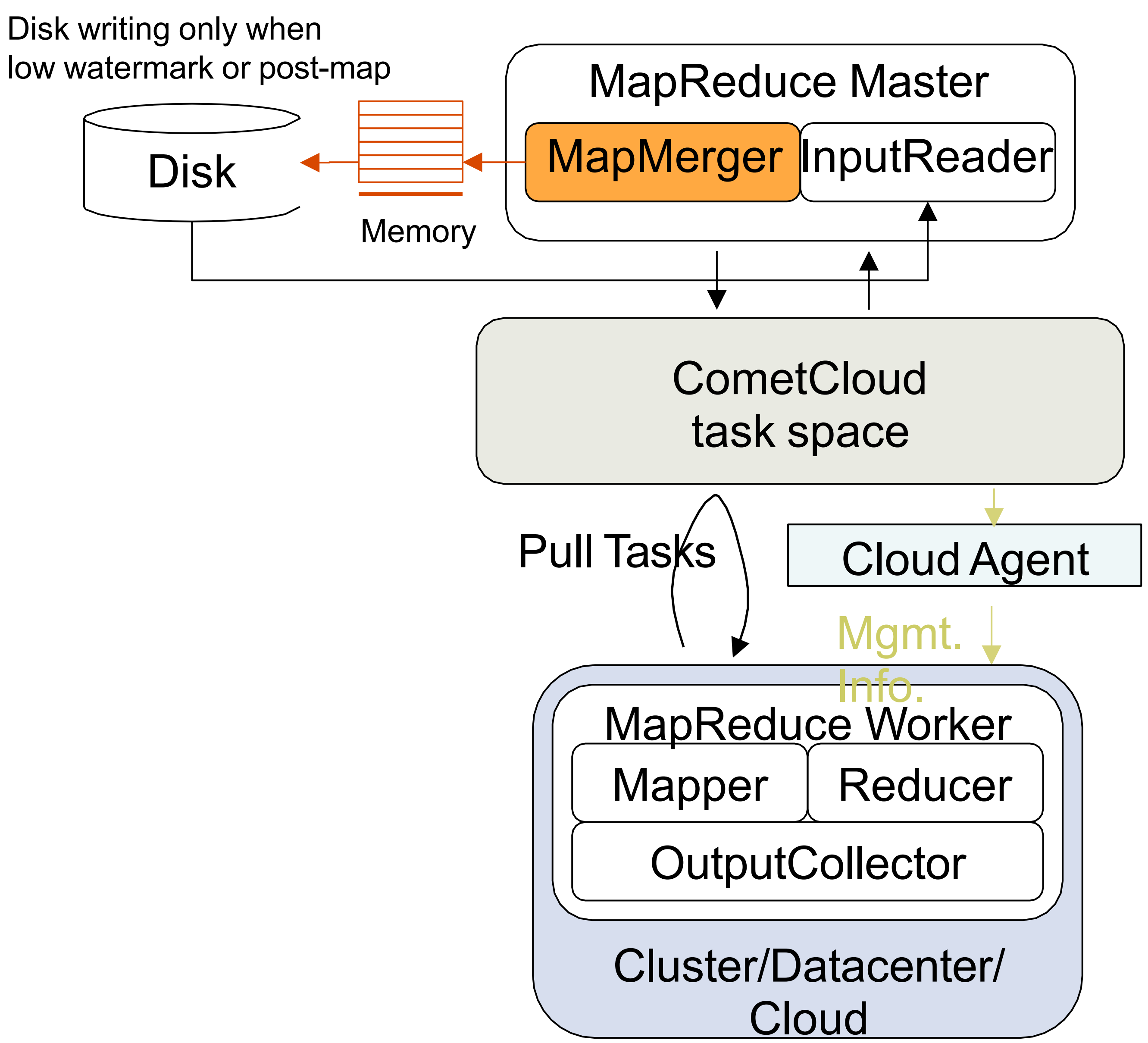
- A **master** generates tasks, submits them into the coordination space, and collects results.
- A **secure worker** provides its local space as the part of the coordination space as well as providing computing capability.
- An **unsecured worker** provides only computing capability and gets a task through the proxy and a request handler.



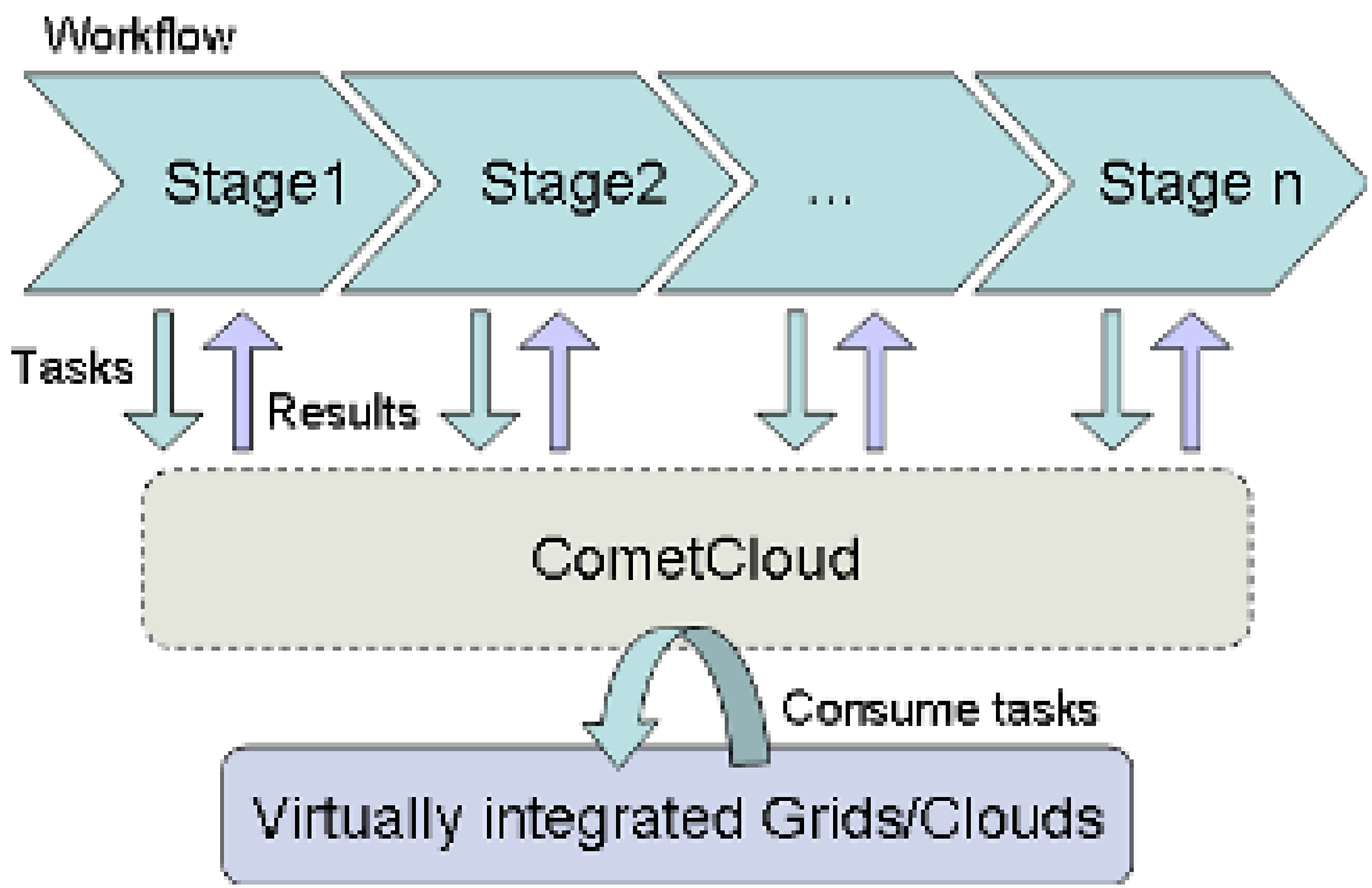
- **Proxy** receives task requests from unsecured workers and forward the requests to one of request handler. **Request handler** is part of the overlay so as to host Comet space and picks up a task for unsecured workers.

Programming models – Map/Reduce

- Accelerate MapReduce for the application running with a large number of small or medium files.
- MapMerger to keep results in memory as much as possible.



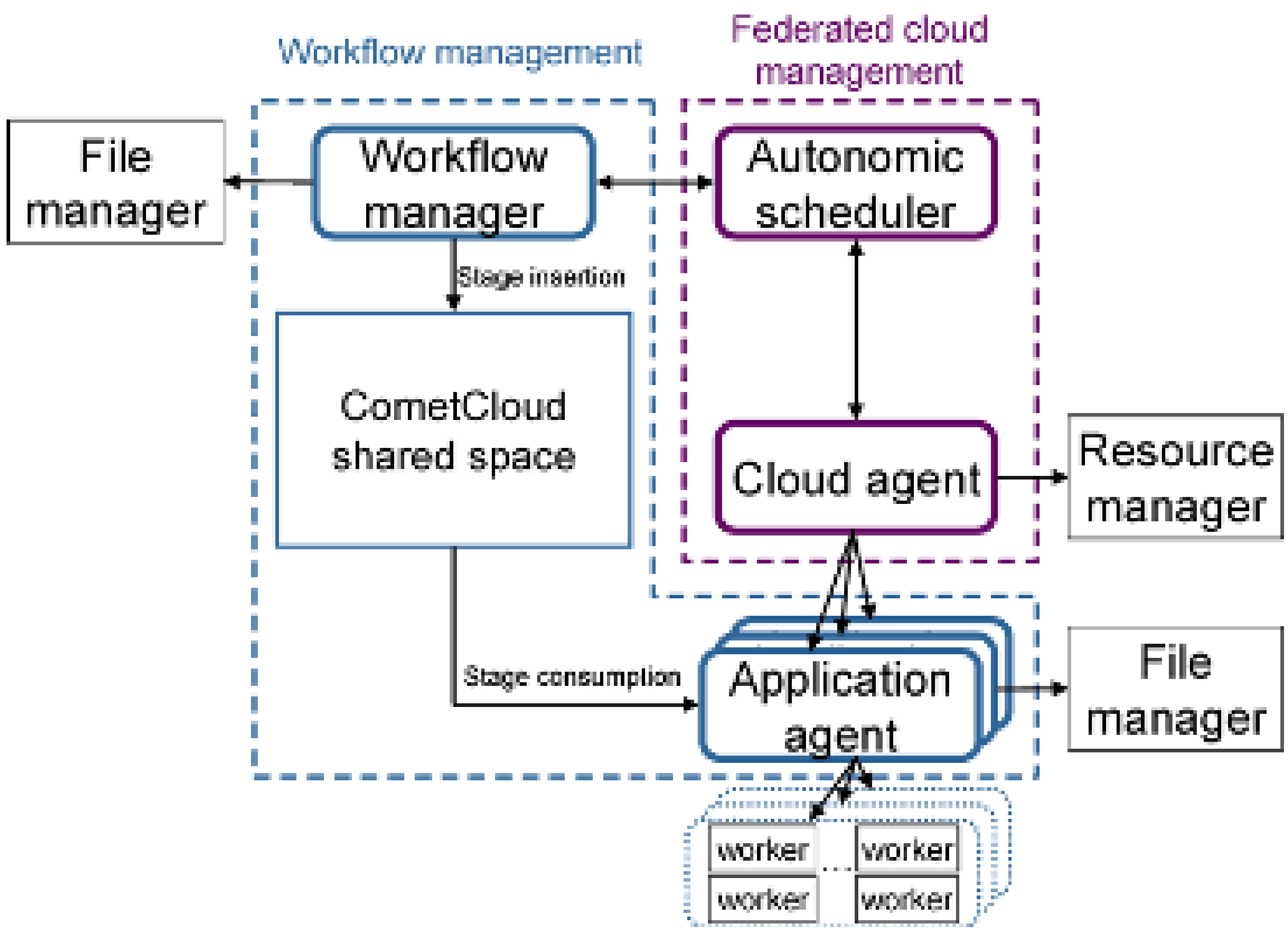
Programming models – Workflow



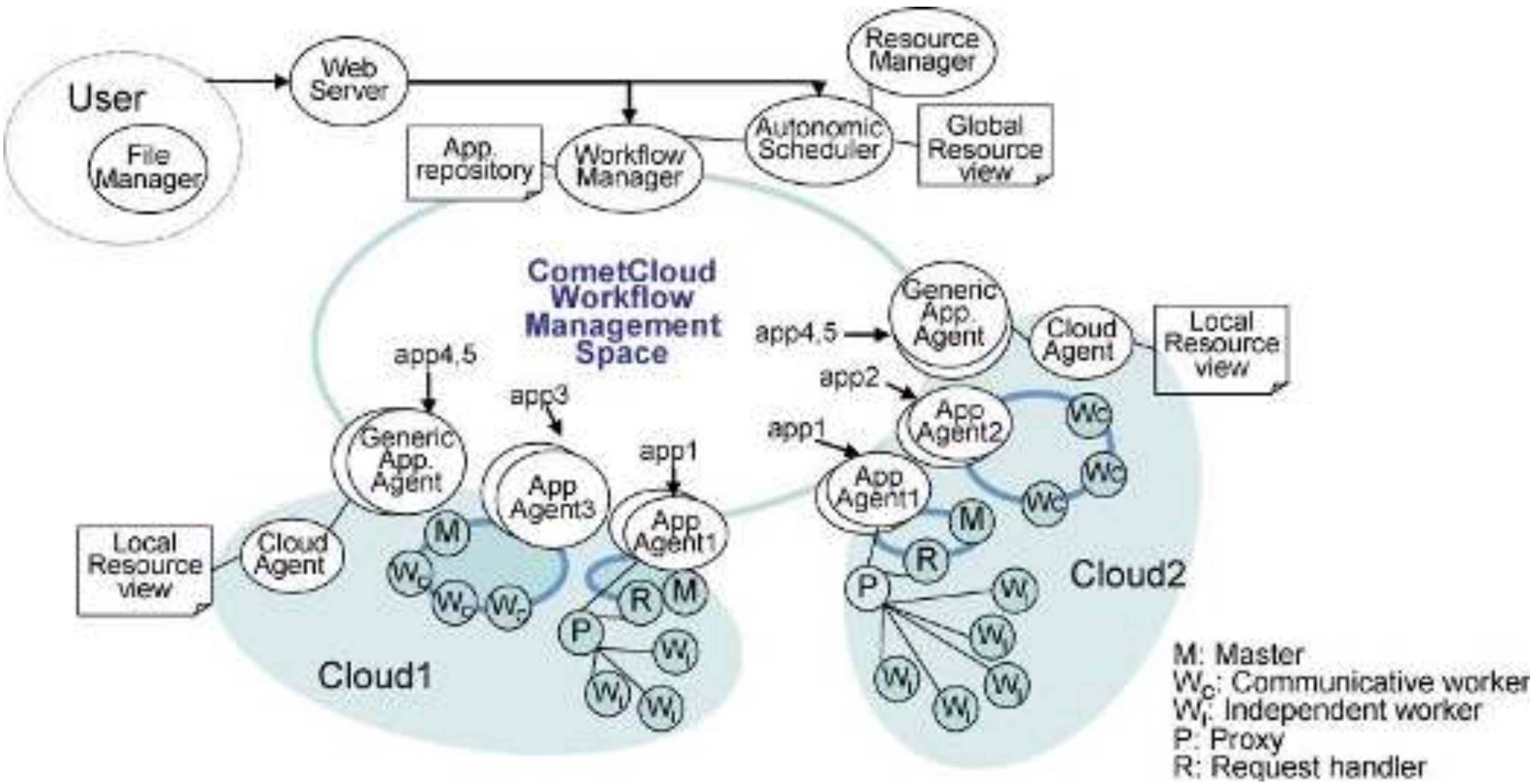
- Each stage is heterogeneous in terms of behavior, the length of computation, the amount of required resources, etc.
- Stages should be completed in an sequence since the output of a stage becomes the input of the next stage.

Workflow management

- Federated cloud management
- Application management



Workflow management



Multimedia Cloud

Multimedia Cloud in Cloud Computing

IPTV is the delivery of media content, videos or live television over an IP network. IPTV (Internet Protocol Television) can either use the public internet, a private local area network (LA) or wide area network (WAN). An IPTV service can be delivered to an IP enabled TV, mobile phone, tablet, laptop or PC and can be easily incorporated into a video on demand solution.

IPTV services are commonly used by businesses and organisations to deliver TV to waiting areas, reception and common rooms and often integrated with digital signage capabilities. IPTV is also a popular solution for the provision of tv services within a hotel, hospital or residential property.

Multimedia Cloud in Cloud Computing

IPTV (Internet Protocol television) is a service that provides television programming and other video content using the Transmission Control Protocol/Internet Protocol (TCP/IP) suite, as opposed to broadcast TV, cable TV or satellite signals.

An IPTV service, typically distributed by a service provider, delivers live TV programs or on-demand video content via IP networks.

An IPTV system may be used to provide video content over a private network in an enterprise, although such implementations are far less common than subscriber-based models due to the complexity, network latency and scaling issues.

How does Internet Protocol television work?

IPTV content is often delivered over a managed or dedicated network, like Digital Subscriber Line connectivity. Compared to the public internet, a private network gives network operators more control over the video traffic and, by extension, the ability to ensure quality of service, uptime, bandwidth and reliability.

In traditional television delivery, all programming is broadcast simultaneously in a multicast format. The available program signals flow downstream, and viewers select programs by changing the TV channel.

An IPTV service, by contrast, sends only one program at a time, i.e., a unicast format. Content remains on the internet service provider's network, and only the program the end user selects is sent to the user's device.

Multimedia Cloud in Cloud Computing

When a viewer changes the channel, a new stream is transmitted from the provider's server directly to the viewer. Like cable television, IPTV requires a set-top box or other customer premises devices, such as a Wi-Fi router or a fiber optic or broadband internet connection.

IPTV primarily uses IP multicasting with Internet Group Management Protocol for IPv4-based live television broadcasts and Real-Time Streaming Protocol for on-demand programs. Multicast Listener Discovery is used on IPv6 networks. Other common protocols include Real-Time Messaging Protocol and Hypertext Transfer Protocol

Multimedia Cloud in Cloud Computing

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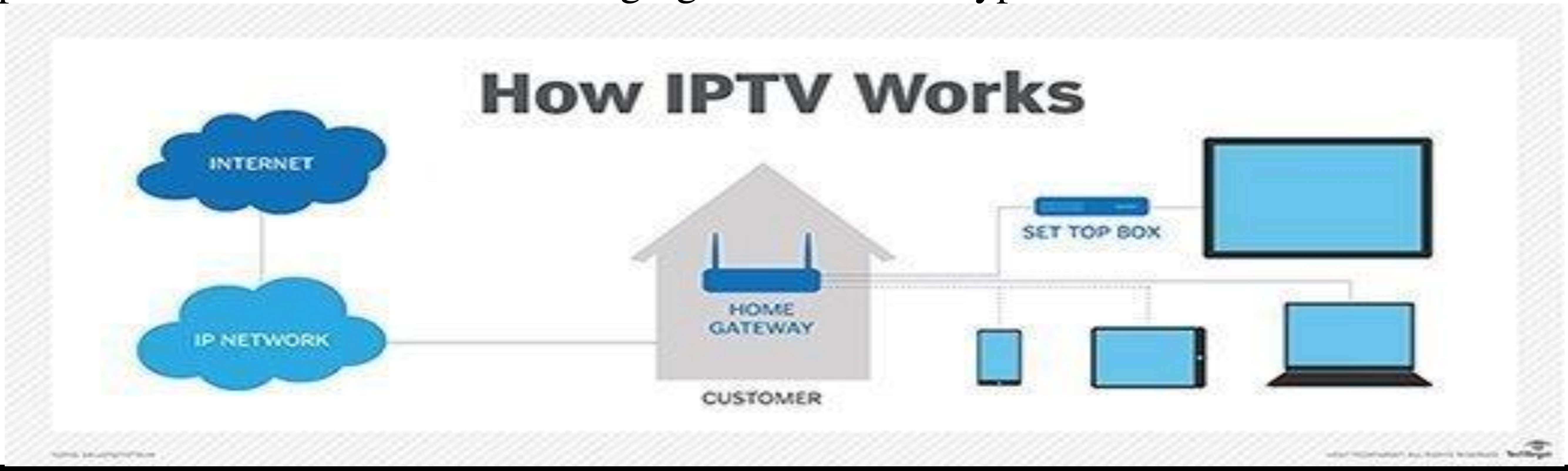


What are IPTV use cases?

Because IPTV uses a packet-based delivery system, it can be bundled with other IP-based telecommunication services, such as voice over IP and high-speed internet.

The use of IP also enables providers to support various other services and applications, such as video on demand, interactive TV, livestreaming, in-program messaging and time shifting, a broad term for TV services that enable viewers to consume content in ways other than live broadcasts, e.g., digital recording, on-demand television shows and the ability to rewind or restart a live program already in progress.

IPTV competes with another delivery model known as internet TV, which refers to television content distributed through a website via a broadband connection.

Multimedia Cloud in Cloud Computing

IPTV providers :

IPTV providers include a wide range of companies from large network operators, like Verizon with its FiOS video services, and major companies, such as Netflix, Google, Apple and Microsoft, to Sony, which also offers video streaming services via smart TV sets and internet-enabled devices, and AT&T. Additional examples of major IPTV providers include Roku, Hulu and YouTube. Some other popular IPTV services include Amazing TV, FalconTV, SelectTV, Best Cast TV, Comstar.tv and Xtreme HD IPTV.

Providers of IPTV also include a wide variety of smaller or niche companies sometimes specializing in certain types of content delivered over a broadband IP connection. Here's a sampling of some additional ITPV offerings:

Multimedia Cloud in Cloud Computing

1. Apollo Group TV
2. Bing TV
3. Decoded Streams
4. Hoopla
5. Hotstar
6. HUTV
7. Iconic Streams
8. IMDb TV
9. IPTVGang
10. IPTV Trends
11. Kanopy
12. King TV
13. Kodi
14. The Matrix IPTV
15. Necro IPTV
16. nVision TV
17. Perfect Player
18. Players Klub IPTV
19. Popcornflix
20. RocketStreams
21. Snap.tv
22. Sportz TV
23. Tubi
24. Vudu
25. YeahIPTV

Energy Aware Cloud Computing

Cloud computing as a trending model for the information technology, provides unique features and opportunities including scalability, broad accessibility and dynamic provision of the computing resources with limited capital investments. This paper presents the criteria, assets, and models for energy-aware cloud computing practices and the envisioned market structure for cloud computing services that exclusively addresses the impact of the quality and price of the energy supply on the quality and cost of cloud computing services. The cloud computing market is driven by a limited number of vendors while a global market is emerging over the horizon. The considerable energy consumption for cloud providers highlights the interdependence among the energy and cloud computing markets. The energy management practices for cloud providers at the macro- and micro- levels to improve the cost and reliability measures of the cloud services are presented.

Energy Aware Cloud Computing

Cloud computing as an emerging computing model provides computing resources as general utilities for the endusers through the internet. Cloud computing is a model that enables on-demand access to the shared pool of customizable computing resources (e.g. servers, storage, networks, and applications) and services [1]. These resources could be rapidly deployed with minimal management efforts and marginal interactions with the service providers. Providing dynamic computing resources in the cloud computing paradigm, enables the corporates to scale up/down the provided services, considering the clients' demand and the cost of the leveraged resources that contribute to the operation cost of the information technology (IT) facilities. The scalability of the cloud services enables the smaller businesses to benefit from different categories of expensive computing-intensive services that were once exclusively available to large enterprises. Cloud computing remedies the IT barriers especially for small and medium-sized enterprises and provides efficient and economical IT solutions as the cloud providers develop tools and skills to exclusively focus on handling the computational and IT challenges.

Energy Aware Cloud Computing

With marvelous effects of cloud computing on the IT industry, large enterprises such as Google, Amazon, and Microsoft endeavor to establish more powerful, reliable and economically efficient cloud computing platforms. The backbone of the cloud computing is data centers. Cloud computing is achieved by establishing distributed data centers that consume significant volume of energy. Data centers leverage advanced energy management solutions to achieve the targeted computing reliability and economic Efficiency.

Jungle Computing

Jungle computing is a form of high performance computing that distributes computational work across cluster, grid and cloud computing.

The increasing complexity of the high performance computing environment has provided a range of choices beside traditional supercomputers and clusters. Scientists can now use grid and cloud infrastructures, in a variety of combinations along with traditional supercomputers - all connected via fast networks. And the emergence of many-core technologies such as GPUs, as well as supercomputers on chip within these environments has added to the complexity. Thus, high-performance computing can now use multiple diverse platforms and systems simultaneously, giving rise to the term "computing jungle".

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

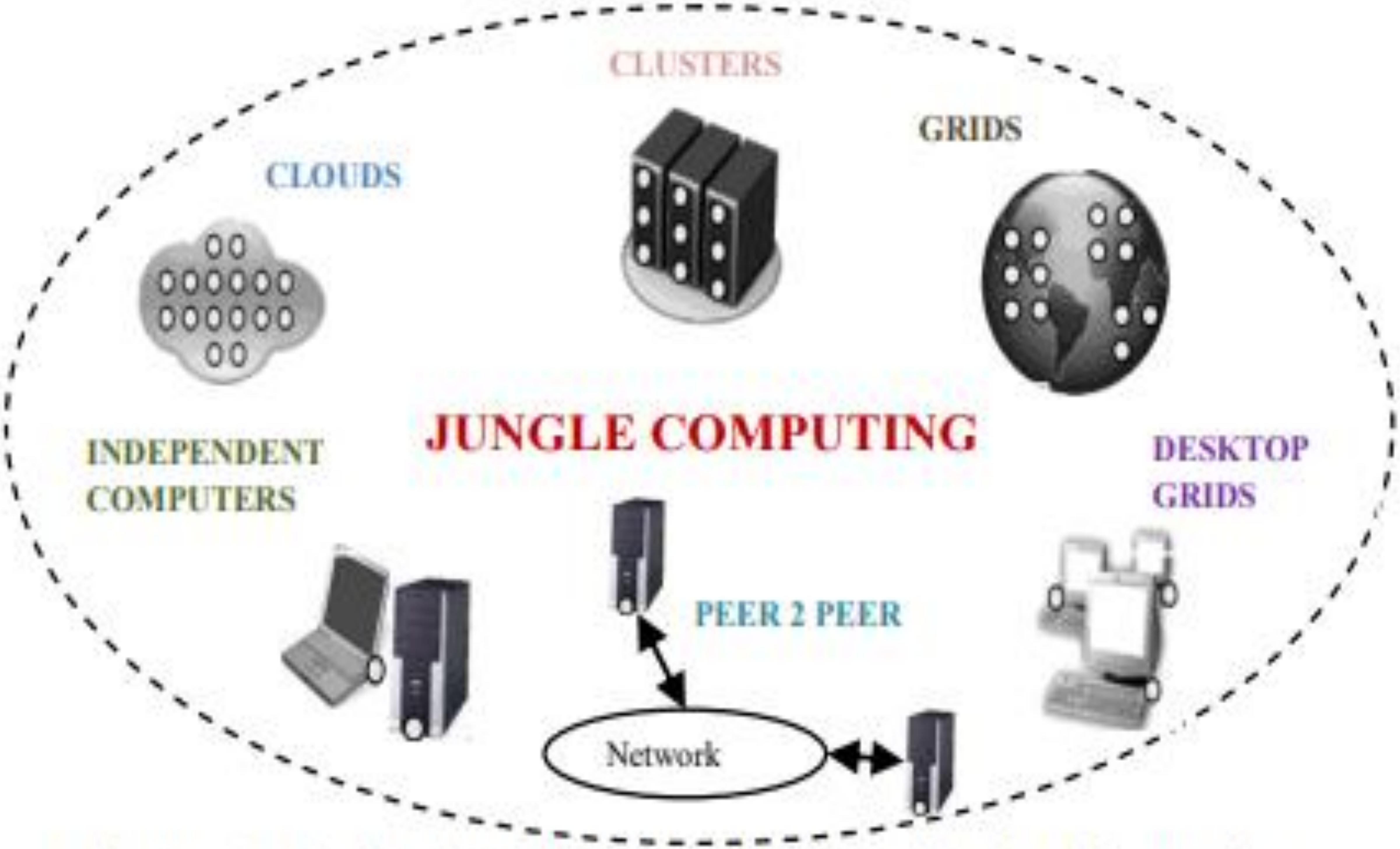


Figure 6.1: The jungle computing - a diverse collection of computing

Jungle Computing

The increasing complexity of the high performance computing environment has provided a bewildering range of choices beside traditional supercomputers and clusters. Scientists can now use grid and cloud infrastructures, in a variety of combinations along with traditional supercomputers- all connected via fast networks. And the emergence of manycore technologies such as GPUs, as well as supercomputers on chip within these environments has added to the complexity. Thus high performance computing can now use multiple diverse platforms and systems simultaneously, giving rise to the term "computing jungle". Ibis high-performance distributed programming system is an example of the jungle computing.

What is Edge Cloud Computing

To handle the massive influx of data being generated on a second basis, the technology of edge computing is used. But what is edge computing? It is part of a distributed cloud infrastructure that advocates on decentralization instead of centralization, meaning it brings data storage and workloads close to the edge to where the data is being generated and where actions are being taken, as possible. IoT devices typically have limited data processing and storage capabilities, so substantial processing has to occur on premises with the edge providing an environment to handle the processing and manage large number of IoT devices and data. Edge systems are essentially remote computing systems such as smartphones, network gateways, or smart objects that work on behalf of the cloud. This way information can be shared quickly, securely and without latency. Plus it improves the speed of data processing as a direct result of lower dependency on the cloud.

What is Edge Cloud Computing

early milestones	Key Layers of the Internet	milestones
email@-1971 Ray Tomlinson	CONTENT	1987-HyperCard Bill Atkinson
Archie-1990 Emtage & Deutsch	SEARCH ENGINE*	1998-Google Brin & Page
DOS Houdini-1986 Neil Larson	BROWSERS	1993-Mosaic Marc Andreessen
(Vannevar Bush, Ted Nelson, Douglas Engelbart)	WORLD WIDE WEB	1990-http:// Tim Berners-Lee
ARPANET-1969 J.C.R. Licklider	INTERNET	1975-TCP/IP Cerf & Kahn
SAGE-1956 George Valley	NETWORKS	1973-Ethernet Robert Metcalfe
Z3-1941 Konrad Zuse	COMPUTERS	1976-Apple Jobs & Wozniak

What is Distributed Cloud Computing

Distributed systems are all around us – Google Search engine, Amazon platforms, Netflix, blockchain, online gaming, online banking, and the list goes on. The most common example of a distributed system is the client-server model. When we talk about distributed systems, we actually refer to a collection of independent software or hardware components called nodes that are linked together via a network and which work together toward a common end goal. So, distributed computing is the study of those distributed systems with multiple components located on different machines. It is a computing model wherein system components are distributed across multiple computers but they run as one system to solve a problem. The system mainly consists of a set of processors that are connected by a communication network which provides information exchange among processors.

Distributed Cloud Vs Edge Cloud Computing

Edge Computing	Distributed Computing
It brings data storage and workloads close to the edge to where the data is being generated and where actions are being taken.	It is a computing model wherein system components are distributed across multiple computers but they run as one system.
It provides additional security measures by incorporating specialized edge data centers.	System components are distributed across multiple computers making the system secure.
Less operational and maintenance costs as the devices and computing is done locally.	Operational and maintenance cost is little bit higher but relatively cost-effective compared to traditional cloud computing architecture.
Examples include autonomous cars, streaming services, smart homes, industrial manufacturing, etc.	Examples include Internet, World Wide Web, Intranet, Email, cellular networks, etc.

Summary of Edge Computing vs. Distributed Computing

Edge systems are based on distributed system architecture and are essentially remote computing systems from established engineering domains of embedded systems, computer security, cloud computing, and telecommunications. It accommodates a wide range of computing devices from small to large end users and data sources. The idea is to place together computing and storage capacity of devices at the data source, real life applications requiring mobility, low latency, reliability, etc., can be better supported. This is a great move away from the traditional cloud computing architecture which focuses on a decentralized architecture model. As innovative devices like self-driving cars become more common, the impact of edge computing on our daily life will be significantly higher.

Container Dockers & Kubernetes

Container in Cloud Computing

“Containers are lightweight packages of your application code together with dependencies such as specific versions of programming language runtimes and libraries required to run your software services”.

Containers make it easy to share CPU, memory, storage, and network resources at the operating systems level and offer a logical packaging mechanism in which applications can be abstracted from the environment in which they actually run.

What are Containers?

1. Containers are executable units of software in which application code is packaged, along with its libraries and dependencies, in common ways so that it can be run anywhere, whether it be on desktop, traditional IT, or the cloud.

2. To do this, containers take advantage of a form of operating system (OS) virtualization in which features of the OS (in the case of the Linux kernel, namely the namespaces and cgroups primitives) are leveraged to both isolate processes and control the amount of CPU, memory, and disk that those processes have access to.

3. Containers are small, fast, and portable because unlike a virtual machine, containers do not need include a guest OS in every instance and can, instead, simply leverage the features and resources of the host OS.

4. Containers first appeared decades ago with versions like FreeBSD Jails and AIX Workload Partitions, but most modern developers remember 2013 as the start of the modern container era with the introduction of Docker.

Use cases of Containers in the Cloud

The following use cases are especially suitable for running containers in the cloud:

1. **Microservices :** containers are lightweight, making them well suited for applications with microservices architectures consisting of a large number of loosely coupled, independently deployable services.

2. **DevOps :** many DevOps teams build applications using a microservices architecture, and deploy services using containers. Containers can also be used to deploy and scale the DevOps infrastructure itself, such CI/CD tools.

3. **Hybrid and multi-cloud :** for organizations operating in two or more cloud environments, containers are highly useful for migrating workloads. They are a standardized unit that can be flexibly moved between on-premise data centers and any public cloud.

4. **Application modernization :** a common way to modernize a legacy application is to containerize it, and move it as is to the cloud (a model known as "lift and shift").

How do Cloud Containers Works?

Container technology began with the separation of partitions and chroot processes, introduced as part of Linux. Modern container engines take the form of application containerization (such as Docker) and system containerization (such as Linux containers).

Containers rely on isolation, controlled at the operating system kernel level, to deploy and run applications. Containers share the operating system kernel, and do not need to run a full operating system—they only need to run the necessary files, libraries and configuration to run workloads. The host operating system limits the container's ability to consume physical resources.

In the cloud, a common pattern is to use containers to run an application instance. This can be an individual microservice, or a backend application such as a database or middleware component. Containers make it possible to run multiple applications on the same cloud VM, while ensuring that problems with one container do not affect other containers, or the entire VM.

How do Cloud Containers Works?

Cloud providers offer several types of services you can use to run containers in the cloud:

- **Hosted container instances :** let you run containers directly on public cloud infrastructure, without the intermediary of a cloud VM. An example is Azure Container Instances (ACI).
- **Containers as a Service (CaaS) :** manages containers at scale, typically with limited orchestration capabilities. An example is Amazon Elastic Container Service (ECS) or Amazon Fargate.
- **Kubernetes as a Service (KaaS) :** provides Kubernetes, the most popular container orchestrator, as a managed service. Lets you deploy clusters of containers on the public cloud. An example is Google Kubernetes Engine (GKE).

Benefits of Cloud Containers

The primary advantage of containers, especially compared to a VM, is providing a level of abstraction that makes them lightweight and portable.

1. **Lightweight:** Containers share the machine OS kernel, eliminating the need for a full OS instance per application and making container files small and easy on resources. Their smaller size, especially compared to virtual machines, means they can spin up quickly and better support cloud-native applications that scale horizontally.
2. **Portable and platform independent:** Containers carry all their dependencies with them, meaning that software can be written once and then run without needing to be re-configured across laptops, cloud, and on-premises computing environments.

Benefits of Cloud Containers

3. Supports modern development and architecture: Due to a combination of their deployment portability/consistency across platforms and their small size, containers are an ideal fit for modern development and application patterns—such as DevOps, serverless, and microservices—that are built are regular code deployments in small increments.

4. Improves utilization: Like VMs before them, containers enable developers and operators to improve CPU and memory utilization of physical machines. Where containers go even further is that because they also enable microservice architectures, application components can be deployed and scaled more granularly, an attractive alternative to having to scale up an entire monolithic application because a single component is struggling with load.

What is Docker in Cloud Computing

Docker is an open platform for developing, shipping, and running applications. Docker enables you to separate your applications from your infrastructure so you can deliver software quickly. With Docker, you can manage your infrastructure in the same ways you manage your applications. By taking advantage of Docker's methodologies for shipping, testing, and deploying code quickly, you can significantly reduce the delay between writing code and running it in production.

Docker Platform

Docker provides the ability to package and run an application in a loosely isolated environment called a container. The isolation and security allows you to run many containers simultaneously on a given host. Containers are lightweight and contain everything needed to run the application, so you do not need to rely on what is currently installed on the host. You can easily share containers while you work, and be sure that everyone you share with gets the same container that works in the same way.

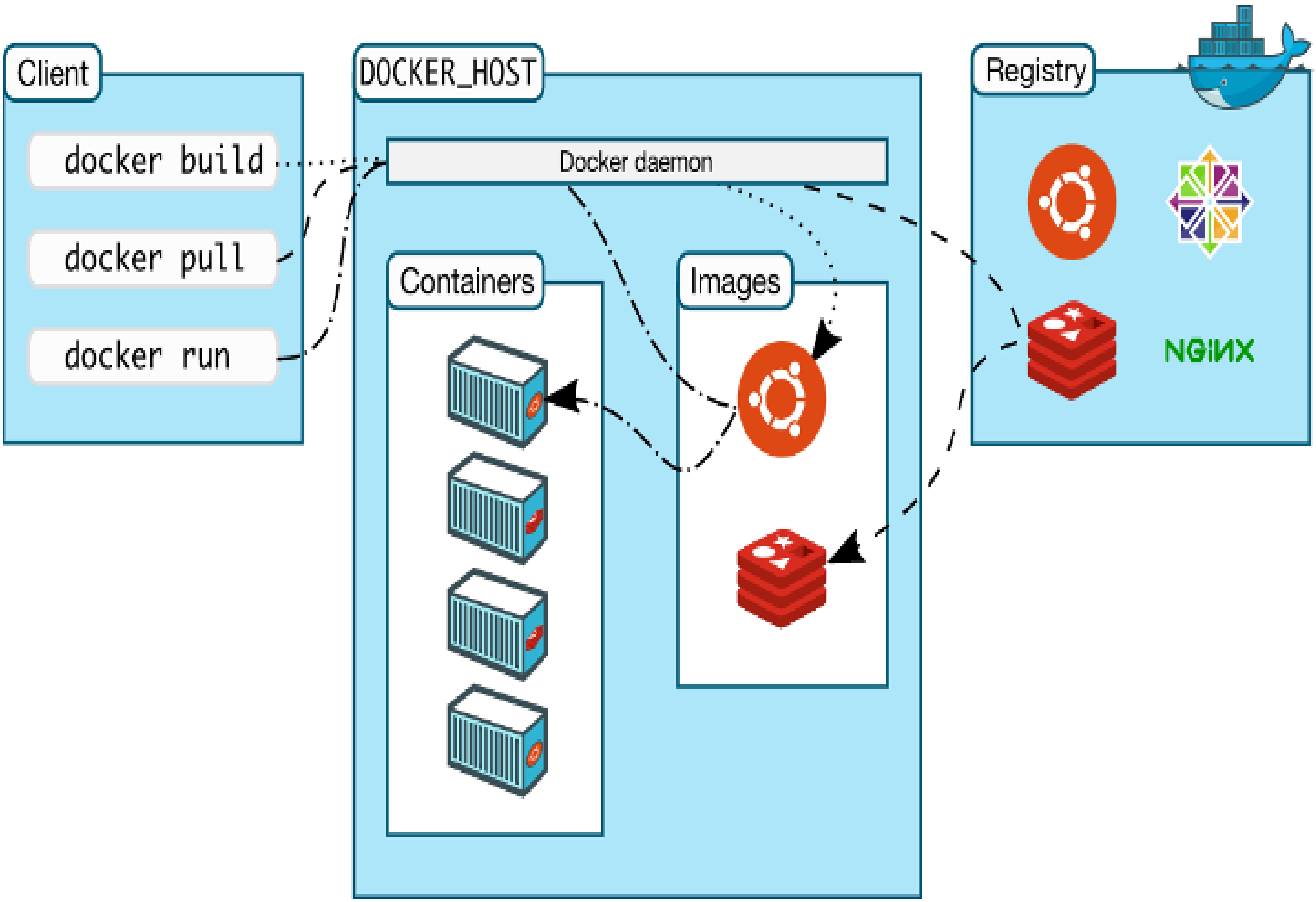
Docker provides tooling and a platform to manage the lifecycle of your containers:

- Develop your application and its supporting components using containers.
- The container becomes the unit for distributing and testing your application.
- When you're ready, deploy your application into your production environment, as a container or an orchestrated service. This works the same whether your production environment is a local data center, a cloud provider, or a hybrid of the two

Docker Architecture

Docker uses a client-server architecture. The Docker client talks to the Docker daemon, which does the heavy lifting of building, running, and distributing your Docker containers. The Docker client and daemon can run on the same system, or you can connect a Docker client to a remote Docker daemon. The Docker client and daemon communicate using a REST API, over UNIX sockets or a network interface. Another Docker client is Docker Compose, that lets you work with applications consisting of a set of containers.

Docker Architecture



Docker Architecture

1. The Docker daemon :

The Docker daemon (dockerd) listens for Docker API requests and manages Docker objects such as images, containers, networks, and volumes. A daemon can also communicate with other daemons to manage Docker services.

2. The Docker client :

The Docker client (docker) is the primary way that many Docker users interact with Docker. When you use commands such as docker run, the client sends these commands to dockerd, which carries them out. The docker command uses the Docker API. The Docker client can communicate with more than one daemon.

3. Docker Desktop :

Docker Desktop is an easy-to-install application for your Mac or Windows environment that enables you to build and share containerized applications and microservices. Docker Desktop includes the Docker daemon (dockerd), the Docker client (docker), Docker Compose, Docker Content Trust, Kubernetes, and Credential Helper. For more information, see Docker Desktop.

Docker Architecture

4. Docker registries

A Docker registry stores Docker images. Docker Hub is a public registry that anyone can use, and Docker is configured to look for images on Docker Hub by default. You can even run your own private registry.

When you use the docker pull or docker run commands, the required images are pulled from your configured registry. When you use the docker push command, your image is pushed to your configured registry.

5. Docker objects

When you use Docker, you are creating and using images, containers, networks, volumes, plugins, and other objects. This section is a brief overview of some of those objects.

Benefits of Docker(Container)

1. **Tailor-made:** Most industries want to use a purpose-built. The Docker in cloud computing enables its clients to make use of Docker to organize their software infrastructure.

2. **Accessibility:** As the docker is a cloud framework, it is accessible from anywhere, anytime. Has high efficiency.

3. **Operating System Support:** It takes less space. They are lightweight and can operate several containers simultaneously.

4. **Performance:** Containers have better performance as they are hosted in a single docker engine.

5. **Speed:** No requirement for OS to boot. Applications are made online in seconds. As the business environment is constantly changing, technological up-gradation needs to keep pace for smoother workplace transitions. Docker helps organizations with the speedy delivery of service.

Benefits of Docker(Container)

6. **Flexibility:** They are a very agile container platform. It is deployed easily across clouds, providing users with an integrated view of all their applications across different environments. Easily portable across different platforms.

7. **Scalable:** It helps create immediate impact by saving on recoding time, reducing costs, and limiting the risk of operations. Containerization helps scale easily from the pilot stage to large-scale production.

8. **Automation:** Docker works on Software as a service and Platform as a service model, which enables organizations to streamline and automate diverse applications. Docker improves the efficiency of operations as it works with a unified operating model.

9. **Space Allocation:** Data volumes can be shared and reused among multiple containers.

Kubernetes in Cloud Computing

Kubernetes is a portable, extensible, open source platform for managing containerized workloads and services, that facilitates both declarative configuration and automation. It has a large, rapidly growing ecosystem. Kubernetes services, support, and tools are widely available.

The name Kubernetes originates from Greek, meaning helmsman or pilot. K8s as an abbreviation results from counting the eight letters between the "K" and the "s". **Google open-sourced the Kubernetes project in 2014.** Kubernetes combines over 15 years of Google's experience running production workloads at scale with best-of-breed ideas and practices from the community

Features of Kubernetes in Cloud

1. **Auto-scaling.** Automatically scale containerized applications and their resources up or down based on usage.

2. **Lifecycle management.** Automate deployments and updates with the ability to:

- Rollback to previous versions
- Pause and continue a deployment

3. **Declarative model.** Declare the desired state, and K8s works in the background to maintain that state and recover from any failures

Resilience and self-healing. Auto placement, auto restart, auto replication and auto scaling provide application self-healing

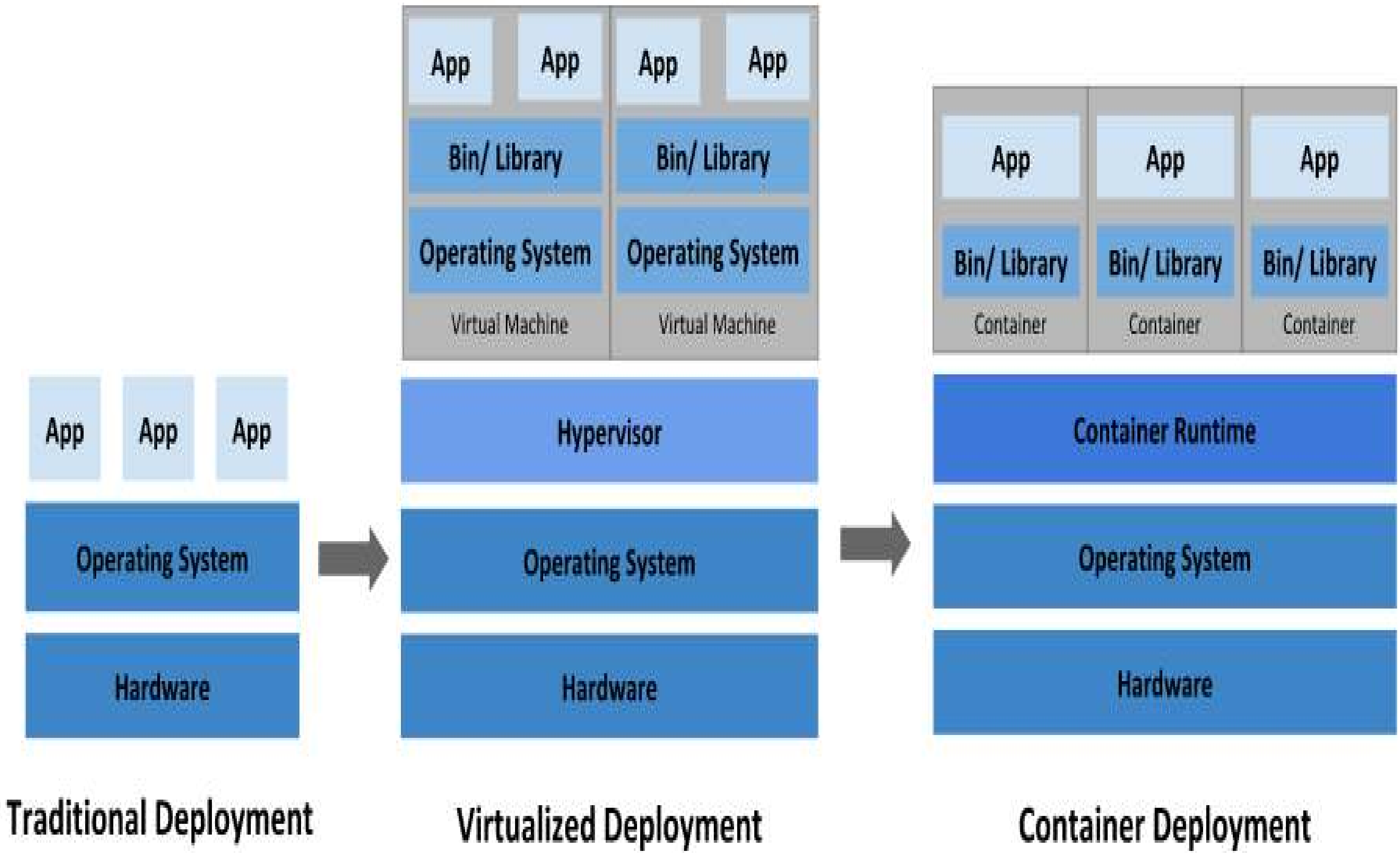
Features of Kubernetes in Cloud

4. **Persistent storage.** Ability to mount and add storage dynamically.

5. **Load balancing.** Kubernetes supports a variety of internal and external load balancing options to address diverse needs

6. **DevSecOps support.** DevSecOps is an advanced approach to security that simplifies and automates container operations across clouds, integrates security throughout the container lifecycle, and enables teams to deliver secure, high-quality software more quickly. Combining DevSecOps practices and Kubernetes improves developer productivity.

Kubernetes in Cloud Computing



Need of Kubernetes in Cloud

1. **Service discovery and load balancing Kubernetes** can expose a container using the DNS name or using their own IP address. If traffic to a container is high, Kubernetes is able to load balance and distribute the network traffic so that the deployment is stable.
2. **Storage orchestration** Kubernetes allows you to automatically mount a storage system of your choice, such as local storages, public cloud providers, and more.
3. **Automated rollouts and rollbacks** You can describe the desired state for your deployed containers using Kubernetes, and it can change the actual state to the desired state at a controlled rate. For e.g., you can automate Kubernetes to create new containers for your deployment, remove existing containers and adopt all their resources to the new container.

Need of Kubernetes in Cloud

4. **Automatic bin packing** You provide Kubernetes with a cluster of nodes that it can use to run containerized tasks. You tell Kubernetes how much CPU and memory (RAM) each container needs. Kubernetes can fit containers onto your nodes to make the best use of your resources.
5. **Self-healing** Kubernetes restarts containers that fail, replaces containers, kills containers that don't respond to your user-defined health check, and doesn't advertise them to clients until they are ready to serve.
6. **Secret and configuration management** Kubernetes lets you store and manage sensitive information, such as passwords, OAuth tokens, and SSH keys. You can deploy and update secrets and application configuration without rebuilding your container images, and without exposing secrets in your stack configuration

Kubernetes Architecture & How it works?

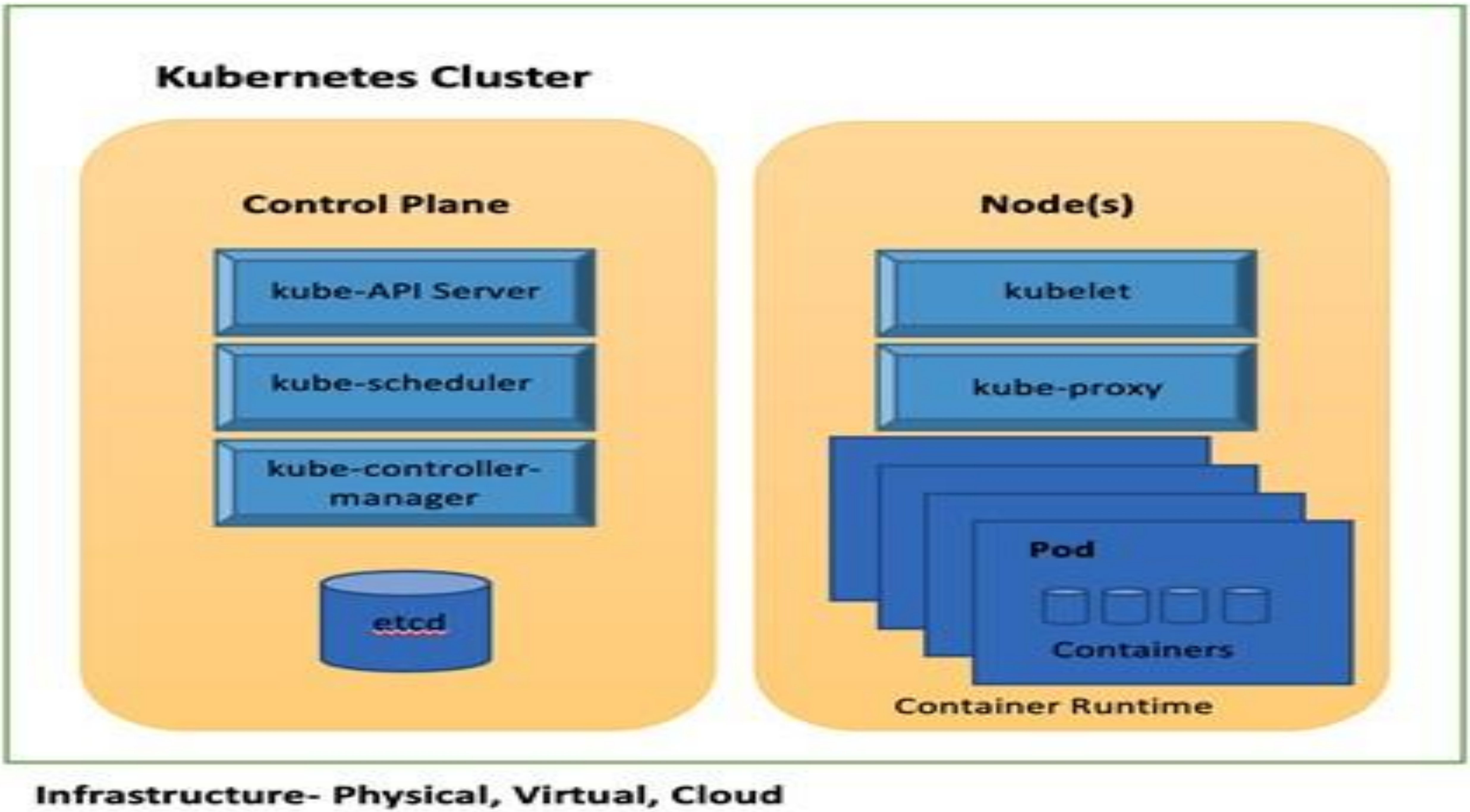
Containers encapsulate an application in a form that’s portable and easy to deploy. The Kubernetes architecture is designed to run containerized applications. A Kubernetes cluster consists of at least one control plane and at least one worker node (typically a physical or virtual server). The control plane has two main responsibilities. It exposes the Kubernetes API through the API server and manages the nodes that make up the cluster. The control plane makes decisions about cluster management and detects and responds to cluster events.

The smallest unit of execution for an application running in Kubernetes is the Kubernetes Pod, which consists of one or more containers. Kubernetes Pods run on worker nodes.

Kubernetes Architecture & How it works?

Additional Kubernetes Terminology :

It's important to know the names and functions of the major K8s components that are part of the control plane or that execute on Kubernetes nodes.



Kubernetes Architecture & How it works?

The control plane has four primary components used to control communications, manage nodes and keep track of the state of a Kubernetes cluster.

1. **Kube-apiserver.** As its name suggests, the kube-apiserver exposes the Kubernetes API.
2. **etcd.** A key-value store where all data relating to the Kubernetes cluster is stored.
3. **Kube-scheduler.** Watches for new Kubernetes Pods with no assigned nodes and assigns them to a node for execution based on resources, policies, and 'affinity' specifications.
4. **Kube-controller-manager.** All controller functions of the control plane are compiled into a single binary: kube-controller-manager.

Kubernetes Architecture & How it works?

A K8s node has three major components:

Kubelet. An agent that makes sure that the necessary containers are running in a Kubernetes Pod.

Kube-proxy. A network proxy that runs on each node in a cluster to maintain network rules and allow communication.

Container runtime. The software responsible for running containers. Kubernetes supports any runtime that adheres to the Kubernetes CRI (Container Runtime Interface).

Kubernetes Architecture & How it works?

Additional terms to be aware of include:

Kubernetes service. A Kubernetes service is a logical abstraction for a group of Kubernetes Pods which all perform the same function. Kubernetes services are assigned unique addresses which stay the same even as pod instances come and go.

Controller. Controllers ensure that the actual running state of the Kubernetes cluster is as close as possible to the desired state.

Operator. Kubernetes Operators allow you to encapsulate domain-specific knowledge for an application similar to a run book. By automating application-specific tasks, Operators allow you to more easily deploy and manage applications on K8s.

Kubernetes Advantages

1. **Portability.** Containers are portable across a range of environments from virtual environments to bare metal. Kubernetes is supported in all major public clouds, as a result, you can run containerized applications on K8s across many different environments.
2. **Integration and extensibility.** Kubernetes is extensible to work with the solutions you already rely on, including logging, monitoring, and alerting services. The Kubernetes community is working on a variety of open source solutions complementary to Kubernetes, creating a rich and fast-growing ecosystem.
3. **Cost efficiency.** Kubernetes' inherent resource optimization, automated scaling, and flexibility to run workloads where they provide the most value means your IT spend is in your control.

Kubernetes Advantages

4. **Scalability.** Cloud native applications scale horizontally. Kubernetes uses "auto-scaling," spinning up additional container instances and scaling out automatically in response to demand.

5. **API-based.** The fundamental fabric of Kubernetes is its REST API. Everything in the Kubernetes environment can be controlled through programming.

6. **Simplified CI/CD.** CI/CD is a DevOps practice that automates building, testing and deploying applications to production environments. Enterprises are integrating Kubernetes and CI/CD to create scalable CI/CD pipelines that adapt dynamically to load.

Kubernetes Vs Docker

Kubernetes	Docker
Kubernetes is an ecosystem for managing a cluster of Docker containers known as Pods.	Docker is a container platform for building, configuring and distributing Docker containers.
Kubernetes is not a complete solution and uses custom plugins to extend its functionality.	Docker uses its very own native clustering solution for Docker containers called Docker Swarm.
Load balancing comes out of the box in Kubernetes because of its architecture and it's very convenient	The load balancer is deployed on its own single node swarm when pods in the container are defined as service.
Takes relatively more time for installation.	Setup is quick and easy compared to Kubernetes.

Docker Vs Container

Sr. No	Docker Image	Docker Container
1	It is Blueprint of the Container.	It is instance of the Image.
2	Image is a logical entity.	Container is a real world entity.
3	Image is created only once.	Containers are created any number of times using image.
4	Images are immutable.	Containers changes only if old image is deleted and new is used to build the container.
5	Images does not require computing resource to work.	Containers requires computing resources to run as they run as Docker Virtual Machine

DevOps in Cloud Computing

The word DevOps is a combination of two words Development and Operations. Before getting into what DevOps is, let us get an idea about the two teams involved in software development. The development team is responsible for developing, designing, and building the application. The operation team deals with the deployment and testing of the application. If there are problems with the application, the operation team also provides feedback to the development team. Now let us get to the history of DevOps.

History of DevOps in Cloud Computing

Let us see some important events of DevOps :

2007-2008: The DevOps idea was started

2009: In the initial stage the first conference was " Deploys a day: Dev and Ops cooperation of flicker." Another conference called "DevOps Days in Ghent, Belgium" also happened.

2010: DevOps days conference happened in the United States at mount view, calif.

2012: Allana browns at puppet creates a state of DevOps report

2014: Publishing the annual "State of DevOps report"

2017: Forrester Research calls 2017 "The Year of DevOps"

2018: 30 DevOps day conferences were scheduled across the united states.

DevOps in Cloud Computing

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Objectives of DevOps in Cloud Computing

It improves the collaboration between stakeholders from planning to delivery and implements automation of the delivery process to:

1. Improve the frequency of the deployment
2. Achieve faster time to market the end product
3. Decreases the failure rate of new releases
4. It shortens the lead time between fixes
5. Improves the meantime for the recovery purpose

What is DevOps ?

DevOps is not a tool or a team, it is the process or a methodology of using various tools to solve the problems between Developers and Operations team, hence the term "Dev-Ops"

The development team always had the pressure of completing the old, pending work that was considered faulty by the operations team. With DevOps, there is no wait time to deploy the code and get it tested. Hence, the developer gets instantaneous feedback on the code, and therefore can close the bugs, and can make the code production ready faster!

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DevOps Architecture in Cloud Computing

Plan – In DevOps planning plays an important role. In this stage, all the requirements of the project and everything regarding the project like time for each stage, cost. etc are discussed. This will help everyone in teams to get a brief idea about the project.

DevOps Architecture in Cloud Computing

Code – In this Stage the code is written over here according to the client's requirements. Here the code is divided into small codes called Units. This is done to get a clear picture of the code. For example, if the team is doing a project on an online -Ekart application then the login part is divided as one unit, after login the page which shows all the categories is divided as another unit, user profile as another unit, etc.

Some of the examples of the tools used are Git, JIRA

Build – In this stage Building of the units is done. Some of the examples of the tools used are maven, Gradle.

Test – Testing of all units is done in this stage. So we will get to know where exactly the code is having bugs and if there are mistakes found it is returned. Some of the examples of the tools used are Selenium, PYtest

DevOps Architecture in Cloud Computing

Integrate – In this stage, all the units of the codes are integrated. That means in this step we will be creating a connection between the development team and the operation team to implement Continuous Integration and Continuous Deployment. An example of the tool used is Jenkins.

Deploy – In this stage, the code is deployed on the client's environment. Some of the examples of the tools used are AWS, Docker.

Operate – Operations are performed on the code if required. Some of the examples of the tools used are Kubernetes, open shift.

Monitor – In this stage monitoring of the application is done over here in the client's environment. Some of the examples of the tools used are Nagios, elastic stack.

Advantages of DevOps

1. Faster development of software and quick deliveries.
2. DevOps is flexible and adaptable to changes easily.
3. Compared to the previous software development models confusion about the project is decreased due to which the product quality and efficiency are increased.
4. The gap between the development team and operation team was bridged. i.e, the communication between the teams has been increased.
5. Efficiency is increased by the addition of automation which includes continuous integration and continuous deployment.
6. Customer satisfaction is enhanced.

Disadvantages of DevOps

1. DevOps is expensive.
2. Certain levels of skills are required for maintaining the DevOps architecture.
3. Adopting DevOps technology into the traditional style of industries is quite a challenge.

Applications of DevOps

Adobe: Adobe

This company faced the issue regarding the monolithic architecture and there are communication issues between the teams so they integrated microservice architecture and CI/CD pipelines for point-to-point communication.

Amazon and Netflix:

These companies faced the same problem. At the initial stages, they were adapted to monolithic architecture. But as they grew to handle the huge amount of traffic they adopted AWS cloud-based microservice architecture.

Applications of DevOps

HP:

This company faced a problem regarding testing their software. Here bugs are detected using manual testing after six weeks of writing code and if there are any bugs found it would take one week to fix them. So to overcome this issue they integrated the Continuous Integration and Continuous Deployment pipeline.

United Airlines:

United Airlines, Inc. is a major American airline. This company changed its traditional method of testing to continuous testing using DevOps which helped the company to save $500,000.It also increased its coverage of code by 85%.

IOT & Cloud Convergence

IOT & Cloud Convergence

Internet-of-Things can benefit from the scalability, performance and pay-as-you-go nature of cloud computing infrastructures. Indeed, as IoT applications produce large volumes of data and comprise multiple computational components (e.g., data processing and analytics algorithms), their integration with cloud computing infrastructures could provide them with opportunities for cost-effective on-demand scaling. As prominent examples consider the following settings:

IOT & Cloud Convergence

A Small Medium Enterprise (SME) developing an energy management IoT product, targeting smart homes and smart buildings. By streaming the data of the product (e.g., sensors and WSN data) into the cloud it can accommodate its growth needs in a scalable and cost effective fashion. As the SMEs acquires more customers and performs more deployments of its product, it is able to collect and manage growing volumes of data in a scalable way, thus taking advantage of a "pay-as-you-grow" model. Moreover, cloud integration allows the SME to store and process massive datasets collected from multiple (rather than a single) deployments.

IOT & Cloud Convergence

A smart city can benefit from the cloud-based deployment of its IoT systems and applications. A city is likely to deploy many IoT applications, such as applications for smart energy management, smart water management, smart transport management, urban mobility of the citizens and more. These applications comprise multiple sensors and devices, along with computational components. Furthermore, they are likely to produce very large data volumes. Cloud integration enables the city to host these data and applications in a cost-effective way. Furthermore, the elasticity of the cloud can directly support expansions to these applications, but also the rapid deployment of new ones without major concerns about the provisioning of the required cloud computing resources.

IOT & Cloud Convergence

A cloud computing provider offering pubic cloud services can extend them to the IoT area, through enabling third-parties to access its infrastructure in order to integrate IoT data and/or computational components operating over IoT devices. The provider can offer IoT data access and services in a pay-as-you-fashion, through enabling third-parties to access resources of its infrastructure and accordingly to charge them in a utility-based fashion.

These motivating examples illustrate the merit and need for converging IoT and cloud computing infrastructure.

Benefits/Functions of IOT Cloud

- IoT Cloud Computing provides many connectivity options, implying large network access. People use a wide range of devices to gain access to cloud computing resources: mobile devices, tablets, laptops. This is convenient for users but creates the problem of the need for network access points.
- Developers can use IoT cloud computing on-demand. In other words, it is a web service accessed without special permission or any help. The only requirement is Internet access.
- Based on the request, users can scale the service according to their needs. Fast and flexible means you can expand storage space, edit software settings, and work with the number of users. Due to this characteristic, it is possible to provide deep computing power and storage.
- Cloud Computing implies the pooling of resources. It influences increased collaboration and builds close connections between users.

Benefits/Functions of IOT Cloud

- As the number of IoT devices and automation in use grows, security concerns emerge. Cloud solutions provide companies with reliable authentication and encryption protocols.
- Finally, IoT cloud computing is convenient because you get exactly as much from the service as you pay. This means that costs vary depending on use: the provider measures your usage statistics. A growing network of objects with IP addresses is needed to connect to the Internet and exchange data between the components of the network.

It is important to note that cloud architecture must be well-designed since reliability, security, economy, and performance optimization depends upon it. Using well-designed CI/CD pipelines, structured services, and sandboxed environments results in a secure environment and agile development.

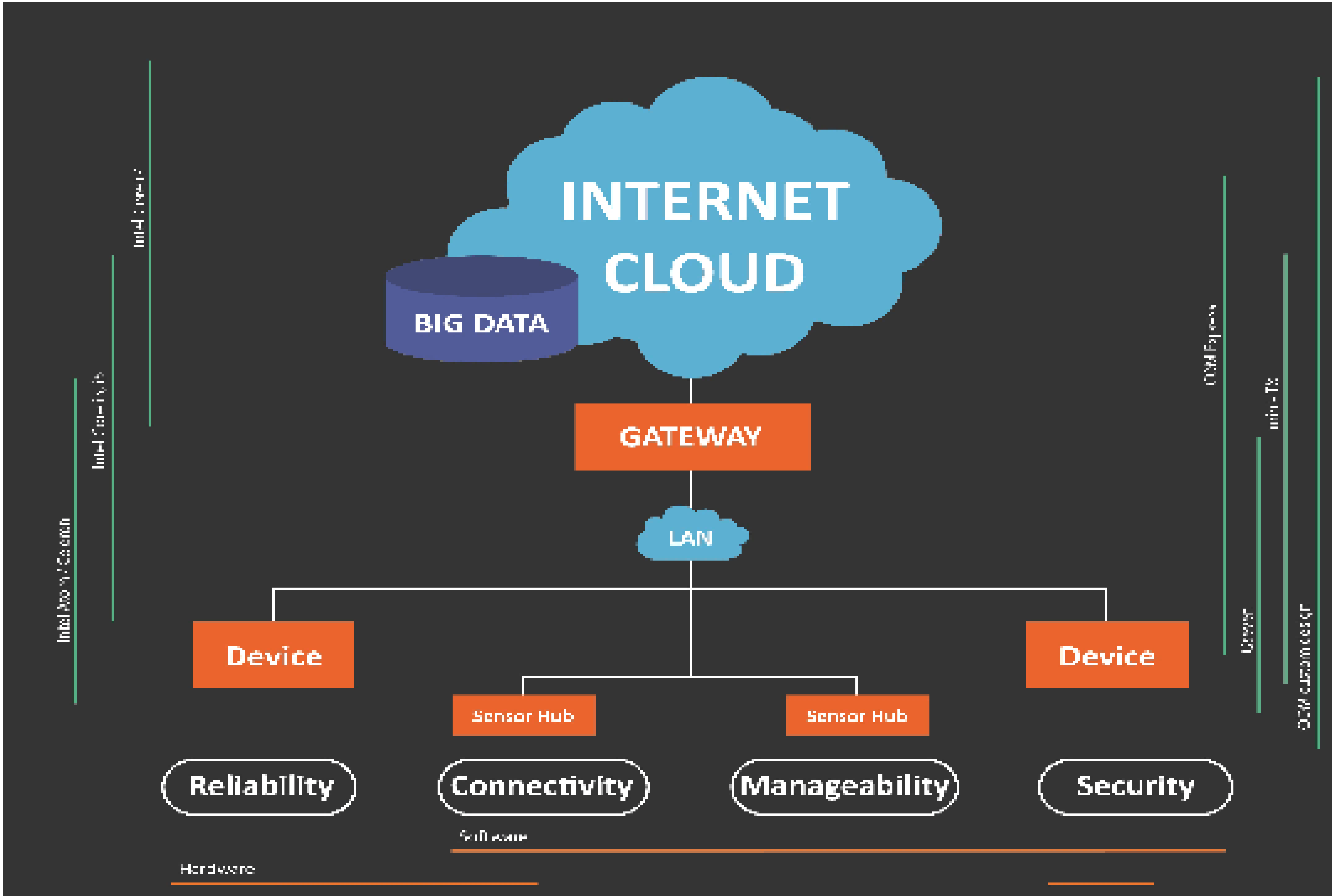
The Cloud and IOT in your Home

The Cloud and IOT in your Home

- The concept of **Home Automation** aims to bring the control of operating your every day home electrical appliances to the tip of your finger, thus giving user affordable lighting solutions, better energy conservation with optimum use of energy. Apart from just lighting solutions, the concept also further extends to have a overall control over your home security as well as build a centralized home entertainment system and much more. The Internet of Things (or commonly referred to as IoT) based Home Automation system, as the name suggests aims to control all the devices of your smart home through internet protocols or cloud based computing.

- The IoT based Home Automation system offer a lot of flexibility over the wired systems s it comes with various advantages like ease-of-use, ease-of-installation, avoid complexity of running through wires or loose electrical connections, easy fault detection and triggering and above and all it even offers easy mobility.

Home Automation Architecture for IOT & Cloud



The Cloud and IOT in your Home

Thus IoT based Home Automation system consist of a servers and sensors. These servers are remote servers located on Internet which help you to manage and process the data without the need of personalised computers. The internet based servers can be configured to control and monitor multiple sensors installed at the desired location.

The Cloud and IOT in your Home

Controller: The Brain of Your System

The main controller or the hub is the most essential part of your Home Automation system irrespective of whether you connect single or multiple sensors in your home. The main controller or the hub is also referred to as gateway and is connected to your home router through the Ethernet cable. All the IoT based sensors transmits or receive commands through the centralised hub. The hub in turn receives the input or communicates the output to cloud network located over the internet.

Due to this kind of architecture, it is possible to communicate with the centralised hub even from remote and distant locations through your smartphone. All you need is just a reliable internet connection at the hub location and the data package to your smartphone that helps you connect to the cloud network.

Most of the smart home controllers available in the market from several manufacturers cater to all three widely used protocols of wireless communication for Home Automation: ZigBee, Z-Wave and Wi-Fi.

The Cloud and IOT in your Home

Smart Devices: The Sensory Organs of Your Home

The IoT based home automation consist of several smart devices for different applications of lighting, security, home entertainment etc. All these devices are integrated over a common network established by gateway and connected in a mesh network. This means that it gives users the flexibility to operate one sensor based followed by the action of the other. For e.g. you can schedule to trigger the living room lights as soon as the door/windows sensor of your main door triggers after 7pm in the evening.

Thus all the sensors within a common network can perform cross-talk via the main controller unit. As shown in the figure, some of the smart sensors in home automation acts as sensor hubs. These are basically the signal repeaters of signal bouncers which that are located in the midway between the hub installation location and the sensors that are at a distant location. For such long distances, these sensor hubs play an important role to allow easy transmission of signals to sensors that are far away from the main controller but in closer proximity to the sensor hub. The commonly used sensor hubs in IoT based Home Automation system are Smart Plugs.

The Cloud and IOT in your Home

Connected with the Cloud: Access Everything on the Go

The Cloud-based-Networking system involves storage and maintenance of data over the Internet location. This gives users the flexibility to have access to the data from any location on the planet.

As a result of this, in IoT based Home Automation systems users over the cloud network can send commands to the hub even from a distant or remote location. The hub will further send the signal for the intended sensors to trigger and perform the user-requested action. Once the action is performed, the hub will update the status of the action taken to the cloud network and in this way users can control and monitor every aspect of their smart homes.

The Cloud and IOT in your Home

Events and Notifications: Get Notified Instantly

Real-time monitoring and notifications is one of the key features of IoT based Home Automation systems. Since **the hub is connected over the cloud network through the Internet,** you can schedule various events as per your routine activities or daily schedules. The cloud network can receive and store all the user inputs and transfer them to the hub as per the scheduled events.

Once the hub transfer the desired signals to the target sensor and the desired action takes places, it will quickly upload the new status over the cloud notifying user instantaneously. For e.g. the motion sensor will instantaneously notify the user wither through emails, SMS, calls or App notifications when it detects any unwanted motion or intrusion. After receiving such notification, the user can quickly turn on the IP based home security smart camera can check the status of your home even from remote location.

Examples of IOT at home

1. Smart Lighting –

Smart lighting for home helps in saving energy by adapting the life to the ambient condition and switching on/off or dimming the light when needed.

Smart lighting solutions for homes achieve energy saving by sensing the human movements and their environments and controlling the lights accordingly.

2. Smart Appliances –

Smart appliances with the management are here and also provide status information to the users remotely.

Smart washer/dryer can be controlled remotely and notify when the washing and drying are complete.

Smart refrigerators can keep track of the item store and send updates to the users when an item is low on stock.

Examples of IOT at home

Intrusion Detection –

- Home intrusion detection systems use security cameras and sensors to detect intrusion and raise alerts.
- Alert can we inform of an SMS or an email sent to the user.
- Advanced systems can even send detailed alerts such as an image shoot or short video clips.

Smoke/gas detectors –

- Smoke detectors are installed in homes and buildings to detect smoke that is typically an early sign of Fire.
- It uses optical detection, ionization for Air sampling techniques to detect smoke.
- Gas detectors can detect the presence of harmful gases such as CO, LPG, etc.
- It can raise alerts in the human voice describing where the problem is.

IOT & Cloud in your Automobile

Internet of Things (IoT) has crucial applications in the transportation system. IoT plays an important role in all the field of transportation as air-transportation, water-transportation, and land transportation. All the component of these transportation fields is built with smart devices (sensors, processors) and interconnected through cloud server or different servers that transmit data to networks.

IOT & Cloud in your Automobile

Connected to every means of travel

IoT in transportation is not only for traveling from one place to another, but it also makes safer, greener and more convenient. For example, a smart car performs work simultaneously such as navigation, communication, entertainment, efficient, more reliable travel. IoT facilitates travelers to remain seamlessly connected to every means of travel. The vehicle is connected with the variety of wireless standards to the internet such as Bluetooth, Wi-Fi, 3G, 4G, intelligent traffic system, and even to other vehicles.

IOT & Cloud in your Automobile

Traffic Monitoring and Avoid Collision

Sensors built inside or outside a vehicle suggest lane departure and continuously monitor object at all side to avoid the collision. IoT component of transportation does not only mean within the vehicle, but it extends beyond car to communicate other, enabling automate real-time decision to optimize travel. For example, traffic monitoring camera identifies the accident or traffic conjunction and send an alert message to the nearest traffic control room and send current traffic conjunction information to other near vehicles to divert their route.

IoT also helps in tracking vehicle current location and distance travel.

AUTONOMOUS VEHICLES

It is important to say that the future of the automotive industry belongs to autonomous vehicles.

Such vehicles guarantee safety on the roads and bring a new level of the users' comfort. The combination of such IoT devices like cameras, sensors, radars, Inertial Measurement Units (IMU), etc. gives a lot of possibilities for further development of the Internet of Things for vehicles.

The development of autonomous vehicles (AV) with IoT implementation will positively impact the environment. For example, Tesla has already announced their new service called Robotaxi. It will let every Tesla owner add via the app their car to the Robotaxi's service and point out particular hours for sharing his/her car with other people. In this way, the amount of cars and air pollution will be reduced, and it is also a chance for car owners to defray their maintenance expenses.

IOT in Healthcare

IoT technology brings numerous applications in healthcare, from remote monitoring to smart sensors to medical device integration. It keeps the patients safe and healthy as well as improves the physician delivers care towards the patients.

Healthcare devices collect diverse data from a large set of real-world cases that increases the accuracy and the size of medical data.

Factor affecting IoT Healthcare Application

There are various factors that affect the IoT healthcare application. Some of them are mention below:

1. **Continuous Research:** It requires continuous research in every field (smart devices, fast communication channel, etc.) of healthcare to provide a fast and better facility for patients.

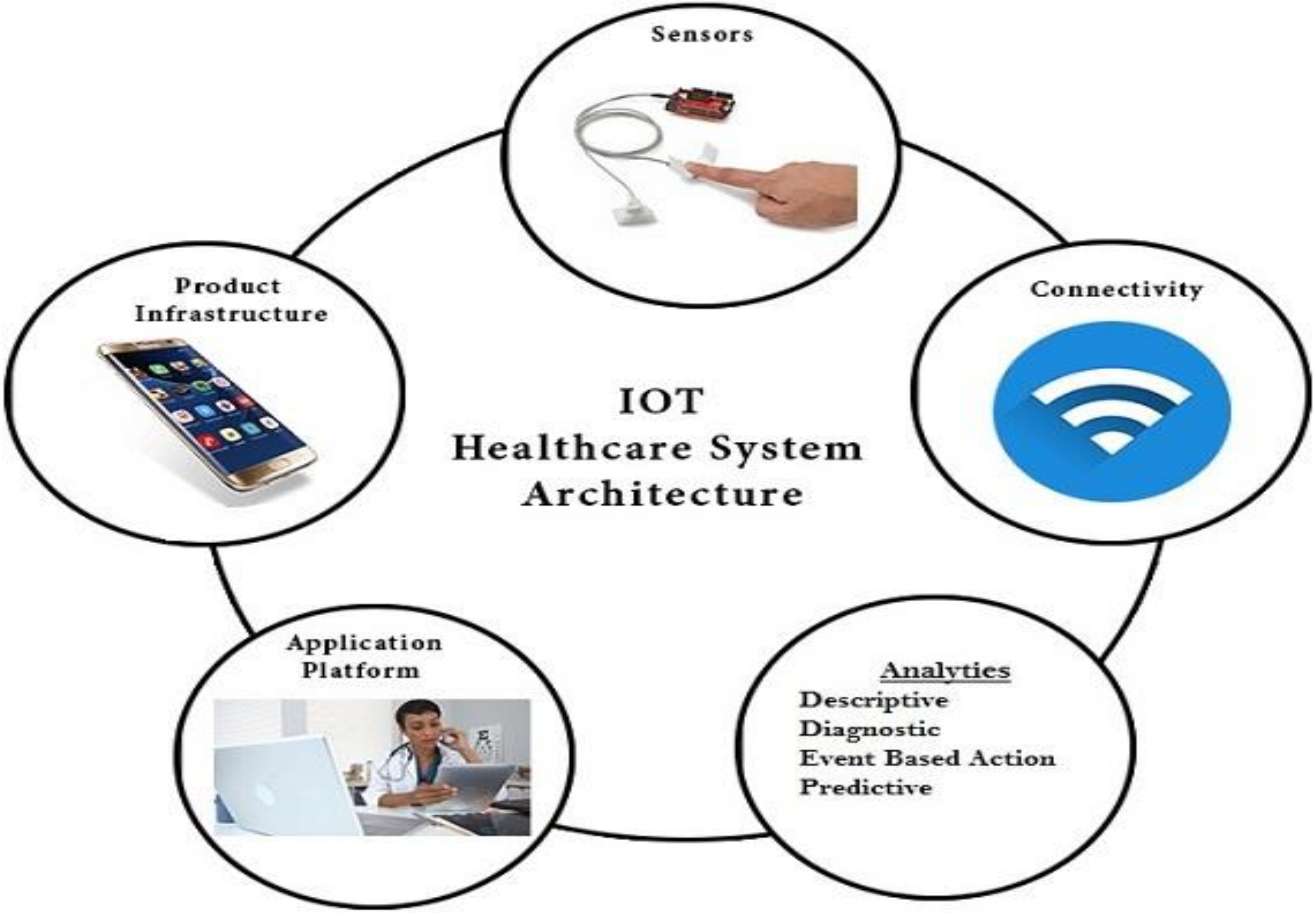
2. **Smart Devices:** Need to use the smart device in the healthcare system. IoT opens the potential of current technology and leads us toward new and better medical device solutions.

3. **Better Care:** Using IoT technology, healthcare professionals get the enormous data of the patient, analysis the data and facilitate better care to the patient.

4. **Medical Information Distribution**: IoT technology makes a transparency of information and distributes the accurate and current information to patients. This leads the fewer accidents from miscommunication, better preventive care, and improved patient satisfaction.

Simple Healthcare System Architecture

The application of the Internet of Things (IoT) in healthcare transforms it into more smart, fast and more accurate. There is different IoT architecture in healthcare that brings start health care system.



Simple Healthcare System Architecture

Product Infrastructure: IoT product infrastructure such as hardware/software component read the sensors signals and display them to a dedicated device.

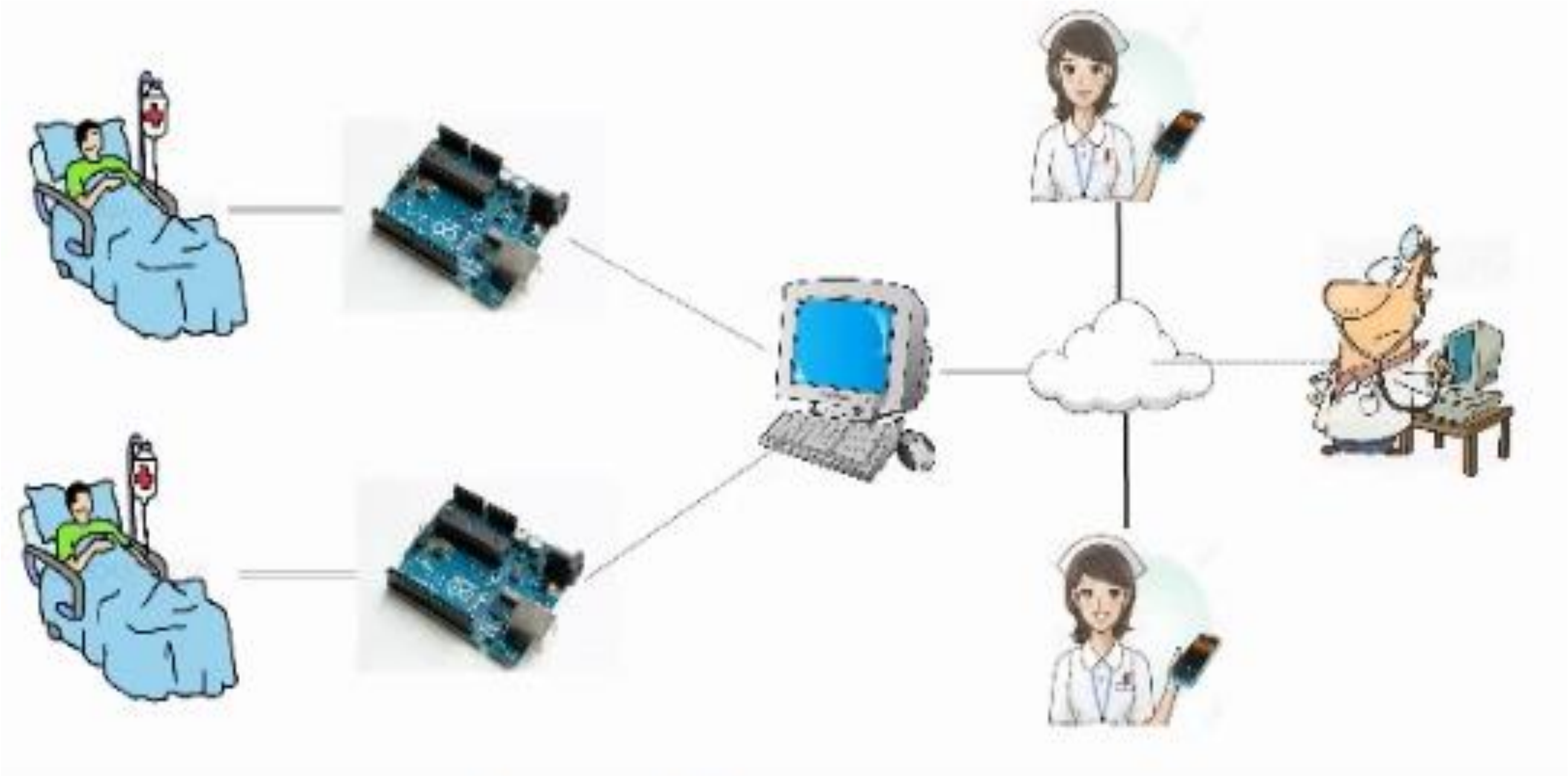
Sensors: IoT in healthcare has different sensors devices such as pulse-oximeter, electrocardiogram, thermometer, fluid level sensor, sphygmomanometer (blood pressure) that read the current patient situation (data).

Connectivity: IoT system provides better connectivity (using Bluetooth, WiFi, etc.) of devices or sensors from microcontroller to server and vice-versa to read data.

Analytics: Healthcare system analyzes the data from sensors and correlates to get healthy parameters of the patient and on the basis of their analyze data they can upgrade the patient health.

Simple Healthcare System Architecture

Application Platform: IoT system access information to healthcare professionals on their monitor device for all patients with all details.



IoT in Healthcare - a concept

IoT challenges in Healthcare

1. Data security & privacy
2. Integration: multiple devices & protocols
3. Data overload & accuracy
4. Cost

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THANK YOU!!!

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