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, in which servers download user's operating system applications and environment settings to any computer user logs in to.

- 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-based location-tracking applications

- A location-tracking application utilizes data from Global Positioning System (GPS) capabilities built into mobile devices to integrate individuals' location into processing it performs. As GPS capabilities are built into more devices, applications will begin to deliver more location – tracking solutions.

- Using cloud and location-tracking solutions, you will be able to track not only packages you ship, but also stolen cars, lost luggage, misplaced cell phones, missing pets, and more.

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

- 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

- Few companies are changing way consumers watch TV. With greater bandwidth available everywhere, DVD's have fallen by wayside.

- TV viewers will not just watch shows on-demand in their homes, in their cars, and on airplanes but also new breed of projection devices will make any flat surface TV screen.

Cloud Based Smart Devices

- Cloud's ability to provide internet access and at any time makes such processing reality. Some devices may initially be intelligent with reference to their ability to regulate power consumption, possibly avoiding power use during peak times and costs.

- Using the cloud for communication, devices can coordinate activities. For example, your car may notify your home automation system that you are down blocking and instruct it to light house, turn on your favorite music and prompt refrigerator for list of ready to cook meals.

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 suc 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 form of high performance computing that distributes computational work across cluster, grid and cloud computing

- Jungle Disk **Encrypted** Cloud Backup - With Encrypted Cloud Backup, Jungle Disk Workgroup for laptops, desktops, & mobile provides automatic backups to keep your data safe and allows teams to securely collaborate using encrypted online disks.

Multimedia Cloud

- After processing the processed data can be easily received from the cloud through a client without any need of installing complex hardware.

- Thus Multimedia cloud computing is the processing, accessing and storing of multimedia contents like audio, video and image using the services and applications available in the cloud without physically acquiring them

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

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.
- 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.

Mobile Cloud Computing (MCC)

- *Mobile cloud computing (MCC)* at its simplest, refers to an infrastructure where both the data storage and data processing happen outside of the mobile device.

- Mobile cloud applications move the computing power and data storage away from the mobile devices and into powerful and centralized computing platforms located in clouds, which are then accessed over the wireless connection based on a thin native client.

Mobile Cloud Computing (MCC)

- Mobile devices face many resource challenges (battery life, storage, bandwidth etc.)

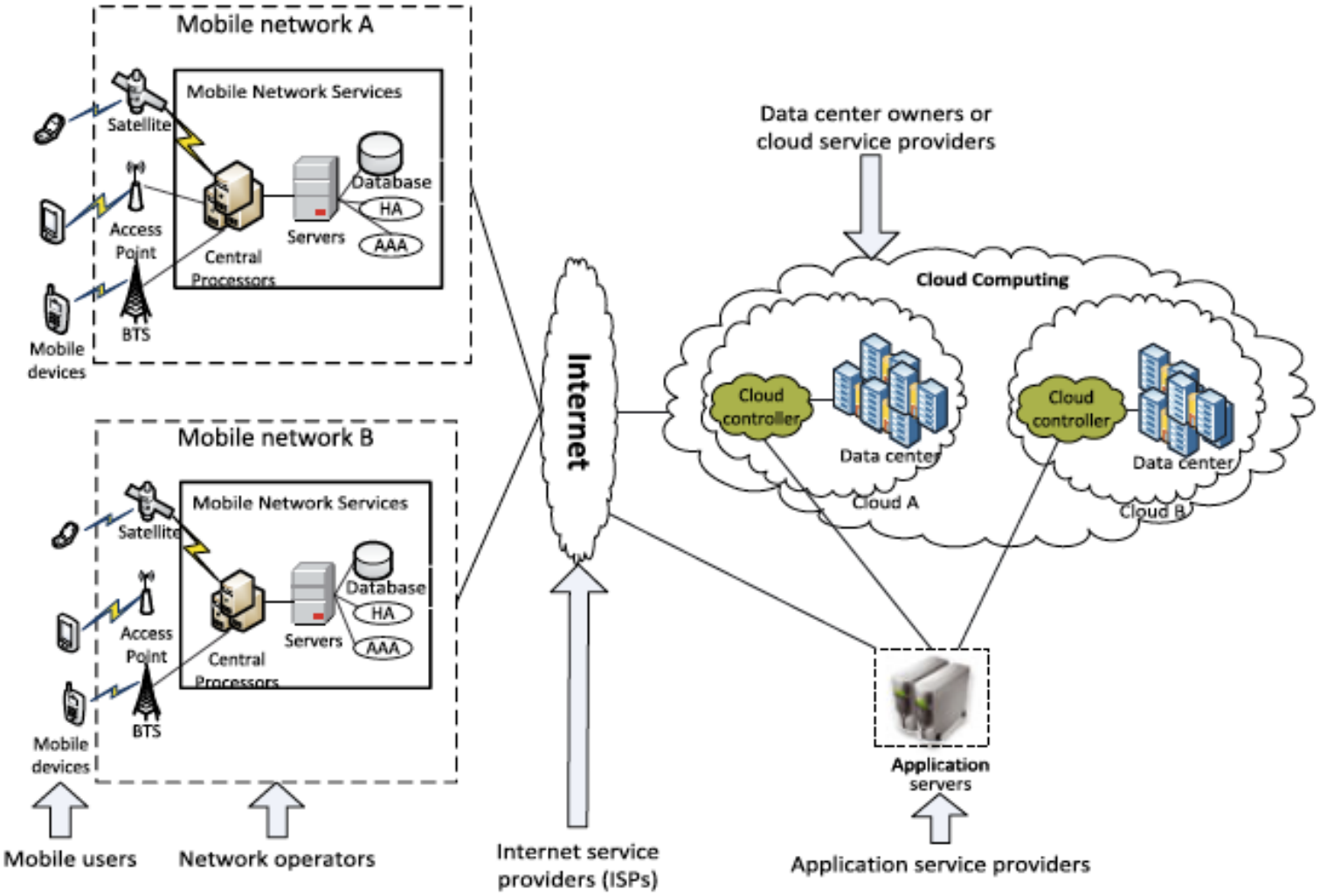
- Cloud computing offers advantages to users by allowing them to use infrastructure, platforms and software by cloud providers at low cost and elastically in an on-demand fashion.

- Mobile cloud computing provides mobile users with data storage and processing services in clouds, obviating the need to have a powerful device configuration (e.g. CPU speed, memory capacity etc), as all resource-intensive computing can be performed in the cloud.

Mobile Cloud Computing (MCC)

- According to a recent study by ABI Research, more than 240 million business will use cloud services through mobile devices by 2015.
- That traction will push the revenue of mobile cloud computing to $5.2 billion.
- Mobile cloud computing is a highly promising trend for the future of mobile computing.

MCC Architecture



Mobile Cloud Computing (MCC)

- Mobile devices are connected to the mobile networks via base stations that establish and control the connections and functional interfaces between the networks and mobile devices.

- Mobile users' requests and information are transmitted to the central processors that are connected to servers providing mobile network services.

- The subscribers' requests are delivered to a cloud through the Internet. In the cloud, cloud controllers process the requests to provide mobile users with the corresponding cloud services.

Advantages of MCC

- Extending battery lifetime:
  - Computation offloading migrates large computations and complex processing from resource-limited devices (i.e., mobile devices) to resourceful machines (i.e., servers in clouds).
  - Remote application execution can save energy significantly.
  - Many mobile applications take advantages from task migration and remote processing.

Advantages of MCC

- Improving data storage capacity and processing power:
  - MCC enables mobile users to store/access large data on the cloud.
  - MCC helps reduce the running cost for computation intensive applications.
  - Mobile applications are not constrained by storage capacity on the devices because their data now is stored on the cloud.

Advantages of MCC

- Improving reliability and availability:
  - Keeping data and application in the clouds reduces the chance of lost on the mobile devices.
  - MCC can be designed as a comprehensive data security model for both service providers and users:
    - Protect copyrighted digital contents in clouds.
    - Provide security services such as virus scanning, malicious code detection, authentication for mobile users.
  - With data and services in the clouds, then are always(almost) available even when the users are moving.

Advantages of MCC

- Dynamic provisioning:
  - Dynamic on-demand provisioning of resources on a fine-grained, self-service basis
  - No need for advanced reservation

- Scalability:
  - Mobile applications can be performed and scaled to meet the unpredictable user demands
  - Service providers can easily add and expand a service

Advantages of MCC

- Multi-tenancy:
  - Service providers can share the resources and costs to support a variety of applications and large no. of users.

- Ease of Integration:
  - Multiple services from different providers can be integrated easily through the cloud and the Internet to meet the users' demands.

MCC Applications

- Mobile Commerce:
  - M-commerce allows business models for commerce using mobile devices.
  - Examples: Mobile financial, mobile advertising, mobile shopping…
  - M-commerce applications face various challenges (low bandwidth, high complexity of devices, security, …)
  - Integrated with cloud can help address these issues
  - Example: Combining 3G and cloud to increase data processing speed and security level.

MCC Applications

- Mobile Learning:
  - M-learning combines e-learning and mobility
  - Traditional m-learning has limitations on high cost of devices/network, low transmission rate, limited educational resources
  - Cloud-based m-learning can solve these limitations
  - Enhanced communication quality between students and teachers
  - Help learners access remote learning resources
  - A natural environment for collaborative learning

MCC Applications

- Mobile Healthcare:
  - M-healthcare is to minimize the limitations of traditional medical treatment (eg. Small storage, security/privacy, medical errors, …)
  - M-healthcare provides mobile users with convenient access to resources(eg. medical records)
  - M-healthcare offers hospitals and healthcare organizations a variety of on-demand services on clouds
  - Examples:
    - Comprehensive health monitoring services
    - Intelligent emergency management system
    - Health-aware mobile devices (detect pulse-rate, blood pressure, level of alcohol etc)
    - Pervasive access to healthcare information
    - Pervasive lifestyle incentive management (to manage healthcare expenses)

MCC Applications

- Mobile Gaming:
  - M-game is a high potential market generating revenues for service providers.
  - Can completely offload game engine requiring large computing resource (e.g., graphic rendering) to the server in the cloud.
  - Offloading can also save energy and increase game playing time (eg. MAUI allows fine-grained energy-aware offloading of mobile codes to a cloud)
  - Rendering adaptation technique can dynamically adjust the game rendering parameters based on communication constraints and gamers' demands

MCC Applications

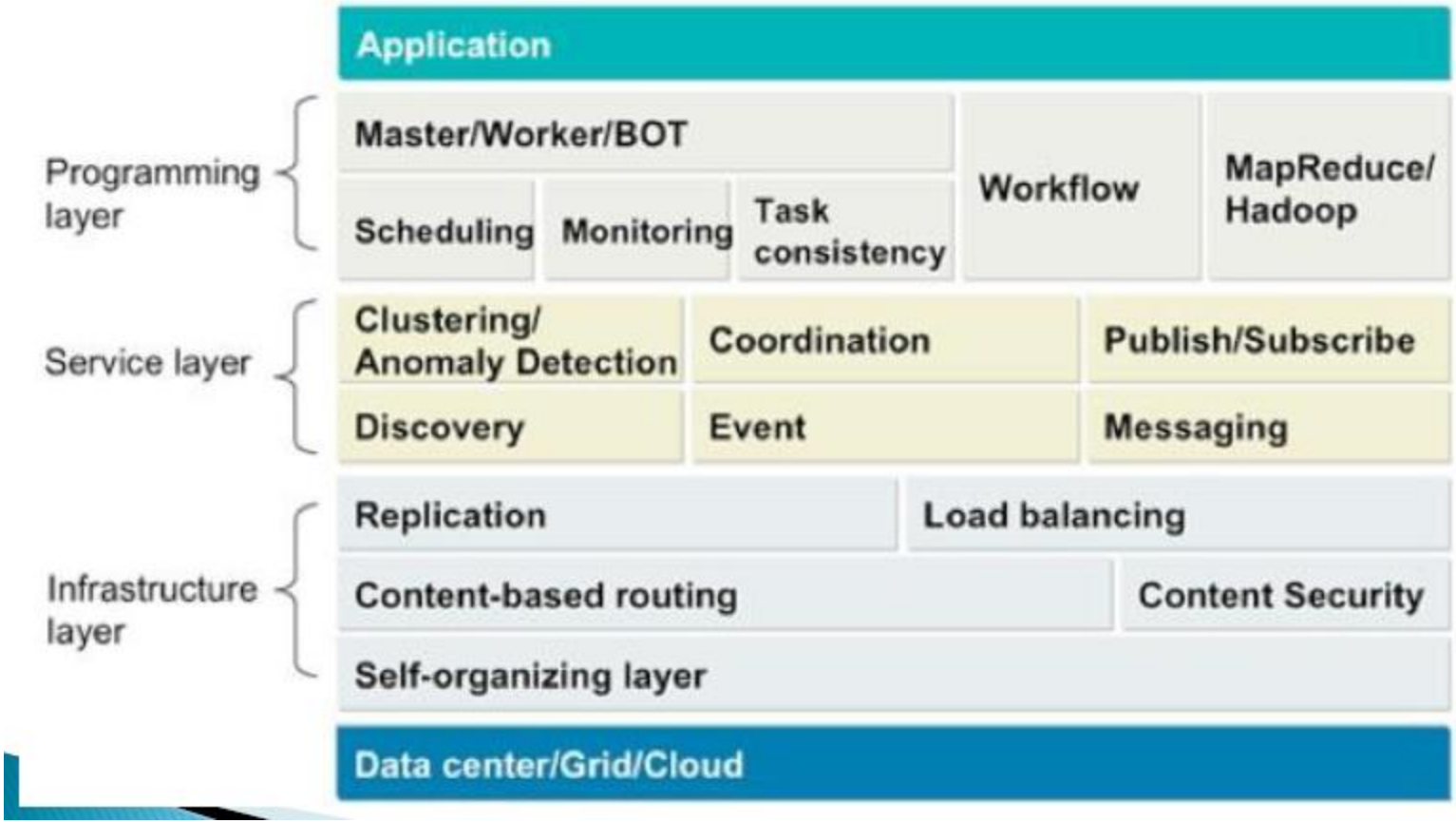
- Assistive technologies:
  - Pedestrian crossing guide for blind and visually-impaired
  - Mobile currency reader for blind and visually impaired
  - Lecture transcription for hearing impaired students

- Other applications:
  - Sharing photos/videos
  - Keyword-based, voice-based, tag-based searching
  - Monitoring a house, smart home systems
  - …

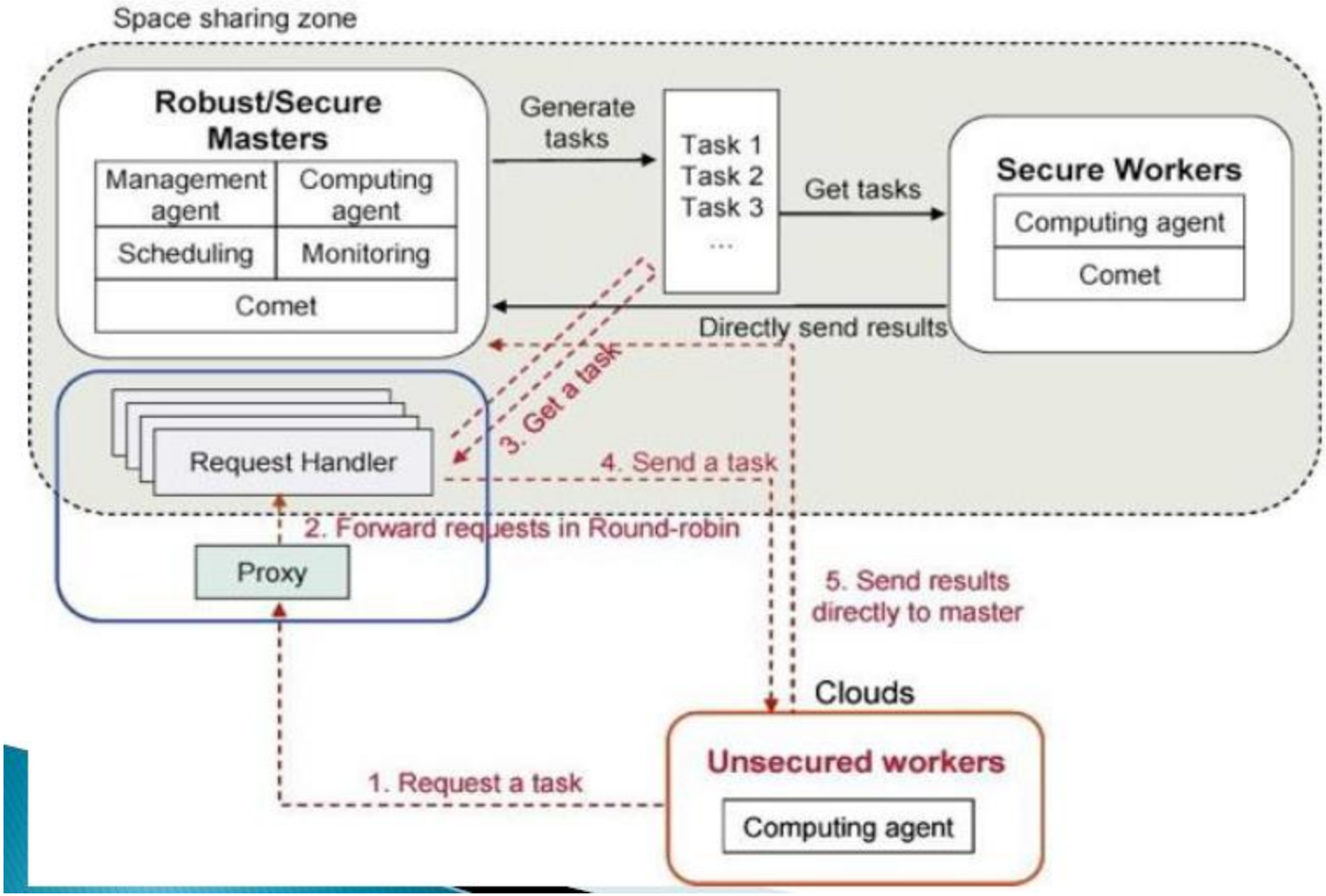
CometCloud

- Integrates of public and private cloud
- Is a PaaS
- to enable on-demand scale-up, scale-down and scale-out
- Cloudbursting
- Cloudbridging

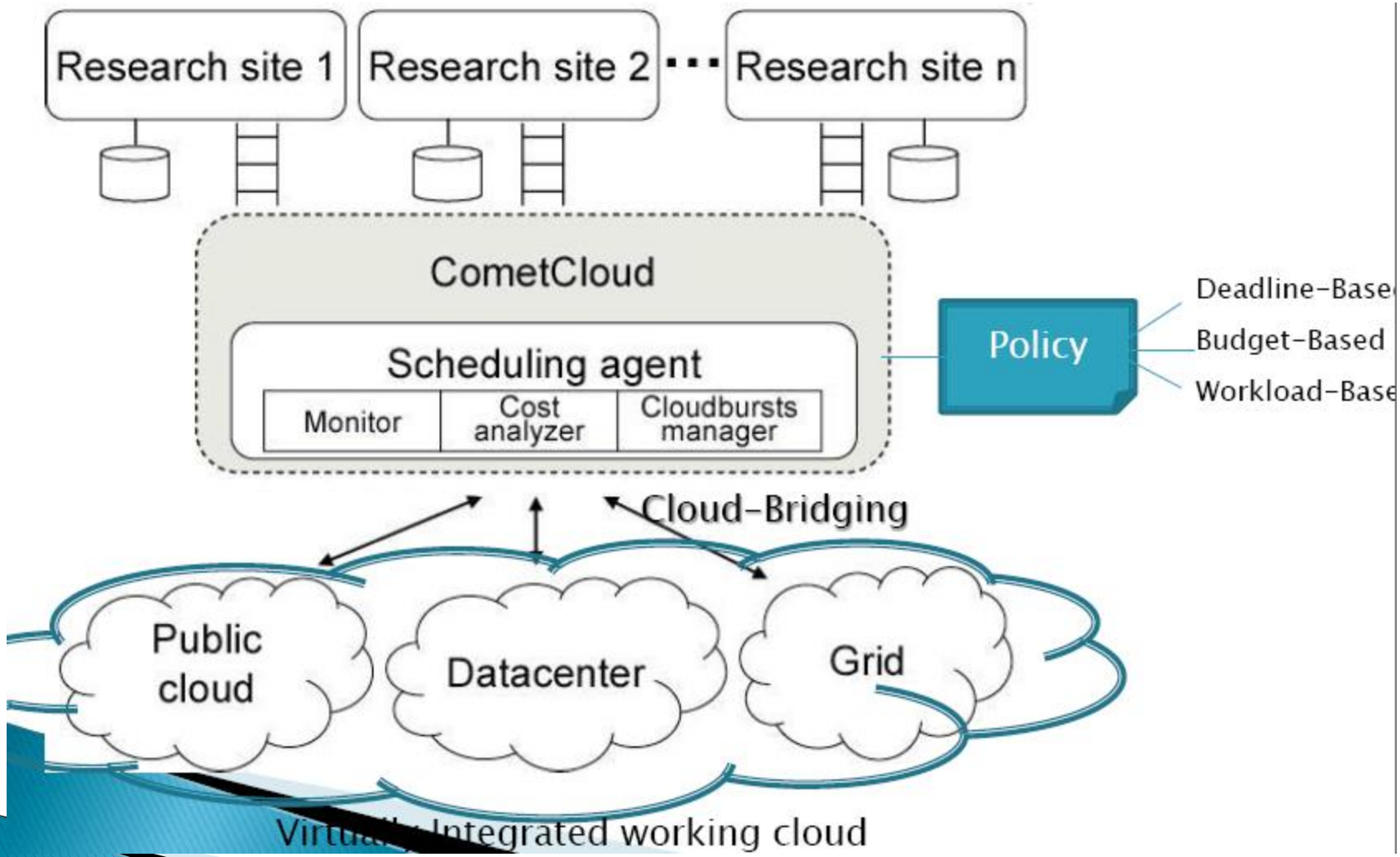
CometCloud


Application
Programming layer
Master/Worker/BOT
Scheduling
Monitoring
Task consistency
Workflow
MapReduce/ Hadoop
Service layer
Clustering/ Anomaly Detection
Coordination
Publish/Subscribe
Discovery
Event
Messaging
Infrastructure layer
Replication
Load balancing
Content-based routing
Content Security
Self-organizing layer
Data center/Grid/Cloud

Automatic Cloud bursting



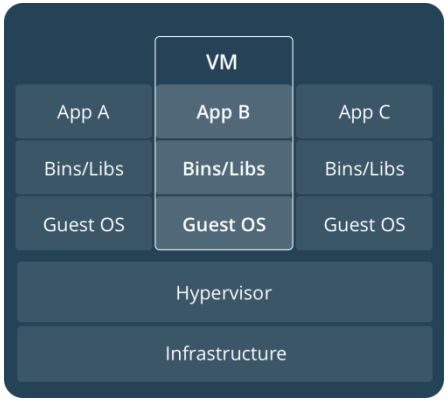
Automatic Cloudbridging

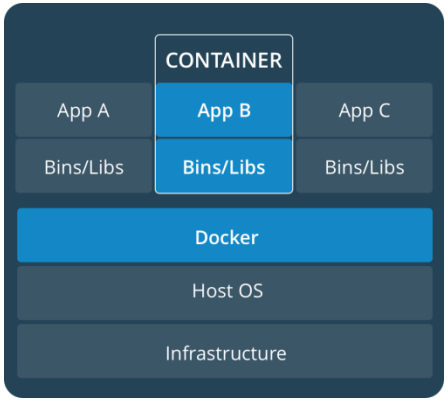


Docker & Container

- Docker is a software platform that allows you to build, test, and deploy applications quickly, packaging software into standardized units called **containers**.

- What is container :
  - Container ≠ VM
  - Isolated
  - Share OS
  - and sometimes bins/libs





Docker

- 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

- 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.

Advantages of Docker

- **Fast, consistent delivery of your applications**
- **Responsive deployment and scaling**
- **Running more workloads on the same hardware**

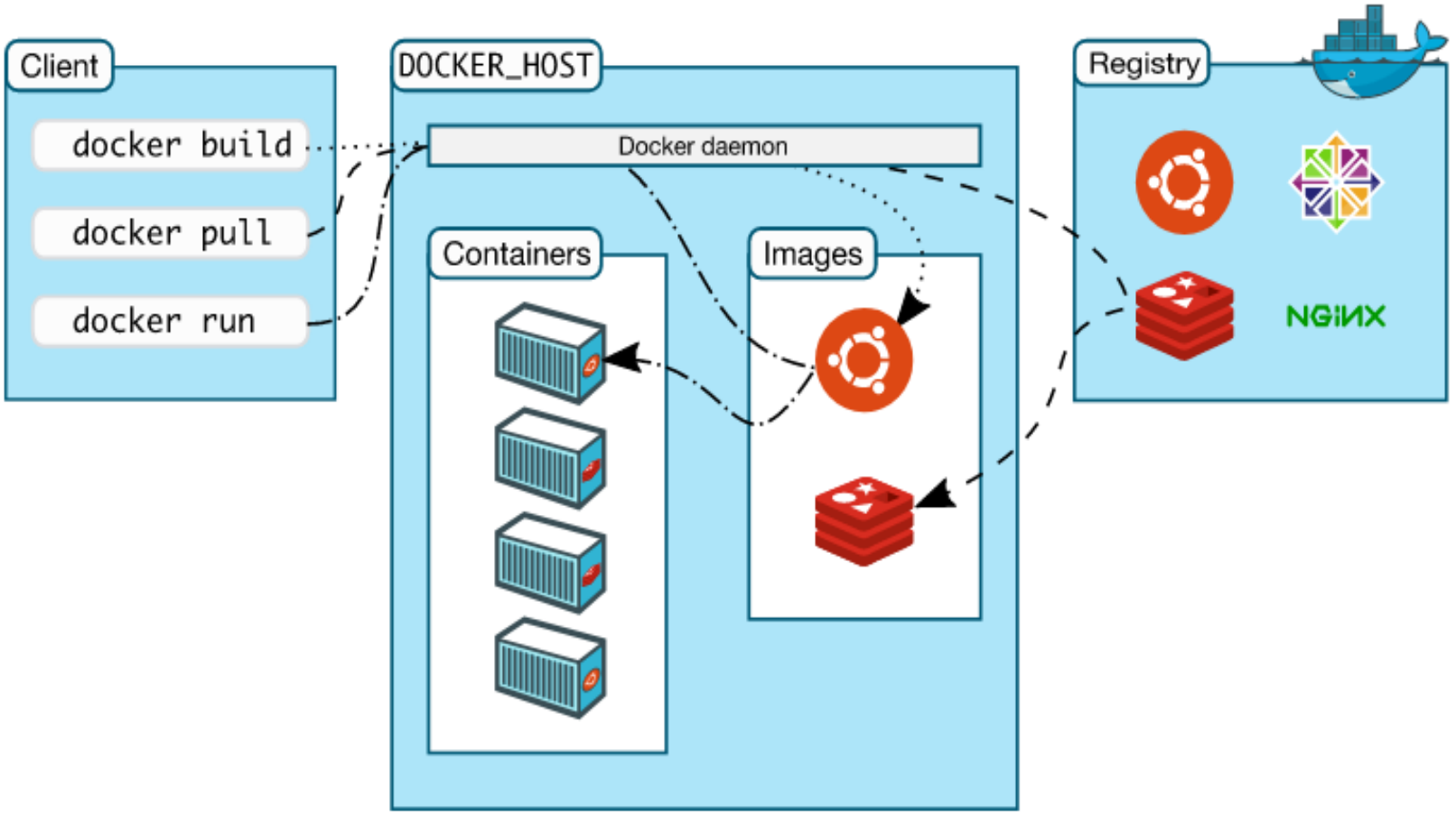
Docker Architecture

- 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

- The Docker daemon
- The Docker client
- Docker Desktop
- Docker registries
- Docker objects

Docker Architecture

- **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.

- **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.

Docker Architecture

- **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

- **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.

- **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.

Docker Images

- An *image* is a read-only template with instructions for creating a Docker container. Often, an image is *based on* another image, with some additional customization.

- For example, you may build an image which is based on the ubuntu image, but installs the Apache web server and your application, as well as the configuration details needed to make your application run.

Docker Images

- You might create your own images or you might only use those created by others and published in a registry. To build your own image, you create a *Dockerfile* with a simple syntax for defining the steps needed to create the image and run it.

- Each instruction in a Dockerfile creates a layer in the image. When you change the Dockerfile and rebuild the image, only those layers which have changed are rebuilt. This is part of what makes images so lightweight, small, and fast, when compared to other virtualization technologies.

Containers

- A container is a runnable instance of an image. You can create, start, stop, move, or delete a container using the Docker API or CLI.

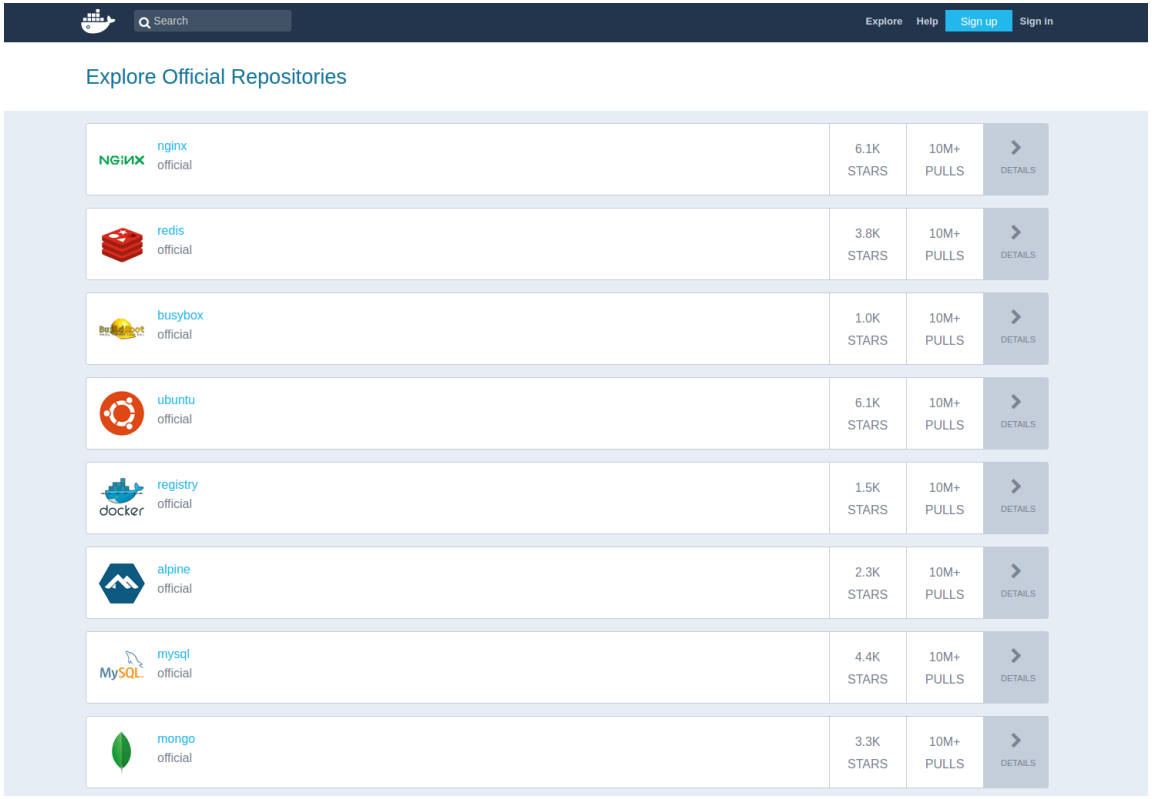
- You can connect a container to one or more networks, attach storage to it, or even create a new image based on its current state.

Containers

- By default, a container is relatively well isolated from other containers and its host machine. You can control how isolated a container's network, storage, or other underlying subsystems are from other containers or from the host machine.

- A container is defined by its image as well as any configuration options you provide to it when you create or start it. When a container is removed, any changes to its state that are not stored in persistent storage disappear.

Docker Images



E-Resources

- 1. Thomas Erl, ZaighamMahmood and Ricardo Puttini, Cloud Computing: Concepts, Technology & Architecture, Pearson, ISBN :978 9332535923, 9332535922, 1 st Edition

- 2. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, 2010, The McGraw-Hill.

THANK YOU!