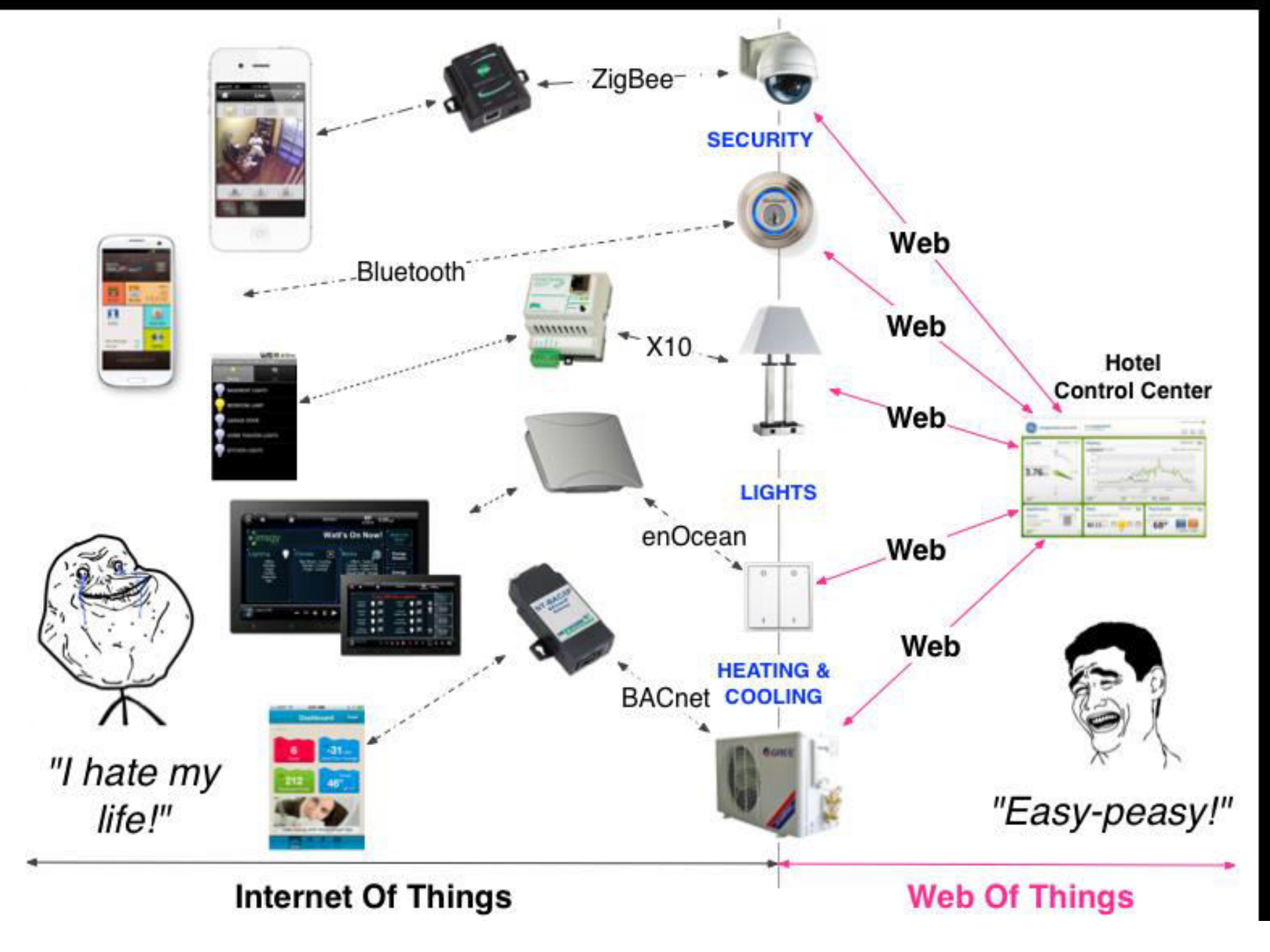
Web of Things and Cloud of Things

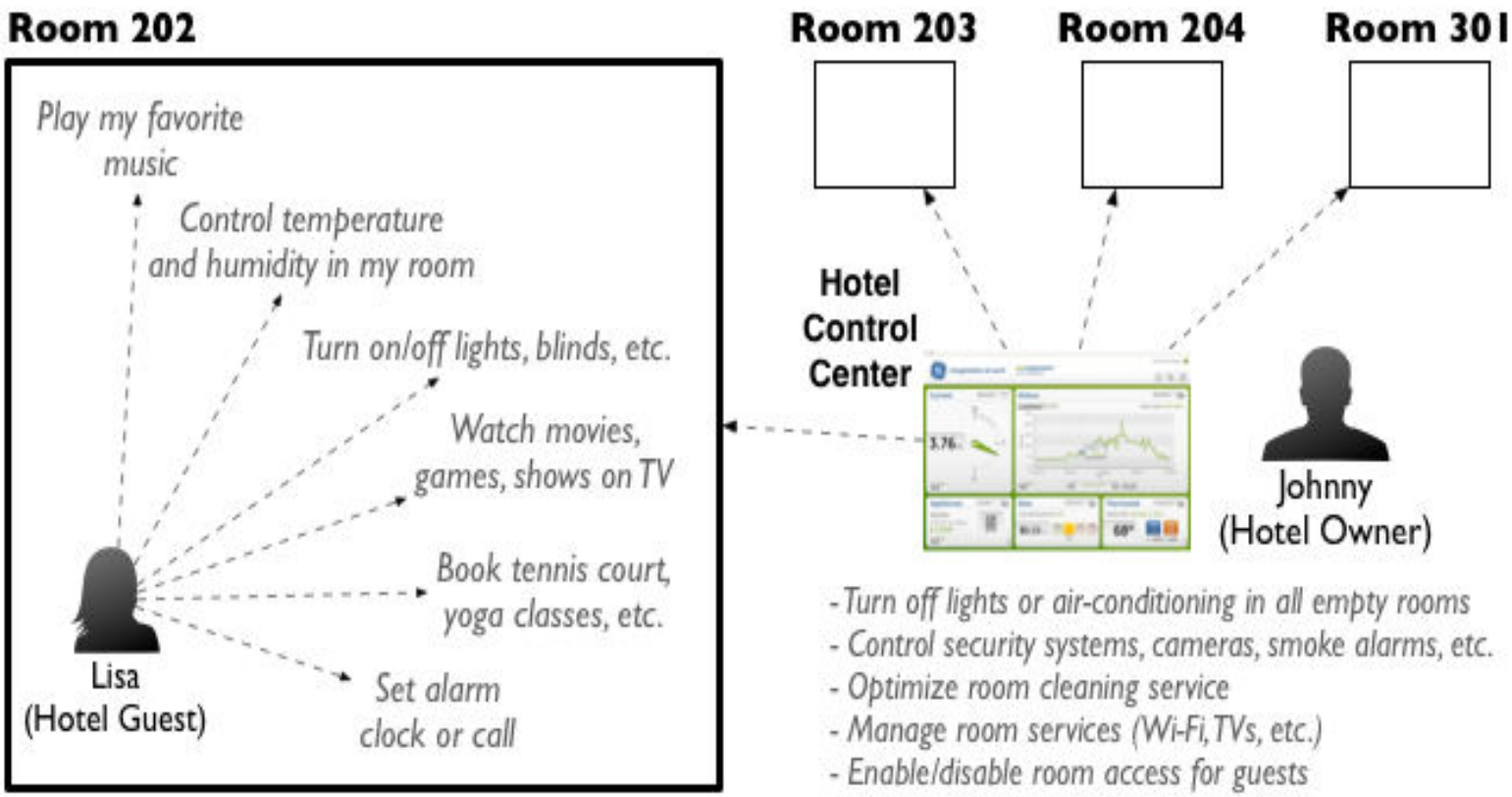
Mrs. K.M. Sanghavi

Contents

- WoT
- WoT Vs IoT
- Architecture Standardization of WoT
  - Platform Middleware for WoT
- Unified Multitier WoT Architecture
- WoT Portals and Business Intelligence
- Cloud Of Things
  - Grid/SOA and Cloud computing
- Cloud MiddleWare
- Cloud Standards
- Cloud Providers
- Mobile Cloud Computing
- Cloud of Things Architecture


ZigBee
SECURITY
Web
Bluetooth
Web
X10
Hotel
Control Center
Web
LIGHTS
enOcean
Web
Web
HEATING &
COOLING
BACnet
"I hate my life!"
"Easy-peasy!"
Internet Of Things
Web Of Things

WoT



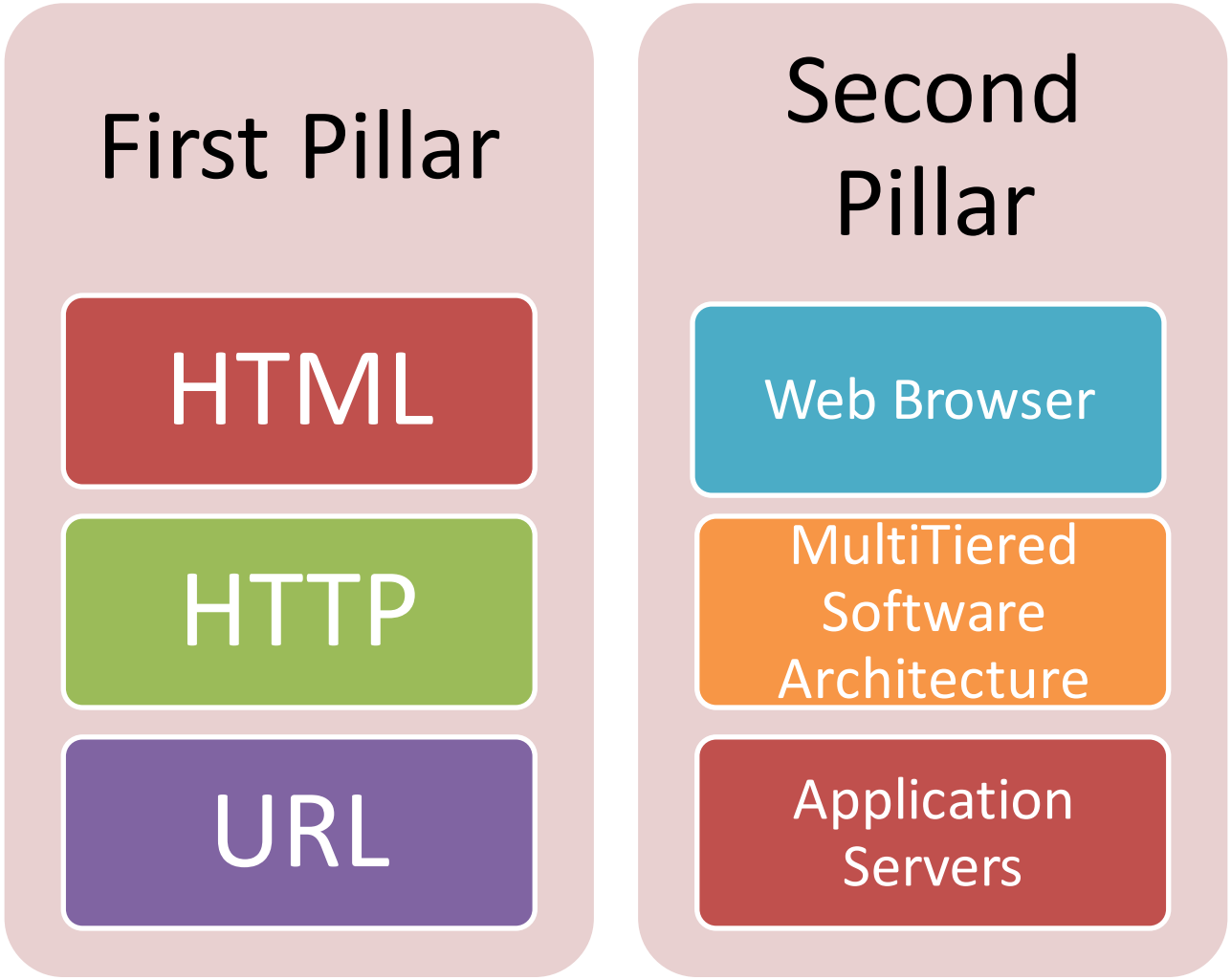
WoT Vs IoT

IoT	WoT
Aggregation of already available technologies i.e It Basically controlling different devices by establishing connection and communicating from mobile app or web browser".	Approaches, software architectural styles and programming patterns that **allow real-world objects to be part of the World Wide Web.**
IoT is about **creating a network of objects, things , people, system** and applications	WoT tries to **integrate objects, things or people and systems to Web.**
The scope of IoT applications is broader and includes systems that not accessible through the web (e.g. conventional WSN and RFID system)	Scope of WoT Applications is limited to Web Only.
Approach to building WoT is based on RESTful principles and REST APIs or even WebSocket, SOAP, COAP	Approach to building WoT is based on RESTful principles and REST APIs

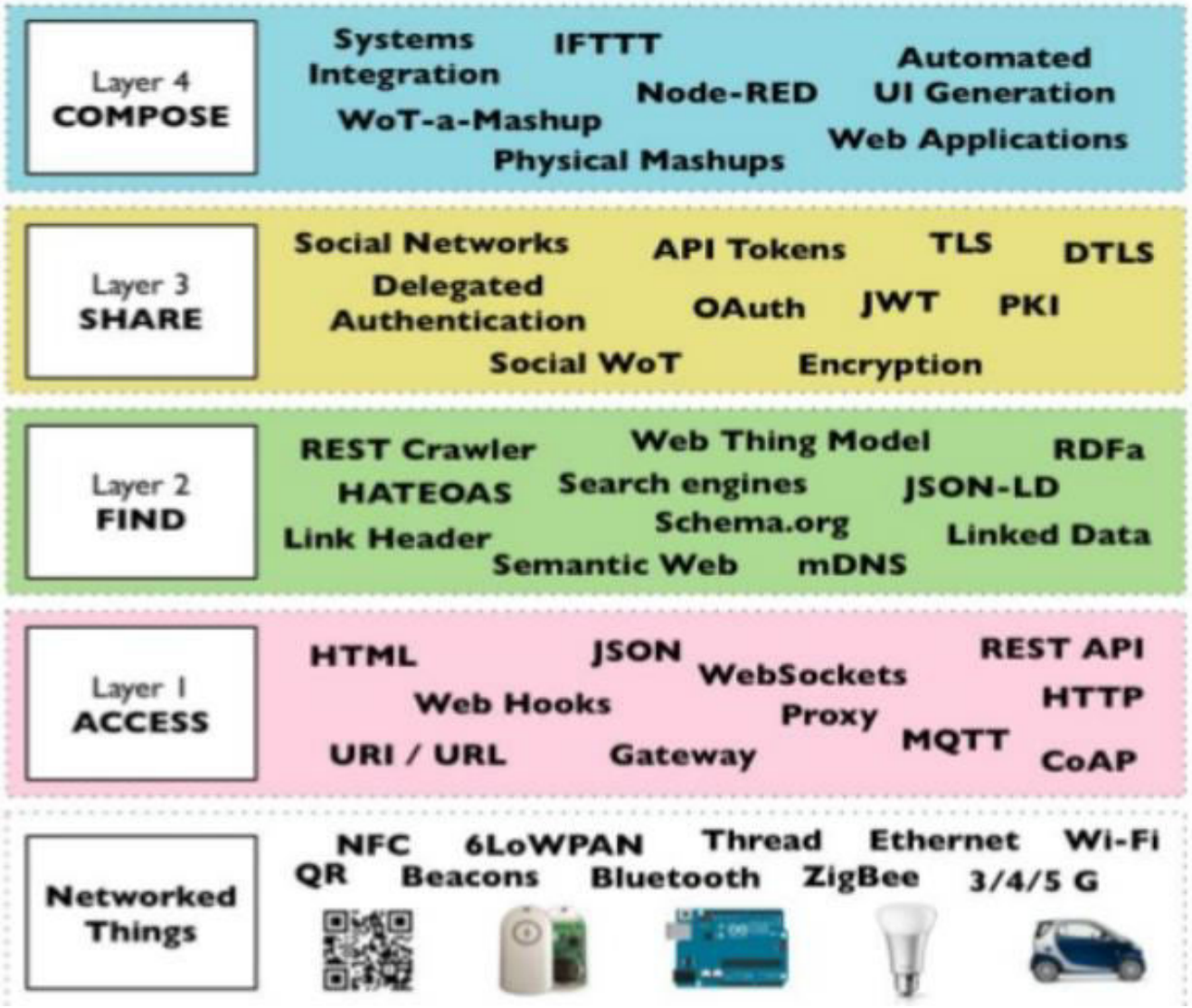
WoT Applications

- Japan Geiger Map … Visualizes Radiation Map of Japan
- National Weather Study Project… Mini Weather Stations in schools of Singapore
- Nanode … Arduino with Inbuilt Web connectivity
- AgSphere….Connecting agricultural products to Web

Two Pillars of Web



WoT Architecture



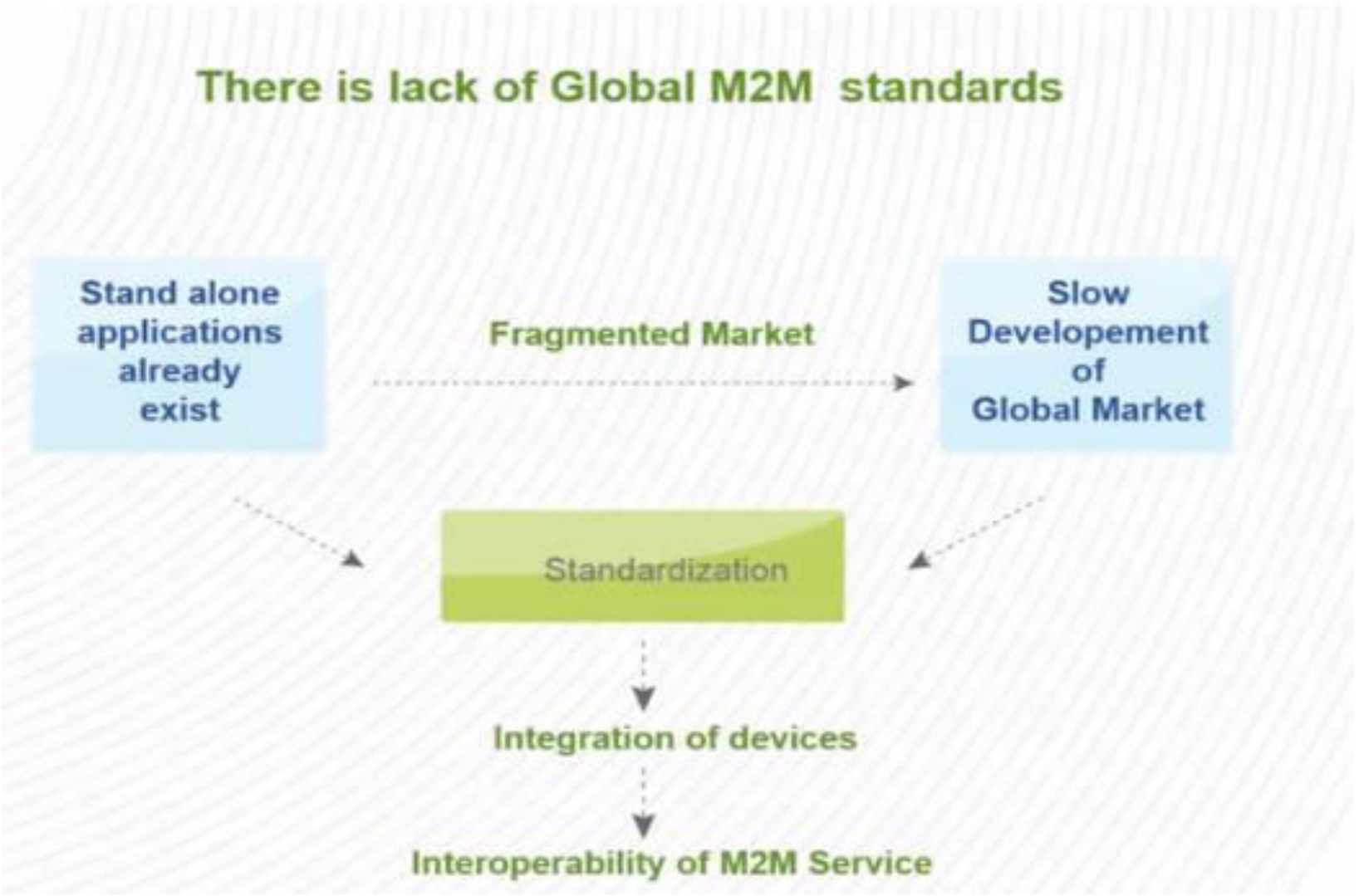
WoT Pillars

- First Pillar focuses on Describing Service, how to locate , and how to transfer
  - HTML…Creates Resource
  - HTTP….Defines the format to transmit messages
  - URL…. Locates Resources
- Second Pillar focuses on Way to access resource, how to design web application and how to run them.
  - Web Browsers… Way to access resource using URL
  - Multitiered Architecture…. how to design web application
  - Application Servers…. How to run web applications i.e database connectivity

Platform Middleware of WoT

- Platform Middleware is also known as **Application framework** Or **Three tiered Application Server**
- Provides Natural fits for mapping the IoT objects to software objects.

Platform Middelware of WoT



Platform Middelware of WoT..M2M

- European Telecommunications Standards Institute (ETSI) is working for M2M Standards
- Resolves
  - N/w Routing
  - Synchronous Communication
  - Subscribe Model
  - Uniform data storage model
  - Language Independent

M2M Middleware Standards .. Key Elements

- M2M Device
- M2M Area Network
- M2M Gateway
- M2M Communication Network
- M2M Application Server

Platform Middelware of WoT..WSN

- The Open Geospatial Consortium, Sensor Web Enablement (OGC SWE) is working for WSN Standardization.
- The goal of SWE is **creation of web- based sensor networks to make all sensors and repositories of sensor data discoverable, accessible, and where applicable, controllable via the World Wide Web**

Platform Middelware of WoT..WSN

- Enables
  - Discovery of sensors, processes, and observations
  - Tasking of sensors or models
  - Access to observations and observation streams
  - Publish–subscribe capabilities for alerts
  - Robust sensor system and process descriptions

Platform Middelware of WoT..WSN

- The following web service specifications have been produced by the OGC SWE Working Group
  - **Sensor observation service**—standard web interface for accessing observations
  - **Sensor planning service**—standard web interface for tasking sensor systems and model and requesting acquisitions
  - **Sensor alert service**—standard web interface for publishing and subscribing to sensor alerts
  - **Web notification service**—standard web interface for asynchronous notification

Platform Middelware of WoT..WSN

- The USN (Ubiquitous Sensor Networks) standardization is working for WSN Standardization.
- USN is a conceptual network or framework built over existing physical networks that makes use of sensed data and provide knowledge services

Main Components of USN

USN applications and services platform

- technology framework to enable the effective use of a USN

USN middleware

- including functionalities for sensor network management and connectivity, event processing, sensor data mining.

Network infrastructure

- makes use of existing networks

USN gateway

- A node that interconnects sensor networks with other networks

Sensor network

- Network of interconnected sensor nodes

Platform Middelware of WoT..SCADA

- ANSI/ ISA-95 is working for SCADA Standardization.
- It is used to specify a framework for **the inter operability of a set of software products** used in the manufacturing domain and to facilitate its **integration into a manufacturing application.**
- The objectives of ISA-95 are to provide consistent terminology that is a **foundation for supplier and manufacturer communication,** to **provide consistent information models**, and to provide a **consistent operations model** as a foundation for clarifying application functionality and how information is to be used.

Main Components of SCADA Middleware

- Interaction
- Communication
- Context
- Secure Distributed Storage
- Proactive knowledge base
- Tools

Main Components of ISA-95 for Middleware platform of SCADA

Interaction

- These manage interaction between Users and Smart Products

Communication

- These provide support for the information exchange between smart products

Context

- These provide components for sensing, processing, and distributing context information

Proactive knowledge base

- components for handling the knowledge of a smart product

Secure distributed storage

- components for storing knowledge of a smart product in a secure and distributed way

Tools

- tools for developing smart products, such as for automatically extracting relevant information from manuals, editors

Platform Middelware of WoT..RFID

- The EPCglobal is working for RFID Standardization.
- BRIDGE Building Radio- frequency Identification solutions for the Global Environment under EPC Global is also working for RFID standardization which manages the **exchange of RFID and aggregated information between nodes.**
- The Cross UBiQuitous Platform (CUBIQ) ..Japan aims to develop a common platform that facilitates the development of context- aware applications.

Platform Middelware of WoT..RFID

- Manage Devices
- Collect and Integrate Data
- Structure and Filter Data
- Tag ID Association

Platform Middleware of WoT..RFID

- The CUBIQ architecture consists of three layers
  - Mobile terminals with RFID tag reader collect RFID tag info and record location.
  - The mobile terminals are connected via the core CUBIQ infrastructure and share RFID tag information.
  - Observers can search RFID tag information to estimate the location of target person.

WoT Portals and Business Intelligence

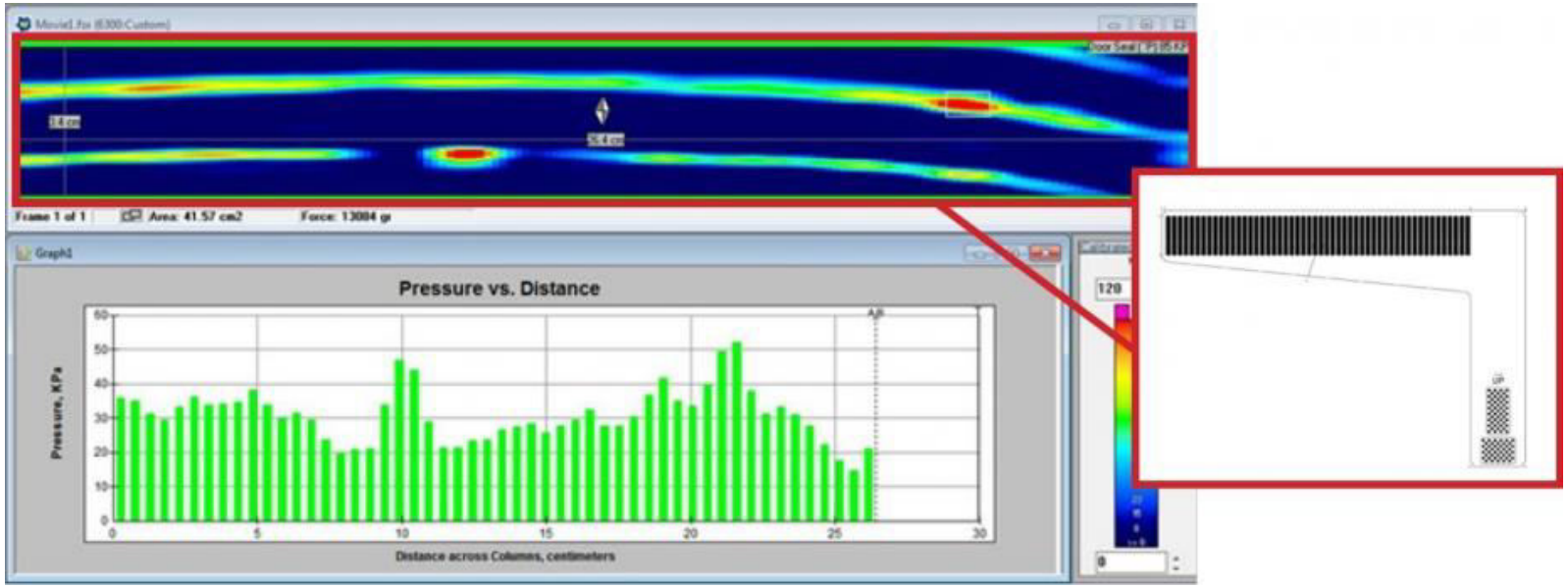
- A web portal or links page is a website that functions as a point of access to information in the World Wide Web
- A portal presents information from diverse sources in a unified way.

WoT Portals

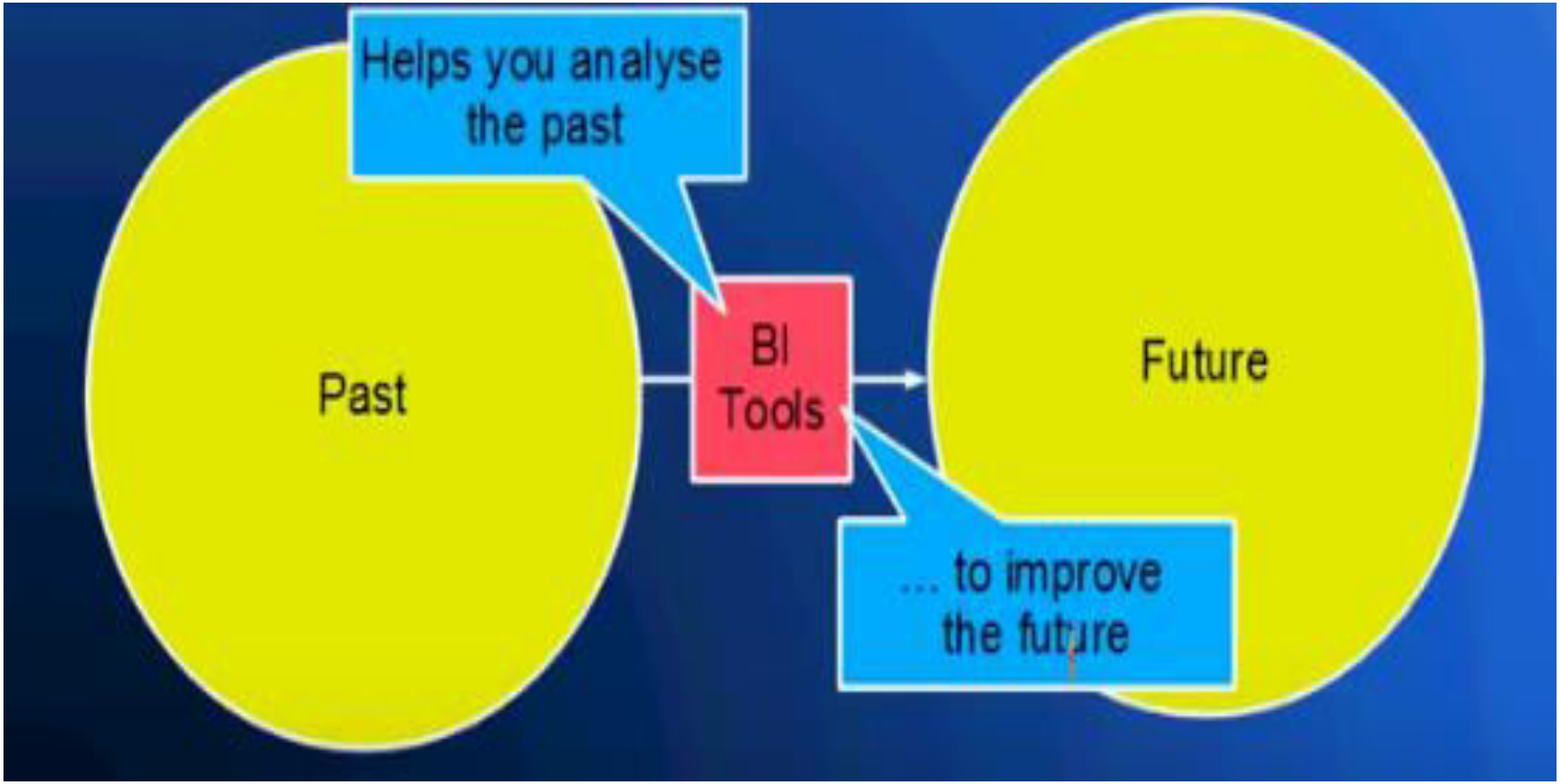
- **Pachube (https://pachube.com)** Pachube enables you to store, share and discover **real-time sensor, energy** and **environment data from buildings or other devices.**

WoT Portals

- **SensorMap** (Microsoft, http://atom.research.microsoft.com/sensewebv3 /sensormap/): The portal and its accompanying tools will allow for more online live data.



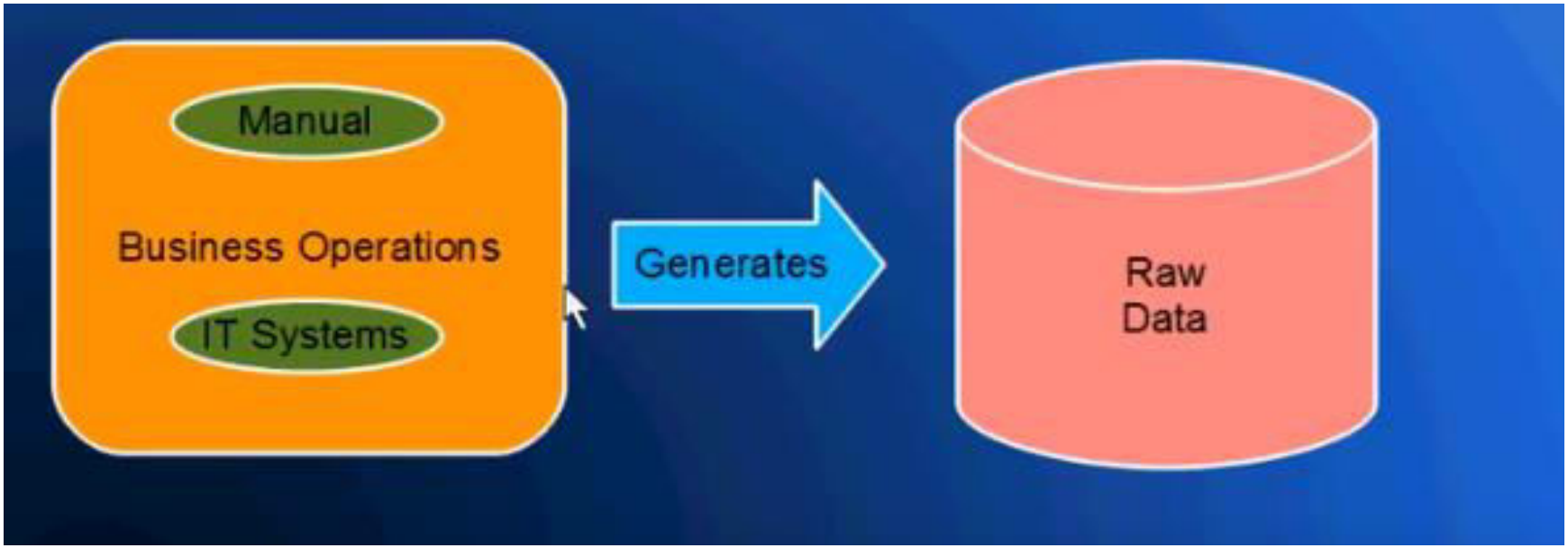
Business Intelligence



https://www.youtube.com/watch?v=N8F7eOqgH8Q&t=684s

Business Intelligence

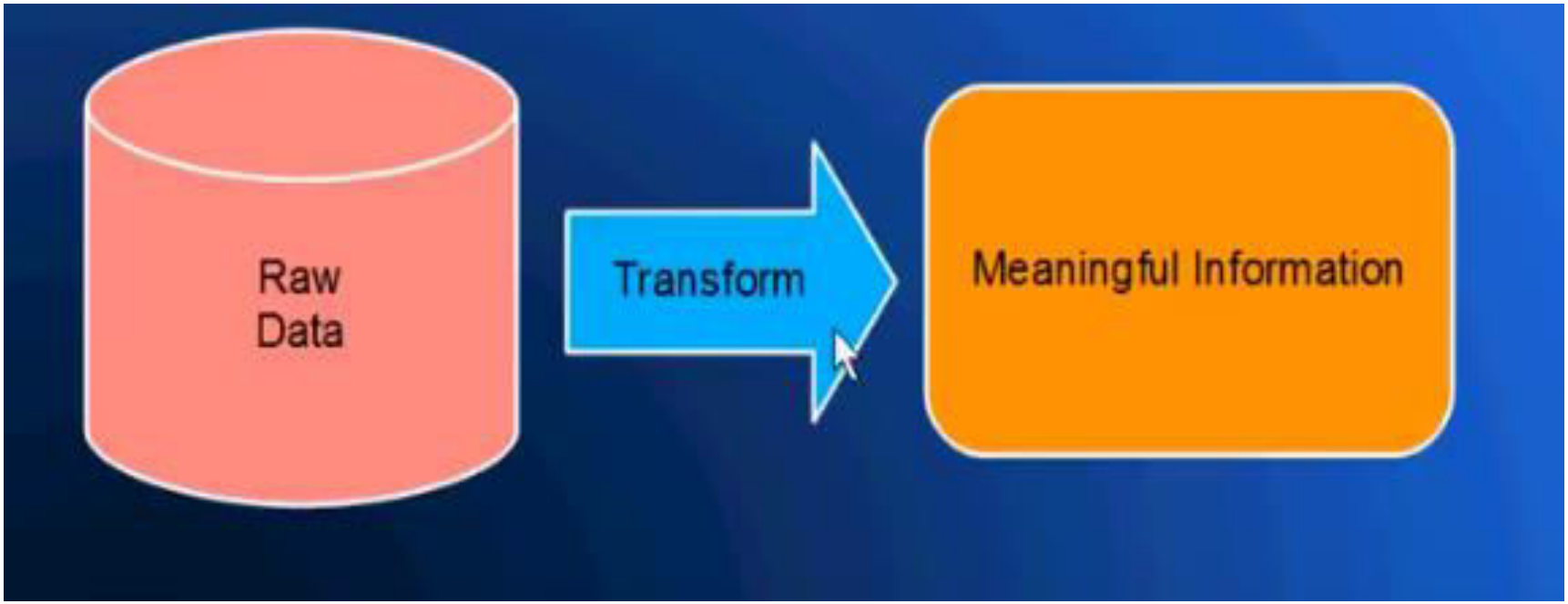
- All Businesses Using IT System / Manual Operations generate **RAW Data**



https://www.youtube.com/watch?v=N8F7eOqgH8Q&t=684s

Business Intelligence

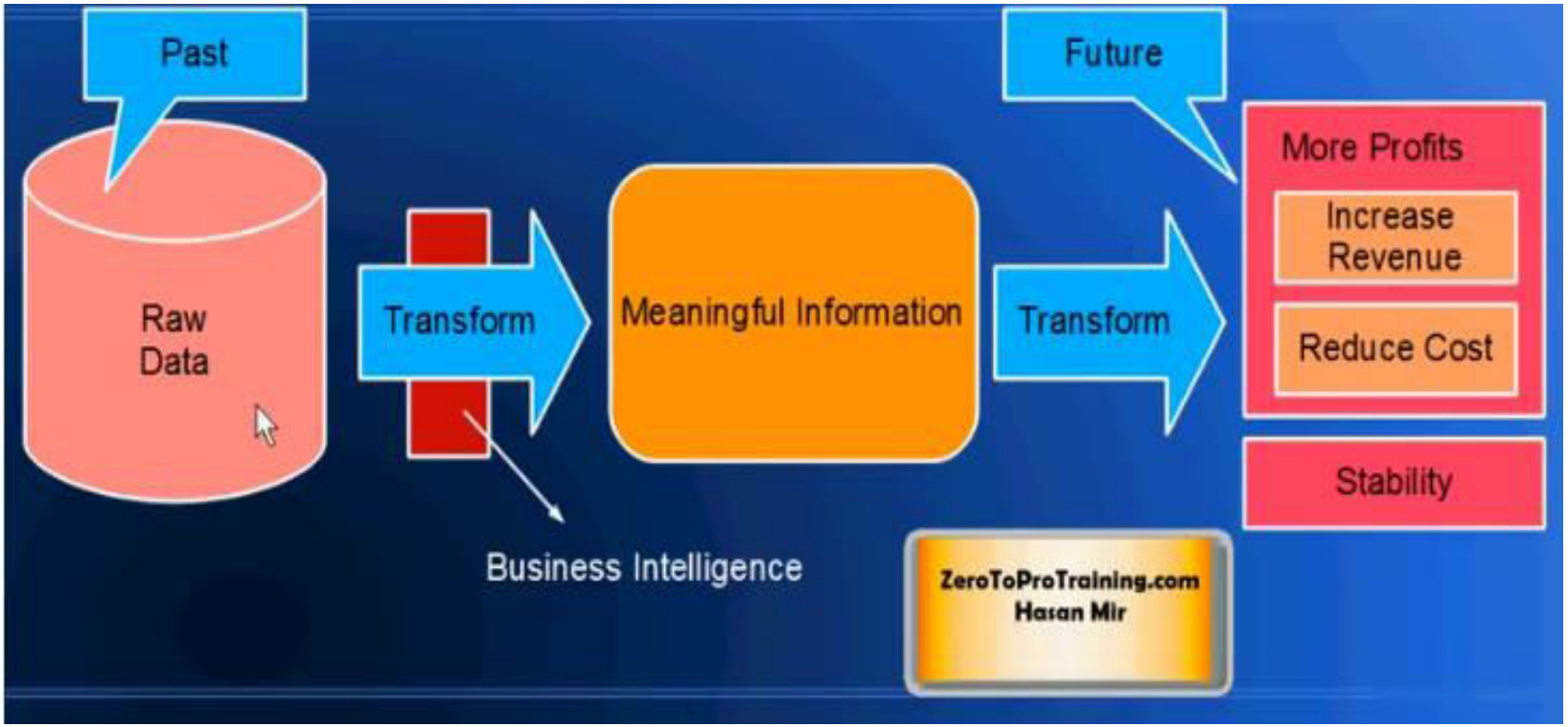
- Typical Objectives of a company will include more stability and more profit .



https://www.youtube.com/watch?v=N8F7eOqgH8Q&t=684s

Business Intelligence

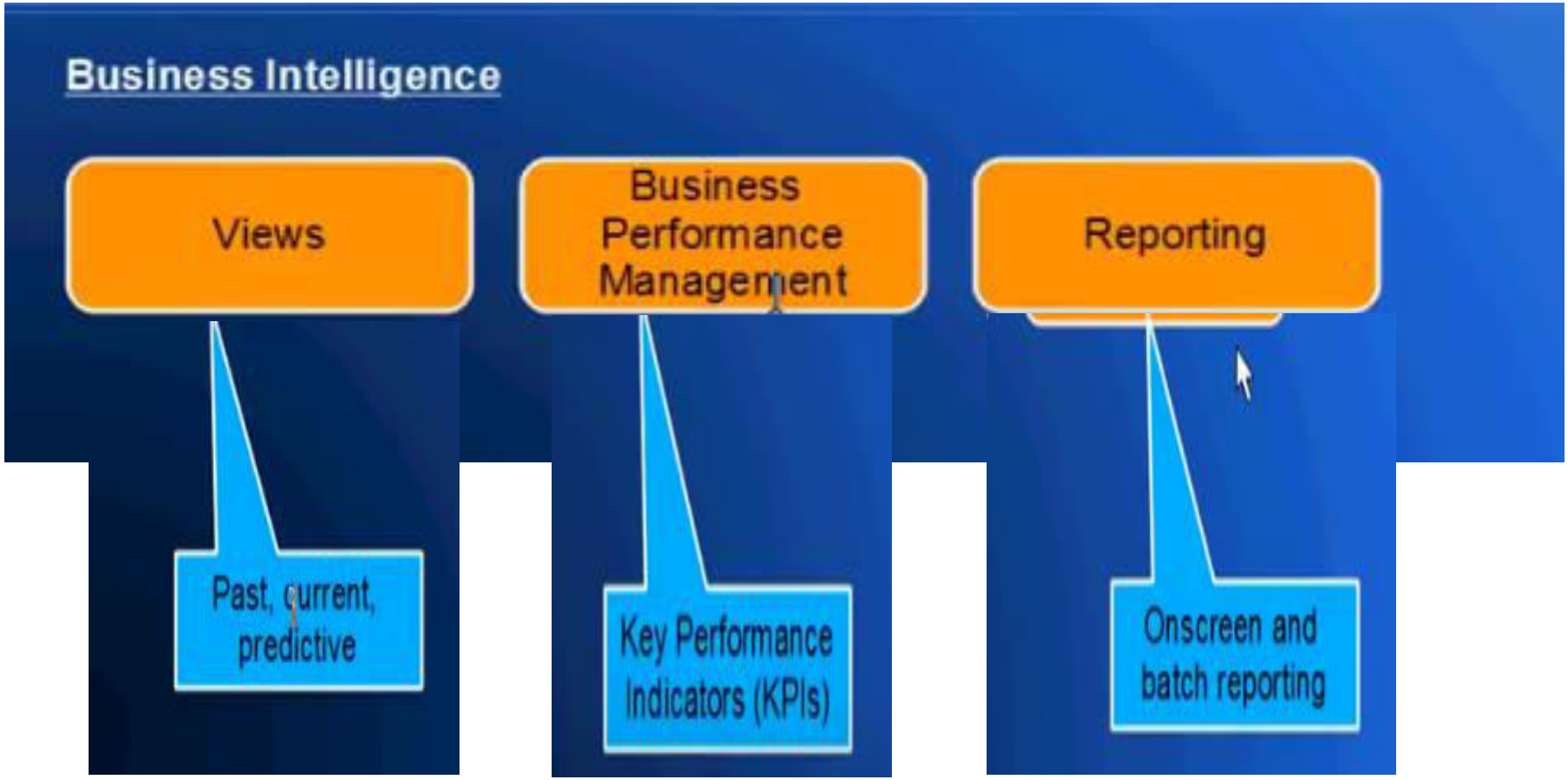
- **RAW Data** needs to be analyzed and transformed into meaningful information to achieve the objective of any company.
- This transformation is done by **Business Intelligence**



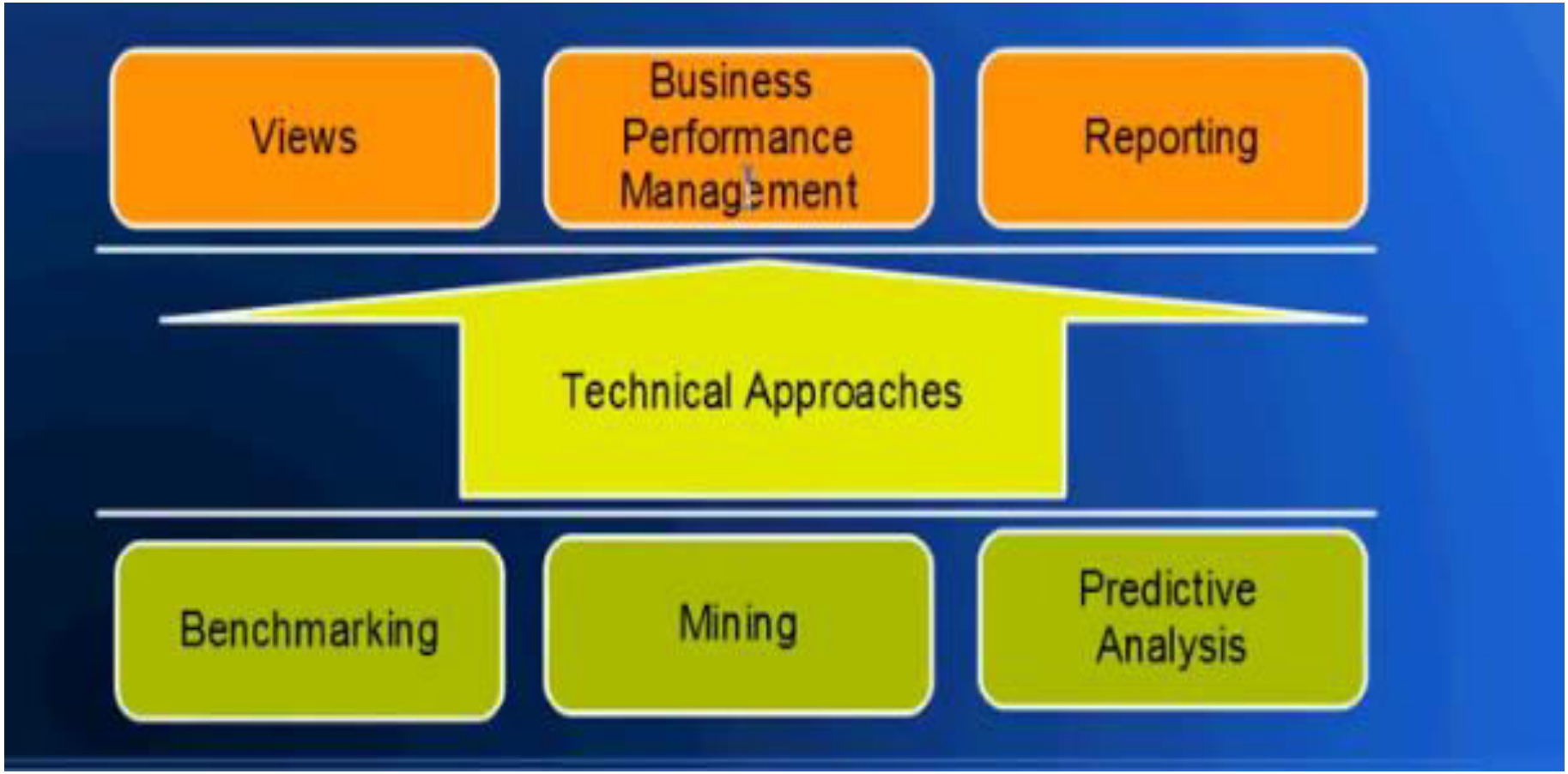
Business Intelligence

- **Business Intelligence** thus helps the company to analyze the past and make actions to get a better future.
- It is an **approach** either **technological or process oriented i.e** anything which is done to convert raw data into meaningful information is **Business Intelligence**

Business Intelligence Objectives

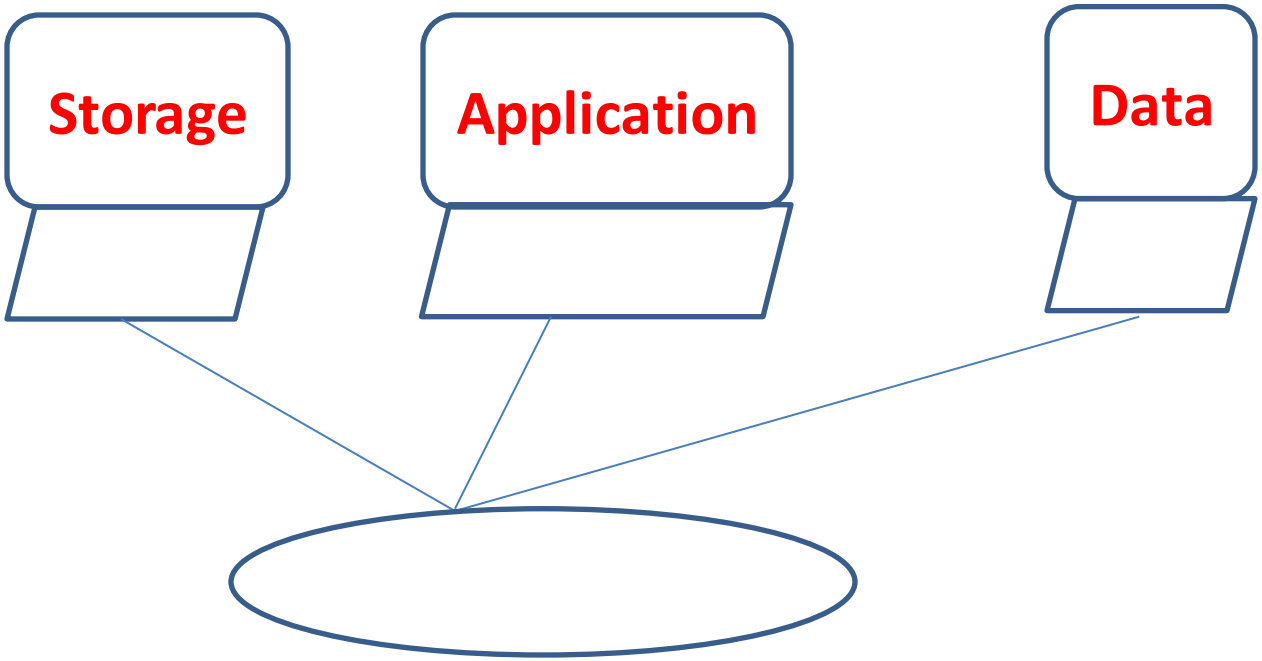


Business Intelligence Technical Approaches



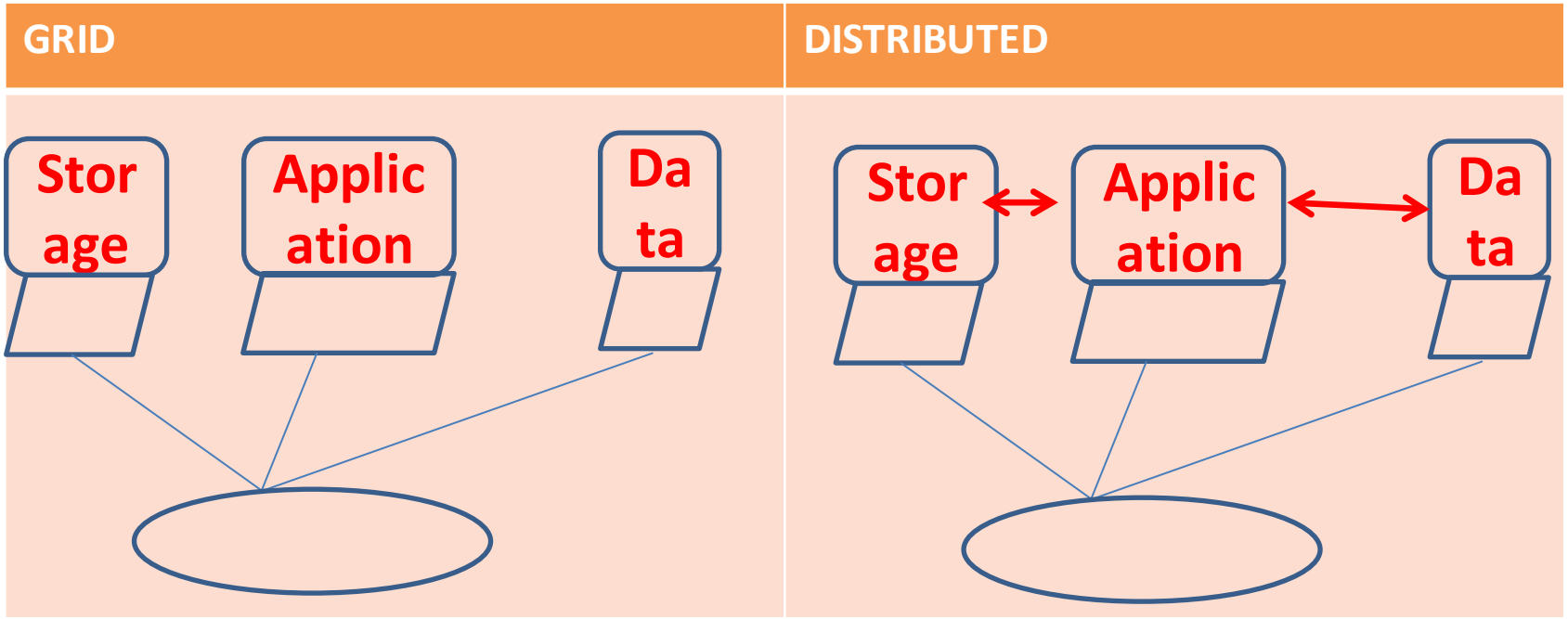
GRID COMPUTING

- It is collection of computing resources (like storage, processor, data , applications) from multiple locations to achieve a common goal.



GRID COMPUTING

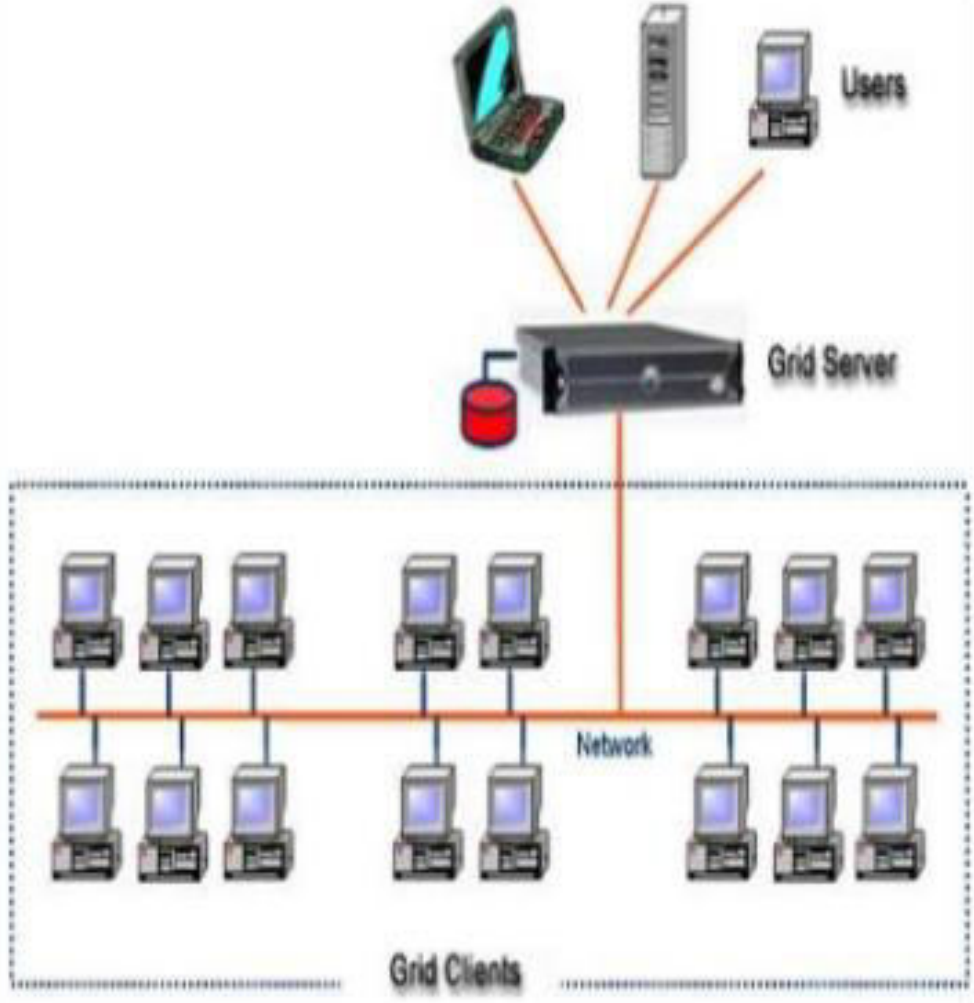
- A grid is a distributed system with **non-interactive workload** that involve large number of files.



GRID COMPUTING

- **A computational grid is a h/w and s/w infrastructure** that provides **dependable**, **consistent** & **inexpensive** access to high end **computational capabilities**.
- **The grid links together the computing resources and provides a mechanism to access them**.

WORKING OF GRID COMPUTING



In general, a grid computing system requires:

- **At least one computer, usually a server, which handles all the administrative duties for the System**
- **A network of computers running special grid computing network software.**
- **A collection of computer software called middleware**

EXAMPLE OF GRID COMPUTING

DESKTOP COMPUTER

Solve,

X = 10+(8 * 2) + (3*2)

Step 1 : X = 10+(8 * 2) + (3*2)
Step 2 : X = 10+ 16 + (3*2)
Step 3 : X = 10+ 16 + 6
Step 4 : X = 32

GRID COMPUTING

Solve,

X = 10+(8 * 2) + (3*2)

Step 1 : X = 10+ 16 + 6
Step 2 : X = 32

- So Grid Computing saves time and increases processing speed.

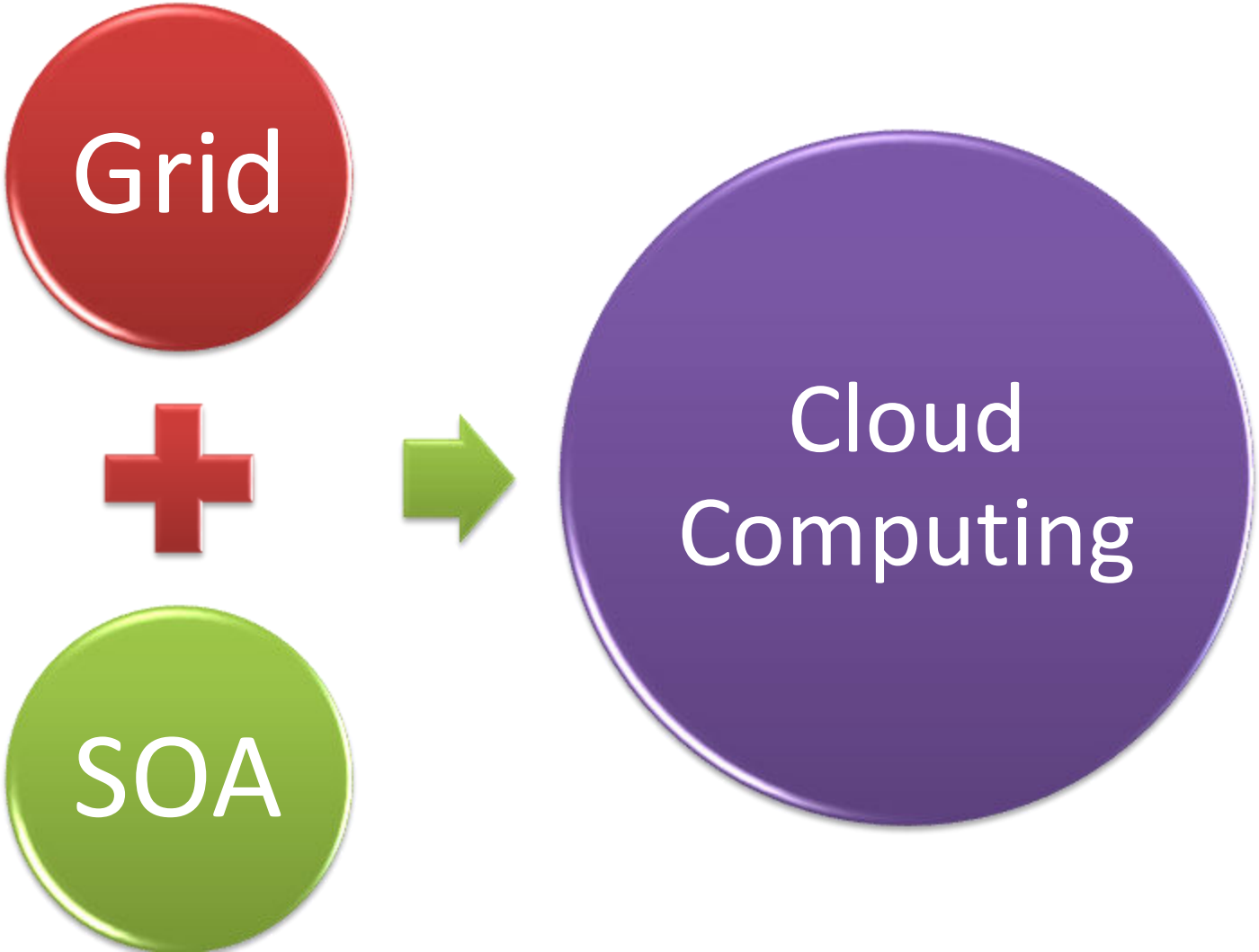
DISADVANTAGE OF GRID COMPUTING

- The users or project sponsors would **have to bear the enormous cost** of setting up and maintaining and monitoring the grid.
- Does not follow standard data communication protocol

APPLICATIONS OF GRID COMPUTING

- The European Organization for Nuclear Research (CERN) is one of the leading organizations running major grid computing initiatives including **analyzing chemical compounds in the search for potential drugs** for diseases such as avian flu.
- SETI (Search for Extraterrestrial Intelligence) @Home project is one of the earliest grid initiatives that downloads and **analyzes data from radio telescope**. Participants simply need to download and run a program to join the grid network.

Cloud as Integration to Grid Computing and SOA



What is THE CLOUD?

- The cloud is a **set of services and technologies** that enable the delivery of **Computing Services** over the **Internet** in real-time, allowing end-users instant access to data and applications from all most any device with Internet access.

- A cloud service has some distinct characteristics that differentiate it from traditional hosting .

- It is, **sold on demand** typically by the minute or the hours
- It is **elastic**-- a user can have as much or as little of a service as they want at any given time; and
- the service is **fully managed by the provider** (the consumer needs nothing but a personal computer and Internet access).

Why Businesses Embracing CLOUD?

Licensing Cost

Latest Technology\Upgrades

Protecting Data

Right Skill Set

Operational Cost

Upgrade Hardware

Most IT departments are forced to spend a significant portion of their time on frustrating implementation, maintenance, and upgrade projects that too often don't add significant value to the company's bottom line.

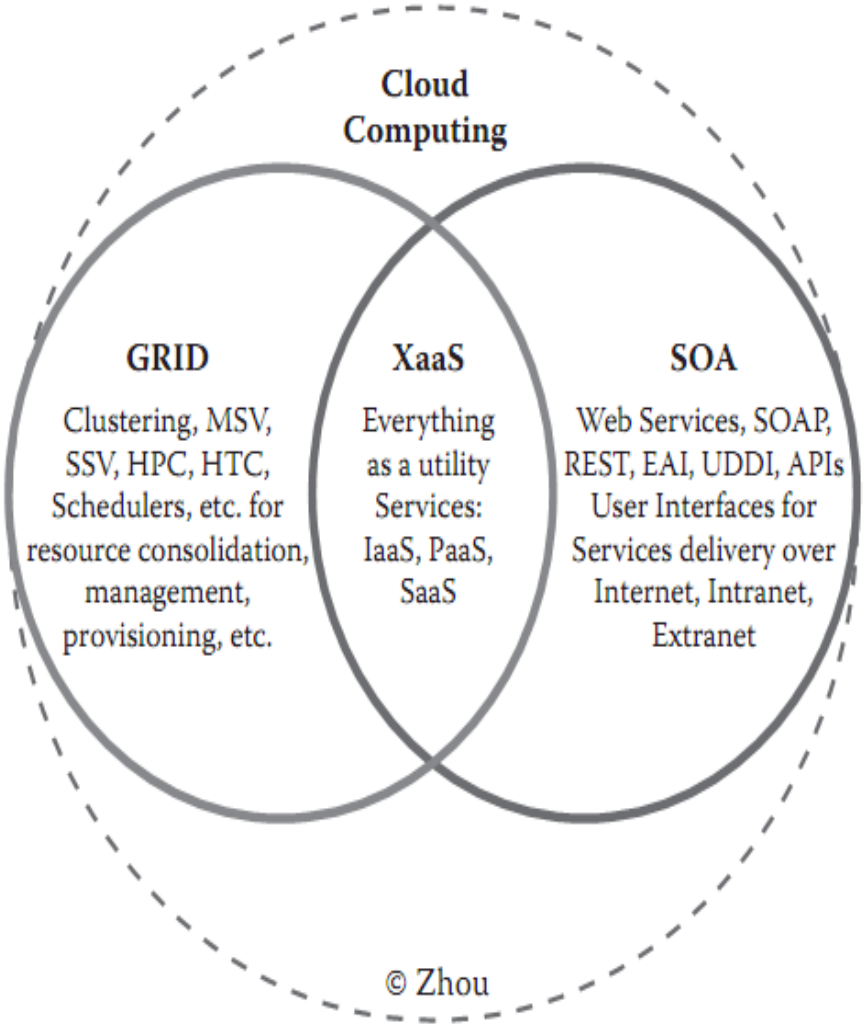
IT Challenges

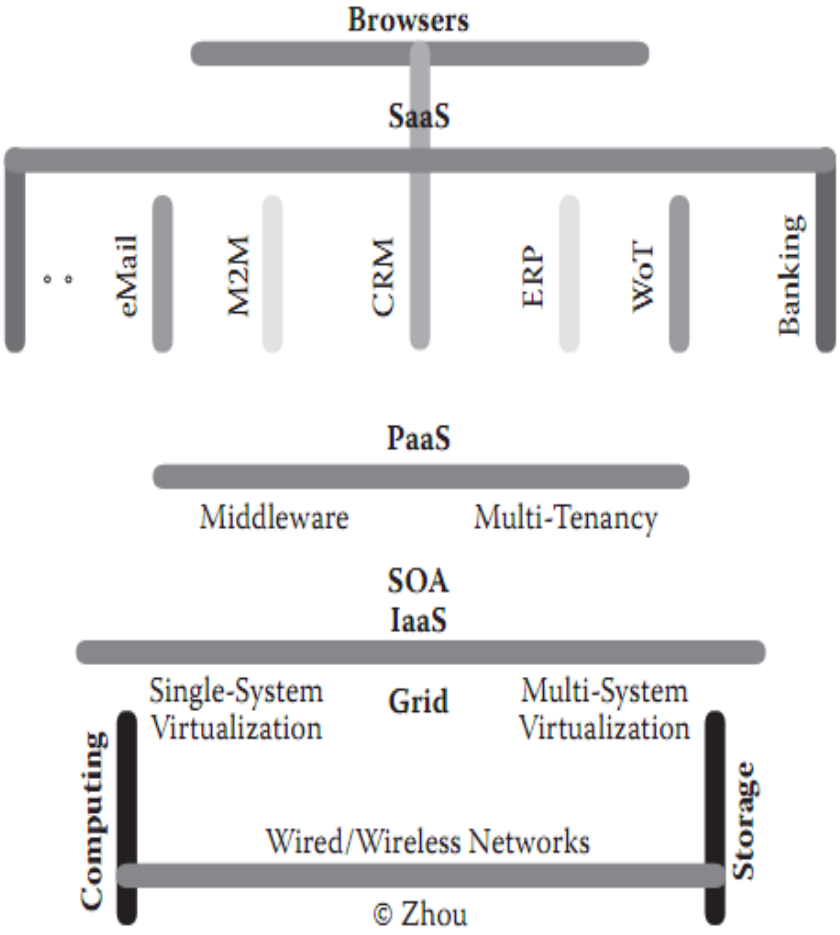
- IT Infrastructure
  - Datacenter facility\Space is a COST
  - Power\Air conditioning
- IT Management
  - Right skill people
  - Upgrade hardware\software\day-to-day maintainence
  - Handle operational failures
- IT Security
  - Protecting data
  - Protecting datacenter facility
- IT Licensing Cost
  - Managing Licenses effectively
- IT Application management
  - Upgrade applications (at par with latest changes\features)
  - Scaling application requirements

BENEFITS OF CLOUD COMPUTING

- Reduced Cost
- Rapid Scalability
- Highly Automated
- Disaster Relief
- Flexibility
- More Mobility

Cloud as Integration to Grid Computing and SOA





Cloud Models

- **Service Model –Iaas, Paas, Saas**
  - Iaas- Infrastructure as a service
  - Paas- Platform as a service
  - Saas- Software as a service

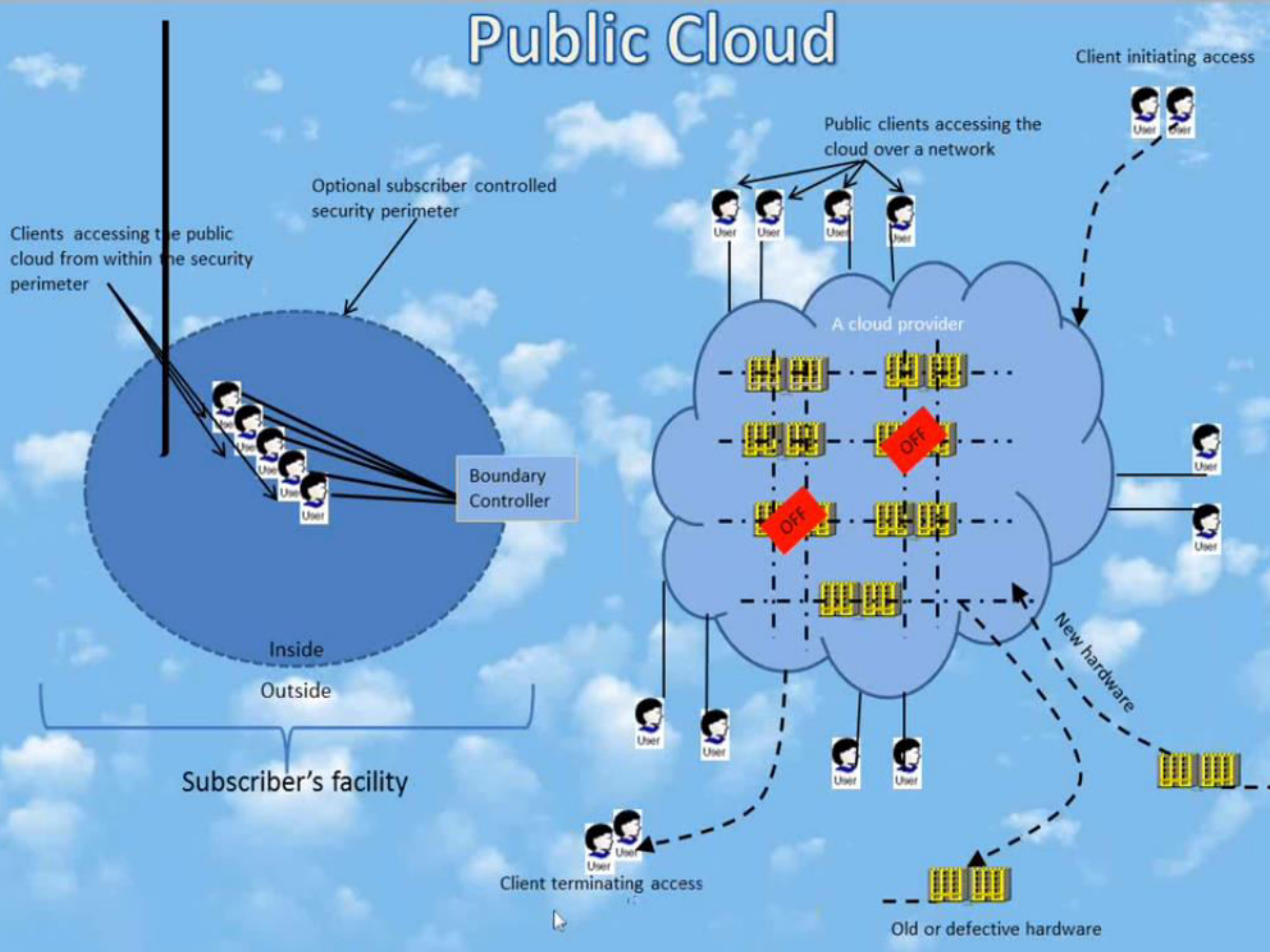
- **Deployment Model –Public, Private, Community, Hybrid**

Deployment Model

- **Public**
  - A public cloud is a type of computing in which a **service provider makes resources available to the public via the internet.**
  - Resources vary by provider but may include storage capabilities, applications or virtual machines.
  - Public cloud allows for scalability and resource sharing that would not otherwise be possible for a single organization to achieve.

Deployment Model..Public

- **Example**
  - Windows Azure and Office 360
  - Google App Engine
  - IBM Blue Cloud
  - Amazon EC2

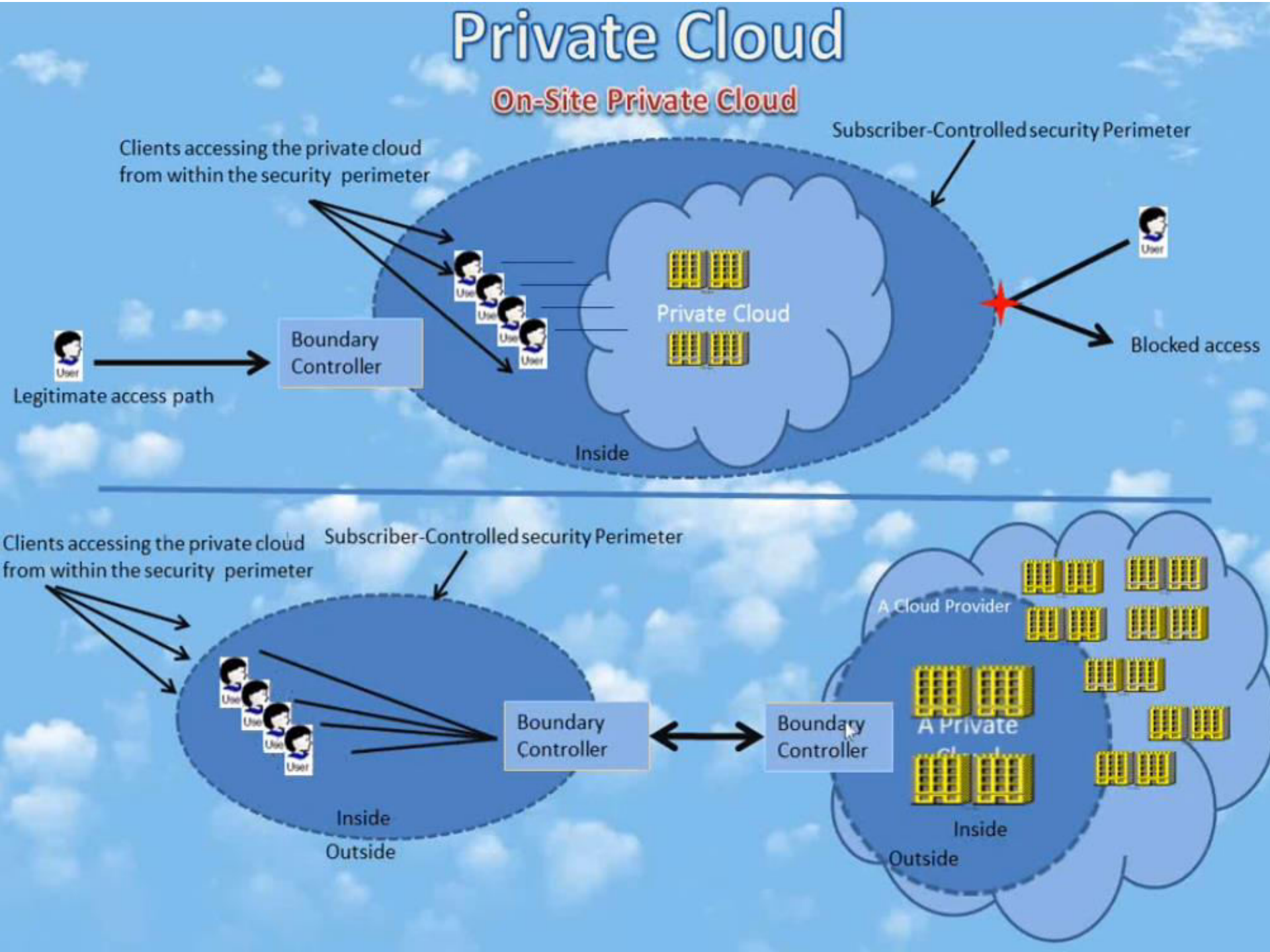

Public Cloud
Client initiating access
Public clients accessing the cloud over a network
Optional subscriber controlled security perimeter
Clients accessing the public cloud from within the security perimeter
A cloud provider
Boundary Controller
OFF
OFF
Inside
Outside
Subscriber's facility
New hardware
Client terminating access
Old or defective hardware

Deployment Model..>Private

- **Private**
  - A private cloud is a particular model of cloud computing that involves a distinct and secure cloud based environment in which only the **specified client can operate**.
  - Can be on premises or Off - Premises

Deployment Model..Private

- **Example**
  - Ubuntu Enterprise CLoud
  - Amazon VPC
  - VMWare
  - Eucalyptus
  - Microsfot ECI (Enrollmet for Cloud Infrastructure)


Private Cloud
On-Site Private Cloud
Clients accessing the private cloud from within the security perimeter
Subscriber-Controlled security Perimeter
Private Cloud
Boundary Controller
Legitimate access path
Blocked access
Inside
Clients accessing the private cloud from within the security perimeter
Subscriber-Controlled security Perimeter
Boundary Controller
Boundary Controller
A Cloud Provider
A Private
Inside
Outside
Inside
Outside

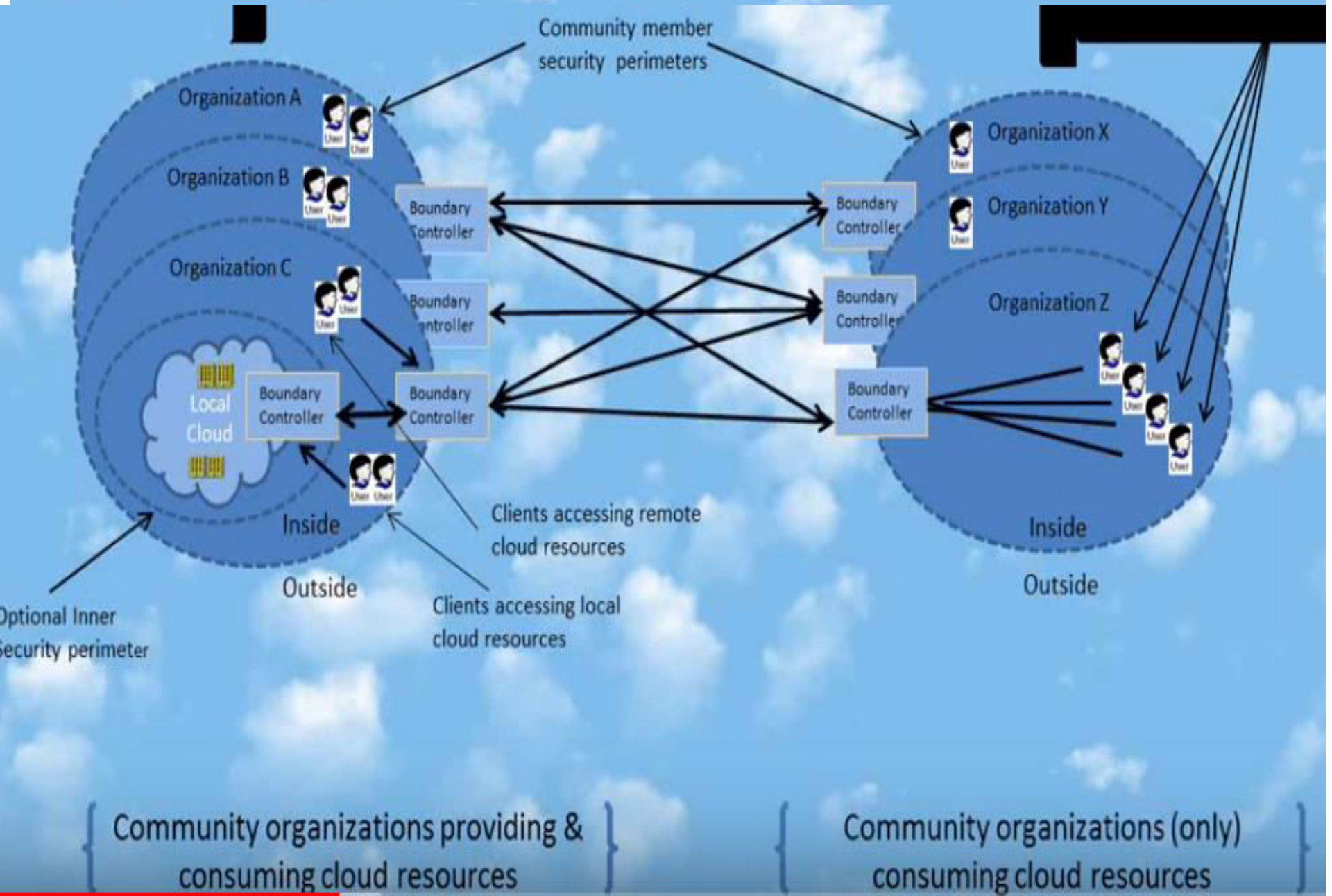
Deployment Model..>Community

- **Community**
  - A **community cloud** in computing is a collaborative effort in which **infrastructure is shared between several organizations from a specific community with common concerns** (security, compliance, jurisdiction, etc.), whether managed internally or by a third-party and hosted internally or externally.
  - This is controlled and used by a group of organizations that have shared interest.

Deployment Model..Community

- **Example**
  - Google Apps for Government
  - Microsoft Government Community Cloud

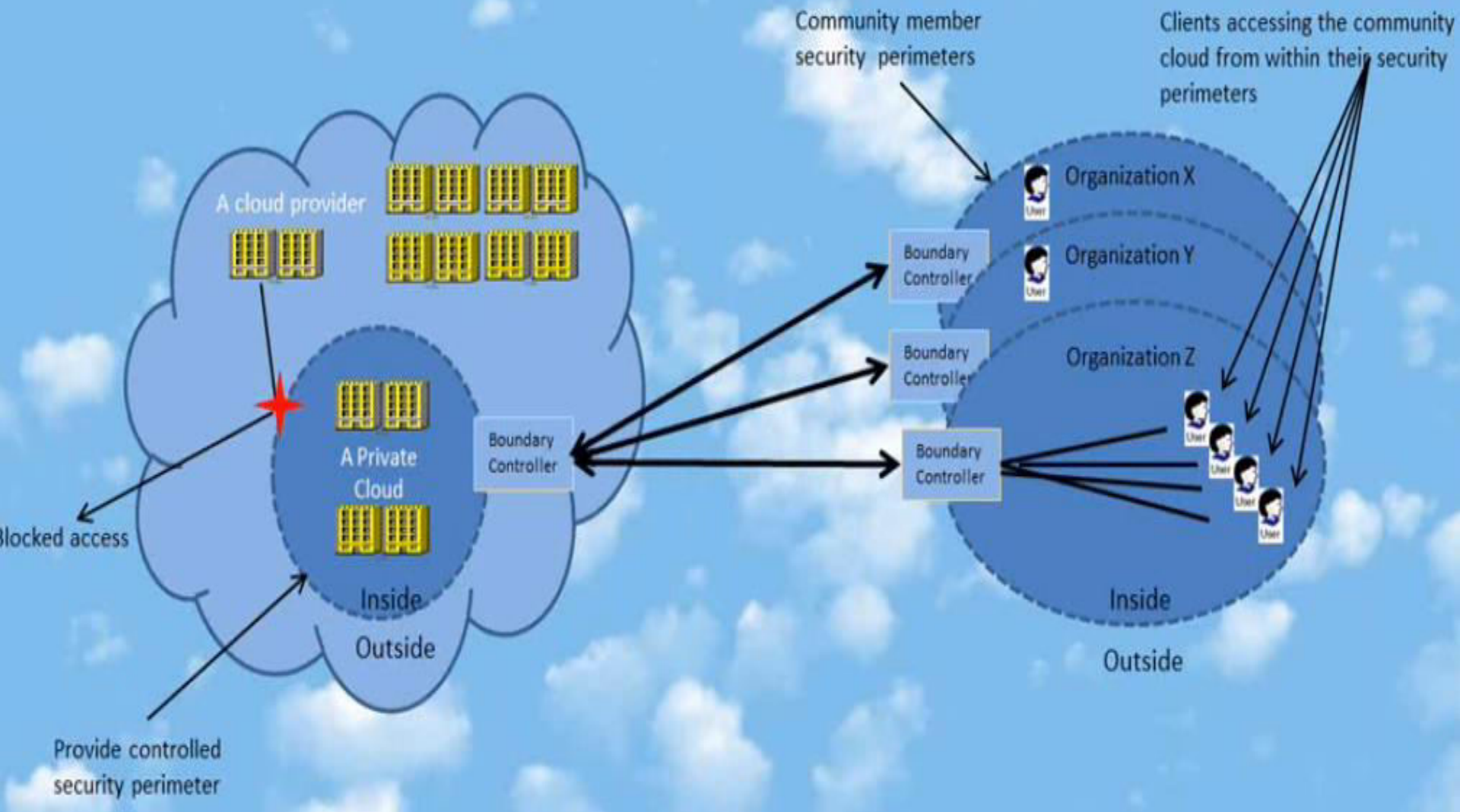
Community Cloud



Community organizations providing & consuming cloud resources

Community organizations (only) consuming cloud resources

Community Cloud



Deployment Model..>HYbrid

- **Hybrid**
  - Hybrid cloud is a cloud computing environment that uses a **mix of on-premises, private cloud and third-party, public cloud services with** orchestration between the two platforms. B
  - y allowing workloads to move between private and public clouds as computing needs and costs change, hybrid cloud gives businesses greater flexibility and more data deployment options.

Deployment Model..Hybrid

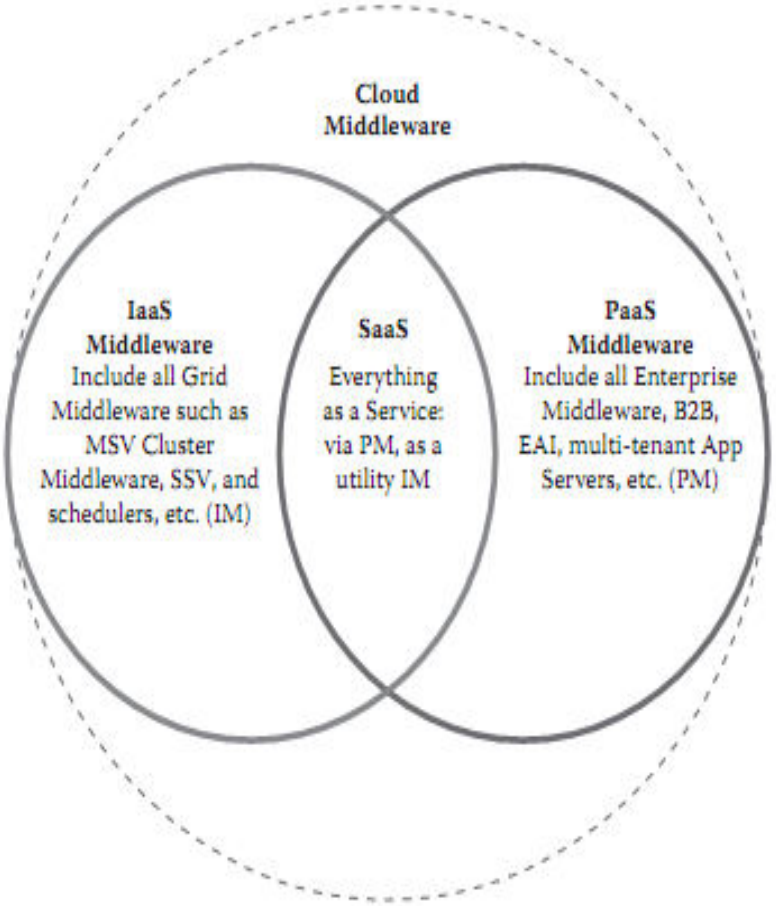
- **Example**
  - Google Apps for Government
  - Microsoft Government Community Cloud

Quick Comparison

Deployment Model	Infrastructure Managed By	Infrastructure Owned By	Infrastructure Located	Accessible & Consumed By*
Public	Third Party Provider	Third Party Provider	Off-Premise	Untrusted
Private/Community	Organization Or Third Party Provider	Organization Or Third Party Provider	On-Premise Off-Premise	Trusted
Hybrid	Both Organization & Third Party Provider	Both Organization & Third Party Provider	Both On-Premise & Off-Premise	Trusted & Untrusted

Cloud Middleware

- The cloud middleware consists of two kinds of middleware
  - IaaS and PaaS middleware
- It reduces the single system virtualization



Cloud Middleware

- **Iaas Middelware**
  - Includes N/W management, Grid Management, Scheduling
- **Paas Middelware**
  - Includes Identity and access management, data management
  - Includes all business level solution