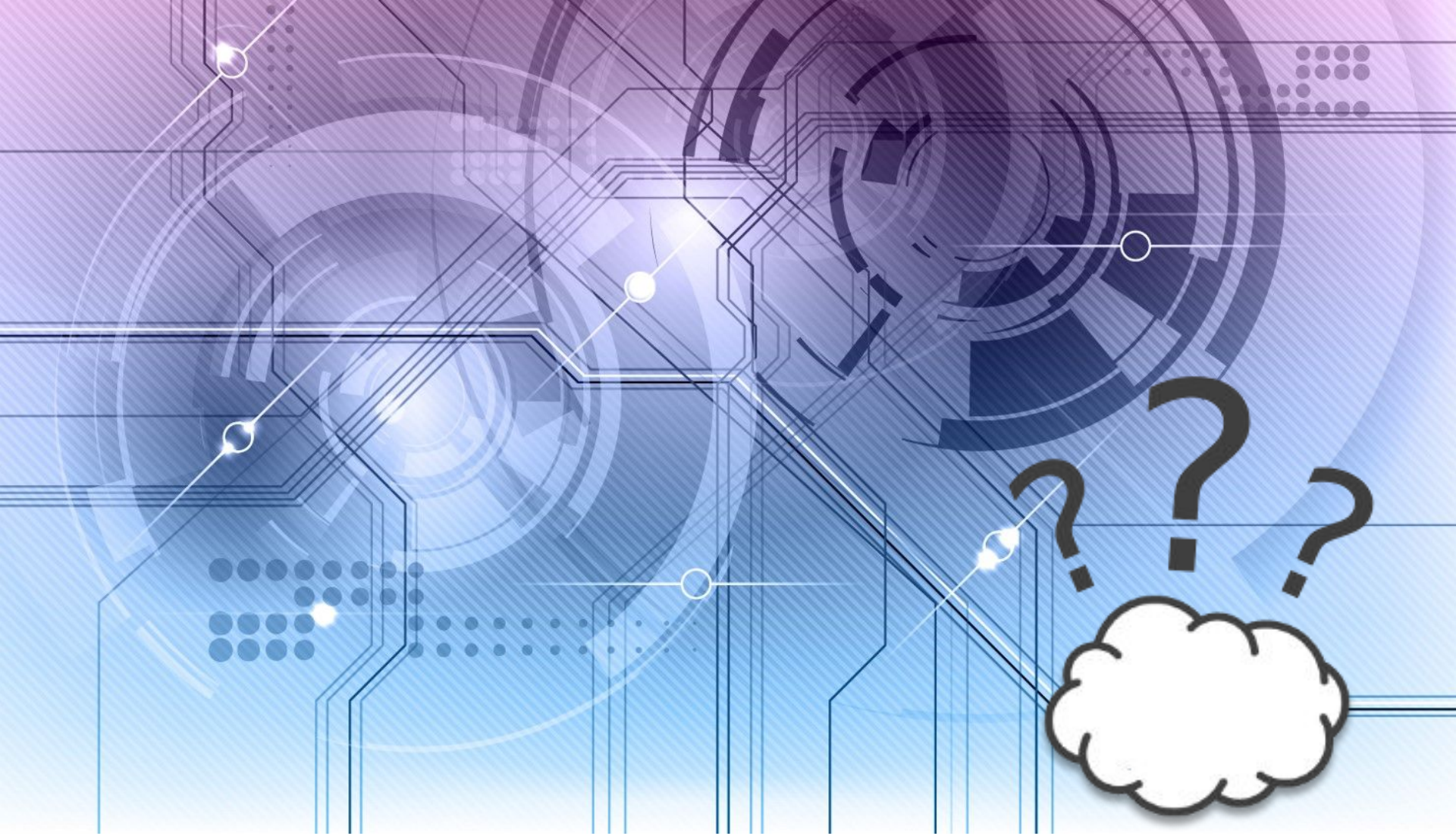
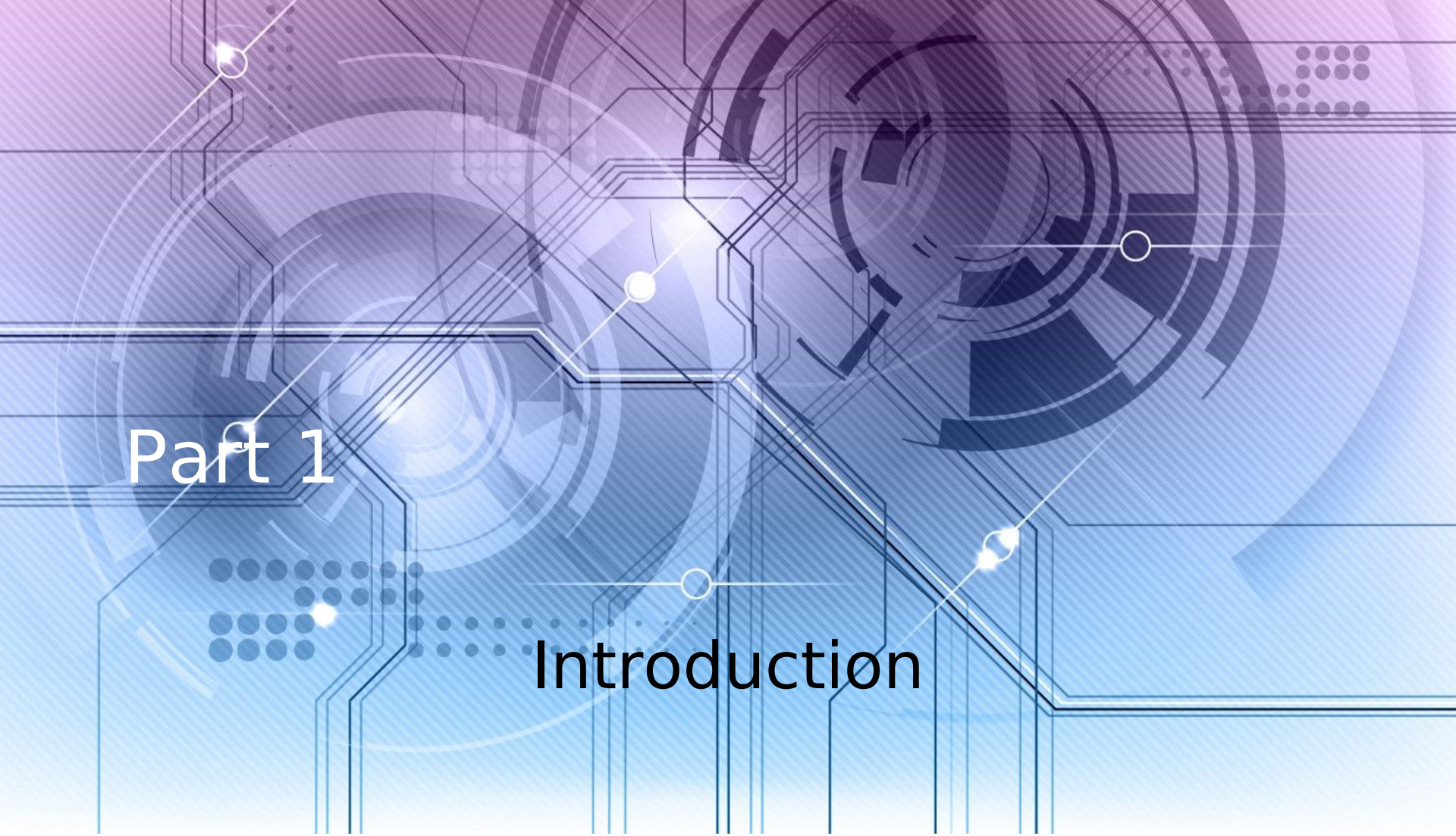


Cloud Computing

By
Nirmallya Mukherjee


Part 1
Introduction

What's in it for me?

- Technology landscape is shifting, "Polyglot" is the mantra now
- In the future these technologies will become very common
- Overall architecture will change going forward
- The design and development process is changing
- The process of application deployment and continuous integration is evolving
- The process of operations is changing
- Pricing models are changing
- Finally, is cloud computing the same as AWS? Hint: What does someone mean if they say "Please get me a Xerox?"

A few stories

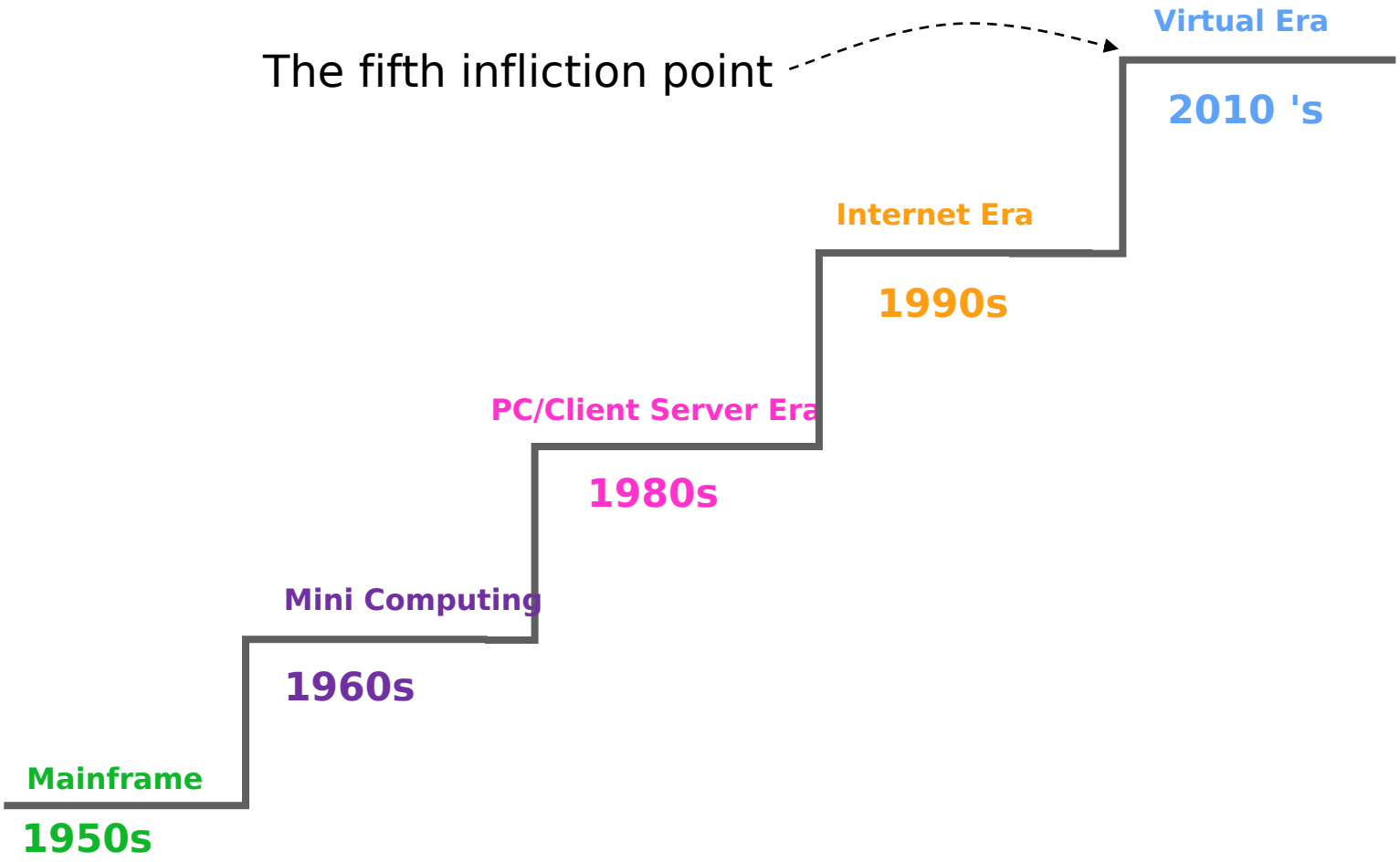
- Instagram launch
- Flipkart billion dollar sale day
- Did you hear about ASP? (this was early 2000)
- How many of us want to build or have already installed a nuclear power plant at home?
- One final thing ... familiar with SETI@HOME?

- Let's start with a little visual(Cloud before and after)

Our first debate ...

- What were the real concerns of the business owner?
- What are the reasons for web applications not succeeding?
- Are these concerns valid?
- What did the business owner look for in the cloud?
- What offerings were useful that made the business owner happy?

A short history and evolution



Any definitions?

- Style of computing in which **massively scalable** IT related capabilities are provided "**as a service**" using internet technologies to multiple **"external customers" –** *Gartner*

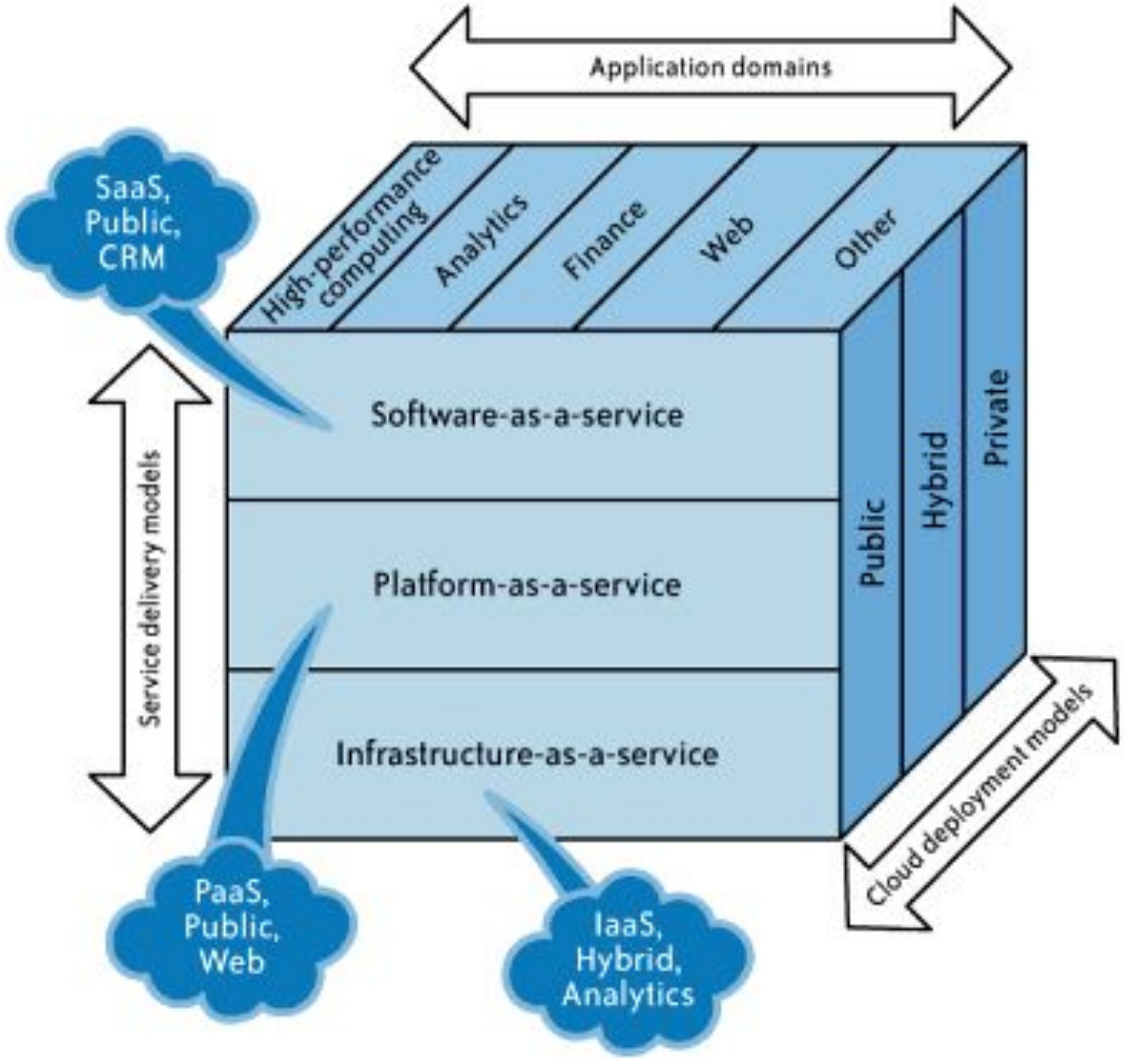
- Pool of abstracted, **highly scalable**, and managed compute infrastructure capable of hosting end-customer applications and **billed by consumption –** *Forrester*

Myths of cloud computing

- There's one single "Cloud"
- All you need is your credit card
- The cloud reduces your workload
- Integration (two versions)
  - You can seamlessly blend your private "Cloud" (your virtualized datacenters) with public providers
  - You won't ever be able to seamlessly blend your public and private clouds
- The cloud always saves you money
- A cloud provider can guarantee security
- If you are using virtualization, you are doing cloud computing
- Cloud computing is about technology

The SPI framework

SPI stands for "**S**aaS", "**P**aaS" and "**I**aaS"

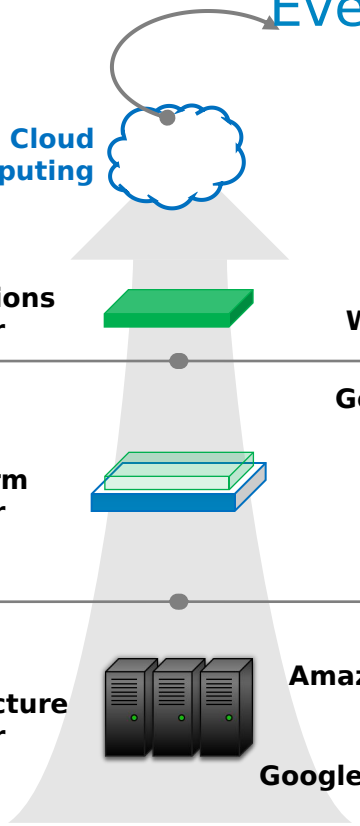


Service delivery models

Gartner: a style of computing where massively scalable IT-enabled capabilities are delivered 'as a service' to external customers using Internet technologies.

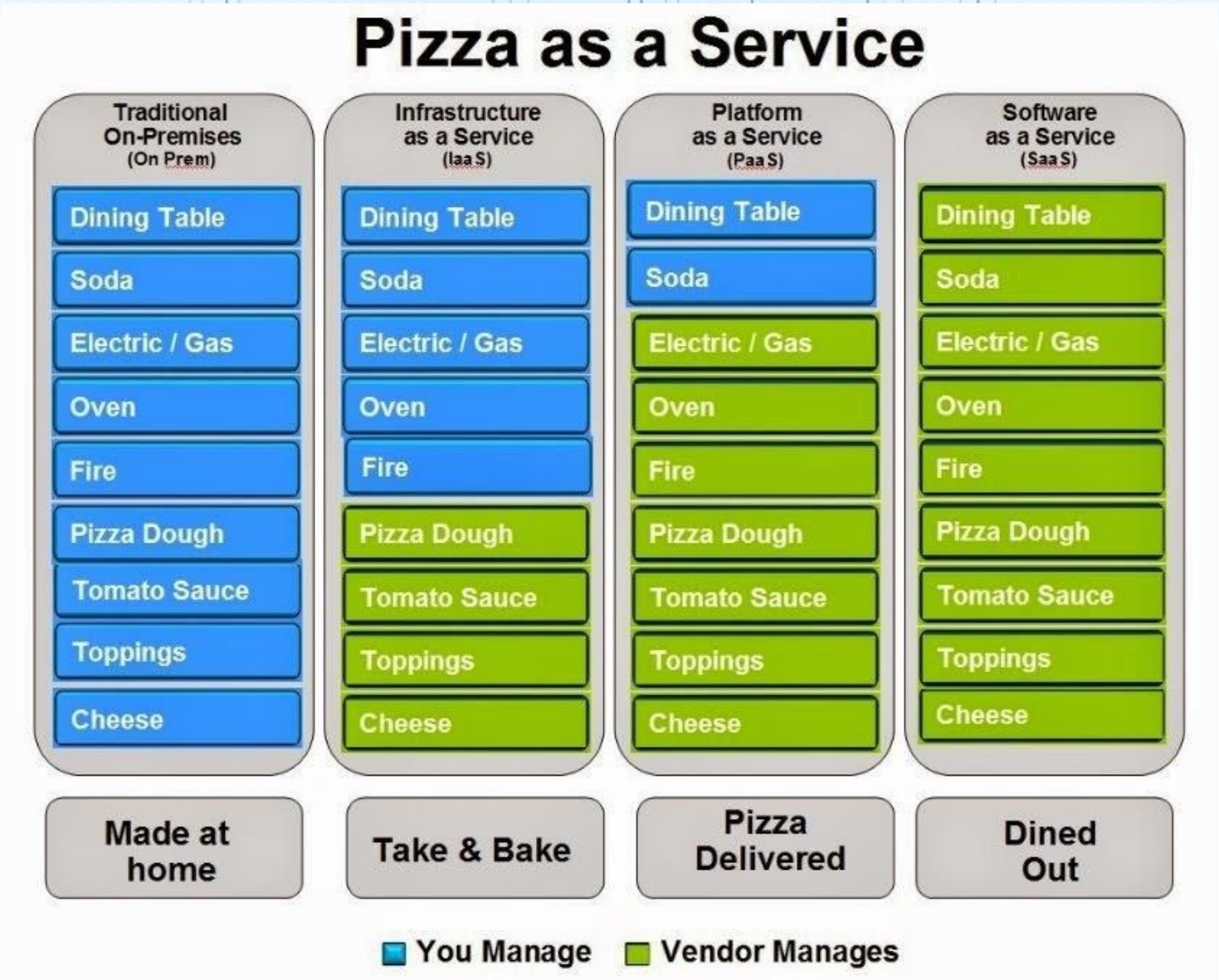
“Everything as a Service”

Public or Private Cloud ?

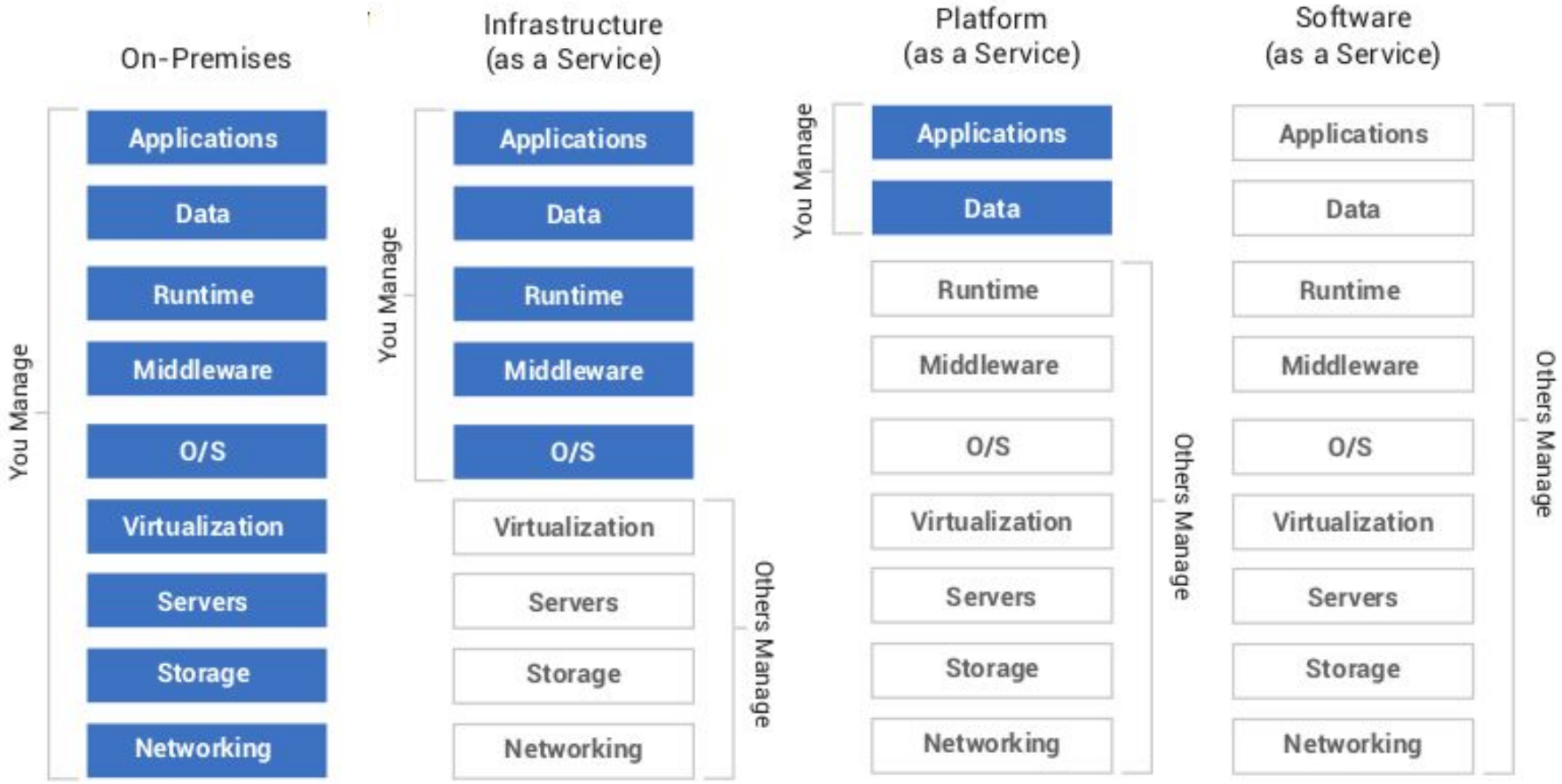


	Provided by	Replaces / Uses / Enhances
Applications Layer	Google Microsoft Salesforce.com Webstore.Amazon	Software as a Service Service Oriented Architecture WebApps - Access from Anywhere Multi-tenancy
Platform Layer	Google App Engine Force.com Cloud Foundry Jelastic	Platform as a Service WebApps - Access from Anywhere Foundation Components Multi-tenancy Click and Administer Big Data Platform Managed Web App Infrastructure
Infrastructure Layer	Amazon Web Services Rack Space Google Compute Engine Azure Linode	Infrastructure As A Service Grid Computing Scalable Datacenters Utility-style Metering & Billing Hardware Virtualization Online Storage On-demand Computing Click and Administer Infrastructure Outsourcing

A perspective



A perspective - continued



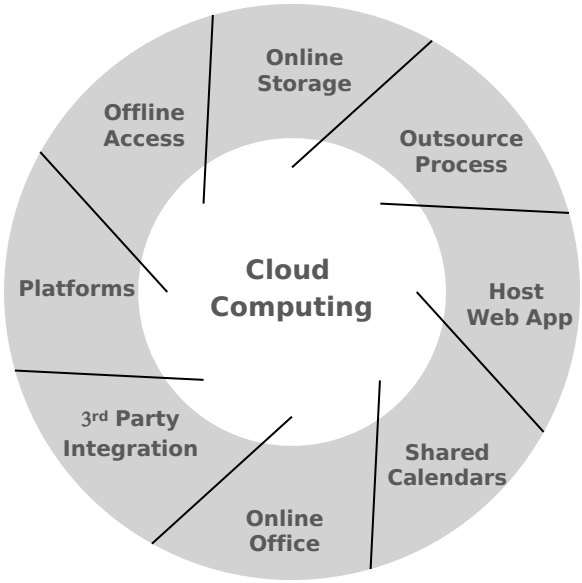
Why now?

Why now?

- Macro economic conditions continue to put pressure on overall business spending
- Pay As You Go model to counter Buy And Own model.
- Widespread adoption of REST Services allowing easy publishing, access and integration of applications

Business demands?

- Cater to predictable and unpredictable peak load demands
- Business continuity and disaster recovery
- Speed to market of new products and succeed or fail faster with lower risk and reduced cost
- Move commodity and productivity tools to cloud and save money
- Data intensive applications need processing power



What should an enterprise do?

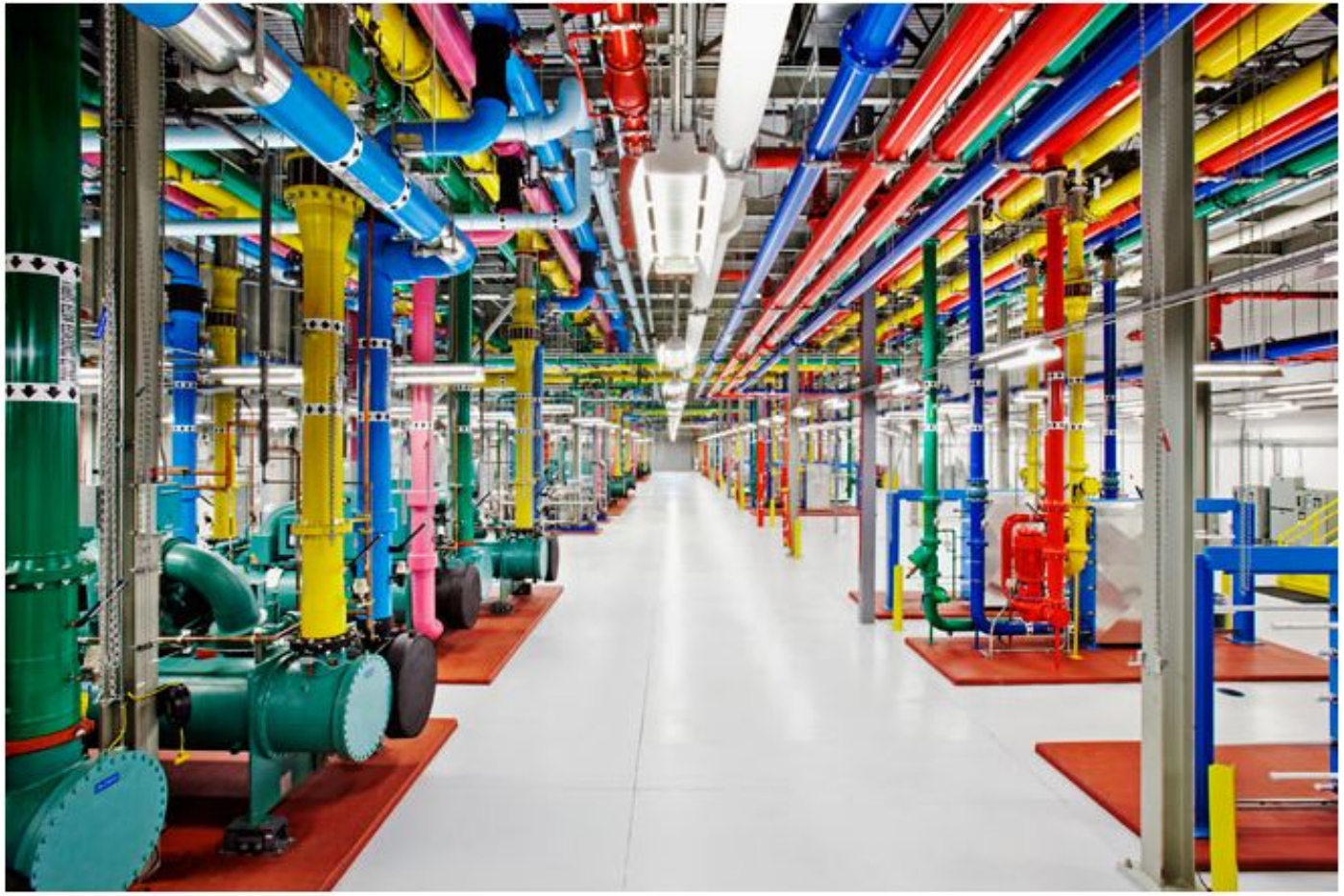
- Assess your current IT environment and pin down areas of cloud computing potential
- Evaluate different cloud provider offerings like IaaS, PaaS and SaaS to match your business needs

Where are these things coming from?

A server room in Council Bluffs, Iowa.

Photo: Google/Connie Zhou

Where are these things coming from?



A central cooling plant in Google's Douglas County, Georgia, data center.

Photo: Google/Connie Zhou

The buildings

Let's see it

https://www.youtube.com/watch?v=avP5d16wEp0

Key messages from the video

- Rooms for specific tasks - routing, compute, storage, maintenance ...
- Communication across multiple DC
- Multiple places for data store
- Virus protection
- Security and data destruction
- Digital tapes for critical data
- Cooling systems

Cloud computing attributes

- Choice of provider
  - Based on business need and partnership models
  - Market competition is good for consumers as it avoids monopoly
- Agility
  - Does classical waterfall model work?
  - Agile development methodology
  - Small iterations and incremental releases
- Open standards
  - Open source
  - Global consortium
- Provisioning
  - Ability to package and deploy to any provider
- Monitoring

Cloud computing attributes

- Technology services are provided at different layers
  - Physical Infrastructure
  - Virtual Infrastructure
  - Software Application
  - Development & Integration Platform
  - Application Components
  - Feature as a Service (REST/JS/WS)

- Services provided via Internet-based networking and large data centers
  - Large facilities
  - Multiple locations
  - Internet bandwidth
  - Power management

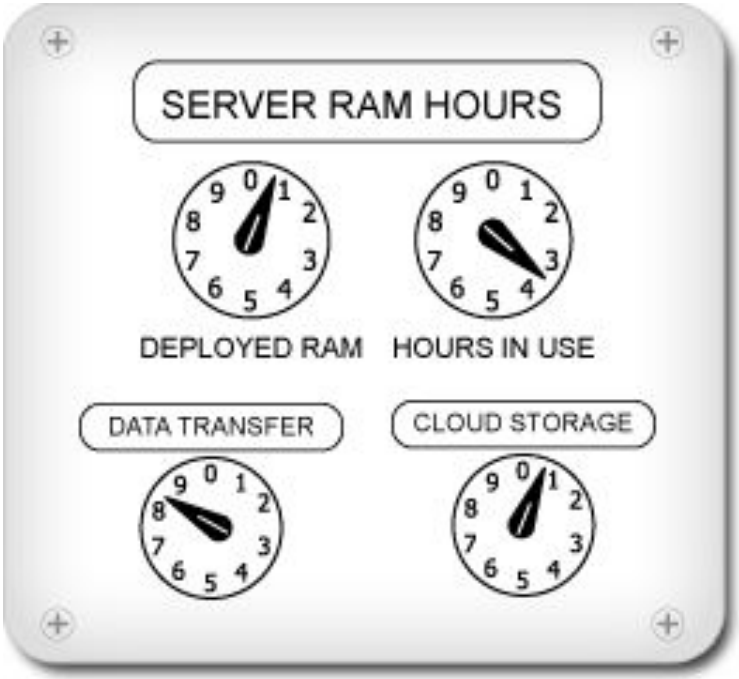
Debate

Analyze these statements -

- From tomorrow everyone needs to pay 2,000/month as electricity charges no matter what.
- Make your CFO spend cash from bottom line

Cloud computing attributes

- Service subscription
  - Customers avoid large upfront capital expense.
  - Pay as an ongoing operational expense.
  - Easily and quickly scale up or down based on business demand and only pay for what is needed (Economies of scale)
  - Better matches today's financial drivers



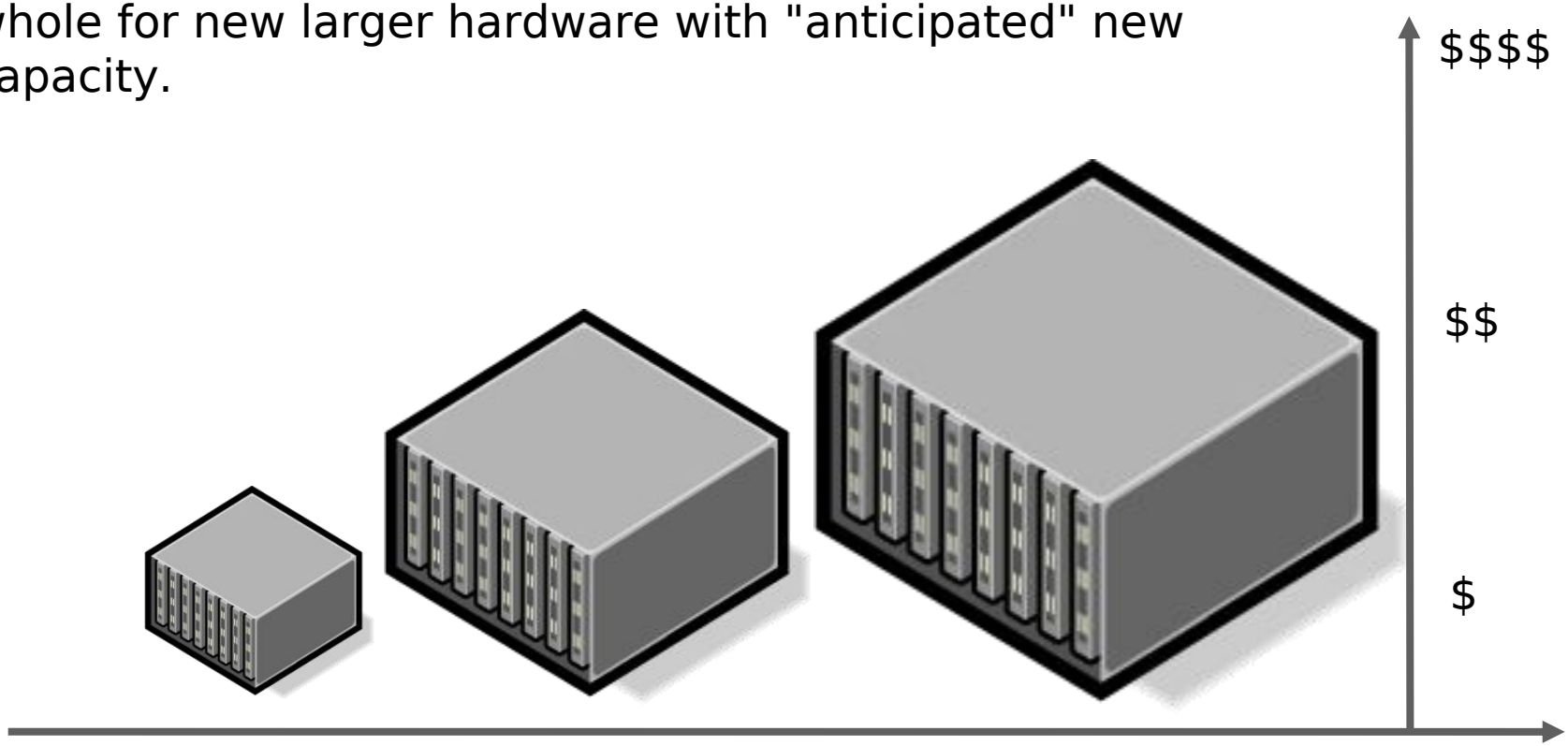
Cloud deployment models

- Public
  - A model where a service provider makes resources, such as applications and storage, available to the general public over the Internet
  - It is hosted and managed by a 3rd party from one or more data centers
  - What does this mean about a customer's data?
- Private (A service provider making computing resources available as a dedicated service to the subscriber)
  - Dedicated - Hosted within a customer's organization
  - Community - Hosted at the data center of a 3rd party
  - Managed - Owned by an organization but managed by a 3rd party
  - Private networking - on public cloud machine instances
- Hybrid
  - A combination of public and private deployment model

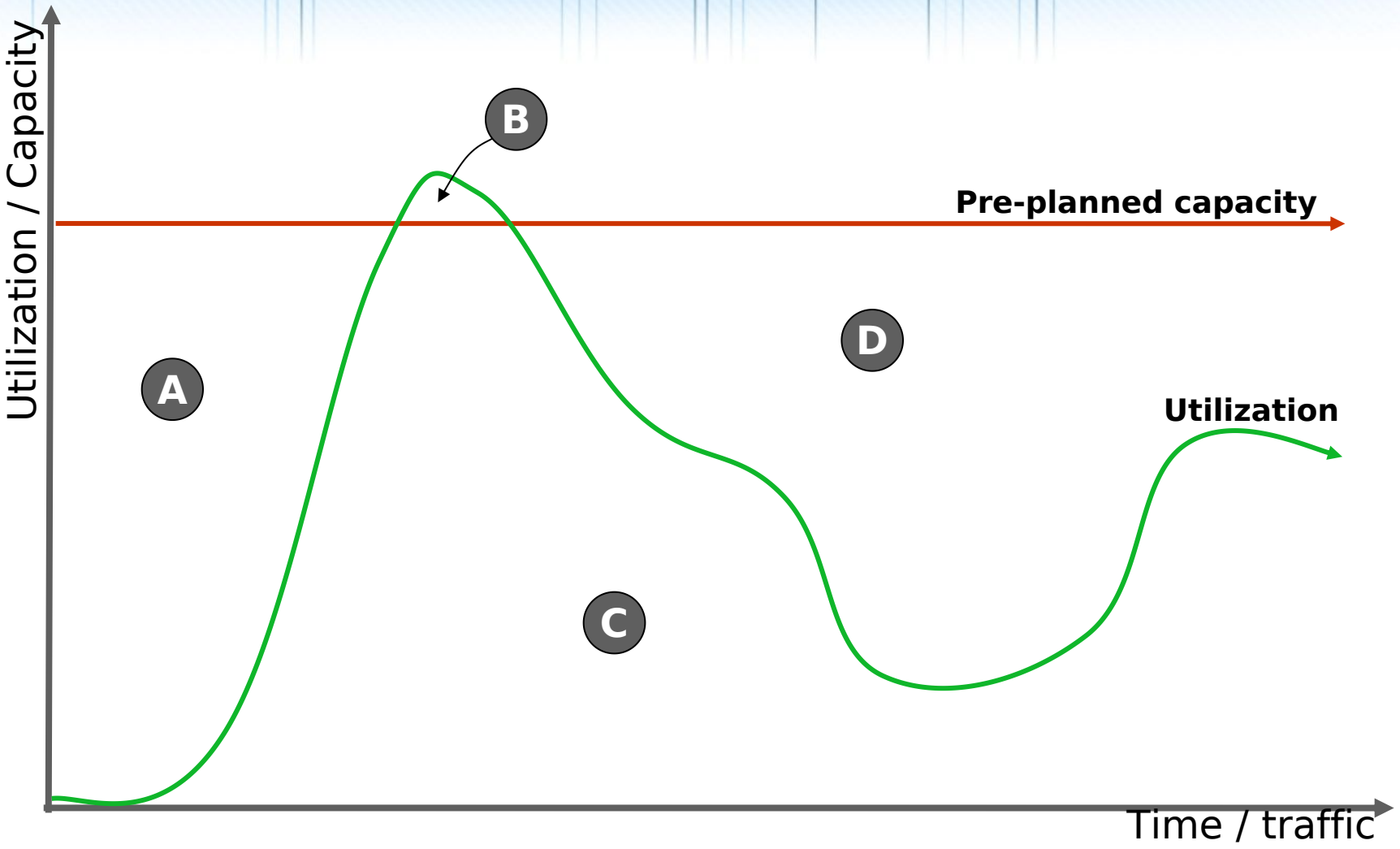
Classic scaling model

Previous generation of application architectures required larger and larger servers to handle capacity needs.

As usage would grow, previous hardware was swapped out whole for new larger hardware with "anticipated" new capacity.



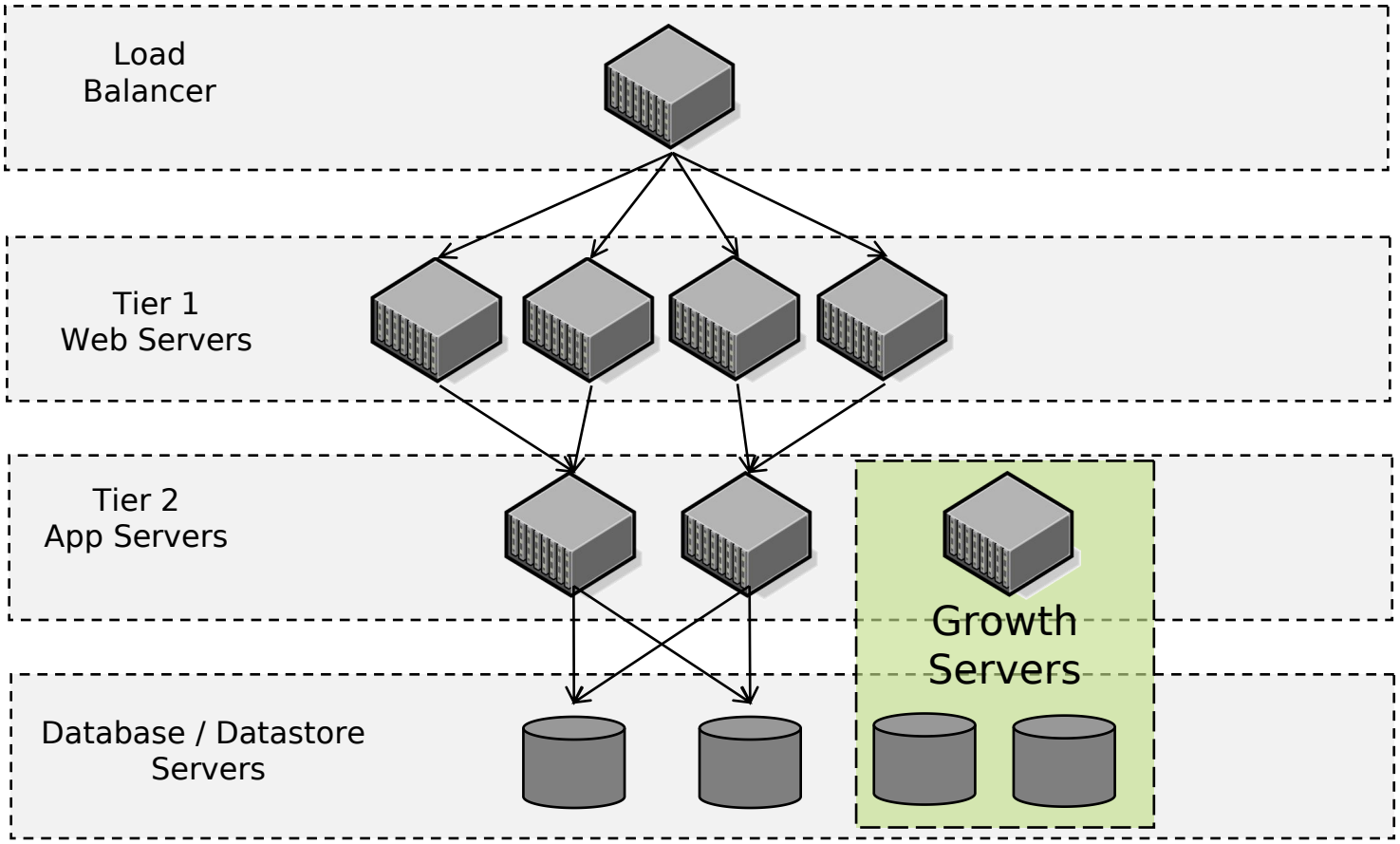
Cost economics - Classical model



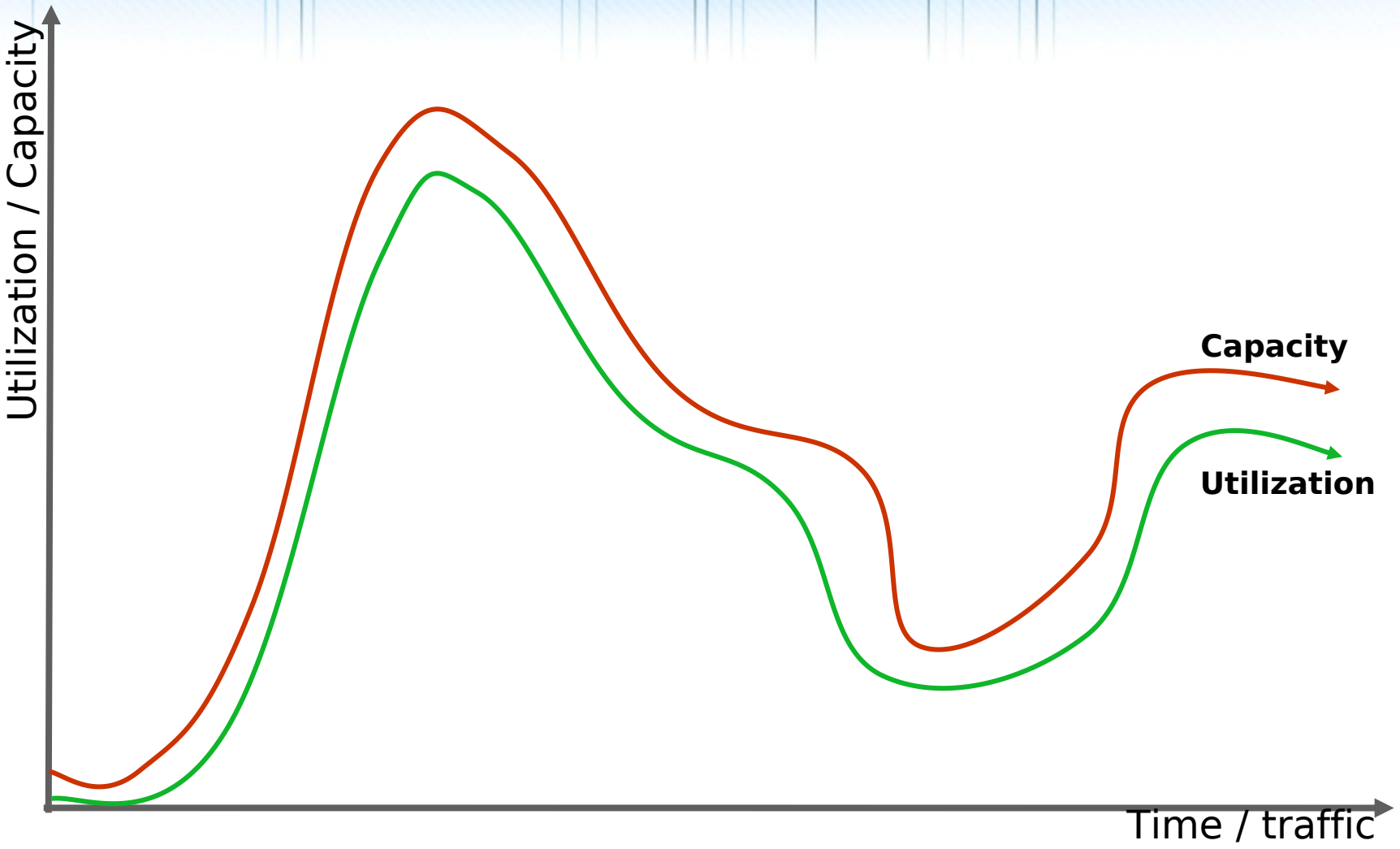
What's happening in areas A, B, C & D? What about OPEX?

New generation scaling - cloud

Modern applications can leverage IaaS or PaaS for scaling only the layers that demand it!



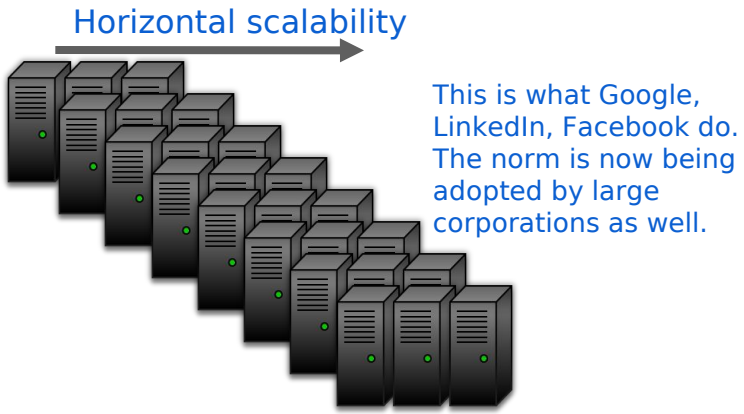
Cost economics - Cloud model



What happened now? Can you articulate the changes?

Commodity vs Specialized hardware

vs



1. Large CAPEX
2. Wasted/Idle resource
3. Failure takes out a large chunk
4. Expensive redundancy model
5. One shoe fitting all model
6. Too much co-existence

1. Low CAPEX (rent on IaaS)
2. Maximum resource utilization
3. Failure takes out a small chunk
4. Inexpensive redundancy
5. Specific h/w for specific tasks
6. Very less to no co-existence

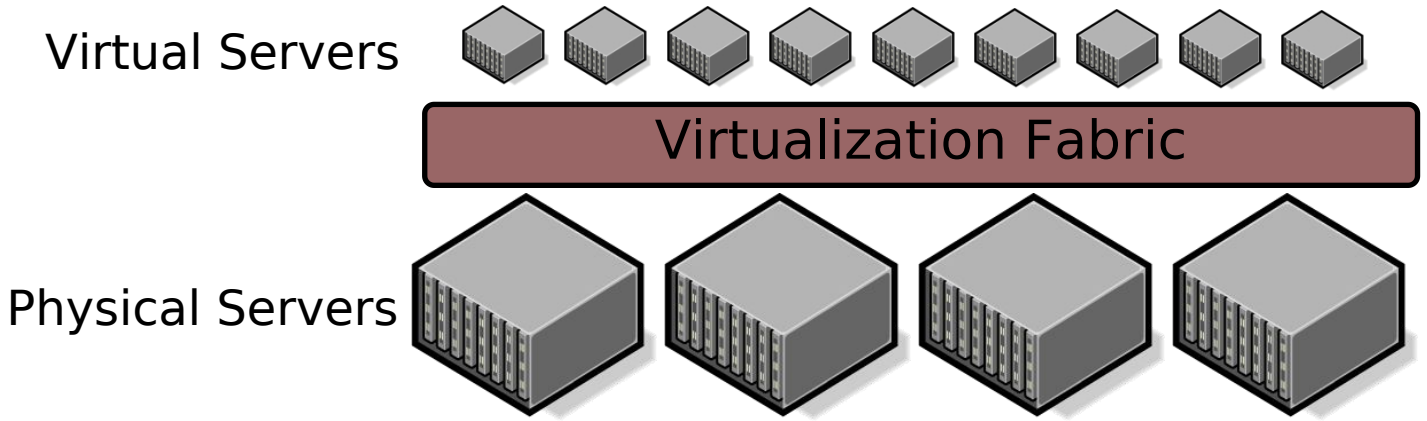
"Just in time" expansion; stay in tune with the load. No need to build ahead in time in anticipation

Distribution of Control between Service Models

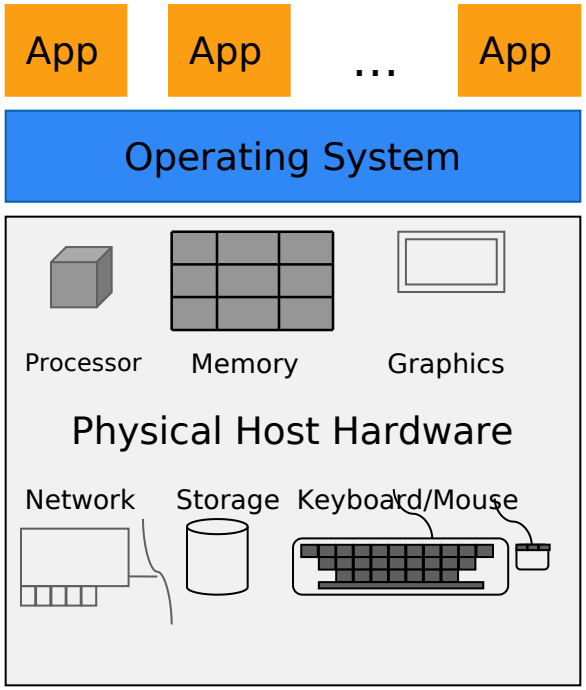
- Decentralized Administration
  - principle of local autonomy, which implies that each service model retains administrative control over its resources
- Secure Distributed Collaboration
  - Due to the heterogeneous nature of the cloud, resource and service policies might use different models requiring seamless interoperation among policies (SLA)
- Credential Federation
  - decentralized single-sign-on mechanism
- Placement of functionality
  - Right provider for the functionality needed in the business process
- Federated Data Collaboration
  - In an interleaved business process it is imminent that data payload is managed
- Loose coupling
  - Services are owned by different providers with their own evolution lifecycle and versioning

Virtualization

- Virtualization of the computing resources, including servers, network, and storage, allows dynamic flexibility.
- Capacity can be more efficiently utilized.
- Quickly add new servers without delay due to procurement or installation.
- Easy to turn on or off virtual servers to handle scalability.
- Physical connectivity is done up front and configuration is done in software at provisioning time.
- Networking equipment and storage is virtualized as well.

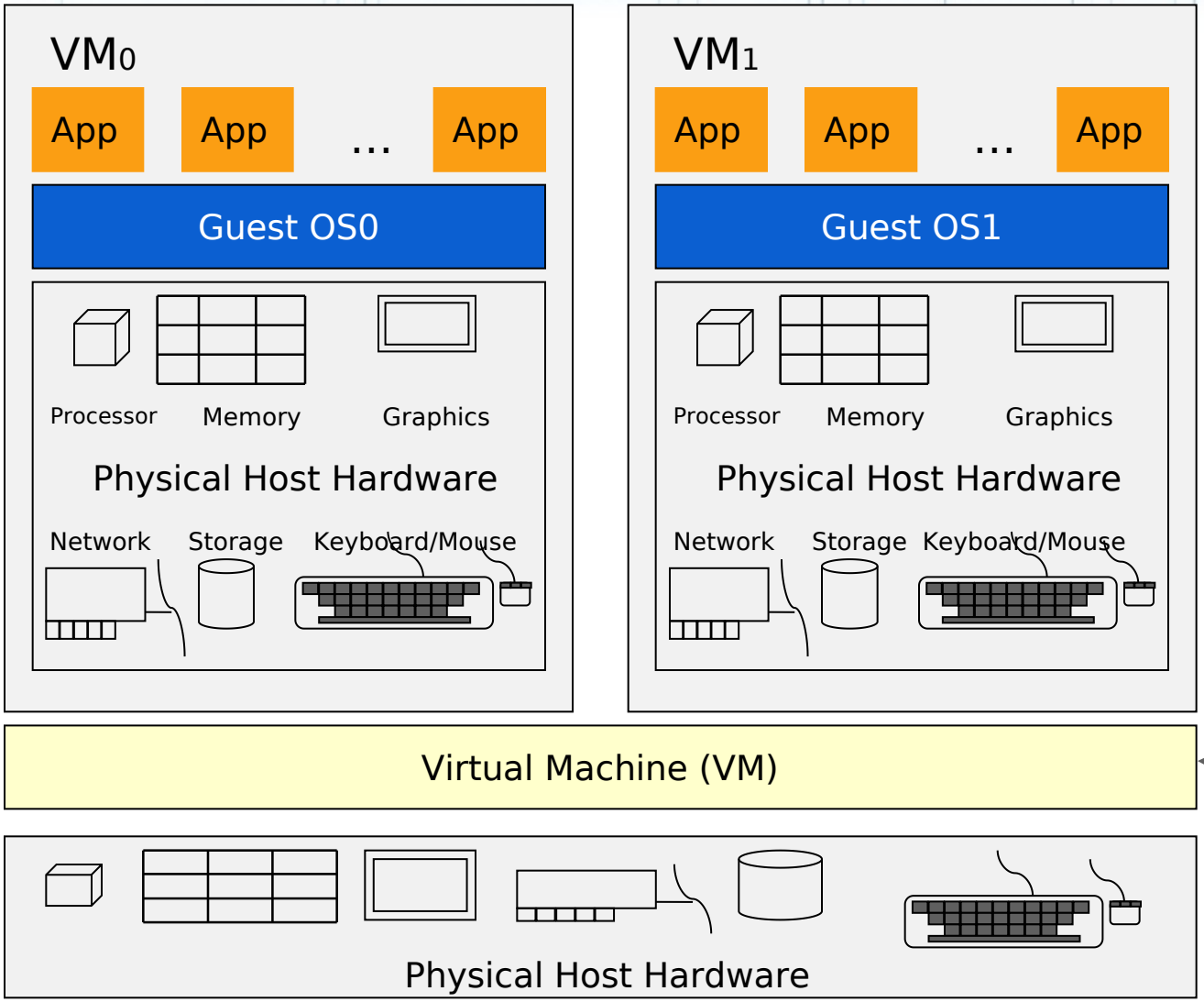


A typical application stack



A single OS owns all physical resources

Virtualized stack



Multiple OS' share physical resources

The new layer

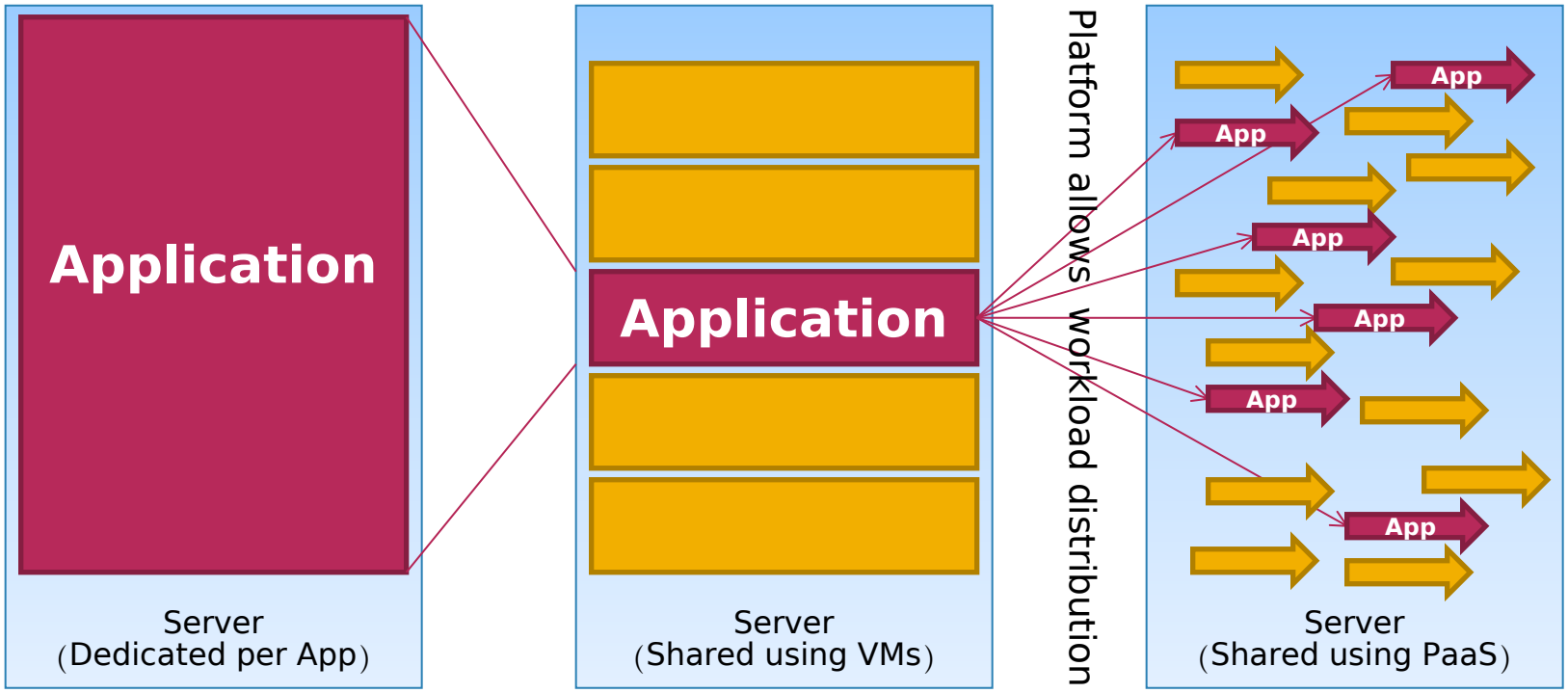
Virtualization characteristics

- Business Perspective
  - Option of infinite computing resources available on demand
  - Elimination of upfront commitment by Cloud users
  - Ability to pay for computing resources on a short term basis as need
  - There are options to acquire compute resources by "auction"

- Technology Perspective
  - All levels should aim at horizontal scalability of virtual machines over the efficiency on a single VM.
  - Application software needs to both scale down rapidly as well as scale up. It needs to cater to location independence of data. Should also support process or thread on the cloud. Such software also needs a pay-for-use licensing model.
  - Infrastructure software needs to be aware that it is not running on bare metal any longer, but on VMs. Needs to have billing built in from the beginning.
  - Hardware systems should factor energy proportionality such as putting idle portions of the memory, disk and network into low power mode. Processors should work well with VMs.

Evolving from IaaS to PaaS

VM allows hardware consolidation ...
but what about the applications?

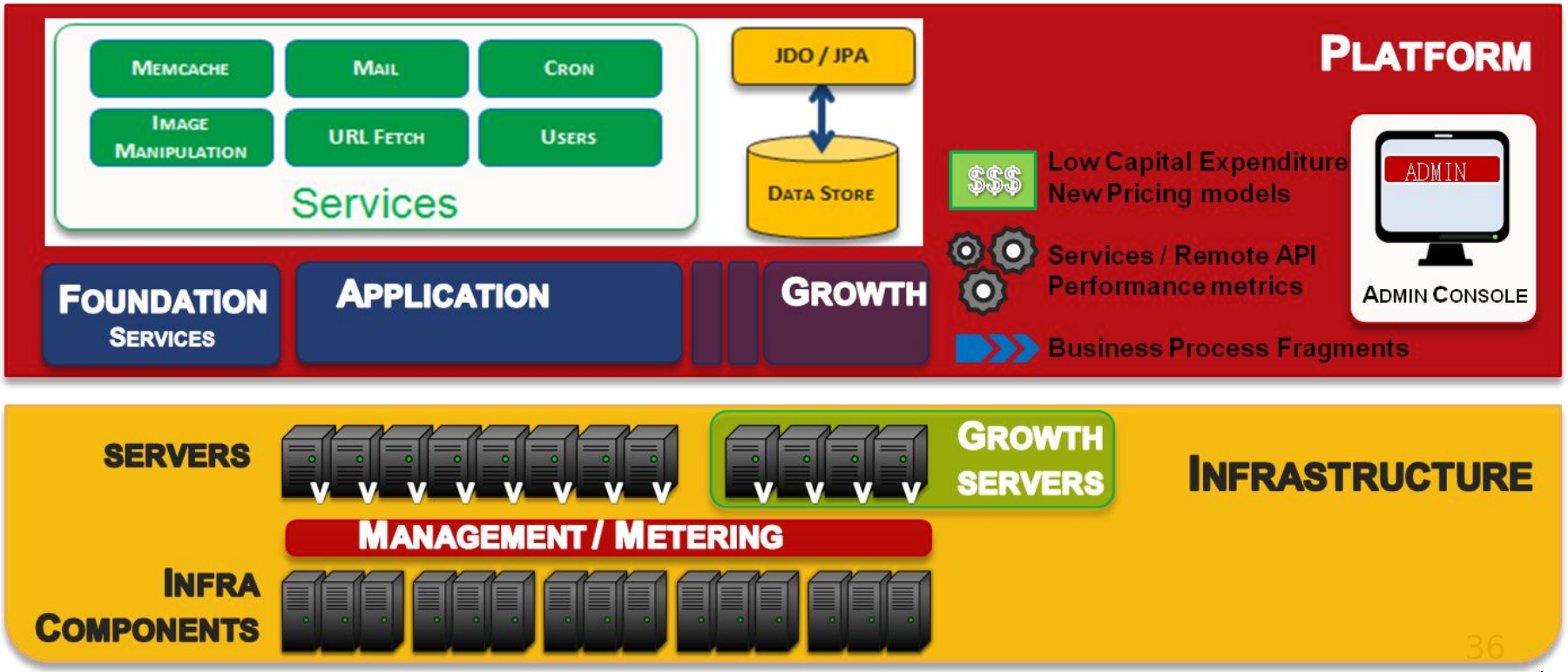


Next gen virtualization

- Is virtualization the most appropriate strategy?
- In the previous example we can deploy at max 5 applications and there is no guarantee that all resources will be fully utilized
- Virtualization gives "pre-defined" buckets, is there something that can provide "on-demand" buckets?
- Container based virtualization is the contemporary option being adopted by most PaaS cloud players
- Container virtualization will be discussed a bit later during IaaS, hang on ... ☺

PaaS overview

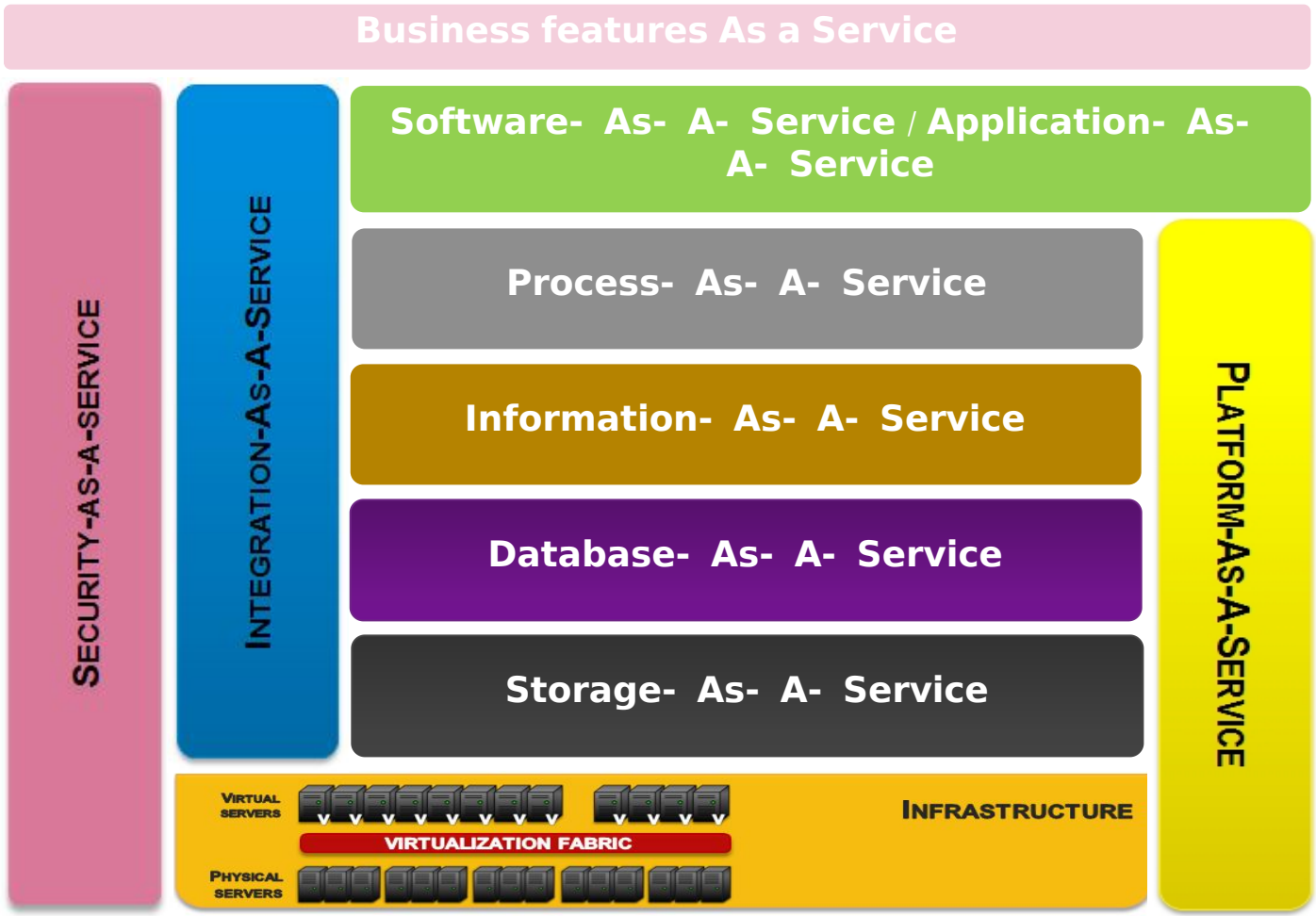
- Needs an operational IaaS to be "effective"
- Abstracts the infrastructure layer completely
- Provides monitoring at two levels
  - Infrastructure
  - Application



Cloud and Open Source

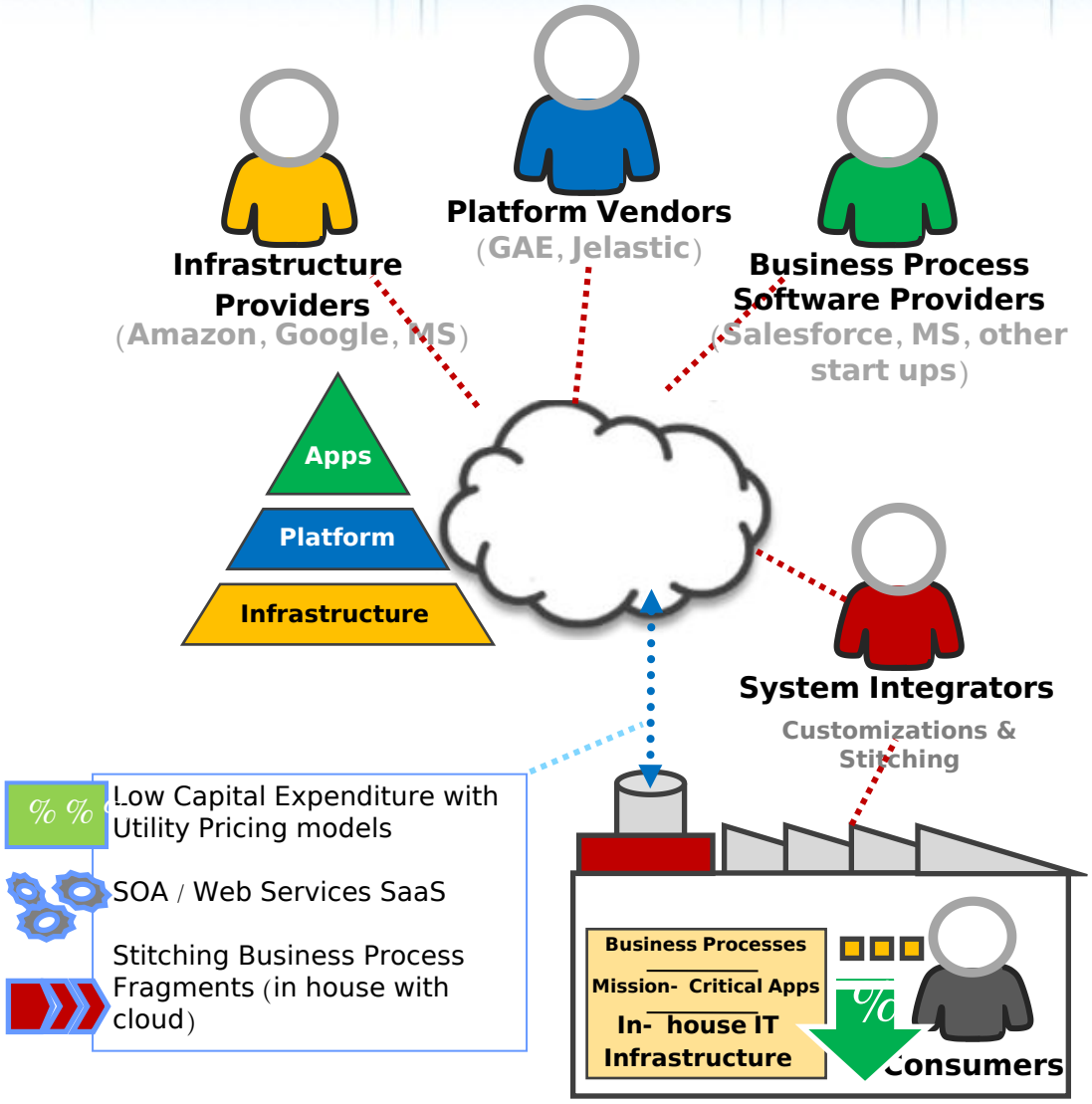
- Operating system
- Languages
- Development environments
- Build and code control tools
- Containers
- Management products
- Monitoring tools
- Specialized libraries (eg machine learning etc)

Cloud services taxonomy



SaaS
PaaS
IaaS

Overview of the ecosystem

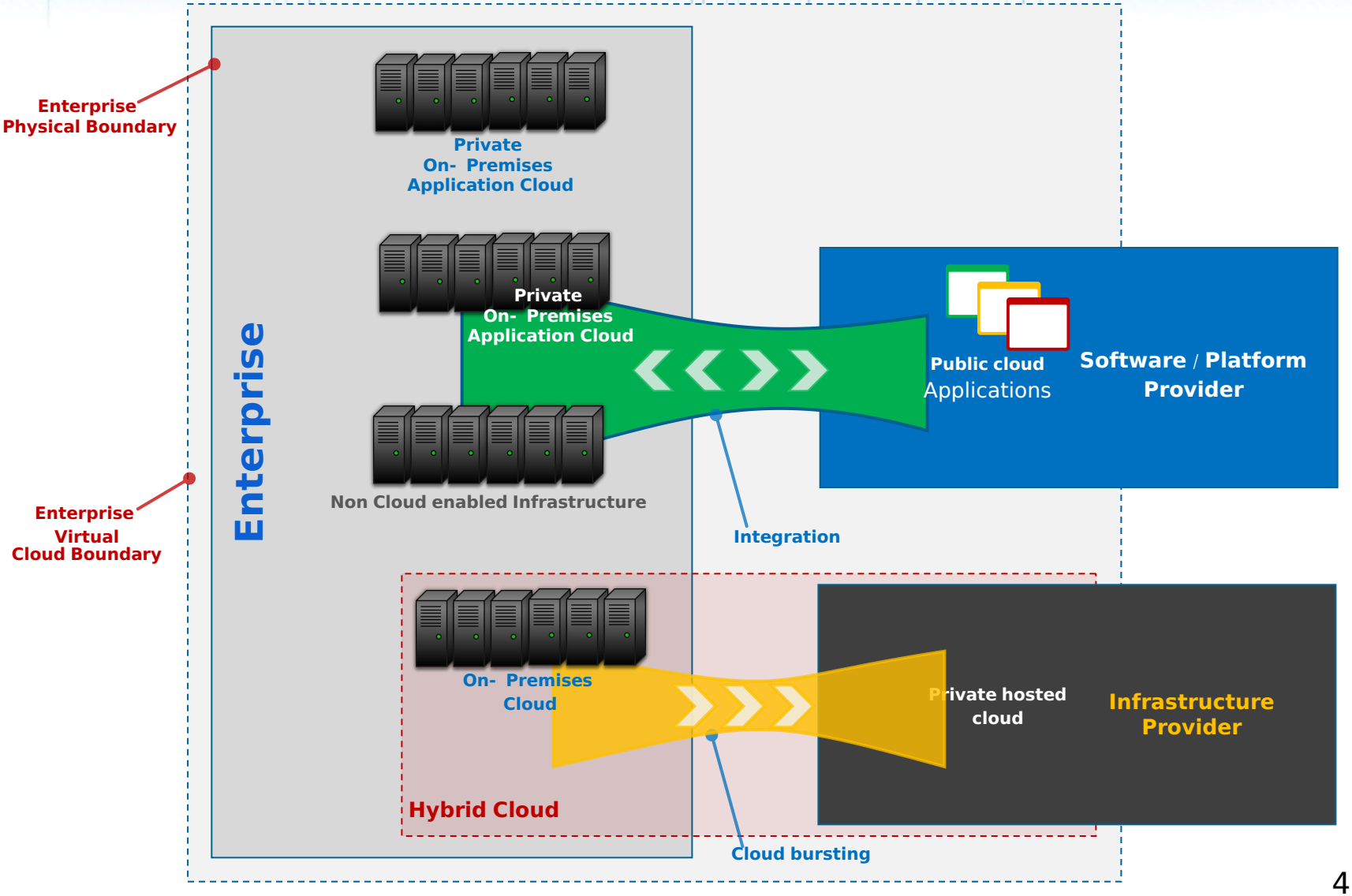


Not all applications can be or should be moved to the cloud.

The real success is to have the right blend that results in business benefits and ease in technology.

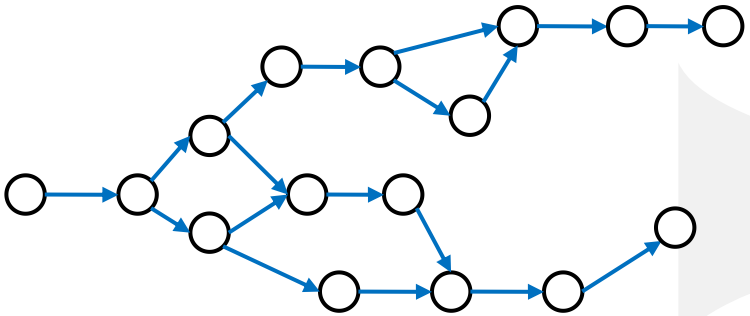
All this is to be considered keeping in view the organization's growth roadmap.

Enterprise cloud deployment



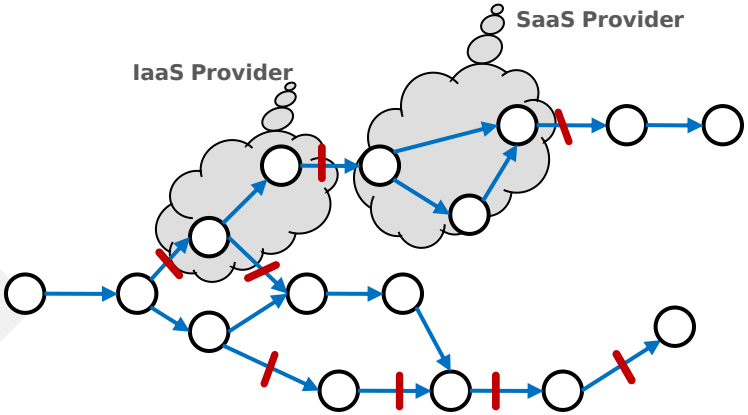
Enterprise Process Integration

As- Is
Enterprise Business Process



100% on/ premises
0% cloud enabled

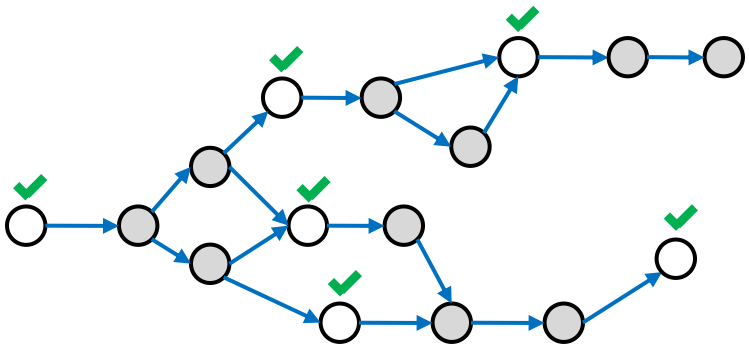
To- Be
Enterprise Business Process



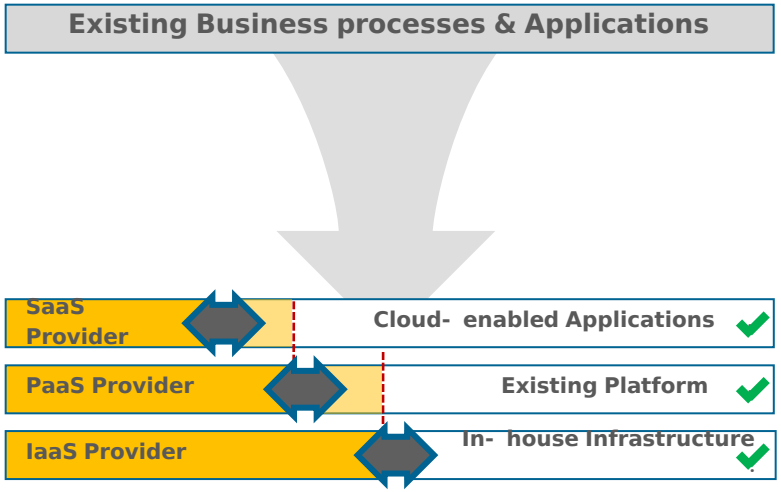
Fully integrated, optimal mix of on/ cloud and off/ cloud environments

◯Business Process Step / Fragment | Integration Point

Migration maturity index



Maturity can be calculated based on the percentage of business processes within an organization that have been evaluated for and migrated to the optimal cloud enabled option

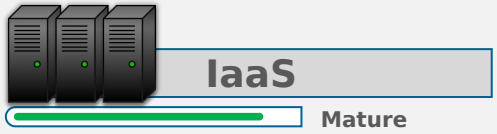


Migration maturity = Evaluated and migrated : Unevaluated

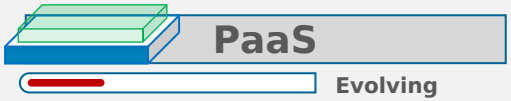
Cloud adoption level = Cloud- enabled applications : Applications left as is

Cloud adoption strategies

Cloud layers



Vendors have existed for a while and provide proven technologies and Infrastructure options. Amazon, Rack space etc are solutions in this area. Assists customers with additional capacity on demand.

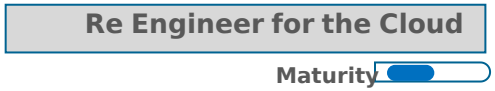


Vendors and “Platforms” are evolving currently. Vendors are yet to provide proven support for transaction/ intensive applications. Most platforms are nascent and provide basic web application support.

Several vendors and software services exist and the market and breadth of these application services is increasing. Applications range from basic Office productivity solutions to niche business function.

Adoption approaches

Approach suitable for applications that can be hosted on a cloud provider’s premises without much changes. Provides immediate benefits as application runs on the providers infrastructure.



Suitable for applications that still have a lifetime and need minimal re engineering to adapt to the cloud. Provides extended benefits through reduced operational costs and improved scalability and associated cloud benefits

Suitable for new application development where the application can be built specifically to make use of the cloud platforms.

Cloud transition - App evaluation

Application Aspect	Application Trait	Cloud Transition
Business Functionality	Commodity	In House → Cloud
	Strategic Differentiator	In-House ← Cloud
	Supporting Function	In- House ↔ Cloud
	Evolving / Maintain	In- House ↔ Cloud
	New Business / Invest	In- House → Cloud
Non- Functional	Data Confidentiality	In-House ← Cloud
	Security	In-House ← Cloud
	Performance / Scale Out	In- House → Cloud
	Availability	In- House → Cloud
	Governance / Audit	In-House ← Cloud
Technology	Legacy	In-House ← Cloud
	Web Based	In- House → Cloud
	Client Server	In- House ↔ Cloud

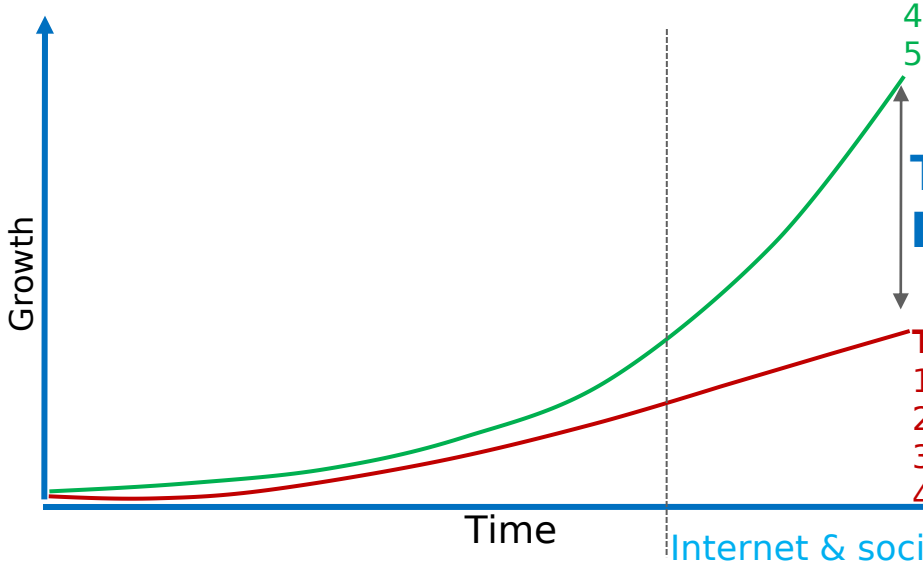
Evaluate Further

Price economics

- Accounting says: Profit = Revenue - Costs
- Cloud allows you to control and monitor the ops costs
- What about pricing model? How can cloud influence it?
- Let's see how price is arrived at
  - Cost based pricing
  - Value based pricing
- Cost based
  - Cost of building product
  - Cost of maintaining the product
  - Providing support for the product
  - Other factors that may be specific to the product as well as the organization
  - Charging for services offered and/or enhanced
  - Pass through costs can find a way in the product price
- Value based
  - Customer perception about the product
  - What values customer derives from the product
  - Longevity of the product
  - Recognizable name associated with luxury
- To get to all of the above we need "Information velocity" ... next

Data to Information xform velocity

Business wants
1. Business agility
2. Data proliferation
3. User generated content
4. Social, near real time analysis
5. Utility based pricing, pay as you go, Low CAPEX



Technology Lag / Delayed insights

Traditional IT
1. Traditional licensing model
2. Large initial CAPEX
3. Pre-planning
4. Batch, time lag to insights

To stay several steps ahead of the competition organizations all over the world are asking a simple question

"Can we get some insights out of our data? Quickly please!"

Price economics

- Can the price of the product be constant/static?
- Does information velocity have a bearing on the rate of price change?
- How can we maximize margins?
  - Alteration to price, popularity based etc
  - Cost of dependent services/api do not remain constant
  - Get analytics quickly
  - Reliability of data and its availability
  - Accessibility of information anytime/anywhere for agile business decisions
  - Accessing business applications to take quick actions

Designing applications for cloud

- Evaluate enterprise architecture impact
- Choice of the right service provider
- Defining the business process and integration touch points
- Security fabric cutting across all providers
- Think stateless, adapters, foundation
- Micro service approach

Challenges with Distributed Computing

- Heterogeneity
- Fault handling
- Consistency
- Clock synchronization
- Global concurrency
- Upgrades and maintenance
- Local resources - file system
- Application sessions & transient data

Data storage compliance

- Driven by compliance regulations such as
  - HIPAA in USA
  - Data Protection Directive in EU
- Data sensitivity - Financial / Medical
- Driven by a sense of "Complete control" as realized by on-premise
- Legal issues with data residency depending on where the data is physically stored off-premise
- Data archival policy impact

Debate - Data usage / ownership

- Cloud providers have APIs to get access to the data
- Social has created a scenario where the data is easily accessible and open
- Let's analyze an example
  - YouTube allows APIs to get access to data (assume publicly available data)
  - The data is created by the anyone in the world
  - Mine the data and extract attributes
  - Create our own database
  - Create and sell APIs leveraging the data
- Is this business model valid?
  - If yes then why?
  - If no then why?

Debate - How to interpret this?

From: Dropbox [no-reply@dropboxmail.com] Sent: Sat 02-05-2015 AM 03:31
To: nirmallya.mukherjee@gmail.com
Cc:
Subject: Update: Changes to better serve our users around the world

Hi there,

If you're a user living outside of North America (U.S., Canada, Mexico), we're updating our Terms of Service to better serve you and the growing number of Dropbox users around the world. These changes include the fact that we'll be providing our services (including Dropbox, Dropbox for Business, Carousel, and Mailbox) to you via Dropbox Ireland starting on June 1, 2015. Please note that none of our services or features are changing as a result of this. You can read the updated terms at https://www.dropbox.com/terms.

Have questions about these changes? Visit our Help Center.

Thanks for using Dropbox!
The Dropbox Team

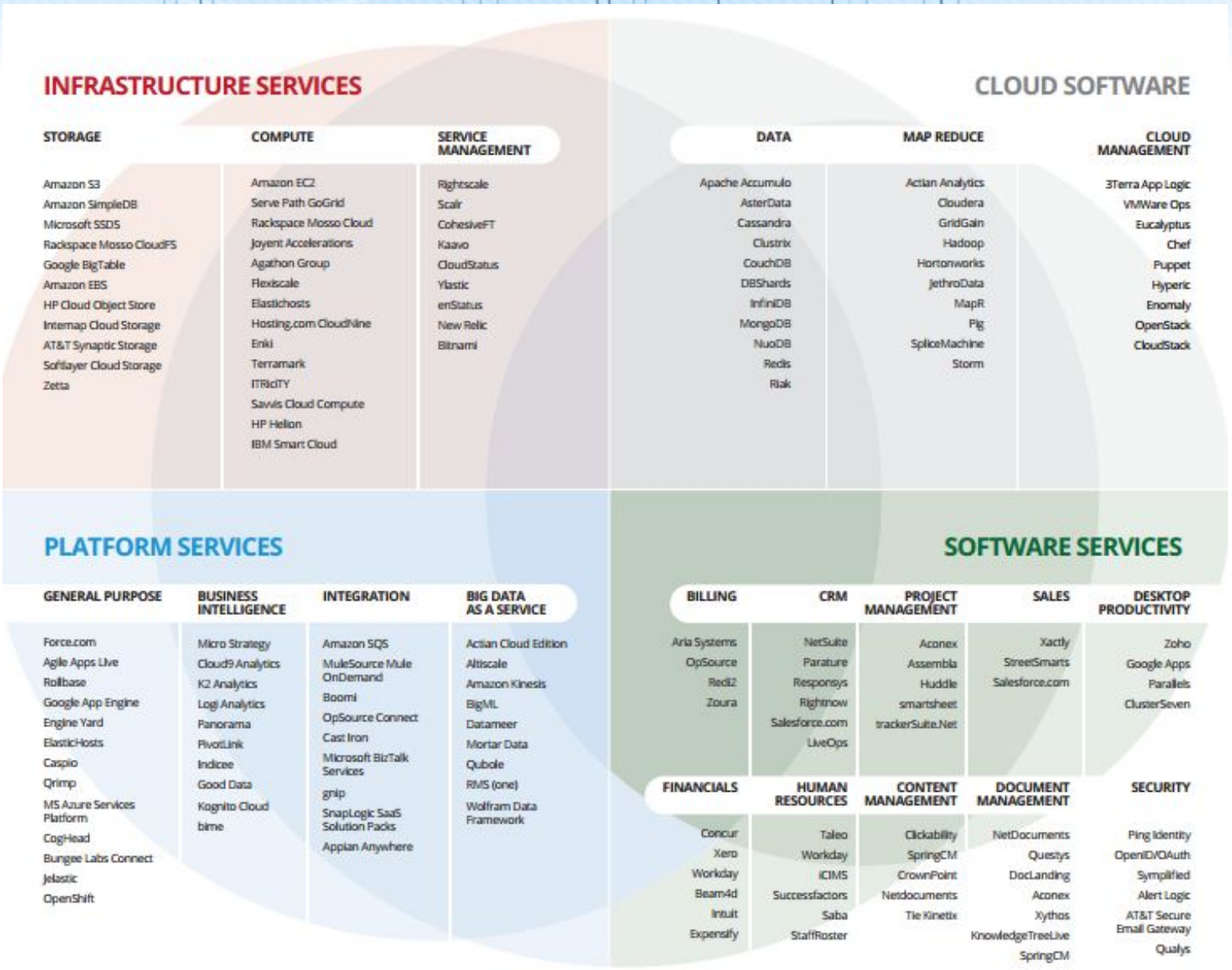
Cloud computing concerns & recommendations

- Progressive Architecture Development is where the overall architecture vision is broken into piece meal and developed over a period of time. The cloud approach should follow a similar approach.

- This is particularly important because the cloud applications space is still maturing barring a few select players. The following are the typical impediments perceived by organizations when it comes to cloud application implementations.

- Current enterprise apps can't be migrated conveniently
- Lock in with proprietary architecture
- Risks – Legal, regulatory, and business
- Difficulty of managing cloud applications
- Lack of clarity of SLA ownership
- Unclear ROI

Cloud provider overview



INFRASTRUCTURE SERVICES

STORAGE

- Amazon S3
- Amazon SimpleDB
- Microsoft SSDS
- Rackspace Mosso CloudFS
- Google BigTable
- Amazon EBS
- HP Cloud Object Store
- Internap Cloud Storage
- AT&T Synaptic Storage
- Softlayer Cloud Storage
- Zetta

COMPUTE

- Amazon EC2
- Serve Path GoGrid
- Rackspace Mosso Cloud
- Joyent Accelerations
- Agathon Group
- Flexiscale
- Elastichosts
- Hosting.com CloudNine
- Enki
- Terramark
- ITRIcITY
- Savvis Cloud Compute
- HP Helion
- IBM Smart Cloud

SERVICE MANAGEMENT

- Rightscale
- Scalr
- CohesiveFT
- Kaavo
- CloudStatus
- Ylastic
- enStatus
- New Relic
- Bitnami

CLOUD SOFTWARE

DATA

- Apache Accumulo
- AsterData
- Cassandra
- Clustrix
- CouchDB
- DBShards
- InfiniDB
- MongoDB
- NuoDB
- Redis
- Riak

MAP REDUCE

- Actian Analytics
- Cloudera
- GridGain
- Hadoop
- Hortonworks
- JethroData
- MapR
- Pig
- SpliceMachine
- Storm

CLOUD MANAGEMENT

- 3Terra App Logic
- VMWare Ops
- Eucalyptus
- Chef
- Puppet
- Hyperic
- Enomaly
- OpenStack
- CloudStack

PLATFORM SERVICES

GENERAL PURPOSE

- Force.com
- Agile Apps Live
- Rollbase
- Google App Engine
- Engine Yard
- ElasticHosts
- Caspio
- Qrimp
- MS Azure Services Platform
- CogHead
- Bungee Labs Connect
- Jelastic
- OpenShift

BUSINESS INTELLIGENCE

- Micro Strategy
- Cloud9 Analytics
- K2 Analytics
- Logi Analytics
- Panorama
- PivotLink
- Indicee
- Good Data
- Kognito Cloud
- bime

INTEGRATION

- Amazon SQS
- MuleSource Mule OnDemand
- Boomi
- OpSource Connect
- Cast Iron
- Microsoft BizTalk Services
- gnip
- SnapLogic SaaS Solution Packs
- Appian Anywhere

BIG DATA AS A SERVICE

- Actian Cloud Edition
- Altiscale
- Amazon Kinesis
- BigML
- Datameer
- Mortar Data
- Qubole
- RMS (one)
- Wolfram Data Framework

SOFTWARE SERVICES

BILLING

- Aria Systems
- OpSource
- Redi2
- Zoura

CRM

- NetSuite
- Parature
- Responsys
- Rightnow
- Salesforce.com
- LiveOps

PROJECT MANAGEMENT

- Aconex
- Assembla
- Huddle
- smartsheet
- trackerSuite.Net

SALES

- Xactly
- StreetSmarts
- Salesforce.com

DESKTOP PRODUCTIVITY

- Zoho
- Google Apps
- Parallels
- ClusterSeven

FINANCIALS

- Concur
- Xero
- Workday
- Beam4d
- Intuit
- Expensify

HUMAN RESOURCES

- Taleo
- Workday
- iCIMS
- Successfactors
- Saba
- StaffRoster

CONTENT MANAGEMENT

- Clickability
- SpringCM
- CrownPoint
- Netdocuments
- Tie Kinetix

DOCUMENT MANAGEMENT

- NetDocuments
- Questys
- DocLanding
- Aconex
- Xythos
- KnowledgeTreeLive
- SpringCM

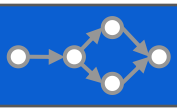
SECURITY

- Ping Identity
- OpenID/OAuth
- Symplified
- Alert Logic
- AT&T Secure Email Gateway
- Qualys

http://cloudtaxonomy.opencrowd.com/static/cloudtaxonomy/pdf/cloud_taxonomy_arch.pdf

Seeding the cloud in the enterprise

Enterprises can seed their cloud initiative at three distinct levels

1  **Strategy for the Enterprise Cloud**

2  **Applications Cloud Roadmap**

3  **Application Implementation**

1. **Recognize which part of the business is ideally suited for cloud**
2. **Identify pilot business unit**

1. **Determine the plausible application zone**
2. **Determine target pilot audience & objectives**

1. **A specific application**
2. **Chosen technology**

Internet of Things (IoT)

The Internet of Things (IoT) is the network of physical objects or "things" embedded with electronics, software, sensors and connectivity to enable it to achieve greater value and service by exchanging data with the manufacturer, operator and/or other connected devices.

-Wikipedia

How do these work?

- Interactive smart tables
- Smart refrigerators
- Smart air conditioners
- Mood based Ambiance
- Smart water heaters
- Control window shades from IP phones
- Google Brillo
- Mars robots!

Google Brillo

- Let's see this
  - https://developers.google.com/brillo

Want to see an example?

- While we cannot get access to the Mars rovers, we can have access to our own!
- Let's play ...

The pinnacle of cloud computing

National Security Administration (NSA) of USA

- https://www.nsa.gov/ia/_files/factsheets/i43v_slick_sheets/slicksheet_cloudsecurityconsiderations_web.pdf
- https://www.nsa.gov/research/_files/publications/cloud_computing_overview.pdf
- Probably the pinnacle of private cloud is NSA http://www.networkworld.com/article/2687084/security0/exclusive-inside-the-nsa-s-private-cloud.html
- Openstack is used by NSA http://fedscoop.com/inside-nsas-data-protection-cloud-strategy
- http://www.androidauthority.com/nsa-creates-android-based-spy-phones-59330/

Closing thoughts

"*Cloud computing as a concept glues together several other, often independent, concepts in a complimentary way to open up new operating models and opportunities for various industries.*

Cloud Computing has evolved from, and extends, several concepts that have been around for some time, such as SaaS, utility Computing, Grid Computing, Virtualization, Real-Time Infrastructure, Web Platforms, and SOA."