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Face the Future with Confidence

CLOUD SECURITY OVERVIEW

Eric Winton

AGENDA

Cloud Overview

Cloud - Common Vendors

Cloud - Security Risks

Cloud - Internal Audit Considerations

Conclusion

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CLOUD OVERVIEW

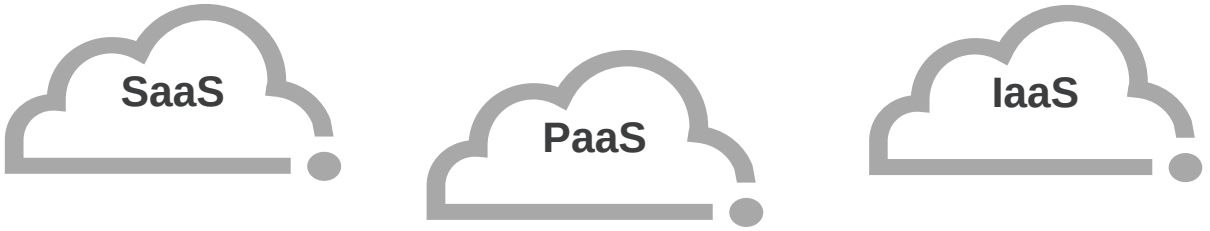
CLOUD COMPUTING OVERVIEW

According to **National Institute of Standards and technology (NIST)**, “Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential **characteristics**, three **service models**, and four **deployment models**.”

Essential Characteristics

- **On-demand self-service**
- **Broad network access**
- **Resource pooling**
- **Rapid elasticity**
- **Measured service**

Service Models



Deployment Models

Source: NIST- Cloud Computing

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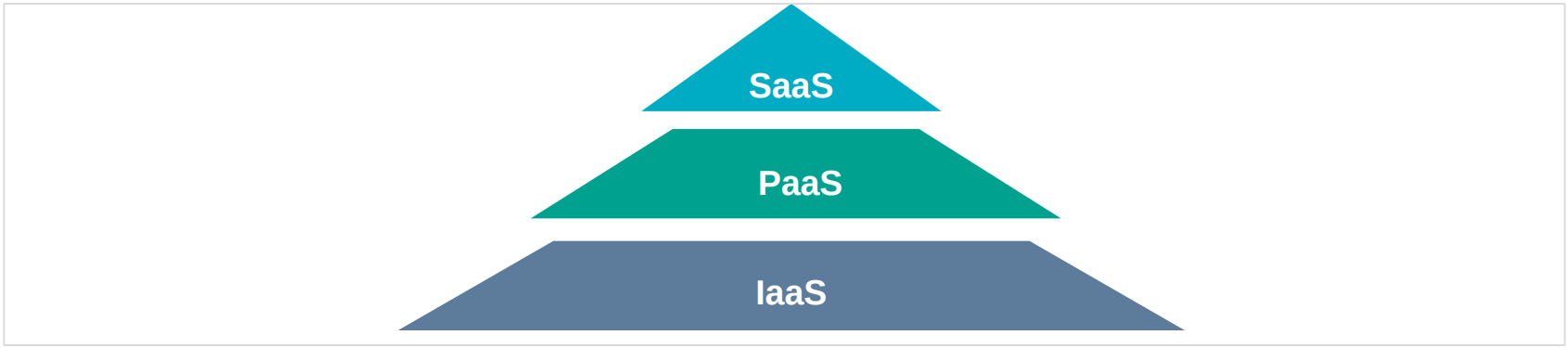
CLOUD COMPUTING SERVICE MODELS



Cloud Computing Service Model

Software as a Service (SaaS)

In this model, a complete application is offered to the customer, as a service on demand. It is the topmost layer of service model.

Platform as a Service (PaaS)

PaaS can be defined as a computing platform that allows the creation of web applications quickly and without the complexity of buying and maintaining the software and infrastructure underneath it.

Infrastructure as a Service (IaaS)

Infrastructure as a Service (IaaS) is a way of delivering Cloud Computing infrastructure – servers, storage, network and operating systems – as an on-demand service.

Source: Rackspace- Cloud Computing, IJMCR- An Overview of Cloud Computing Service Models

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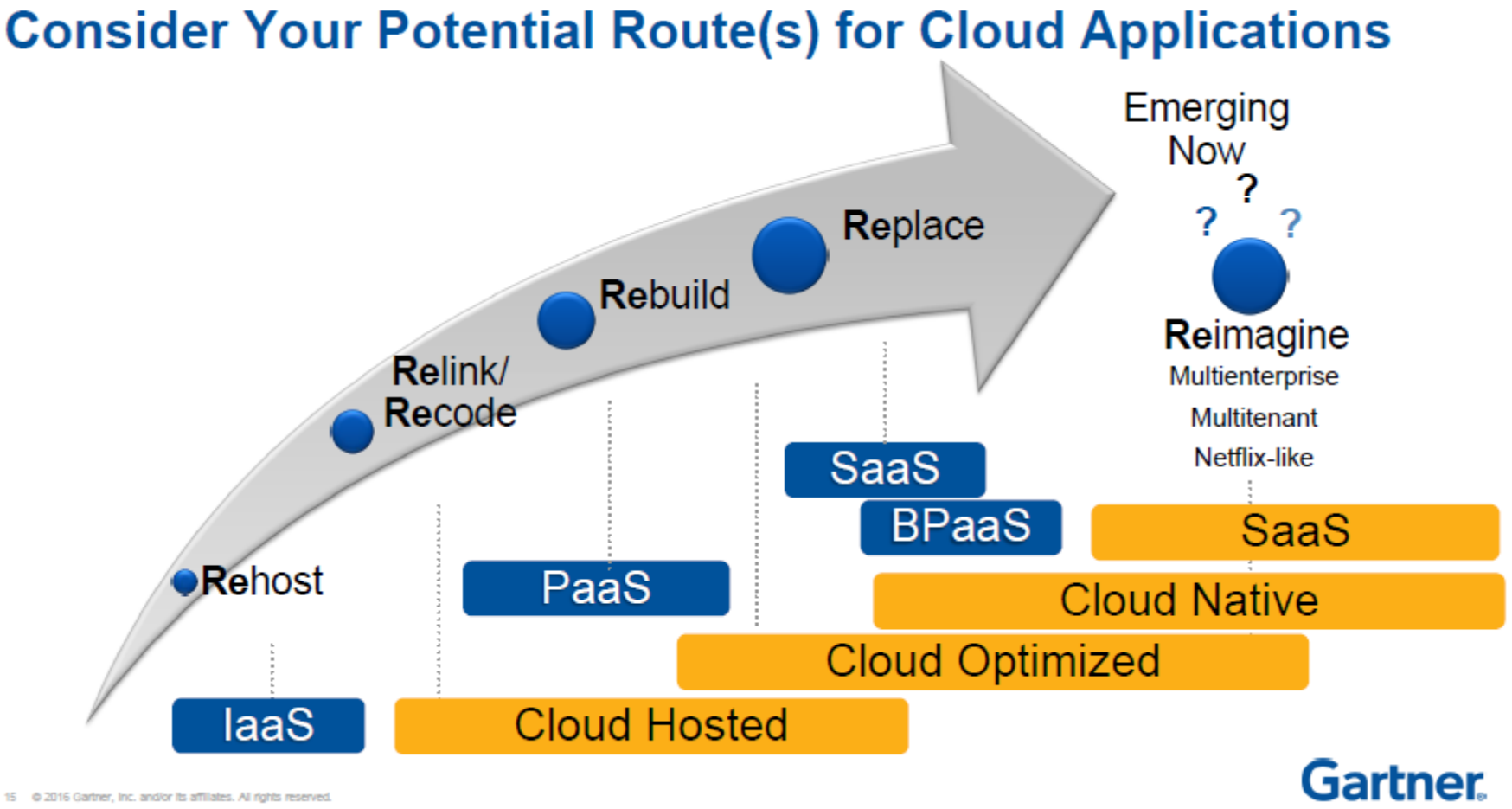
APPLICATION OF CLOUD MODELS



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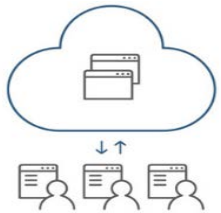
CLOUD COMPUTING DEPLOYMENT MODELS

Private Cloud

It is also known as internal cloud or on- premise cloud, a private cloud provides a **limited access to its resources and services** to consumers that belong to the same organization that owns the cloud.

Public Cloud

It is also known as external cloud or multitenant cloud. It is **available and open used by general public**.



Hybrid Cloud

It is **composition of two or more distinct cloud infrastructure(private or public)** but are bound together by standardized technology that enable data and application portability.

Source: IJARCSSE- An Overview of Cloud Computing

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KEY CLOUD MARKET TRENDS

The below trends are constantly evolving, and our approach to assessing cloud migration strategies take these and other trends into account.

- Cloud has matured to become an enterprise class solution.
- Business and IT agility and transformation are increasingly drivers of Cloud adoption.
- Operational efficiency and effectiveness – shifting CapEx to OpEx, reducing/eliminating data center operations, elastic capacity – remain key drivers of Cloud adoption.
- Data and analytics capabilities are rapidly moving to the Cloud.
- Maturing security capabilities have largely eliminated security as a primary deterrent of Cloud adoption.
- Industry and geographic considerations – regulatory differences, infrastructure (network) reliability – can be critical concerns.
- Financial Services companies looking to modernize their core computing platforms, digitize their processes, and respond to (or incorporate) Fintech advances are also driving the demand for Cloud consulting.
- IT Governance and Risk Management is not keeping up with the pace of change – vendor risk management, unmanaged Cloud "sprawl" (shadow IT), changing business continuity management considerations (positive and negative), information management, etc.

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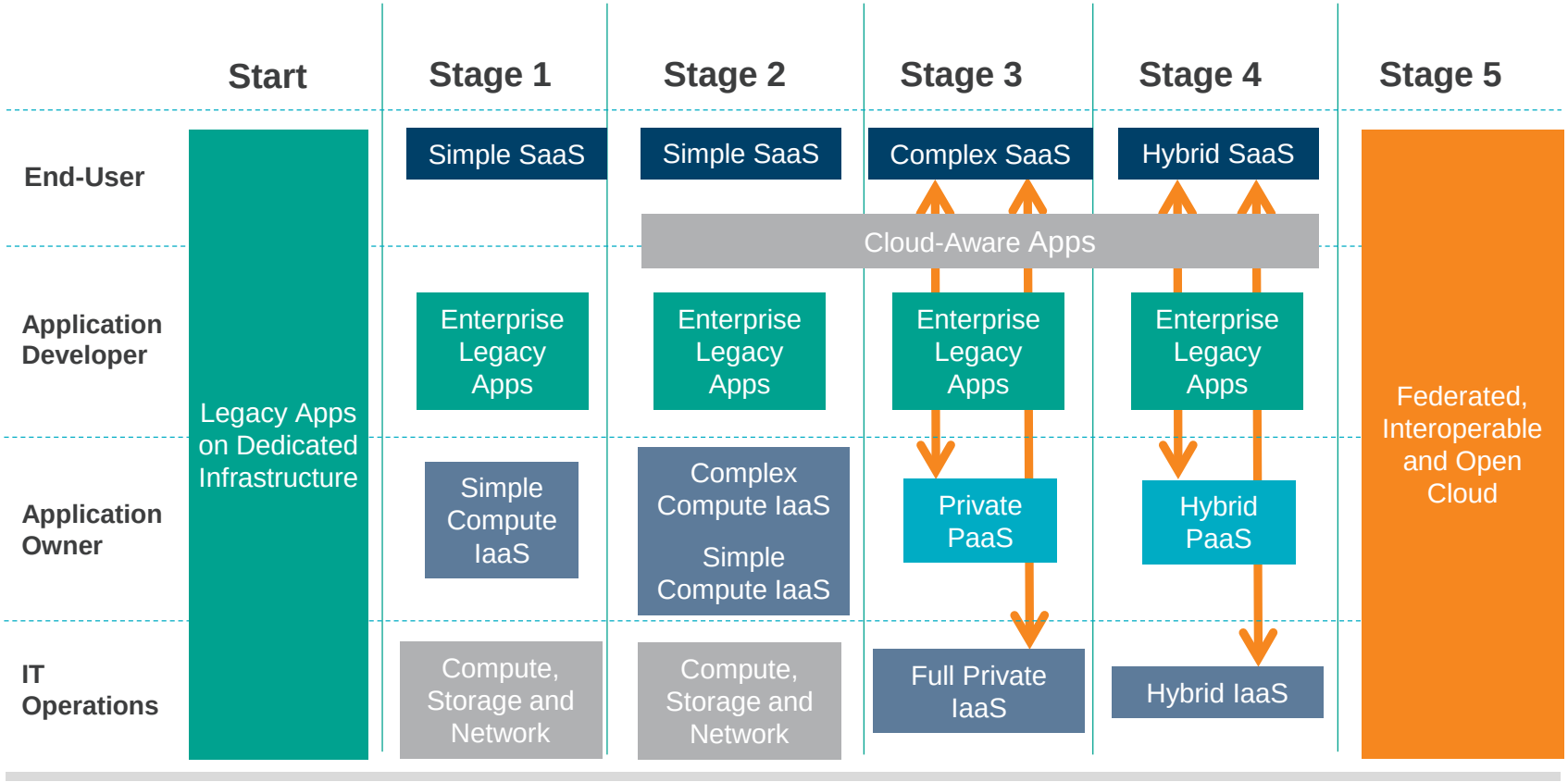
CLOUD ADOPTION ROADMAP

The cloud adoption roadmap provides an end-to-end visualization for how the technical use of cloud technologies in the enterprise develops over time. As technical implementation matures, the use of cloud becomes more sophisticated, comprehensive, and optimized. Based on ODCA industry experience, many large enterprises are progressing using the same overall trajectory but at different rates of adoption. A typical technical adoption roadmap is represented below.



Source: Open Data Center Alliance Usage Model: Cloud Maturity Model Rev 2.5

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CLOUD - COMMON VENDORS

COMMON VENDORS

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MAJOR CLOUD PROVIDERS

Magic Quadrant for Cloud Infrastructure as a Service, Worldwide	
AWS	Leader
Microsoft	Leader
Google	Visionary

Evaluation Criteria	Weighting
Product or Service	Leader
Overall Viability	Visionary
Sales Execution/Pricing	Medium
Market Responsiveness/ Record	High
Marketing Execution	Operations
Customer Experience	Operations
Operations	Operations

Source: Gartner

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AMAZON WEB SERVICES

Amazon Web Services (AWS), is a collection of cloud computing services. The most central and well-known of these services arguably include Amazon Elastic Compute Cloud, also known as "EC2", and Amazon Simple Storage Service, also known as "S3".

Compute & Networking
(Direct Connect, EC2, Route 53, etc.)

Storage & Content Delivery
(Cloud Front, Glacier, Storage Gateway, etc.)

Deployment & Management
(Cloud Formation, CloudTrail, etc.)

App Services
(AppStream, CloudSearch, SES, etc.)

Databases
(DynamoDB, ElasticCache, Redshift ,etc.)

Analytics
(Data Pipeline, Elastic MapReduce, etc.)

Mobile Services
(Cognito, Mobile Analytics, SNS, etc.)

Applications
(WorkSpaces, Zocato, etc.)

Source: PC Mag- Amazon Web Services

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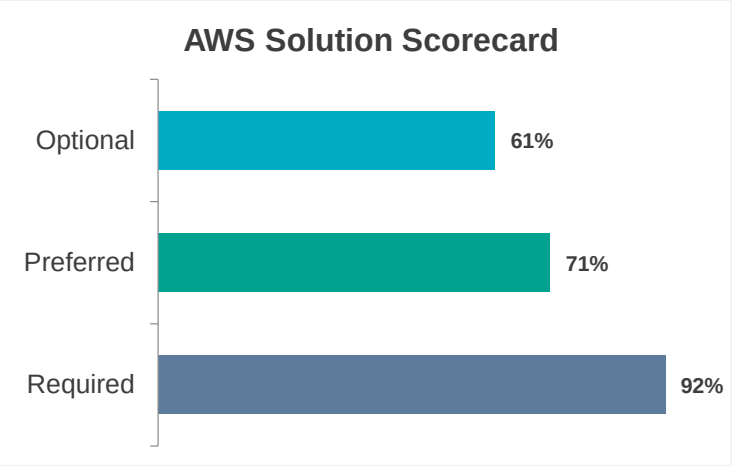
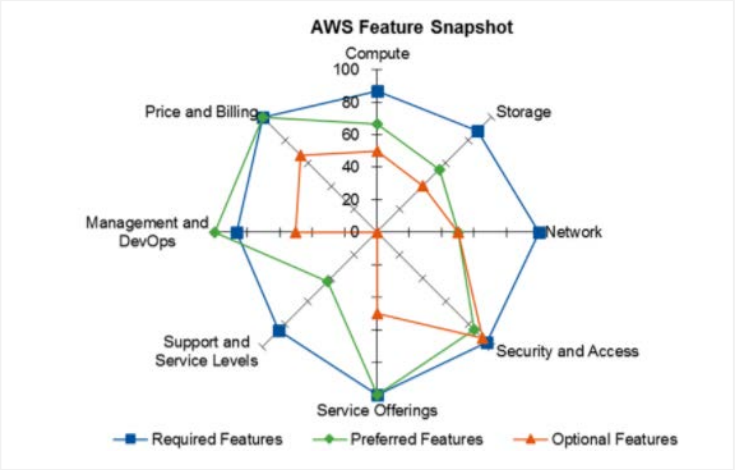
AMAZON WEB SERVICES (AWS)

Amazon Web Services is the market share leader in public cloud infrastructure as a service and is often evaluated against Microsoft Azure, Google Cloud and other cloud providers. Amazon Web Services (AWS) meets 92% of the required criteria in Gartner's "Evaluation Criteria for Cloud Infrastructure as a Service." Consequently, Gartner recommends AWS for most cloud infrastructure as a service (IaaS) production deployment scenarios.





- Amazon Web Services (AWS) meets 92% of the required criteria in Gartner's "Evaluation Criteria for Cloud Infrastructure as a Service." Consequently, Gartner recommends AWS for most cloud infrastructure as a service (IaaS) production deployment scenarios.
- Gartner also states that AWS meets 100% of the required criteria in the network, service offerings, and price and billing categories. However, AWS has some deficiencies in the storage, support and service levels, and management and DevOps categories.

- For Gartner's required criteria, AWS is strong in all categories except storage, support and service levels, and management and DevOps.
- For Gartner's preferred criteria, AWS is strong in service offerings, management and DevOps, and price and billing. AWS has room for improvement in the compute, network, and support and service levels categories.
- For Gartner's optional criteria, AWS performs well in the security and access and price and billing categories but can improve in the compute, network, storage, service offerings, support and service levels, and management and DevOps categories.

Source: Gartner: In-Depth Assessment of Amazon Web Services

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MICROSOFT CLOUD (AZURE)

Microsoft currently provides services for two of the three service models **(IaaS and PaaS)** through its Azure offering. And it offers the **third (SaaS)** separately on Azure via applications such as **Office 365, X-box Live, Bing, etc.**

Compute (Azure Container Service, Virtual Machines, etc.)	**Internet of Things** (Azure IoT Hub, Event Hubs, etc.)
Networking (Azure DNS, Express Route, Traffic Manager, etc.)	**Enterprise Integration** (Logic Apps, BizTalk Services, Service Bus, etc.)
Storage (Blob Storage, Queue Storage, etc.)	**Security + Identity** (Microsoft Identity, Azure Active Directory, etc.)
Web + Mobile (Web Apps, Mobile Apps, Logic Apps, etc.)	**Developer Tools** (Visual Studio Team Services, HockeyApp, etc.)
Databases (SQL Database, SQl Server Stretch, etc.)	**Monitoring + Management** (Azure Resource Manager, Log Analytics, etc.)
Intelligence + Analytics (Machine Learning, Stream Analytics, etc.)	**Intelligence + Analytics** (Machine Learning, Stream Analytics, etc.)

Source: Microsoft Azure

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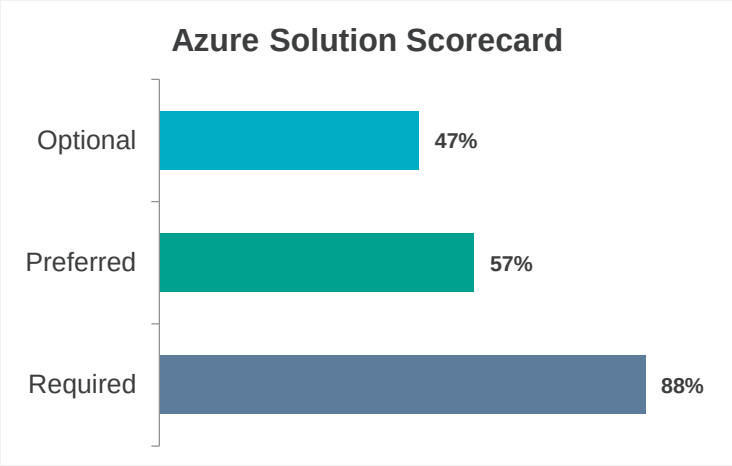
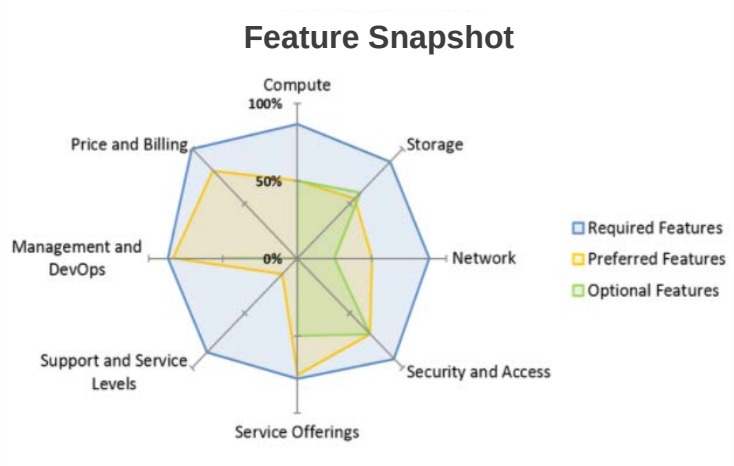
MICROSOFT AZURE

Azure is the No. 2 market share leader in public cloud IaaS behind Amazon Web Services (AWS). Microsoft Azure meets 88% of Gartner's "Evaluation Criteria for Cloud Infrastructure as a Service." Consequently, Gartner advises enterprises that it is safe to consider Azure for many projects, deployments and applications





- The Microsoft Azure solution scorecard is shown the graph above.
- Azure meets 88% of Gartner's required criteria, 57% of Gartner's preferred criteria and 47% of Gartner's optional criteria.

- The Microsoft Azure feature snapshot is shown in the figure above.
- For Gartner's required criteria, Azure scores highest in the categories of "Price and Billing" and "Security and Access" and lowest in "Service Offerings" and "Management and DevOps.
- For Gartner's preferred criteria, Azure scores highest in "Management and DevOps," but is lacking in "Support and Service Levels.“
- For Gartner's optional criteria, Azure performs well in "Storage," but can improve in "Support and Service Levels" and "Price and Billing."

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GOOGLE OFFERINGS

Google Cloud Platform is heavily influenced by Linux. For one, at its most fundamental layer, it's powered by its own Google Linux variant. Below mentioned are the products and services offered by Google Cloud Platform:

Compute
(Compute Engine, App Engine, etc.)

Storage and Databases
(Compute Storage, Cloud SQL, etc.)

Networking
(Cloud CDN (Content delivery Network), etc.)

Big Data
(Big Query, Cloud Dataflow, Cloud Dataproc, etc.)

Machine Learning
(Vision API, Speech API, etc.)

Management Tools
(Stack Driver Overview, Monitoring, Logging, etc.)

Developer Tools
(Cloud SDK, Google plugin for Eclipse, etc.)

Security + Identity
(Cloud IAM, Cloud Resource Manager, etc.)

Source: Google- Cloud Platform

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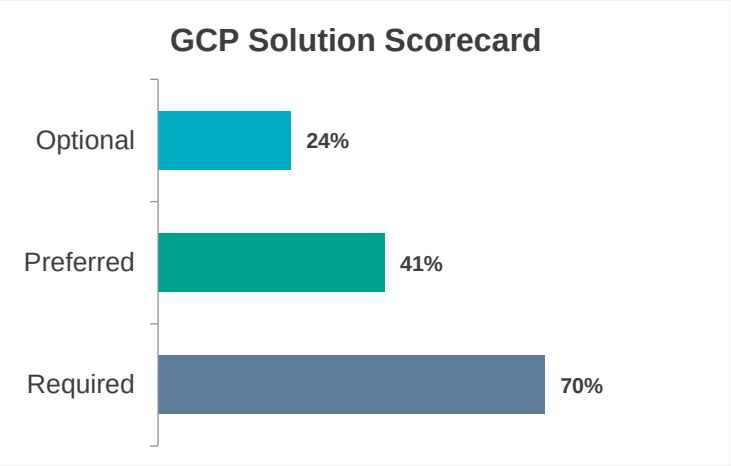
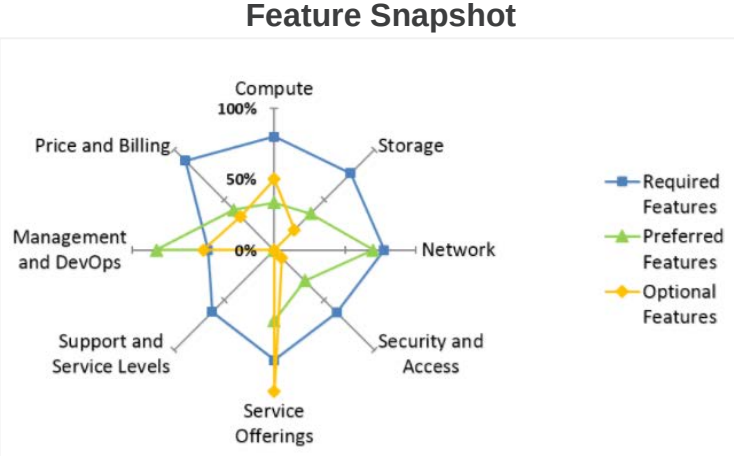
GOOGLE CLOUD

Google Cloud Platform (GCP) meets 70% of the required criteria in Gartner's "Evaluation Criteria for Cloud Infrastructure as a Service." Therefore, Gartner recommends only limited use of GCP for cloud infrastructure as a service (IaaS) production deployment in scenarios where GCP's shortcomings are not problematic.





- The Google Cloud Platform solution scorecard is shown the graph above.
- GCP meets 70% of Gartner's required criteria (Back-end load balancing, Session-affinity load balancing, Large data import, RDBaaS, 90-day SLA change notice).
- GCP meets 41% of Gartner's preferred criteria (Web application firewall (WAF), HSM Support, CDN, etc.).
- GCP meets 24% of Gartner's optional criteria (Export VM image, Bare-metal provisioning, Dedicated HSM, Cloud storage gateway (CSG), Compute instance leases, etc.).

- For Gartner's required criteria, GCP is strong in compute, service offerings, price and billing, storage, and network. GCP requires improvement in support and service levels and in management and DevOps.
- For Gartner's preferred criteria, GCP is strong in network and management and DevOps but has room for improvement in all other areas, most notably in the compute and support and service level categories.
- For Gartner's optional criteria, GCP does not perform well and has most notable issues in network, support and service levels, price and billing, and security and access.

Source: Gartner: In-Depth Assessment of Google Cloud Platform

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CLOUD – SECURITY RISKS

THE POTENTIAL RISKS OF CLOUD COMPUTING

Privileged user access

How will the provider control access to our data? How can we be assured they will not abuse that access?

Regulatory compliance

Our business must adhere to regulatory requirements. How will we know if the provider is complying with those requirements?

Data location and ownership

Once our data is “in the cloud,” where exactly will it reside? Is the provider’s data center located in a jurisdiction in which we don’t currently operate?

Privileged user Data segregation

If the same servers are used to store data from multiple customers, how will the provider ensure other customers cannot see our data – and that we will not see theirs?

Recovery

Can the cloud go offline? If so, who is responsible for getting it back online? How quickly can that be done?

The use of cloud computing does pose risks to the enterprise; but if key risks to the business are understood and planned for from the outset, they can be managed.

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THE POTENTIAL RISKS OF CLOUD COMPUTING (CONTD.)

Investigative support

What happens if we receive a legal hold notice? Will the cloud service provider help us secure the data?

Long-term viability

If our cloud service provider goes out of business, how do we get our data back? If our provider is a startup, do they have the long-term funding and business model to serve us?

IT general controls

Will our cloud environment be supported by fundamental IT general controls? How do we know the environment is secure?

Unknown cloud services

Do we know all the cloud services already in use in our organization?

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CLOUD – INTERNAL AUDIT CONSIDERATIONS

INTERNAL AUDIT CONSIDERATIONS

Internal audit is well positioned through its role as an assurance function of the organization to help management and the board identify and consider the key risks of leveraging cloud computing technology.

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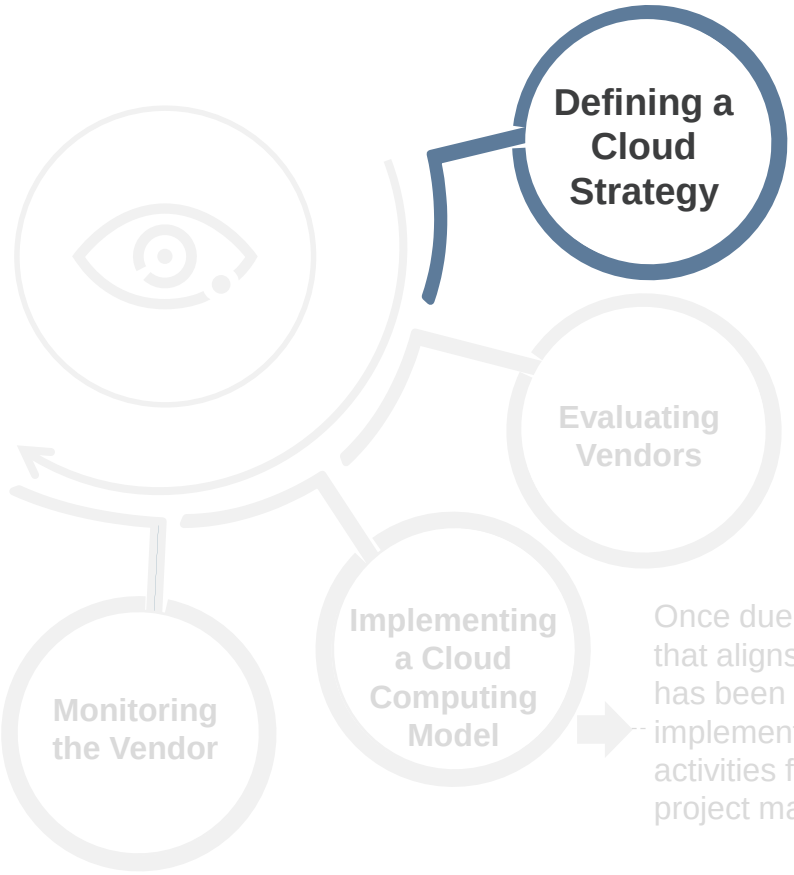
INTERNAL AUDIT'S ROLE IN THE CLOUD COMPUTING DECISION



Internal audit should engage company management to determine if a cloud computing strategy has been defined and communicated.

After weighing the potential benefits and risks of moving to the cloud computing model, the next step is to select the right vendor. Companies are often tempted to leverage the first cloud vendor they identify, or opt for the most popular provider.

Once due diligence activities are complete, and a cloud service provider that aligns with the company's strategy, objectives and control framework has been selected, internal audit may shift to evaluating the implementation process. Internal audit should evaluate implementation activities for adherence to the company's system development life cycle, project management and change management methodologies.

Once your company integrates the planned systems and data into a cloud environment, internal audit may evaluate whether the defined owner is adequately monitoring and controlling the vendor relationship. By this time, the organization should be formally monitoring and reporting on the agreed-upon service levels, while investigating and resolving any variances.

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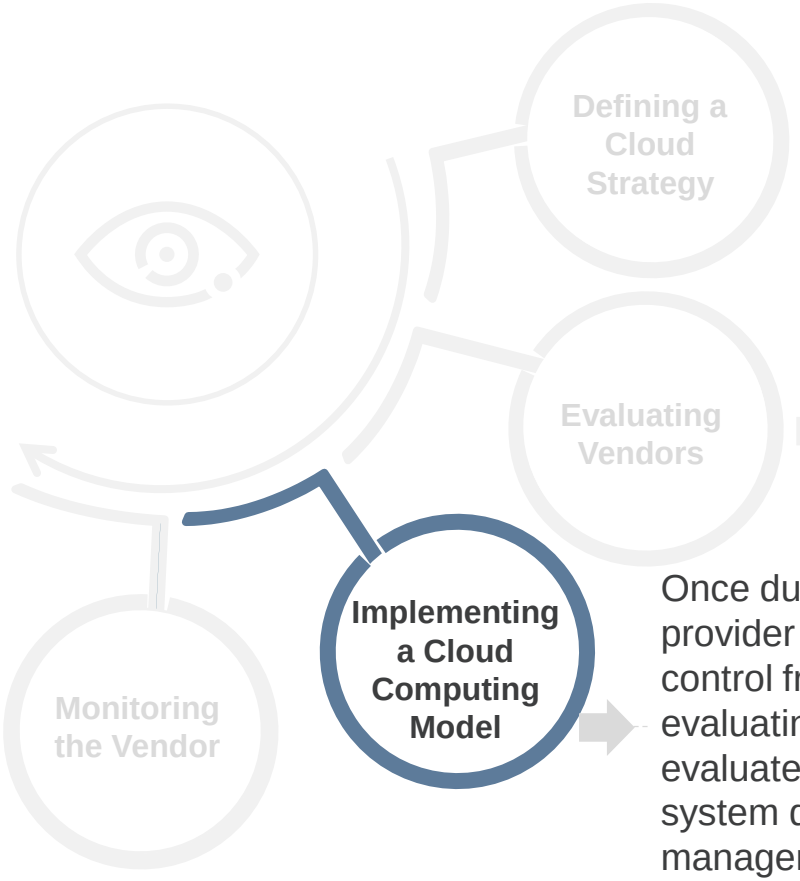

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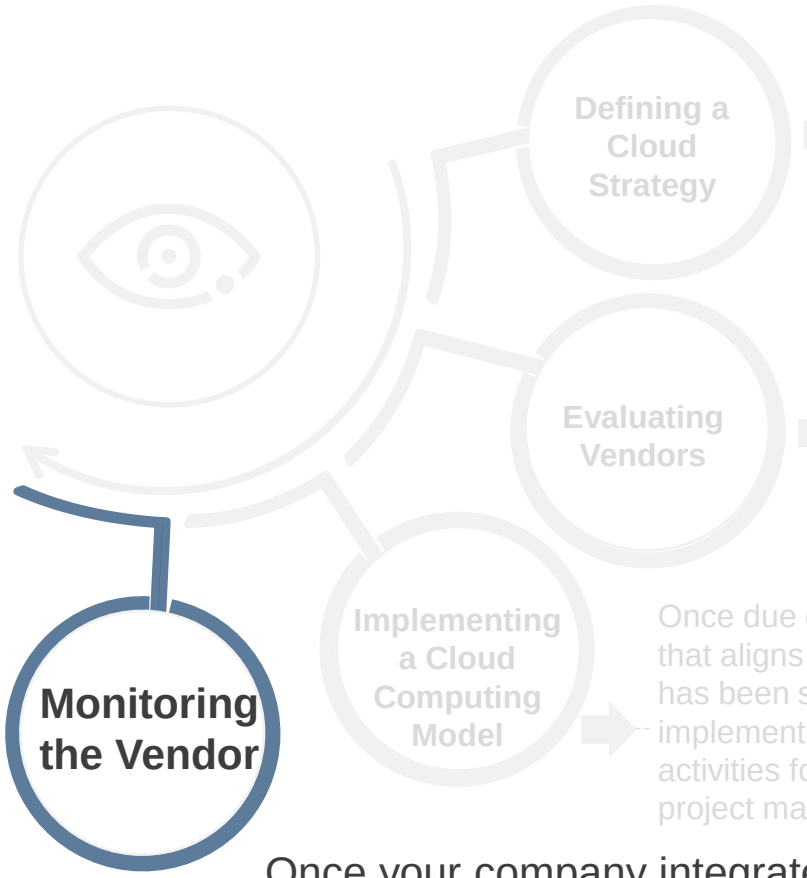
INTERNAL AUDIT'S ROLE IN THE CLOUD COMPUTING DECISION



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MONITORING THE VENDOR

It is the responsibility of the chief audit executive to understand the security risks facing the organization, and to work as a conduit to ensure the audit committee understands the risks and how well management is mitigating them.

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CONCLUSION

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Cloud computing will continue to transform the way organizations manage IT – increasing efficiencies while reducing costs – but there are risks. Proactively identifying and understanding relevant risks before signing a contract and committing to a cloud hosting implementation is essential for success and for ensuring both data security and adherence to compliance demands.

Organizations should establish processes to routinely re-evaluate and monitor risks once the business is working “in the cloud.” Internal audit should consider the risks and controls outlined in this paper and ensure management has evaluated potential risks and taken steps to address them proactively.

Further, it is the responsibility of the chief audit executive to understand the security risks facing the organization, and to work as a conduit to ensure the audit committee understands the risks and how well management is mitigating them.

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