Roadmap to Moving Your Applications to the Cloud
A Practical Guide for Evaluation, Planning and Effective Deployment

Cloud Adoption. Simplified.
Sit back, relax and enjoy the ride.

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Roadmap to Moving Your Applications to the Cloud
A Practical Guide for Evaluation, Planning and Effective Deployment

Abstract
Leading organizations need IT to be a business enabler, focused on core business goals. However, according to research studies\(^1\), it is widely recognized that IT spends most of its budget, time and energy on maintaining the organization’s infrastructure and business applications and managing the availability of these resources. Cloud computing has become increasingly significant as a potential solution to help shift the balance from capital expenditure on infrastructure to operating expenditure on maintenance and support due to its elasticity, scalability and virtually instant availability. Of course, widespread use of cloud may not be prudent for all situations and a roadmap to cloud is not a simple, cookie-cutter formula for most enterprises. In this document, we will look at how cloud computing can solve various business challenges and how one should plan to effectively leverage cloud computing for enterprise-class use cases.

Challenges Facing IT Organizations
Information Technology organizations are under increasing pressure to become more agile and applications that require months (even years) to implement with underlying infrastructure that is inflexible and obsolete as soon as it hits the data center are rapidly becoming the proverbial “millstone around the neck”. The roadmap to a more efficient future state must define the most expedient and direct path while recognizing that wholesale change is not only impossible for most organizations but, also, quite risky. However, organizations that don’t begin the journey will soon find themselves losing valuable ground to the competition.

\(^1\) Source: Gartner, Inc., IT Key Metrics Data. December 2011.
If you are facing any of the following challenges then cloud computing may, in fact, be one of the ingredients in the formula for success:

- Significant % of capital expenditure is allocated to infrastructure and hardware refresh
  - No direct linkage to business benefit

- Infrastructure capacity is misaligned to typical load or in frequent, even unpredictable, spikes in demand and the organization must pay in full for carrying excess capacity
  - Capacity sizing is based on ‘best guess’ estimate of peak load plus a factor for excess capacity to ensure demand is met over expected life
  - Spontaneous or infrequent scale up/down of capacity for experimentation, proof-of-concept and research cycles are not possible
  - Virtualization only takes you so far in terms of load balancing and management

- Capital expenditure approval cycles and hardware procurement can be long with significant risk of missing window of need and opportunity
  - Lack of agility in order to dynamically react to changing business drivers and shrink time-to-value

- Cost ratios are not changing fast enough to match business requirements and allow for investments to drive efficiency and productivity
  - Operating expenditures to maintain and support current applications and infrastructure are not sustainable at current level

Key attributes of cloud computing include decreased cost per unit, agility, scalability and flexibility including the ability to move towards a utility-based model. For the purposes of this White Paper, cloud computing is defined as Infrastructure-as-a-Service (IaaS) and Software-as-a-Service (SaaS). Platform-as-a-Service (PaaS) and Business Process-as-a-Service (BPaaS) are considered out of scope for the purpose of this review but, of course, may also be viable elements of your roadmap that will require careful planning and consideration. In addition, you will need to consider the appropriate use of public cloud, private cloud or a hybrid model. The overall decision will depend on both business and architectural factors.
Building Your Cloud Roadmap

Cloud has been offered as a panacea for all of the aforementioned challenges. Of course, the reality is that there is no magic bullet. While it may be true that infrastructure as we know it today will not be the same over the next decade, the road that each organization travels to get there may be quite different. However, in general, there are a number of valuable enterprise use cases which provide a baseline for building your roadmap.

Strategically, each organization must take a step back and prepare a roadmap built on the following key steps:

1. Classify your applications
2. Assess your application requirements
3. Identify target application(s) and platform
4. Migrate applications to cloud
   a. Migrate your non mission-critical applications
   b. Migrate your mission critical applications or applications of record (e.g. financial back-end)

Step 4b must be planned carefully to ensure address factors such as performance, scalability and security.

![Cloud Migration Roadmap Diagram]

While it may be true that infrastructure as we know it today will not be the same over the next decade, the road that each organization travels to get there may be quite different.
Step 1: Classify Your Applications

The first step towards building a successful roadmap to the cloud is to prepare an inventory of the organizations’ current business applications. Once the inventory is ready, these applications may be classified into the following (7) broad categories:

<table>
<thead>
<tr>
<th>Workload Type</th>
<th>Description</th>
<th>Benefit of moving applications to Cloud</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cloud - Native Applications</td>
<td>Specifically architected to run effectively in a cloud IaaS environment;</td>
<td>Reduce network load, high availability, scalability for sporadic workloads</td>
</tr>
<tr>
<td></td>
<td>workload is highly unpredictable E.g.: Web sites, Portals, Mobile apps</td>
<td></td>
</tr>
<tr>
<td>E-Business / E-Commerce Hosting</td>
<td>e-commerce sites, SaaS and web-based applications; critical in nature</td>
<td>High availability, scalability (requires careful design and SLAs)</td>
</tr>
<tr>
<td></td>
<td>E.g.: CRM Portal, Web Store</td>
<td></td>
</tr>
<tr>
<td>General Business Applications</td>
<td>General-purpose workloads typically found in the internal data centers of</td>
<td>Achieve economies of scale by reducing OPEX while increasing utilization, scalability</td>
</tr>
<tr>
<td></td>
<td>most traditional businesses E.g.: E-Mail, Collaboration Suites</td>
<td></td>
</tr>
<tr>
<td>Enterprise Applications</td>
<td>General purpose mission critical applications (e.g. ERP workloads); often</td>
<td>High performance, scalability, availability (requires careful design for performance, SLAs, security, disaster recovery and, perhaps, geo-redundancy)</td>
</tr>
<tr>
<td></td>
<td>complex, performance-sensitive or systems of record or sensitive data E.g.:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ERP systems, esp. back-end finance like Oracle E-Business Suite, PeopleSoft,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SAP</td>
<td></td>
</tr>
<tr>
<td>Test and Development</td>
<td>These workloads are related to the development and testing of applications.</td>
<td>Cost optimization by reducing CAPEX, utility billing/pay-as-you-go billing, frequent spin up/down</td>
</tr>
<tr>
<td></td>
<td>E.g.: CRP, QA, Test, Dev environments</td>
<td></td>
</tr>
<tr>
<td>Batch Computing</td>
<td>High-performance computing (HPC), &quot;big data&quot; analytics, Business Intelligence tools</td>
<td>High performance, elasticity on demand, reduced CAPEX, load balancing</td>
</tr>
<tr>
<td></td>
<td>E.g.: Business Intelligence, Analytics, Hadoop, Map Reduce</td>
<td></td>
</tr>
<tr>
<td>Disaster Recovery</td>
<td>Disaster Recovery setups for enterprise applications, tape backups, offsite</td>
<td>Reduced CAPEX/ OPEX, high availability with geo-redundancy; Elasticity</td>
</tr>
<tr>
<td></td>
<td>backups, hot standby environments E.g.: Offsite DR setup’s</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Application Classification Table

Source: Magic Quadrant for Cloud Infrastructure as a Service - 18 October 2012 by Gartner Inc
Step 2: Assess Your Application Requirements

Once the classification of applications is done, each application needs to be evaluated against each of the below factors:

- Networking
- External Facing
- Scalability
- Architecture
- Storage
- Licensing Constraints
- Security

Scalability is one of the most attractive benefits of cloud computing... For all those who struggle in predicting future application loads (and who doesn’t?), cloud computing allows for seamless scalability when application demands change suddenly.

Networking

You will need to identify whether an application needs high bandwidth or extremely low latency connection to systems within the network. Such applications are not the best candidates for moving to the cloud unless you move all the dependent applications at the same time. If the end users who are accessing these applications are external users, then there is a possibility that cloud providers can offer much better bandwidth and low latency. Additionally, data transfer volume between the application tier and desktop tier has to be fully considered, as applications with lower data transfer needs are better suited for cloud migration.

External Facing

If the application is used by people from outside the organization’s network, in general, these applications are highly suitable candidates for the cloud. Moving such applications to the cloud will help your organization to offload the network load but also will help to isolate and buffer the internal network making it more secure. On the other hand, if the application is accessed within the corporate WAN or at multiple partner sites, proper security and access considerations must be implemented.

Scalability

Scalability is one of the most attractive benefits of cloud computing. This is not confined to the incremental infrastructure you’ll need as you grow but more importantly scalability allows you to flexibly manage the peaks and troughs of changing user demand. To some degree, virtualization was the poster child for flexibility and scalability in the early stage of infrastructure evolution and still plays...
a role. For all those who struggle in predicting future application loads (and who doesn’t?), cloud computing allows for seamless scalability when application demands change suddenly. Applications that need to scale (e.g. seasonal or peak loads) or might need to scale (e.g. analytical or research workloads that are contingent on predecessor activity and, therefore, unpredictable) are good candidates for migration to the cloud. To add extra capacity for peak hours based on the demand, it is much more cost-effective to schedule additional capacity (compute, transient storage) when needed and then release that excess capacity during non-peak hours in order to take advantage utility-based billing. Of course, not all applications can be scaled up/down seamlessly and architectural design must be considered in order to provision and support the required scalability.

**Architecture**

Cloud is not suitable for all applications by default, e.g. those applications which depend on non-Intel based systems. If the application depends on standard, commodity technologies then it is a great fit for moving to cloud. For example, HP-UX and AIX environments are not readily available on all cloud environments. If the application is best suited to run on non-standard hardware like SPARC environments, efforts involved in migrating them to a cloud-based environment and the risks involved should be considered while making the decision. These applications might be better suited for private cloud or hybrid solutions in which manufacturer cloud offerings may be a viable option as part of the overall cloud roadmap. The complexity of the architecture will change dramatically in a hybrid environment.

**Storage**

There is an immense difference in the way traditional storage and cloud storage is provisioned. You will need to consider the IOPS (input/output operations per second) requirement of your applications before moving to the cloud. Cloud provides various options from basic to high IOPS. Cloud storage differs in performance characteristics and price, allowing one to tailor the storage performance and cost to the application requirements. Designing the architecture with storage performance in focus will help to optimize the application performance and minimize associated costs.

**Licensing Constraints**

Licensing is another major factor to consider during cloud migration. License portability and rules associated with cloud licensing are not necessarily the same across software vendors. Cloud vendors also provide perpetual licenses in a pay-per-use model which could prove costly over an extended period of time. TCO over long term should be analyzed before making your decision.

**Security**

Security is a major consideration before moving to the cloud. Cloud security can be broadly classified into computer security, network security, and information security. It refers to a broad set of policies, technologies, and controls deployed to protect data, applications, and the associated infrastructure of
cloud computing. Most of the cloud service providers are following security best practices and are compliant in major security certifications (like SOC 1, PCI, HIPAA, FISMA, etc.) However, these security policies only cover the platform and not the user data. For example, security provided by an IaaS provider only covers the underlying datacenter and the virtualization platform. Security within the guest operating system (O/S) and the application built on top of that O/S is the customer’s responsibility. Designing/redesigning the application architecture for security should be one of the significant steps in your cloud migration roadmap.

**Step 3: Identify Target Applications and Platforms**

Business applications can be represented in a dependency tree which can help to determine which applications can be migrated first. Figure 2 depicts a representative application dependency tree for reference.

![Application Dependency Tree](image)

From this diagram, we can easily identify the “low hanging fruit” – the ones which have the lowest dependency on other applications to begin the migration process or upon which other applications have a dependency to sustain operations. Replicated instances or databases used for development or test are classic examples of applications not typically on the critical path for operations and are examples of prime targets for leveraging cloud.
Cloud computing provides multiple options for application migration like IaaS, PaaS, SaaS etc. Identifying the right option for each type of application based on the needs of that application as assessed in Step 2 is the key to successful migration. As per the workload type classification of applications made in Step1, without assessing the specific requirements of the application, an example of a suitable type of cloud service is given below.

<table>
<thead>
<tr>
<th>Application Type</th>
<th>Identified Target Cloud Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cloud - Native Applications</td>
<td>IaaS/SaaS/PaaS</td>
</tr>
<tr>
<td>E-Business/E-Commerce Hosting</td>
<td>SaaS/PaaS</td>
</tr>
<tr>
<td>General Business Applications</td>
<td>SaaS</td>
</tr>
<tr>
<td>Enterprise Applications</td>
<td>IaaS/SaaS</td>
</tr>
<tr>
<td>Test and Development</td>
<td>IaaS</td>
</tr>
<tr>
<td>Batch Computing</td>
<td>PaaS</td>
</tr>
<tr>
<td>Disaster Recovery</td>
<td>IaaS</td>
</tr>
</tbody>
</table>

Table 2: Target Application Type-Cloud Platform Table

...identify the “low hanging fruit”...Replicated instances or databases used for development or test are classic examples of applications not typically on the critical path for operations and are examples of prime targets for leveraging cloud.
Step 4: Migrate Applications to Cloud

Once a cloud migration roadmap is ready, the next step is the actual migration. Below is a high level approach for the cloud migration process. As noted previously, you will also need to consider the appropriate use of public, private or hybrid cloud, depending on related factors. For the purpose of this White Paper and illustration of the roadmap process, we elected to exclude that layer of the decision process but recognize it as another important piece of the puzzle that you will need to consider when laying out your roadmap.

Step 4a: Migrate Non Mission Critical Applications to Cloud

The migration of non-mission critical applications can be done first in a single window allowing for a low-risk approach while leveraging the benefits of cloud computing immediately. In some cases, it will be appropriate to include a short-duration Proof of Value, evaluation step using a pilot environment thereby allowing you to validate the use case and gain the support of the line-of-business. The application migration process depends on the type of application and a vendor-specific approach will need to be adopted in order to ensure a smooth migration process.

In general, it is advised to develop a phase 1 cloud migration plan in which you simply categorize and prioritize all non-mission critical applications and workloads. Any workload that is short cycle, transient, non-operational are all immediate, low-risk candidates for cloud and, in many cases with correct provisioning and architectural design, for public cloud, e.g. dev/test environments, backups, disaster recovery. If you are a growing company or scrambling for valuable infrastructure resources, you are likely wasting precious time and money by not executing a phase 1 migration of non-mission critical applications.
Step 4b: Migrate Mission-Critical Applications

Migration of mission critical applications can also get a jumpstart using Proof of Value (POV) pilot environments. With cloud, the advantages of a POV are two-fold: first, agility and speed of deployment (no equipment procurement lead time and cost, no borrowing or re-purposing of equipment) and, secondly as usual, early line-of-business engagement in the process. However, the actual migration process needs to be planned carefully. Before considering your migration process, a proper backup environment needs to be configured. Below are the two most common approaches used for the migration of mission-critical applications.

1. Employ Disaster Recovery method
   a. Build a disaster recovery environment on target cloud platform
   b. Perform a mock switch-over test
   c. If results from step (b) are satisfactory, perform switch over process
   d. Continue in-house application as a Disaster Recovery environment
   e. Build a new Disaster Recovery environment using appropriate platform before retiring in-house application

2. Build parallel production environment
   a. Build a parallel environment for applications on target cloud platform
   b. Perform data migration and ensure proper replication method
   c. Migrate non-critical user base to cloud environment
   d. Migration entire user base to cloud environment
   e. Retire in-house business application

Use of the first approach is best suited when phase-wise migration of end-users is not feasible. In the case of employing the second approach, a proven replication method will be crucial.
Conclusion

The total time-to-value for cloud migration for some organization has been as little as a few weeks. For most enterprises, the question about migration to cloud is becoming more of “when and how” the migration should be made rather than “if” the migration should be made. If you are responsible for your organization’s IT infrastructure, we would recommend that, as a first step, prepare a cloud roadmap using the above given framework and make an internal case for migration to the cloud.

There is a technology revolution forming in the cloud. CIOs, IT Directors, IT Managers, Enterprise Architects are taxed with the question of how to cloud enable their enterprise while separating the “hype” from reality given the myriad options and acronyms out there in the market. This White Paper provides a framework for you to begin taking a step in the right direction.

For most enterprises, the question about migration to cloud is becoming more of “when and how” the migration should be made rather than “if” the migration should be made...CIOs, IT Directors, IT Managers, Enterprise Architects are taxed with the question of how to cloud enable their enterprise while separating the “hype” from reality...
Appendix 1

Cloud Adoption Statistics

Enterprise infrastructure has been through major innovation from physical to virtual and finally to cloud. Cloud computing offers many features, which when properly utilized can unleash exponential results. Understanding these different use cases within the enterprise and the right approach to address them is the first step for a successful journey to the cloud. Cloud offers potentially significant advantages in delivering greater business and IT agility, quicker access to application enhancements, innovative new cloud-optimized applications, and a shift from capex to opex. As per a recent study by a leading analyst firm, total spending on cloud services will increase from $110 billion USD in 2012 to $210 billion USD in 2016. Below are the highlights of this analysis:

<table>
<thead>
<tr>
<th>Segment</th>
<th>Revenue in 2012 (in USD)</th>
<th>Expected Revenue in 2016 (in USD)</th>
<th>CAGR%</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPaaS(^1)</td>
<td>$84.1B</td>
<td>$144.7B</td>
<td>15%</td>
</tr>
<tr>
<td>SaaS(^2)</td>
<td>$11.8B</td>
<td>$26.5B</td>
<td>17.4%</td>
</tr>
<tr>
<td>PaaS(^3)</td>
<td>$0.9B</td>
<td>$2.9B</td>
<td>26.6%</td>
</tr>
<tr>
<td>IaaS(^4)</td>
<td>$4.2B</td>
<td>$24.4B</td>
<td>41.7%</td>
</tr>
<tr>
<td>CMSS(^5)</td>
<td>$2.3B</td>
<td>$7.9B</td>
<td>27.2%</td>
</tr>
</tbody>
</table>

Table 3: Public Cloud Services Forecast, 2012-2016 by Segment, 2Q12 Update (Billions of Dollars)

\(^1\)Business Process as a Service (BPaaS), \(^2\)Software as a Service (SaaS), \(^3\)Platform as a Service (PaaS), \(^4\)Infrastructure as a Service (IaaS), \(^5\)Cloud Management and Security Services (CMSS)

Source: Public Cloud Services Forecast, 2010-2016, 2Q12 Update (Billions of Dollars) by Gartner Inc
Drivers for Cloud Computing Adoption

Cost Reduction is a key driver for a cloud migration/implementation project. Cost savings from cloud adoption might not be visible immediately, but over a period of time the savings can be observed not only in the actual Capex/Opex, but also in the maintenance costs and increased utilization of infrastructure.

Time to Market is the next big driver for cloud adoption, where better business value can be realized by reducing the deployment time of new applications, bringing new features/services faster to the customer etc.

Flexibility/Scalability – Scaling up/down the infrastructure serving end-users to match the peak user load can have a significant impact on customer satisfaction. Scalability of an application is a significant driver for cloud adoption.

Reduced complexity – With increased adoption of technology across various groups, IT systems are becoming more and more complex, hindering the agility and manageability. Cloud adoption can help to reduce these architectural complexities.

Consolidation – One of the major efforts by organizations for efficient IT operations is through Consolidation and this is another key driver for cloud computing. Consolidation is not just limited to the reduction of infrastructure but also required in applications and business processes.

Figure 4: Drivers for Cloud Computing Adoption
Appendix 2

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Cloud Expertise @ Apps Associates

Apps Associates is a premier cloud service provider and was the first Oracle specialized partner to attain the level of Advanced Consulting Partner with Amazon Web Services. Our cloud services include advisory, deployment, managed services, and Oracle in Cloud. Find out more at: www.appsassociates.com/cloud-computing.php and http://www.appsassociates.com/awslabs.

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Founded in 2002, Apps Associates is a global provider of business and technology consulting services that partners with companies to help them maximize the value from their IT investments. Services range from new technology deployments to 24x7 global support services with practices in BI, ERP, CRM, Integration, Cloud Services, Infrastructure, Testing Services and Custom Development.