Google Cloud Whitepaper
May 2020

CIO's Guide to Application Migration

Google Cloud

Google Cloud

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Introduction

Increasingly, enterprise organizations seek to leverage the many advantages delivered by a successful digital transformation. At Google Cloud, we believe that effective integration of public cloud capabilities is fundamental to this critical journey. By augmenting or replacing on-premises infrastructure with cloud resources, enterprises can eliminate many of the IT-centric constraints that often distract from, and sometimes inhibit, their core business. Cloud integration opens the door to simplified IT management, elastically scalable resources, flexible cost models, and innovative new services...ultimately enabling increased operational efficiency and fueling business growth.

In addition, as cloud resources have become broadly and easily accessible, they enable many organizations to proactively evolve their IT infrastructure to support continued success in increasingly competitive markets. Sometimes, by maintaining an unoptimized status quo, organizations can inadvertently hamper innovation and squander internal capital, thereby increasing exposure to market disruptors and aggressive competition.

However, a well-executed digital transformation should do much more than keep you competitive...it should also position you to excel by untethering IT staff from low value, labor-intensive tasks, allowing them to focus on innovation and high-impact projects. Also, replacing (or supplementing) legacy systems with modern technologies can reduce complexity and cost, while also positioning you to leverage cloud-native tools to achieve enhanced business intelligence and key strategic insights. Finally, with nearly unlimited scalability at your fingertips, applications can scale up and scale down on demand, while you pay only for what you consume. This allows you to maintain a continuously right-sized cost profile, while also accelerating development and reducing procurement cycles. Each of these benefits can yield tremendous value to your business which, after all, is the goal of a digital transformation. Unfortunately, while many organizations are ready to embrace a digital transformation via the cloud, it can be challenging to devise an effective migration strategy. They need practical, prescriptive approaches, designed in context

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with their technical requirements, business goals, and a deep knowledge of cloud technology... thereby enabling them to reap the cost, efficiency, agility, and innovation benefits of cloud in a way that returns value continuously. We've written this paper to help. Here, we'll provide simple, prescriptive guidance to assist with the most important part of your digital transformation: the beginning.

In this paper, we'll focus on migration of on-premises datacenter infrastructure. However, similar guidance would also apply to infrastructure hosted elsewhere (e.g. in public clouds or in an on-premises colocation facility) and it's worth noting that migration into Google Cloud from other clouds can offer a quick, simple path to cost savings and enhanced flexibility.

We'll first explain how to perform effective discovery and assessment to ensure a clear understanding of your current application stacks and underlying infrastructure. Then we'll help you leverage that information to define the first steps for transforming your existing applications and workloads. Since different applications may be best served by differing strategies, those first steps can be crucial to success.

Truthfully - there is no single right answer when embarking on digital transformation and planning a corresponding migration strategy. Every transformation will have its own nuances and unique considerations. It's about understanding the advantages and disadvantages of the options at your disposal and realizing that you are embarking on a journey. One great way to achieve this is to partner with a cloud provider who will help you:

1. Assess your environment
2. Plan your cloud architecture and migration roadmap
3. Establish cloud landing zones
4. Perform the migration
5. Ensure efficient optimization, and
6. Support your staff during and after the migration to ensure their productivity post-migration.

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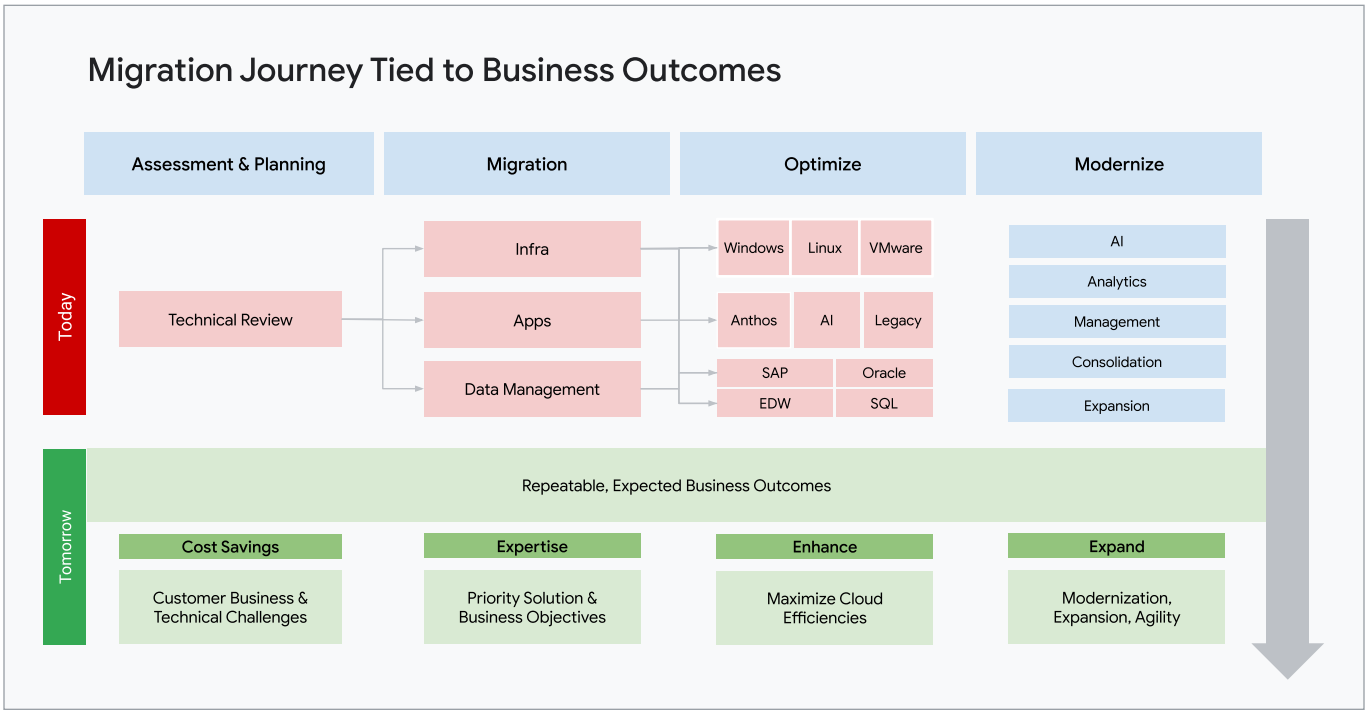
Digital transformation is truly an exercise in change management, requiring determined effort and focused leadership across people, process and technology domains; it is as much a culture shift as a technology revamp. But the rewards in velocity and productivity are certainly worth the journey. Rest assured, we will be with you every step of the way.



Chapter 1:
Where to begin?

When deciding on a migration strategy, we recommend taking a comprehensive view, including not only technical requirements, but also consideration of your business goals (both present and future), any critical timelines, and your own internal capabilities. Depending on your situation, any one of these considerations may necessitate a particular approach. For example, if faced with aggressive timelines for a datacenter shutdown, you should consider a multi-stage migration that may include an initial "lift and shift" of application infrastructure as-is...thus delivering immediate infrastructure modernization via relocation to cloud. The "lift and shift" can then be followed by additional modernization at a later time. Alternatively, if seeking to immediately leverage the full benefits of cloud (e.g. elasticity, scale, managed services), it may be most efficient to modernize more aggressively (e.g. by adopting container technology) in conjunction with migration.

In all cases, however, it is important to carefully consider the characteristics of the applications and workloads that power your business. It is crucial to carefully assess those applications to deeply understand their requirements, their dependencies, and the state of your current environment. Understanding your starting point is essential to planning and executing a successful application migration strategy.

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Building an application inventory

To scope your application migration efforts, you must first catalog the various items, such as applications and hardware appliances, that exist in your current environment, along with their dependencies. Building this inventory is a non-trivial task and we recommend that you leverage the expertise of the internal teams responsible for the design, deployment, and operation of each workload in your current environment, in addition to the teams responsible for the environment

itself. Also, we encourage you to contact us for recommendations and assistance with tools that can help simplify your internal assessment.

The inventory should not be limited to applications. Instead, at a minimum, it should also contain the following:

- The dependencies associated with each application (e.g. databases, message brokers, and configuration storage systems). In other words, the full application stack
- Any dependencies between applications (e.g. within sequential workflows)
- Services supporting your application (e.g. source repositories, continuous integration (CI) tools, and artifact repositories)
- Servers...either virtual or physical and the current operating systems
- Resource utilization of all compute workloads, VMs, hypervisors, etc..
- Physical appliances (e.g. network devices, firewalls, and other dedicated hardware)

When compiling this list, you should also gather salient information about each item, such as:

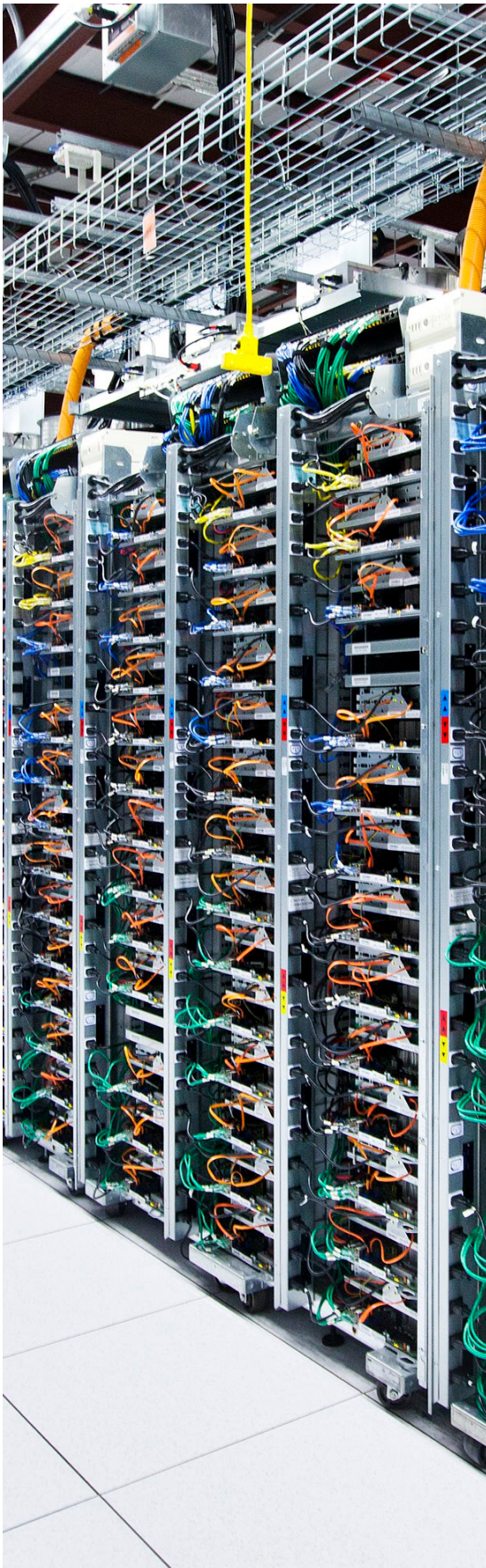
- Source code locations and whether you are able to
  1) modify the source code and/or
  2) rebuild the application
- Deployment methods for the workload in a runtime environment. (e.g. whether you use an automated deployment pipeline or a manual one)
- Network restrictions
- Security requirements
- Licensing requirements for any software or hardware
- Critical performance requirements

Your inventory should also include non-technical information, such as compliance requirements. For example, you should capture the licensing terms under which you are allowed to use each item. While

Contact us for recommendations and assistance with tools that can help simplify your internal assessment.

some licenses allow you to deploy an application in a cloud environment, others explicitly forbid cloud deployment. In addition, some licenses are assigned based on the number of CPUs or sockets in use, and these concepts might not be applicable when running on cloud technology. Also, some of your data may have restrictions regarding the geographical region where it's stored. Finally, some sensitive workloads can require sole tenancy.

After you complete your inventory, you should analyze the characteristics of each application stack to help facilitate decision-making and planning for your transformation journey.



Chapter 2:
Should I migrate my application to Google Cloud?

The benefits of cloud infrastructure are numerous and we strongly recommend leveraging Google Cloud to extract maximum value from your applications and workloads. Google Cloud offers many options to support your application stacks including Google Kubernetes Engine, Google Compute Engine and various managed services covering storage, networking, big data, monitoring, AI/ML, and more. That said, there are situations where migration to cloud may be either 1) technically infeasible or 2) impractical in the near term. To determine whether your application can and should migrate to cloud, begin by asking yourself the following questions:

- Are the components of my application stack virtualized or virtualizable?
- Can my application stack run in a cloud environment while still supporting any and all licensing, security, privacy, and compliance requirements?
- Can all application dependencies (e.g. 3rd party languages, frameworks, libraries, etc.) be supported in the cloud?

If the answer is “No” for any of the above questions, we recommend evaluating whether it is feasible to replace those application components with a cloud offering. If not, we recommend leaving those components on-premises during the initial phase of your digital transformation, while you focus on the migration of your other application components. If retention on-premises is no longer viable (e.g. if you must completely shut down your datacenter) or if you want to increase proximity to cloud resources, then taking advantage of Google Cloud’s Bare Metal Solution, or shifting to a colocation facility (colo) adjacent to the appropriate cloud region are recommended alternatives. Colocation facilities can allow you to migrate large portions of the application to the cloud as desired, while still maintaining high-throughput, low latency connectivity (<1ms) to the legacy components. Google Cloud also offers a Bare Metal Solution

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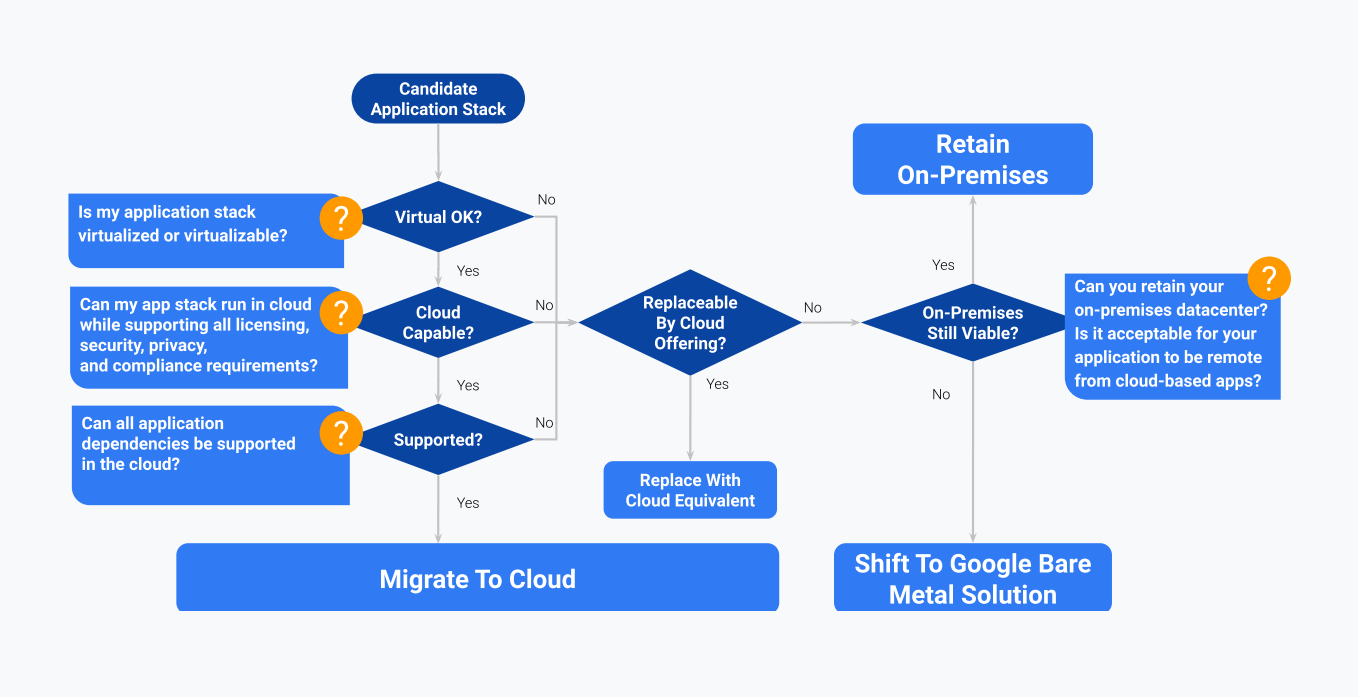
for running specialized workloads with low latency to other cloud resources. We recommend that non-migrated components be reevaluated periodically to determine whether migration to Google Cloud has become a more advantageous strategy.



Application Migration Guidance

Also, note that strategic business considerations must also be factored into any migration decision. As alluded to previously, if facing a corporate mandate to reduce datacenter footprint by a specific deadline, you may need to migrate applications more aggressively in the initial phase of transformation. When you engage with Google Cloud to plan your migration strategy, we will assist you with appropriate scoping, in consideration of both technical and business factors.

Chapter 3:
Which migration path is right for me?

To help you define an appropriate migration path, we will highlight key technical considerations and provide prescriptive guidance regarding suggested approaches based on your situation. Of course, as referenced previously, the migration path you choose should also consider non-technical factors, including, but not limited to: any critical time constraints, your available resources, your existing expertise with cloud technologies, and your appetite for change (e.g. aggressive vs incremental). We suggest a balanced approach considering both the technical and non-technical characteristics of your business landscape.

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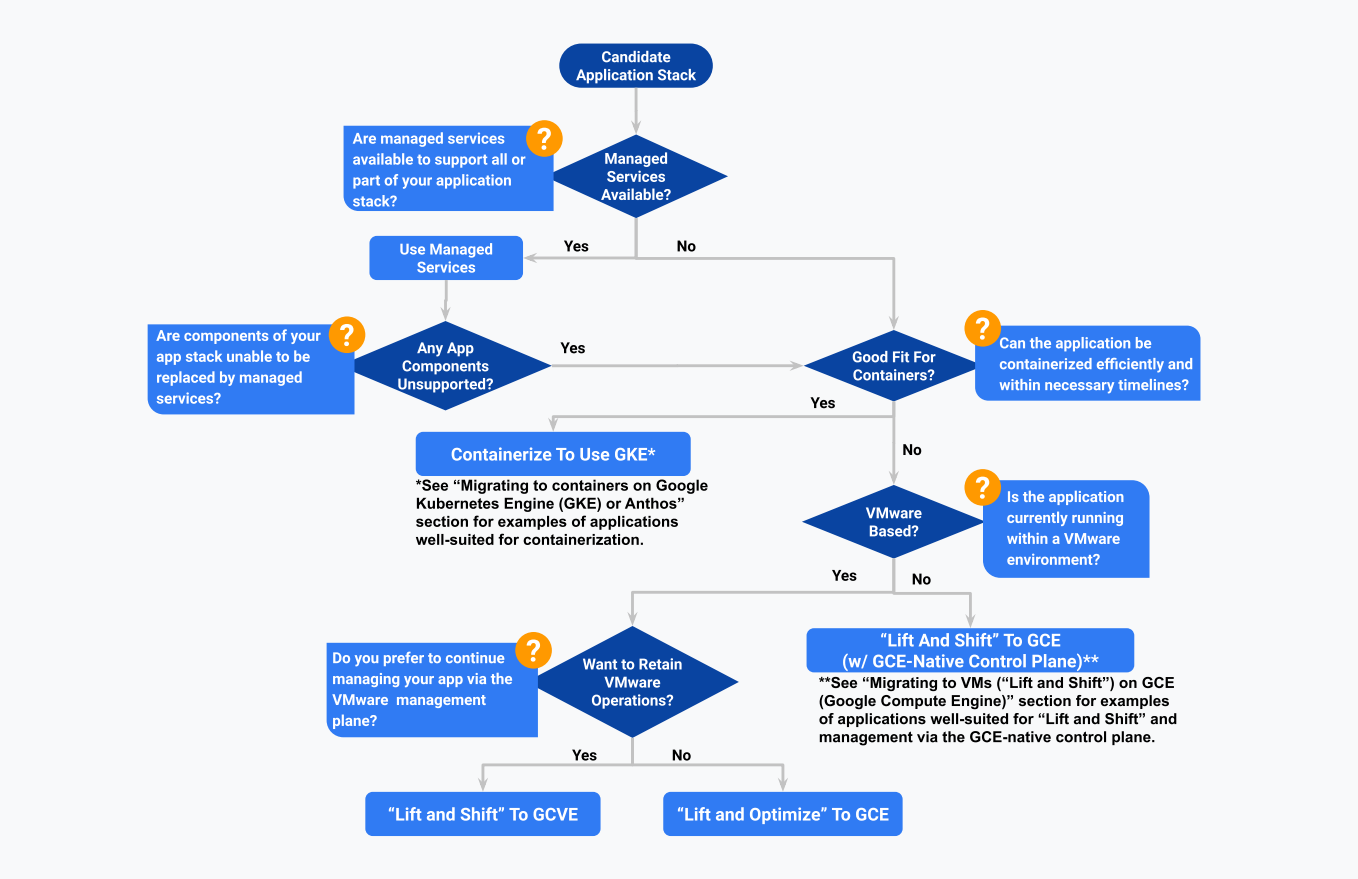
As you embark on your transformation journey, we recommend considering five key types of migration to Google Cloud:

- Migrating to Google Cloud managed services
- Migrating to containers on Google Kubernetes Engine (GKE) or Anthos
- Migrating to VMs ("Lift and Shift") on GCE (Google Compute Engine)
- Migrating to Google Cloud VMware Engine
- Migrating to the Google Cloud Bare Metal Solution

The guidance below will help you select effective migration paths, considering both your existing technology stack and the recommended technology options.



Modernization Guidance for Application Migrations

Migrating to Google Cloud managed services

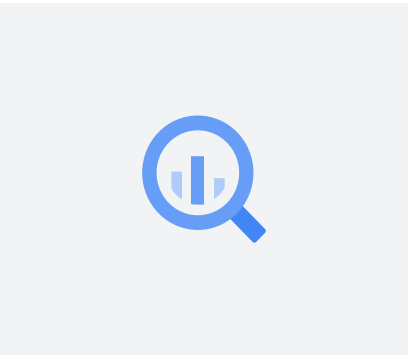
Commonly-used application stacks are increasingly available in the cloud via managed services. As you begin devising your migration strategy, check whether managed services are available to support your application. If so, and if the associated components of your application have minimal customization, leveraging one or more Google Cloud managed services should be considered as a primary path for migration. In some cases, transition to managed services may take longer than a wholesale "lift and shift", however, for many common on-premises applications, we can provide specific guidance and best practices to assist as you transition to the Google Cloud equivalent services. Many of these services can be accessed on-demand via Google Cloud Platform Marketplace.

Use of Google Cloud managed services can deliver significant benefits. For example, leveraging these services can eliminate much of the complexity associated with application maintenance and upgrades, freeing more resources to focus on your core business. In addition, managed services can also simplify and integrate access to other powerful,

specialized cloud services (e.g. machine learning) that can deliver differentiated value to your business. Within Google Cloud, we have a wide variety of managed services that may provide value for you, including: BigQuery, Cloud SQL, Cloud Filestore, and more. Many of our customers are leveraging these services heavily to benefit their businesses.

For example, leading global enterprises like 20th Century Fox, Domino's Pizza, Heathrow Airport, HSBC, The New York Times, and many others migrated their traditional on-premises databases and data warehouses to BigQuery for their data analysis needs, helping them do everything from break down data silos to jump-start their predictive analytics journey—all while greatly reducing costs.

BigQuery



Migrating to containers on Google Kubernetes Engine (GKE) or Anthos

If you have application components that are not supported by managed services, or if you prefer not to use managed services, then migrating your application into containers on Google Kubernetes Engine (GKE) should be your next consideration as a first step into the cloud.

Google Kubernetes Engine (GKE)

GKE provides a managed environment for deploying, managing, and scaling your containerized applications and delivers numerous benefits such as:

- Delivering cost savings by efficiently managing workload density (i.e. via increased density due to lighter-weight containers and intelligent workload management)
- Container health monitoring and automatic restarts
- Increasing agility and reducing time-to-market (e.g. by facilitating faster, automated continuous integration and continuous delivery processes...a.k.a. CI/CD)
- Access to advanced modern operational management capabilities with Cloud Operations , Istio and other cloud services

To determine whether your application is a good fit for containerization on GKE, consult your application inventory details and do the following:

- If your application is developed by a 3rd-party vendor, then work with the vendor to validate support for the intended usage with containers (e.g. dev/test, training, staging, production) and to identify any required configuration or setup updates. **Containerized usage supported => Good candidate for containerization**

- Evaluate the current operating system (OS) licensing model to confirm the ability to run in containers. If needed, identify any necessary configuration changes, Google Cloud support alternatives, and/or GKE-provided OS replacement options. **Compatible licensing => Good candidate for containerization**

- Assess whether the application workload is resilient to restarts and being scaled out? **Resilient to restarts and scale-out? => Good candidate for containerization**

After answering these questions, if your application is a good candidate for containerization, you should then confirm support for any prerequisites[1] associated with your desired migration. Some examples of good candidates for containerization include: web application servers, business logic, J2EE middleware (e.g. Apache Tomcat), multi-tier stacks (e.g. LAMP, WordPress), dev/test applications, training, labs, and low load services.

Note that, when leveraged within the Anthos platform, Google-managed containers can deliver application and workload portability across hybrid and multi-cloud environments. If a hybrid or multi-cloud approach aligns with your strategic goals, we recommend adopting Anthos. With Anthos, you can achieve a unified view of all GKE-managed environments, thus simplifying global application management.

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1 GKE migration documentation (see “Prerequisites” sections):

Either way, when migrating into GKE, you should consider your long-term goals in conjunction with the practical realities associated with your situation. In the long term, a microservices-based approach will maximize efficiency in most cases. However, directly adopting microservices may be impractical based on your available resources, your teams' expertise, project timelines, etc. As a first step, we recommend using Migrate for Anthos to lower the complexity of converting VMs into containers.

As you attain familiarity with containers, cloud, and Kubernetes, we recommend that you eventually consider refactoring your application stack to adopt a microservices architecture as a next step in your transformation journey. Microservices can deliver additional benefits to your application stack including improved fault tolerance, easier maintenance, portability, and enhanced scalability.

To accelerate your GKE adoption, use the Migrate for Anthos product to orchestrate automated migration of your applications. As an example, Atos, a global systems integrator, has been using Migrate for Anthos to accelerate their customer's cloud journeys.

Migrating to VMs on Google Compute Engine (GCE)

The vast majority of applications can be migrated as-is to VMs on GCE, thus "lift and shift" provides the simplest, fastest path to cloud adoption. If you are migrating VMware-based workloads to GCE this would follow a "Lift and Optimize" approach. This would require changes to your VM operating structure, but would allow you to take full advantage of more cloud-native capabilities. If you want to modernize in phases, have time constraints, or if your application stack is not well-suited for immediate containerization...then performing a "lift and shift" should be your primary path.

Migrating to VMs on GCE provides immediate infrastructure modernization by delivering access to the scalability and elasticity of cloud, along with all of the accompanying technical and business

> "Containers are already a part of our cloud landscape, giving us a powerful way to manage and maintain our systems as well as customer environments. At the same time, we have a lot of VMs in production and we are always looking for optimized ways of migrating these over to hybrid cloud delivery models. Migrate for Anthos gives us an additional fantastic tool in transformational projects and it will further accelerate our cloud success."
>
> **Michael Kollar**, SVP for Cloud Engineering at Atos

benefits. The broad applicability of the “lift and shift” strategy allows these benefits to be applied to application components with a wide range of profiles, including: varying operating systems (e.g. Windows, Linux), demanding performance requirements, specialized kernel needs (e.g. kernel modules), or with HW-specific license constraints (e.g. per CPU).

A “lift and shift” and “lift and optimize” also set the stage for future application-level modernization. Once your application is in the cloud, additional modernization (e.g. adoption of container technology) becomes much easier. As you gain familiarity with cloud tools and the variety of cloud services, you can approach subsequent modernization efforts incrementally and at your own pace.

To accelerate your GCE adoption, consider leveraging the Migrate for Compute Engine product to orchestrate automated migration of your applications into GCE VMs.

Industry leaders such as Cardinal Health, a $130B Fortune 500 healthcare provider, are reaping major benefits after migrating their VMs to GCE. Cardinal Health migrated existing systems to cloud to enhance their security and data protection, to leverage speed and cost savings, and to gain additional infrastructure flexibility and business agility. Starting with no prior experience on Google Cloud, they collaborated with Google Cloud services teams to plan and execute their migration, achieving production-readiness in just 3 months.

Migrating to VMs on GCE provides immediate infrastructure modernization by delivering access to the scalability and elasticity of cloud, along with all of the accompanying technical and business benefits.

Migrating VMware workloads to Google Cloud VMware Engine (GCVE)

Finally, if your existing environment is VMware-based, and you prefer to minimize change to your current operations, GCVE is a managed VMware-as-a-Service offering purpose-built for VMware workloads on Google Cloud. GCVE is the fastest, safest, most flexible way to “lift and shift” VMware virtual machines to the cloud. GCVE enables enterprise customers to run VMware virtual machines natively in a

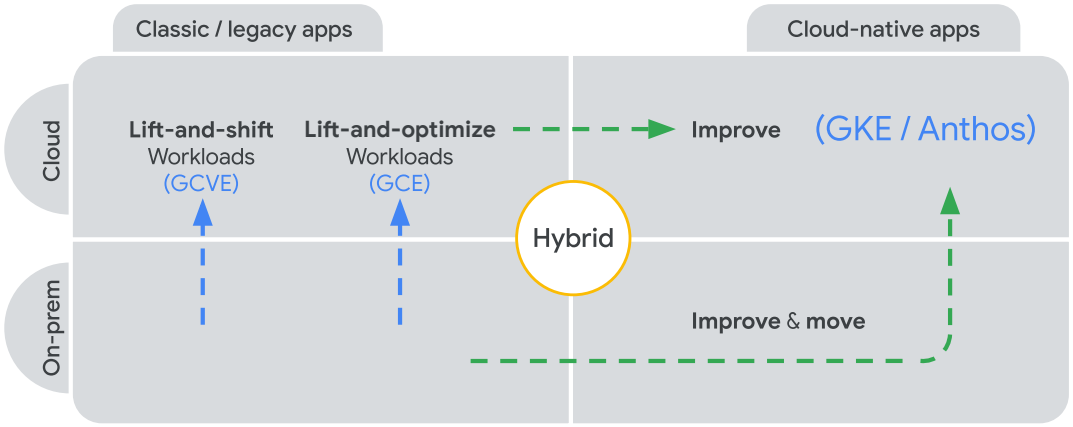
dedicated, private Software Defined Data Center within Google Cloud. This allows customers to move VMware from on-premises to Google Cloud with no customer changes to tools, processes, policies, or ecosystem integrated solutions. This new service allows our customers to run VMware vSphere-based workloads in Google Cloud, while also benefiting from Google Cloud's unique strengths, including: our secure and scalable global infrastructure, our innovative data analytics, and our AI/ML capabilities. Users will retain full, native access to the VMware stack including vCenter, vSAN and NSX.

"Google Cloud has been exemplary in the “how can we help you” approach and with understanding what we want to do and how to make what we want happen.”

Brian Hanlin, Sr. Director, Cloud Platform, Cardinal Health

One size does not fit all

Meeting customers where they are



Chapter 4:
Modernization without Migration

Anthos

Anthos on-premises

What if you have applications that will have to remain on-premises? In many cases, those applications may still benefit from infrastructure modernization. Specifically, leveraging Anthos GKE on-premises can provide the best of both worlds, enabling the applications to remain on-premises, while still leveraging the benefits of containerization and the benefits of Google Cloud. As discussed previously, Anthos simplifies hybrid and multi-cloud application management, by delivering a unified view of all GKE-managed environments, whether running on-premises or in Google Cloud. Finally, by modernizing with Anthos, you also set the stage for future hybrid cloud integration, if desired. To learn more about Anthos and to determine whether your on-premises applications are good candidates for moderization via Anthos, see this Anthos overview.

Chapter 5:
Project Implementation

The guidance above will help define a template for the first steps of your migration strategy, including consideration of non-technical factors that may be specific to your business (e.g. risk/timing associated with migration of business-critical applications). As you proceed with both strategic and tactical (including timelines, resourcing, etc.) planning, we will work closely with you to help achieve your goals. Then, as you look beyond your initial migrations to subsequent phases of your transformation journey, we can help you plan accordingly.

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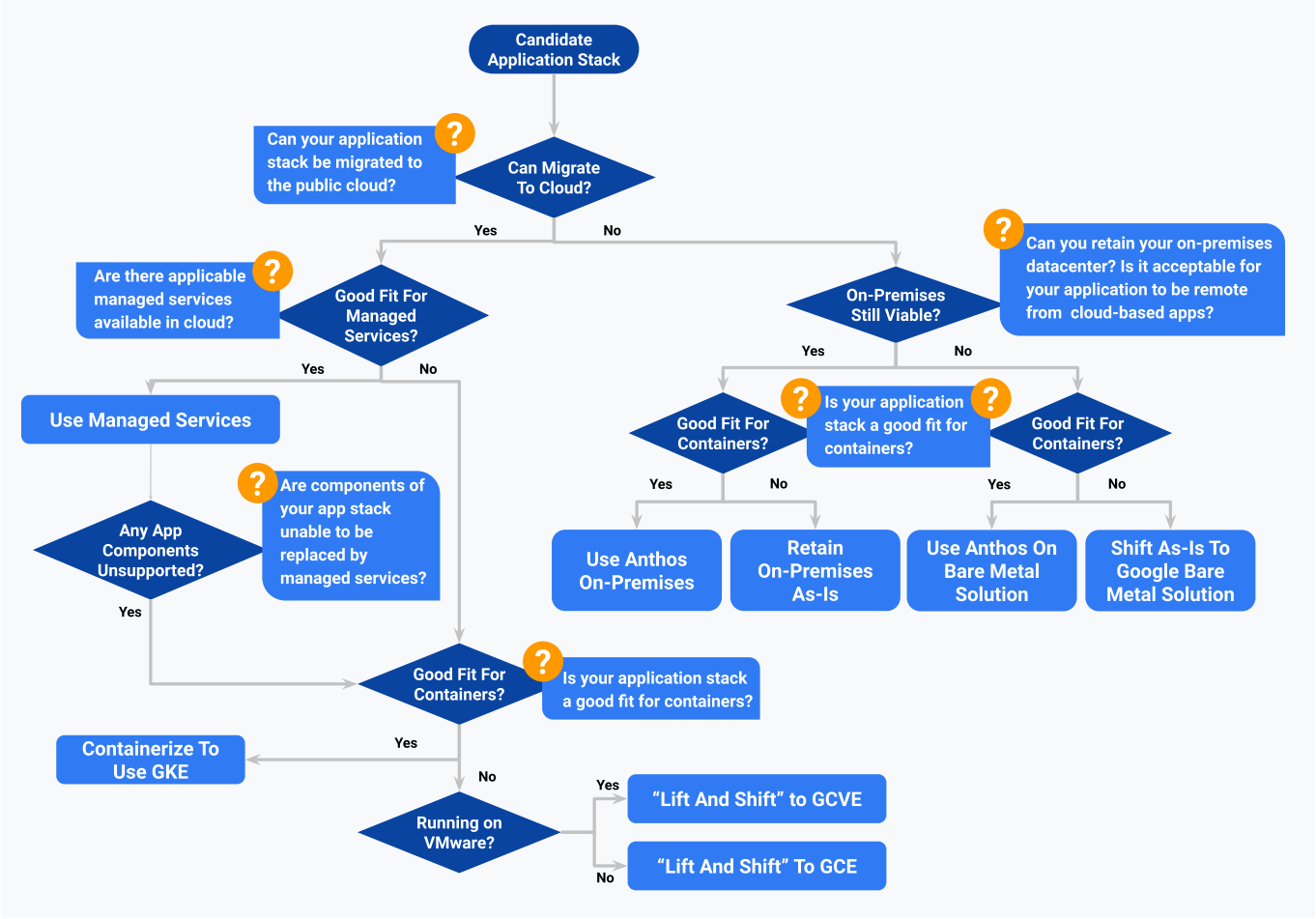
Conclusion



Application Migration Guidance Summary

In this paper, we've provided simple guidance regarding key decisions required in the first phase of your digital transformation, for example. whether to migrate applications to the cloud and how to approach those migrations. As stated previously - there is no single right answer. Digital transformation is a journey and, as with most journeys, there are many paths to choose from. With the guidance we've provided, however, you can begin your journey with confidence, having defined practical first steps for enhancing your business in partnership with Google Cloud.

If you have questions or would like more detailed guidance based on the specifics of your environment or business requirements, we encourage you to contact us. We're here to help.

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