

CLOUD COMPUTING

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Migrating to— or away from— the Public Cloud

NETFLIX HAS BEEN THE POSTER CHILD FOR PUBLIC CLOUD ADOPTION. It is widely (and incorrectly) believed to be “all in” on Amazon Web Services, and has famously reported that it has closed its last datacenter. Similarly, General Electric has committed to the cloud, and plans on migrating its applications to the public cloud as well.

However, although Netflix may well have closed its last datacenter, that doesn't mean that it has gone 100 percent cloud. In fact, although many key Netflix applications—such as its recommendation engine and media transcoding—run on AWS, it uses Google for data backups and provider diversity/risk mitigation, and its real heavy lifting—content delivery—is actually performed on

dedicated, Netflix-owned equipment in colocation facilities. And, although GE and many others might be migrating to the cloud, many other high-profile companies—such as Instagram and Dropbox—are migrating away from the public cloud and into their own datacenters. Yet others, such as Apple, have announced a partial migration from one public cloud provider to another. How can leading companies be moving—with conviction—in opposite directions, and what factors should your company consider?

The Strategy and Economics of Migration

When people talk about “cloud migration,” they could be referring to either architecture or operations. The first involves migrating legacy applications to a scalable, cloud-ready architecture, often using newer languages such as Google's Go and Apple's Swift and newer components such as NoSQL databases. The second involves migrating either such cloud-ready applications or newly designed and coded applications from a private cloud to the public cloud or vice versa, or among public clouds. This second approach might itself require different APIs and recoding, or it might be made easier through the use of containers or standard stacks or services—such as OpenStack or Hadoop.

The economics of the first type of migration are clear, and don't always favor application rewrites, because the upfront costs to rearchitect and rewrite an existing application might not generate a sufficient stream of benefits and thus might not be justified. Legacy applications have often been built as monolithic entities. A change to a single line of code would necessitate retesting and recompiling and redeploying the entire application. Today, applications are built for the cloud out of composable objects or services that can independently scale. For example, a Web tier might include a load-balancing layer that can independently scale based on the number of users, with a database layer that can independently scale based on the quantity of data or reads and writes. Emerging approaches include microservices and new approaches such as Amazon Web Services Lambda functions, which don't use resources until they're invoked.

However, as attractive as such functionality and architectures are, legacy applications might represent decades of continuous development. A classic example is an airline reservation system,



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which might have millions—or tens of millions or more—lines of code. There might not be a compelling economic rationale to migrate such an application to a cloud-y architecture, yet there might be substantial risk. The best approach in such cases may well be “if it ain’t broke, don’t fix it.”

Here, I’ll consider the factors involved in migrating to or away from the public cloud, first reviewing a number of case studies such as Netflix and Evernote. Of course, any of these companies could rethink their strategies at any time.

Case Studies

It would appear that there are as many migration strategies as there are companies (Figure 1).¹ Here are a few example cases.

Never Migrate to the Cloud: Evernote

Evernote operates in a colocation environment. Unlike, say, Facebook, where everyone is connected sooner or later to everyone else, Evernote can partition users and their data into “shards,” which are separable hardware environments each servicing 100,000 users. To prevent data loss, each item of user data is replicated four times, twice through RAID and twice at a different physical server, and is also backed up.² According to Alexei Rodriguez, VP of Operations at Evernote, “it would be four times as expensive to run Evernote in a cloud than what it costs us today. The costs of running a data center are actually miniscule.” Besides cost, a major consideration was data security, according to Rodriguez: “We want to know that something that holds our user data is under our control at all times.”³

Never Migrate out of the Cloud: Coursera

Coursera offers online classes from universities such as Stanford, Princeton, and Duke.⁴ The company was founded in 2012 on AWS, and has remained there since, utilizing services such as object storage and content delivery for courseware. Although startups are well known for increasingly eschewing capital expenditures for datacenters and equipment and for being cloud-native from day one, not all stay there. Uber and MemSQL are two more or less well-known companies that started at AWS but moved to their own infrastructure to save money.⁵ Dropbox is another.

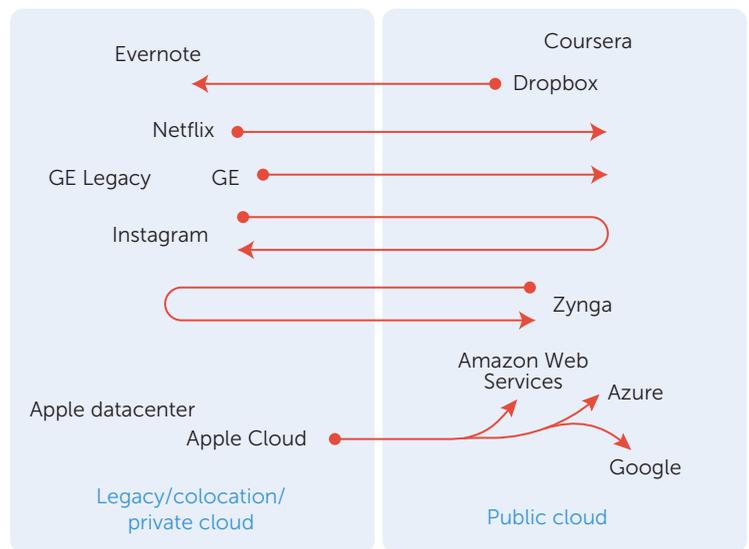


FIGURE 1. Companies follow a great variety of cloud migration strategies.

Migrate out of the Cloud: Dropbox

For eight years, Dropbox used AWS to store its users’ files. However, it spent two years migrating almost all of those files—about 500 petabytes—off of AWS and into its own datacenters (the data remaining at AWS is largely in non-US regions). In fact, it migrated twice, once to commodity servers, and then shortly thereafter to a purpose-built Dropbox hardware technology called “Diskotech.” There might be strategic reasons for such a migration—after all, AWS is clearly on a growth trajectory and introduces new services at a dizzying pace. However, the stated reason, according to Dropbox Vice President of Engineering Aditya Agarwal, was “raw economics, not politics.”⁶

Migrate to the Cloud: Netflix Streaming

Netflix is the poster child for migration to the public cloud. However, the headlines disguise some lesser-known facts. For example, Netflix has two major media businesses: DVDs and streaming. The DVD portion of the business runs entirely in a traditional datacenter. For streaming, Netflix uses AWS for tens of thousands of servers and tens of petabytes of storage to support search, the famed Netflix personalization/recommendation engine, media transcoding, and billing and payments. However, it maintains data backups at Google (in the event of a major AWS catastrophe), and it runs its own content-delivery

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network, positioning Netflix “Open Connect” servers at colocation and interconnection facilities, a critical cost and performance decision given that Netflix has been estimated to use over a third of downstream edge bandwidth at peak periods such as prime time.⁷

Migrate Where Possible to the Cloud: GE

According to Chris Drumgoole, GE’s chief operating officer of Global Operations CoreTech, GE is going “all in” to the public cloud. He cites three primary drivers: “flexibility, possibility, and cost.”⁸ Flexibility means greater elasticity and business agility. Possibility means new applications that can leverage unique cloud functionality. Beginning with about 30 datacenters, GE is closing them one at a time, migrating the applications resident therein largely to the public cloud. The company’s objective is to get to a single-digit number of datacenters.

The company’s cost savings due to migration to the public cloud are averaging above 30 percent. However, cost reductions aren’t primarily due to infrastructure cost savings. For example, Drumgoole recounts a particular application used in the oil and gas business for which operating cost was reduced by over 90 percent by moving to the cloud. However, the reduction in infrastructure cost was inconsequential. Instead, much of the cost reduction came about by eliminating process overhead for application, infrastructure, and change management.

It’s worth noting that not all apps will move to the cloud. Drumgoole points out that “most of the apps and the systems that build machines [such as turbines] or transport them are not cloud-ready by any stretch.”⁷

Migrate to the Cloud, Then Back: Instagram

According to Instagram cofounder and chief technology officer Mike Krieger, Instagram originally used a managed services provider. However, as the company began to grow exponentially, the managed services provider’s provisioning interval of four days to turn up a new server became clearly inadequate, so Instagram famously migrated to the public cloud. However, after its acquisition by Facebook, it migrated out of the public cloud to Facebook’s internal datacenters, achieving compelling economic advantages partly due to performance gains and partly due to more cost-efficient resources.

The integration with Facebook began with areas such as spam blocking, where Instagram found Facebook’s capabilities much more robust. It then moved on to monetization and ad serving. According to Krieger, there were unnecessary complexities inherent in linking AWS-resident Instagram components with those now running at Facebook datacenters, helping to drive an eventual migration to an all-Facebook datacenter architecture.⁹

Jay Parikh, the vice president of Global Engineering and Infrastructure, points out that migrating away from AWS and into Facebook’s internal datacenters led to a variety of improvements, including reducing the number of servers required threefold and reducing photo upload time by 80 percent.¹⁰

Migrate out of the Cloud, Then Back in: Zynga

Zynga is a fascinating tale of the drivers for migrating into and out of the public cloud. This game developer, known for hits such as FarmVille, used AWS during its heyday, when it experienced exponential growth. In 2011, once it had a stable base of gamers across multiple games and therefore its demand was more predictable and flatter, it migrated off of AWS and into its own datacenters. However, as smartphones took users away from the desktop, Zynga found its user demand substantially impacted, and over the same period, AWS cut prices significantly. As a result, in 2015, it reversed its reversal, moving back to AWS.^{11,12}

Migrate to Several Cloud Providers: Apple

Apple has reportedly been using both AWS and Microsoft Azure for parts of its iCloud services. In March 2016 it was reported that Apple will be using Google as well, potentially shifting applications and hundreds of millions of dollars of spending from AWS or Microsoft to Google. Interestingly, this shift has occurred even though Apple competes with Google in a number of strategic areas, such as mobile devices and app stores.¹³

Lessons

A number of lessons can be drawn from the decisions of leading companies.

Lesson 1: Every company is unique. The eight companies I’ve highlighted—Evernote, Coursera, Dropbox,

Netflix, GE, Instagram, Zynga, and Apple—each have had different trajectories in not migrating or in migrating to or from the cloud or clouds. They based these choices on their unique competitive positioning, business models, user growth, and compute versus data needs.

Lesson 2: Things change over time. Technologies, architecture best practices, and business conditions evolve. Therefore, an architecture that enables portability might be advantageous for most firms.

Lesson 3: Cost is not the only thing, nor even necessarily the most important thing. As Drumgoole says, GE's three main drivers are flexibility, possibility, and cost. And Drumgoole rates cost a distant third. That said, all other things being equal, companies and their leaders can't afford financial misfeasance, and must seek to optimize costs where possible.

Lesson 4: Rich service portfolios are a double-edged sword. Platforms, APIs, and newer services, such as AWS Lambda functions, that provide on-demand microservices can accelerate application development, lower cost, and maximize quality by reusing tested components. As a result, they can drive competitive advantage for digitally enabled businesses. However, to the extent that they make migration out of a cloud costly or cause lock-in to a particular provider, they can cause issues.

Lesson 5: There's a complex interplay between relative costs, services portfolio maturity, and demand uncertainty and variability. If the public cloud has a higher cost than a do-it-yourself approach, it can still be economically preferable to fixed infrastructure when demand varies. Such a cost structure isn't unexpected, given that service providers are intermediaries offering access to resources that companies might be able to get at similar cost levels (see Figure 2). However, a higher unit cost might be more than compensated for by the total cost benefits created by the pay-per-use charging model of the cloud.¹⁴ Companies in periods of exponential change, as is the case for most startups, might be best served by the cloud. However, when growth flattens, cost differentials might drive migration to owned or dedicated resources, such as within one's own datacenter, or at

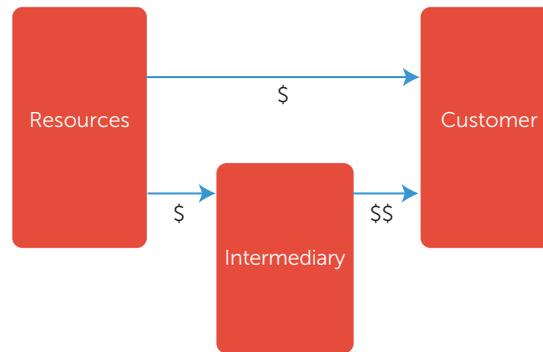


FIGURE 2. Interplay between relative costs, services portfolio maturity, and demand uncertainty and variability in a cloud ecosystem.

a colocation or managed services provider. Exponential change might not just entail a growth scenario; it also applies during exponential decline, as some companies experience. Owned resources can then become an albatross.

Lesson 6: Beyond unit cost, performance differentials are also relevant. Instagram and Zynga, for example, found that being able to craft a custom architecture based on the unique requirements of their applications achieved resource savings, thus driving cost savings beyond any unit cost differentials between private resources and public cloud.

Lesson 7: Storage and compute are different. Although compute requirements can be spiky, thanks to everything from seasonal peaks to exponential growth to circadian rhythms to special events such as Cyber Monday or April 15 or breaking news, storage requirements typically increase monotonically.¹⁵ As a result, storage-intensive companies, such as Instagram and Evernote, are likely to disproportionately benefit from owned infrastructure.

Lesson 8: Although most of the case studies highlighted here are tech companies, increasingly, all companies are tech companies. For example, pizza requires little technology, yet Domino's Pizza has dramatically outperformed the Dow Jones Industrial Average, largely due to a heavy investment in Web and mobile ordering, restaurant gamification, and the like. If every company is a tech company, digital technologies become critical to survival and growth, and

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correctly leveraging the benefits and balance of private and public solutions becomes business critical.

Lesson 9: In the last issue of *IEEE Cloud Computing*, my focus was on hybrid clouds. In this column, I focus on the major patterns and economics of cloud migration. However, hybrid and multicloud solutions are the most likely end state based on the economics reviewed in the last issue.

Lesson 10: Finally, although I've focused on economic and performance considerations, strategic considerations also apply. Thus, we might see some customers changing cloud providers based on not driving business to companies that are competing directly or indirectly. On the other hand, others might ignore such factors, choosing instead to optimize a particular function or user experience regardless of a broader strategic context.

ONE THING IS CLEAR. There is no single answer, but rather a broad set of considerations, in determining whether to migrate, and if so, with what end state in mind. ●●

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