AWS Architecture Monthly

Travel and Hospitality

May 2021

Editor's note

In our Travel and Hospitality issue, we feature several customers: Southwest Airlines, American Airlines, Wyndham, Meliá, Just Eat Take Away, Domino's, KFC, and more. We also have some great articles from NLX, IBS, Elenium, Datalex - our T&H competency partners. Through blogs and case studies, you'll see how the double challenge of the pandemic and downturn has been faced and addressed with creative solutions.

We're also adding a new segment this month, *Customer Conversations.* We are excited to publish this new content and unique perspective.

We'd like to thank Kim Macaulay, Head of Data, Quality & Governance, IATA, Sekhar Mallipeddi, Tech Leader, Travel and Hospitality, AWS (our Expert for this issue), and Bonnie McClure, our technical editor, for their contributions to this issue. We hope you find it useful and informative.

Please give us your feedback! Include your comments on the Amazon Kindle page. You can view past issues and reach out to aws-architecture-monthly@amazon.com anytime with your questions and comments.

Jane Scolieri, Managing Editor

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Ask an Expert:

Sekhar Mallipeddi, Tech Leader, Travel and Hospitality, AWS

What are the general architecture pattern trends for Travel and Hospitality in the cloud?
The Travel and Hospitality industry has been an early adopter of new technologies for decades. The industry began using reservation and global distribution systems as early as the 1960s. In the early 1990s, heavy compute and storage were used for optimization, planning, forecasting, and revenue management systems. Later in the 1990s, e-commerce was implemented.
The industry manages and uses large amounts of data and builds digital applications to empower customers and employees. Building these data assets and applications can be expensive and time consuming, and they may not always meet business needs. To help with this, many businesses have migrated to the cloud and use data lake/lakehouse patterns, purpose-built databases like no-SQL, and serverless architecture. This democratizes access to data and accelerates the building of digital applications while reducing total cost of ownership.

When putting together an AWS architecture to solve business problems specifically for Travel and Hospitality customers, what are some of the considerations?
Helping our customers reduce total cost of ownership while allowing them to innovate quickly to meet market demand is critical. Unfettered access to all data by developers, business users, data scientists, and business partners is integral to rapid innovation. AWS enables this by freeing up data and reducing dependencies on legacy, on-premises, and mainframe applications. We are moving data off these applications using a Command Query Responsibility Segregation (CQRS) pattern to operational data stores (ODS) built using purpose-built databases. We help our customers efficiently build data assets and analytics using data lake/lakehouse architecture patterns that use the data mesh methodology. In addition, we enable access to real-time operations and customer data by using Internet of Things (IoT)-based connected aircraft, airports, hotels, and restaurant architectures. By democratizing this data, we enable our customers to improve and build customer-/employee-facing applications.

Do you see different trends in Travel and Hospitality in the cloud versus on-premises?
Absolutely—without unfettered access to data and the ability to elastically scale compute on premises, our Travel and Hospitality customers are more limited in their capabilities. It is harder for them to create fuel-efficient flight plans, offer dynamic pricing and marketing offers, attribute based room pricing, manage revenue for all future flights, manage customer master data, and create a 360 view of customers. These services require heavy compute usage for short periods of time that on-premises data centers cannot provide. They also require quick access to large amounts of data that on-premises databases and data warehouses cannot provide at scale.
AWS provides elastic compute, serverless architectures, data lakes with elastic storage, purpose-built databases, and separation of compute from storage. Our customers need these services to ensure they can deploy at scale without advanced planning and capital expenditure. AWS adoption has assisted our customers in realizing capabilities like these and helped optimize operations and enhance customer service.

What's your outlook for Travel and Hospitality, and what role will the cloud play in future development efforts?
My outlook for the Travel and Hospitality industry is very positive. Our customers connect the world, create amazing dining experiences, enable travel for business and tourism and significantly impact local economies. With cloud adoption in the early stages, there is a huge

opportunity to use the elasticity of compute and storage, serverless, IoT, and artificial intelligence (AI)/machine learning (ML) capabilities on AWS. Building on democratization of data, the industry can use Amazon Machine Learning (Amazon ML) and create interactions and experiences to delight their customers while keeping costs down and optimizing operations. Beyond that, customer engagement capabilities like Amazon Connect and Amazon Pinpoint will further add to the industry's ability to interact with and engage their customers.

Anything else you'd like to add?

COVID-19 has been devastating to the Travel and Hospitality industry, but the industry is resilient. It has quickly responded to drastic reduction in demand, rapidly changing with uncertain demand and health restrictions. It has started to recover by adjusting to a new operating model and consumer behavior. Customers now have new services like home delivery, self-service, contactless, and touchless applications and the industry continues to make steady progress towards other innovations. Our customers also are moving away from data center and CAPEX-centric IT spending that has historically restricted their ability to scale down to customer demand, and they have adopted cloud and OPEX models that will allow them to be completely elastic to meet current and future customer demand. We will continue to work with our customers and help them innovate on AWS to improve operational efficiencies and enhance the customer experience.

Sekhar Mallipeddi is the Worldwide Technical Leader for Travel and Hospitality at AWS with the charter to support and help travel and hospitality customers innovate using AWS cloud to enhance customer experience and improve operational efficiency. Sekhar leads the technical field community for Travel and Hospitality that enables internal AWS teams, ISVs, and GSIs creating technical assets, reference architectures, and solutions. Prior to joining AWS,he spent 20 years in the Travel and Hospitality industry in information technology strategy, cloud strategy, and enterprise architecture roles and built products for aircraft predictive maintenance, revenue management, customer master data management, and analytics. He holds a M.S. in computer science from University of Texas at Arlington, and an MBA from theUniversity of Chicago Booth School of Business. In his spare time, Sekhar loves to cook and experiment with ingredients and cuisines from around the world, and traveling with his family in search of amazing food and wine and has visited over 40 countries.

Customer Conversations:

Kim Macaulay, Head of Data, Quality and Governance, IATA

Please explain the current challenges with data products at IATA and the new products being developed

At the International Air Transport Association (IATA), we are data custodians. We pride ourselves on serving our aviation members with evolving and best-of-breed data products that further their business goals.

As you might expect, it's a challenging time to be in aviation. But in a way, it's also very exciting! Because of the pandemic, there is more data available today than there was 5 years ago. Though the pandemic has presented many unexpected challenges, it has also created opportunities. For example, we have so much "non-traditional" data available that we can create new datasets. By mixing the new and existing data, we can deliver value-added data products and services to cater to the "new ways of working."

One of our most significant challenges occurs when data products are developed in silos. When this happens, we sometimes cannot use the full benefits of all the data we have access to. A lot of organizations struggle with this—often data is created or used based on an operating or functional model. To avoid silos, we created a shared data architecture where data assets can be mined and modeled efficiently. This architecture is not tied to any operating model. It is driven through explicit organizational use cases. This strategy drives data centricity, which allows us to target new opportunities that would not have ordinarily been open to us. Additionally, we can mix datasets, which allows more power in analytics and we can act on the insights we derive from the data.

What is the IATA Unified Infrastructure and its architecture?

IATA is an integral part of the airline ecosystem. Therefore, our data processing environment needs to operate with flexibility and agility to grow beyond existing products and enhance them with other datasets. To ensure scalability for product enhancement and to generate new products and services, we need to include datasets currently not referenced in everyday activities.

The IATA Unified Infrastructure seeks to achieve an integrated data ecosystem. It aligns tools and technological building blocks to reduce cost, simplify setup, consolidate operational/support teams, and reduce risks usually created by using multiple IT-related tools and products. When we introduce new products to the infrastructure, we reuse and enhance common core components to minimize waste and optimize costs.

Our Unified Infrastructure is built on AWS cloud to expand our API, data lake, event-based data architecture, DevOps, security, front-end and backend components, and microservices. The decoupled nature of this infrastructure means that we can find the latest technologies and easily install/uninstall them based on new or added functionalities. This decoupling means that we can move quickly and be proactive when new requirements come our way. With the ever-changing technologies out there, we want to make sure we aren't tied to a specific technology.

Our current set of data products under development will be used as the baseline for the future design of new products and services. This ensures we do not have multiple solutions doing similar things. It will also confirm we have a data platform that can be mined and modeled across all available datasets.

We have a product mindset for our Unified Infrastructure—not only do our customers use it, we also use it internally. Treating it as an internal and external product means we pay special attention to monitoring the value it adds and the overall benefits realized when we deliver products or roll out features.

By creating an open platform, we can reuse

components we have built and expand where we need to. This single integrated platform encompasses a myriad of solutions and technologies, but it is simple enough to ensure we reduce legacy technical debt. In the end, this simplified IT landscape gives rise to faster digitization and automation. That is a key principle for us, and we never embark on any technology without understanding how it will benefit our customers.

What are the guiding principles and core tenets of IATA Unified Infrastructure?

The underlying principle of our Unified Infrastructure is agility, agility, and agility. We do not have time to roll out projects that span multiple years. Our customers are tech savvy and they need what they need now. We co-develop products and services with our customers, which adds a special something to the final product. This is key to us keeping our customers at the heart of everything we develop. Because we engage the customer in the development process, we earn their trust, which ultimately means the migration and roll out of new solutions is much more successful. Creating "Friends of the Product" ensures we react quickly to feedback and that can be flexible if requirements change. For example, requirements often change once you see it "in the flesh," and being agile means that we are not only quick to deliver but also quick to react. The other tenets underpinning the Unified Infrastructure include reducing costs of our IT infrastructure but also spending where it makes sense. With an ever-growing need for data products, there comes an even bigger need to secure our customers' data and interactions with IATA. We therefore follow a zero-trust philosophy when implementing new products and services and are always vigilant about security.

Our Unified Infrastructure is guided by further principles of cloud-first and open-secure architecture, allowing us to be always on and always secure.

How do you use data lake and lake house architecture patterns for the IATA Unified Infrastructure?

Many organizations struggle with the complexity of maintaining both data lakes and data warehouses. This complexity often translates into complicated data pipelines, slow-to-market products, and reduced decision making speed.

IATA embarked on a lake house architecture a few years ago. We looked at implementing similar data structures and data management features to those in a data warehouse directly onto our AWS cloud data lake. This enhanced, simplified architecture allows for traditional business intelligence analytics and data science to co-exist in the same system. We are expanding approach as part of the Unified Infrastructure strategy by opening our data formats. When combined with unstructured data, this approach will expand our artificial intelligence (AI)/machine learning (ML) use case reach. We are also implementing a take-on-any-format approach to assist our customers because they are not always able to comply with certain data standards and formats.

We have so many use cases we need to provide solutions for, and just implementing a data lake was never going to be enough. In the early days of data, organizations were almost always data warehouse only or data lake only shops. IATA is proud to have the best of both worlds. We have worked closely with AWS to optimize our architecture, but given the size of the datasets in the aviation space, we still need to join cross-organizational data lakes. Thus, expanding the data lake within the Unified Infrastructure to cater to all nuances is critical. This includes all ancillary data services like data science, predictive analytics, and real-time business analytics. By reusing the data pipelines we build, the landscape is simpler, and we can focus on the new and not the already in place.

The lake house architecture has helped us establish the foundation of our Unified Infrastructure as we expand our event-based data architecture to cater for a microservices-based strategy. However, I see it as almost

becoming a lake house-lake architecture in some respects. (Yes, this is not exactly the correct technical term, but I think you understand where I am going. :)) For example, aircraft operational data can run into the thousands of petabytes, and storing all the data in one data lake may not make much commercial sense. If we could have our data lake talk to an OEM's (original equipment manufacturer) data lake, then the increased insights would give us opportunities to join datasets and potentially new/unseen additional analytics.

What is your development and support model for the IATA Unified Infrastructure and how do you use the modern data mesh methodology?

Interestingly, we started investigating data mesh architecture a year ago when we were looking at enhancing our current data lake into a "game changing" platform for new product development. Enabling rapid delivery of new capabilities is very close to our heart, and it is something we share with data mesh methodology. As a DevOps organization, we follow the premise of "you build it, you run it," and this mentality flows into the data space. We have specific concepts we follow for data-as-a-service and infrastructure-as-a-service. Now we have complemented these with security-as-a-service and operations-as-a-service to ensure all facets are addressed in the Unified Infrastructure.

The Unified Infrastructure looks at simplifying and speeding up data acquisition, processing, storage, analysis, and exposure processes with a specific focus on agile delivery. Our prioritization process prioritizes shifts that will directly impact business goals and strategies. Prioritizing items like real-time messaging platforms like Apache Kafka as well as streaming processes and analytics solutions like Apache Kafka and Apache Spark will add competitive advantage in the data space.

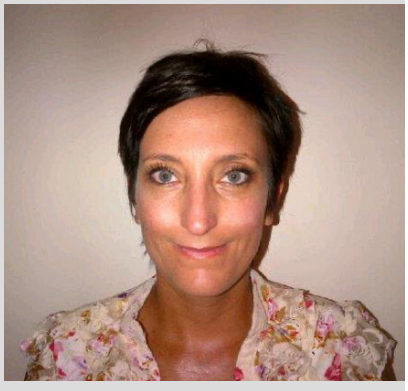
We have already rolled out data science models that use predictive analytics. We did this in a scaled, agile way to ensure iterative enhancements and extensible data models. This allows us to compare patterns and signals in the data and evolve quickly. For data mesh, we have streamlined our data pipelines and API integration to get the most out of our architecture. Exposing data via APIs ensures we have direct access to view and modify the data while allowing faster access times to common datasets in the platform.

The support and development model looks at establishing a network-based group that incorporates all facets of IT (operations, data, architecture, integration, and testing) into a cross-functional team that focuses on testing and deployment. These network-based groups allow us to focus on DevSecDataOps to ensure our design deploys new components quickly, securely, and iteratively.

Our Unified Infrastructure expands past creating a data culture. We aim to create a unified culture in technology practices that support and work within our business and with customers. It is a great time to be in aviation IT!

Kim Macaulay is the Head of Data, Quality and Governance for Information Technology at IATA. She began her career in the Financial Services & Banking sector where she executed strategic IT initiatives around data and digitization by implementing technologies to support strategy. In 2014, she joined the Standard Bank of South Africa (SBSA) and was responsible for implementing the technical data capability for Global Markets and Transactional Products and Services. After 15 years in the banking world, she joined IATA in 2020 to head up the data capability in IT specifically relating to transforming the AWS Cloud environment for an ever-changing data landscape.

Kim has an Honours Degree in Business Commerce from the University of Johannesburg in South Africa as well as further postgraduate studies in Data and Digitization.



Case Study:

Elenium Enables Safer and Smoother Airport Travel Using AWS

Innovative technology has extraordinary potential for streamlining passenger flow through airports, enhancing safety, and providing a more enjoyable experience to all. Australian-based startup Elenium Automation (Elenium) is leading the way, using automation to create advanced self-service technology that delivers a connected and seamless traveler experience.

Elenium employed a suite of services from Amazon Web Services (AWS) to create a touchless system that eliminates outdated, confusing, and time-consuming processes and that increases passenger flow. When the COVID-19 pandemic began, Elenium again used AWS to quickly deploy an early-detection health tool to make airport travel even safer.

> **"We wouldn't have the intellectual freedom to even think about these ideas if we didn't have AWS to help us take them to market."**
>
> ***Aaron HornLimann***
> *CEO, Elenium Automation*

Rapidly Deploying New Technology Using AWS

Founded in 2016, Elenium aims to help airports and airlines securely modernize their operational technology. With its focus on building sophisticated hardware solutions for airports, Elenium and its team of 80 employees were not interested in building advanced software solutions from scratch and then also having to manage them. The company determined that outsourcing to a managed cloud service provider was the most efficient way to deploy its products. The company turned to AWS because of its breadth of quickly deployable managed services.

In late 2018, Elenium began developing Voyager, a program that uses biometrics, voice recognition, artificial intelligence, and cloud technologies to replace outdated processes—such as scanning boarding passes and manually entering data—in place at many airports. "We developed the first working prototype in 4 months," says Aaron Hornlimann, Elenium CEO, "and that includes building a whole new set of hardware, bag drop design, new kiosk design, boarding gate design, and a new virtual duty-free shopping experience, as well as all the AWS-backed software behind that." In March 2019, Elenium introduced Voyager at an exposition in London, essentially setting up a virtual airport in which users could download Voyager onto their mobile phone and interact with it to check in, drop off luggage, shop, and more. The process was simple, but behind it is an integrated array of AWS services working seamlessly with Elenium's hardware.

Turning a Selfie into an All-Access Pass at the Airport on AWS

When passengers check in for their flight, they use the Voyager mobile app to take a selfie that is submitted through Amazon Rekognition, which uses highly accurate facial analysis for identity verification. Amazon Rekognition generates an ID from the photo that passengers use throughout their check-in process. The data is housed in Amazon DynamoDB, a key-value and document database that delivers single-digit millisecond performance at any scale, which then creates a map of passengers' progress as they pass from touch point to touch point—from security to an airport retail shop, for example. From that information, Voyager predicts what data will be needed at the next touch point, caching that data to speed up the overall airport experience.

Voyager also uses Amazon Polly, which turns text into lifelike speech, and Amazon Lex, which turns speech into text to create a conversational interface, to provide support and instructions to passengers during the check-in process. Passengers can talk to the app on their mobile device or at Voyager kiosks in airports to check in bags, figure out seat changes, perform automatic visa checks, scan passports, manage bookings, and more.

Another key feature is Voyager Bag Drop, which eliminates the need to use a bag tag by using computer vision to identify passengers' luggage. Once travelers place their bags on the conveyor belt, Voyager sends a confirmation message that the luggage was received along with a photo of it so travelers have a record of its condition before the journey. Passengers can also purchase duty-free products at the Voyager Virtual Shopping Wall—powered by AWS—and have them delivered to their homes or hotels rather than carry them on board.

At the time of boarding, Voyager uses Amazon Rekognition to automatically validate each passenger using biometrics (i.e., facial structure), which is much more secure than the traditional process of printing and scanning boarding passes. "The chance of someone getting a copy of your boarding pass and using it to access your frequent flyer number or anything else that's normally stored in those barcodes is greatly minimized," explains Hornlimann.

Since March 2019, Elenium has implemented various Voyager features to create a connected and seamless traveler experience in 13 airports worldwide and is currently deploying in another 7. Airports with Voyager technology report that the system is able to reduce processing time by up to 60 percent. New Zealand's Auckland Airport has installed Voyager kiosks and reduced its average check-in time from 20 minutes to 8 minutes. Etihad Airways is now implementing Voyager Bag Drop units and plans to incorporate the entire Voyager process in the next 6 months, becoming the first airline to deploy the complete contactless self-service technology. This adoption process, says Hornlimann, "is much faster than it has ever been. A check-in kiosk was effectively the same for a decade before we saw any kind of innovation there. But now we're seeing that adoption much faster. And that can only happen because of cloud service providers like AWS."

Enabling Safer Airport Travel during the COVID-19 Pandemic

Soon after Voyager's launch, Elenium began to investigate touchless technology as a solution to make self-service more accessible for passengers with reduced mobility. When the COVID-19 pandemic brought new safety concerns to air travel, Elenium quickly realized that Voyager's contactless, voice-controlled technology was especially relevant and useful because it could help people pass more safely through airports without having to touch a single surface, reducing the risks of viral or bacterial germ transmission.

The company also realized the potential for this technology across a wide array of sectors in which public screening may be vital in the future, including healthcare, aged care, sporting arenas, and more.

In less than 8 weeks, Elenium was able to evolve its customer-facing Voyager kiosks into health screening points that use contactless detection to measure three vital signs: temperature, heart rate, and respiratory rate. If the tool detects an abnormality, it connects the person to a medical professional through a virtual conference or diverts the person to manual screening to do a second round of screening. The Elenium tool has been deployed in Abu Dhabi International Airport, and a US trial at airports and healthcare facilities will begin soon. Throughout this process, AWS has helped Elenium innovate to bring confidence to the public, the air travel industry, and other sectors that will be required to transform their practices after the COVID-19 pandemic. "We wouldn't have the intellectual freedom to even think about these ideas if we didn't have AWS to help us take them to market," says Hornlimann.

Changing the Relationship between Aviation and Technology

Building on AWS, Elenium deployed a touchless self-service system that facilitates a faster, more secure passenger experience in airports. When the COVID-19 pandemic began, Elenium used AWS services to rapidly adjust its focus, adapting self-service kiosks to create health-screening checkpoints that make airport travel safer. In the end, what Elenium really accomplished on AWS was changing the aviation industry's relationship with technology. "The advent of cloud computing marks a fundamental shift for the aviation industry," Hornlimann says. "It changes how quickly airports can adapt and consume technology."

Learn more about AWS for Travel and Hospitality: aws.amazon.com/travel-and-hospitality

About Elenium Automation
Australian company Elenium Automation develops innovative technologies that improve the passenger experience and passenger-flow management in airports worldwide. Founded in 2016, it has supplied more than 700 devices to 13 airports globally.

Benefits of AWS

- Processes passenger traffic 60% more efficiently in an airport
- Reduced average check-in time by 12 minutes
- Enabled a production cycle of just 4 months
- Developed and deployed a new tool in less than 8 weeks

Read Case Study online

Blog:

NLX is helping Travelers Amid Disruption with AI-Powered Automation

by Andrei Papancea, CEO, NLX, Vlad Papancea, CTO, NLX and Sekhar Mallipeddi, AWS

Travel impacts brought by the global pandemic left several airlines experiencing frequent flight disruptions, which increased flight scheduling change notifications being made to affected travelers.

Every month, tens of thousands of passengers and related flight crew have to be contacted to ensure that airlines maintain streamlined travel operations. International airlines must call and notify customers in multiple languages, across multiple locations, and in different time zones. Each notification creates a surge of return calls that requires live agent handling as customers update their travel plans.

In response, NLX, an AWS Advanced Technology Partner and AWS Travel and Hospitality Competency Partner, stood up a dynamic conversational AI solution within two weeks. With this solution, airline operators can automatically contact impacted customers and crew members, regardless of language, location, and time zone.

Initiating the customer callback process with Amazon Connect

The first step in defining the architecture was to establish how airline staff would initiate the callback process. For speed and simplicity, we encoded all the callback information into a CSV file. Multiple data points were included in the file to personalize the call notification. These fields include details like the passenger's basic information such as name and phone number and their flight details, passenger name record (PNR), and language of preference. This CSV file created the easiest way to securely allow non-technical airline staff to start the notification process. Staff then upload the CSV file to an Amazon Simple Storage Service (Amazon S3) bucket with encryption enabled to protect passenger information (see [1] on Figure 1). In the future, the CSV file could also be created from the Passenger Sales System (PSS), a system of reference for PNRs that airlines manage and maintain, or from the PNR data lake.

Next, we created an S3 PUT function that invokes an AWS Lambda function every time a new CSV file is uploaded in the S3 bucket. The Lambda function initiates an AWS Step Functions workflow (see [2] on Figure 1) that reads and parses the file from Amazon S3. For each passenger entry, we use the AWS SDK to initiate an outbound call using Amazon Connect. Any error that occurs when initiating an outbound call is logged to Amazon CloudWatch. The specific event is then placed into one of three Amazon Simple Queue Service (Amazon SQS) queues (see [3] on Figure 1). Phone numbers that are formatted incorrectly or incomplete are placed in the "Bad Contacts" queue. If a throttling error is caused by making too many outbound calls or if there are too many concurrent calls at one time, those are placed in the "Throttled Contacts" queue. Finally, all the other events that cause errors are placed in the "Unhandled Contacts" queue. Failed contacts are polled from the SQS queues to be analyzed and retried.

The Step Functions (see [2] on Figure 1) are configurable to make outbound calls in batches of different sizes with wait times between each API call in addition to wait times between each completed batch. This allows for flexibility when working with large workloads. It also lessens the risk of hitting any limits on Amazon Connect, such as the number of concurrent outbound calls or the number of transactions per second

for initiating outbound calls. Each outbound call is initiated with a set of attributes that contains the customer's name and flight information.

Personalizing customer notifications with Amazon Pinpoint

Once a call is answered, a Smart IVR built using NLX Studio (available via the AWS Marketplace) and powered by Amazon Lex (see [4] on Figure 1) engages with the customer. First, the customer is prompted to choose their preferred language (in this case, English or Spanish) by either verbally confirming or pressing 1 or 2 on their keypad.

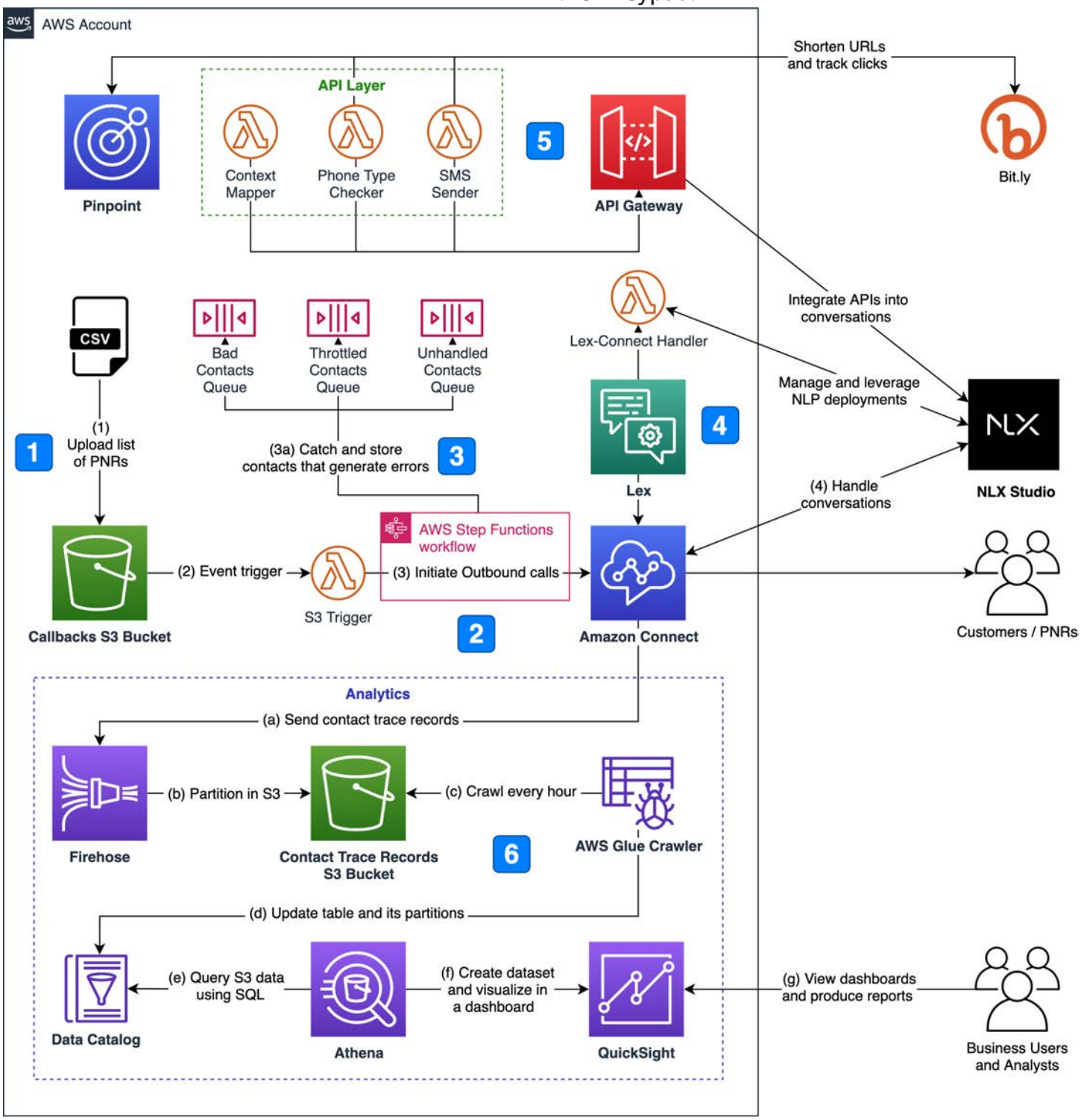


Figure 1. AI-powered Passenger Callback System for Airlines

Once the language is selected, the passenger's information from Amazon Connect is passed to the Context Mapper API (see [5] on Figure 1). This allows the Smart IVR to greet the customer by their first name and deliver specific booking information. After that, a second API (see [5] on Figure 1) is invoked that uses Amazon Pinpoint to check if the originating phone number is a mobile phone or a landline. Logging these criteria satisfies one of our important goals: sending users an SMS with a personalized URL they can use to access to manage their upcoming booking. If the originating phone number is a landline, the customer is notified about a change to their booking. Then they are offered the option to enter a mobile phone number via the dial pad to receive a personalized link over SMS. If the originating phone number is a mobile phone, the notification is spoken out and sent using the SMS Sender API (see [5] on Figure 1), which uses the AWS SDK to send the SMS via Amazon Pinpoint. The URL from the message is shortened using Bitly to optimize SMS message length and for engagement analytics. After the SMS is sent, the Smart IVR asks the customer to confirm the receipt of the notification or repeat the notification, after which the call is ended.

Tracking KPIs with AWS Glue, Athena, and QuickSight

Knowing how many customers answered the call and changed their booking allows airlines to track their key performance indicators (KPIs). To achieve this, we enabled contact trace records to be streamed out of Amazon Connect and into an Amazon Kinesis Data Firehose delivery stream with an Amazon S3 destination (see [6] on Figure 1). A crawler is automatically invoked every hour by AWS Glue to update a table with new partitions in the data catalog. Amazon Athena is then used to explore the data and build queries that answer key business questions such as how many contacts have a landline number and entered their mobile phone number to receive the SMS. Additionally, Bitly reports containing the personalized URLs and click information are exported and delivered to Amazon S3 to be joined with the Amazon Connect contact trace records. This enables queries that address how many passengers have clicked on the links and can be further joined with internal datasets about booking changes to get the full picture. Finally, the solution can use Amazon QuickSight to connect the Athena queries and produce dashboards that can be shared directly with the business stakeholders to ensure operational efficiency.

Conclusion

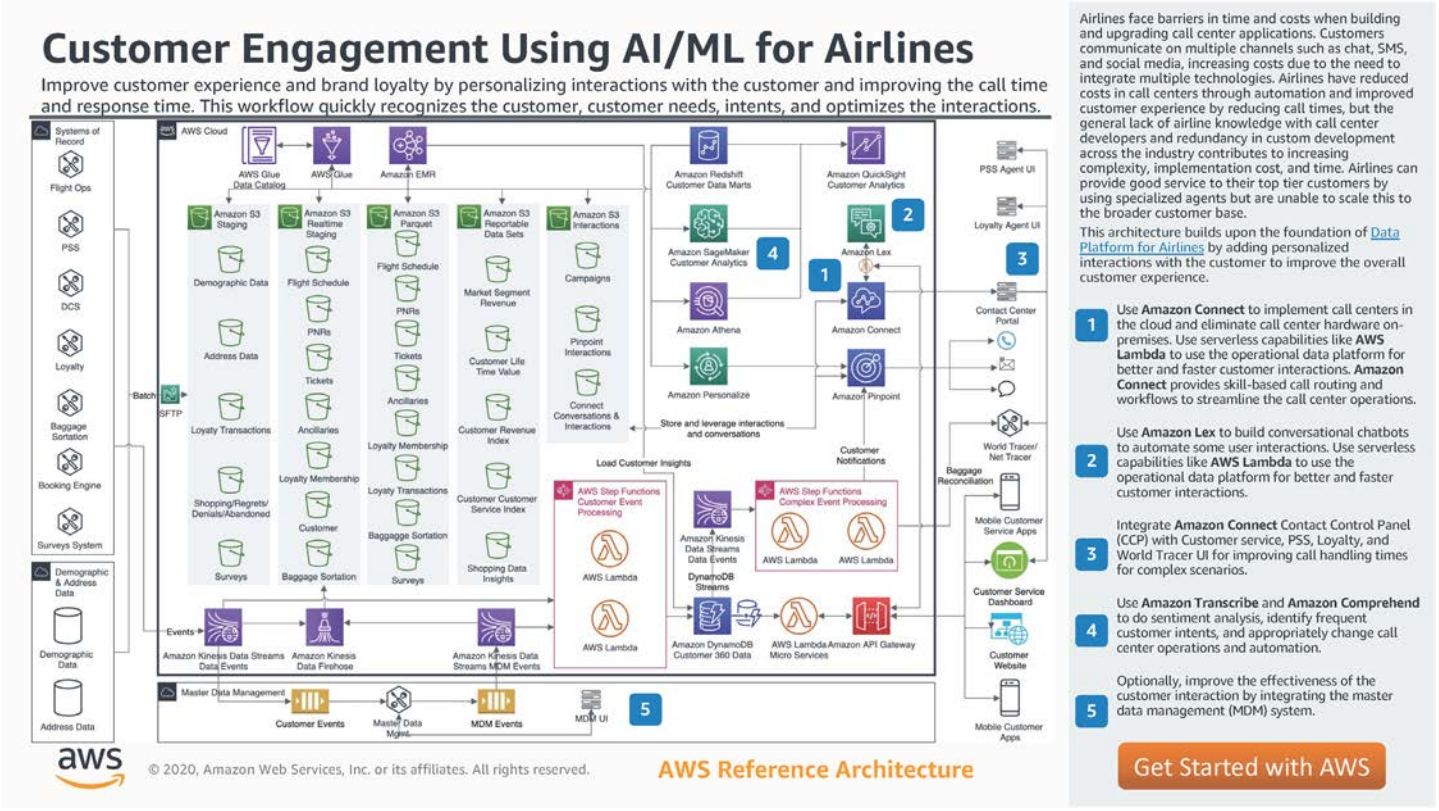
Because of the pandemic, airlines have been forced to explore ways of creating more customer intimacy and cohesion through every part of their travel experience. AI-powered automation by NLX and AWS delivers a platform/solution that not only creates cohesion but keeps the customer at the center of the brand experience. From a practical perspective, the same platform/solution delivers a new level of operational efficiency without compromising customer satisfaction. It also creates an engaging self-service option that cuts across channels while delivering high levels of personalization.

Read Blog online

Reference Architecture:

Customer Engagement Using AI/ML for Airlines

Improve customer experience and brand loyalty by personalizing interactions with the customer and improving the call time and response time. This workflow quickly recognizes the customer, customer needs, intents, and optimizes the interactions.



[View Reference Architecture online]

Blog:

Migrating to Amazon API Gateway: A Datalex success story

by Ronan Prenty, AWS, Daniel Morrow and Alberto Galan, Datalex

Datalex is an industry leader of omni-channel retail solutions for airlines around the world. The Datalex product portfolio supports end-to-end retail capabilities that include pricing, shopping, and order management.

This year, Datalex's multi-year deal with their API provider was up for renewal. As part of a best practice review, they considered other options. When the AWS Account team showed Datalex a demo of Amazon API Gateway, Datalex was impressed by its rich integrations, flexible pricing model, and compatibility with the OpenAPI Specification (OAS). Because Datalex APIs were consumed by applications out of Datalex's direct control, any API migration had to be totally invisible and have no impact on existing customers.

This blog post explains how Datalex migrated REST APIs from another provider across all environments to AWS within two weeks and realized a savings of almost 98%.

Considerations

Datalex had to accomplish the initial migration of its REST APIs to Amazon API Gateway quickly, without any impact to their customers. In the API service that was being replaced, applications that consumed Datalex APIs were generally out of Datalex's control. Speed, maintaining service to customers, and ensuring zero hands-on work were critical to the success of the migration project. The two primary considerations were to import existing API keys and maintain the existing structure of HTTP requests.

Existing API keys

Datalex customers were using preexisting API keys in production environments. If a change to the API keys was required, the goal of a seamless migration could not be realized. Datalex used Amazon API Gateway APIs to import existing API keys to complete a seamless cutover and avoid the need for new API keys. Amazon API Gateway usage plans allowed Datalex to improve control by implementing quotas and throttles at the API key level. Datalex did not have this kind of control with the former API service.

HTTP request structure

The existing structure of the HTTP request was to send the API key to the former provider in a format that was not supported by Amazon API Gateway.

Facilitating the invisible swap

Datalex used AWS Lambda custom authorizers to ensure calling clients were not impacted in the process. This made it possible to intercept the request and retrieve the API key without having to change the HTTP request structure.

API Gateway has two options for the source of the API key: HEADER or AUTHORIZER. Initially, Datalex used AUTHORIZER as the source for the API key. The Datalex migration team was able obtain the value of the API key in the Lambda custom authorizer code and send it back as usageIdentifierKey in the response payload. API Gateway uses this value to validate the API key against a usage plan to decide whether a request will be allowed to the backend.

After ensuring that all HTTP methods and resources were represented in the APIs they created in API Gateway and required an API key, Datalex executed existing tests against the newly built APIs in development. This proved everything worked as expected before they moved to production.

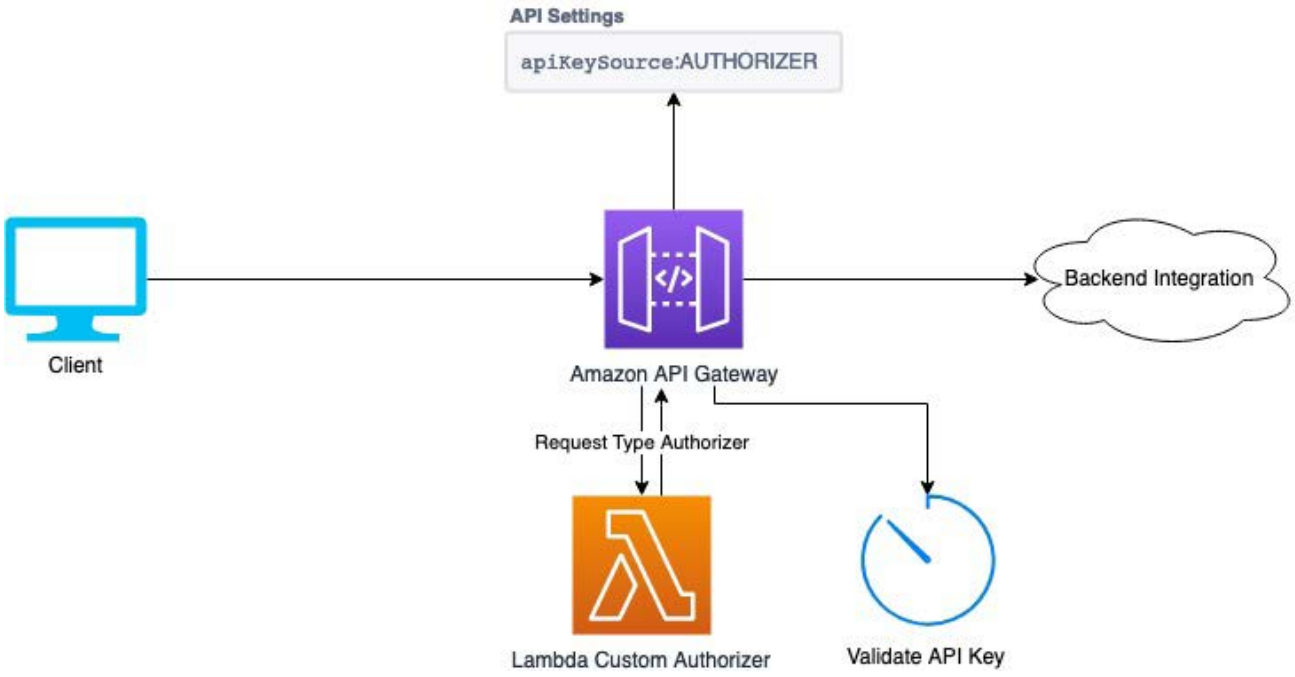


Figure 1: HTTP request with AUTHORIZER used as the API key source

After validating success in dev/test environments, the migration team made a CNAME change to point Datalex's domain name to API Gateway instead of their previous provider. With that, they achieved their goal of a zero-downtime migration that was invisible to customers and their end users. All Datalex customer API environments were now on AWS.

Thinking long term

The partnership between the Datalex API team and the AWS team was productive and useful. The AWS team provided consultative services throughout the project. In their existing API setup, Datalex was accepting requests to REST APIs from clients with the API key in a format not supported by API Gateway.

After a careful review with the AWS team, Datalex moved to a structure where the API key is sent in a natively supported method, the x-api-key header. Datalex was able to reduce costs by eliminating Lambda authorizer invocations to facilitate API key mapping.

After the successful invisible migration to API Gateway, Datalex sent depreciation notices to their clients, to get them migrated to the new HTTP request structure. In the words of **Daniel Morrow:**

> *"By representing our infrastructure as code, this allowed us to quickly clone the API and deploy a parallel version which sources the API key from the x-api-key header. We gave our customers a timeframe in which they needed to point their clients to the new API endpoint which takes the API key in a new format. During this time, both sources were supported. Once all customers were leveraging the new endpoint, the AWS CloudFormation stack representing the original API was deleted."*

Instead of invoking a Lambda function when a request arrives, Datalex can now fully rely on API Gateway usage plans for fine-grained quotas and throttling.

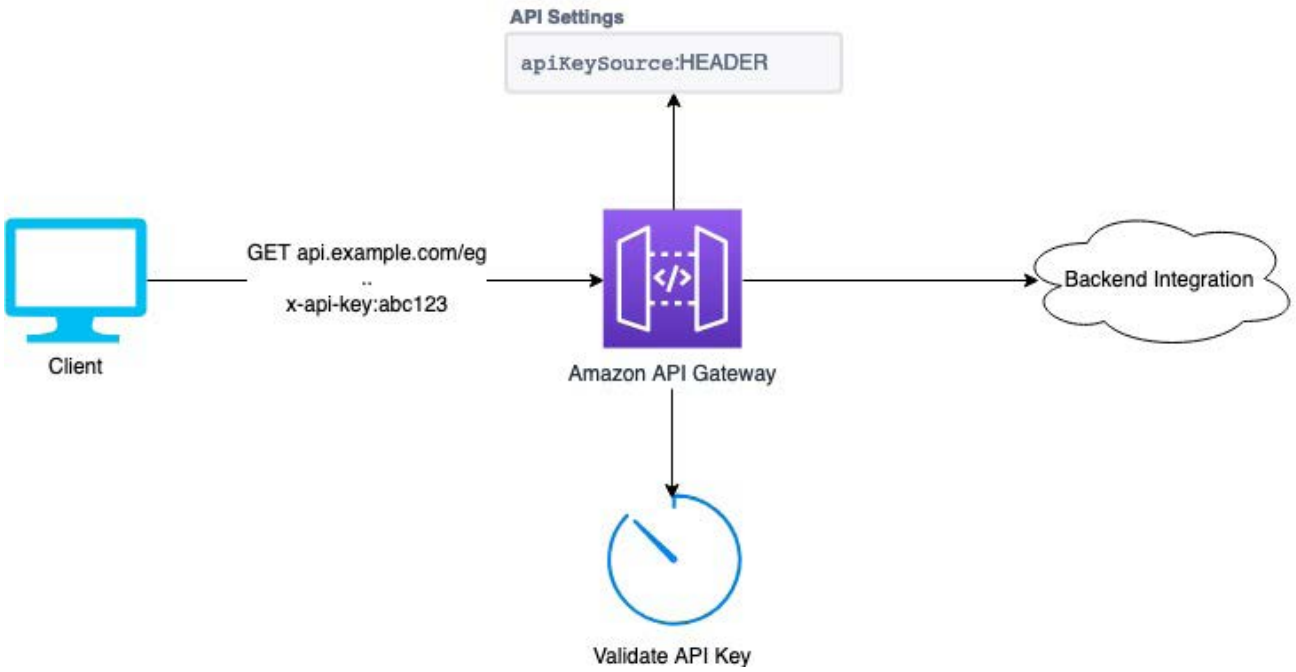


Figure 2: HTTP request to API Gateway with HEADER as the API key source

Business outcomes

Infrastructure as code
Previously, building APIs was a manual process. By using AWS CloudFormation, Datalex was able to develop a repeatable, baseline API architecture represented as YAML code. Developers can also use version control when they make changes to APIs. API Gateway and AWS CloudFormation have removed the heavy lifting of the previous process so developers can innovate at speed.

Fine-grained quota control
By using AWS usage plans and API keys in API Gateway, Datalex has more control over individual API keys. This allows Datalex to allocate a certain number of requests per month on a per-customer basis. It also enhances Datalex's capability to monetize future APIs.

Cost savings
By migrating to API Gateway, the cost to operate the API solution has dropped by an order of magnitude from the previous implementation. Compared to the pricing agreement with their previous vendor, Datalex has saved almost 98% across all of their REST APIs.

Payment model
Instead of an up-front fixed payment, Datalex wanted a more flexible payment plan based on actual usage instead of projected committed usage. The AWS pay-as-you go pricing model better suits the Datalex business plan and is better tied to Datalex's transaction-based pricing model.

Tight integration with AWS services
Through their partnership with AWS and use of API Gateway, Datalex realized benefits that include a rich set of integrations with AWS Lambda, HTTP endpoints, and direct integrations with Amazon Simple Queue Service (Amazon SQS), Amazon Simple Notification Service (Amazon SNS), and Amazon Kinesis. For information, see the Datalex and AWS Are Modernizing Airline Retailing blog post.

Future migrations

After more Datalex applications are migrated from the on-premises environment to AWS, API Gateway will facilitate a seamless, straightforward integration between Datalex applications.
Conclusion

Datalex was looking for a more cost-effective solution that would allow the company to scale as its business grows and use cases are added for their customers. The AWS native integrations in API Gateway, such as Lambda custom authorizers, allowed Datalex to make a clean, invisible migration without impacting customers and their end users. The AWS solution is a fraction of the cost of the previous implementation. It makes it possible for Datalex to integrate directly with AWS services and represent the Datalex API footprint as code in a pay-as-you-go model.

Voice of the customer

In the words of Daniel Morrow, the Engineering Director at Datalex, "We completed a seamless cutover from our previous provider to API Gateway. We are now fully cut over on all production and nonproduction systems and no longer have any use for our old provider in Datalex environments. The success of this project will have a big influence on our use of API Gateway when it comes to migration time from the datacenter."

Read Blog online

Datalex

Blog:

Maslow's Hierarchy of Hospitality Technology

by Phil Le-Brun

Imagine a young child who aspired to drive a Ferrari by the age of seven on a public road. Would you let them? Unlikely. You would counsel them on what they need to do, why, and, critically, build a number of steps for them to achieve this goal. After all, who would let a toddler loose on a highway? Crazy! Yet sometimes in business it feels like we are all too quick to pump the accelerator before we've checked there are tires on the car.

To address this progressive approach towards competency or appropriateness, I like mental models. They help clarify thinking, and create common frames of reference for teams. I learned a few lessons from leading technology for McDonald's that formed the basis of a mental model I used when thinking about priorities for restaurant technology. I loosely based this off Maslow's hierarchy of needs. If you are unfamiliar with this model, psychologist Abraham Maslow looked at what motivated individuals. He postulated that as an individual, while you might want respect or recognition for example, neither would be motivating or important unless precursors such as shelter and security were in place.

So why use this as a model? The travel and hospitality industry works in a similar pyramidal manner. If the foundational needs of customers, employees, or franchisees are not met, whether with technology or other approaches, everything else is of limited value or interest. It can be applied to both aspects we talk a lot about: operational efficiency and customer experience.

Clearly an initiative needs to do something useful, which we'll come back to as even this is subjective, but beyond this, communication with stakeholders can be challenging as we stray into the architectural territory of what we called the "ilities." These include affordability, deployability, supportability, configurability, scalability, and so on through the other one hundred-odd non-functional requirements. But how do you simplify these down in a business meaningful way that resonates with customers?

Let's take a hypothetical project, Project X, which is desired by your business colleagues, probably more the folks who sit in the same office as you rather than necessarily the staff on the frontline.

How can such a model be used to ensure your next project is adopted and used without any unfortunate surprises? Simply by honestly appraising each layer in sequence.

Affordability

First and foremost, financially does X help me maintain liquidity and is it affordable? As technologists, you're probably used to being told your technology is "too expensive." Although I bite my tongue from the normal refrain of "compared to what?" three questions weigh on my mind: does the cost justify the benefit, do you understand the real cost, and does the benefit outweigh your economic buyers' other investment options?

We do like our predictable projects where detailed business cases are written and then, to no-ones' surprise, the project takes longer than expected, costs more, and fails to deliver the expected benefits. Much of the effort goes into justifying the money needed to build the initiative, not honestly appraising the Total Cost of Ownership (TCO). It's usual to find a woeful underestimation of factors such as support, maintenance, training, deployment, and the reams of subsequent change requests.

While not a panacea, the use of agile to deliver initiatives incrementally, allowing regular checkpoints based on tangible deliverables and pivoting where lessons are learned quickly, is fundamental to being successful here. This, coupled with the financial elasticity and pay-as-you-go nature of the cloud, enables investments to pace realisation of benefits versus making large upfront capital investments on the promise of future returns.

A huge opportunity with cloud-based applications is the reduction in capital expenditure possible for a restaurant or hotel. As franchisees reminded me, every capital investment is often another loan they have to take out, and one where they need to consider whether a loan for this new initiative makes more sense than a new grill or refurbishing the building. In today's volatile environment, the elasticity of being able to scale up or down is a key benefit of cloud-based solutions. The travel company TUI capitalised on this to ramp down costs by 55% as the pandemic impacted business, while also being able to scale up capacity in areas such as the call centre. Melia Hotels International approached the pandemic similarly, saving 58% of its normal spend as a consequence. Alternatively companies can choose to reinvest these savings in differentiated work that can drive business growth as Restaurant Brands International did when it moved their on-premises data centres to AWS.

Reliability

Assuming you pass the investment hurdle, reliability takes centre stage. There is almost nothing worse in a high-pressure environment than the technology failing, whether in the form of a full outage, impaired functionality, or poor non-functional performance such as speed. In my mind, it encompasses job number one as well: security.

Werner Vogels, the AWS CTO, is widely quoted here: "everything fails all the time." In the often technologically hostile, distributed environment found with most T&H companies, not every edge case can be easily coded for. I've lost count of the number of pieces of technology I've found in sinks around the world! This is reality and when this happens there are three main options: fix it, failover, or escalate. Three pieces of advice have helped me appropriately address these issues: train the end user to be knowledgeable, instrument applications, and build in resilience. We train frontline employees to do all sorts of maintenance today, but for some reason often treat technology differently. McDonald's used the concept of "Operations Technology People" (OTPs) in restaurants who were trained to varying levels to be able to proactive maintain and reactively repair hardware and applications. It went a long way to demystifying the technology and giving the franchisees a degree of self-sufficiency. Instrumenting applications to report on issues and deviations is important, but equally teams need to be positioned to react to this data,

prioritising incremental reliability improvements as much as new features. Finally, hardening the system such as with the use of automated failover is important but not to the point of adversely impacting complexity and cost.

Companies such as Jack in the Box have seen the benefits of going all-in with the cloud, in a large part due to the heightened reliability that can be achieved.

Usability

If you have an affordable, reliable system, the question arises on whether the system is usable. How obvious, you say! For us, the iPad generation, it does seem obvious, so why don't we apply the same care and attention to usability when it comes to our own technology? Usability here means the holistic design of technology including the environment it operates in. Take for example a self-order kiosk in a restaurant. Is it obvious before you get to the device what it does? Is the interface intuitive to navigate, or does it trap you in a prescribed method of ordering? After you order, is it obvious how you pay and what you need to do afterwards? Customers (or employees) don't like to look stupid and will assiduously avoid technology that they feel will counter this. Both the airline and hospitability business have learned this lesson over several decades, and yet there are still too many examples of poorly thought through usability. I'd invite you to go into the average McDonald's and compare the holistic kiosk ordering experience with the average supermarket. In the latter case as much as I like technology I rarely can get through an order without having to call someone over to help. Push the envelope here. Services such as Amazon Lex and Amazon Comprehend open the door to the most natural interface of all: voice. Taking a steer from Maslow though, only introduce these if they don't adversely impact cost and reliability.

Qantas focused on usability to simplifying how information on passengers and services is served up to employees, forming the foundation for innovation including areas such as reacting proactively to potential complaints. Similarly Melco Resorts & Entertainment simplified reduced the set-up time of its casino management system from nine months to four weeks, allowing their employees to focus on higher value-add activities, and its customers to take advantage of services sooner.

Basic Impact

Finally, before we even think deeply about the "wow" factor, is there a basic, positive impact the new system or feature will make? For T&H I look here for either an improvement in the customer experience such as reduced friction and frustration, or improvements in operational efficiency normally measured in speed or cost. This shouldn't be based on an opinion or just in a controlled environment that is, rather evidenced through meaningful data in typical operating conditions. How can you prove out your hypotheses here using a Minimum Loveable or Viable Product?

Domino's Pizza Enterprises grew its business by focusing the impact on predictive ordering to accelerate its ability to satisfy customers. Hyatt Hotels focused on the customer too, using personalisation to elevate the Hyatt experience.

And Now, We Can Wow!

Finally, let's end where most business cases start. What's the "wow" factor about the technology? The efficacy of our working backwards process comes into its own here, centring the whole design of an application on the single big customer benefit. While it sounds simple, it is an incredibly powerful process to steer away from death-by-a-thousand-requirements, and to ensure the customer remains at the centre of the design. The defined outcome allows the product team to discover their way to a compelling product, rather than going through the ritual tick box requirements

development process with no accountability at the end for the usefulness of the application. After all, it is reckoned that over 40% of features and applications that are deployed are not used. What a waste.

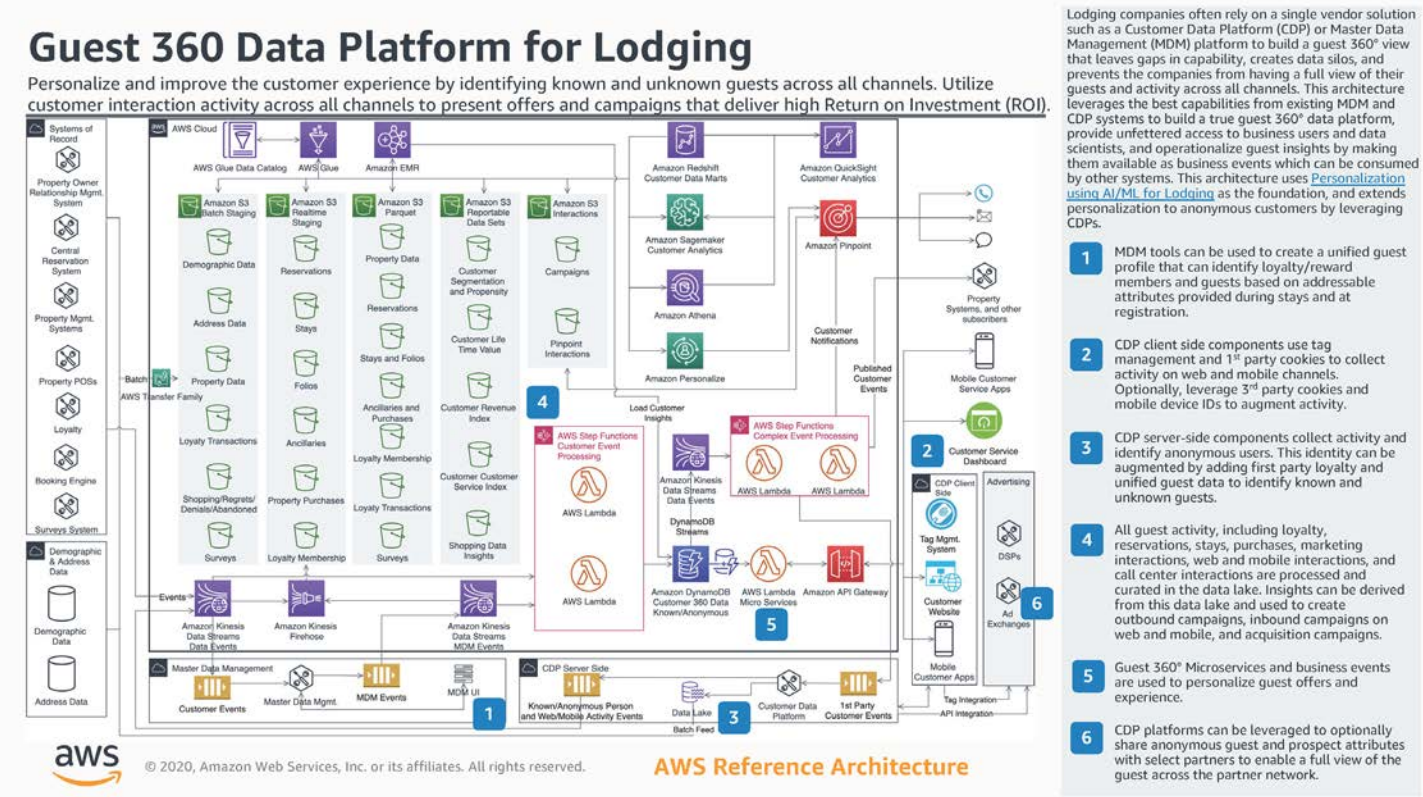
In reality, new initiatives should start with this last step, but the pyramid guides think through the foundational elements that will make or break your success. The reality is that too many business cases are based on made up financials, reliability as an after-thought, and a list of requirements that are often someone's opinion of what is needed. I'd counter that early thinking on a cost point and reliability for an initiative will help shape an architecture upon which we can test hypotheses. The "requirements" are accepted as a best guess of what is required, but now delivered on the cloud in a way that can rapidly validate or invalidate them. If the requirements turn out to be correct, early thinking about cost and reliability enable them to be scaled quickly to realise early ROI. If they are wrong, pivot.
Am I right? What mental model do you use when thinking through new initiatives?
Learn more about how AWS is helping transform the travel and hospitality industry.

Read Blog online

Reference Architecture:

Guest 360 Data Platform for Lodging

Personalize and improve the customer experience by identifying known and unknown guests across all channels. Utilize customer interaction activity across all channels to present offers and campaigns that deliver high Return on Investment (ROI).



View Reference Architecture online

Case Study:

On AWS, Meliá Saves 58% and Builds Organizational Resilience During Unexpected Downturn

Based in Majorca, Spain, Meliá Hotels International (Meliá) is the third-largest hotel chain in Europe and the largest leisure hotel company in the world. Using cloud services such as Amazon Web Services (AWS) has been a growth tactic since the start of what Christian Palomino, Meliá's global IT vice president, calls its "digital transformation" six years ago: "AWS provided a fast way of testing and piloting new things with modern technologies while lowering costs for infrastructure by linking our demand to the cost," says Palomino. One key workload Meliá migrated to the cloud was its central reservation system, which handles all online bookings.

Meliá has been able to scale up and down with demand and save on costs with a pay-for-use AWS-supported infrastructure. The company has also been able to use AWS to quickly modify its traditional call center model to respond to global challenges by pivoting to a work-at-home model with Amazon WorkSpaces and to experiment with an expedited, contact-free check-in process for its hotels.

> **"AWS provided a fast way of testing and piloting new things with modern technologies while lowering costs for infrastructure by linking our demand to the cost."**
>
> ***Christian Palomino***
> *Global IT Vice President,*
> Meliá

Linking Infrastructure Cost to Varying Demand

The hospitality industry was hit especially hard by the COVID-19 pandemic, as social distancing, travel restrictions, and economic hardships forced the cancellation or alteration of millions of travel plans around the world. Meliá found AWS to be an invaluable resource in responding and effectively adapting to those challenges. With its already nimble cloud-based IT architecture, Meliá was more prepared than most when the COVID-19 pandemic caused a 95 percent decrease in reservations virtually overnight. "The way the AWS infrastructure is built, you pay per use, and you pay for computing power," says Palomino. "The less you use, the less you pay." If Meliá had retained its on-premises architecture, it would have had to pay for servers regardless of the drop in reservations. Meliá, which was already saving 40 percent yearly by switching to the cloud before the crisis, saved an additional 58 percent by scaling down during the erratic period of dry spells.

Meliá tested the elasticity of its cloud architecture again when the company offered 20,000 free room nights to medical professionals as thanks for their service during the COVID-19 pandemic. The company released 2,000 rooms for booking every day at 9:00 a.m. over a 10-day period, and the rooms sold out in minutes each day. After weeks of relatively low activity, Meliá was able to efficiently scale its infrastructure up again to accommodate these spikes. "On AWS, you can be ready to absorb all that workload without dropping your performance," says Palomino, "and then you can reduce your costs the rest of the day, when you have no activity." The extreme swings in demand during this time underscored the value of the AWS pay-for-use model that had motivated Meliá to move to the cloud in the first place: creating cost savings for the company while setting it up to scale as needed in any situation.

Developing a Remote Working Platform

Meliá's cloud infrastructure helped prepare it for the reservation fluctuation brought on by the global health crisis, but there were other areas where the company needed to adapt in real time. When a stay-at-home order left Meliá's 500 call center agents without a place to work, the company turned to Amazon WorkSpaces—a managed, secure desktop-as-a-service solution—to effectively set up 500 home offices in just 10 days.

"Our technical staff said it was easy to understand how everything worked in AWS," says Palomino. The team quickly adapted Meliá's security architecture to a new cloud-based platform, testing call center applications and ensuring they met payment card industry compliance.

When they were finished, the technical staff gave its 500 users access to the Amazon WorkSpaces platform, enabling the call center staff to answer the sudden influx of customer questions from the comfort and safety of their own homes in a secure and efficient manner.

Innovating the Check-In Process

Even before the COVID-19 pandemic, Meliá had been exploring new ways to perform essential processes with help from AWS. One idea the company gleaned from its AWS account team was a way to build a fast, sophisticated check-in system. Because many of Meliá's hotels are located in resort destinations, large numbers of guests often arrive at once, which can create bottlenecks in hotel lobbies. "Many of our hotel guests arrive on the same plane and the same bus," says Palomino. "Then there's a front desk that needs to check in all of them, give them keys, and ensure everybody is who they are supposed to be for safety reasons."

The new, more efficient system in development is contactless and combines the use of the Meliá mobile app with facial recognition software, ID document scanning, and terminals in the hotels that actually recognize the customer. Palomino describes this zero-contact system: "When the customer arrives at the hotel, if they are tech savvy enough, they will be able to go directly to the room. But if they prefer to have a physical key, they may go to one of our totems and check in with face recognition."

Once the COVID-19 pandemic hit, the need to minimize social contact between guests and employees became even more critical. Suddenly, Meliá's experimental zero-contact check-ins went from a convenience to a necessity. Building on its existing remote check-in system, Meliá was able to quickly and efficiently eliminate the need for physical contact between guests and hotel employees during check-in. The system is currently under development, and Meliá plans to begin rolling it out in late 2020.

What Comes Next for Meliá

AWS helps give Meliá the power to respond to unforeseen challenges and push new ideas even further while minimizing cost and maximizing customer safety and comfort. Meliá rose to the challenge that the COVID-19 pandemic presented in the hospitality industry by crafting sustainable business practices that are now poised to move the company forward. By linking its infrastructure cost to demand, Meliá is prepared not only for fluctuations from off-season to peak season but also to cost effectively manage extreme scaling shifts in either direction. At the same time, by quickly enabling secure remote work, Meliá has demonstrated that it can handle drastic staffing changes in response to changing requirements, and by enabling a contact-free check-in process, Meliá is poised to solve daily customer-management problems with innovative, modern solutions. This readiness is possible in part due to the shared vision of Meliá and AWS, explains Palomino: "The AWS Digital Innovation Program is very customer oriented. It has been amazing to find a technology company with so many similarities to us and our values."

Meliá does everything it can to ensure its guests feel relaxed—but before guests can relax, they need to know they're safe. In addition to its plan to streamline the check-in process, Meliá is developing new ways to improve guests' stays. "We are working on technologies that help us manage the flows of people in the resort in real time so guests can safely book experiences in advance," says Palomino. Meliá hotels are not just surviving but adapting: no matter what the future holds, the company will be better equipped than ever to provide guests the stress-free luxury they're looking for.

About Meliá Hotels International
Founded in 1954, Meliá is an international chain of luxury hotels based in Spain. Operating 374 hotels in 40 countries and on 4 different continents, Meliá is one of the top-15 largest hotel chains in the world.

Benefits of AWS

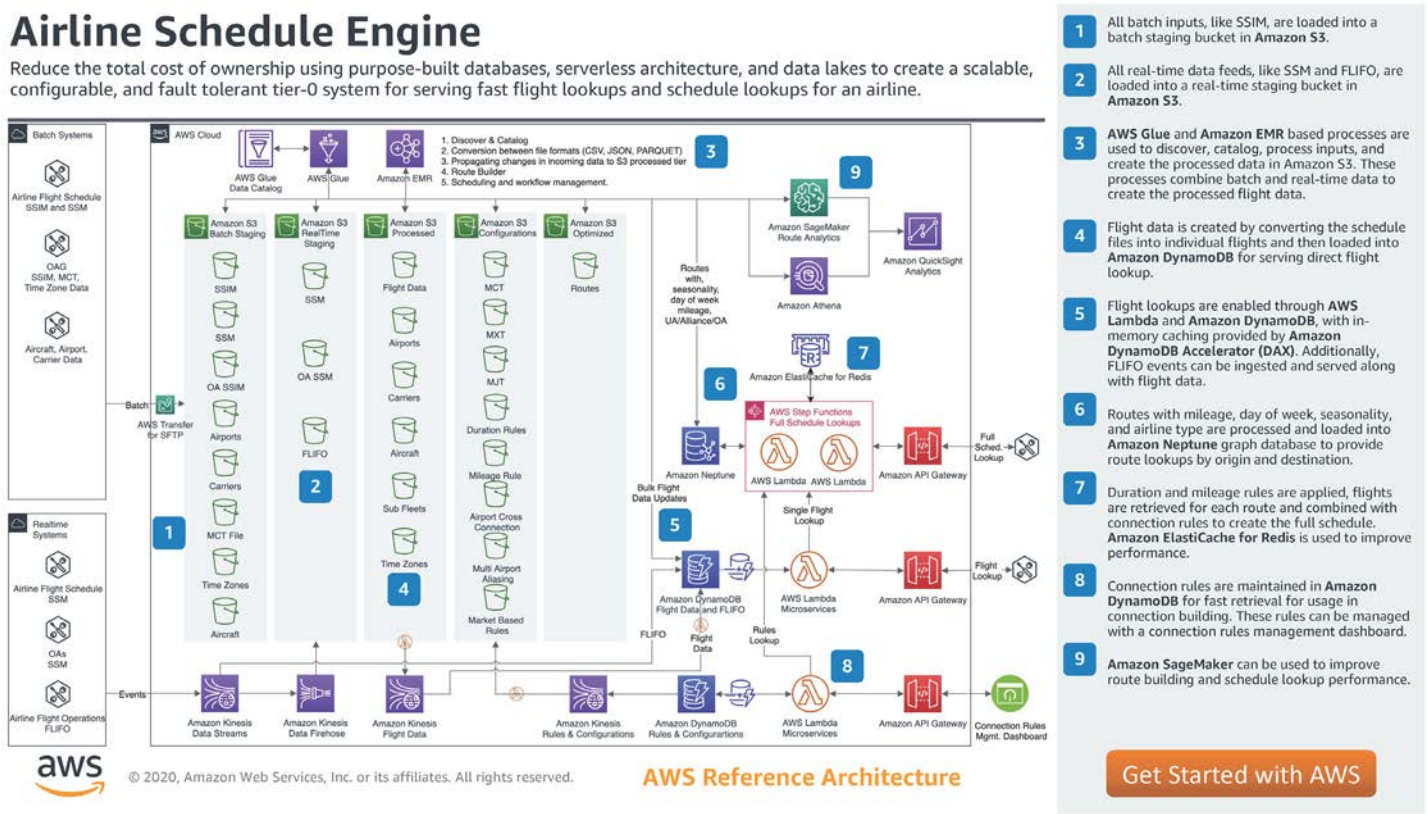
- **Saved** 58% on infrastructure costs
- **Moved** 500 employees to remote work in 10 days
- **Developed** zero-contact check-in technology

Read Case Study online

Reference Architecture:

Airline Schedule Engine

Reduce the total cost of ownership using purpose-built databases, serverless architecture, and data lakes to create a scalable, configurable, and fault tolerant tier-0 system for serving fast flight lookups and schedule lookups for an airline.



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Blog:

Executive Conversations: Building Resiliency with Alison Taylor, Chief Customer Officer, American Airlines

by Sekhar Maillipeddi

Alison Taylor, Chief Customer Officer of **American Airlines**, joins Sekhar Mallipeddi, WW Technical Leader for AWS Travel and Hospitality, for a broad-ranging discussion about the recent disruption faced by travel and hospitality companies – and her company's response to that disruption. American's purpose is to care for people on life's journey. Shares of American Airlines Group Inc. trade on Nasdaq under the ticker symbol AAL and the company's stock is included in the S&P 500. This Executive Conversation is one of a series of discussions held with industry leaders, where we seek to learn more about their resiliency, tenacity, and capacity for innovation.

The series follows the publication of the AWS Travel and Hospitality E-book: "Building Resilience For The Long Run." Filled with strategic observations, hints, and tips, the E-book provides guidance for building a more resilient organization, potentially serving as a useful resource as travel and hospitality companies address both current challenges and those yet to come.

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Sekhar Mallipeddi: While your business is recognized publicly by many, what's one unique characteristic or feature that is either lesser known or understood about your company?

Alison Taylor: Our mission for caring for people on life's journey informs everything we do. This focus on care is for both our team members and our customers. As we navigated the last year, we depended on other lesser known parts of our business to be able to continue to serve our customers and team members. In addition to transporting passengers, for more than 75 years, cargo flights have played a significant role in the history of American Airlines. And now in the face of a global pandemic, cargo flights are once again placing cargo in the history books for American. Cargo-only fights have allowed us to transport medical equipment, communications and technology tools, pharmaceuticals and food supplies. On top of the temperature-controlled containers and refrigeration facilities we have throughout our network, our team actively monitors flight times and temperatures along the way to make sure perishable shipments like seafood, fruit, flowers and berries get delivered fresh off the plane. We also have an incredible privilege to be part of history by transporting COVID-19 vaccines.

SM: Many companies across travel and hospitality have been managing through a period of unprecedented disruption. What have been the biggest challenges you've faced during this recent period and how have you managed through them?

AT: One of the biggest challenges we have faced is building confidence in health and safety while traveling. We built strong partnerships with organizations such as the Vanderbilt University Medical Center, which has advised us as we've developed and implemented programs and procedures to keep customers and team members safe. This includes our very strict face covering policy and cleaning regime. We have also become more nimble and get to solutions faster. We have managed through this with communication, sharing industry-led research, and hosting many customer virtual calls.

SM: As we all prepare for the next phase of traveler or guest demand, what are some of the changes your company has taken (or plans on taking) to adjust to the current operating environment?

AT: As part of building confidence and giving travelers peace of mind to travel, we implemented many changes. Our planes receive electrostatic spraying once a week with an EPA-approved disinfectant that provides enhanced protection by sustained killing of 99.9% of viruses, including coronaviruses, on surfaces. We've rolled out the treatment across our fleet. High-touch and public areas like tray tables, seatbelt buckles, armrests, window shades, seatback screens, doors and overhead bin handles continue to be cleaned before every flight. We also provide PURELL® Advanced Hand Sanitizer in our lounges and hub airports across the U.S. and work with Vanderbilt University Medical Center for guidance on health matters and our cleaning procedures.

SM: In the face of the current disruption to the travel and hospitality industry, we've observed incredible innovations coming from across the industry. How has your company innovated through these challenging times and what are you most proud of?

AT: We continue to work on building a touchless experience throughout the travel journey. For example, although we sanitize our kiosks often, travelers can check their bags in a hands-free experience at most U.S. airports. Customers need to check in before their trip, select checked bags and get their mobile or printed boarding pass. At the airport they'll scan their boarding pass at a kiosk to automatically print their bag tag, then attach it for drop-off at bag drop. Customers can also test the latest mobile ID technology by using our biometric bag drop at Dallas Fort Worth International Airport or Ronald Reagan Washington National Airport.

SM: The travel and hospitality industry is incredibly resilient. As you look toward recovery, what role does technology play for your company moving forward? How do you see technology enhancing the customer experience and improving operational efficiency?

AT: Just as we do today, we'll continue to develop technologies to streamline the customer travel journey from the time they start thinking about a trip to arriving at their destination. For example, we've introduced several conveniences for customers over the last year including the ability to use a live chat 24/7 through the American app for all a traveler's questions, and creating contactless experiences for things like checking in at an airport kiosk through QR code, printing bag tags and more. Additionally, we are trialing contactless biometric technology that will enable customers to move through the airport more quickly without having to present a boarding pass or show ID. By giving our customers' more ability to self-service when they want to, we're freeing up our team members' to be able to provide more dedicated attention to customers as they need it. We'll continue to adapt and develop new capabilities to support our mission to care for people on life's journey.

SM: There's much talk at the moment about how the travel experience has changed and there will be a "new normal" going forward. What does this "new normal" look like to you and how do you think the travel experience will look 3 years from now?

AT: I believe the travel experience will continue to expand with more self-service and contactless experiences for the customer, putting them in control of their travel journey. Health and well-being will continue to be part of our decision making process when it comes to services we offer in our lounges and our planes. One example of this is the mobile health wallet, VeriFLY. We continue to make it easier for customers to travel to and from international destinations by expanding our acceptance of VeriFLY, which simplifies testing verification requirements. Using the VeriFLY app, customers can upload documents to meet travel requirements, and we will accept the verification for flights operated from U.S. airports we operate from to eight countries currently.

With more partners like British Airways, Alaska Airlines, and others across the industry expanding their acceptance of VeriFLY, we can further our common goal of preventing the spread of COVID-19 and ensure compliance with local regulations that have been put in place to protect our customers and team members.

SM: What makes you excited for the future of travel and hospitality? As a traveler or guest, where are you looking forward to visiting next?

AT: We are a resilient industry and have faced and overcome many challenges working with our travel agency partners, Alliance and Joint Business Partners, and the travel industry on the recovery. As I haven't been able to see my adult son, who is in Australia, in over a year, my first trip would be to reunite with him.

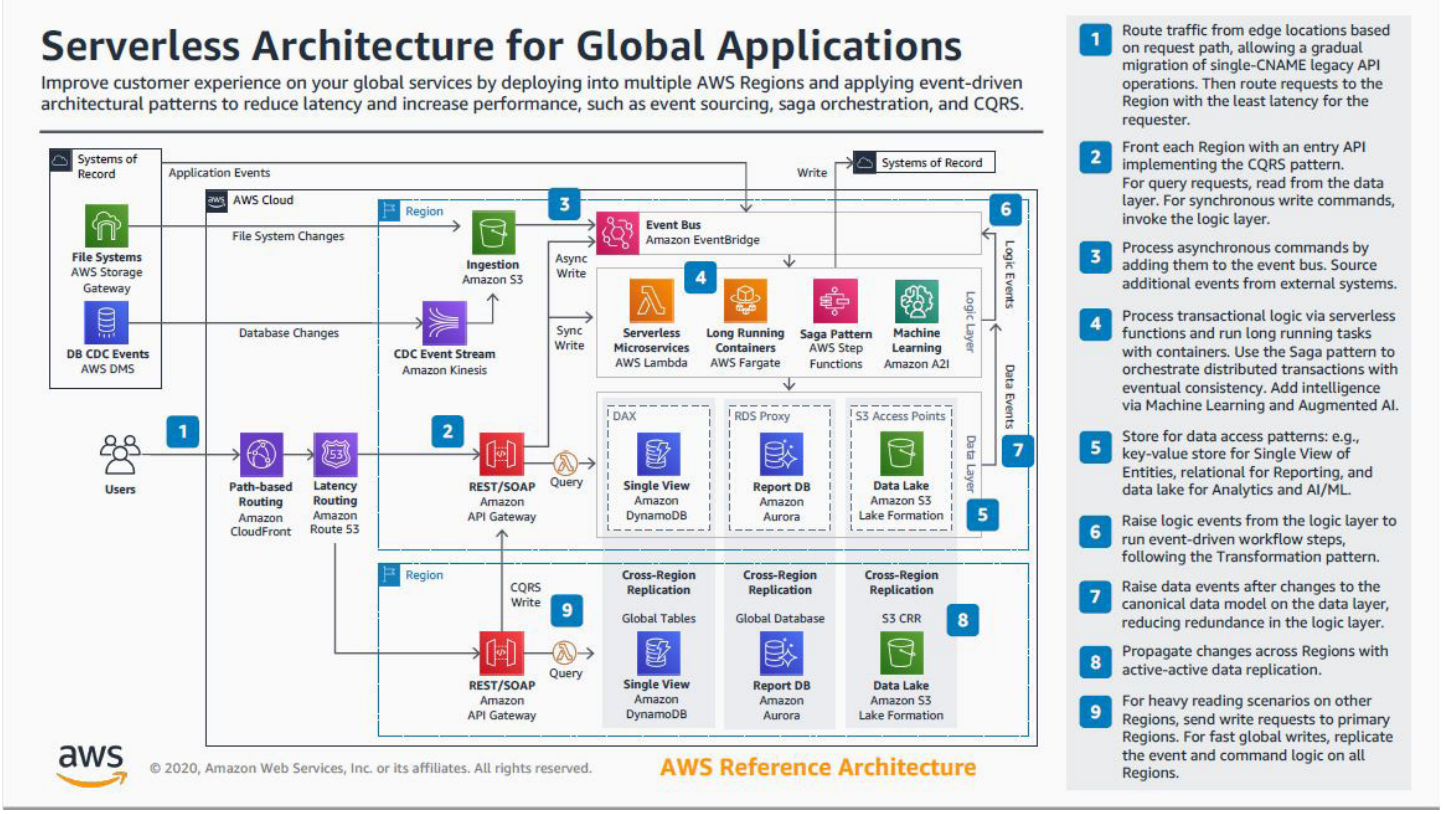
Read Blog online

Alison Taylor As Chief Customer Officer, Alison works to create a welcoming environment for the airline's customers on every step of their journey. She is responsible for the American Airlines Vacations, Customer Experience and Reservations, Global Sales and Distribution, and Marketing and Digital Customer Experience teams.
She has served in many leadership roles in two of the world's top travel organizations. Before joining American in September 2016, she led the Sales team at Starwood Hotels & Resorts Worldwide as Senior Vice President of Global Sales, based in New York. Her prior roles at Starwood include Senior Vice President of Sales and Revenue Management and Vice President of Sales, Revenue Management and Digital Marketing. She has lived and worked in eight countries, including more than 20 years in Asia.

Reference Architecture:

Serverless Architecture for Global Travel and Hospitality Applications

Improve customer experience on your global services for retail availability, travel documents and restrictions, and shopping by deploying into multiple AWS Regions and applying event-driven architectural patterns to reduce latency and increase performance, such as event sourcing, saga orchestration, and command query responsibility segregation.



[View Reference Architecture online]

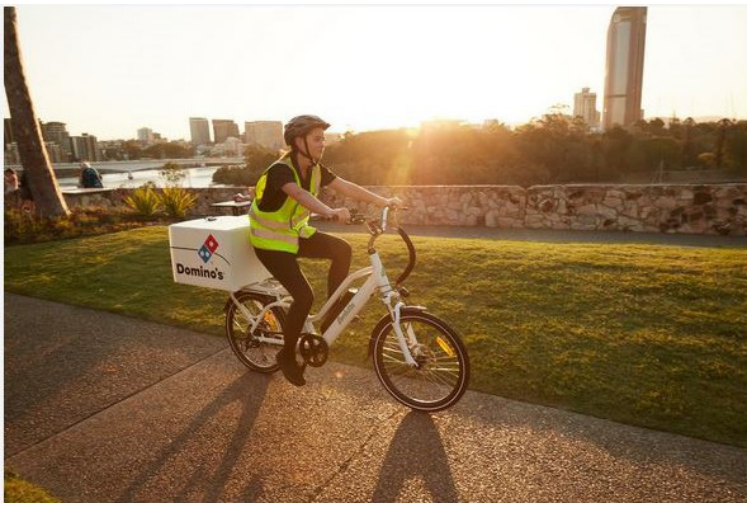
Case Study:

Domino's Pizza Enterprises Delivers in Record Time Using AWS for Predictive Ordering

When it comes to the global pizza business, Domino's Pizza Enterprises Limited (Domino's) has a large slice of the pie. The company, which is the largest Domino's franchise holder, represents the Domino's brand in Australia, New Zealand, Belgium, France, the Netherlands, Japan, Germany, Luxembourg, and Denmark. Domino's maintains a network of more than 2,600 stores globally and is based in Brisbane, Australia.

Domino's is an increasingly digital business, with more than 70 percent of sales coming from online orders. "Our investment in technology is a key ingredient to our growth as a business," says Michael Gillespie, chief digital and technology officer for Domino's. "We strive to use it to reduce pickup and delivery times, because we've identified that the sooner we can get a pizza to our customers, the more satisfied they are with their meal."

To enable faster pickup and delivery, the company recently launched Project 3TEN, an initiative that aims to have a pizza ready for pickup within 3 minutes or safely delivered within 10. This is all possible through efficiencies in cooking methods and transportation and by opening more stores closer to customers. To support this initiative, the company wanted to use predictive technologies to help reduce pizza making and delivery times. "We can use technology to increase the speed of our ovens, and we can give our drivers more efficient technology like e-bikes or scooters, but we also needed to look at how we can help stores anticipate what customers order," says Gillespie.



> **"Customers are getting their pizza faster, hotter, and fresher because of the improvements we've put into place with Project 3TEN. The predictive ordering solution we developed by using AWS is a big part of that."**
>
> ***Michael Gillespie***
> *Cheif Digital and Technology Officer, Domino's Pizza Enterprises Limited*

Developing Accurate, Predictive Ordering on AWS

Domino's turned to Amazon Web Services (AWS) and Max Kelsen, an Advanced Consulting Partner in the AWS Partner Network (APN), to help create a predictive ordering solution. "We knew we needed a smart, accurate system, and we liked what we saw in AWS machine learning technologies," says Gillespie. "We knew that by using AWS services we could develop a solution that would give our stores a glimpse into the future by predicting what pizzas would be ordered next."

The company created a data lake consisting of key order information by taking advantage of Amazon Simple Storage Service (Amazon S3) for data storage and AWS Glue for data querying. It also uses Amazon SageMaker to build and train machine learning models to predict the likelihood that an order will be placed, so a store can begin making that order right before it is placed.

As a trial, Domino's initially deployed its predictive ordering solution in some of its stores in Australia. Store employees could view an ordering screen displaying specific pizzas with various color indicators corresponding to the likelihood of those pizzas being ordered. "This isn't making pizzas and leaving them in a hot box for half an hour—this is getting the pizzas lined up, coming out of the oven, and ready to go as an order is placed," Gillespie says.

The company enhanced the solution during the trial so it would be ready for a wider rollout. Domino's then began deploying the solution to stores in New Zealand, France, the Netherlands, Japan, and Germany.

From Order to Delivery in 10 Minutes or Less

Using the AWS-based solution, Domino's has given its stores a tool to help drive down pickup and delivery times for customers. For example, in 2019, a Domino's store in Australia averaged delivery times of under 5 minutes, from order to doorstep, across an entire week. "It's exciting that nothing changes from the customer's perspective, except that the post-order experience can be much quicker," says Gillespie. "Customers are getting their pizza faster, hotter, and fresher because of the improvements we've put into place with Project 3TEN. The predictive ordering solution we developed by using AWS is a big part of that."

Domino's is gaining a competitive advantage in the marketplace. "When our customers are hungry, they're hungry now, and we want to deliver their meal as quickly and safely as possible," says Allan Collins, chief marketing officer for Australia and New Zealand at Domino's. "That's our market differentiator. Some of our competitors still take 45 minutes to an hour to deliver a meal, when we can have a pizza delivered in 10 minutes or less following an order. That really impresses our customers."

Enabling Fast, Easy Deployment for Franchisees

Another advantage is that franchisees don't need to spend much time being trained. "One thing we always try to keep in mind when developing technology is ease of use—the technology has to be accessible and easy to implement," says Gillespie. "We knew if we had barriers to deployment, it would be challenging to roll this out." Domino's Technology Team worked hand-in-hand with the Operations Team to ensure a smooth rollout, with all new processes seamlessly dovetailing into existing operations.

Making Customers Happier

The solution is contributing to a boost in customer satisfaction. "Our data shows that the stores with faster pickup and delivery times have higher customer satisfaction scores," says Collins. "And those customers are more likely to come back and recommend our brand to others."

Domino's has deployed the solution to stores in a number of other countries. "AWS has been a great company for us to work with because it's helping us provide a new, unparalleled level of service to our customers," says Gillespie. "In addition, we hope to take what we've achieved with AWS so far and push it to new heights in the future."

To learn more, visit aws.amazon.com/sagemaker and aws.amazon.com/travel-and-hospitality.

Read Case Study online

About Domino's Pizza Enterprises Limited
Based in Brisbane, Queensland, Domino's Pizza Enterprises Limited is the largest pizza chain in Australia and the world's largest franchise holder for the Domino's Pizza brand. The company has more than 2,600 stores in Australia, New Zealand, Belgium, France, the Netherlands, Japan, Germany, Luxembourg, and Denmark.

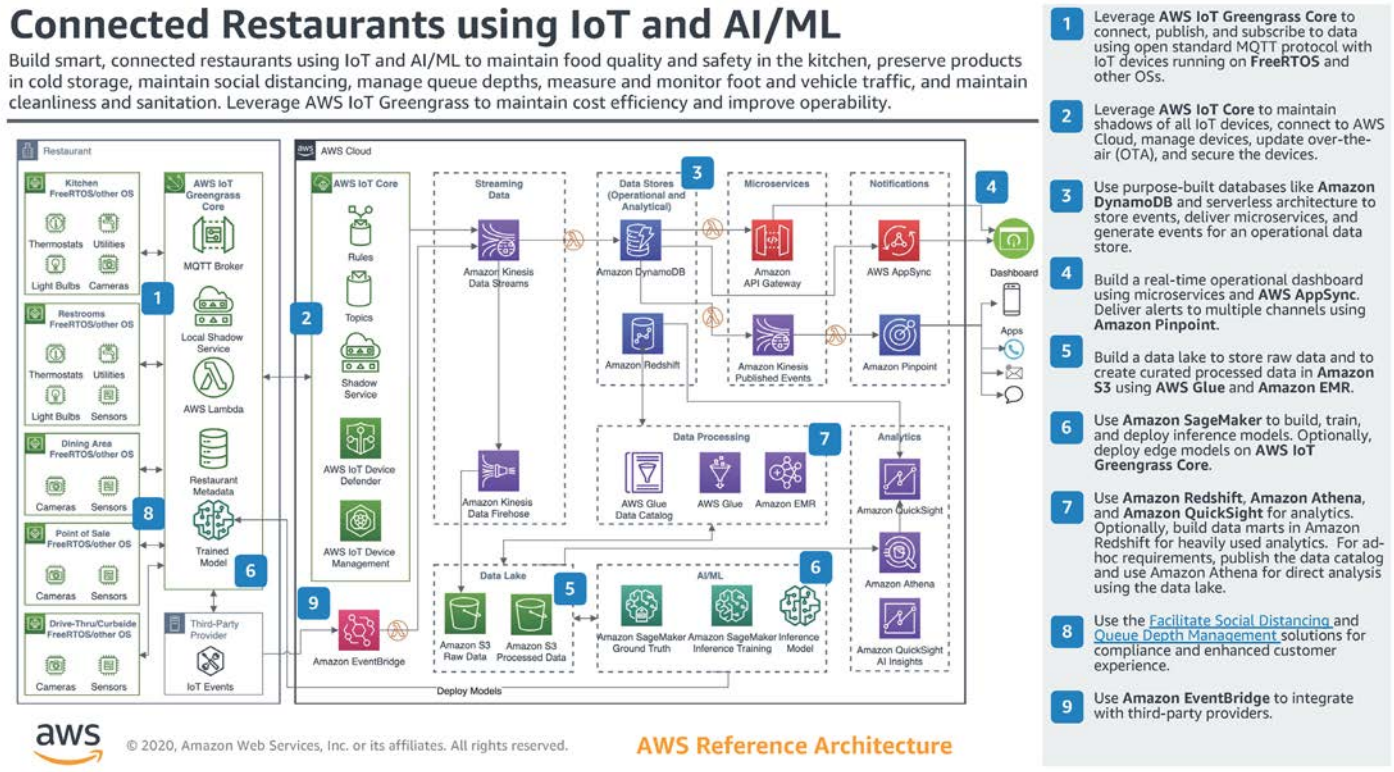
Benefits of AWS

- Assists Domino's stores in achieving goal of pizza delivery in 10 minutes or less
- Deploys accurate, predictive ordering solution quickly and easily
- Enables fast, easy deployment for franchisees

Reference Architecture:

Connected Restaurants using IoT and AI/ML

Build smart, connected restaurants using IoT and AI/ML to maintain food quality and safety in the kitchen, preserve products in cold storage, maintain social distancing, manage queue depths, measure and monitor foot and vehicle traffic, and maintain cleanliness and sanitation. Leverage AWS IoT Greengrass to maintain cost efficiency and improve operability.



[View Reference Architecture online]

Blog:

The Technology Behind KFC's Finger Lickin' Good Success

By Jaime Hall

At Kentucky Fried Chicken (KFC), our platform has constantly evolved over the past four years. Since the shift to bring all development in house, we've been making great progress. During this time, KFC has grown dramatically within the digital space. Underpinning it all, we aim to make it as easy as possible to order our great chicken.

Some innovations that have helped us get closer to this goal include: fully integrated aggregator delivery, collect service via the front counter or drive-thru, table service, improved loyalty system, in-store kiosk integrations, direct point of sale (POS) integration, and a centralized menu service. There is much more to come, as well! KFC's digital technology stack has grown to process nearly half of the transactions processed through our restaurants.

To build these applications and services, we partnered with AWS to implement a serverless infrastructure. Our stack was originally a fully Terraform implementation, but we chose to adopt a hybrid model of Terraform and the serverless framework. Our language of choice was Node.JS. This allowed us to create a more microservice-based topology. This setup puts the full ecosystem of development within the service teams. It also allows us to move towards a continuous delivery lifecycle while keeping it fully automated as part of the infrastructure for code.

We created a series of design patterns to follow within each of our services. This allows for a fully event-driven logic and highly scalable system while keeping standardized services, which is key to creating a successful design. Scalability can be fairly predictable due to peak ordering food times, but we also need to be able to handle unexpected orders as well. For example, the recent shift from on-premises to web ordering has put our design to test.

The following sections show some of the design patterns we use to solve some of our more unique requirements like accepting orders to be processed asynchronously and processing orders on a first-come-first-serve basis when dealing with 950+ restaurants.

Accept, queue, and process with Amazon SQS and AWS Step Functions

This design pattern is used heavily as part of any webhook process. It is performed asynchronously with queueing. In this design pattern, authorization can be customized in the initial AWS Lambda function depending on the payload's origin. This pattern allows us to quickly accept and process orders. It also gives control back to the webpage and updates the page as the order status is updated.

Figure 1. Accept, queue, and process pattern

Service communication with Amazon SNS and Amazon SQS

This design pattern allows communication or processing between services while decoupling them from one another, minimizing each services' reliance on the other. For example, this could look like the email service notifying a customer that their order has been processed successfully via the order service. Or it can include the payment service notifying the order service that an order has been paid for successfully.

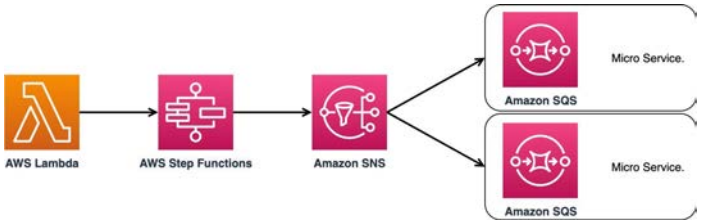


Figure 2. Service communication pattern

Guaranteed single message delivery with conditional concurrency with Amazon SQS

This design pattern is used when a guaranteed delivery is required. It also needs to throttle the flow of the system with specific parallelism through grouping. One of our use cases for this is order injection into our restaurants where we want to send orders in a strict first-in-first-out basis and one order at a time while still being able to inject into multiple restaurants at the same time.

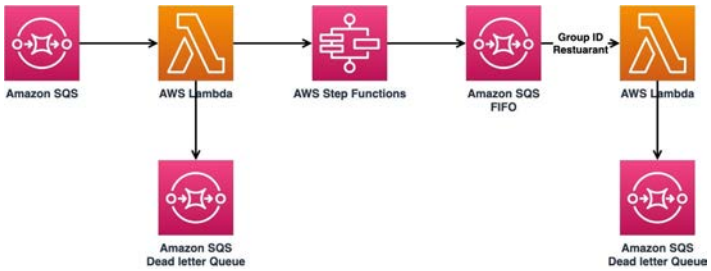


Figure 3. Guaranteed delivery pattern

Reporting stream with Amazon S3 and Amazon Athena

This design pattern is used for long-term storage of transient data for post analysis or querying for reporting/analytics. This allows us to perform detailed historical analysis of order processing, routing, and SLAs to identify any root causes and process improvements.

Figure 4. Reporting stream pattern

Tidy and archive with Amazon DynamoDB and Amazon S3

Using Amazon DynamoDB to maintain restaurant transient data, we can use its Time to Live (TTL) mechanism to automatically clean and persist the data. Amazon Simple Storage Service (Amazon S3) offers a cheap long-term storage solution ready for future use for things like predictive analytics to customer personalization.

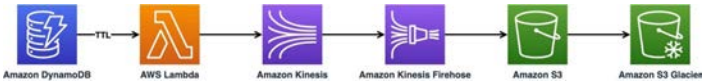


Figure 5. Tidy and archive pattern

Store and process Amazon SQS and Amazon S3

This design pattern offers long-term storage with replay ability while still maintaining a fully event-driven process. This pattern is used extensively when processing large payloads like restaurant transactions where a high throughput/concurrency requires throttling, which in our case is handled through Amazon Simple Queue Service (Amazon SQS).

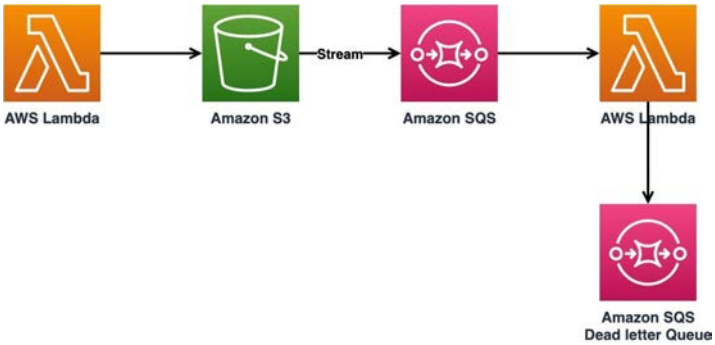


Figure 6. Store and process pattern

Store and time process with Amazon DynamoDB and Amazon SQS

This design pattern allows for a holding gate with timed processing on a per-payload basis. It uses Amazon SQS to throttle downstream processing for when the gate/time is up. It also allows for a single delivery and easy replay.

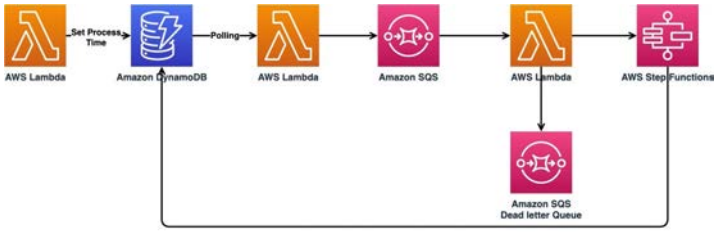
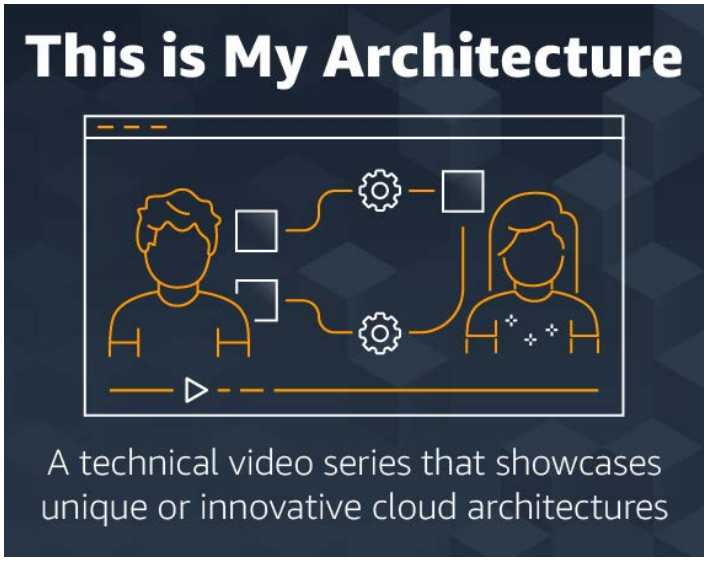


Figure 7. Store and time pattern

Conclusion

AWS serverless infrastructure has allowed KFC to create a highly scalable, quick-to-market digital platform. It gives us the ability to develop applications and services quickly and also gives us the flexibility and agility to adapt quickly within the quick-service restaurant market. Because of this, we have seen accelerated growth and scale, which has ultimately provided greater flexibility to our customers to buy finger lickin' good chicken wherever and whenever.



Videos:

Just Eat Takeaway Scales to Meet Unprecedented Demand

Richard Haigh, Chief Technology Officer, Just Eat Brands at Just Eat Takeaway (the largest food delivery company outside of China) discusses how AWS helped his organization scale to meet unprecedented demand while still enabling innovation.

Wyndham Hotels and Resorts is Transforming Their Business

The world's largest hotel company, with 9,300 properties globally, Wyndham Hotels & Resorts is transforming its business by migrating its platforms from traditional data centers to the Amazon Web Services (AWS) Cloud. Doing so has allowed Wyndham to standardize its platforms, making it easier to innovate and deliver an improved user experience for guests, employees, and franchisees alike. "What I was looking for in AWS is somebody who's already there, not somebody who had a roadmap to get there, but somebody who was already delivering," says Wyndham CIO Scott Strickland.

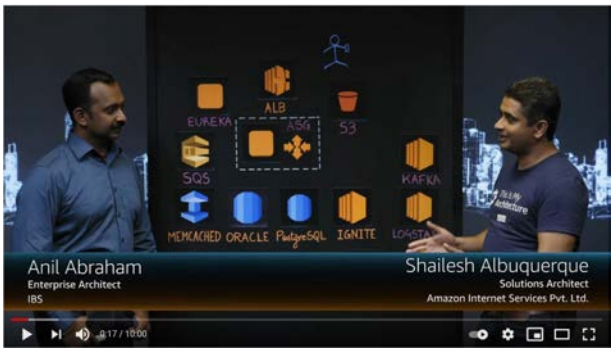
AWS re:Invent 2020 – Lauren Woods of Southwest Airlines on using AWS to improve its technical health

Southwest Airlines uses AWS and AWS partners, like Onica, to help it build the technology it needs to thrive. In this video, Lauren Woods, Managing Director of Technology Platforms, describes how AWS helps Southwest become more efficient, technically advanced, and able to take on new opportunities. Southwest Airlines is the largest carrier by originating passengers in the U.S., celebrating its 50th anniversary in 2021. Southwest Airlines uses a variety of AWS services, including Amazon Aurora and Amazon EKS, to modernize its applications, and it used AWS Lake Formation, Amazon S3, and Amazon Athena to build its first cloud-native data lake.

Intent: Analyzing Billions of Customer Events Per Day Using Serverless!

In this episode of This is My Architecture, Will takes us through a completely Serverless data science platform for travel and commerce sites. Allowing data scientists to make iterative changes to their customer's advertisements, based upon their analysis of Billions of events.
Host: Christopher Marsh-Bourdon, Global Account Solutions Architect. Customer: Will Norman, Director of Engineering

IBS: Mission Critical Microservices on AWS



IBS is transforming their mission critical applications from monolith to micro services. Anil explains their deployment architecture, choice of databases, service discovery mechanism and log aggregation services built on top of the AWS platform.
Host: Shailesh Albuquerque, Solution Architect, Amazon Internet Services Pvt Ltd.
Speaker: Anil Abraham, Enterprise Architect, IBS

Enterprise IT: Optimizing Airline Revenue Management with Containers

In this video, you'll find out how Enterprise IT helped a large airline to run hundreds of complex machine learning predictions every day using containers and AWS Fargate. This solution allows the airline to meet their daily deadlines for data availability by running hundreds of R scripts inside of containers, utilising Amazon Aurora to store results. This solution scales up during the morning processing window, and is completely shut down outside of that, meaning the airline pays only for the processing they require - which would be extremely difficult to achieve on an equivalent on premises infrastructure.