Greetings everyone. Service-based architectures have very much become the norm for building applications and more importantly integrating with third-party platforms. Genesys Cloud has long recognized this and provides a rich and deep set of services to deliver solutions. However, services are not the only form of integration offered by Genesys Cloud. Genesys Cloud has long supported the concept of event-driven integrations, where as state changes in and activities occur within Genesys Cloud, an event will published asynchronously to be consumed by an application or integration.

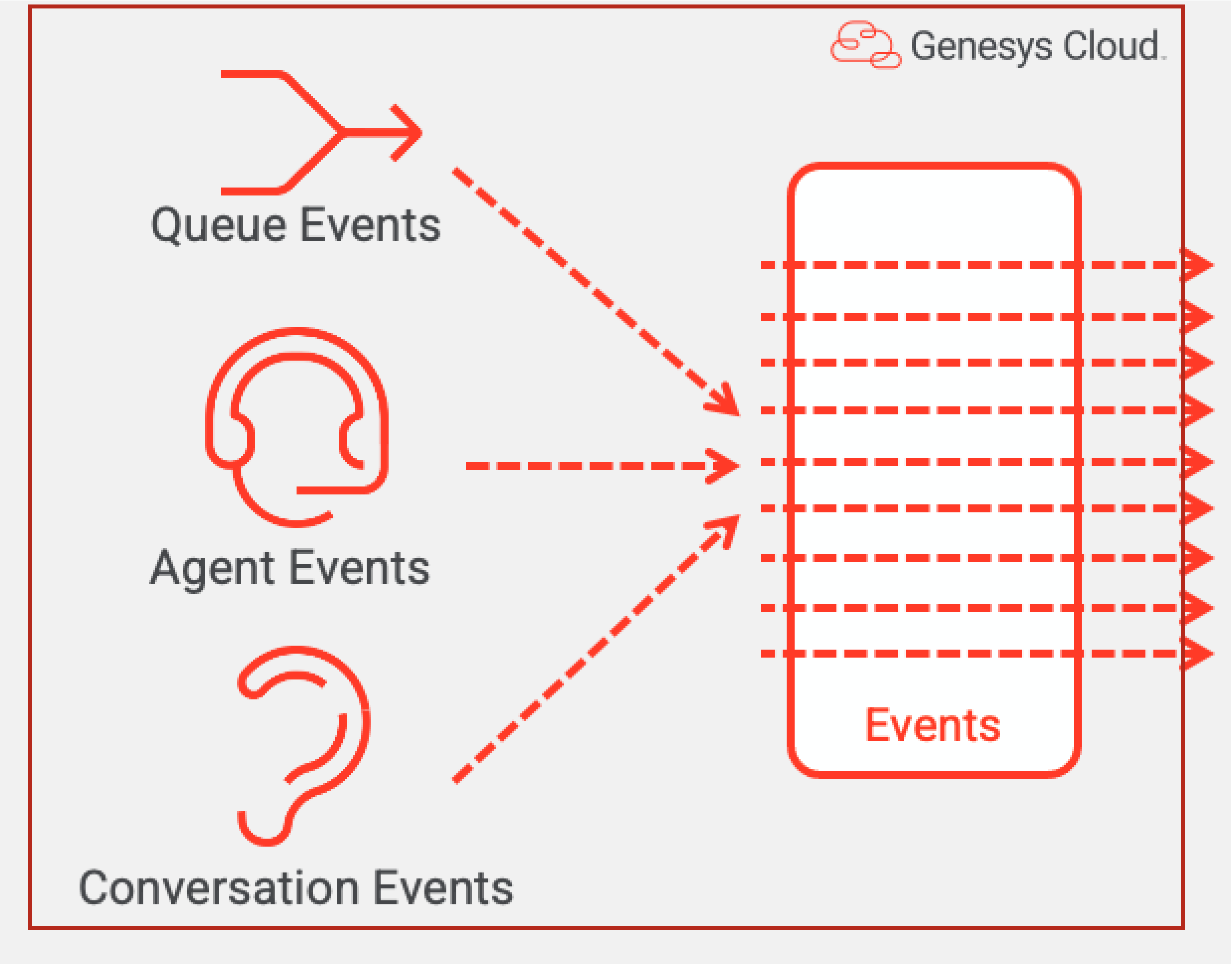
This article is going to explore:

1. When to consider leveraging event-driven integrations for your own applications
2. Using the Genesys Cloud notification service for event-driven integrations
3. Using the Genesys Cloud AWS Event Bridge for event-driven integrations
4. Coming Soon: The Genesys Cloud event orchestrator

When to consider leveraging event-driven integrations for your own applications

Service-based architecture, particularly microservice-based architectures, has made it incredibly easy to build and integrate applications together. However, service-based architectures follow a synchronous request-response model. This requires the consuming application to be responsible for when to call the API. In many scenarios, applications leveraging APIs to carry out an action need to continuously "call" or "poll" the API. Based on the frequency of this call, this can often introduce "rate-limiting" or scalability problems when having to call a cloud-based service APIs.

Event-driven architectures take a different approach. In an event-driven architecture, as data is updated or an action is taken, a message is generated and *published* to a pipe. The publisher of the event has no idea who is going to actually do anything with the message. Instead an application will *subscribe* to the pipe and listen for any messages coming down the "pipe." The diagram below depicts this:



In the above diagram, as call state changes, as there are several advantages to using an event-driven architecture:

1. **Events are asynchronous**. The producer of the event can publish an event and immediately return. The producer does not have to wait for the consumer to acknowledge they have received the message or successfully consumed it.
2. **Events are published as they happen**. Events are produced milliseconds after they occur so the events can be consumed in near time. This means a message consumer can get a message almost as soon as it happens.
3. **Events reduces the need for unnecessary API polling**. Synchronous service invocations use a pull model where the data is "pulled" from the provider. In an event-driven architecture, the data is pushed to the consumer.
4. **Events provide opportunities for increased scalability and resiliency**. In many event-driven architectures messages can be queued up and consumed by multiple consumers very quickly. In addition, because messages can be queued up if a consumer can not immediately consume a message because of any outage, the messages are not lost.

Not all event-driven architectures use message queueing. Genesys Cloud provides two different message implementations: a web-socket based solution and AWS event bridge. The web-socket based solution does not implement message queueing. Please be aware of this as you select which implementation of an event-driven architecture you are going to use here.

Event-driven architectures are extremely powerful, but they do have downsides. The biggest complaint with event-driven architectures are that they are hard to reason through and debug. With a synchronous service invocation you can walk through a very linear set of actions to determine what happens before, during and after the service invocation. Asynchronous events are harder to debug because they are coming in at different times and can be processed at different rates of speed. In a high volume, event-driven architecture debugging issues can be maddening.

Genesys Cloud provides two different implementations of an events-based architecture:

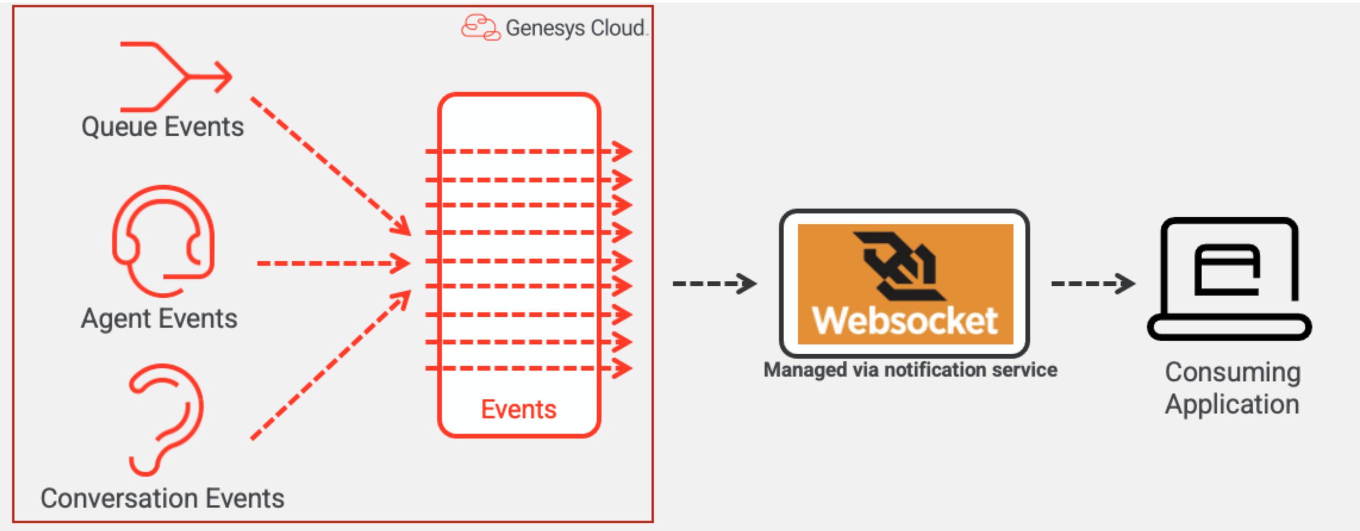
1. A platform-agnostic, web-socket event implementation
2. A message bus implementation based on the AWS EventBridge technology

Lets walkthrough each of these event-based architectures in more detail.

Using the Genesys Cloud notification service for event-driven integrations

At a high-level the Genesys Cloud notification service allows you to create a "channel" to Genesys Cloud and the subscribe to Genesys Cloud Events. Once this channel and subscription is created you can establish a WebSocket with Genesys Cloud and listen for these subscribed events as they occur.

The diagram below illustrates this flow and behavior.



It is important to realize that the original intent of this event-driven architecture was to allow developers to build real-time dashboards without having to constantly poll the Genesys Cloud API to retrieve data.

This model can be leveraged in backend services to build near-time data integrations, but as a developer you need to be aware of when using this model:

1. **No message durability**. Genesys Cloud will only send events over an open WebSocket. If a WebSocket is killed, any events that are generated while the WebSocket will not be queued will not be sent or retried. This means that in the event of any kind of network interruption, once a WebSocket is re-established, the developer must use the Genesys Cloud API to "fill in" the data that is missing during the time period the socket was down.

2. **WebSockets are a lower-level primitive**. With a WebSocket, you as the developer are responsible for establishing the network connection, handling network connectivity issues , scaling based on volume of messages, and processing messages. While these individual activities are not very complicated taken together they can make building message-based integrations significantly more complicated.

3. **Limited generalization for to subscribing topics**. When subscribing to topics, you must explicitly know the id of the Genesys Cloud object you are listening to events on. For example, to subscribe to events associated with multiple queues, you must explicitly subscribe to each individual queues. This can be painful to do and their is no mechanism to say subscribe to tell the notification service to subscribe to events from all queues.

In addition to the limitations above, you need also need to manage to and respect the Genesys Cloud rate-limits associated with the notification service.

1. **Channels remain active for 24 hours**. To maintain a channel for longer than 24 hours, resubscribe to topics.

2. **You can create up to 20 channels per user and application**. When the channel limit is reached, then the new channel replaces the oldest channel that does not have an active connection.

3. **Each WebSocket connection is limited to 1,000 topics**. If you subscribe to more than 1,000 topics, then the notification service returns a 400 error code.

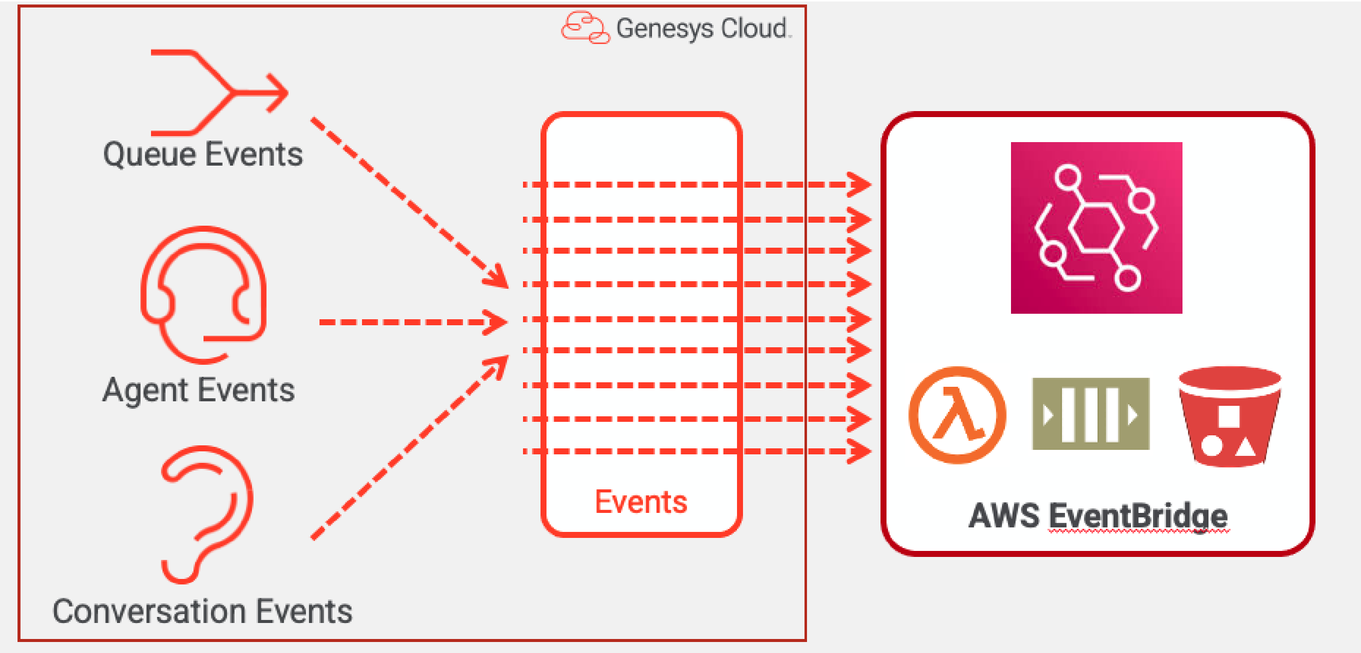
4. **Each channel can only be used by one WebSocket at a time**. If you connect a second WebSocket with the same channel ID, the first WebSocket disconnects.

We are not going to do a walk through in detail how to setup a web socket using the notification service, but I would recommend you review the following resources

1. Using the Genesys Cloud CLI to listen to Notification Service Events
2. Using the Genesys Cloud Python SDK with the Notification Service
3. Build a chat translation assistant with the AWS Translate service

Using the Genesys Cloud AWS Event Bridge for event-driven integrations

Genesys Cloud is currently beta-ing a new mechanism to publish and subscribe to events by using AWS's EventBridge. AWS EventBridge allows you to subscribe to Genesys Cloud messages originating from your Genesys Cloud account and process them to various pieces of AWS-based resources for processing. The diagram below illustrates:



AWS EventBridge provides significant advantages over the notification system model. These advantages include:

1. **Serverless**. The Amazon EventBridge is completely serverless. It requires no services to run and using it involves minor configuration error.
2. **Message durability**. Genesys Cloud will attempt to deliver messages for up to 4 days in the event of an AWS EventBridge outage. In addition, AWS EventBridge will allow you to publish a message to Kinesis where it can be persisted for up to 7 days before it is processed.
3. **Strong message filtering and routing capabilities**. AWS EventBridge can subscribe to whole classes of events (e.g. no need to identify the specific item you are looking for) and can apply sophisticated routing rules to an it receives.
4. **Multiple routing targets for messages**. AWS EventBridge can send an incoming message to multiple AWS targets. Targets for processing include (just to name a few): SQS, Lambda, SNS, Kinesis and Cloudwatch.

The only real limitation for using AWS EventBridge to integrate with Genesys Cloud is that you need to have an AWS Account in order to use it.

In preparation for the AWS EventBridge release, we have been building new content to demonstrate how to configure and use it. This content includes:

1. DevDrop - Introducing the Genesys Cloud AWS EventBridge
2. Blueprint - AWS EventBridge: Create a PagerDuty Incident in response to OAuth client deletes
3. Blueprint - AWS EventBridge: Write user presence updates to DynamoDB
4. CX as Code Remote Module - AWS EventBridge

Coming Soon: The Genesys Cloud Event orchestrator

Genesys is continuing to build out the Genesys Cloud event processing capabilities. Up until this point Genesys Cloud allows you to consume messages with your own external integrations via a WebSocket or AWS EventBridge. The Genesys Cloud development teams are currently working on a mechanism to consume Genesys Cloud events and process them without having to leave Genesys Cloud. This new capability, called Genesys Cloud Event Orchestrator is currently in beta with a target release date of Q1 2022. With the Event Orchestration you can define "triggers" that will fire when an event occurs. The trigger when invoked will use Genesys Cloud Architect Workflow to process the event.

The Genesys Cloud EventBridge and the Genesys Cloud Event Orchestration features are properly thought of as opposite sides of the same coin; similar functionality but for very different use cases. Event Orchestration is intended to invoke workflows within Genesys Cloud in order to react to events that occur within Genesys Cloud; EventBridge is a high throughput messaging bus with specific service level guarantees for archiving information in an external system or the creation of your own process automation flows within your AWS infrastructure. The Genesys Cloud Event Orchestration do not have the same level of service level guarantees, message retries, etc. that are crucial for something like a BI pipeline, while EventBridge was specifically built to service these sorts of use case.

If you are interested in finding out more about the Genesys Cloud Event Orchestration feature please reach out to Richard Schott (richard.schott@genesys.com) for more information.

Closing Thoughts

Event-based integration is incredibly powerful because it allows for real-time consumption of events while avoiding the heavy costs of heavy API polling. Genesys Cloud has three event-based integration models. They include:

1. Notification Service using WebSockets. This works best for real-time UI integrations like dashboards and agent applications. This was originally the only mechanism that could be used for back-end integration, but had severe limitations around message durability. It also a complicated programming model that pushes many core resiliency and scalability responsbilities to the developer.

Additional Resources

1. Notification Service
2. Event topics
3. Genesys Cloud AWS EventBridge
4. Using the Genesys Cloud CLI to listen to Notification Service Events
5. Using the Genesys Cloud Python SDK with the Notification Service
6. Build a chat translation assistant with the AWS Translate service
7. AWS EventBridge - Create a PagerDuty Incident in response to OAuth client deletes
8. AWS EventBridge - Write user presence updates to DynamoDB
9. DevDrop - Introducing the Genesys Cloud AWS EventBridge
10. CX as Code Remote Module - AWS EventBridge