Using Cloud PubSub with Cloud Run

Overview

Pub/Sub enables applications to take advantage of efficient message queues. The service is compatible with a range of Google Cloud services, and in this lab, you learn how to integrate it with Cloud Run.

This lab is based on resolving a customer use case by using serverless infrastructure. The lab features three high level sections that resolve a technical problem:

- Situational Overview
- Requirements Gathering
- Developing a minimal viable product

Objectives

In this lab, you learn to:

- Enable the Cloud Run API.
- Deploy microservices to Cloud Run.
- Create a Pub/Sub topic.
- Invoke a Cloud Run service from a Pub/Sub subscription.

Prerequisites

These labs are based on intermediate knowledge of Google Cloud. While the steps required are covered in the content, it would be helpful to have familiarity with any of the following products:

- Pub/Sub
- Cloud Run

Situational overview

In this lab, you will help the development team at Critter Junction investigate the use of Pub/Sub for their requirements. The team would like to explore how to perform efficient queue processing within their applications.

Requirements gathering

The team at Critter Junction has a public web application and several microservices built on Google Cloud. Communication between the microservices is critical and needs a resilient form of messaging to be established between each application component.

The development team's previous attempts were unsuccessful due to the microservices needing to know a lot about each other (High Coupling). In addition, if a service was temporarily unavailable, messages would be lost.

The team needs a solution that includes a level of resilience without introducing additional service dependencies (Low Coupling) into their systems. Now that you know a bit more about Critter Junction and the issues they face, try to prioritize the key criteria for a solution.

Defining Critter Junction priorities

To ascertain the key use cases and priorities, initial discussions are held with the Critter Junction stakeholders. The results of the discussions are shown below:

Ref	**User Story**
1	As a lead developer, I want to ensure that messaging is resilient, so service operations will be restored without needing manual intervention.
2	As a program manager, I want services to be capable of scaling seamlessly so additional transactional load does not lead to system instability.
3	As an operations lead, I want services to be managed so staff does not need to be reassigned from important maintenance work.

From a discussion with the team leads, the following high level tasks are defined:

Ref	Definition of Done
1	Establish an asynchronous component for inter-service communication.
2	Implement the proven scalability of the solution.
3	Services must run unsupervised.

The team at Critter Junction is keen to define a solution that can be implemented quickly. In consideration of the requirements, the development team narrows their options down to:

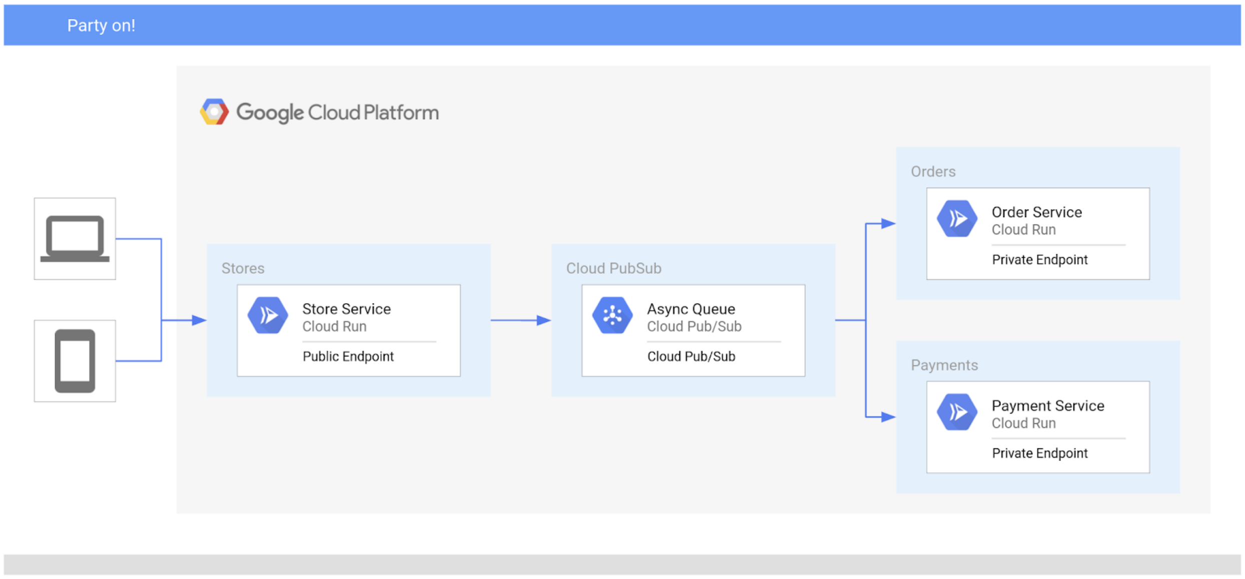
- Pub/Sub
- Cloud Tasks

See Pub/Sub versus Cloud Tasks to learn more.

Product	Use case	Choice

Pub/Sub	***"Optimal for more general event data ingestion and distribution patterns where some degree of control over execution can be sacrificed."***	✓
Cloud Tasks	"Appropriate for use cases where a task producer needs to defer or control the execution timing of a specific webhook or remote procedure call."	✗

After considering the requirements, the development team chooses Pub/Sub because they only require a push based distribution pattern. The following high level architecture diagram summarizes the minimal viable product (MVP) that they need to investigate.



In the proposed solution, Pub/Sub will be used to handle asynchronous messages between services.

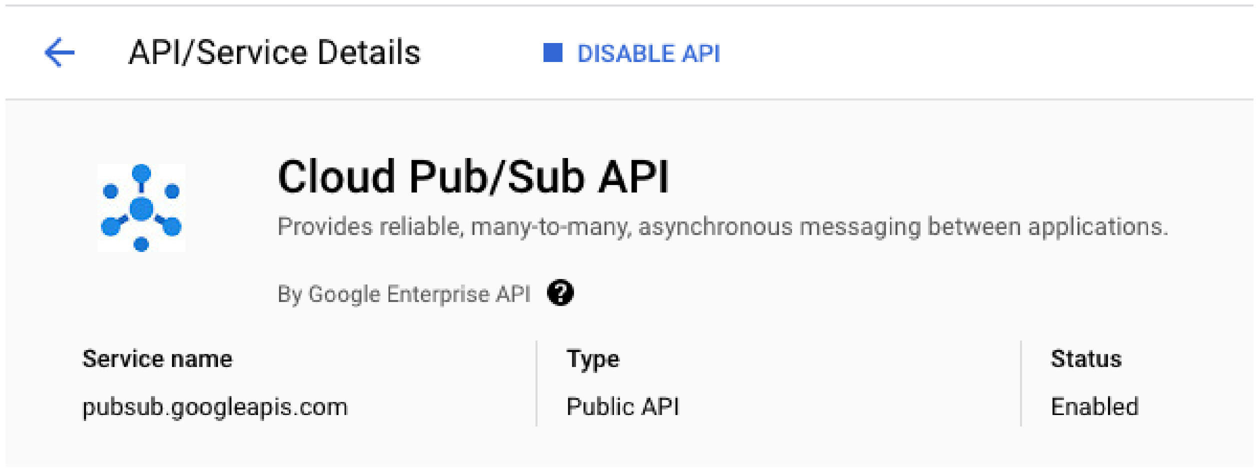
Task 1. Ensure that the Pub/Sub API is successfully enabled

To ensure access to the necessary API, re-enable the **Pub/Sub** API.

1. In the Google Cloud console **Navigation menu** (☰), under **APIs & Services**, click **Library**.
2. In the **Search** box, type **Pub/Sub**
3. Click the result for **Cloud Pub/Sub API**.

4. Click **Manage**.
5. Click **Disable API**. If asked to confirm, click **Disable**.
6. Again, when prompted `Do you want to disable Cloud Pub/Sub API and its dependent APIs?`, Click **Confirm**.
7. To re-enable the API, click **Enable**.

   When the API has been re-enabled, the page displays information about the API.



Cloud Pub/Sub API

Provides reliable, many-to-many, asynchronous messaging between applications.

By Google Enterprise API

Service name	Type	Status
pubsub.googleapis.com	Public API	Enabled

Task 2. Developing a minimal viable product (MVP)

Critter Junction has multiple Cloud Run services that they would like integrated with Pub/Sub. To build an MVP, the following tasks are required:

- Deploy a producer service
- Deploy a consumer service

- Create a service account
- Create a Pub/Sub topic

Deploy a producer service

Critter Junction specifies that the externally facing *store* service should be configured as a public endpoint, indicating these requirements:

Type	**Permission**	**Description**
URL Access	--allow-unauthenticated	Make the service PUBLIC (Unauthenticated users can see it).
Invoke Permission	allUsers	Allow the service be invoked/triggered by anyone.

The producer *store* service accepts public internet based connections for *purchase orders*. To do this, the service must not require authentication and must be able to be triggered by anyone.

Information collected by this service will be passed to the backend consumer services.

Configure and deploy the *store* service on Cloud Run. Execute the following commands in Cloud Shell.

1. Enable the **Cloud Run** API and configure your Shell environment:
2. `gcloud services enable run.googleapis.com`

3. Create a LOCATION environment variable:
4. `LOCATION=us-west1`
5. Set the compute region:
6. `gcloud config set compute/region $LOCATION`
7. Deploy the *store* service:

```
gcloud run deploy store-service \
  --image gcr.io/qwiklabs-resources/gsp724-store-service \
  --region $LOCATION \
  --allow-unauthenticated
```

Once the store service is deployed, the store service is publicly accessible over the internet.

Deploy a consumer service

The development team also needs to configure the *order* service that can be accessed at a private endpoint. Unlike the *store* service, the *order* service is not meant to be publicly accessible over the internet, and should only be invoked by an account with the appropriate permissions.

For Cloud Run based services, this can be achieved by using the following settings:

Type	**Permission**	**Description**
URL Access	--no-allow-unauthenticated	Make the service PRIVATE (Only authenticated users can see it).

Invoke Role/Permission	Cloud Run Invoker	Only allow the service to be invoked by an account with the Cloud Run Invoker role.

Configure and deploy the *order service*:

```
gcloud run deploy order-service \
  --image gcr.io/qwiklabs-resources/gsp724-order-service \
  --region $LOCATION \
  --no-allow-unauthenticated
```

Pub/Sub overview

Pub/Sub is an asynchronous messaging service that decouples services that produce events from services that consume and process events.

Pub/Sub core concepts:

- Topic
- Subscription
- Message
- Message attribute

Pub/Sub requires a couple of options to be completed prior to successful deployment. In the Google Cloud console, Pub/Sub can be accessed under the Big Data menu option.

Field	**Description**
Topic	A named resource to which messages are sent by publishers.
Subscription	A named resource representing the stream of messages from a single, specific topic, to be delivered to the subscribing application. For more details about subscriptions and message delivery semantics, see the Subscriber Guide.
Message	The combination of data and (optional) attributes that a publisher sends to a topic and is eventually delivered to subscribers.
Message attribute	A key-value pair that a publisher can define for a message. For example, key ***iana.org/language_tag*** and value **en** could be added to messages to mark them as readable by an English-speaking subscriber.

Pub/Sub can be used in a wide variety of use cases, the most common of which are listed below:

Use Case	**Example**
Balancing workloads in network clusters	For example, a large queue of tasks can be efficiently distributed among multiple workers, such as Compute Engine instances.

Implementing asynchronous workflows	For example, an order processing application can place an order on a topic, from which it can be processed by one or more workers.
Distributing event notifications	For example, a service that accepts user signups can send notifications whenever a new user registers, and downstream services can subscribe to receive notifications of the event.
Refreshing distributed caches	For example, an application can publish invalidation events to update the IDs of objects that have changed.
Logging to multiple systems	For example, a Google Compute Engine instance can write logs to the monitoring system, to a database for later querying, and so on.
Data streaming from various processes or devices	For example, a residential sensor can stream data to backend servers hosted in the cloud.
Reliability improvement	For example, a single-zone Compute Engine service can operate in additional zones by subscribing to a common topic, to recover from failures in a zone or region.

Task 3. Deploying Pub/Sub

Now that the producer (`store service`) and consumer (`order service`) services have been successfully deployed, you can focus on the main features of Pub/Sub. Using Pub/Sub requires two activities:

- Create a Topic
- Create a Subscription

Create a Topic

When an asynchronous (push) event is created on a topic, applications that subscribe to the topic will be able to process the associated messages. Push event processing with Pub/Sub provides a scalable way to handle messaging on Google Cloud.

The new Pub/Sub Topic will have following values.

Field	**Value**
Name	ORDER_PLACED
Encryption	Google-managed key

1. Create a Topic in Pub/Sub:

```
gcloud pubsub topics create ORDER_PLACED
```

Note: Messages that are sent using Pub/Sub are encoded as base64 on transmission, and need to be decoded on receipt.

Task 4. Creating a service account

To deliver a Pub/Sub message to a Cloud Run service, you need a Pub/Sub subscription. The subscription must be able to invoke the service using a service account with the appropriate permissions. In this lab, the consumer *order* service will be invoked by a subscription using the service account.

To achieve this functionality, the following activities are required:

- Create a Service Account
- Bind the Invoker Role permissions to the service account

Service account creation

Create a new service account that will provide authenticated access.

1. Create a new service account called **Order Initiator**:

```
gcloud iam service-accounts create pubsub-cloud-run-invoker \
2.   --display-name "Order Initiator"
```

3. Confirm that the service account has been created:
4. `gcloud iam service-accounts list --filter="Order Initiator"`

At this point, the **Order Initiator** service account is available. However, it does not have a role or permissions assigned. To assign it IAM permissions, you need to apply or bind role permissions to the service account.

Bind role permissions

To bind permissions to an account that is used to invoke a service on Cloud Run, you need the following information:

Category	**Description**
Service Name	The name of the deployed service to be invoked.
Member	The account to bestow the role permissions.
Region	The region in which the service is deployed.
Platform	The platform type (Cloud Run Managed, Cloud Run for Anthos, or Cloud Run for VMWare)

1. Bind the service account with the role `Cloud Run Invoker` on the *order service*:

```
gcloud run services add-iam-policy-binding order-service --region
$LOCATION \

--member=serviceAccount:pubsub-cloud-run-invoker@$GOOGLE_CLOUD_PROJECT.iam
.gserviceaccount.com \
```

2. `--role=roles/run.invoker --platform managed`
3. Copied!
4. content_copy
5. The new service account has now been given permissions to invoke a Cloud Run service.
6. Create an environment variable to store the project number:

```
PROJECT_NUMBER=$(gcloud projects list \
  --filter="qwiklabs-gcp" \
```

7. `--format='value(PROJECT_NUMBER)')`
8. Enable the project service account to create tokens:

```
gcloud projects add-iam-policy-binding $GOOGLE_CLOUD_PROJECT \

--member=serviceAccount:service-$PROJECT_NUMBER@gcp-sa-pubsub.iam.gservice
account.com \
```

9. `--role=roles/iam.serviceAccountTokenCreator`

Task 5. Create a Pub/Sub subscription

In this task, you create the Pub/Sub subscription and configure it to use the new service account.

1. Create an environment variable to store the endpoint of the *order service*:

```
ORDER_SERVICE_URL=$(gcloud run services describe order-service \
   --region $LOCATION \
```

2.
   ```
       --format="value(status.address.url)")
   ```
3. Create a subscription and bind it to the *order service*:

```
gcloud pubsub subscriptions create order-service-sub \
   --topic ORDER_PLACED \
   --push-endpoint=$ORDER_SERVICE_URL \
```

4.
   ```
   --push-auth-service-account=pubsub-cloud-run-invoker@$GOOGLE_CLOUD_PROJECT.iam.gserviceaccount.com
   ```

Task 6. Testing the application

To test the application, send a sample JSON payload to the store service.

1. Create a file called `test.json` with the following content. You can use your choice of editor such as `nano`, `vi`, or the Cloud Shell editor.

```
{
 "billing_address": {
   "name": "Kylie Scull",
   "address": "6471 Front Street",
   "city": "Mountain View",
   "state_province": "CA",
   "postal_code": "94043",
   "country": "US"
 },
 "shipping_address": {
   "name": "Kylie Scull",
   "address": "9902 Cambridge Grove",
   "city": "Martinville",
   "state_province": "BC",
   "postal_code": "V1A",
   "country": "Canada"
 },
 "items": [
   {
     "id": "RW134",
     "quantity": 1,
     "sub-total": 12.95
   },
   {
     "id": "IB541",
     "quantity": 2,
     "sub-total": 24.5
   }
 ]
```
2. }
3. Create an environment variable to store the endpoint of the *store service*:

```
STORE_SERVICE_URL=$(gcloud run services describe store-service \
   --region $LOCATION \
```
4. `    --format="value(status.address.url)")`
5. To test communication between the microservices and generate an order ID, post a message to the *store service*:

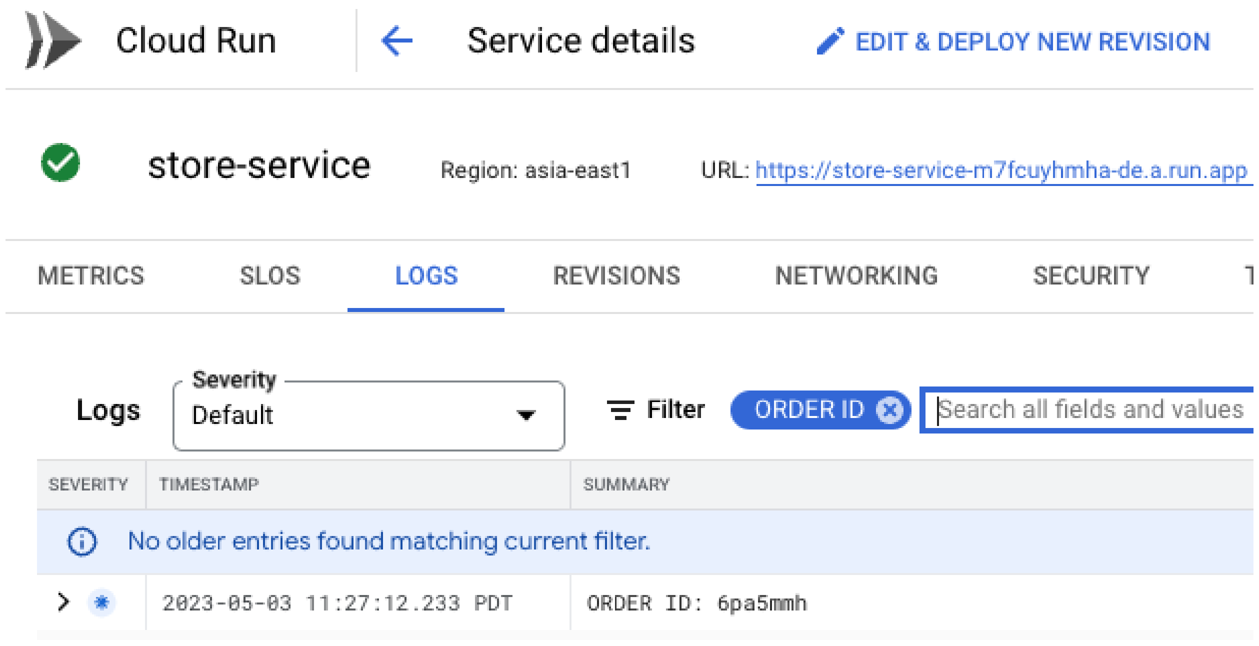
6. `curl -X POST -H "Content-Type: application/json" -d @test.json $STORE_SERVICE_URL`
7. Copied!
8. content_copy
9. The output of the command indicates that an order had been successfully created, and should be similar to:
10. `{"status":"success","order_id":"6pa5mmh"}`

Store service

The *store service* (public endpoint) uses Pub/Sub to transmit information to the *order service* (private endpoint).

1. In the Google Cloud console **Navigation menu** (☰), click **Cloud Run**.
2. Click the link to the *store-service*.
3. To view the service logs, click **Logs**. Check the store service logs to view the order ID that was generated.

4. Add the log filter `ORDER ID` to see the ID generated by the *store service*.



No older entries found matching current filter.

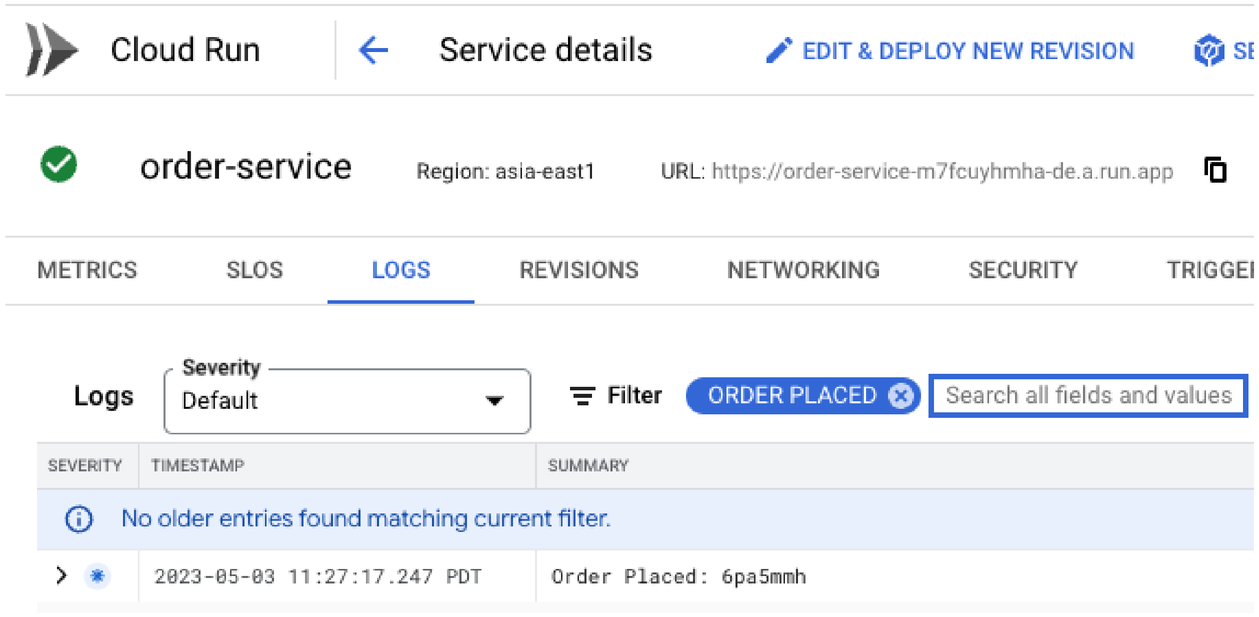
```
2023-05-03 11:27:12.233 PDT    ORDER ID: 6pa5mmh
```

Order service

The *order service* receives a message from the *store service* passed with Pub/Sub.

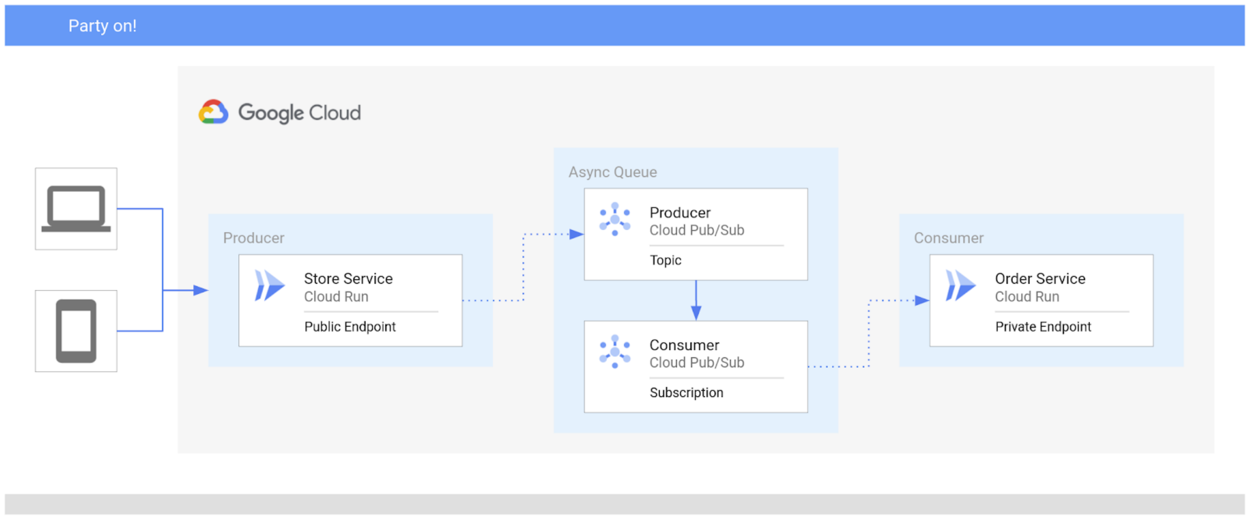
1. Check the order service logs to confirm that the JSON data was successfully transferred.

2. Add the log filter `Order Placed` to see the generated order ID that was passed to the *order service*.



SEVERITY	TIMESTAMP	SUMMARY
No older entries found matching current filter.		
	2023-05-03 11:27:17.247 PDT	Order Placed: 6pa5mmh

Critter Junction have now updated their solution to take advantage of Pub/Sub. The following high level architecture diagram summaries the solution deployed.



You have successfully deployed Pub/Sub on Google Cloud to asynchronously communicate between Cloud Run services.

Congratulations!

In this lab, you learned how to integrate Cloud Run services with Pub/Sub in your Google Cloud infrastructure. You learned how to:

- Deploy services to Cloud Run
- Create a Service Account with the appropriate role and permissions
- Define a Pub/Sub Topic
- Bind a Pub/Sub Subscription to a Service Account