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# Predictive User Engagement Implementation Guide



## **Predictive User Engagement: Implementation Guide**

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# Solution that uses Amazon Pinpoint to help improve customer engagement by delivering personalized messaging to users and increase brand loyalty and conversion rates

*November 2019*

This implementation guide discusses architectural considerations and configuration steps for deploying Predictive User Engagement in the Amazon Web Services (AWS) Cloud. It includes links to an [AWS CloudFormation](#) template that launches and configures the AWS services required to deploy this solution using AWS best practices for security and availability.

The guide is intended for enterprise front-office marketing professionals and enterprise developers who deal with front-end systems who have practical experience with analytics platforms, and architecting on the AWS Cloud.

# Overview

Given the ever-increasing number of brands competing for a finite amount of customer attention, maximizing customer engagement is vital. In today's digital marketplace, it is critical to keep your users coming back to your app.

One method that can help improve customer engagement is to deliver personalized messaging to your users. Personalized messaging can help build trust in your brand and increase conversion rates. [Amazon Pinpoint](#) helps you [engage with your customers](#) by sending personalized email, SMS and voice messages, and push notifications. With Amazon Pinpoint, you can place your customers in groups based on demographics, behaviors, or other key performance indicators that are important for your business, and send highly personalized, timely, and relevant messages to those groups.

Machine learning (ML) can also help you improve your customer engagement by analyzing your customer activity, identifying patterns, and making recommendations to help you convert users. However, it can be a challenge to integrate ML models with messaging tools for companies without deep, in-house ML expertise.

To help you more easily leverage the personalized messaging engine of Amazon Pinpoint with machine learning without ML expertise, AWS offers the Predictive User Engagement solution. This solution combines Amazon Pinpoint and [Amazon Personalize](#), an ML service that analyzes user activity against predefined ML models and makes recommendations.

With Predictive User Engagement, you can build a simple architecture that automates the process of making predictive recommendations based on user activity in Amazon Personalize, and updating Amazon Pinpoint [endpoints](#) with those recommendations.

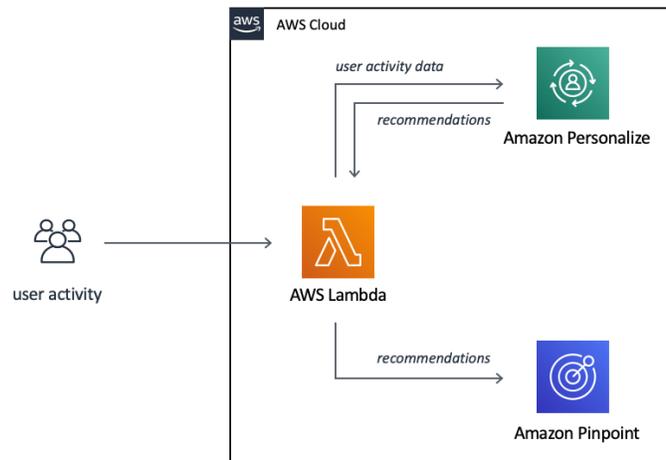
This solution is designed to provide a simple architecture to demonstrate how to use ML to make product recommendations and automatically update your endpoints and [segments](#). You can build upon this architecture for a variety of use cases.

## Cost

You are responsible for the cost of the AWS services used while running this solution. The cost for running this solution depends on the number of SMS messages you send, the number of endpoints you contact, the amount of data this solution ingests, how many compute hours it takes to train your ML model, the number of AWS Lambda requests, and how much compute time the Lambda function uses. Prices are subject to change. For full details, see the pricing webpages for [Amazon Pinpoint](#), [Amazon Personalize](#), and [AWS Lambda](#).

## Architecture Overview

Deploying this solution builds the following environment in the AWS Cloud.



**Figure 1: Predictive User Engagement architecture on AWS**

The AWS CloudFormation template deploys an AWS Lambda function that ingests user activity data from an application. The function sends that data to Amazon Personalize, which runs a machine learning (ML) model on the data to identify patterns. Amazon Personalize generates a personalized ranking of recommended items for each user ID.

The Lambda function retrieves the personalized rankings and sends them to Amazon Pinpoint, which uses these recommendations to automatically update endpoints that belong to your segments based on how the personalized ranking matches your segment filters. For example, if a customer who you were sending messaging on product A now shows a preference for product B based on recent activity, this solution will automatically update the customer endpoint to move the endpoint from the segment that receives product A messaging to the segment that receives product B messaging.

You can also set campaigns to send personalized, timely, and relevant messages to the segments this solution updates. You can choose to send messages immediately, in the future, or you can create a recurring campaign that sends messages at set intervals. For more information, see [Amazon Pinpoint Campaigns](#).

This solution includes a sample dataset of personalized car searches that is used to train the solution's machine learning (ML) model. The solution also includes a demo that shows how to use ML to make product recommendations and automatically update your endpoints and segments. You can build upon this architecture for a variety of use cases.

# Design Considerations

## Regional Deployments

This solution uses Amazon Pinpoint and Amazon Personalize which are available in specific AWS Regions only. Therefore, you must launch this solution in a region that supports these services. For the most current service availability by region, see [AWS service offerings by region](#).

# AWS CloudFormation Template

This solution uses AWS CloudFormation to automate the deployment of the Predictive User Engagement solution in the AWS Cloud. It includes the following AWS CloudFormation template, which you can download before deployment:

[View  
Template](#)

**predictive-user-engagement.template:** Use this template to launch the solution and all associated components. The default configuration deploys an AWS Lambda function, Amazon Personalize, and Amazon Pinpoint, but you can also customize the template to meet your specific needs.

# Automated Deployment

Before you launch the automated deployment, please review the architecture and considerations discussed in this guide. Follow the step-by-step instructions in this section to configure and deploy Predictive User Engagement into your account.

**Time to deploy:** Approximately five minutes

## Prerequisites

Before you deploy the solution, verify that meet the following prerequisites.

- You must have an account with permissions to create resources for each service. You can manually add permissions for each service to your account, or you can use an account with administrative permissions.
- You must have the AWS Command Line Interface (AWS CLI) installed. For instructions, see [Installing the AWS CLI](#) in the *AWS CLI User Guide*.
- You must have the Jupyter Notebook App installed. For instructions, see [Installation](#) in the *Jupyter/iPython Notebook Quick Start Guide*.

## What We'll Cover

The procedure for deploying this architecture and demonstrating its functionality consists of the following steps. For detailed instructions, follow the links for each step.

### [Step 1. Create an Amazon Pinpoint Project \(p. 7\)](#)

- Create an Amazon Pinpoint project to test the solution.

### [Step 2. Configure Amazon Personalize \(p. 7\)](#)

- Configure the sample Amazon Personalize resources and campaign.

### [Step 3. Launch the Stack \(p. 8\)](#)

- Launch the AWS CloudFormation template into your AWS account.
- Enter values for required parameter: **Stack Name**, **Personalize Campaign ARN**, **Pinpoint Project ID**

### [Step 4. Create an Endpoint in the Amazon Pinpoint Project \(p. 9\)](#)

- Create an endpoint for testing the Amazon Pinpoint project.

### [Step 5. Validate the Endpoint \(p. 9\)](#)

- Verify that the endpoint is loaded correctly with the correct attributes.

[Step 6. Test the Lambda Function \(p. 10\)](#)

- Execute the `pue-get-recs` Lambda function to retrieve recommendations and update the endpoint.

[Step 7. Create a Segment That Filters on Recommended Items \(p. 10\)](#)

- Create Amazon Pinpoint segments from the Amazon Personalize recommendations.

[Step 8. Create a Campaign Using the Recommendations Segment \(p. 11\)](#)

- Create and send a campaign using the Amazon Personalize recommendations.

## Step 1. Create an Amazon Pinpoint Project

Use this procedure to create a project in Amazon Pinpoint.

1. Navigate to the [Amazon Pinpoint console](#).
2. On the **All projects** page, choose **Create a project**.
3. For **Project name**, enter `pueDemo`, and then choose **Create**.
4. On the **Configure features** page, under **SMS and voice**, choose **Configure**.
5. Select **Enable the SMS channel for this project**.
6. Select **Save changes**.
7. In the navigation pane, select **Settings, General settings**.
8. Copy the **Project ID**. You will need it when you launch the stack.

## Step 2. Configure Amazon Personalize

Use this procedure to create sample data, load it into Amazon Personalize datasets, and create campaigns and training.

1. In a terminal window, run the following command to clone the sample data and Jupyter Notebooks GitHub repository.

```
git clone https://github.com/markproy/personalize-car-search.git
```

2. Navigate to the directory that contains the sample data and run the following command.

```
jupyter notebook
```

The Jupyter interface opens in a browser window.

3. In the Jupyter notebook interface, open the `01_generate_data.ipynb` file.
4. In the **Cell** dropdown menu, select **Run All** to run the file.
5. Open the `02_make_dataset_group.ipynb` file.
6. In the **Cell** dropdown menu, select **Run All** to run the file.
7. Open the `03_make_campaigns.ipynb` file.

8. In the **Cell** dropdown menu, select **Run All** to run the file.
9. Open the `04_use_the_campaign.ipynb` file.
10. In the **Cell** dropdown menu, select **Run All** to run the file.
11. Navigate to the [Amazon Personalize console](#).
12. In the navigation pane, select **Dataset groups** and verify that Amazon Personalize contains the `car-dg` dataset group.
13. Select the `car-dg` dataset group.
14. In the navigation pane, choose **Campaigns** and verify that the `car-hrnn` campaign shows with an **Active** status.
15. Select the `car-hrnn` campaign and copy the **Campaign ARN**. You will need it when you launch the stack.

## Step 3. Launch the Stack

This automated AWS CloudFormation template deploys Predictive User Engagement in the AWS Cloud. Please make sure that you've reviewed the architecture, prerequisites, and considerations before launching the stack.

### Note

You are responsible for the cost of the AWS services used while running this solution. See the [Cost \(p. 2\)](#) section for more details. For full details, see the pricing webpage for each AWS service you will be using in this solution.

1. Sign in to the AWS Management Console and click the button below to launch the `predictive-user-engagement` AWS CloudFormation template.



You can also [download the template](#) as a starting point for your own implementation.

2. The template is launched in the US East (N. Virginia) Region by default. To launch this solution in a different AWS Region, use the region selector in the console navigation bar.

### Note

This solution uses Amazon Pinpoint and Amazon Personalize, which are currently available in specific AWS Regions only. Therefore, you must launch this solution in an AWS Region where these services are available. For the most current service availability by region, see [AWS service offerings by region](#).

3. On the **Create stack** page, verify that the correct template URL shows in the **Amazon S3 URL** text box and choose **Next**.
4. On the **Specify stack details** page, assign a name to your solution stack.
5. Under **Parameters**, review the parameters for the template, and modify them as necessary. This solution uses the following default values.

Parameter	Default	Description
<b>Personalize Campaign ARN</b>	<i>&lt;Requires input&gt;</i>	The <code>car-hrnn</code> campaign ARN of the Amazon Personalize campaign you created in <a href="#">Step 2 (p. 7)</a>

Parameter	Default	Description
Pinpoint Project Id	<Requires input>	The project ID of the Amazon Pinpoint project you created in <a href="#">Step 1 (p. 7)</a>

6. Choose **Next**.
7. On the **Configure stack options** page, choose **Next**.
8. On the **Review** page, review and confirm the settings. Be sure to check the box acknowledging that the template will create AWS Identity and Access Management (IAM) resources.
9. Choose **Create stack** to deploy the stack.

You can view the status of the stack in the AWS CloudFormation console in the **Status** column. You should see a status of **CREATE\_COMPLETE** in approximately five minutes.

## Step 4. Create an Endpoint in the Amazon Pinpoint Project

Create an endpoint that you will use to test the SMS channel and store the recommendations from Amazon Personalize.

### Note

For this demo, you will use the AWS Command Line Interface (AWS CLI) to create the endpoint. If necessary, [install the AWS CLI](#).

Run the following command. Replace *<project-id>* with the project ID you copied in the previous step. Replace *<mobile-number>* with a U.S. mobile number using the using the E.164 format (+1XXX5550100).

```
AWS pinpoint update-endpoint --application-id "<project-id>"  
--endpoint-id "12456" --endpoint-request "Address='<mobile-  
number>', ChannelType='SMS', User={UserAttributes={recommended_items=[ 'none' ]}, UserId='12456'}"
```

For this demo, you will use 12456 for the `UserId`. This user ID matches the ID that is used in the Amazon Personalize dataset.

## Step 5. Validate the Endpoint

Use this procedure to create a segment for the endpoint you created in the previous step.

1. Navigate to the [Amazon Pinpoint console](#).
2. On the **All projects** page, choose the `pueDemo` project.
3. In the navigation pane, select **Segments**. Then, select **Create a segment**.
4. For **Name**, enter `pueNoRecommendations`.
5. For **Add a filter**, choose **Filter by user**.
6. For **Choose a user attribute**, select **recommended-items**. Then, set the value to `none`.
7. Choose **Create Segment**.

You might receive a **Segment might include multiple channels** message. If so, select **I understand**.

8. In the navigation pane, select **Segments** and choose the segment you just created.
9. Under **Segment details**, verify that **Total endpoints** shows 1 endpoint.
10. In the navigation pane, select **Campaigns**. Then, select **Create a campaign**.
11. For **Campaign name**, enter `SMS to users with no recommendations`.
12. Select **Next**.
13. On the **Choose a segment** page, select the `pueNoRecommendations` segment, choose **Next**.
14. On the **Create your message** page, enter `Sample pueNoRecommendations segment SMS test message`. Then, select **Next**.
15. On the **Choose when to send the campaign** page, select **Next**.
16. Choose **Launch Campaign**.
17. Verify that you received the test message at the mobile number you specified.

## Step 6. Test the Lambda Function

Use this procedure to test the Lambda function you created in step 5.

1. Navigate to the [AWS Lambda console](#).
2. In the navigation pane, select **Functions**.
3. Select the `pue-get-recs-test` function.
4. Select **Test**.

The **Configure test event** window opens.

5. For **Event name**, enter `pue-get-recs-test`. Then, select **Create**.
6. Choose **Test**.
7. Navigate to the [Amazon Pinpoint console](#), and open the `pueDemo` project.
8. In the navigation pane select **Segments**. Then, select the `pueNoRecommendations` segment.
9. On the **Segment details** page, the **Total endpoints** should show 0 endpoints.

The Lambda function retrieved the recommendations from Amazon Personalize and updated the recommendations field of the endpoint. This segment has a filter (`recommended_items` attribute = 'none'). When the Lambda function updated the endpoint, the `recommended_items` attribute value was updated and no longer has a none value. The endpoint was removed from the segment.

To view the recommendations value of the endpoint, you can create a new segment and choose the user attributes filter of `recommended_items`. Then, you can look at the values in the values dropdown list.

## Step 7. Create a Segment That Filters on Recommended Items

Now that the Amazon Personalize user recommendations are stored in Amazon Pinpoint as user attributes, you will create Amazon Pinpoint segments that automatically update based on which users have recommendations.

1. Navigate to the [Amazon Pinpoint console](#).
2. On the **All Projects** page, choose the `pueDemo` project.

3. In the navigation pane, select **Segments**. Then, select **Create a segment**.
4. For **Name**, enter `pueItemRecommendations`.
5. For **Add a filter**, choose **Filter by user**.
6. For **Choose a user attribute**, select **recommended-items**. Then, set the value to any item ID in the dropdown list.
7. Choose **Create Segment**.

You might receive a **Segment might include multiple channels** message. If so, select **I understand**.

8. In the navigation pane, select **Segments** and choose the `pueNoRecommendations` segment.
9. Under **Segment details**, verify that **Total endpoints** shows 0 endpoint.

When the Lambda function retrieved the Amazon Personalize recommendations, the endpoint's `recommended_items` attribute was updated to include a list of item IDs. Because the filter on this segment is `recommended_items` attribute = 'none' there will be no endpoints in the segment.

10. Optional: You can do [Step 3 \(p. 8\)](#) again and verify that the `pueNoRecommendations` segment shows one endpoint and that the `pueItemRecommendations` segment shows no endpoints.
11. To populate the endpoint `recommended_items` attribute with recommendations from Amazon Personalize, invoke the `pue-get-recs` Lambda function again.
12. Verify that the `pueNoRecommendations` segment shows no endpoints and that the `pueItemRecommendations` segment shows one endpoint.

## Step 8. Create a Campaign Using the Recommendations Segment

Use this procedure to create an Amazon Pinpoint campaign that uses the `pueItemRecommendations` segment.

1. In the navigation pane, select **Campaigns**. Then, select **Create a campaign**.
2. For **Campaign name**, enter `SMS to users with item recommendations`.
3. Select **Next**.
4. On the **Choose a segment** page, select the `pueItemRecommendations` segment, choose **Next**.
5. On the **Create your message** page, enter `Sample item recommendations segment SMS test message`. Then, select **Next**.
6. On the **Choose when to send the campaign** page, select **Next**.
7. Choose **Launch Campaign**.
8. Verify that you received the test message at the mobile number you specified in [Step 4 \(p. 9\)](#).

You can set this campaign to execute on a recurring basis. You can also set the campaign to run the `pue-get-recs` Lambda function automatically when it executes, updating this list of endpoints that will receive the message based on the most current recommendations data from Amazon Personalize. For more information, see [Customizing Segments with AWS Lambda](#).

# Additional Resources

## **AWS services**

- [Amazon Pinpoint](#)
- [Amazon Personalize](#)
- [AWS Lambda](#)

# Source Code

Visit our [GitHub repository](#) to download the templates and scripts for this solution, and to share your customizations with others.

# Document Revisions

Date	Change
November 2019	Initial release

## Notices

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