

\*Created with assistance from DALL-E

## Capstone Paper

### CONTACT CENTER MODERNIZATION USING AMAZON CONNECT

Spring 2024 - ISMT E-599 - Capstone Seminar in Digital Enterprise

Team 1: Kalle Georgiev,

May 2, 2024

## **Table of Contents**

EXECUTIVE SUMMARY.....	3
PART 1. BUSINESS REQUIREMENTS.....	5
PART 2. TECHNICAL SOLUTION.....	15
PART 3. IMPLEMENTATION PLAN.....	29
Glossary.....	42
Part 1 Appendix.....	46
Part 2 Appendix.....	52
Part 3 Appendix.....	60
References.....	65
Acknowledgments.....	70

## EXECUTIVE SUMMARY

### A. The Company

Crimson Financial is a regional bank with \$26 billion in assets with a strong focus on credit card lending products. Crimson has 23 branch locations along the East Coast. Crimson was founded in 1858 and has been privately owned ever since.

Crimson is focused on efficiencies and lowering costs in the next 5 years. The bank is facing pressure because of higher charge-offs and regulations forcing Crimson to save more money for potential future loan losses. Since the pandemic, Crimson has invested a large percentage of their technology budget into modernizing both systems and infrastructure. The largest IT initiative completed in 2023 was to move customer databases to the cloud.

### B. The Team

As the Contact Center IT Squad, we have been tasked with engineering an end-to-end solution to solve our contact center issues.

### C. The Business Goal

The business goals are twofold: increase the quality of customer experience (CX) while enhancing employee satisfaction. Achieving these goals will improve overall business performance and support Crimson's multi-year vision.

### D. The Scope

The first iteration of contact center modernization will focus on three key areas of improvements, which will be referenced going forward as "three promises". These areas were identified by our internal research team as the most urgently needed and are expected to yield significant cost reduction to Crimson contact center operation:

1. *Interactive Voice Response (IVR) improvement*: to build an intelligent IVR system that will voice authenticate, converse naturally with customers, and handle business transactions
2. *Warm call transfer process update*: to improve the procedure for transferring calls between contact center agents to ensure the caller's "digital breadcrumbs" are linked and available throughout all touchpoints
3. *Automated post-call summarization*: to automate the post-call note taking activity that is currently done manually by the agents

### E. The Solution

Technology	Purpose
AWS Connect	An omni-channel contact center as a service (CCaaS)
AWS Bedrock	A serverless, fully managed service that will generate post call summaries. It will give us access to customizable pre-trained foundation models. Under the hood, Amazon Transcribe will convert the speech to text. Post-transcription, Amazon Bedrock applies generative AI models to distill the transcribed text into summaries, focusing on key points and takeaways.
Amazon Lex	A service that uses automatic speech recognition (ASR) and natural language understanding (NLU). With Connect + Lex we can design a sophisticated Interactive Voice Response (IVR) that can understand customer intentions, respond in a conversational manner, and make business decisions like credit line increases, enhancing user experience and taking pressure off agents.

## F. The Business Outcome

After a successful implementation of the proposed solutions, Crimson can expect an improved business outcomes, specifically in the following areas:

- Increased quality of service to customers by having an improved IVR system with a functional voice command that can process certain transaction requests start-to-finish
- Reduced call volume pressure to be handled by agents by improving the first line of defense, the IVR
- Improved customer experience (CX) by reducing the need to re-authenticate the customer and re-explain the problem during transfers between contact center agents
- Enhanced employee experience by automating a routine task which then allows employees to do more engaging work
- Reduced operating costs associated with labor cost to perform after call work (ACW) task
- Having high quality of post call notes for future use of training and further business capability enhancements

## PART 1. BUSINESS REQUIREMENTS

### A. Business Context

Contact center work has historically been a stressful job. Thirty-one percent of agents industry-wide are looking for a new job and of that population, only 60% are looking at another contact center<sup>1</sup>. Crimson agents are burned out and it is becoming more difficult to attract new ones. A recent industry survey reports 47% of contact center managers say turnover is their biggest problem<sup>2</sup>. We know the problem is complex, but factors contributing to the attrition story include:

- Quiet quitting
- Demand for remote work and flexible scheduling
- Low unemployment rates—ease of finding alternative employment

The average contact center attrition rate industry wide was 38% in 2023, up from 26% in 2018. An acceptable turnover rate goal post-pandemic is 30%<sup>3</sup>. Crimson's is at 40% as shown in Fig 1.

Month	Departing Agents	Average Agents
January	15	405
February	10	390
March	11	385
April	12	376
May	11	366
June	12	355
July	10	349
August	12	341
September	9	330
October	14	322
November	15	310
December	10	300
	Total Departing Agents <b>141</b>	Average Agent Count <b>352.5</b>
		Agent Attrition Rate <b>40%</b>

Figure 1. Crimson Contact Center Attrition Rate

According to a recent survey, 57% of customers say customer service has gotten worse in the last year<sup>4</sup>. Since the pandemic, the Crimson customer has migrated to conducting business remotely. Due to this change in customer habits, our contact center volume has increased from 250,000 calls per month pre-pandemic to 300,000 calls per month. The consequences of this increase in volume can be measured in the following areas:

<sup>1</sup> NICE, "Contact Centers—From Attrition to Retention". <https://www.nice.com/websites/prepared-agents-wem/files/2022-NICE-WFM-Global-Survey.pdf>. 19 February 2024.

<sup>2</sup> Mike Desmarais. "Call Center Turnover". SQM, 19 February, 2024. <https://www.sqmgroup.com/resources/library/blog/call-center-attrition-rate>

<sup>3</sup> Mike Desmarais. "Call Center Turnover". SQM, 19 February, 2024. <https://www.sqmgroup.com/resources/library/blog/call-center-attrition-rate>

<sup>4</sup> NICE. "7 Critical CX trends for your 2024 strategy". 2024. <https://get.nice.com/forrester-2024-Trends>

- Our current full time staff level of 300 agents cannot handle the increase in call volume and consequently average hold times (AHT) have increased from an average of 400 seconds to 600 seconds
- Average Hold Time (AHT) has led to an increase in abandonment rate—customers hanging up—from 3% pre-pandemic to 12%
- More than half of callers are pressing 0 to get out of the deep menu of options and landing in the wrong department leading to additional transfers and more authentication

Agent performance is partly measured by how many calls are worked each hour. Our agents are incentivized to take the next call quickly, which contributes to inadequate post-call note taking. This task can also contribute to agent fatigue and because there is no incentive to be detailed or accurate, the quality of these notes is inconsistent. When post-call notes are inadequate or inconsistent, the next interaction will require the customer to repeat themselves. And 69% of customers report that it makes them very or somewhat frustrated when agents are unfamiliar with the history of previous calls<sup>5</sup>.

Additionally, our customers have become more comfortable conducting business in an automated fashion and foot traffic to our branches have steadily decreased in the last 3 years. In 2023, the average number of bank branches fell for the 14th year in a row<sup>6</sup>. Since the pandemic, Crimson has reduced its branch footprint by 10%. Customers simply do not go to the bank anymore.

We have spoken with our customers and our agents. Our customers report the number one reason they close their accounts is poor customer experience. We have a vicious cycle of poor agent experience feeding into decreased quality of customer experience and therefore contact center modernization can no longer go unaddressed.

Customer demand to move through integrated lines of business in an omni-channel manner is becoming more important. This is why we are beginning the initiative to give our contact center agents a better way to service customers on their channel of choice. We will implement AWS Connect omni-channel CCaaS beginning with the telephony channel and IVR replacement and future iterations will focus on additional channels.

## B. As-Is State

Currently, our agents use Salesforce CRM for contact management in addition to the legacy phone platform for dialing and transferring functions in their day to day work. Salesforce does not currently contain any balance or financial information—only customer contact data like name, address, phone, email, notes, and follow up tasks for agents. The customer contact data in Salesforce is currently populated by a Snowflake API integration and provides up-to-date customer contact profiles.

There are 15 other bank applications that agents could potentially touch given the nature of the specific transaction, customer request, or agent specialty involved in the call. The current phone system is

<sup>5</sup> Nuance Communications. “Happy Agents = Happy Customers”. 7 July 2021.

[https://www.nuance.com/content/dam/nuance/en\\_uk/collateral/enterprise/white-paper/wp-nuance-happy-agent-ai-en-uk.pdf](https://www.nuance.com/content/dam/nuance/en_uk/collateral/enterprise/white-paper/wp-nuance-happy-agent-ai-en-uk.pdf). 20 February 2024.

<sup>6</sup> Orla McCaffrey. “PNC, U.S. Bank closed roughly one in 10 branches in 2023”. 15 December 2023.

<https://www.americanbanker.com/list/pnc-u-s-bank-closed-roughly-one-in-10-branches-in-2023>. 20 February 2023.

independent of these bank applications and there is no integration between the phone system and the bank applications that deal with customer financial data.

Figure B8 shows the current application, account, and transaction data flow at Crimson. In a recent modernization project, Crimson customer data has been consolidated from the Application Mainframe, Account Mainframe, and Transaction Mainframe into Snowflake. Our IVR will be interacting with a few of these systems via APIs to perform business tasks for callers as we will detail in Part 2. Existing data flow components are outlined in the table below.

Existing Component	Description and Purpose
Consumer Credit Application	External facing website to allow customers to apply for a credit card.
Credit Decisioning System	This system is programmed with underwriting strategy flows based on product code and channel. The application intakes the customer application input details as well as the response details from outside vendors on fraud, Know Your Customer (KYC), and credit bureau attributes and returns an application decision. The initial credit limit assignment is made based on these details.
Card Delivery and Onboarding system	After a customer is approved for a card, the card delivery and onboarding system will issue the plastic and send all of the necessary disclosures and marketing materials to welcome the customer. It will also be involved in the activation process of the card.
Payment Authorization System	When a customer uses their credit card, the authorization system will have to be called to approve or deny the payment request. The components in this process are related to checking balance and a payment fraud check.
Credit Line Management System	This system will manage the criteria for credit line increases (both proactive and reactive) and decreases. The criteria around these actions has been defined by the credit risk business unit.
Legacy Mainframe System	There are three mainframes that contain different types of customer data: application mainframe, account mainframe, and transaction mainframe.
Snowflake	As part of the recent modernization efforts, a Snowflake database has been set up in the cloud to hold all customer data including application, account, and transaction.
Salesforce	Salesforce is Crimson's CRM. Our contact center agents use Salesforce to manage customer contacts.
Outside vendors	Fraud/KYC vendor: Our fraud and KYC Credit Bureau: One of the three main US Credit Bureaus (Experian, Equifax, or TransUnion)

The As Is process flow for IVR, Warm Call Transfer, and Post-Call Summarization can be found in the Part 1 Appendix. The table below describes the current state of each of the three key areas of improvements.

Category	Current State
IVR	Today this system is a phone menu that allows callers to interact with the system using keypad inputs. Upon selecting a series of numbers on the keypad, callers are routed to the corresponding department where they will be assisted by the next available agent. The IVR itself cannot process or perform any business tasks, and it currently has 0% containment rate.
Warm Call Transfer	<p>Our high zero out rate has led to agents accepting inappropriate calls for their department focus. When a caller presses 0—as more than half of them do—the call routes to a general queue and is picked up by the first available agent. Many times the customer request deals with a subject outside the agent’s department. The agent has to find the correct department and transfer the call. This process leads to the following list of issues:</p> <ul style="list-style-type: none"> <li>• Case creation is not automatic—a caller could be touched and then transferred without a case being opened</li> <li>• 60% of the time, our caller is “cold” transferred to another agent forcing the customer to re-authenticate and re-explain their problem</li> <li>• The agent is motivated by calls-per-hour, disincentivizing them to spend the time to warm transfer the call</li> </ul>
Post-Call Summarization	After each completed call, the agent is required to write a post-call summary outlining the conversation in great detail. This after call work (ACW) takes an average of 5 minutes to complete. There is pressure on the agent to get to the next call leading to inaccurate and insufficient notes.

### C. To-Be State

In the to-be state, our agents will continue to use Salesforce. Within the Salesforce screen, the agent will also be viewing AWS Connect Contact Control Panel (CCP). This integration will match and pull the caller profile. Salesforce is populated with up-to-date customer contact information. However, implementing AWS Connect and integrating it with Salesforce will not reduce agent swivel chair activity in tasks that involve customers’ specific banking needs.

Category	Future State
IVR	The new IVR will be an automated conversational agent powered by Amazon Lex. In addition to authenticating the customer’s natural speaking voice, the voiceID will match the customer against known fraudsters. The IVR will be

	given business transaction capabilities in certain areas like credit line increases to provide customers a way to complete transactions and requests without speaking to an agent. The IVR will pass the voiceID authentication to an agent and give a fraud risk score based on a fraudster voice match attempt.
Warm Call Transfer	<p>We will introduce the concept of “digital breadcrumbs” that will allow the customer’s call progress and authentication to be linked for each touch point. The new process will automatically open a case for every single touch inside Crimson’s contact center starting with the IVR and continuing for each agent transfer. This will eliminate the negative CX impact of a cold or blind transfer and maintain connectivity throughout the experience. The records for a contact are linked together through the contactId fields: initial, next, and previous. AWS Bedrock will summarize notes after each transfer.</p> <p>Crimson's call transfer protocol mandates a "warm" transfer procedure. That means that it is the agent's responsibility to put the customer on hold and explain the situation to the next agent—this will not change. Sometimes this handoff does not happen for several reasons: agents are in a hurry, phone malfunctions, or transfer button sequence accidents. Numerous approaches could address this issue, such as offering bonuses to agents for meticulously executing "warm" transfers. However, we intend to address this problem through technology. The solution we will implement is the AWS Connect native call transfer process. This involves “digital breadcrumbs” that will string together a customer journey, preventing the mistake of a “cold” transfer accident. The agent procedures manual will still mandate that a customer hand over a caller to the next agent by explaining details, but AWS Connect provides a failsafe.</p>
Post-Call Summarization	Post-call note summaries will be automated by AWS Bedrock after AWS Transcribe converts the voice call to a text transcript. The agent will save 3 minutes of after call work (ACW) on average. Notes will now be accurate and homogenized across agents.

## Functional Requirements

The functional requirements are approached from three different personas within Crimson Contact Center Operation: Contact Center Agent, Contact Center Supervisor, and Caller.

Contact Center Agent	Details	Goal
 Helpful Helen	<p>She has worked as a Customer Service Representative (CSR) for Crimson for the last three years.</p> <p>She is also pursuing an undergraduate degree in Management.</p> <p>She has a 4-year-old son and previously worked as CSR for another financial institution.</p> <p>She is well-versed in Crimson products.</p>	<p>She needs to know how to perform operations using the new Contact center, such as call transfers and various CRM requests.</p>

Contact Center Supervisor	Details	Goal
 Supervisor Sam	<p>He has been working with Crimson Customer Service for the last seven years. He was hired as a CSR after receiving his high school diploma and was promoted to a manager role four years ago.</p> <p>He holds an Undergraduate degree in Finance.</p> <p>He is single and loves baseball. He is experienced with Crimson CRM software.</p>	<p>He needs to know how to perform advanced operations using the new Contact center, such as follow-ups and agent performance evaluations, adherence to talk scripts evaluation, compliance checks with sensitive data collection practices, etc.</p>

Caller	Details	Goal
 Dialing Danielle	<p>She is a single working mom in her thirties, juggling two jobs to provide for her two young daughters.</p> <p>She is a high school dropout, works as a maid for a local service, and works as a cashier in a grocery store during the evening hours.</p>	<p>She needs to know how to interact with the new Crimson Contact Center, such as setting up her voice ID for authentication, inquiring about her balance, making a payment, disputing a charge, requesting a credit line increase, etc.</p>

The functional requirements are decomposed into the following Epics and User Stories. The Acceptance Criteria for each user story using the Scenario-Given-When-Then framework can be found in the Part 1 Appendix.

- **Epic #1: Interactive Voice Response (IVR)**
  - User Story #1.1 As a contact center agent, I would like the IVR to resolve customer requests from start to finish and use Voice ID for authentication. This would allow completing basic tasks without a live agent.
  - User Story #1.2: As a caller, I want to get my balance information using IVR. This will allow me to use the service outside business hours like nights, holidays, or weekends.
  - User Story #1.3: As a caller, I want to make a payment from my previously enrolled payment bank account using IVR. This will allow me more flexibility to pay my bill on time.
  - User Story #1.4: As a caller, I want to Request a Credit Limit Increase using IVR. It will limit access to confidential data.
- Epic #2: Warm Call Transfer
  - User Story #2.1: As a contact center supervisor receiving a transferred call from another agent, I want to see the caller's identity and a transcript of their previous conversation. It will improve customer experience and CSR productivity.
- Epic #3: Post-Call Summarization
  - User Story #3.1: As a contact center agent, I want the post-call summary to be automated and available for review after the call ends. It will free up CSRs time to serve more callers.

#### D. Non-functional Requirements

These non-functional requirements are essential for operational effectiveness: availability, customizability, interoperability, maintainability, scalability, security, and usability. For that reason, we would require the proposed solution to provide the following functions:

- *Availability*: To provide customers with contact center access 24 hours a day. AWS Connect ensures high availability of 99.9% uptime<sup>7</sup>
- *Customizability*: To meet the evolving needs of Crimson's customers and business objectives
- *Interoperability*: To exchange data with existing Snowflake databases through API integration. As a member of AWS Partner Network (APN), Snowflake has a suite of integration tools
- *Maintainability*: To keep in Payment Card Industry (PCI) compliance with system updates and patches without significant downtime. The time it takes to get the system up and running after an issue will also be minimal
- *Scalability*: To accommodate fluctuations in the contact center volume and agent activities. The system will have elasticity to scale up or down quickly, as needed
- *Security*: To protect data, AWS protects global infrastructure that runs the AWS cloud. Crimson is responsible for controlling the content, security configuration and management tasks
- *Usability*: To utilize speech recognition and language understanding with a fully managed system that is easy for staff to use

## E. Business Benefit Justification

As part of Crimson's contact center modernization strategy, we have gathered the following key metrics to measure success. They include an increase in: IVR containment rate, first contact resolution, net promoter score, and customer satisfaction, as well as a decrease in: average handle time, zero out rate, and after call work. The table below depicts Crimson's 2023 fiscal year metric as well as the goal at the end of contact center modernization implementation. The goal is based upon banking industry standards:

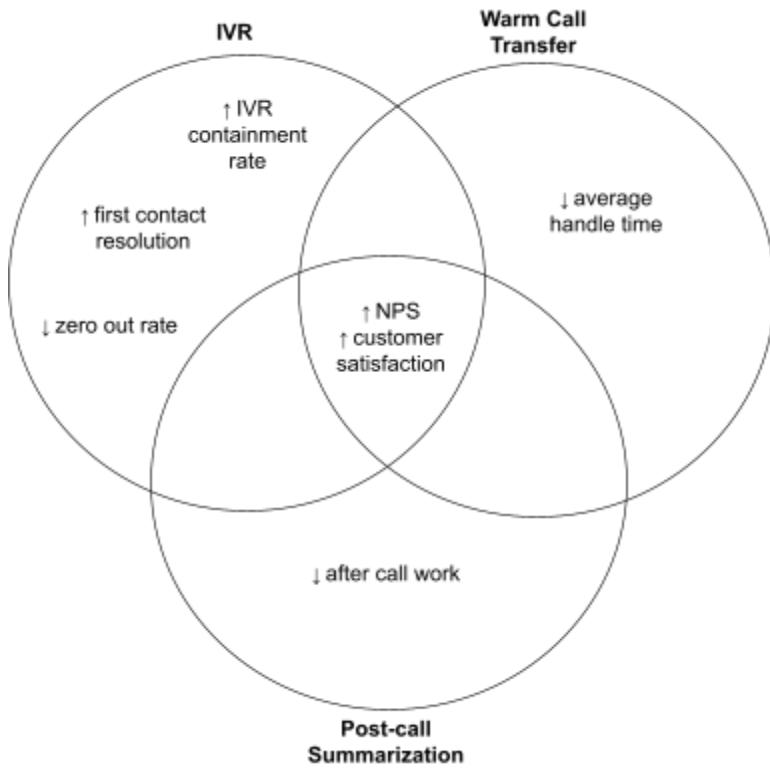
Metric	Per 2023 FY	Goal
IVR Containment Rate	0%	75%
Average Handle Time (AHT)	600 seconds	300 seconds
Zero Out Rate	55%	10%
First Contact Resolution	50%	75%
After Call Work (ACW)	300 seconds	0 seconds
Net Promoter Score	10	60
Customer Satisfaction	55%	85%

Additionally, the following Venn diagram illustrates the relationship between each key metric and issue category outlined in the modernization strategy:

---

<sup>7</sup> Amazon Web Services. (2024) *AWS Well Architected Framework*.

<https://docs.aws.amazon.com/wellarchitected/latest/sustainability-pillar/sustainability-as-a-non-functional-requirement.html>. 19 February 2024.



AWS Connect, as mentioned, provides an omni-channel contact center as a service. The service comes inherently with a set of capabilities including omni-channel warm transfers that create digital breadcrumbs. In the case of passing a caller agent-to-agent or agent-to-supervisor, cold or blind transfer mistakes are eliminated because the receiving party sees the automated summary notes from the previous interaction. This capability has the potential to reduce the average handle time by half. Each agent can provide service to twice as many customers as they do today.

AWS Bedrock comes native with post-call summary capability via speech-to-text function offered by Amazon Transcribe. Today, our agents need 3 minutes on average to complete this summary that is inconsistent in quality. At Crimson's current monthly call volume of 300,000 and after call work at 90,000 hours per year, this solution can save about US\$116,000 in labor costs per month at \$19/hr wage. Furthermore, the quality of these summaries will increase, as will employee's satisfaction.

AWS Lex is the technology solution for the IVR category. We expect this to be the most complex to implement, specifically in the testing stage. Hence, we would like to tackle this in the third and final phase of the project. On the other hand, it is associated with the most key metrics: IVR containment rate, first contact resolution, and zero out rate. We have the potential to reduce our monthly call volume from 300,000 to just 75,000 based on our goal of 75% containment rate alone. If Crimson would like to keep the same ratio of agents to calls, Crimson would have the option to reduce staff from 300 to just 75 people. And it costs up to 48x less to resolve a customer request within an IVR than with a live agent<sup>8</sup>.

<sup>8</sup> Brooke Isacs. "Interactive Voice Response (IVR): How It Works, Benefits & Best Practices for Your Contact Center". <https://www.twilio.com/en-us/blog/ivr-what-it-is-and-how-it-benefits-contact-center>. 27 November 2023.

All three promises will affect both NPS and customer satisfaction in a positive way. Similarly, either one of them has the potential to break the vicious cycle currently happening at Crimson's contact center operation. Agents who are empowered by the system and feel supported by their colleagues will provide higher quality of service to customers. Subsequently, on the receiving end, customers will receive better service, thus increasing their customer experience. Happy employees, happy customers.

Implementation of this project requires senior leadership buy-in and commitment from both technology and business stakeholders. After securing their buy-ins and commitments, our rollout will begin with a pilot encompassing all three promises: Warm Call Transfer, Post Call Summarization, and IVR. Upon successful implementation, we will expand to include additional groups of agents.

Based upon our preliminary research, it will take the development team approximately two 2-week sprints to gather requirements and configure the initial business logic into our non-production environment. Then, it will take another two 2-week sprints to complete user integration testing prior to production rollout. With this estimation and assumptions that the project plan is on track, Crimson can begin to analyze whether the new technology implementation is trending towards the projected outcome in as early as two months.

## PART 2. TECHNICAL SOLUTION

### A. Architectural Approach

Crimson's existing infrastructure is hosted on-premises, which is common for legacy systems. The current architecture consists of several interconnected components including:

- **Private Branch Exchange (PBX):** Handles the incoming and outgoing calls from the customers and the agents
- **Computer Telephony Integration (CTI):** This system integrates with Salesforce, providing agents with customer information and call history on their computers
- **Automatic Call Distributor (ACD):** Provides a basic call queue and distributes calls to available agents, without any skill-based routing or prioritization features
- **Interactive Voice Response (IVR):** A simple menu system that primarily directs customers to different departments or agents based on number presses, offering no self-service options
- **Logger:** Records and keeps track of calls details for performance analysis and quality assurance
- **Application Servers:** Hosts and runs the applications used by the agents. These applications interact with Crimson's existing APIs providing integration with our banking systems
- **Call Detail Records (CDR) Database:** Stores data records generated by the logger

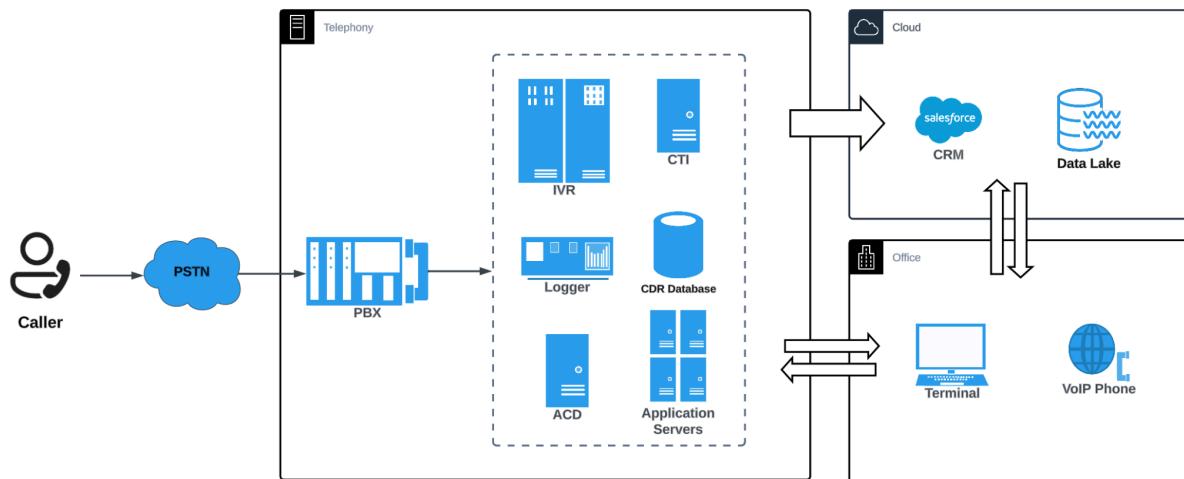


Figure 1. As-Is Architecture

With regards to IVR in particular, the current infrastructure does not support communications between multiple systems. For every caller request, the agent will still need to interact with multiple systems creating a 'swivel chair' situation. The Application Servers host the applications that interact with Crimson's existing APIs.

At the conclusion of Crimson's existing infrastructure analysis and using the three promises as a consideration, our architectural approach arrived at suites of services offered by AWS (Amazon Web Services) due to a number of reasons as later explained in the Software Solution section. The table below maps each promise with the suite of solutions that will be used.

Promise	Solutions
IVR	Amazon Lex, Voice ID
Warm Call Transfer Business Process	Contact Lens (AWS Transcribe, AWS Bedrock), ContactID
Post-Call Summarization	Contact Lens (AWS Transcribe, AWS Bedrock)

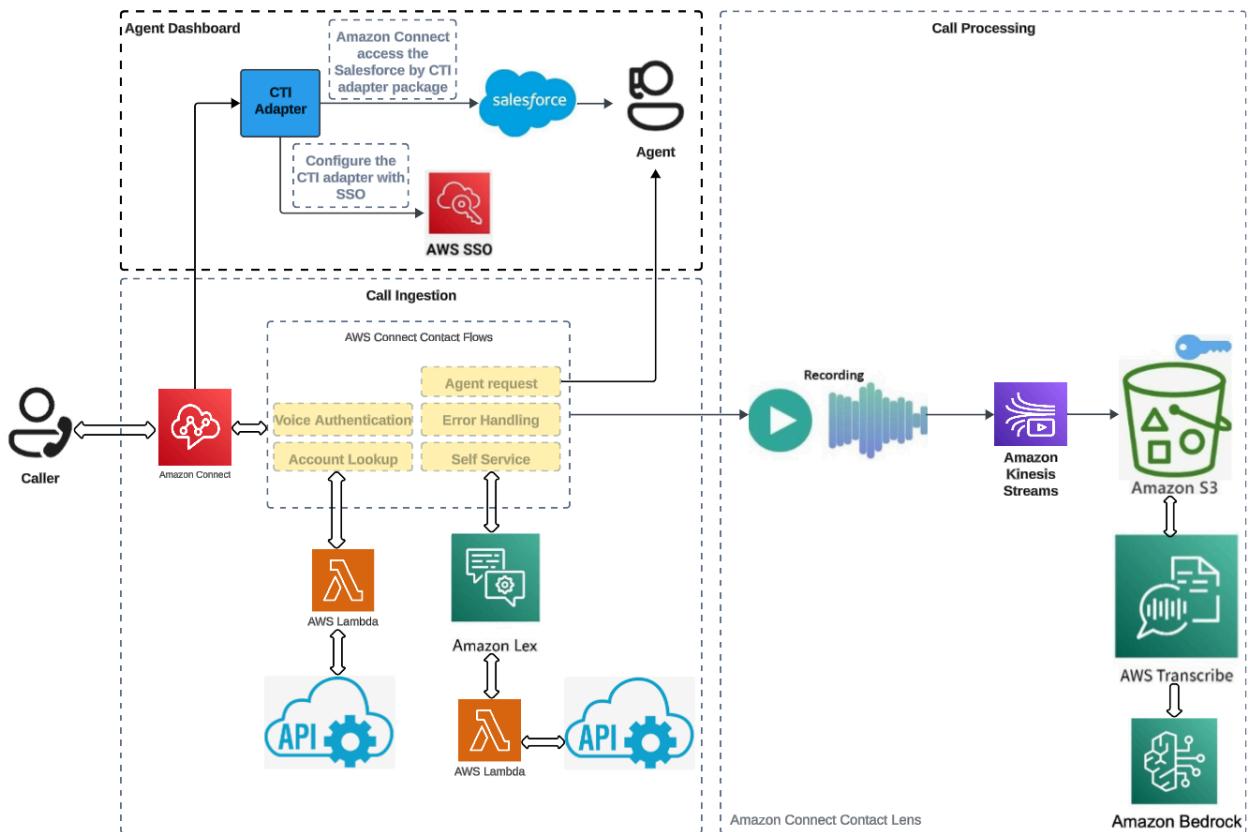


Figure 2. To-Be Architecture

There are three important components of the To-Be Architecture diagram above:

I. *Call Ingestion*

1. Callers dial the Crimson contact center line to interact with the IVR in Amazon Connect.
2. Amazon Connect Voice ID sets up a voiceprint for first time callers or performs voice authentication for repeat callers for added security.
3. Upon successful voice authentication, callers can proceed to IVR self-service functions, such as checking their account balance, making a payment, or request a credit line increase. Amazon Lex handles the voice intent analysis.
4. An API call through the Lambda function is used to look up the caller's account in Crimson's database.

5. We will retrieve the caller's balance information, post their payment, or process their credit line increase request by calling the three relevant Crimson's APIs.
6. Amazon Lex converts the API response to voice.
7. If a caller requests to be connected to an agent, the agent will be presented with the customer's information and IVR interaction details on their agent dashboard.

*II. Agent Dashboard (Integration with Salesforce, the existing CRM software)*

1. Amazon Connect CTI Adapter is used to provide a WebRTC browser-based Contact Control Panel (CCP) within existing Salesforce Customer Relationship Management (CRM) system (see [Figure B8](#)).
2. Salesforce will be set up as the Identity Provider, and Single Sign-On (SSO) is configured via SAML to allow contact center personnel to log into Salesforce, using the same credentials for automatic authentication into AWS Connect.

*III. Call Processing (Contact Lens)*

1. In Amazon Connect, we capture customer audio during an interaction with the contact center by sending the audio to a Kinesis Stream.
2. Call recordings are stored in S3 storage.
3. Amazon Transcribe is used to generate transcripts.
4. Amazon Bedrock will process transcripts to generate conversation summaries.

## B. Software Solution

We chose AWS Connect because it has all the functionalities we want today as well as more capabilities that we may want to implement in the future. In addition to the functional requirements, from the non-functional requirements aspect, it is important for Crimson to have technology solutions that are highly available, customizable, interoperable, maintainable, scalable, secure, and usable. AWS Connect will integrate well with our existing architecture and our IT integration teams are already familiar with the platform.

AWS Connect CCaaS is accessed through a browser, which our agents will view through Salesforce. From the agent's and caller's perspectives, there won't be any difference than if the solution was on-premises. Moreover, it has native connections to Salesforce, our current CRM, which means configuring the integration would be a rather lightweight effort, without extensive customization. Additionally, AWS Connect scored the highest on services and support, integration and deployment, and evaluation.<sup>9</sup>

AWS Connect manages Telephony infrastructure which will take care of core components such as carrier connections, redundancy, and routing<sup>1</sup>. The subsequent sections outline each of the three promises along with detailed description of the proposed software solutions.

### 1.1 IVR with Amazon Lex and Voice ID

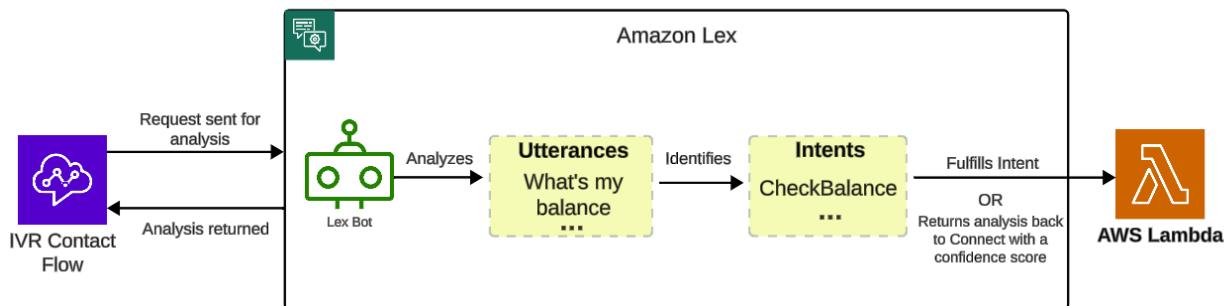
The IVR is designed using Amazon Connect Flows and it uses the following services:

---

<sup>9</sup> Gartner, "AWS Connect Alternatives: Competitors and alternatives to AWS Connect ".  
<https://www.gartner.com/reviews/market/contact-center-as-a-service/vendor/amazon-web-services/product/amazon-connect/alternatives>. 3 March 2024.

- **Amazon Lex**, which provides voice-based intent analysis to determine the underlying intention behind customer interactions.
- **AWS Lambda**, which connects various of Crimson's custom APIs and databases.

The diagram below illustrates what happens when a caller interacting with Crimson's new IVR utters a request and the request is processed by Lex for analysis. Upon receiving the request, Lex will analyze it to determine the caller's intent as well as its confidence score (0.00 to 1.00)<sup>10</sup>. Depending on the configuration, once an intent has been identified, Lex can either fulfill the request by executing a Lambda function or return the identified intent with its confidence score back to the flow for further processing, in which case, the flow will determine how to handle the request.



*Figure 3. Intent Analysis with Amazon Lex*

One key enabler to implement the IVR solutions is *User Authentication* which we will be implementing using AWS Connect Voice ID. It needs 30 seconds to create the initial enrollment voiceprint and 10 seconds of a caller's voice to authenticate their identity. If there is not enough net speech to perform the voice authentication, the IVR will ask the caller some additional questions, such as their first and last names, until it has collected enough net speech. In the event it cannot successfully authenticate the caller's voice, it will fall back to a dual-tone input to obtain the caller's credentials, such as the last four digits of their credit card or social security number.

We will set up voice authentication in Contact Flow by adding the “Set security behavior” contact block and configuring the authentication threshold (see [Figure B1](#)). Then, we will also configure the “Check security status” contact block, which determines whether the user has been successfully authenticated (see [Figure B2](#)). It will also demonstrate the results that may return if the caller is not successfully authenticated, including “Not authenticated,” “Inconclusive,” “Not enrolled,” “Opted out,” and “Error.”

<sup>10</sup> AWS. *IntentConfidence*. Amazon Lex Developer Guide. [https://docs.aws.amazon.com/lex/latest/dg/API\\_runtime\\_IntentConfidence.html](https://docs.aws.amazon.com/lex/latest/dg/API_runtime_IntentConfidence.html)  
Accessed March 20, 2024.

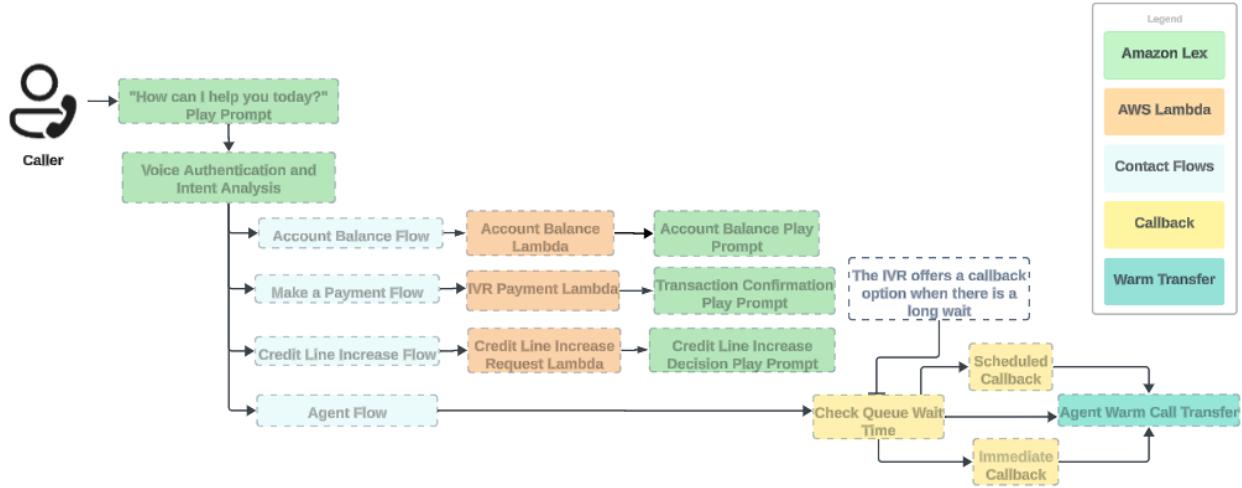


Figure 4. IVR Process Flow

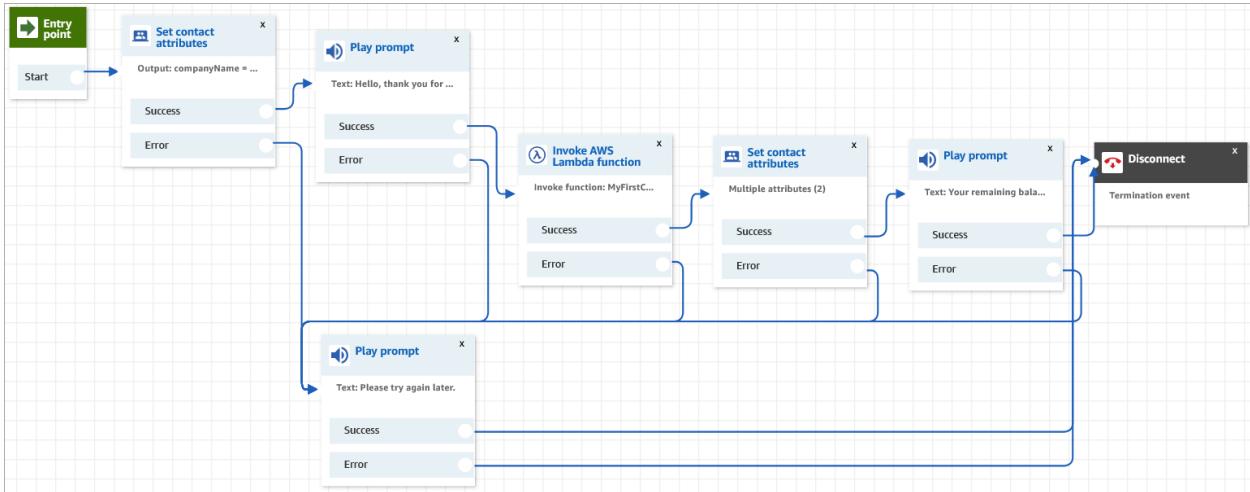


Figure 5. Contact Flow Configuration

After capturing the caller's intent at the start of the call, the IVR activity is logged using a “Set contact attribute” contact block, which prompts the `$.Lex.SessionAttributes.transcript`. The Lambda function then uses this transcript to build the interface. When the customer's call is routed out of the IVR to an agent, the agent will be able to see the IVR transcript (see [Figure B4](#)). By default, we will set this transcript to be summarized by Bedrock, which is what the agent will see. They will also have the option to expand the summary to view the full transcript if necessary.

To store the values returned as contact attributes and then reference them, we use a Set contact attributes block in the flow after the Invoke AWS Lambda function block (see [Figure B3](#)). We set the Destination Attribute to `MyAccountId`, and set the attribute to `AccountId`, and do the same for `MyBalance` and `Balance` (see [Figure B5](#)).

## 1.2 Warm Call Transfer Business Process

In the to-be state, all events that happen during a call will be associated with a ContactID—an out-of-the-box feature of AWS Connect. When the call is transferred, it will retain the original ContactID and the Previous ContactID<sup>11</sup>. In this way, the VoiceID authentication and the call transcript and summary are linked together as shown in Figure 6. The customer call journey will be connected and passed from AWS Connect via the CTI Adapter to Salesforce in the event of any transfer throughout Crimson.

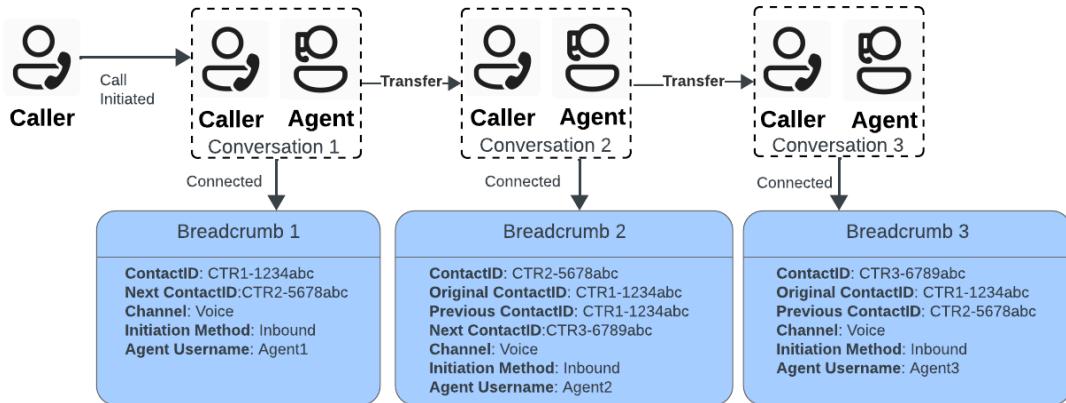


Figure 6. Warm Call Transfer Digital Breadcrumbs

[Figure B11](#) shows the transcript option that will flow from one agent to another in the case of a transfer. “Agent 2 receives a call transcript at the time of accepting the conference/warm transfer call from Agent 1. The transcript includes everything said by Agent 1 and the customer, from the moment Agent 1 accepts the call, until Agent 1 leaves the conference/warm transfer portion of the call. The transcript includes the flow (transfer/queue flow) prompt messages.<sup>12</sup>” AWS Bedrock will be summarizing this transcript for the contact notes as shown in [Figure B11](#) as part of call summarization discussed in section 1.3.

Figure 7 shows how the data will flow during the transfer process and is written to S3. The yellow arrow signifies that at the end of each caller event, the call artifacts will be linked to the customer profile in Salesforce. Agents will have a unified view of authentication and notes in the Contact Control Panel within Salesforce without switching between systems—all of this is made possible with the Salesforce CTI Adapter.

Sensitive Personally Identifiable Information (PII) will be automatically redacted from recordings and summaries for security purposes. See [Figure B9](#) and [Figure B10](#) for more details on the call summary and PII redaction.

<sup>11</sup> AWS. Transfer Calls. <https://docs.aws.amazon.com/connect/latest/adminguide/transfers.html>. Accessed March 20, 2024.

<sup>12</sup> AWS. Enable Amazon Contact Lens. <https://docs.aws.amazon.com/connect/latest/adminguide/enable-analytics.html>. Accessed March 22, 2024.

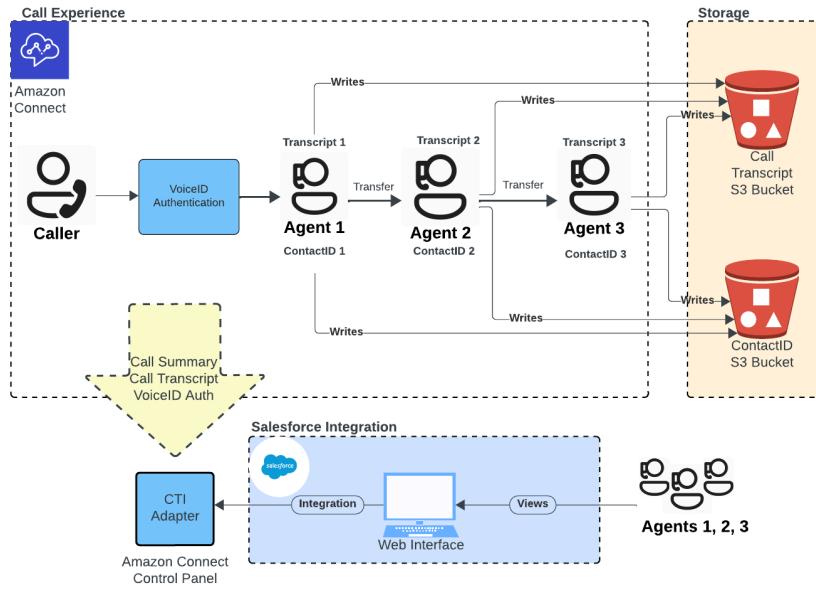


Figure 7. Warm Call Transfer Process Flow

### 1.3 Post-Call Summarization with Transcribe and Bedrock

Crimson doesn't currently have the capability to automate agents' after call work (ACW). This is a manual process that produces varying quality of post-call notes. In order to solve this problem, we will use the built-in service through AWS Connect called Contact Lens. We will update the agent procedures to reflect that post-call notes will be automated in the to-be state.

To summarize a transcript, Contact Lens for AWS Connect uses AWS Bedrock under the hood. To enable call summarization, we will add a “Set recording and analytics behavior” block to a Contact Flow and configure it to enable Contact Lens for voice, chat, or both (see [Figure B6](#)). With call summarization, Contact Lens identifies key parts of the customer conversation, assigns a label (e.g., issue, outcome, or action item), and displays a summary that can be expanded to view the full call transcript.

Figure 8 illustrates how the call data will flow under-the-hood from the voice call to Salesforce for agent view via the CTI Adapter.

We will be writing the call summaries from S3 to Snowflake via a secure, built-in integration between the two<sup>13</sup>. We will use these stored summaries for our own future analytics and training purposes. Contact Lens also provides analytics tools that we will be exploring in future iterations.

<sup>13</sup> Snowflake. *Configuring a Snowflake storage integration to access Amazon S3*. <https://docs.snowflake.com/en/user-guide/data-load-s3-config-storage-integration>. Accessed March 20, 2023.

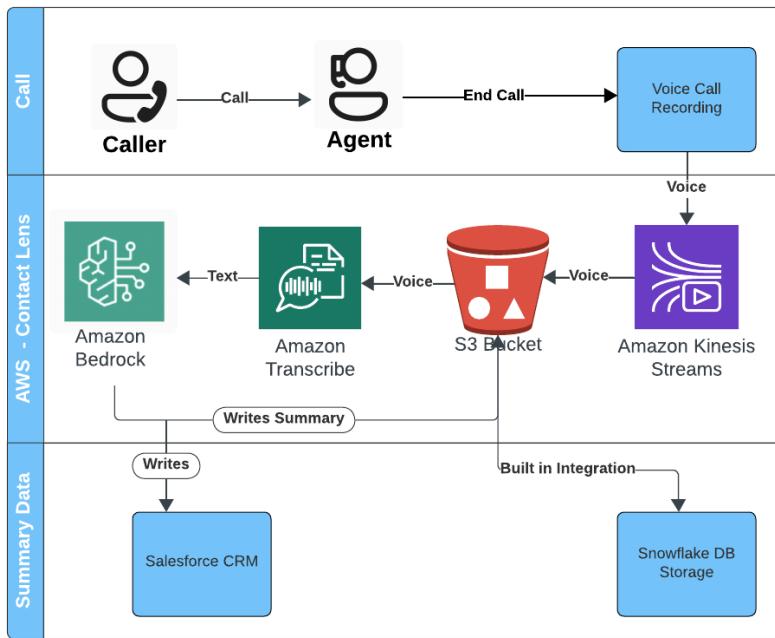


Figure 8. Voice to Summary Data Flow

### C. Integration with Other Applications and Data Sources

Salesforce serves as our current Customer Relationship Management (CRM) platform and is the repository for all customer-related contact data and case management. It features integration capabilities with AWS Connect, ensuring a continuous integration process that minimizes downtime and disruption for our customers.

#### AWS Connect Integration with CRM

Integration between AWS Connect CTI Adapter and Salesforce will be through a Streams API<sup>14</sup>, which our developer team is customizing for our needs<sup>15</sup>. The systems required for agents to perform their job will be streamlined by integrating the dialing and call transferring mechanism into the Salesforce environment via the AWS Connect Contact Control Panel (CCP). The agents will continue to use their Salesforce Lightning Console with CCP embedded—all in one screen. Figure 9 shows the integration architecture between AWS Connect and Salesforce. This integration will reduce the number of systems agents need to touch by one. Notes, summaries, tasks, and customer profiles will be consolidated into this integrated Salesforce environment with a Single Sign On (SSO). In future iterations, agents will manage chat and email channels via the integrated CCP.

<sup>14</sup> AWS. AWS Streams API Github. <https://github.com/amazon-connect/amazon-connect-streams>. Accessed March 20, 2024.

<sup>15</sup> AWS. Amazon Connect CTI Adapter v5 for Salesforce Lightning Setup and Installation Guide.

<https://connect-blogs.s3.amazonaws.com/Amazon+Connect+Salesforce+CTI+Adapter/Amazon+Connect+CTI+Adapter+for+Salesforce+Lightning+-+Setup+and+Installation+Guide.pdf>. September 2020.

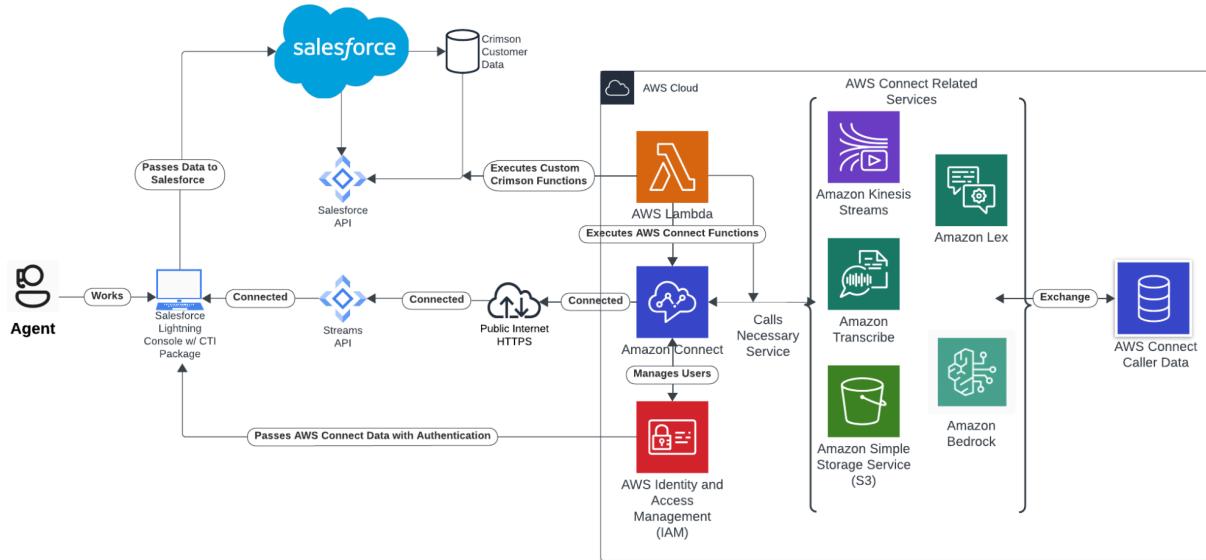


Figure 9. AWS Connect to Salesforce Integration

#### D. Data Design and Management Data Sources

There are two categories of data involved in our solution: *Caller Data* and *Crimson Customer Data*. As illustrated in the Figure 10 below, the IVR will be interacting with both Caller Data and Crimson Customer Data and will be customized by our team. The Warm Transfer Business Process and Post-Call Summarization are contained within AWS Connect and deal only with Caller Data housed at AWS. The important distinctions between these two types of data are described below.

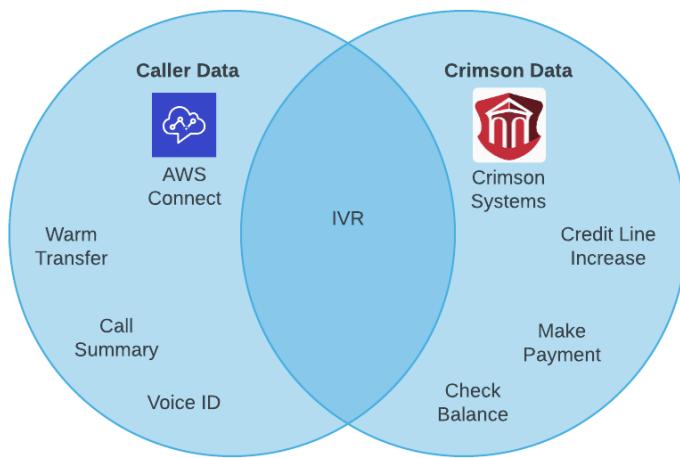


Figure 10. Data Category Interaction Venn Diagram

#### 2.1 Crimson Data

Crimson has many existing in-house APIs and microservices that provide necessary customer functionalities to get an account balance, make a payment, or request a credit line increase. Our IVR

solution will only interact with three of these to start (GetAccountBalance, MakePayment, CreditLineIncrease). The customer data involved with these APIs are account numbers, credit scores, balances, income, social security numbers, names, and addresses.

Existing data flow components are detailed below with their description and purpose. The existing systems that the IVR will be interacting with via an API are noted below.

Existing Component	Interacting with IVR	Purpose
Consumer Credit Application	✗	-
Credit Decisioning System	✗	-
Card Delivery and Onboarding system	✗	-
Payment Authorization System	✗	-
Credit Line Management System	✓	Credit line increase request
Legacy Mainframe System	✗	-
Snowflake	✓	Retrieving balance and making a payment
Salesforce	✓	Passing VoiceID authentication
Outside vendors	✗	-

Figure 11. IVR-Crimson Customer Data and Application Interactions

## 2.2 Caller Data

When a caller reaches out to Crimson, it's important to note that they might not be existing account holders. Instead, they could be potential customers or third parties. Regardless of their status, AWS Connect captures extensive data from these interactions. This includes the caller's phone number, VoiceID match, ContactID, as well as the call's transcript and summary. Amazon Connect, via the CTI Adapter, links customer profiles to data in Salesforce by matching identifiers like phone numbers, email addresses or account IDs between the two.

When a call comes into Connect, it will attempt to match the caller data (such as phone number) to an existing contact in Salesforce. If a match is found, the contact details like name, call history, and notes will be displayed to the agent in the Contact Control Panel embedded in the CRM environment<sup>16</sup>. This allows agents to view a consolidated profile of the customer during calls containing information from both systems. New Caller Data components are detailed in Figure 12 with their description and purpose.

---

<sup>16</sup> AWS. Agent training guide for the CCP and agent workspace. <https://docs.aws.amazon.com/connect/latest/adminguide/agent-user-guide.html>. Accessed March 20, 2024.

New Component	Description and Purpose
AWS Connect CCaaS	This cloud platform will replace our current telephony and enable us to deliver on our three promises: IVR, warm transfer, and post-call summarization. It will be integrated with our CRM and the Contact Control Panel will show the caller profile details and give agents the telephony to receive, dial, and transfer calls. Associated data is stored in the cloud.
VoiceID Container	This will enable the IVR to verify customers using their voice.
AWS S3 Bucket	Caller data like call recordings and transcripts will be stored in S3.
AWS Bedrock (Contact Lens)	AWS Bedrock will provide access to machine learning models selected by AWS which will be invoked whenever a call ends and summarization is required. Bedrock is serverless and fully managed by AWS.

Figure 12. New Data Flow Components

### 2.3 Data Integration

Figure 13 details how the integration structure is managed: to illustrate the Crimson Customer Data that will be connected to the IVR in the form of APIs, the IVR business functions are shown in yellow. There are three layers: the system layer, the process layer, and the data layer. Our new IVR will be interacting with the process API layer to call existing Crimson APIs via a Lambda function in the Contact Flow to help customers complete business tasks that we have pre-defined. These will start out as making a payment, requesting a credit line increase, and checking a balance. We will be expanding these capabilities in future iterations.

REST API	Request Parameters	Response	Lambda Call	Response Type
GetBalance <sup>17</sup>	Account Number	New Balance	✓	JSON
MakePayment <sup>18</sup>	Account Number, Amount, Date	Success/Failure	✓	JSON
CreditLineIncrease <sup>19</sup>	Account Number, Income, Amount Requested	<i>Success:</i> New Credit Line Amount <i>Failure:</i> Existing Credit Line Amount	✓	JSON

<sup>17</sup> Galileo. GetBalance API Example. [https://docs.galileo-ft.com/pro/reference/post\\_getbalance](https://docs.galileo-ft.com/pro/reference/post_getbalance). Accessed March 28, 2024.

<sup>18</sup> Oracle. Make a Payment API Example.

<https://docs.oracle.com/en/industries/communications/billing-revenue/12.0/restapi/op-payments-post.html>. Accessed March 28, 2024.

<sup>19</sup> Zeta. Credit Line Management API Example. <https://docs.zetaapps.in/display/fusion/Simple+Credit+Line+Management+APIs>

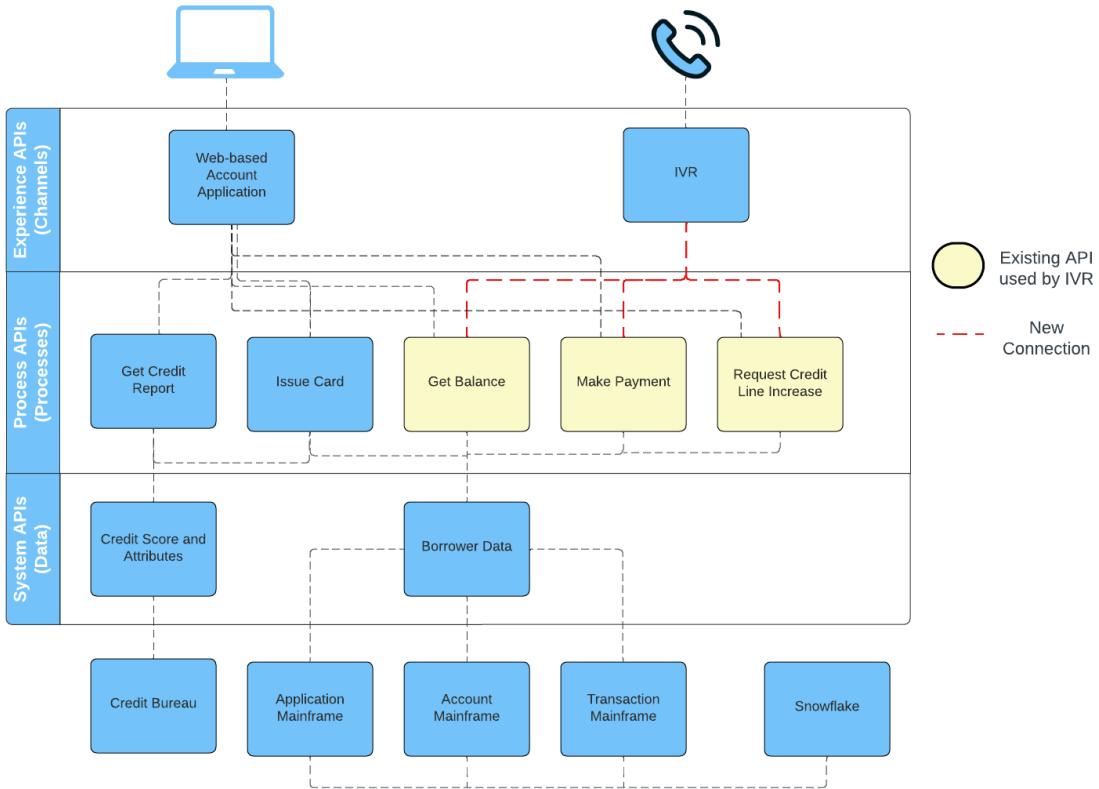


Figure 13. Crimson's API Integration

## E. Data: Three Promises

### 3.1 IVR

The APIs that the IVR will be connecting to are already in existence and currently connect to the web channel.

We will now be allowing customers to complete the process of proactively requesting an increase to their credit line via our new IVR by connecting it via a Lambda call in the process flow to the existing CreditLineIncrease API. An account's credit line amount is evaluated periodically—this process involves the Credit Line Management system ([Figure B8](#), 4.1). As shown in the figure, a persistent connection between Crimson and the Credit Bureau is maintained to allow for an up-to-date exchange of status. On a monthly basis, Crimson and the Credit Bureau exchange information on a particular customer and the decision is made to either increase or decrease the credit line of an account as defined by the Credit Risk business unit's policy. In the case of a proactive increase request, the Credit Bureau is called by the Credit Line Management system and retrieves up to date details to approve or deny the request.

The two other business task functions that the IVR will have are retrieving an account balance and making a payment. As shown in Figure 13, the APIs we will use for these business functions are already in existence.

### 3.2 Warm Transfer Business Process Data

The new warm transfer business process is made possible with Caller Data stored at AWS. As a business process improvement that is solved by AWS Connect out-of-the-box, the data involved in this process is the ContactID and previous call data that has been detailed in Part B. When a customer is authenticated, this will persist through all subsequent transfers within Crimson. Thanks to the integration between AWS Connect and Salesforce via the CTI Adapter, the authentication and linked summaries will be integrated with the Salesforce Contact Control Panel for the next agent.

### 3.3 Post-Call Summarization Data

Once an agent or the IVR finishes a call and AWS Transcribe has converted voice to text, the call will be summarized with the AWS Bedrock model Jurassic-2 as shown in Part B.

In Figure 14, an example of a call transcript between an agent and a customer is shown with the subsequent summarization output. This output shows how our customer contact notes will be automated and standardized allowing our agents to have access to notes of a customer's experience throughout Crimson.

Bedrock event	Call Data Input/Output
<b>Call transcription input summary prompt</b>	<pre>prompt = """Summarize the following conversation.\n\n#Person1#: Hello. My name is John Harvard and I need to add an authorized user to my credit card.\n\n#Person2#: Sure, hello Mr. Harvard, I see you've been verified. How are you today? Is this for the card ending in 5019?\n\n#Person1#: I'm good. Yes, that's the one.\n\n#Person2#: Thank you so much. What is the person's name you would like to add?\n\n#Person1#: It's Mary S. Harvard.\n\n#Person2#: And their date of birth?.\n\n#Person1#: Her date of birth is 1-4-81.\n\n#Person2#: Thank you, sir. And her social security number?\n\n#Person1#: It's 111-11-0000.\n\n#Person2#: Thank you. I have added Mary to your account and she will receive a card in 7-10 business days. Is there anything else I can help you with?\n\n#Person1#: Yes, I also need to open a savings account.\n\n#Person2#: Ok John. I'd like to help you, unfortunately I will have to transfer you to our checking and savings department to take care of that. Can you hold please?\n\n#Person1#: Sure, thank you.\nSummary: """</pre>
<b>Summary output<sup>20</sup></b>	#Person2# helps John Harvard add an authorized user, Mary S. Harvard, to his account ending in 5019 and says the card will be received in 7-10 business days.

<sup>20</sup> A Barth. *Customize models in Amazon Bedrock with your own data using fine-tuning and continued pre-training*. 28 Nov 2023.  
<https://aws.amazon.com/blogs/aws/customize-models-in-amazon-bedrock-with-your-own-data-using-fine-tuning-and-continued-pre-training/>

	John then wants to open a savings account so he is transferred to the checking and savings department.
--	--

*Figure 14. Bedrock Payload Example*

## PART 3. IMPLEMENTATION PLAN

### A. Solution Delivery Map

In creating the project timeline, there were several assumptions that have been validated such as: having secured buy-ins from senior leadership in both Technology and Business departments, having an approved budget and resources from the Finance department to move forward as this project is Crimson's top priority initiative in 2024. And finally, business requirements have been completed and agreed upon.

It is also important to understand that two promises, *Warm Call Transfer* and *Post-Call Summarization*, will be the least complex technological lift as the solutions to these promises are an Amazon Connect out-of-the-box solution made possible with built-in capabilities. The IVR configuration will be the most labor intensive as connections need to be made to existing Crimson APIs. The steps to deliver these promises are detailed in the *Migration Steps* section.

#### 1.0 Teams

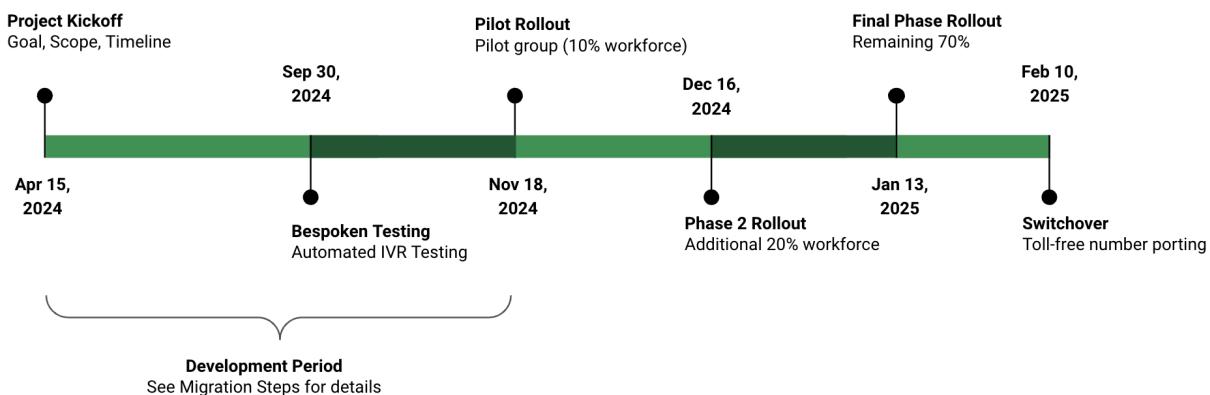
There are several internal teams and one external that will be involved throughout the duration of this project. While our internal teams will be responsible for development, configuration, and integration of the systems, our external vendor, Bespoken, will be responsible for testing the IVR. Details of each team's contribution are outlined in the migration steps as seen in the Migration Steps section. The table below further illustrates their involvement in each of our three promises.

Team (# of members)	IVR	Warm Call Transfer	Post-Call Summarization
Cloud Engineering Team (5)	✓	✓	✓
Identity & Access Management Team (5)	✓	✓	✓
Platform Integration Team (6)	✗	✓	✓
QA Team (5)	✗	✓	✓
Contact Center IT Squad (5)	✓	✓	✓
Integration Developers (6)	✓	✗	✗
Telecom Infrastructure Team (5)	✓	✓	✓
Senior Project Manager (1)	✓	✓	✓
Bespoken (external vendor)	✓	✗	✗

During the Development Period, the teams will be using Scrum methodology. This was selected due to the teams' familiarity with this method. A scrum master from each team will be facilitating all ceremonies

including sprint planning, daily stand-up, backlog refinement, sprint review, and retrospective. They will be managing their work in Jira, and their sprint length is 2-week. Additionally, a Scrum of Scrum will happen every other sprint to manage dependencies across multiple teams.

## 1.1 Project Timeline

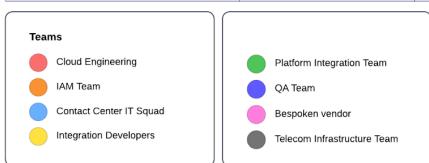


- *Project Kickoff*: The project manager will articulate the project's main objectives, clarifying its purpose, significance to the organization, and how success will be gauged. They will delineate the project's deliverables, specifying what's included and what's excluded. Additionally, they will present the project timeline, emphasizing milestones and deadlines crucial for timely completion.
- *Bespoken Testing*: Bespoken's testing approach for IVR combines automation, scripting, voice replay, monitoring, and regression testing to ensure the system is performing as we expect.
- *Pilot Rollout*: A pilot rollout for the new AWS CCaaS system selects a representative group of agents for limited-scale deployment. These agents undergo training and support to use the system, providing feedback and testing its functionality. Collected data and feedback are evaluated to assess system performance, with adjustments made if necessary before wider agent deployment.
- *Phase 2 Rollout*: After a successful pilot phase, phase 2 extends the new system's deployment to a wider agent audience. Building on pilot insights, making adjustments or improvements based on the lessons learned during the pilot phase.
- *Final Phase Rollout*: In the final phase rollout, AWS CCaaS is deployed to all remaining agents. AWS CCaaS will be fully integrated and internally routed to all agents and the new IVR will be functioning for all callers.
- *Carrier Switchover*: Crimson's 800 number will be ported and all agent queues and IVR are enabled. After transitioning to AWS CCaaS, we will temporarily keep the legacy system intact but inactive for six months as a precaution.

## 1.2 Migration Steps

A schedule of activities from the start of the migration work to the full Switchover event is below. Each deliverable resulting from the relevant team's activities are also detailed in the chart.

Activity	Deliverable	Duration	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 25	Week 32	Week 40	Week 44
Create AWS Connect Instance including provisioning AWS resources, and setting up non-functional components such as CloudWatch and CloudTrail	AWS Connect instance with Contact Lens enabled	2 weeks													
Create Access profiles in Amazon Connect (Agent, Supervisor, Quality Analyst)	AWS Connect Access profiles set up	2 weeks													
Create Contact Flows in AWS Connect and create queues to route calls (Fraud, New Accounts, etc)	Queues and Contact Flows set up in AWS Connect	6 months													
Develop code to connect IVR to existing APIs	IVR enabled with business transaction functionality (make payment, check balance, request credit increase)	6 months													
Integrate Salesforce and AWS Connect UI	AWS Connect Integrated Contact Control Panel embedded into Salesforce	8 weeks													
Quality Assurance Testing (agent facing)	Agent-facing tests completed (warm transfer, post call summary, agent system functionality)	8 weeks													
Performance Testing, Training, and Monitoring (IVR)	IVR tests completed	16 weeks													
Pilot + Phased Rollout	AWS Connect enabled for Pilot groups 1, 2, 3 + IVR enabled	12 weeks													
Number Porting Process	Porting paperwork is completed and old carrier is ready to port to AWS Connect	4 weeks													
Carrier Switchover event	All queues and IVR enabled for AWS Connect and number is ported	1 day													



### 1.3 Testing

We will employ a multifaceted testing approach through the course of six months. Crimson Bank has established a robust structure of testing teams, procedures, and guidelines. Our IT testing team will adhere to these protocols. We believe that this timeframe will allow us to address usability, functionality, and performance issues that may arise during testing. Starting with 3 layers of environment which are identical to one another—DEV, TEST, and PROD—we will only be promoting fully tested functionality to the higher level of environment. The suite of tests will consist of unit testing of individual components as well as end-to-end validation of the entire system.

Crimson's internal QA Team will prepare and oversee the User Acceptance Testing for Warm Call Transfer as well as Post-Call Summarization based on the functional requirements written in the User Stories. Contact center agents will serve as testers who will validate whether AWS CCaaS meets their requirements and expectations. In Warm Call Transfer, we will create test scenarios that replicate real-world situations where an agent must transfer a call to another agent, but the call is transferred cold. Testers would ensure the receiving agent has access to the summary of the previous call and the customer authentication details. In Post-Call Summarization, we will randomly pick the automatically generated summaries and review it against the recording of the test call. Testers must document each scenario, its desired outcome, actual results and any comments. See Appendix [Table C1 Testing Scenarios](#).

Our new Interactive Voice Response (IVR) system will undergo a rigorous test spanning multiple months. We have hired Bespoken to conduct automated testing for IVR. They specialize in testing IVR

end-to-end, which includes speech recognition. This will ensure that our IVR system is functioning properly.<sup>21</sup>

#### **1.4 Pilot and Phased Rollout**

The new contact center as a Service (CCaaS) will be rolled out in a phased approach starting with a pilot group consisting of 10% of the total workforce. This pilot will be experiencing new capabilities from three promises—IVR, Warm Call Transfer, and Post-Call Summarization. This pilot consists of approximately 35 senior contact center agents with 5+ years experience working in Crimson’s Contact Center. Selecting senior agents offers several strategic advantages rooted in their experience, expertise, and influence within the organization. They typically possess a deep understanding of processes, systems, and customer interactions. Senior agents exhibit strong leadership skills and the ability to adapt quickly to change. Additionally, their feedback and observations can provide valuable perspectives for refining and optimizing the change before rolling it out to the rest of the group. Prior to enrolling in the pilot program, each one of them will be required to attend AWS CCaaS training, including navigating the Consolidated Agent Desktop unified interface.

Insights from our data analytics show that inbound calls from area code 703 (Ashburn, VA) have been steady for the past year and they represent the average number of all inbound calls. Hence, the teams agreed that those calls would be an ideal candidate for the pilot program. Inbound calls from 703 will be routed to the pilot group. Calls can be forwarded between the Amazon Connect queue for the pilot group and the legacy system as needed during the testing and transition phase.

The pilot will run in parallel with the existing processes. It will be configured in the production environment, allowing for testing the system under actual operational conditions with real data and interactions. Agent queues and contact flows outside of the pilot will continue operating business as usual. We do not need to change Crimson’s customer-facing phone number.

During the pilot phase of AWS Connect CCaaS, key areas will be prioritized to ensure smooth integration with the existing system. Call routing strategies will be carefully synchronized to avoid conflicts, while robust reporting and analytics mechanisms will be established to glean insights from both systems. Unified authentication mechanisms will streamline user access across platforms, supported by diligent monitoring to swiftly address any issues. Consistency in customer experience will be upheld through aligned processes, and comprehensive training and support will be offered to users for optimal utilization of resources during this transition period.

We will run reports to monitor and analyze performance of the pilot.<sup>22</sup> During the pilot evaluation several key metrics are vital performance indicators. These metrics cover various aspects, including service level agreement adherence, call quality, first contact containment rate, agent performance, customer wait times and abandonment rates, system uptime and reliability, cost per contact, customer feedback, and integration success. By analyzing these metrics comprehensively, the IT Squad can assess the effectiveness of AWS Connect CCaaS, identify areas for improvement, and make informed decisions

---

<sup>21</sup> AWS. Bespoken Automated Testing for IVR. 9 April 2024. <https://aws.amazon.com/marketplace/pp/prodview-likpt54rpqvtg>

<sup>22</sup> AWS. Amazon Q. Accessed March 27, 2024. Prompt: *Is it possible to implement a pilot group test for AWC connect contact center and forward calls to that group, while having other groups still use a legacy contact center system.*

regarding its future deployment and scalability. The pilot metrics that will indicate a successful pilot run and that it is safe to move forward are detailed below. If a metric is missed, an investigation on cause and solution remedy will be prioritized.

Pilot Metric	Measured Entity	Desired Level
Voice Quality	Telephony	Jitter < 30 milliseconds, latency < 150 milliseconds, and packet loss < 1%
Connection Stability	Telephony	Dropped calls < 2%
Uptime/Downtime	AWS Connect	99.99% uptime
Agent Satisfaction	Agents	>= 75% satisfaction level
Performance Scores	Agents	> 80%
Average Handle Time	Agents	5 minutes
Customer Satisfaction	Callers	> 80%

After we have reviewed and approved the pilot results, we will proceed with the next phase of the rollout which is an additional 20% of the workforce. In this second phase, we will be routing inbound calls from three additional area codes. Similar to the pilot group, this rollout will be experiencing all three promises—IVR, Warm Call Transfer, and Post-Call Summarization.

Finally, four weeks following Phase 2 Rollout, during Phase 3, all three promises will be rolled out to the remainder 70% of the workforce. At this point, Crimson’s contact center will be operating with the required CCaaS capabilities to deliver all three promises.

## 1.5 Carrier Switchover

The Telecom Infrastructure and the Cloud Engineering Team will oversee the number porting process from Crimson’s current carrier to Amazon Connect. The switchover will occur after the pilot phase has been completed and all relevant testing has been satisfied. To minimize disruptions, the switchover will happen during a low-traffic window on a Sunday night between 12-3 AM. The porting process will take approximately 4 weeks to account for the multiple steps involved<sup>23</sup>, including carrier coordination, obtaining a Letter of Authorization (LOA), and addressing any potential delays outside of our direct control. After the customer-facing number has been fully ported and the legacy system has been deprecated, all area codes will flow to AWS Connect CCaaS at Crimson.

## 1.6 Change Management

To manage any modifications to the scope, we will implement a formal change control process. Changes will primarily focus on refining existing business logic and introducing new features to enhance customer

---

<sup>23</sup> AWS, *How to port your numbers to Amazon Connect* <https://docs.aws.amazon.com/connect/latest/adminguide/about-porting.html> Accessed April 13, 2024

experience and operational efficiency. This could involve optimizing call routing, adding new interaction channels, or additional AI tools. We will strive to continuously innovate to meet evolving customer needs and business objectives while leveraging the flexibility and scalability of the AWS Connect CCaaS. All new requests will be subject to this approval process. To submit a change request, it must be created as a Jira ticket. These tickets will be added to the project backlog and assessed at the Sprint planning meeting. Approval from relevant stakeholders will be required as part of the assessment process. For example, if a request has a negative impact on the planned timeline and is not within the project scope, it will remain in the backlog and will be reviewed again after project completion.

Throughout the duration of the implementation, we will be restricting requests of new functionality outside of our three promises. An exception would be any production issues resulting from the configuration of AWS CCaaS. Those issues will be treated as a High Priority item and the teams will resolve it as soon as possible.

## B. Operationalization: inserting the new system into company's flow of operations

### 2.0 User Administration

- *User Management and Security Profiles:* The Identity and Access Management Team will be facilitating the creation and management of user accounts for individuals responsible for configuring contact flows, queues, and other Amazon Connect settings (e.g., admins, supervisors). Security profiles establish granular control over access levels and permissions as illustrated in [Figure C6](#).
- *Salesforce User Management:* The Identity and Access Management Team will set up Salesforce profiles and customized permission sets for agents or supervisors. These permission sets grant access to customer data, cases, and other Salesforce objects. They also control the agent's ability to perform actions within the Amazon Connect CCP embedded in Salesforce (e.g., transfer calls, create cases).

### 2.1 Performance Reporting

- *Real-time and Historical Dashboards:* Dashboards deliver real-time performance metrics (updating every 15 seconds) alongside historical data for up to 3 months. This data is analyzed to understand call volume patterns, optimize staffing levels, and identify potential performance issues. (Reference Figure [C2](#) & [C3](#)) The Contact Center IT Squad will be customizing the Real Time Metrics Report by specifying the metrics that need to be measured using the GetCurrentMetricData API<sup>24</sup> Some metrics will be calculated using a survey that will be built and customized by the Cloud Engineering Team and Integration Developers<sup>25</sup>. After the Contact Center IT Squad has set up a Contact Flow module to deploy the survey as shown in [Figure C4](#), a caller will have the opportunity to opt-in to the survey during the IVR experience.

---

<sup>24</sup> AWS. *GetCurrentMetricData API*. [https://docs.aws.amazon.com/connect/latest/APIReference/API\\_GetCurrentMetricData.html](https://docs.aws.amazon.com/connect/latest/APIReference/API_GetCurrentMetricData.html). Accessed March 29, 2024.

<sup>25</sup> Aurelien Plancque, et al. *Analyze customer satisfaction scores with post-contact surveys using Amazon Connect Tasks*. AWS. 19 April 2023. <https://aws.amazon.com/blogs/contact-center/analyze-customer-satisfaction-scores-with-post-contact-surveys-using-amazon-connect-tasks/>.

- *Amazon CloudWatch*: The Cloud Engineering Team will set up CloudWatch to provide system-wide monitoring, logging, and alert generation. CloudWatch is used to track the performance of various AWS resources, including those supporting the contact center.

## 2.2 Security and Compliance

- *AWS Identity and Access Management (IAM)*: The IAM team will configure security controls, granting users only the necessary level of access across AWS services. This layered security approach ensures secure access to resources and services.
- *AWS CloudTrail*: The Cloud Engineering Team will leverage AWS CloudTrail to generate and track the logs from API calls made to and from Amazon Connect and other AWS services. This audit trail is essential for security investigations and compliance.

## 2.3 Incident Management

- *ServiceNow*: To manage incidents, Crimson will continue to use ServiceNow where users can report incidents that occur on their day-to-day job. Crimson has an existing Enterprise Infrastructure IT service desk that is available as a first line of defense. Agents are already familiar with how to submit tickets to ServiceNow. The Enterprise Infrastructure Team will be trained on AWS Connect so that they are trained on the system. If they are unable to resolve an issue regarding AWS Connect, the service desk will submit a ticket request to AWS tech support.

## 2.4 Service Level Agreement (SLA)

AWS commits to ensuring that Amazon Connect is available with a Monthly Uptime Percentage of at least 99.99% in each AWS region during any monthly billing cycle. If Amazon Connect fails to meet this commitment, Crimson Financial may be eligible for a Service Credit.<sup>26</sup>

## C. User enablement: how will people use the system

The Identity and Access Management administrators will create user accounts for agents and supervisors in AWS Connect. They will create security profiles for supervisors to access data analytics and reporting dashboards with appropriate permissions.

## 3.0 Agent Enablement

The Crimson Contact Center IT Team will schedule multiple in-person AWS Connect agent call control panel (CCP) training sessions and share online training videos<sup>27</sup>. This training includes:

- agent setup
- managing agent status
- accepting incoming calls
- after-call work (ACW)
- placing an outbound call
- initiating call transfers

---

<sup>26</sup> AWS. AWS Connect Service Level Agreement. 9 April 2024. <https://aws.amazon.com/connect/sla/>

<sup>27</sup> AWS Connect agent call control panel training. <https://www.youtube.com/watch?v=BVa6OZvAvsA>

Agents will not change their warm call transfer procedure which is to place the caller on hold and execute a friendly transfer to the next agent explaining details and authentication. However, agents will be trained on a “cold transfer mistake scenario”. This training will explain where they can find the previous call summary and authentication details should this occur.

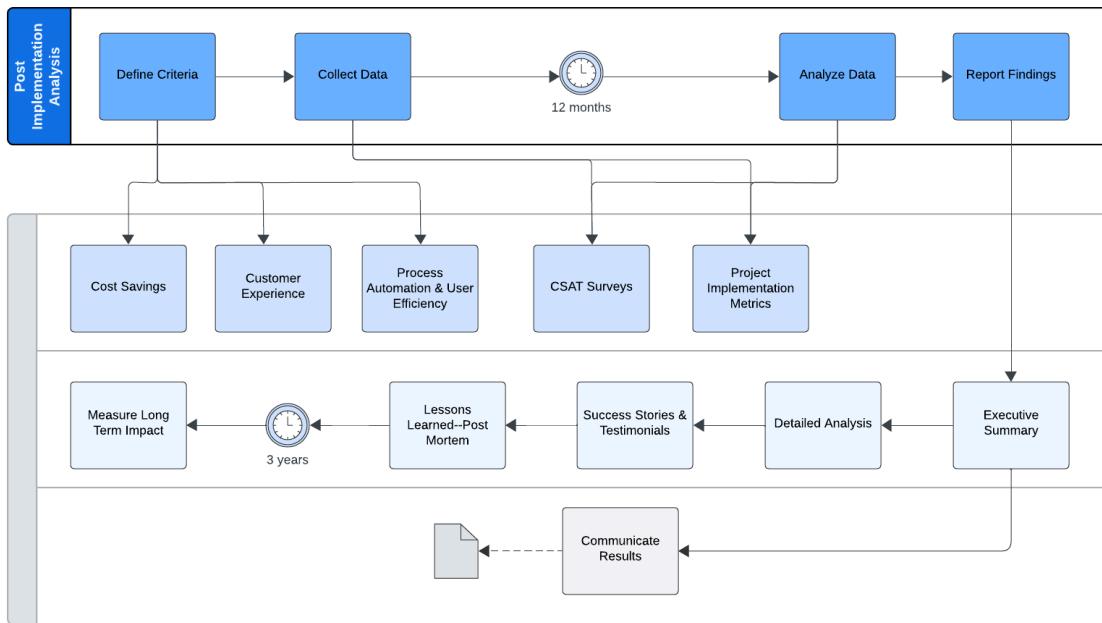
### **3.1 Supervisor Enablement**

AWS Connect provides analytics and optimization capabilities for supervisors and managers to proactively detect and address issues with their customer experience (CX), agent performance, and contact center operations. That's why the Crimson Contact Center IT Team will facilitate multiple in-person AWS Connect Supervisor training sessions. Additionally, online training videos will be available for Supervisors to access. The training includes:

- accessing call recordings and transcripts for review
- agent profile-based routing
- live conversation monitoring
- compliance and sentiment analysis on calls and create notifications when thresholds are missed
- real-time analytics dashboard
- create custom report templates based on current needs to continue to provide reporting
- automate the process of manually pulling and summarizing the reports on a weekly or monthly basis so they can spend time doing more meaningful analysis of operations
- historical reporting
- set up and integrate with Crimson's knowledge database to provide agents with real-time knowledge articles based on verbal conversation, eliminating the need for agents to search the knowledge database manually

## **D. Success metrics: how will the promised results be achieved**

### **4.0 Project Analysis**



*Figure 4.0. Post Implementation Analysis Road Map*

After implementation has been completed, we will measure the success of the project using a 12-month post-implementation analysis process as shown in Figure 4.0:

- I. Define specific measurement criteria to measure business outcome projections.
  - A. Cost Savings
  - B. Customer Experience
  - C. Process Automation & User Efficiency
- II. Collect Data: relevant data will be collected using AWS Connect's Real Time Metrics Dashboard and post-call survey results. See Figure 4.1 for details on KPIs.
  - A. Customer Satisfaction (CSAT Surveys)
  - B. Project Implementation Metrics
- III. Data will be monitored and collected for a period of time.
- IV. Data will be analyzed and compared to projections.
- V. The findings will be summarized in an executive summary after which an analysis of the project's outcomes will be detailed.
  - A. The executive summary will be presented to the executive team.
- VI. Success stories and testimonials will be gathered and communicated to stakeholders.
- VII. A post-mortem will be conducted to detail lessons learned from the project and its outcomes.
- VIII. Relevant metrics will be continuously monitored and long term impact will be measured in three years.

#### 4.1 Metrics

Figure 4.1 details each metric measurement to track business outcome success and how it will be done. Supervisors will be monitoring the metrics as part of their daily activities.

Metric	Purpose	How Measured
After Call Work (ACW)	To measure the amount of time spent by agents on administrative work after a call is completed.	Real Time Metrics Report
Average Handle Time (AHT)	The average time it takes for a call from start to finish. $(\text{Total Talk Time sec} + \text{Total Hold Time sec} + \text{ACW sec}) / \text{Total Number of Calls}$	AWS Connect Queue Performance Dashboard (see <a href="#">Figure C2</a> ).
Customer Satisfaction	A measurement of how satisfied our customers are. $(\text{Number of 4 \& 5 survey responses} / \text{Total Responses}) * 100$	Post call survey: "On a scale of 1-5, 1 being dissatisfied and 5 being very satisfied, how would you rate your experience today?" (Results sample shown in <a href="#">Figure C5</a> ).
First Contact Resolution	A measurement of how many calls we resolved on the first attempt. $\text{FCR} = (\text{Resolved Queries on First Contact} / \text{Total Queries}) * 100$	Post call survey: "Did we resolve your issue on the first try?"
IVR Containment Rate	How many calls are fully contained within the IVR. $(\text{Calls Handled} / (\text{Calls Handled} + \text{Calls Abandoned})) * 100$	Real Time Metrics Report
Net Promoter Score (NPS)	The number of surveys with a score of 9 or 10 (promoters), 7 or 8 (passives), and 0 to 6 (detractors). Calculate the NPS by subtracting the percentage of detractors from the percentage of promoters. For example, if you had 30% promoters and 20% detractors, your NPS would be $30 - 20 = 10$ .	Post call survey: "How likely are you to recommend Crimson Financial to your friend or colleague based on your call experience today?"
Zero Out Rate	The rate at which calls press 0 from the IVR to get to an agent. $\text{Calls Transferred to an Agent} / \text{Total Calls} * 100$	Real Time Metrics Report

Figure 4.1 Metrics Description

Post deployment metric goals are projected in the graphs shown in Figure 4.2. Metric goals were projected on a twelve month basis after the full switchover to AWS Connect. The ACW automation goal is expected to be immediately realized, but most others will be realized after a transition period. This transition period for agents, callers, and supervisors will give all parties time to digest the changes.

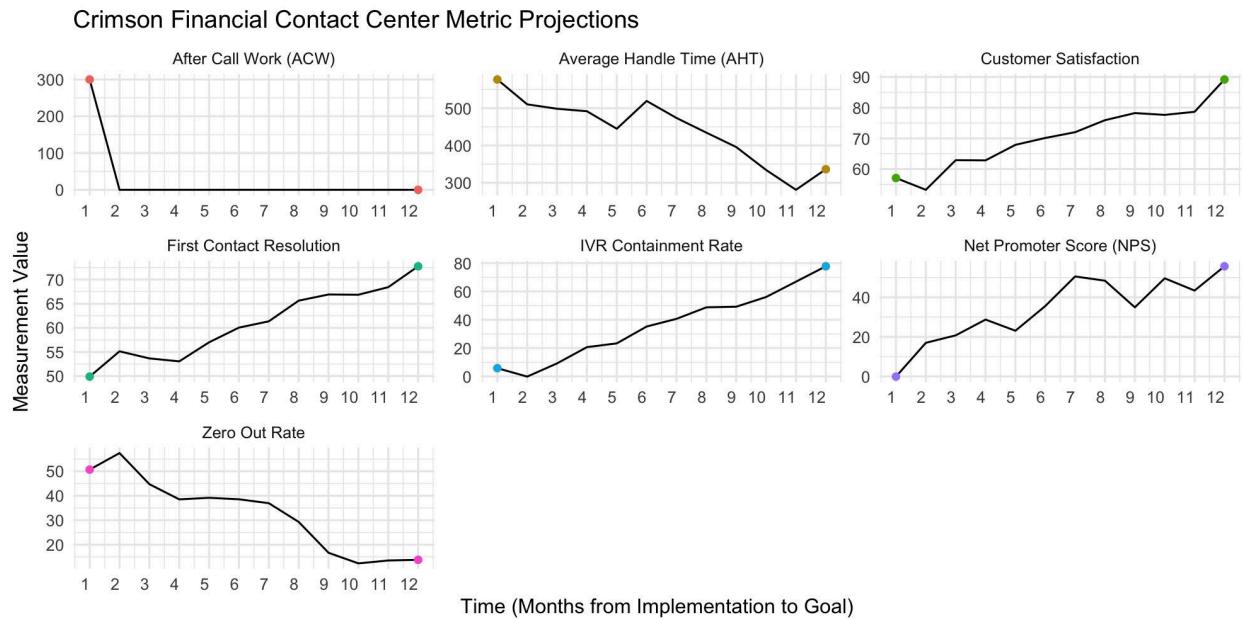


Figure 4.2 12-month Contact Center Metric Goal Projections

## 4.2 System Cost Comparison Savings

At a current level of 350 agents at implementation, the cost savings for the system operation itself is not large. As Crimson expands and adds more agents in the future, these savings will grow due to the pricing per user in the legacy system vs. the pricing per minute of voice usage with AWS Connect. The legacy system also has a vast amount of technical debt that is not quantified in this chart, but is becoming a liability. The majority of our IT team's time is spent fixing bugs and downtime is becoming a serious issue. Eliminating this technical debt will increase the efficiency of our IT team and free them up to work on other tasks.

Category	Legacy Solution	AWS Connect
Peak Number of Users	350	350
Annual Call Volume	3,600,000	3,600,000
Annual Hours of Voice Usage	400,000 hours connected 200,000 hours IVR and wait time	400,000 hours connected 200,000 hours IVR and wait time
Core Service Pricing	\$150 per peak concurrent user per month	\$0.018 per minute of voice usage

Additional Costs	21% overhead Account-level charges for integrations, recording, and support (\$70,000)	18.1% overhead Usage fees for number of Lex and Lambda calls gigabytes of S3 call storage (\$50,000)
Total Annual Cost	\$832,300	\$815,288
Cost per User, per month	\$198.17	\$194.12
Cost per Hour of Usage	\$1.39	\$1.36

#### 4.3 After Call Work (ACW) Automation Savings

Crimson has an annual call volume of 3,600,000. Fifty percent of those calls are currently subject to post call note taking: sometimes notes are not taken or not necessary. The average time spent on this task is 3 minutes. Savings from ACW automation is not expected to be direct to the bottom line. There is a labor time savings of 90,000 hours per year that will be spent on other tasks such as answering calls, directly translating to reduced hold times for callers. This is expected to directly improve the efficiency ratio of agents.

Category	Legacy Solution	AWS Connect
Hourly Wage	\$19.00/hr (\$0.316/min)	\$19.00/hr (\$0.316/min)
Annual Call Volume	3,600,000	3,600,000
Annual Call Time	400,000 hours	400,000 hours
Average After Call Work	3 min	0 min
% of calls with post call notes	50%	100%
Agent Annual Total ACW Time	90,000 hours	0 hours
Total Cost of Contact Lens	\$0	\$0.0125/min (\$0.75/hr)
Total Annual Cost of After Call Work	\$1,700,000	\$300,000

#### 4.4 Customer Experience (CX) Improvement Savings Estimation<sup>28</sup>

According to interviews of similar organizations that have implemented AWS Connect in their contact center, we can expect estimated improvements to our revenue that are detailed below. We have assumed a stable revenue for the next three years as well as a 12% operating margin. In year three for example, we estimate a \$1.2 million boost to the bottom line as a result of improved CX.

Ref	Metric	Calculation	Year 1	Year 2	Year 3
A	Annual Revenue	Crimson Data	\$323,000,000	\$323,000,000	\$323,000,000
B	Increased Revenue due to AWS Connect	Interview Data	0%	1%	2%

<sup>28</sup> Forrester. The Total Economic Impact of AWS Connect. June 2020.

[https://pages.awscloud.com/rs/112-TZM-766/images/Forrester-Total-Economic-Impact-Of-Amazon-Connect\\_June-2020\\_V4\\_7\\_24.pdf](https://pages.awscloud.com/rs/112-TZM-766/images/Forrester-Total-Economic-Impact-Of-Amazon-Connect_June-2020_V4_7_24.pdf)

C	Operating Margin	Crimson Data	12%	12%	12%
D	Increased Operating Income due improved CX	A*B*C	\$0	\$387,600	\$775,200
E	Percent of Revenue Typically Forfeited	Crimson Data	1%	1%	1%
F	Avoided Refunds Credits and Errors due to AWS Connect	Interview Data	5%	10%	15%
G	Reduced Lost Revenue with improved CX	A*E*F	\$161,500	\$323,000	\$484,500
H	Enhanced CX total	D+F	\$161,500	\$710,600	\$1,259,700

#### E. Conclusion

The launch of our contact center modernization project marks the first step in our transformation from a traditional contact center to an omni-channel, AI-enhanced CCaaS. We have a clear, achievable roadmap to meet our implementation objectives, and our dedicated teams are ready to begin. The senior leadership team is enthusiastic about the potential outcomes and benefits, and our agent team is eager to see improvements in their day-to-day tools and processes. The implementation of this project will deliver significant and quantifiable improvements for our customers, agents, and Crimson's financial performance.

## Glossary

Term	Description
After Call Work (ACW)	A task that a contact center agent needs to perform after they have ended the call with a customer.
Agent queue	These are created when an agent is added to the system. Higher priority is given to callers in an agent queue with zero delay; if an agent with that specialty is free, the caller is sent directly to their queue.
Average Handle Time (AHT)	A common metric used in contact centers to measure the average length of duration of customer interaction from start to finish.
Average Hold Time (AHT)	The amount of time that customer spends waiting for the next available agent to assist them.
Channels and concurrency	<p>There are two options to set up agent profiles to handle multiple channels; voice, chat and tasks.</p> <ul style="list-style-type: none"> <li>• Cross-channel concurrency: Agents can work with agents while simultaneously working on another channel.</li> <li>• Agents are set up to receive voice, chat, or tasks if they are available based on what's in their queue. When an agent begins working with a caller on one channel, they will not be sent work from another channel.</li> </ul>
Charge-off	An accounting term which means that a debt can no longer be collected due to a number of reasons.
Cold transfer	A situation where there has not been any sharing of customer information and their needs.
Contact Flows	A flow is a customizable customer contact center experience from start to finish. We will be using it to customize our IVR processes.
Contact ID	Every time a caller is transferred to an agent a unique Contact ID is generated and associated with that call. Any previous Contact ID's for this call are linked and stored together. AWS recommends searching by Contact ID to find a particular recording.
Containment rate	A common metric used in contact centers to measure the amount of customer requests that can be addressed by the initial medium of contact.

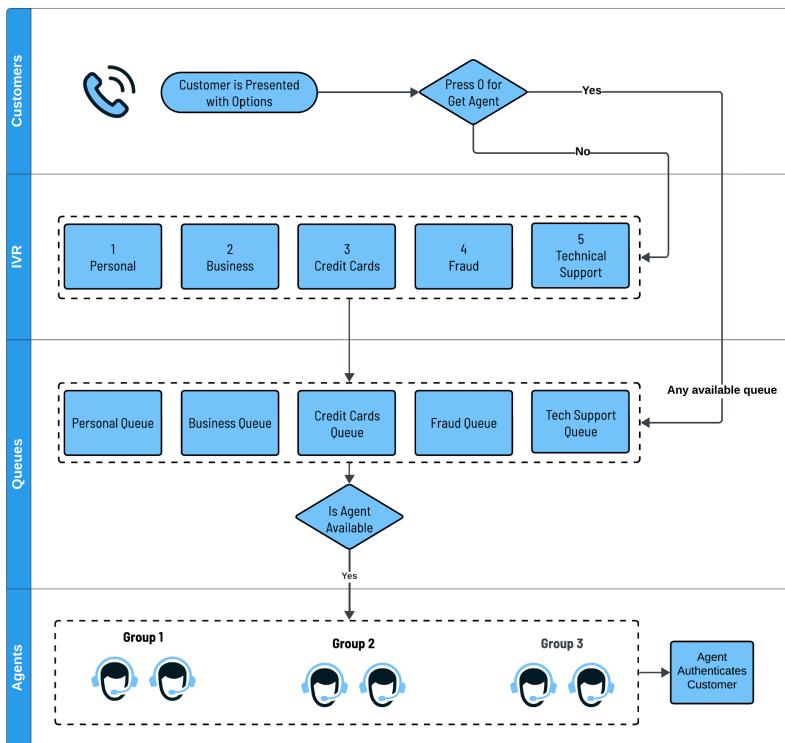
Digital breadcrumbs	A trail of data left behind in an online activity, usually this data is available in the digital platform where multiple users can access the said data.
Epic	A large body of work which can be broken down into smaller bodies of work which can then be completed in a single sprint.
Foundation model	A large-scale machine learning model that is trained on a broad range of data across numerous tasks and can be adapted to a wide variety of AI applications without needing to be trained from scratch.
Hypercare period	A designated period reserved immediately after a deployment of new code which focuses on providing support to the affected users and systems.
Interactive Voice Response (IVR)	A technology that allows interaction between a caller and a computer system; this interaction is conducted via voice.
Know Your Customer (KYC)	A process financial institutions use to verify clients' identities to prevent fraud and comply with Customer Identification Program (CIP) regulations as part of the US Patriot Act. It involves collecting personal information and documents to confirm identity.
Omni-channel	A term in commerce to describe multiple ways to conduct business: via phone, chat, SMS, email, social media, etc.
Pause and resume tasks	Agents have the ability to pause and restart all tasks that are not expired, disconnected, or scheduled for a later time. With this capability, agents can free up an active slot, allowing them to receive more critical tasks while their current task is stalled due to a missing approval or waiting on additional input.
Post-call summary	A statement written by contact center agents to outline details of the call including, but are not limited to reasons for calling, outcome of the call, next step items.
Queues	These features allow for load balancing among agents. Each queue can be assigned a priority, such as one (the primary specialty) for sales, and two (a secondary specialty) for support. A one priority is assigned to a zero second delay. A two priority could be assigned a 30 second delay. However, if the call is not taken within that time it'll be treated as a priority one.

Queue-based routing	Calls routed to agents based on skill. For example, a caller seeking to get pre-approved for a mortgage will get routed to an agent with that specialty as a priority one.
Routing profiles	A routing profile defines the types of calls an agent will receive, and determines the call routing priority. A routing profile can have multiple agents assigned to it but each agent is assigned to one routing profile. Profile-based assigning streamlines updates. A single profile can be updated instead of an individual agent's setting.
Serverless	A type of cloud computing where the consumer (in this case the developer of the application) is only responsible for writing the code, while the provider (in this case could be various cloud platform providers such as AWS, Azure, GCP) is responsible to manage the infrastructure.
Sprint	A time-boxed period of time when the development team is performing their assigned task to deliver value.
Standard queue	A virtual line where callers virtually wait to be routed to an agent.
Tasks	Tasks are the customer work handled by the contact center. With AWS Connect Tasks, agents can prioritize, assign, track, and automate tasks using various support tools.
Telephony	Technology and systems used for transmitting voice and other data over distances. It has historically involved the use of traditional landline phones and analog signals to enable voice communication. Modern telephony has evolved to include digital and Internet-based communications, such as VoIP (Voice over Internet Protocol), which allows voice, video, and other forms of data to be sent over the internet. Telephony encompasses both the hardware (phones, exchange systems) and software (call management, VoIP protocols) that make these communications possible.
User story	A concise description of a piece of functionality written from the perspective of the end-user.
Warm transfer	A situation where there has been a knowledge sharing session between contact center agents about the customer and their needs.
Zero out rate	A metric that measures the frequency at which customers opt to press "0" to bypass automated menu options and seek immediate assistance from a live agent. This indicates the preference for a human over

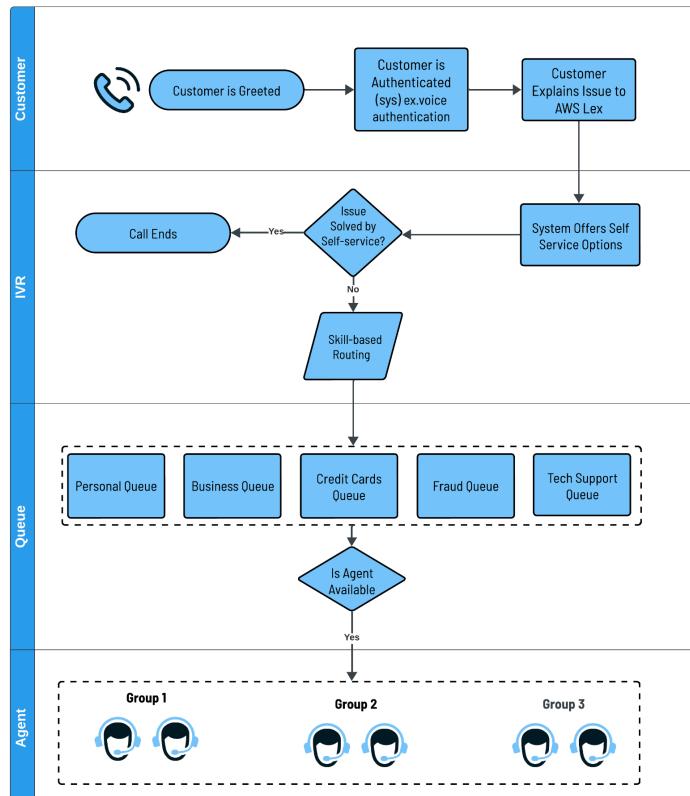
	navigating through automated responses.
--	---

## Part 1 Appendix

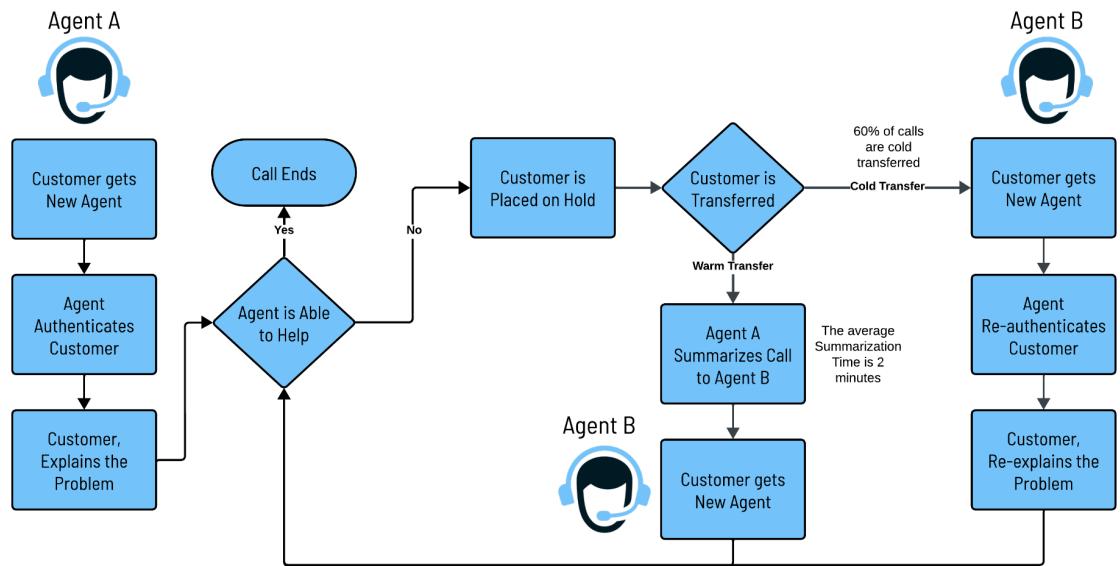
### IVR As-Is Process Flow



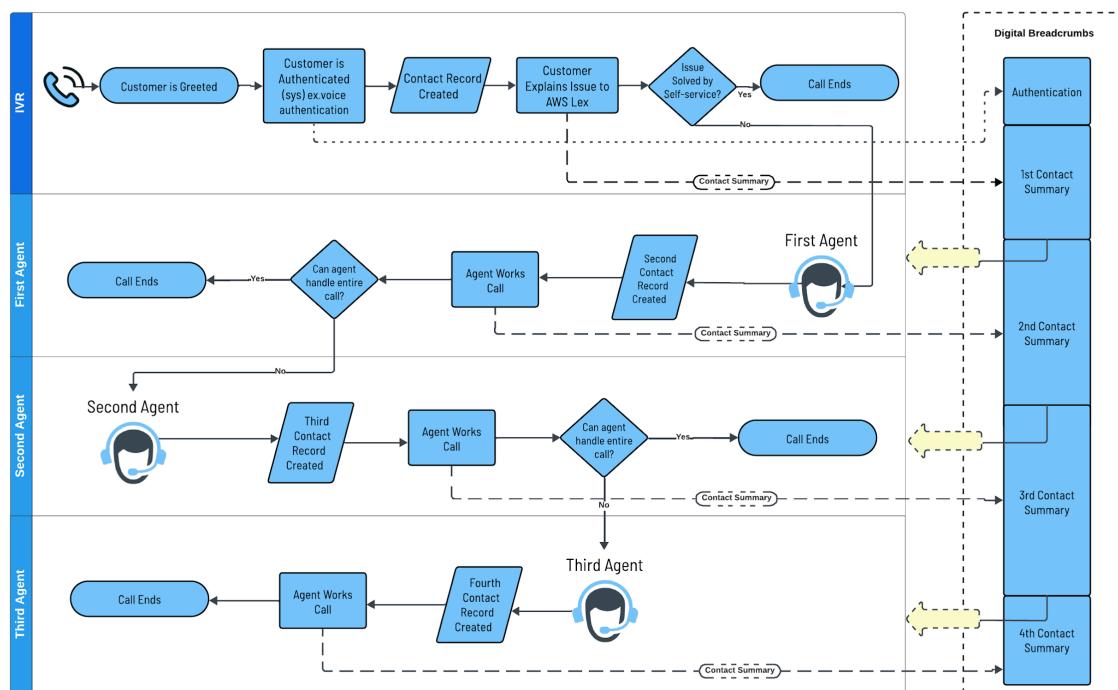
### IVR To-Be Process Flow



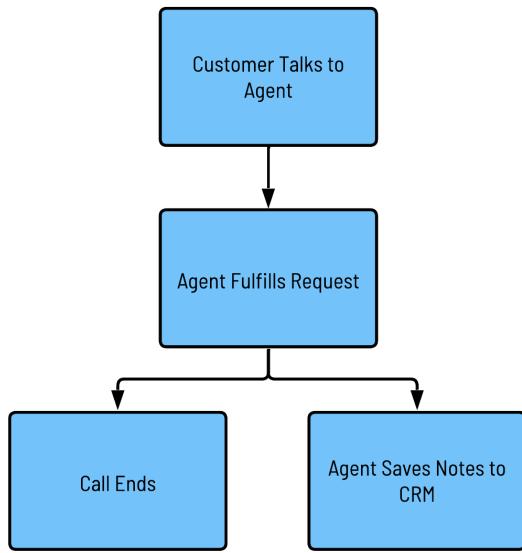
### Warm Call Transfer As-Is Process Flow



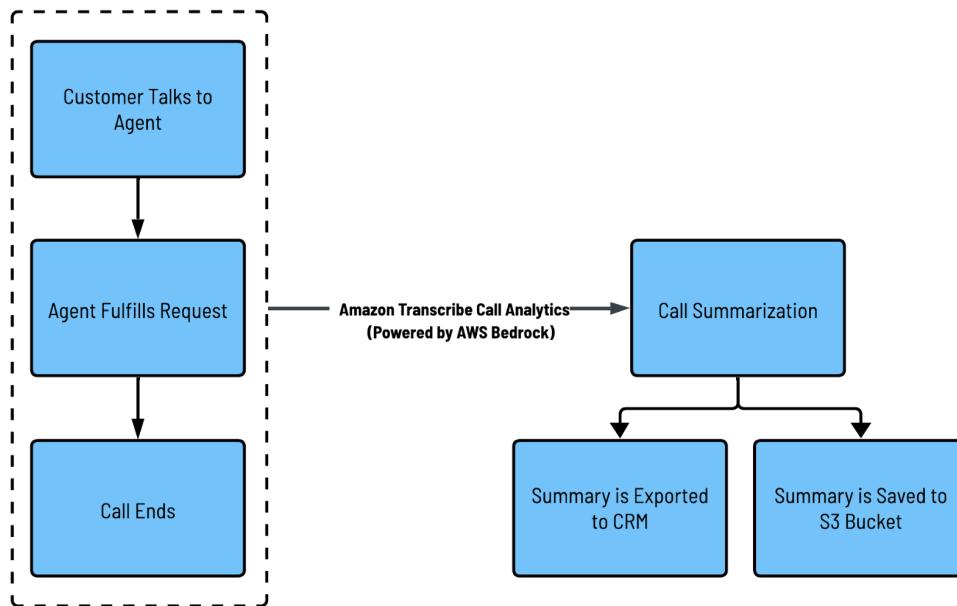
### Warm Call Transfer To-Be Process Flow



### *Post-Call Summarization As-Is Process Flow*



### *Post-Call Summarization To-Be Process Flow*



### *Acceptance Criteria of Functional Requirements Epic #1 User Story #1.1*

<i>Scenario</i>	When a valid user dials the contact center
<i>Given</i>	Interactive Voice Response handles the call
<i>When</i>	IVR authenticates the caller's identity using voice ID

<i>Then</i>	The authenticated caller can choose from the “Get Balance”, “Make a Payment”, “Credit Line Increase”, “End Call”, or “Agent” options
-------------	--

<i>Scenario</i>	When an invalid user dials the contact center
<i>Given</i>	Interactive Voice Response handles the call
<i>When</i>	IVR fails to authenticate the caller's identity using voice ID
<i>Then</i>	The user is informed
<i>And</i>	The call is disconnected

*Acceptance Criteria of Functional Requirements Epic #1 User Story #1.2*

<i>Scenario</i>	When a valid caller wants to inquire about their balance
<i>Given</i>	The caller has been authenticated using Voice ID
<i>When</i>	The caller chose the “Get Balance” option
<i>Then</i>	The balance information is retrieved and provided to the caller

*Acceptance Criteria of Functional Requirements Epic #1 User Story #1.3*

<i>Scenario</i>	When a valid caller wants to make a payment from their previous enrolled payment bank account, and the payment is of valid amount
<i>Given</i>	The authenticated caller chose the “Make a Payment” option
<i>When</i>	At the payment prompt, the caller says a valid payment amount less than or equal to the balance
<i>Then</i>	Information is saved for processing
<i>And</i>	The caller is provided with task completion information
<i>And</i>	The caller is given a chance to choose another option again

<i>Scenario</i>	When a Valid user wants to make a payment from their previously enrolled bank account - Invalid payment Amount
<i>Given</i>	Then authenticated user chose the “Make a Payment” options
<i>When</i>	At the payment prompt, the user says an invalid payment amount

<i>Then</i>	The user is informed that the payment amount is invalid
<i>And</i>	The user is prompted to enter a valid payment amount. (After three failed attempts, the message ‘Invalid input received. We are unable to serve your request at this time.’ is played, and the call is disconnected)

*Acceptance Criteria of Functional Requirements Epic #1 User Story #1.4*

<i>Scenario</i>	When a Valid user wants to request a Credit Limit Increase - Request Approved
<i>Given</i>	The authenticated user chose the “Credit Line Increase” option
<i>When</i>	<p>At the prompt, the user provided numeric values for the following:</p> <ul style="list-style-type: none"> <li>● Annual Gross Income</li> <li>● Monthly Mortgage/Rent Payment</li> <li>● Any other annual income from other sources</li> <li>● Any other monthly debt/credit card payments</li> </ul> <p>And provided consent to check their credit history</p>
<i>Then</i>	The Credit Line Increase request is processed
<i>And</i>	The user is provided with request approval information
<i>And</i>	The user is given a chance to choose an option again

<i>Scenario</i>	When a Valid user wants to request a Credit Limit Increase - Request Denied
<i>Given</i>	The authenticated user chose the “Credit Line Increase” option
<i>When</i>	<p>At the prompt, the user provided numeric values for the following:</p> <ul style="list-style-type: none"> <li>● Annual Gross Income</li> <li>● Monthly Mortgage/Rent Payment</li> <li>● Any other annual income from other sources</li> <li>● Any other monthly debt/credit card payments</li> </ul> <p>And provided consent to check their credit history</p>
<i>Then</i>	The Credit Line Increase request is processed
<i>And</i>	The user is informed that the request is denied
<i>And</i>	The user is given a chance to choose an option again

<i>Scenario</i>	When a Valid user wants to request a Credit Limit Increase - provide non-numeric data at the information prompt
-----------------	---

<i>Given</i>	The authenticated user chose the “Credit Line Increase” option
<i>When</i>	<p>At the prompt, the user provided non-numeric values for any of the following:</p> <ul style="list-style-type: none"> <li>● Annual Gross Income</li> <li>● Monthly Mortgage/ Rent Payment</li> <li>● Any other annual income from other sources</li> <li>● Any other monthly debt/ credit card payments</li> </ul> <p>Or didn't provide consent to check their credit history</p>
<i>Then</i>	The user is requested to provide the value again to proceed. (After three failed attempts, the message ‘Invalid input received. We are unable to serve your request at this time.’ is played, and the call is disconnected)

*Acceptance Criteria of Functional Requirements Epic #2 User Story #2.1*

<i>Scenario</i>	When receiving a transferred call from another agent
<i>Given</i>	I am a contact center supervisor
<i>When</i>	I join the conference call
<i>Then</i>	I would like to see the caller's identity
<i>And</i>	<p>A transcript of their previous conversation is available on the contact details page. (Contact records capture the events associated with a contact in the contact center. Contact record attributes include: Contact ID, Next Contact ID, Original Contact ID, Previous Contact ID, Channel, Initiation Method, and Agent Username. Here is the data model of a Contact Record: <a href="https://docs.aws.amazon.com/connect/latest/adminguide/ctr-data-model.html">https://docs.aws.amazon.com/connect/latest/adminguide/ctr-data-model.html</a>)</p>

*Acceptance Criteria of Functional Requirements Epic #3 User Story #3.1*

<i>Scenario</i>	When answering a customer call
<i>Given</i>	I am a contact center agent
<i>When</i>	Call ends
<i>Then</i>	<p>The summary is available on the contact detail page (This summary captures important information from customer conversations for both voice and chat, such as issues, outcomes, or action items. Real-time analytics can access these summaries to provide sentiment analysis that will generate a score between -5 (most negative) and +5 (most positive). Here is the description of Summary attributes: <a href="https://aws.amazon.com/connect/contact-lens/">https://aws.amazon.com/connect/contact-lens/</a>)</p>

## Part 2 Appendix

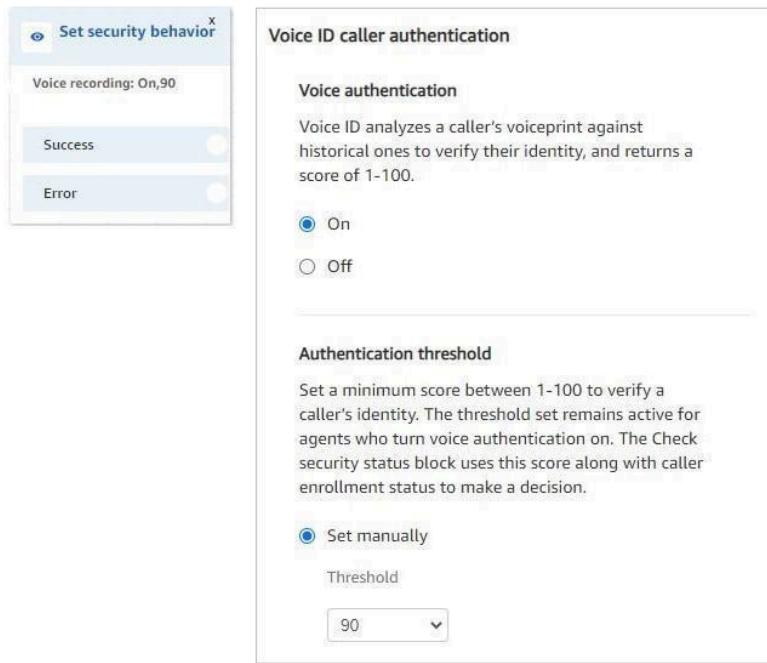


Figure B1. Set security behavior:

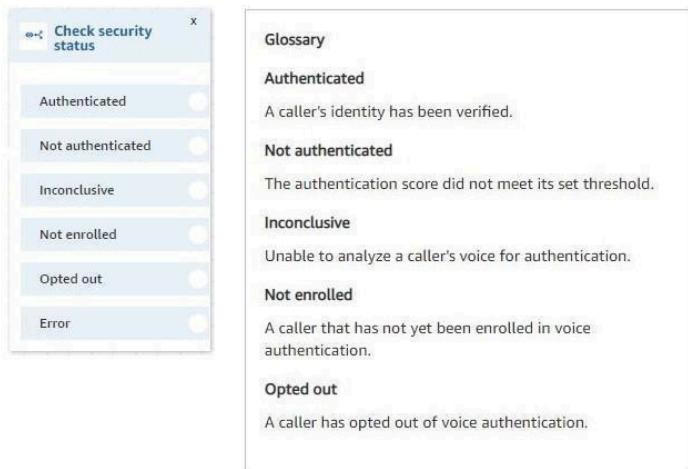


Figure B2. Check security status

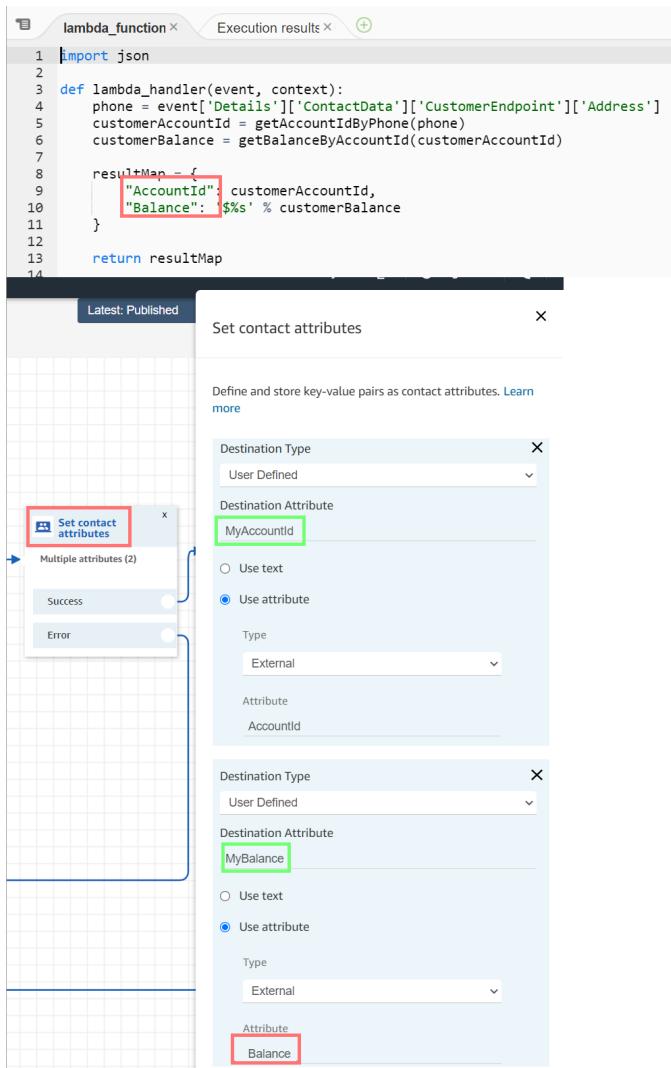


Figure B3. Lambda function invocation from a Contact Flow passing input parameter

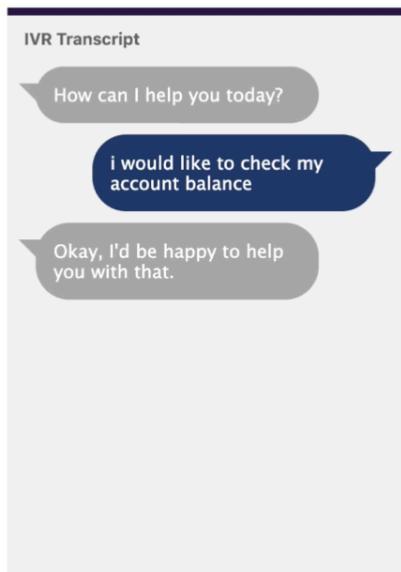


Figure B4. IVR Transcript

Prompt

- Select from the prompt library (audio)
- Text-to-speech or chat text
- Enter text

Your ID is <say-as interpret-as="characters">\$Attributes.MyAccountId</say-as>

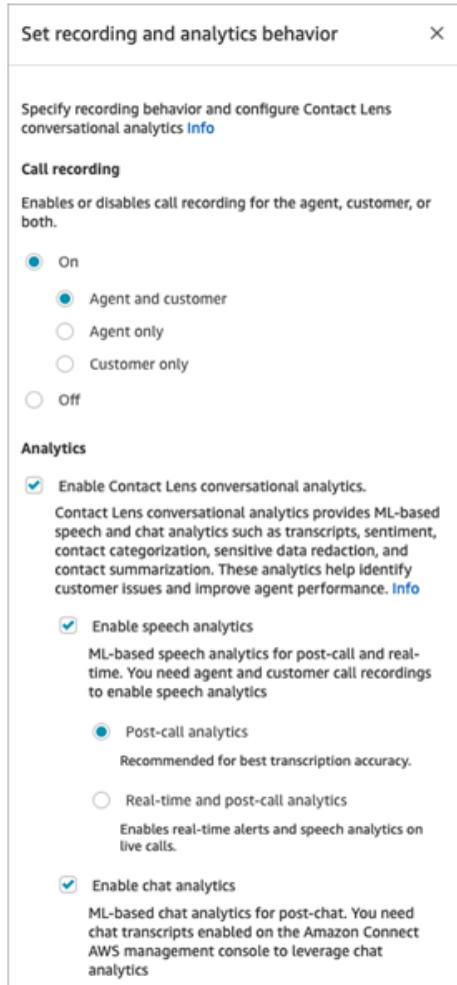
Your balance is <say-as interpret-as="cardinal">\$Attributes.MyBalance</say-as>

Enter dynamically

Interpret as

SSML

Figure B5. Set contact attributes



*Figure B6. Set recording and analytics behavior*

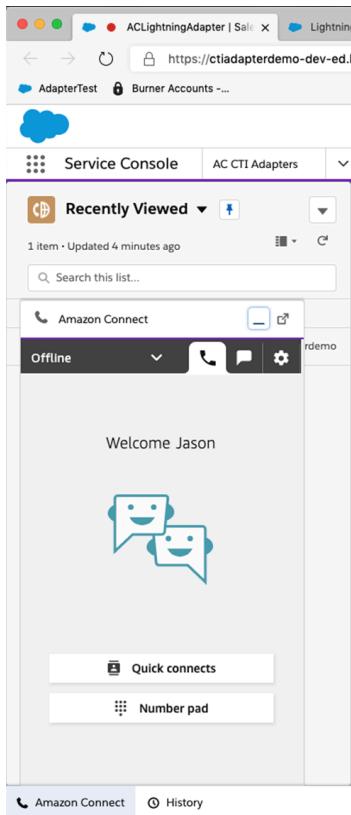


Figure B7. Agent Screen

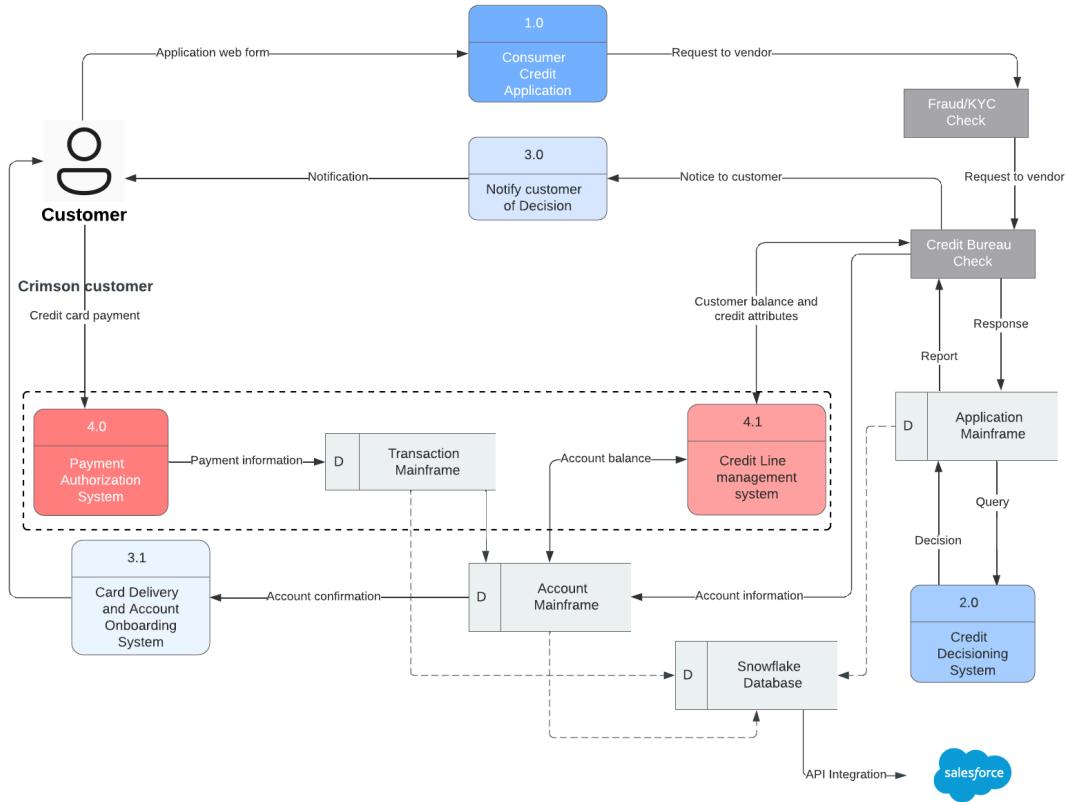


Figure B8. Current Application, Account, and Transaction Data Flow

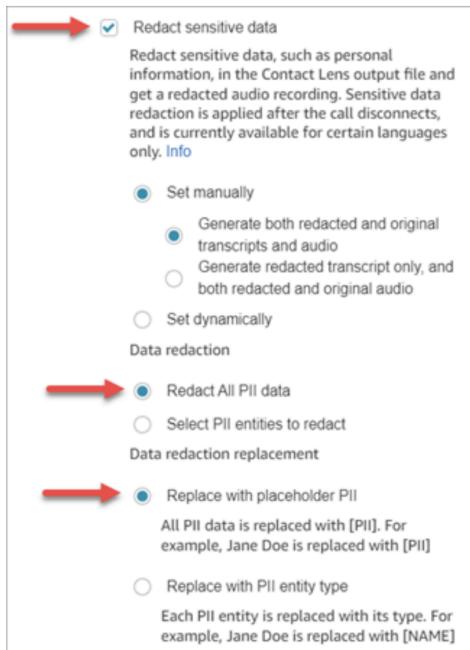


Figure B9. Redact Sensitive Data in AWS Connect Contact Lens

Contact details

Completed | Last updated: Oct 28, 2019, 10:36:32 pm | [Edit](#)

Overview

Voice | Duration: 7 mins 14 s (Nov 17, 2023, 11:08–11:15 AM)

Queue	Agent	Initiation method	Disconnect reason	Customer phone number
BasicQueue	[REDACTED]	Inbound	Customer disconnect	+17059988721

**Summary** [Generated by AI](#) (red arrow)  
The customer expresses frustration about a delayed gift delivery, providing the order number. The call center agent apologizes, explains the delay, and suggests sending a replacement item with expedited delivery at no extra cost to appease the customer. The customer reluctantly agrees, emphasizing the importance of timely delivery, and the agent assures they will monitor the new shipment closely to ensure prompt arrival.

Figure B10. Call Summary

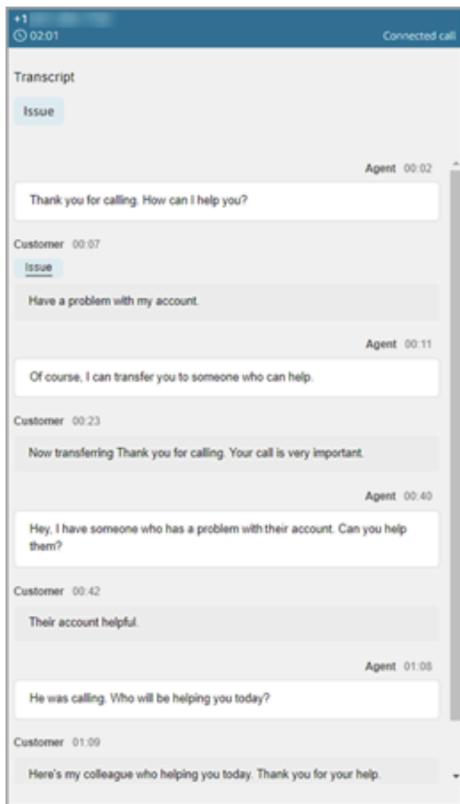


Figure B11. Warm Call Transfer Transcript Option

### Part 3 Appendix

**Table C1. Testing Scenarios**

<b>Epic #1: Interactive Voice Response (IVR)</b>			
<b>User Story #1.1:</b> As a contact center agent, I would like the IVR to resolve customer requests from start to finish and use Voice ID for authentication. This would allow completing basic tasks without a live agent.			
<b>Scenario #1:</b> When a valid user dials the contact center. Interactive Voice Response handles the call. IVR <u>authenticates</u> the caller's identity using voice ID. The authenticated caller chooses:	<b>Actual Results</b>	<b>Desired Outcome</b>	<b>Feedback</b>
“Get Balance”		The caller hears their balance.	
“Make a Payment”		The caller is able to make a payment.	
“Credit Line Increase”		The caller is able to request an increase to their credit line.	
“Agent” options		The caller is transferred to an agent.	
<b>Scenario #2:</b> When a valid user dials the contact center. Interactive Voice Response handles the call. IVR <u>fails to authenticate</u> the caller's identity using voice ID. Then:	<b>Actual Results</b>	<b>Desired Outcome</b>	<b>Feedback</b>
		The caller is asked for additional identifying information.	

**Epic #2: Warm Call Transfer**

**User Story #2.1:** As a contact center supervisor receiving a transferred call from another agent, I want to see the caller's identity and a transcript of their previous conversation. It will improve customer experience and agent productivity.

Scenario:	Actual Results	Desired Outcome	Feedback
When receiving a transferred call from another agent		A transcript of their previous conversation is available on the contact details page. (Contact records capture the events associated with a contact in the contact center. Contact record attributes include: Contact ID, Next Contact ID, Original Contact ID, Previous Contact ID, Channel, Initiation Method, and Agent Username.)	

### Epic #3: Post-Call Summarization

**User Story #3.1:** As a contact center agent, I want the post-call summary to be automated and available for review after the call ends. It will free up agent time to serve more callers.

Scenario:	Actual Results	Desired Outcome	Feedback
An agent completes a call with a customer.		The call summary is available on the contact detail page.	

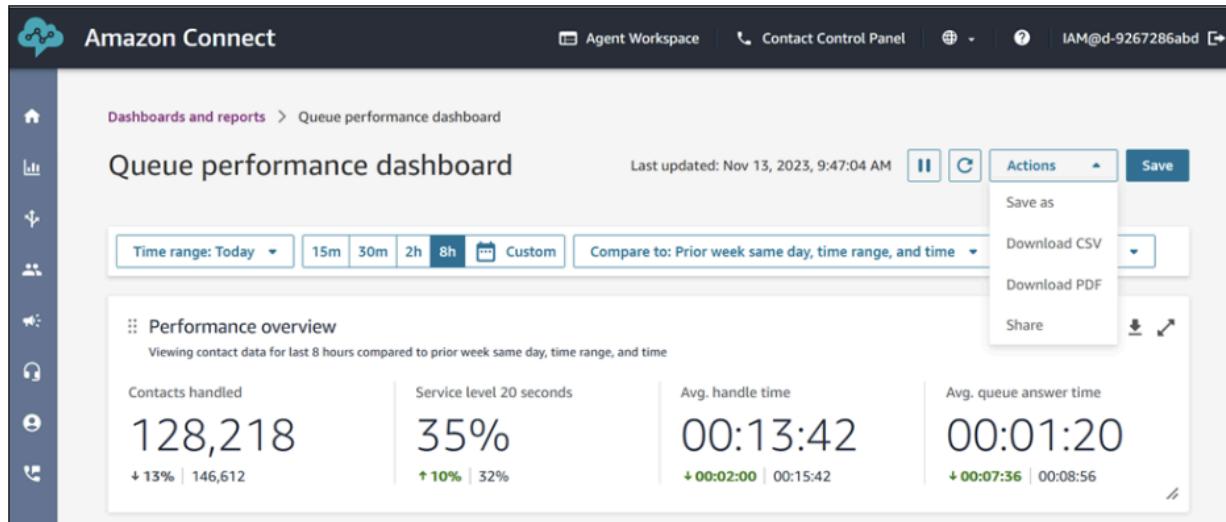


Figure C2. AWS Connect Queue Performance Dashboard

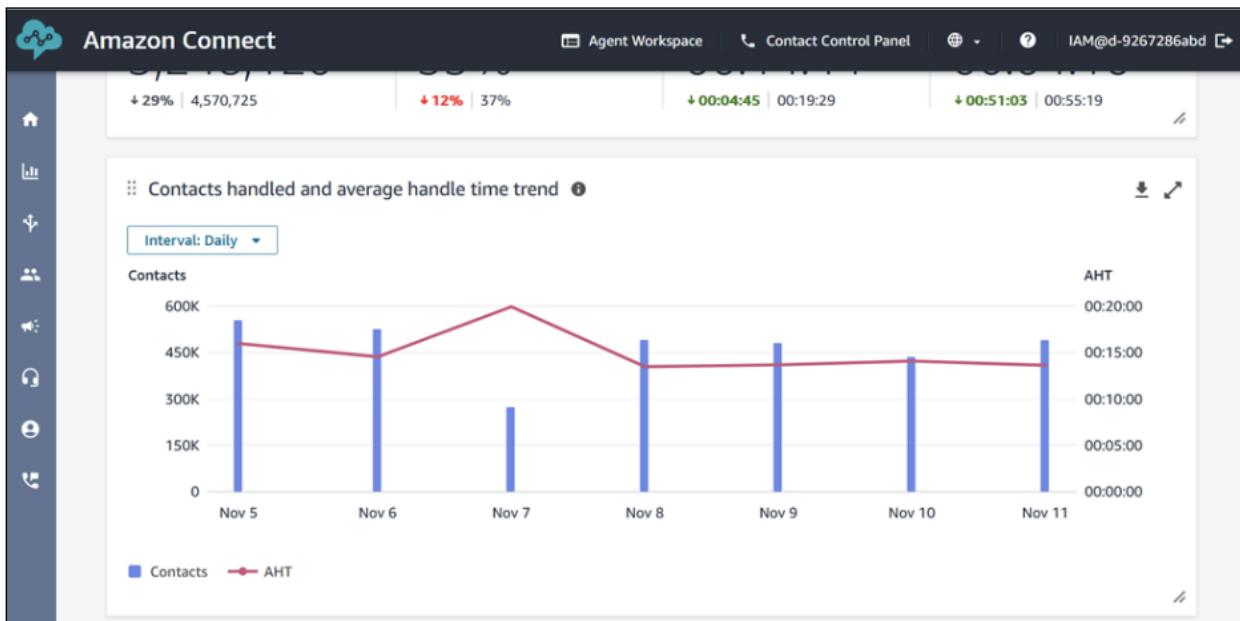


Figure C3. AWS Connect Queue Performance Dashboard Visualization

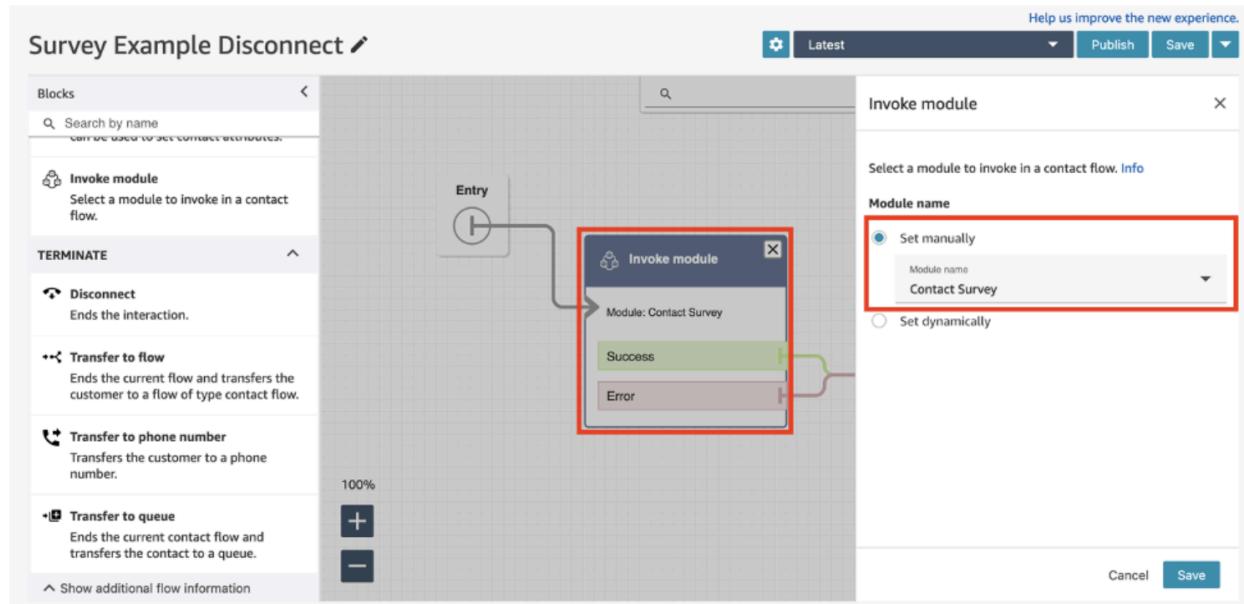


Figure C4. Offer survey opt-in to callers in IVR Contact Flow

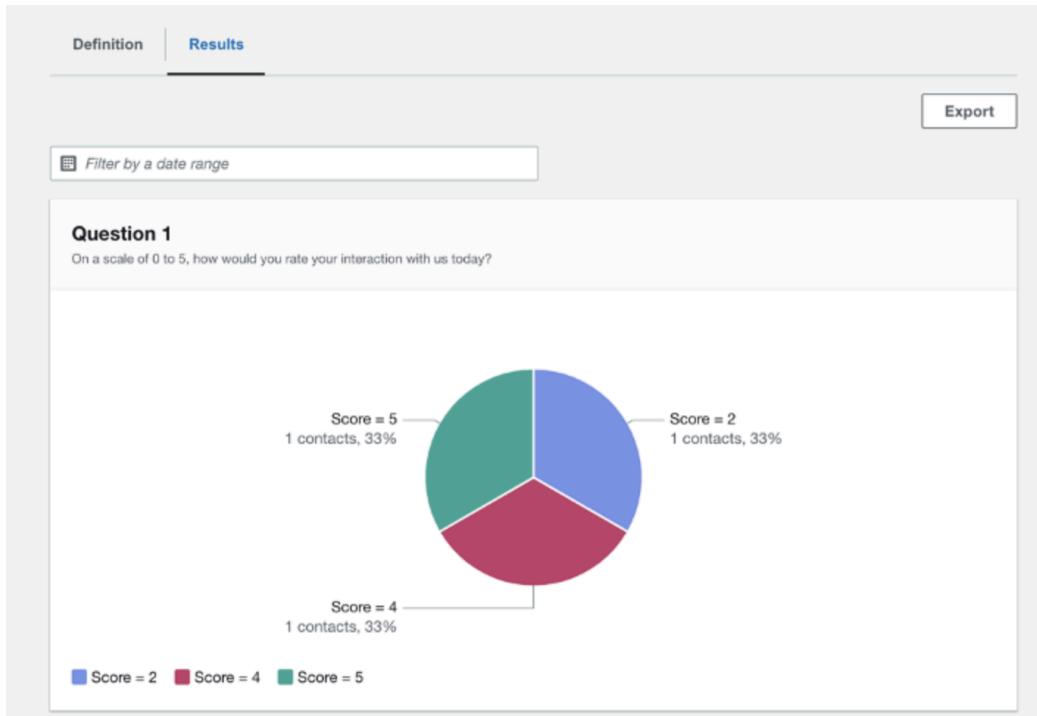


Figure C5. Survey Results in Amazon Connect

<input type="checkbox"/> <b>Agent</b>	An agent is a user of the system that is focused on customer care and/or sales. Their role is unlikely to be technical.	CCP: Access CCP   CCP: Outbound	—
<input type="checkbox"/> <b>CallCenterManager</b>	A call center manager (or call center admin) manages the day-to-day aspects of the call center.	Routing: Routing profiles   Quick connects.View   Quick connects.Edit Quick connects.Create   Hours.View   Hours.Edit   Hours.Create Routing: Queues   Routing: Task templates   Channels and flows: Prompts Channels and flows: Flows   Channels and flows: Flow modules Channels and flows: Phone numbers   Users.View   Users.Edit Users.Create   User permissions: Agent status   Analytics: Access metrics Analytics: Contact search   Analytics: Contact attributes Analytics: Agent time card   Analytics: Real-time contact monitoring Analytics: Recorded conversations   Analytics: Saved reports Customer profiles: Calculated Attributes	—
<input type="checkbox"/> <b>QualityAnalyst</b>	A quality analyst works to improve the customer experience and keeps track of live service metrics.	Analytics: Access metrics   Analytics: Contact search Analytics: Contact attributes   Analytics: Agent time card	—

*Figure C6. User Management and Security Profiles*

## References

AI21 Labs. AI21 Labs partners with Amazon to offer top-performing, easily accessible foundation models. <https://www.ai21.com/blog/announcing-amazon-partnership>. Accessed March 16, 2024.

AI21Labs. (2024). *Announcing Jurassic-2 and Task-Specific APIs*.  
<https://www.ai21.com/blog/introducing-j2>. Accessed February 29, 2024.

Amazon Web Services. (2023) *Amazon Connect Voice ID*. <https://aws.amazon.com/connect/voice-id/>

Amazon Web Services. (2023, December 22) *Amazon Connect now supports routing contacts according to the proficiency of agents*.  
<https://aws.amazon.com/about-aws/whats-new/2023/12/amazon-connect-routing-contacts-proficiency-agents/>

Amazon Web Services. (2024) *AWS Well Architected Framework*.  
<https://docs.aws.amazon.com/wellarchitected/latest/sustainability-pillar/sustainability-as-a-non-functional-requirement.html>

Amazon Web Services. (2024) *Amazon Connect Voice Id*. <https://aws.amazon.com/connect/voice-id/>

Antonelli, L., Camilleri, G., Torres, D., & Zarate, P. (2023). *AGUTER a platform for automated generation of user acceptance tests from requirements specifications*. Kybernetes, 52(1), 44–63.  
<https://doi.org/10.1108/K-04-2021-0252>

AWS. *Agent training guide for the CCP and agent workspace*.  
<https://docs.aws.amazon.com/connect/latest/adminguide/agent-user-guide.html>. Accessed March 20, 2024.

AWS. Amazon Q. Accessed March 27, 2024. Prompt: *Is it possible to implement a pilot group test for AWC connect contact center and forward calls to that group, while having other groups still use a legacy contact center system*.

AWS. *AWS Connect Service Level Agreement*. 9 April 2024. <https://aws.amazon.com/connect/sla/>

AWS. (2020, September). *Amazon Connect CTI Adapter v5 for Salesforce Lightning. Setup and Installation Guide*.  
<https://connect-blogs.s3.amazonaws.com/Amazon+Connect+Salesforce+CTI+Adapter/Amazon+Connect+CTI+Adapter+for+Salesforce+Lightning+-+Setup+and+Installation+Guide.pdf>

AWS. *AWS Lambda*. <https://docs.aws.amazon.com/lambda/latest/dg/services-lex.html>. Accessed March 15, 2024.

AWS. *AWS Prescriptive Guidance*.

<https://docs.aws.amazon.com/prescriptive-guidance/latest/ivr-design-on-connect/example.html>. Accessed March 15, 2024.

AWS. *AWS Streams API Github*. <https://github.com/amazon-connect/amazon-connect-streams>. Accessed March 20, 2024.

AWS. *Bespoken Automated Testing for IVR*. 9 April 2024.

<https://aws.amazon.com/marketplace/pp/prodview-likpt54rpqvtg>

AWS. *Enable Amazon Contact Lens*.

<https://docs.aws.amazon.com/connect/latest/adminguide/enable-analytics.html>. Accessed March 22, 2024.

AWS. Miller, C. *Transforming contact center teams when using Amazon Connect*. 29 January 2024.

<https://aws.amazon.com/blogs/contact-center/transforming-contact-center-teams-using-amazon-connect/>

AWS. *Transfer Calls*. <https://docs.aws.amazon.com/connect/latest/adminguide/transfers.html>. Accessed March 20, 2024.

AWS. *VoiceID Domains*. <https://docs.aws.amazon.com/connect/latest/adminguide/voiceid-domain.html>. Accessed March 5, 2024.

Barth, A. (2023, September 28). *Amazon Bedrock Is Now Generally Available – Build and Scale Generative AI Applications with Foundation Models*. AWS.

<https://aws.amazon.com/blogs/aws/amazon-bedrock-is-now-generally-available-build-and-scale-generative-ai-applications-with-foundation-models/>

Barth, A. (2023, November 28). *Customize models in Amazon Bedrock with your own data using fine-tuning and continued pre-training*. AWS.

<https://aws.amazon.com/blogs/aws/customize-models-in-amazon-bedrock-with-your-own-data-using-fine-tuning-and-continued-pre-training/>

Barr, J. (2021, November 21) *New – Use Amazon S3 Event Notifications with Amazon EventBridge*.

<https://aws.amazon.com/blogs/aws/new-use-amazon-s3-event-notifications-with-amazon-eventbridge/>.

Boya, V. (2023, November 28). *New generative AI features in Amazon Connect, including Amazon Connect Voice ID, facilitate improved contact center service*. Amazon Web Services.

<https://aws.amazon.com/blogs/aws/new-generative-ai-features-in-amazon-connect-including-amazon-q-facilitate-improved-contact-center-service/>

Caldwell, A. (2023, August 10). *AWS recognized as a Leader in 2023 Gartner Magic Quadrant for Contact Center as a Service with Amazon Connect*. Amazon Web Services.

<https://aws.amazon.com/blogs/contact-center/aws-recognized-as-a-leader-in-2023-gartner-magic-quadrant-for-contact-center-as-a-service-with-amazon-connect/>

Call Miner. *What Is Average Handle Time? Challenges, examples, and best practices for improving AHT.* 5 June 2020.

<https://callminer.com/blog/average-handle-time-challenges-examples-best-practices-improving-aht>

Chiu, M. (2023, June 12). *The Minus Mindset: Subtract From Your Customer Experience Instead of Adding to It.* Gartner. <https://www.gartner.com/document/4437399>

Desmarais, M. (2023, Mar 30). Call Center Turnover. SQM Group.  
<https://www.sqmgroup.com/resources/library/blog/call-center-attrition-rate>

Elliot, C. (2023, March 18). *Thank you for not calling! Agents are on the verge of burnout, study finds.* Forbes.  
<https://www.forbes.com/sites/christopherelliott/2023/03/18/thank-you-for-not-calling-agents-are-on-the-verge-of-burnout-study-finds/>

FDIC. (2023). *Bank Failures In Brief.*  
<https://www.fdic.gov/resources/resolutions/bank-failures/in-brief/bfb2023.html>

Federal Reserve. (2023). *Supervision and Regulation Report.*  
<https://www.federalreserve.gov/publications/2023-november-supervision-and-regulation-report-banking-system-conditions.htm>

Forrester. *The Total Economic Impact™ Of Amazon Connect.*  
[https://pages.awscloud.com/rs/112-TZM-766/images/Forrester-Total-Economic-Impact-Of-Amazon-Connect-June-2020\\_V4\\_7\\_24.pdf](https://pages.awscloud.com/rs/112-TZM-766/images/Forrester-Total-Economic-Impact-Of-Amazon-Connect-June-2020_V4_7_24.pdf). June 2020.

Galileo. *Get Balance API Example.* [https://docs.galileo-ft.com/pro/reference/post\\_getbalance](https://docs.galileo-ft.com/pro/reference/post_getbalance). Accessed April 9, 2024.

Gartner. *Amazon Connect Alternatives: Competitors and Alternatives to Amazon Connect* Gartner. (2024)  
<https://www.gartner.com/reviews/market/contact-center-as-a-service/vendor/amazon-web-services/product/amazon-connect/alternatives>.

Gupta, V., et al. (2019, January). *Customer First: Personalizing the Customer-Care Journey.* McKinsey & Company.

IBM. *What is Zero-Shot Learning?* <https://www.ibm.com/topics/zero-shot-learning>. Accessed 16 March, 2024.

International Banker. (2023, October 6). *Higher Loan Loss Provisions Demonstrate Credit Quality Concerns at US Banks.*  
<https://internationalbanker.com/banking/higher-loan-loss-provisions-demonstrate-credit-quality-concerns-at-us-banks/>

Isaacs, B., et al. (2023, Nov 27) *Interactive Voice Response (IVR): How It Works, Benefits & Best Practices for Your Contact Center*. Twilio.

<https://www.twilio.com/en-us/blog/ivr-what-it-is-and-how-it-benefits-contact-center>

Johnson, C. (2024, January 3). *Generative AI in operations: Capturing the value*. McKinsey & Company. <https://www.mckinsey.com/capabilities/operations/our-insights/generative-ai-in-operations-capturing-the-value>

McCaffrey, O. (2023, Dec 15). *PNC, U.S. Bank closed roughly one in 10 branches in 2023*. American Banker. <https://www.americanbanker.com/list/pnc-u-s-bank-closed-roughly-one-in-10-branches-in-2023>

NICE. (2024). *7 Critical CX trends for your 2024 strategy*. <https://get.nice.com/2024-CX-Trends>

Norrie, D. (2023, Nov 7). *Overcome 3 Pitfalls When Implementing GenAI in Customer Service*. Gartner. <https://www.gartner.com/document/4902931>

Olding, Elise, et al, (9 November 2021). *Use 6 Tactics to Help Employees Navigate Change and Thrive in an Ambiguous World*. Gartner.

<https://www.gartner.com/document/3985920?ref=solrrqp&refval=405020288&>

OpenAI. (2024). *Description of legacy call center architecture*. ChatGPT.

<https://chat.openai.com/share/d508b3ad-d0d4-48ad-8e31-4a557dd910c5>. Prompted 20 February, 2024.

Opher Lieber, et al. *Jurassic-1 Technical Details and Evaluation*.

[https://assets-global.website-files.com/60fd4503684b466578c0d307/61138924626a6981ee09caf6\\_jurassi\\_c\\_tech\\_paper.pdf](https://assets-global.website-files.com/60fd4503684b466578c0d307/61138924626a6981ee09caf6_jurassi_c_tech_paper.pdf). Accessed February 29, 2024.

Oracle. *Credit Line Increase API Example*.

[https://docs.oracle.com/cd/E18727\\_01/doc.121/e13502/T395686T395693.htm](https://docs.oracle.com/cd/E18727_01/doc.121/e13502/T395686T395693.htm). Accessed April 9, 2024.

Oracle. *Make Payment API Example*.

<https://docs.oracle.com/en/industries/communications/billing-revenue/12.0/restapi/op-payments-post.htm>. Accessed April 9, 2024.

Paradkar, Sameer, (2017). *Mastering non-functional requirements: analysis, architecture, and assessment*. 1st edition, Birmingham, [England]

Plancque, Aurelien, et al. *Analyze customer satisfaction scores with post-contact surveys using Amazon Connect Tasks*. AWS. 19 April 2023.

<https://aws.amazon.com/blogs/contact-center/analyze-customer-satisfaction-scores-with-post-contact-surveys-using-amazon-connect-tasks/>.

Snowflake. *Configuring a Snowflake storage integration to access Amazon S3*.  
<https://docs.snowflake.com/en/user-guide/data-load-s3-config-storage-integration>. Accessed March 20, 2023.

Stephan, C., et al. (2023, May 15). *Use Generative AI in Applied Innovation to Drive Business Value*. Gartner. <https://www.gartner.com/document/4358299>

Stewart, Brent. (2023, February 24). *How to Measure the Value of User Experience Design*. Gartner. <https://www.gartner.com/document>

### **Acknowledgements**

We would like to express our heartfelt appreciation to Professor Zoya Kinstler and Takayuki Iida for their exceptional mentorship, sincere support, and invaluable guidance throughout the course of this capstone paper. Their expertise, feedback, and encouragement have been paramount in our understanding of the subject matter. We are profoundly grateful for their presence and involvement.