CONVERSATIONAL AI: REDEFINING HUMAN EXPERIENCE

Mohammed Hashim

GTM Leader – Digital Infrastructure
Brillio
Mohammed.hashim@brillio.com

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Introduction

Advancement in Conversational interfaces have changed how we relate to machines. Conversational Artificial Intelligence (CAI) recognizes users' speech or text patterns, predicting their intents and responding with an adaptive, automated script, creating truly natural, human-like interactions. It's a combination of different technologies including natural language processing (NLP), machine learning (ML), deep learning (DL) and intent based contextual awareness.

Today, CAI is driving Conversational experiences which in turn is driving extraordinary customer outcomes and opening new business avenues. We are on the cusp of an AI paradigm shift wherein CAI has become a centerpiece of many organizations' digital transformation; as the way businesses and customers communicate is changing particularly in the wake of the global pandemic, with Remote Work from anywhere, anytime, any way becoming the new norm. Figure 1 illustrates the building blocks of a CAI platform that is redefining Human-Bot interactions and transforming digital experiences.

Figure 1: Building Blocks of Conversational AI

- **Omni-channel User Experience (UX)** interfaces help customers connect and interact with brands in increasingly varied and impulsive ways, often transitioning between channels throughout the product or service lifecycle relationship with the brand. It extends cross-channel engagements so the experience 'loops' continuously across channels while staying in-line with the customer's motivation and   habits.

- **Automated Speech Recognition (ASR)** is the voice recognition technology that makes sense of the spoken words and translates them into a machine-readable format, text.

- **Natural Language Understanding (NLU)** is one part of Natural Language Processing (NLP) that deciphers the text to realize the user intent and context behind the text. It parses human language text, a prerequisite for understanding natural sentence structures versus simple keyword triggers.

- **Natural Language Generation (NLG)** is the other part of NLP that uses Dialog management to build and orchestrate user responses based on NLU of the text and converts them into human understandable format, to interact with users most intuitively and permit autonomous actions.

- **Synthetic Voice Response (SVR)** either delivers the response in text or uses speech synthesis – artificial production of human speech – or text-to-speech to deliver the response over a voice modality.

- **Deep Learning (DL)** or reinforced learning is responsible for continuously learning and improving with the ability to accept corrections and learn from past experiences to deliver a better response in future interactions.

According to Gartner[1], CAI adoption rates are expected to almost double over the next two to five years. The rapid adoption of Conversational AI will likely be underpinned by innovations in the various steps of chatbot development that have the potential to hasten the creation and training of chatbots and enable them to efficiently handle complex requests with empathy and personalization. Yet, the future looks extremely promising with advancements in experience design, behavioral sciences, and democratized localized services such as Customer Experience (CX) as a Service. Across the board, sales/marketing lifecycle, from pre-purchase, purchase to post-purchase, has seen customer engagement surpassing social media through AI-based Conversational messaging with chat automation techniques like chat bots and live chat - to provide 24/7 technical/advisory support, reduce operating costs, optimize support agent workloads, lead generations, sales and more.

This article discusses the fundamentals and adoption strategy of Conversational AI, the Global CAI market, CAI technology, solution models, top platforms, practical use cases, risk mitigations and future of CAI. The article would guide enterprises, digital automation, cognitive services, hyper intelligent automation- consultants, technologists, solution architects and the academic community; interested in understanding CAI technology, practical applications, market dynamics, identifying transformation opportunities; designing enterprise-wide CAI solutions; and adopting CAI automating conversational customer experience at scale and accelerating their digital experience journeys.

Industry Trends and Why it Matters

About 70% of white-collar workers[2] today interact regularly with conversational platforms. The rise and proliferation of CAI is evident from some of the following market research and industry trends:

- A study[3] from Juniper Research has found that the total spend over conversational commerce channels will reach USD 290 Bn by 2025. One of their earlier studies[4] estimated that by replacing humans with intelligent bots, companies in the retail, banking and healthcare sectors can trim off 2.5 Bn Hours of the time needed for humans to respond to customer inquiries leading to savings of about USD 11 Bn over a 5-year timeframe.
- This is supplemented by research[5] from Khoros, where 70% of respondents expect near instant responses on a customer chat support; and Markets&Markets research estimates[6] the global NLP market that also support chatbots and intelligent virtual assistants to reach USD 35 Bn by 2026.

Why does it really matter?

Digital customer experience matters more than ever, beating product and pricing as the biggest brand differentiator. According to Forbes[7], 82% customers will discontinue doing business with a company after a bad experience, and 80% will share with others about their experience.

Here is where CAI unleashes the power of customer intelligence and actionable analytics, to reduce friction and make interactions highly relevant to drive strong connections of brands with their customers. CAI-based solutions deliver inclusive and responsive customer experience, to augment and accelerate the customer success journey right from engagement, purchase, fulfilment, and service.

There are a variety of CAI platform applications across industries from customer service to marketing, security, retail, hospitality, telecom healthcare and so on. These hyper intelligent solutions are helping businesses connect with customers and employees in never-before-seen ways, transforming end to end user experience.

Deloitte Insights[8] identified five vectors of progress from top CAI-related patents that are most likely to increase the value of CAI, from conversing to engaging with customers and expanding their use across industries. These are:

1. **Training conversational agents** related to domain and learn from past transactions
2. **Handling complex conversations** related to multi-topics, multi-commands, multi-intents
3. **Hyper personalized experiences** related to user customization, communication styles, local settings
4. **Voice assistant enhancements** related to improvising speech recognition, noise filtration, voice precision
5. **Virtual assistant ensembles** related to combining specialized bots across functions such as Human Resources, IT Services, Finance, Marketing, Legal and so on

How does CAI Technology Work?

Gartner defines[9] "enterprise CAI platform as the software applications used to build, orchestrate, and support the development of multiple use cases of conversational automation, while targeting multiple roles within the enterprise." Enterprise CAI platforms enable conversational automation as a strategic enterprise digital capability. Some of the leading players in this space are Amelia, Cognify, Gupshup, Kore, OneReach, Rasa, ServiceNow and Watson amongst many others.

Simply put, CAI is a form of advanced AI that facilitates real-time human-like conversation between a human and a computer. The key is the differentiating solutions need to be driven by Customer Intent for building deeper connections and unlocking wider opportunities. The increasing integration of advanced AI capabilities with Natural Language Understanding, Automated Speech Recognition and Deep Learning are the major factors adding value to conversational AI offerings. Figure 2 depicts the functional layers of an enterprise scale CAI architecture and their relationship.
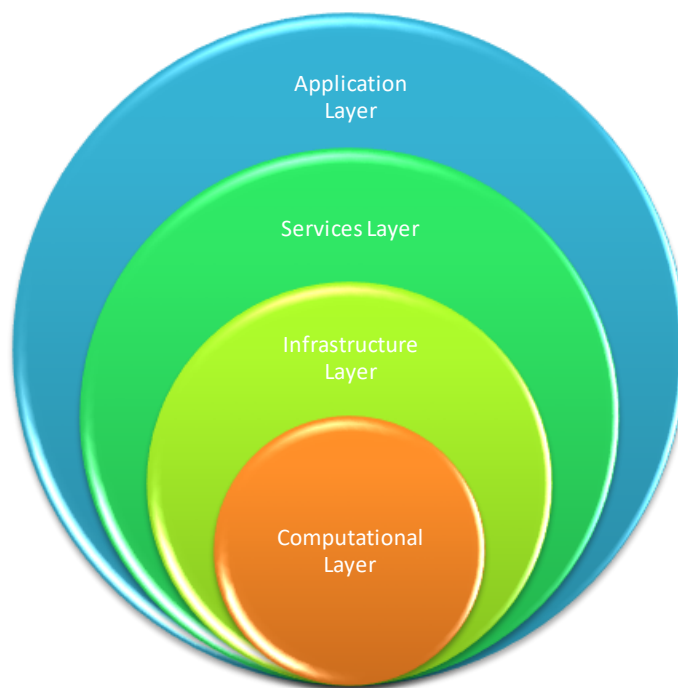

Figure 2: Functional Layers of CAI Architecture

1. **Computational Layer**: This is the foundational layer on top of which other layers sit. This is made up of AI, ML, DL programming languages like R, Python, Julia; supported with open-source ML/DL frameworks like TensorFlow, PyTorch, SpaCy, NumPy, SciKit-learn that provide APIs to build and experiment with various models. They are pre-packaged with advanced algorithms that can solve common ML problems such as machine translation using neural networks, named entity recognition, training data and so on.

2. **Infrastructure Layer:** This layer sits atop the computational layer and provides an integrated development framework that helps developers build CAI assistants. It includes NLU capabilities that identify intents and entities, ML-powered dialogue management, connectors that help integrate with popular messaging services, and custom actions that can be invoked to integrate with external systems and third-party platforms. IBM Watson Assistant, Facebook's Wit.ai, Google Dialogflow, SAP Conversational AI, Microsoft Bot Framework are some of the leading chatbot development frameworks used by B2B and B2C businesses alike.

3. **Services Layer:** The services layer sits on top of the infrastructure layer and helps to build a CAI agent that can hold conversations, understand intent and context, and execute certain tasks. This layer comprises various tools to collect, visualize, and review user conversations to test and improve CAI agent performance, contextual awareness, and intent accuracy. The tools work in conjunction to enable test with real users, set up and orchestrate CI/CD pipelines across the environments and make continuous improvements.

4. **Application Layer:** This is where the CAI agent resides and interacts alongside other systems and applications. i.e. enterprises Finance, Marketing, HR, and IT systems, depending on CAI use cases. Applications at this layer also have omni-channel user interfaces for users to see and interact. CAI agent can be deployed on hyperscaler clouds or hosted by on-premises data centers based on various security and privacy considerations.

A study of industry-leading CAI technology and platform players is covered in Appendix 3 with link to detailed analysis which would come in handy when choosing the appropriate CAI technology and platforms.

Conversational Artificial Intelligence vs. Chat Bots

Conversational AI and chatbots are widely used interchangeably to describe the same thing, which is valid to a small extent, but overall, their differences are stark in a user business interaction. CAI has evolved from chatbots from early 1960s, becoming more sophisticated as the decades rolled on.

While by mid 2000s, chatbots began to be commercially deployed for automating basic customer requests, it often was disappointing with customers because of AI limitations that resulted in the need to transfer requests to a human agent. However, in the last five years, rapid advances in NLP and ML combined with democratized cloud computing has seen CAI solutions becoming game changers today handling complex tasks and requests, delivering customer experiences that are unrecognizable from the early chatbots with many Bot interactions now indistinguishable from that of a human.

Essentially, chatbots are rule-based and follow a pre-determined conversational flow, while CAI is just the opposite. Rather than following a rigid structure, CAI relies on Natural Language Processing, Natural Language Understanding, Machine Learning, Deep Learning, and Predictive Analytics to deliver a more dynamic, less constrained user experience than chatbots.

Figure 3 compares them and shows a clear superiority of CAI over chatbots. However, despite the obvious benefits of CAI, chatbots are widely prevalent and utilized on a global scale, indicating that these two technologies are not at odds.

Conversational AI

✔ Capable of voice and text commands, inputs, and outputs

✔ Omnichannel: can be deployed on websites, voice assistants, smart speakers, and call centers

✔ Natural language processing, understanding, and contextualization

✔ Wide-scope, non-linear, dynamic interactions

✔ Dialogue focused

✔ Continual learning and fast iteration cycles

✔ Highly scalable. As the company's database and pages are updated, so does the conversational AI interface

✔ Easy deployment and integration with existing databases, text corpora

Chatbots

✘ Capable of text only commands, inputs, and outputs

✘ Single channel: can be used as a chat interface only

✘ Pre-determined scripted conversational flow

✘ Rule-based, canned linear interactions. Cannot handle out of scope tasks

✘ Navigational focused

✘ Any update or revision to the pre-defined rules and conversational flow demands reconfiguration

✘ Manual maintenance, updates and revisions = difficult and time-consuming to scale

✘ Time-consuming and complicated building process

Figure 3: CAI vs Chatbots (Courtesy: Hyro Hub[11])

Although CAI branched out from chatbots and is unquestionably more advanced, chatbots will go on to fill customer specific needs and tasks based on varying business scale, sectors, and operating models. With continuous innovation in AI, ML, and NL understanding, CAI will further evolve to become even more sophisticated. What is clear, however, is that the demand for both solutions will skyrocket over the coming decades. Broadly, routine work-based consumers prefer to use chatbots for quick tasks like Ordering Fashion Apparel and Food Delivery. Whereas dynamic work-based consumers intending to replace their visits to their healthcare provider, travel or bank would require CAI-based virtual assistants.

Solution Approach for CAI

Although building and implementing a CAI solution in-house might sound fascinating, the fastest and most efficient way is by partnering with technology firms specializing in CAI. These players have been perfecting their CAI engines and ML/DL algorithms, investing heavily in R&D, and learning from real-world implementations.

The proven Majorel phased approach[12] depicted in Figure 4 is an ideal execution model to yield a successful Conversational AI Solution.
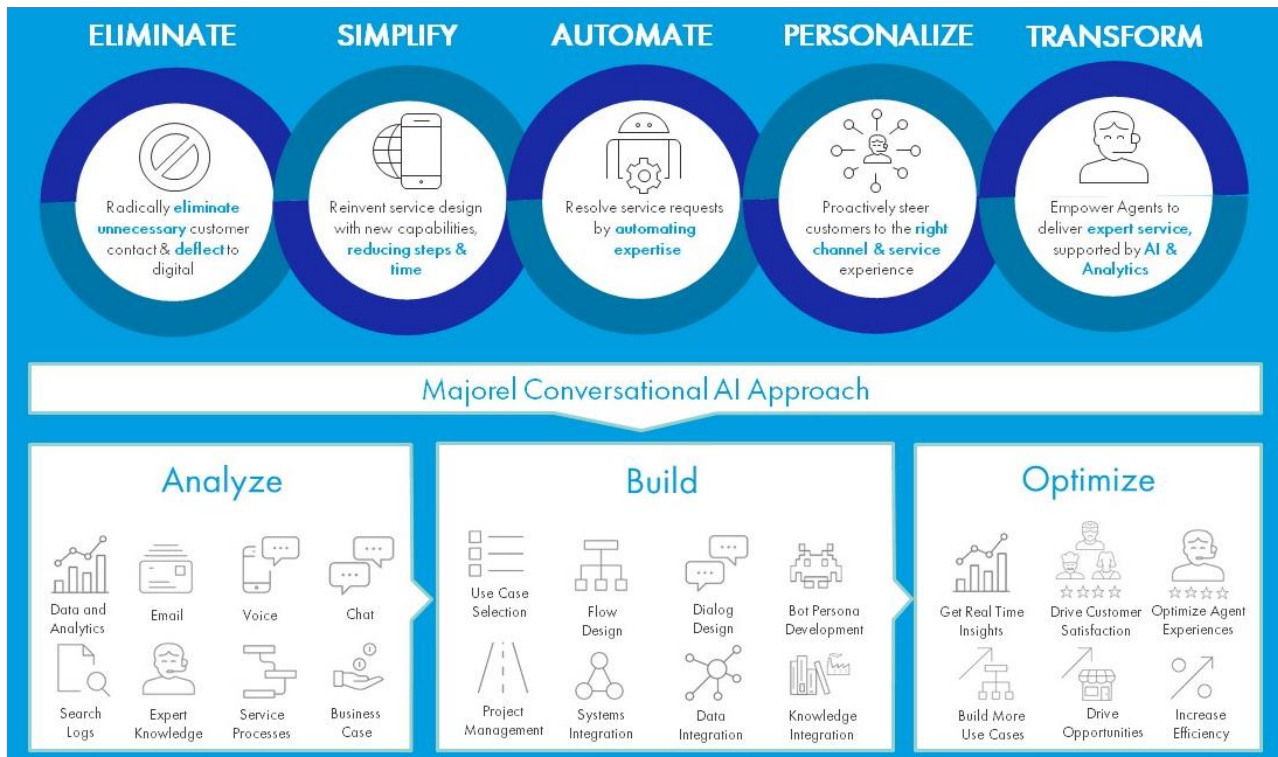

Figure 4: CAI Solution Approach (Source[13]: Majorel)

Analyze Phase focuses on Requirements Gathering, Data Analysis and Direction Setting with a Business case.

All the relevant stakeholders are involved to gain a thorough understanding of business drivers, target users, overarching vision, and critical requirements that would guide the direction, use and implementation of CAI. This also includes analyzing existing customer service systems, challenges, pain points, and processes appropriate for automation and CAI. This is supplemented with industry research to discover market opportunities, competitive advantages, and innovative use cases idea backlogs.

Build Phase focuses on Idea prioritization and Design Prototyping with pilot use cases.

Process mapping and use case analysis would help prioritize ideas based on value streaming and business drivers. As part of future-state, each Bot persona is assigned a primary actor and value-driver. These scenarios are then ranked on Business Impact, Organizational Readiness, and Ease of Implementation to determine stakeholder readiness and potential ROI. This helps to create a catalog of key features, functionality and use cases that show the most potential, explore their applicable delivery channels, analyze their alignment with current initiatives, and define the CAI pilot and roadmap. This is followed by CAI Pilot Use case Design with Conversational Dialog Flows, along with detailed integration requirements.

Optimize Phase focuses on Pilot Feedbacks, Use case refinement, Recommendations and Roadmap finalization.

Here, refinement of pilot and roadmap is based on comprehensive stakeholder inputs, user trials and key performance metrics gathered throughout the process. Additionally, organizational change management processes and associated organizational readiness would help determine the phased roadmap and next-step recommendations to optimize design processes, drive higher efficiencies, gain productivity, and improve customer experiences.

How to build an enterprise-grade conversational bot based on Azure Bot framework with a detailed reference architecture leveraging Azure services is discussed in Appendix-4. Although, every CAI bot is different, the architecture broadly covers the essential patterns, workflows, and technologies to be aware of while building a CAI solution.

Design Considerations & Model for CAI

It is vital to understand how the CAI solution will integrate with front/mid/back-office operations and 3rd party applications and systems. The various design considerations to keep in mind include specific requirements of the existing technical environment, integration architecture, source systems, solution layers and components, technology and toolsets, application and infrastructure requirements, security and risk compliance factors, manageability, and IT operations control.

The AI behind the conversational functionality of a CAI platform can range from complex techniques such as Machine Learning and Deep Learning to surface layers that rely on simple if-else chains to guide users through a flowchart. CAI Solutions broadly follow one or more of the models below with increasing levels of maturity.

Model 1: Simple handler exchanges through pre-built conversational flows that anticipate numerous possible standard use cases resembling classic chatbot. NLP technologies process incoming user messages and Information extraction to understand their intents.

Model 2: A generative and neural conversation-based model that helps cater to queries which the bot is usually not trained on. The bot clarifies queries with users if it fails to understand a particular part of their request on the first pass. Deep Learning technologies are embedded for reinforced learning from time to time.

Model 3: Advanced versions akin to Google Small talk that can handle random open-ended queries for a casual conversation. Here, the bot would pick up the intent and context to understand where the conversation is heading, generating an adaptive response based on the information provided and deliver an appropriate response to the user.

Simply put, the level of AI in CAI is what defines the 'brains' necessary to converse like a human. The key enablers which would shift the balance over time and transform CAI to more humane are:

- Simultaneous Multi-Intent Identification

- Managing Complex Context Switching

- Adapting to Interruption Handling

- Realtime Sentiment Analysis

An alternate 5-level CAI function-based capability maturity model is detailed in Appendix-2.

Practical Industry Applications of CAI

CAI is constantly focused on creating value across industries enhancing customer experience. On the demand front, most analysts predict BFSI, Public Sector, and Telecom will emerge as the leading adopters of Conversational AI, followed by Healthcare and Retail. COVID-19 has clearly accelerated the adoption and implementation of Conversational AI, even developing newer use cases. Nonetheless, the business implication of this momentum would be witnessed in the post-COVID era based on how quickly enterprises across verticals will adopt this technology.

Intelligent conversational interfaces are the simplest way for businesses to interact with devices, services, customers, suppliers, and employees everywhere. The rapid strides in AI and CAI solutions make it possible to conduct unique conversations with stakeholders at scale, delivering increasingly satisfying experiences that drive engagement and loyalty across industries.

Telecom: CAI-assisted call centers have been significantly supporting throughout the COVID-19-induced crisis particularly in telecom, which is the industry's backbone, handling an average of 2Bn hours of phone calls daily. Hence, CAI-assisted call centers will directly save both time and money by providing a simplified and intuitive customer experience.

Healthcare: CAI in healthcare has made it more accessible and improvising the patient care experience. Medical transcription powered with ASR is being used for physician-dictated notes, capturing physician and patient consultations, and for automatically converting speech to text for clinical documentation. NLU is being utilized to assist patients in selecting the right health insurance plan, onboarding, and appointment scheduling. NLU is also used to extract relevant medical information from large volumes of unstructured data to help with complex medical diagnoses.

Retail: CAI is commonly used in retail applications to accurately understand and resolve customer queries, process order requests and offer recommendations. CAI virtual assistants supports online shopping with voice, bridging the gap between physical and virtual shopping, and improving operational efficiencies in stores. NLP is also used for mining customer feedback, sentiment analysis, assessing buying styles, leading to higher customer retention rates. It further helps brands form customer relationships that last, hold conversations that have context, and ultimately sell more products.

Financial Services: CAI applications are enhancing customer service functions at banking and financial institutions by helping users autonomously manage simple tasks such as making payments, managing refunds, and facilitating transactions. In the insurance sector, CAI assistants accelerate claims by engaging customers with dynamic conversations. Further, it also aids in advanced fraud detection by identifying anomalies from past experiences, activities, and behaviors.

Travel and Tourism: CAI solutions in travel enable travel agents to save time and effort answering routine queries. Best of all, it can improve overall customer experience by delivering personalized, 24/7 assistance to help them book flights, access their booking plans, check flight status and boarding passes and even proactively suggest the best tourism deals and times to users based on their preferences.

Education: CAI bots can interact with students at any time of day, through multiple channels and in multiple languages. It can also access student data and past interactions to know the level they are in with regards to the lectures and keep them updated, while recommending relevant learning content, making learning easier. Advanced CAI bots can also act as virtual teaching assistants, answering questions that are stored in a knowledge base. The fact that chatbots can integrate with multiple channels is particularly useful as students use multiple channels and devices.

CAI Risk Mitigations

Like any other digital solution, CAI is not immune to security risks, threats and vulnerabilities. Threats are mostly one-time events such as malware and DDoS (Distributed Denial of Service) assaults. These targeted strikes frequently lock workers out and violate users' privacy. Vulnerabilities are systemic problems that enable hackers to breach in and allow threats to enter the system. Hence, both threats and vulnerabilities are inextricably linked.

Threats come in a variety of forms; Team member impersonation, Ransomware and malware, Phishing, Whaling, and Bot repurposing that can lead to data theft and modifications if not addressed, causing substantial harm to organizations and customers.

Vulnerabilities such as unprotected chats and an absence of clear security measures allow attackers to enter. If the HTTPS protocol is unused, hackers may gain rear access to the database via chatbots. The hosting platform itself can occasionally be the source of the problems.

Threat- and vulnerability-related security risks can be mitigated to a significant extent through Encryption, Authentication, Procedures and protocols, and User education.

End to end encryption imparts higher levels of security and ensures that apart from the sender and receiver, no one can access the chat records. This is a mandate to comply with General Data Protection Regulation (GDPR).

Authentication process guarantees that individuals utilizing the CAI gadget are genuine and not fraudsters. The authentication method can be one or more, i.e. biometric authentication, multi-factor authentication, timeouts, or user ID.

Procedures and protocols like HTTPS should be a security system's default configuration and any data transfer should be enforced over HTTPS and encrypted connections.

User education includes educating employees, self-erasing messages, web application firewall, etc.

CAI can be used to both break and defend systems. AI will improve cybersecurity as its use across industries increases. Humans can only scrutinize to a limited extent, while AI has infinite reach and ability for in-depth analysis allowing it to react to threat-prone customers as required.

Conclusion: The Future of CAI and Metaverse

Advancements in AI and technology companies rapidly enhancing their CAI product portfolios to stay ahead in the race is driving the following trends:

- Hyper Personalization: Emergence of newer "Speaking Styles" in virtual assistants, to suit specific personalities such as news anchors
- Prominent application of Neural Voice Cloning powered by Deep Learning technology to create "Customized Brand Voices"
- Rising emotional quotient in virtual assistants; NVIDIA launched an interactive 3D chatbot that recognizes vision and sound to power Conversational AI workflows
- Greater technology convergence between Conversational AI & RPA during COVID-19 to optimize call center operations with a growing focus on the "Human in the loop" model

CAI integrated with social media platforms, increases user engagement and acts as a newer medium for user communication, delivering continuous insights and feedback to enterprises to improve their collaboration efforts and even product and service offerings. CAI would still need Humans to function optimally with both skilled teams behind them and implementers who understand how best to use these advanced technologies.

Metaverse is characterized[14] as an expansive virtual space created by merging augmented and virtual reality (AR/VR) with AI to create scalable and realistic virtual worlds. Here, users can interact with 3D digital objects and virtual avatars in a complex manner that mimics the real world.

As the Metaverse boom picks up steam[15], CAI has a unique role to play by enabling creation of AI-driven virtual characters that can be used to populate virtual immersive worlds. These CAI powered avatars would be able to engage with many of the modalities that people utilize, such as facial expressions, body language, emotions, and physical interactions, in addition to speaking. CAI would create sophisticated, naturally interacting virtual characters that deliver more compelling digital experiences for users inside metaverse. The level of immersion offered by these experiences will determine whether the metaverse lives or dies.

CAI and Hyper Intelligent Automation are going to be an integral part of business transformations and our daily lives with growing adoption and innovation. The most prominent use case across industries and functions will be customer services where specifically voice-enabled CAI systems will be a priority for many organizations. Global enterprises could have intelligent bots talking to millions of customers soon, transforming digital interactions and redefining human experiences!

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Appendix-2: CAI Capability Maturity Matrix

Rasa has defined a guide[16] to Five Levels of CAI Assistants in enterprises based on capability maturity, illustrated in Figure 5. In this diagram, the distinctive levels of capabilities are on the right, the evolution timeline on the left, and example experiences at each level.
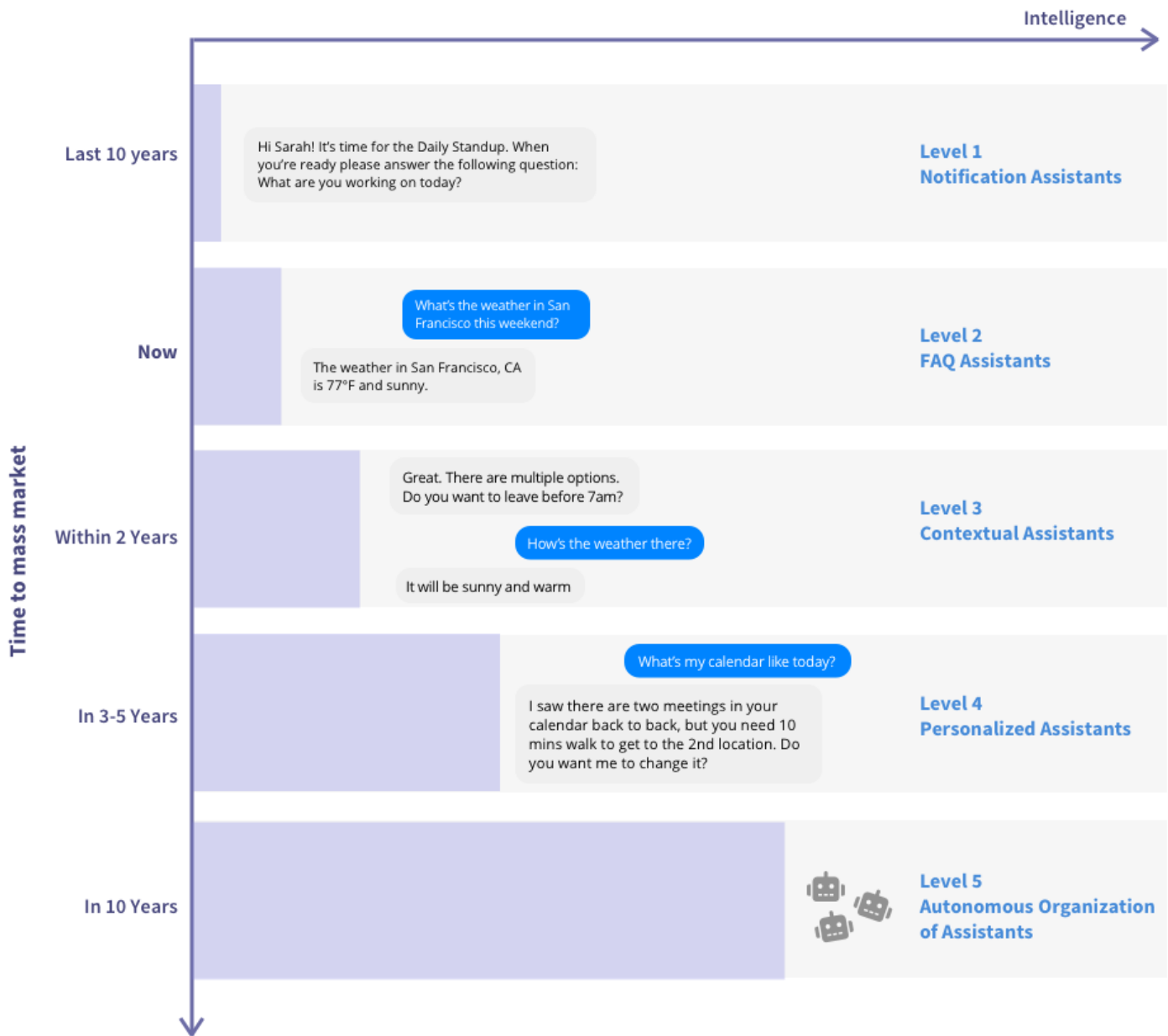

Figure 5: CAI Maturity Model (Courtesy: Rasa)

Level 1: Notification Assistants are intended for receiving notifications on cell phones or messaging apps, such as WhatsApp. This is how push notifications work on iOS and Android devices, with basic settings.

Level 2: FAQ Assistants are among the most common type of CAI that allows users to ask simple questions and get responses through a basic dialogue mechanism.

Level 3: Contextual Assistants are intermediate CAI that identifies the context based on past transactions that matter. Accordingly, it is capable of understanding and responding to different and unexpected inputs.

Level 4: Personalized Assistants are Intelligent Virtual agents that learn when it's a good time to get in touch and proactively reach out based on the context. It will remember user preferences and give them an ultimate, personalized interface.

Level 5: Autonomous Organization of Assistants are a group of CAI assistants that personally know every customer and run large parts of company operations, from lead generation over marketing, sales, HR, or finance.

Appendix-3: CAI Ecosystem

The Conversational AI Ecosystem graphic in Figure 6 depicts the various companies, products, and technologies shaping the future of conversational agents.
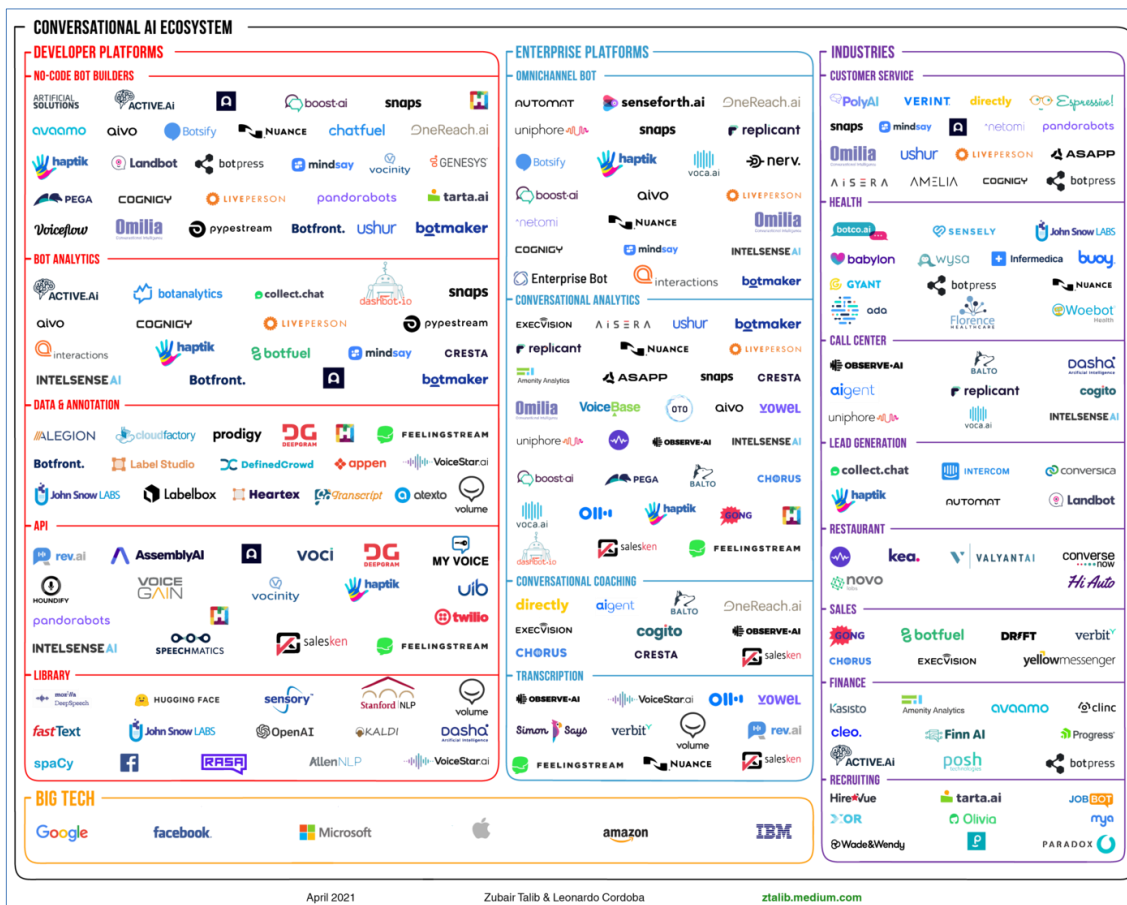
Figure 6: CAI Ecosystem (Source[17]: ztalib.medium.com)

CAI is a fast-growing industry with several start-ups and established companies offering a wide variety of products and services across industries for a wide range of customers. The analysis covers the top 200 companies and technologies based on:

- Category of Product / Service Offering
- Domain or Industry Area
- Investment / Funding

The detailed study is updated timely and available at the publicly shared Google[18] sheet. It is a solid reference for anyone exploring CAI solutions and platforms. (Source: ztalib.medium.com)

Appendix 4: Enterprise Grade CAI Platform Architecture

The reference architecture in Figure 7 depicts how to build an enterprise-grade conversational bot using the Azure Bot Framework, to serve enterprise-grade workloads. It covers the most essential design aspects, and introduces the tools needed to build a robust, secure, and actively learning bot.
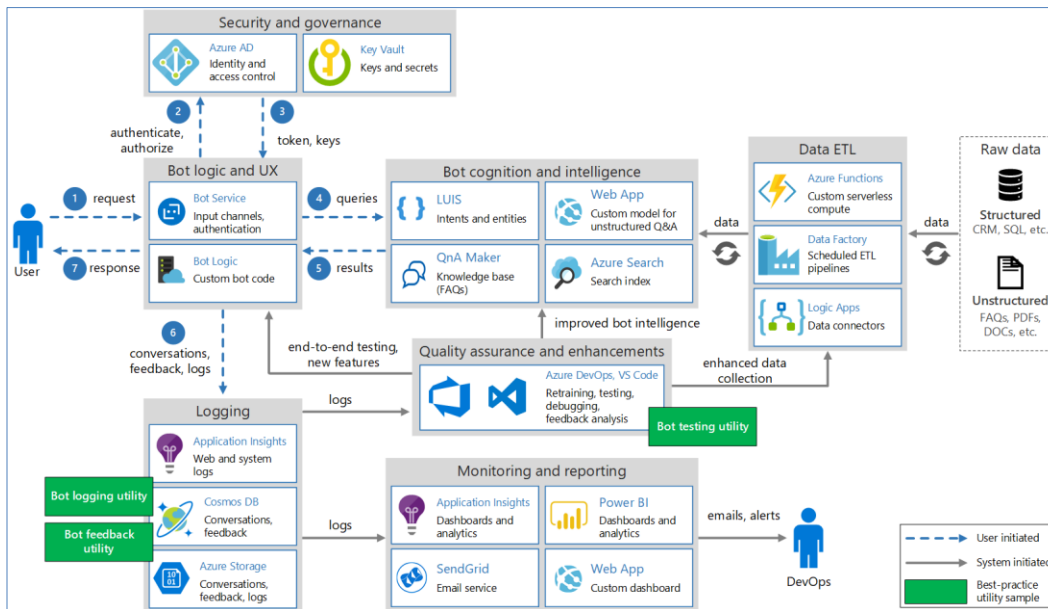

Figure 7: Enterprise CAI Platform Architecture (Source: Microsoft Conversational Bot[19])

The architecture shown here primarily uses the following Azure services:

Bot logic and user experience

1. Bot Framework Service (BFS) connects the bot to a communication app such as Cortana, Facebook Messenger, or Slack, and facilitates communication between the bot and user.
2. Azure App Service hosts the bot application logic.

Bot cognition and intelligence

1. Language Understanding (LUIS) enables your bot to understand natural language by identifying user intents and entities.
2. Azure Search is a managed service that provides a quick searchable document index.
3. QnA Maker is a cloud-based API service that creates a conversational, question-and-answer layer over the data. Typically, it's loaded with semi-structured content such as FAQs and used to create a knowledge base for answering natural-language questions.
4. Web app provides a web endpoint for the bot to call if it needs AI solutions not provided by an existing service. It helps to implement custom AI and host it as a web app.

Data ingestion

The bot will rely on raw data that must be ingested and prepared leveraging any of the following options to orchestrate this process:

1. Azure Data Factory orchestrates and automates data movement and data transformation.
2. Logic Apps is a serverless platform for building workflows that integrate applications, data, and services. It provides data connectors for many applications, including Office 365.
3. **Azure Functions** can help to write custom serverless code that is invoked by a trigger, i.e. whenever a document is added to blob storage or Cosmos DB.

Logging and monitoring

1. Application Insights can be used to log the bot's application metrics for monitoring, diagnostic, and analytical purposes.
2. Azure Blob Storage is optimized for storing massive amounts of unstructured data.
3. Cosmos DB is well-suited for storing semi-structured log data, such as conversations.
4. Power BI can be used to create monitoring dashboards for the bot.

Security and governance

1. Azure Active Directory (Azure AD) helps user authentication through an identity provider such as Azure AD. The Bot Service handles the authentication flow and OAuth token management.
2. Azure Key Vault store credentials and other secrets.

Quality assurance and enhancements

1. Azure DevOps provides many services for app management, including source control, building, testing, deployment, and project tracking.
2. VS Code is a lightweight code editor for app development. Any other Integrated Development Environment (IDE) with similar features can be used.