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Incident management assistant using artificial intelligence chatbots

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Abstract. The implementation for the concept presented in this paper was inspired by the fact that producers or service providers who want to furnish an extraordinary experience of their product have to be available and to give support 24/7 to their customers. More and more companies are opting for Artificial Intelligent Chatbots as part of their customer service team. This project aims to optimize and automate support for customers using the ServiceNow platform with a chatbot. Customers will have their own personal assistant who will create, delete, or modify the incidents assigned to them, but can also be used for recreational purposes or weather forecasts. Users can communicate with the chatbot using natural language through various chat applications: Skype, Webex Teams or through an intelligent speaker. The objectives that are proposed: illustration of the chatbot concept, illustrating the notion of chatbot through different scenarios, approaches; integration and use of common messaging services; using a platform as a service, named Firebase; create or modify data streams structured as incidents through APIs.

1. Key concepts for chatbot communication

A chatbot is an artificial intelligence software designed to perform a series of tasks on its own without a human being [1]. Even if the chatbot has limited capabilities, it has certain advantages over human agents: it is available non-stop and has access to a wide range of information and functionality, so it exceeds human performance in terms of speed and accuracy [3].

Taking the information from the annual report AT&T Inc. [4], it can be said that the intentions of the telecommunications leaders regard chatbots refers at cutting costs, achieved through automation of transactions, supply chain, optimization of network costs. In addition, continuous network transition to more software-based technology is expected to continue to drive favourable spending trends in the next years.

It can be seen the uniqueness and the impact will have on the users of the ServiceNow platform, but also the different method of development and testing compared to traditional applications.

Definition of the terms needed in order to build the chatbot on the Dialogflow platform [7]:

- the “intent” represents a mapping between what a user says and what actions should be taken by the chatbot or in other words represents the task that the user needs to solve. Also named “the base concept” in building the interface, it has several sections: key statements, action, reply and contexts.

- The entities are instruments used to extract the values of the parameters out of the natural language entries. The important data that we need to obtain from the request of a user will have a corresponding entity. A developer doesn't need to create an entity for each possible concept mentioned in the agent, but only for the ones needed for data execution. The entities are including the important details for the user intentions, and they can be anything: location, date, time.
- The action and its parameters are defined in the section "action", found under the "intent". The action corresponds with the step that the application will execute when a certain intention was triggered by the entrance of a user. The actions might have parameters to extract the needed information from a user's request and they will appear in a JSON (JavaScript Object Notation) answer.
- The contexts help with saving and sharing the parameters for the whole session.

2. Business logic for the implemented application

Because the application was developed based on various unrelated technologies and platforms, several things had to be taken into account:

2.1. API (Application Programming Interface) Calls

- On the Client Side, the following events occur:
 - a) The Client sends a request GET API with a URL (Uniform Resource Locator) parameter as a question
 - b) The Client will specify in the request the filtering parameter
 - c) The server will respond with either the requested information or an error
 - d) The Client will be able to analyze the JSON and determine whether or not there was an error
- The Server Side has the following tasks:
 - a) To send all API request data in a JSON response filtered according to the parameters described in the code
 - b) To respond with a status code of 200 OK if it is a valid API query
 - c) To respond with 400 Bad Request if the request does not meet the standards

2.2. Conceiving questions as contexts

Because NLP (Natural Language Processing) language has been used, the chatbot is successful when the instructions and intentions for which it has been trained are used. It is not flawless, but the user must be aware of the agent's ability to know which phrases are appropriate to trigger the actions.

It is necessary to think of the dialogue structure before the start of the chatbot conception, as it helps in selecting the right tools within the Dialogflow platform.

An error during the conversation means there was a problem in analyzing the sentence and obviously creating a generic question. In this case, a "Default Fallback" intention returns the message "Sorry, I did not understand that".

2.3. ServiceNow Instance

It is very important to verify that the developer instance on the ServiceNow platform is perfectly functional because it enters into a hibernation state in case of inactivity even for a short period of time. If the instance has not been accessed for a period of 10 consecutive days, the instance, the data and the changes will be permanently deleted.

2.4. Processing cloud commands

Functions that work with chatbot actions and which consist of JavaScript code are found in Firebase Cloud, a hosted, private, and scalable Node.js environment. These Cloud features integrate the Firebase platform, enabling the code to respond to events, and invoke features made available by other Firebase features.

The project structure contains 2 files:

- package.json: contains a list of NPM package dependencies for this project
- index.js: used to implement Cloud features

3. Application Architecture

The intelligent agent must be able to turn a sentence from English into a smart query, then go through the relevant data to find the necessary information and finally return a natural language response.

The main features of the chatbot are as it follows: the API Web call will include a query as a string of URL queries and the service will respond with a JSON file; the system will process questions written in English; answers to the questions will be written in standard English and easy to understand; extract the information that will be made from the ServiceNow platform that holds the database space containing all the necessary information.

Users can communicate with the chatbot using natural language through various chat applications: Skype, Webex Teams, or through the intelligent speaker.

Chatbot is on the Dialogflow platform, and the processing of functions take place in Cloud, specifically on Firebase that supports NLP. The code is written in NodeJS entirely. The assistant communicates with the ServiceNow platform using the API table this platform provides. ServiceNow is the platform that incorporates the database of records that need to be processed.

In Figure1 can be seen the application architecture:

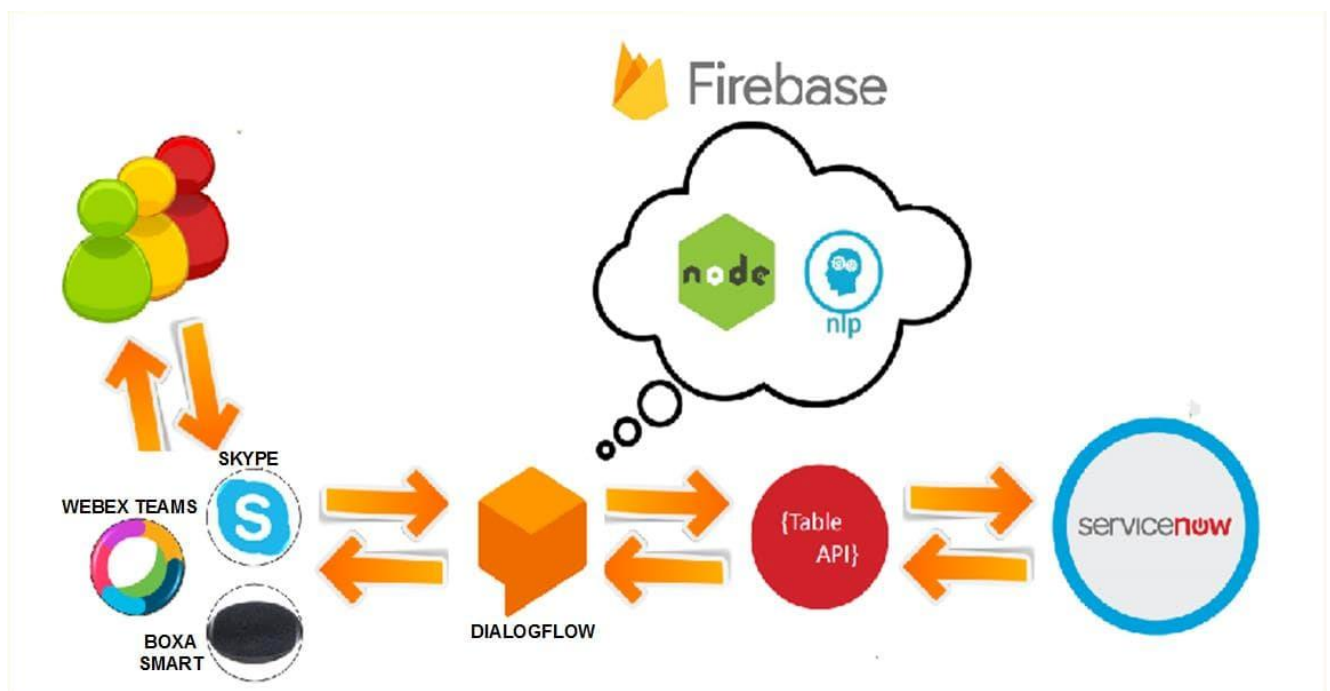


Figure 1 Application Architecture with the used platforms

4. Used Software technologies

4.1. Dialogflow

Dialogflow is a Google platform, used to develop human-computer interactions technologies, based on natural language conversations. Supports 20 languages and the integration with 14 different platforms [11]. It has a code editor, which allows the creation of new applications without the need for a server connection.

In order for the agent to understand the interactions of a user with the natural language, he uses Machine Learning. In the Dialogflow terminology, the agent uses learning algorithms for machines in order to match with the user requests having specific intentions and uses entities in order to extract the relevant data from them.

An agent “learns” from the examples provided in the Training Phrases section and from the language models developed by Dialogflow. Based on this data, the agent builds an algorithm in order to decide the best course of action regarding the intention that needs to be triggered by a user entry, and what data it needs to extract. This algorithm is unique for that chatbot.

The algorithm is capable of dynamic adjustments, based on the modifications operated on the Dialogflow platform. The chatbot is constantly educated using real conversation journals.

4.2. ServiceNow

ServiceNow is a cloud based platform. Many organizations have started to migrate from the old ITSM (IT service management) platforms to ServiceNow, due to the fact that it has an easy to use GUI (Graphical User Interface), doesn't need a database or networking equipment due to data being saved in the cloud, and the price it's much lower. It's in a continuous development, and each upgrade brings new and exciting features. The purpose of this platform is the managing of a company's IT infrastructure, including the managing of the ticketing system. It is a win-win for both sides, client and company. It automates the IT operations by creating a unique registration system for the various IT processes from inside the company [13].

4.3. Firebase

Firebase is a robust application developing platform, which simplifies a number of tasks related to the production of quality software solutions. It's almost sure that it will pose a strong competition for Amazon Web Services and alike, not in small part due to the fact that is owned by one of the most respected software developing companies in the world: Google.

The testing environment is designed so the developer receives not only notifications about the moment the application crashes, but also complete reports and diagnosis, so he can repair the errors in the software. The delivered report offers the option for monitoring fatal and non-fatal errors, to collect the relevant data needed to diagnose the initial problem that has triggered the event, and to integrate the event statistics with Firebase Analytics, and all of this for free [14].

Basically, Firebase is Backend-as-a-Service—BaaS, the server used in this application. It's a real time database, but it doesn't require connection over HTTP, using instead a WebSocket connection, which is faster. All data synchronize automatically through the WebSocket.

4.4. REST API

ServiceNow offers access to instances through a set of APIs. The ServiceNow REST APIs are using basic authentication and OAuth2.0 in order to authenticate the requests. There are several types of APIs, in order to allow requests for creating, reading, updating and deleting entries in the existing tables [15].

4.5. Actions on Google

Actions on Google allows to extend the functions for the intelligent agent, the virtual assistant belonging to Google that is integrated in over 500 million devices, such as smartphones, cars, tv's, watches and many more [16].

5. Chat platforms used as a third party

In the following are presented some pictures that captured the chatbot at the moment of conversation on both platforms: Skype and Webex Teams:

5.1. Skype

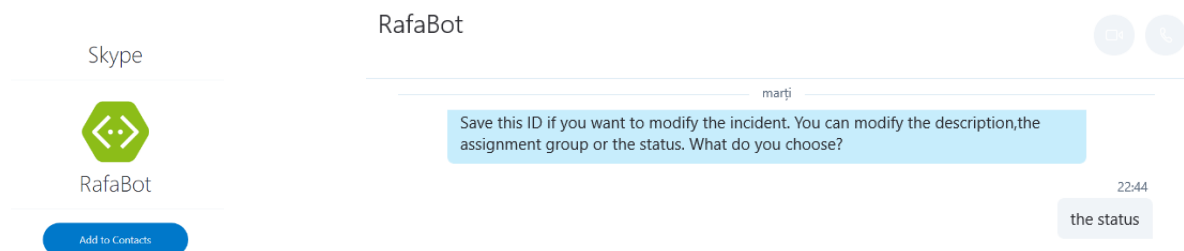


Figure 2 Adding chatbot to contacts

Figure 3 Conversation with the chatbot

5.2. Webex teams

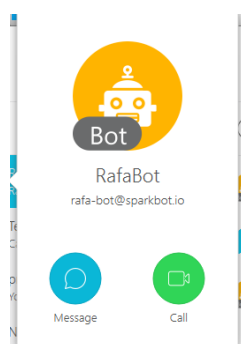


Figure 4 Adding chatbot to contacts

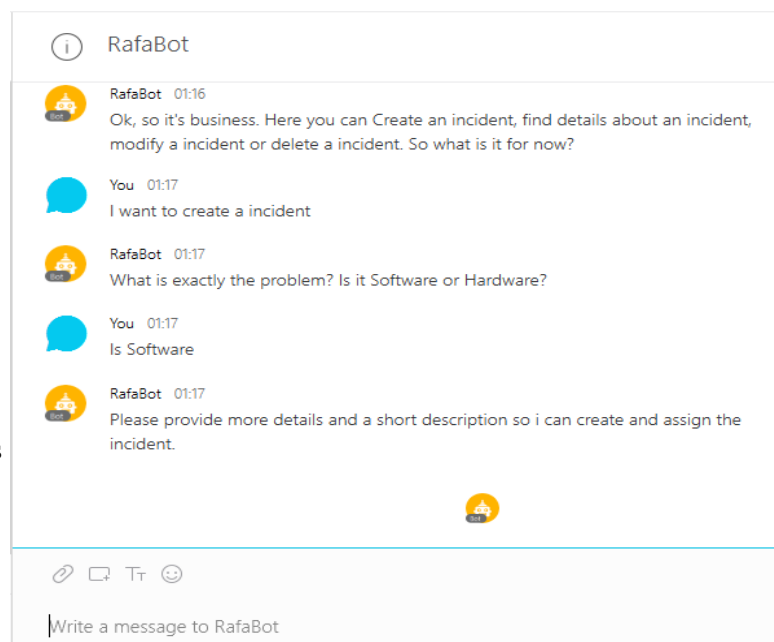


Figure 5 Conversation with the chatbot

The user's intentions are ranked according to the task it has to fulfill, so they contain the training phrases of the agent, which are in fact examples of what a user might say. For example, when the agent asks for the user's name, he could respond with: "My name is Rafaela," "I'm Rafaela," or just "Rafaela." All these queries are unique, but they have the same intent.

When an intention changes, Dialogflow will start to train the agent with the new added data. If the training is not complete, the updates may not be reflected in the agent.

In ServiceNow the table that has been used is called Incidents, here are stored all the tickets that will be modified, created, deleted or interrogated by a client.

Incidents New Go to Number Search 21 to 40 of 83									
	Number	Opened	Short description	Caller	Priority	State	Category	Assignment group	Assigned to
		13:58:10	my dog says mu		5 - Planning	New	Inquiry / Help	Service Desk	
	INC0010042	2018-06-20 13:53:19	my dog says mu		5 - Planning	New	Inquiry / Help	Service Desk	
	INC0010041	2018-06-20 13:51:47	my cat says mu		5 - Planning	New	Inquiry / Help	Service Desk	
	INC0010040	2018-06-20 13:48:17	my cat miauuu		5 - Planning	New	Inquiry / Help	Service Desk	
	INC0010039	2018-06-20 13:43:18	my cat is miau		5 - Planning	New	Inquiry / Help	Service Desk	
	INC0010038	2018-06-20 13:38:38	my cat says miau again		5 - Planning	New	Inquiry / Help	Service Desk	
	INC0010037	2018-06-20 13:32:51	my cat says miau		5 - Planning	New	Inquiry / Help	Service Desk	
	INC0010035	2018-06-18 04:51:47	my PC is broken	IT Virtual Agent Rafa	5 - Planning	In Progress	Inquiry / Help		SLA Manager
	INC0010033	2018-06-17 12:56:04	notificari overdue	IT Virtual Agent Rafa	5 - Planning	New	Inquiry / Help	Hardware	
	INC0010030	2018-06-16 08:48:13	my cat is Meuuu	IT Virtual Agent Rafa	3 - Moderate	New	Inquiry / Help	Hardware	
	INC0010026	2018-06-08 08:14:38	test3		5 - Planning	New	Inquiry / Help		

Figure 6 ServiceNow Incident table

The Number field refers to the ticket number, is one of the key parameters in handling tickets. Another important parameter is Short Description, which will be the decision element in assigning the ticket to a ServiceNow user. Priority is a field that can have values between 1-5, the State parameter refers to the status of the ticket, a parameter that changes according to its pickup and update. There are also other fields that can be considered or not in filtering and processing vouchers.

In the firebase logs can be seen the success of the intent. In case of errors, the output is the following:

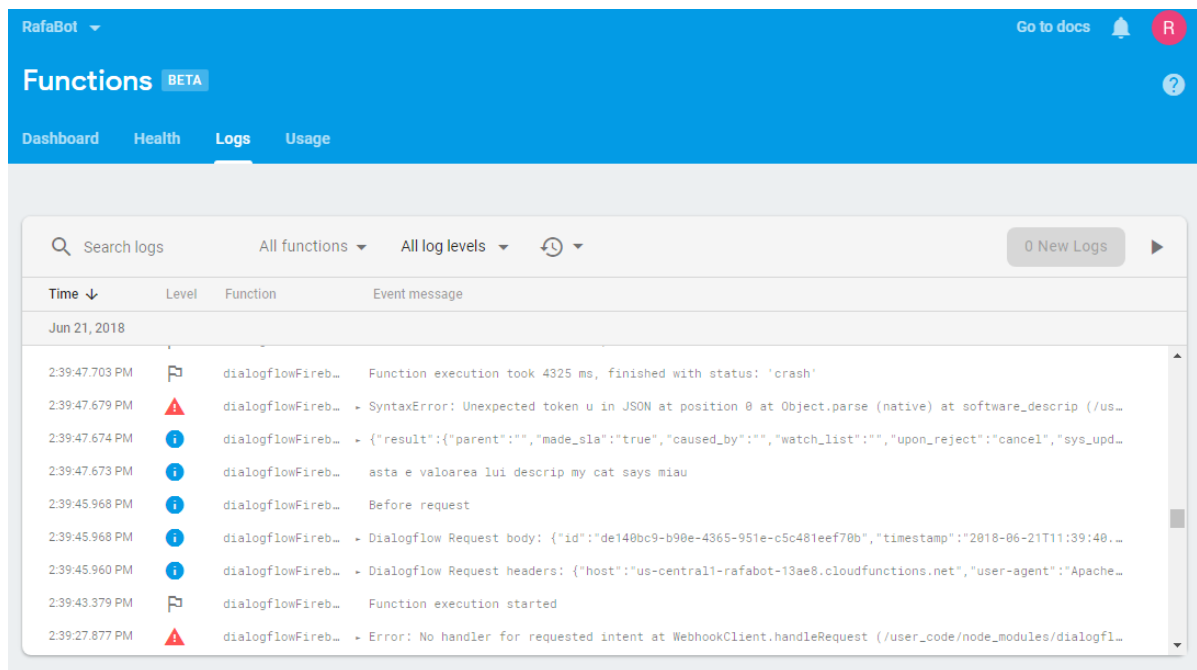


Figure 7 Log analysis in Firebase

All the code is saved in an `index.js` file, but with this code some constraints also appear. It is necessary to include in the `package.json` the libraries and the versions necessary for proper operation. This file can be modified along the way and installs these pieces of software that depend on the `index.js` code when the Deploy button is clicked.

Limitations and issues when using Firebase cloud features were as it follows: all changes must be made to the Firebase console in Dialogflow; the function must be called "dialogflowFirebaseFulfillment", if the function name changes, it will not be implemented through Dialogflow; the modified code in the dialogflow editor can not be saved or downloaded without being implemented; the Dialogflow Editor only supports two files: `index.js` and `package.json` (modifying `package.json` will install any dependencies you specify when deploying); network Calls generated by this feature for non-Google destinations are paid.

6. Results

Throughout this documentation, it was noted that the design of a chatbot is quite complex and depends on many factors. The fact that it has been an integration of 4 different platforms to work together, propels the level of difficulty well above average.

Finally, the scope is accomplished: to create a support staff that will solve some tasks for creating, modifying, and receiving data from certain information in the ServiceNow platform. In addition to this main purpose, there have been implemented certain features such as getting the temperature from a certain city or some conversations for fun.

PaaS (platform-as-a-service) provides all the infrastructure needed to run applications over the Internet. The benefits of PaaS include changing and frequently improving the application, as well as accessing the platform from various geographic points.

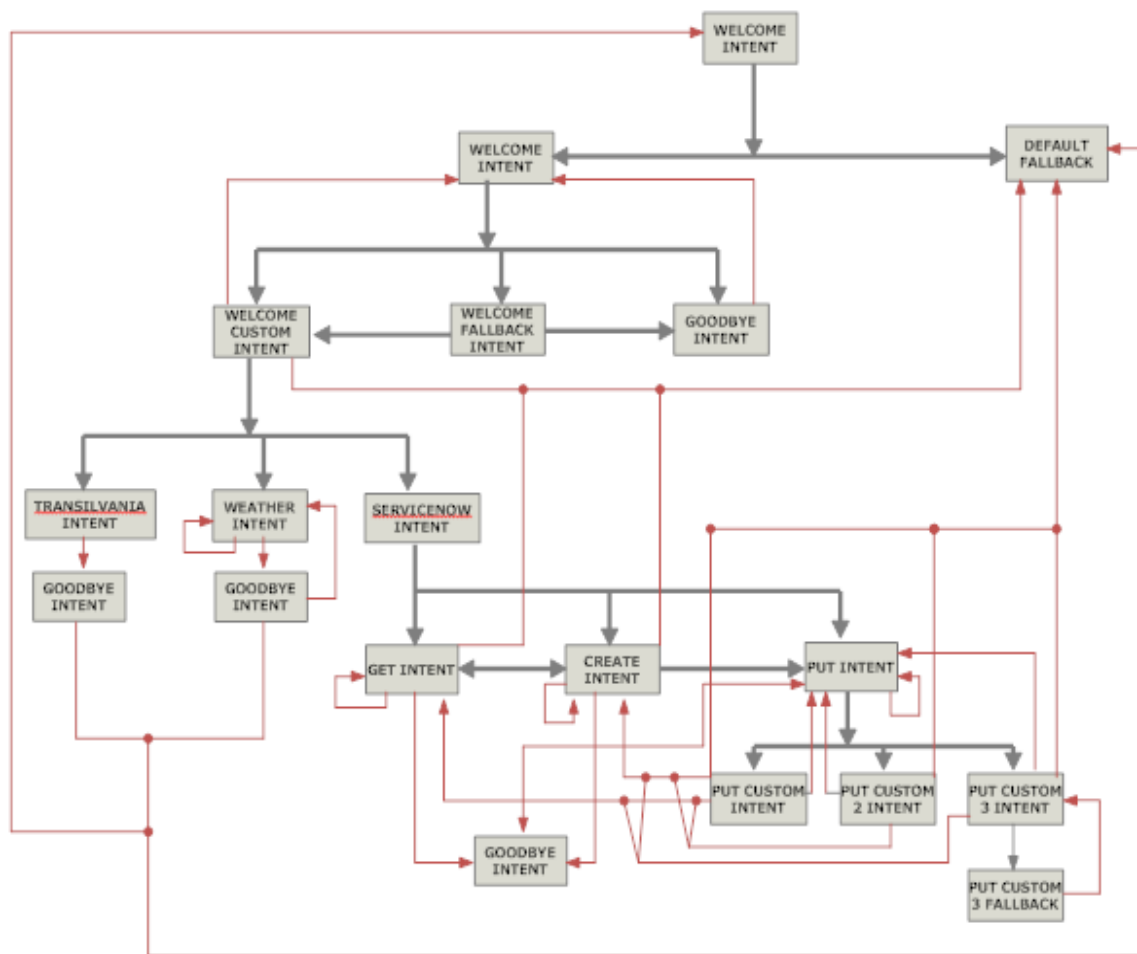


Figure 8 The conversational flow a user can have with this chatbot

Several things were taken into account in designing the conversational workflow, for example: the Conversion Chart has been sketched and a conversation flow has been designed for each task the chatbot can fulfill. The developer has assured that the chatbot can handle any information received from the user and may suggest the type of response it is expected to get if the user is not properly analysed.

Creating the flowchart could be resembled with a tree. Figure 9 propose the bot user expected interactions and ensures that each user request is covered by a part of the bot logic. Every sentence sent by chatbot needs to be carefully thought out. There should be avoided personal pronouns and open questions. To build a more natural conversation, bot responses need to be diversified as much as possible.

The problems that slowed down the developing process were: compatibility issues between platforms, the rules on ServiceNow platform, the fact that the code was processed with delay in Firebase.

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