Author Name : Krishna Swamy N A
Author Email : krishna.swamyna@tpv-tech.com

Alexa with Philips TV
FP Milestone

DOCUMENT REFERENCE FRAME

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1. INTRODUCTION

This is a FP milestone document for Alexa project.

1.1 SCOPE

Scope of this project was to

- Understand various terminologies in Alexa
- Understand how to build Alexa skills
- Propose a model for integrating Philips TV with Alexa along with implementation
- Identify cost aspects in the entities used
- Identify pending items for Asset Creation

2. DELIVERABLES

Following PBIs were identified for the Project.

PBI#	Description	Document Path	Code	Date
36833	Creation of training material : Alexa	Document Link	NA	2017-10-13
36834	Channel change on TV	NA	ssh://astagit/device/tpvision/common/app/voice branch: scrum/voice_ad	2017-09-29
36835	Control Ambilight with Echo	NA	ssh://astagit/device/tpvision/common/app/voice branch: scrum/voice_ad	2017-10-13

Code Structure

git ssh://astagit/device/tpvision/common/app/voice

./android/alexaclient	Android App to be installed in TV. Responds to database changes in firebase. Apk generated after building is deployed onto Philips Android N MSAF TV.
./nodejs/customskill	Ambilight style change feature implementation in NodeJs using custom skill. This is zipped and uploaded to Lambda server
./nodejs/smarthome	Channel change feature implementation in NodeJs using smart home skill. This is zipped and uploaded to Lambda server

3. BRIEF OVERVIEW OF ALEXA IN CONTEXT OF TV

Alexa is amazon's cloud based voice control system. Alexa can be accessed/used using Alexa enabled devices like Echo. Alexa has a set of built in abilities like playing music, weather forecast etc … These are called skills.

Amazon also provides an Alexa Skill Kit (ASK) using which developers can add new skills.
Different types of Skill one can develop are.

- Custom Skill – Order a pizza from domino's
- Smart Home Skill API – Turn lights on and off
- Smart Home Skill for Entertainment Devices – Change TV volume
- Video Skill API – Play a movie
- Flash briefing Skill API - What's the latest news.

Once a skill is developed, it has to be certified by Amazon for it to be available in Alexa Skill store. Once available in Alexa Skill store users can enable and use.

To add a skill, amazon alexa app is required which is available for free for Android, iOS and Web.
In web it can be accessed using https://alexa.amazon.com/spa/index.html

Alexa is currently available in US, UK, Germany and India.

In context of TV, below skills are applicable.

- Smart Home Skill for Entertainment Devices
  - It has a set of built-in interfaces that can be used
  - We cannot add any custom interfaces other than the ones available as built-in
  - TV forms part of Smart home ecosystem, so addressing multiple Philips TVs in a home can be done using TVs friendly name
  - It needs AWS Lambda to host skill specific code. This has billing implications
  - Utterances are fixed and no clear documentation on the utterances exists. There is a very active developer forum where we can post questions.
  - Currently this skill is only supported for US region.

  Supported Smart home skills interfaces applicable for TV

Operation	Capability Interface	Comments
Turn things on and off	Alexa.PowerController	Waking up from standby will not possible. But TV can be put to Standby
Change the channel on a device	Alexa.ChannelController	Channel change using display number possible. Channel change using channel name may not be possible, since it is not clear if this interface support all channel names applicable for Philips TV
Change the input of a playback device	Alexa.InputController	
Change the volume in incremental steps	Alexa.StepSpeaker	Step increment
Change the volume to anywhere on a continuous range	Alexa.Speaker	Set volume to any value

- Custom Skill
  - This has maximum flexibility
  - Conversation can be decided by us. We need to provider set of utterances, arguments.
  - We have to design Voice UX ourselves. Hence it has flexibility to support any feature we want

- It needs to have an invocation name along with every command.
  Eg: Ask Philips TV to switch on ambilight.
  Multiple TV's at home needs additional interaction handling.
- This does not need AWS Lambda. We can have our own https server.
- Skill is supported in all alexa enabled regions – US, UK, Germany (German), India

Broad level changes involved in creating a skill

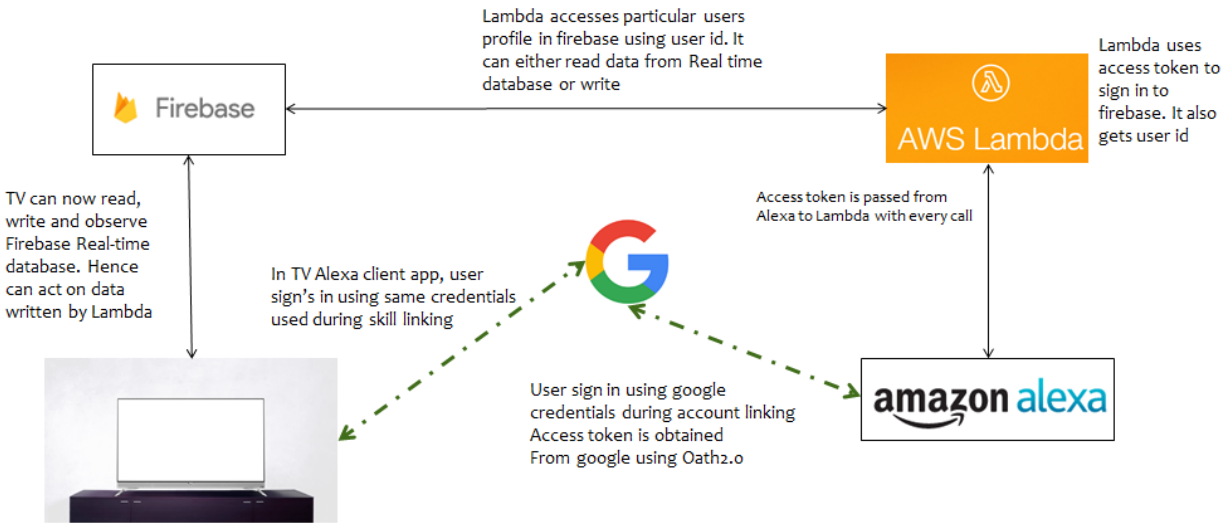
1) Configuration in amazon developer portal for Alexa
   a. For custom skills this may involve building an interaction model in portal
2) Implementing intent or directive handling in cloud service
   a. For custom skill, cloud service can run on any https server with valid trusted certificate and additional security checks or on a AWS Lambda server
   b. For Smart home skill, implementation needs to be present in AWS Lambda server
   AWS Lambda supports coding only in NodeJs, Java, C#, Python.
3) Implementation of functionality for triggers in cloud service. This is where the business logic of the skill is implemented. Eg: If the trigger is for channel change, cloud service needs to be communicated to device cloud
4) Implementation on the client device which acts on trigger from device cloud. Eg: Device cloud can trigger the TV for channel change, TV in turn tunes to the channel
5) Beta testing
6) Privacy URL and ToU update in configuration
7) Getting clearance for using Brand licence for Philips TV
8) Certification by Amazon for it to be publicly available

As part of this project, one feature was proven for Custom skill and Smart home skill.

- In Smart home skill, Alexa.ChannelController built in interface was implemented to change channel using digits
- In custom skill, changing Ambilight style to Hot Lava, Fresh Nature and Deep Water was implemented. Also Ambilight On/Off was supported

Below is the overview of design used to prove the functionality for both.

- Alexa needs an endpoint to which text-to-speech directives/intents are sent. AWS Lambda was used for this. Programing language used was NodeJs.
- AWS Lambda needs to communicate with TV cloud. Firebase Real time database is used as Philips TV cloud.
- Amazon Echo device was used.
- An android application Alexa client in TV was needed to connect to firebase for listening to database changes. The same was implemented



4. MILESTONE OUTPUT

- Channel Change using Smart home skill built-in interface was proven on a MSAF set using AWS Lambda and Firebase
- Ambilight style changing using custom skill was demonstrated on MSAF set using AWS Lambda and Firebase
- A conversation with Alexa known as Dialog mode was also demonstrated.
- Understanding of Alexa was documented as a presentation.

5. BILLING

AWS Lambda service and Firebase both has cost implications.

AWS Lambda - lets you run code without provisioning or managing servers
Advantages

- No Servers to Manage
- Continuous Scaling
- Sub second Metering

AWS Lambda billing

- Requests – Numbers of function invokes in AWS Lambda
  - First 1 million requests per month are free
  - $0.20 per 1 million requests thereafter ($0.0000002 per request)
- Duration –
  - 1M free requests per month and 400,000 GB-seconds of compute time per month
  - $0.00001667 for every GB-second thereafter

Eg:
If **128MB** is the RAM Lambda function uses, and executed the function **3 million** times in one month, and each function ran for **3 second** each time

Monthly compute charges
The monthly compute price is $0.00001667 per GB-s and the free tier provides 400,000 GB-s.
Total compute (seconds) = 3M * (3s) = 9,000,000 seconds
Total compute (GB-s) = 9,000,000 * 128MB/1024 = 1125000 GB-s
Total compute – Free tier compute = Monthly billable compute GB- s
1125000 GB-s – 400,000 free tier GB-s = 725,000 GB-s
Monthly compute charges = 725,000 * $0.00001667 = $ 12.08575

Monthly request charges
The monthly request price is $0.20 per 1 million requests and the free tier provides 1M requests per month.
Total requests – Free tier requests = Monthly billable requests
3M requests – 1M free tier requests = 2M Monthly billable requests
Monthly request charges = 2M * $0.2/M = $0.40

Total monthly charges
Total charges = Compute charges + Request charges = $12.08575 + $0.40 = **$12.48575** per month

Firebase –
Advantages

- Backed by Google. Ideal for Android TVs.
- Cross platform Real time database.
- Can use Google sign In authentication. Since google supports Oath2.0 it is a good candidate for account linking with alexa
- Firebase sdk is available for Nodejs and android

Firebase billing

Products	Spark Plan Generous limits for hobbyists Free	Flame Plan Fixed pricing for growing apps $25/month	Blaze Plan Calculate pricing for apps at scale Pay as you go
Realtime Database			
Simultaneous connections	100	100K/instance	100K/instance
GB stored	1 GB	2.5 GB	$5/GB
GB downloaded	10 GB/month	20 GB/month	$1/GB
Automated backups	✗	✗	✓

Storage: Appx. 1GB of storage is required for 1 million users.
Connections: Assuming 1 million TVs use alexa, 1 million connections is required

Alexa client needs to continuously monitor firebase realtime database, it needs to have a connection to it.
As in picture, in free plan maximum parallel connections allowed to database are 100 which is not suitable at scale for TVs.

Next alternative is to choose Flame Plan.
It provides 2.5 GB of storage which is sufficient

But Connection limit is 100k. To scale we need to host multiple realtime database and distribute TVs among these realtime database. This adds additional complexity.

For 1 million connections we need to host 10 realtime databases which translates to $25*10/month = **$250** per month

6. FURTHER ACTION FOR PRODUCTIZATION

6.1 ADDITION OF MORE USE CASES

- Usecases for voice control over Alexa for Philips TVs needs to be identified and implemented
  Sample usecases can include:
  - Channel Change using channel name
  - Volume Change
  - Source Change
  - Launching of application
  - Additional Ambilight features
  - Launching “How To” or “Help”
- Definition of Voice User experience and interaction model if custom skill is used
- Definition of UX and flow for Alexa client android app in TV

6.2 SKILL LISTING IN AMAZON SKILL STORE

- Custom skills and Smart home skills cannot be combined into a single skill in amazon skill store. This means there would be 2 skills for Philips TV. From end user point of view we need to see if this is acceptable.
- Amazon & Google account creation for Company along with linked credit card in case of AWS Lambda usage
- Creating Brand Icons for hosting in Amazon skill store
- Content for skill description (for hosting in Amazon skill store), eUM update for Alexa usage

6.3 CERTIFICATION PROCESS

- Skill Beta testing
- Getting clearance for using Philips TV Brand.
- Skill certification with Amazon
- Privacy URL and ToU URL content definition and hosting on a publicly accessible server

6.4 COST OPTIMIZATION

- Alternatives for Firebase for reducing cost. Includes checking if a feature like Real time database is available with Gson.
- For custom skills, Cost implication of https server can be compared against AWS Lambda server billing and best among them can be used.

6.5 ALEXA ENGINE INTEGRATED ON TV

- Exploration of Alexa Voice Service (AVS SDK) – to voice-enable connected products with a microphone and speaker. C++ SDK available.

7. REVISION HISTORY

Version	Date	Status	Author	Description
0.1	13-10-2017	Proposed	Krishna Swamy N A	Initial draft
0.2	16-10-2017	Proposed	Krishna Swamy N A	Review comments from Vijayan incorporated.
0.3	16-10-2017	Proposed	Krishna Swamy N A	Modified section 6