ZLK38AVS User Guide
Microsemi AcuEdge™ Development Kit for Amazon AVS

Microsemi
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Contents

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1 Revision History

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

1.1 Revision 2.0

Revision 2.0 was the first publication of this document.

1.2 Revision 1.0

Revision 1.0 was the preliminary publication of this document.

2 Overview

Microsemi AcuEdge™ Development Kit for Amazon AVS is engineered to help you evaluate voice-enabled front-end audio systems for your Alexa-enabled products. This kit features Microsemi's ZL38063 voice processor powered by Microsemi's proprietary AcuEdge™ technology for front-end audio clean-up and Sensory's TrulyHandsFree™ "Alexa" wake-word engine. Two separate microphone configurations allow you to test applications with 180° or 360° far-field pick-up.

This document walks you through all the steps of building an Alexa-powered prototype using Microsemi's ZLK38AVS development kit and a Raspberry Pi. It takes you from setting up the ZLK38AVS kit, integrating it with an 'Alexa' wake word engine and connecting to the Alexa Voice Services (AVS) cloud. Once completed you will have an Alexa-enabled application that will function like an Amazon Echo.

2.1 Other References

The following are documents you may want to refer to when using this guide. These documents can be found on the Microsemi Audio Processing GitHub for the ZLK38AVS:

- ZLK38AVS Quick Start Guide
- ZLK38AVS Product Brief
- ZLE38AVS Evaluation Board Hardware Guide
- ZL38063 Product Brief
- ZLS38100 Microsemi VProc SDK Documentation

3 ZLK38AVS Development Kit Contents

The ZLK38AVS development kit is shipped with some of the required hardware while other hardware must be provided by the user. All the software for the ZLK38AVS development kit is provided through GitHub.

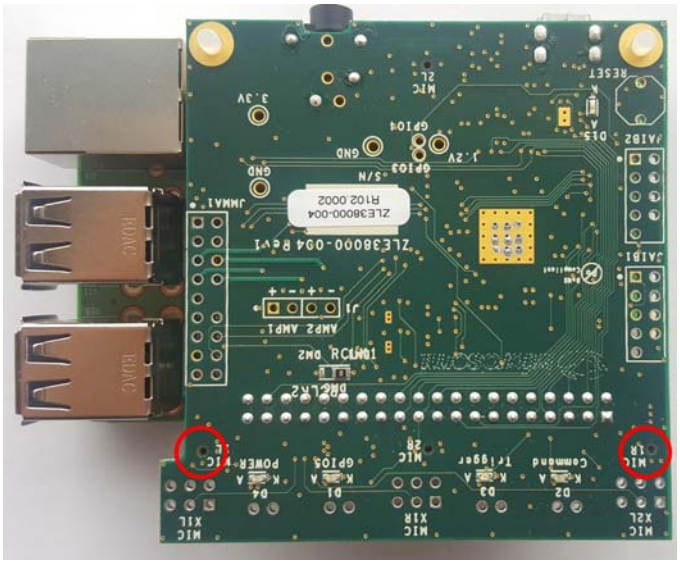
3.1 Hardware Provided

The following hardware is provided in the ZLK38AVS Development Kit:

1. ZLE38AVS evaluation board
2. Pillar (speaker and Raspberry Pi plastic stand)
3. Plastic standoffs and screws

Figure 1 • **ZLK38AVS development kit contents**

Figure 2 • **Raspberry Pi and ZLE38AVS evaluation board**



3.2 Hardware Not Provided

The following hardware is needed to run the ZLK38AVS demonstration and needs to be provided by the user of the development kit:

1. Raspberry Pi 3
2. 2 A or greater power supply for the Raspberry Pi 3 (power can be provided via a USB3/Micro-USB connection from a PC).
3. Micro SD card (8 GB or higher; a card with a 90 MB/s or greater read speed is recommended)
4. External Speaker with a 3.5 mm jack (the example in Figure 6, page 6 is the JBL Clip Speaker, available from Amazon at https://www.amazon.com/gp/product/B00KH636V2/)
5. USB keyboard and mouse
6. HDMI monitor and cable
7. Ethernet Cable (or WiFi) for Internet connection

Note: The monitor, keyboard, and mouse connections are optional if using VNC (or similar) to connect to the Raspberry Pi.

3.3 Software

The following software for the ZLK38AVS Development Kit is provided through GitHub:

1. A make file which installs all the required software
2. The latest Timberwolf device series Voice Processing Software Development Kit (SDK). The Voice Processing SDK is a collection of software, tools, code examples, and documents for rapid development with the Microsemi's Timberwolf device series.
3. A Firmware Loader Application: This application makes use of the Voice Processing SDK functions to load the firmware into the ZL38063 device.

Note: During the ZLK38AVS installation, the software will download the sample application "alexa-avs-sample-app" from Amazon. The Amazon sample application will download all prerequisite files, drivers, and applications needed by the Alexa Voice service, including the Sensory Library.

4 Hardware Assembly

To assemble the ZLK38AVS kit the following instructions should be followed:

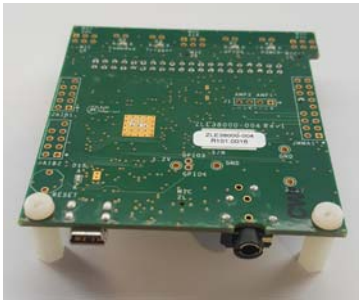
4.1 Pillar Assembly

1. Screw in the Raspberry Pi onto the front side of the Raspberry Pi mounting ring and add the 2nd set of standoffs

Figure 3 • **Mounted Raspberry Pi with standoffs attached**

2. Add the standoffs to the ZLE38AVS evaluation board

Figure 4 • **ZLE38AVS board with standoffs attached**



3. Plug in the ZLE38AVS evaluation board and add the remaining screws

Figure 5 • **ZLE38AVS board attached to mounted Raspberry Pi**

4. Place the speaker facing downwards into the lower plastics

Figure 6 • **Pillar with speaker attached**

5. Plug in the speaker to the ZLE38AVS evaluation board

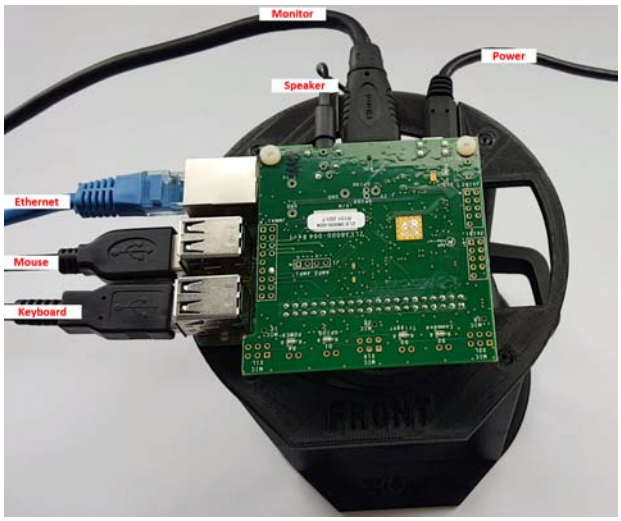
Figure 7 • **Speaker plugged in to ZLE38AVS board**

4.2 Raspberry Pi Connections

1. Connect an HDMI monitor to the Raspberry Pi
2. Connect a USB mouse and keyboard to USB ports of the Raspberry Pi
3. Connect the Raspberry Pi to your network with an Ethernet cable or Wi-Fi
4. Flash image onto the SD card using the Wind32Diskimager application (see Creating Raspbian Image, page 8)
5. Insert the SD card into the SD card slot of the Raspberry Pi
6. Connect a compatible 5V power supply to the Raspberry Pi's Micro-USB port in order to power up the Raspberry Pi

Note: The monitor, keyboard, and mouse connections are optional if using VNC (or similar) to connect to the Raspberry Pi

Figure 8 • **Raspberry Pi connections**



5 ZLK38AVS Software Installation

There are two steps to installing the software on the Raspberry Pi:

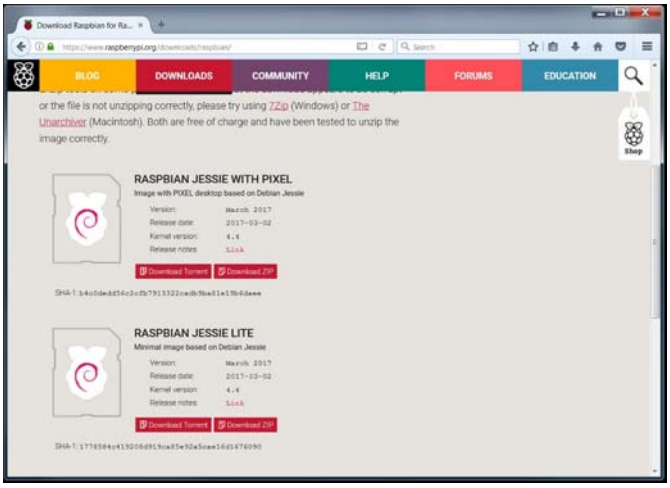
1. Creating Raspbian image: This step is performed on a separate PC.
2. Raspberry Pi Software Installation: This step downloads the installation scripts and installs the Microsemi, Amazon, and Sensory software onto the Raspberry Pi. This step requires a monitor, keyboard, and mouse connected to the Raspberry Pi, or a VNC (or similar) connection to the Raspberry Pi in order to control and monitor the installation process.

5.1 Creating Raspbian Image

Raspbian Jessie with Pixel is the operating system that will be installed on the SD card. On a separate PC, follow the steps below:

1. Format the SD card to FAT32 to ensure you are starting with an empty card.
2. Download and install Win32DiskImager from https://sourceforge.net/projects/win32diskimager/.
3. Download Raspbian Jessie with Pixel from https://www.raspberrypi.org/downloads/raspbian.

Figure 9 • **Raspbian download page**

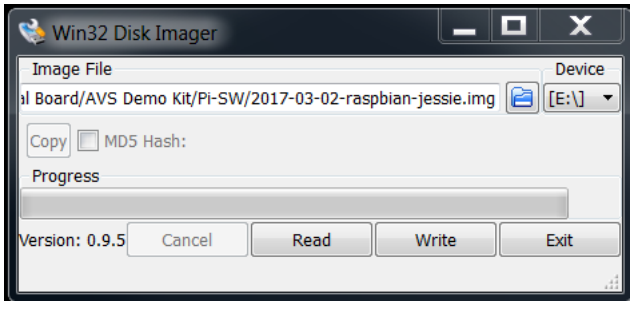


4. Unzip the downloaded image.
5. Write the image to the SD card using Win32DiskImager:
   a. Select the downloaded image.
   b. Select the SD card device in the Device drop down menu.

Note: Ensure the correct device is selected as all data on the selected device will be overwritten.

   c. Select write to save the image to the SD card. This process will take approximately 6 minutes.

Figure 10 • **Win32 Disk Imager example**



6. Once the card has been written, exit Win32 Disk Imager and install the SD card into the Raspberry Pi.

5.2 Raspberry Pi Software Installation

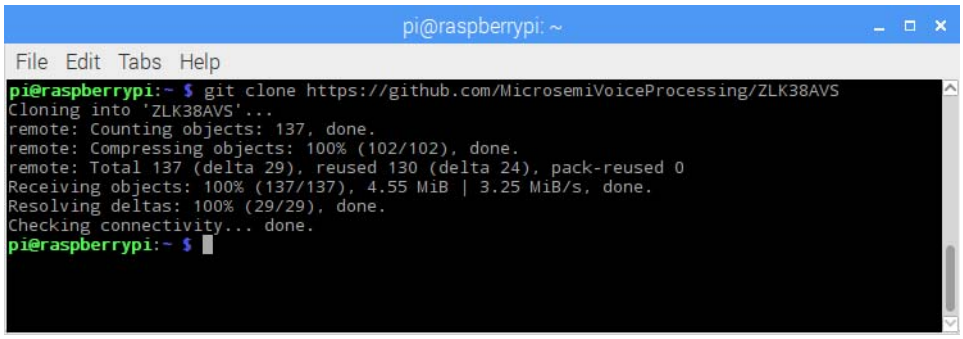
Once the Raspberry Pi is up and running, make sure the it is connected to the Internet by opening up the web browser. Open a terminal window and change into your desired working directory, or create one.

5.2.1 Downloading ZLK38AVS Software

The Microsemi software for the ZLK38AVS kit can be found on the Microsemi Voice Processing GitHub repository. To download the repository on your Raspberry Pi run the following command:

```
git clone https://github.com/MicrosemiVoiceProcessing/ZLK38AVS
```

Figure 11 • **Downloading ZLK38AVS software**

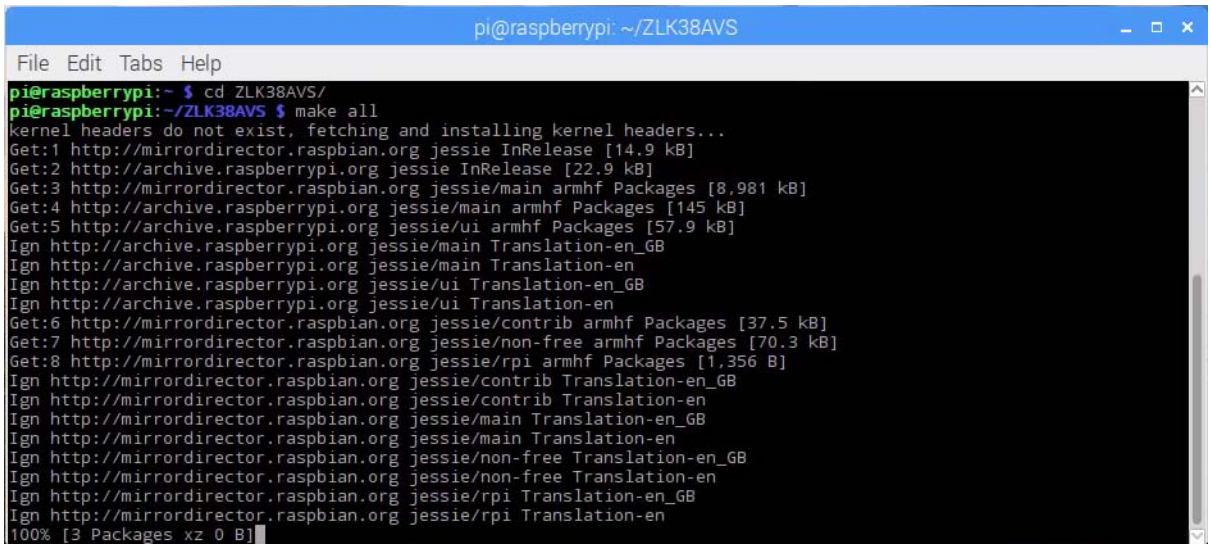


Note: git is installed by default with the Latest Raspian Jessie, but it can also be installed using the command:
`sudo apt-get install git`

5.2.2 Installing ZLK38AVS Software

1. Cd into the location where the GitHub package was downloaded.
   `cd ZLK38AVS/`
2. Run “make all” command.
   a. During “make all” the software will download the headers for the current kernel running into the PI. This step can take as long as 30+ minutes.
   b. If the Pi seems to be staying on a message saying “Unpacking and installing raspberrypi-Kernel-headers ….” and shows no progress for a long time (~20-30+ minutes), this does not indicate a problem with the installation or the Pi. This is the correct behavior because this processing of unpacking kernel headers takes time. If there is a problem an error message will be shown.
   While this step is running, it may be a good time to create your Amazon account. You will need information from the creation of your Amazon account later in the software installation (See Amazon Developer Account Creation, page 16)

Figure 12 • **"make all" command running**



3. "make all" will automatically download the Amazon Alexa Sample application and install it. The installation of the Amazon sample apps requires an Amazon developer account (see Amazon Developer Account Creation, page 16).
4. When prompted, enter the following information from your Amazon Developer Account (see Amazon Developer Account Creation, page 16):
   a. Device Type ID
   b. Client ID
   c. Client Secret

Figure 13 • **Alexa app installation example**

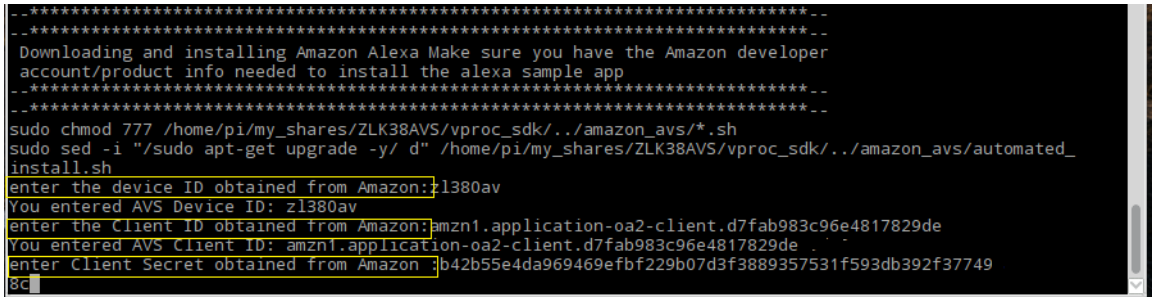
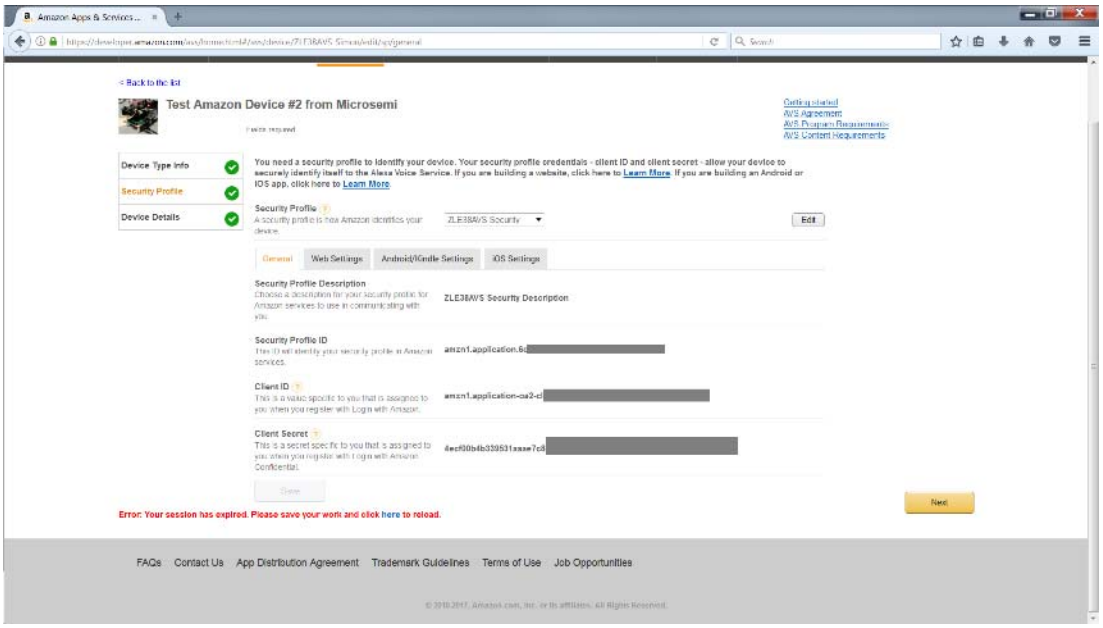


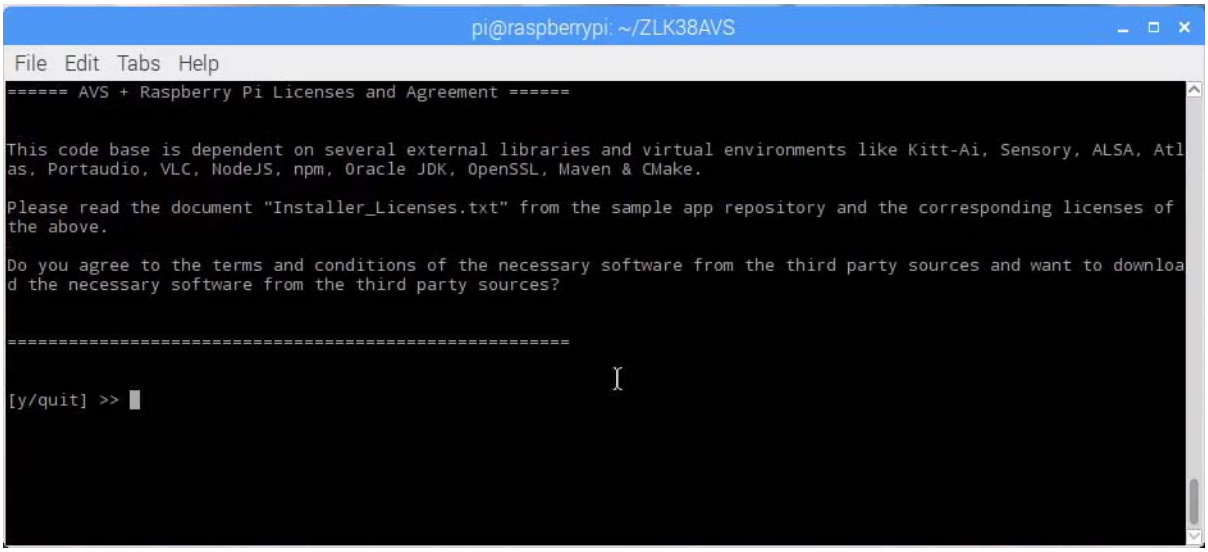
Figure 14 • **Amazon Developer Account ID example**



Note: The IDs shown above are only given as example and they are not valid, enter the correct information from your Amazon Developers Account.

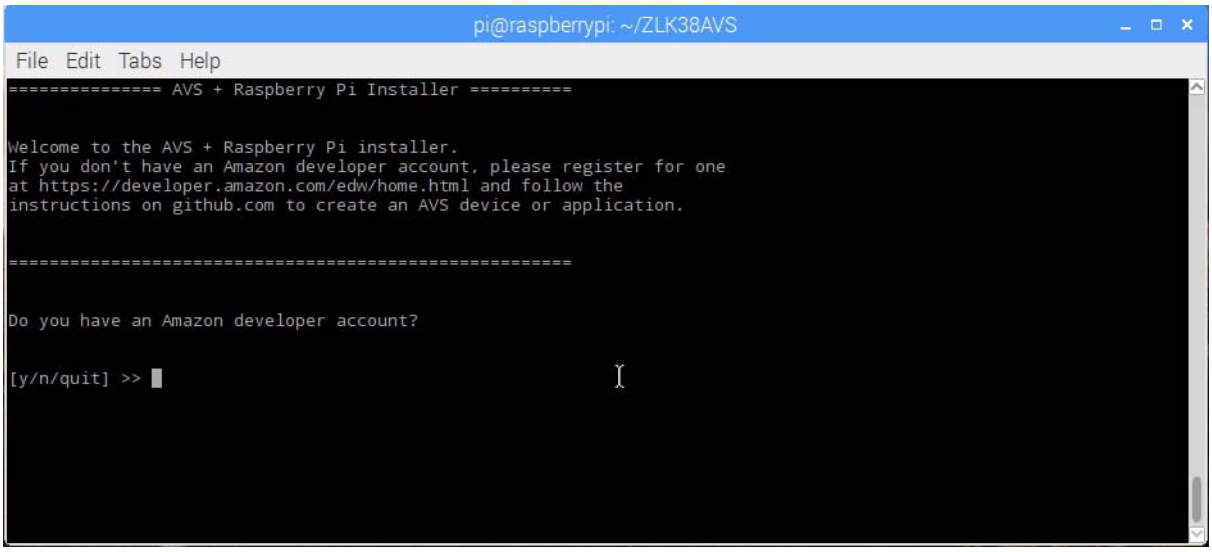
5. After entering the requested IDs, the installation of the Amazon sample application will start. Further questions that require an answer from the user will be asked by the Amazon installation:
   a. Continue Installation?

Figure 15 • **License and agreement verification**



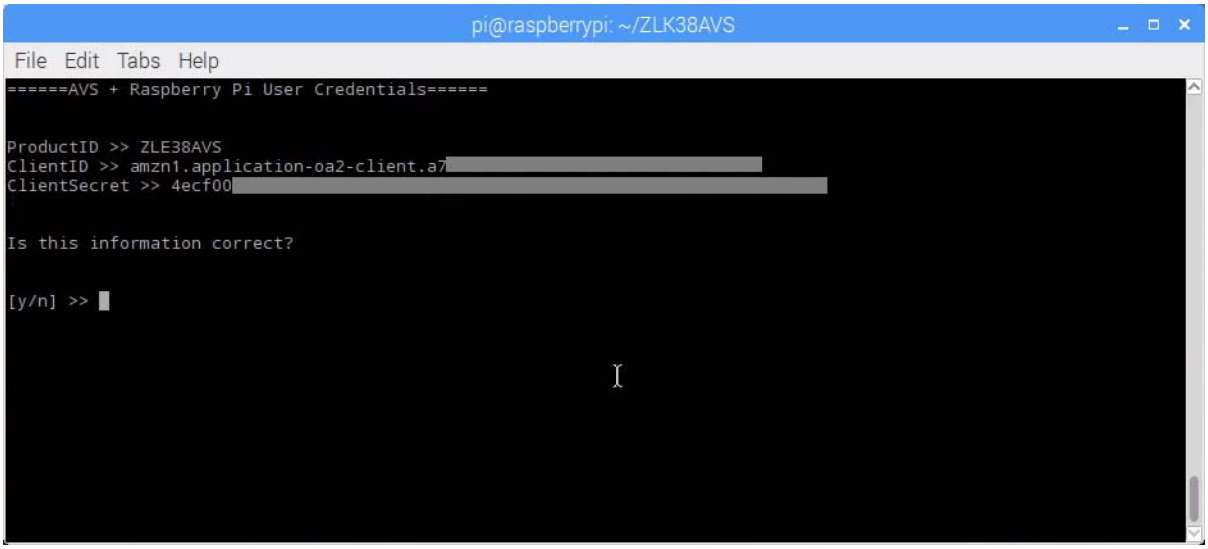
   b. Do you have an Amazon developer account?

Figure 16 • **Amazon developer account verification**



c. Is this information correct? (Verify and reply with the appropriate answer.)

Figure 17 • **User Credentials verification**

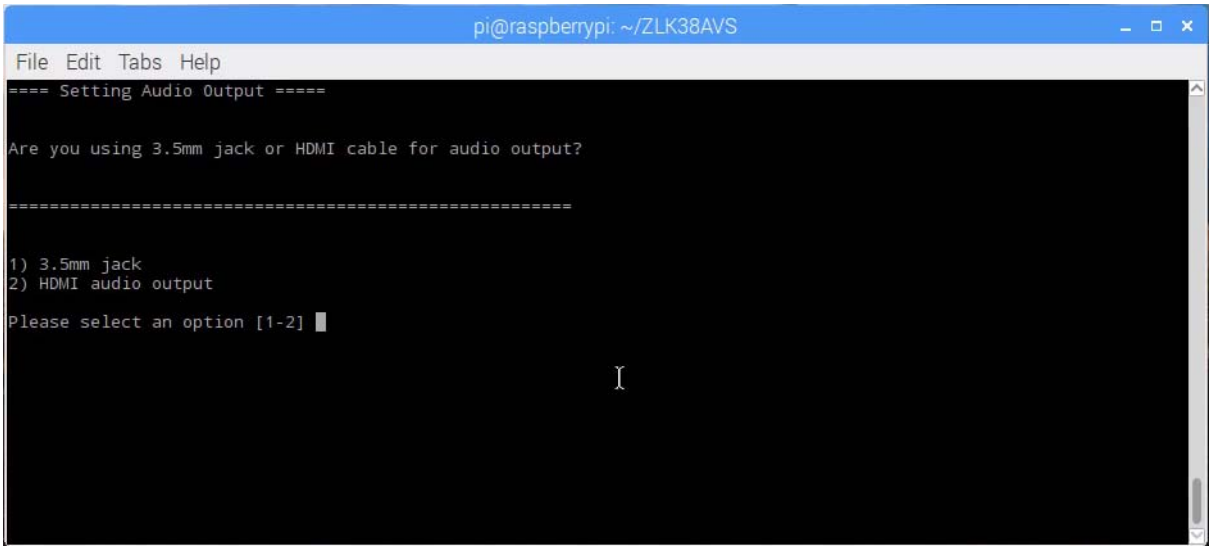


d. Which locale would you like to use?

Figure 18 • **Setting Locale**

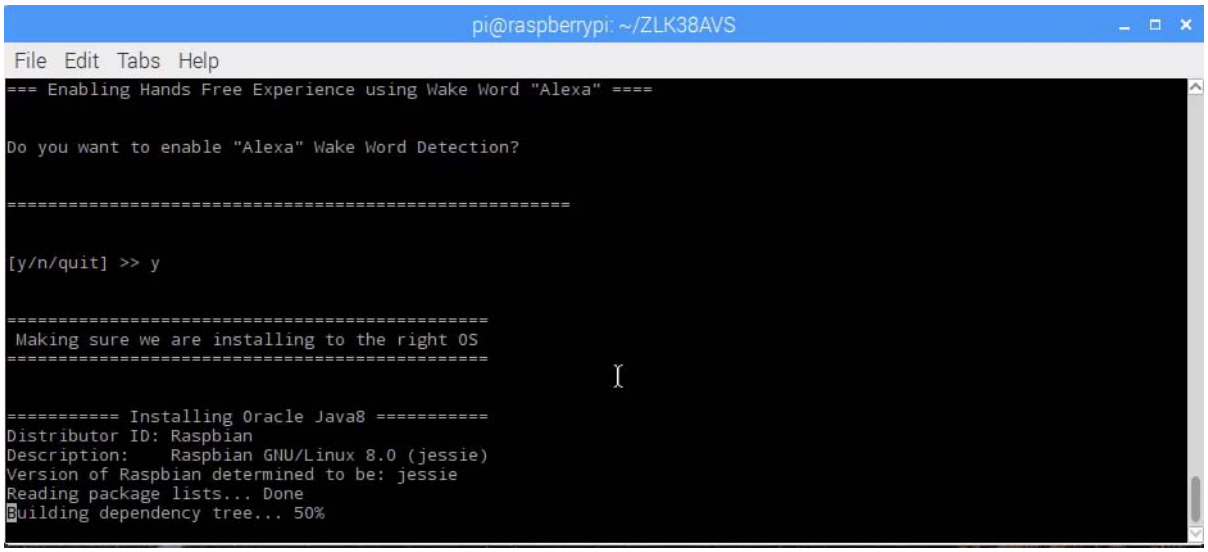
e. Are you using 3.5mm jack or HDMI cable for audio output? (Since the audio will be generated and processed by the ZLK38AVS audio device, either option can be selected.)

Figure 19 • **Setting Audio Output**



f. Do you want to enable "Alexa" Wake Word Detection?

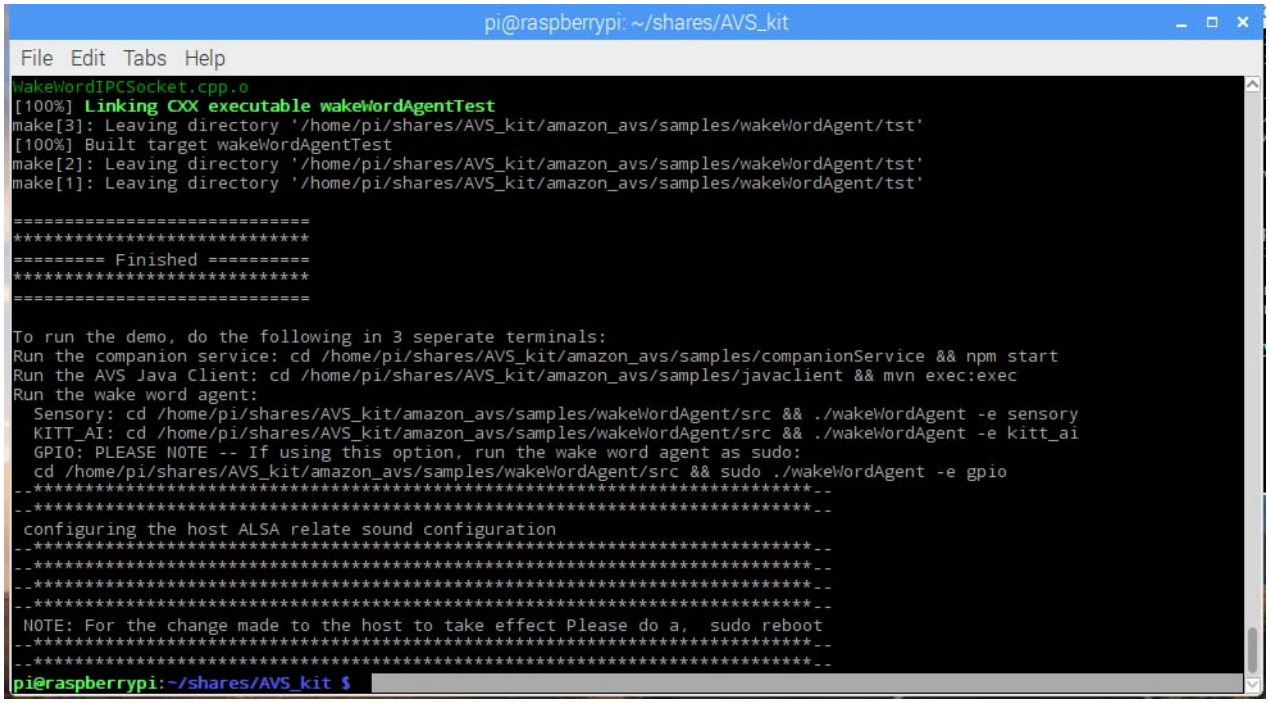
Figure 20 • **Alexa Wake Word Detection installation verification**



Note: Installation of the Amazon Alexa application can takes as long as 45+ minutes.

6. A successfully completed installation should show the message in the image below:

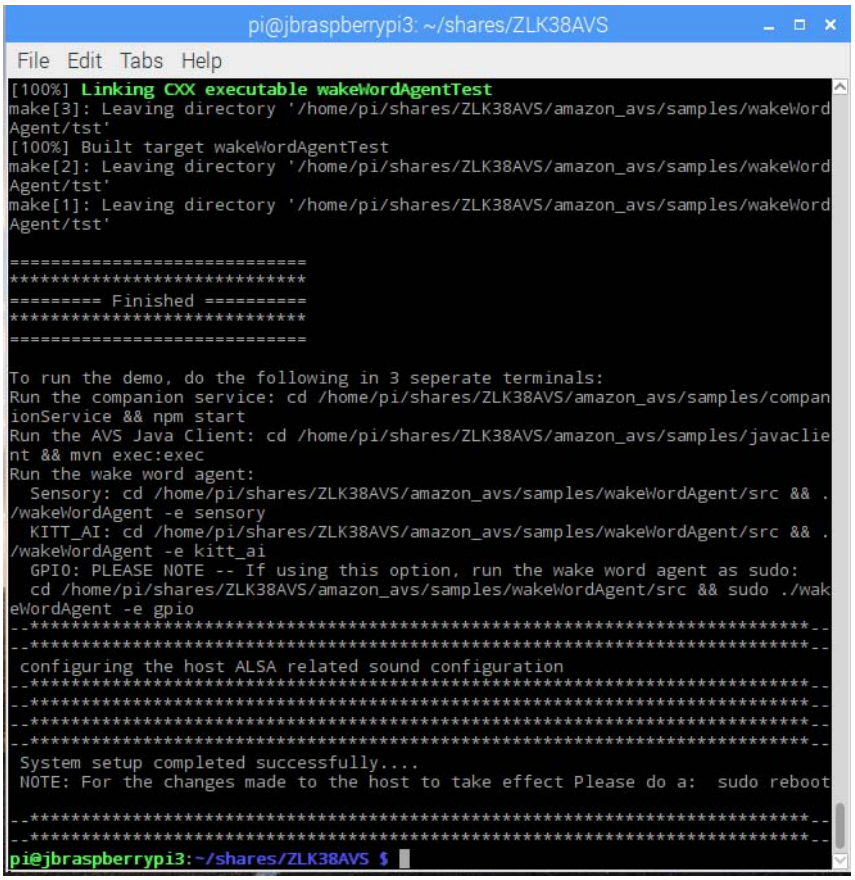
Figure 21 • **Completed installation**



7. Upon the completion of the ZLK38AVS kit installation, issue a reboot command to reboot the Raspberry Pi:

```
sudo reboot
```

Figure 22 • **Raspberry Pi reboot command**



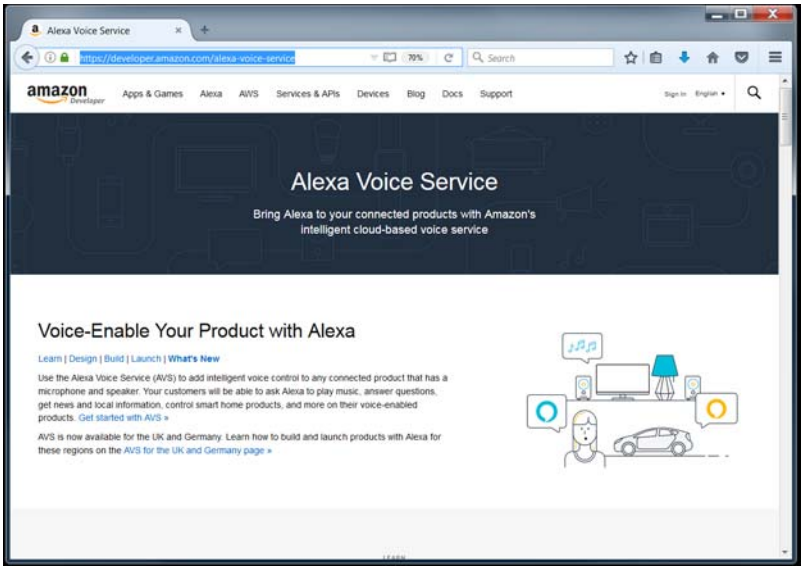
This completes the installation of the required software for the ZLK38AVS demonstration.

6 Amazon Developer Account Creation

An Amazon developer account is needed in order to run the ZLK38AVS demonstration kit. The instructions below describe the steps required to create an account to use with the ZLK38AVS demonstration kit.

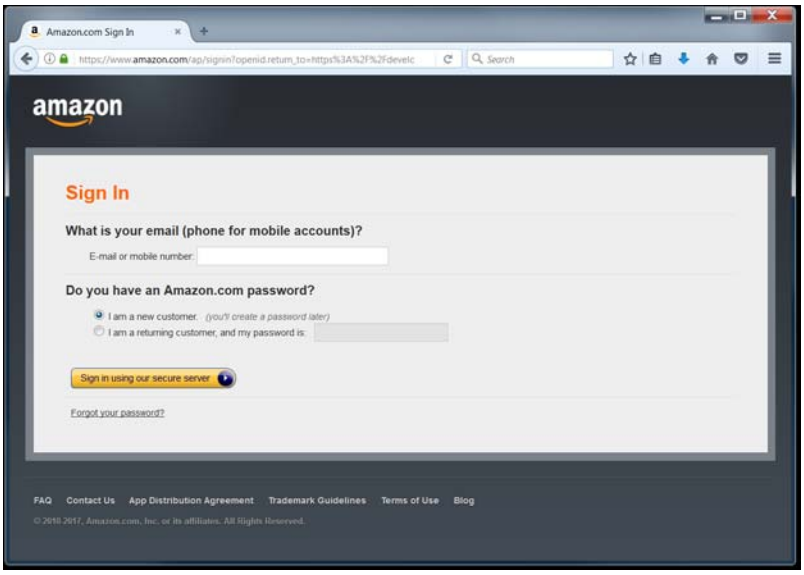
1. Go to https://developer.amazon.com/alexa-voice-service.

Figure 23 • **Alexa Voice Service website**



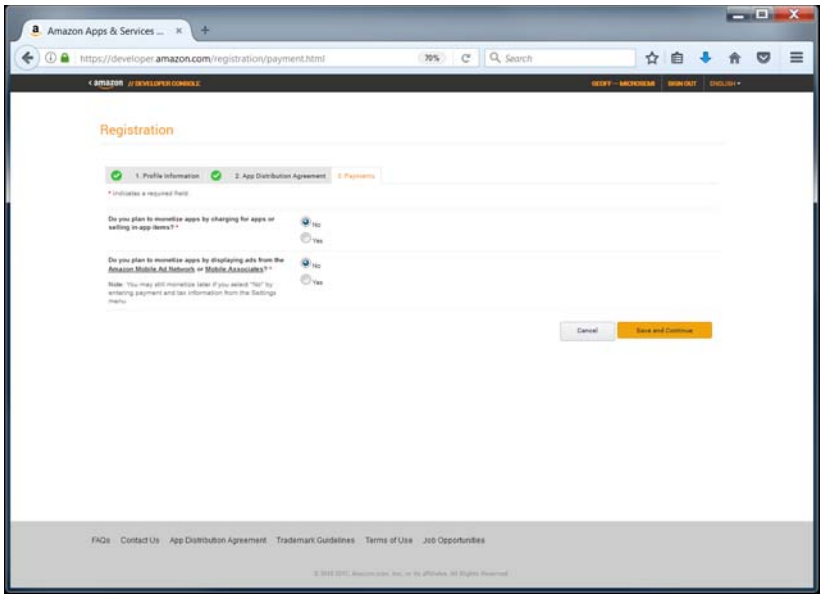
2. Click Sign-in on the top right of the screen.

Figure 24 • **Amazon sign-in**



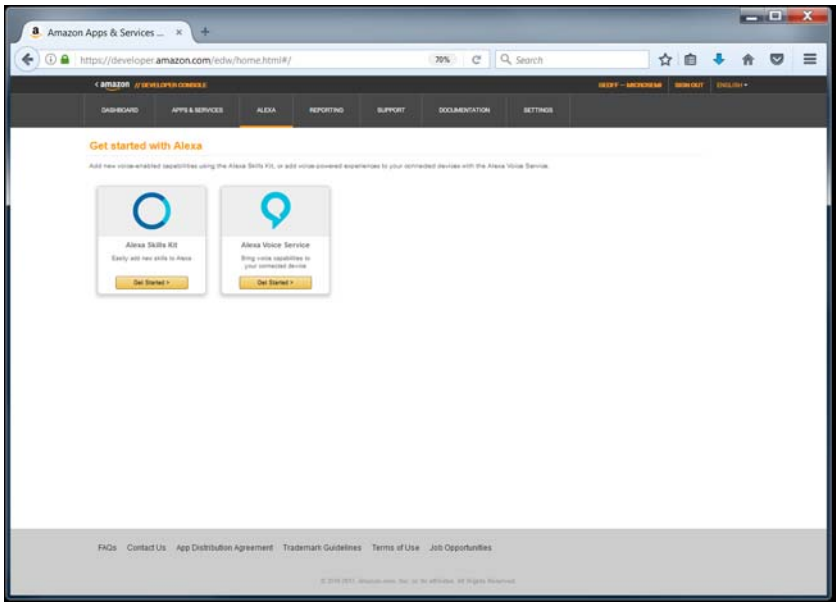
3. Either sign-in with your account, or create a new account if a new customer. Fill out the registration forms as requested by Amazon.
4. When prompted for information on the Apps Distribution Agreement select No for both options:

Figure 25 • **Apps distribution agreement**



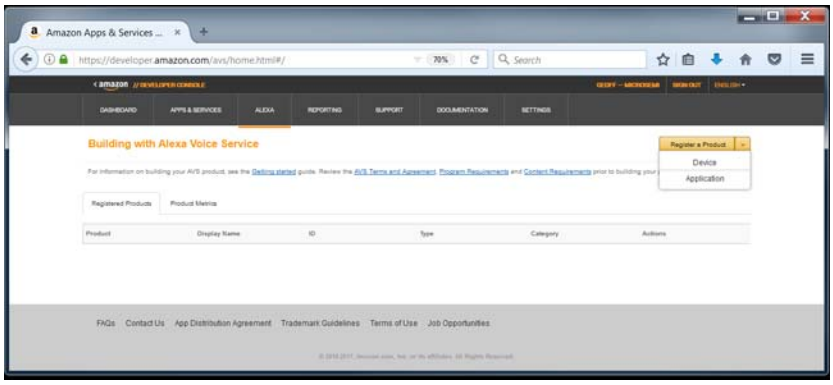
5. Select Alexa on the top navigation bar, Select Alexa Voice Service, Get Started

Figure 26 • **Get Started**



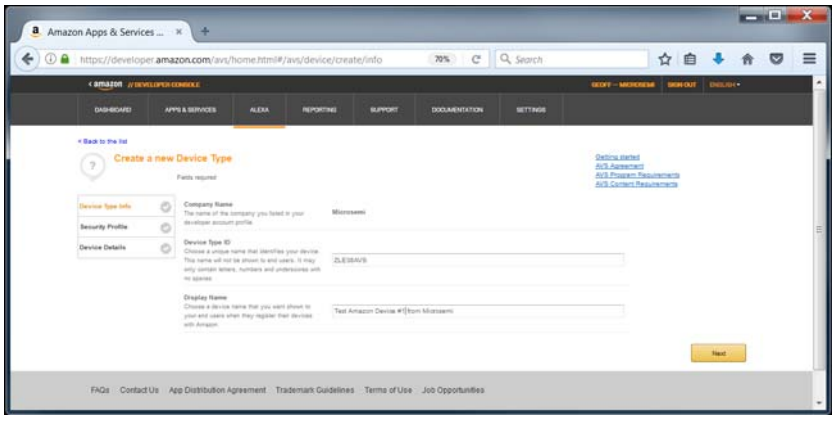
6. Select Register a Product, Device on the right side of the page. Provide a name and description and click next.

Figure 27 • **Register a Product**



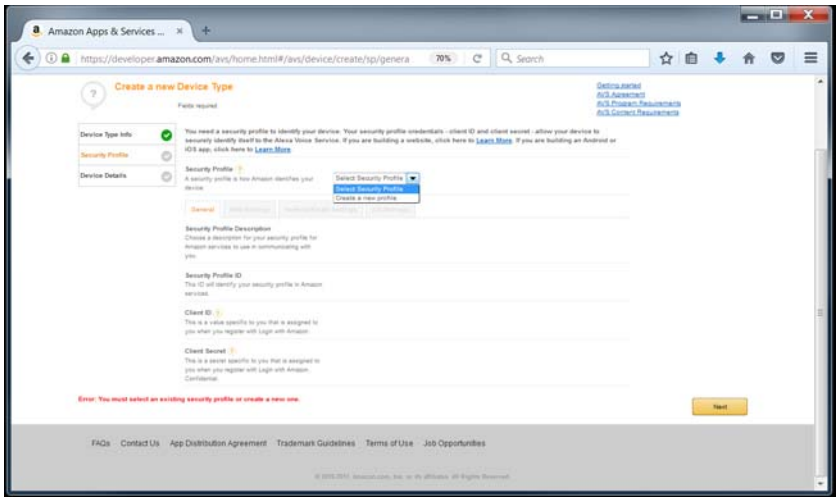
Note: Device ID is used when installing the Amazon software onto the Raspberry Pi.

Figure 28 • **Create a New Device Type**



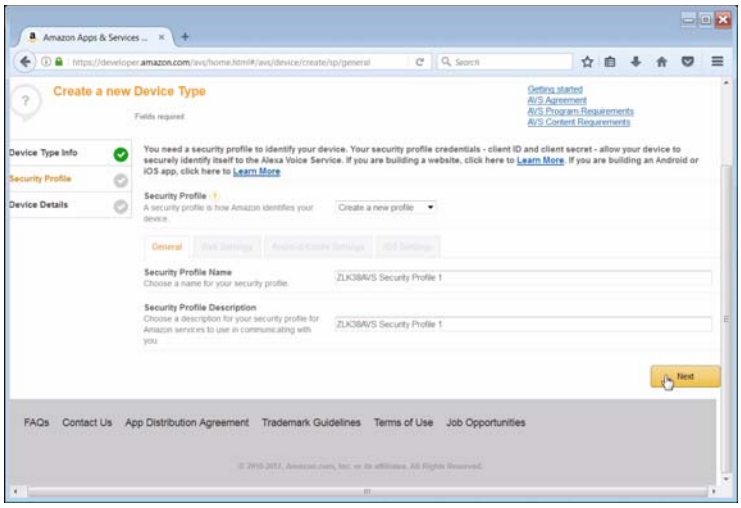
7. Select “Create a new profile” from the pull-down

Figure 29 • **Create New Profile**



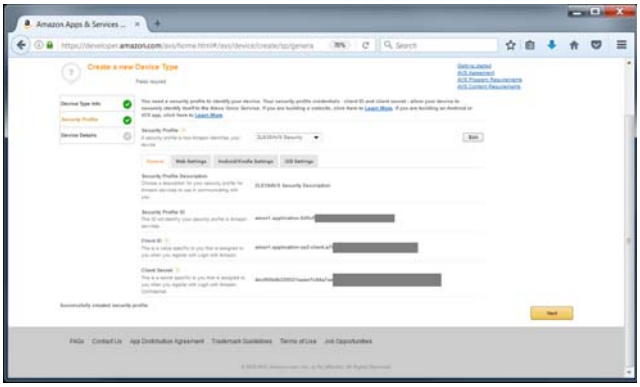
8. Enter a Security profile name and description and click next.

Figure 30 • **Create New Security Profile**



9. The Security profile will be displayed.

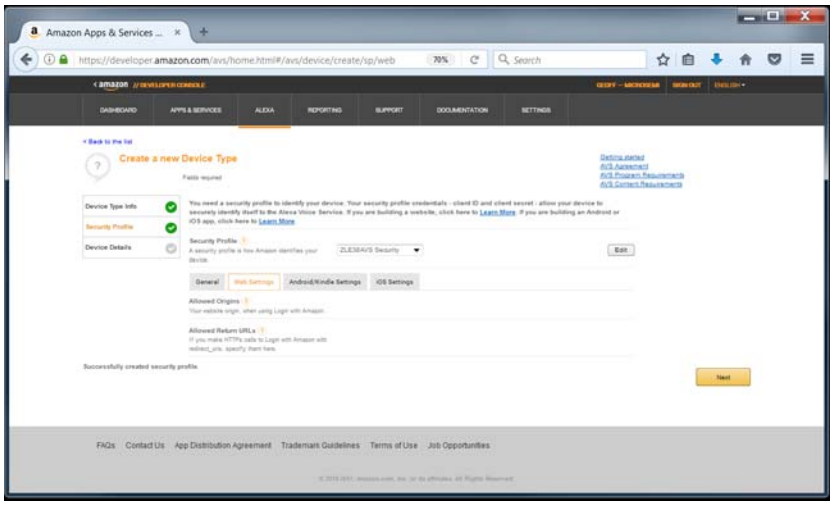
Figure 31 • **Security Profile**



Note: The Client ID and Client Secret are used when installing the Amazon software onto the Raspberry Pi.

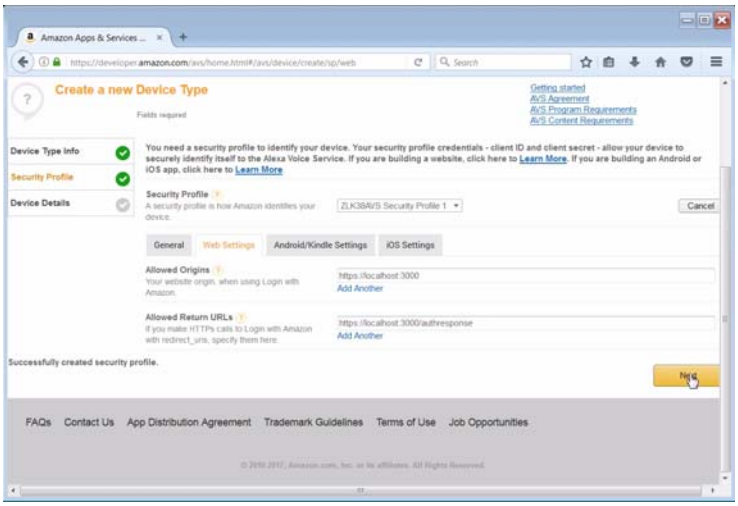
10. Select the Web Settings tab, then select Edit

Figure 32 • **Edit Security Profile**



11. Enter the following (click Add Another):
    a. Allowed Origins: https://localhost:3000
    b. Allowed Return URLs: https://localhost:3000/authresponse
    c. Select Next

Figure 33 • **Allowed Origin and Return URLs**



13. Fill out the form, click Submit

Figure 34 • **Device Details**

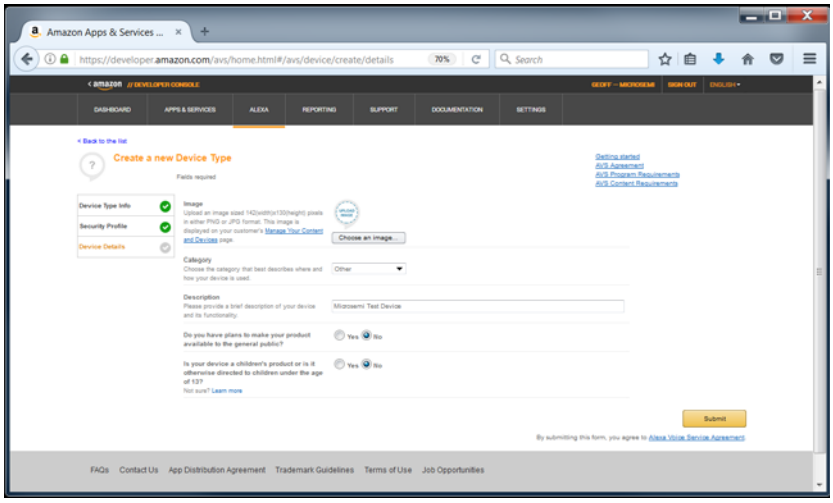
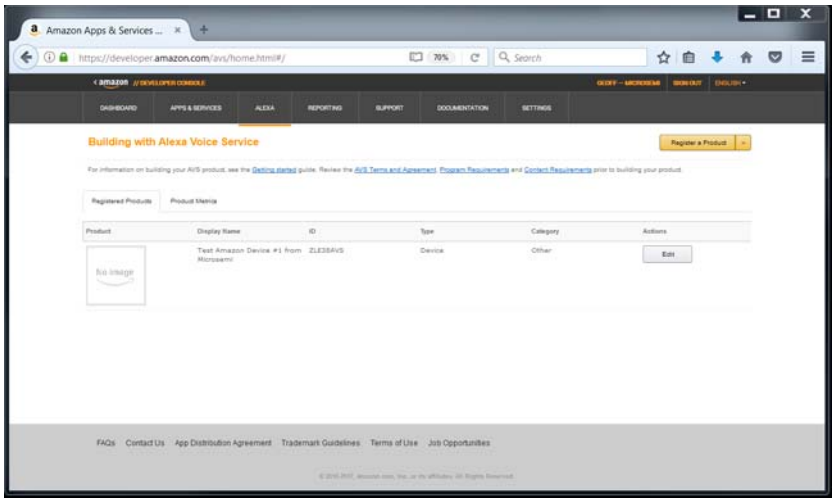


Figure 35 • **Registration confirmation**



This completes the registration for the Amazon Developer Account.

7 Demonstrating the ZLK380AVS (software)

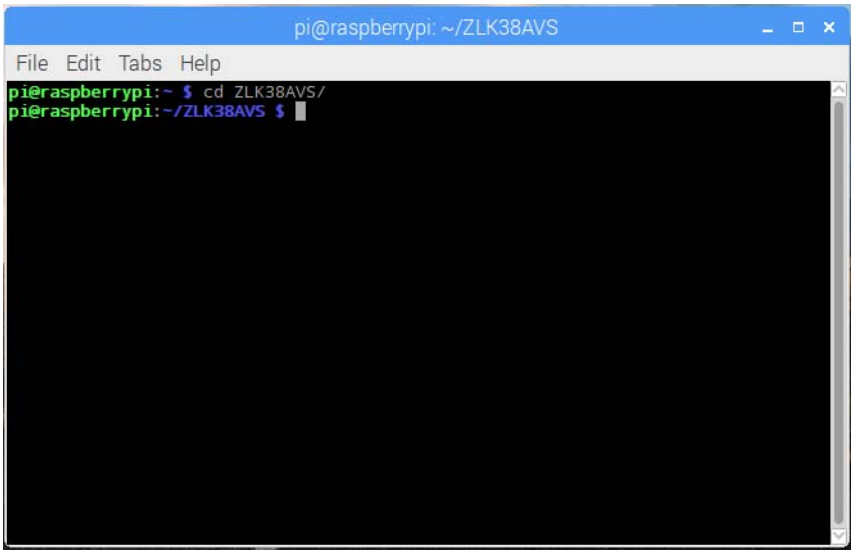
After installing the software (See ZLK38AVS Software Installation, page 8) and rebooting the Raspberry Pi, you can now demonstrate Alexa Voice Services.

The ZLK38AVS supports two separate microphone configurations: 180° or 360°. The ZLK38AVS default installation uses the 180° configuration. To change the configuration, see Changing ZL38063 Microphone Mode, page 26.

7.1 Starting AVS Software Demo

1. Cd into the location where the GitHub package was downloaded. (eg: `cd ZLK38AVS/`)

Figure 36 • **ZLK38AVS directory**



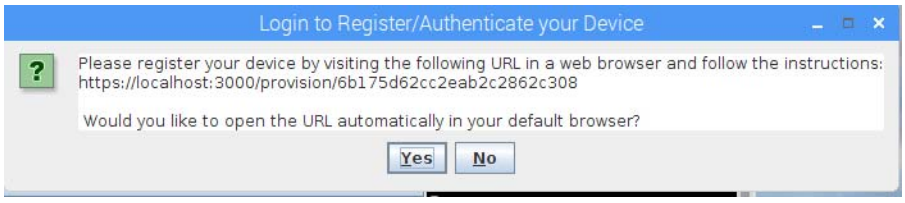
2. Issue the following make command to start the AVS software:
   `make start_alexa`

   The command will open 3 terminals. Each of the terminal windows will start executing the appropriate command as required by the Alexa application

Note: An error in one of the terminals screen is not an indicator that Alexa failed to start. The error may be due to the fact that the Internet browser is not opened yet.

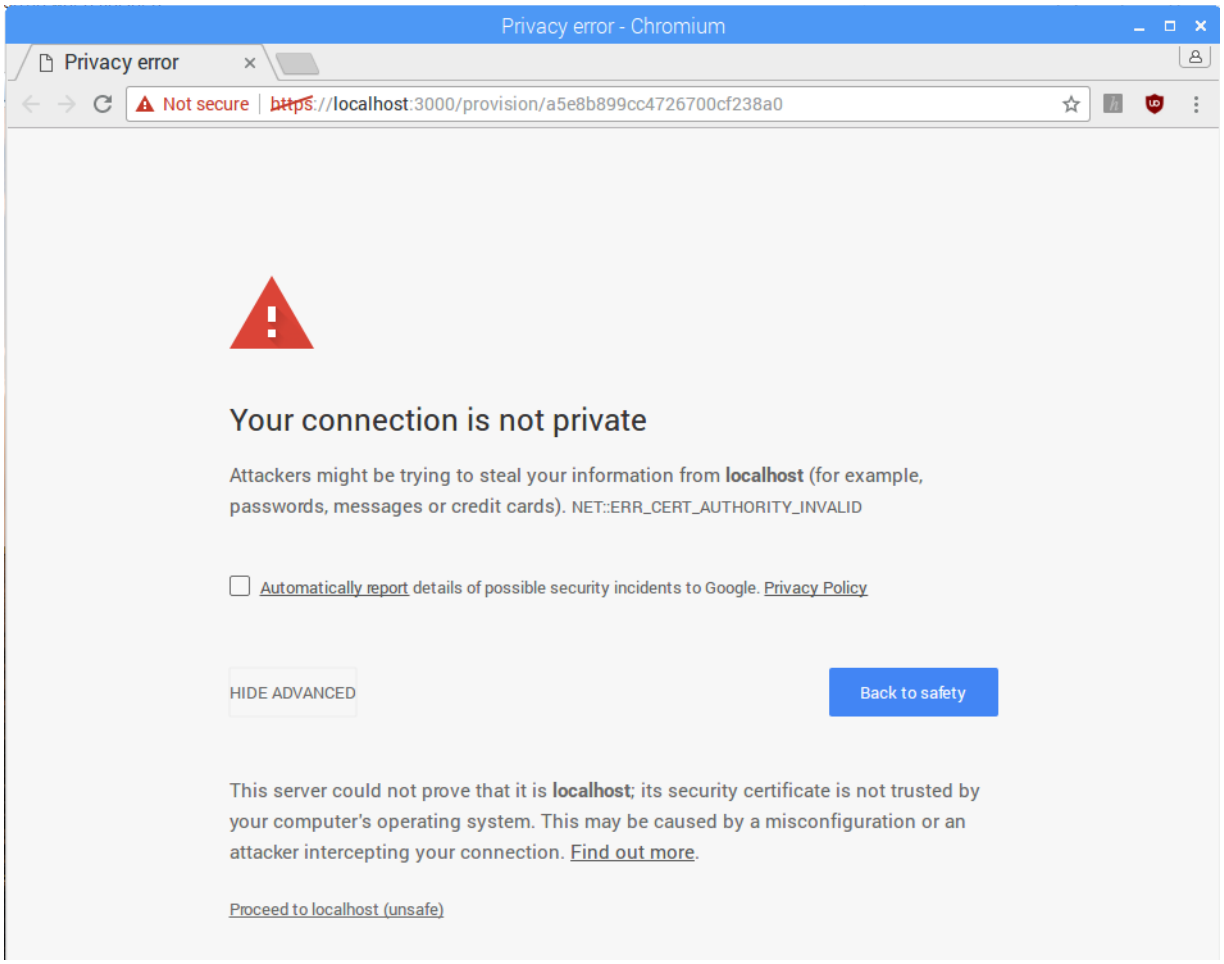
3. Open the default browser by clicking “Yes” when you see the pop-up window below:

Figure 37 • **Login to Register/Authenticate Your Device**



4. When the web browser opens, which may take up to a minute, a warning page will be shown stating that a secure connection was requested but not available. As this connection is to the localhost, it is safe to proceed with an insecure connection. Click Show Advanced and “Proceed to localhost (unsafe)”

Figure 38 • **Privacy error**

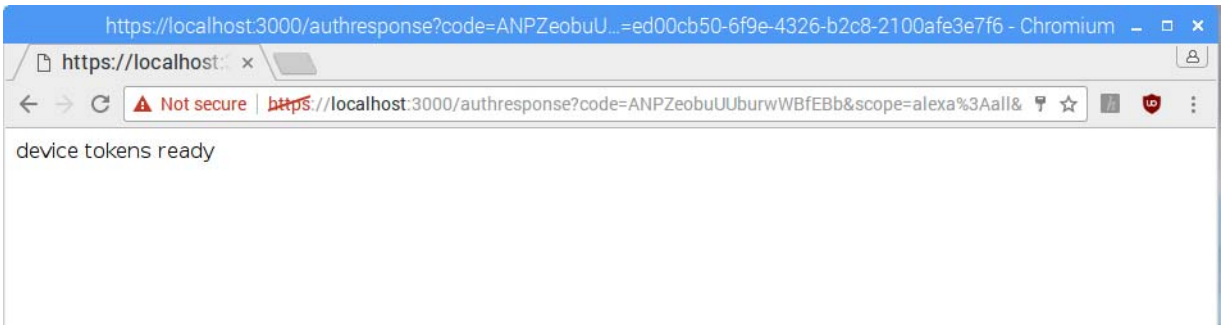


5. Sign into your Amazon developer account, entering the E-mail and password used when creating your Amazon developer account.

Figure 39 • **Amazon sign-in**

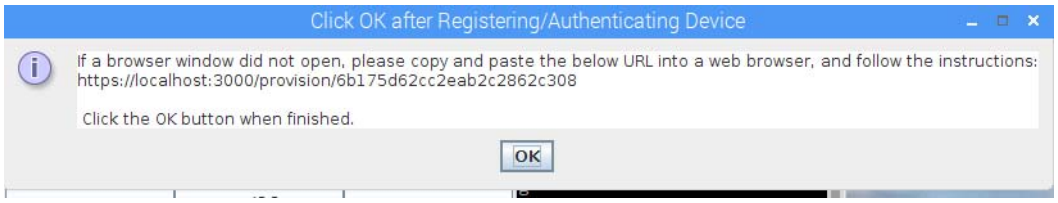
6. After logging in, the browser will display a confirmation that device tokens are ready. Close the browser window.

Figure 40 • **Device token confirmation**



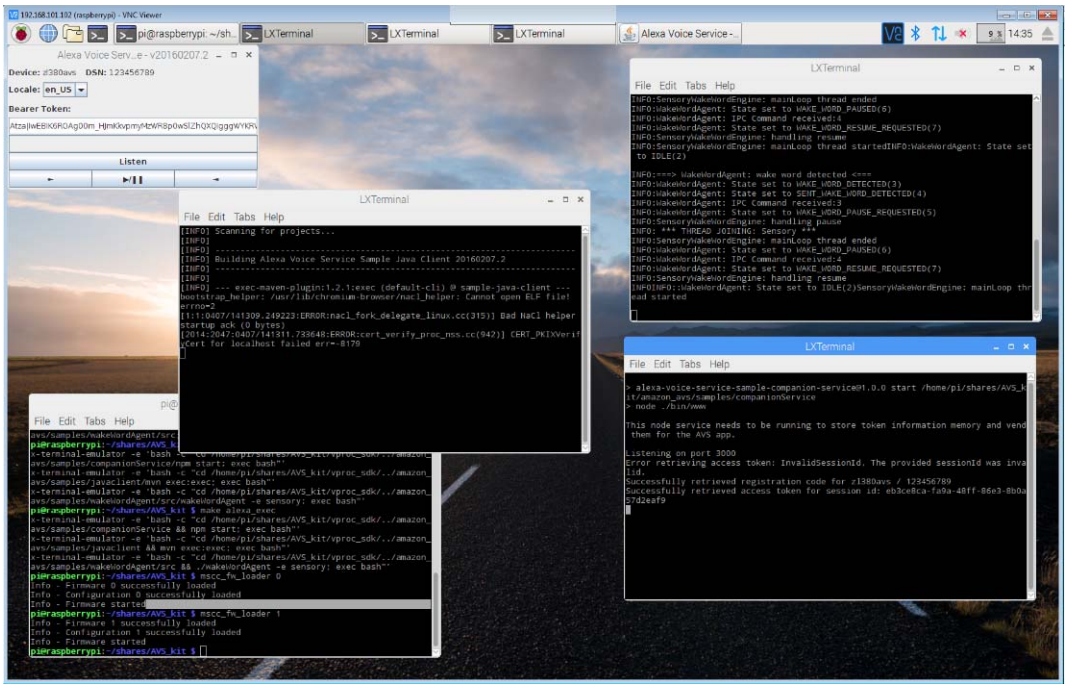
7. After closing the browser window, a pop-up window will appear. Click OK to confirm registration and authentication of the Alexa device.

Figure 41 • **Registration/Authentication confirmation**



8. Once you have confirmed your Amazon account, Amazon will generate a Bearer Token that will be displayed in the Alexa Voice Service screen as shown below.

Figure 42 • **Bearer token**



9. Turn on the speaker (using power button on the speaker bezel) and set the volume to maximum using the “+” button on the bezel.

Note: The speaker has an auto-turn-off feature to save battery life, so before testing the unit, make sure turn the speaker on, if switched off

10. At this point Alexa is ready to accept commands. Try a few quick commands like “Alexa, what time is it?” or “Alexa, what is the capital of Peru?” to confirm the software and hardware are activated. A full list of Alexa Voice commands can be found at https://www.cnet.com/how-to/the-complete-list-of-alexa-commands/.

Note: Some commands listed on the above website require accounts on the desired services (eg. Pandora stations).

8 Microphone Configuration

8.1 Microphone Array Overview

This kit features Microsemi's ZL38063 voice processor powered by Microsemi's proprietary AcuEdge™ technology for front-end audio clean-up and Sensory's TrulyHandsFree™ "Alexa" wake-word engine. Two separate microphone configurations allow you to test applications with 180° or 360° far-field pick-up. The default configuration is 180° which can be changed following the steps below.

Figure 43 • **Raspberry Pi and ZLE38AVS evaluation board with microphones for 180° far-field pick-up**

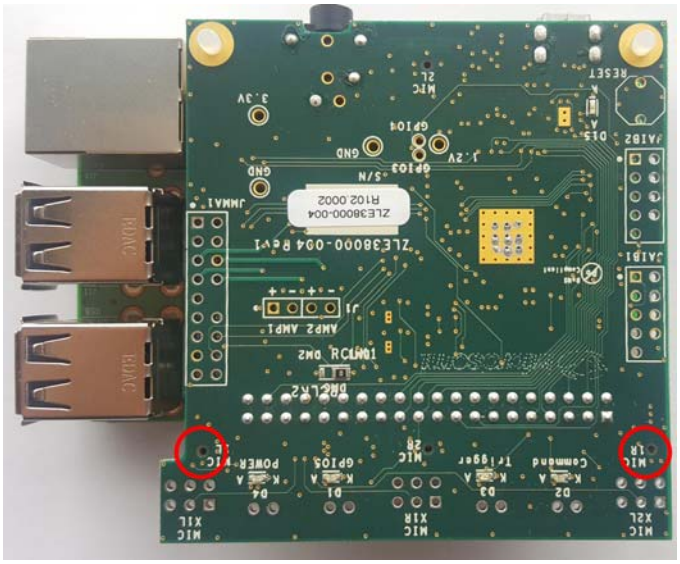
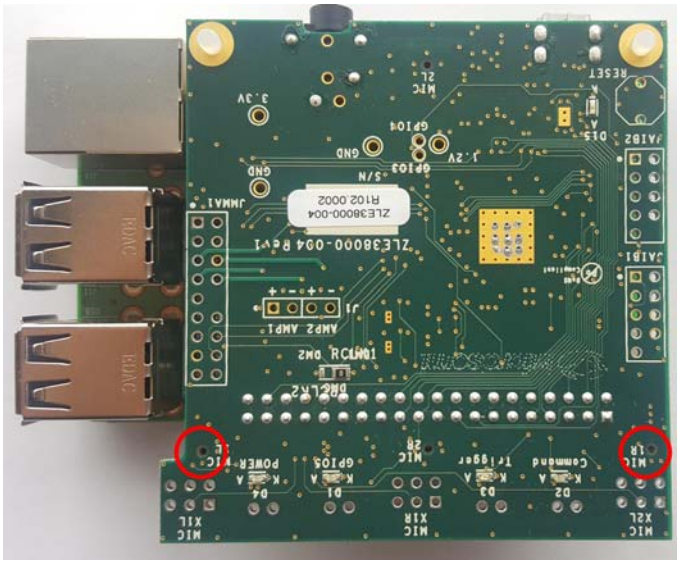


Figure 44 • **Raspberry Pi and ZLE38AVS evaluation board with microphones for 360° far-field pick-up**



8.2 Changing ZL38063 Microphone Mode

8.2.1 Runtime Selection

In order to change to or from 180° or 360° microphone modes the following steps should be followed:

1. Open a terminal instance on the Raspberry Pi.
2. Issue the following command for 180° sound pick-up mode:
   `mscc_fw_loader 0`
3. Issue the following command for 360° sound pick-up mode:
   `mscc_fw_loader 1`

8.2.2 Boot Selection

The selection of microphone modes 180° or 360° sound pick-up is configurable prior to installing the ZLK38AVS by editing the `MSCC_TW_CONFIG_SELECT` variable within the /ZLK38AVS/config.mk file.

- To use the 180° mode, set `MSCC_TW_CONFIG_SELECT=180`
- To use the 360° mode, set `MSCC_TW_CONFIG_SELECT=360`

9 Uninstalling the ZLK38AVS Software

The Pi can be returned back to its state prior to the installation of the ZLK38AVS SDK install. To do this run the following command in a terminal window from the installation directory:

```
make cleanall
```

Note: This command will undo everything that was done during the make all during the ZLK38AVS Software Installation (see ZLK38AVS Software Installation, page 8).

To clean the ZLK38AVS installation without removing the Amazon Alexa software, run

```
make clean
```

To re-make the ZLK38AVS, without re-compiling/re-installing Amazon Alexa, run

```
make host
```

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About Microsemi

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