

# EXTENDING User Guide

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# 1 Introduction

The EXTENDING tool is an implant designed for Samsung F Series Smart Televisions. The implant is designed to record audio from the built-in microphone and egress or store the data.

The implant is configured on a Linux PC, and then deployed onto the TV using a USB stick. Audio files can then be extracted using a USB stick or setting up a Wi-Fi hotspot with-in range of the TV. It is also possible to listen to audio exfiltration live, using the Live Listen Tool, designed for use on a Windows OS.

The implant can be uninstalled by inserting a USB stick into the TV or configuring a Death Date.

Known Issues can be found at the end of this Guide.

The EXTENDING system consists of the following components. These components can be found or generated from the “EXTENDING Settings and Installer” CD

- An **Installation Application**, which installs the implant to the target TV
- An **Implant Executable**, which runs on the target TV and records audio. This is installed by the Installation Application
- An **Encrypted Settings File**, which configures the implant
- A Linux application called **encryptSettings** which will encrypt an unencrypted Settings file, and check that the XML contents are valid.
- A Linux application called **rsakeygen** to generate rsa keys.

The EXTENDING application is shipped as two folders.

The first folder “Support” contains the default unencrypted settings file, a tool to generate rsa keys, and a tool to encrypt Settings files

The second folder “TV” contains the Application Installer. The application installer folder is called “Update”. This should be loaded onto a USB stick that can then be used to deploy the implant onto a target TV. The only modification that should be made to the installer is to add the encrypted settings file for each deployment.

To support the EXTENDING deployment the following tools can be used. These tools can be found on the “EXTENDING Tools” CD

- A Windows audio decrypt application, **ECDLive.exe** that can be used to decrypt audio files and Live Listen to an audio stream.
- A **wifiConnect** folder that should be placed in the root directory of a Web server intending to receive files from the EXTENDING implant.
- A windows web server called **XAMPP**, offline installer included.
- An Android web server called **PAW Server**, apk and pre-configured EXTENDING folder “**PAW2**” included.

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- A **wlan.bat** batch script that can be used to configure a Hosted Network Virtual Adapter on a Windows laptop.
- An **Ubuntu 12.10 ISO** file used to create a Linux VM for generating encrypted Settings files.
- **Oracle VM Virtual Box** Windows Installer, that can be used host the Ubuntu VM created from the 12.10 ISO file above

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## 2 Key Features

### Close Access Installation

The EXTENDING implant can be installed using a Close Access method. The EXTENDING installer is loaded onto a USB stick. This USB stick is then inserted into the target SAMSUNG F Series TV, and the installer is run. The installer deploys the implant and Settings file onto the TV. EXTENDING begins to run when the TV is next powered on.

### Close Access Uninstall

The EXTENDING implant can be uninstalled either by Close Access installation, or at a pre-configured time. To remove by Close Access, a USB stick must be loaded with a certain file, containing a certain string, as set in the configuration file. When this USB is inserted into the TV, the implant uninstalls.

### Close Access Audio File Retrieval

The EXTENDING implant can exfiltrate audio files to a USB stick. To exfiltrate files by Close Access, a USB stick must be loaded with a certain file, containing a certain string, as set in the configuration file. When this USB is inserted into the TV, files are copied onto it.

### Remote Audio File Retrieval

The EXTENDING implant can exfiltrate audio files over a Wi-Fi hotspot. To exfiltrate files over a Wi-Fi hotspot, the hotspot must be setup within range of the TV with a pre-configured SSID, set in the config file. Files are then exfiltrated over this Wi-Fi network to a server as configured in the configuration file.

### Live Audio Listening

The EXTENDING implant also exfiltrates audio over a Wi-Fi hotspot, to a Live Listening Tool, running on a laptop. The Live Listening Tool can save files locally to disk as well as playing the received audio through the speakers.

### Fake-off Recording

EXTENDING will continue to record audio, even whilst the TV appears to be off. This is achieved by intercepting the command for the TV to switch-off and turning off the TV screen, leaving the processor running.

### 3 Implant configuration

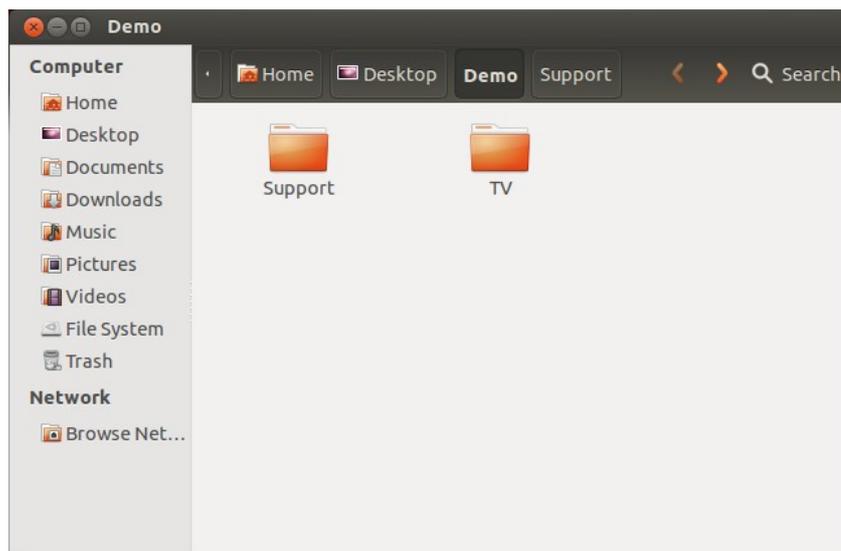
#### 3.1 Configuration Environment

The Settings file should be configured on an Airgap or secure machine. Please ensure the unencrypted settings file, encryptSettings tool and rsakeygen tool are always stored securely.

The encryptSettings Tool and rsakeygen Tool need to be run in a Linux environment. We suggest that this is performed in a Linux VM on a Windows machine. Oracle VM VirtualBox and an Ubuntu 12.10 Desktop ISO are provided on the “EXTENDING Tools” CD. Please refer to VirtualBox Documentation for guidance on setting up the Ubuntu VM from an ISO file.

In VirtualBox devices attached to the Physical machine can be attached to the VM through the “Devices” tab in the top left corner.

Once the Ubuntu VM has been created copy the Support and TV folders from the “EXTENDING Settings and Installer” disk, onto the Desktop of the VM. Then follow the instructions below to configure a deployment.



#### 3.2 Settings file

With each deployment a Settings file must be deployed. This Settings file configures the operation of EXTENDING. If the configuration file is missing or configured incorrectly, EXTENDING will not run. Correct configuration of the Settings is very important.

#### 3.3 Settings file configuration

The Default Settings file can be configured on a Linux machine using a text editor.

Navigate to the Build Folder provided.

In the “Support” folder the unencrypted settings.xml file, encryptSettings tool and rsakeygen generation tool can be found. To allow you to execute the encryptSettings tool and rsakeygen tool you may need to add the execute permission:

```
ubuntu@ubuntu-VirtualBox:~/Desktop/Demo/Support$ chmod +x encryptSettings
```

To edit the settings file use the “nano” or “gedit” text editors

```
ubuntu@ubuntu-VirtualBox:~/Desktop/Demo/Support$ nano settings.xml
```

For a list of Settings and what can be configured see the “Configuration Options” Section.

### 3.4 Public Key Generation

A different rsa key pair should be used with every deployment. The public rsa key is used to encrypt audio files on the TV. The private half of the rsa key should be stored securely and is used to decrypt audio files in a secure environment.

To generate the public key type the following:

```
ubuntu@ubuntu-VirtualBox:~/Desktop/Demo/Support$ ./rsakeygen
Generating public/private keys...
Done.
ubuntu@ubuntu-VirtualBox:~/Desktop/Demo/Support$
```

This will generate two files: private\_key.pem and public\_key.pem. The whole contents of public\_key.pem should be copied into the “PublicKey” setting field. The private\_key.pem will be required to decrypt the audio files generated by this deployment.

### 3.5 WPA Passphrase generation

To ensure the passphrase required to connect to our hotspot is not stored in plain text on the TV it must be de-obfuscated in the settings file. This is performed using the wpa\_passphrase command on linux:

```
ubuntu@ubuntu-VirtualBox:~/Desktop/Demo/Support$ wpa_passphrase SSID passphrase
network={
    ssid="SSID"
    #psk="passphrase"
    psk=28964ba6ea8b8f3a0db1c4414b327da253d0af5d4f4adccec0f8abf5b05b10f8
}
ubuntu@ubuntu-VirtualBox:~/Desktop/Demo/Support$
```

Where SSID is the SSID of the Wi-Fi hotspot you wish the application to connect to and passphrase is the plain text passphrase for that SSID. The resulting psk output produced by this command should then be pasted into the “WPAPreSharedkey” setting.

### 3.6 Encrypting Settings File

Once the Settings have been configured the file needs to be encrypted. This is done using the encryptSettings tool provided. The settings encrypter tool will verify all the Settings in the XML file before Encrypting. The table in Appendix A give a list of error codes and their meaning.

```
ubuntu@ubuntu-VirtualBox:~/Desktop/Demo/Support$ nano settings.xml
ubuntu@ubuntu-VirtualBox:~/Desktop/Demo/Support$ ./encryptSettings settings.xml
Input file : settings.xml
Output file : config.xml.cmk
Config verification passed
Config file 'config.xml.cmk' can be found in folder '25'
```

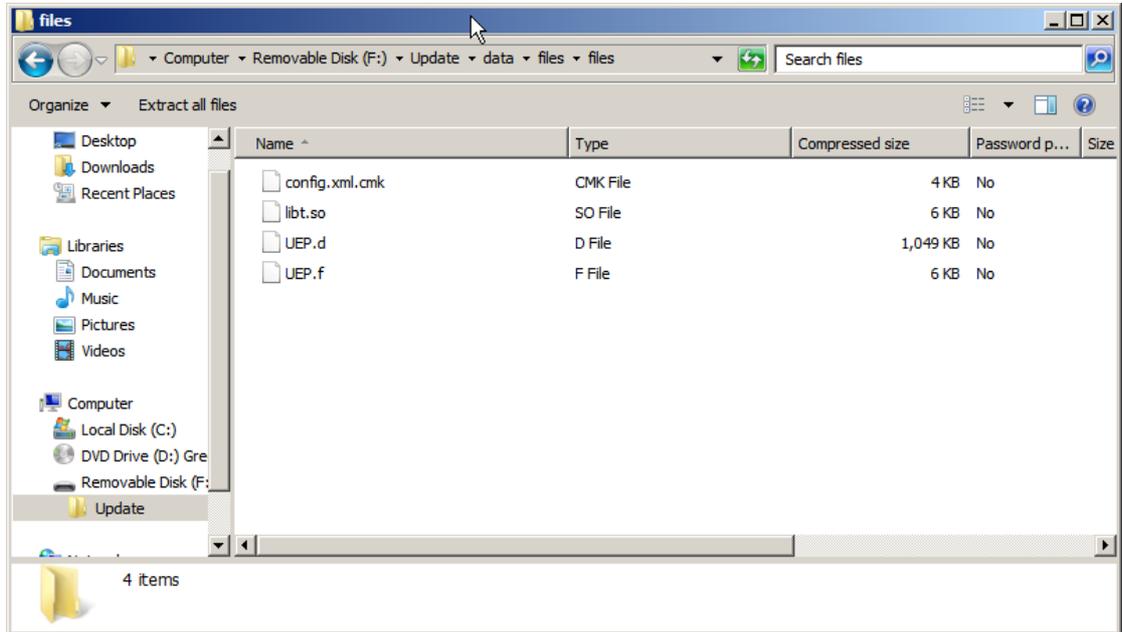
The encryptSettings tool will place the encrypted settings file (called config.xml.cmk) in a folder numbered with the deployment id.

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If you try to encrypt a settings.xml file with the same deployment ID as a file already encrypted you will be warned and asked if you wish to overwrite the old file.

### 3.7 Setting File Location

Once the Settings file has been encrypted, it needs to be added to files.zip in the Installer application. This is most easily performed on a Windows machine. Copy the config.xml.cmk file into the files.zip folder next to UEP.d, UEP.f and libt.so.



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### 3.8 Configuration options

These options can be configured on a per-deployment basis if desired:

| Option               | Value Range | Default                | Explanation  |
|----------------------|-------------|------------------------|--|
| deploymentID         | 0 – 65535   | 1                      | This is the unique deployment ID to be deployed with each installation of EXTENDING  |
| deathDate            |             | 15:23:59 28-07-2013    | This is the Death Date of EXTENDING. It should only be used in situations where an NTP server is to be used and available. The Death Date should be configured in the format: hh:mm:ss DD-MM-YYYY e.g. 15:23:50 17-07-2013   |
| audioRecordingMode   | 0 – 3       | 1                      | This setting specifies how audio will be exfiltrated by the EXTENDING application.<br>0 = No Audio Recording<br>1 = Audio Stored to disk; Exfiltration by USB only<br>2 = Audio Stored to disk; Exfiltration by USB or WiFi<br>3 = Audio Stored to disk and streamed Live to Live Listening Application; Locally stored files can be retrieved by USB. |
| takeOffMode          | 0 – 2       | 1                      | This Setting controls when EXTENDING records audio from the built-in microphone.<br>0 = Records at all times;<br>1 = Records when TV in Fake-Off mode only;<br>2 = Records when TV on only;  |
| PublicKey            |             | Dummy key              | The public RSA key associated with this EXTENDING Deployment. Generated during the set-up of the base end.   |
| usbDeletekeyFile     |             | delkey                 | The name of the key file EXTENDING should look for on a USB stick when performing a manual uninstall. EXTENDING will only manually uninstall if the "usbDeletekeyFileGUID" is contained in the "usbDeletekeyFile" on the USB stick.  |
| usbDeletekeyFileGUID |             | {1234-09876-asdf-wert} | The GUID that must be contained in the "usbDeletekeyFile" for a manual uninstall to take place.  |
| usbDownloadkeyFile   |             | loadkey                | The name of the key file EXTENDING should look for on a USB stick when exfiltrating audio. EXTENDING will only copy files to the USB stick if the "usbDownloadkeyFileGUID" is contained  |

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| Option                       | Value Range   | Default               | Explanation   |
|------------------------------|---------------|-----------------------|---|
|                              |               |                       | in the "usbDownloadKeyFile".  |
| usbDownloadKeyFileGUID       |               | {0987-poiu-4567-vcxz} | The GUID that must be contained in the "usbDownloadKeyFile" for USB exfiltration to take place.   |
| NTPServer                    | Valid address | IP<br>127.0.0.1       | This should be set to the IP address of an NTP server that EXTENDING is to connect to. This should be used in conjunction with the "ignoreMissingNTPServer" setting. <b>WARNING: If EXTENDING is configured to need an NTP server and it cannot connect to the NTP Server in this setting on TV boot, it will self-delete.</b>                                  |
| ignoreMissingNTPServer       | 0 - 1         | 1                     | 0 = NTP Server Required; EXTENDING will self-delete if it cannot connect get NTP from the Server stated in the "NTPServer" setting<br>1 = run without NTP Server; EXTENDING will still try to get NTP from the Server set in "NTPServer" however it will not self-delete if NTP is not available  |
| baseURL                      | Valid address | IP<br>127.0.0.1       | This should be set to the IP address EXTENDING will send audio files to. When EXTENDING connects to the Wi-Fi hotspot configured in its settings, it will exfiltrate audio files to this IP address, if "audioRecordingMode" = 2.   |
| basePort                     | 1 - 65535     | 80                    | This should be set to the Port that EXTENDING will send audio files to. When EXTENDING connects to the Wi-Fi hotspot configured in its settings, it will exfiltrate files to this Port at the "baseURL", if "audioRecordingMode" = 2.   |
| speexQuality                 | 0 - 7         | 5                     | The Quality of the audio recording to be performed. A higher quality will use more space, but will record at a higher bit-rate giving a better recording.   |
| storageFolderMaxStorage      | 0 - 800       | 700                   | The maximum size of the audio Storage Folder in MB. When this folder is filled up, EXTENDING will delete the oldest file or stop recording audio (depending on the "audioFolderDeleteOldestFiles" Setting"). It is important to keep this folder a sensible size, as it will affect the user's experience if all the TV storage is clogged up with audio files. |
| audioFolderDeleteOldestFiles | 0 - 1         | 0                     | This controls what EXTENDING does when the audio storage folder is filled up.<br>0 = Stop Recording Audio<br>1 = Delete Oldest Files  |

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| Option           | Value Range | Default   | Explanation  |
|------------------|-------------|---|--|
| wifiADHOC        | 0 – 1       | 1   | This controls the Wifi Connection method attempted by the TV.<br>0 – Connection being made through Router<br>1 – Connection being made direct to device. E.g. Virtual Wi-Fi hotspot setup on phone or laptop   |
| wifiSSIDname     |             | testwifi ssid   | The name of the Wi-Fi SSID EXTENDING will connect to for exfiltration of audio files, or live audio packets. When this SSID comes into range, EXTENDING will connect and will start, either sending audio files to the "baseURL", or sending audio packets to the "uploadServerIP" depending on the "audioRecordingMode" |
| WPAPreSharedkey  |             | dcafe0856b5<br>0df984cefa48<br>a9613aff9feb<br>def66b783e12<br>21a8c74bb684<br>8a40 | The value entered in this setting is generated by running the linux command:<br><br>wpa_passphrase SSID passphrase<br>where SSID is the wifiSSIDname variable, and passphrase is the unencrypted passphrase the Wi-Fi hotspot is configured with.  |
| uploadServerIP   |             | 127.0.0.1   | This should be set to the IP address EXTENDING will send UDP audio packets to. When EXTENDING connects to the Wi-Fi hotspot configured in its settings, it will send UDP audio packets to this IP address, if "audioRecordingMode" = 3.  |
| uploadServerPort |             | 8080  | This should be set to the Port that EXTENDING will send UDP audio packets to. When EXTENDING connects to the Wi-Fi hotspot configured in its settings, it will exfiltrate UDP audio packets to this Port at the "uploadServerIP", if "audioRecordingMode" = 3.   |

There are also a number of "engineering" settings in the XML file. **Under no circumstances should these be changed without consulting the Design Authority**, as in most cases the effects of changing these values will not have been tested. The default settings provided with the implant should be suitable for most deployments.

| Option       | Default | Explanation   |
|--------------|---------|---|
| silenceLevel | 1200    | This is a number between 0 -32767. Higher values require louder sound to activate recordings. |

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| Option                 | Default                 | Explanation   |
|------------------------|-------------------------|---|
| silencePeriod          | 1000                    | This is a number between 0 – 2147483647. Lower values stop recording sooner after a silence level is encountered. |
| usbFolder              | /dtv/usb                | The folder the TV mounts the USB devices into.  |
| usbConnectionPollSecs  | 10                      | The period (in seconds) which EXTENDING checks for the "usbDeleteKeyFile" or "usbDownloadKeyFile".                |
| audioBufferSizeKb      | 100                     | The size of the audio buffer on the TV in Kb  |
| audioMaxFileSizeKb     | 100                     | The size of an individual audio file stored to the TV's storage area  |
| storageFolder          | /mnt_rwcommon/temps     | The folder that audio files are stored to   |
| audioDeviceName        | hw:0                    | The name of the internal Microphone   |
| wifiDeviceName         | wlan0                   | The name of the internal Wi-Fi Device   |
| wifiConnectionPollSecs | 10                      | The period (in seconds) which the TV collects the names of all Wi-Fi SSIDs in range                               |
| wifiServerUploadScript | /wifiConnect/upload.php | The php script used to control upload of audio to the Server  |

## 4 Installation

### 4.1 Installing the Implant

For each deployment an Installer folder should be created. This installer can be found inside the TV folder provided in the "Build" directory. Copy the whole "Update" folder onto a USB stick. Make sure that the encrypted settings file (config.xml.cmk file) for the deployment has been added to the files.zip.

The Implant is installed onto the TV using the USB stick. Follow the steps below to install:

1. Check that the "Update" folder is present on the USB stick, with the config.xml.cmk file in the Update/data/files.zip/files folder with UEP.d, UEP.f and libt.so.
2. Turn on the Target TV
3. For EXTENDING to run, Voice Recognition must be turned off. This can be done by pressing the Menu button on the remote; then Smart Features -> Voice Control.
4. Press the Smart Hub menu icon
5. Our application can't be installed until the Smart HUB has been set-up. The TV must be supplied with an internet connection the first time the Smart HUB is used to allow a license agreement to be accepted.
6. Use the remote control to open the "More Apps" section of the Smart Hub, at the bottom of the Apps page.
7. Once you are in the "More Apps" Section, insert the USB stick into the TV
8. If a pop-up appears press the "RETURN" button
9. A new application called "Update" will pop-up on the screen
10. Select the "Update" application.
11. Watch the progress bar
12. When the progress bar has reached the end, the installation is fully complete
13. Press the power button on the remote to restart the TV
14. The implant is now installed and will operate using the provided settings
15. If the target's TV remote has a History button, press this and clear the history of installed applications.

## 5 Platform compatibility

### 5.1 Operating systems

#### 5.1.1 Implant

The EXTENDING implant supports the following Samsung Smart TVs:

- Samsung F Series

#### 5.1.2 Live Listen Tool

The EXTENDING Live Listen Tool works on the following Windows Operating Systems:

- Windows 7 32/64bit
- Windows 8 32/64 bit

## 6 Setting up the Wi-Fi Hotspot

A Wi-Fi hotspot is required for Remote Access Audio Retrieval and Live Audio Exfiltrating.

The section below details the method to create a WiFi hotspot on a Windows laptop and Android phone. These devices should be configured to use the values configured in the Settings file for “wifiSSIDname” and the plain text passphrase used to generate “WPAPreSharedKey” in the *WPA Passphrase generation* section.

### 6.1 Windows - Configuration of a Wi-Fi hotspot

A Wi-Fi hotspot can be set up on a Windows laptop in the following ways.

- 1) By running the wlan.bat script (provided on the “EXTENDING Tools” CD), with Administrator rights. Use the Enter key to step through the script. Read all output to ensure the hosted network is stopped, configured and then started again. PLEASE NOTE, THIS SCRIPT WILL NOT WORK WHEN:
  - a. Airplane Mode is ON
  - b. It is run without Administrator rights
  - c. The Virtual Wireless Appliance is Disable in Device Manager

```

C:\Windows\system32>pause
Press any key to continue . . .

C:\Windows\system32>netsh wlan stop hostednetwork
The hosted network stopped.

C:\Windows\system32>pause
Press any key to continue . . .

C:\Windows\system32>netsh wlan set hostednetwork mode=allow ssid=testaccess25 key=dx78KJer
The hosted network mode has been set to allow.
The SSID of the hosted network has been successfully changed.
The user key passphrase of the hosted network has been successfully changed.

C:\Windows\system32>pause
Press any key to continue . . .

C:\Windows\system32>netsh wlan start hostednetwork
The hosted network started.

C:\Windows\system32>pause
Press any key to continue . . .

```

- 2) Alternatively run the command individually with admin rights:

```
netsh wlan set hosted network mode=allow ssid=*YOURSSIDNAMEHERE*
key=*YOURKEYHERE*
```

```
netsh wlan start hostednetwork
```

If you look in the “Network & Sharing Centre” a new Adapter should have appeared.

To control the IP address that is served by this hotspot you can change the following registry setting:

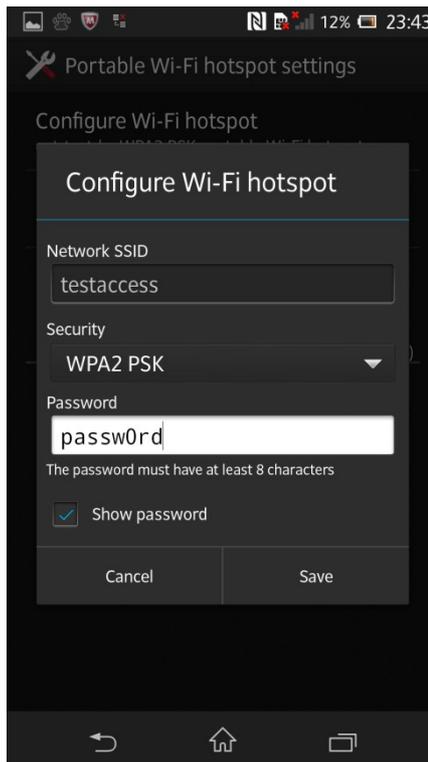
HKEY\_LOCAL\_MACHINE\SYSTEM\CurrentControlSet\services\SharedAccess\Parameters\Standalone DhcpAddress

By default the laptop will give itself 192.168.173.1 as an IP address and any device that connects and IP address in the 192.168.173.0/24 address range. 192.168.173.1 (or the alternative value set in the registry settings) should be set as the baseURL or UploadServerIP in the settings, depending on the mode the implant is being deployed in.

## 6.2 Android – Configuration of a Wi-Fi hotspot

A Wi-Fi hotspot can also be configured on an Android phone in the following way:

Settings -> More -> Tethering & portable hotspot -> Portable Wi-Fi hotspot settings



When the Portable Wi-Fi hotspot is turned on the phone will give itself 192.168.43.1 as an IP address and any device that connects an IP address in the 192.168.43.0/24 range. 192.168.43.1 should be set as the baseURL in the settings, as the Android phone can only be used to receive file transfer from the implant (audioRecordingMode = 2).

## 6.3 Router – Configuration of a Wi-Fi hotspot

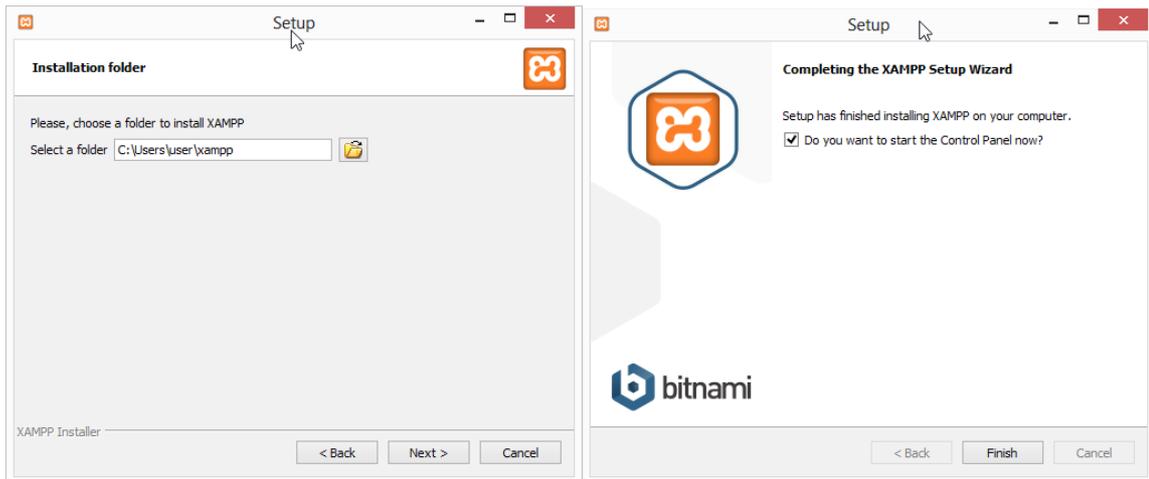
Finally a Wi-Fi hotspot can be configured on a HUB or Router, and the receiving laptop/phone can also be connected to the device. When deploying through this method please test the setup before deployment to ensure IP addresses are configured correctly in the settings file. The set-up of Wi-Fi routers is beyond the scope of this project.

## 7 Setting up the Web Server

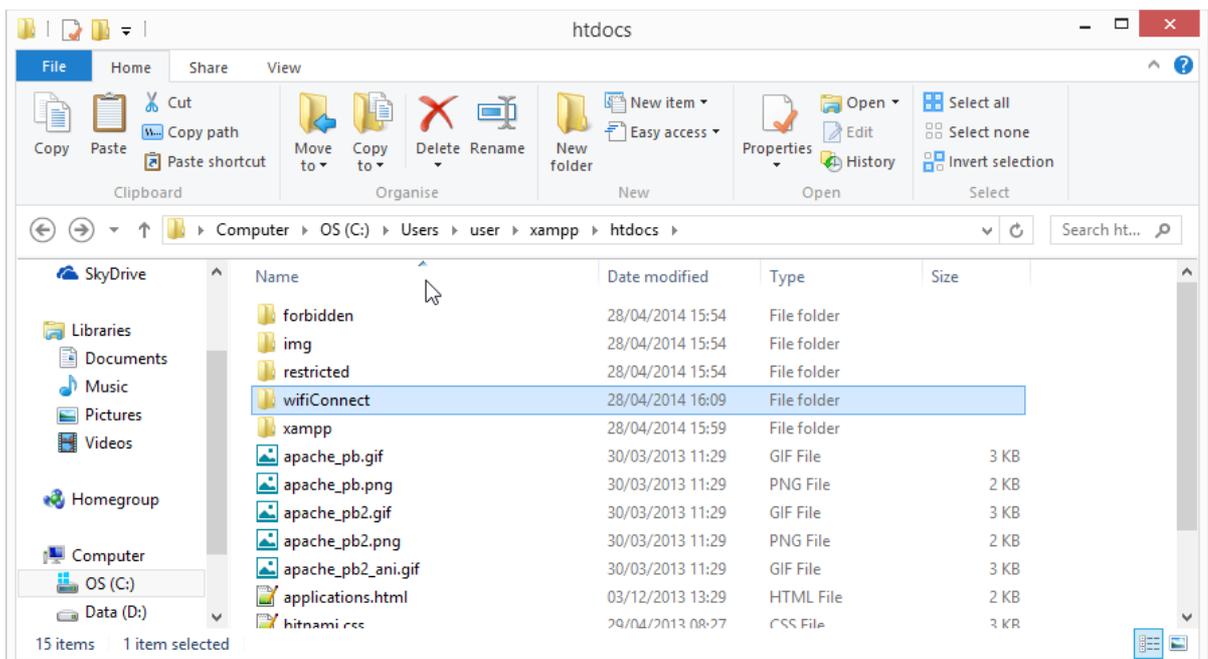
A Web Server is required to receive files from the EXTENDING implant in audioRecordingMode = 2. This Web Server can be setup on a Windows laptop, an Android phone or any other device that can run an Apache Web Server that supports PHP.

### 7.1 Windows – Configuring XAMPP Server

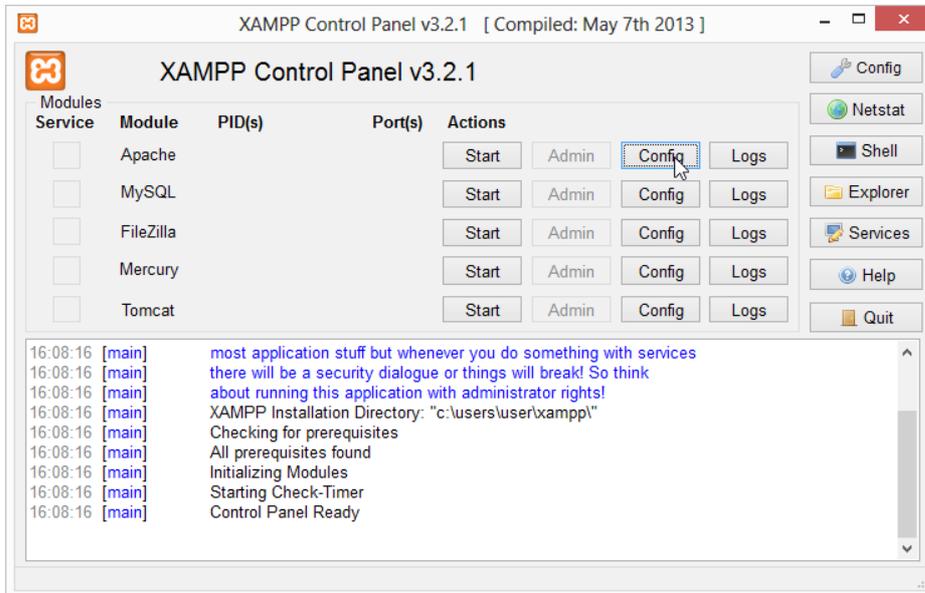
To setup XAMPP server double click the Installer provided on the “EXTENDING Tools” disk. Follow the on-screen instructions to install XAMPP. When prompted for the location to place XAMPP files select an area you have **permissions to read & write to** e.g. Your user’s Workspace.



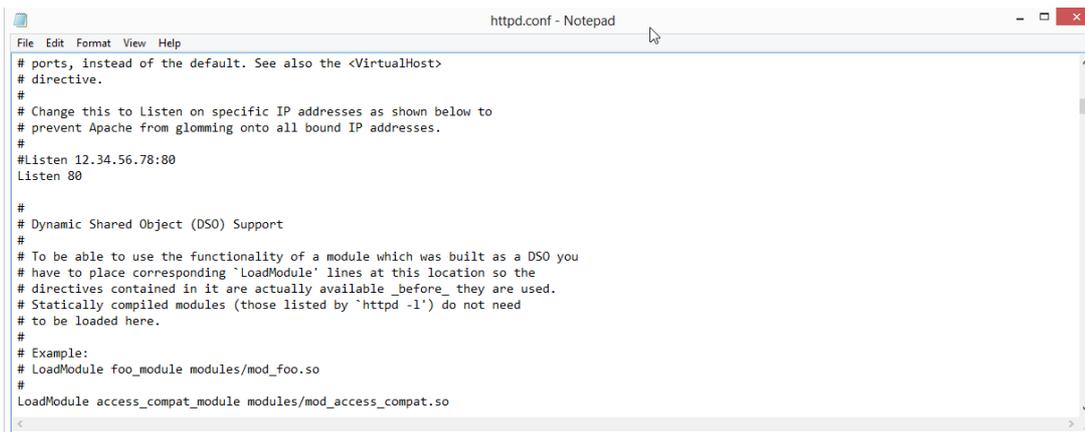
Once XAMPP has been configured through the installer, open the area XAMPP files have been stored on your laptop. Navigate to xampp/htdocs/. Copy the wifiConnect folder from the “EXTENDING Tools” CD into this folder location. Open the wifiConnect folder. Right-click the “audio” folder and create a shortcut to it on the Desktop. This is the location audio files will be transferred to by the implant.



Open the XAMPP Control panel.



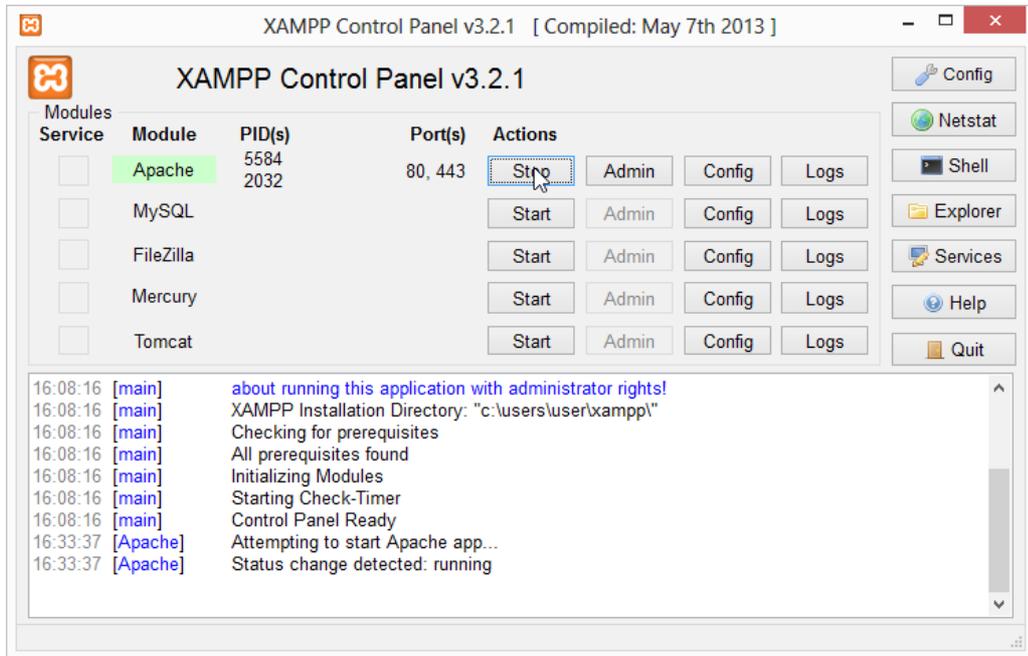
The port that the XAMPP apache server will listen on can be configured by pressing the “Config -> Apache (httpd.conf)” button in the Apache section of the Control Panel. Scroll down to the “Listen 80” line of the config. The number after Listen is the port number the server will listen on. Make sure this matches with the “basePort” setting.



When you start the Apache web server allow it access through the firewall.



Received files can be decrypted by the ECDLIVE.exe tools usb mode. See the Live Listener Section for more details.



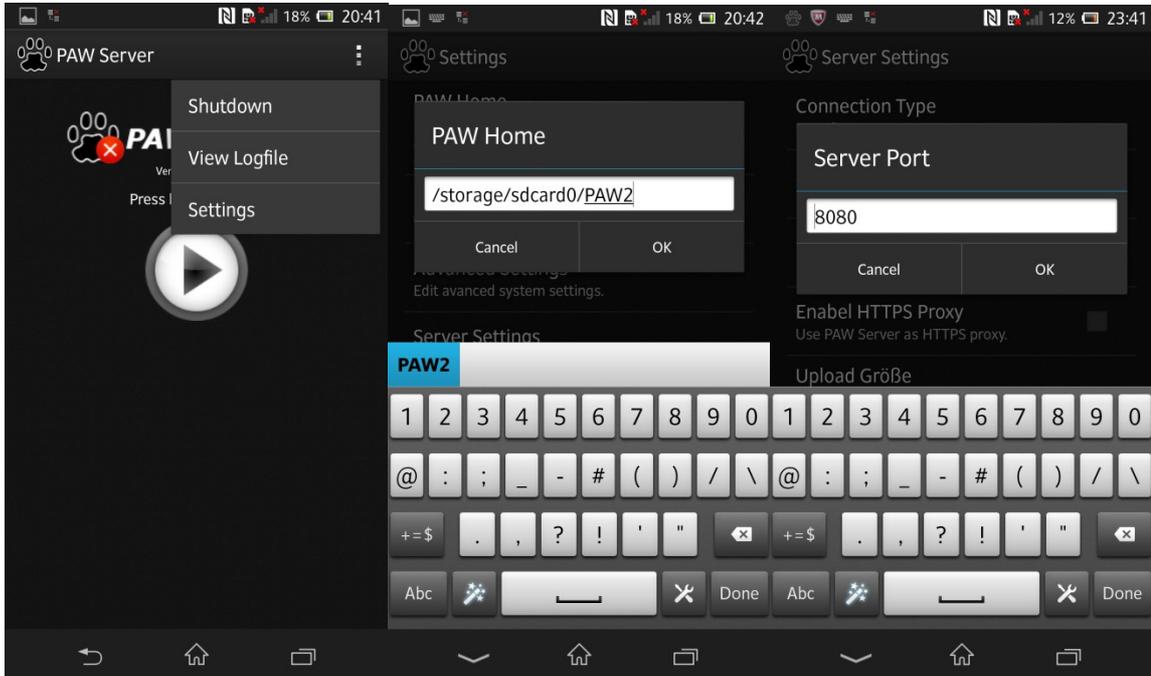
## 7.2 Android – Configuring PAW Server

To setup PAW server move the de.fun2code.android.pawserver-1.apk file onto an SD card with the PAW2 directory. Insert the SD card into the Android phone to act as the web server. On the phone navigate to **Settings -> Security -> and tick “Unknown Sources”** to allow you to install the .apk from the SD card. Using a File Manager navigate to the SD card. Click on the de.fun2code.android.pawserver-1.apk to install it and accept the permissions. When the app has been installed copy the PAW2 directory from the SD card to the root directory of the phone.

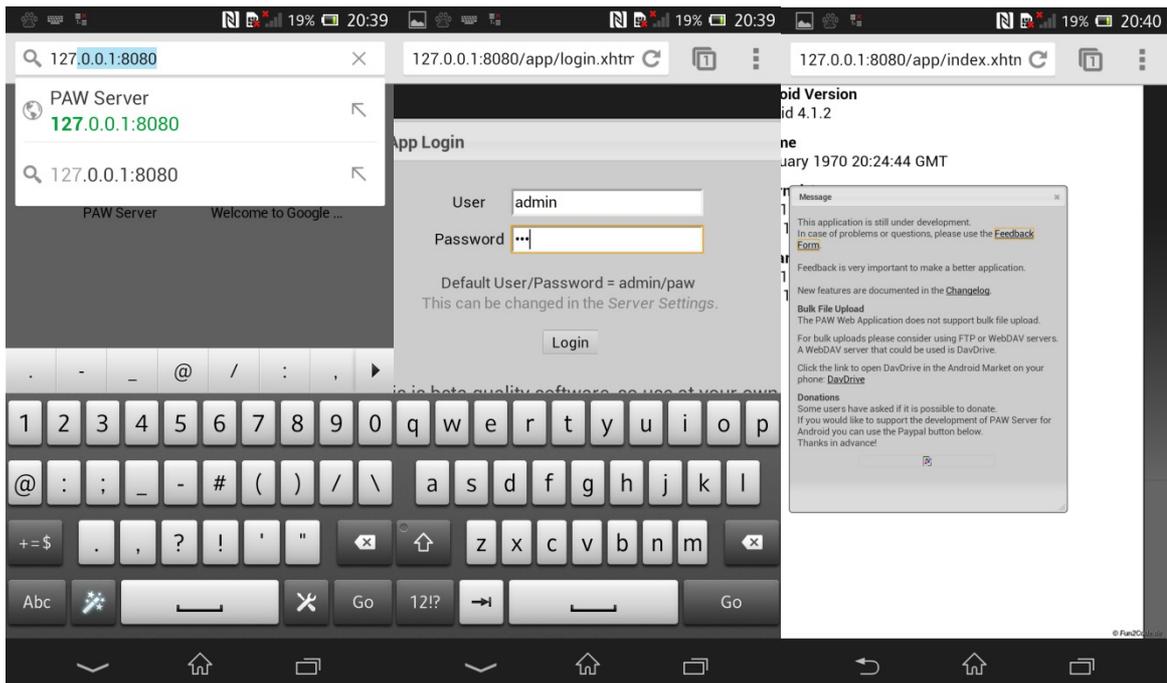


Next open the PAW application, open the Options by selecting the **⋮** in the top right of the screen. Change the PAW root directory to the PAW2 folder you have just copied. You can also change the port the server is running on.

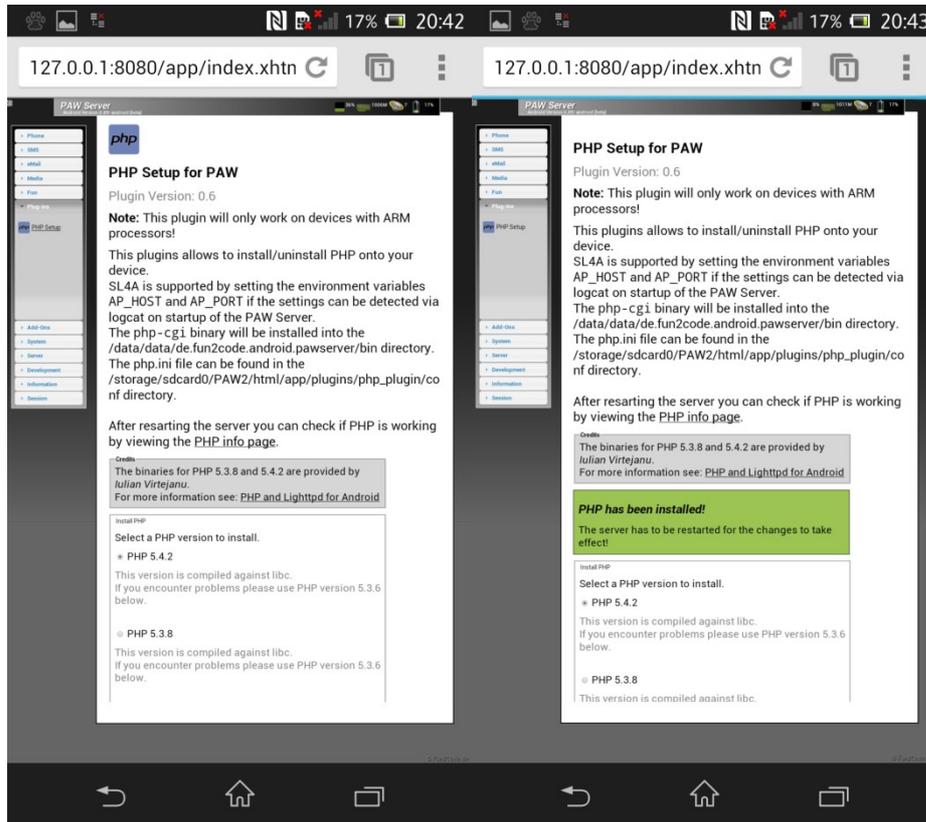
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Start the PAW server. Open the phone Web browser. Navigate to 127.0.0.1:8080. This should open the web server home page. Log in as “admin” “paw”. Close the Warning message.



Select Plugins from the Left-hand Menu. Install the php plugin (5.4.2) and restart paw. The web server is now ready to receive files from the EXTENDING implant.



Audio files received by the phone will be stored in the **/PAW2/html/wifiConnect/audio** folder. They can then be copied onto an SD card and decrypted on a Windows laptop with the ECDLIVE.exe tool installed.

## 8 Audio Exfiltration

### 8.1 Close Access Audio File Retrieval

Audio Files are recorded by the implant when the “audioRecordingMode” Setting is set 1-3. These files are stored locally on the TV hard drive. They can be retrieved by inserting a USB stick into the TV. The USB stick inserted into the TV will be authenticated by the presence of a filename on the stick, and a unique string held with-in the file. These values are set in the “usbDownloadKeyFile” and “usbDownloadKeyFileGUID” Settings.

To Retrieve Files from the TV:

1. Create a file with the same name as the “usbDownloadKeyFile” Setting in the configuration file
2. Edit this file with a text editor and enter the “usbDownloadKeyFileGUID” Setting unique string
3. Save the file onto a USB stick. Preferably the stick should have an LED that flashes
4. Turn on the target TV
5. Insert the USB stick into the TV. A pop-up may appear asking what you want to do with the TV. IGNORE this.
6. Watch the USB stick LED flashing. Once the LED stops flashing all files should have been transferred. Transferred files are deleted from the TV storage area.
7. To ensure that files have been copied, you can open the USB stick to look at files using the remote.
8. Remove the USB stick from the TV.
9. The files on the USB stick can now be decrypted using the ECDLIVE tool.

### 8.2 Remote Access Audio File Retrieval

Audio files that are stored locally on the disk can also be retrieved over a Wi-Fi hotspot. Remote File Retrieval is enabled when the “audioRecordingMode” setting is set to **2**. The hotspot that EXTENDING will use for exfiltration is configured in the Settings file and controlled by the “wifiSSIDname” and “WPAPreSharedKey” Settings. The IP address and port that the files will be transmitted to is configured by the “baseURL” and “basePort”. Make sure a Web Server has been configured to receive the files. See *Setting up the Web Server*.

To exfiltrate the audio files:

1. Set up a Wi-Fi hotspot with the SSID and password as set in the configuration file. See *Setting up the Wi-Fi Hotspot* Section.
2. The Wi-Fi hotspot can be set up on a laptop, phone or a Wi-Fi router.
3. When the Wi-Fi hotspot is turned on with-in range of the TV, EXTENDING will connect to it and begin to exfiltrate files to the IP address “baseURL” and port “basePort” as configured in the Settings file.
4. To receive the files the device with the “baseURL” must be running a Web Server on the “basePort” port number. See *Setting up the Web Server*.
5. Audio files will be transferred to <WebServer>/wifiConnect/audio on the receiving device.
6. Files can be decrypted using the ECDLIVE tool. The files should be placed in the “./store” directory and the command **ECDLIVE.exe -usb** run
7. When the WiFi hotspot or web server is turned off EXTENDING will stop transferring files.

### 8.3 Live Audio Exfiltration and Listening

#### 8.3.1 Introduction

Audio can also be streamed “Live” to a listening application over a Wi-Fi hotspot. Live Listen Streaming is enabled when the “audioRecordingMode” setting is set to **3**. The hotspot that EXTENDING will use for exfiltration is configured in the Settings file and controlled by the “uploadServerIP” and “uploadServerPort” Settings.

The Live Listener runs as a Windows Command Line application on the platform presenting itself as Wi-Fi Hotspot. For information on the EXTENDING Wi-Fi Hotspot see section “Setting up the Wi-Fi Hotspot”.

The Live Listener’s primary function is to receive and decode incoming packets from the EXTENDING TV application and play the decrypted audio through the platform’s sound card / headphones. Received data is also saved to file in a “./store” folder to allow playback at a later date. The data files are stored in the same encrypted format as the data is received over Wi-Fi.

A Public RSA key is stored within the TV application configuration file. In order to decode the received data the corresponding Private RSA key must be present in the same folder as the Live Listener application. This is the private\_key.pem generated in the *Public Key Generation* section. The Private key file must be stored as ‘key.prv’. The presence of the private key and storage of the data files upon the same platform requires that the necessary security protocols be followed.

#### 8.3.2 Live Listener Command Line Options

```
ECDLIVE.exe -p {port no.} [-d] [-r] [-f] [-l [-usb] [-b]
```

Options:

- p - port number, set this to the same value as stored in the TV application configuration file ‘uploadServerPort’ typically 8080.
- d - do not store live play data to file
- r - replay audio stored in files from previous live listen session
- f - save live listener data to file without playing through the sound card
- l - set audio latency (1 - 10), depending upon the quality of the wifi connection, higher latency may improve the listening experience by reducing the ‘stuttering’ effect of dropped packets. By default the latency is set to ‘3’.
- usb - playback files downloaded either via USB during close access to the TV, or by connection to a mobile webserver. The files must be stored in the ‘./store’ folder of the Live Listener platform.
- b - set the playback bitrate. By default the Speex decoder produces an audio stream of 32,000bps. By changing this value playback may be sped up / slowed down. However, this is without any pitch correction.

Example Commands:

Listen to live in coming audio, and save data to file...

```
ECDLIVE.exe -p 8080
```

Replay stored audio from previous live listen session...

```
ECDLIVE.exe -r
```

Replay audio from USB or files downloaded via the webserver...

```
ECDLIVE.exe -usb
```

#### 8.3.3 Live Listener Output

Whilst running, the Live Listener generates text output to provide the user with feedback as to the level of success of the data transfer.

The first text line displays the 'mode' in which the Live Listener is operating ie. 'replay mode', 'replay usb files', 'live mode, storage on...' etc.

If listening to the Wifi port, or reading packets from previously saved files, the application reports the running total of the packets decoded, together with the actual packet sequence number (from data embedded within the packet). The difference between these two numbers gives an indication of the number of dropped packets. At the start of each Speex frame being received, the application reports the size of the new frame being constructed, 'new frame, size 4248', followed by the packet sequence no.s used to create that frame. Once the whole frame has been constructed the amount of data stored is reported, ie. 'buffering 4248'.

Due to the nature of the Speex decoder there is a certain amount of internal buffering within the Live Listener which is outside the control of the Live Listener application, thus it is quite normal for 30 to 50 packets of data to be received before the audio is heard. This will equate to approx. 10 – 15 seconds of latency.

### **Dropped Packets**

The transport protocol used for the audio data transfer over Wifi is UDP. Unlike the TCP/IP protocol packets are not guaranteed to reach the destination, this can result in some frames of Speex data being incomplete. This is further compounded by the fact that it takes approx. 2 to 4 packets of data to make up a complete Speex audio frame (depending upon the Speex quality configuration setting), so a single dropped packet will result in a whole frame of data being discarded. The Live Listener monitors the incoming data and can identify missing headers or headers arrived before their expected time, in these cases the application will attempt to retrain against the new data and build a complete Speex frame. Each Speex frame will contain about 0.25 seconds of real time audio.

#### **8.3.4 Troubleshooting**

Silence at the Listening end could be caused by the following:

- a. The TV is not in range
- b. There is nothing being recorded by the implant due to silence
- c. The implant is incorrectly configured
- d. The Live Listen tool is not running

## 9 Uninstalling the Implant

### 9.1 Close Access Uninstall

The implant can be uninstalled by inserting a USB stick into the TV. The USB stick inserted into the TV will be authenticated by the presence of a filename on the stick, and a unique string held with-in the file. These values are set in the “usbDeleteKeyFile” and “usbDeleteKeyFileGUID” Settings.

To uninstall EXTENDING:

1. Create a file with the same name as the “usbDeleteKeyFile” Setting in the configuration file
2. Edit this file with a text editor and enter the “usbDeleteKeyFileGUID” Setting unique string
3. Save the file onto a USB stick.
4. Turn on the target TV
5. Insert the USB stick into the TV. A pop-up may appear asking what you want to do with the TV. IGNORE this.
6. Wait for 1 minute.
7. Remove the USB stick.
8. EXTENDING is now uninstalled

### 9.2 Time-based Uninstall

EXTENDING can be configured to automatically uninstall itself after a set period of time. In order to achieve this a reliable clock must be available for the implant. This means that the target TV must be connected to the internet, so the implant can get a reliable NTP based time from a server. If a reliable time source is not available this removal method should not be used to uninstall EXTENDING. Instead the Manual Uninstall method should be used.

To set the time at which EXTENDING should be uninstalled then set the “DeathDate” setting to the desired time. Also set the “NTPServer” setting to a valid IP address and the “ignoreMissingNTPServer” setting to 0. This means that if an NTP server is not available to EXTENDING when it starts up, then it will automatically uninstall itself. This negates the danger of an application missing its Death Date if the TV is disconnected from the internet. It also means that EXTENDING will never run if it cannot reach the NTP server when it is first installed.

## 10 Testing / Troubleshooting

### 10.1 Incorrectly Configured Settings

The most common reason for EXTENDING to not be running is a misconfigured Settings file.

All Settings must be configured within their valid ranges, or EXTENDING will self-delete when it is installed. This should be checked by the encryptSettings tool.

If an NTP Server is required to provide time for Time-based death date, and the implant cannot connect to one on start-up then EXTENDING will Self-delete.

### 10.2 Testing the Configuration

Before deploying the implant to a target TV, it is recommended that EXTENDING is installed to a test TV. This ensures that the configuration file is correct before attempting to deploy it.

## 11 Known issues and Limitations

### 11.1 Known Issues

#### **Microphone Sharing**

The current implant cannot share the microphone with other applications. Therefore if Voice Recognition is turned on, or if an application such as Skype is started, our application will close its access to the microphone. When the other application stops using the microphone again, EXTENDING will start recording again. In future releases of the implant we will be able to record from the microphone simultaneously with other applications.

#### **Fake-off – TV Communications**

When the TV is in Fake-off mode the processor functionality has not been limited. Practically, this means that the TV will still flash the LEDs on USB drives when they are inserted and continue to send packets on the network. Many Smart TVs do this as part of their functionality; however Samsung TVs do not normally. As an improvement for the next release of the implant we hope to reduce the processor functionality when the implant enters Fake-off mode. This will involve just recording from the TV, and only connecting to the SSIDs set in the implant Settings file.

#### **Fake-off – LED**

When the TV is in Fake-off mode the “Samsung” LED at the front and centre of the TV remains on.

#### **Wi-Fi Interference**

The EXTENDING implant will interrupt a user’s use of the wireless card on the TV. If a target is connected to their home wireless network, then EXTENDING will break this connection when it detects the presence of the SSID it wishes to connect to.

#### **audioRecordingMode=0**

When operating in audioRecordingMode=0 (not recording any audio) the implant will stop running when fake-off mode is entered. The source of this problem has been located and will be fixed in the next release.

### 11.2 Limitations

#### **Lag before application starts**

The implant is started by the TV when the TV powers on. It can take up to 30 seconds from the user turning the TV on for EXTENDING to start running. As the exploit relies on being started by the TV then there is no way to avoid this.

A Side-effect of this is that if the user turns the TV on and then off quickly and before EXTENDING has started up, then the TV does not enter Fake-off mode. The next time the TV is turned on, the implant will still start as normal, however we will have missed a period of Fake-off recording.

#### **Smart HUB setup**

To install our application the Smart HUB needs to be setup and the license agreements accepted. It is only possible to do this with an internet connection.

#### **Smart HUB Storage Available**

When on the Smart Hub “More Apps” page the available storage space is shown in the bottom right hand corner. If the implant is configured to record audio to the “mtd\_rwcommon” folder area, then this storage

area will appear fuller as the implant records audio. However it is impossible to discover what is using this storage without exploiting the TV to gain command line access. Limiting the “storageFoldermaxStorage” setting has reduced the potential impact of this.

## 12 History

|       |            |                       |
|-------|------------|-----------------------|
| Draft | 28/02/2014 | EXTENDING 2.0 RC 20   |
| 1.0   | 29/04/2014 | EXTENDING 2.0 Release |

## Appendix A – encryptSettings Error Codes

This table provides a list of Error Codes that can be reported by the encryptSettings tool. Each error code relates to the presence of a setting, or the validation of a setting:

| Error Code | Code Meaning  |
|------------|---|
| 0          | deploymentID setting is missing or has incorrect format. OR whole Settings file is misconfigured. |
| 1          | deploymentID setting is outside allowed range.  |
| 2          | deathDate setting is missing.   |
| 3          | deathDate setting is not formatted correctly.   |
| 4          | NTPServer setting is missing.   |
| 5          | NTPServer setting is not formatted correctly.   |
| 6          | ignoreMissingNTPServer setting is missing or has incorrect format.                                |
| 7          | ignoreMissingNTPServer setting is outside allowed range.  |
| 8          | silenceLevel setting is missing or has incorrect format.  |
| 9          | silenceLevel setting is outside allowed range.  |
| 10         | silencePeriod setting is missing or has incorrect format.   |
| 11         | silencePeriod setting is outside allowed range.   |
| 12         | baseURL setting is missing.   |
| 13         | baseURL setting is not formatted correctly.   |
| 14         | basePort setting is missing or has incorrect format.  |
| 15         | basePort setting is outside allowed range.  |
| 16         | speexQuality setting is missing or has incorrect format.  |
| 17         | speexQuality setting is outside allowed range.  |
| 18         | audioRecordingMode setting is missing or has incorrect format. Or no Storage Folder Specified     |
| 19         | audioRecordingMode setting is outside allowed range.  |
| 20         | fakeOffMode setting is missing or has incorrect format.   |
| 21         | fakeOffMode setting is outside allowed range.   |

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|    |  |
|----|--|
|    |  |
| 22 | audioBuffSizeKb setting is missing or has incorrect format.            |
| 23 | audioBuffSizeKb setting is outside allowed range.                      |
| 24 | audioMaxFileSizeKb setting is missing or has incorrect format.         |
| 25 | audioMaxFileSizeKb setting is outside allowed range.                   |
| 26 | audioMaxFileSizeKb is smaller than audioBuffSizeKb                     |
| 27 | storageFolderMaxStoreageMb setting is missing or has incorrect format. |
| 28 | storageFolderMaxStoreageMb setting is outside allowed range.           |
| 29 | storageFolderMaxStoreageMb is smaller than audioMaxFileSizeKb.         |
| 30 | storageFolder setting is missing or has incorrect format.              |
| 31 | usbFolder setting is missing or has incorrect format.                  |
| 32 | usbDownloadKeyFile setting is missing or has incorrect format.         |
| 33 | usbDownloadKeyFileGUID setting is missing or has incorrect format.     |
| 34 | usbDeleteKeyFile setting is missing or has incorrect format.           |
| 35 | usbDeleteKeyFileGUID setting is missing or has incorrect format.       |
| 36 | INDEX FILE ????  |
| 37 | audioDeviceName setting is missing or has incorrect format.            |
| 38 | wifiDeviceName setting is missing or has incorrect format.             |
| 39 | wifiSSIDName setting is missing or has incorrect format.               |
| 39 | WPAPreSharedKey setting is missing or has incorrect format.            |
| 40 | PublicKey setting is missing.  |
| 41 | PublicKey is not a valid public rsa key.                               |
| 42 | uploadServerIP setting is missing.                                     |
| 43 | uploadServerIP setting is not formatted correctly.                     |
| 44 | uploadServerPort setting is missing or has incorrect format.           |
| 45 | uploadServerPort setting is outside allowed range.                     |
| 46 | wifiConnectionPollSecs setting is missing or has incorrect format.     |

|    |  |
|----|--|
|    |  |
| 47 | wifiConnectionPollSecs setting is outside allowed range.                 |
| 48 | usbConnectionPollSecs setting is missing or has incorrect format.        |
| 49 | usbConnectionPollSecs setting is outside allowed range.                  |
| 50 | wifiServerUploadScript setting is missing or has incorrect format.       |
| 51 | audioFolderDeleteOldestFiles setting is missing or has incorrect format. |
| 52 | audioFolderDeleteOldestFiles setting is outside allowed range.           |
| 53 | wifiADHOC setting is missing or has incorrect format.                    |
| 54 | wifiADHOC setting is outside allowed range.                              |