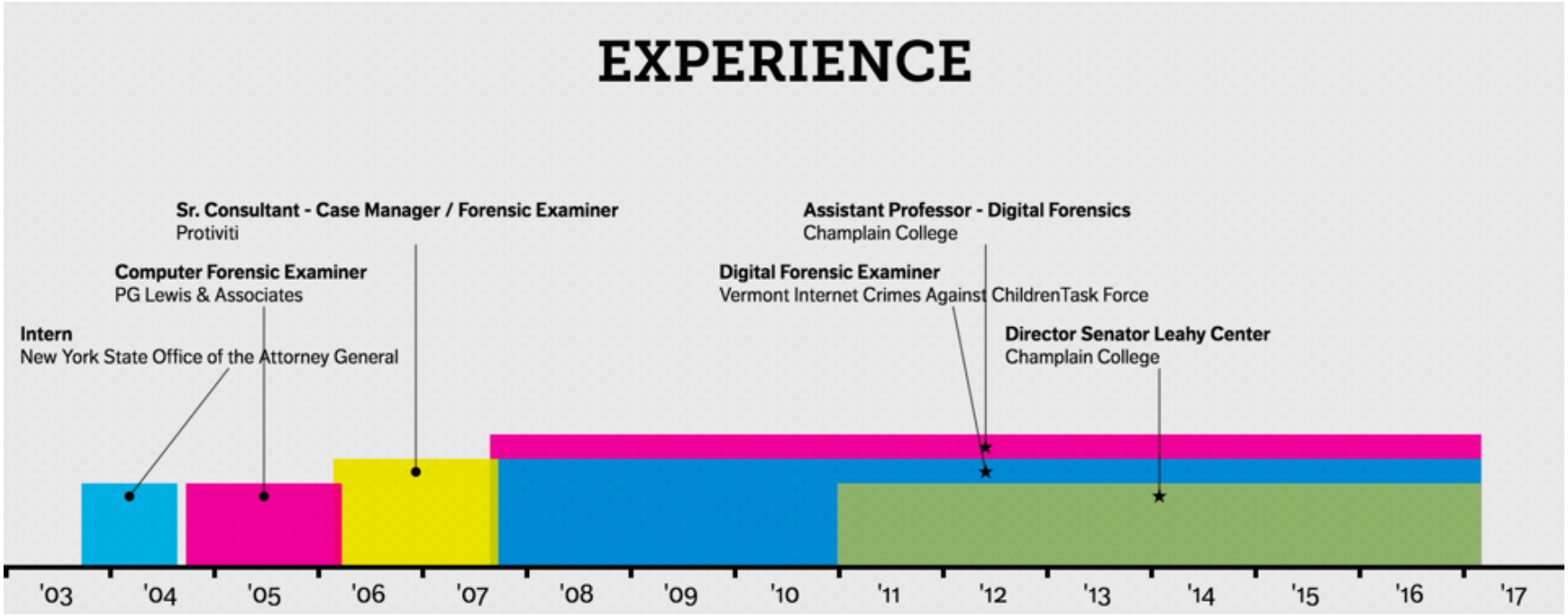
enfuse
2017

Internet of Things Forensics

Jonathan Rajewski
@jtrajewski



Jonathan Rajewski, MS, CCE, CFE, CISSP, ENCE

Director - Senator Leahy Center for Digital Investigation @jtrajewski

Associate Professor - Digital Forensics | Cyber Security

Digital Forensic Examiner - Vermont Internet Crimes Against Children Task Force

How the IoT is Making Cybercrime Investigation Easier | Jonathan Rajewski | TEDxBuffalo

TEDx Talks

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Leahy Center Research Assistants

Thank you!

Joe Diorio
Justin Waite
Kayla Williford
Mary Braden Murphy
Michael Cook
Mitch Green
Zack Smith
Tyler Wright

How many of you have an IOT device in your home?

Alexa, can you help with this murder case?

By **Eliott C. McLaughlin** and **Keith Allen, CNN**

Updated 8:48 PM ET, Wed December 28, 2016

Another smart device, Bates' water heater, points to an exorbitant amount of water being used in the early-morning hours, in what investigators believe was an attempt to cover up a crime, the affidavit says.

The path to doing this yourself

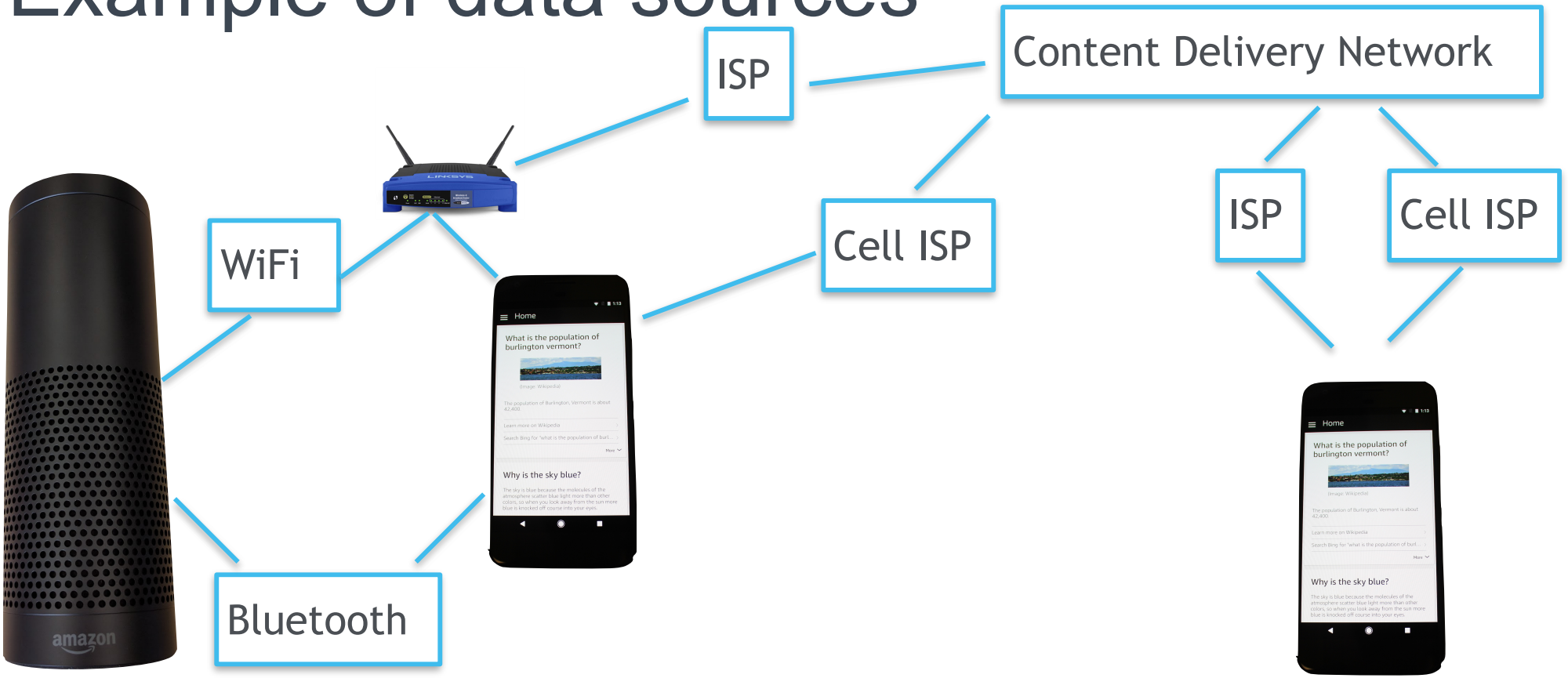

Buy 30 IOT devices
Build a PCAP capture system
Create alternative personas
Root multiple Nexus/Pixel Phones
Generate Data/Document Everything
Analyze all of the things - Chip/Network/App/Phone etc

Network Forensics of IOT

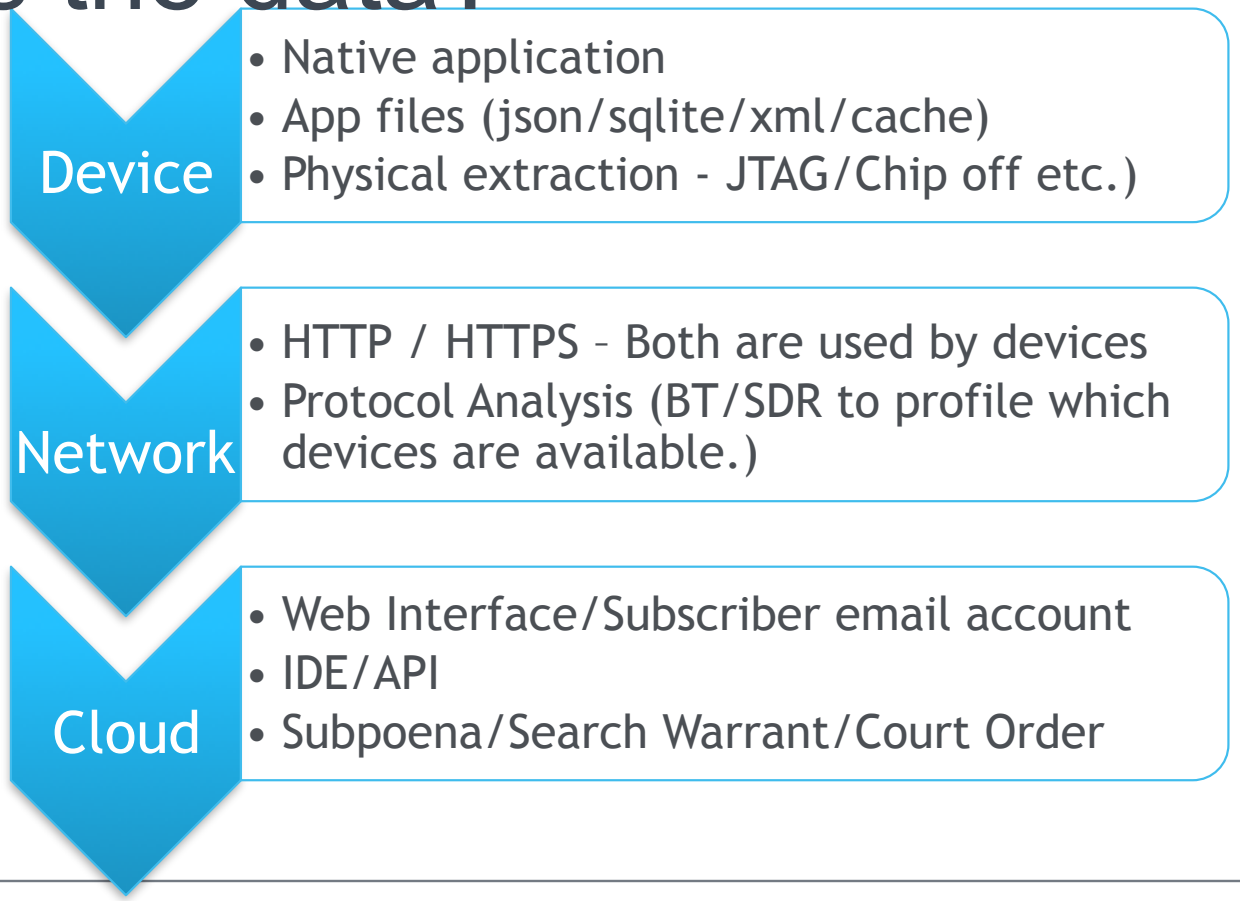
Quick overview of the findings

- Most IOT devices transmitted encrypted data to content delivery networks
- Others did not
- Others communicated with China

Example of data sources



Where is the data?



Meet Crissy Michaels

I build really fun scenarios for my students

Feel free to help me generate data for students to look at

@missycrissy

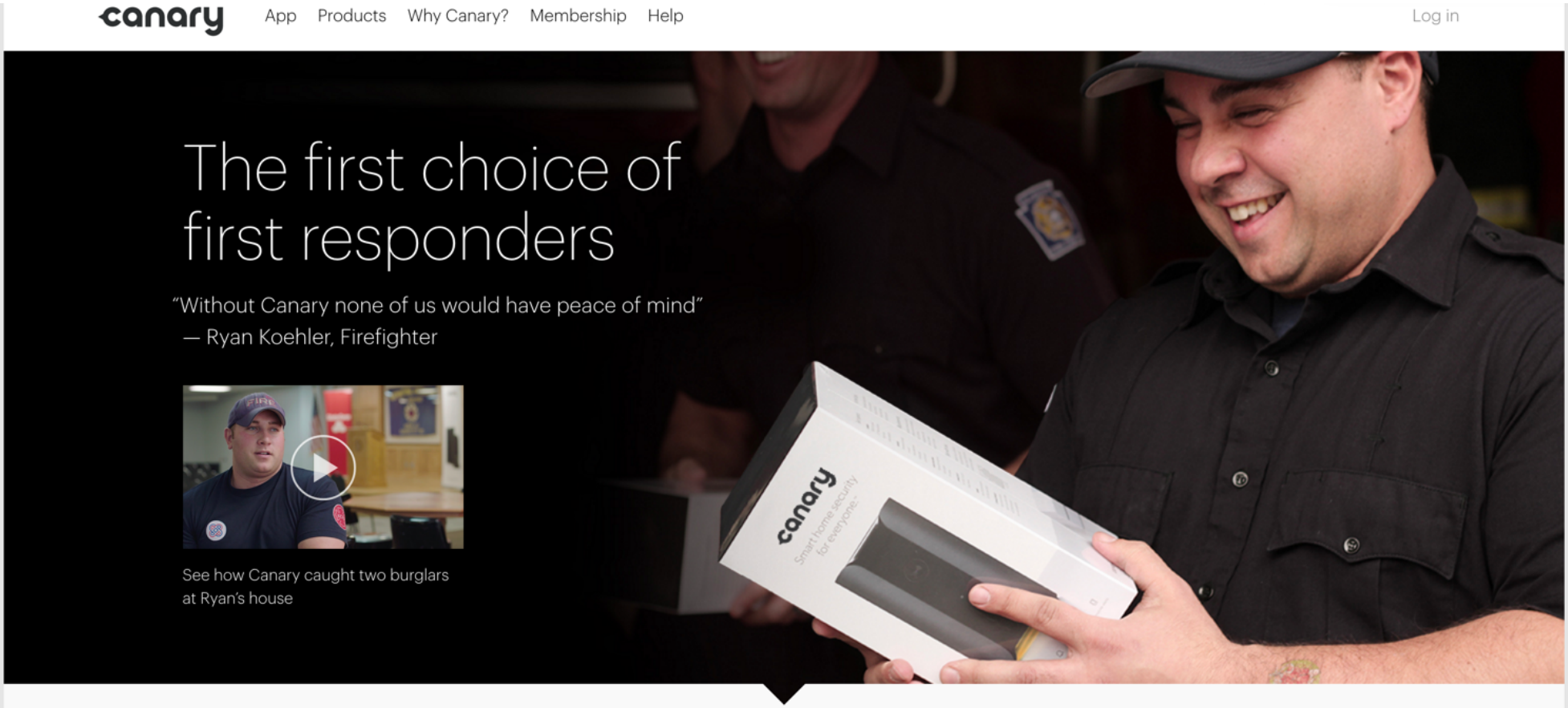
missycrissym@gmail.com

Random Artifact 1

Samsung SmartCam	New firmware updates allow for image and video encryption. This is turned off by default when the app and firmware on the camera is updated. The encryption is also only for video and image transmission over the network. Saved media in the /sdcard/SmartCam location as well as /data/data/com.techwin.shc/files location are not encrypted and can be viewed as if encryption was not enabled. ARP spoofed the phone and was able to intercept traffic between the camera and phone, verified that the data sent is encrypted.	Images and videos in two locations. One within /sdcard/ SmartCam and the other /data/data/com.techwin.shc/files/. Pictures (.jpg) are automatically saved to /sdcard/SmartCam when user takes a photo via the application. The .jpg images are named in the format YYYY-MM-DD_HH.MM.SS.jpg. This date and time is the time the user saved the picture. Under /data/data/ com.techwin.shc/files/ are folders named in Epoch timestamp format. These folders are created when a user saves a video. The epoch timestamp is the date and time that user started recording the video. A user can go into the app and to it's saved videos and export a video to /sdcard/SmartCam. This will be saved under the format of <serialNumberOfDevice>_<epochTimeThatTheVideoWasExported>.mp4

Random Artifact 2

	With the addition of image and video encryption for the Samsung SmartCam, encryption must be turned off to use the SmartCam with the SmartThings Hub. If encryption is enabled, when you attempt to view the live stream on the SmartThings app you are prompted to disable encryption to display feed. Events are stored at /data/data/com.smartthings.android/databases/ua_analytics.db with Unix timestamps, whether the activity started or stopped, event ID, and if it occured as a rooms activity or primary activity. / data/data/com.smartthings.android/databases/ua_preferences.db contains the alias for the account, which is the email account logged in to the hub. There are three timestamps com.urbanairship.analytics.LAST_SEND which is a unix value corresponding to the time data was last sent to the analytics server or online application? com.urbanairship.application.metrics.LAST_OPEN is the time the SmartThings app was last opened. Last, com.urbanairship.push.LAST_APID_REGISTRATION_TIME is the time registration was last done on the app. (creating a new account).
Samsung SmartThings Hub + Sensors	



Complete Smart Home Security

Canary

01

Faster response from the authorities.

Canary automatically pulls in contacts for police, fire and EMS closest to your home, giving you one touch access to the proper authorities no matter where you are in the world. With video and audio evidence of burglaries in progress, your call will get the priority it deserves.

> "A notification from Canary alerted me to video of two men entering my home. After I called the police, they were on the scene less than 4 minutes later to catch the would-be thieves."
> — Mike, Indiana

2:34 pm
Burglars detected by Canary

2:35 pm
Emergency call placed

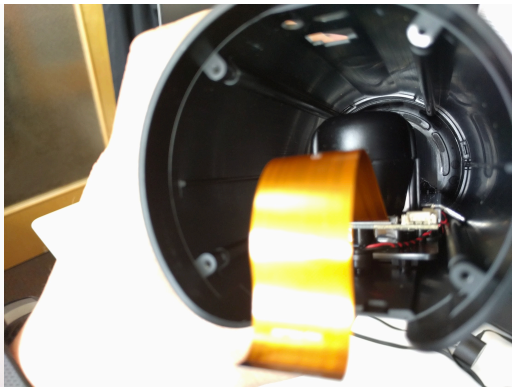
2:38 pm
Police arrive on the scene

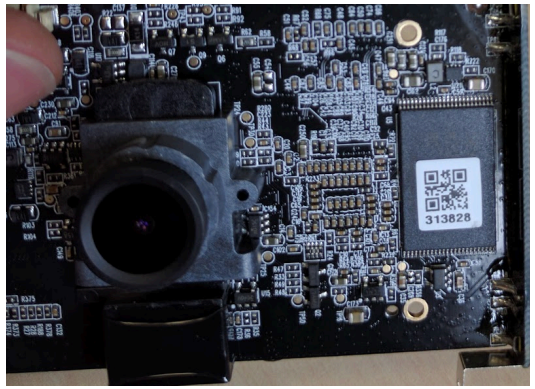
https://canary.is/compare/

Canary

Hardware Artifacts

TSOP Chip
Hynix H27U2G8F2CTR-BC
2GB NAND





Canary

App Artifacts

is.yranac.canary/databases/canary_base.sqlite

customer_table

_id	created	curent_location	email	first_name	customer_id	last_location_change	last_name	notifications_sound	phone	resource_uri	username
2	2017-05-10T18:44:32	/v1/locations/413339/	missycrissym@gmail.com	Crissy	476318	2017-05-11T18:03:57	Michaels	canary.wav	17254651282	/v1/customers/476318/	missycrissym@gmail.com

emergency_contacts_table

_id	id	contact_type	customer_id	location_id
430	1316953	ems	18026582700	413339
431	1316954	fire	18028643796	413339
432	1316952	police	18026582700	413339
433	1316974	ems	18026582700	413346
434	1316975	fire	18028643796	413346
435	1316973	police	18026582700	413346

*Some columns were removed from this slide

Canary

App Artifacts

is.yranac.canary/databases/canary_base.sqlite

location_table

_id	address	city	country	created	current_mode	geofence_radius	location_id	lat	lng	last_modified	name	owner
3	175 Lakeside Avenue	Burlington	United States	5/10/17 1:44 PM	4	50	413339	44.461011	-73.215953	5/11/17 18:20	Home	/v1/customers/476318/
4	175 Lakeside Avenue	Burlington	United States	5/10/17 2:07 PM	4	50	413346	44.461011	-73.215953	5/11/17 18:20	Home	/v1/customers/476318/

*Some columns were removed from this slide

mode_table

_id	id	name
1	2	armed
2	5	away
3	1	disarmed
4	4	home
5	6	night
6	3	privacy

Canary

App Artifacts

is.yranac.canary/databases/canary_base.sqlite entry_table

_id	end_time	entry_description	entry_type	entry_id	last_modified	location_id	start_time	device_mode	exported
3	5/10/17 5:26 PM	Crissy left Home	location	2563336143	5/10/17 5:26 PM	413339	5/10/17 4:26 PM	/v1/modes/4/	0
4	5/10/17 5:26 PM	Canary entered away mode	mode	2563336145	5/10/17 5:26 PM	413339	5/10/17 4:26 PM	/v1/modes/5/	0
5	5/10/17 5:03 PM	Crissy arrived at Home	location	2563197429	5/10/17 5:03 PM	413339	5/10/17 4:03 PM	/v1/modes/4/	0
72	5/11/17 8:29 AM	Crissy arrived at Home	location	2567133980	5/11/17 8:29 AM	413339	5/11/17 7:29 AM	/v1/modes/5/	0
73	5/11/17 8:29 AM	Canary entered home mode	mode	2567133981	5/11/17 8:29 AM	413339	5/11/17 7:29 AM	/v1/modes/4/	0

*Some columns were removed from this slide

Canary

App Artifacts

is.yranac.canary/databases/canary_base.sqlite

video_export_table

_id	processing	device_uuid	video_size	video_length	download_id	request_at	entryId
3	0	49be340a2ab44e5a8c256026552d95df	0	0		0	2568754949
7	0	49be340a2ab44e5a8c256026552d95df	0	0		0	2568774817
10	0	49be340a2ab44e5a8c256026552d95df	0	0		0	2568806616
19	0	49be340a2ab44e5a8c256026552d95df	28	2380		5/11/17 2:17 PM	2568809577
22	0	49be340a2ab44e5a8c256026552d95df	0	0		0	2568879477

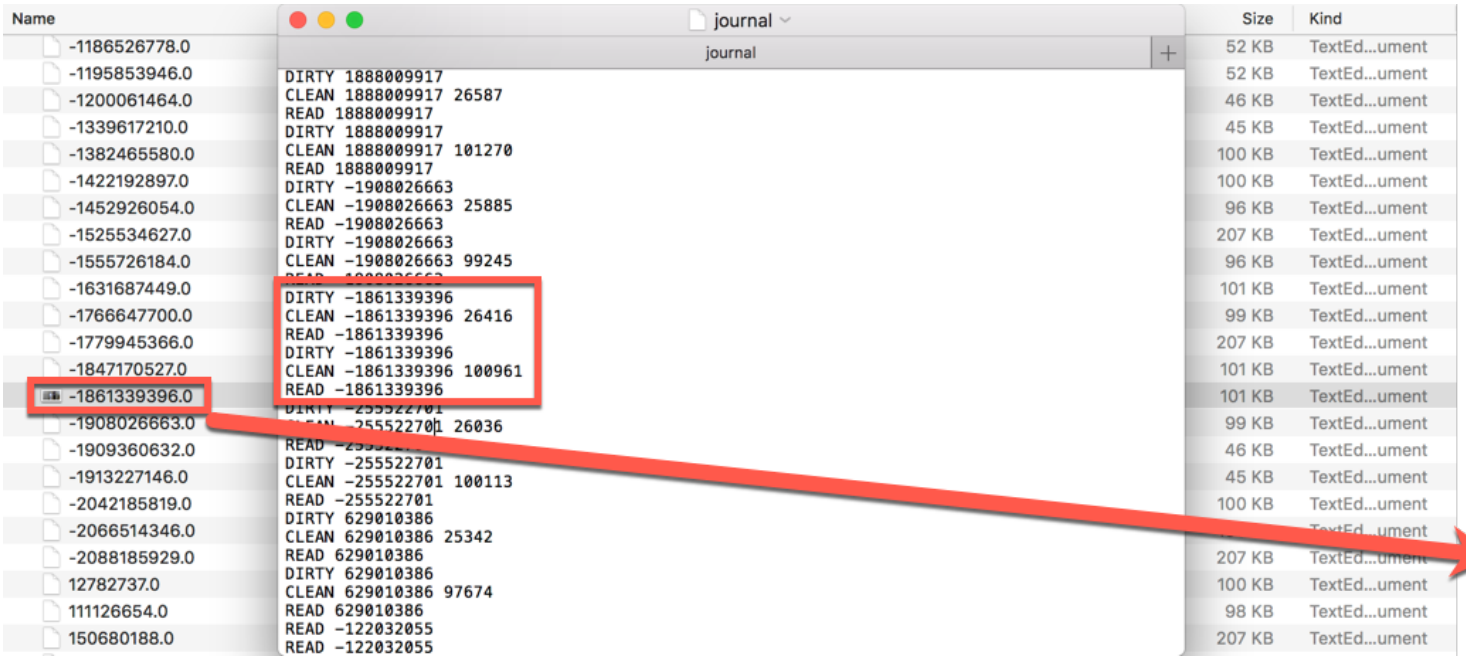
Canary

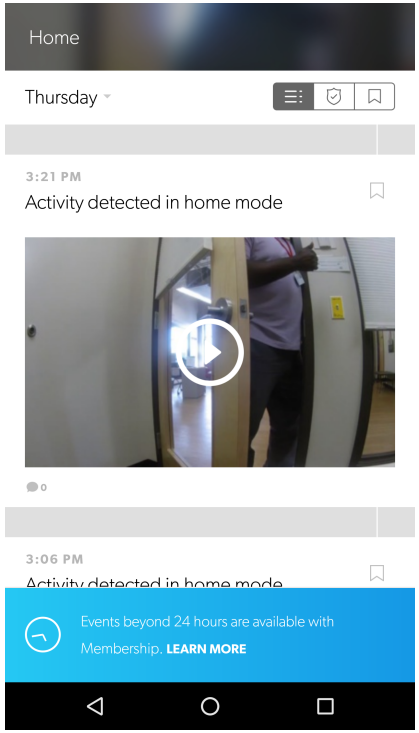
App Artifacts

is.yranac.canary/cache

https://developer.android.com/samples/DisplayingBitmaps/src/com.example.android.displayingbitmaps/util/DiskLruCache.html

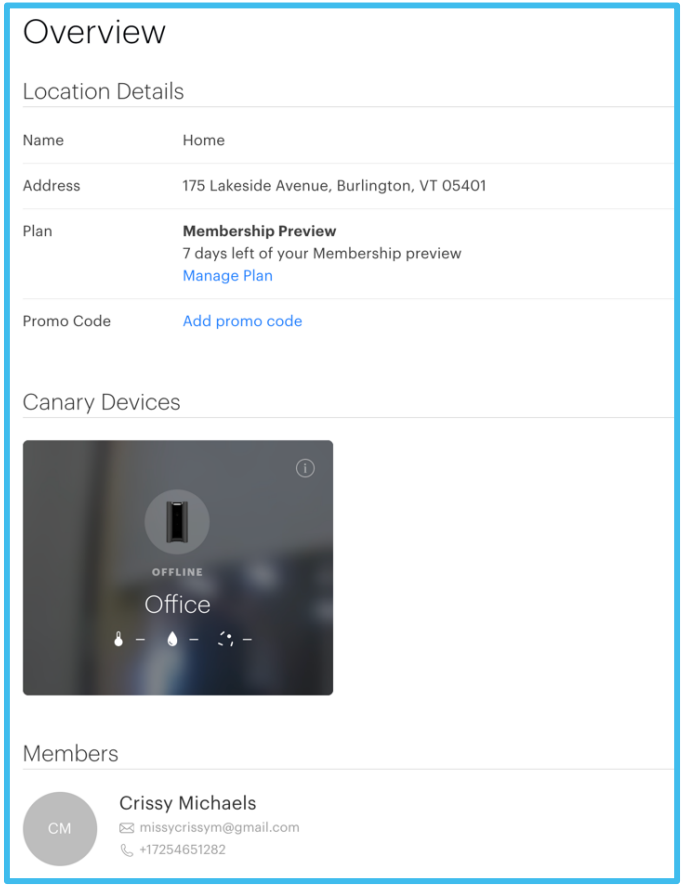
```
* The first five lines of the journal form its header. They are the
* constant string "libcore.io.DiskLruCache", the disk cache's version,
* the application's version, the value count, and a blank line.
*
* Each of the subsequent lines in the file is a record of the state of a
* cache entry. Each line contains space-separated values: a state, a key,
* and optional state-specific values.
*   o DIRTY lines track that an entry is actively being created or updated.
*     Every successful DIRTY action should be followed by a CLEAN or REMOVE
*     action. DIRTY lines without a matching CLEAN or REMOVE indicate that
*     temporary files may need to be deleted.
*   o CLEAN lines track a cache entry that has been successfully published
*     and may be read. A publish line is followed by the lengths of each of
*     its values.
*   o READ lines track accesses for LRU.
*   o REMOVE lines track entries that have been deleted.
*
* The journal file is appended to as cache operations occur. The journal may
* occasionally be compacted by dropping redundant lines. A temporary file named
* "journal.tmp" will be used during compaction; that file should be deleted if
* it exists when the cache is opened.
```

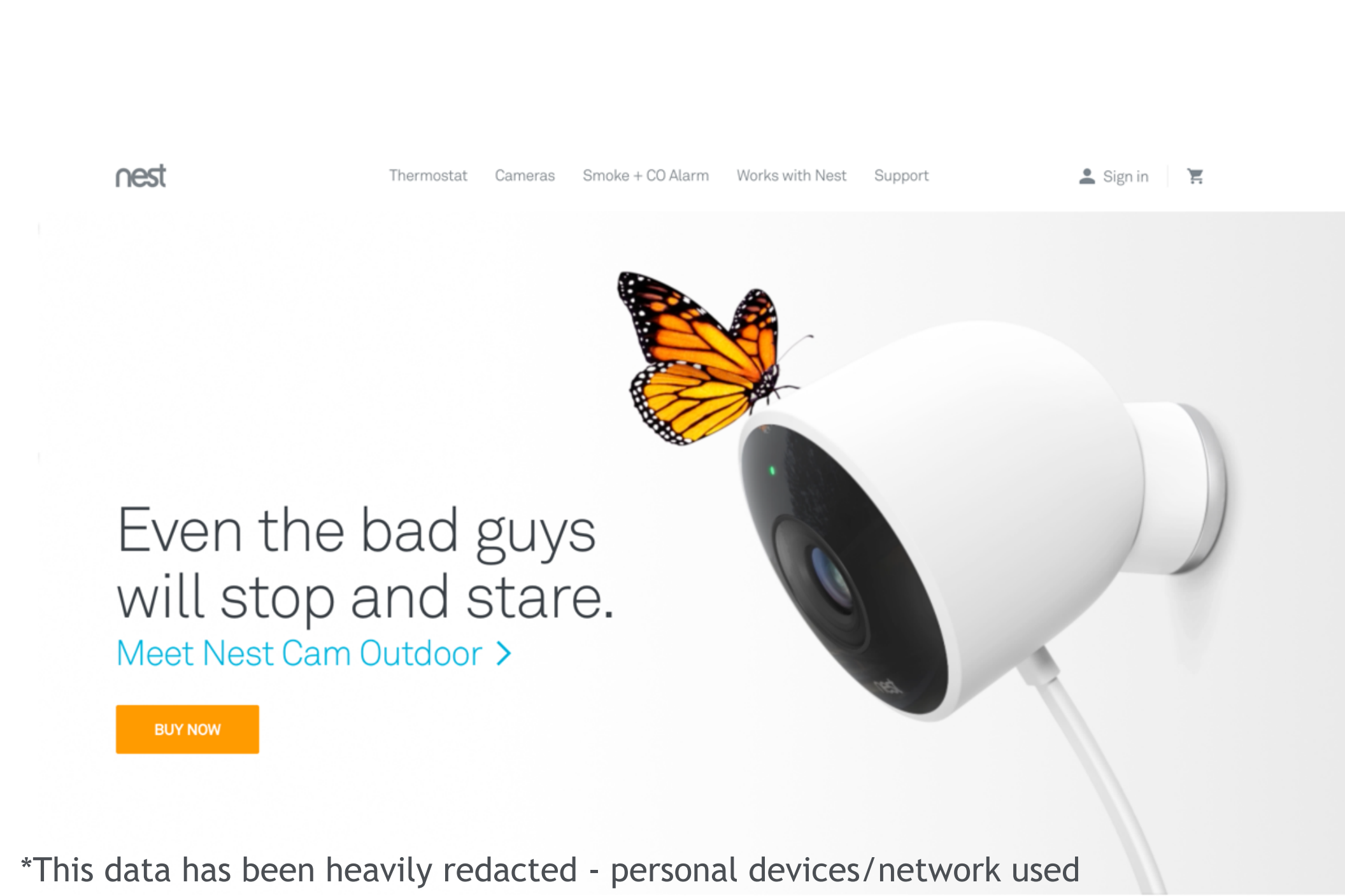




Canary

Cloud Artifacts





*This data has been heavily redacted - personal devices/network used


nest


nest
AIRWAVE
74


nest

Nest

App Artifacts

All Nest Products are bundled into one app folder

com.nest.android/files/com.nest.android.preferences.xml

Nest

App Artifacts

com.nest.android/files/com.google.android.gms.analytics.prefs.xml

```
<?xml version='1.0' encoding='utf-8' standalone='yes' ?>
<map>
    <long name="monitoring:start" value="1495246376426" />
    <long name="monitoring:count" value="81" />
    <string name="monitoring:value">[redacted]</
        string>
    <long name="first_run" value="1476192503984" />
</map>
```

com.nest.android/databases/cache.db

	key	path	created	last_modified	last_accessed	policy
	Filter	Filter	Filter	Filter	Filter	Filter
1	bucketMap	cache1725969177.json	1494106249573	1495295042009	1494106249573	0
2	account	cache1488797587.json	1495295041918	1495295041918	1495295041918	0

Metadata

Subscriber data

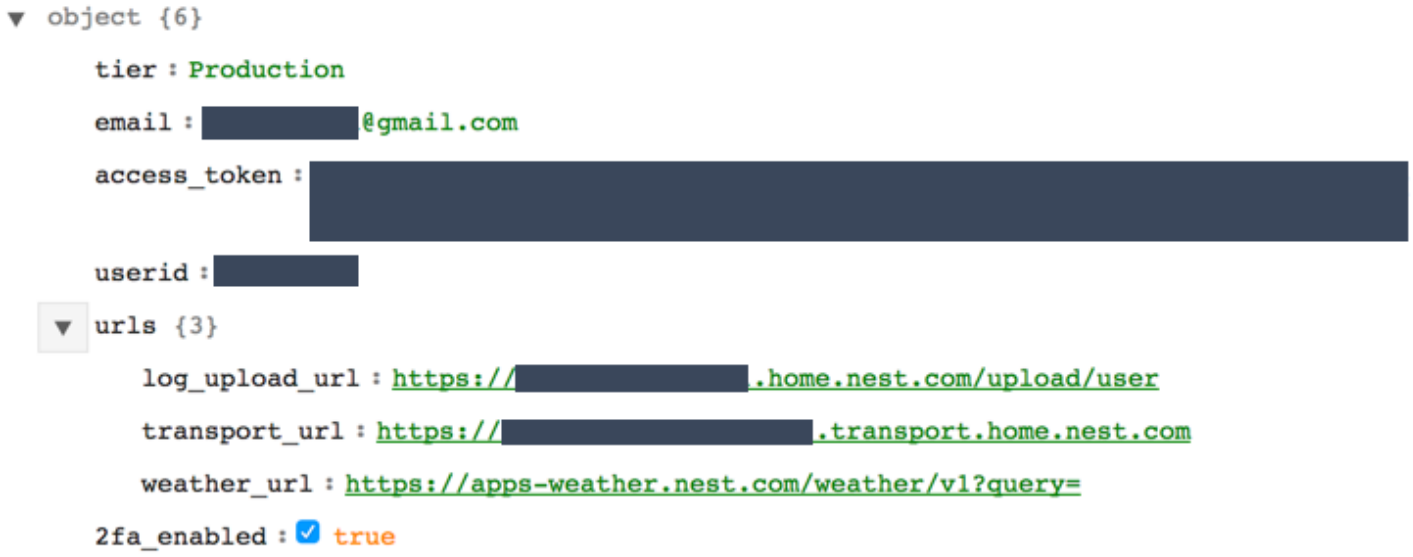
Nest

App Artifacts

com.nest.android/databases/cache.db

	key	path	created	last_modified	last_accessed	policy
	Filter	Filter	Filter	Filter	Filter	Filter
1	bucketMap	cache1725969177.json	1494106249573	1495295042009	1494106249573	0
2	account	cache1488797587.json	1495295041918	1495295041918	1495295041918	0

com.nest.android/cache/cache/cache1488797587.json



Nest

App Artifacts

com.nest.android/cache/cache/cache1725969177.json

- Nest Metadata for all devices the user has permission to access
- Users, locations and device specific behavioral artifacts will be discussed in this presentation

```
▶ array [57]
```

com.nest.android/databases/cache.db

	key	path	created	last_modified	last_accessed	policy
	Filter	Filter	Filter	Filter	Filter	Filter
1	bucketMap	cache1725969177.json	1494106249573	1495295042009	1494106249573	0
2	account	cache1488797587.json	1495295041918	1495295041918	1495295041918	0

Nest

App Artifacts

com.nest.android/cache/cache/cache1725969177.json

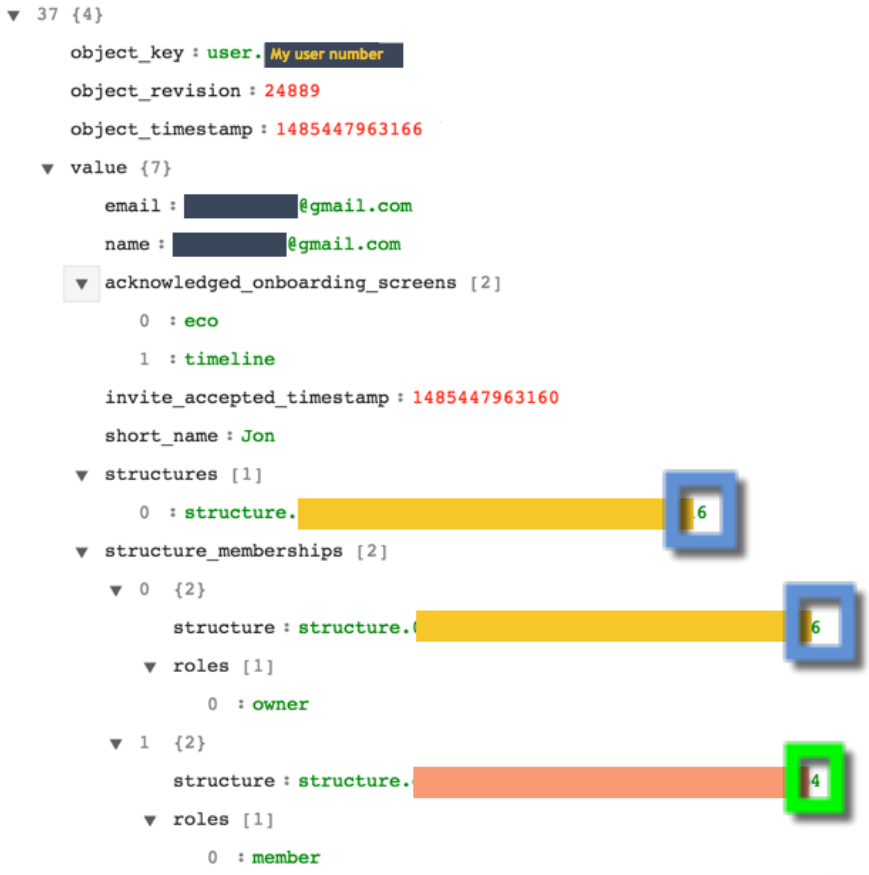
- **This is the primary user's profile**
  - **user_settings.######**
  - **location_primary_Device**
  - **primary_phone**

Nest

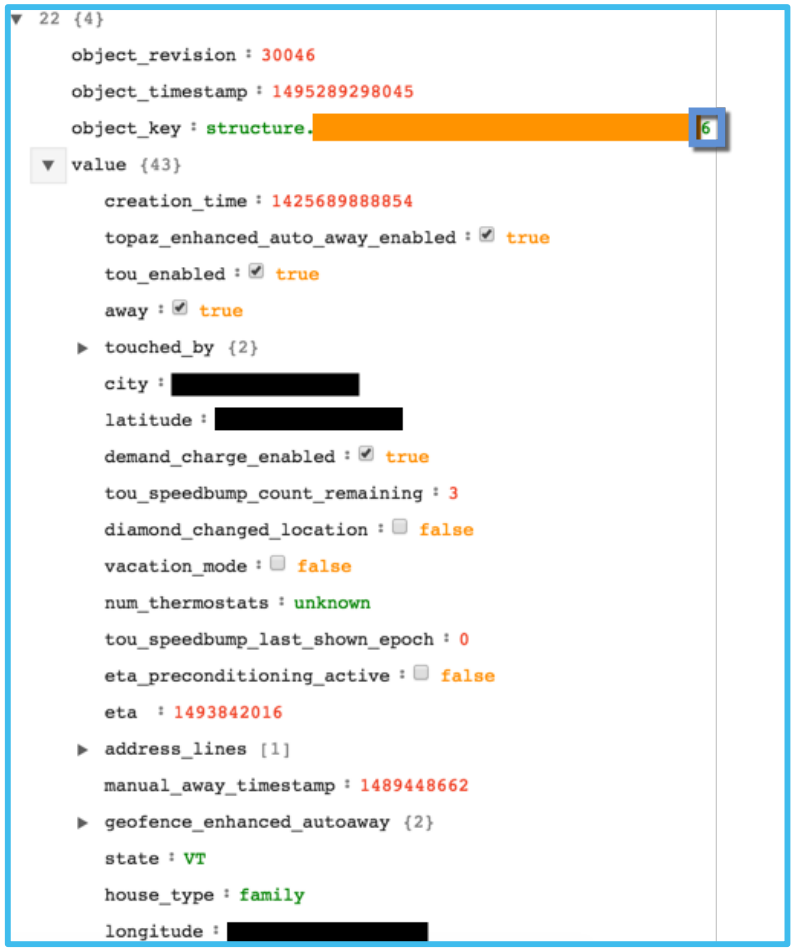
App Artifacts

com.nest.android/cache/cache1725969177.json

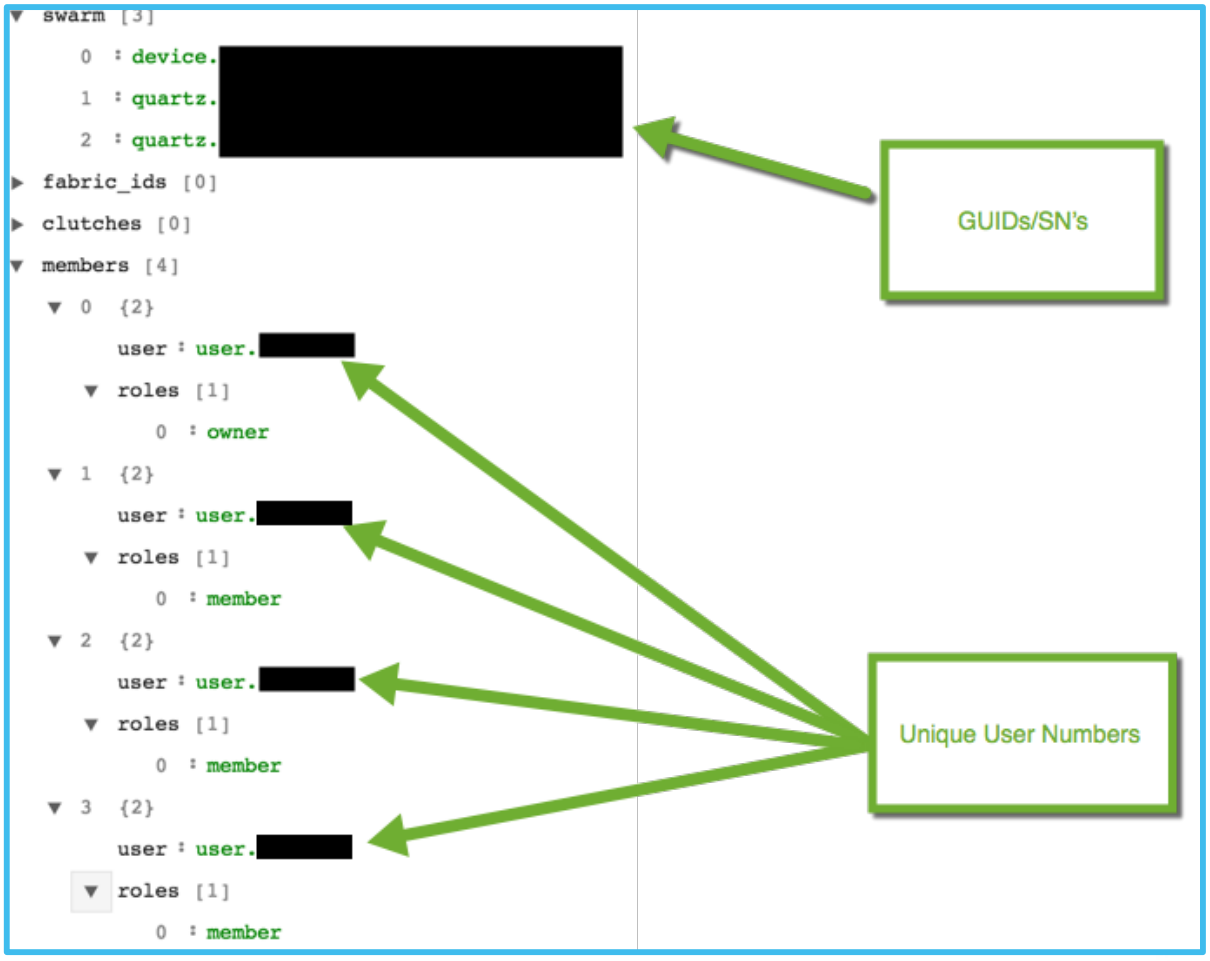
- **User - The user who is signed into the Nest App**
- **Structures are logical groups**
- **Two memberships - Owner vs. Member**



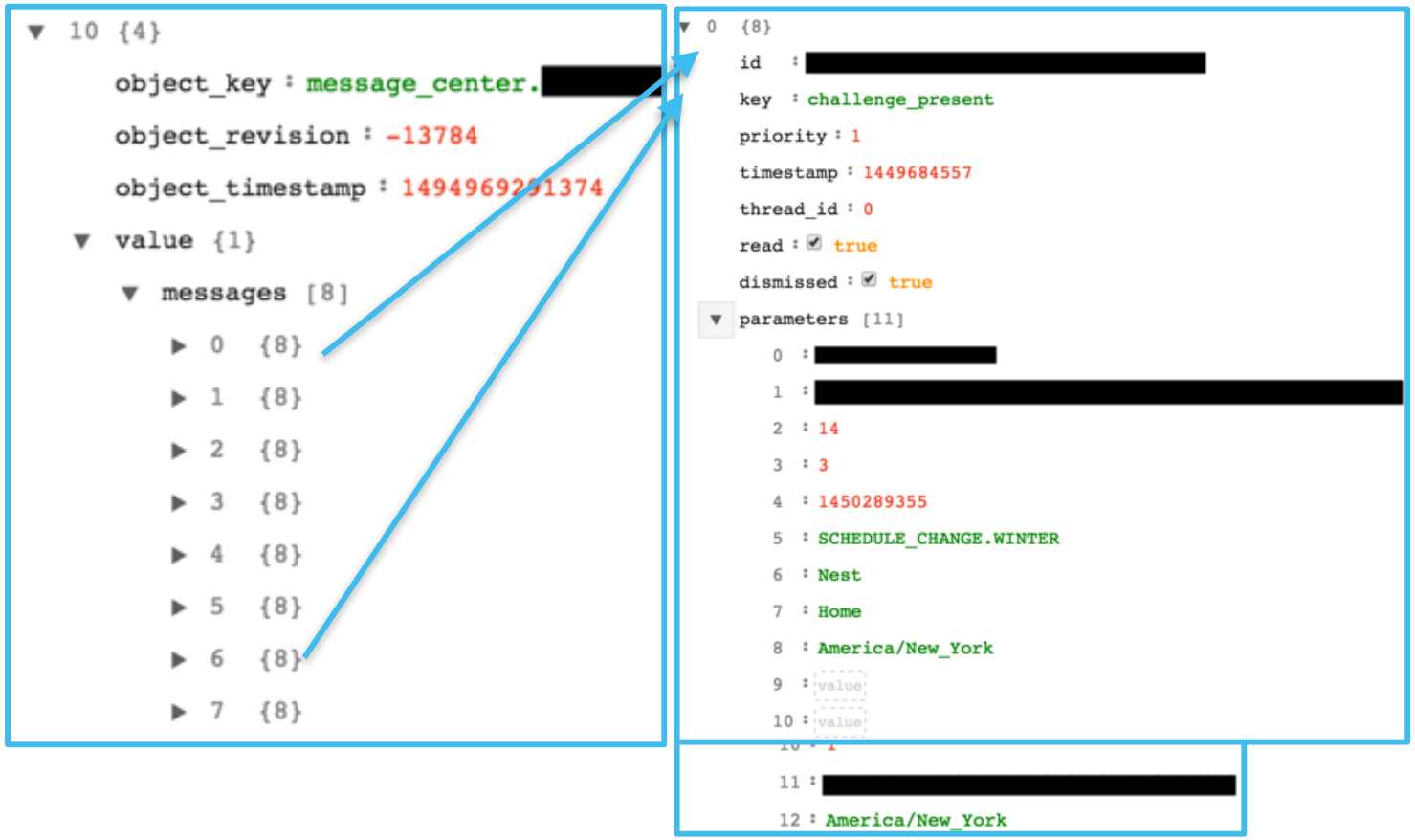
Locations aka “Structure”



Locations aka “Structure”



message_center_USERNUMBER



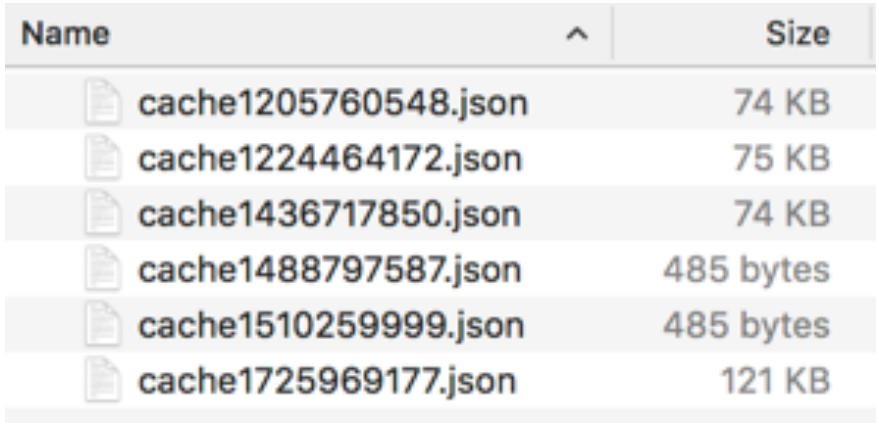
Nest Protect - Movement…

Nest

App Artifacts

com.nest.android/cache/cache/cache##########.json

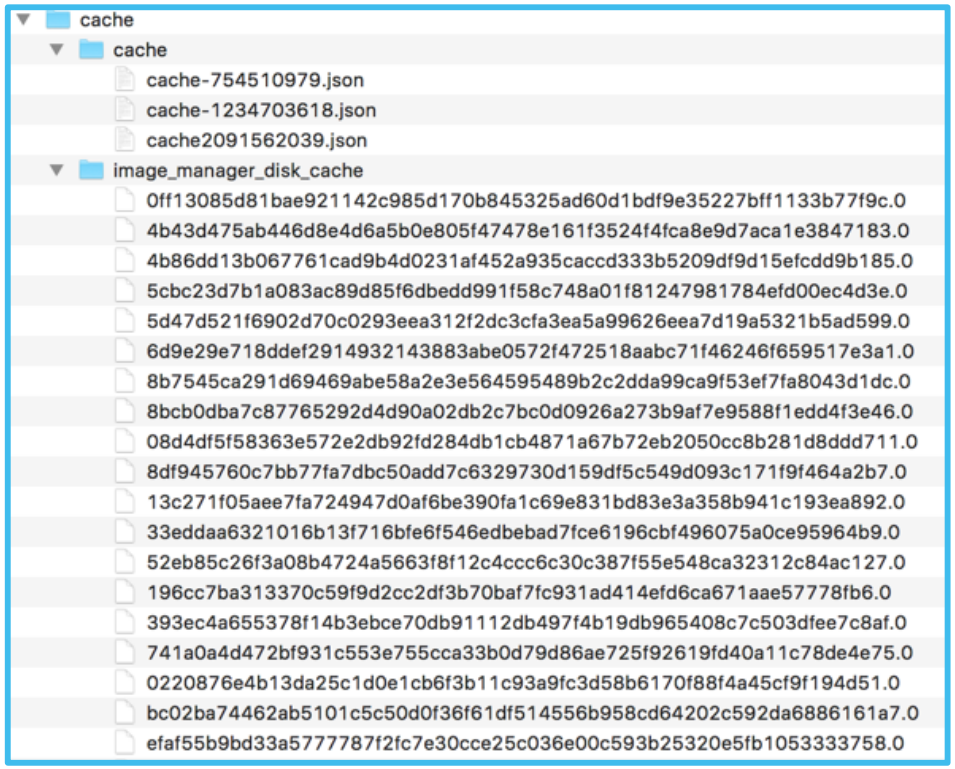
- **You will find historical data not merged into the main history file**



Nest

VIDEO RECOVERY
This trick doesn't work anymore

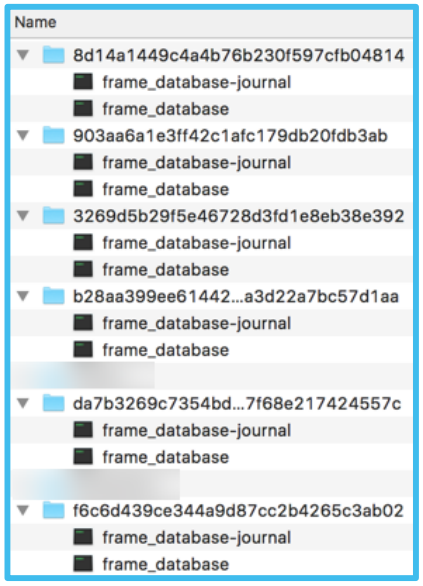
ffmpeg -f h264 -i VIDEOFILE -vcodec copy OUTPUT.mp4

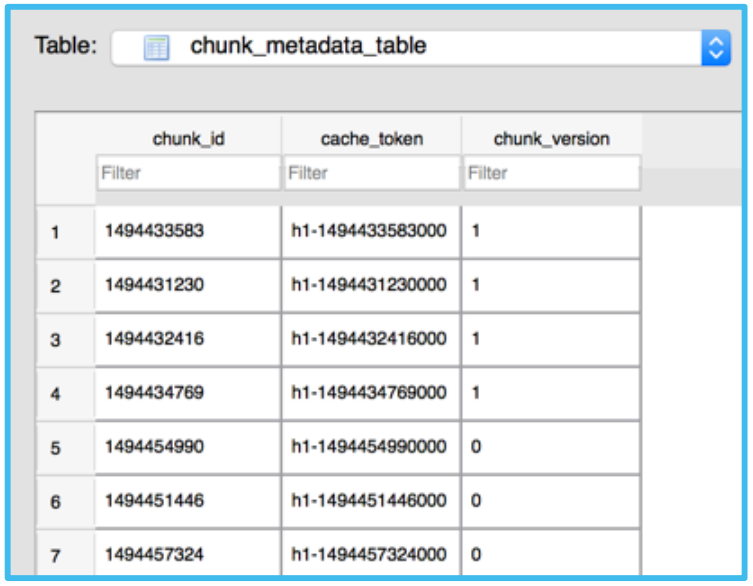


Nest

App Artifacts

com.nest.android/cache/…





	chunk_id	cache_token	chunk_version
	Filter	Filter	Filter
1	1494433583	h1-1494433583000	1
2	1494431230	h1-1494431230000	1
3	1494432416	h1-1494432416000	1
4	1494434769	h1-1494434769000	1
5	1494454990	h1-1494454990000	0
6	1494451446	h1-1494451446000	0
7	1494457324	h1-1494457324000	0

Table: frame_raw_data_table

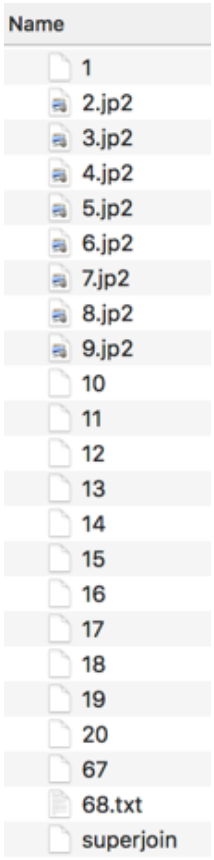
New Record | Delete Record

	frame_time	chunk_id	chunk_version	gop_start_rowid	sps_bytes	pps_bytes	frame_bytes	chunk_complete
	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter
1	1494430042644	1494430044	NULL	-1	BLOB	BLOB	BLOB	0
2	1494430106644	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
3	1494430170644	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
4	1494430234644	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
5	1494430299132	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
6	1494430363132	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
7	1494430427132	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
8	1494430491132	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
9	1494430555132	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
10	1494430618645	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
11	1494430642645	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
12	1494430706645	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
13	1494430770645	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
14	1494430837312	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
15	1494430901825	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
16	1494430965825	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0

Table: frame_raw_data_table

New Record | Delete Record

	frame_time	chunk_id	chunk_version	gop_start_rowid	sps_bytes	pps_bytes	frame_bytes	chunk_complete
	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter
1	1494430042644	1494430044	NULL	-1	BLOB	BLOB	BLOB	0
2	1494430106644	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
3	1494430170644	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
4	1494430234644	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
5	1494430299132	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
6	1494430363132	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
7	1494430427132	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
8	1494430491132	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
9	1494430555132	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
10	1494430618645	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
11	1494430642645	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
12	1494430706645	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
13	1494430770645	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
14	1494430837312	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
15	1494430901825	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0
16	1494430965825	1494430044	NULL	1494430042644	NULL	NULL	BLOB	0




```
cat 67 68.txt 1 2.jp2 3.jp2 4.jp2 5.jp2 6.jp2 7.jp2 8.jp2 9.jp2 10 11
12 13 14 15 16 17 18 19 20 > superjoin
```

```
ffmpeg -i superjoin -c copy output.mp4
```

Proof of Concept - https://github.com/bicyclemicycle/NestVideoConverter

Roll over image to zoom in

Amazon Echo - Black

Amazon

4.5 out of 5 stars ▾ 54,966 customer reviews | 1000+ answered questions

#1 Best Seller in Home Automation Hubs & Controllers

Price: $179.99 Prime

or 5 monthly payments of $36.00

In Stock.

Want it tomorrow, May 19? Order within **5 hrs 13 mins** and choose **One-Day Shipping** at checkout. Details

Ships from and sold by Amazon Digital Services LLC. Gift-wrap available.

Color: **Black**

Configuration: **Amazon Echo**

Amazon Echo | Amazon Echo + Philips Hue Color Starter Kit | Amazon Echo + TP-Link Smart Plug Mini

- Plays all your music from Amazon Music, Spotify, Pandora, iHeartRadio, TuneIn, and more using just your voice
- Introducing Alexa calling and messaging, a new way to be together with family and friends. Just ask Alexa to call or message anyone with an Echo, Echo Dot, or the Alexa App.
- Fills the room with immersive, 360º omni-directional audio
- Hears you from across the room with far-field voice recognition, even while music is playing
- Answers questions, reads the news, reports traffic and weather, reads audiobooks from Audible, gives info on local businesses, provides sports scores and schedules, and more using the Alexa Voice Service
- Controls lights, fans, switches, thermostats, garage doors, sprinklers, locks, and more with compatible connected devices from WeMo, Philips Hue, Samsung SmartThings, Nest, ecobee, and others
- Always getting smarter and adding new features, plus thousands of skills like Uber, Domino's, and more

Jump to: Compare devices | Technical details

New (1) from $179.99 Prime

Amazon Echo

App Artifacts

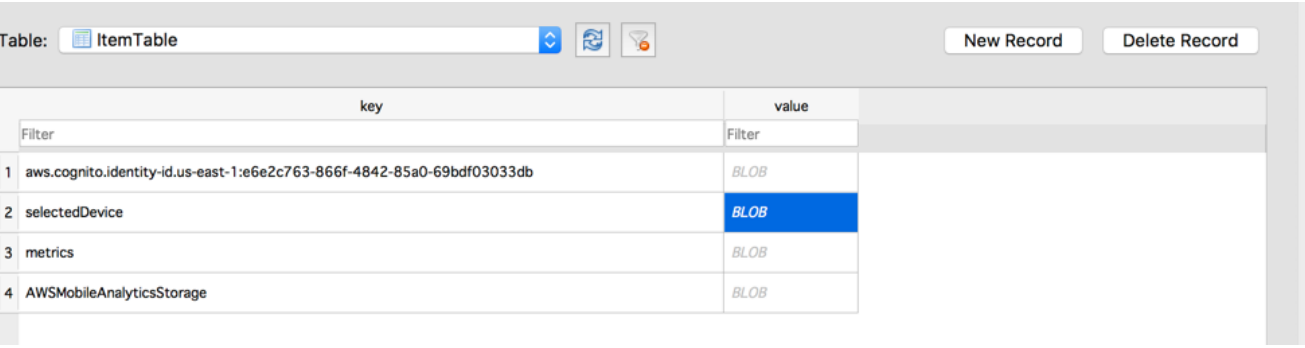
com.amazon.dee.app/shared_prefs/service.identity.xml

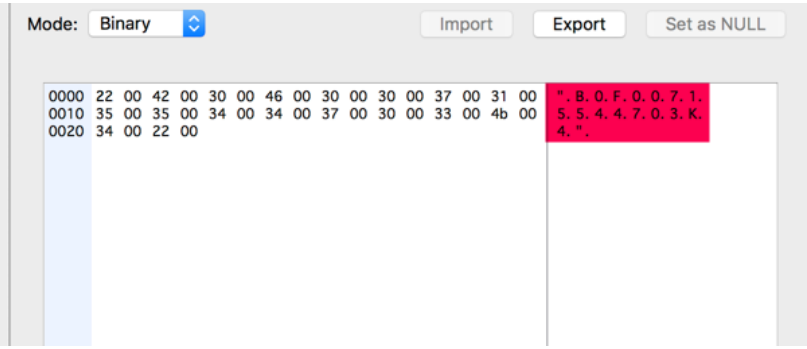
```
<?xml version='1.0' encoding='utf-8' standalone='yes' ?>
<map>
    <boolean name="user.eulaAccepted" value="true" />
    <string name="user.name">Crissy Michaels</string>
    <string name="user.directedId">amzn1.account.AEHA7OWPJNYSHCUXNX7CRVI6NKHQ</string>
    <string name="user.[version]">2</string>
    <boolean name="user.hasDevices" value="false" />
    <string name="user.tokens">{&amp;quot;comms-has-shown-oobe&amp;quot;:&amp;quot;true&amp;quot;}</string>
    <string name="user.id">A2XASK2DFR7ZCX</string>
    <string name="user.email">missycrissym@gmail.com</string>
    <set name="user.features">
        <string>VOX_TACHYON_NA</string>
    </set>
    <string name="user.marketplace">[redacted]</string>
</map>
```

Amazon Echo

App Artifacts

com.amazon.dee.app/app_webview/Local Storage/http_alexa.amazon.com_0.localstorage



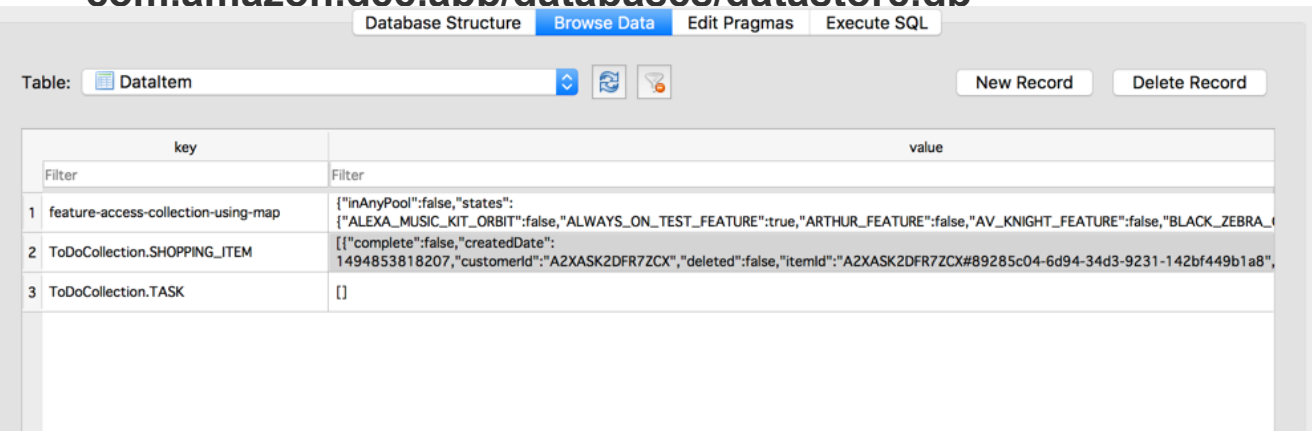


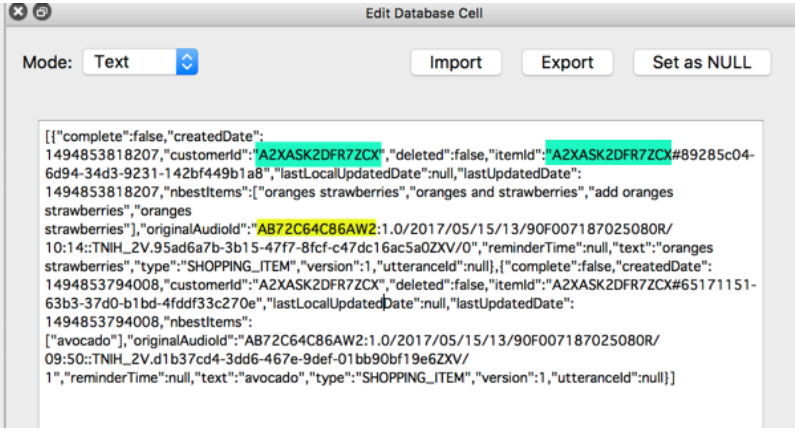
Echo Serial Number

Amazon Echo

App Artifacts

com.amazon.dee.app/databases/datastore.db

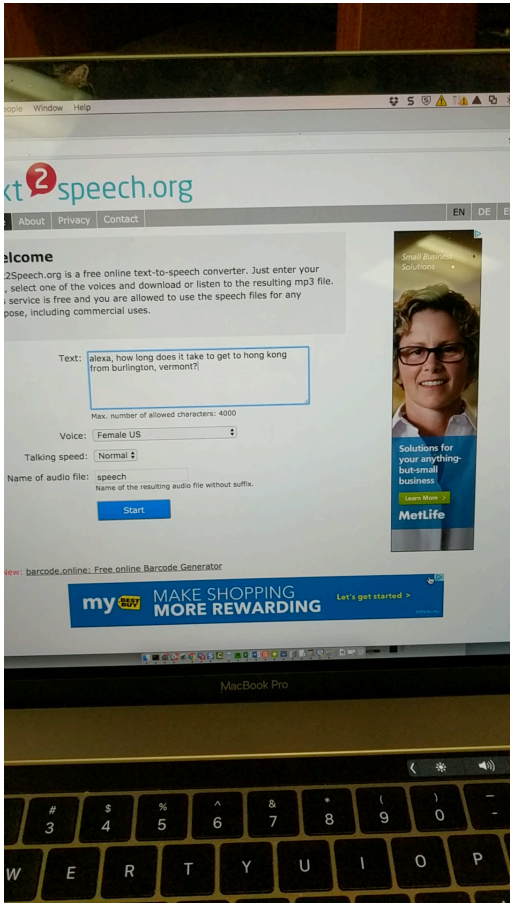




Customer ID - A2XASK2DFR7ZCX
Echo Device Type - AB72C64C86AW2

Amazon Echo

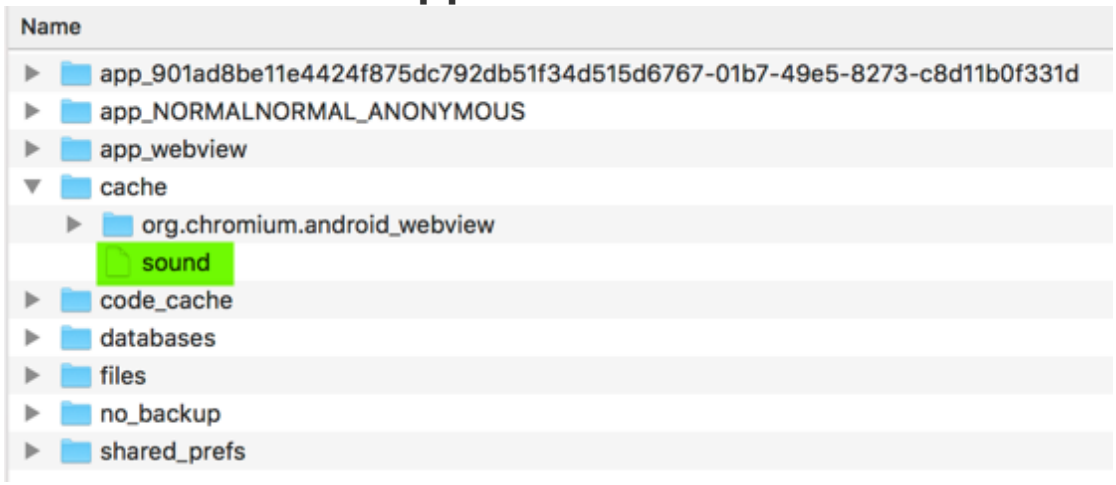
App Artifacts

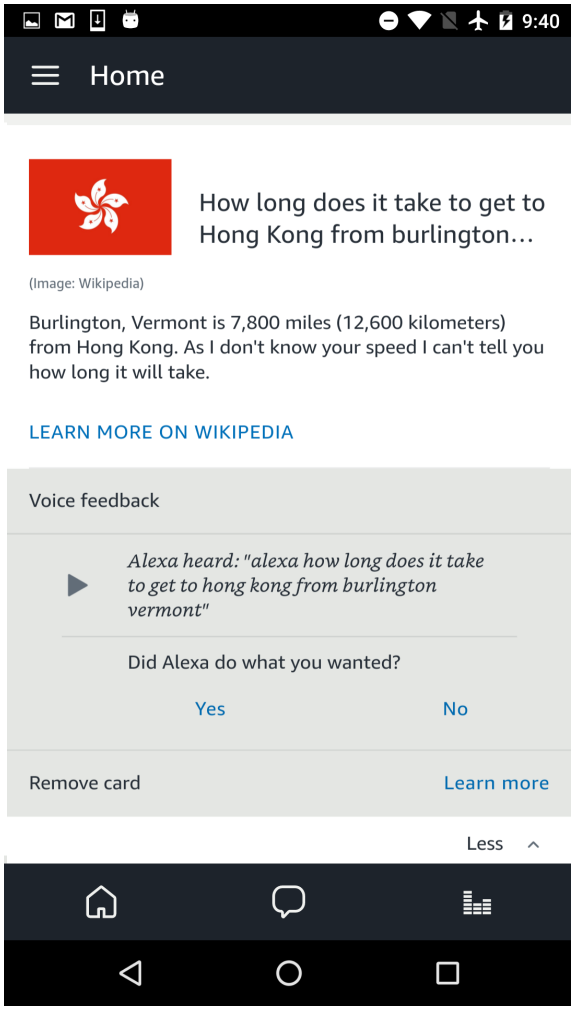


Amazon Echo

App Artifacts

com.amazon.dee.app/cache/sound



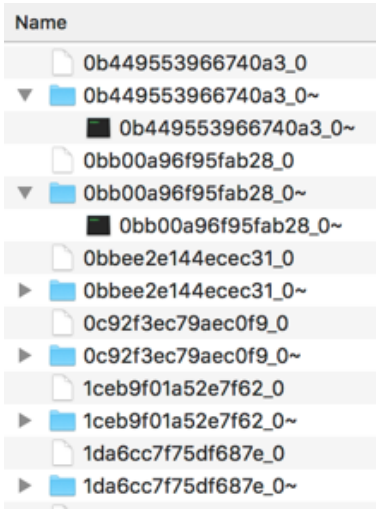


Amazon Echo

App Artifacts

com.amazon.dee.app/cache/org.chromium.android_webview

Step 1 - Decompress the gziped files (7zip)



Amazon Echo

App Artifacts

com.amazon.dee.app/cache/org.chromium.android_webview

Step 2 – Search for the following:

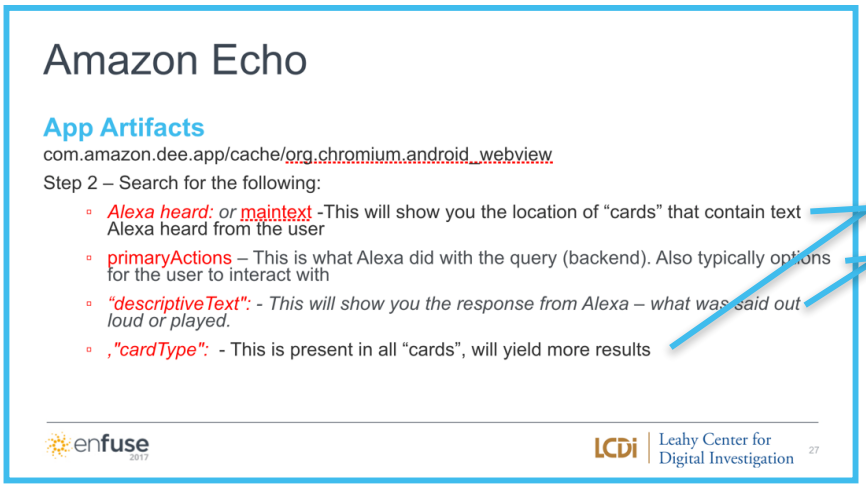
- *Alexa heard:* *or* maintext -This will show you the location of “cards” that contain text Alexa heard from the user
- primaryActions – This is what Alexa did with the query (backend). Also typically options for the user to interact with
- *“descriptiveText":* *- This will show you the response from Alexa – what was said out loud or played.*
- *,"cardType":* - This is present in all “cards”, will yield more results

Amazon Echo

App Artifacts

com.amazon.dee.app/cache/org.chromium.android_webview

Step 3 – Find your favorite JSON parser

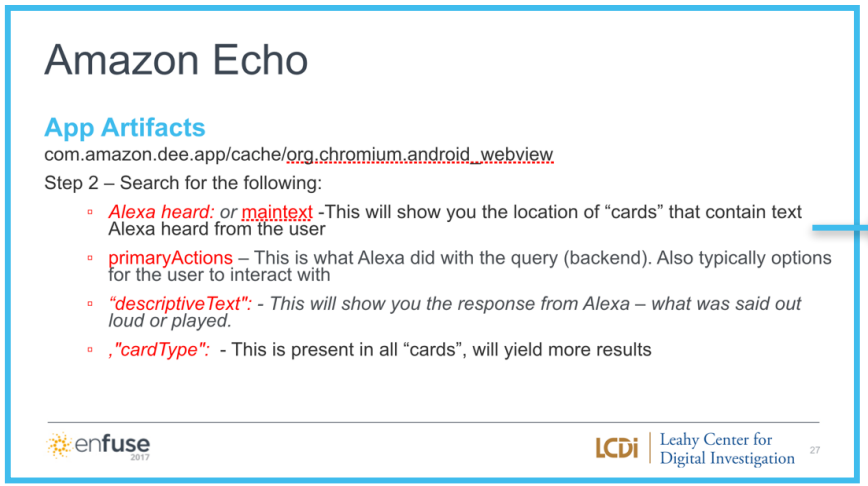


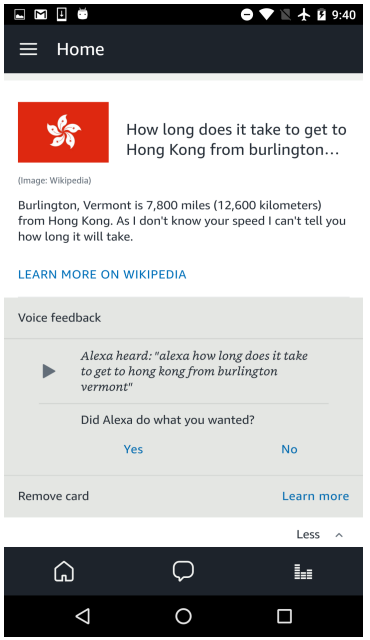
Amazon Echo

App Artifacts

com.amazon.dee.app/cache/org.chromium.android_webview

Step 3 – Find your favorite JSON parser





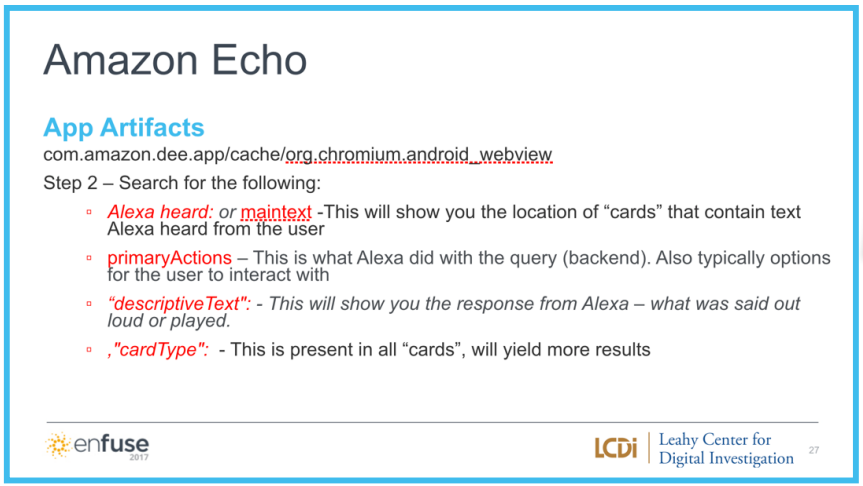

```
playbackAudioAction {5}
    actionType : PlayAudioAction
    mainText : Alexa heard: \"alexa how long does it take to get to hong kong from
               burlington vermont\"
```

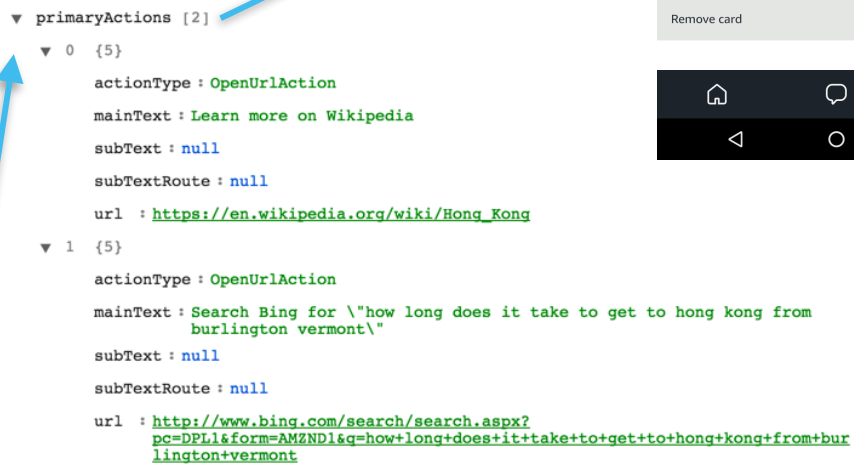
Amazon Echo

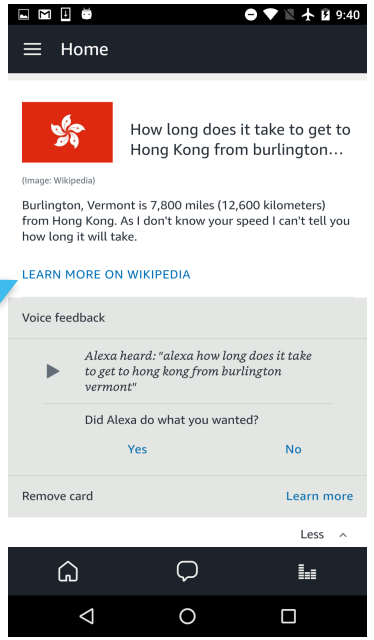
App Artifacts

com.amazon.dee.app/cache/org.chromium.android_webview

Step 3 – Find your favorite JSON parser





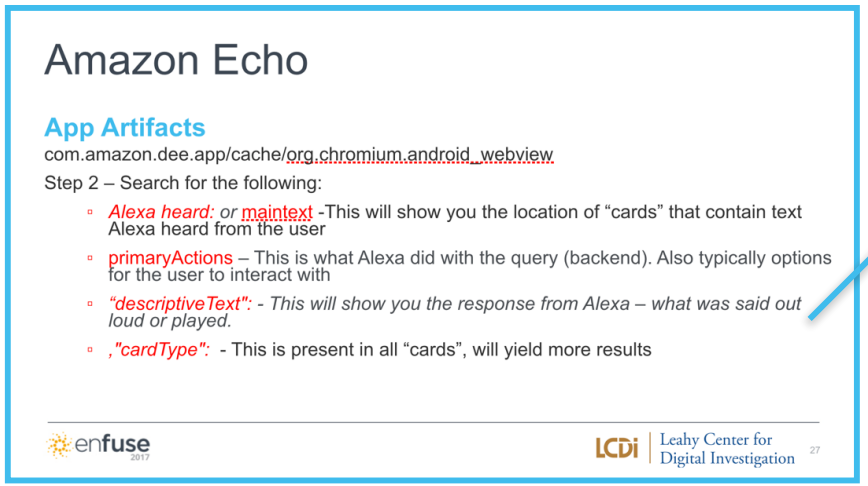


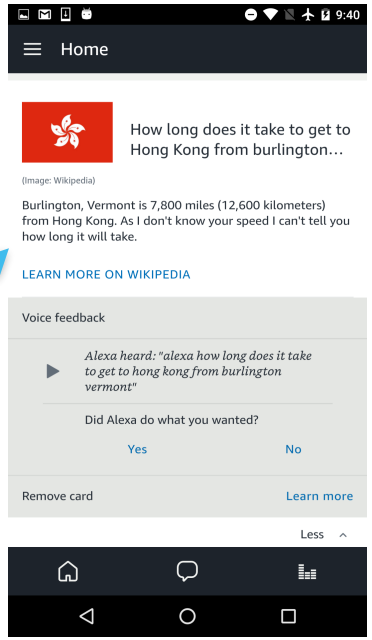
Amazon Echo

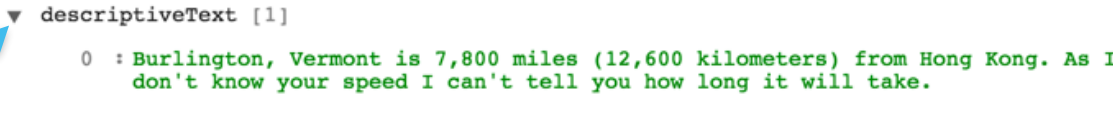
App Artifacts

com.amazon.dee.app/cache/org.chromium.android_webview

Step 3 – Find your favorite JSON parser

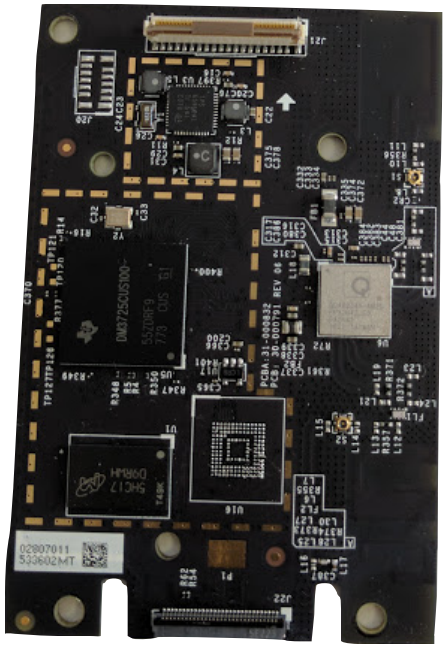


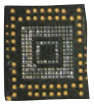




Amazon Echo

Hardware Artifacts





SanDisk SDIN7DP2-4G 4 GB iNAND Ultra Flash Memory - eMMC

https://www.amazon.com/Amazon-Echo-Bluetooth-Speaker-with-WiFi-Alexa

Amazon Echo

Hardware Artifacts

\data\local\token\registrationInfo.JSON


```
"registrationCredentials":  {
    "userID":   "amzn1.account.AEHA7OWPJNYSHCUXNX7CRVI6NKHQ",
    "firstName":    "Crissy",
    "fullName": "Crissy Michaels",
    "deviceName":   "Crissy's Echo",
    "accountPool":  "Amazon",
    "countryOfResidence":   "",
    "preferredMarketplace": ""
```

Amazon Echo

Hardware Artifacts

\hda1\mfg.idme.rec

```
IDMEø…y˜als0=50,0,0
als1=51,0,75
als10=96,100,75
als11=97,100,150
als12=133,200,0
als13=134,200,75
als14=134,200,150
als2=52,0,150
als3=62,25,0
als4=62,25,75
als5=63,25,150
als6=73,50,0
als7=74,50,75
als8=75,50,150
als9=95,100,0
btmac=74C2466BC78C
devicetype=AB72C64C86AW2
dsn=B0F00715544703K4
mac=74C2467D1C48
mfg=OZRY2T2GTGA0IRGWFD08
mic0=14243
mic1=15907
mic2=16093
mic3=23717
mic4=17073
mic5=17124
mic6=14559
pcbsn=02807011544702MX
wifimodulerev=3M2D
```

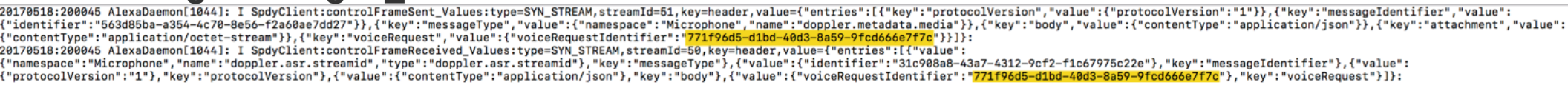
Amazon Echo

Hardware Artifacts

\data\log*

There are many logs that one would expect to find on a linux system…

\data\log\messages_####….



\data\log*.gz

Make sure you mount these before you search!

Amazon Echo

Hardware Artifacts

\data\log\metrics_generic

```
May 18 20:00:47 localhost AlexaSpeechPlayer[1290]: metric_generic,1495137647,timer,AlexaSpeechPlayer,TTS,FirstDataToAudioOutput.SpeechSynthesizer.speak,391,voiceRequestId=771f96d5-d1bd-40d3-8a59-9fcd666e7f7c
May 18 20:01:22 localhost AlexaSpeechPlayer[1290]: metric_generic,1495137682,timer,AlexaSpeechPlayer,TTS,FirstDataToAudioOutput.SpeechSynthesizer.speak,359,voiceRequestId=845758c5-3030-4426-9378-e01504c6fe3e
May 18 20:01:59 localhost AlexaSpeechPlayer[1290]: metric_generic,1495137719,timer,AlexaSpeechPlayer,TTS,FirstDataToAudioOutput.SpeechSynthesizer.speak,373,voiceRequestId=f7a19124-0bc5-4e48-8d2f-f876c6e5111a
May 18 20:02:35 localhost AlexaSpeechPlayer[1290]: metric_generic,1495137755,timer,AlexaSpeechPlayer,TTS,FirstDataToAudioOutput.SpeechSynthesizer.speak,378,voiceRequestId=e4a79317-e597-4827-b87d-b7151d5d70aa
May 18 20:03:19 localhost AlexaSpeechPlayer[1290]: metric_generic,1495137799,timer,AlexaSpeechPlayer,TTS,FirstDataToAudioOutput.SpeechSynthesizer.speak,416,voiceRequestId=ced963e6-bb88-4c41-8d9b-4c8d74549760
May 18 20:08:39 localhost AlexaSpeechPlayer[1290]: metric_generic,1495138119,timer,AlexaSpeechPlayer,TTS,FirstDataToAudioOutput.SpeechSynthesizer.speak,402,voiceRequestId=ef2fde56-9161-4dc3-a3c2-0acd88d8bcd1
```

\data\log\metric_high_priority

```
May 18 20:00:45 localhost ASRD[1431]: metric_high_priority,1495137645,timer,asrd,WW,pryon_latency_msec,254,voiceRequestId=771f96d5-d1bd-40d3-8a59-9fcd666e7f7c
May 18 20:00:45 localhost MetricsCollector[976]: metric_high_priority,1495137645,timer,metrics-collector,audioencoderd,WakewordToEncodeStream,40,voiceRequestId=771f96d5-d1bd-40d3-8a59-9fcd666e7f7c
May 18 20:00:45 localhost MetricsCollector[976]: metric_high_priority,1495137645,timer,metrics-collector,asrd,WakewordToOpenASRStream,91,voiceRequestId=771f96d5-d1bd-40d3-8a59-9fcd666e7f7c
May 18 20:00:45 localhost MetricsCollector[976]: metric_high_priority,1495137645,timer,metrics-collector,asrd,WakewordToBeamLed,142,voiceRequestId=771f96d5-d1bd-40d3-8a59-9fcd666e7f7c
May 18 20:00:46 localhost MetricsCollector[976]: metric_high_priority,1495137646,timer,metrics-collector,alexad,WakewordToThinkingStart,1609,voiceRequestId=771f96d5-d1bd-40d3-8a59-9fcd666e7f7c
May 18 20:00:47 localhost AlexaSpeechPlayer[1290]: metric_high_priority,1495137647,timer,AlexaSpeechPlayer,TTS,UserPerceivedLatency.SpeechSynthesizer.speak,1356,voiceRequestId=771f96d5-d1bd-40d3-8a59-9fcd666e7f7c
May 18 20:01:20 localhost ASRD[1431]: metric_high_priority,1495137680,timer,asrd,WW,pryon_latency_msec,260,voiceRequestId=845758c5-3030-4426-9378-e01504c6fe3e
May 18 20:01:20 localhost MetricsCollector[976]: metric_high_priority,1495137680,timer,metrics-collector,asrd,WakewordToBeamLed,35,voiceRequestId=845758c5-3030-4426-9378-e01504c6fe3e
May 18 20:01:20 localhost MetricsCollector[976]: metric_high_priority,1495137680,timer,metrics-collector,audioencoderd,WakewordToEncodeStream,81,voiceRequestId=845758c5-3030-4426-9378-e01504c6fe3e
May 18 20:01:20 localhost MetricsCollector[976]: metric_high_priority,1495137680,timer,metrics-collector,asrd,WakewordToOpenASRStream,168,voiceRequestId=845758c5-3030-4426-9378-e01504c6fe3e
May 18 20:01:22 localhost MetricsCollector[976]: metric_high_priority,1495137682,timer,metrics-collector,alexad,WakewordToThinkingStart,1610,voiceRequestId=845758c5-3030-4426-9378-e01504c6fe3e
May 18 20:01:22 localhost AlexaSpeechPlayer[1290]: metric_high_priority,1495137682,timer,AlexaSpeechPlayer,TTS,UserPerceivedLatency.SpeechSynthesizer.speak,1892,voiceRequestId=845758c5-3030-4426-9378-e01504c6fe3e
May 18 20:01:56 localhost ASRD[1431]: metric_high_priority,1495137716,timer,asrd,WW,pryon_latency_msec,245,voiceRequestId=f7a19124-0bc5-4e48-8d2f-f876c6e5111a
May 18 20:01:56 localhost MetricsCollector[976]: metric_high_priority,1495137716,timer,metrics-collector,audioencoderd,WakewordToEncodeStream,76,voiceRequestId=f7a19124-0bc5-4e48-8d2f-f876c6e5111a
May 18 20:01:56 localhost MetricsCollector[976]: metric_high_priority,1495137716,timer,metrics-collector,asrd,WakewordToBeamLed,117,voiceRequestId=f7a19124-0bc5-4e48-8d2f-f876c6e5111a
May 18 20:01:57 localhost MetricsCollector[976]: metric_high_priority,1495137717,timer,metrics-collector,asrd,WakewordToOpenASRStream,166,voiceRequestId=f7a19124-0bc5-4e48-8d2f-f876c6e5111a
May 18 20:01:58 localhost MetricsCollector[976]: metric_high_priority,1495137718,timer,metrics-collector,alexad,WakewordToThinkingStart,1857,voiceRequestId=f7a19124-0bc5-4e48-8d2f-f876c6e5111a
May 18 20:01:59 localhost AlexaSpeechPlayer[1290]: metric_high_priority,1495137719,timer,AlexaSpeechPlayer,TTS,UserPerceivedLatency.SpeechSynthesizer.speak,1526,voiceRequestId=f7a19124-0bc5-4e48-8d2f-f876c6e5111a
```

5/18/2017, 4:00:46EDT

Amazon Echo

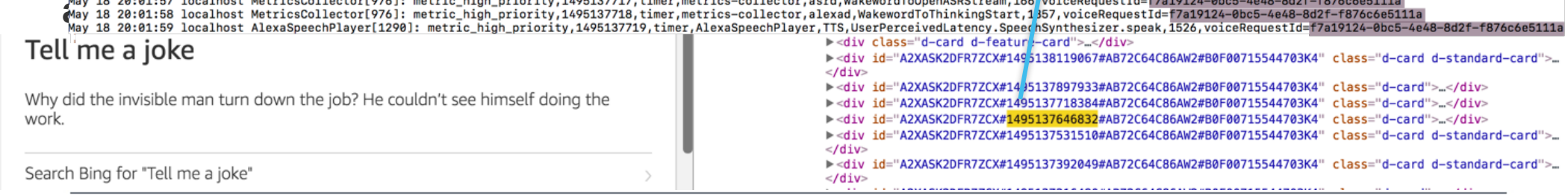
1495137646

1495137646832

Hardware Artifacts

```
May 18 20:00:47 localhost AlexaSpeechPlayer[1290]: metric_generic,1495137647,timer,AlexaSpeechPlayer,TTS,FirstDataToAudioOutput.SpeechSynthesizer.speak,391,voiceRequestId=771f96d5-d1bd-40d3-8a59-9fcd666e7f7c
May 18 20:01:22 localhost AlexaSpeechPlayer[1290]: metric_generic,1495137682,timer,AlexaSpeechPlayer,TTS,FirstDataToAudioOutput.SpeechSynthesizer.speak,359,voiceRequestId=845758c5-3030-4426-9378-e01504c6fe3e
May 18 20:01:59 localhost AlexaSpeechPlayer[1290]: metric_generic,1495137719,timer,AlexaSpeechPlayer,TTS,FirstDataToAudioOutput.SpeechSynthesizer.speak,373,voiceRequestId=f7a19124-0bc5-4e48-8d2f-f876c6e5111a
May 18 20:02:35 localhost AlexaSpeechPlayer[1290]: metric_generic,1495137755,timer,AlexaSpeechPlayer,TTS,FirstDataToAudioOutput.SpeechSynthesizer.speak,378,voiceRequestId=e4a79317-e597-4827-b87d-b7151d5d70aa
May 18 20:03:19 localhost AlexaSpeechPlayer[1290]: metric_generic,1495137799,timer,AlexaSpeechPlayer,TTS,FirstDataToAudioOutput.SpeechSynthesizer.speak,416,voiceRequestId=ced963e6-bb88-4c41-8d9b-4c8d74549760
May 18 20:08:39 localhost AlexaSpeechPlayer[1290]: metric_generic,1495138119,timer,AlexaSpeechPlayer,TTS,FirstDataToAudioOutput.SpeechSynthesizer.speak,402,voiceRequestId=ef2fde56-9161-4dc3-a3c2-0acd88d8bcd1
```

```
May 18 20:00:45 localhost ASRD[1431]: metric_high_priority,1495137645,timer,asrd,WW,pryon_latency_msec,254,voiceRequestId=771f96d5-d1bd-40d3-8a59-9fcd666e7f7c
May 18 20:00:45 localhost MetricsCollector[976]: metric_high_priority,1495137645,timer,metrics-collector,audioencoderd,WakewordToEncodeStream,0,voiceRequestId=771f96d5-d1bd-40d3-8a59-9fcd666e7f7c
May 18 20:00:45 localhost MetricsCollector[976]: metric_high_priority,1495137645,timer,metrics-collector,asrd,WakewordToOpenASRStream,91,voiceRequestId=771f96d5-d1bd-40d3-8a59-9fcd666e7f7c
May 18 20:00:45 localhost MetricsCollector[976]: metric_high_priority,1495137645,timer,metrics-collector,asrd,WakewordToBeamLed,142,voiceRequestId=771f96d5-d1bd-40d3-8a59-9fcd666e7f7c
May 18 20:00:46 localhost MetricsCollector[976]: metric_high_priority,1495137646,timer,metrics-collector,alexad,WakewordToThinkingStart,1609,voiceRequestId=771f96d5-d1bd-40d3-8a59-9fcd666e7f7c
May 18 20:00:47 localhost AlexaSpeechPlayer[1290]: metric_high_priority,1495137647,timer,AlexaSpeechPlayer,TTS,UserPerceivedLatency.SpeechSynthesizer.speak,1356,voiceRequestId=771f96d5-d1bd-40d3-8a59-9fcd666e7f7c
May 18 20:01:20 localhost ASRD[1431]: metric_high_priority,1495137680,timer,asrd,WW,pryon_latency_msec,260,voiceRequestId=845758c5-3030-4426-9378-e01504c6fe3e
May 18 20:01:20 localhost MetricsCollector[976]: metric_high_priority,1495137680,timer,metrics-collector,asrd,WakewordToBeamLed,35,voiceRequestId=845758c5-3030-4426-9378-e01504c6fe3e
May 18 20:01:20 localhost MetricsCollector[976]: metric_high_priority,1495137680,timer,metrics-collector,audioencoderd,WakewordToEncodeStream,81,voiceRequestId=845758c5-3030-4426-9378-e01504c6fe3e
May 18 20:01:20 localhost MetricsCollector[976]: metric_high_priority,1495137680,timer,metrics-collector,asrd,WakewordToOpenASRStream,168,voiceRequestId=845758c5-3030-4426-9378-e01504c6fe3e
May 18 20:01:22 localhost MetricsCollector[976]: metric_high_priority,1495137682,timer,metrics-collector,alexad,WakewordToThinkingStart,1610,voiceRequestId=845758c5-3030-4426-9378-e01504c6fe3e
May 18 20:01:22 localhost AlexaSpeechPlayer[1290]: metric_high_priority,1495137682,timer,AlexaSpeechPlayer,TTS,UserPerceivedLatency.SpeechSynthesizer.speak,1892,voiceRequestId=845758c5-3030-4426-9378-e01504c6fe3e
May 18 20:01:56 localhost ASRD[1431]: metric_high_priority,1495137716,timer,asrd,WW,pryon_latency_msec,245,voiceRequestId=f7a19124-0bc5-4e48-8d2f-f876c6e5111a
May 18 20:01:56 localhost MetricsCollector[976]: metric_high_priority,1495137716,timer,metrics-collector,audioencoderd,WakewordToEncodeStream,76,voiceRequestId=f7a19124-0bc5-4e48-8d2f-f876c6e5111a
May 18 20:01:56 localhost MetricsCollector[976]: metric_high_priority,1495137716,timer,metrics-collector,asrd,WakewordToBeamLed,117,voiceRequestId=f7a19124-0bc5-4e48-8d2f-f876c6e5111a
May 18 20:01:57 localhost MetricsCollector[976]: metric_high_priority,1495137717,timer,metrics-collector,asrd,WakewordToOpenASRStream,166,voiceRequestId=f7a19124-0bc5-4e48-8d2f-f876c6e5111a
May 18 20:01:58 localhost MetricsCollector[976]: metric_high_priority,1495137718,timer,metrics-collector,alexad,WakewordToThinkingStart,1357,voiceRequestId=f7a19124-0bc5-4e48-8d2f-f876c6e5111a
May 18 20:01:59 localhost AlexaSpeechPlayer[1290]: metric_high_priority,1495137719,timer,AlexaSpeechPlayer,TTS,UserPerceivedLatency.SpeechSynthesizer.speak,1526,voiceRequestId=f7a19124-0bc5-4e48-8d2f-f876c6e5111a
```



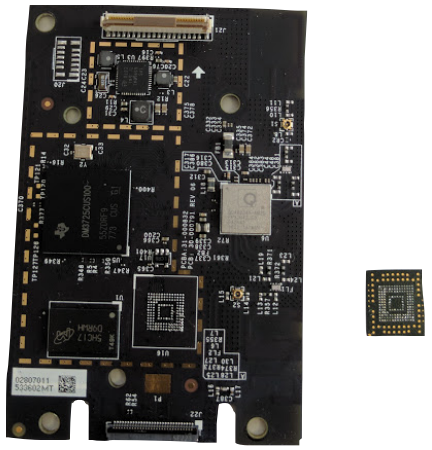
Amazon Echo

Hardware Artifacts

Hypothetical scenario

A crime was committed in the home on May 18, 2017 between 3-4PM

The phone and Alexa app data are currently unavailable



Amazon Echo

Hardware Artifacts

- \data\local\token\registrationInfo.JSON
  - Find userID
- \hda1\mfg.idme.rec
  - Find devicetype and dsn
- \data\log
  - Mount everything, search for "May 18 19"
- Timeline Analysis
- Search "voiceRequestId="
  - Document that GUID - this will help you search for all metadata for that audio (from what I can tell, this does not hit the cloud)
- Search *devicetype*:1.0/YYYY/MM/DD/HH/XXXXXXXXXXXXXXXX/##:##
  - Document "::TNIH_2V.GUIDGUID-GUID-GUID-GUID-GUID-GUID-GUI/0" - this data hits the app and the cloud
- You now have:
  - Timeline
  - Unique identifiers that can be used to locate the transcript/audio

Amazon Echo

Amazon Echo

Hardware Artifacts

\data\local\token\registrationInfo.JSON

- Find userID

\hda1\mfg.idme.rec

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- Search devicetype:1.0/YYYY/MM/DD/HH/XXXXXXXXXXXXXXXX/##:##
  - Document "::TNIH_2V.GUIDGUID-GUID-GUID-GUID-GUID-GUID-GUI/0" - this data hits the app and the cloud
- You now have:
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  - Unique identifiers that can be used to locate the transcript/audio

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```
"registrationCredentials":  {
    "userID":   "amzn1.account.AEHA7OWPJNYSHCUXNX7CRVI6NKHQ",
    "firstName":    "Crissy",
    "fullName": "Crissy Michaels",
    "deviceName":   "Crissy's Echo",
    "accountPool":  "Amazon",
    "countryOfResidence":   "",
    "preferredMarketplace": ""
```

Amazon Echo


```
IDMEø…y˜als0=50,0,0
als1=51,0,75
als10=96,100,75
als11=97,100,150
als12=133,200,0
als13=134,200,75
als14=134,200,150
als2=52,0,150
als3=62,25,0
als4=62,25,75
als5=63,25,150
als6=73,50,0
als7=74,50,75
als8=75,50,150
als9=95,100,0
btmac=74C2466BC78C
devicetype=AB72C64C86AW2
dsn=B0F00715544703K4
mac=74C2467D1C48
mfg=OZRY2T2GTGA0IRGWFD08
mic0=14243
mic1=15907
mic2=16093
mic3=23717
mic4=17073
mic5=17124
mic6=14559
pcbsn=02807011544702MX
wifimodulerev=3M2D
```

Amazon Echo

Amazon Echo

Hardware Artifacts

\data\local\token\registrationInfo.JSON

- Find userID

\hda1\mfg.idme.rec

- Find devicetype and dsn

\data\log

- Mount everything, search for "May 18 19"
- Timeline Analysis
- Search "voiceRequestId="
  - Document that GUID - this will help you search for all metadata for that audio (from what I can tell, this does not hit the cloud)
- Search devicetype:1.0/YYYY/MM/DD/HH/XXXXXXXXXXXXXXXX/##:##
  - Document "::TNIH_2V.GUIDGUID-GUID-GUID-GUID-GUID-GUID-GUI/0" - this data hits the app and the cloud
- You now have:
  - Timeline
  - Unique identifiers that can be used to locate the transcript/audio

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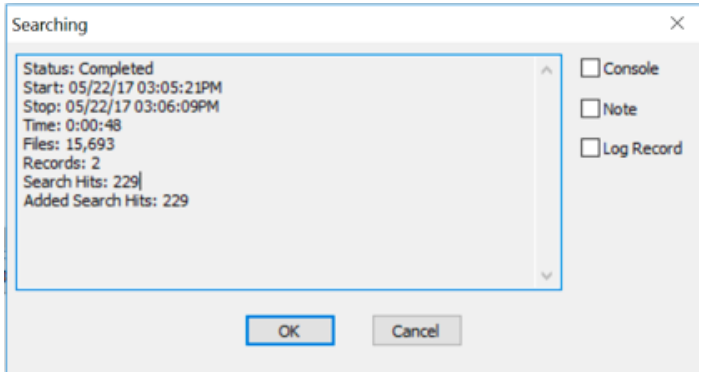
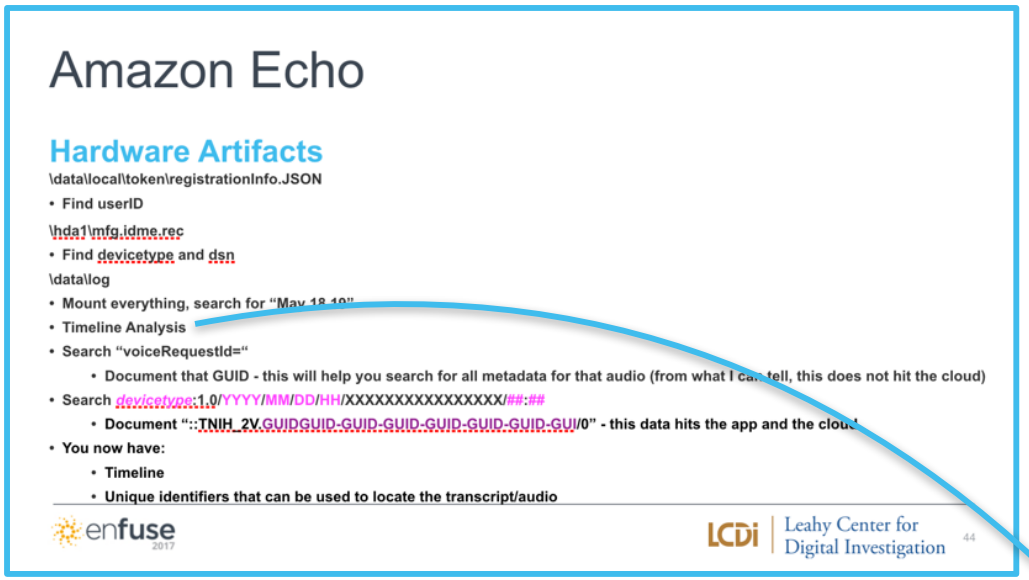
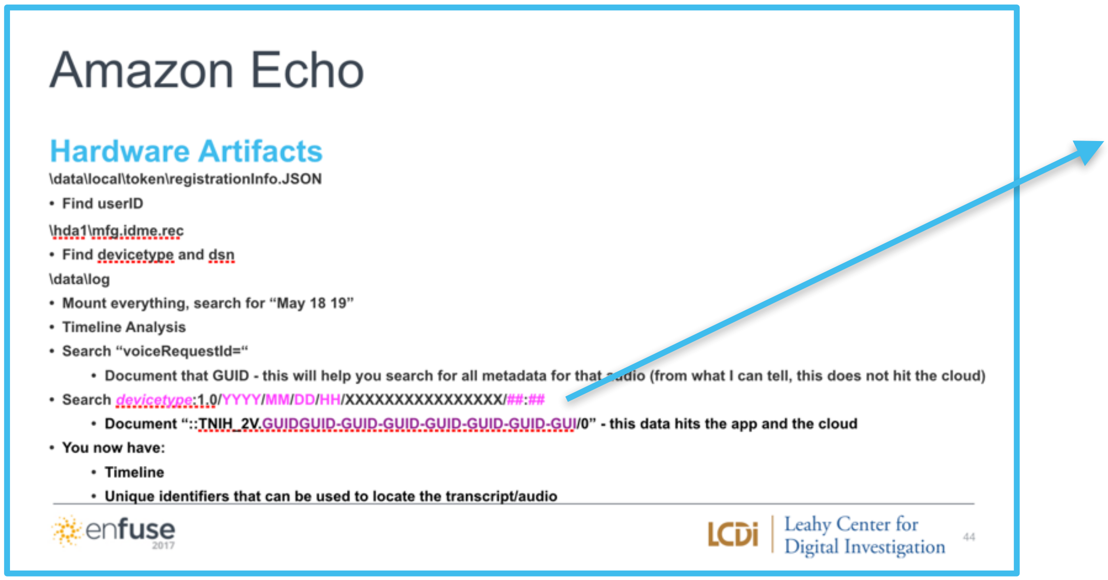


Amazon Echo

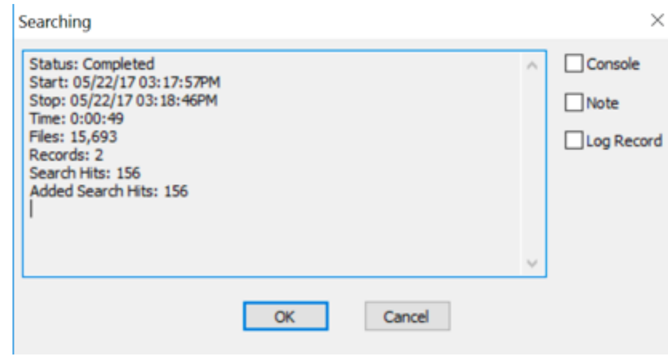


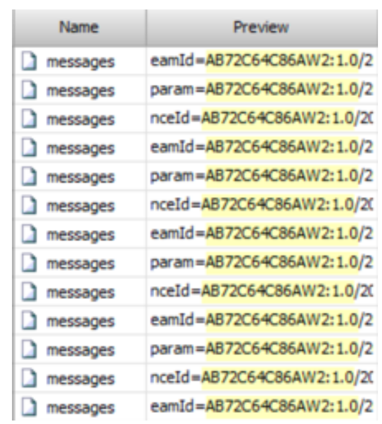

```
May 18 19:58:46 (none) ASRD[1431]: metric_high_priority,1495137526,timer,asrd,WW,pryon_latency_msec,250,voiceRequestId=72f032e0-9ce0-477c-bb69-49f533c16010
May 18 19:58:46 (none) MetricsCollector[976]: metric_high_priority,1495137526,timer,metrics-collector,audioencoderd,WakewordToEncodeStream,54,voiceRequestId=72f032e0-9ce0-477c-bb69-49f533c16010
May 18 19:58:46 (none) MetricsCollector[976]: metric_high_priority,1495137526,timer,metrics-collector,asrd,WakewordToBeamLed,96,voiceRequestId=72f032e0-9ce0-477c-bb69-49f533c16010
May 18 19:58:46 (none) MetricsCollector[976]: metric_high_priority,1495137526,timer,metrics-collector,asrd,WakewordToOpenASRStream,128,voiceRequestId=72f032e0-9ce0-477c-bb69-49f533c16010
May 18 19:58:51 (none) MetricsCollector[976]: metric_high_priority,1495137531,timer,metrics-collector,alexad,WakewordToThinkingStart,5135,voiceRequestId=72f032e0-9ce0-477c-bb69-49f533c16010
May 18 19:58:52 (none) AlexaSpeechPlayer[1290]: metric_high_priority,1495137532,timer,AlexaSpeechPlayer,TTS,UserPerceivedLatency.SpeechSynthesizer.speak,1920,voiceRequestId=72f032e0-9ce0-477c-bb69-49f533c16010
```

Amazon Echo



"AB72C64C86AW2:1.0"





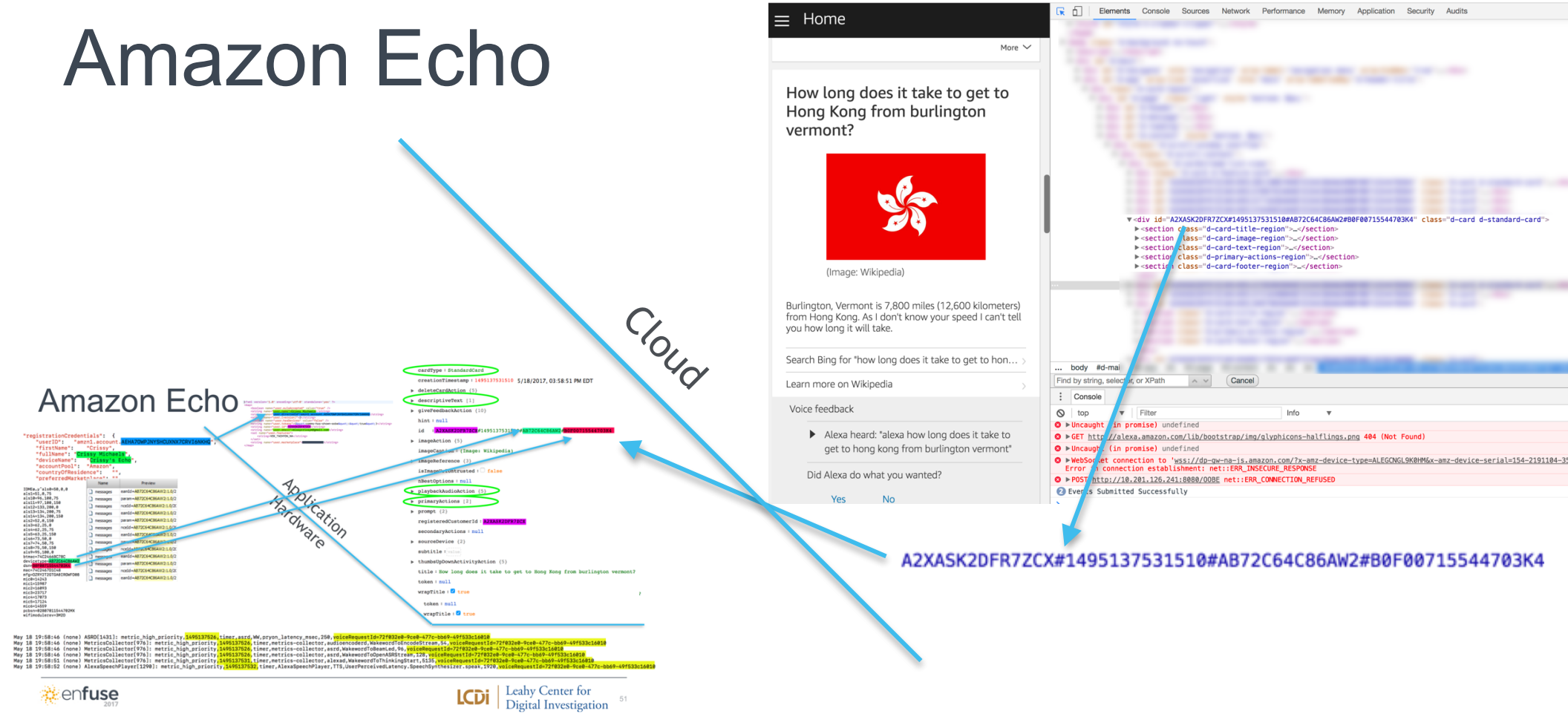
Amazon Echo

Someone found the phone/app :)

Amazon Echo


```
May 18 19:58:46 (none) ASRD[1431]: metric_high_priority,1495137526,timer,asrd,WW,pryon_latency_msec,250,voiceRequestId=72f032e0-9ce0-477c-bb69-49f533c16010
May 18 19:58:46 (none) MetricsCollector[976]: metric_high_priority,1495137526,timer,metrics-collector,audioencoderd,WakewordToEncodeStream,54,voiceRequestId=72f032e0-9ce0-477c-bb69-49f533c16010
May 18 19:58:46 (none) MetricsCollector[976]: metric_high_priority,1495137526,timer,metrics-collector,asrd,WakewordToBeamLed,96,voiceRequestId=72f032e0-9ce0-477c-bb69-49f533c16010
May 18 19:58:46 (none) MetricsCollector[976]: metric_high_priority,1495137526,timer,metrics-collector,asrd,WakewordToOpenASRStream,128,voiceRequestId=72f032e0-9ce0-477c-bb69-49f533c16010
May 18 19:58:51 (none) MetricsCollector[976]: metric_high_priority,1495137531,timer,metrics-collector,alexad,WakewordToThinkingStart,5135,voiceRequestId=72f032e0-9ce0-477c-bb69-49f533c16010
May 18 19:58:52 (none) AlexaSpeechPlayer[1290]: metric_high_priority,1495137532,timer,AlexaSpeechPlayer,TTS,UserPerceivedLatency.SpeechSynthesizer.speak,1920,voiceRequestId=72f032e0-9ce0-477c-bb69-49f533c16010
```

Amazon Echo


Amazon Echo
Cloud
Application
Hardware
Home
More
How long does it take to get to Hong Kong from burlington vermont?
(Image: Wikipedia)
Burlington, Vermont is 7,800 miles (12,600 kilometers) from Hong Kong. As I don't know your speed I can't tell you how long it will take.
Search Bing for "how long does it take to get to hon…
Learn more on Wikipedia
Voice feedback
Alexa heard: "alexa how long does it take to get to hong kong from burlington vermont"
Did Alexa do what you wanted?
Yes
No
Elements
Console
Sources
Network
Performance
Memory
Application
Security
Audits
A2XASK2DFR7ZCX#1495137531510#AB72C64C86AW2#B0F00715544703K4
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```
Sep 13 19:49:13 (none) ASRD[1374]: metric_high_priority,1473796153,timer,asrd,WW,pryon_latency_msec,248,voiceRequestId=15b8237a-2642-467d-8926-d6dee9449420
Sep 13 19:49:13 (none) MetricsCollector[985]: metric_high_priority,1473796153,timer,metrics-collector,audioencoderd,WakewordToEncodeStream,31,voiceRequestId=15b8237a-2642-467d-8926-d6dee9449420
Sep 13 19:49:14 (none) MetricsCollector[985]: metric_high_priority,1473796154,timer,metrics-collector,asrd,WakewordToOpenASRStream,144,voiceRequestId=15b8237a-2642-467d-8926-d6dee9449420
Sep 13 19:49:14 (none) MetricsCollector[985]: metric_high_priority,1473796154,timer,metrics-collector,asrd,WakewordToBeamLed,175,voiceRequestId=15b8237a-2642-467d-8926-d6dee9449420
Sep 13 19:49:14 (none) MetricsCollector[985]: metric_high_priority,1473796154,timer,metrics-collector,conductor,LocalStopToStopProcessed,9,voiceRequestId=15b8237a-2642-467d-8926-d6dee9449420
Sep 13 19:49:14 (none) ASRD[1374]: metric_high_priority,1473796154,timer,asrd,LocalCmd,pryon_latency_msec,274,voiceRequestId=15b8237a-2642-467d-8926-d6dee9449420
Sep 13 19:51:34 (none) MetricsCollector[985]: metric_high_priority,1473796294,timer,metrics-collector,audioencoderd,WakewordToEncodeStream,28,voiceRequestId=4948aab9-24ee-4f59-a119-c88ed7cea99c
Sep 13 19:51:34 (none) ASRD[1374]: metric_high_priority,1473796294,timer,asrd,WW,pryon_latency_msec,251,voiceRequestId=4948aab9-24ee-4f59-a119-c88ed7cea99c
Sep 13 19:51:34 (none) MetricsCollector[985]: metric_high_priority,1473796294,timer,metrics-collector,asrd,WakewordToOpenASRStream,93,voiceRequestId=4948aab9-24ee-4f59-a119-c88ed7cea99c
Sep 13 19:51:34 (none) MetricsCollector[985]: metric_high_priority,1473796294,timer,metrics-collector,asrd,WakewordToBeamLed,128,voiceRequestId=4948aab9-24ee-4f59-a119-c88ed7cea99c
Sep 13 19:51:37 (none) MetricsCollector[985]: metric_high_priority,1473796297,timer,metrics-collector,alexad,WakewordToThinkingStart,3467,voiceRequestId=4948aab9-24ee-4f59-a119-c88ed7cea99c
Sep 13 19:51:38 (none) AlexaSpeechPlayer[1251]: metric_high_priority,1473796298,timer,AlexaSpeechPlayer,TTS,UserPerceivedLatency.VoiceRequest.GetTrafficIntent,2375,voiceRequestId=4948aab9-24ee-4f59-a119-c88ed7cea99c
Sep 13 19:54:11 (none) ASRD[1374]: metric_high_priority,1473796451,timer,asrd,WW,pryon_latency_msec,255,voiceRequestId=1a6e7d94-2971-481c-aa1c-ecab6ee2b414
Sep 13 19:54:11 (none) MetricsCollector[985]: metric_high_priority,1473796451,timer,metrics-collector,audioencoderd,WakewordToEncodeStream,29,voiceRequestId=1a6e7d94-2971-481c-aa1c-ecab6ee2b414
Sep 13 19:54:11 (none) MetricsCollector[985]: metric_high_priority,1473796451,timer,metrics-collector,asrd,WakewordToOpenASRStream,103,voiceRequestId=1a6e7d94-2971-481c-aa1c-ecab6ee2b414
Sep 13 19:54:12 (none) MetricsCollector[985]: metric_high_priority,1473796452,timer,metrics-collector,asrd,WakewordToBeamLed,147,voiceRequestId=1a6e7d94-2971-481c-aa1c-ecab6ee2b414
Sep 13 19:54:13 (none) MetricsCollector[985]: metric_high_priority,1473796453,timer,metrics-collector,alexad,WakewordToThinkingStart,2111,voiceRequestId=1a6e7d94-2971-481c-aa1c-ecab6ee2b414
Sep 13 19:54:14 (none) AlexaSpeechPlayer[1251]: metric_high_priority,1473796454,timer,AlexaSpeechPlayer,TTS,UserPerceivedLatency.SpeechSynthesizer.speak,1346,voiceRequestId=1a6e7d94-2971-481c-aa1c-ecab6ee2b414
Sep 13 19:55:10 (none) MetricsCollector[985]: metric_high_priority,1473796510,timer,metrics-collector,audioencoderd,WakewordToEncodeStream,32,voiceRequestId=5d3d5e79-3b10-459c-befb-d2f172baab46
Sep 13 19:55:10 (none) ASRD[1374]: metric_high_priority,1473796510,timer,asrd,WW,pryon_latency_msec,236,voiceRequestId=5d3d5e79-3b10-459c-befb-d2f172baab46
Sep 13 19:55:10 (none) MetricsCollector[985]: metric_high_priority,1473796510,timer,metrics-collector,asrd,WakewordToOpenASRStream,92,voiceRequestId=5d3d5e79-3b10-459c-befb-d2f172baab46
Sep 13 19:55:10 (none) MetricsCollector[985]: metric_high_priority,1473796510,timer,metrics-collector,asrd,WakewordToBeamLed,164,voiceRequestId=5d3d5e79-3b10-459c-befb-d2f172baab46
Sep 13 19:55:13 (none) MetricsCollector[985]: metric_high_priority,1473796513,timer,metrics-collector,alexad,WakewordToThinkingStart,2778,voiceRequestId=5d3d5e79-3b10-459c-befb-d2f172baab46
```

Thank You

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rajewski@champlain.edu I @jtrajewski