NEW & IMPROVED!
Version 2.0!

Smartphone and Network Forensics go Together Like Peas and Carrots

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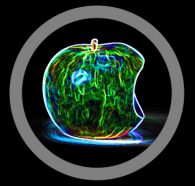
SANS DFIR

DIGITAL FORENSICS & INCIDENT RESPONSE

FOR408
Windows Forensics



FOR518
Mac Forensics

FOR526
Memory Forensics In-Depth

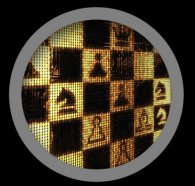
FOR585
Advanced Smartphone Forensics

OPERATING SYSTEM & DEVICE IN-DEPTH

INCIDENT RESPONSE & ADVERSARY HUNTING

FOR508
Advanced Incident Response

FOR572
Advanced Network Forensics and Analysis



FOR578
Cyber Threat Intelligence

FOR610
REM: Malware Analysis

SEC504
Hacker Tools, Techniques, Exploits, and Incident Handling

MGT535
Incident Response Team Management

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dfir.to/DFIRLinkedInCommunity

dfir.to/gplus-sansforensics

dfir.to/MAIL-LIST

Background

- No single forensic discipline can give a complete view of an incident
- Leveraging multiple disciplines can give comprehensive visibility
- Incidents are multifaceted…

…analysis must be as well

- Version 2 designed to dive deeper into interesting findings and address great questions raised from previous talk

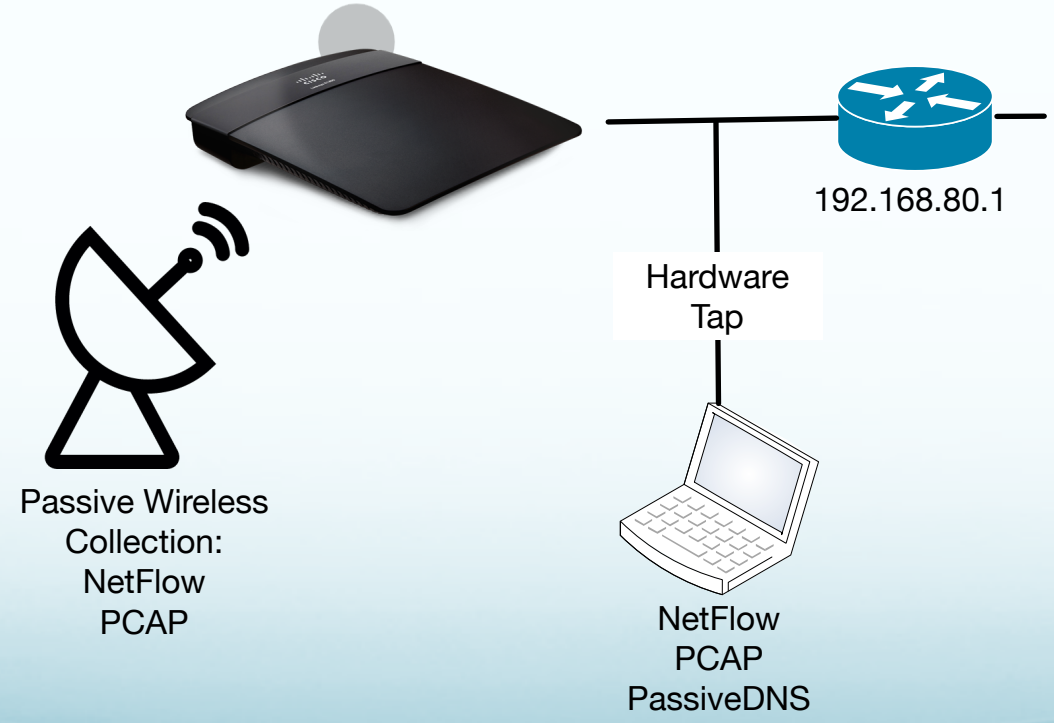
The Plan

- Associate all devices to wireless access point
- Capture all network traffic via tap inside gateway
- Capture wireless traffic
- Conduct typical activity on smartphone devices
- Acquisition on two iPhones and Android
- Network traffic examination from all traffic

Assumptions

- Smartphones
  - Passcodes are known or “crackable”
  - User did not wipe or delete the data
- Network
  - Legal permission to capture wired and wireless
  - Passphrase to WPA2 wireless network

The Setup



Evidence Used

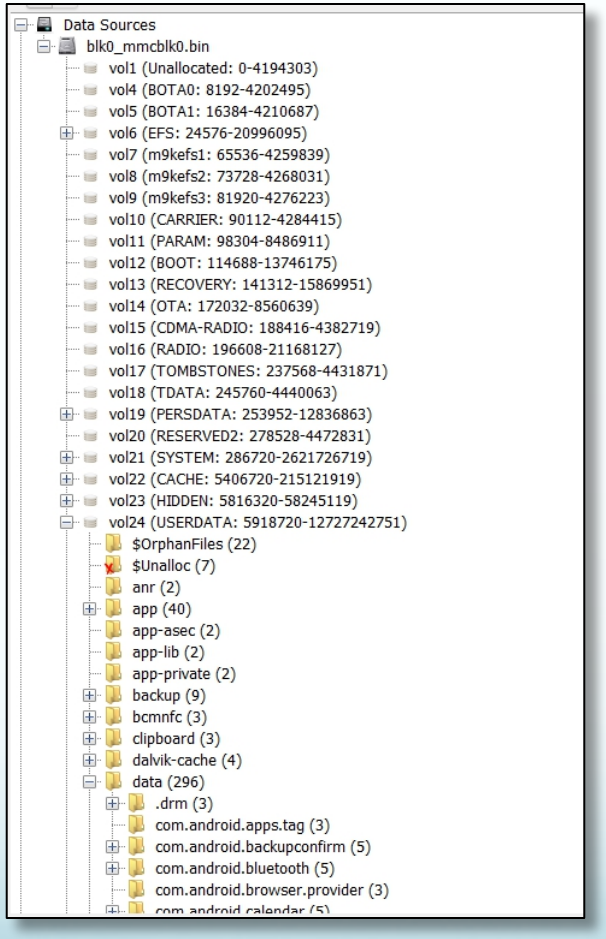
Device-based

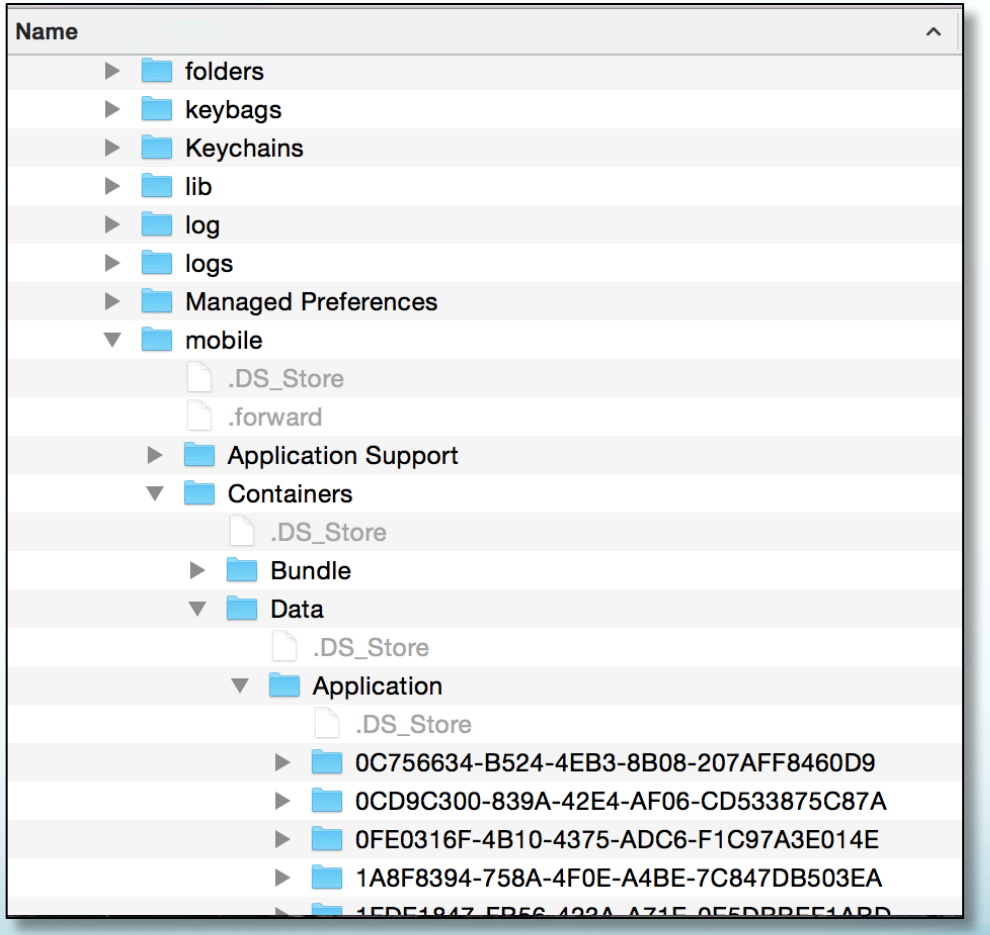
- Jailbroken iPhone 6
  - Advanced logical acquisition
  - Easiest acquisition for jailbroken iOS devices with A7+ chip
- Rooted Samsung Galaxy S5
  - Physical dump
  - Best option when available (assuming the device isn't encrypted)
- Commercial and Open Source tools

Network-based

- NetFlow
  - Statistical traffic abstraction: all metadata – no content
  - From tap and wireless
- Full packet capture
  - ALL content of network communications
  - From tap and wireless
- PassiveDNS logs
  - ASCII logs detailing all DNS queries and responses

Filesystem Dump





Device Arrival

```
6E 74 65 72 6E 65 74 5F 63 68 65 63 6B 3D 30 0A 7D 0A 0A 6E 65 74
77 6F 72 6B 3D 7B 0A 09 73 73 69 64 3D 22 70 65 61 73 2D 63 61 72
72 6F 74 73 22 0A 09 70 73 6B 3D 30 65 39 61 32 36 63 37 35 37 35
65 36 34 39 63 37 34 37 62 32 62 33 31 36 30 31 64 38 37 33 30 0A
09 6B 65 79 5F 6D 67 6D 74 3D 57 50 41 2D 50 53 4B 0A 09 70 72 69
6F 72 69 74 79 3D 33 0A 09 66 72 65 71 75 65 6E 63 79 3D 32 34 33
32 0A 09 61 75 74 6F 6A 6F 69 6E 3D 31 0A 09 75 73 61 62 6C 65 5F
69 6E 74 65 72 6E 65 74 3D 31 0A 09 73 6B 69 70 5F 69 6E 74 65 72
6E 65 74 5F 63 68 65 63 6B 3D 30 0A 7D 0A
```

```
nternet_check=0.}..net
work={..ssid="peas-car
rots"..psk=0e9a26c7575
e649c747b2b31601d8730.
.key_mgmt=WPA-PSK..pri
ority=3..frequency=243
2..autojoin=1..usable_
internet=1..skip_inter
net_check=0.}.
```

CHANNEL_WIDTH	integer	20
FT_ENABLED	boolean	true
IE	data	...
NOISE	integer	0
ORIG_AGE	integer	
PHY_MODE	integer	
RATES	array	
RSN_IE	dict	
RSSI	integer	
SCAN_RESULT_FRO	boolean	
SNR	integer	
SSID	data	
SSID_STR	string	
ScaledRSSI	real	
ScaledRate	real	
SecurityMode	string	
Strength	real	
WEPKeyLen	integer	
WiFiManagerKnow	integer	
authMode	integer	
isValid	boolean	
isWPA	integer	
lastAutoJoined	date	
lastJoined	date	

ollow TCP Stream (tcp.stream eq 808) · peascarrots_v2_tap_all-ip

Wireshark · Follow TCP Stream (tcp.stream eq 7) · peascarrots_v2_tap_all-ip

```
GET /lp7w1KxUs/OTMFc2vgO/MrlRVpHRf/YPMYriReZ/xgsGb3T79.html HTTP/1.0
Host: captive.apple.com
Connection: close
User-Agent: CaptiveNetworkSupport-306.20.1 wispr

HTTP/1.0 200 OK
Content-Type: text/html
Content-Length: 68
Date: Sat, 06 Feb 2016 21:26:40 GMT
Connection: close

<HTML><HEAD><TITLE>Success</TITLE></HEAD><BODY>Success</BODY></HTML>
```

FaceTime Audio, Video Device-Device Calls


```
SELECT ZCALLRECORD.ZCALLTYPE,
  ZCALLRECORD.ZDATE,
  ZCALLRECORD.ZDURATION,
  ZCALLRECORD.ZADDRESS,
  ZCALLRECORD.ZNAME
FROM ZCALLRECORD
```

Results, Rows = 19

ZCALLTYPE	ZDATE	ZDURATION	ZADDRESS
1	2016/02/06 21:29:17	69	+1703
16	2016/02/06 21:31:20	75	phil-apple@
8	2016/02/06 21:33:34	77	nevie@i
8	2016/02/06 21:35:55	0	+1703
1	2016/02/06 21:36:06	24	+1703
8	2016/02/06 21:36:29	61	+1703
1	2015/08/11 11:15:04	0	571
1	2015/08/11 18:50:15	0	703
8	2015/08/12 11:21:26	0	+1571
1	2015/08/12 16:11:36	0	610

1 = Cellular
8 = FT Video
16 = FT Audio

Icon = FT Video **only via WiFi!**

FaceTime Audio, Video Device-Device Calls

Tap

```
pc@sift:$ nfdump -R 2016/ -t '2016/02/06.21:31-2016/02/06.21:38' 'proto tcp and (host 192.168.80.12 or host 192.168.80.6) and not (port 80 or port 443)'
Date first seen          Duration Proto      Src IP Addr:Port          Dst IP Addr:Port   Packets    Bytes Flows
2016-02-06 21:31:16.154   139.278 TCP      192.168.80.12:49337 ->    17.172.239.61:5223        57    26886     1
2016-02-06 21:31:16.000   139.507 TCP      17.172.239.61:5223  ->    192.168.80.12:49337       56    14630     1
2016-02-06 21:35:53.928    72.191 TCP      192.168.80.12:49337 ->    17.172.239.61:5223        58    27408     1
2016-02-06 21:35:53.958    72.189 TCP      17.172.239.61:5223  ->    192.168.80.12:49337       54    13296     1
Summary: total flows: 4, total bytes: 82220, total packets: 225, avg bps: 1878, avg pps: 0, avg bpp: 365
```

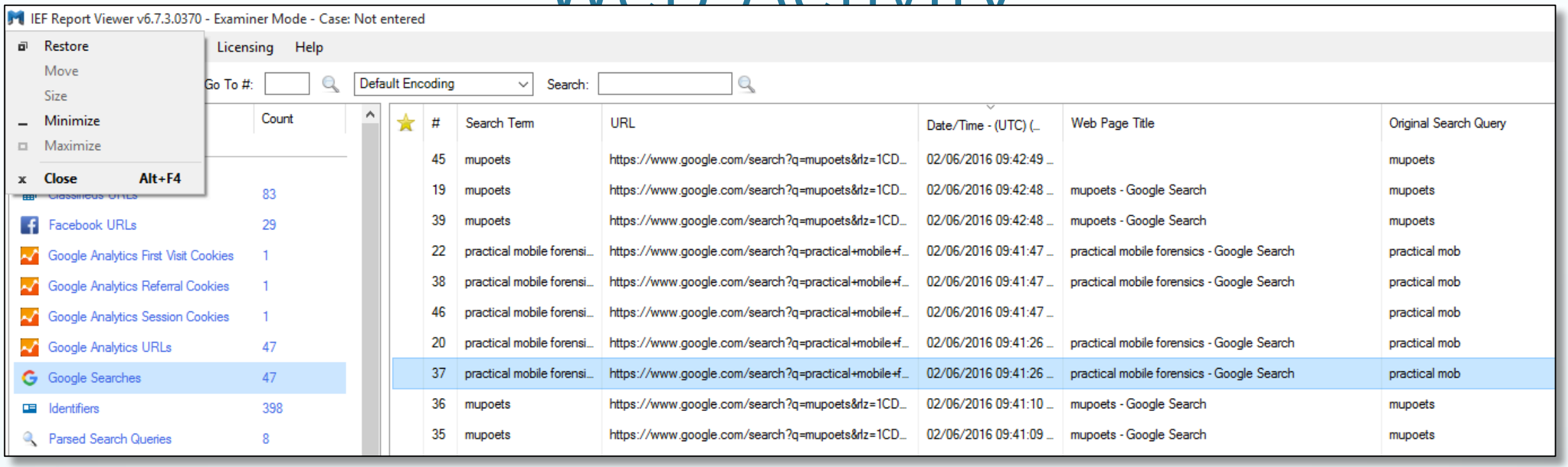
Tap

```
192.168.80.6        192.168.80.12       STUN      198 Binding Success Response user: '@,[ MAPPED-ADDRESS: 192.168.80.12:16402
192.168.80.6        192.168.80.12       STUN      198 Binding Success Response user: '@,[ MAPPED-ADDRESS: 192.168.80.12:16402
192.168.80.6        192.168.80.12       STUN      186 Binding Request user: '@,[ ��
192.168.80.6        192.168.80.12       STUN      198 Binding Success Response user: '@,[ MAPPED-ADDRESS: 192.168.80.12:16402
192.168.80.12       192.168.80.6        STUN      194 Binding Success Response user: [ ��  MAPPED-ADDRESS: 192.168.80.6:16402
192.168.80.6        192.168.80.12       STUN      378 Binding Request user: '@,[ ��
192.168.80.12       192.168.80.6        STUN      298 Binding Success Response user: [ ��  MAPPED-ADDRESS: 192.168.80.6:16402
192.168.80.6        192.168.80.12       SIP/SDP   801 Request: INVITE sip:user@192.168.80.12:16402 |
192.168.80.12       192.168.80.6        SIP       387 Status: 100 Trying |
192.168.80.12       192.168.80.6        SIP       438 Status: 180 Ringing |
192.168.80.12       192.168.80.6        SIP/SDP   740 Status: 200 OK |
192.168.80.6        192.168.80.12       SIP       433 Request: ACK sip:192.168.80.12:16402 |
192.168.80.6        192.168.80.12       UDP       197 16402 → 16402  Len=87
192.168.80.6        192.168.80.12       UDP       197 16402 → 16402  Len=87
```

WiFi

```
pc@sift:$ nfdump -R 2016/ 'host 192.168.80.12 and host 192.168.80.6'
Date first seen          Duration Proto      Src IP Addr:Port          Dst IP Addr:Port   Packets    Bytes Flows
2016-02-06 21:31:19.637    75.417 UDP      192.168.80.12:16402 ->     192.168.80.6:16402     3673   452444     1
2016-02-06 21:31:19.937    75.146 UDP       192.168.80.6:16402 ->    192.168.80.12:16402     3580   548290     1
2016-02-06 21:36:29.432    61.156 UDP      192.168.80.12:16402 ->     192.168.80.6:16402    12440   12.1 M     1
2016-02-06 21:36:29.000    61.646 UDP       192.168.80.6:16402 ->    192.168.80.12:16402     9373    3.4 M     1
Summary: total flows: 4, total bytes: 16582386, total packets: 29066, avg bps: 357562, avg pps: 78, avg bpp: 570
Time window: 2016-02-06 21:26:35 - 2016-02-06 22:54:02
Total flows processed: 10743, Blocks skipped: 0, Bytes read: 517272
Sys: 0.016s flows/second: 671437.5   Wall: 0.005s flows/second: 1828595.7
```

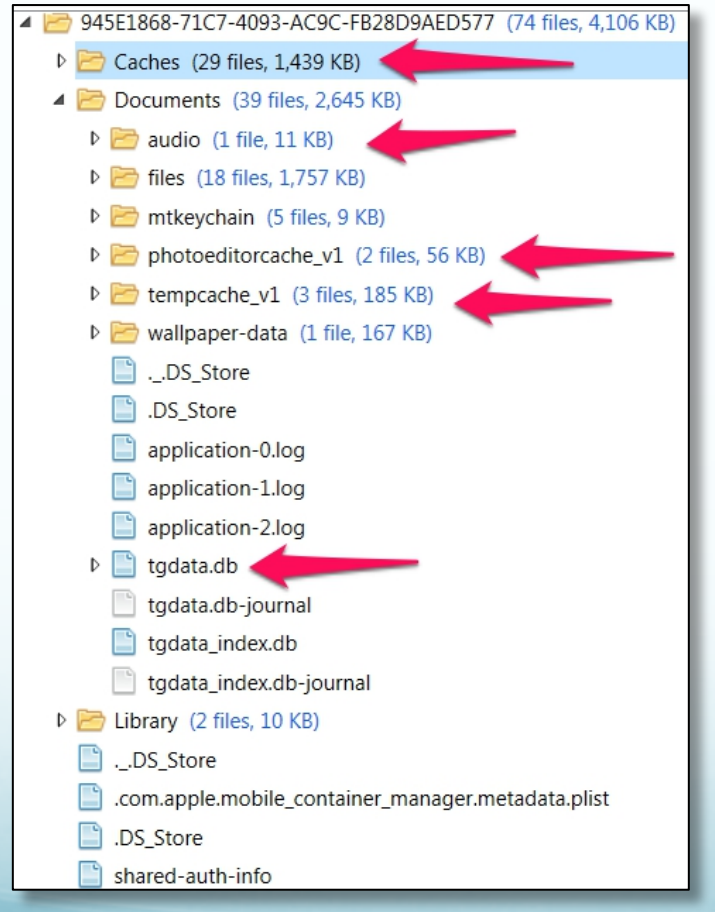
Web Activity




```
GET /Practical-Mobile-Forensics-Satish-Bommisetty/dp/1783288310 HTTP/1.1
Host: www.amazon.com
Connection: keep-alive
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8,image/webp
Referer: https://www.google.com/
User-Agent: Mozilla/5.0 (iPhone; CPU iPhone OS 8_3 like Mac OS X) AppleWebKit/600.1.4 (KHTML, like Gecko) GSA/12.0.68608 Mobile/12F70
Safari/600.1.4
Accept-Encoding: gzip, deflate
Accept-Language: en-US,en
```

Telegram Chats

- Messaging application, including private secure chat



Telegram Chats

```
pc@sift:$ grep telegram passivedns.log
pc@sift:$ grep tele passivedns.log
pc@sift:$
```

No.	Time	Source
30813	2016-02-06 21:46:07.358113	192.168.80.1
30814	2016-02-06 21:46:07.400140	149.154.175.
30815	2016-02-06 21:46:07.402850	192.168.80.1
30816	2016-02-06 21:46:07.419599	192.168.80.1
30817	2016-02-06 21:46:07.460977	149.154.175.
30818	2016-02-06 21:46:07.463306	192.168.80.1
30819	2016-02-06 21:46:07.486474	192.168.80.1
30820	2016-02-06 21:46:07.527643	149.154.175.
30821	2016-02-06 21:46:07.536492	192.168.80.1
30822	2016-02-06 21:46:07.536537	192.168.80.1
30823	2016-02-06 21:46:07.587619	149.154.175.
30824	2016-02-06 21:46:07.589790	192.168.80.1
30825	2016-02-06 21:46:07.595249	149.154.175.
30826	2016-02-06 21:46:07.596359	149.154.175.

```
phil@mbp:~ phil$ whois 149.154.175.50

inetnum:        149.154.172.0 - 149.154.175.255
netname:        Telegram_Messenger_Network
descr:          Telegram Messenger Network
country:        GB
admin-c:        ND2624-RIPE
tech-c:         ND2624-RIPE
status:         ASSIGNED PA
mnt-by:         MNT-TELEGRAM
created:        2014-09-19T22:27:16Z
last-modified:  2014-09-19T22:27:16Z
source:         RIPE

person:         Nikolai Durov
address:        P.O. Box 146, Road Town, Tortola, British Virgin Islands
phone:          +357 96 287319
nic-hdl:        ND2624-RIPE
mnt-by:         MNT-TELEGRAM
created:        2014-03-07T19:25:00Z
last-modified:  2014-03-08T03:31:36Z
source:         RIPE

% Information related to '149.154.172.0/22AS59930'

route:          149.154.172.0/22
descr:          Telegram Messenger Network
origin:         AS59930
mnt-by:         MNT-TELEGRAM
created:        2014-10-15T14:23:11Z
last-modified:  2014-10-15T14:23:11Z
source:         RIPE
```

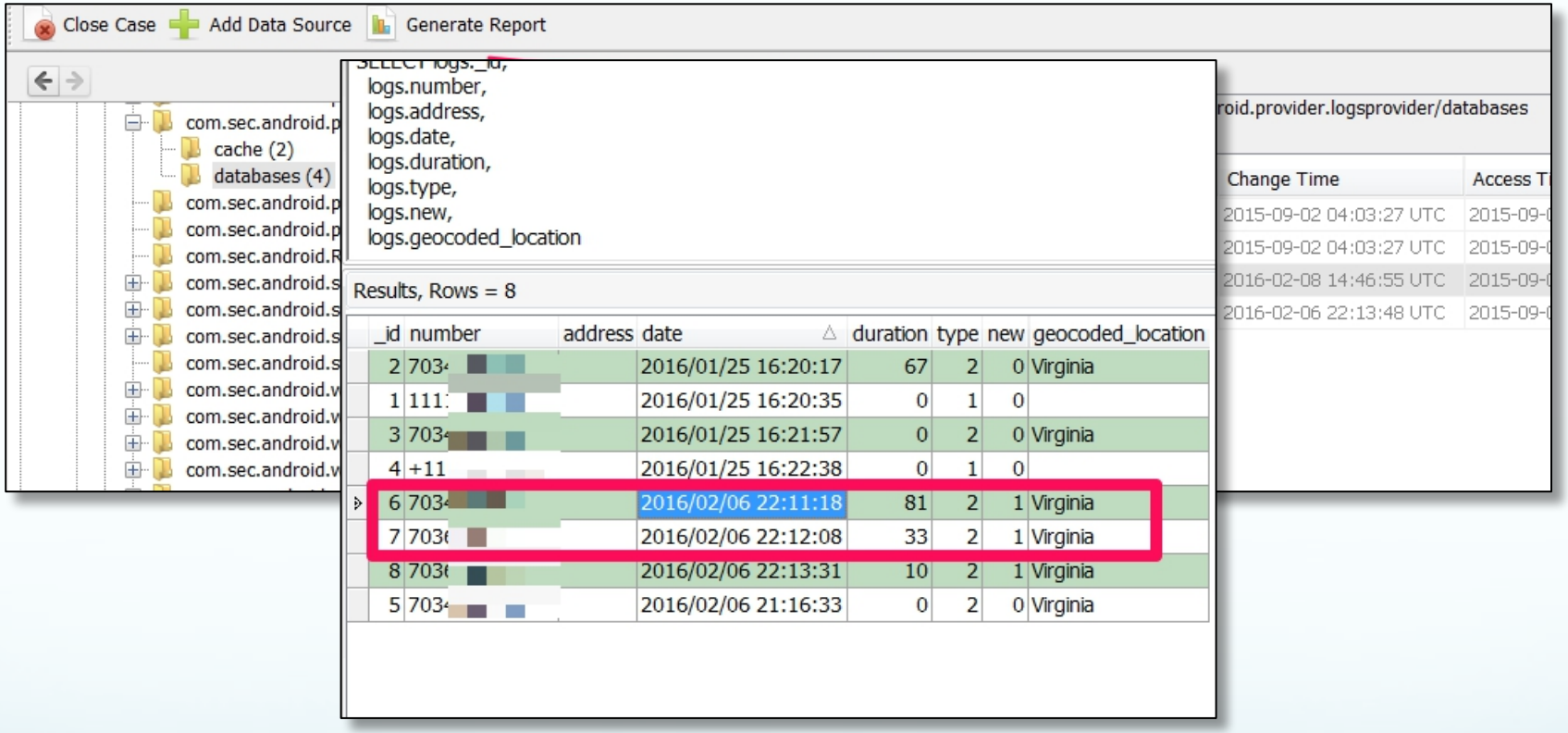
Wireshark · Follow TCP Stream (tcp.stream eq 587) · peascarrots_v2_tap_all-ip

Telegram Chats

46		777000	Martha Vines	162132182	New in version 3.4:...	02/06/2016 09:46:07 ...	
38	Martha Vines	162132182	P Nasty	153339917		02/06/2016 09:46:54 ...	<click to v
39	Martha Vines	162132182	P Nasty	153339917	I'm drinking your beer!	02/06/2016 09:47:01 ...	
40	P Nasty	153339917	Martha Vines	162132182	Oh shit	02/06/2016 09:47:06 ...	
41	P Nasty	153339917	Martha Vines	162132182	It's on	02/06/2016 09:47:09 ...	
6	P Nasty	153339917	Martha Vines	162132182		02/06/2016 09:48:38 ...	<click to v
			Martha Vines	162132182	I drank your wine	02/06/2016 09:48:44 ...	
				-2147483650	Oh no!!!!	02/06/2016 09:49:03 ...	
				-2147483650	Must chug the beer	02/06/2016 09:49:10 ...	

3786aa57bbfca7d97	2/6/2016 4:48 PM	File
d0df941604d2d0b40	2/6/2016 4:46 PM	File

Samsung Call Join



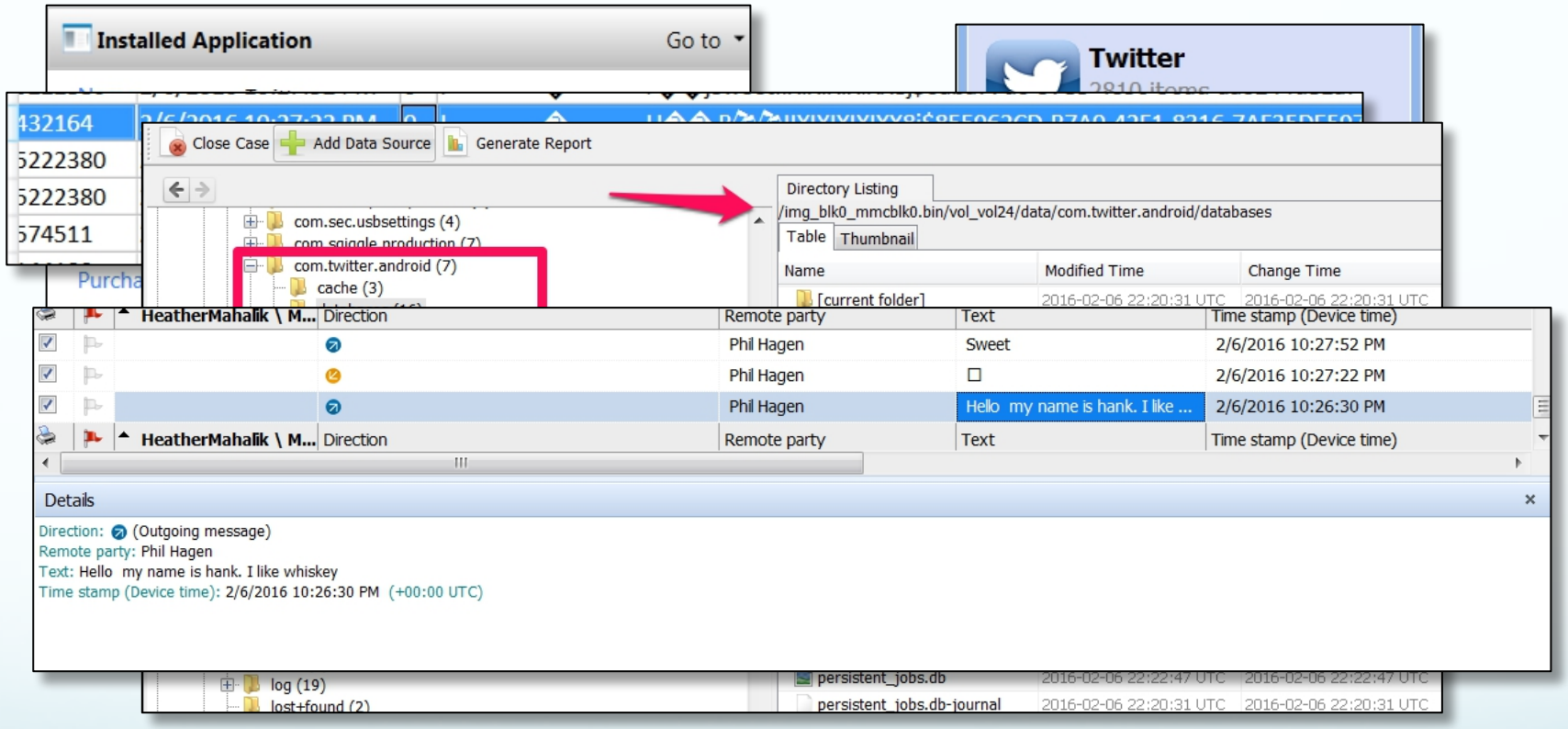
Samsung Call Join

Twitter Activity

```
pc@sift:$ grep twitter passivedns.log |grep 192.168.80.13
1454796908.905159||192.168.80.13||192.168.80.1||IN||platform.twitter.com.||CNAME||cs472.wac.edgecastcdn.net.||11||1
1454797069.091571||192.168.80.13||192.168.80.1||IN||twitter.com.||A||199.16.156.6||27||1
1454797069.092616||192.168.80.13||192.168.80.1||IN||mobile.twitter.com.||A||199.16.156.107||2||1
1454797069.092616||192.168.80.13||192.168.80.1||IN||mobile.twitter.com.||A||199.16.156.43||2||1
1454798548.352627||192.168.80.13||192.168.80.1||IN||twitter.com.||A||199.16.156.6||28||6
1454798548.352627||192.168.80.13||192.168.80.1||IN||twitter.com.||A||199.16.156.102||29||8
1454798548.352627||192.168.80.13||192.168.80.1||IN||twitter.com.||A||199.16.156.230||29||10
```

Date first seen	Duration	Proto	Src IP Addr:Port		Dst IP Addr:Port	Packets	Bytes	Flows
2016-02-06 22:15:11.510	47.060	TCP	192.168.80.13:54000	->	199.16.156.200:443	20	1944	1
2016-02-06 22:15:11.510	47.060	TCP	192.168.80.13:42126	->	199.16.156.75:443	14	1678	1
2016-02-06 22:15:11.541	46.998	TCP	199.16.156.75:443	->	192.168.80.13:42126	15	5011	1
2016-02-06 22:15:11.542	46.997	TCP	199.16.156.200:443	->	192.168.80.13:54000	16	4830	1
2016-02-06 22:17:49.138	0.610	TCP	192.168.80.13:52613	->	199.16.156.70:443	11	1918	1
2016-02-06 22:17:49.138	0.640	TCP	192.168.80.13:45793	->	199.16.156.107:443	12	1582	1
2016-02-06 22:17:49.138	0.790	TCP	192.168.80.13:59808	->	199.16.156.104:443	16	3212	1
2016-02-06 22:17:49.169	0.704	TCP	199.16.156.104:443	->	192.168.80.13:59808	14	10397	1
2016-02-06 22:17:49.169	0.525	TCP	199.16.156.70:443	->	192.168.80.13:52613	8	4507	1
2016-02-06 22:17:49.171	0.562	TCP	199.16.156.107:443	->	192.168.80.13:45793	11	6119	1
2016-02-06 22:17:49.828	0.240	TCP	192.168.80.13:56516	->	199.16.156.104:443	7	1815	1
2016-02-06 22:17:49.828	0.265	TCP	192.168.80.13:36250	->	199.16.156.104:443	7	1551	1
2016-02-06 22:17:49.859	0.204	TCP	199.16.156.104:443	->	192.168.80.13:56516	7	1353	1
2016-02-06 22:17:49.859	0.209	TCP	199.16.156.104:443	->	192.168.80.13:36250	7	1494	1
2016-02-06 22:17:59.381	120.422	TCP	192.168.80.13:35499	->	199.16.156.72:443	445	30875	1
2016-02-06 22:17:59.410	120.384	TCP	199.16.156.72:443	->	192.168.80.13:35499	684	648401	1
2016-02-06 22:18:32.535	8.593	TCP	192.168.80.13:51956	->	199.16.156.230:443	15	3596	1
2016-02-06 22:18:32.565	8.264	TCP	199.16.156.230:443	->	192.168.80.13:51956	14	4787	1
2016-02-06 22:18:37.487	21.304	TCP	192.168.80.13:57021	->	199.16.156.199:443	12	2042	1
2016-02-06 22:18:37.519	21.245	TCP	199.16.156.199:443	->	192.168.80.13:57021	12	4888	1
2016-02-06 22:18:57.050	52.711	TCP	192.168.80.13:45734	->	199.16.156.38:443	17	7352	1
2016-02-06 22:18:57.082	52.639	TCP	199.16.156.38:443	->	192.168.80.13:45734	12	1856	1
2016-02-06 22:19:58.263	0.570	TCP	192.168.80.13:42409	->	199.16.156.102:443	13	6024	1
2016-02-06 22:19:58.295	0.526	TCP	199.16.156.102:443	->	192.168.80.13:42409	9	1154	1

Twitter Activity



Profiling: iOS

- User Agent strings
  - 192.168.1.6 (iPhone 6S)

```
    102 Mozilla/5.0 (iPhone; CPU iPhone OS 9_2_1 like Mac OS X) AppleWebKit/601.1.46 (KHTML, like Gecko) Version/9.0 Mobile/13D15 Safari/601.1
     45 News/351 CFNetwork/758.2.8 Darwin/15.0.0
     14 Mozilla/5.0 (iPhone; CPU iPhone OS 9_2_1 like Mac OS X) AppleWebKit/601.1.46 (KHTML, like Gecko) Mobile/13D15 [FBAN/FBIOS;FBAV/48.0.0.
;FBSV/9.2.1;FBSS/2; FBCR/AT&T;FBID/phone;FBLC/en_US;FBOP/5]
     13 Mozilla/5.0 (iPhone; CPU iPhone OS 9_2_1 like Mac OS X) AppleWebKit/601.1.46 (KHTML, like Gecko) Mobile/13D15
      3 securityd (unknown version) CFNetwork/758.2.8 Darwin/15.0.0
      3
      2 T84QZS65DQ.com.facebook.Facebook
      2 server-bag [watch OS,2.1,13S661,watch1,2]
      2 server-bag [iPhone OS,9.2.1,13D15,iPhone8,1]
      2 Search%20Framework/1.0 CFNetwork/758.2.8 Darwin/15.0.0
      2 com.apple.invitation-registration [iPhone OS,9.2.1,13D15,iPhone8,1]
      1 MobileAsset/1.1
      1 iPhone8,1/9.2.1 (13D15)
```

  - 192.168.1.12 (Jailbroken iPhone 6)

```
    233 Mozilla/5.0 (iPhone; CPU iPhone OS 8_3 like Mac OS X) AppleWebKit/600.1.4 (KHTML, like Gecko) CriOS/47.0.2526.107 Mobile/12F70 Safari/600.1.4
    177 Mozilla/5.0 (iPhone; CPU iPhone OS 8_3 like Mac OS X) AppleWebKit/600.1.4 (KHTML, like Gecko) GSA/12.0.68608 Mobile/12F70 Safari/600.1.4
    131 AppStore/2.0 iOS/8.3 model/iPhone7,2 build/12F70 (6; dt:106)
     36 Mozilla/5.0 (iPhone; CPU iPhone OS 8_3 like Mac OS X) AppleWebKit/600.1.4 (KHTML, like Gecko) Version/8.0 Mobile/12F70 Safari/600.1.4
     27
      6 CommCenter (unknown version) CFNetwork/711.3.18 Darwin/14.0.0
      5 securityd (unknown version) CFNetwork/711.3.18 Darwin/14.0.0
      3 server-bag [iPhone OS,8.3,12F70,iPhone7,2]
      3 com.apple.invitation-registration [iPhone OS,8.3,12F70,iPhone7,2]
      2 MobileAsset/1.1
      2 iPhone7,2/8.3 (12F70)
      2 CaptiveNetworkSupport-306.20.1 wispr
      1 gamed/4.10.18.4.6.15.5.3.2 (iPhone7,2; 8.3; 12F70; GameKit-194.29)
      1 assetsd (unknown version) CFNetwork/711.3.18 Darwin/14.0.0
```

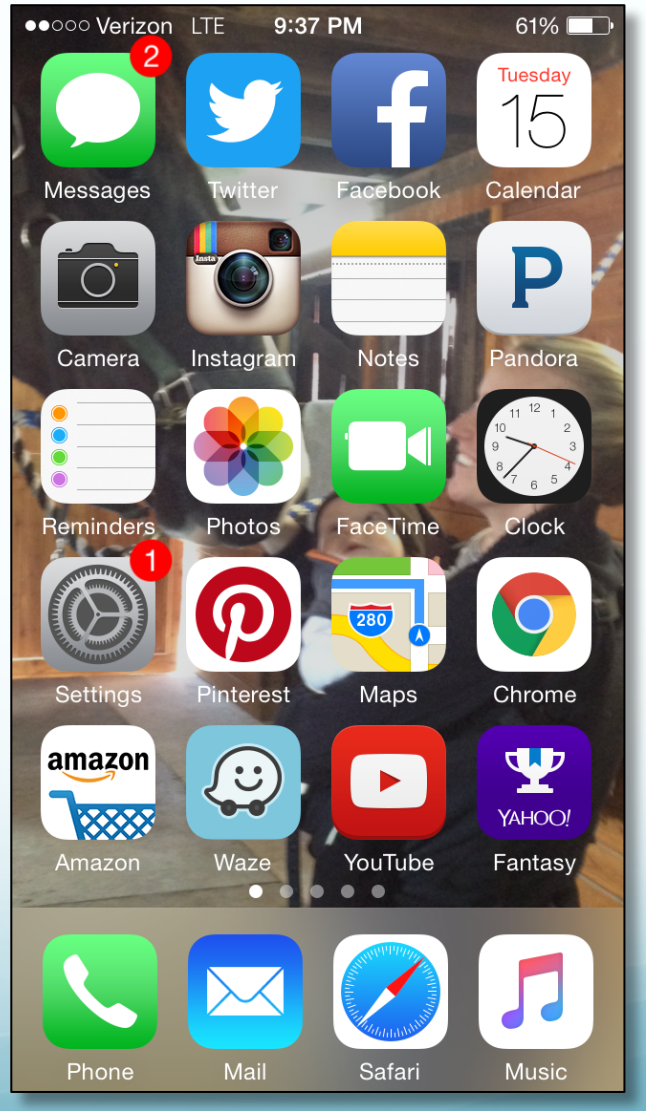
Profiling: Android

- Samsung Galaxy S5

```
510 Mozilla/5.0 (Linux; Android 5.0; SM-G900H Build/LRX21T) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/48.0.2564.95 Mobile Safar
106 okhttp/2.3.0
 79 Mozilla/5.0 (Linux; Android 5.0; SM-G900H Build/LRX21T; wv) AppleWebKit/537.36 (KHTML, like Gecko) Version/4.0 Chrome/47.0.2526
 66 Dalvik/1.6.0 (Linux; U; Android 4.3; SM-G900H Build/JSS15J)
 12 okhttp/2.1.0
 10
  9 Dalvik/2.1.0 (Linux; U; Android 5.0; SM-G900H Build/LRX21T)
  6 unused/0 (k3g LRX21T); gzip
  4 TwitterAndroid/5.94.0 (5110031-r-844) SM-G900H/5.0 (samsung;SM-G900H;samsung;k3gxx;0;;1)
  3 Mozilla/5.0 (Linux; Android 5.0; SAMSUNG SM-G900H Build/LRX21T) AppleWebKit/537.36 (KHTML, like Gecko) SamsungBrowser/2.1 Chrom
  2 SAMSUNG-Android
  2 Pinterest for Android/5.8.2 (k3g; 5.0)
  2 Mozilla/5.0 (Linux; Android 5.0; SM-G900H Build/LRX21T; wv) AppleWebKit/537.36 (KHTML, like Gecko) Version/4.0 Chrome/47.0.2526
  1 Android
```

Reality of the Smartphone

- How secure are our chats?
- One tool can't do it all
- Do we really know when we are on WiFi vs. LTE?
  - Does it change our user capabilities?
  - What happens when we drop off the network?



Takeaways

- Smartphone Forensics
  - Tools primarily give insight to human-initiated actions… Reality is they miss a lot of data that must be manually recovered
  - Includes artifacts from encrypted communications
  - Provides consistent view as device enters/leaves networks
    - Not when the device fails to connect
  - Have to acquire device – not always easy with mobile devices

Takeaways (2)

- Network Forensics
  - Scoping and profiling activity relatively easy for plaintext protocols
  - Encryption means functionally opaque communications, but PassiveDNS can give some insight
  - Un/poorly documented protocols hinder analysis
  - Includes all activity including system/background tasks
  - Relatively easy to profile and analyze most protocols

Comprehensive Analysis!!

- If you rely on only one forensic methodology, you lose perspective!
- No such thing as a single-discipline investigation
  - Don't let yourself be a single-discipline forensicator

FOR585: Advanced Smartphone Forensics: GASF
http://for585.com/course

FOR572: Advanced Network Forensics and Analysis: GNFA
http://for572.com/course