NAVAL
POSTGRADUATE
SCHOOL

Residual Network Data on Android Devices

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What

- Consider Implications:
  - Enemy use of COTS Smartphones
  - US DoD Deployed COTS Smartphones
- Intuitively, we believe this is insecure. For many reasons…
- This work examines the extent to which **current and residual network data can be retrieved from Smartphone Flash memory**

My Research

- Our Research:
  - Conduct carefully controlled experiments using our own infrastructure to create known ground-truth Smartphone corpus
  - Examine residual network data in corpus
  - We limit our exploration to Android mobile OS

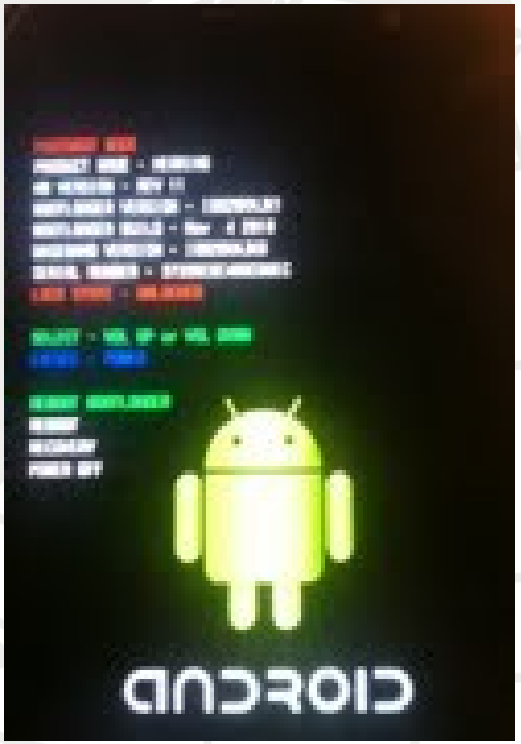
Nexus One Flash Partitions

- mtd0: "misc“
- mtd1: "recovery“
- mtd2: "boot“
- mtd3: "system“
- mtd4: "cache“
- mtd5: "userdata“

Source: Android Forensics: Hoog

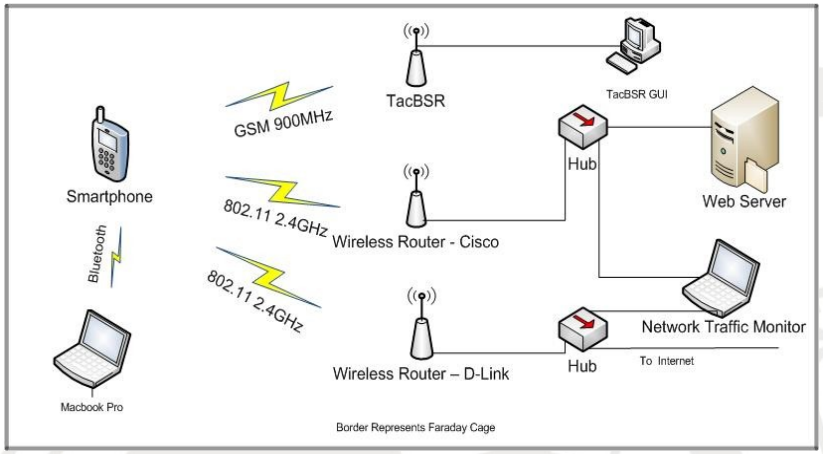
Acquisition

- Rooting Tools
  - theunlockr.com
    - Adds superuser.apk to mtd3(system)
  - Gingerbreak.exe
  - superboot
- ssh / netcat / dd
- ADB Pull
- Nandroid



Building the Corpus

- Clean Android Smartphones
- Performed in Faraday Cage
- Communication. Run our own:
  - GSM BTS
  - 802.11 WiFi
  - Bluetooth
- Different experiments using different communication channels:
  - To our web server/content
- Per-experiment imaging
- Gives us known ground-truth corpus



Building the Corpus

NAVAL POSTGRADUATE SCHOOL

Binary IP

Physical dump – 5 instances

```
0x3A3D7F8 FF FF FF FF FF FF FF FF 02 01 06 00 B3 E8 4F EC 00  ·····????·....
0x3A3D809 00 00 00 00 00 00 00 C0 A8 00 64 00 00 00 00 00 00  .......·.d......
0x3A3D81A 00 00 90 21 55 07 47 36 00 00 00 00 00 00 00 00 00  ..·!U.G6........
0x3A3D82B 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D83C 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D84D 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D85E 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D86F 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D880 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D891 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D8A2 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D8B3 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D8C4 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D8D5 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D8E6 00 00 00 00 00 00 63 82 53 63 35 01 05 01 04 FF FF  ......c·Sc5....·
0x3A3D8F7 FF 00 33 04 00 09 3A 80 03 04 C0 A8 00 01 06 04 C0  ·.3.. :·..·....
0x3A3D908 A8 00 01 36 04 C0 A8 00 01 00 00 00 00 00 00 00 00  ..6.·...........
0x3A3D919 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D92A 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D93B 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D94C 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D95D 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D96E 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D97F 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D990 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D9A1 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D9B2 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D9C3 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D9D4 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D9E5 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0x3A3D9F6 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
```

Logical dump – 1 instance

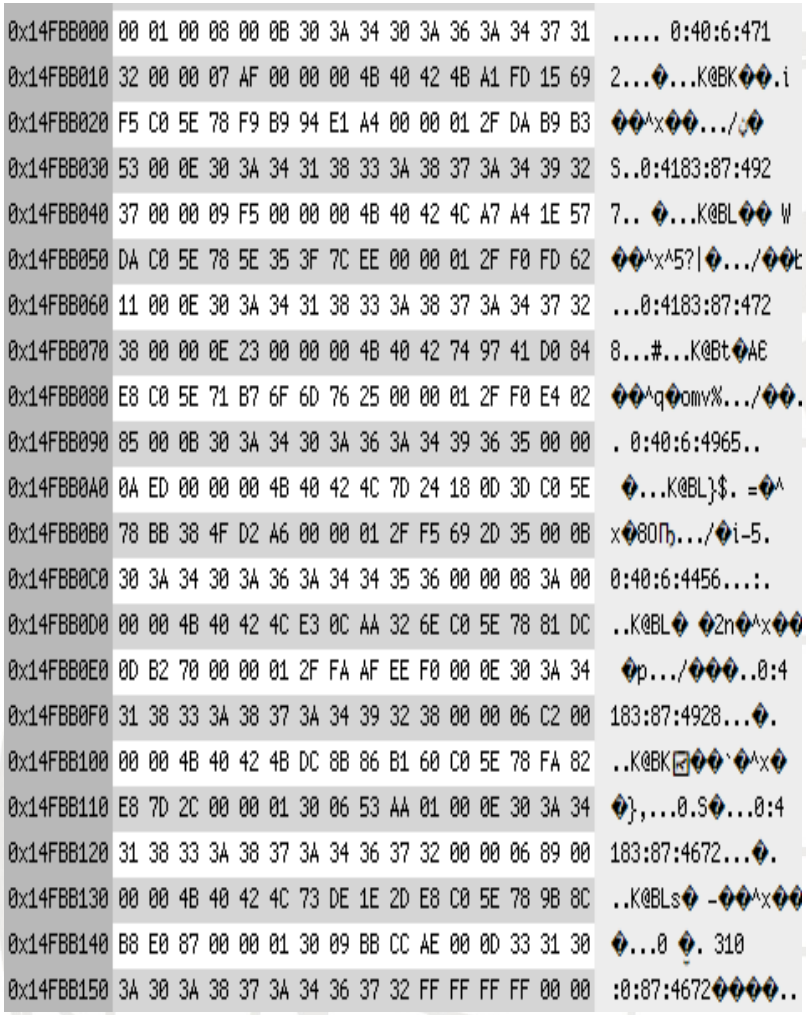
```
0xDFBFB5 FF FF FF FF FF FF FF FF FF FF FF FF 02 01 06 00 6F C9  ????????????????
0xDFBFC6 0E E2 00 00 00 00 00 00 00 C0 A8 00 64 00 00 00  .·.....·.d...
0xDFBFD7 00 00 00 00 00 90 21 55 07 47 36 00 00 00 00 00 00  .....·!U.G6.....
0xDFBFE8 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0xDFBFF9 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0xDFC00A 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0xDFC01B 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0xDFC02C 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0xDFC03D 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0xDFC04E 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0xDFC05F 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0xDFC070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0xDFC081 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0xDFC092 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0xDFC0A3 00 00 00 00 00 00 00 00 00 00 63 82 53 63 35 01 05 01  ..........c·Sc5...
0xDFC0B4 04 FF FF FF 00 33 04 00 09 3A 80 03 04 C0 A8 00 01  .···.3.. :·..·.
0xDFC0C5 06 04 C0 A8 00 01 36 04 C0 A8 00 01 FF FF FF FF FF  ..·..6.·..·????
```

Signature – 0x020106
DHCP ACK-Bootstrap Protocol
Message Type - 0x02
Hardware type - 0x01
Hardware Add len - 0x06
Hops - 0x00

Cellular Base Stations

User Data Partition – HTC Evo 4G

- Android Location Package
  - Installs cache.cell
  - DB records cell towers
- Unallocated Instances



0x14FBB000	00 01 00 08 00 0B 30 3A 34 30 3A 36 3A 34 37 31	..... 0:40:6:471
0x14FBB010	32 00 00 07 AF 00 00 00 4B 40 42 4B A1 FD 15 69	2...¯...K@BK¡ý.i
0x14FBB020	F5 C0 5E 78 F9 B9 94 E1 A4 00 00 01 2F DA B9 B3	õÀ^xù¹.á¤..../Ú¹³
0x14FBB030	53 00 0E 30 3A 34 31 38 33 3A 38 37 3A 34 39 32	S..0:4183:87:492
0x14FBB040	37 00 00 09 F5 00 00 00 4B 40 42 4C A7 A4 1E 57	7... õ...K@BL§¤.W
0x14FBB050	DA C0 5E 78 5E 35 3F 7C EE 00 00 01 2F F0 FD 62	ÚÀ^x^5?|î.../ðýb
0x14FBB060	11 00 0E 30 3A 34 31 38 33 3A 38 37 3A 34 37 32	...0:4183:87:472
0x14FBB070	38 00 00 0E 23 00 00 00 4B 40 42 74 97 41 D0 84	8...#...K@Bt.AÐ.
0x14FBB080	E8 C0 5E 71 B7 6F 6D 76 25 00 00 01 2F F0 E4 02	èÀ^q·omv%.../ðä.
0x14FBB090	85 00 0B 30 3A 34 30 3A 36 3A 34 39 36 35 00 00	...0:40:6:4965..
0x14FBB0A0	0A ED 00 00 00 4B 40 42 4C 7D 24 18 0D 3D C0 5E	.í...K@BL}$...=À^
0x14FBB0B0	78 BB 38 4F D2 A6 00 00 01 2F F5 69 2D 35 00 0B	x»8OÒ¦.../õi-5..
0x14FBB0C0	30 3A 34 30 3A 36 3A 34 34 35 36 00 00 08 3A 00	0:40:6:4456...:.
0x14FBB0D0	00 00 4B 40 42 4C E3 0C AA 32 6E C0 5E 78 81 DC	..K@BLã.ª2nÀ^x.Ü
0x14FBB0E0	0D B2 70 00 00 01 2F FA AF EE F0 00 0E 30 3A 34	.²p.../ú¯îð...0:4
0x14FBB0F0	31 38 33 3A 38 37 3A 34 39 32 38 00 00 06 C2 00	183:87:4928...Â.
0x14FBB100	00 00 4B 40 42 4B DC 8B 86 B1 60 C0 5E 78 FA 82	..K@BKÜ.†±`À^xú.
0x14FBB110	E8 7D 2C 00 00 01 30 06 53 AA 01 00 0E 30 3A 34	è},....0.Sª...0:4
0x14FBB120	31 38 33 3A 38 37 3A 34 36 37 32 00 00 06 89 00	183:87:4672...‰.
0x14FBB130	00 00 4B 40 42 4C 73 DE 1E 2D E8 C0 5E 78 9B 8C	..K@BLsÞ.-èÀ^x.Œ
0x14FBB140	B8 E0 87 00 00 01 30 09 BB CC AE 00 0D 33 31 30	¸à‡...0.»Ì®..310
0x14FBB150	3A 30 3A 38 37 3A 34 36 37 32 FF FF FF FF 00 00	:0:87:4672ÿÿÿÿ..

IP and MAC

User Data Partition – Nexus One

Count	IP Address
80	3.0.0.5
8	193.113.200.195
8	192.168.192.192
8	192.168.77.1
4	1.8.8.1
4	1.4.0.1
3	192.168.251.150
3	200.142.130.104
3	2.6.32.9
3	139.7.24.1
2	213.158.194.226
2	210.241.199.199
2	194.182.251.158
2	212.53.51.143
2	200.192.230.142
2	149.254.201.135

.

.

Count	MAC Address	Pre	Post
1479	00:26:08:BC:D4:14	0x01	0x00
18	00:26:08:BC:D4:14	0xff	0x20
15	00:26:08:BC:D4:14	0x0a	0x23
12	90:21:55:2C:4D:67	0xff	0x00
11	00:26:08:BC:D4:14	0x5f	0x31
1	**c0:c1:c0:40:cd:ac**	**0x11**	**0xff**
1	**00:11:95:39:13:d1**	**0x11**	**0xff**

- cache.wifi

SSIDs

- Associated to a wireless access point
  - wpa_supplicant.conf
    - 3 Instances
    - 1 currently allocated

```
0x3A23FFF FF 63 74 72 6C 5F 69 6E 74 65 72 66 61 63 65 3D 65 74 68 ▯ctrl_interface=eth
0x3A24012 30 0A 75 70 64 61 74 65 5F 63 6F 6E 66 69 67 3D 31 0A 0A 0 update_config=1
0x3A24025 6E 65 74 77 6F 72 6B 3D 7B 0A 09 73 73 69 64 3D 22 4E 50 network={  ssid="NP
0x3A24038 53 22 0A 09 6B 65 79 5F 6D 67 6D 74 3D 4E 4F 4E 45 0A 09 S"  key_mgmt=NONE
0x3A2404B 70 72 69 6F 72 69 74 79 3D 33 0A 7D 0A 0A 6E 65 74 77 6F priority=3 }  netwo
0x3A2405E 72 6B 3D 7B 0A 09 73 73 69 64 3D 22 41 6E 64 72 6F 69 64 rk={  ssid="Android
0x3A24071 46 6F 72 65 6E 73 69 63 73 22 0A 09 70 73 6B 3D 22 6E 70 Forensics"  psk="np
0x3A24084 73 70 61 73 73 77 6F 72 64 22 0A 09 6B 65 79 5F 6D 67 6D spassword"  key_mgm
0x3A24097 74 3D 57 50 41 2D 50 53 4B 0A 09 70 72 69 6F 72 69 74 79 t=WPA-PSK  priority
0x3A240AA 3D 32 0A 7D 0A 00 00 00 00 00 00 00 00 00 00 00 00 00 00 =2 } ..............
```

IMSI

User Data Partition – Nexus One

- CheckInService.xml
  - 1 Currently Allocated
- Current IMSI

- 29 - 915050000000122
- 01 - 915050000000122

Bluetooth Data

User Data Partition – Nexus One

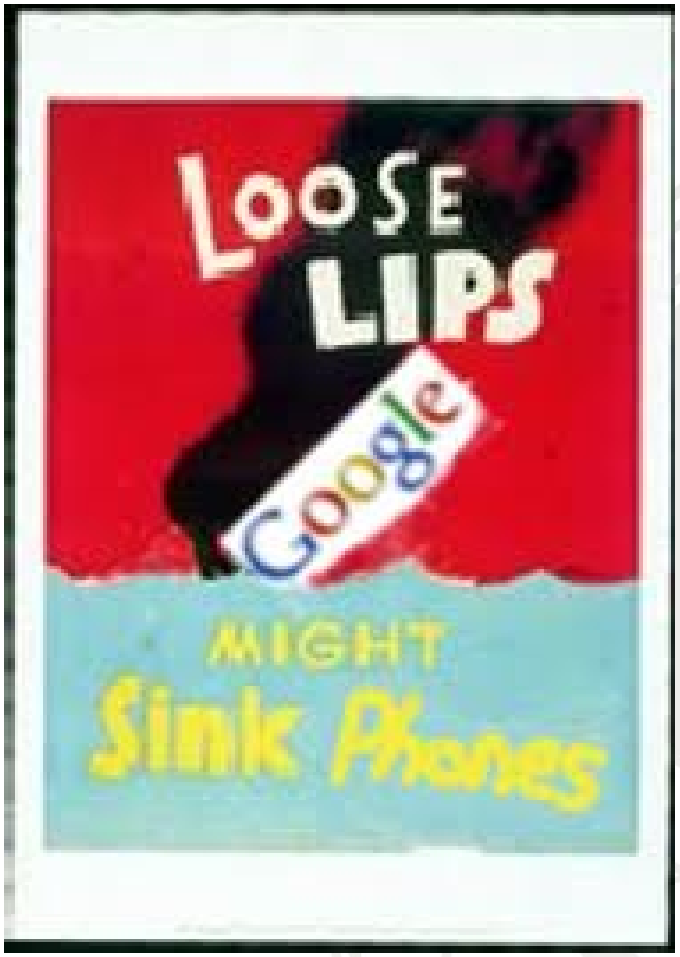
- Btopp.db
- Settings.db

- 1479 - 00:26:08:BC:D4:14 0x01 0x00
- 18 - 00:26:08:BC:D4:14 0xff 0x20
- 15 - 00:26:08:BC:D4:14 0x0a 0x23
- 11 - 00:26:08:BC:D4:14 0x5f 0x31

Future Work

- MAC Address Database
- YAFFS Forensic Tools
- Mobile RAM Capture

Questions ?????????????



Source: precentral.net