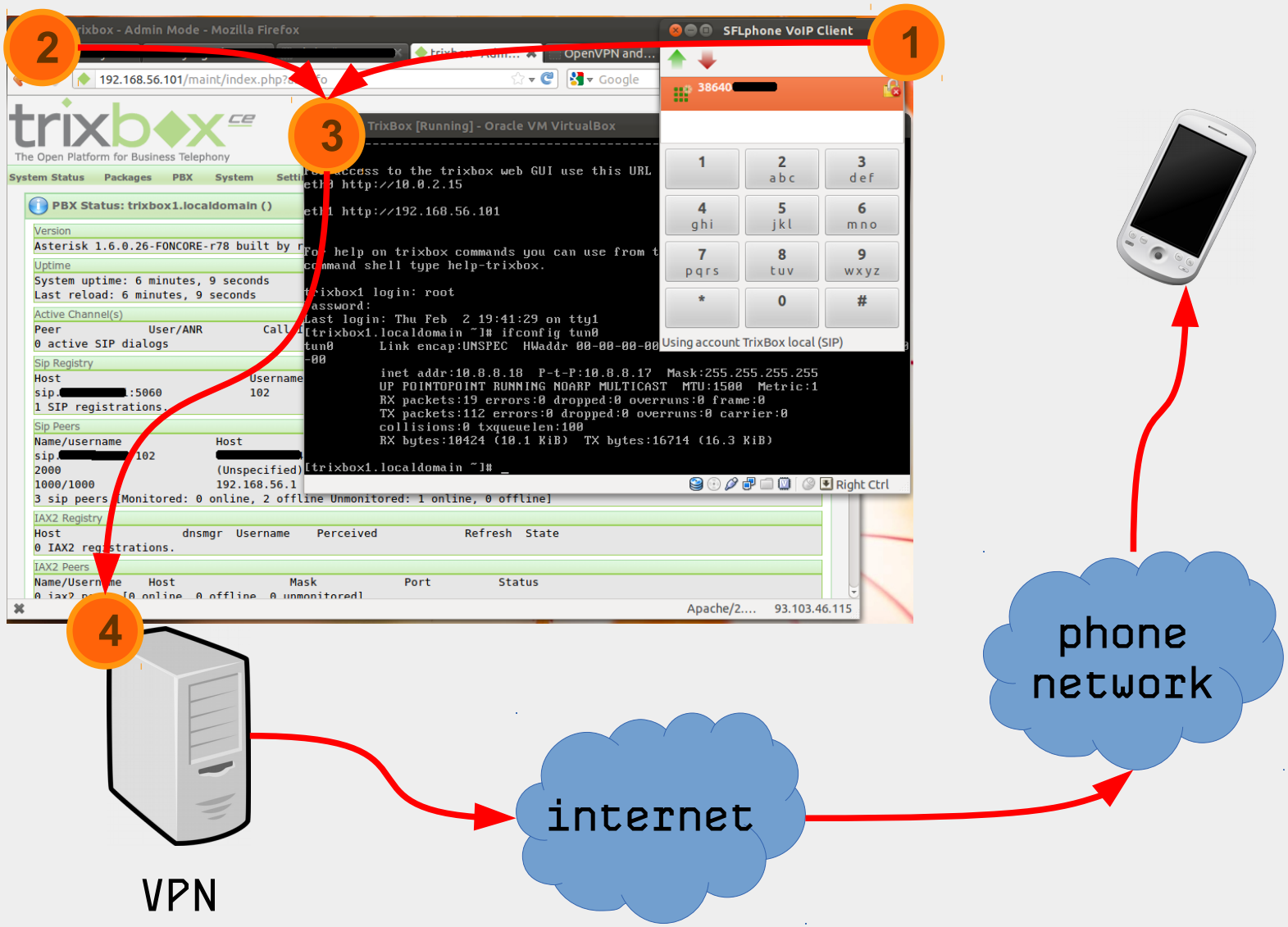
Mobile communications security

Matej Kovačič, (CC) 2017

Jozef Stefan Institute

Part I:
Identity spoofing

CallerID spoofing



CallerID spoofing

CallerID spoofing

	25.02.2012	11:11:02	1 E	0	SVNSM-Si.mobil	SMS_poslan / 38631595xxx	Out
	25.02.2012	11:57:43	0:01:00	0	SVNSM-Si.mobil	[illegible]	In
	25.02.2012	13:07:13	0:00:41	0	SVNSM-Si.mobil	[illegible]	In
	25.02.2012	15:39:09	0:02:05	0	SVNSM-Si.mobil	[illegible]	In
	25.02.2012	16:37:28	0:00:50	0	SVNSM-Si.mobil	[illegible]	In
	25.02.2012	23:41:22	0:00:04	0	SVNSM-Si.mobil	38640222xxx	In
	25.02.2012	23:43:21	0:00:02	0	SVNSM-Si.mobil	38640444xxx	In
	25.02.2012	23:45:04	0:00:02	0	SVNSM-Si.mobil	38640666xxx	In
	25.02.2012	23:46:37	0:00:02	0	SVNSM-Si.mobil	38640888xxx	In
	27.02.2012	9:51:56	1 E	0	SVNSM-Si.mobil	[illegible]	Out
	27.02.2012	9:53:05	1 E	0	SVNSM-Si.mobil	[illegible]	In
	27.02.2012	12:02:08	0:02:44	0	SVNSM-Si.mobil	[illegible]	Out
	27.02.2012	12:06:54	0:00:20	0	SVNSM-Si.mobil	[illegible]	Out
	27.02.2012	12:36:34	0:00:42	0	SVNSM-Si.mobil	[illegible]	Out
	27.02.2012	12:46:55	1 E	0	SVNSM-Si.mobil	[illegible]	Out
	27.02.2012	12:49:48	1 E	0	SVNSM-Si.mobil	[illegible]	In

Practical use of spoofing :-)

GSM module to open garage or front door

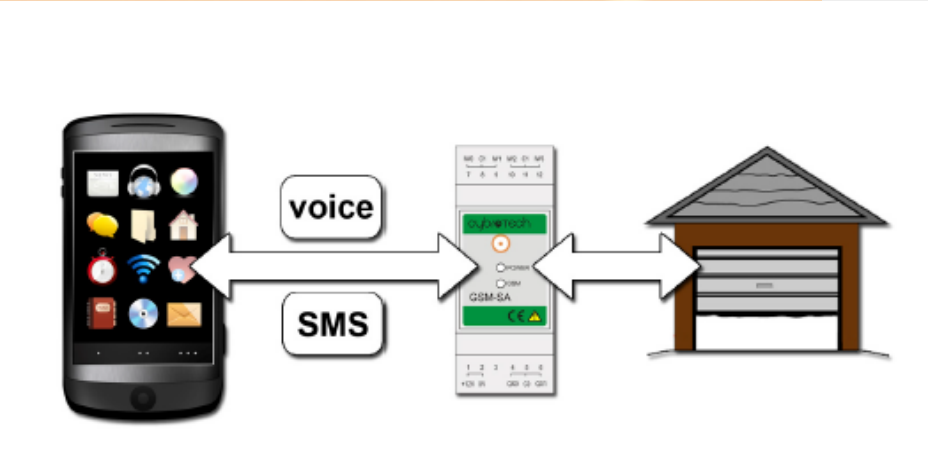
We offer a useful device with a simple phone call opens or closes the automated garage or front door.

GSM module is a device which allows an authorized user to open or close the door. Device recognizes up to five specific phone numbers from which they can call on a GSM module which opens or closes the door.

Iku d.o.o. offers you:

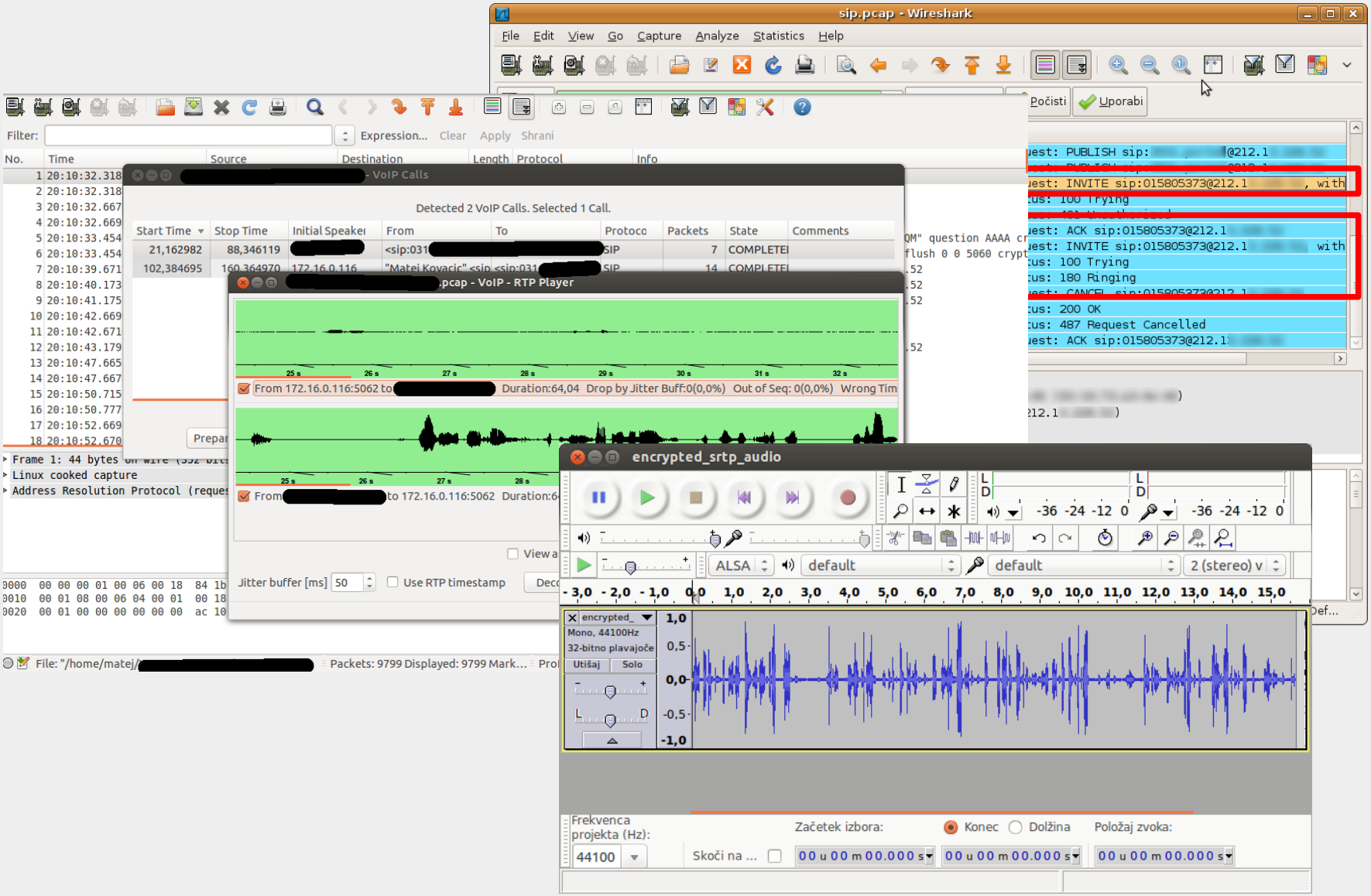
- delivery of a package with instructions for use,
- mounting points agreed upon (please call us and we will send you the offer).

Using the GSM module to open the door:
on automated garage, front door or other GSM module is installed, in which the records are up to five phone (mobile) numbers, which is possible with a quick phone call, in order to door opened or close the door. This method accounts for the use of remote controls or additional equipment and appliances, because we assume that the mobile phone is already



Part II: Intercepting (VoIP) communications

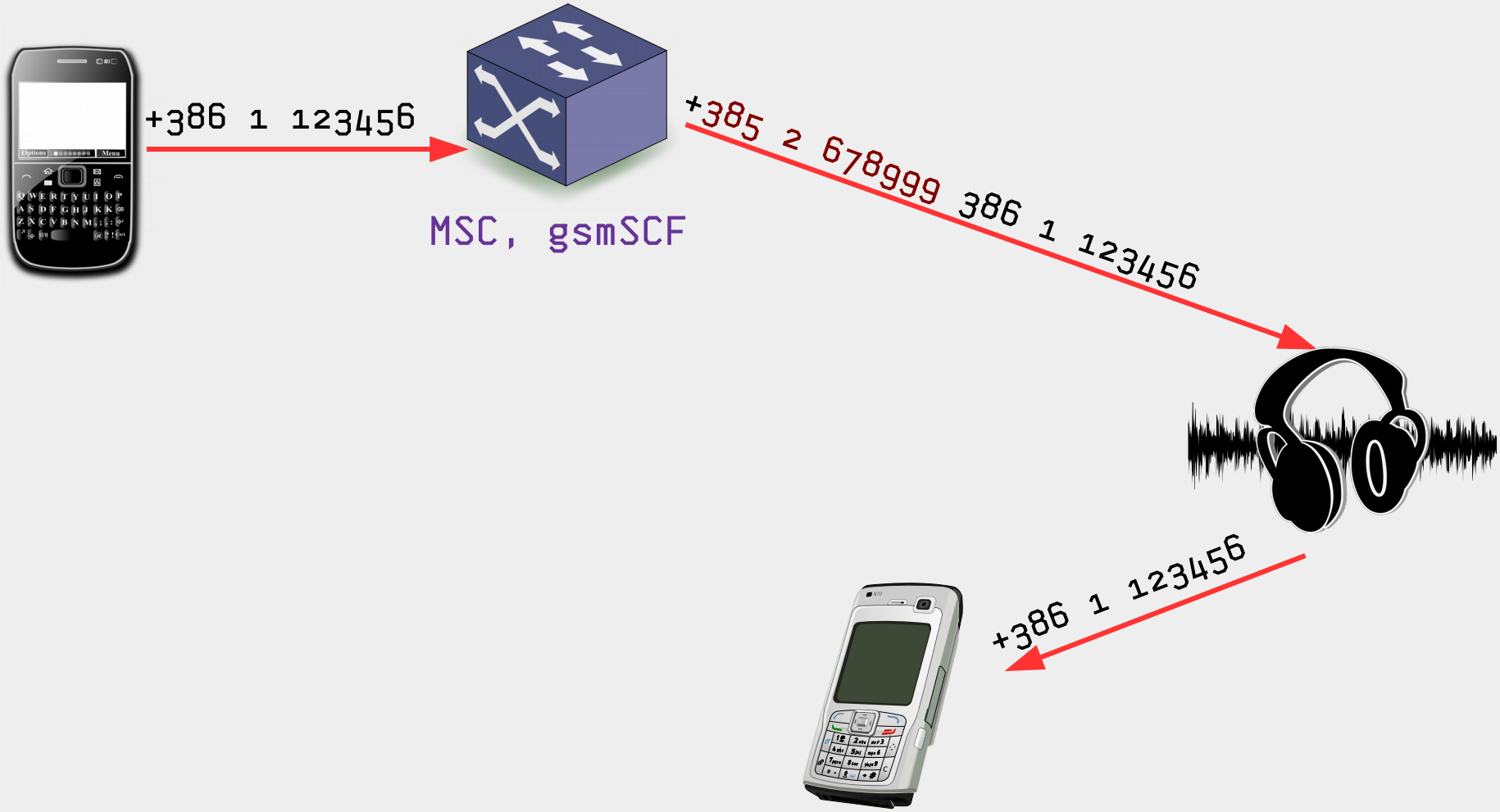
Unencrypted vs. encrypted phone call



Part III:
Rerouting outgoing calls

Example: intercepting outgoing calls

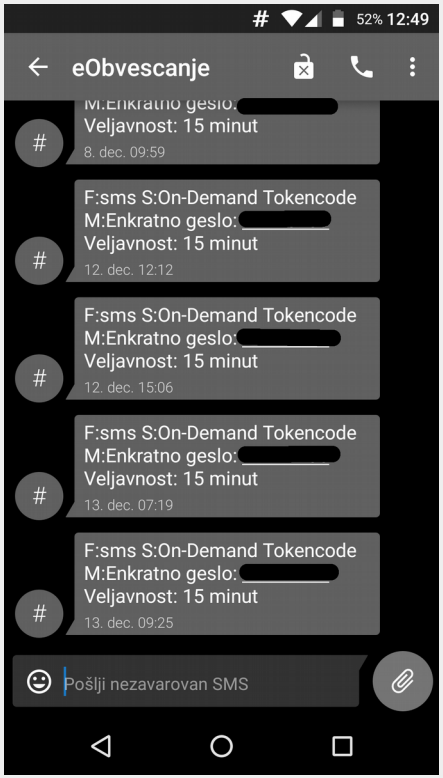
SS7 attacks.



Part IV: Rerouting incoming calls/SMS messages

Example: intercepting incoming calls

An attacker pretends that a subscriber is roaming in his network… From this point on, all calls and SMS messages for that subscriber are routed to the attacker.



Now a victim logs into his bank account, and since he is using two-factor authentication, his bank sends SMS to his number with mTAN access code…

How to obtain SS7 access?

Posing as a potential customer, this reporter registered an email domain—“smsrouter.co”— and, acting as a new text-message routing service, approached a division of a large-scale, legitimate telecommunications provider in Western Europe.

After exchanging emails over a weeklong period (and specifying the fake company would need coverage in Europe), the telco provided a quote: a one-time setup fee of around $2,650, with 50 percent paid upfront and the rest with the first invoice after testing, and then a $6,600 monthly rental fee for a so-called global title (GT)—a designated address for routing messages. The telco also offered to connect The Daily Beast’s imaginary company over a SIGTRAN link.

-- https://www.thedailybeast.com/you-can-spy-like-the-nsa-for-a-few-thousand-bucks

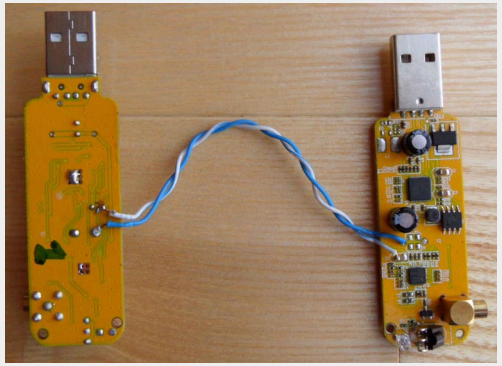
Part V:
GSM Interception

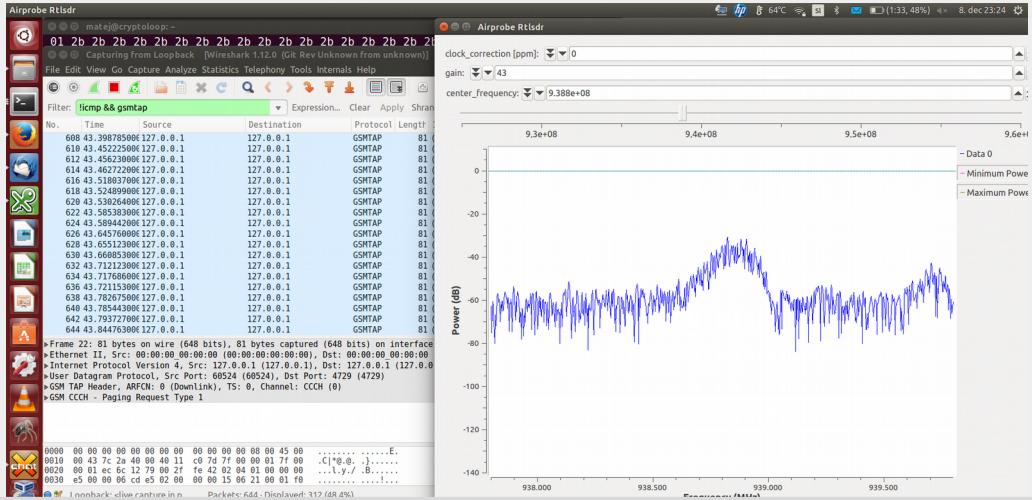
gr-gsm

Toolset for capture and analysis of GSM signals.

```
grgsm_livemon -p 35 -f 938.8M
```

```
wireshark -k -Y '!icmp && gsmtap' -i lo
```





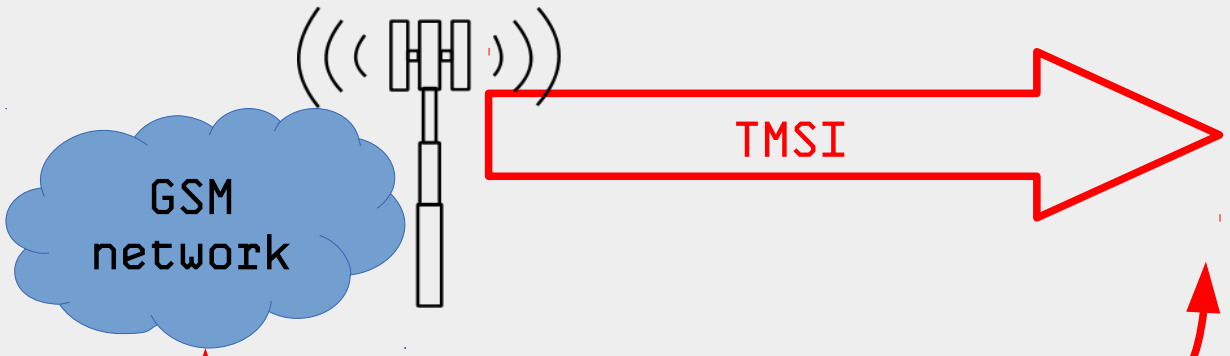

```
grgsm_scanner -p 35
```

```
linux; GNU C++ version 4.9.1; Boost_105500; UHD_003.007.003-0-unknown

ARFCN:   18, Freq:  938.6M, CID:     0, LAC:   100, MCC: 293, MNC:  40, Pwr: -35
ARFCN:   24, Freq:  939.8M, CID:  1313, LAC:   100, MCC: 293, MNC:  40, Pwr: -33
ARFCN:   26, Freq:  940.2M, CID:   501, LAC:   100, MCC: 293, MNC:  40, Pwr: -27
ARFCN:  124, Freq:  959.8M, CID:     0, LAC:     0, MCC:   0, MNC:   0, Pwr: -29
```

Osmocom/gr-gsm

Typical (passive) attack setup...

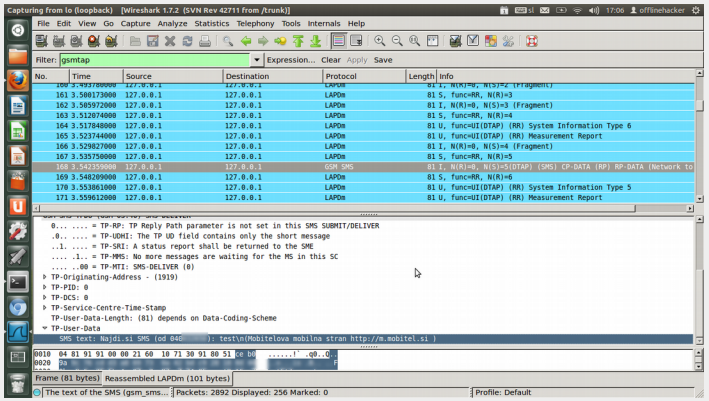


Mobile phone user does not detect reception of silent SMS.

silent
SMS

Osmocom

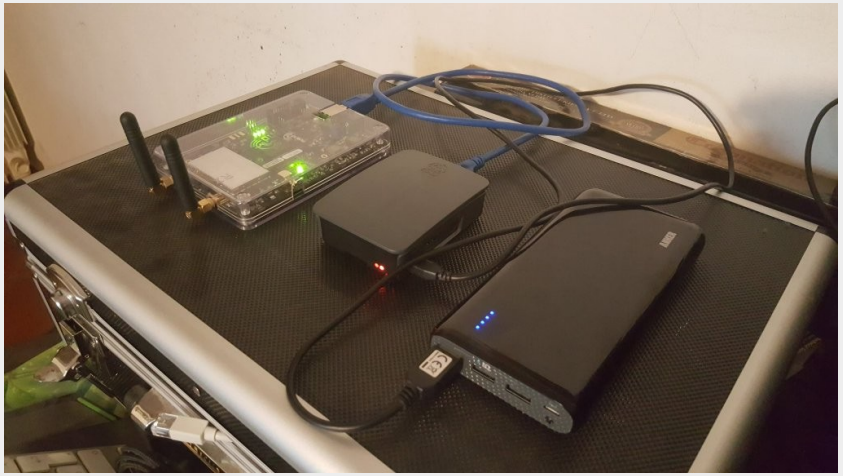
Attacker is intercepting wireless communications and performs cryptanalysis...

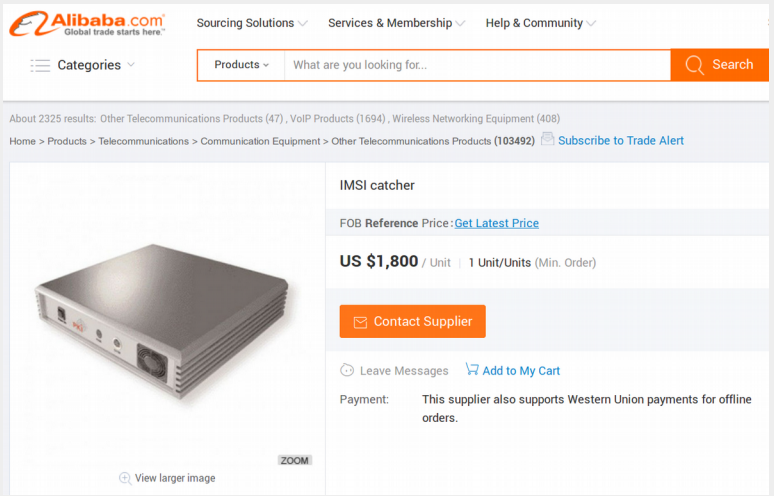


Part VI:
IMSI Catchers

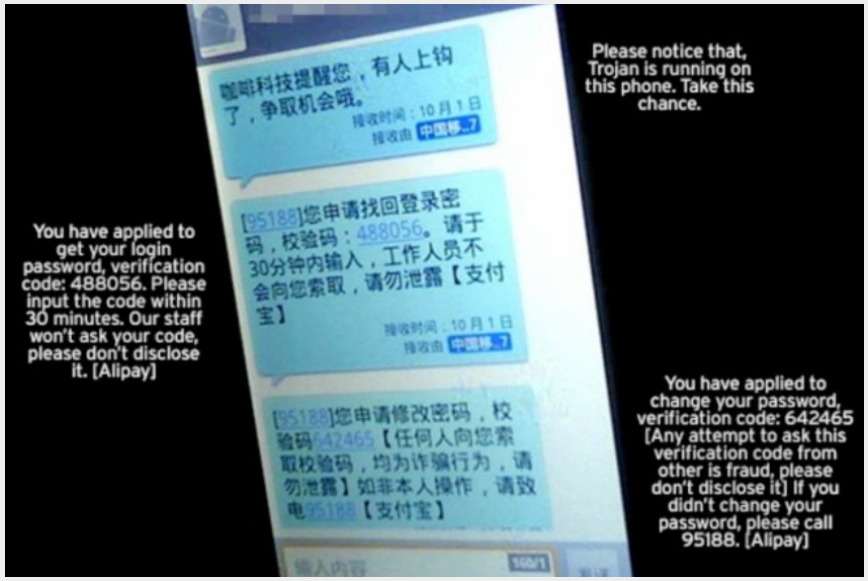
IMSI Catchers

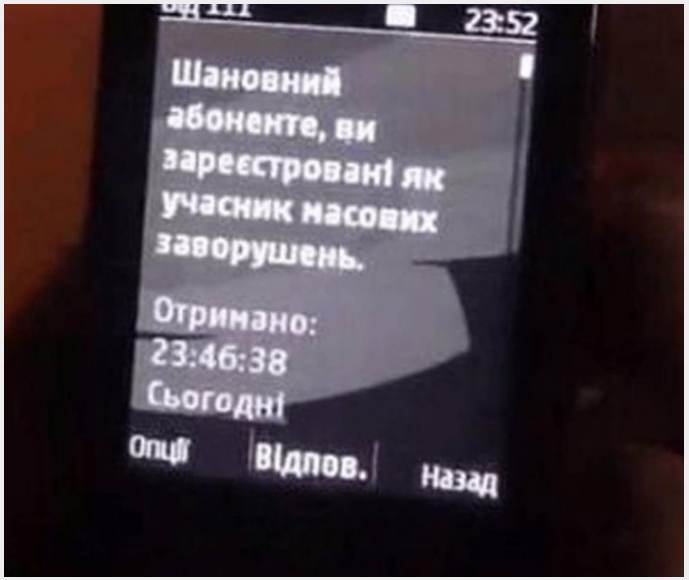
Basically, they are fake base stations...

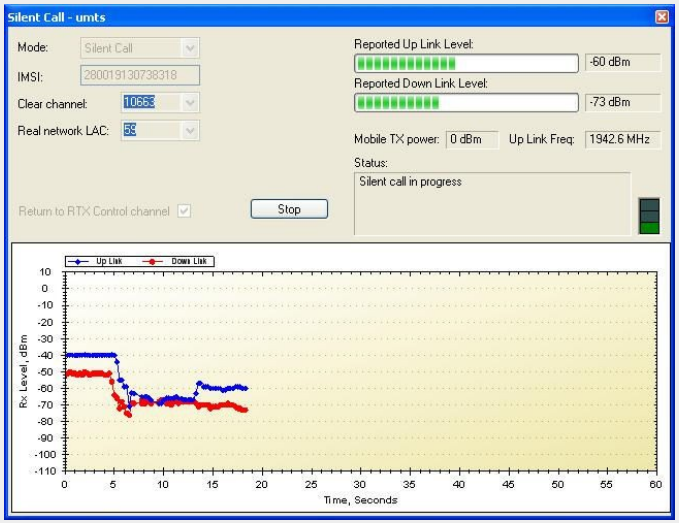




IMSI Catchers







UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

- X

IN THE MATTER OF AN APPLICATION OF :
THE UNITED STATES OF AMERICA FOR
AUTHORIZATION TO CONTINUE TO :
INTERCEPT ORAL COMMUNICATIONS
OCCURRING AT (i) THE SEATING AREA :
INSIDE BRUNELLO TRATTORIA, 227 EAST
MAIN STREET, NEW ROCHELLE, NEW YORK :
10801; (ii) THE SEATING AREA INSIDE
MARIO'S RESTAURANT, 2342 ARTHUR :
AVENUE, BRONX, NEW YORK 10458;
(iii) THE SEATING AREA INSIDE :
AGOSTINO'S RESTAURANT, 969 BOSTON
POST ROAD, NEW ROCHELLE, NEW YORK :
10801; AND (iv) THE SEATING AREA
INSIDE THE MARINA RESTAURANT, WRIGHT :
ISLAND MARINA, 280 DRAKE AVENUE, NEW

APPLICATION FOR AN
ORDER AUTHORIZING THE
INTERCEPTION OF ORAL
COMMUNICATIONS

IMSI Catcher (*when it is caught :-)*)

[redacted]

e212.imsi Expression... +

No.	Time	Source	Destination	Protocol	Length	Info
24…	56.627398…	127.0.0.1	127.0.0.1	GSMTAP	81	(CCCH) (RR) Paging Request Type 1
34…	81.125671…	127.0.0.1	127.0.0.1	GSMTAP	81	(CCCH) (RR) Paging Request Type 1

```
▸ User Datagram Protocol, Src Port: 57272, Dst Port: 4729
▸ GSM TAP Header, ARFCN: 0 (Downlink), TS: 0, Channel: CCCH (5)
▾ GSM CCCH - Paging Request Type 1
  ▸ L2 Pseudo Length
  ▸ .... 0110 = Protocol discriminator: Radio Resources Management messages (0x6)
    Message Type: Paging Request Type 1
  ▸ Page Mode
  ▸ Channel Needed
  ▾ Mobile Identity - Mobile Identity 1 - IMSI ([redacted])
      Length: 8
      0010 .... = Identity Digit 1: 2
      .... 1... = Odd/even indication: Odd number of identity digits
      .... .001 = Mobile Identity Type: IMSI (1)
    ▾ IMSI: [redacted]
        Mobile Country Code (MCC): Slovenia (293)
        Mobile Network Code (MNC): SI Mobil (40)
  ▸ P1 Rest Octets
```

```
0010  00 43 70 31 40 00 40 11  cc 76 7f 00 00 01 7f 00   .Cp1@.@. .v......
0020  [redacted]                                          [redacted]..
0030  [redacted]                                          [redacted]
0040  [redacted] 2b 2b                                    [redacted]++++
0050  2b                                                  +
```

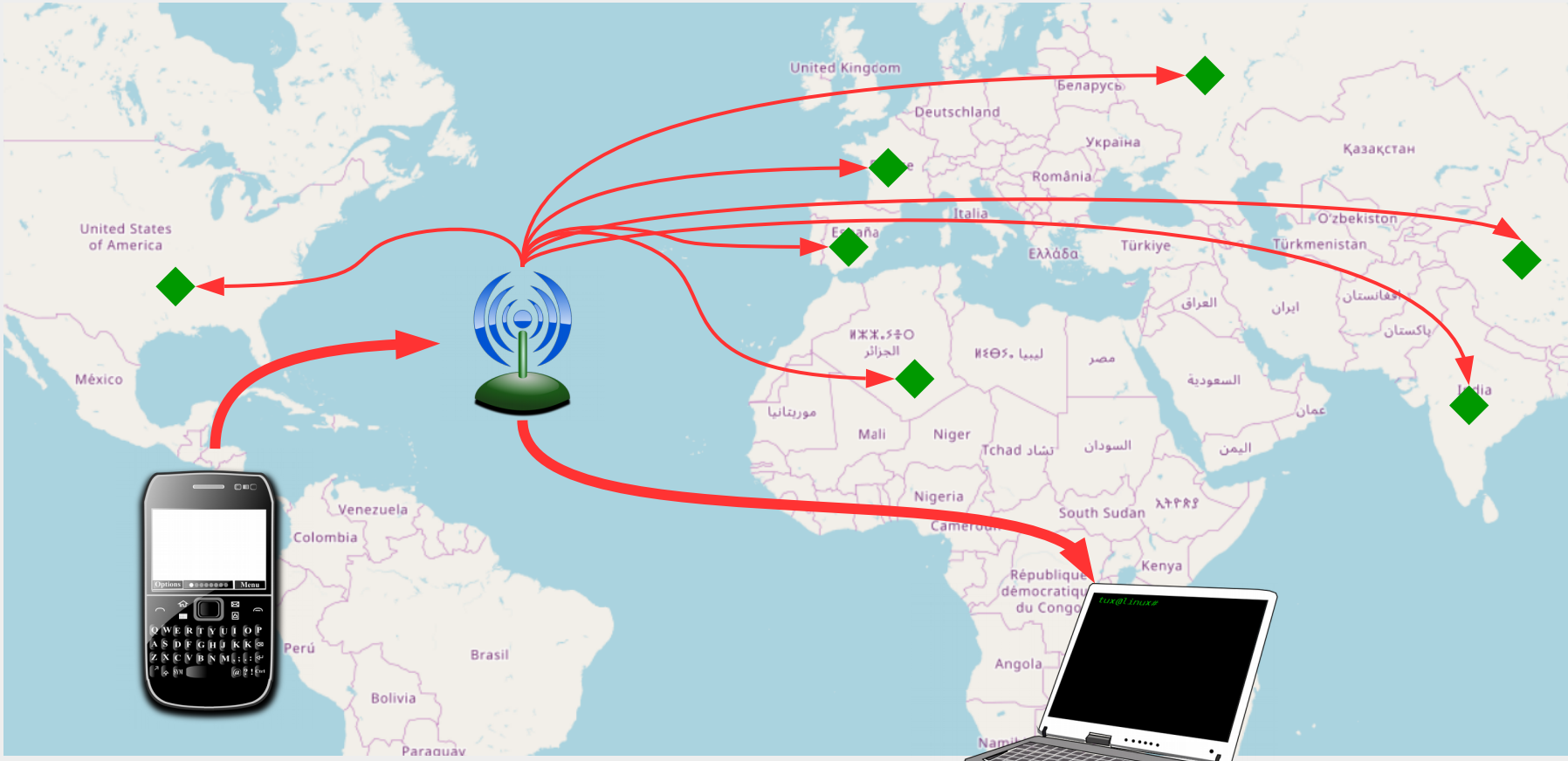
International mobile subscriber identity(IMSI) (e212.imsi), 8 bytes Packets: 4196 · Displayed: 2 (0.0%) · Load time: 0:0.83 Profile: Default

Part VII:
Mobile Phone Infection

(via “classical” malware or via baseband attack)

Real Case (Netflow Analysis)

First we intercept mobile phone network connections and collect IP network traffic.



Then we analyse netflow data.

Real Case (Netflow Analysis)

CapAnalysis — Welcome Guest : Manual - Status

Data Sets | telefon

Flows [2] | Overview | Statistcs | Per Hour | GeoMAP | IPs Source [1] | IPs Destination [1] | Protocols | Timeline

Date	Time	Source IP	Destination IP	Destination Name	Source Port	Destination Port	L4	Protocol	Country
2017-[redacted]	10:25:10	192.168.160.251	[redacted]		50280	443	TCP	SSL	[redacted]
2017-[redacted]	10:25:09	192.168.160.251	[redacted]		50277	443	TCP	SSL	[redacted]

Wireshark · Packet 201114 [redacted] 2017

```
▾ TLSv1.2 Record Layer: Handshake Protocol: Certificate
    Content Type: Handshake (22)
    Version: TLS 1.2 (0x0303)
    Length: 2805
  ▾ Handshake Protocol: Certificate
      Handshake Type: Certificate (11)
      Length: 2801
      Certificates Length: 2798
    ▾ Certificates (2798 bytes)
        Certificate Length: 1685
      ▾ Certificate: 30[redacted]... (id-at-
        ▾ signedCertificate
            version: v3 (2)
            serialNumber: 0x[redacted]
          ▾ signature (sha256WithRSAEncryption)
              Algorithm Id: 1.2.840.113549.1.1.11 (sha256WithRSAEncryption)
          ▾ issuer: rdnSequence (0)
            ▾ rdnSequence: 3 items (id-at-commonName=[redacted]
              ▸ RDNSequence item: 1 item (id-at-countryName=[redacted])
              ▸ RDNSequence item: 1 item (id-at-organizationName[redacted]
              ▸ RDNSequence item: 1 item (id-at-commonName=[redacted]
          ▸ validity
          ▸ subject: rdnSequence (0)
          ▸ subjectPublicKeyInfo
          ▾ extensions: 9 items
            ▾ Extension (id-ce-subjectAltName)
                Extension Id: 2.5.29.17 (id-ce-subjectAltName)
              ▾ GeneralNames: 6 items
                ▾ GeneralName: dNSName (2)
                    dNSName: [redacted]
                ▾ GeneralName: dNSName (2)
                    dNSName: [redacted]
                ▾ GeneralName: dNSName (2)
                    dNSName: [redacted]
                ▾ GeneralName: dNSName (2)
                    dNSName: [redacted]
                ▾ GeneralName: dNSName (2)
                    dNSName: [redacted]
                ▾ GeneralName: dNSName (2)
                    dNSName: [redacted]
            ▸ Extension (id-ce-basicConstraints)
            ▸ Extension (id-ce-keyUsage)
```

No.: 201114 · Time: 1552.980957 · Source: 217.20.156.148 · Destination: 192.168.160.251 · Protocol: TLSv1.2 · Length: 1282 · Info: Certificate

Help

```
USER     PID   PPID  VSIZE  RSS   WCHAN          PC  NAME
root     1     0     23296  972   SyS_epoll_ 0000000000 S /init
root     2     0     0      0       kthreadd 0000000000 S kthreadd
root     3     2     0      0     smpboot_th 0000000000 S ksoftirqd/0
root     7     2     0      0     rcu_gp_kth 0000000000 S rcu_preempt
root     8     2     0      0     rcu_gp_kth 0000000000 S rcu_sched
root     9     2     0      0     rcu_gp_kth 0000000000 S rcu_bh
root     10    2     0      0     smpboot_th 0000000000 S migration/0
root     11    2     0      0     smpboot_th 0000000000 S watchdog/0
root     12    2     0      0     smpboot_th 0000000000 S watchdog/1
root     13    2     0      0     smpboot_th 0000000000 S migration/1
root     14    2     0      0     smpboot_th 0000000000 S ksoftirqd/1
root     17    2     0      0     smpboot_th 0000000000 S watchdog/2
root     18    2     0      0     smpboot_th 0000000000 S migration/2
root     19    2     0      0     smpboot_th 0000000000 S ksoftirqd/2
root     22    2     0      0     smpboot_th 0000000000 S watchdog/3
root     23    2     0      0     smpboot_th 0000000000 S migration/3
root     24    2     0      0     smpboot_th 0000000000 S ksoftirqd/3
root     27    2     0      0     smpboot_th 0000000000 S watchdog/4
root     28    2     0      0     smpboot_th 0000000000 S migration/4
root     29    2     0      0     smpboot_th 0000000000 S ksoftirqd/4
root     32    2     0      0     smpboot_th 0000000000 S watchdog/5
root     33    2     0      0     smpboot_th 0000000000 S migration/5
root     34    2     0      0     smpboot_th 0000000000 S ksoftirqd/5
```

Questions?

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https://telefoncek.si