

BUSINESS LOGIC FLAWS IN MOBILE OPERATORS SERVICES

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ABOUT ME

- Independent security researcher
- Sysadmin
- Passionate about security, specially when it's related to mobile devices; started with NetMonitor (thanks Cosconor), continued with VoIP and finally GSM networks / mobile phones

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GOALS

- SIM Toolkit: what is it, how can we exploit it
- Understanding of business logic flaws in mobile operators services
- What you should do in order to protect from these attacks

TOPICS

1. SIM TOOLKIT
2. HTTP HEADERS
3. DATA TRAFFIC VULNERABILITY
4. THE EXTRA DIGIT
5. SUMMARY

THE BUGGY WORLD

1 SIM TOOLKIT

THE BUGGY WORLD



Play Music



Play Store



Polkast



Romania
Android



Settings



Shazam



SIM Toolkit



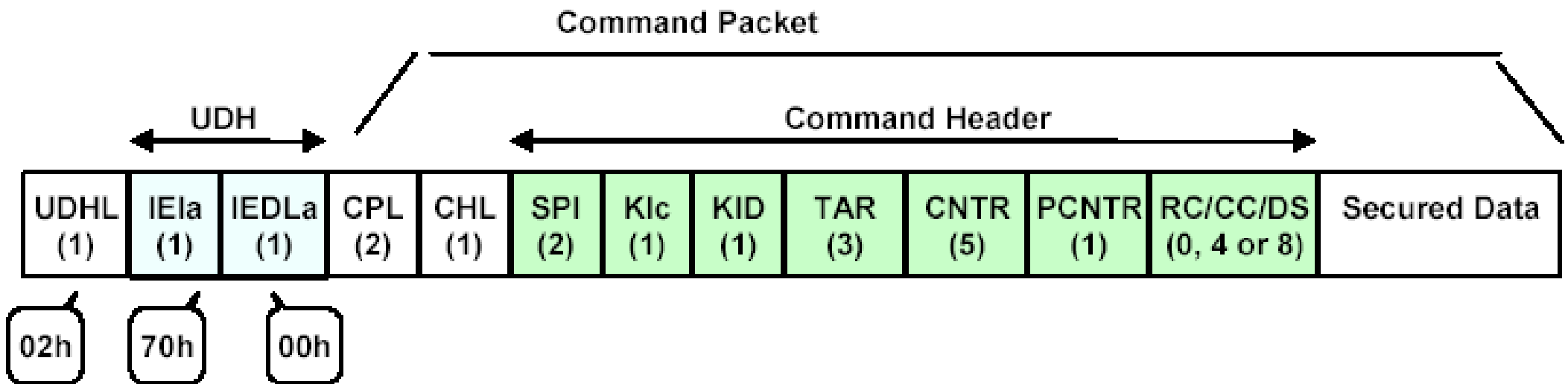
Skype

Example of SIM Toolkit icon on your mobile device

THE BUGGY WORLD

For sending Ringtones, operator logo, concatenated messages, SMS makes use of the User Data Header

THE BUGGY WORLD



ETSI TS 101 181 V8.9.0

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The type of message sent is addressed directly to the SIM, by setting the PID to 0x7F, corresponding to USIM Data Download and by setting DCS to F6

THE BUGGY WORLD

“

... then the ME shall pass the message transparently to the SIM

... shall not display the message, or alert the user of a short message waiting

ETSI GSM 11.14

”

THE BUGGY WORLD

Second Byte:

Security Parameter Indicator



00: No PoR reply to the Sending Entity (SE)
 01: PoR required to be sent to the SE
 10: PoR required only when an error has occurred
 11: Reserved

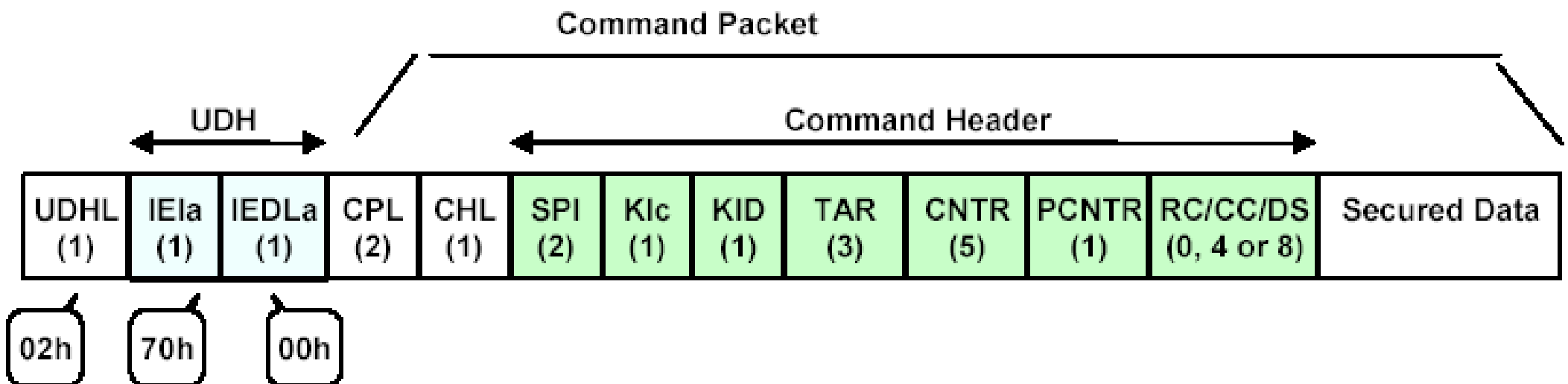
00: No RC/CC/DS applied to PoR response to SE
 01: PoR response with simple RC applied
 10: PoR response with CC applied
 11: PoR response with DS applied

0: PoR response not to be encrypted
 1: PoR response to be encrypted

(For SMS only
 0: PoR response to be sent using SMS-DELIVER-REPORT
 1: PoR response to be sent using SMS-SUBMIT)

Reserved (set to zero and ignored by the RE)

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THE BUGGY WORLD

UDH (User Data Header): 027000

PID (Protocol ID): 7F

DCS (Data Coding Scheme): F6

000e0d00210000b20000aabbccdde00

CPL

CHL

SPI

SPI

KIc

KID

TAR

CNTR

00100001

THE BUGGY WORLD

```
263 12.553036 127.0.0.1 127.0.0.1 GSMTAP 75 GSM TERMINAL RESPONSE SEND SHORT MESSAGE : 0100
▶ Frame 263: 75 bytes on wire (600 bits), 75 bytes captured (600 bits)
▶ Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00)
▶ Internet Protocol Version 4, Src: 127.0.0.1 (127.0.0.1), Dst: 127.0.0.1 (127.0.0.1)
▶ User Datagram Protocol, Src Port: 55844 (55844), Dst Port: gsmtap (4729)
▶ GSM TAP Header, ARFCN: 0 (Downlink), TS: 0, Channel: UNKNOWN (0)
▼ GSM SIM 11.11
  Class: GSM (0xa0)
  Instruction: TERMINAL RESPONSE (0x14)
▼ Card Application Toolkit ETSI TS 102.223
  ▼ Command details: 011300
    Command Number: 0x01
    Command Type: SEND SHORT MESSAGE (0x13)
    Command Qualifier: 0x00
  ▼ Device identity: 8281
    Source Device ID: Terminal (Card Reader) (0x82)
    Destination Device ID: SIM / USIM / UICC (0x81)
  ▼ Result: 00
    Result: Command performed successfully (0x00)
  Status Word: 0100
```


THE BUGGY WORLD

- SIM card automatically replies to the sending number
- Nothing in Inbox, Outbox – only on your bill

THE BUGGY WORLD

LET'S SEE IT IN ACTION!

THE BUGGY WORLD

2 HTTP HEADERS

THE BUGGY WORLD

Mobile operators have their own WAP / WEB page for customers:

- Balance check
- Money transfer
- Download music, videos, wallpapers
- Subscribe to services (eg. custom ringback tones)

THE BUGGY WORLD

Are you connecting over Wi-Fi?



You need to be connected to Three's mobile network to access Planet 3. You may need to disconnect your Wi-Fi and reconnect it to the Three network to do this.

Usually, you can go to your phone's settings menu to switch off Wi-Fi.

If you're on the Three network and you're having trouble getting online, go to your internet browser's settings menu, click "clear cache" and try again.

Are you connecting over another mobile operator's network?

You won't be able to access Planet 3 from another mobile operator's network. Order a free Pay As You Go SIM to get on to the Three mobile internet network.

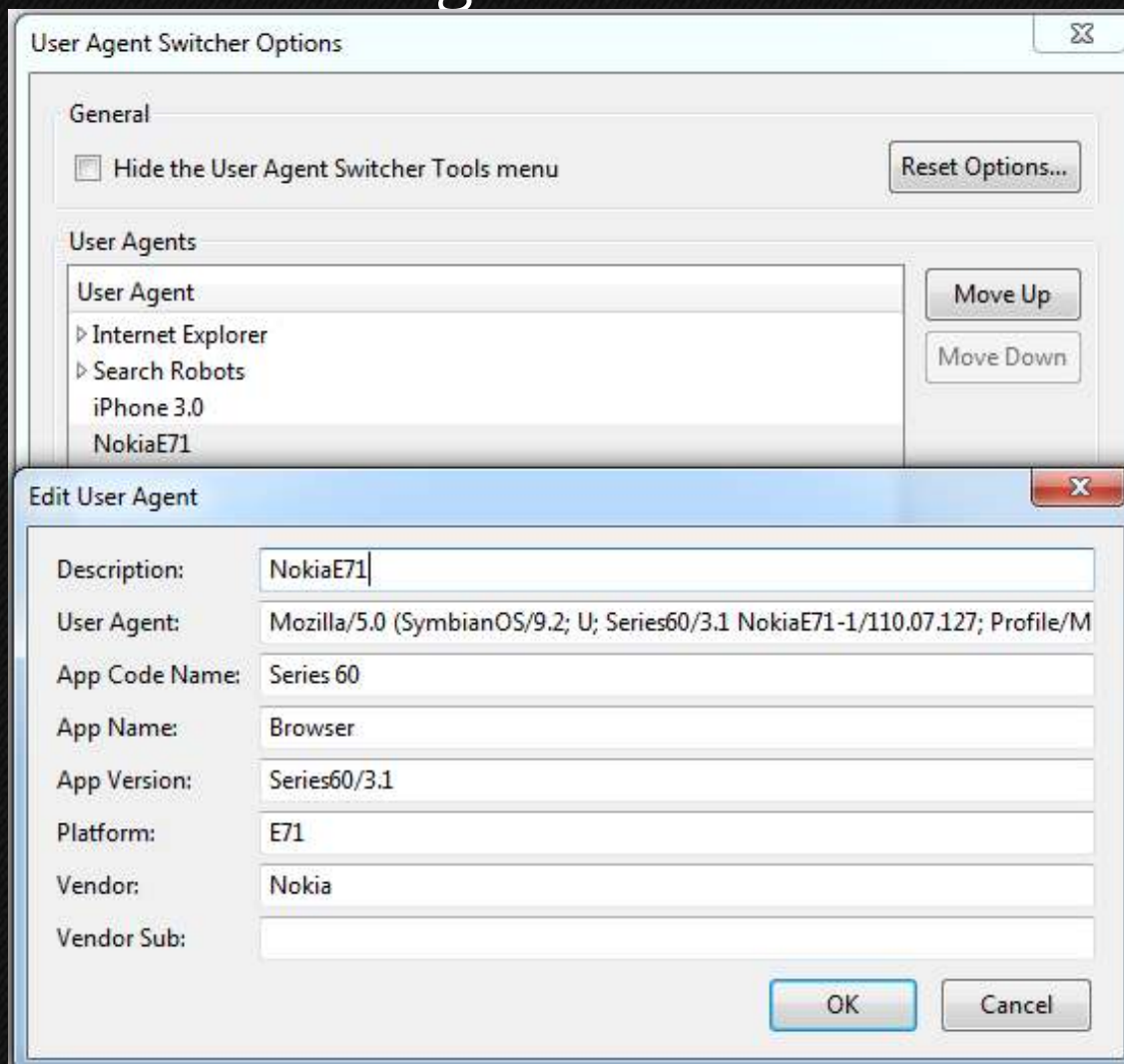
> [Order a free SIM.](#)

[Three.co.uk mobile site.](#)

[Three.co.uk full site.](#)

THE BUGGY WORLD

User Agent Switcher <https://addons.mozilla.org/en-US/firefox/addon/user-agent-switcher/>



THE BUGGY WORLD

- Operators know who to charge based on HTTP headers
- Sniff the traffic your phone does and look for the headers having mobile number
- “Privacy Leaks in Mobile Phone Internet Access” by Collin Mulliner

REJECTED

THE BUGGY WORLD

The screenshot shows a window titled "Modify Headers" with a toolbar containing icons for Start, Headers, Options, About, and Help. Below the toolbar is a form with fields for "Header name (e.g)", "Header value", and "Descriptive comment", along with "Add" and "Reset" buttons. A table lists several headers, all with the value "451234567890" and a green dot indicating they are enabled. To the right of the table are buttons for "Edit", "Delete", "Move to Top", "Move to Bottom", "Enable/Disable", "Enable All", and "Disable All". A legend at the bottom right shows a green dot for "Enabled" and a red dot for "Disabled". An "OK" button is at the bottom right of the window.

Action	Name	Value	Comment	Enabled
Modify	X-UP-CALLING-LINE-ID	451234567890		●
Modify	X_FH_MSISDN	451234567890		●
Modify	MSISDN	451234567890		●
Modify	X-MSISDN	451234567890		●
Modify	X-NOKIA-MSISDN	451234567890		●
Modify	M	451234567890		●
Modify	X_NETWORK_INFO	451234567890		●

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The old fashioned way of the attack



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CSD (Circuit Switched Data)

- Think about it like dial-up
- Since it involves actually placing a phone call, it is exposed to the same vulnerabilities like a regular call

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DEMO TIME!

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3 Data traffic vulnerability

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- What happens when you reach data limit?
- Have you ever tried to perform a DNS query?

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But what if ...

- you setup a VPN server listening on port 53 UDP (DNS port)
- connect to this server and route all the traffic

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Internet traffic

Works also in Roaming!

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4 The extra digit

THE BUGGY WORLD

Do you have a flat-rate plan with unlimited minutes in the operator's network?

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Do _{not} try this at home!

- Take a ported number that was in your network
- Add two more digits to the end of the number
- Place the call
- You will be charged like calling in your network

THE BUGGY WORLD

Joi 03/01/2013	00:00:52	4	0581	Voce	NECUNOSCU(-)	0.00	National/Intl
Joi 03/01/2013	00:00:43	4	05_P	Voce	150 minutes/SMS to all national destinations(00:01:00)	0.00	National/Intl

Legendă: ((P) Număr portat (transferat) in altă rețea

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If that does not work...

- try with one digit, all the digits
- divert all calls to that number, but add a digit at the end of it

THE BUGGY WORLD

5 Summary

SUMMARY

“Our technology does not allow unauthorized access. Occurrence of errors in billing regarding data traffic or voice is excluded.”



SUMMARY

- Test yourself and report the issues to your carrier
- Check if your carrier allows you to disable access to premium rate services

SUMMARY

- Filter SIM command messages
- Do not rely only on the caller ID
- Always authenticate, do not forget about privacy

THANK YOU

FOR YOUR ATTENTION



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