Hacking Bluetooth enabled mobile phones and beyond – **Full Disclosure**

layerone

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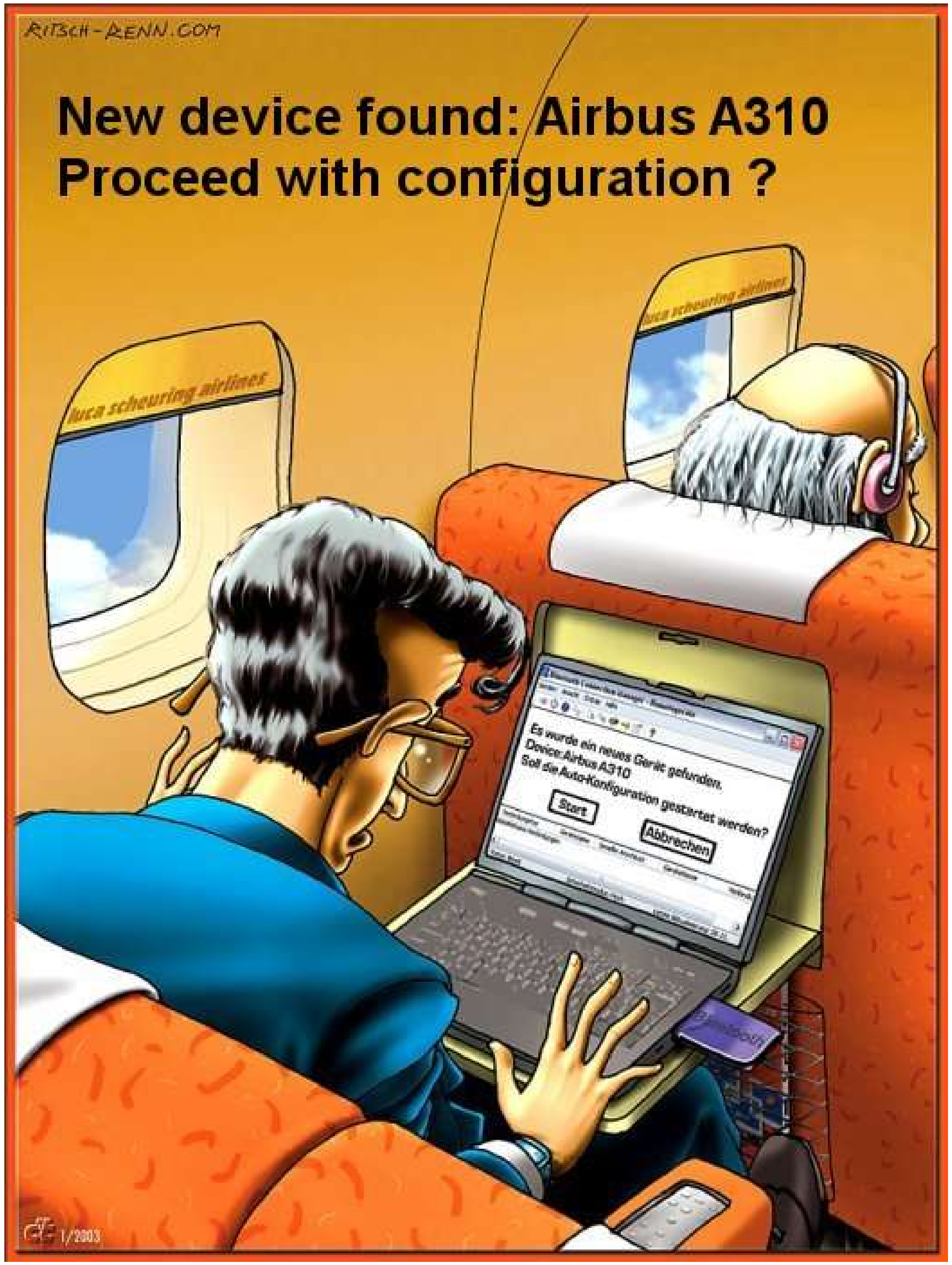
trifinite.org

Who we are

- Adam Laurie
  - CSO of The Bunker Secure Hosting Ltd.
  - Co-Maintainer of Apache-SSL
  - DEFCON Staff/Organiser
- Marcel Holtmann
  - Maintainer and core developer of the Linux Bluetooth Stack BlueZ
- Martin Herfurt
  - Security Researcher & Java Programmer
  - Founder of trifinite.org

Bluetooth Technology Overview

- Bluetooth SIG
  - Trade Association
  - Founded 1998
  - Owns & Licenses IP
  - Individual membership free
  - Promoter members: Agere, Ericsson, IBM, Intel, Microsoft, Motorola, Nokia and Toshiba
  - Consumer http://www.bluetooth.com
  - Technical http://www.bluetooth.org


RITSCH-RENN.COM
New device found: Airbus A310
Proceed with configuration ?
luca scheuring airlines
luca scheuring airlines
Es wurde ein neues Gerät gefunden.
Device:Airbus A310
Soll die Auto-Konfiguration gestartet werden?
Start
Abbrechen
1/2003

Bluetooth Technology

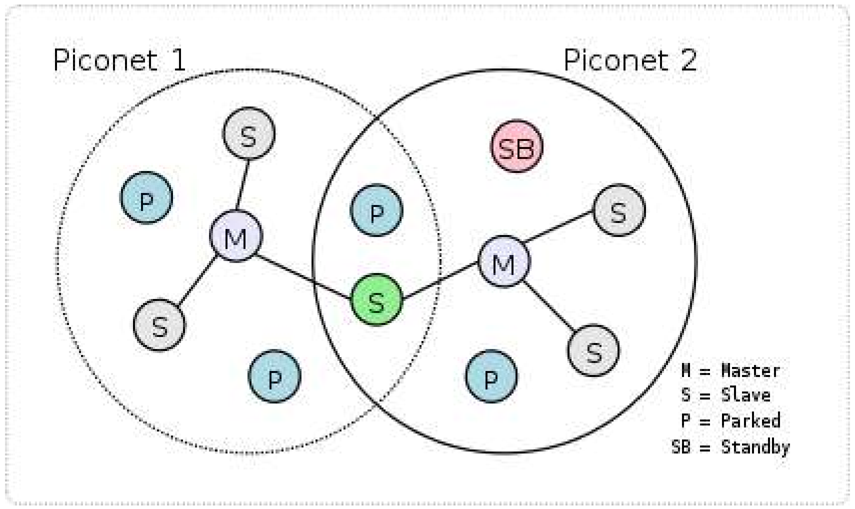
- Data and voice transmission
  - ACL (Asynchronous Connectionless) data connections
  - SCO (Synchronous Connection Oriented) voice channel
    - Fixed rate - 64Kbps
  - eSCO (Extended SCO)
    - Variable data rate & retransmit for Audio / Video etc.
- Frequency hopping
  - ISM band at 2.4 GHz
  - 79 channels
  - 1600 hops per second
  - Multi-Slot packets
    - Up to 5 slots per packet

Bluetooth Piconet

- Bluetooth devices create a piconet
  - One master per piconet
  - Up to seven active slaves
  - Over 200 passive members are possible
  - Master sets the hopping sequence
  - Transfer rates of 721 Kbit/sec
- Bluetooth 1.2 and EDR (aka 2.0)
  - Adaptive Frequency Hopping
  - Faster connection times
  - Transfer rates up to 2.1 Mbit/sec

Bluetooth Scatternet

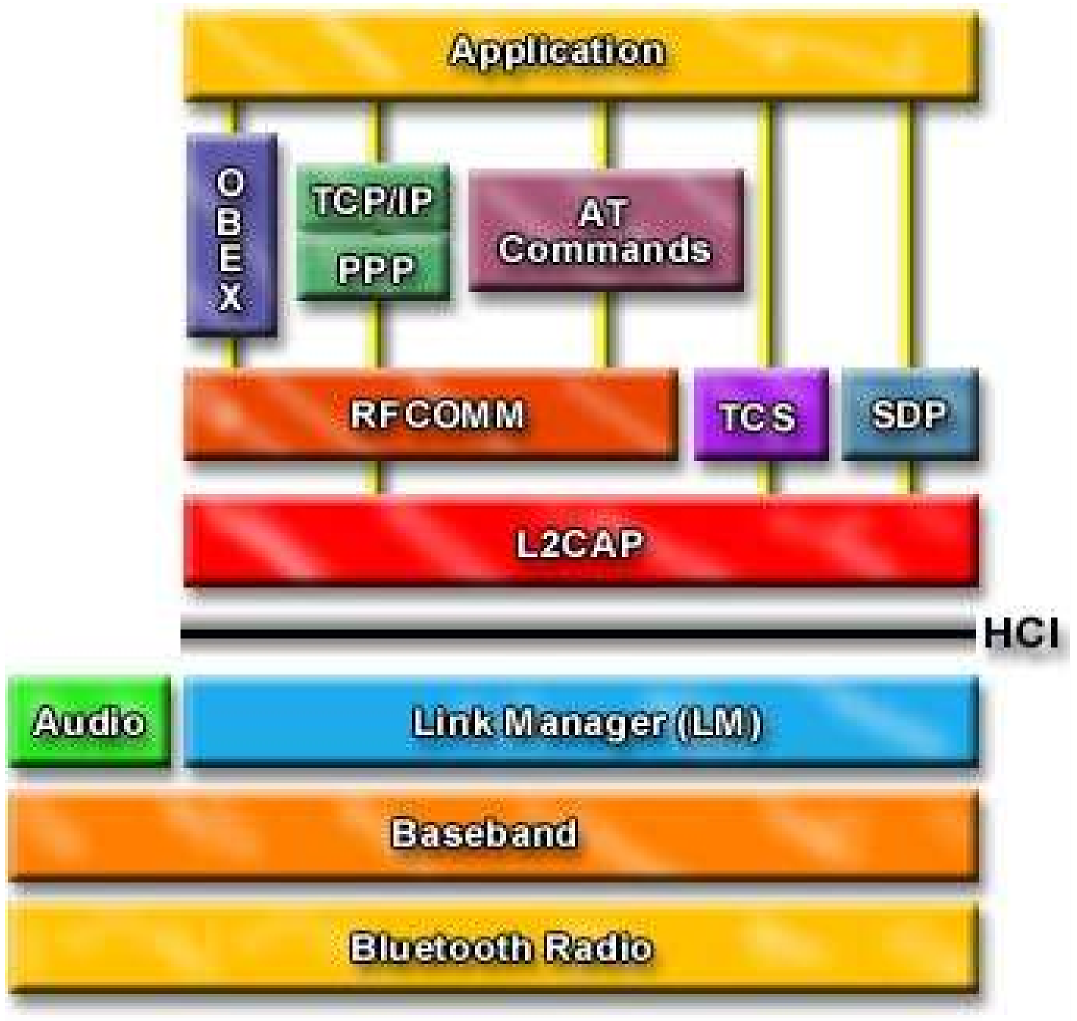
- Connected piconets create a scatternet
  - Master in one and slave in another piconet
  - Slave in two different piconets
  - Only master in one piconet
  - Scatternet support is optional



Bluetooth Architecture

- Hardware layer
    - Radio, Baseband and Link Manager
    - Access through Host Controller Interface
        - Hardware abstraction
        - Standards for USB and UART
- Host protocol stack
    - L2CAP, RFCOMM, BNEP, AVDTP etc.
- Profile implementations
    - Serial Port, Dialup, PAN, HID etc.

Bluetooth Stack



Application specific security mechanisms

Bluetooth host security mechanisms

Security mechanisms on the Bluetooth chip

Bluetooth Security

- Link manager security
  - All security routines are inside the Bluetooth chip
  - Nothing is transmitted in “plain text”
- Host stack security
  - Interface for link manager security routines
  - Part of the HCI specification
  - Easy interface
  - No further encryption of pin codes or keys

Security Mode

- Security mode 1
  - No active security enforcement
- Security mode 2
  - Service level security
  - On device level no difference to mode 1
- Security mode 3
  - Device level security
  - Enforce security for every low-level connection

Linux and Bluetooth

```
# hciconfig -a
hci0:   Type: USB
        BD Address: 00:02:5B:A1:88:52 ACL MTU: 384:8  SCO MTU: 64:8
        UP RUNNING PSCAN ISCAN
        RX bytes:9765 acl:321 sco:0 events:425 errors:0
        TX bytes:8518 acl:222 sco:0 commands:75 errors:0
        Features: 0xff 0xff 0x8b 0xfe 0x9b 0xf9 0x00 0x80
        Packet type: DM1 DM3 DM5 DH1 DH3 DH5 HV1 HV2 HV3
        Link policy: RSWITCH HOLD SNIFF PARK
        Link mode: SLAVE ACCEPT
        Name: 'Casira BC3-MM'
        Class: 0x1e0100
        Service Classes: Networking, Rendering, Capturing, Object Transfer
        Device Class: Computer, Uncategorized
        HCI Ver: 1.2 (0x2) HCI Rev: 0x529 LMP Ver: 1.2 (0x2) LMP Subver: 0x529
        Manufacturer: Cambridge Silicon Radio (10)

# hcitool scan
Scanning ...
        00:04:0E:21:06:FD       AVM BlueFRITZ! AP-DSL
        00:01:EC:3A:45:86       HBH-10
        00:04:76:63:72:4D       Aficio AP600N
        00:A0:57:AD:22:0F       ELSA Vianect Blue ISDN
        00:E0:03:04:6D:36       Nokia 6210
        00:80:37:06:78:92       Ericsson T39m
        00:06:C6:C4:08:27       Anycom LAN Access Point
```

Sniffing with hcidump

- Recording of HCI packets
  - Commands, events, ACL and SCO data packets
- Only for local connections
- Decoding of higher layer protocols
  - HCI and L2CAP
  - SDP, RFCOMM, BNEP, CMTP, HIDP, HCRP and AVDTP
  - OBEX and CAPI
- No sniffing of baseband or radio traffic

Security Commands

- HCI_Create_New_Unit_Key
- HCI_{Read|Write}_Pin_Type
- HCI_{Read|Write|Delete}_Stored_Link_Key
- HCI_{Read|Write}_Authentication_Enable
- HCI_{Read|Write}_Encryption_Mode

- HCI_Authentication_Requested
- HCI_Set_Connection_Encryption
- HCI_Change_Local_Link_Key
- HCI_Master_Link_Key

Pairing Functions

- Events
    - HCI_Link_Key_Notification
    - HCI_Link_Key_Request
    - HCI_Pin_Code_Request
- Commands
    - HCI_Link_Key_Request_Reply
    - HCI_Link_Key_Request_Negative_Reply
    - HCI_Pin_Code_Request_Reply
    - HCI_Pin_Code_Request_Negative_Reply

How pairing works

- First connection
  1. HCI_Pin_Code_Request
  2. HCI_Pin_Code_Request_Reply
  3. HCI_Link_Key_Notification

- Further connections
  1. HCI_Link_Key_Request
  2. HCI_Link_Key_Request_Reply
  3. HCI_Link_Key_Notification (optional)

BlueSnarf

- Trivial OBEX PUSH channel attack
  - PULL known objects instead of PUSH
  - No authentication
- Infrared Data Association
  - IrMC (Specifications for Ir Mobile Communications)
    - e.g. telecom/pb.vcf
- Sony Ericsson T68, T68i, R520m, T610, Z1010
- Nokia 6310, 6310i, 8910, 8910i
- Devicelist on bluestumbler.org

BlueSnarf++

- Trivial OBEX PUSH channel attack
  - Connect to Sync, FTP or BIP UUID/target
  - No authentication
  - Contents Browseable
  - Full read/write access
  - External Media Storage

Mode3 Abuse

- Create Pairing
  - Authenticate for benign task (e.g. vCard exchange)
  - Force authentication if required (set Mode 3)
- Connect to unauthorised Channels
  - Serial Profile, OBEX FTP, etc.
- * NEW for layerone *

BlueBump

- Forced Re-keying
  - Authenticate for benign task (e.g. vCard exchange)
  - Force authentication if required (Mode 3)
- Partner deletes pairing
  - Hold connection open
  - Request Link Key Exchange
- Connect to unauthorised Channels
  - Serial Profile, OBEX FTP, etc.

HeloMoto

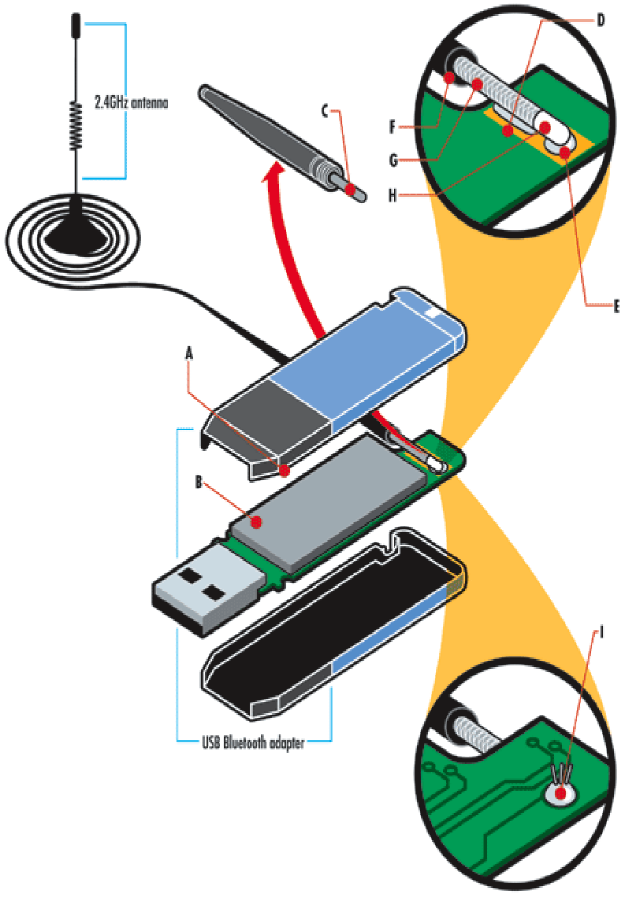
- Requires entry in 'My Devices'
- OBEX PUSH to create entry
- Connect RFCOMM to Handsfree or Headset
  - No Key required
  - Full AT command set access
- Motorola V80, V5xx, V6xx and E398

BlueBug

- Issuing AT Commands to covert service
  - BlueBug is based on AT Commands (ASCII Terminal)
    - Very common for the configuration and control of telecommunications devices
  - High level of control...
    - Call control (turning phone into a bug)
    - Sending/Reading/Deleting SMS
    - Reading/Writing Phonebook Entries
    - Setting Forwards
    - -> causing costs on the vulnerable phones!

Bluetooone

- Enhancing the range of a Bluetooth dongle by connecting a directional antenna -> as done in the Long Distance Attack
- Original idea from Mike Outmesguine (Author of Book: “Wi-Fi Toys”
- Step by Step instruction on trifinite.org



Long-Distance Attacking

- Beginning of August 2004 (right after DEFCON 12)
- Experiment in Santa Monica California with Flexilis
- Modified Class-1 Dongle Snarfing/Bugging Class-2 device (Nokia 6310i) from a distance of 1,78 km (1.01 miles)

Blooover -What is it?

- Blooover - *Bluetooth* Wireless Technology Hoover
- Proof-of-Concept Application
- Educational Purposes only
- Phone Auditing Tool
- Running on Java
  - J2ME MIDP 2.0
  - Implemented JSR-82 (Bluetooth API)
  - Nokia 6600, Nokia 7610, Nokia 6670, ... Series 60 Siemens S65 SonyEricsson P900 ...

Blooover- What does it do?

- Blooover performs the BlueBug attack
  - Reading phonebooks
  - Writing phonebook entries
  - Reading/decoding SMS stored on the device (buggy..)
  - Setting Call forward (predef. Number) +49 1337 7001
  - Initiating phone call (predef. Number) 0800 2848283
    - Not working well on Nokia phones :(but on some T610
- Please use this application responsibly!
  - Not with phones of strangers...

Blueprinting – What is it?

- Blueprinting is fingerprinting *Bluetooth* Wireless Technology interfaces of devices
- This work has been started by Collin R. Mulliner and Martin Herfurt
- Relevant to all kinds of applications
  - Security auditing
  - Device Statistics
  - Automated Application Distribution
- Released paper and tool at 21C3 in December 2004 in Berlin

Blueprinting - How

- Hashing Information from Profile Entries
  - RecordHandle
  - RFCOMM channel number
  - Adding it all up $(RecHandle_1*Channel_1)+(RecHandle_2*Channel_2)+...+(RecHandle_n*Channel_n)$
- Bluetooth Device Address
  - First three bytes refer to manufacturer
- Example of Blueprint

00:60:57@2621543

BlueSmack

- Using L2CAP echo feature
  - Signal channel request/response
  - L2CAP signal MTU is unknown
  - No open L2CAP channel needed
- Buffer overflow
- Denial of service attack

BluePot

- Bluetooth HoneyPot
  - Runs on J2ME phones
  - Imitates vulnerable phone
  - Logs incoming attacks & device info
  - Strikeback capable
  - Released today
- Authored by Martin Herfurt
- * NEW * for layerone

Conclusions

- Bluetooth is a secure standard (per se)
  - Problems at application level
- Cooperation with Bluetooth SIG
  - Pre-release testing at UPF (UnplugFests)
  - Better communication channels for external testers
    - Security Expert Group mailing list
    - bluetooth.org more open areas
  - Mandatory security at application level

trifinite.org

- http://trifinite.org/
- Loose association of BT security experts
- Features
  - **trifinite.**blog
  - **trifinite.**stuff
  - **trifinite.**album
  - **trifinite.**group

trifinite.group

- Adam Laurie (the Bunker Secure Hosting)
- Marcel Holtmann (BlueZ)
- Collin Mulliner (mulliner.org)
- Tim Hurman (Pentest)
- Mark Rowe (Pentest)
- Martin Herfurt (trifinite.org)
- Spot (Sony)

Questions / Feedback / Answers

- Contact us via mailto:layerone@trifinite.org (group alias for Adam, Marcel and Martin)