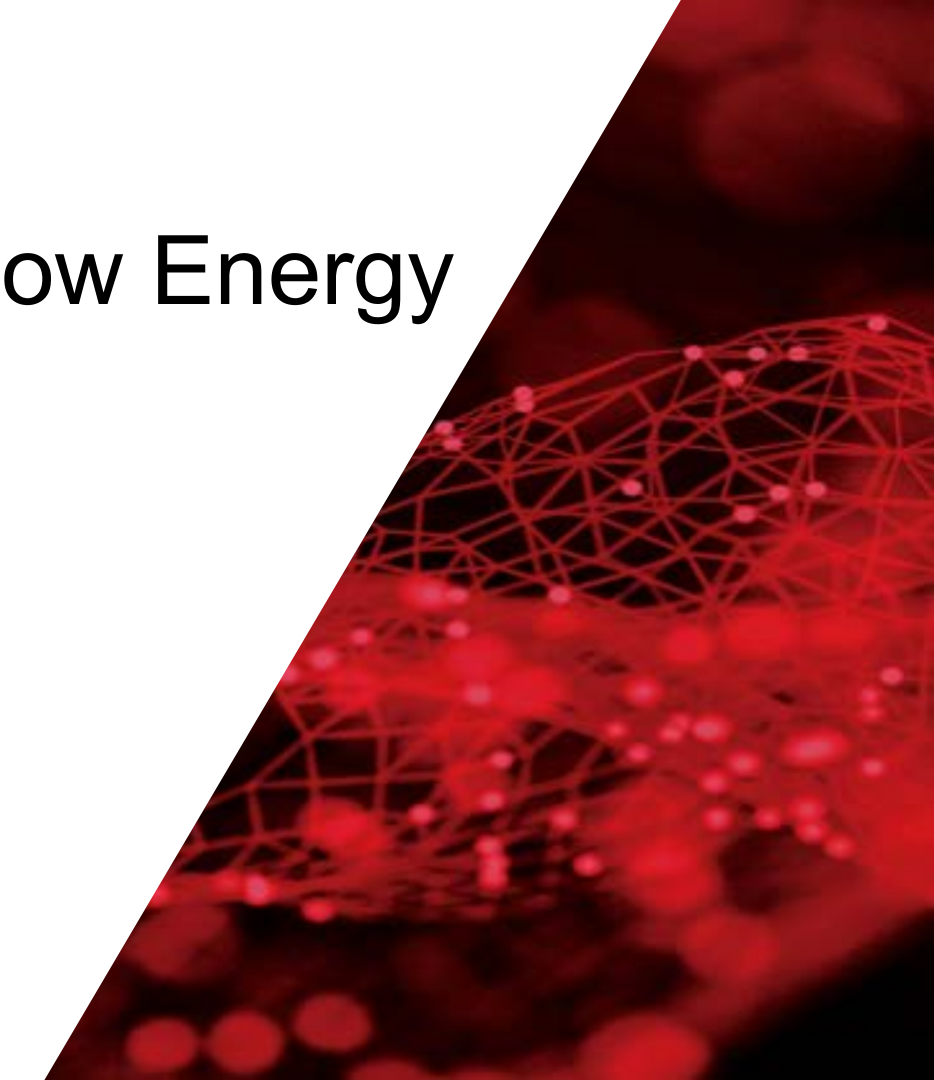
Breaking Bluetooth Low Energy

Maxine Filcher
Security Consultant



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Agenda

- Part 1
  - BLE Protocol Basics
- Part 2
  - Vulnerabilities
- Part 3
  - Code

CAUTION

ALL YOUR RF ARE BELONG TO US!

Your proximity to this device constitues consent to be monitored on all applicable parts of the electro-magnetic spectrum.
You have no chance for privacy make your time.

wirelessvillage.ninja WIRELESS VILLAGE www.wctf.us

Whoami

- Maxine Filcher
- Security Consultant with IOActive
- US Army Veteran
- B.S. Info Assurance & Cybersecurity
  - Minor: Law & Policy
- SANS Women's Academy 2018 Cohort
- GSEC, GCIH, GPEN
  - maxine.filcher@ioactive.com
  - @FreqyXin

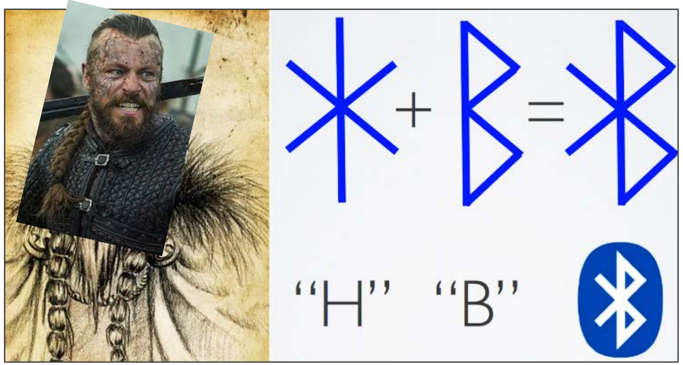
Disclaimer:

I am not a Bluetooth Developer
This is not a comprehensive class on Bluetooth

Part I

A Quick History

- Herald “Bluetooth”
- King of Norway and Denmark



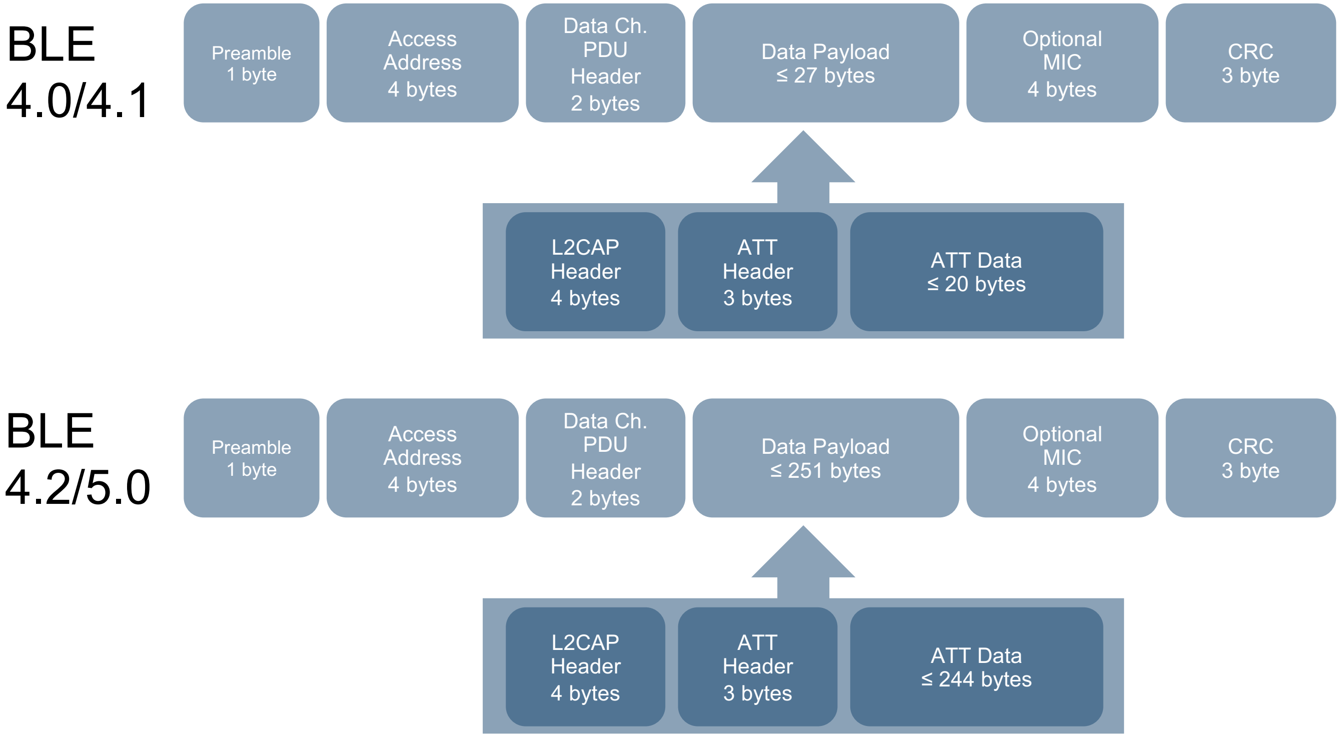
- Hedy Lamarr
- 1914-2000
- Frequency Hopping Spread Spectrum (FHSS)
- Radio Controlled Torpedoes
- George Antheil & Self-playing Piano’s

Bluetooth Low Energy (BLE)	Point-to-Point Low energy consumption 2.4 – 2.485 GHz
Bluetooth Mesh	Many-to-Many Supports 32,767 nodes per mesh network

The Protocol

- Advertising
  - 3 Channels for advertisement 37, 38, 39
  - 4 Advertising PDU Types
- Connecting
  - 36 Channels (Japan, Spain, France have 23)
  - 1 MHz spacing
  - FHSS:
    - Channel = (currentChannel + hop) % 37

Link Layer Packet Organization



BLE 4.0/4.1

Preamble 1 byte	Access Address 4 bytes	Data Ch. PDU Header 2 bytes	Data Payload ≤ 27 bytes	Optional MIC 4 bytes	CRC 3 byte

L2CAP Header 4 bytes	ATT Header 3 bytes	ATT Data ≤ 20 bytes

BLE 4.2/5.0

Preamble 1 byte	Access Address 4 bytes	Data Ch. PDU Header 2 bytes	Data Payload ≤ 251 bytes	Optional MIC 4 bytes	CRC 3 byte

L2CAP Header 4 bytes	ATT Header 3 bytes	ATT Data ≤ 244 bytes

Broadcasting and Connections

- One way
- Connectionless
- Two Roles
  - Broadcaster
  - Observer
- iBeacons

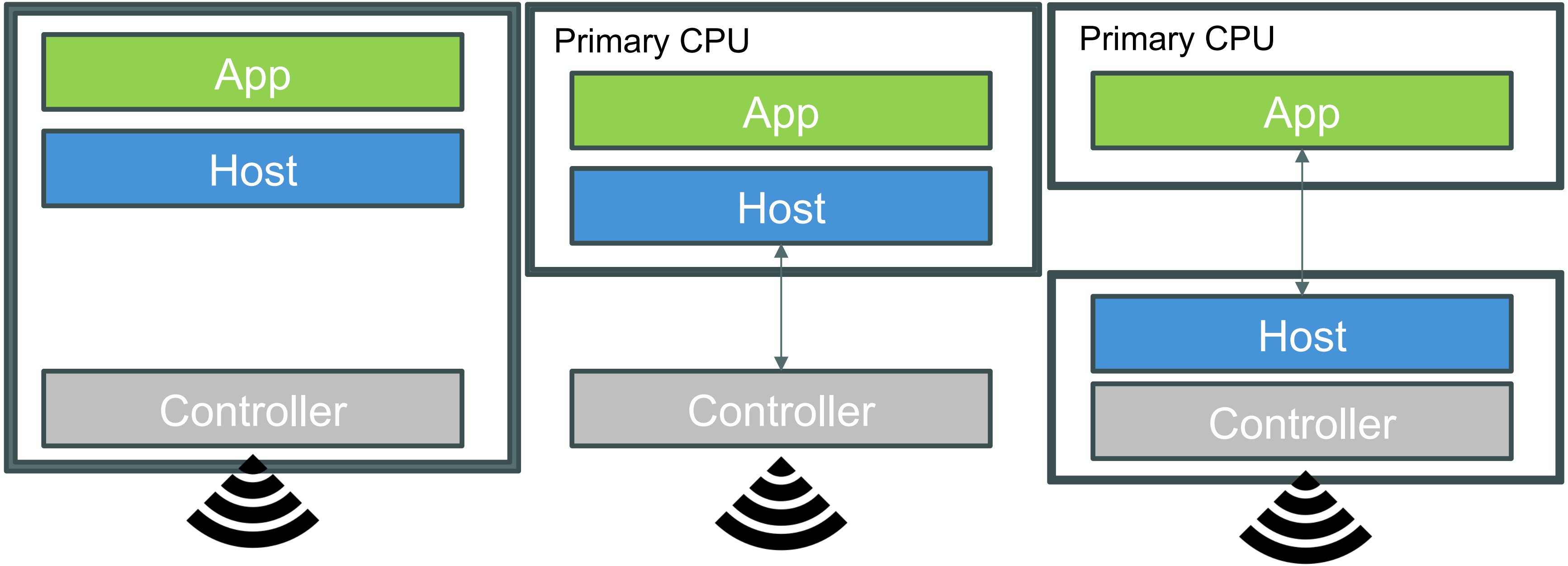
- Two way
- Additional Protocol Layers
- Two Roles
  - Central
  - Peripheral
- Phone to Thingy52

Connections

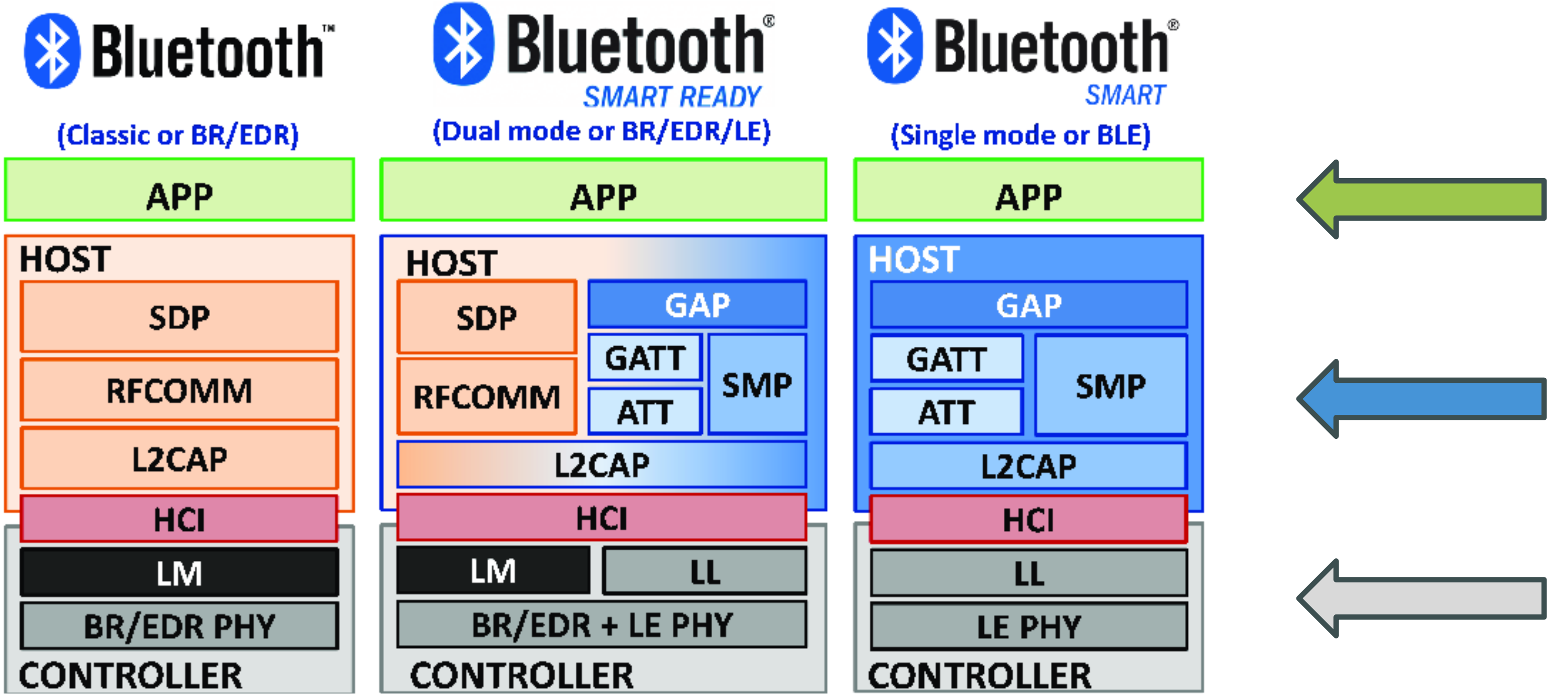
- Devices:
  - Central (i.e. Phone)
    - Connection Initiator
    - Controls timing and data exchange
  - Peripheral (i.e. Thingy 52)
    - Advertises
    - Accepts incoming connections

Common Configurations

- SoC
- IC over HCI
- Dual IC



Bluetooth Protocol Stack



Layers of Interest

- Logical Link
  - Modifies connection params
  - Performs encryption/ decryption

- HCI
  - Commands and Events for host and controller interaction

- L2CAP
  - ‘Like’ TCP
  - Enables many protocols coexisting
  - Encapsulation from upper to lower layers

Link Layer

- CRC creation and verification
- Encryption (AES)
- Random number generation

L2CAP

- Controls ATT and SM
- Fragments packets into 27 (4.1) / 251 (4.2+) byte payload

SM

- Protocol
- Security Key generation and exchange algorithms
- Pairing
- Bonding
- Encryption Reestablishment

Part II

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Bluetooth Vulnerabilities

- Blueborne – Smart Devices, wormable via BLE
- Bleedingbit – Wireless APs, security bypass & malicious OTA
- SweynTooth – BLE chips, DoS

Bleedingbit

- https://www.armis.com/bleedingbit/

- Armis
- CVE-2018-16986
- CVE-2018-7080
- TI BLE Chip RCE Vulnerability
- Cisco, Aruba, Meraki

SweynTooth

- https://asset-group.github.io/disclosures/sweyntooth/
- 2019 / 2020
- Singapore University of Technology and Design
  - Matheus E. Garbelini, Sudipta Chattopadhyay, Chundong Wang

CVE-2019-16336 / CVE-2019-17519

- Cypress PSoC4/6 BLE Component 3.41/2.60
- *NXP KW41Z 3.40* SDK

- Link Layer Length Overflow
- DoS
- Potential for Further RCE

Part III

BLE Fuzzing

- A shift in research

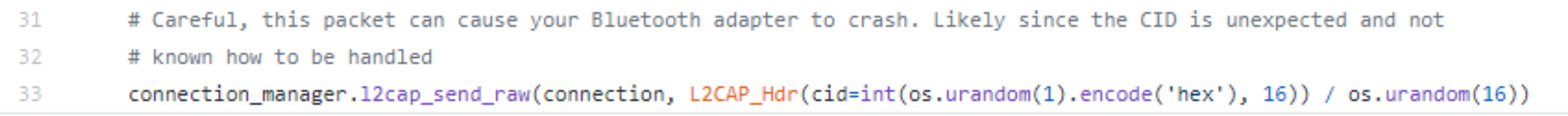
NCCGroup’s BLEsuite

- https://github.com/nccgroup/BLESuite

- BLE python library
- Fuzzing tool

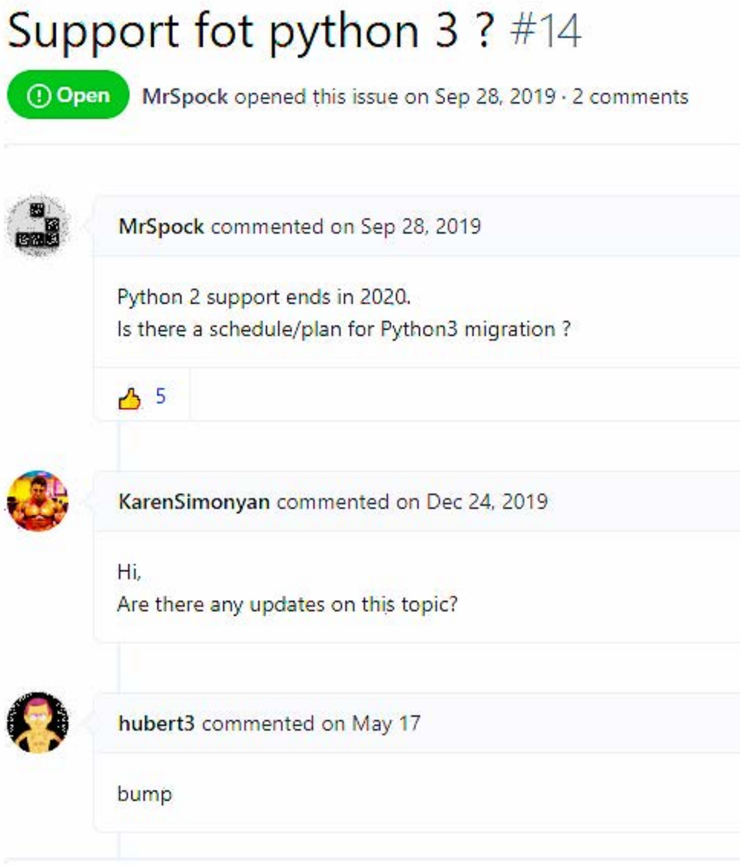
Foreshadowing

- https://github.com/nccgroup/BLESuite/blob/master/docs/examples/advanced_manual_packets.py
- Channel ID -



```
# Careful, this packet can cause your Bluetooth adapter to crash. Likely since the CID is unexpected and not
# known how to be handled
connection_manager.l2cap_send_raw(connection, L2CAP_Hdr(cid=int(os.urandom(1).encode('hex'), 16)) / os.urandom(16))
```

The Issues



Support fot python 3 ? #14

Open MrSpock opened this issue on Sep 28, 2019 · 2 comments

MrSpock commented on Sep 28, 2019

Python 2 support ends in 2020.
Is there a schedule/plan for Python3 migration ?

👍 5

KarenSimonyan commented on Dec 24, 2019

Hi,
Are there any updates on this topic?

hubert3 commented on May 17

bump

GO!

- https://github.com/go-ble/ble
- Go Module for BLE

Go BLE Scanner Demo

DEMO

Additional Info

- ‘Introduction to BLE Exploitation’ – IOActive webinar (May 2020) https://act-on.ioactive.com/acton/media/34793/ioactive-webinars#block-b1574346531854
- Getting Started With Bluetooth Low Energy: Tools and Techniques for Low-Power Networking
- Hacking Exposed Wireless: Wireless Security Secrets and Solutions

https://www.youtube.com/playlist?list=PLkMJSkfvo46OWMWzCqQUkFdVg27ILF7Hi

Thank You

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