Auditing 6LoWPAN networks

Using Standard Penetration Testing Tools

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The 6LoWPAN protocol

- **IPv6 over Low power Wireless Personal Area Networks**
- **Header compression flags**
  - Addresses factoring (IID or predefined)
  - Predefined values (e.g., TTL)
  - Fields omission (when unused)
  - Use of contexts (index-based)
  - UDP header compression (ports and checksum)
- **Packet fragmentation**
  - MTU 127 bytes Vs 1500 bytes
  - 80 bytes of effective payload

What’s the big deal ?

The IEEE 802.15.4 standard

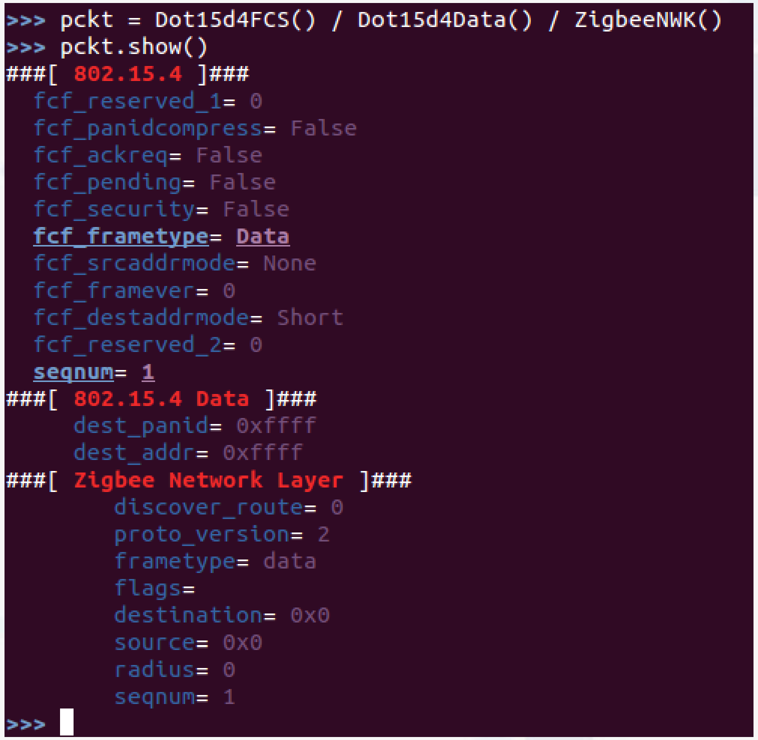
- **PHY layer and MAC sublayer**
- **Multiple possible configurations**
  - Network topology
  - Data transfer model
- **Multiple security suites**
  - Integrity, Confidentiality or both
  - Encryption key size (32, 64 or 128)
- **Multiple standard revision**
  - 2003
  - 2006 and 2011

Deviations for the standard

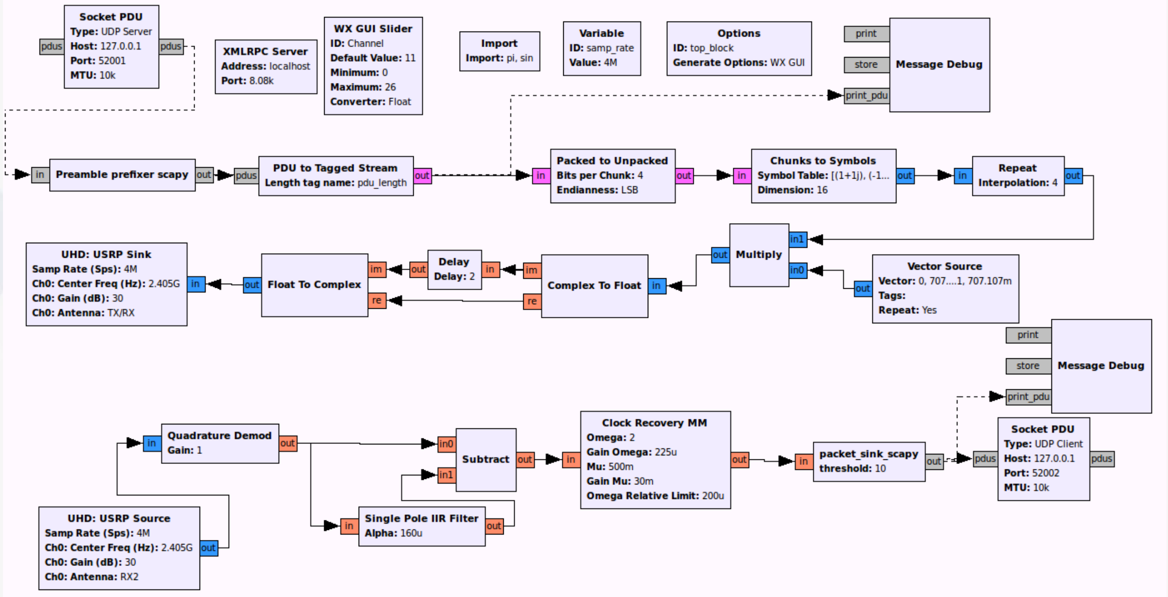
The ARSEN project

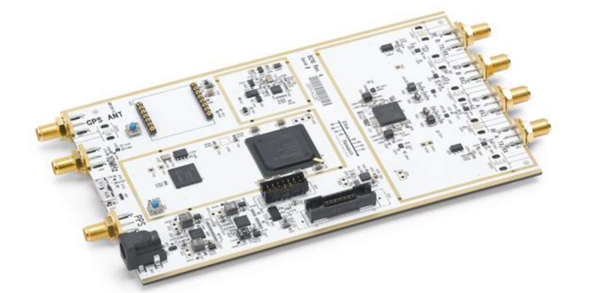
- **Advanced Routing between 6LoWPAN and Ethernet Networks**
- **Detect the configuration of existing 802.15.4 infrastructure**
  - Network topology
  - Data transfer model
  - Security suite
  - Standard revision
  - Standard deviations
- **Handle packet translation**
  - Compression/decompression
  - Fragmentation/defragmentation
  - Support all possible IEEE 802.15.4 configurations

Based on Scapy-radio



```
>>> pckt = Dot15d4FCS() / Dot15d4Data() / ZigbeeNWK()
>>> pckt.show()
###[ 802.15.4 ]###
  fcf_reserved_1= 0
  fcf_panidcompress= False
  fcf_ackreq= False
  fcf_pending= False
  fcf_security= False
  fcf_frametype= Data
  fcf_srcaddrmode= None
  fcf_framever= 0
  fcf_destaddrmode= Short
  fcf_reserved_2= 0
  seqnum= 1
###[ 802.15.4 Data ]###
     dest_panid= 0xffff
     dest_addr= 0xffff
###[ Zigbee Network Layer ]###
        discover_route= 0
        proto_version= 2
        frametype= data
        flags=
        destination= 0x0
        source= 0x0
        radius= 0
        seqnum= 1
>>> 
```





Two main components

- **The IEEE 802.15.4 scanner**
  - Build a database of devices and captured frames
  - The devices that are running on a given channel
  - The devices that are communicating with each other
  - The types of frames that are exchanged between devices
  - The parameters that are used to transmit these frames
- **The 6LoWPAN border router**
  - TUN interface
  - Ethernet omitted
  - Scapy automaton

New Scapy layers

- **Dot15d4.py**
  - Several bug fixes
  - Complete 2003 and 2006 support
- **Sixlowpan.py**
  - Uncompressed IPv6 support
  - Complete IP header compression support
  - UDP header compression support
  - Fragmentation and defragmentation support

Demonstration

Thank you for your attention