For Fun and Profit

Build your stack with Scapy

Disclaimer

We do not pretend to know everything about the topics discussed in this workshop. If you happen to know that we are for a fact wrong about something, don't just sit there quietly, SPEAK UP.

If you have a question about anything discussed in this workshop, SPEAK UP. There are no stupid or dumb questions. Odds are, the smart looking person next to you is more lost than you are. SPEAK UP, and ask those questions!

We won't get mad at ya for doing so. We might even buy you a beer!

ping stryngs

- UAV operator USMC
- Linux since 2006
- Information Assurance – 4+ Years
- <3 802.11

ping Jack64

- Does AppSec stuff for Checkmarx (2016-)
- Cobalt Core Researcher
- 3+ years experience in infosec

nmap workshop -vvv

- tmux/Screen
- iPython
- Primer on 802.11
- Primer on TCP
- Scapy
  - Auth/assc
  - kSnarf
  - Out of Band communications
  - airpwn-ng
  - pyDot11
  - Utils (pcap-geolocate, port-knocking backdoor)
- Comments / Questions / Tomato throwing session

Primer Questions

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- Q: How many of you are red teamers?

tmux / Screen

- Used as a terminal multiplexer
- Allows you to re-ssh without nohup nonsense
- Essential for headless
- Saves real-estate
- Scapy wants shells.

IPython

- ncurses based
  - We don’t need no stinkin GUI
- Tab it out
- ?
- When used with Scapy
  - Endless results
  - Severe happiness
  - Pwnage

802.11

- Radio waves are all around us
- Works off the concept of “Shared Medium”
- All we have to do, is listen
  - Can’t hide from me….

Useful 802.11 Acronyms

- Authenticator: An entity at one end of a point-to-point LAN segment that facilitates authentication of the entity attached to the other end of that link. (IEEE Std 802.1X-2004)
- BSSID: Basic Service Set Identifier. Commonly known as the MAC address of a specific Access Point.
- Distribution system (DS): A system used to interconnect a set of basic service sets (BSSs) and integrated local area networks (LANs) to create an extended service set (ESS).
- ESSID: Extended Service Set Identifier. Commonly referred to as the SSID and known by the masses as the “Network Name”.

Useful 802.11 Acronyms

- Group Temporal Key (GTK): A random value, assigned by the group source, which is used to protect group addressed medium access control (MAC) protocol data units (MPDUs) from that source. The GTK might be derived from a group master key (GMK).
- Medium Access Control (MAC) Protocol Data Unit (MPDU): The unit of data exchanged between two peer MAC entities using the services of the physical layer (PHY).
- Pairwise Master Key (PMK): The key derived from a key generated by an Extensible Authentication Protocol (EAP) method or obtained directly from a preshared key (PSK).
- Pairwise Transient Key (PTK): A concatenation of session keys derived from the pairwise master key (PMK) or from the PMK-R1. Its components include a key confirmation key (KCK), a key encryption key (KEK), and one or more temporal keys that are used to protect information exchanged over the link.

Useful 802.11 Acronyms

- Station (STA): A logical entity that is a single addressable instance of a medium access control (MAC) and physical layer (PHY) interface to the wireless medium (WM).
- Supplicant: An entity at one end of a point-to-point LAN segment that is being authenticated by an Authenticator attached to the other end of that link. (IEEE Std 802.1X-2004)

From-DS and To-DS

Table 8-2—To/From DS combinations in data frames

To DS and From DS values	Meaning
To DS = 0 From DS = 0	A data frame direct from one STA to another STA within the same IBSS, a data frame direct from one non-AP STA to another non-AP STA within the same BSS, or a data frame outside the context of a BSS, as well as all management and control frames.
To DS = 1 From DS = 0	A data frame destined for the DS or being sent by a STA associated with an AP to the Port Access Entity in that AP.
To DS = 0 From DS = 1	A data frame exiting the DS or being sent by the Port Access Entity in an AP, or a group addressed Mesh Data frame with Mesh Control field present using the three-address MAC header format.
To DS = 1 From DS = 1	A data frame using the four-address MAC header format. This standard defines procedures for using this combination of field values only in a mesh BSS.

Address Fields

From DS Set, To DS Clear:
Address 1: Destination
Address 2: BSSID
Address 3: Source

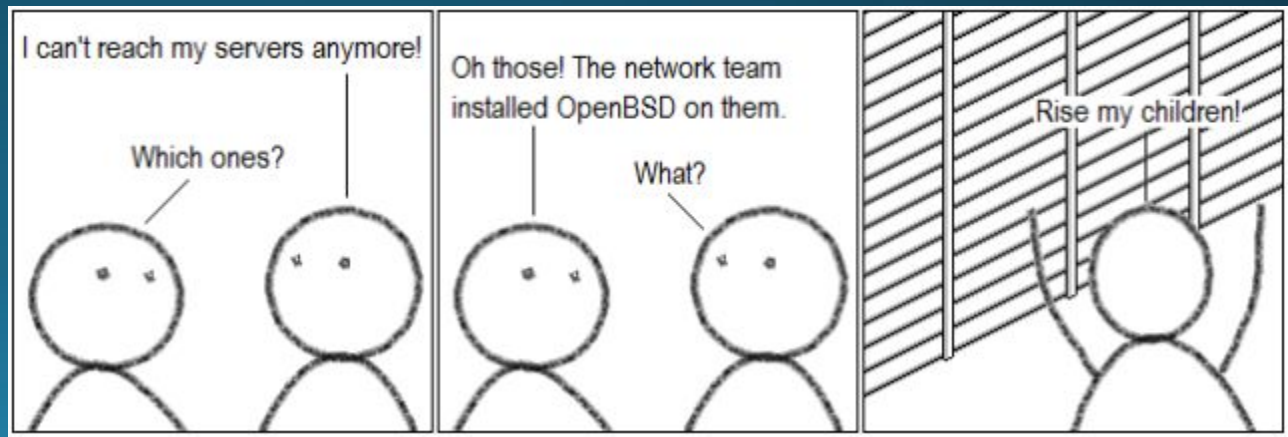
From DS Clear, To DS Clear:
Address 1: Destination
Address 2: Source
Address 3: BSSID

From DS Clear, To DS Set:
Address 1: BSSID
Address 2: Source
Address 3: Destination

From DS Set, To DS Set:
Address 1: Receiver
Address 2: Transmitter
Address 3: Destination
Address 4: Source

Crazy Memory Time

- Remember To First
  - ‘Tis better TO give than to receive
- Next remember BSD
  - That crazy operating system TO give to your friends
    - BSSID
    - SOURCE
    - DESTINATION
      - To-DS



Crazy Memory Time

- Smart people use Databases (DBS), not Excel
  - Excel Sucks
    - Destination
    - BSSID
    - Source
      - From-DS

Crazy Memory Time

- Learn your Scapy Decimals for Direction
  - 1 - To-DS
  - 2 - From-DS
  - 65 - To-DS (with Encryption)
  - 66 - From-DS (with Encryption)

Crazy Memory Time

- Learn your Scapy Decimals for Type
  - 0 - Management
  - 1 - Control
  - 2 - Data

"First you have to Manage, then you can Control the Data"

Crazy Memory Time

- All of this corresponds to the Dot11 Class
  - FCfield
  - addr1
  - addr2
  - addr3
  - type
- Learn how to manipulate and interpret the above
  - The world is your oyster

TCP

- What do you think of when you hear TCP-IP?

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  - syn , syn/ack, ack
  - FIN, PSH, URG

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  - First horse across the finish line, wins

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- If you remember nothing else

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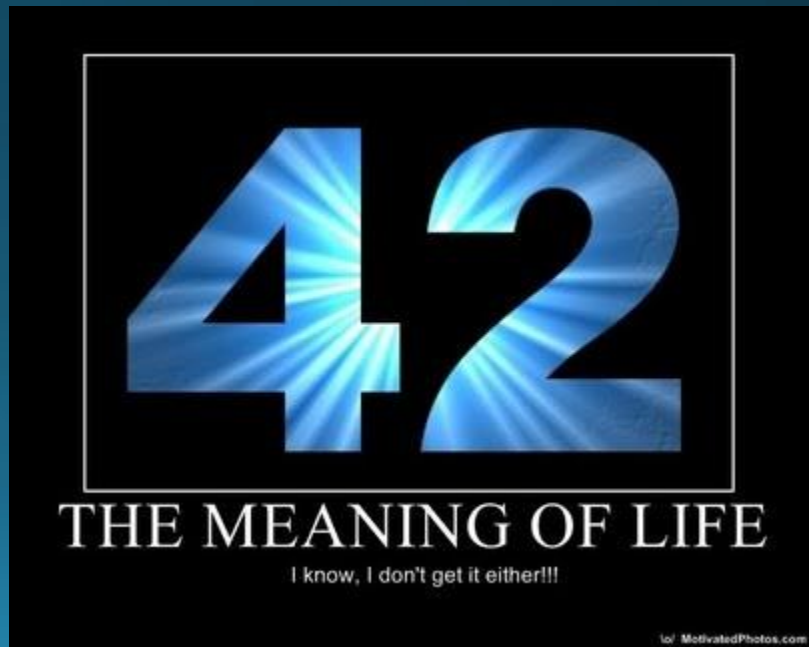
- If you remember nothing else
  - Sequence + Length == Acknowledgement
    - This is your 42



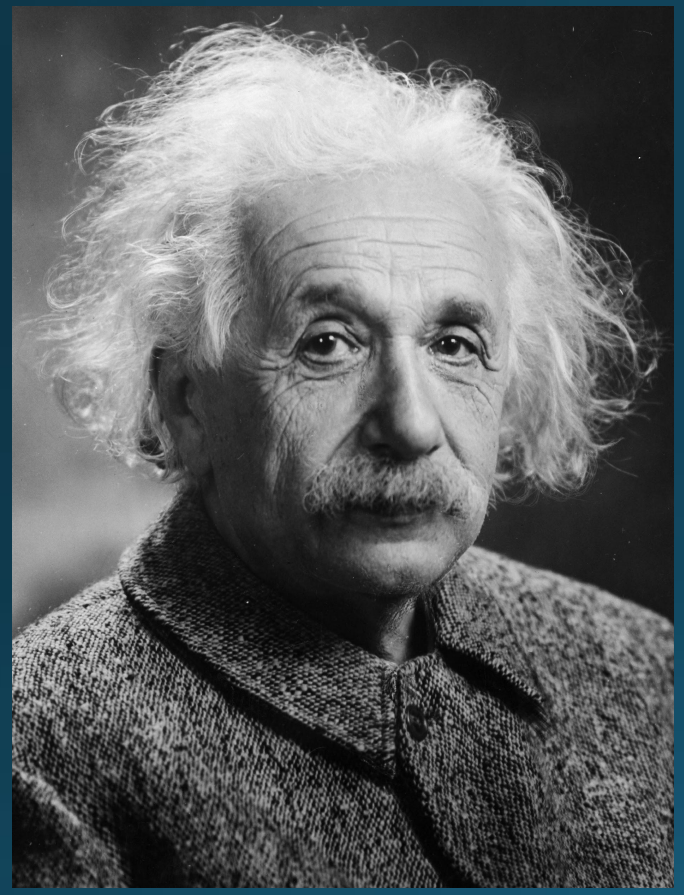
TCP Flags

less

TCP Flags

- FIN – No more data from sender (Seen after a connection is closed)
- URG – indicates that the URGent pointer field is significant
- CWR – Congestion Window Reduced (CWR) flag is set by the sending host to indicate that it received a TCP segment with the ECE flag set (added to header by RFC 3168).
- ACK – indicates that the ACKnowledgment field is significant (Sometimes abbreviated by tcpdump as ".")
- SYN – Synchronize sequence numbers (Seen on new connections)
- PSH – Push function
- ECE (ECN-Echo) – indicate that the TCP peer is ECN capable during 3-way handshake (added to header by RFC 3168).
- RST – Reset the connection (Seen on rejected connections)

TCP #s



-VS-


ABSOLUT
Country of Sweden
VODKA
Every drop of this superb vodka has been crafted only with Swedish winter wheat near the small town of Åhus and continues a determined commitment to the pursuit of perfection since 1879.
IMPORTED
40% ALC./VOL. (80 PROOF) 700 ML
PRODUCED AND BOTTLED IN ÅHUS, SWEDEN

TCP #s

```
 1 0.000000        192.168.1.125 192.168.1.132   TCP        74 37310 → 80 [SYN] Seq=0 Win=29200 Len=0 MSS=1460 SACK_PERM=1 TSval=37983574 TSecr=0 WS=1024
 2 0.000396        192.168.1.132 192.168.1.125   TCP        74 80 → 37310 [SYN, ACK] Seq=0 Ack=1 Win=28960 Len=0 MSS=1460 SACK_PERM=1 TSval=359152 TSecr=37983574 WS=128
 3 0.000452        192.168.1.125 192.168.1.132   TCP        66 37310 → 80 [ACK] Seq=1 Ack=1 Win=29696 Len=0 TSval=37983574 TSecr=359152
 4 0.000544        192.168.1.125 192.168.1.132   HTTP      143 GET / HTTP/1.1
 5 0.000790        192.168.1.132 192.168.1.125   TCP        66 80 → 37310 [ACK] Seq=1 Ack=78 Win=29056 Len=0 TSval=359152 TSecr=37983574
 6 0.002040        192.168.1.132 192.168.1.125   HTTP      338 HTTP/1.1 200 OK  (text/html)
 7 0.002066        192.168.1.125 192.168.1.132   TCP        66 37310 → 80 [ACK] Seq=78 Ack=273 Win=30720 Len=0 TSval=37983574 TSecr=359152
 8 0.002241        192.168.1.125 192.168.1.132   TCP        66 37310 → 80 [FIN, ACK] Seq=78 Ack=273 Win=30720 Len=0 TSval=37983574 TSecr=359152
 9 0.004016        192.168.1.132 192.168.1.125   TCP        66 80 → 37310 [FIN, ACK] Seq=273 Ack=79 Win=29056 Len=0 TSval=359153 TSecr=37983574
10 0.004060        192.168.1.125 192.168.1.132   TCP        66 37310 → 80 [ACK] Seq=79 Ack=274 Win=30720 Len=0 TSval=37983575 TSecr=359153
```

-VS-

```
Out[9]: <Ether  dst=aa:bb:cc:dd:ee:ff src=08:00:27:0d:60:76 type=0x800 |<IP  version=4L ihl=5L tos=0x0 len=52 id=50023 flags=DF frag=0L ttl=64 proto=t
cp chksum=0xf30a src=192.168.1.132 dst=192.168.1.125 options=[] |<TCP  sport=http dport=37310 seq=840022423 ack=454279889 dataofs=8L reserved=0L flags
=A window=227 chksum=0x835d urgptr=0 options=[('NOP', None), ('NOP', None), ('Timestamp', (359152, 37983574))] |>>>
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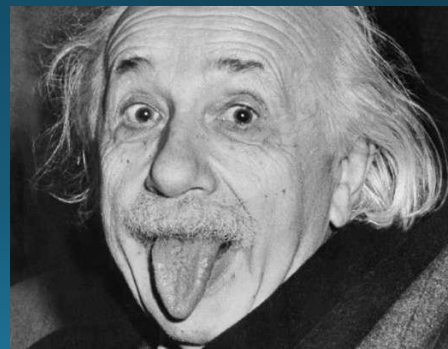


Coooookies!

- HTTP is stateless
- Cookies create a bridge for this purpose
- Have the cookie == Access
  - Mostly…
- Demo

Scapy

- Created by Philippe Biondi
- Best damn interactive packet manipulator, ever.
- Who here has used?

Scapy tidbits

- Namespace overwrite warning…
  - ls()
- lsc()
- pkt.show()
- rdpcap()/wrpcap()
- PcapReader()/PcapWriter()
- hexstr
- str
- send()/sendp()
  - prn
    - Closure example
  - lfilter

Learning to fly

- sendp() and send() only "work" if the tgt gets a packet it expects
  - Garbage in, Garbage out
- So, how do we build?
  - We could learn by reading the RFC and building the packet from scratch…
  - OR:
  - We use a pre-existing packet/frame from a PCAP!
- Take the pre-existing packet, and reverse enginee
  - World domination follows shortly

This is my Rifle

- We now know how to listen
- We wait for the trigger, then pull

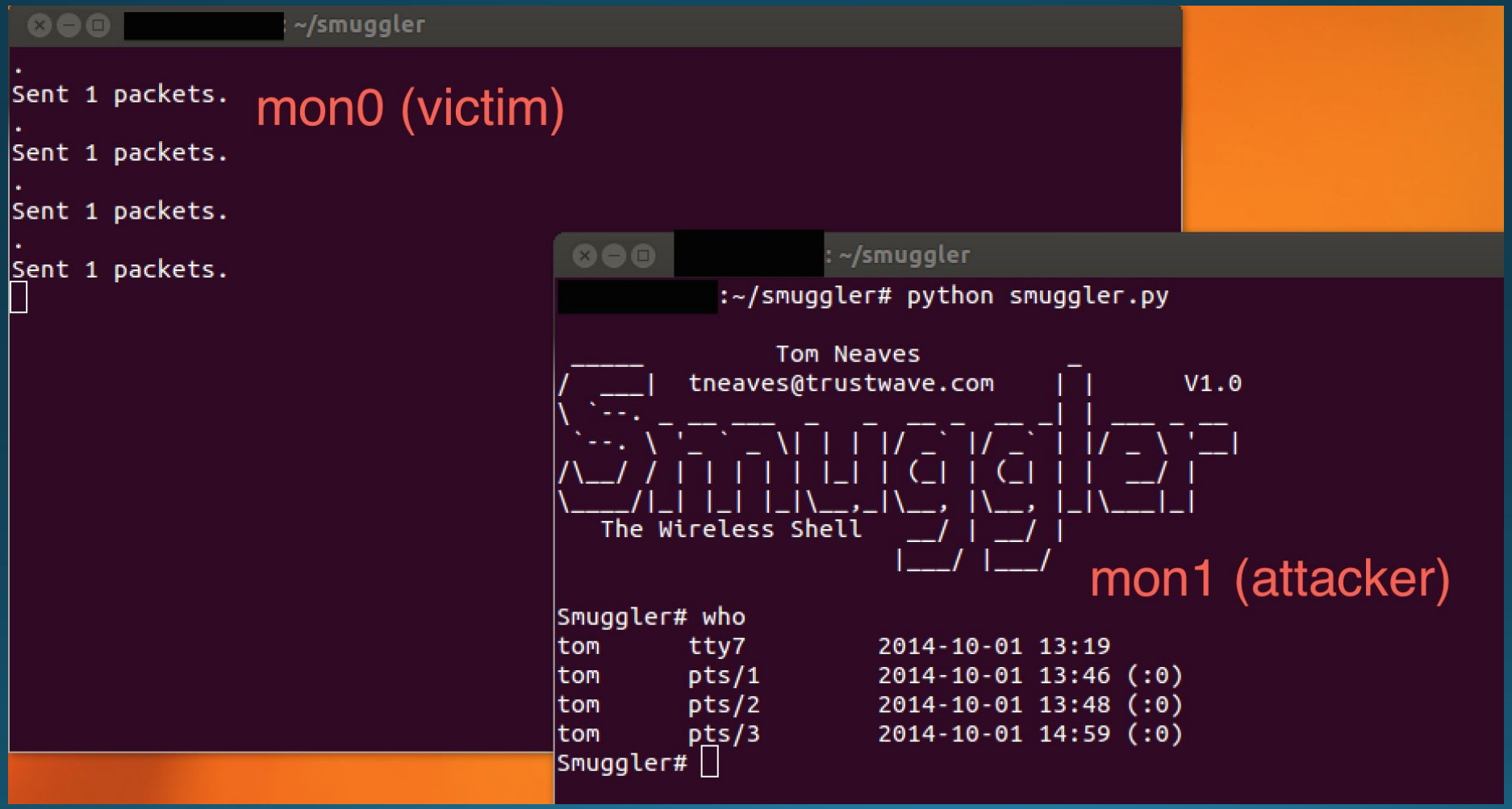
Out-of-Band Communications Channel

- Problem: How to exfiltrate data from:
  - A) Airgapped systems or networks (no internet connection)?
  - B) system with highly monitored or restricted internet access (DPI, egress filtering, etc)?

Out-of-Band Communications Channel

- Answer: Use custom 802.11 frames!

Out-of-Band Communications Channel



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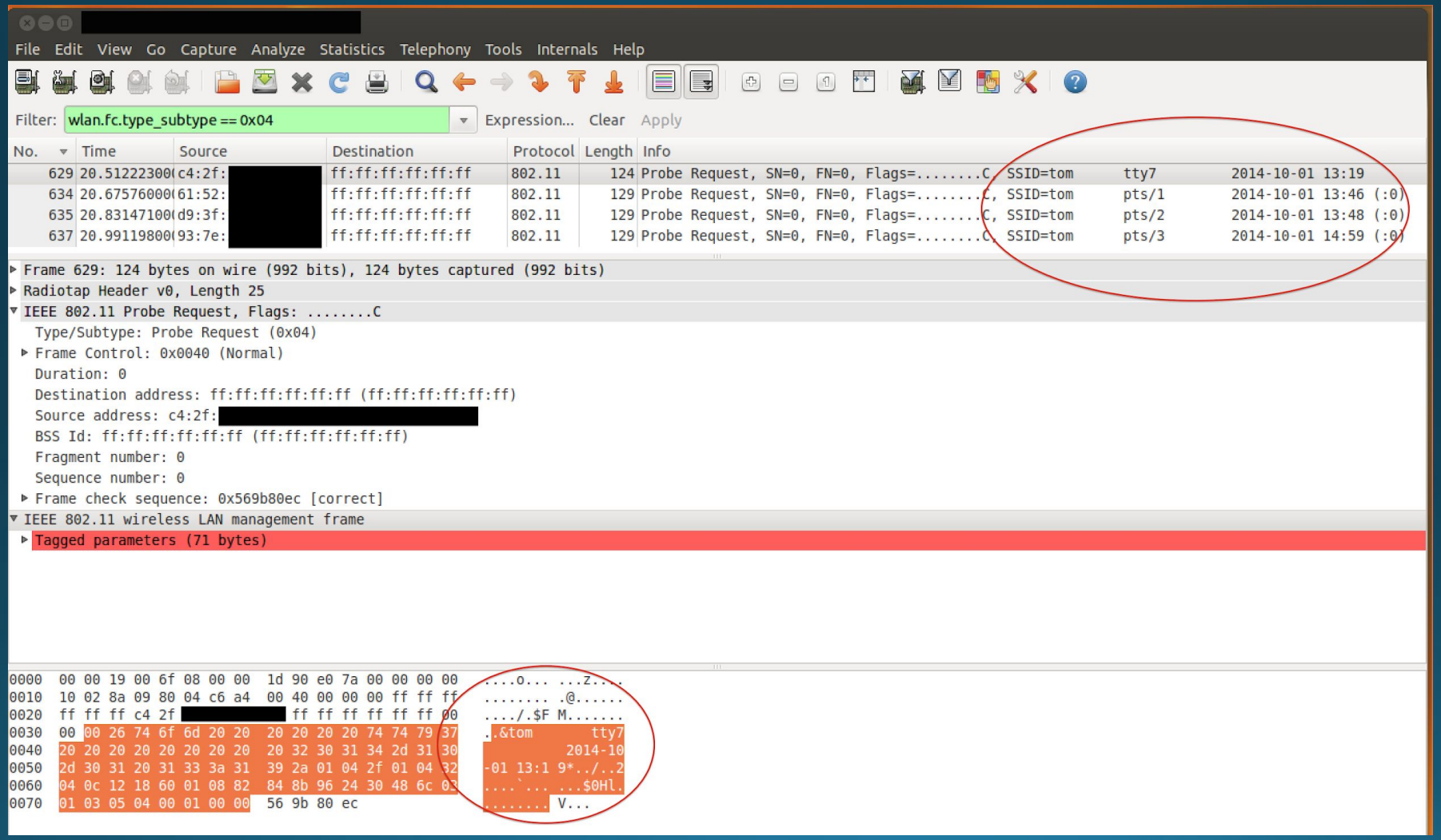

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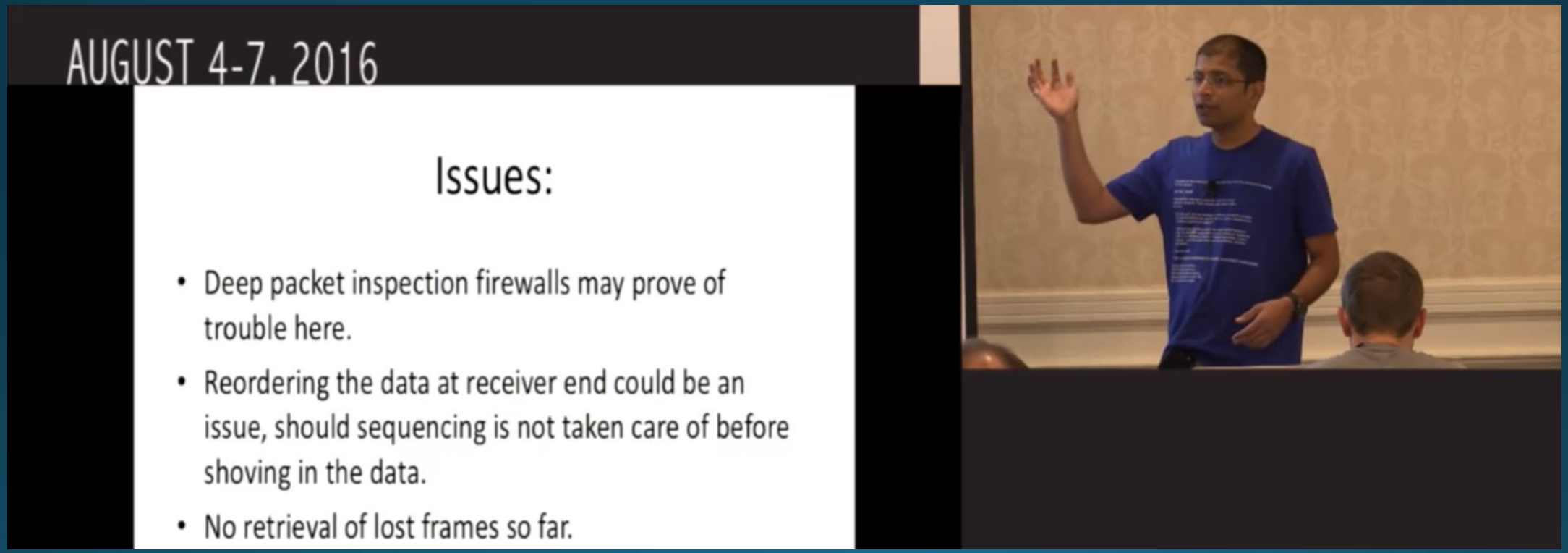


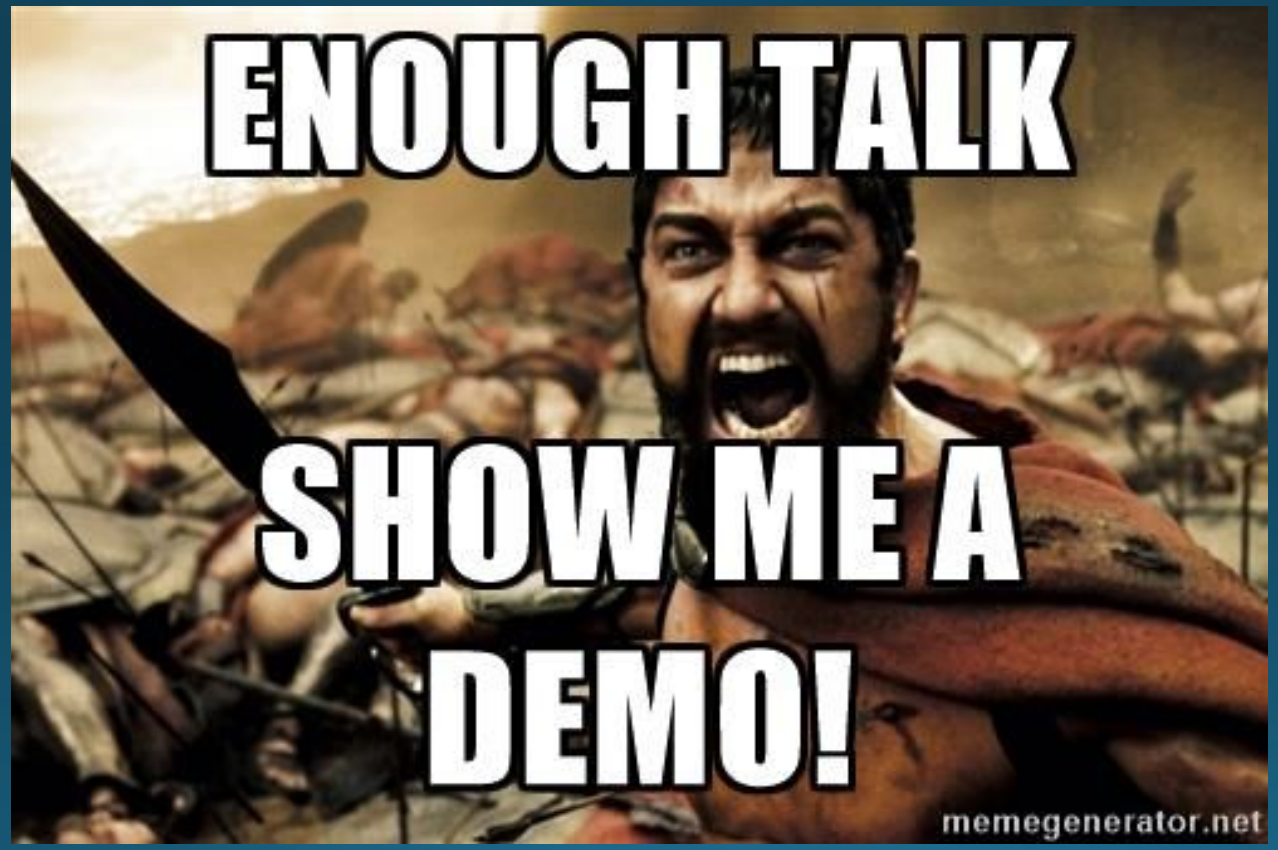
Out-of-Band Communications Channel

- Writing a detector for Smuggler/Covert Cupid/Chura-Liya:
  - Beacon frames with SSID field larger than 32 bytes
  - Probe Requests with Rates field larger than 32 bytes
  - Regex search for common unix words (root, bash, etc)

Out-of-Band Communications Channel

- A different approach - Use 802.11 Data Packets

Out-of-Band Communications Channel



Out-of-Band Communications Channel

- Detecting OOBackdoor
- Protocol limitations
- Work-in-Progress

Scapy Utils

Geolocate-pcap.py

Port-Knocking Backdoor

airpwn-ng

- Conceptualized from the original airpwn by toast
- POC in bash
  - Remastered in Python
- Why does it work?
  - 1st to the finish line of course…

airpwn-ng

- Open wifi simple concept demonstration
  - This is our fastest example as no encryption needed

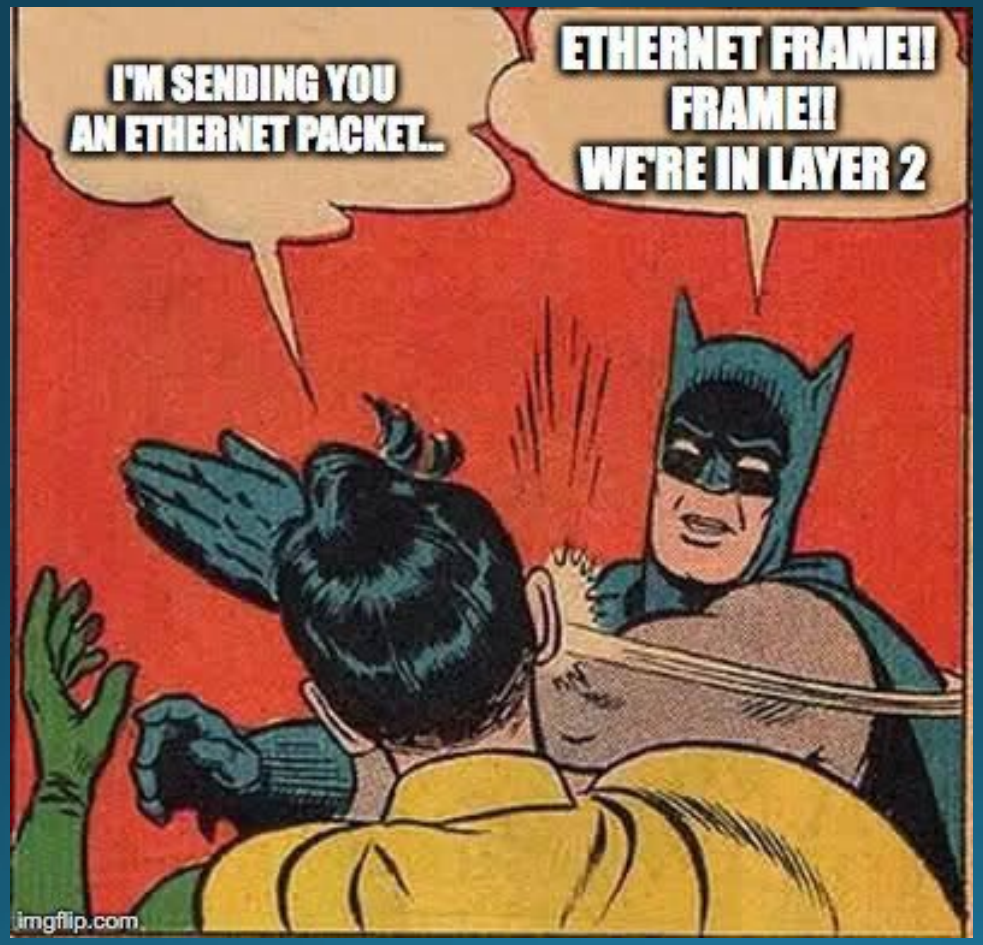
pyDot11

- On-the-fly encryption and decryption of 802.11
  - WEP or WPA
    - CCMP only right now, no TKIP…
- Created because stryngs could not find any other tool like it
  - airventriloquist-ng…
- Learned, so much
  - Passion and devotion pays off.
- Eventually will be scrapped in favor of airventriloquist-ng as a .so for Python

airpwn-ng

- Encrypted wifi demo

Questions?


I'M SENDING YOU AN ETHERNET PACKET..
ETHERNET FRAME!! FRAME!! WE'RE IN LAYER 2
imgflip.com