Connected Factories lecture 5/6: Security

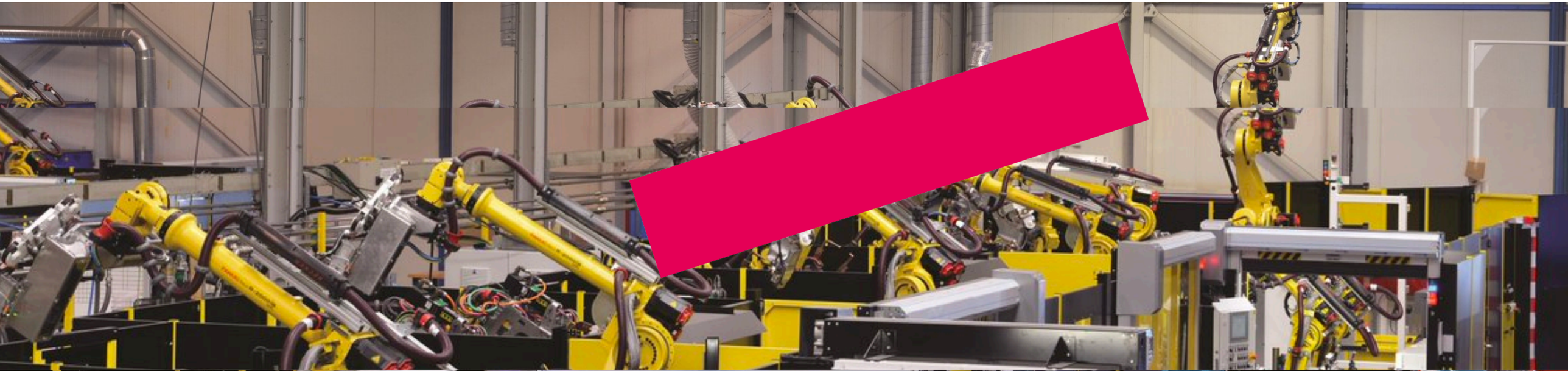

Image: AWL-Techniek

Associate Degree Smart Industry
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V1.0 April 8, 2020

HAN_UNIVERSITY
OF APPLIED SCIENCES

Schedule

	Theme	
Lecture 1	Introduction	
Lecture 2	Network connections	
Lecture 3	Network protocols	
Lecture 4	Interconnections	
Lecture 5	**Today: Security**	
Lecture 6	Safety	
Assessment		

Security by design

Security (and safety) should be considered at design time already.

Patching leaks as we go (like the Microsoft approach) has proven to be a road to disaster.

How to enter a ‘secured’ area and wreak havoc:

Common IoT Security Issues: TEDx by Ken Munro

https://youtu.be/pGtnC1jKpMg

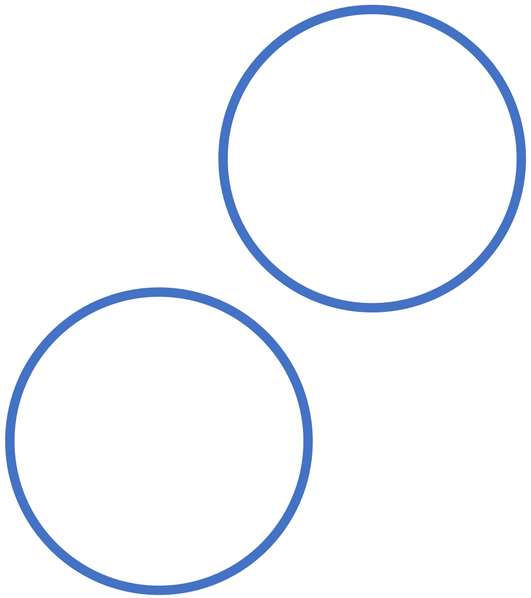
Common Networking Tools 1/2

Tool name	Usage	Common Flag(s) / usage
netstat	Shows incoming and outgoing TCP connections	-r (ip route), -i (interfaces)
lsof	list open files	-i -n -P | grep programname (e.g. “lsof -i -n -P | grep mosquitto”)
tcpdump	(TCP) packet analyser	
ping	Sends echo request to specified host	e.g. “ping www.han.nl"
traceroute	Shows route of a packet	-i (e.g. “traceroute -i google.com”)
nmap	Network exploration and security scanner tool	

Common Networking Tools 2/2

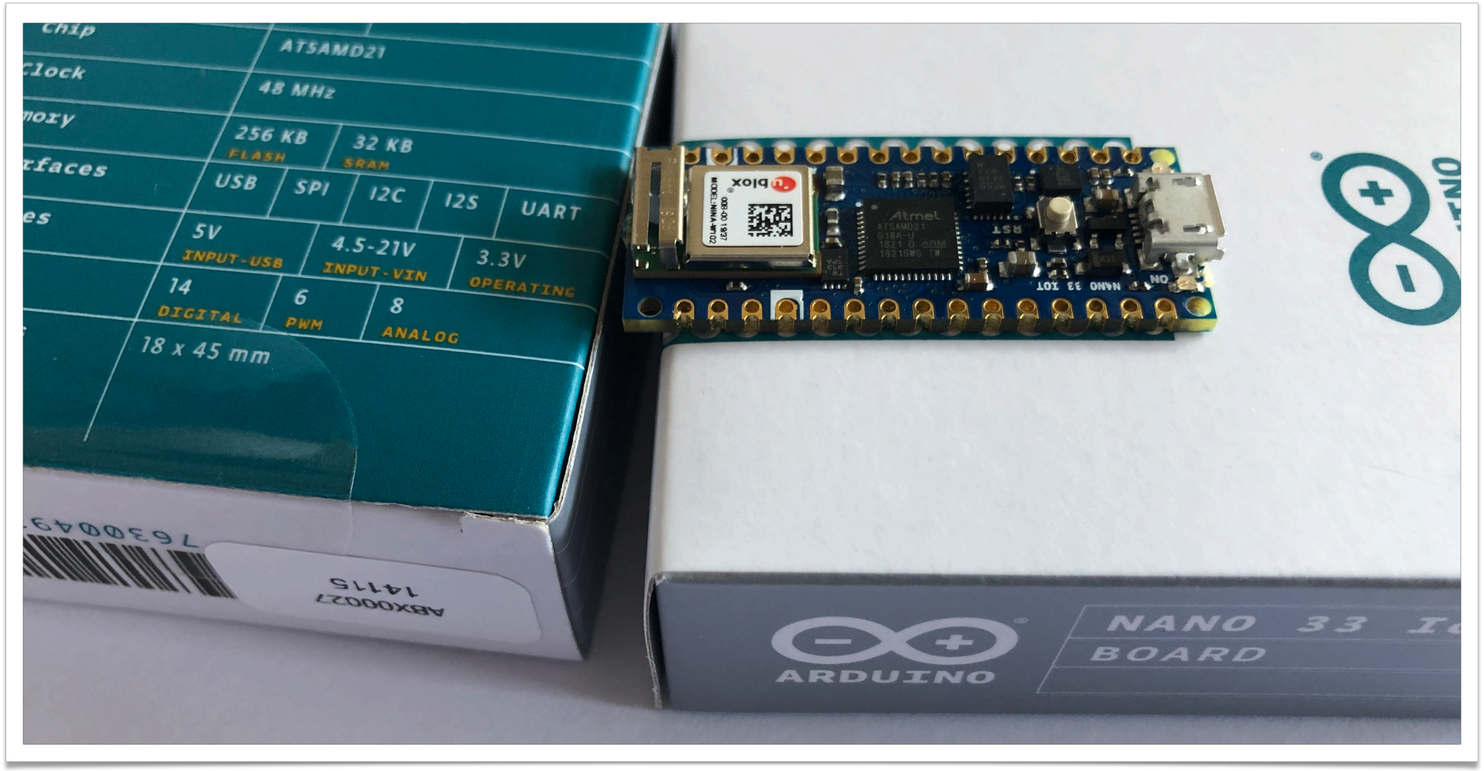
Tool name	Usage	Common Flag(s) / usage
dig / nslookup / host	Show DNS record information	dig / nslookup / host
hostname	Returns hostname of your system	hostname
ifconfig	Network interface configuration overview tool	
whois	Retrieving domain name information	
arp	Display the ARP table	-an
ssh	SSH client to connect to some host	`ssh –l pi other_hostname`

Security by design



Your secure IoT / MQTT device.

Practical: using your Nano 33 IoT Board Crypto chip (ATECC608A)



Your secure IoT / MQTT device.

Microchip ATECC608A

Features:

- Cryptographic co-processor with secure hardware-based key storage
- Protected storage for up to 16 Keys, certificates or data
- ECDH: FIPS SP800-56A Elliptic Curve Diffie-Hellman
- NIST standard P256 elliptic curve support
- SHA-256 & HMAC hash including off-chip context save/restore
- AES-128: encrypt/decrypt, galois field multiply for GCM

https://github.com/MicrochipTech/gcp-iot-core-examples/wiki

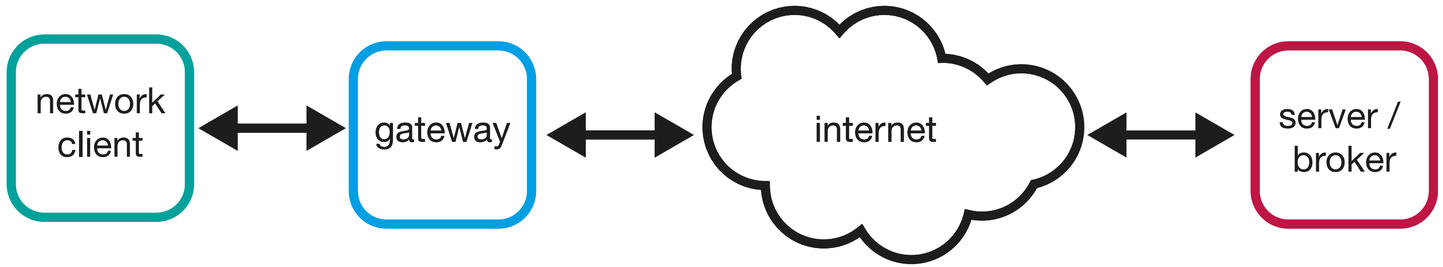
ARP Poisoning / Spoofing

Why:

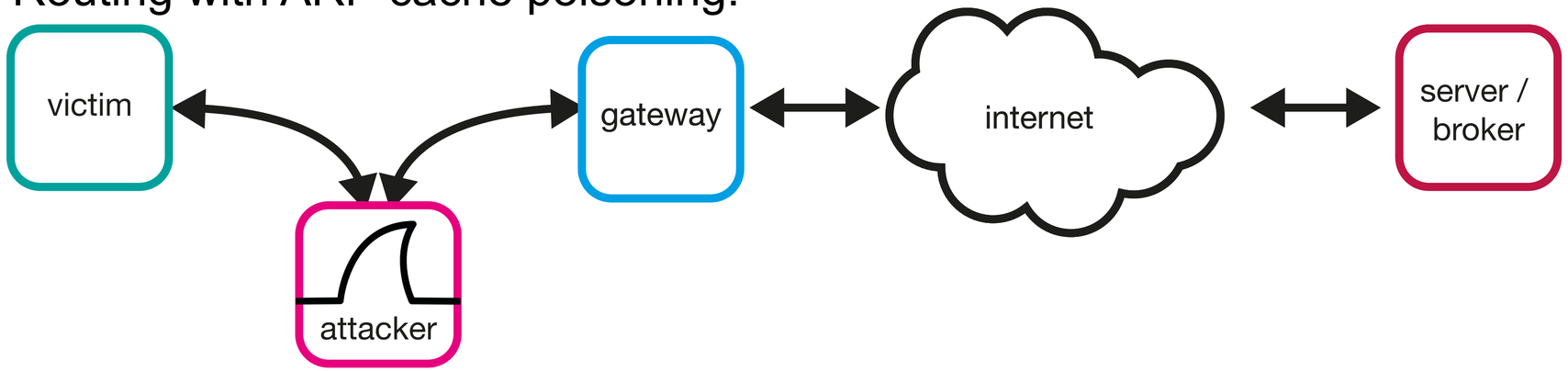
- get more insight into networking
- see why encryption matters
- get some intuition on how security can be tested

How does ARP Poisoning / Spoofing work?

Normal routing operation:



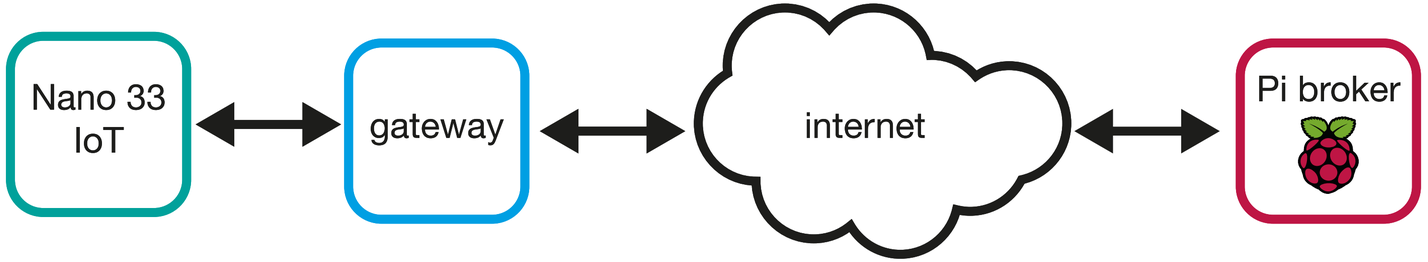
Routing with ARP cache poisoning:



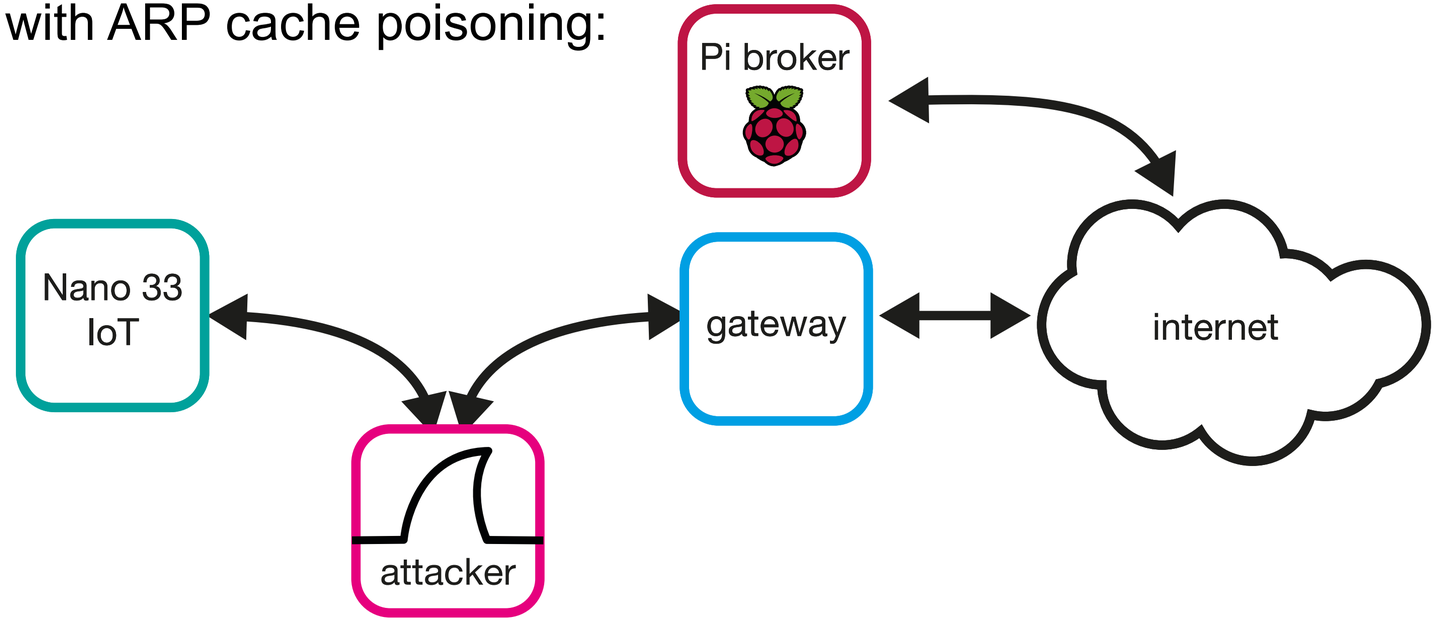
Note: victim needs to be in same subnetwork (wired, wireless, bridged)

Ok, time for our very evil plans:

Normal routing operation:



Routing with ARP cache poisoning:



Preparation: moving the broker outside of your local network

Either:

- Put your Pi in the DMZ of your Router (*possibly puts your device at risk!*)

Or:

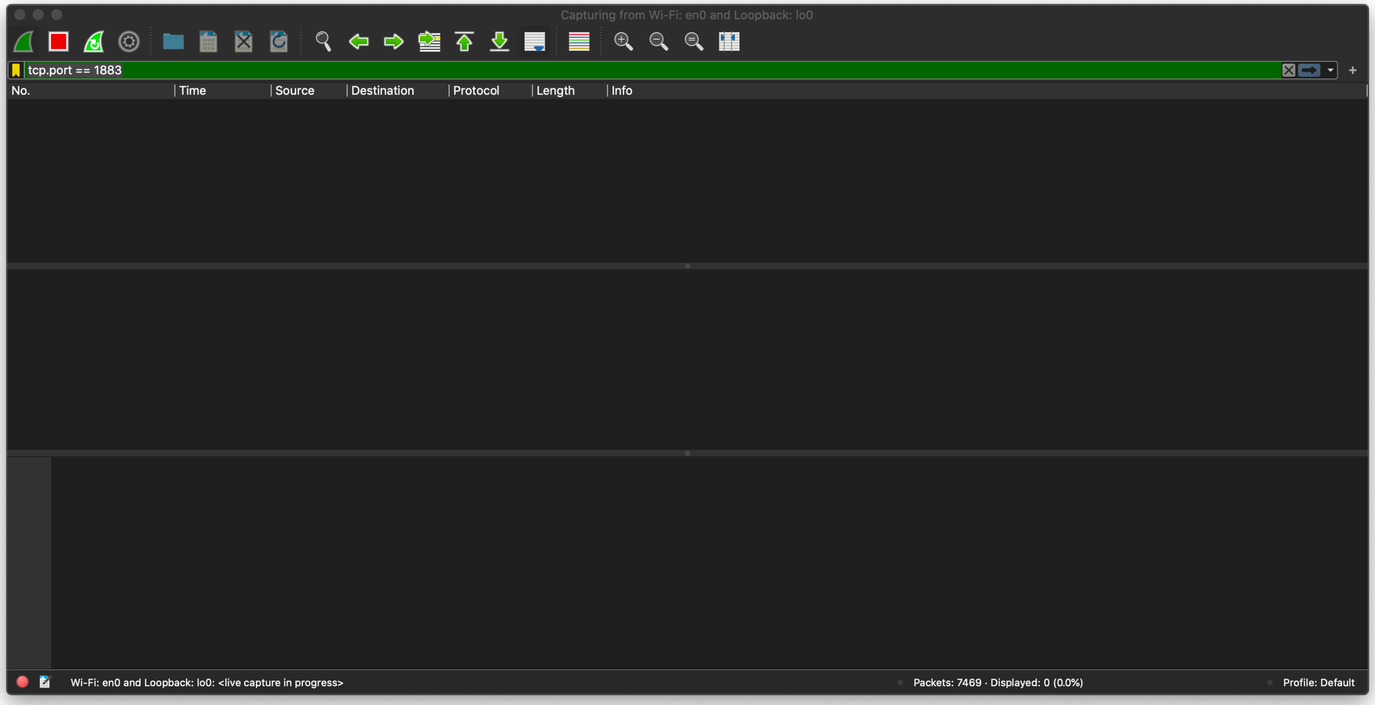
- Port Forward 1883 in your router to the local IP address of your Pi

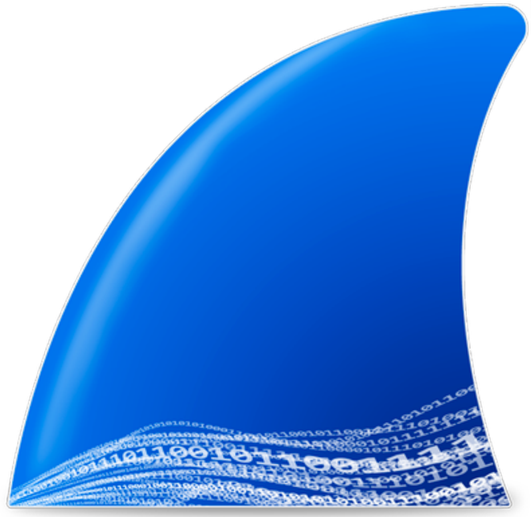
- Change MqttNano33 credentials to (external) IP address of your ISP router

(Find it in your router settings or use https://www.whatismyip.com)

Prepare Wireshark

1. Go to https://www.wireshark.org
2. Download and install Wireshark
3. Open Wireshark
4. Monitor your WiFi and local loopback





ARP Poisoning:

Step 1: get available local network *interfaces*

Step 2: get local network interfaces *gateways*

Step 3: get *gateway information* found in step 2

Step 4: show the *connected devices* to the particular gateway

Step 5: select the *intended victim*

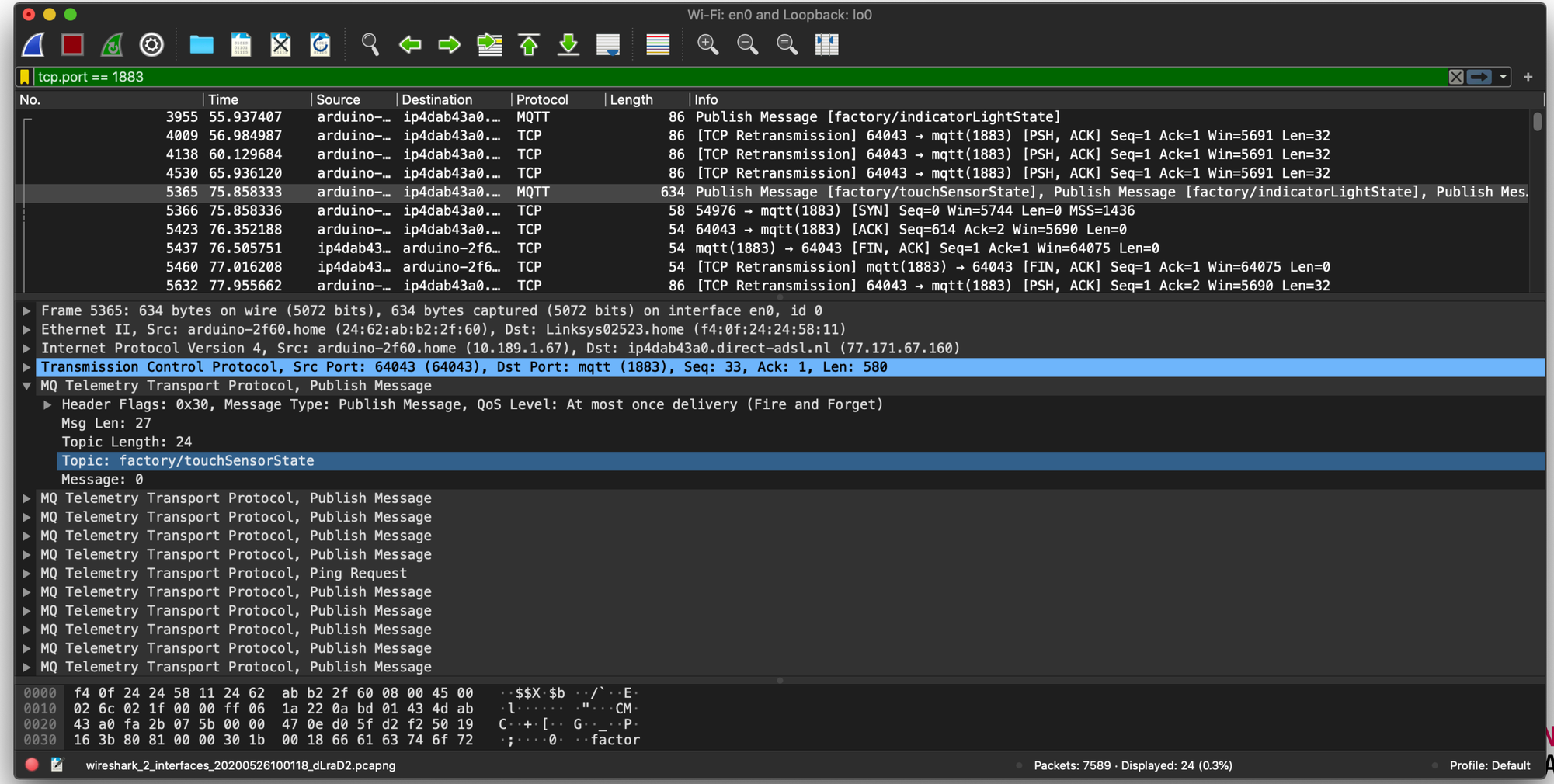
Step 6: poison ARP table (*pretend you are the gateway by broadcasting this*)

Step 7: do your analysis

Step 8: restore ARP tables

Results

Filter: "tcp.port == 1883"



Other types of network ‘misuse’

DNS Poisoning

TCP/IP Hijacking

etc. etc.

See e.g. https://www.tutorialspoint.com/ethical_hacking/ethical_hacking_dns_poisoning.htm

See also: https://github.com/ammarx/ARP-spoofing

SSL and Let's Encrypt

https://medium.com/@flynam/securing-your-iot-device-using-ssl-4643110ab901

See also the PDF "Study of the Development of an IoT-based sensor platform for E-Agriculture"

Links

Ethical Hacking:

https://www.tutorialspoint.com/ethical_hacking/index.htm

ARP Poisoning:

https://www.tutorialspoint.com/ethical_hacking/ethical_hacking_arp_poisoning.htm