Internet of Things...
Let's Not Forget Security Please!

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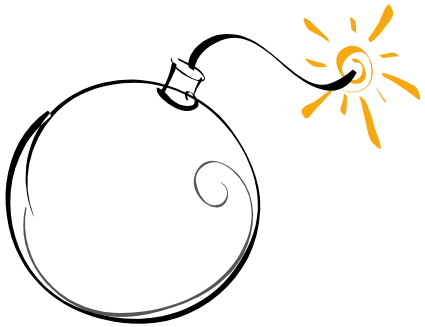
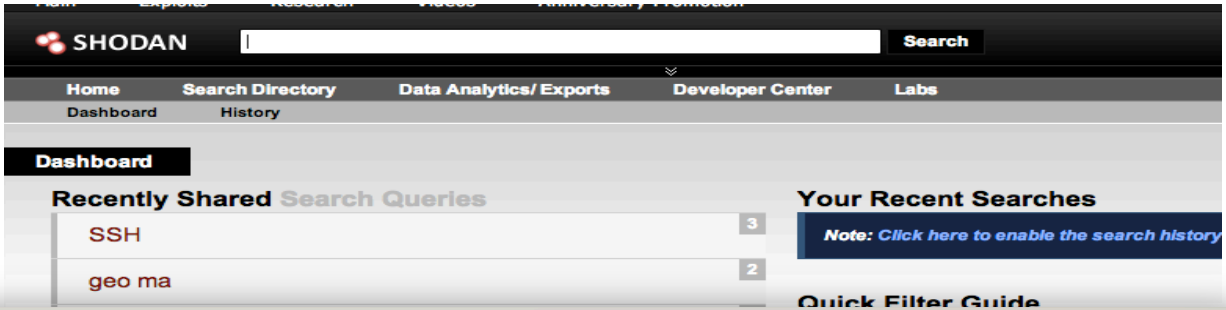
Internet of Things: Threats

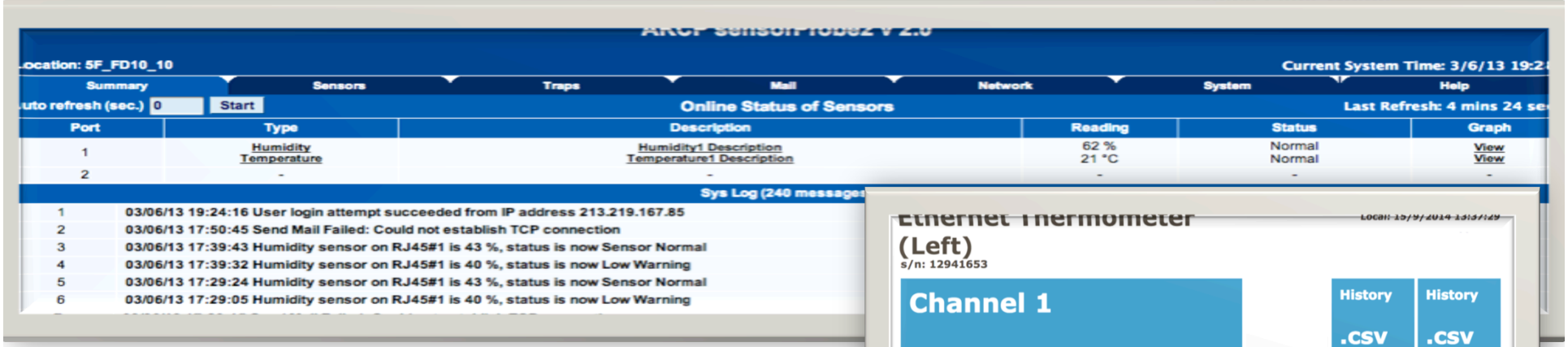
What are the threats?
Too many of them

- Plain worms escaping the plain IT world into the IoT?
  - Limited to ‘things’ running a consumer OS: Windows, Linux, iOS, Android, ...
- Script kiddies or other targeting at random residential IoT
  - Unprotected webcams
  - Stealing content
  - Having ‘fun’ with heating system
- Organized crime
  - Access to intellectual property
  - Sabotage and espionage
  - See also further
- Cyber-terrorism
  - Against nuclear plants, traffic monitoring, railways, ... (critical infrastructure)



Shodan





- http://www.shodanhq.com/ a IPv4 scan of the Internet
- Do not believe that IPv6 will help....

Risks to Industrial Control Systems

Risk to Human Beings

- Implantable Medical Device (such as pacemakers)
- *former Vice President Dick Cheney revealed that his doctor ordered the wireless functionality of his heart implant disabled due to fears it might be hacked in an assassination attempt.*
- *The late Barnaby Jack demonstrated how a certain model of implanted insulin pump could be lethally hacked to administer incorrect dosages from up to 300 feet way.*

http://www.washingtonpost.com/blogs/the-switch/wp/2013/10/21/yes-terrorists-could-have-hacked-dick-cheneys-heart/

Privacy even for residential

- Example: smart metering

  Using this example simply because it is easy to understand, deployed and could be fixed (if not yet done)

- In case of unauthorized access:

  Less consumption as usual => nobody at home, let's break into it!

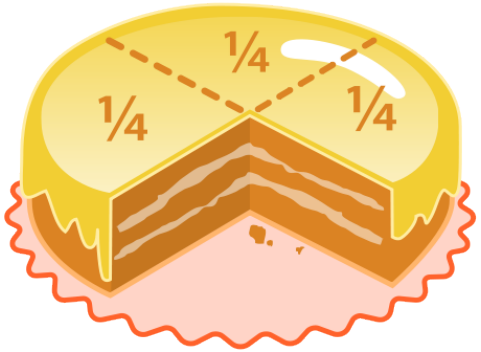
  5-min interval consumption meter => can guess the TV channel!

  http://events.ccc.de/congress/2011/Fahrplan/events/4754.en.html

Source: wikimedia.org

A System Approach to IoT Security

System Approach to IoT Security?



Source: wikimedia.org

- Too many IoT to do security analysis for all use cases
- Let's cut the big cakes in smaller edible pieces
- Let's focus on generic properties of IoT

  Property can be: mobile vs. fixe, tamper-proof

  And derives threats on each properties

  Then, design mitigation techniques or risk managements (work in progress...)

Lifetime: cost vs. crypto resistance

- Example: smart metering?
  - How old it your house?
  - How old is your electricity meter?
- Compare with lifetime of DES
  - 1977: published by US NIST
  - 1999: EFF breaks it in 22 hours
  - 2005: removed by US NIST
  - Guess: crypto has a limited lifetime of 20-30 years...
  - Compare with above...
- Even public key cryptography could be defeated with quantum computer...
  - OK, not within 10 years probably
  - Search also for ‘post quantum cryptography’

Source: wikimedia.org

Identity: pre-shared keys are back...

- X.509 Certificates and Public Key Infrastructure
  - Relies on cryptography (see previous slide)
  - Requires a long-term established Certificate Authority
  - Suitable for any to any authentication

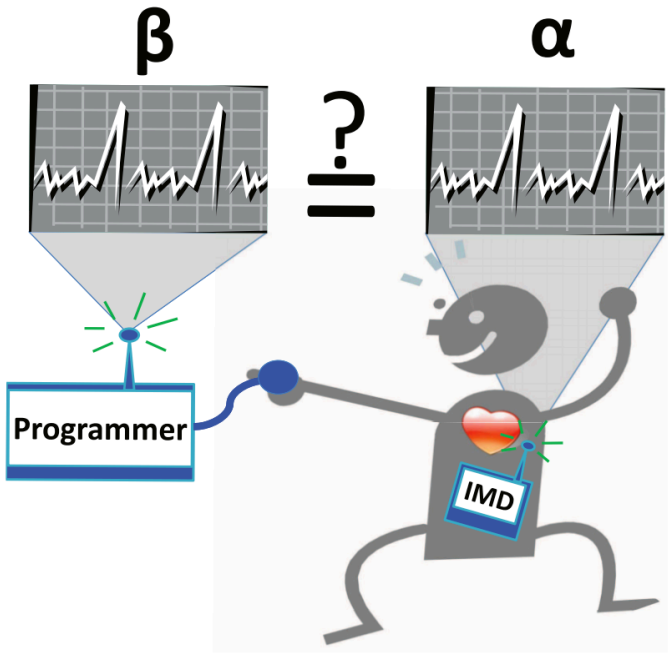
- Pre-shared keys
  - Suitable for pre-defined authentication (such as meters to server)
  - Well understood

Device identity vs. group membership?

- Any can handle access control
- Device identity/authentication
  - Smart meter to get your own bill
  - Actuators (and even)
  - Smart vehicles
  - But, scalability issue...
- Group membership
  - Array of sensors for physical environment, what is important is location not individual identity
  - Actuators: all bulbs in the same room
  - Easier to scale

Identity or Proximity?

- Sometimes, no need for real identity of peers
- Heart-to-Heart protocol to give programmatic access to Implantable Medical Device
- Sharing a common physical measurement with enough entropy is enough
- Can also be done with radio wave parameters



http://www.arijuels.com/wp-content/uploads/2013/09/RJK131.pdf (Ari Juels & Rice University)

Multi-Party Networks...

- Use case: smart metering, home surveillance, ...
  - Where the residential network (operated by SP/subscriber) is shared
- Availability?
  - Quality of Service is an obvious must
  - VLAN separation can also help (or SDN even?)
  - But shared/unmanaged CPE???
- Threat: Man-in-the middle attack to be assumed
  - Impact on confidentiality & integrity => crypto could help
- Provisioning? Vendor? Service Provider? Owner?
- Liability?

Mobility

- If a ‘thing’ is mobile, then it can be moved maliciously, i.e. stolen, but can still know its new position
- If a ‘thing’ is fixed, then a move could still be physically possible but undetectable

- Pick your devil!

Source: wikimedia.org

Always on?

- Always on:
  - Removal/loss detection is immediate
  - High rate of poll makes man-in-the-middle more complex
- Periodic poll:
  - Wait until next poll before detecting removal/loss
  - Balance between cost/energy and security
- On-event push:
  - Removal/loss detection is impossible

Source: wikimedia.org

Wisdom of the crowd

- Assuming cheap ‘things’, then one lost thing is not a major issue
  - Loss in the sense of physically destroyed (availability) or owned (integrity)
  - Averaging the surrounding sensor measurements (temperature, ...)
  - Could also be applicable to actuators such as parallel electrical switch

  Proven technique: using 3 ‘things’ and using a majority vote on the outcome. The voting system could be sheer dumb electronics

Summary

Summary

- IoT is a broad term covering
  - Different vulnerabilities: software, crypto, can be stolen, ...
  - Different risks: national critical infrastructure vs. home heating system
- Let's be pragmatic and cut the problem is smaller pieces
- Example: IoT Grand Security Challenge
  - http://blogs.cisco.com/security/join-the-challenge-secure-the-internet-of-things/
- Work in progress ☺, not all solutions are available yet
  - This is normal
  - Let's focus on the problem statement first
  - ***Solutions exist for specific IoT use cases (smart metering, ...)***
- What can we trust in Internet of Thing?
  - The network that we know or things to be built?

Thank you.