Securing the Internet of Things

Fred Baker

Agenda

- I'd like to look at problems reported with the Internet of Things, and potential solutions
  - Where do known issues come from?
  - Are there assumptions that would bear a challenge?

- What can we learn from the Internet that would help?
  - What issues and potential solutions are intrinsic?
  - Can network design help?
  - Can AAA solutions help?

Issues

- Recent reports include:
  - A failing light bulb that DOS'd a home
    - *http://fusion.net/story/55026/this-guys-light-bulb-ddosed-his-entire-smart-house/*
  - Attacks in which IOT devices were infected by Bots
    - *http://www.darkreading.com/endpoint/another-iot-dominated-botnet-rises-with-almost-1m-infected-devices/d/d-id/1326776*
    - *http://news360.com/digestarticle/ukyHHhsarU6yLKZr_xIQ4Q*
  - Attacks in which IOT devices are engaged in surveillance
    - *https://www.theguardian.com/commentisfree/2016/feb/09/internet-of-things-smart-devices-spying-surveillance-us-government*
- IOT devices/applications may be designed to engage in surveillance
  - Home health care devices and applications may log or export data for medical purposes
  - GPS apps often export location or activity information
  - *IOT information also in back end systems - "the cloud"; that has to be secured as well*

I proposed this talk before the recent wave of Mirai attacks

Just for the record

I feel like we are fighting yesterday's battle

- We have had problems with "consumer-grade" products in the Internet for quite some time
- Often essentially issues with manufacturing and specification:
  - Off-the-shelf software that is not necessarily up to date
  - Best Engineering Practices
    - Applying patches as they come out,
    - Regular software updates
    - Continuity between software or hardware versions.
- *How many products did we just describe? How many do you own?*

Add to that:

- Major argument against state of the art security software in IOT:
  - “These machines may not have enough power to implement it”
  - “There is no market for security”

Effect:
Nations regulating IOT and Internet markets

- US Presidential Cybersecurity Directive
  - *https://www.whitehouse.gov/the-press-office/2016/07/26/presidential-policy-directive-united-states-cyber-incident*
- EU Cybersecurity Directive
  - *http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2016.194.01.0001.01.ENG&toc=OJ:L:2016:194:TOC*
- More to come…

So - how best to secure the Internet of Things?

Lessons from the Internet of People…

Components

- Securing Communications
- Securing sites
- Manufacturing and Maintanence

Securing Communications

- What can be secured?
  - Data at rest (record encryption)
  - Data in flight (encrypted transfer, encrypted query/access)
  - Sessions (TLS, DTLS, IPsec, http/2)
    - http/2 allows secured encapsulation of multiple sessions
  - Peers (mutual authentication/authorization)
- Which is best?
  - All are needed, but maybe not all at the same time

Thinking about IOT data flows

- Many, especially in academia, look at IOT as a great source of data to study.
  - Lots of flows, lots of traffic, Big Data is all the rage.

- Think about this: if you suddenly have everyone else's data to look at and make inferences from, *they also have yours.*
  - *Is that what you intended?*

Site security

This is not a plug for perimeter security (firewalls)

- **However, it can have its uses…**

Three major ways IOT devices communicate:

- **Locally among peers or with a manager**
- **With a remote manager**
- **Among a set of peers managed remotely**

Site security: Local-only access

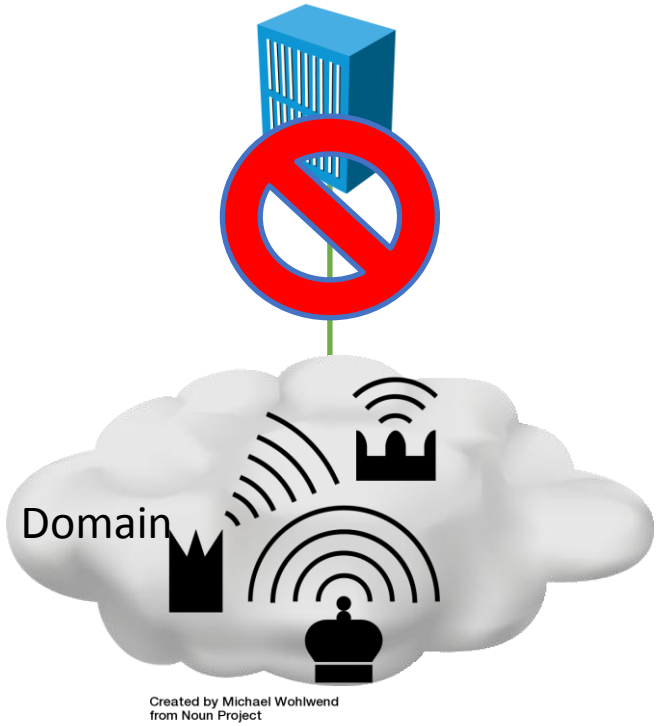
This is not a plug for perimeter security (firewalls)

- However, it can have its uses…

Three major ways IOT devices communicate:

- **Locally among peers or with a manager (air gap, addressing, or firewall)**
- With a remote manager
- Among a set of peers managed remotely

- Premise: if it has no route, it can't be attacked.
- But consider Stuxnet, and firewall-hopping viruses



Site security: Remote Manager

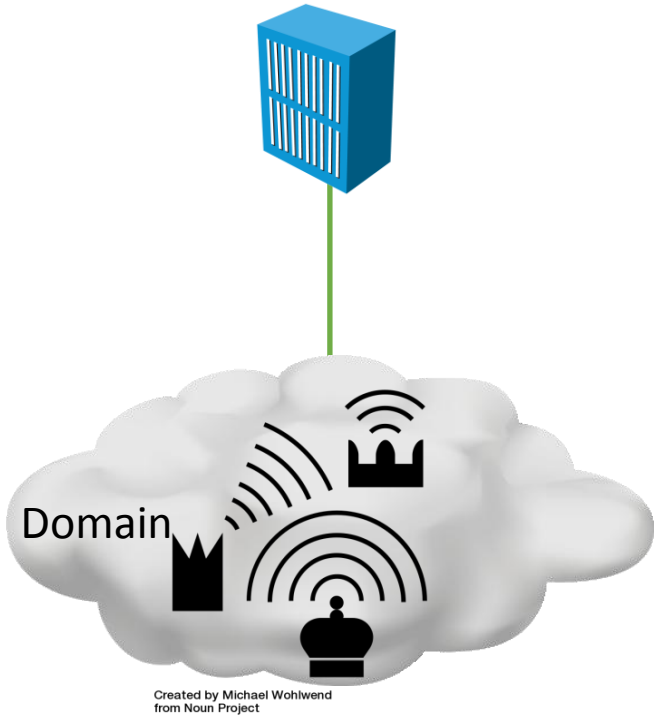
This is not a plug for perimeter security (firewalls)

- However, it can have its uses…

Three major ways IOT devices communicate:

- Locally among peers or with a manager
- **With a remote manager**
- Among a set of peers managed remotely

- Alexa, Siri, others
- Is your data visible to others? Recorded? Encrypted? Do you know?



Site security: Gateway plus Remote Manager

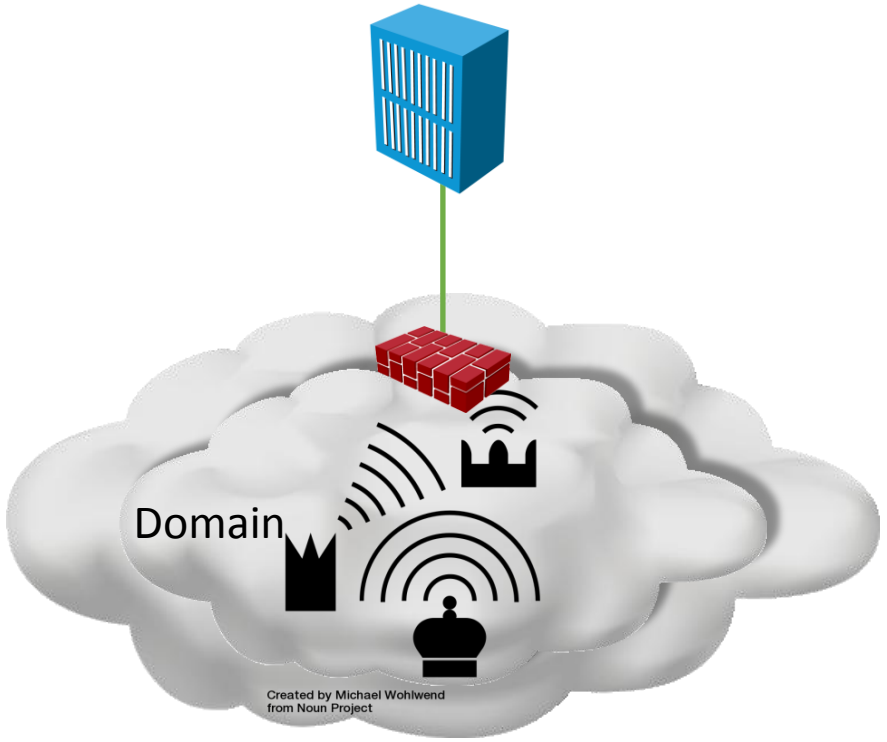
This is not a plug for perimeter security (firewalls)

- However, it can have its uses…

Three major ways IOT devices communicate:

- Locally among peers or with a manager
- With a remote manager
- **Among a set of peers managed remotely**

- AMQP, MQTT, and others
- Enables gateway function that limits access to the domain



Who is ultimately responsible for device security?

- We teach our children to not talk with strangers
  - Why do we let our computers talk with strangers?
- The network can provide a second layer of security
  - Defense in depth
- Ultimately, every device has to protect itself
  - Many attacks come from behind site security technologies
- How?
  - **Mutual authentication** – IOT devices have a small number of peers they are intended to communicate with, and those peers have specific things they can do.
  - Introduce them, and don’t let others intrude.

Example: Home Health Care

- **Imagine you have a motion detector and bed monitor at your mother's house, so you can tell if she's OK**
  - You and her doctor know
    - Whether she got up today,
    - What part of the house she is in
  - You can measure her heartbeat and motion in bed
  - Intelligent alerts can get your attention if needed
- **Who needs to know?**
  - Her doctor, you,
    - not nosy neighbors or thieves
  - What if someone hacks the server?
    - is her data there encrypted?
  - Communications in flight –
    - Server identity can reveal information
  - And of course, what computers should the probes communicate with? Not just anybody…

Manufacturing and Maintenance

- Open Source software is often a good source of functionality
  - Even so, it is often not up to date, and needs to be updated as vulnerabilities are identified
  - This is an ongoing problem
- Testing:
  - Test the failure modes as well as the normal operation modes. You don’t want to own the light bulb that DOS’d a house.
- When patches become available, you want them applied
  - Vendor should be maintaining/curating software
  - Device should update software from a provable source
    - On installation
    - On demand
    - Periodically

The lesson from Mirai - 1

- Manufacturers are being forced to recall product
  - http://www.welivesecurity.com/2016/10/24/webcam-firm-recalls-hackable-devices-mighty-mirai-botnet-attack/
  - Tell me about “shooting the messenger”?

- Wouldn’t it be better if they could post a new software load and tell users to trigger a software update?
  - Or had updated the software before the attack was launched?
  - Or followed security 101 (not left a well known password open) before the product left the door?

The lesson from Mirai – DHS, US CERT

- Important reading:
  - http://www.welivesecurity.com/2016/10/24/10-things-know-october-21-iot-ddos-attacks/

- Recommendations from DHS/US CERT:
  - Ensure all default passwords are changed to strong passwords.
  - Update IoT devices with security patches as soon as patches become available.
  - Disable Universal Plug and Play (UPnP) on routers unless absolutely necessary.
  - Purchase IoT devices from companies with a reputation for providing secure devices.

- Come on, guys. We know this. It's not news. We can do better.