Medical Device Security and the Curse of The Internet of Things

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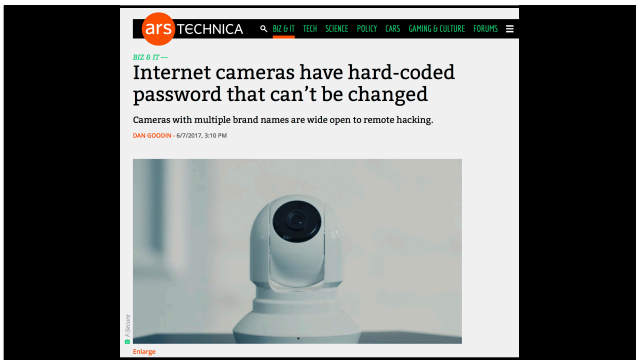
The Internet of Things

- Almost everything has a computer in it.

The Curse of the Internet of Things

- Almost everything with a computer in it is broken.


ars TECHNICA
BIZ & IT TECH SCIENCE POLICY CARS GAMING & CULTURE FORUMS
BIZ & IT —
Internet cameras have hard-coded password that can't be changed
Cameras with multiple brand names are wide open to remote hacking.
DAN GOODIN - 6/7/2017, 3:10 PM
Enlarge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BIZ & IT TECH SCIENCE POLICY CARS GAMING & CULTURE FORUMS
BIZ & IT —
Crypto weakness in smart LED lightbulbs exposes Wi-Fi passwords
More evidence the Internet of things treats security as an afterthought.
DAN GOODIN - 7/7/2014, 12:20 PM
WiFi
6LoWPAN mesh network


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SLEEPING GIANT —
Internet-paralyzing Mirai botnet comes roaring back with new strain
100,000 devices infected in 60 hours by strain that targeted ZyXEL devices.
DAN GOODIN - 11/29/2017, 9:21 AM
CenturyLink
Enlarge / One of the modems targeted by a newly discovered strain of Mirai.

COMPUTERWORLD

NEWS ANALYSIS

Researchers hack Philips Hue lights via a drone; IoT worm could cause city blackout

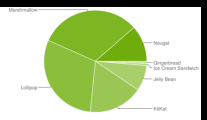
Researchers hijack Philips Hue lights with a drone to show how IoT worm could take over smart lights in a city.

MORE LIKE THIS

- Your router won't protect you when smartphones attack smart homes
- Side channel power, the new security front
- Code in the wild to infect millions of IoT devices for crippling DDoS attacks
- VIDEO Tech Talk: Uber hack, Google tracks, AWS packs (in China) ... and Firefox is...

Android Version Adoption

Version	Codename	API	Distribution
2.3.3 - 2.3.7	Gingerbread	10	0.7%
4.0.3 - 4.0.4	Ice Cream Sandwich	15	0.7%
4.1.x	Jelly Bean	16	2.8%
4.2.x		17	4.1%
4.3		18	1.2%
4.4	KitKat	19	17.1%
5.0	Lollipop	21	7.8%
5.1		22	22.3%
6.0	Marshmallow	23	31.8%
7.0	Nougat	24	10.6%
7.1		25	0.9%



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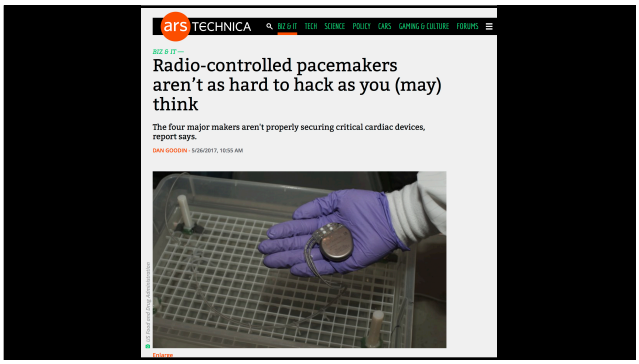
DEALERS, READY YOUR FLASH DRIVES —

Fiat Chrysler recalls 1.4 million cars over remote hack vulnerability

Uconnect bug can shut down engine and brakes, take over steering.

SEAN GALLAGHER - 7/24/2015, 8:54 AM



Alert (ICS-ALERT-13-164-01) Medical Devices Hard-Coded Passwords

- The affected devices are manufactured by a broad range of vendors and fall into a broad range of categories including but not limited to:
  - Surgical and anesthesia devices.
  - Ventilators.
  - Drug infusion pumps.
  - External defibrillators.
  - Patient monitors.
  - Laboratory and analysis equipment.

Flaws

- Software bugs.
- Hard coded passwords.
- Lack of updates.
- Unsigned updates.
- Unnecessary services.
- Unpatched vulnerabilities in necessary services.

Attacks

- Botnets.
- Privacy and identity theft.
- Ads.
- Ransomware.
- Foothold for attacking other devices in the network.

Causes

- Low profit margins on cheap devices.
- Investor expectations on expensive devices.
- Lack of knowledge by manufacturers.
- Lack of knowledge by consumers.

The cost of making secure devices is borne by the manufacturer.

The cost of using insecure devices is borne by the consumer.

Medical Device Integration

- Place collected data into the patient's medical record.
- Generate billing information.
- Five R's
  - The right patient.
  - The right drug (procedure).
  - The right dose (equipment).
  - The right route (location on the patient).
  - The right time.

Device Security

- Depends upon software reliability.

Software Reliability

- Reduced bugs.
- Maintainable.
- Solved problem.
- Agile Methods.

Agile Methods

- Clarity.
- Continuous delivery.
- Test Driven Development (TDD).
- Robust design.

Clarity

- Code should be written to be easily understood by people.
  - Avoid cleverness.
  - Avoid terseness.
  - Use consistent style.
- Writing is rewriting.
- Rewriting software is refactoring.
- Can only refactor when the code is clear and covered by tests.
- Each time a programmer touches code, he/she should improve it.

Continuous Delivery

- Each feature is completed before the next feature is started.
- The opposite of Waterfall.
- Requires robust design.
- Can ship at any time!

Test Driven Development

- Each routine and module is individually tested.
- Very short cycle.
- Test can be written first.
- Entire suite of tests is run with each compilation.
- Additional tools are also used.
  - Static analyzers.
  - Memory sanitizers.
  - Thread sanitizers.
  - Performance profiling tools.

Robust Design

- Is about dependency management.
- SOLID principles.
  - Single-Responsibility principle.
  - Open-Closed principle.
  - Liskov substitution principle.
  - Interface segregation principle.
  - Dependency inversion principle.
- Can be implemented in any programming language.

Secure Software Design

- Simplicity.
- Continuous updates.
- Use best practices for secure software development.

Best Practices for Secure Software Development

- Use well tested software libraries.
- Avoid other libraries.
- Avoid interpreted environments like HTML, JavaScript, Python and VisualBasic.
- Validate and sanitize all input.
- Eliminate unnecessary services.
- Use certificate pinning.
- Use code signing.
- Enable remote updates.

Fixing Existing Products

- Most important first step is completing an external security audit.
- Shut off all unused services.

Creating a New Product

- Use a secure hardware platform.
- Use a modern programming language and development tools.
- For embedded systems, use established secure system software.
  - Internet RFC on Firmware Update Architecture.
- For PC based systems, use specially hardened versions of the operating system.
  - No great choices here.
- Plan for security and update infrastructure from the start.

Clean Code:
A Handbook of Agile Software Craftsmanship
Robert C. Martin, 2008

Clean Architecture:
A Craftsman's Guide to Software Structure and Design
Robert C. Martin, 2017

Secure Programming Cookbook for C and C++:
Recipes for Cryptography, Authentication, Input Validation & More
John Viega and Matt Messier, 2003

Securing the Internet of Things
Shancang Li and Li Da Xu, 2017

The Open Web Application Security Project (OWASP)
https://www.owasp.org/

A Firmware Update Architecture for Internet of Things Devices
Internet Engineering Task Force (IETF)
https://tools.ietf.org/html/draft-moran-suit-architecture-00