Electrical & Computer ENGINEERING

18-642:
Security Plans

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Carnegie Mellon University

SECURITY PLAN

Edge Case Research

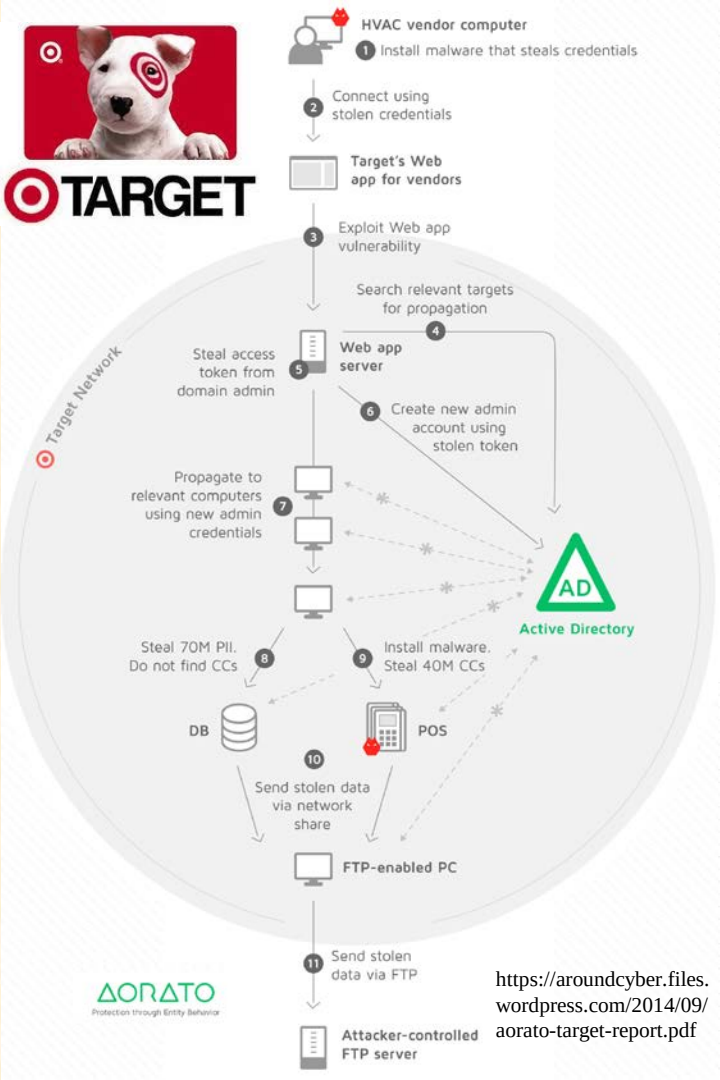
- **Anti-Patterns:**
  - **No security plan**
  - **Expecting "perfect" security**
  - **Unrealistic security assumptions**

- **Plan for security: Why, What, How**
  - Why is security important to your system?
    - Which aspects matter; which don't?
  - What types of attacks do you expect?
    - Which attackers present the most risk
  - How can you mitigate the risk?
    - How do you know you succeeded?

Elements of a Security Plan

- **Requirements**
- **Threats**
- **Vulnerabilities**
- **Mitigation**
- **Validation**

Target Attack



https://aroundcyber.files.wordpress.com/2014/09/aorato-target-report.pdf

- **Wake-up call to US credit card system**
  - Credit card skim at Point of Sale Terminals
    - Personal info (PII) also stolen from database
  - $150M - $300+M costs to Target
    - Additional costs bank write-off costs
  - Accelerated move to chip security in US
  - Ultimately, cost CEO of Target his job
- **Complex attack**
  - Many steps, 3 month timeframe
  - Generated multiple security alerts
  - 11 GB of data, 40M credit cards, 70M other PII
    - http://www.zdnet.com/article/the-target-breach-two-years-later/
    - https://www.commerce.senate.gov/public/_cache/files/24d3c229-4f2f-405d-b8db-a3a67f183883/23E30AA955B5C00FE57CFD709621592C.2014-0325-target-kill-chain-analysis.pdf
    - https://aroundcyber.files.wordpress.com/2014/09/aorato-target-report.pdf

Security Requirements: Why Secure?

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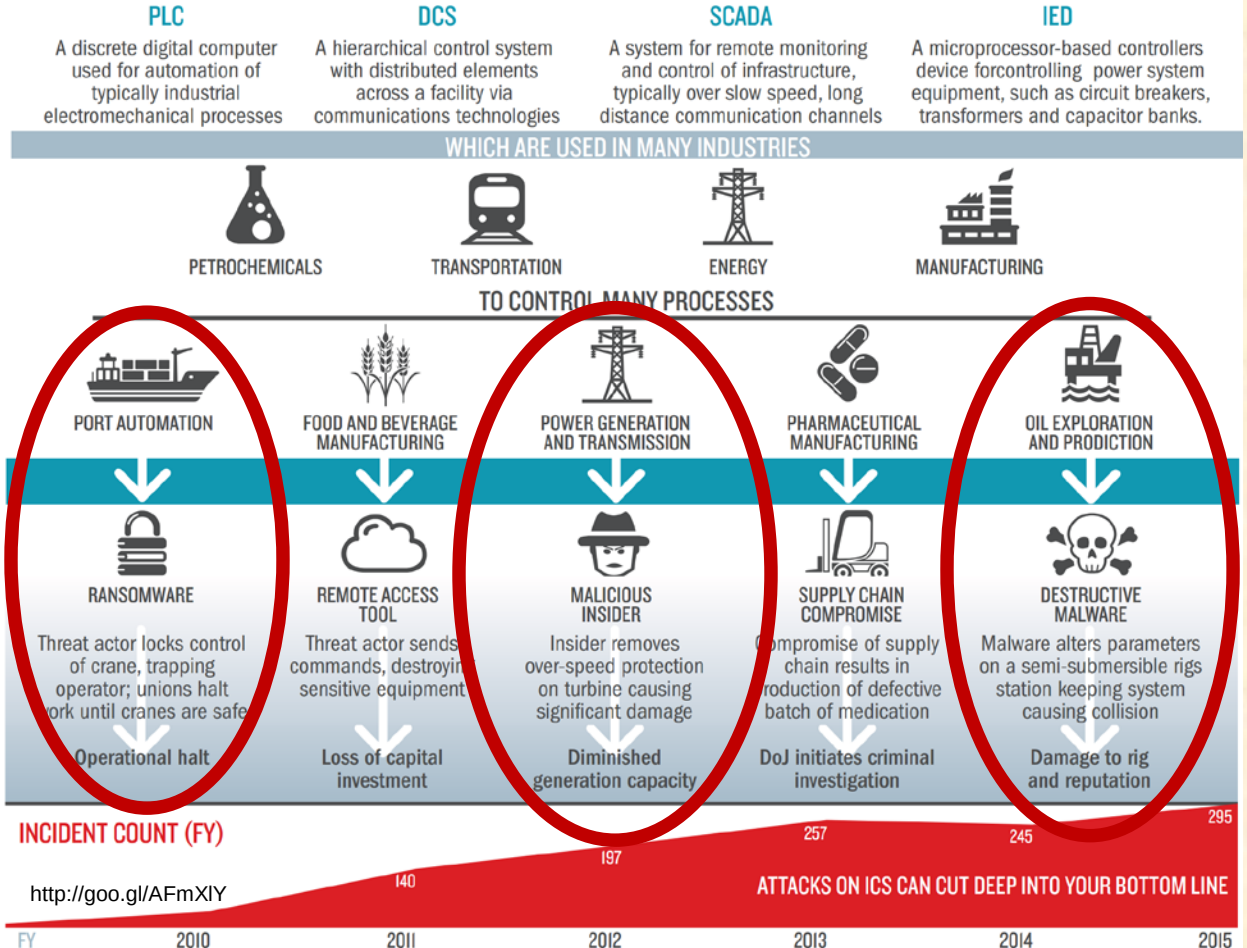
- **Security: Protecting against unauthorized access, use, disclosure, disruption, modification, and destruction**
  [http://csrc.nist.gov/drivers/documents/FISMA-final.pdf]
  ➔ ("CIA" properties)

- **Confidentiality: is information released?**
  - Information is kept secret (**Secrecy**) ➔ Encryption
  - Activities can't be associated with an individual or other entity (**Privacy**)
- **Integrity: have changes been made?**
  - Unauthorized data alteration or destruction is detected or prevented (**Data Integrity**)
  - Changes to system state made by authorized entities (**Authentication**; **Non-Repudiation**)
- **Availability: is it working?**
  - Services are available when requested in a timely manner (opposite is **Denial of Service**)
- **Which of these are most important to you?**
  - Often **Data Integrity** matters more than **Secrecy**

Threats: What Types Of Attacks?



http://goo.gl/AFmXlY

- **Who:**
  - Nation State
  - Organized group
  - Script Kiddie
  - Casual abuser
  - Insider

- **Motivation: $$$$(?)**
  - Politics & economics
  - Surveillance
  - Denial of Service
  - Ransom
  - Fame & Notoriety
  - Just for the lulz

Vulnerabilities: Weaknesses & Tactics

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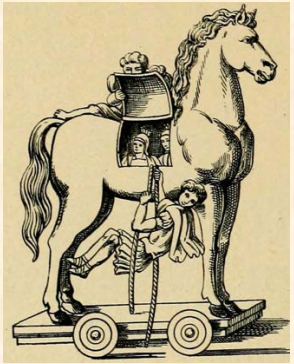
- **Resource management**
  - Buffer overflow
  - Garbage collection; timeouts
- **Improper input validation**
  - Crash due to exceptional inputs
  - Executing input as a command (SQL)
- **Improper Authentication**
  - Bad configuration; information exposure
  - Delayed message playback
  - Man-in-the-middle attacks
- **Bad Cryptography**
  - Weak algorithms
  - Non-random keys
  - Insecure protocols



http://goo.gl/n3spNF

- **Back door**
  - e.g. Not-so-secret factory password
- **Brute Force**
  - Dictionary of common passwords
  - Random parameters to see what breaks
- **Phishing**
  - Trick victim into installing malware
  - Trick victim into revealing info
- **Worms that self-propagate**
  - USB flash drive infections
- **Trojan Horse**
  - e.g., Fake software update
- **Side Channel**
  - Power consumption reveals secret keys

Mitigation: Good Security Design

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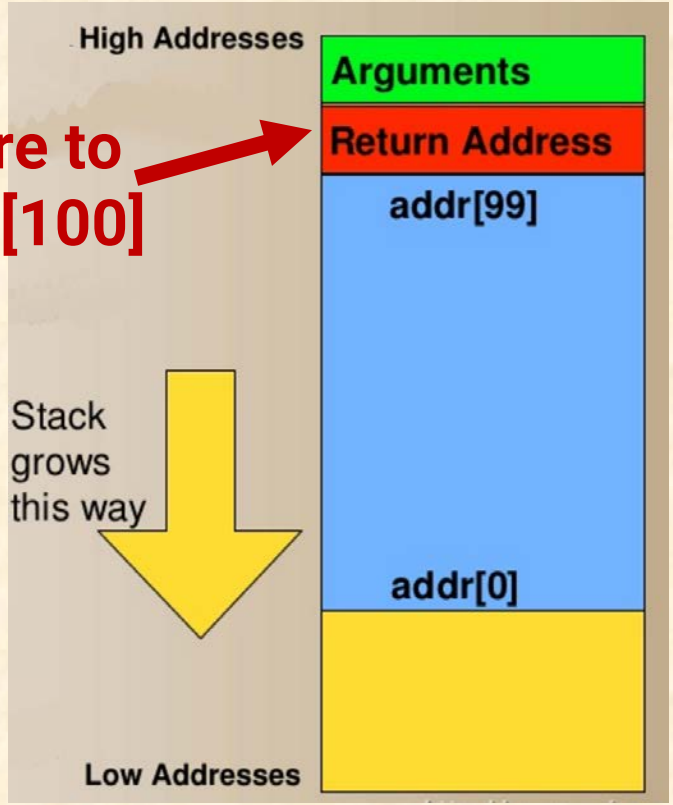
- **Pay attention to resource management**
  - Especially, avoid buffer overflows
- **Validate all inputs**
  - Check size & data validity
- **Ensure authentication is done properly**
  - No master password!
  - Configuration, permissions
- **Use strong crypto & proven protocols**
  - If you write it yourself, probably it's broken
  - Principle of Least Privilege (don't run as root)
- **Secure boot**
  - Authenticate updates
- **Avoid "security via obscurity"**
  - Proprietary network protocols are NOT secure
  - Rely primarily on a unique, per-system crypto key



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Validation: How Do You Know You're Secure?

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- **Check code quality**
  - Buggy code is probably insecure
  - Static analysis, stack checker tool, dynamic checkers
  - Peer reviews (e.g., follow Cert C 98 Coding Standard)
    - http://www.open-std.org/jtc1/sc22/wg14/www/docs/n1255.pdf

- **Penetration testing**
  - Mostly helps deal with known exploits
- **Penetration analysis**
  - Hire a "red team" to attempt to penetrate system
- **Plan to be imperfect**
  - What if assumptions are violated (e.g., customer firewall)
  - Defense in depth
  - Plan for security patches (on-line updates are a vulnerability too!)

Elements of a Security Plan

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A written document with plan for making your product secure:

- **Security Requirements**
  - What does security mean to your product?
- **Threat Model**
  - Who is likely to attack you, and why?
  - What is the operational environment?
- **Vulnerabilities**
  - What are the paths of attack on your system?
  - What are the likely objectives of an attacker?
- **Mitigation Strategies**
  - Rank probably & severity (to the degree you can) and prioritize risk (e.g., with a Risk Table)
  - How will you address each risk, including ones that appear after deployment?
- **Validation Strategies**
  - Does your mitigation really work?