



The Cyber Security Mess

Simson L. Garfinkel

Associate Professor, Naval Postgraduate School

May 16, 2013

DISCLAIMER:

“The views expressed in this document are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.”

NPS is the Navy's Research University.

Monterey, CA — 1500 students

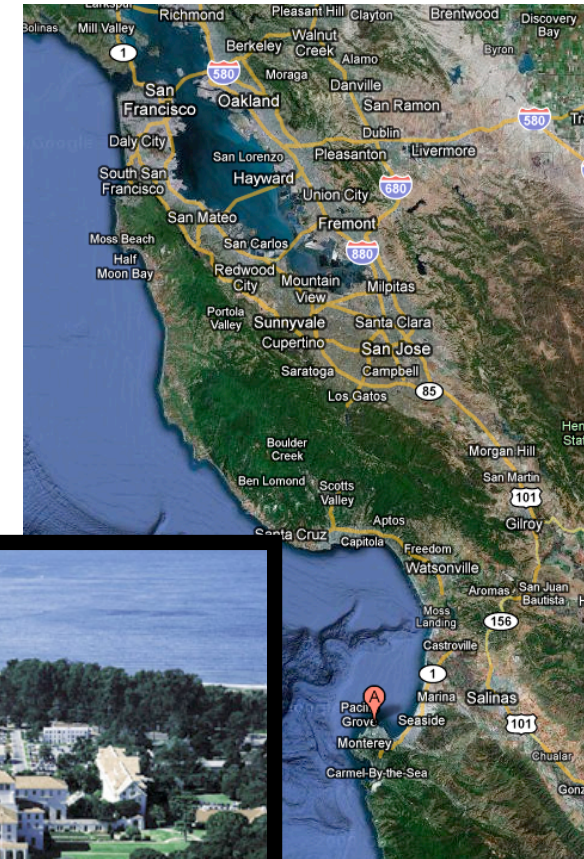
- US Military & Civilian (Scholarship for Service & SMART)
- Foreign Military (30 countries)

Graduate Schools of
Operational & Information Sciences (GSOIS)

- Computer Science
- Defense Analysis
- Information Sciences
- Operations Research
- Cyber Academic Group

National Capital Region (NCR) Office

- 900 N Glebe (Ballston)/Virginia Tech building



“The Cyber Security Risk”, *Communications of the ACM*, June 2012, 55(6)

V

viewpoints

001358.1146/7184312.1204310

Simon L. Garfinkel

Inside Risks

The Cybersecurity Risk

Increased attention to cybersecurity has not resulted in improved cybersecurity.

The risk of being “hacked”—whatever that expression actually means—is at the heart of our civilization’s chronic cybersecurity problem. Despite decades of computer security research, billions spent on secure operations, and growing training requirements, we seem incapable of operating computers securely.

There are weekly reports of penetrations and data thefts at some of the world’s most sensitive, important, and heavily guarded computer systems. There is good evidence that global interconnectedness combined with the proliferation of hacker tools means that today’s computer systems are actually less secure than equivalent systems a decade ago. Numerous breakthroughs in cryptography, secure coding, and formal methods notwithstanding, cybersecurity is getting worse as we watch.

So why the downward spiral? One reason is that cybersecurity’s goal of reducing successful hacks creates a large target to defend. Attackers have the luxury of choice. They can focus their efforts on the way our computers represent data, the applications that process the data, the operating systems on which those applications run, the networks by which those applications communicate, or any other area that is possibly subverted. And faced with a system that is beyond one’s technical hacking skills, an attacker can go around the security perimeter and use a range of other techniques, including social engineering, supply-chain insertion, or even kidnapping and extortion.

It may be that cybersecurity appears to be getting worse simply because society as a whole is becoming much more dependent upon computers. Even if the vulnerability were not increasing, the successful hacks can have significantly more reach today than a decade ago.

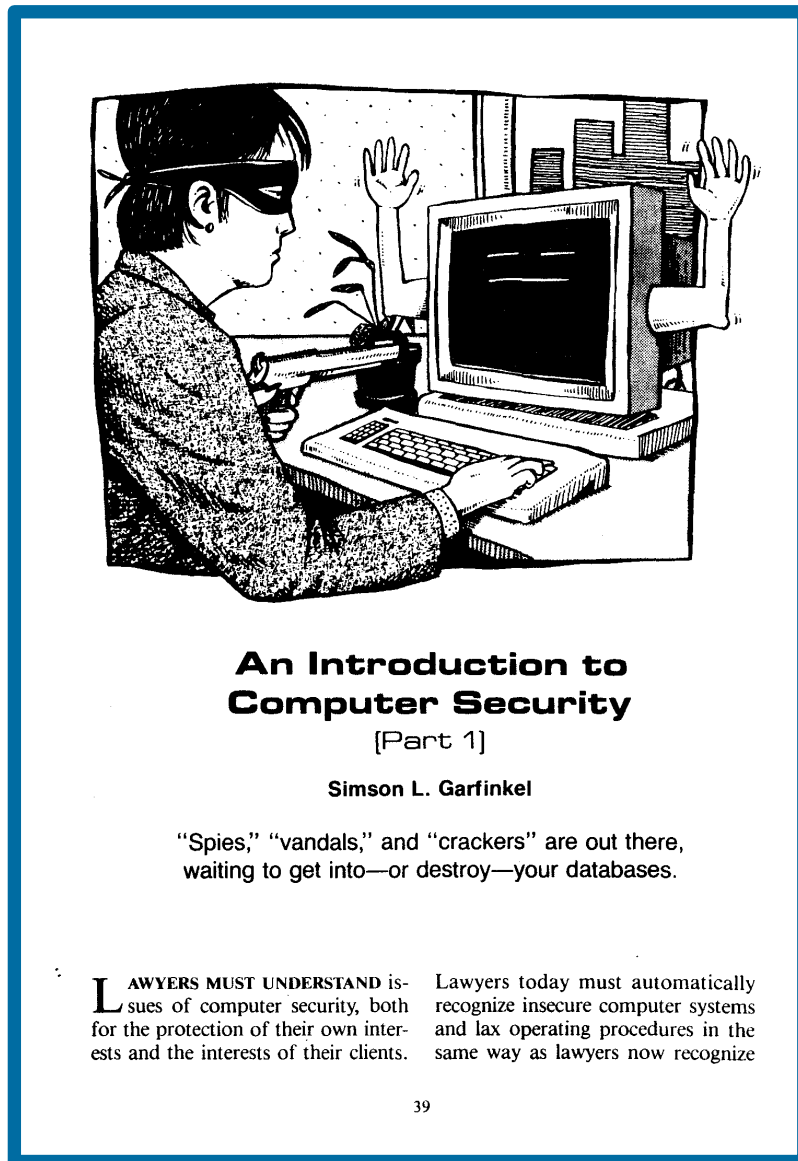
Views of Cybersecurity

The breadth of the domain means many different approaches are being proposed for solving the cybersecurity problem:

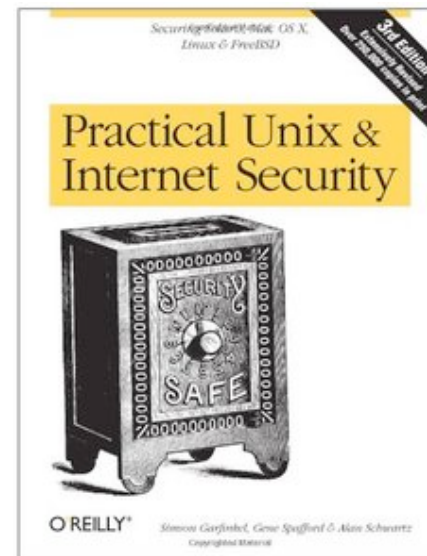
- Cybersecurity can be viewed solely as an insider problem. What is needed, say advocates, are systems that prevent

1

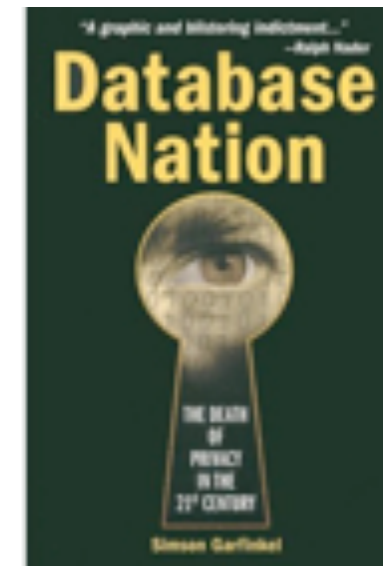
I have spent 25 years trying to secure computers...



Sept. 1987



1991



2000



2006

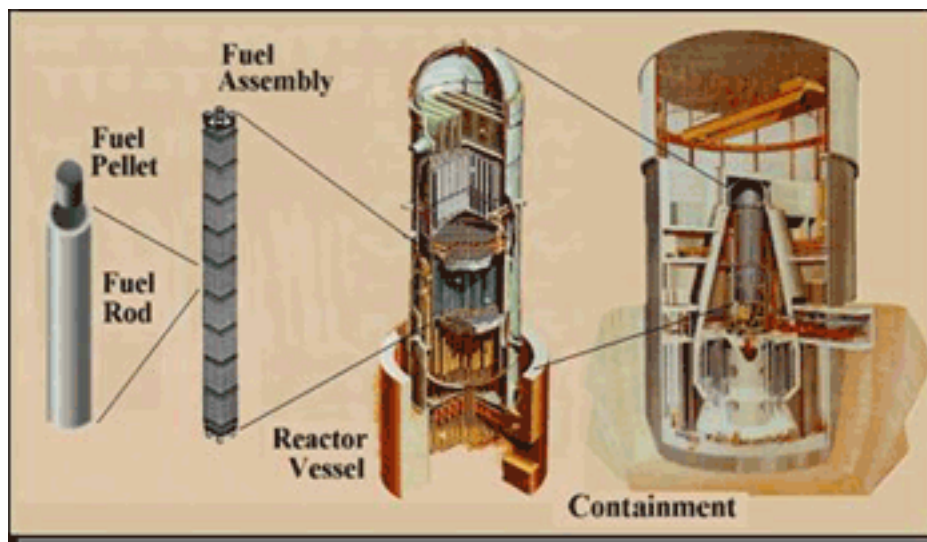


2006

Today's systems are less secure than those of the 1970s.

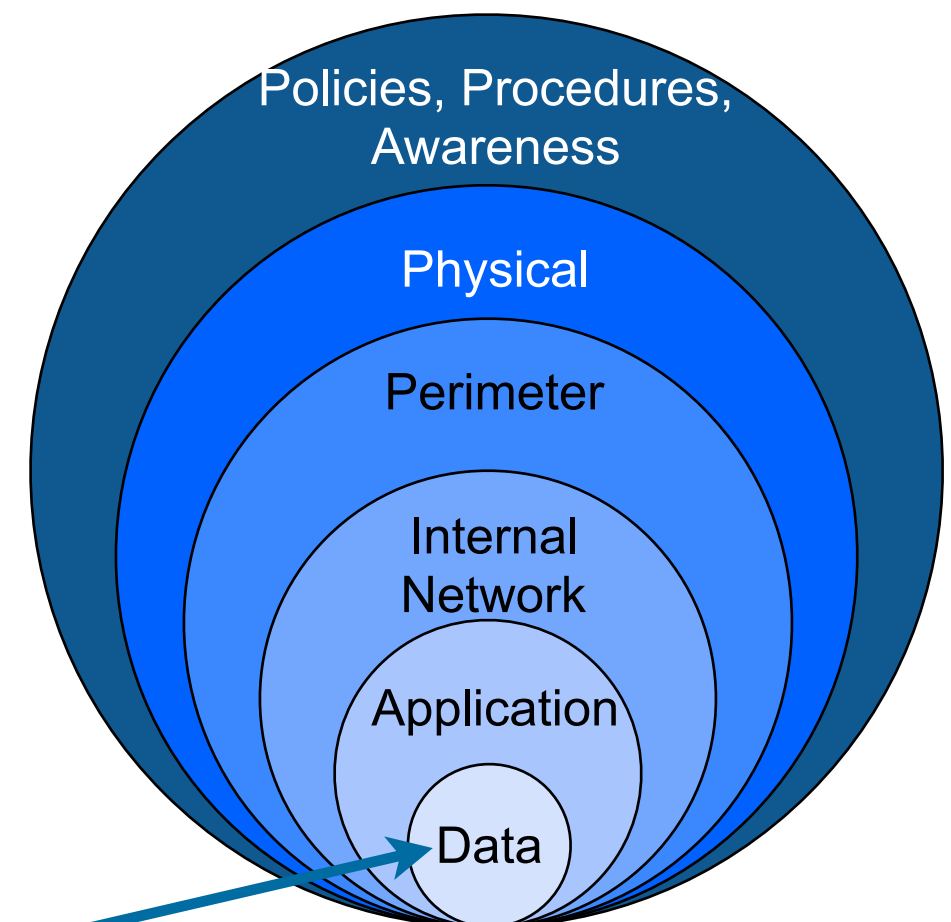
The lack of security is **inherent** in modern information systems.

- Attack is **easier and cheaper** than defense.
- Cyber “Defense in depth” does not work
— *a single vulnerability compromises.*



Defense in depth of nuclear reactors

<http://www.nrc.gov/about-nrc/regulatory/research/soar/soarca-accident-progression.html>



**Cyber can directly target
inner defenses**

It's easier to break things than to fix them.

Windows

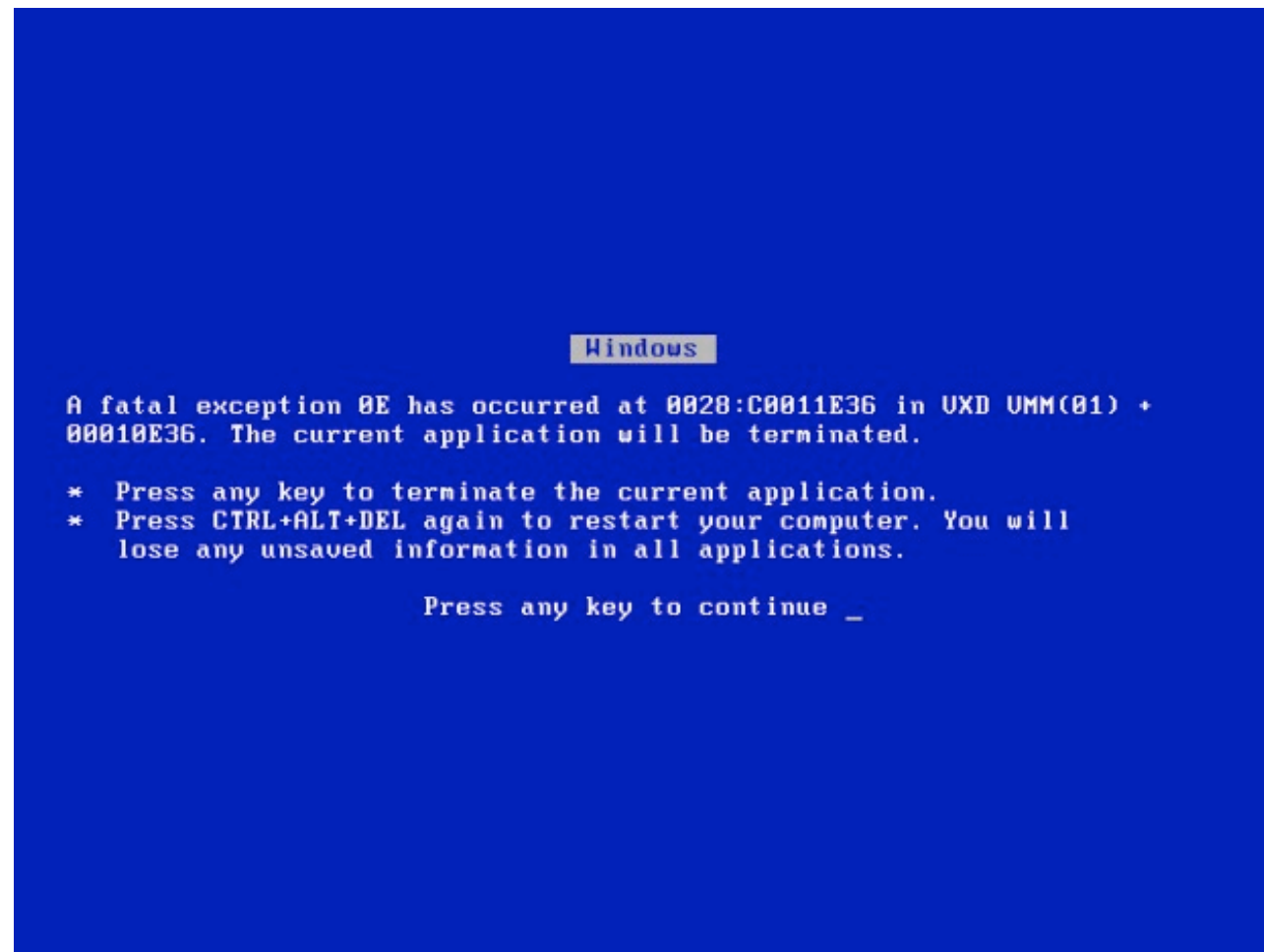
A fatal exception 0E has occurred at 0028:C0011E36 in UXD UMM(01) + 00010E36. The current application will be terminated.

- * Press any key to terminate the current application.
- * Press CTRL+ALT+DEL again to restart your computer. You will lose any unsaved information in all applications.

Press any key to continue _

Today we expect computers to crash

We should also expect them to be hacked.



The solution is not better security

I start every day with...

[ISN] Internet Security News



[ISN] — infosecnews.org

Search results - simsong@ x

https://mail.google.com/mail/ca/u/0/#search/from%3Ainfosec+news

VA nps TTD Shop news doc ref Jobs rev

+Simson Search Images Maps Play YouTube News Gmail Drive Calendar More -

Google from:infosec news

Simson Garfinkel 1 + Share

Gmail 1-20 of many

COMPOSE

Inbox (2)
Sent Mail
All Mail
Spam (2,131)
Trash

Circles
More

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Search, chat, or SMS

Info	From	Subject	Date
<input type="checkbox"/> ☆	InfoSec News	[ISN] Amy's Baking Company Says 'We Were Hacked!' Following Yesterday's Scorched Earth ... - Visit the InfoSec New	2:23 am
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<input type="checkbox"/> ☆	InfoSec News	[ISN] Theft at DFSS in Chicago could lead to health data breach - While Chicago News Affairs Office Joshua Purkiss di	May 9
<input type="checkbox"/> ☆	InfoSec News	[ISN] Feds Drop Hacking Charges in Video-Poker Glitching Case - Visit the InfoSec News Security Bookstore Best Selli	May 9

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May 2013 — \$45 million stolen from US banks with phony ATM cards

RISK ASSESSMENT / SECURITY & HACKTIVISM

How hackers allegedly stole “unlimited” amounts of cash from banks in just hours

Feds accuse eight men of participating in heists that netted \$45 million.

by Dan Goodin - May 9 2013, 3:45pm EDT

BLACK HAT HACKING 55



Wikipedia

Federal authorities have accused eight men of participating in 21st-Century Bank heists that netted a whopping \$45 million by hacking into payment systems and eliminating withdrawal limits placed on prepaid debit cards.

The eight men formed the New York-based cell of an international crime ring that organized and executed the hacks and then used fraudulent payment cards in dozens of countries to withdraw the loot from automated teller machines, federal prosecutors alleged in court papers unsealed Thursday. In a matter of hours on two separate occasions, the eight defendants and their confederates withdrew about \$2.8 million from New York City ATMs alone. At the same times, "cashing crews" in cities in at least 26 countries withdrew more than \$40 million in a similar fashion.



April 2013 — AP Twitter feed reports White House bombing

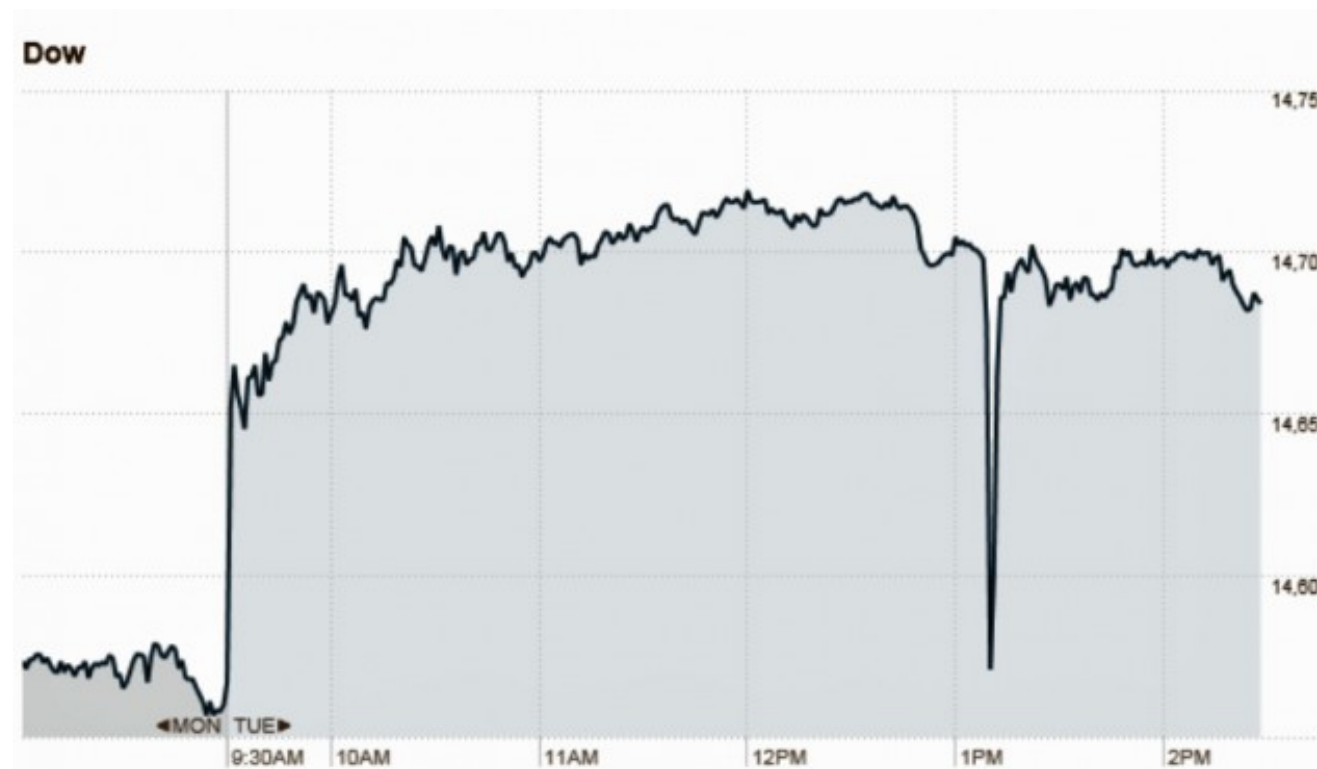
RISK ASSESSMENT / SECURITY & HACKTIVISM

Hacked AP Twitter feed reporting fake White House attack rocks markets

Account compromise comes after AP targeted by malware and phishing e-mails.

by Dan Goodin - Apr 23 2013, 3:44pm EDT

HACKING INTERNET CRIME 74




The seven-minute drop in the Dow Jones Industrial Average touched off by a single tweet falsely claiming the White House had been bombed. It temporarily wiped out about 1 percent of the average, which can translate into millions or billions of dollars in market capitalization.

Stock prices plunged and then quickly recovered after a Twitter account belonging to the Associated Press was hacked and used to send a bogus report falsely claiming that the White House had been bombed and President Obama was injured.




“Stolen laptop could contain important patient information” 14 May 2013

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Photo



IU Health Arnett

Larger Photo

Local News

 **Owner talks on Great Skates' closing**
A once-popular skating rink announced this

Stolen laptop could contain important patient information

Updated: Tuesday, 14 May 2013, 5:32 PM EDT
Published: Tuesday, 14 May 2013, 11:40 AM EDT

Kelly Roberts

LAFAYETTE, Ind. (WFLI) - In a letter to patients from Indiana University Health Arnett it was announced that an employee's laptop computer was stolen from the employee's car. The theft occurred on April 9.

Hospital officials said the laptop was password-protected but not encrypted. It was stolen in White County.

Officials said the White County Sheriff's Office was immediately contacted and IU Health Arnett began an internal investigation to determine what information may have been on the computer.

That investigation determined that the laptop contained patient information. Emails stored on the laptop's hard drive may have contained patient names, dates of birth, physicians' names, medical record numbers, diagnoses and dates of service.

The news made one patient, who wishes to remain anonymous, nervous.

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- Bullet enters through car window
- Naked man arrested: "My pants fell off"
- .05 drunken driving limit recommended
- LPD tracks down wanted fugitive
- Deputy honored for saving small child

Comments on news stories



Commenting via Facebook
We're changing the way comments are posted on each story on WFLI.com, and we believe you'll find this ...

Site Tools

How many “stolen laptop” cases have there been?

Possibly the only good news: cyber-weapons may not be terribly effective, either.



“The 2009 version of Stuxnet was neither very effective nor well-timed and, in hindsight, may have been of net benefit to Tehran.”

The cyber security mess: technical *and* social.

Most attention is focused on technical issues:

- Malware and anti-viruses
 - Default allow vs. default deny*
- Access Controls, Authentication, Encryption & Quantum Computing
- Supply chain issues
- Cyberspace as a globally connected “domain”

Non-technical issues are at the heart of the cyber security mess.

- Education & career paths
- Immigration
- Manufacturing policy

We will do better when we *want* to do better.



What do we ~~know~~
think about cyber
security today?



Cyber Security is expensive.

Global cyber security spending: \$60 billion in 2011

- *Cyber Security M&A*, pwc, 2011

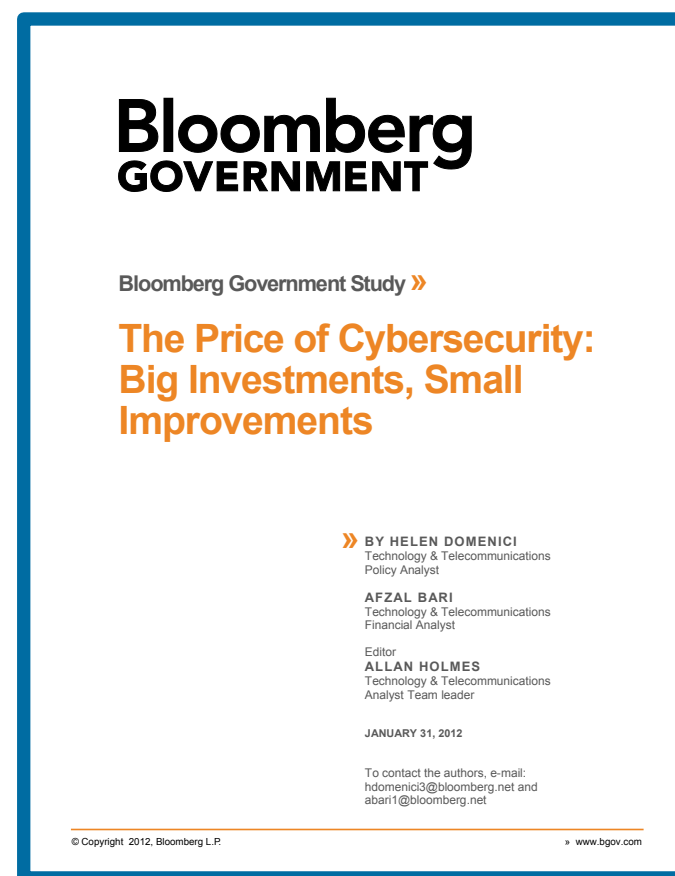
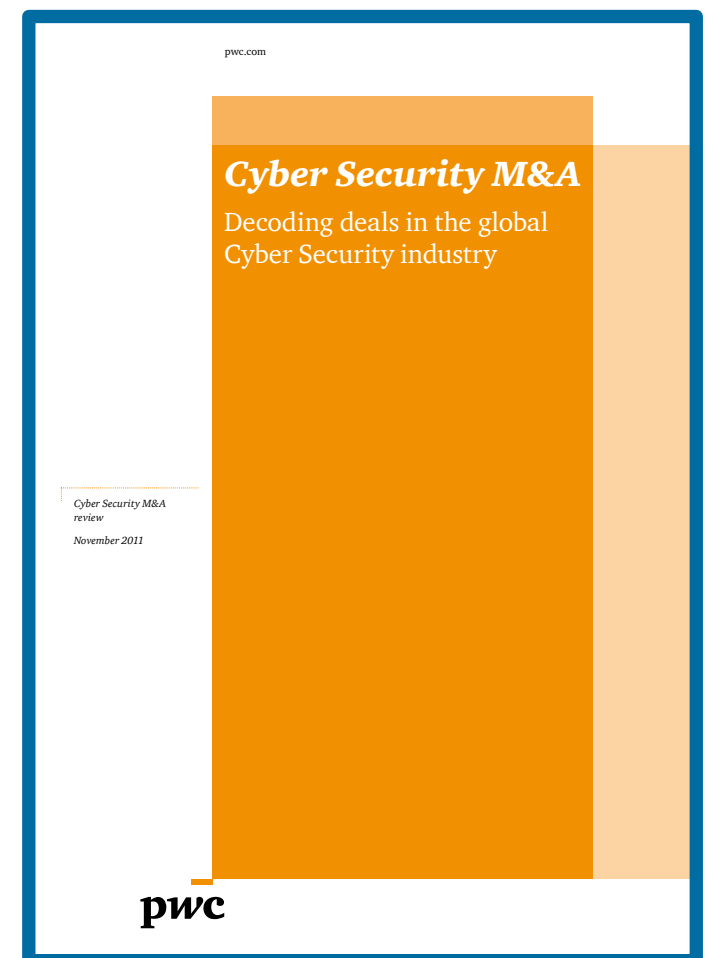
172 Fortune 500 companies surveyed:

- Spending \$5.3 billion per year on cyber security.
- Stopping 69% of attacks.

If they raise spending...

- \$10.2 billion stops 84%
- \$46.67 billion stops 95%
- “highest attainable level”

95% is not good enough.



Cyber Security... is undefined.

There is no good definition for “cyber”

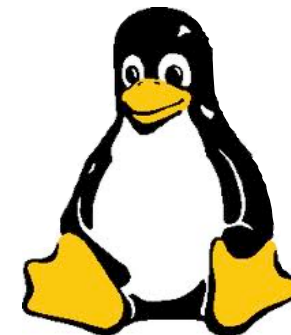
- Computers?
- Computer networks?
- Hacking?
- Using “network security” to secure desktops & servers?
- ~~Something having to do with cybernetics~~



**Norbert
Weiner**

There is no way to *measure* cyber security

- Which OS is more secure?
- Which computer is more secure?
- Is “open source” more secure?



**William
Gibson**

—A system that seems “more secure” can suffer a total compromise from a single unknown attack.

We do know one thing about cyber security...

Does spending more money make a computer more secure?



Cyber Security research makes computers less secure!

- Data
- Encoding
- Apps
- OS (programs & patches)
- Network & VPNs
- DNS, DNSSEC
- IPv4 / IPv6
- Embedded Systems
- Human operators
- Hiring process
- Supply chain
- Family members



The more we learn about securing computers,
the better we get at attacking them

Cyber Security is an “insider problem.”

bad actors
good people with bad instructions
remote access
malware



<http://www.flickr.com/photos/shaneglobal/5115134303/>

If we can stop insiders, we might be able to secure cyberspace....
—... *but we can't stop insiders.*



Ames



Hanssen

Cyber Security is a “network security” problem.

We can't secure the hosts, so secure the network!

- Isolated networks for critical functions.
- Stand-alone hosts for most important functions.



<http://www.flickr.com/photos/dungkal/2315647839/>

But strong crypto limits visibility into network traffic, and...

... stuxnet shows that there are no isolated hosts.



“to a first approximation, every computer in the world is connected to every other computer.”



<http://www.nytimes.com/2011/06/30/technology/30morris.html>

—*Robert Morris (1932-2001), to the National Research Council’s Computer Science and Technology Board, Sept. 19, 1988*

“Computer Insecurity”, Peter G. Neumann *Issues In Science & Technology*, Fall 1994

“Action is needed on many fronts to protect computer systems and communications from unauthorized use and manipulation.”



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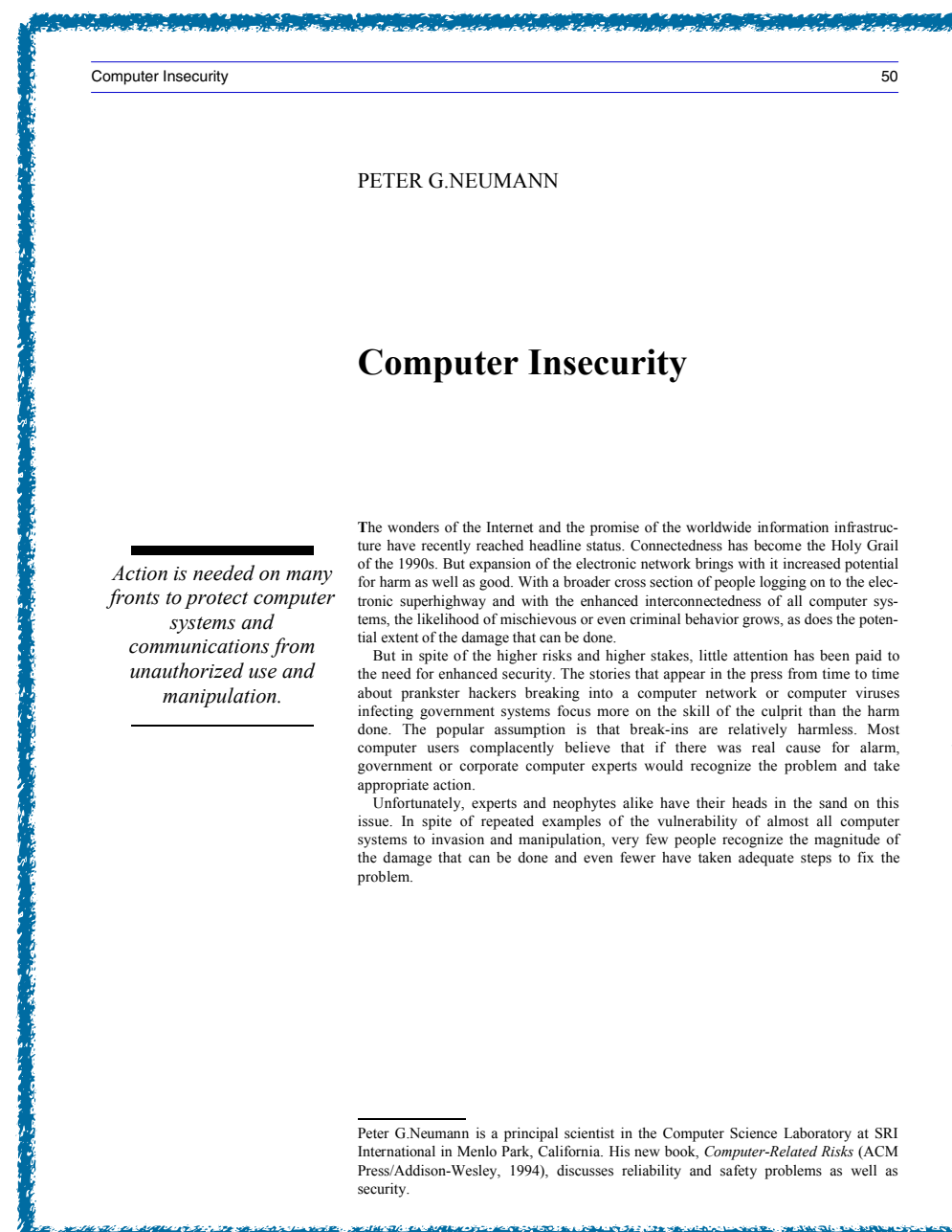
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Computer Insecurity 50

PETER G. NEUMANN

Computer Insecurity

Action is needed on many fronts to protect computer systems and communications from unauthorized use and manipulation.

The wonders of the Internet and the promise of the worldwide information infrastructure have recently reached headline status. Connectedness has become the Holy Grail of the 1990s. But expansion of the electronic network brings with it increased potential for harm as well as good. With a broader cross section of people logging on to the electronic superhighway and with the enhanced interconnectedness of all computer systems, the likelihood of mischievous or even criminal behavior grows, as does the potential extent of the damage that can be done.

But in spite of the higher risks and higher stakes, little attention has been paid to the need for enhanced security. The stories that appear in the press from time to time about prankster hackers breaking into a computer network or computer viruses infecting government systems focus more on the skill of the culprit than the harm done. The popular assumption is that break-ins are relatively harmless. Most computer users complacently believe that if there was real cause for alarm, government or corporate computer experts would recognize the problem and take appropriate action.

Unfortunately, experts and neophytes alike have their heads in the sand on this issue. In spite of repeated examples of the vulnerability of almost all computer systems to invasion and manipulation, very few people recognize the magnitude of the damage that can be done and even fewer have taken adequate steps to fix the problem.

Peter G. Neumann is a principal scientist in the Computer Science Laboratory at SRI International in Menlo Park, California. His new book, *Computer-Related Risks* (ACM Press/Addison-Wesley, 1994), discusses reliability and safety problems as well as security.

<http://issues.org/19.4/updated/neumann.pdf>



It is easy to hide & exfiltrate information...

October 16, 2005

Secret Code in Color Printers Lets Government Track You

Tiny Dots Show Where and When You Made Your Print

San Francisco – A research team led by the Electronic Frontier Foundation (EFF) recently broke the code behind tiny tracking dots that some color laser printers secretly hide in every document.



**Sample closeup of
printer dots on a
normal printed page**

<http://seeingyellow.com/>



**Sample closeup of the
same dots showing only
the blue channels to
make the dots more
visible.**

Cyber Security is a process problem.

Security encompasses all aspects of an organization's IT and HR operations.

Microsoft Security Development Lifecycle

What is the Security Development Lifecycle ?

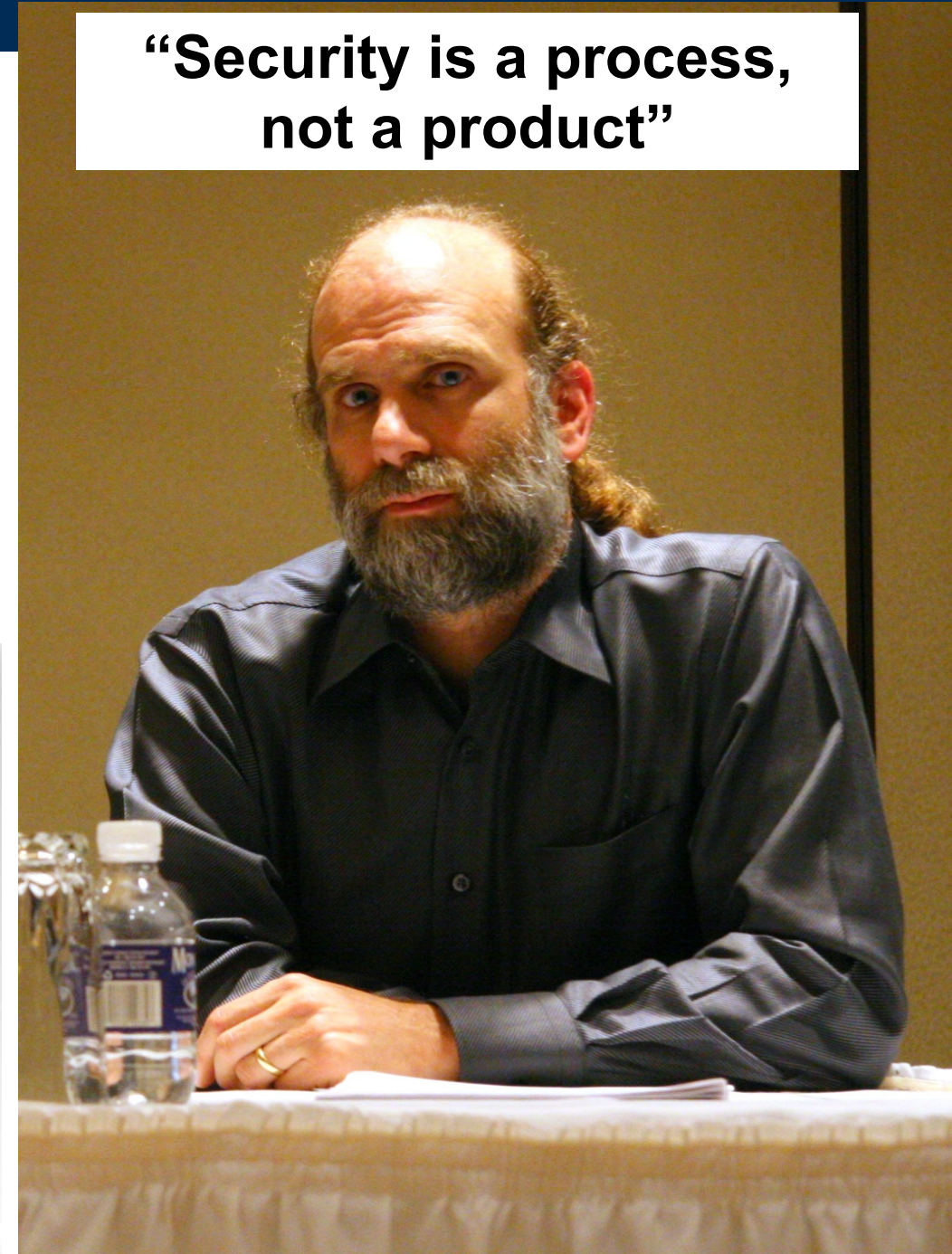
The Security Development Lifecycle (SDL) is a software development security assurance process consisting of security practices grouped by seven phases: training, requirements, design, implementation, verification, release, and response.



"Those practicing SDL specifically reported visibly better ROI results than the overall population."

Forrester Consulting

**"Security is a process,
not a product"**



http://en.wikipedia.org/wiki/File:Bruce_Schneier_1.jpg

- Few organizations can afford SDL.*
- ~~Windows 7~~ *Windows 8 is still hackable...*



Windows RT hack

Microsoft controlled the hardware and the software.

Windows RT — still hacked



nakedsecurity.sophos.com/2013/01/08/windows-rt-jailbroken-shows-its-w

VA W wikis apps nps \$ TTD Shop Stats news

nakedsecurity

Award-winning news, opinion, advice and research from **SOPHOS**

malware mac facebook android vulnerability data loss privacy more...

142
Like
4
+1
120
Tweet
14
Share

Smart octogenarian foils scammer w... The TURKTRUST SSL certificate fia...

Windows RT "jailbroken", shows its Windows 8 roots

Join thousands of others, and sign up for Naked Security's newsletter

you@example.com Do it!

Don't show me this again X

by Chester Wisniewski on January 8, 2013 | 2 Comments
FILED UNDER: [Featured](#), [Microsoft](#), [Vulnerability](#), [Windows](#)

Hey Windows RT, your roots are showing!

Not that it is all that surprising to most people, but the first person to post about jailbreaking a Microsoft Windows RT device says it is a **direct port of Windows 8**.

Microsoft has gone to some lengths to disguise this fact: no desktop mode applications (except Office, Explorer and IE10), only runs software from the Windows Store and can't



Cyber Security is a money problem.

Security is a cost.....Not an “enabler”

- No ROI

Chief Security Officers are in a no-win situation:

- Security = passwords = frustration
- No reward for spending money to secure the infrastructure
- Money spent on security is “wasted” if there is no attack

“If you have responsibility for security but have no authority to set rules or punish violators, your own role in the organization is to take the blame when something big goes wrong.”

—Spaf’s first principle of security administration
Practical Unix Security, 1991



Cyber Security is a “wicked problem”

No clear definition of the wicked problem

—*You don't understand the problem until you have a solution.*

No “stopping rule”

—*The problem can never be solved.*

Solutions not right or wrong

—*Benefits to one player hurt another — Information security vs. Free speech*

Solutions are “one-shot” — no learning by trial and error

—*No two systems are the same. The game keeps changing.*

Every wicked problem is a symptom of another problem

- Rittel and Webber, “Dilemmas in a General Theory of Planning,” 1973
- Dave Clement, “Cyber Security as a Wicked Problem,” Chatham House, October 2011
 - <http://www.chathamhouse.org/publications/twt/archive/view/178579>



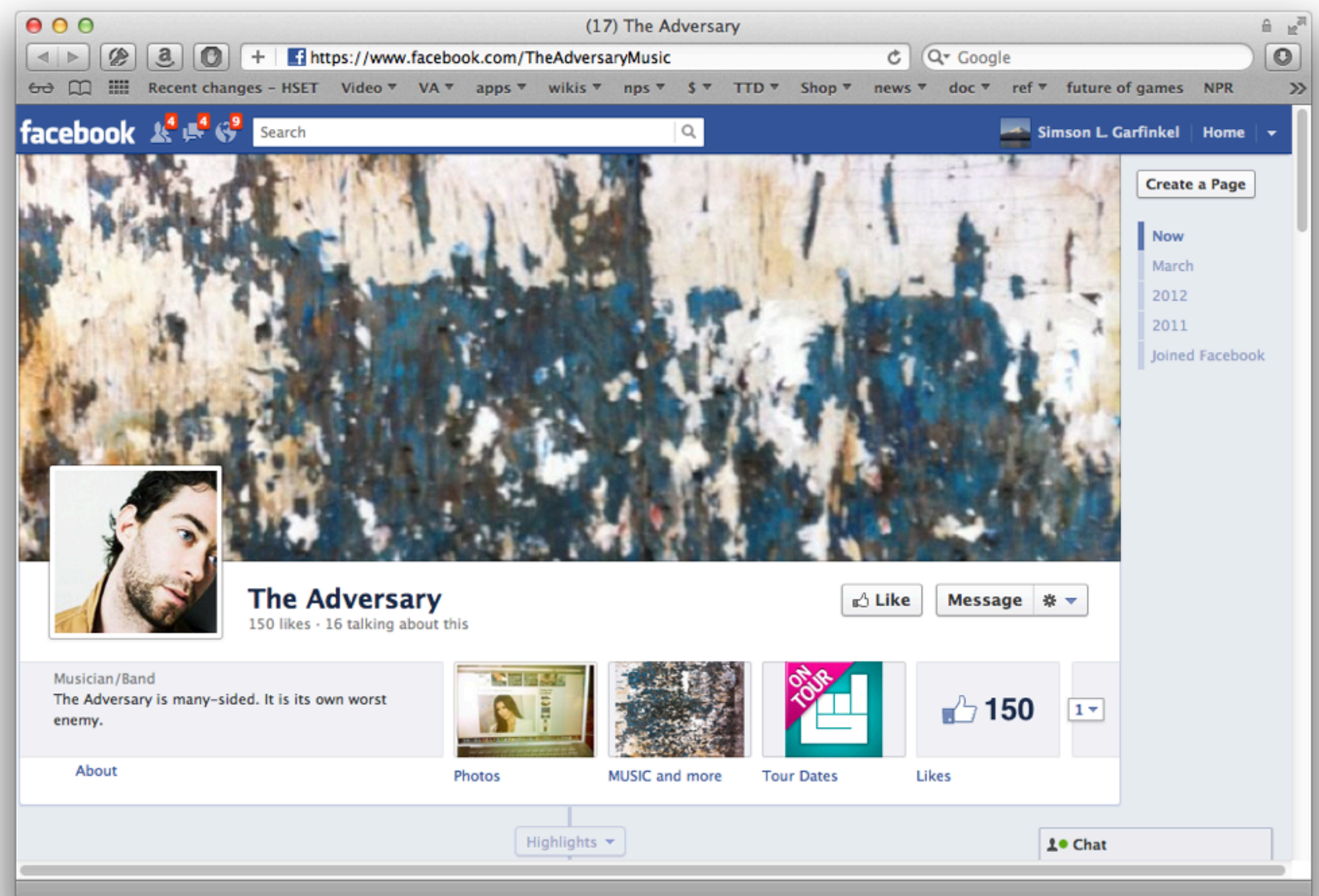
Why is cyber security so hard?



Cyber Security has an active, malicious adversary.

The adversary...

- Turns your bugs into exploits*
- Adapts to your defenses*
- Waits until you make a mistake*
- Attacks your employees when your systems are secure*



For example...

Compiler bugs are security vulnerabilities!

The adversary chooses:

- What to exploit
- When to exploit it
- How to exploit it

We have seen:

- Optimizations can become security vulnerabilities
- The same errors are repeatedly made by different programmers

What's difference between a bug and an attack?

—*The programmer's intent.*



The screenshot shows a web browser window displaying a US-CERT Vulnerability Note. The browser's address bar shows the URL <http://www.kb.cert.org/vuls/id/162289>. The page header features the US-CERT logo and the text "UNITED STATES COMPUTER EMERGENCY READINESS TEAM". Below the header is a navigation bar with links: "DATABASE HOME", "SEARCH", "REPORT A VULNERABILITY", and "HELP". The main content area is titled "Vulnerability Note VU#162289" in red, followed by the subtitle "C compilers may silently discard some wraparound checks". Below this, it states "Original Release date: 04 Apr 2008 | Last revised: 08 Oct 2008". There are social media sharing buttons for Print, Tweet, Send, and Share. The "Overview" section explains that some C compilers optimize away pointer arithmetic overflow tests that depend on undefined behavior without providing a diagnostic (a warning). Applications containing these tests may be vulnerable to buffer overflows if compiled with these compilers. The "Description" section states that in the C language, given the following types:

```
char *buf;
int len;
```

some C compilers will assume that `buf+len >= buf`. As a result, code that performs wrapping checks similar to the following:

```
len = 1<<30;
[...]
if(buf+len < buf) /* wrap check */
    [...overflow occurred...]
```

are optimized out by these compilers; no object code to perform the check will appear in the resulting executable program. In the case where the wrap test expression is optimized out, a subsequent manipulation of `len` could cause an overflow. As a result, applications that perform such checks may be vulnerable to buffer overflows.

It's worse than that...

CPU bugs are remotely exploitable!

This means:

- Programs that are “secure” on one CPU may be vulnerable on another.
- Auditing the code & the compiler isn't enough.

Kaspersky:

- “Fact: malware that uses CPU bugs really does exist;”
- “not apocalypse, just a new threat;”
-

Remote Code Execution
through Intel CPU Bugs

CPU bugs are like a bullet from behind

Kris Kaspersky, Alice Chang
Endeavor Security, Inc.

HITBSECCONF2008
27th - 30th October 2008 MALAYSIA

6 Weeks of Hands-on Technical Security Training
40 Experts Speaking and over 100 International Experts
Nightclub Security Hackers including over 100000
Capture the Flag "RedHacking" Competition
Look for the "RedHacking" Competition
Winner: 10000 (USD), 10000 (USD), 10000 (USD)
Don't miss the opportunity

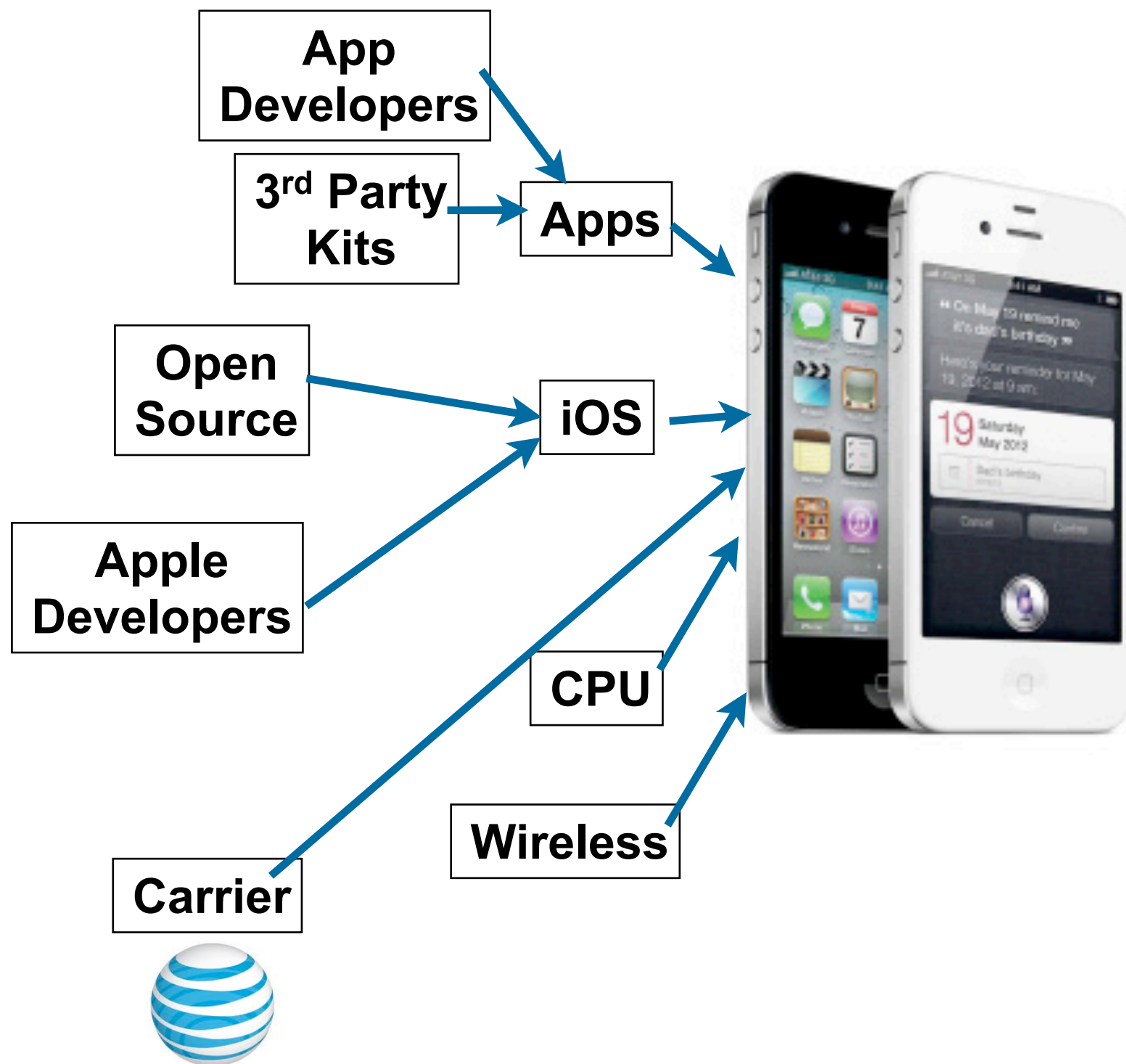
10Mbps INTERNETLINK
VIA METRO ETHERNET!

endeavor
security, inc.

www.cs.dartmouth.edu/~sergey/cs258/2010/D2T1 - Kris Kaspersky - Remote Code Execution Through Intel CPU Bugs.pdf



The supply chain creates numerous security vulnerabilities



The attacker is smarter than you are... ... and has more time to find a good attack.

ACComplce: Location Inference using Accelerometers on Smartphones

Jun Han, Emmanuel Owusu, Le T. Nguyen, Adrian Perrig, Joy Zhang
{junhan, owusu, lenguyen, perrig, sky}@cmu.edu
Carnegie Mellon University

Abstract—The security and privacy risks posed by smartphone sensors such as microphones and cameras have been well documented. However, the importance of accelerometers have been largely ignored. We show that accelerometer readings can be used to infer the trajectory and starting point of an individual who is driving. This raises concerns for two main reasons. First, unauthorized access to an individual's location is a serious invasion of privacy and security. Second, current smartphone operating systems allow any application to observe accelerometer readings without requiring special privileges. We demonstrate that accelerometers can be used to locate a device owner to within a 200 meter radius of the true location. Our results are comparable to the typical accuracy for handheld global positioning systems.

I. INTRODUCTION

Location privacy has been a hot topic in recent news after it was reported that Apple, Google, and Microsoft collect records of the location of customers using their mobile operating systems [12]. In some cases, consumers are seeking compensation in civil suits against the companies [8]. Xu and Teo find that, in general, mobile phone users express lower levels of concern about privacy if they control access to their personal information. Additionally, users expect their smartphones to provide such a level of control [20].

There are situations in which people may want to broadcast their location. In fact, many social networking applications incorporate location-sharing services, such as geo-tagging photos and status updates, or checking in to a location with friends. However, in these instances, users can control when their location is shared and with whom. Furthermore, users express a need for an even richer set of location-privacy settings than those offered by current location-sharing applications [2]. User concerns over location-privacy are warranted. Websites like "Please Rob Me" underscore the potential dangers of exposing one's location to malicious parties [5]. The study presented here demonstrates a clear violation of user control over sensitive private information.

This research was supported by CyLab at Carnegie Mellon under grants DAAD19-02-1-0389 and W911NF-09-1-0273, from the Army Research Office, and by support from NSF under TRUST STC CCF-0424422, IGERT DGE-0903659, and CNS-1050224, and by a Google research award. The views and conclusions contained here are those of the authors and should not be interpreted as necessarily representing the official policies or endorsements, either express or implied, of ARO, CMU, Google, NSF or the U.S. Government or any of its agencies.

978-1-4673-0298-2/12/\$31.00 © 2012 IEEE

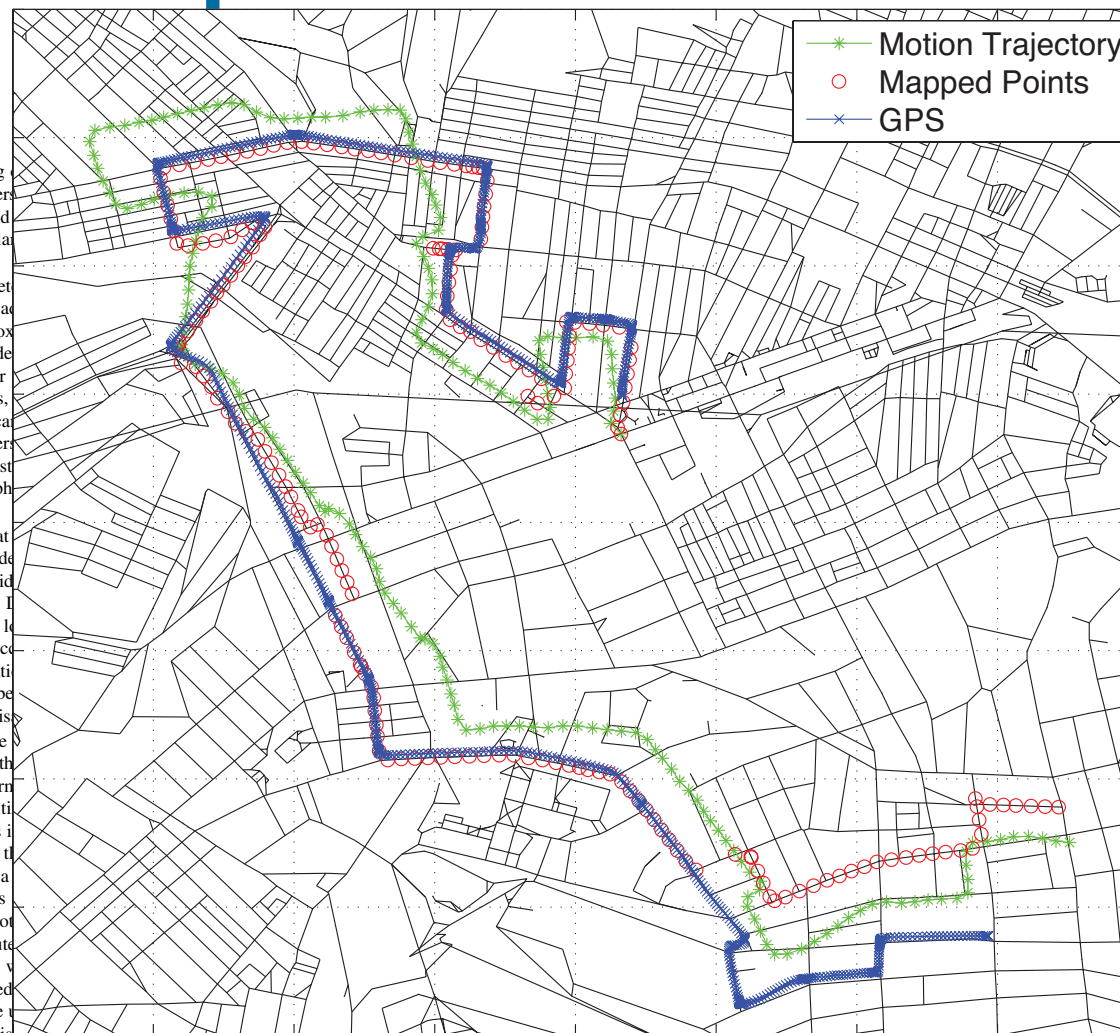
Accelerometers are a particularly interesting device due to their pervasiveness in a large assortment of personal devices including tablet PCs, MP3 players, and other mobile devices. This array of devices provides a large number of opportunities for spyware to exploit.

Furthermore, by correlating the accelerometer readings between multiple phones it is possible for an adversary to determine whether the phones are in close proximity. Phones undergoing similar motions can be identified by their accelerations, events such as earthquakes or activities like public transportation (e.g., bus, train, etc.) produce identifiable motion signatures that can be correlated with other users. As a consequence, if one person's location is accessed, or exposes their cellular or Wi-Fi base station, the adversary has access to these devices.

a) Contributions: Our key insight is that by analyzing the motion trajectory of a user's phone, we can enable the identification of one's location despite the noisy trajectory output. This is because the idiosyncratic roadways create globally unique constraints. It can be used to track a user's location long after location services have been disabled [6]. But as we show, the accelerometer can be used to infer a location with no initial location. This is a very powerful side-channel that can be exploited if location-based services on the device are disabled.

b) Threat Model: We assume that the adversary can execute applications on the mobile device, with privileges except the capability to send information over the network. The application will use some legitimate means to obtain access to network communication. This is accomplished by mimicking a popular application that requires a download; e.g., a video game. In the case of a successful attack, access would be needed to upload high scores or advertisements. We assume that the OS is not compromised so that the malicious application simply executes. The application can communicate with a server to leak acceleration information. Based on this information, the adversary can extract a mobile user's location from the compromised device via data analysis.

Our goal is to determine the location of an individual driving in a vehicle based solely on motion sensor measurements. The general approach that we take is to first derive an approximate motion trajectory given acceleration measurements—which we discuss in §II. We then correlate that trajectory with map



**3 accelerometers
no privacy**

https://sparrow.ece.cmu.edu/group/pub/han_ACComplce_comsnets12.pdf

Jun Han, Emmanuel Owusu, Thanh-Le Nguyen, Adrian Perrig, and Joy Zhang
"ACComplce: Location Inference using Accelerometers on Smartphones" In Proceedings of the 4th International Conference on Communication Systems and Networks (COMSNETS 2012), Bangalore, India, January 3-7, 2012.

Fortunately adversaries are not all powerful.

Adversaries are impacted by:

- Economic factors*
- Attention span*
- Other opportunities*

You don't have to run faster than the bear....



There are solutions to many cyber security problems... ... but we don't use them.

30% of the computers on the Internet run Windows XP

- Windows 7 has vulnerabilities, but it's better.



Apple users don't use anti-virus.

- Yes, Apple tries to fix bugs, but

Most “SSL” websites only use it for logging in.

DNSSEC

Smart Cards



Many people liken cyber security to the flu.

DHS calls for “cyber hygiene”

- install anti-virus
- update your OS
- back up key files

—“STOP, THINK, CONNECT”



Another model might be *obesity*....

Making people fat is good business:

- Farm subsidies
- Restaurants
- Healthcare and medical utilization
- Weight loss plans

—*Few make money when Americans stay trim and healthy.*

Lax security is also good business:

- Cheaper cost of deploying software
- Private information for marketing
- Selling anti-virus & security products
- Cleaning up incidents

—*Few benefit from secure computers*



Obesity Rates Increase

During the past 20 years, there has been a dramatic increase in obesity in the U.S.

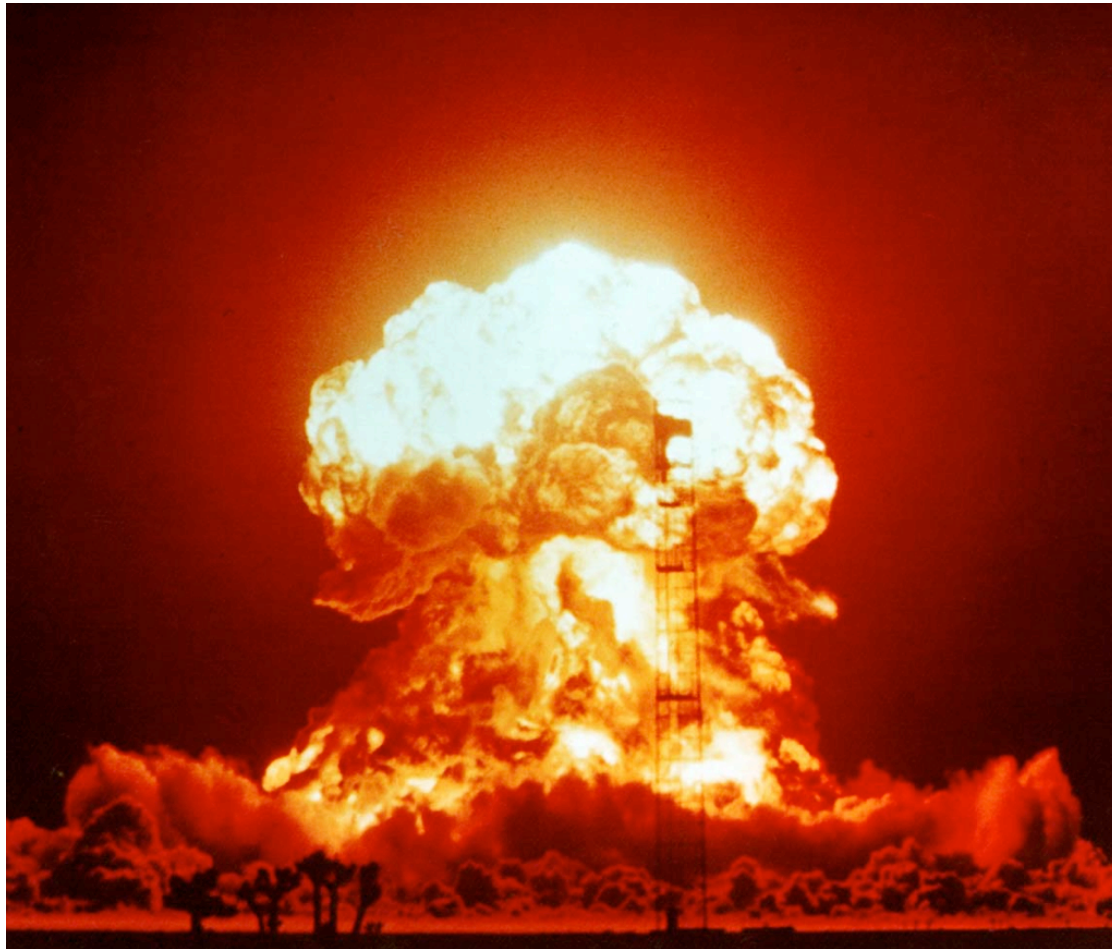
OAC
Obesity Action Coalition

The Obesity Action Coalition (OAC) is the only non-profit organization whose sole focus is helping individuals affected by obesity through education, advocacy, and support.

www.obesityaction.org (800) 717-3117

The graphic features a photograph of a person's midsection, showing a very large, protruding belly wearing a yellow tank top and grey shorts. The text is overlaid on the left side of the image.

Some people say that cyber war is like nuclear war.



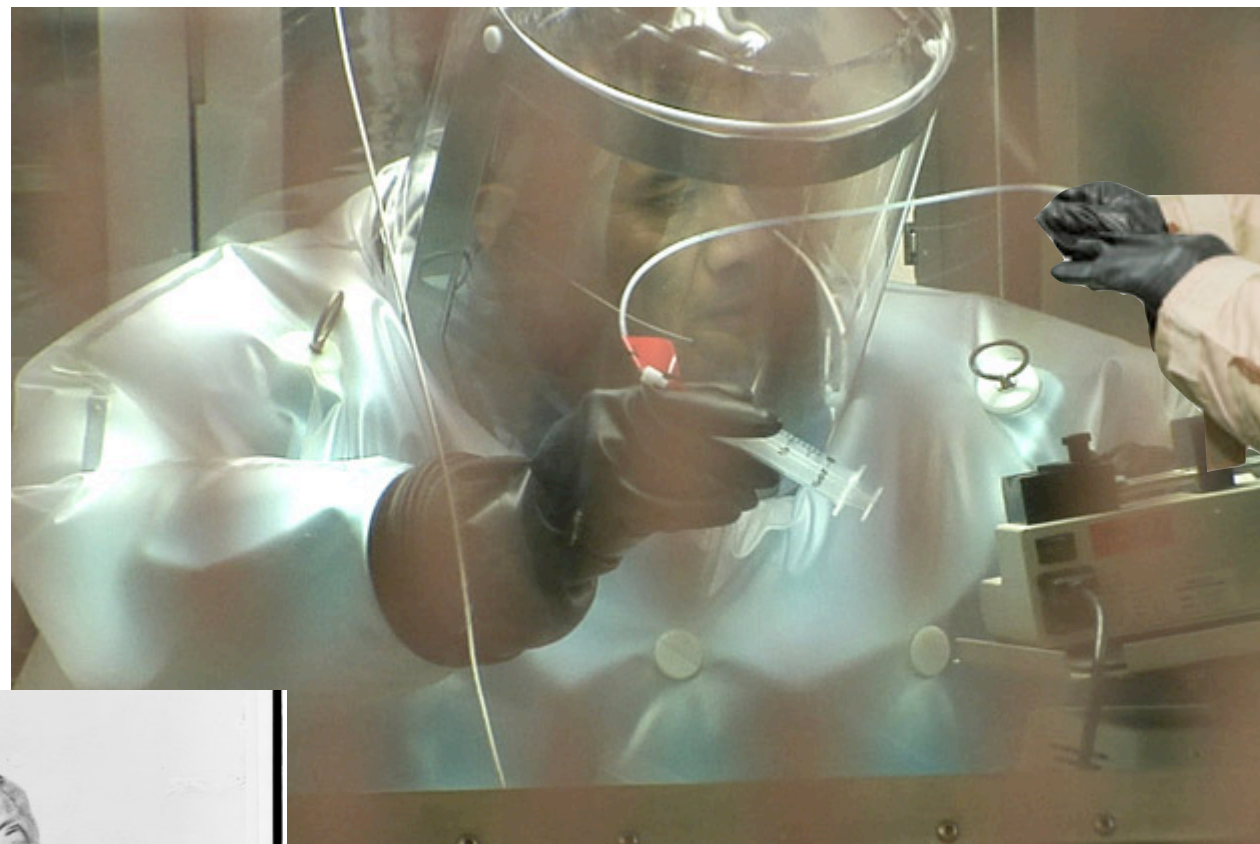
http://www.acus.org/new_atlanticist/mind-cyber-gap-deterrence-cyberspace



<http://www.beyondnuclear.org/security/>

Biowar may be a better model for cyberwar.

- Cheap to produce*
- Easy to attack*
- Hard to control*
- Hard to defend*
- No clear end*



Irving Lachow: Cyber Insecurity is Air Pollution

By-product of:

- eCommerce
- Web browsing
- email
- social media

Inherent with [today's] technology

Impacts society as a whole

“Negative externality”

Good news: we can reduce insecurity to an acceptable level.




TIME

TECHNOLOGY

Cyber Insecurity: The 21st Century's Version of Air Pollution

By Irving Lachow | May 10, 2013 | 1 Comment

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GETTY IMAGES

– Then-defense secretary Leon Panetta referred to the threat of cyber attacks as a “**cyber Pearl Harbor**.”

– A senior Cyber Command official has declared that we are in the middle of a “**cyber arms race**.”

– Other experts have used **public health** as a metaphor for the cyber security challenge facing our nation.

Email Print

Share Comment

Follow @TIME

Non-technical factors impact cyber security.

These factors reflect deep divisions within our society.

- ***Shortened*** development cycles
- ***Education:*** General failure in teaching science, engineering & math
- ***HR:*** Inability to attract and retain the best workers
- ***Immigration Policy:*** Foreign students; H1B Visa
- ***Manufacturing Policy:*** Building in your enemy's factories is a bad idea

Solving the cyber security mess requires solving these issues



Short development cycles

Insufficient planning:

- Security not “baked in” to most products.
- Few or no security reviews
- Little Usable Security

Insufficient testing:

- Testing does not uncover security flaws
- No time to retest after fixing

Poor deployment:

- Little monitoring for security problems
- Difficult to fix current system when new system is under development



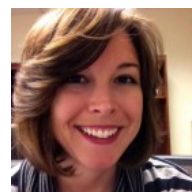
Education is not supplying enough security engineers

Security HR Pipeline

- High School → College → Graduate School → Career

Mastery Issue:

- Many professional programmers learn their craft in college.
 - College English graduates: 16 years' instruction in writing
 - College CS graduates: 4 years' instruction in programming
- Is it any wonder their code has security vulnerabilities?*



Kashmir Hill, Forbes Staff
Welcome to The Not-So Private
Follow (1,349) [Follow](#)



TECH | 5/09/2013 @ 4:51PM | 261,967 views

Snapchats Don't Disappear: Forensics Firm Has Pulled Dozens of Supposedly-Deleted Photos From Android Phones

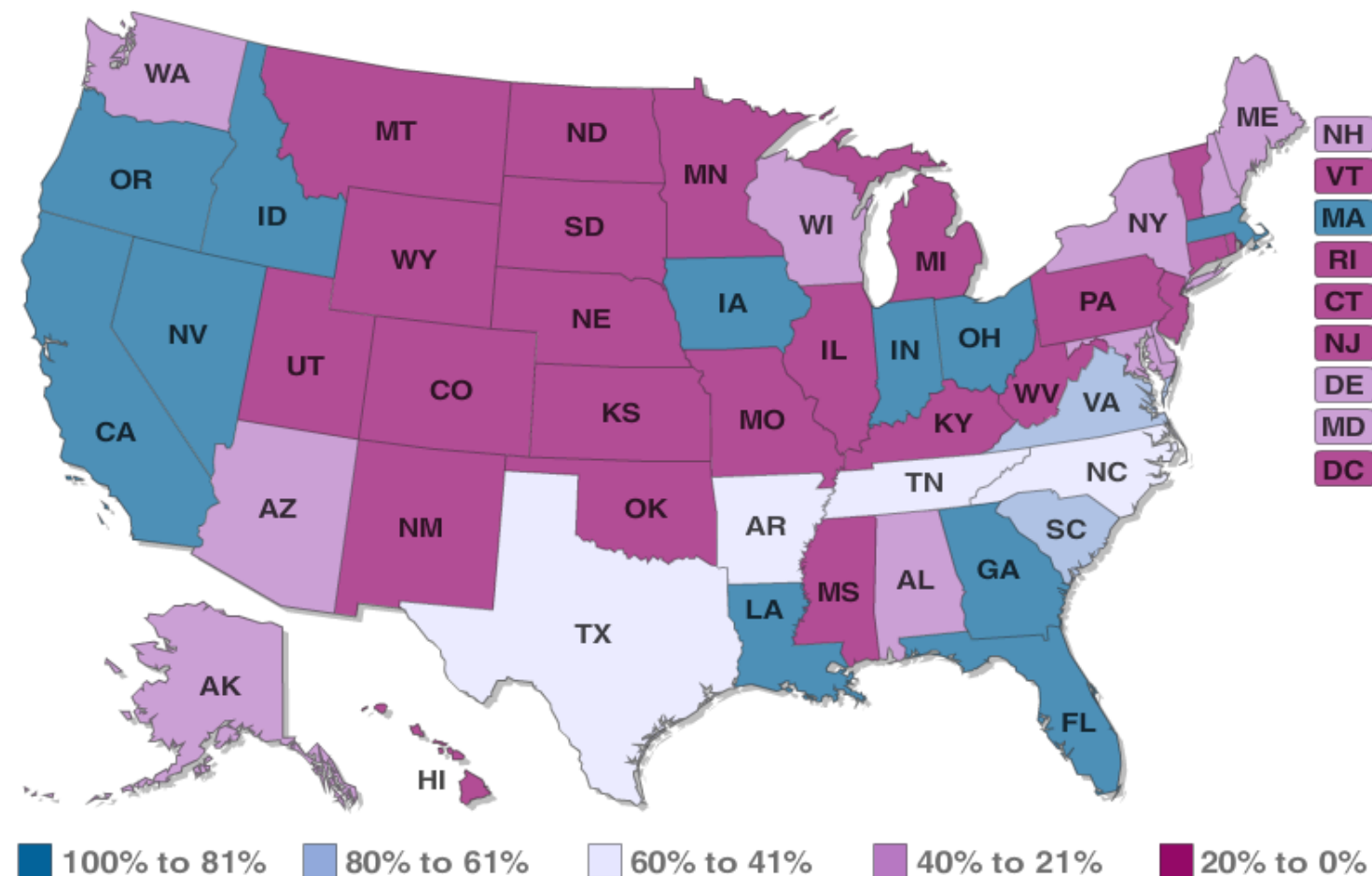
<http://www.forbes.com/sites/kashmirhill/2013/05/09/snapchats-dont-disappear/>

iPhone Screenshots



73% of states require computer “skills” for graduation. Only 37% require CS “concepts”

Concepts Adoption Rates

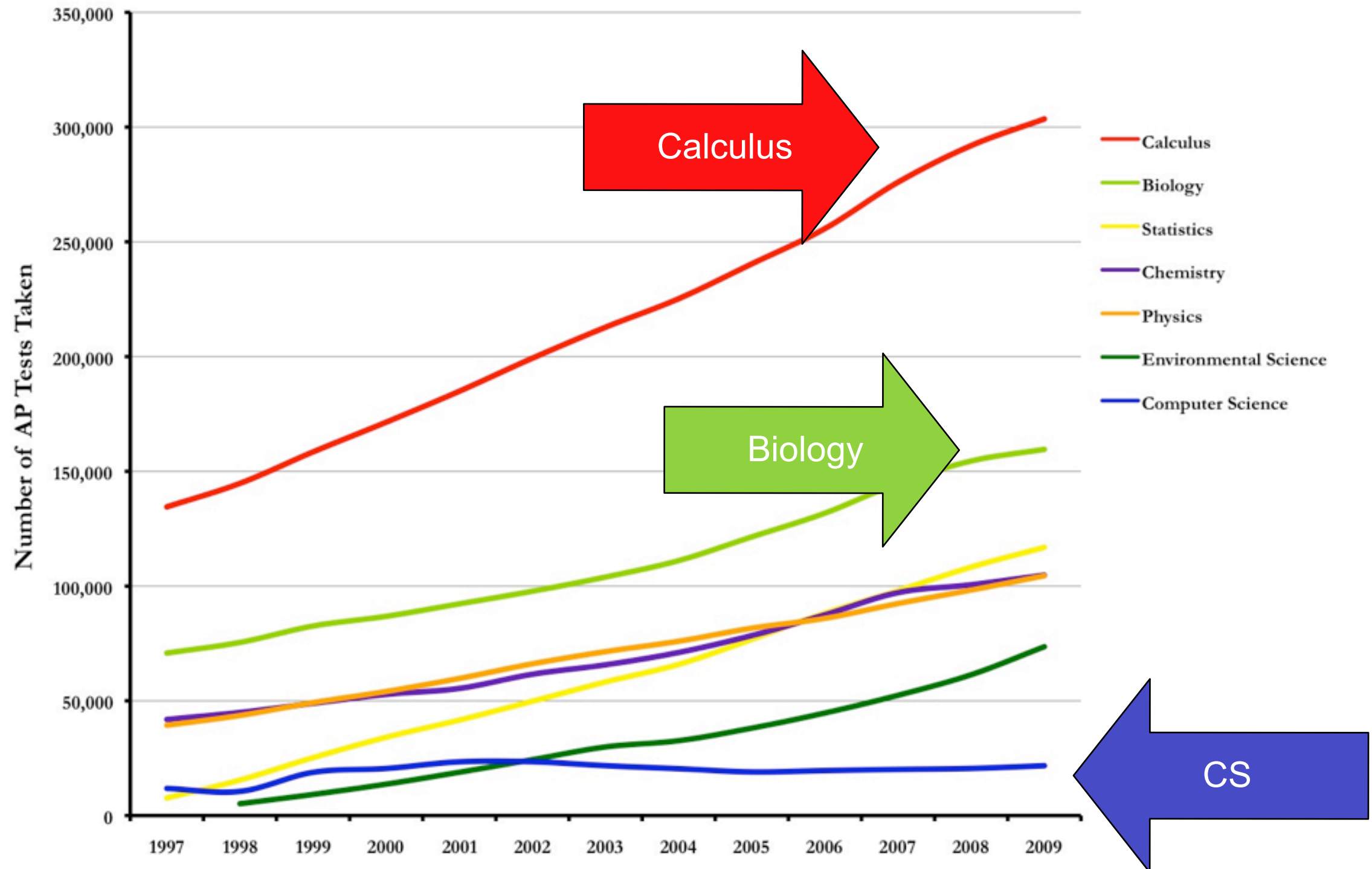


And teachers are poorly paid!

- Salaries for beginning & average teachers lag CS engineers by 30%
- Adjusting for cost-of-living and shorter work week.

- Linda Darling-Hammond, Stanford University, 2004
http://www.srnleads.org/data/pdfs/ldh_achievemen_gap_summit/inequality_TCR.pdf

High school students are not taking AP computer science!

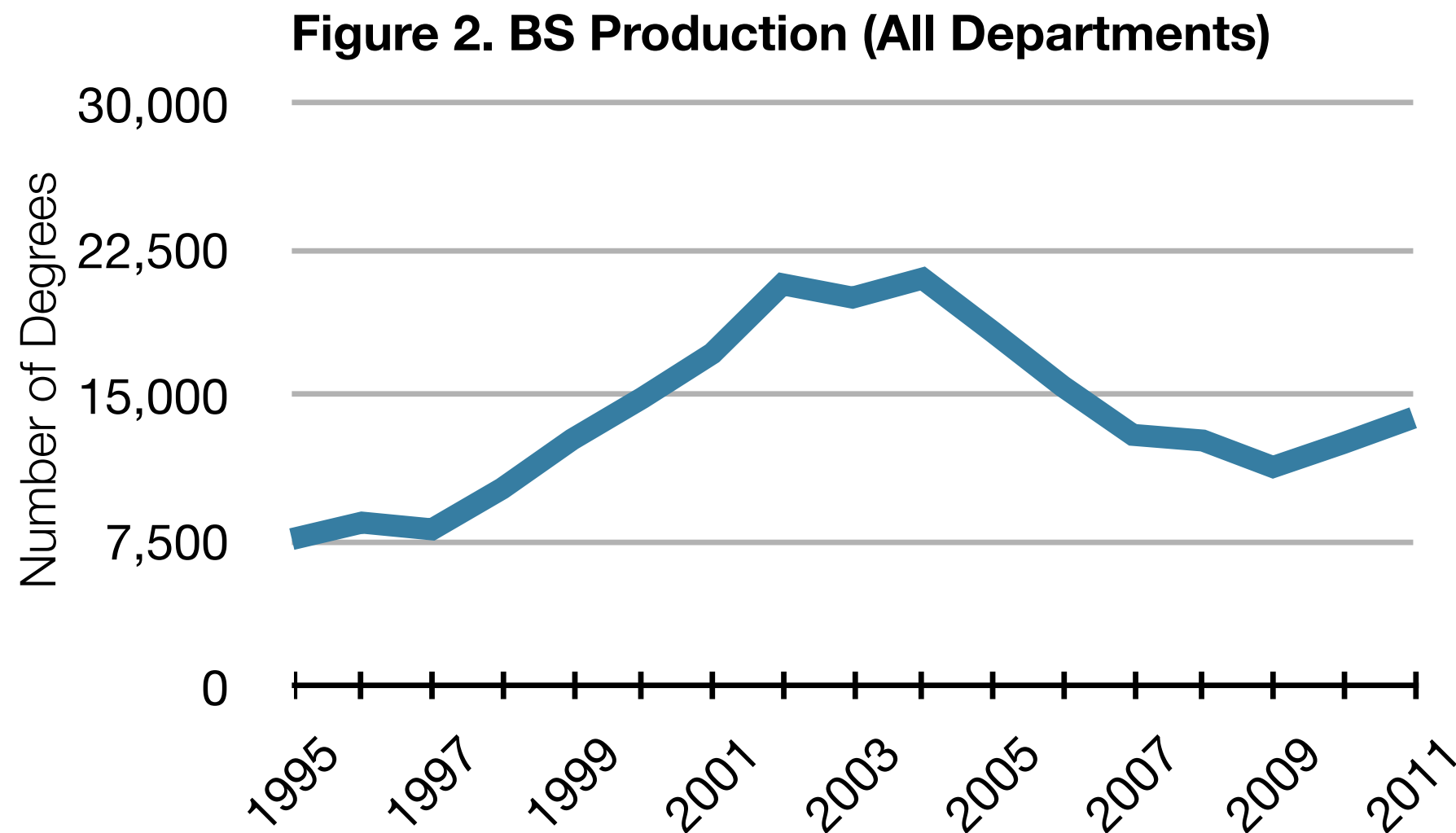


<http://www.acm.org/public-policy/AP%20Test%20Graph%202009.jpg>



Computer Science undergraduate enrollment is low.

2010-2011 CRA Taulbee Survey:



Source: Table 3: Bachelor's Degrees Awarded by Department Type



7% of Bachelor's degrees awarded to “nonresident alien” (12,800 to US citizens)

Table 5. Bachelor's Degrees Awarded by Ethnicity									
	CS		CE		I		Total		
Nonresident Alien	524	7.0%	179	10.0%	78	3.6%	781	6.8%	
Amer Indian or Alaska Native	39	0.5%	8	0.4%	16	0.7%	63	0.5%	
Asian	1,115	14.8%	337	18.8%	302	13.9%	1,754	15.3%	
Black or African-American	274	3.6%	106	5.9%	151	6.9%	531	4.6%	
Native Hawaiian/Pac Islander	22	0.3%	7	0.4%	8	0.4%	37	0.3%	
White	5026	66.9%	981	54.7%	1432	65.8%	7,439	64.8%	
Multiracial, not Hispanic	104	1.4%	28	1.6%	3	0.1%	135	1.2%	
Hispanic, any race	409	5.4%	146	8.1%	187	8.6%	742	6.5%	
Total Residency & Ethnicity Known	7,513		1,792		2,177		11,482		
Resident, ethnicity unknown	741		200		99		1,040		
Residency unknown	1032		112		140		1,284		
Grand Total	9,286		2,104		2,416		13,806		

—Most do not go on to advanced degrees.



50% of Master's degrees awarded to nonresident alien (4960 to US citizens)

Table 9. Master's Degrees Awarded by Ethnicity

	CS		CE		I		Total	
Nonresident Alien	3,332	56.7%	776	72.6%	389	19.6%	4,497	50.4%
Amer Indian or Alaska Native	12	0.2%	0	0.0%	12	0.6%	24	0.3%
Asian	753	12.8%	108	10.1%	245	12.3%	1,106	12.4%
Black or African-American	96	1.6%	13	1.2%	123	6.2%	232	2.6%
Native Hawaiian/Pac Island	19	0.3%	0	0.0%	6	0.3%	25	0.3%
White	1533	26.1%	142	13.3%	1113	56.1%	2,788	31.2%
Multiracial, not Hispanic	8	0.1%	4	0.4%	4	0.2%	16	0.2%
Hispanic, any race	119	2.0%	26	2.4%	92	4.6%	237	2.7%
Total Residency & Ethnicity Known	5,872		1,069		1,984		8,925	
Resident, ethnicity unknown	320		88		205		613	
Residency unknown	419		26		17		462	
Grand Total	6,611		1,183		2,206		10,000	



50% of PhDs awarded in 2011 to nonresident aliens (642 to US citizens)

Table 13. PhDs Awarded by Ethnicity										
	CS		CE		I		Total			
Nonresident Alien	634	48.1%	130	67.4%	44	37.0%	808	49.6%		
Amer Indian or Alaska Native	2	0.2%	0	0.0%	2	1.7%	4	0.2%		
Asian	171	13.0%	16	8.3%	14	11.8%	201	12.3%		
Black or African-American	16	1.2%	1	0.5%	6	5.0%	23	1.4%		
Native Hawaiian/Pac Islander	4	0.3%	0	0.0%	0	0.0%	4	0.2%		
White	465	35.3%	42	21.8%	52	43.7%	559	34.3%		
Multiracial, not Hispanic	3	0.2%	0	0.0%	0	0.0%	3	0.2%		
Hispanic, any race	22	1.7%	4	2.1%	1	0.8%	27	1.7%		
Total Residency & Ethnicity Known	1,317		193		119		1,629			
Resident, ethnicity unknown	43		4		2		49			
Residency unknown	96		8		0		104			
Grand Total	1,456		205		121		1,782			

—We did not train Russia's weapons scientists at MIT during the Cold War.



Just 67 / 1275 (5%) PhDs went into Information Assurance 15 professors & postdocs; 48 to industry & government

Table 14. Employment of New PhD Recipients By Specialty																						
	Artificial Intelligence	Computer-Supported Cooperative Work	Databases / Information Retrieval	Graphics/Visualization	Hardware/Architecture	Human-Computer Interaction	High-Performance Computing	Informatics: Biomedica/ Other Science	Information Assurance/Security	Information Science	Information Systems	Networks	Operating Systems	Programming Languages/ Compilers	Robotics/Vision	Scientific/ Numerical Computing	Social Computing/ Social Informatics	Software Engineering	Theory and Algorithms	Other	Total	
North American PhD Granting Depts.																						
Tenure-track	14	1	5	6	2	10	1	2	5	9	2	6	2	3	3	1	4	7	6	13	102	7.1%
Researcher	6	1	4	6	1	1	0	6	2	0	2	7	2	2	2	3	1	3	7	17	73	5.1%
Postdoc	38	1	12	17	4	12	0	20	7	5	2	12	7	7	14	6	3	10	30	34	241	16.8%
Teaching Faculty	2	1	1	0	0	1	0	1	1	2	1	1	1	1	0	0	3	4	4	4	28	2.0%
North American, Other Academic																						
Other CS/CE/I Dept.	3	0	4	1	1	1	4	2	2	0	5	6	1	0	0	0	0	3	1	18	52	3.6%
Non-CS/CE/I Dept.																						
North American, Non-Academic																						
Industry	64	2	49	46	41	24	20	17	40	5	6	67	29	22	25	6	12	86	32	83	676	47.2%
Government	7	0	5	2	6	2	5	3	8	1	2	1	0	0	2	4	1	4	2	5	60	4.2%
Self-Employed	0	0	0	1	0	1	0	1	0	0	2	2	2	0	1	0	0	1	1	1	13	0.9%
Unemployed	2	0	2	1	2	2	1	0	2	0	1	3	0	0	1	0	2	0	1	3	23	1.6%
Other	2	0	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	1	0	7	0.5%
Total Inside North America																						
	138	6	83	80	57	54	32	53	67	22	23	106	44	35	48	20	26	118	85	178	1,275	89.0%

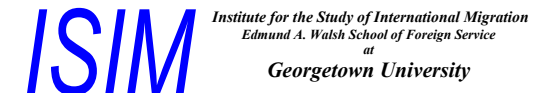
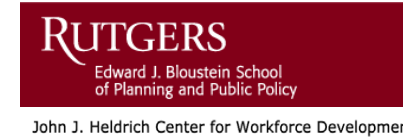
Security should be taught to everyone, but we need specialists



Georgetown Prof: 50% of graduate students in sciences are foreigners because salaries aren't high enough.

“...the problem may not be that there are too few STEM qualified college graduates, but rather that STEM firms are unable to attract them.

Highly qualified students may be choosing a non-STEM job because it pays better, offers a more stable professional career, and/or perceived as less exposed to competition from low-wage economies.”



Steady as She Goes? Three Generations of Students through the Science and Engineering Pipeline *

October 2009

B. Lindsay Lowell^a
Hal Salzman^{b,c}
Hamutal Bernstein^a
with
Everett Henderson^c

Paper presented at:
Annual Meetings of the
Association for Public Policy
Analysis and Management
Washington, D.C.

November 7, 2009

^a Institute for the Study of International Migration, Georgetown University
B. Lindsay Lowell: lowellbl@georgetown.edu

^b Heldrich Center for Workforce Development
Bloustein School of Public Policy
Rutgers University &
^c The Urban Institute
Hal Salzman: HSalzman@Rutgers.edu

* Michael Teitelbaum provided insightful comments on an earlier draft of this paper and on the research throughout the project. We appreciatively acknowledge the contributions to this paper by Katie Vinopal of the Urban Institute. Research for this paper was funded by the Alfred P. Sloan Foundation.



Bureau of Labor Statistics puts CS as 12th highest paying profession, after...

Highest paying occupations:

- Oral Surgeons > \$166,400
- Orthodontists > \$166,400
- Physicians and Surgeons > \$166,400
- CEOs: \$165,080
- Dentists: \$161,020
- Judges: \$119,260
- Architectural & Eng. Mgrs \$119,260
- Prosthodontists \$118,400
- Podiatrists \$118,030
- Natural Sci. Mgrs. \$116,020
- Computer Scientists: \$115,070
- Petroleum Engineers \$114,080
- Marketing Managers \$112,800
- Lawyers: \$112,760

Highest Paying Occupations : Occupational Outlook Handbook : U.S. Bureau of Labor Statistics

http://stats.bls.gov/ooh/highest-paying.htm

salaries of professionals

Recent changes - HSET Video VA apps wikis nps \$ TTD Shop news doc ref future of games NPR >>

Highest Paying Occupations

Highest paying occupations: 20 occupations with the highest median annual pay in 2010.

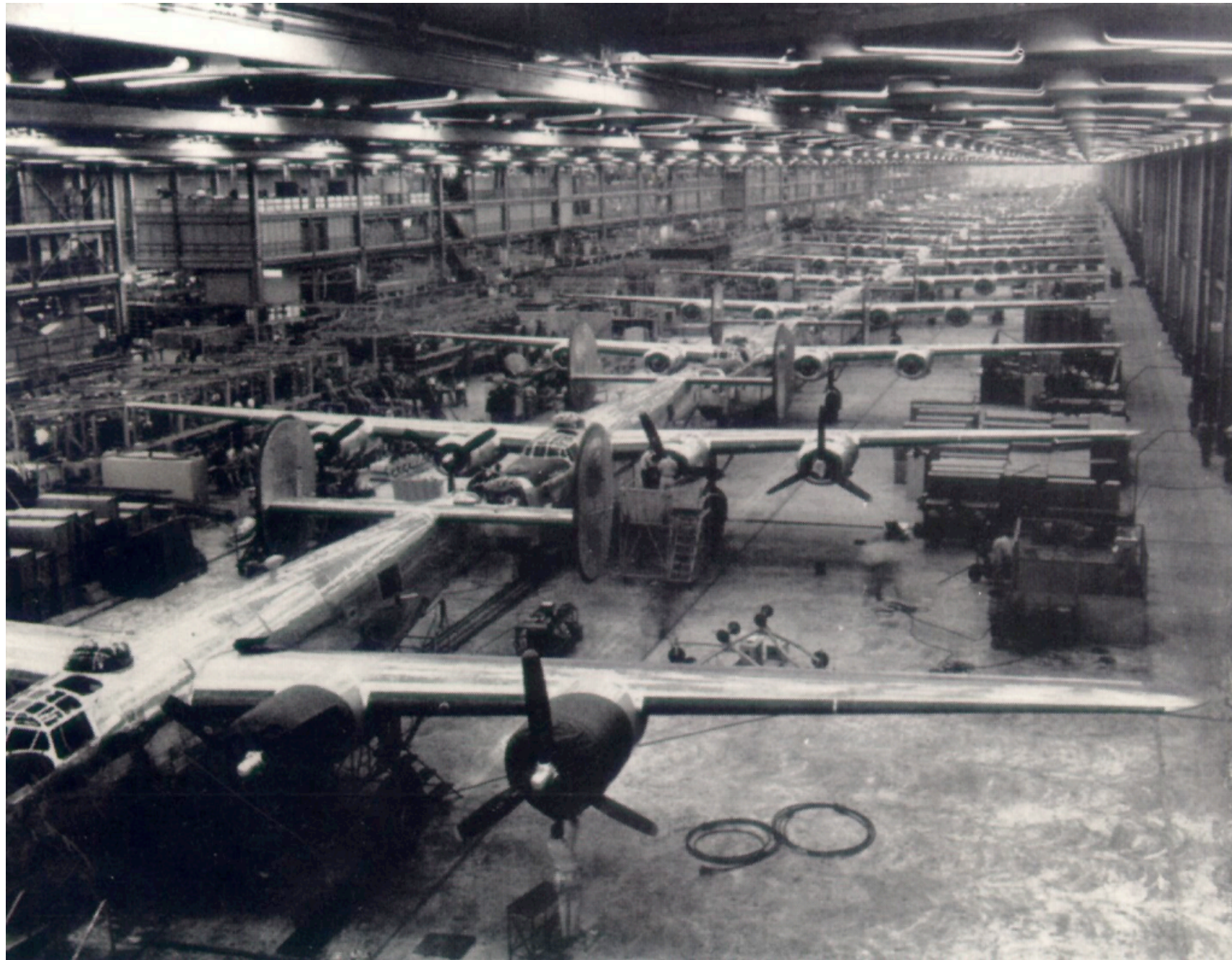
Click on an occupation name to see the full occupational profile.

OCCUPATION	2010 MEDIAN PAY
Oral and Maxillofacial Surgeons	This wage is equal to or greater than \$166,400 per year.
Orthodontists	This wage is equal to or greater than \$166,400 per year.
Physicians and Surgeons	This wage is equal to or greater than \$166,400 per year.
Chief Executives	\$165,080 per year.
Dentists, All Other Specialists	\$161,020 per year.
Dentists, General	\$141,040 per year.
Judges, Magistrate Judges, and Magistrates	\$119,270 per year.
Architectural and Engineering Managers	\$119,260 per year.
Prosthodontists	\$118,400 per year.
Podiatrists	\$118,030 per year.
Natural Sciences Managers	\$116,020 per year.
Computer and Information Systems Managers	\$115,780 per year.
Petroleum Engineers	\$114,080 per year.
Marketing Managers	\$112,800 per year.
Lawyers	\$112,760 per year.
Pharmacists	\$111,570 per year.
Air Traffic Controllers	\$108,040 per year.
Political Scientists	\$107,420 per year.
Physicists	\$106,370 per year.
Financial Managers	\$103,910 per year.

Publish Date: Thursday, March 29, 2012



Manufacturing policy



- US did not buy WW2 aircraft in Germany

Security problems are bad for society as a whole...

... because [wireless] computers are everywhere.

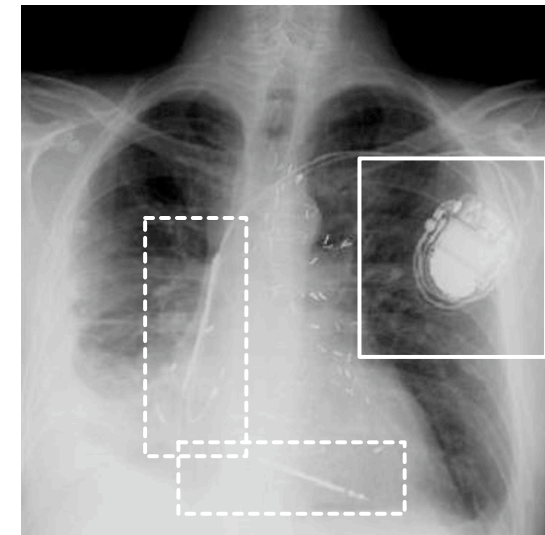


**50 microprocessors
per average car**

<http://www.autosec.org/>

- *Comprehensive Experimental Analysis of Automotive Attack Surfaces (2011)*
- *Experimental Security Analysis of a Modern Automobile (2010)*

*Remote take-over of EVERY safety-critical system from
ANY wired or wireless interface*



2008: demonstrated wireless
attack on implantable pacemakers

2012: demonstrated wireless
attack on insulin pump

DDoS the endocrine system!

[ISN] TV-based botnets? DoS attacks on your fridge? More plausible than you think

From: InfoSec News <alerts@infosecnews.org>

Subject: [ISN] TV-based botnets? DoS attacks on your fridge? More plausible than you think

Date: April 23, 2012 3:16:23 AM EDT

To: isn@infosecnews.org

<http://arstechnica.com/business/news/2012/04/tv-based-botnets-ddos-attacks-on-your-fridge-more-plausible-than-you-think.ars>

By Dan Goodin
ars technica
April 22, 2012



It's still premature to say you need firewall or antivirus protection for your television set, but a duo of recently diagnosed firmware vulnerabilities in widely used TV models made by two leading manufacturers suggests the notion isn't as far-fetched as many may think.

... While poking around a Samsung D6000 model belonging to his brother, he inadvertently discovered a way to remotely send the TV into an endless restart mode that persists even after unplugging the device and turning it back on.

"It wasn't even planned," Auriemma told Ars, referring to the most damaging of his two attacks, which rendered the device useless for three days...



[ISN] ATM Attacks Exploit Lax Security

From: InfoSec News <alerts@infosecnews.org>

Subject: [ISN] ATM Attacks Exploit Lax Security

Date: April 23, 2012 3:15:54 AM EDT

To: isn@infosecnews.org

<http://www.bankinfosecurity.com/atm-attacks-exploit-lax-security-a-4689>



<http://krebsonsecurity.com/2011/12/pro-grade-3d-printer-made-atm-skimmer/>

By Tracy Kitten
Bank Info Security
April 19, 2012

Lax security makes non-banking sites prime targets for skimming attacks...



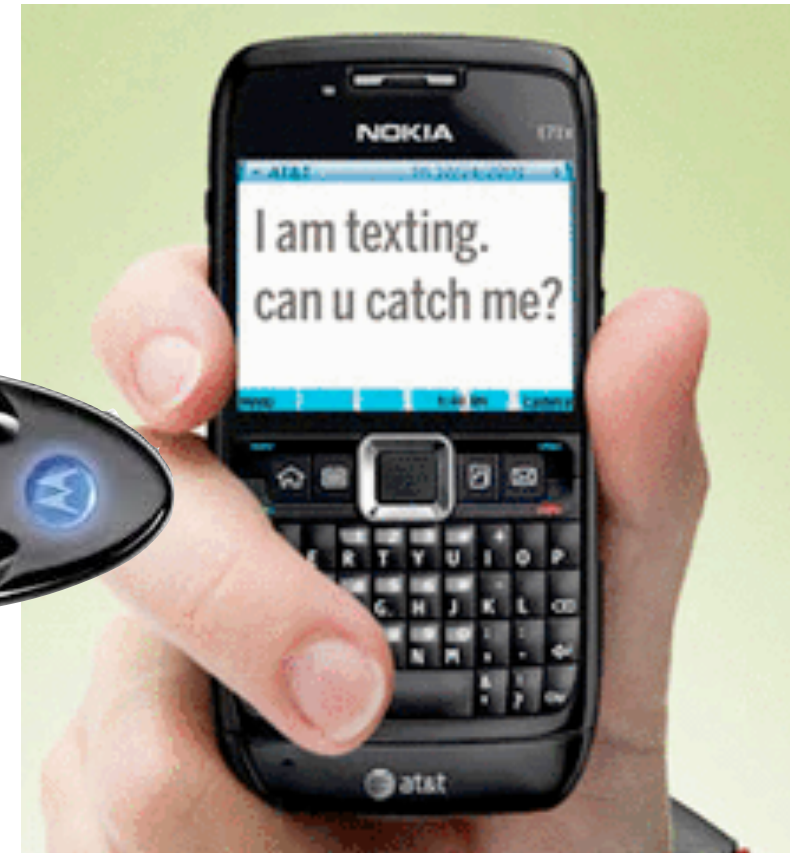
Cell phones cannot be secured.

Cell phones have:

- Wireless networks, microphone, camera, & batteries
- Downloaded apps
- Bad crypto

Cell phones can be used for:

- Tracking individuals
- Wiretapping rooms
- Personal data



<http://connectedvehicle.challenge.gov/submissions/2706-no-driving-while-texting-dwt-by-tomahawk-systems-llc>

Five DARPA & NSF cyber security PMs walk into a bar...

Major security breakthroughs since 1980:

- Public key cryptography (RSA with certificates to distribute public keys)
- Fast symmetric cryptography (AES)
- Fast public key cryptography (elliptic curves)
- Easy-to-use cryptography (SSL/TLS)
- Sandboxing (Java, C# and virtualization)
- Firewalls
- BAN logic
- Fuzzing.

But none of these breakthroughs has been a “silver bullet”

—“*Why Cryptosystems Fail*,” Ross Anderson,
1st Conference on Computer and Communications Security, 1993.
<http://www.cl.cam.ac.uk/~rja14/Papers/wcf.pdf>



There is no obvious way to secure cyberspace.

We *trust* computers...

—*but we cannot make them trustworthy.*

(A “trusted” system is a computer that can violate your security policy.)

We know a lot about building secure computers...

—*but we do not use this information when building and deploying them.*

We know about usable security...

—*but we can’t make any progress on usernames and passwords*

We should design with the assumption that computers will fail...

—*but it is cheaper to design without redundancy or resiliency.*

Despite the newfound attention to cyber security, our systems seem to be growing more vulnerable every year.



Be a [polite] critic of USG Information Systems

Our computers are *terrible*, but we can make them better.

Things you can do:

- Participate in contracting efforts and reviews.
- Read user agreements.
- Report bugs

Use Section 508!

- Section 508 of the Rehabilitation Act (29 USC 794 d) requires that federal government information systems accommodate people with disabilities.
- Bad typography, poor choice of fonts, use of Flash *may be illegal!*
- Speak with the Section 508 Coordinator — or volunteer to become one!

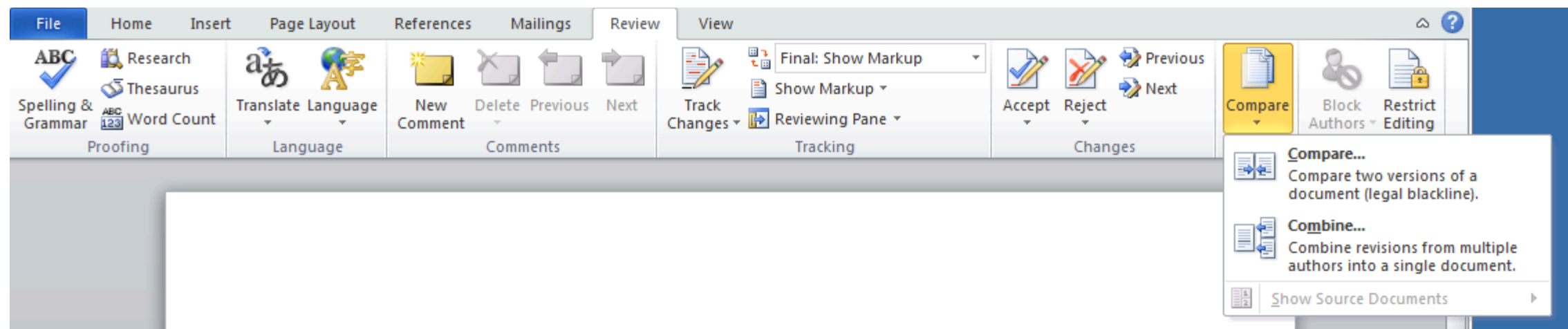


Be a helpful

We don't teach people to use Windows / Word / Excel productively.

Real live case:

- A Microsoft Word document was passed to multiple people for edits.
- I showed the admin how to “compare” and “merge” documents.



- I was a hero!

Take the time to learn:

- Microsoft Word Styles; Acrobat Forms; Excel Macros

Push an INFOSEC AGENDA that is *realistic*.

Help your agencies deploy:

- IPv6
- DNSSEC
- Modern Web Browsers

Help your agencies eliminate:

- Windows XP
- Internet Explorer 6 / 7 / 8

Ask about backups!

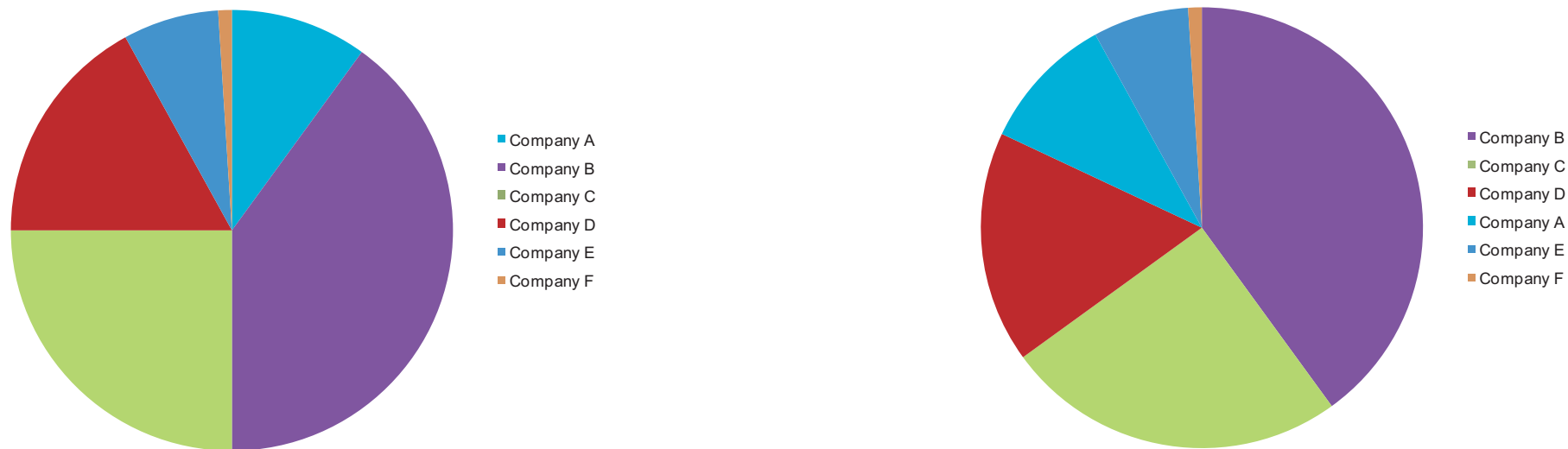
- “Delete” an important file “by accident.”
- Can your IT group get it back? ***IF NOT, REPORT IT!***

Submit bug reports!

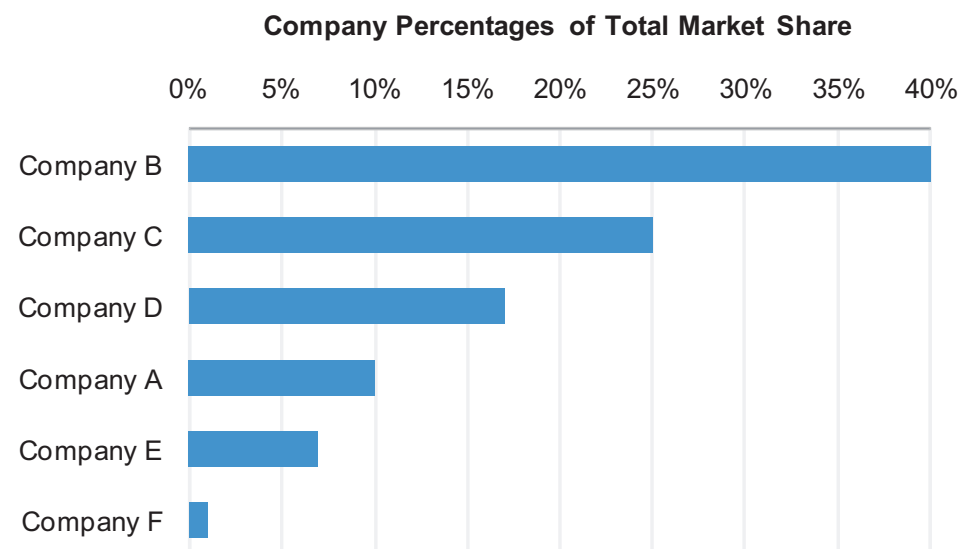


Don't use pie charts

These two pie charts present exactly the same information.



This graph presents the same information better:



—And it's Section 508 compliant!

Save the Pies for Dessert

Stephen Few, Perceptual Edge
Visual Business Intelligence Newsletter
August 2007



Other things for SFS students to know...

Continuing education is really important!

- Go to conferences
- Read journals and magazines
- Keep reading the academic literature
- Concentrate on self-development.

Find a mentor.

Stay in touch with your faculty advisor!

Algorithms matter.

Data matters

- Learn how to present data



Security problems reflect deep societal problems. We need to fix our society.

Follow the money.

IEEE Security & Privacy

Florêncio and Herley, Dec. 2012

- Emptying accounts is hard
- Mules, not victims, lose money
- Passwords are not the bottleneck
- Underground markets are not thriving
- Credential Stealing is a terrible business

Supporting slides:

— https://www.usenix.org/sites/default/files/conference/protected-files/woot_herley.pdf

Video

— <https://www.usenix.org/conference/woot12/keynote-tba> (1 hour, 25 minutes)



PASSWORDS

Is Everything We Know about Password Stealing Wrong?

Dinei Florêncio and Cormac Herley | Microsoft Research

Passwords are but one link in the cybercrime value chain. Contrary to popular belief, compromised users are made whole and thieves have a hard time monetizing stolen credentials.

It's not what you don't know that kills you, it's what you know for sure that ain't true. —Mark Twain

It is worth, at the outset, dispelling a widely held misapprehension about password stealing. Thieves certainly steal passwords, and money is certainly a large part of their motivation. However, when they successfully extract money from financial accounts, individual consumers do not pay. In the US, Federal Reserve Regulation E limits consumer liability to US\$50 in the event of fraud (this is separate from Regulation CC's \$50 limit for credit card fraud) and covers "any electronic transfer that is initiated through an electronic terminal, telephone, computer or magnetic tape."¹ This regulation governs banks, brokerages, and credit unions, and many organizations go beyond it and offer consumers a zero-liability policy.

Bank of America, for example, "guarantees zero liability for any unauthorized activity originating from Online Banking or Bill Pay."² Wells Fargo says, "We guarantee that you will be covered for 100 percent of funds removed from your Wells Fargo accounts in the unlikely event that someone you haven't authorized removes those funds through our Online Services."³ Fidelity "will reimburse your Fidelity account for any losses due to unauthorized activity,"⁴ and "under HSBC's \$0 Liability, Online Guarantee, you're covered 100% and liable for \$0."⁵ Even nontraditional financial

institutions offer this guarantee. For example, in eBay's December 2009 10-K filing, the company states, "PayPal currently voluntarily reimburses consumers for all financial losses from transactions not authorized by the consumer, not just losses above \$50."⁶

Thus, in the US, individual consumers are largely insulated from the direct financial consequences of credential theft (we later briefly mention losses of small businesses and indirect losses). (Although consumer protections in the US are good, they are by no means unique. EU Directive 2007/64/EC of the European Parliament limits consumer liability to €150, and many banks go beyond this. Mannan and van Oorschot found that most major Canadian banks offer a "100% reimbursement guarantee for online banking fraud losses," but they also suggest that most consumers are unlikely to meet the standard of care required to be eligible.⁷) Consumers who have their accounts emptied through stolen credentials are made whole. Of course, the cost of the fraud does not just go away: covering fraud is a cost that gets passed back to consumers in the form of increased fees. However, the idea that consumers are "just a few clicks away" from having their accounts irretrievably emptied is simply incorrect. There is a world of difference between being personally liable for losses and sharing losses that are diluted across the whole population. Although "we all pay for cybercrime" is true in a general sense, individual users do not face grave financial risk.

We begin with this misconception because it is widely held and generates enormous confusion. Regulation

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We need to build a society that values computing.

K-12 Education that:

- Integrates data, communications & computation across the curricula
- Graduating programmers should have 10 years' experience before writing code that can steal you credit card numbers!

Recovery Oriented Computing — backups that are:

- Trustworthy — (digital signatures)
- Multiple tiers — Online / Offline / Disconnected / Geographically Remote
- Durable — years / decades
- Organized — so information can be found

Policies that accomplish their stated goals.

- 16 character passwords are no more secure than 12 character passwords

S





Backup Slides