Usable Security and Privacy Thinking & Threat Modeling

INFR11158/11230 Usable Security and Privacy

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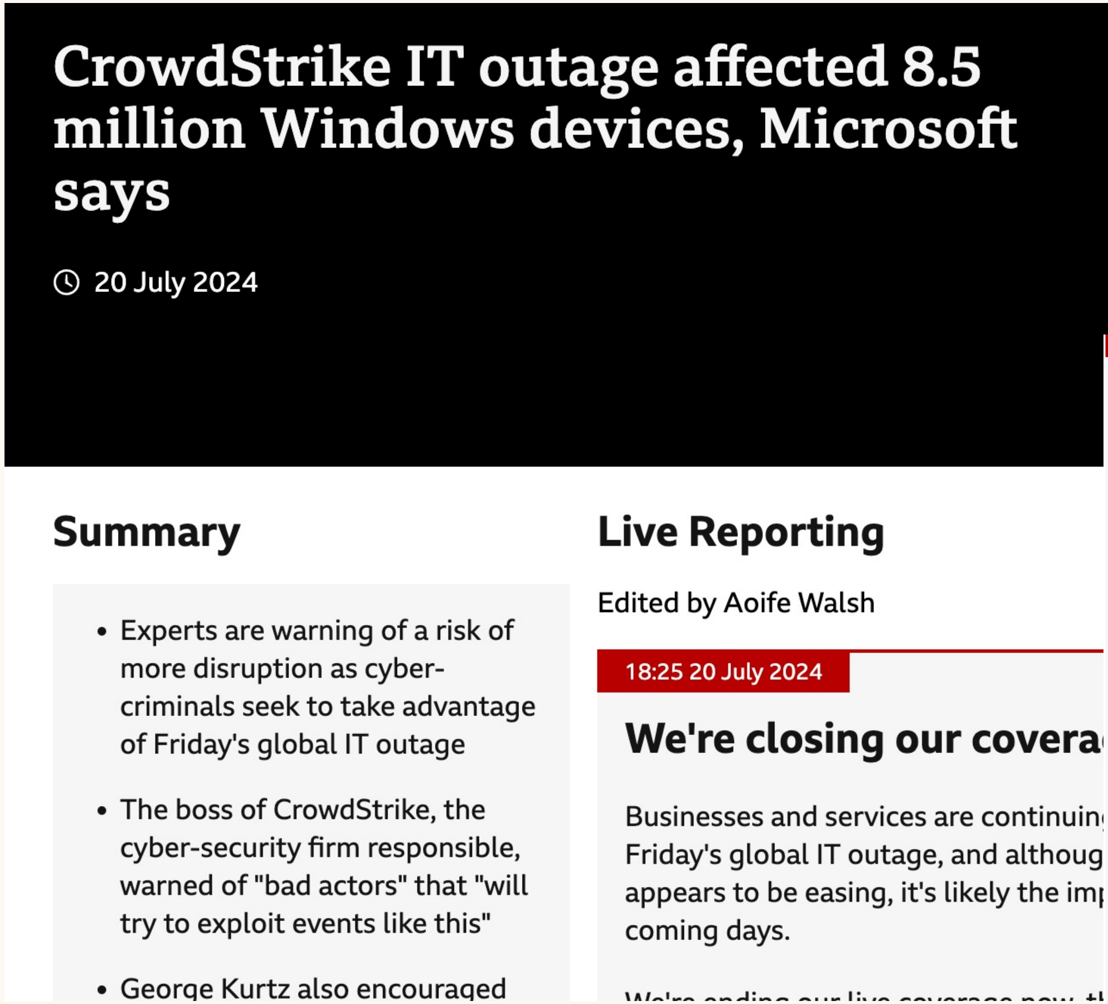
17/01/2024

THE UNIVERSITY *of* EDINBURGH

Overview

- Warm-up discussion
- Fighting virus
- Threat modeling
- How to read and review a research paper?
- Take-home



CrowdStrike IT outage affected 8.5 million Windows devices, Microsoft says

20 July 2024

Summary

- Experts are warning of a risk of more disruption as cyber-criminals seek to take advantage of Friday's global IT outage
- The boss of CrowdStrike, the cyber-security firm responsible, warned of "bad actors" that "will try to exploit events like this"
- George Kurtz also encouraged

Live Reporting

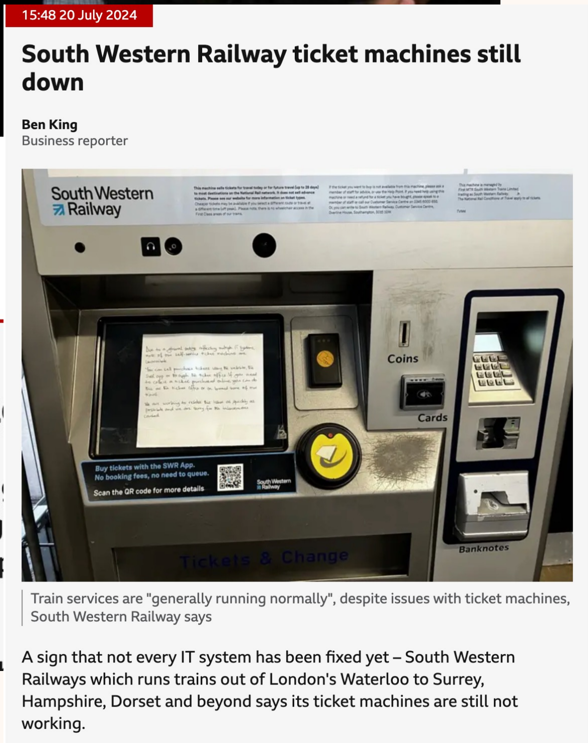
Edited by Aoife Walsh

18:25 20 July 2024

We're closing our covera

Businesses and services are continuin Friday's global IT outage, and althoug appears to be easing, it's likely the imp coming days.

We're ending our live coverage now, th



15:48 20 July 2024

South Western Railway ticket machines still down

Ben King
Business reporter

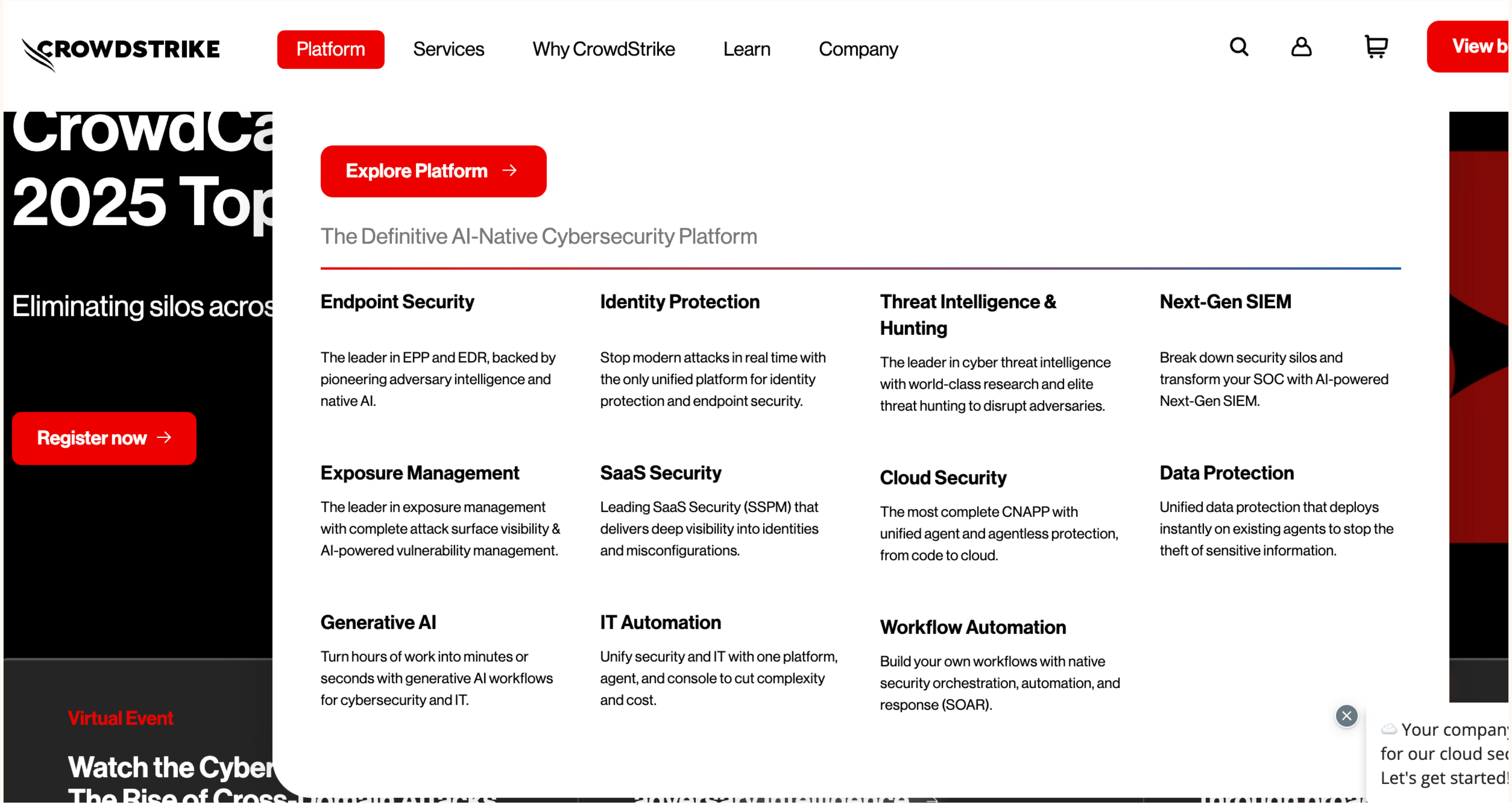
South Western Railway
Buy tickets with the SWR App. No booking fees, no need to queue.
Scan the QR code for more details
Coins
Cards
Banknotes
Tickets & Change

Train services are "generally running normally", despite issues with ticket machines, South Western Railway says

A sign that not every IT system has been fixed yet – South Western Railways which runs trains out of London's Waterloo to Surrey, Hampshire, Dorset and beyond says its ticket machines are still not working.

https://www.bbc.co.uk/news/live/cn056371561t

Do you know what does Crowdstrike do?



CrowdCa
2025 Top

Eliminating silos acros

Register now →

Virtual Event

Watch the Cyber
The Rise of Cross-Domain Attacks

Explore Platform →

The Definitive AI-Native Cybersecurity Platform

Endpoint Security

The leader in EPP and EDR, backed by pioneering adversary intelligence and native AI.

Identity Protection

Stop modern attacks in real time with the only unified platform for identity protection and endpoint security.

Threat Intelligence & Hunting

The leader in cyber threat intelligence with world-class research and elite threat hunting to disrupt adversaries.

Next-Gen SIEM

Break down security silos and transform your SOC with AI-powered Next-Gen SIEM.

Exposure Management

The leader in exposure management with complete attack surface visibility & AI-powered vulnerability management.

SaaS Security

Leading SaaS Security (SSPM) that delivers deep visibility into identities and misconfigurations.

Cloud Security

The most complete CNAPP with unified agent and agentless protection, from code to cloud.

Data Protection

Unified data protection that deploys instantly on existing agents to stop the theft of sensitive information.

Generative AI

Turn hours of work into minutes or seconds with generative AI workflows for cybersecurity and IT.

IT Automation

Unify security and IT with one platform, agent, and console to cut complexity and cost.

Workflow Automation

Build your own workflows with native security orchestration, automation, and response (SOAR).

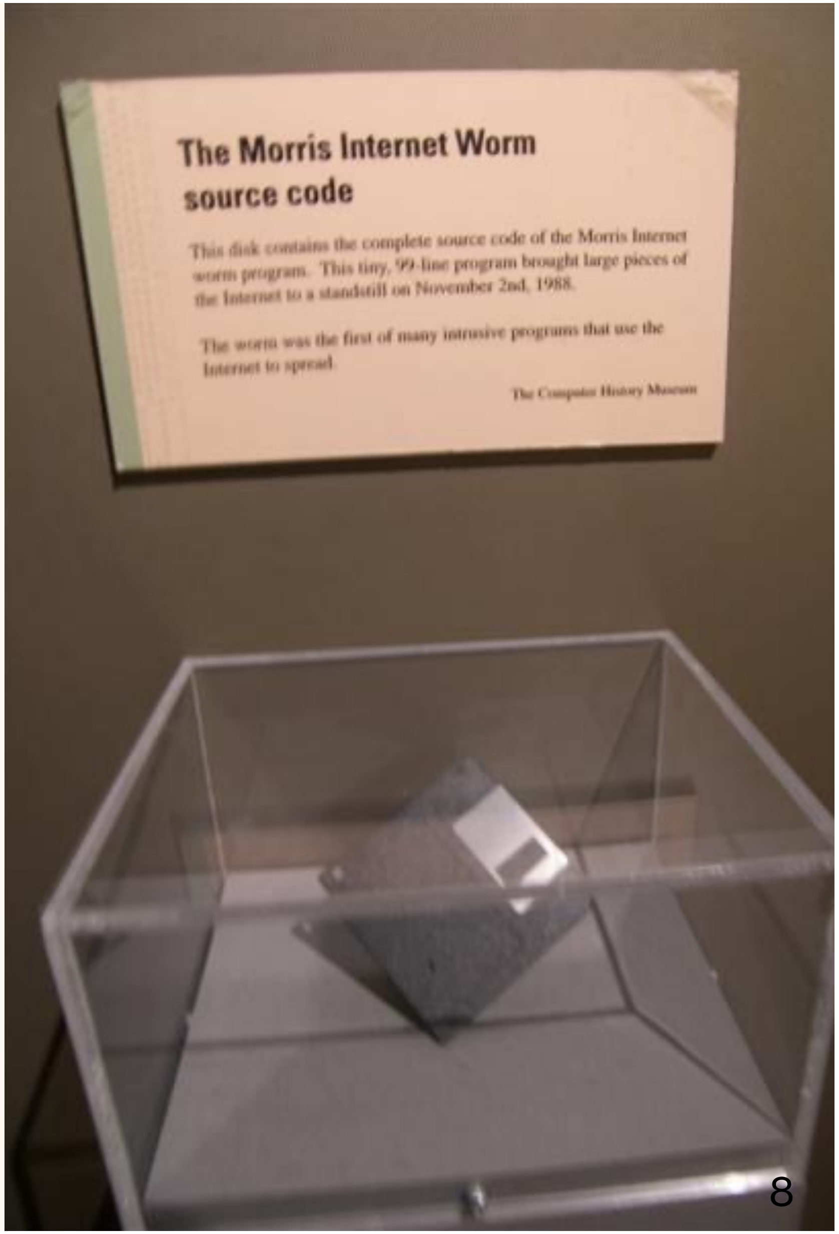
Your compan
for our cloud sec
Let's get started!

How the outage of Crowdstrike may impact end user security?

Problem: **How do we keep bad software off from computers without upsetting users?**

“Bad” software

- Worm
  - **Self-propagating malicious software** that “crawls” through the internet
  - Morris Internet Worm first example
  - Dangerous because no human involvement needed
- Virus
  - Malicious software that hides in other files and then infects the target.
  - Often viruses require **some human interaction** (click a link, plug in a USB, download a file)
- Potentially Unwanted Programs (PUP)
  - Full programs that **provide functionality but the user may not actually want them**.
  - Require some type of human interaction to install, but are often sneaky in how they explain themselves
  - Ask Toolbar

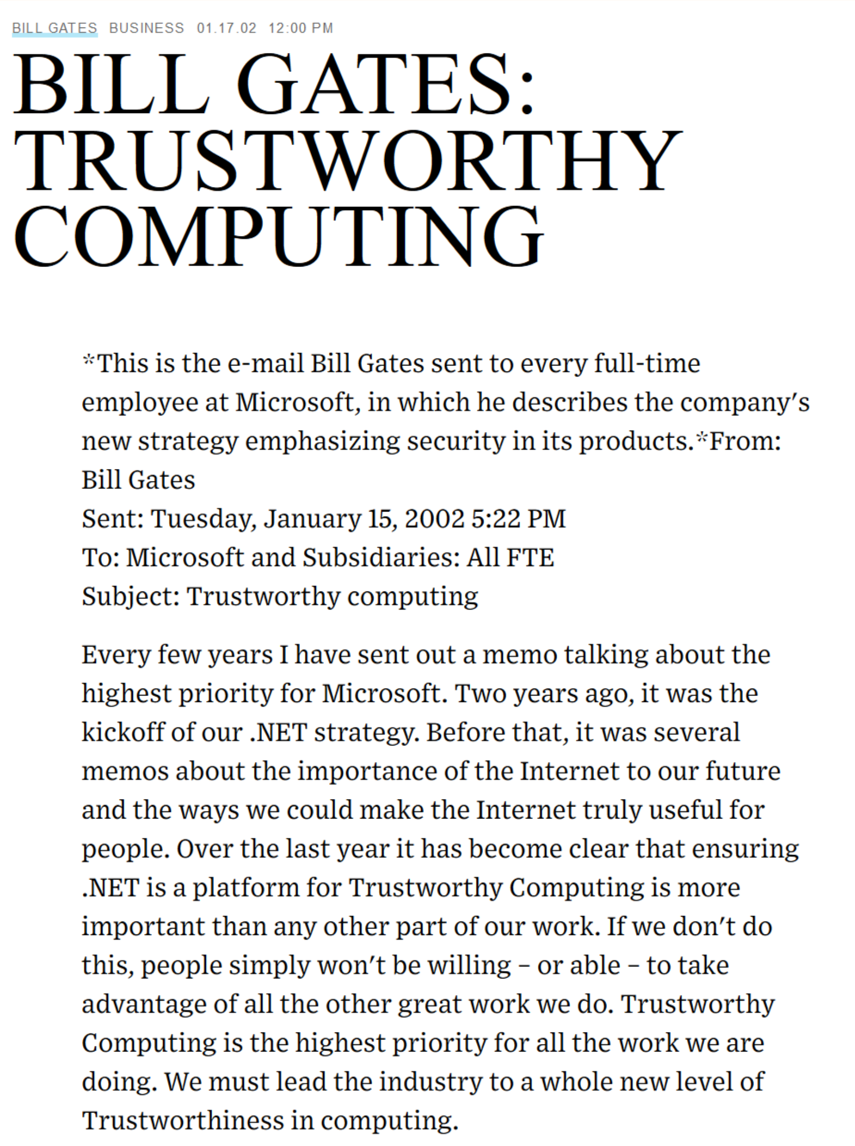


The Morris Internet Worm
source code

This disk contains the complete source code of the Morris Internet worm program. This tiny, 99-line program brought large pieces of the Internet to a standstill on November 2nd, 1988.

The worm was the first of many intrusive programs that use the Internet to spread.

The Computer History Museum

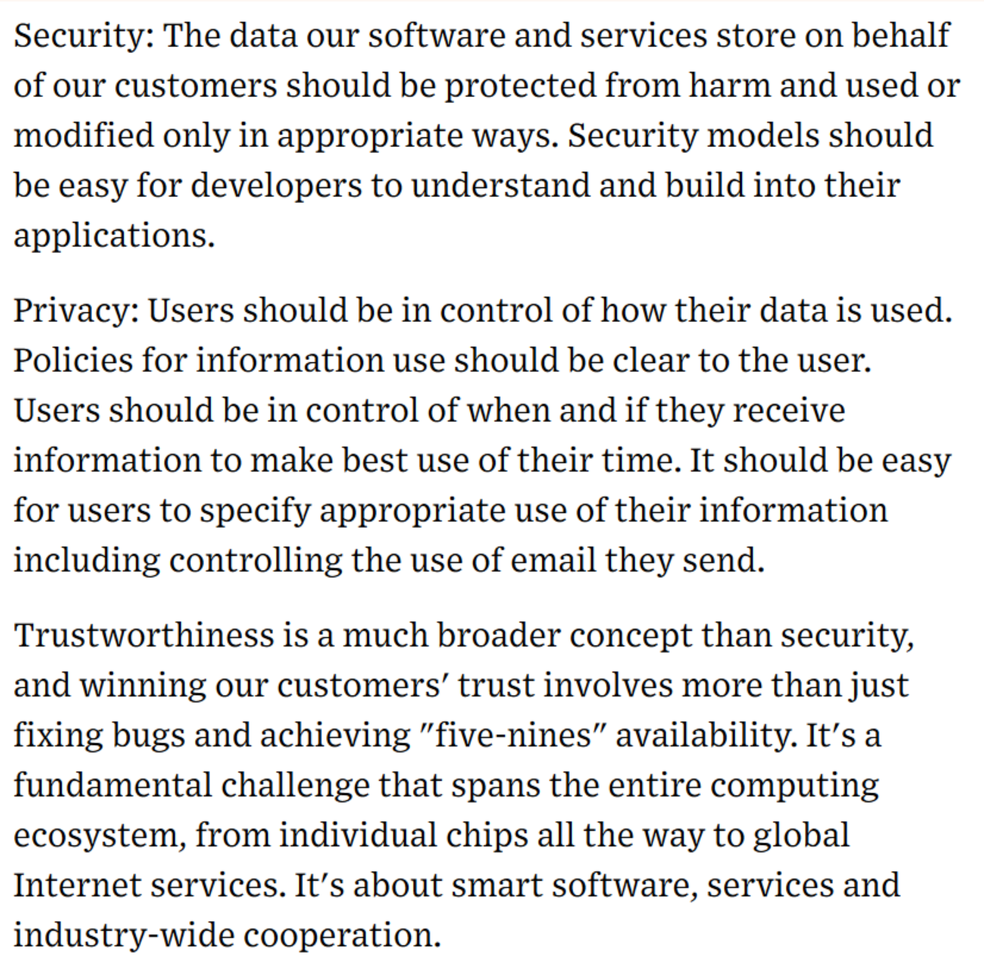


BILL GATES BUSINESS 01.17.02 12:00 PM

BILL GATES: TRUSTWORTHY COMPUTING

*This is the e-mail Bill Gates sent to every full-time employee at Microsoft, in which he describes the company's new strategy emphasizing security in its products.*From: Bill Gates
Sent: Tuesday, January 15, 2002 5:22 PM
To: Microsoft and Subsidiaries: All FTE
Subject: Trustworthy computing

Every few years I have sent out a memo talking about the highest priority for Microsoft. Two years ago, it was the kickoff of our .NET strategy. Before that, it was several memos about the importance of the Internet to our future and the ways we could make the Internet truly useful for people. Over the last year it has become clear that ensuring .NET is a platform for Trustworthy Computing is more important than any other part of our work. If we don't do this, people simply won't be willing – or able – to take advantage of all the other great work we do. Trustworthy Computing is the highest priority for all the work we are doing. We must lead the industry to a whole new level of Trustworthiness in computing.



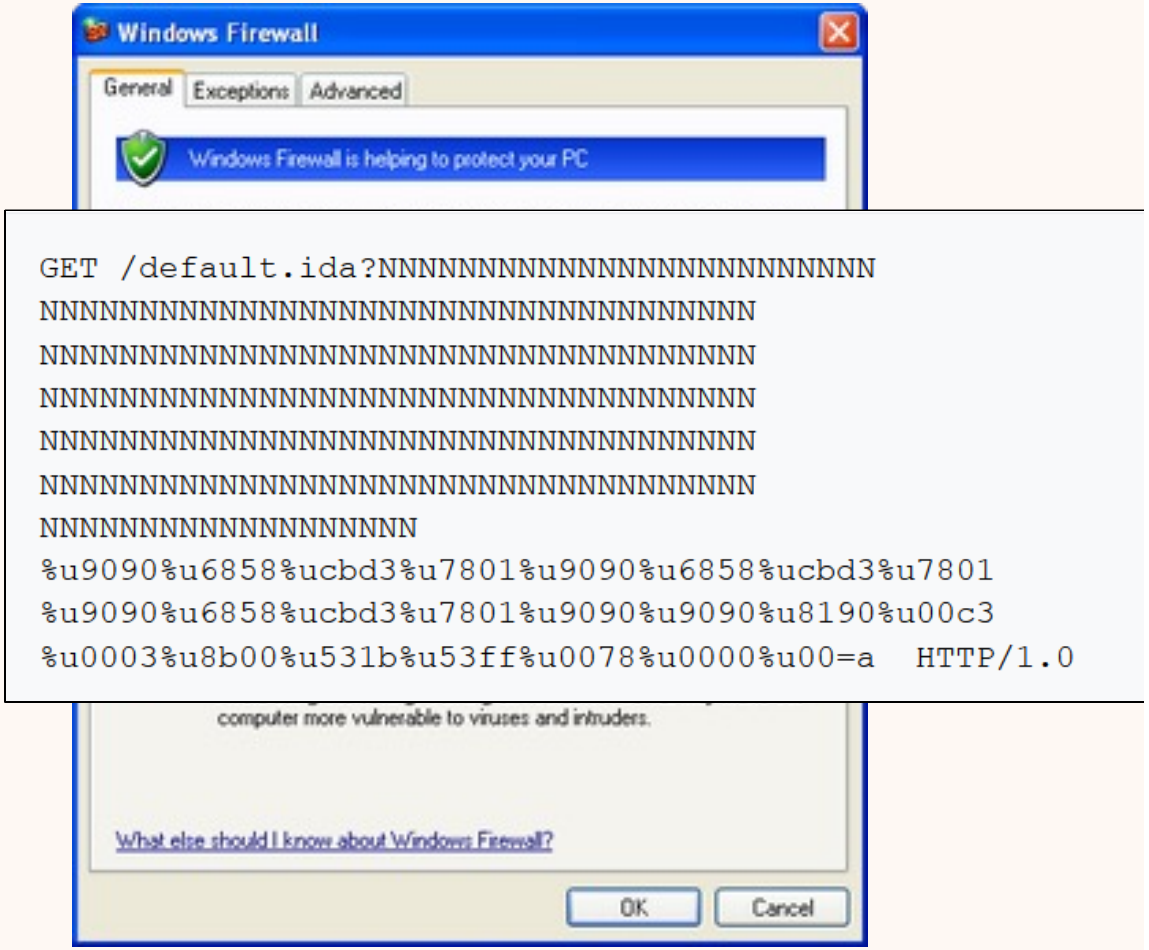
Security: The data our software and services store on behalf of our customers should be protected from harm and used or modified only in appropriate ways. Security models should be easy for developers to understand and build into their applications.

Privacy: Users should be in control of how their data is used. Policies for information use should be clear to the user. Users should be in control of when and if they receive information to make best use of their time. It should be easy for users to specify appropriate use of their information including controlling the use of email they send.

Trustworthiness is a much broader concept than security, and winning our customers' trust involves more than just fixing bugs and achieving "five-nines" availability. It's a fundamental challenge that spans the entire computing ecosystem, from individual chips all the way to global Internet services. It's about smart software, services and industry-wide cooperation.

Solving worms

- Firewalls prevent all unsolicited incoming connections
- They also block outgoing “phone home” behavior of viruses
- Internet Connection Firewall released in 2001 with Windows XP but disabled by default
- Windows Firewall released with Windows XP SP2 in 2004 default on



Windows Firewall is helping to protect your PC

computer more vulnerable to viruses and intruders.

What else should I know about Windows Firewall?

```
GET /default.ida?NNNNNNNNNNNNNNNNNNNNNNNNNN
NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN
NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN
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%u9090%u6858%ucbd3%u7801%u9090%u6858%ucbd3%u7801
%u9090%u6858%ucbd3%u7801%u9090%u9090%u8190%u00c3
%u0003%u8b00%u531b%u53ff%u0078%u0000%u00=a  HTTP/1.0
```
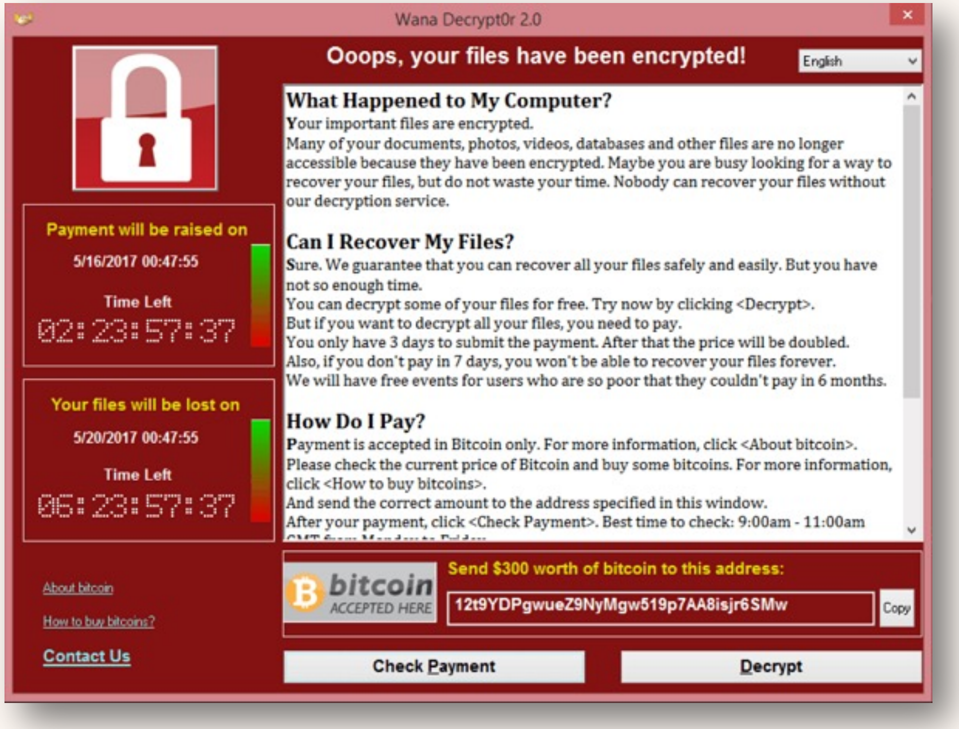

https://en.wikipedia.org/wiki/Code_Red_(computer_worm)

Still solving worms

- WannaCry and NotPetra were both worms released in 2017
- They targeted an open priter port, thereby avoiding the first defense of a firewall
- Open ports



Ooops, your files have been encrypted!

What Happened to My Computer?

Your important files are encrypted.
Many of your documents, photos, videos, databases and other files are no longer accessible because they have been encrypted. Maybe you are busy looking for a way to recover your files, but do not waste your time. Nobody can recover your files without our decryption service.

Can I Recover My Files?

Sure. We guarantee that you can recover all your files safely and easily. But you have not so enough time.
You can decrypt some of your files for free. Try now by clicking <Decrypt>.
But if you want to decrypt all your files, you need to pay.
You only have 3 days to submit the payment. After that the price will be doubled.
Also, if you don't pay in 7 days, you won't be able to recover your files forever.
We will have free events for users who are so poor that they couldn't pay in 6 months.

How Do I Pay?

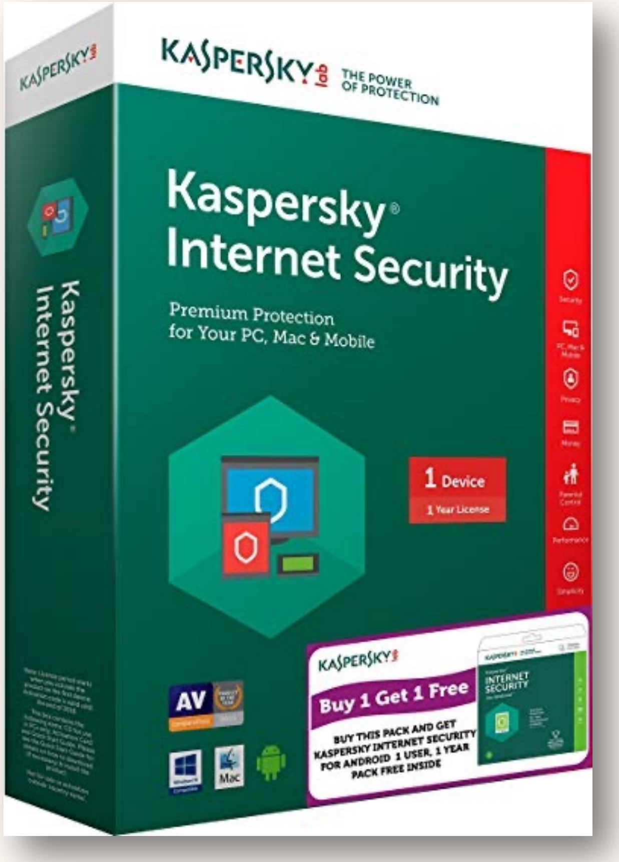
Payment is accepted in Bitcoin only. For more information, click <About bitcoin>.
Please check the current price of Bitcoin and buy some bitcoins. For more information, click <How to buy bitcoins>.
And send the correct amount to the address specified in this window.
After your payment, click <Check Payment>. Best time to check: 9:00am - 11:00am

Send $300 worth of bitcoin to this address:

12t9YDPgwueZ9NyMgw519p7AA8isjr6SMw

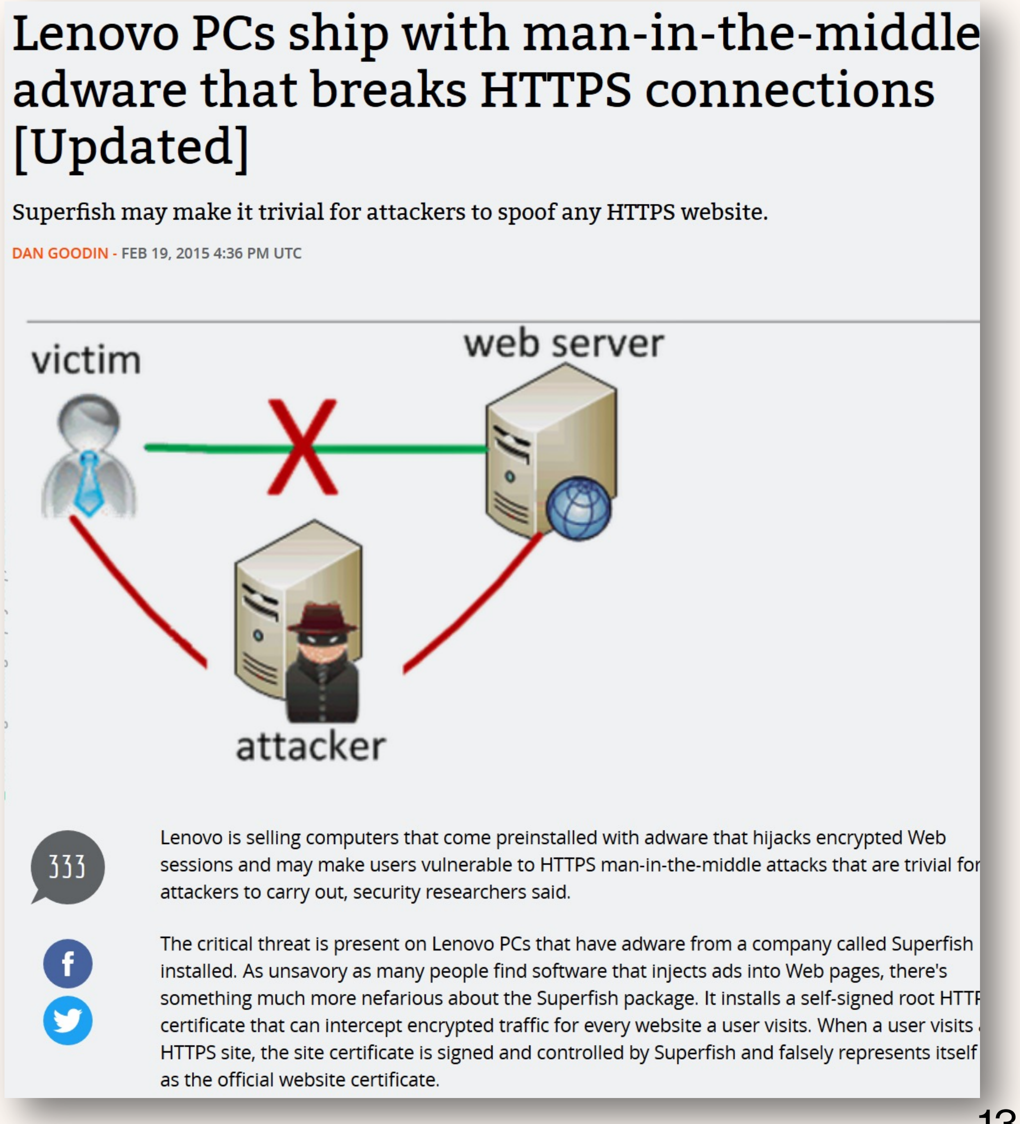
Solving Viruses

- Antivirus tries to match known bad patterns against code on the computer
- Requires end user to spend money
- Can expire
- When expired keeps running, but no longer downloads lists of known bad code
- 2006 Windows Defender made freely available


KASPERSKY lab THE POWER OF PROTECTION
Kaspersky® Internet Security
Premium Protection for Your PC, Mac & Mobile
1 Device
1 Year License
Buy 1 Get 1 Free
BUY THIS PACK AND GET KASPERSKY INTERNET SECURITY FOR ANDROID 1 USER, 1 YEAR PACK FREE INSIDE

Potentially Unwanted Programs (PUPs)

- Do people really want things like copy protection and SuperFish?
- Should we auto-uninstall things that are not technically attacking?



Lenovo PCs ship with man-in-the-middle adware that breaks HTTPS connections [Updated]

Superfish may make it trivial for attackers to spoof any HTTPS website.

DAN GOODIN - FEB 19, 2015 4:36 PM UTC

Lenovo is selling computers that come preinstalled with adware that hijacks encrypted Web sessions and may make users vulnerable to HTTPS man-in-the-middle attacks that are trivial for attackers to carry out, security researchers said.

The critical threat is present on Lenovo PCs that have adware from a company called Superfish installed. As unsavory as many people find software that injects ads into Web pages, there's something much more nefarious about the Superfish package. It installs a self-signed root HTTP certificate that can intercept encrypted traffic for every website a user visits. When a user visits HTTPS site, the site certificate is signed and controlled by Superfish and falsely represents itself as the official website certificate.

So…are we secure enough today?

Who are the “bad guys” and “good guys”

Adversaries

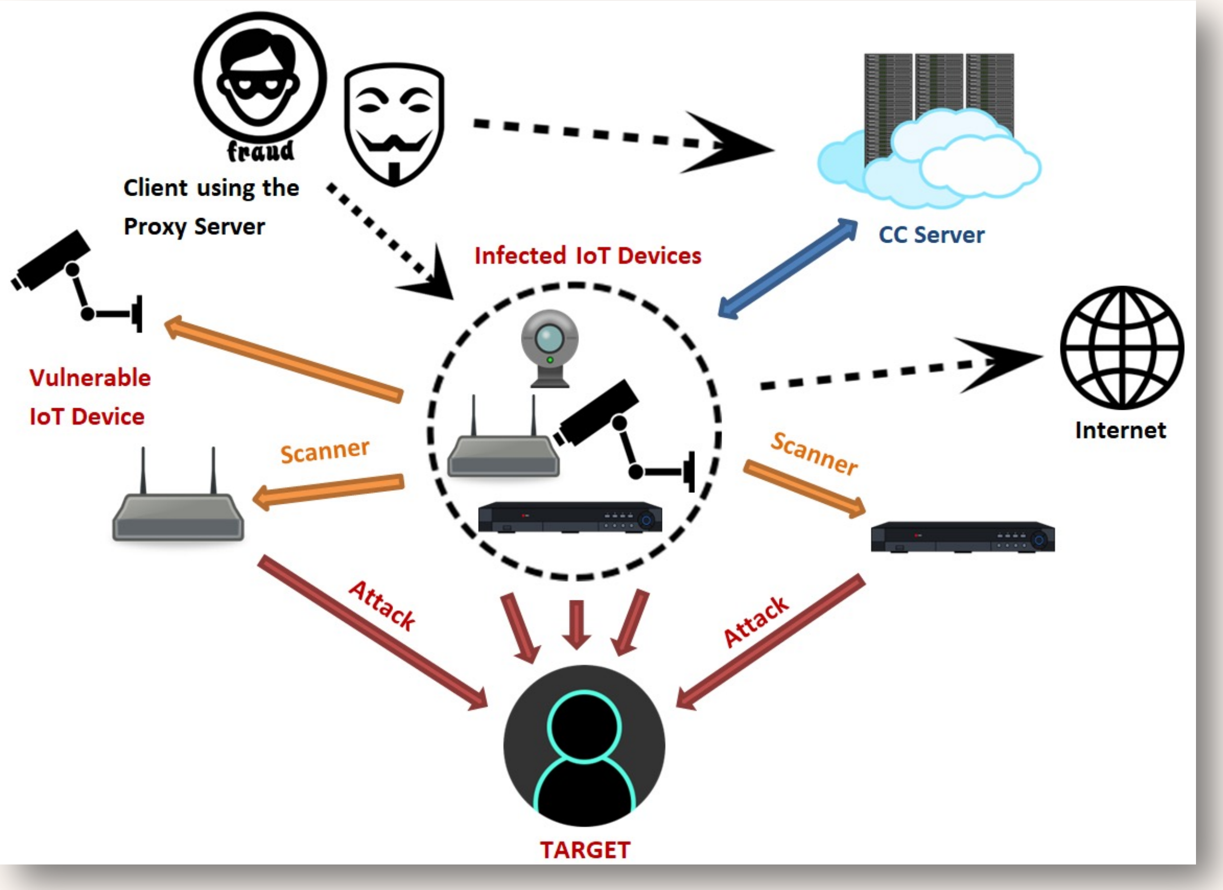
- Malicious actors
  - Hacker
  - Users (your family, your friend, your customer, etc.)
- Service providers
  - Company
  - App developers
- “Big brother”
- … (depending on your position)

What are your protecting?

Assets

- Computer hardware: phone, laptop, server…
- Computer software: apps, operating systems, database…
- Physical assets: house, car…..
- Information: health record, your profile/identity, business info…
- Emotion, reputation, user experience….

Attack on IoT devices



https://www.hackread.com/website-streams-from-private-security-cameras/

- IoT devices can be overlooked and lacked proper protection/management

What can the bad guys do?

Risk, threat and vulnerability

- Vulnerability: the weakness of X (system/human) that can be exploited
  - The program is overprivileged to access things
  - The user reuses their password across applications
- Threat is an action performed by the adversary to damage the asset by exploiting a vulnerability
- Risk = asset X threat X vulnerability

What is the threat model here?

Me trying to wipe out my log in record from Mom's computer after playing computer games

Mom coming home and suspecting kid playing games without permission again

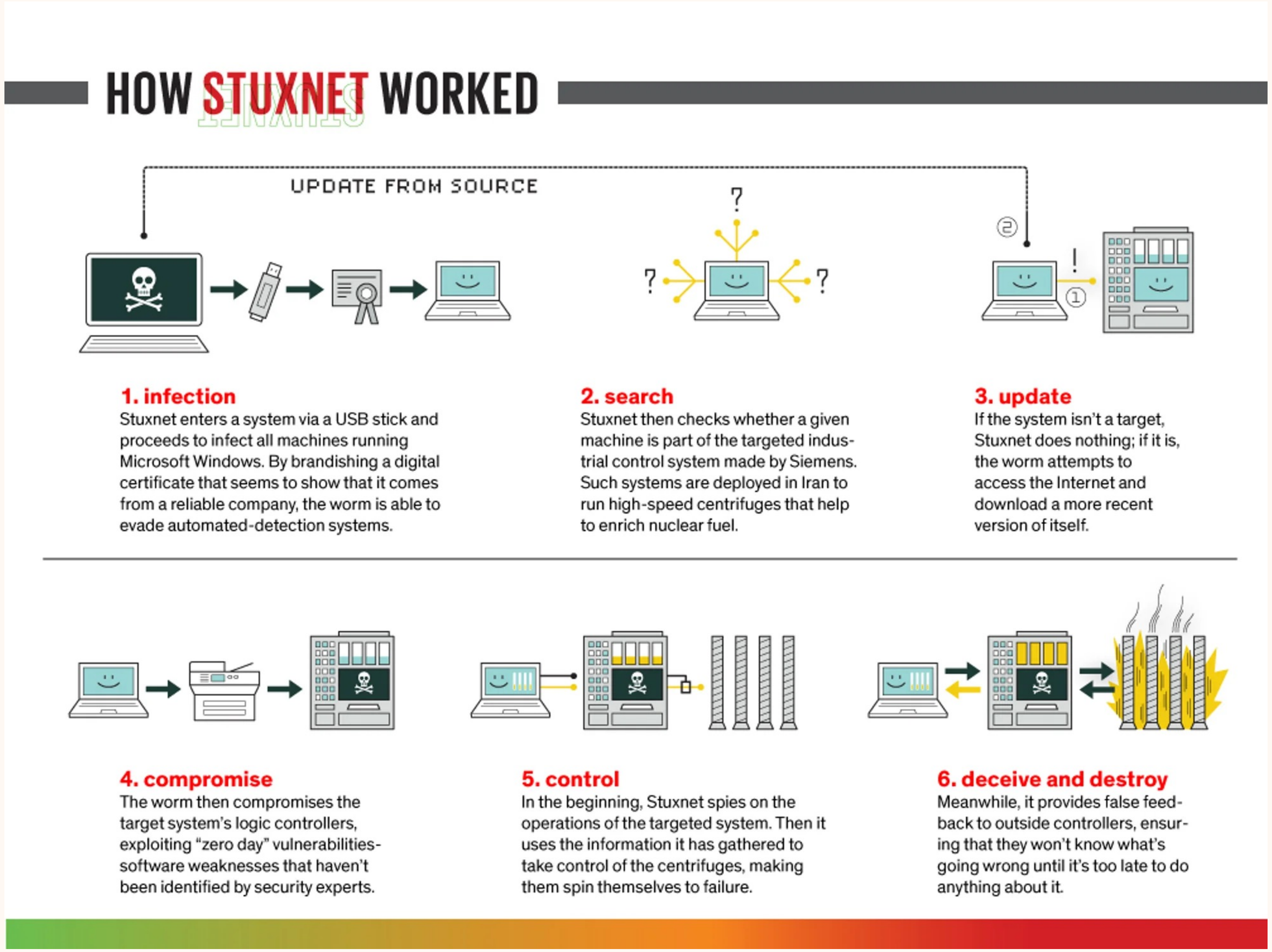
- **Adversary = ?**
- **Asset = ?**
- **Threat = ?**
- **Vulnerability = ?**

Stuxnet: a worm that targets nuclear facilities

- Jan 2010 – International Atomic Energy Agency found out a nuclear plant in Iran is malfunctioning
- Five months later, people confirmed that it is a result of an intended cyber attack. How?

https://www.wired.com/2014/11/countdown-to-zero-day-stuxnet/

Stuxnet: a worm that targets nuclear facilities



HOW STUXNET WORKED

1. infection
Stuxnet enters a system via a USB stick and proceeds to infect all machines running Microsoft Windows. By brandishing a digital certificate that seems to show that it comes from a reliable company, the worm is able to evade automated-detection systems.

2. search
Stuxnet then checks whether a given machine is part of the targeted industrial control system made by Siemens. Such systems are deployed in Iran to run high-speed centrifuges that help to enrich nuclear fuel.

3. update
If the system isn't a target, Stuxnet does nothing; if it is, the worm attempts to access the Internet and download a more recent version of itself.

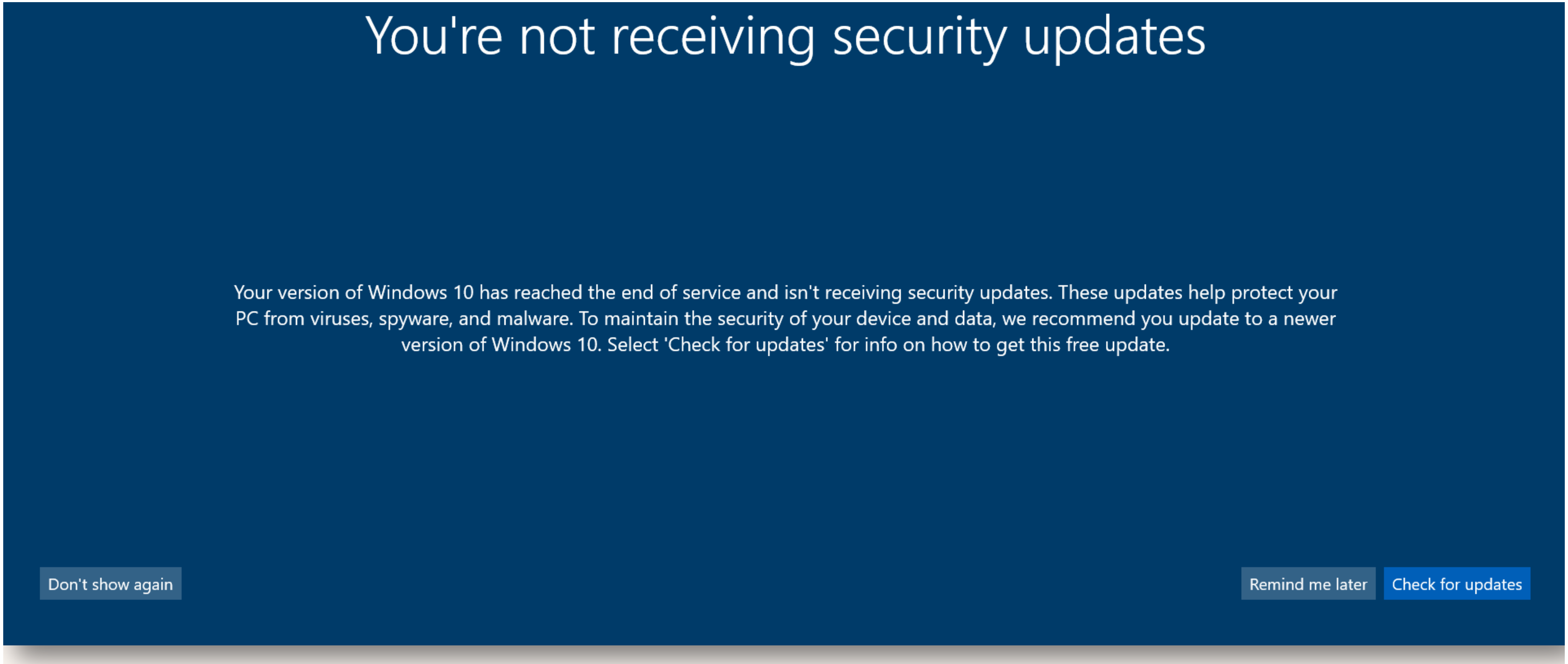
4. compromise
The worm then compromises the target system's logic controllers, exploiting "zero day" vulnerabilities-software weaknesses that haven't been identified by security experts.

5. control
In the beginning, Stuxnet spies on the operations of the targeted system. Then it uses the information it has gathered to take control of the centrifuges, making them spin themselves to failure.

6. deceive and destroy
Meanwhile, it provides false feedback to outside controllers, ensuring that they won't know what's going wrong until it's too late to do anything about it.

https://spectrum.ieee.org/the-real-story-of-stuxnet/

Are we still falling behind?

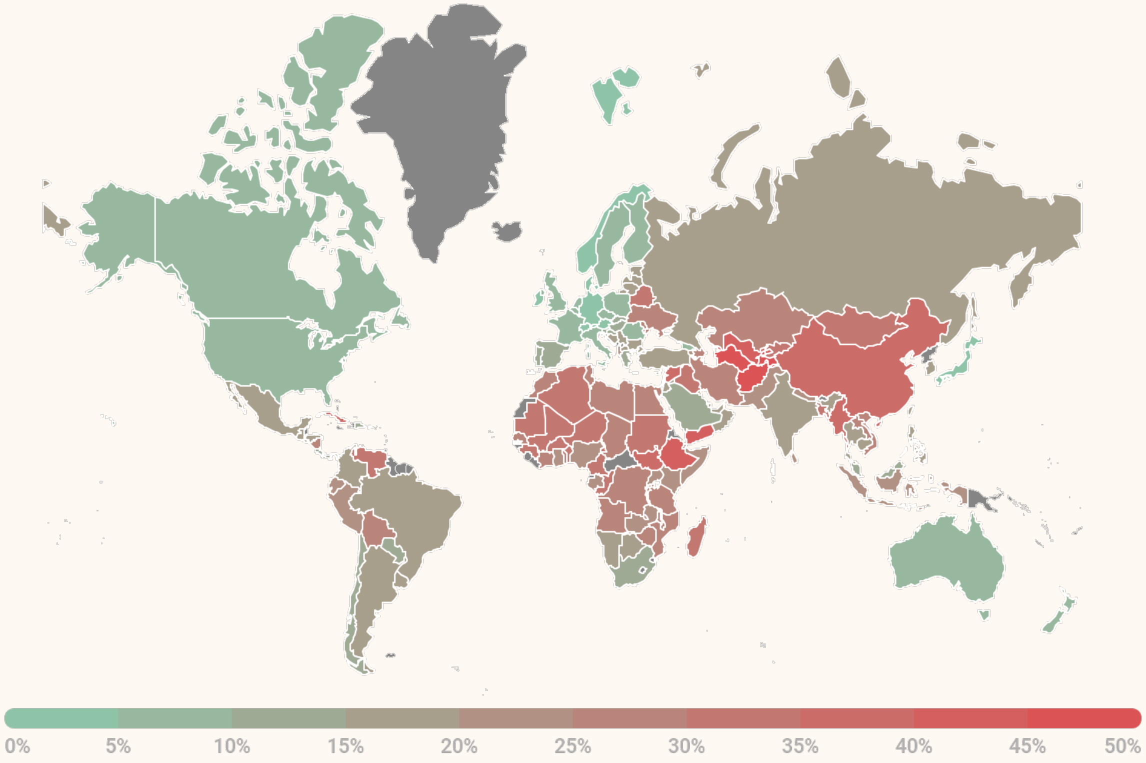


You're not receiving security updates

Your version of Windows 10 has reached the end of service and isn't receiving security updates. These updates help protect your PC from viruses, spyware, and malware. To maintain the security of your device and data, we recommend you update to a newer version of Windows 10. Select 'Check for updates' for info on how to get this free update.

Lack of support/security update

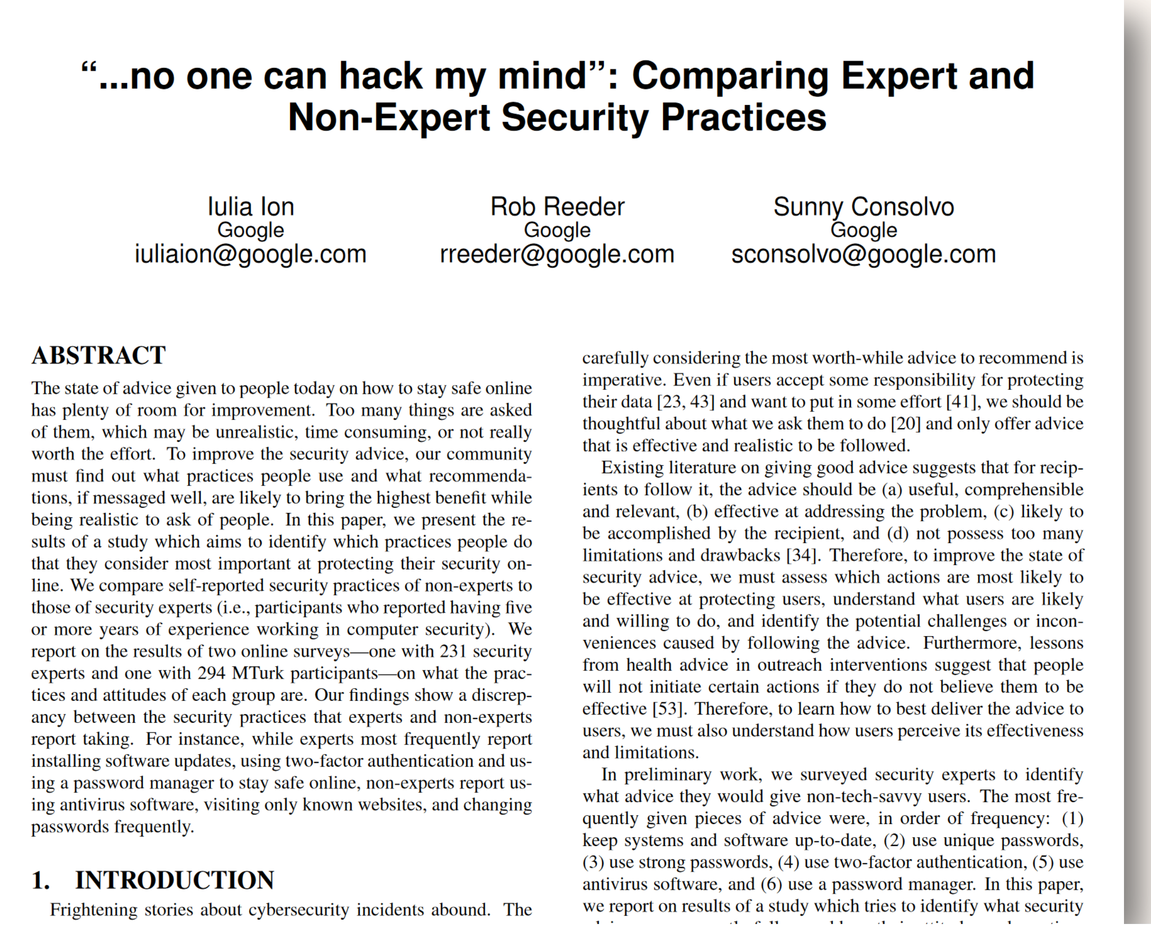
Geographical difference of malware infection



https://securelist.com/it-threat-evolution-in-q2-2021-pc-statistics/103607/ kaspersky

- IoT devices can be overlooked and lacked proper protection/management

Gap in security literacy and behavior



"...no one can hack my mind": Comparing Expert and Non-Expert Security Practices

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ABSTRACT

The state of advice given to people today on how to stay safe online has plenty of room for improvement. Too many things are asked of them, which may be unrealistic, time consuming, or not really worth the effort. To improve the security advice, our community must find out what practices people use and what recommendations, if messaged well, are likely to bring the highest benefit while being realistic to ask of people. In this paper, we present the results of a study which aims to identify which practices people do that they consider most important at protecting their security online. We compare self-reported security practices of non-experts to those of security experts (i.e., participants who reported having five or more years of experience working in computer security). We report on the results of two online surveys—one with 231 security experts and one with 294 MTurk participants—on what the practices and attitudes of each group are. Our findings show a discrepancy between the security practices that experts and non-experts report taking. For instance, while experts most frequently report installing software updates, using two-factor authentication and using a password manager to stay safe online, non-experts report using antivirus software, visiting only known websites, and changing passwords frequently.

1. INTRODUCTION

Frightening stories about cybersecurity incidents abound. The carefully considering the most worth-while advice to recommend is imperative. Even if users accept some responsibility for protecting their data [23, 43] and want to put in some effort [41], we should be thoughtful about what we ask them to do [20] and only offer advice that is effective and realistic to be followed.

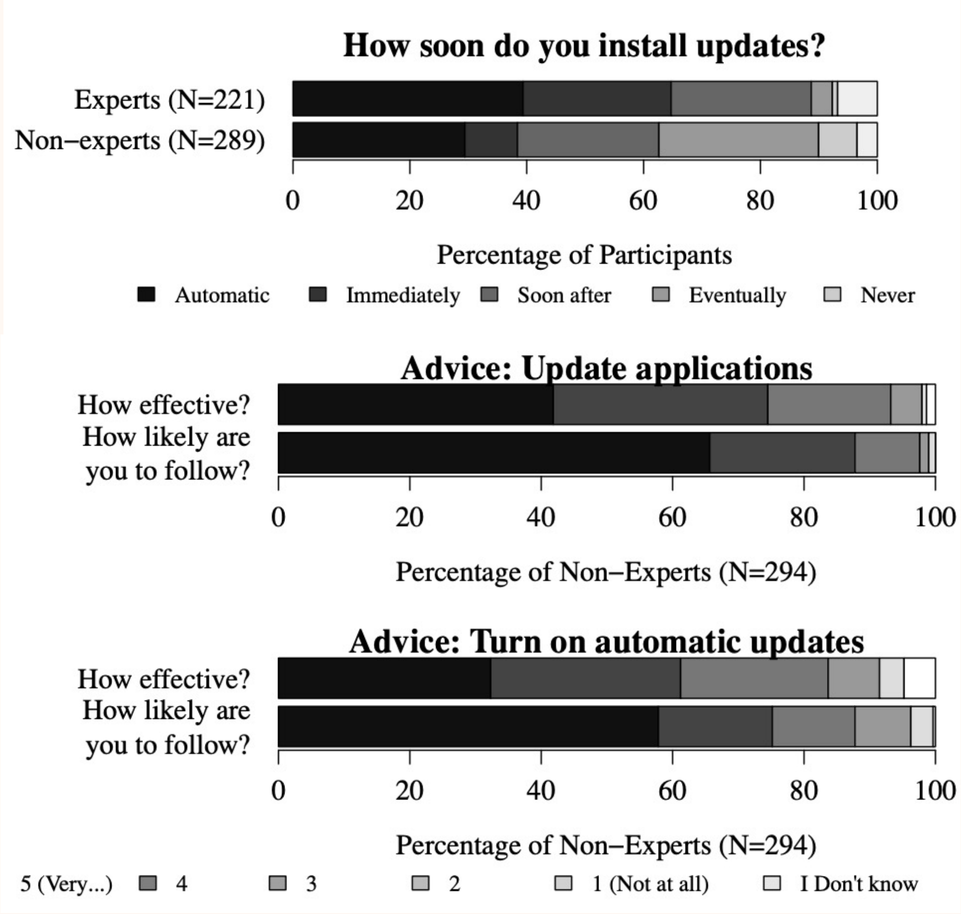
Existing literature on giving good advice suggests that for recipients to follow it, the advice should be (a) useful, comprehensible and relevant, (b) effective at addressing the problem, (c) likely to be accomplished by the recipient, and (d) not possess too many limitations and drawbacks [34]. Therefore, to improve the state of security advice, we must assess which actions are most likely to be effective at protecting users, understand what users are likely and willing to do, and identify the potential challenges or inconveniences caused by following the advice. Furthermore, lessons from health advice in outreach interventions suggest that people will not initiate certain actions if they do not believe them to be effective [53]. Therefore, to learn how to best deliver the advice to users, we must also understand how users perceive its effectiveness and limitations.

In preliminary work, we surveyed security experts to identify what advice they would give non-tech-savvy users. The most frequently given pieces of advice were, in order of frequency: (1) keep systems and software up-to-date, (2) use unique passwords, (3) use strong passwords, (4) use two-factor authentication, (5) use antivirus software, and (6) use a password manager. In this paper, we report on results of a study which tries to identify what security

Gap in security literacy and behavior

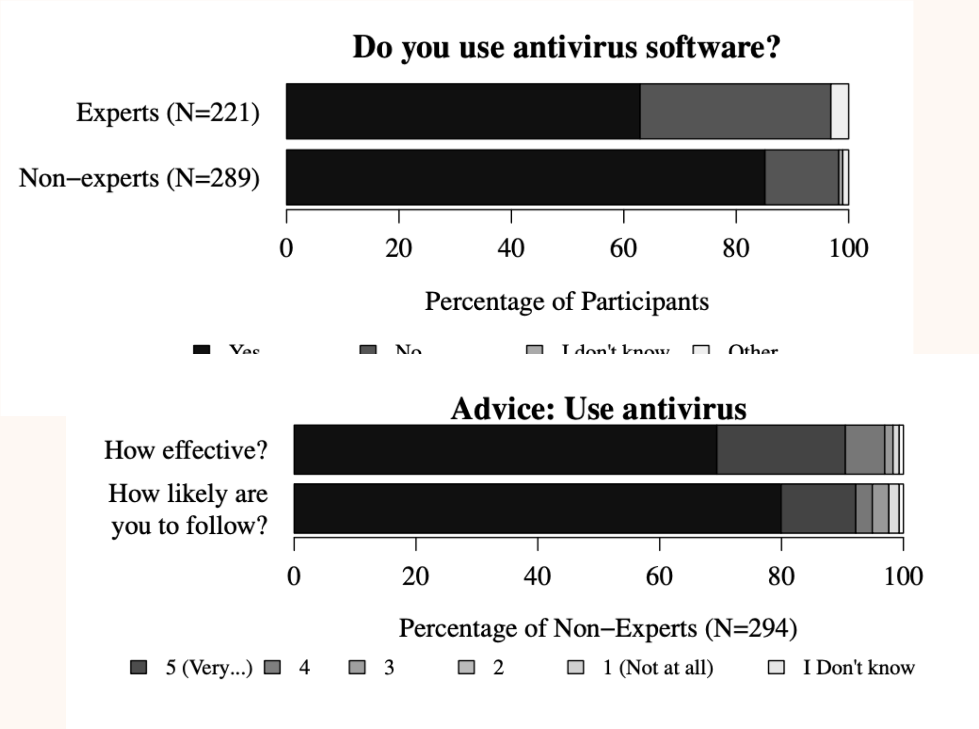
- Types of security behaviors
  - Security updates
    - Bundled with undesirable features; not sure about the benefits of it...
  - Antivirus software
    - Whether people install and how they configure it
  - Account security
    - Password use...
  - Mindfulness
    - Website visits; email habits; phishing notices...

Gap in security literacy and behavior



- Non-experts consider installing security updates not effective, but they will likely to follow if they heard it was effective

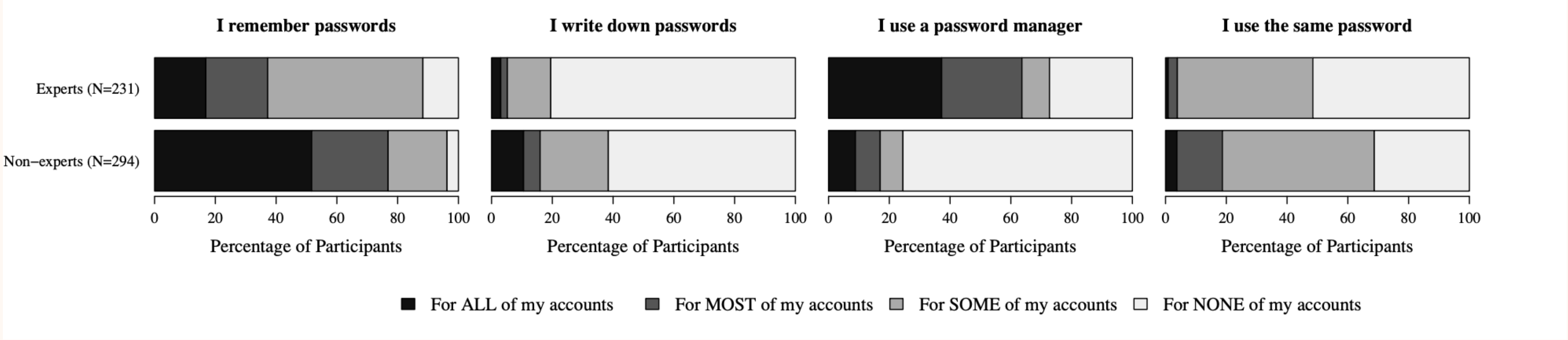
Gap in security literacy and behavior



- More non-experts use anti-virus software than experts and consider it very effective – likely because it is a one-stop solution for them

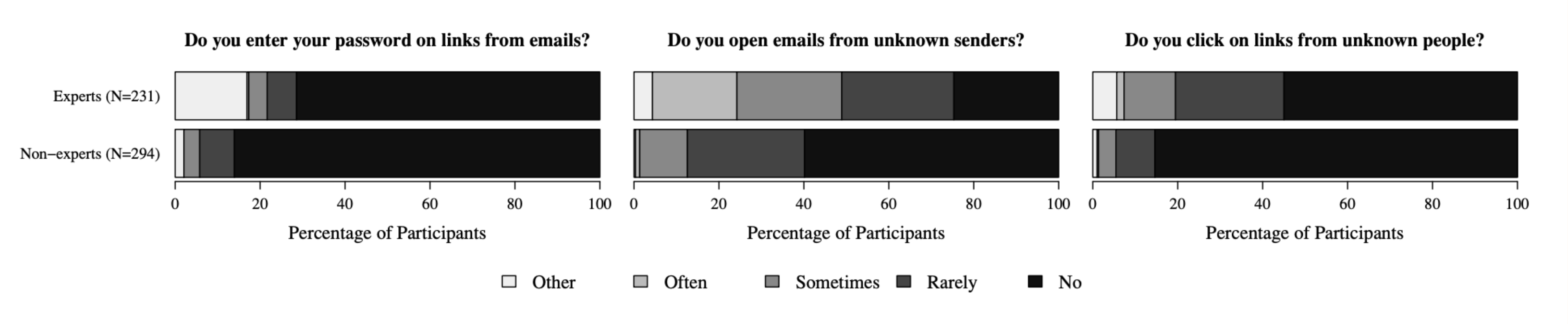
Is it still true today?

Gap in security literacy and behavior

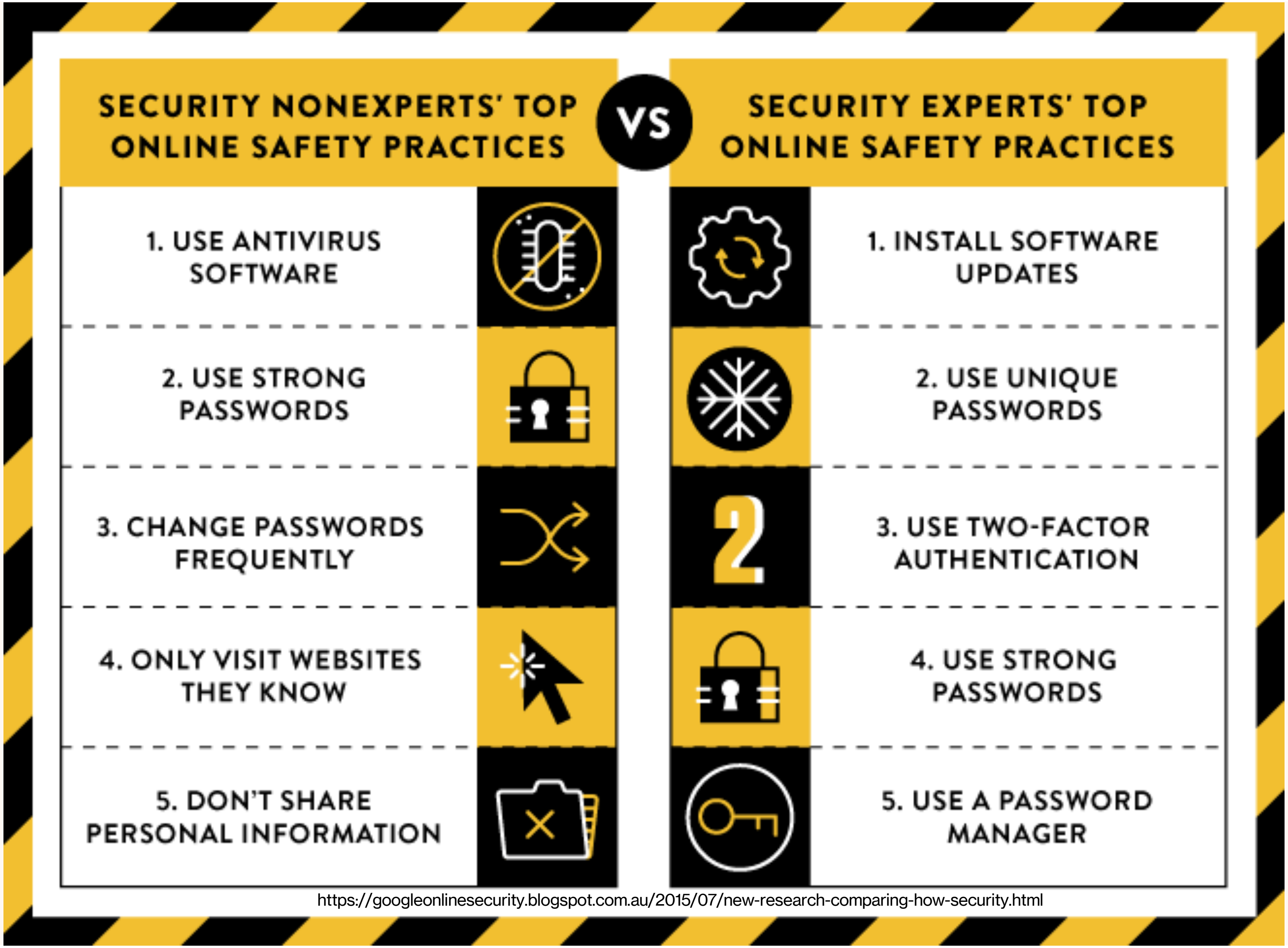


- More experts mention *strong password,* using *password manager, and two-factor authentication*; more non-experts mention using unique password and changing password frequently
- Only one expert mentions writing down passwords is fundamentally bad

Gap in security literacy and behavior



- Paradoxically, more experts clicks on links from unknown senders than non-experts Why?
- Other mindfulness aspects include checking HTTPS, clearing browser cookies, and email habits.



SECURITY NONEXPERTS' TOP ONLINE SAFETY PRACTICES	VS	SECURITY EXPERTS' TOP ONLINE SAFETY PRACTICES
1. USE ANTIVIRUS SOFTWARE		1. INSTALL SOFTWARE UPDATES
2. USE STRONG PASSWORDS		2. USE UNIQUE PASSWORDS
3. CHANGE PASSWORDS FREQUENTLY		3. USE TWO-FACTOR AUTHENTICATION
4. ONLY VISIT WEBSITES THEY KNOW		4. USE STRONG PASSWORDS
5. DON'T SHARE PERSONAL INFORMATION		5. USE A PASSWORD MANAGER

https://googleonlinesecurity.blogspot.com.au/2015/07/new-research-comparing-how-security.html

How to read and review (USEC) research paper?

Where should I look for them?

*(*it’s not an exhaustive list below)*

- Computer security and privacy
  - IEEE Symposium on Security and Privacy
  - USENIX Security Symposium
  - ACM Computer and Communications Security Conference
  - Network and Distributed System Security (NDSS) Symposium
- Human computer interaction
  - ACM Conference on Human Factors in Computing Systems (CHI)
  - ACM Conference on Computer Supported Cooperative Work (CSCW)
- More dedicated USEC and privacy conferences
  - USENIX Symposium on Usable Privacy and Security
  - Privacy Enhancing Technologies Symposium (PETS)

How do I read a paper?

*(*you may have more personalized way to read them)*

- Understanding what is the problem being solved and the impact?
  - Title, abstract, and introduction
- What are the (technical) innovation being made?
  - Method and design
- What are the state-of-arts and competing solutions?
  - Related work and evaluation
- What are the future (research and practical) implications?
  - Discussion

Start from the high-level ideas, dig into interesting details, iterate and reflect on them.

How do I write a review/blog?

- Summary of the work and your overall comments
- Strengths and weakness of the work; give clear, specific, and **constructive** arguments
  - Motivation and focus: if it is relevant/new/too board or too narrow?
  - Technical contribution: if it's important/applicable/useful/done properly?
  - Evaluation: if it considers relevant metrics/related baselines/is consistent and clear?
  - Writing and presentation: if it's easy to read regarding structure, notation, examples...?
  - Related work: if it is sufficient/biased?
- Suggestions to improve: based on the above, what can be improved?
- Discussion (for the blog): what's your idea for future research?

Let's practice it through the blog :)

How do I write a review/blog?

- We don’t have a fixed format for news blogs, and the general idea is to stimulate further thinking and discussion.
- Summary of the news and your overall comments
- Why are you interested in this news?
- Discussion (for the blog): what’s your idea for future research?
  - What is the problem you are trying to understand/solve and why it is important?
  - What can be a potential solution, and what’s your hypothesis?
  - A plan for testing out the solution?

***Let’s practice it through the blog :)**

Take-home

- **(Blog)** Munyendo, C., Acar, Y. and Aviv, A.J., 2023, May. “In Eighty Percent of the Cases, I Select the Password for Them”: Security and Privacy Challenges, Advice, and Opportunities at Cybercafes in Kenya. In *2023 IEEE Symposium on Security and Privacy*.
- **(Blog)** Hielscher, J. and Parkin, S., 2024. " What Keeps People Secure is That They Met The Security Team": Deconstructing Drivers And Goals of Organizational Security Awareness. In *2024 USENIX Security and Privacy*.
- Note: feel free to choose other papers/news that you are interested in