CNT 4406, Spring 2024

Introduction

Viet Tung Hoang

Some slides are based on material from Prof. Stefano Tessaro (University of Washington) and Prof. Dan Boneh (Stanford)

Agenda

1. **The Internet & Its Problems**

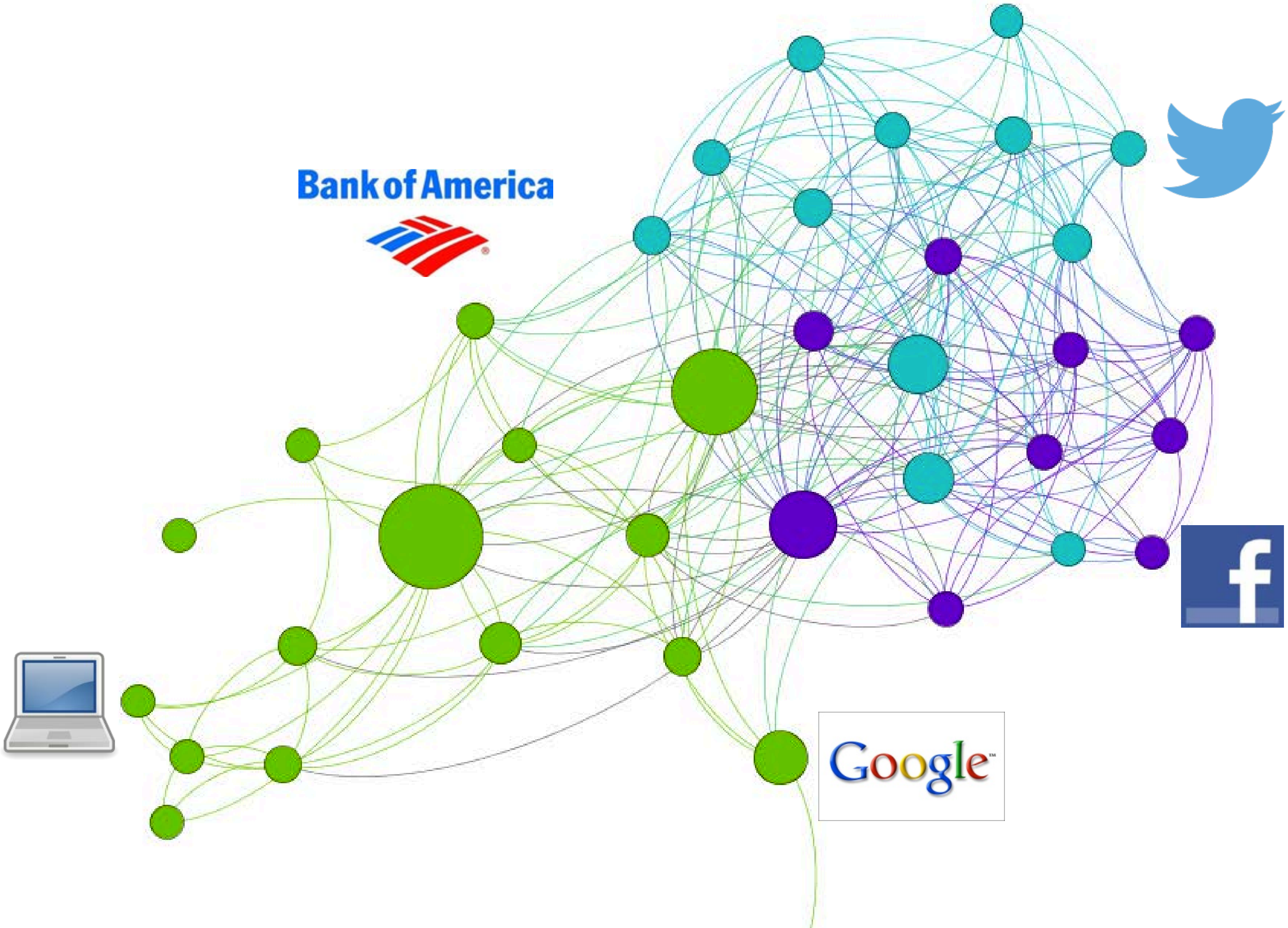
2. **HTTP Issues**

3. **IP Issues**

4. **Privacy Issue**

The Internet

Global network that provides **best-effort delivery** of packets between connected hosts



OSI Layer Model

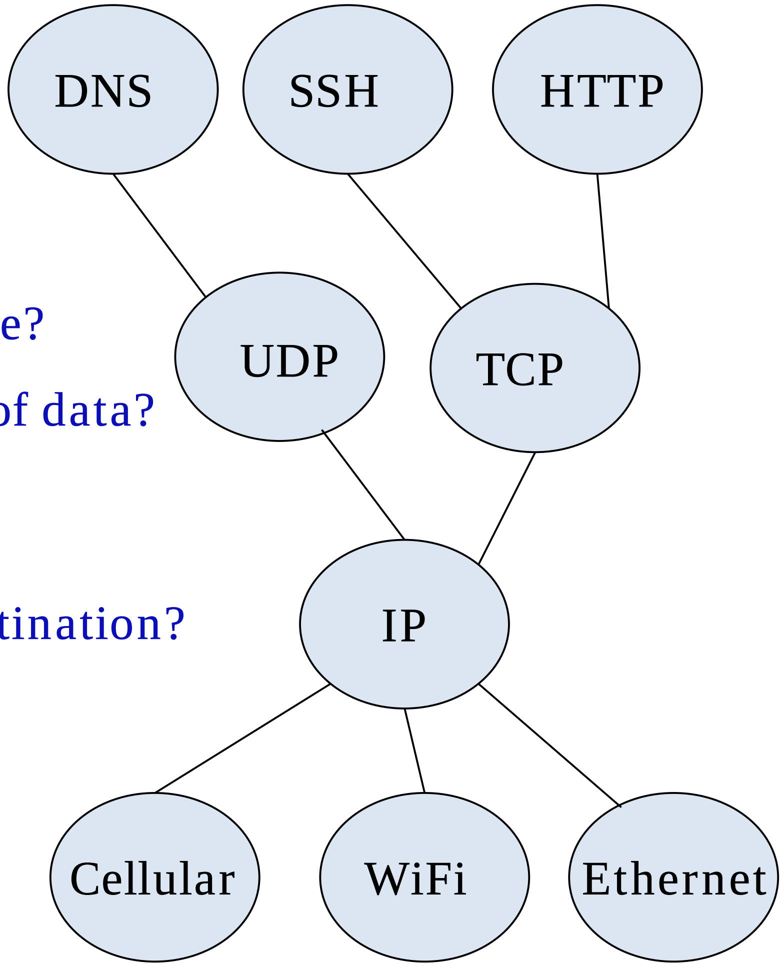
How does Application structure data?

How do I get to the right service?

How to have a reliable stream of data?

How a packet get to a final destination?

How to get to the next hop?

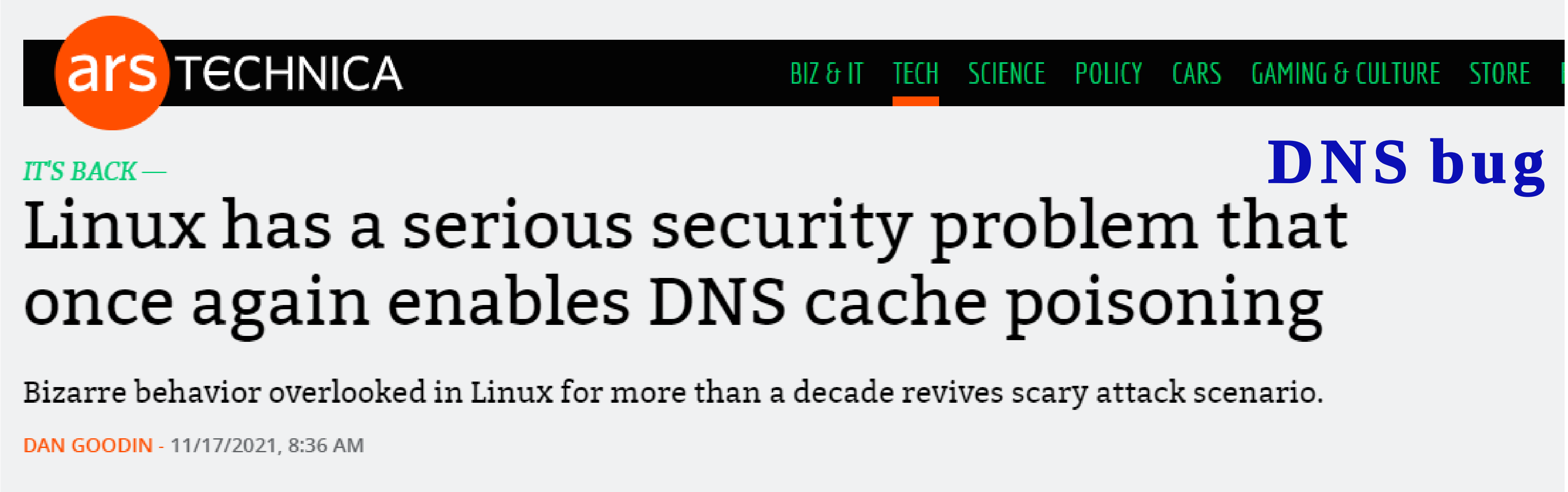


Application layer

Transport layer

Network layer

Link layer



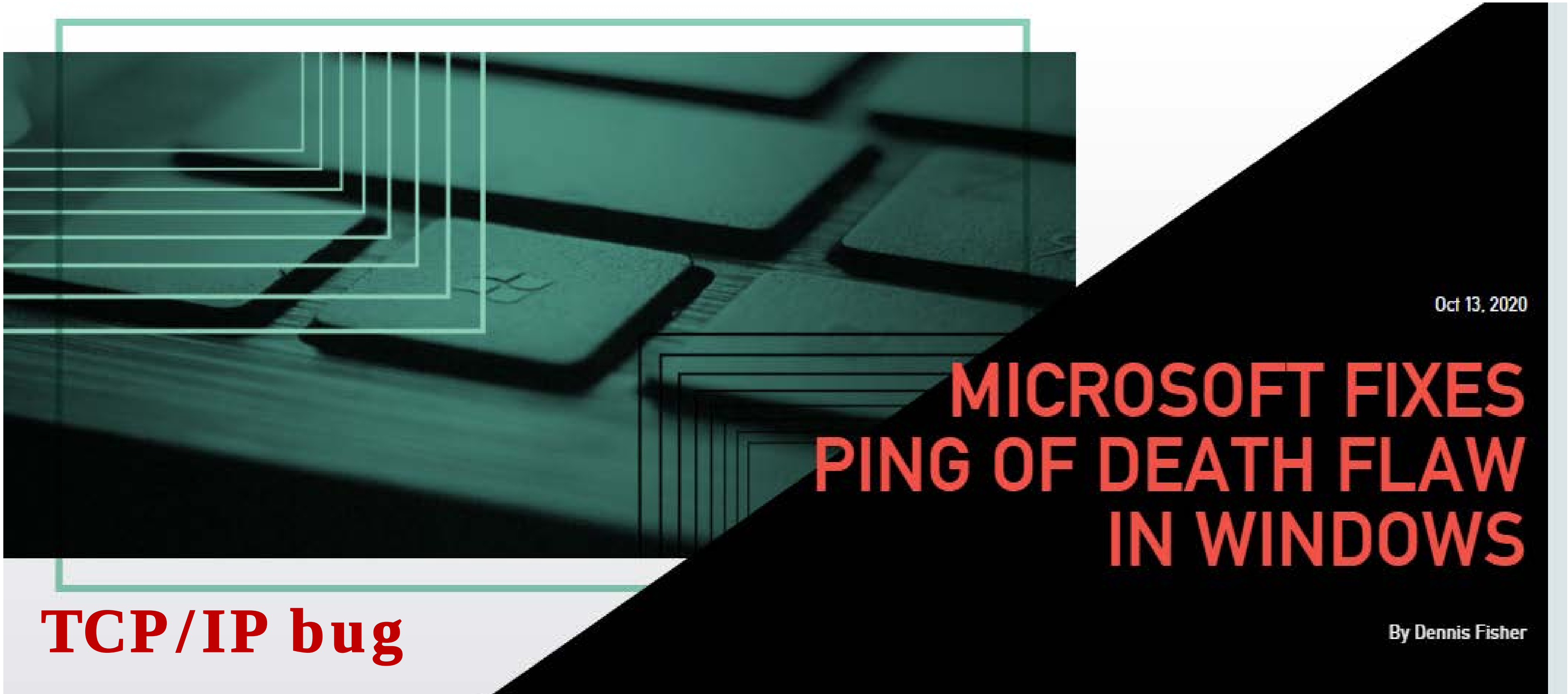
IT'S BACK —

Linux has a serious security problem that once again enables DNS cache poisoning

Bizarre behavior overlooked in Linux for more than a decade revives scary attack scenario.

DAN GOODIN - 11/17/2021, 8:36 AM

DNS bug



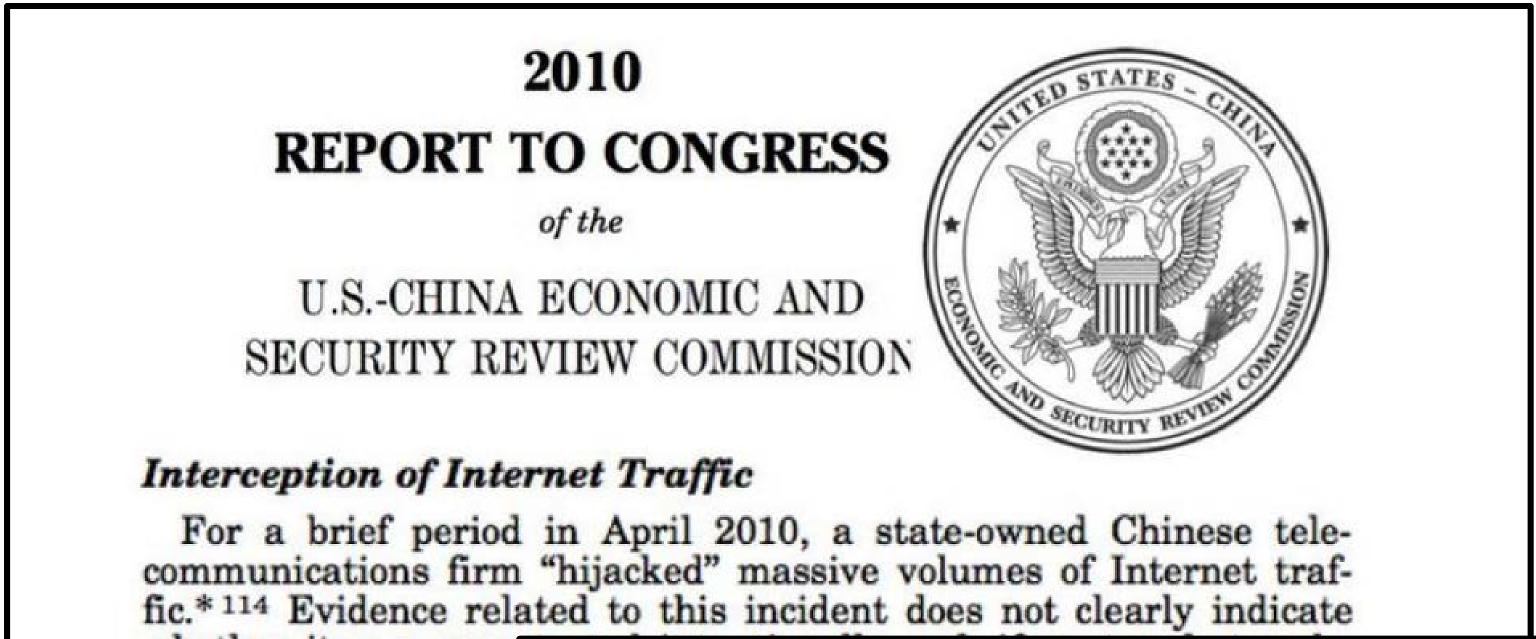
Oct 13, 2020

MICROSOFT FIXES PING OF DEATH FLAW IN WINDOWS

By Dennis Fisher

TCP/IP bug

Routing bugs



2010

REPORT TO CONGRESS

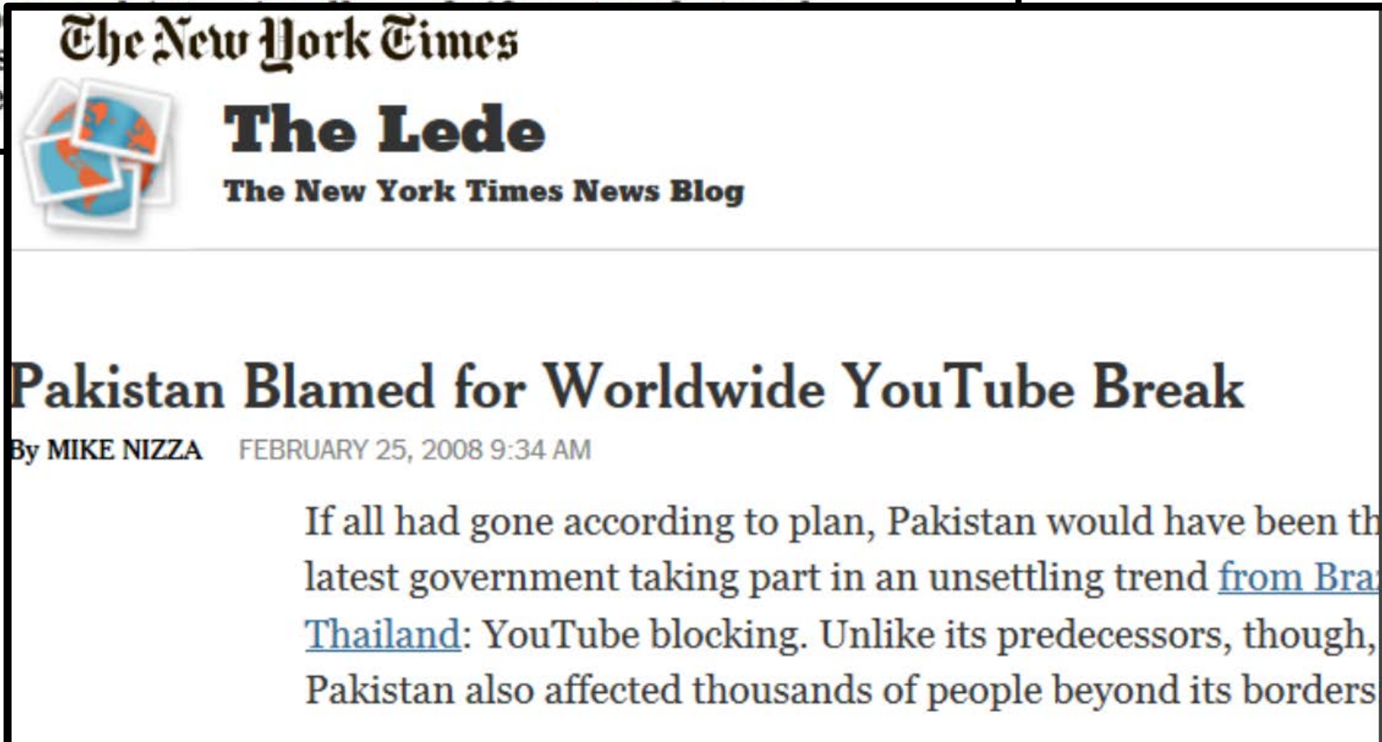
of the

U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

UNITED STATES – CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

Interception of Internet Traffic

For a brief period in April 2010, a state-owned Chinese telecommunications firm "hijacked" massive volumes of Internet traffic.* [114] Evidence related to this incident does not clearly indicate whether it was perp
However, computer s
bility could enable se



The New York Times

The Lede

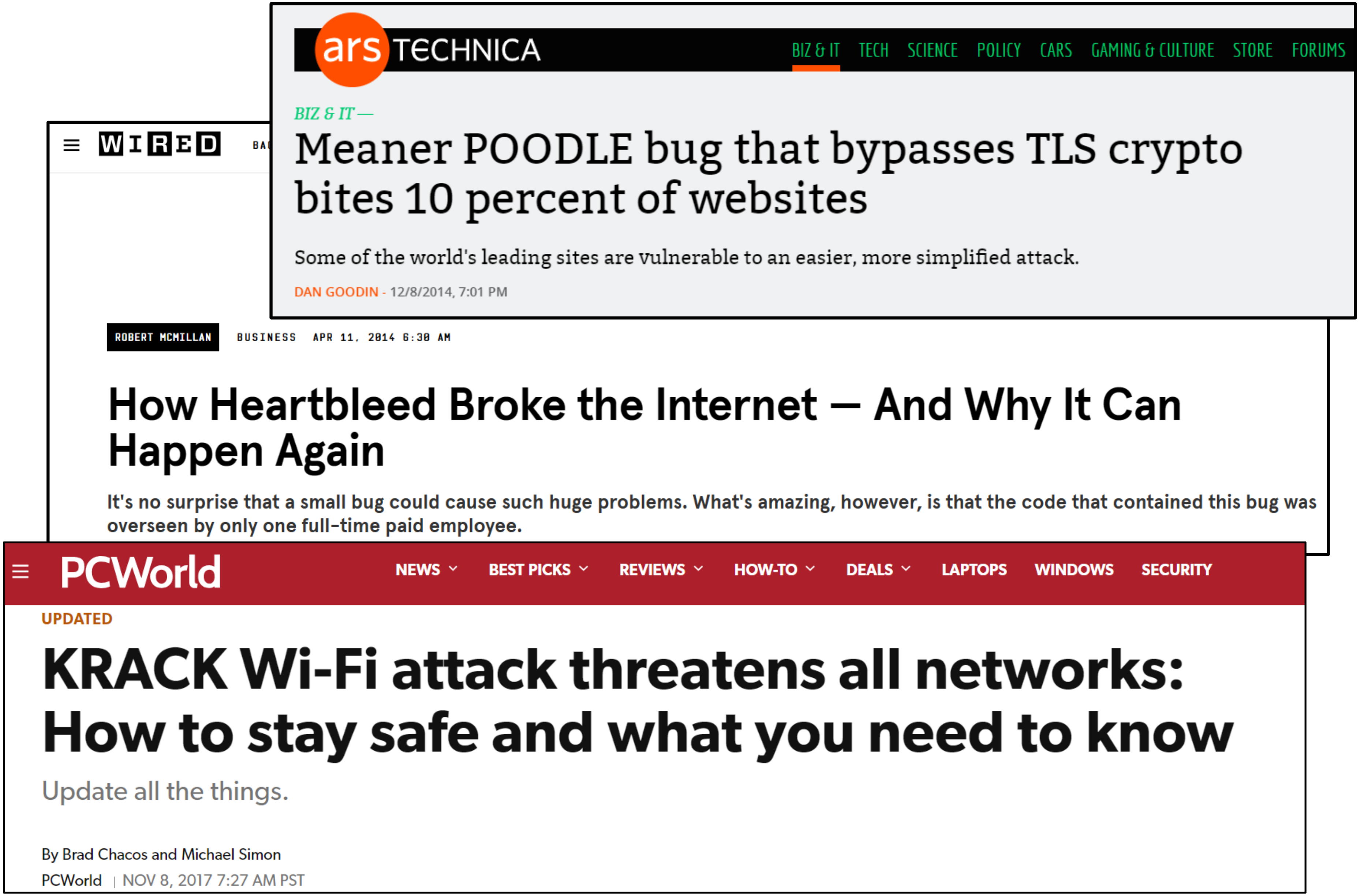
The New York Times News Blog

Pakistan Blamed for Worldwide YouTube Break

By MIKE NIZZA FEBRUARY 25, 2008 9:34 AM

If all had gone according to plan, Pakistan would have been th
latest government taking part in an unsettling trend from Bra
Thailand: YouTube blocking. Unlike its predecessors, though,
Pakistan also affected thousands of people beyond its borders

Crypto bugs



BIZ & IT —

Meaner POODLE bug that bypasses TLS crypto bites 10 percent of websites

Some of the world's leading sites are vulnerable to an easier, more simplified attack.

DAN GOODIN - 12/8/2014, 7:01 PM

ROBERT MCMILLAN BUSINESS APR 11, 2014 6:30 AM

How Heartbleed Broke the Internet — And Why It Can Happen Again

It's no surprise that a small bug could cause such huge problems. What's amazing, however, is that the code that contained this bug was overseen by only one full-time paid employee.

UPDATED

KRACK Wi-Fi attack threatens all networks: How to stay safe and what you need to know

Update all the things.

By Brad Chacos and Michael Simon

PCWorld | NOV 8, 2017 7:27 AM PST

Agenda

1. The Internet & Its Problems

2. **HTTP Issues**

3. IP Issues

4. Privacy Issues

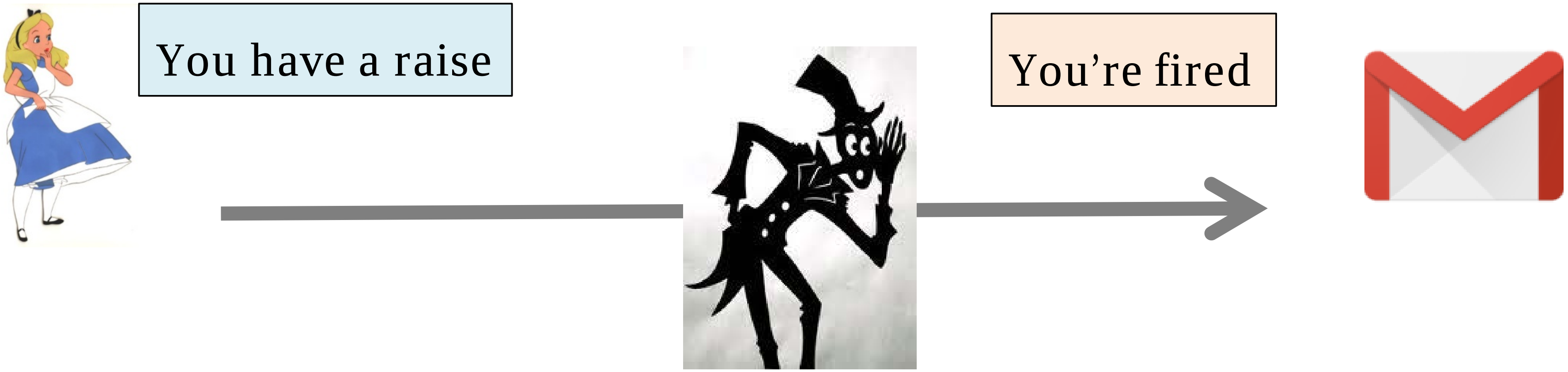
HTTP Issues

Was not designed with security

Privacy issue: Adversary can read Alice's emails

HTTP Issues

Was not designed with security



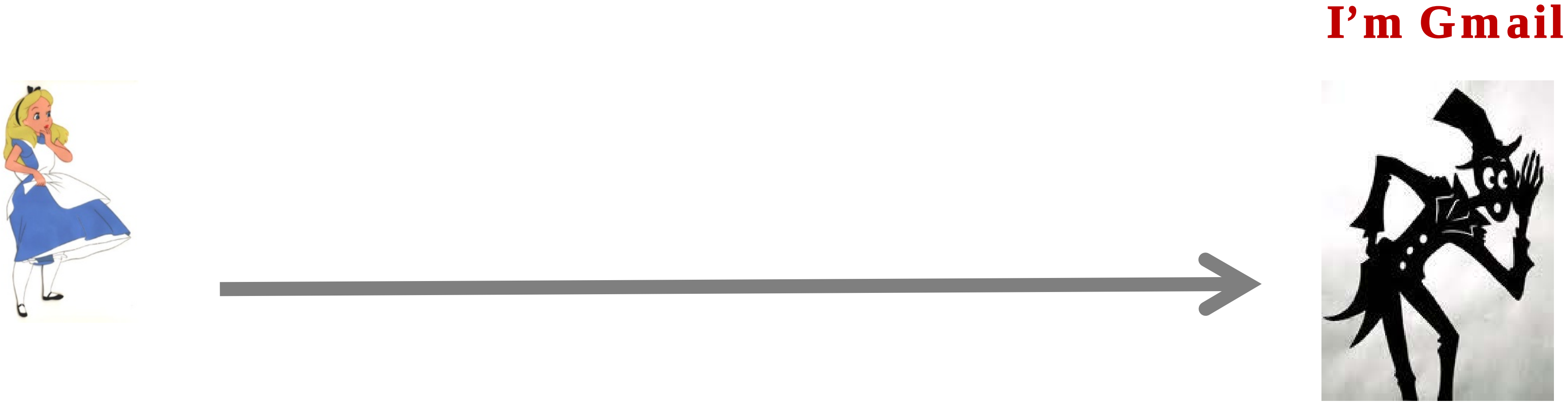
You have a raise

You’re fired

Authenticity issue: Adversary can modify Alice’s emails

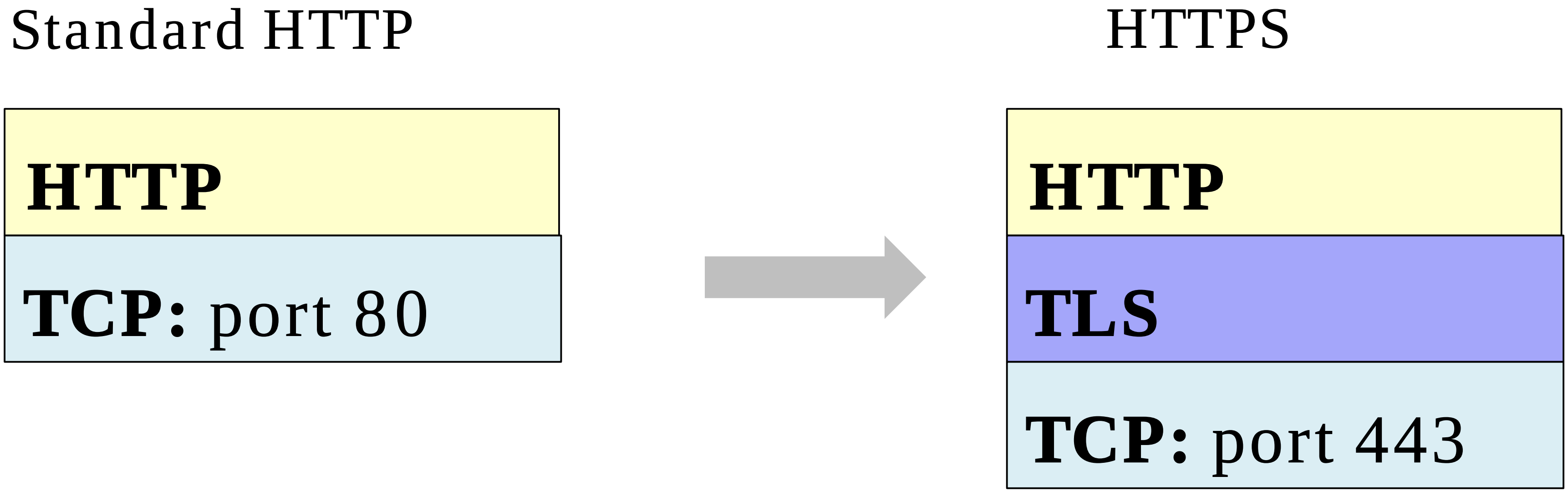
HTTP Issues

Was not designed with security



Impersonation: Adversary can pretend to be Gmail

The Fix: HTTPS



Standard HTTP

HTTP

TCP: port 80

HTTPS

HTTP

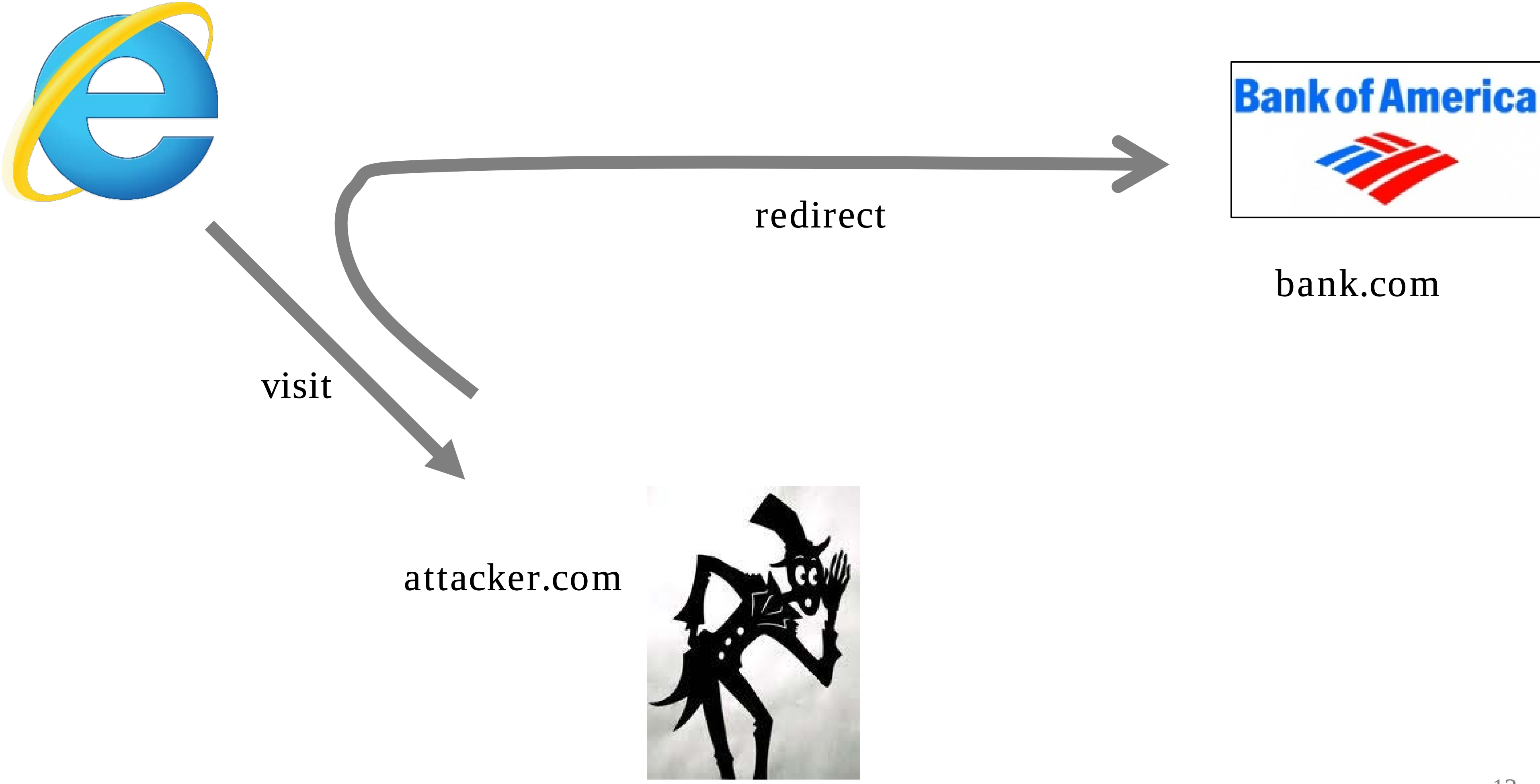
TLS

TCP: port 443

TLS encrypts and authenticates HTTP data

No change to HTTP itself

Cookie Cutter Attack on TLS



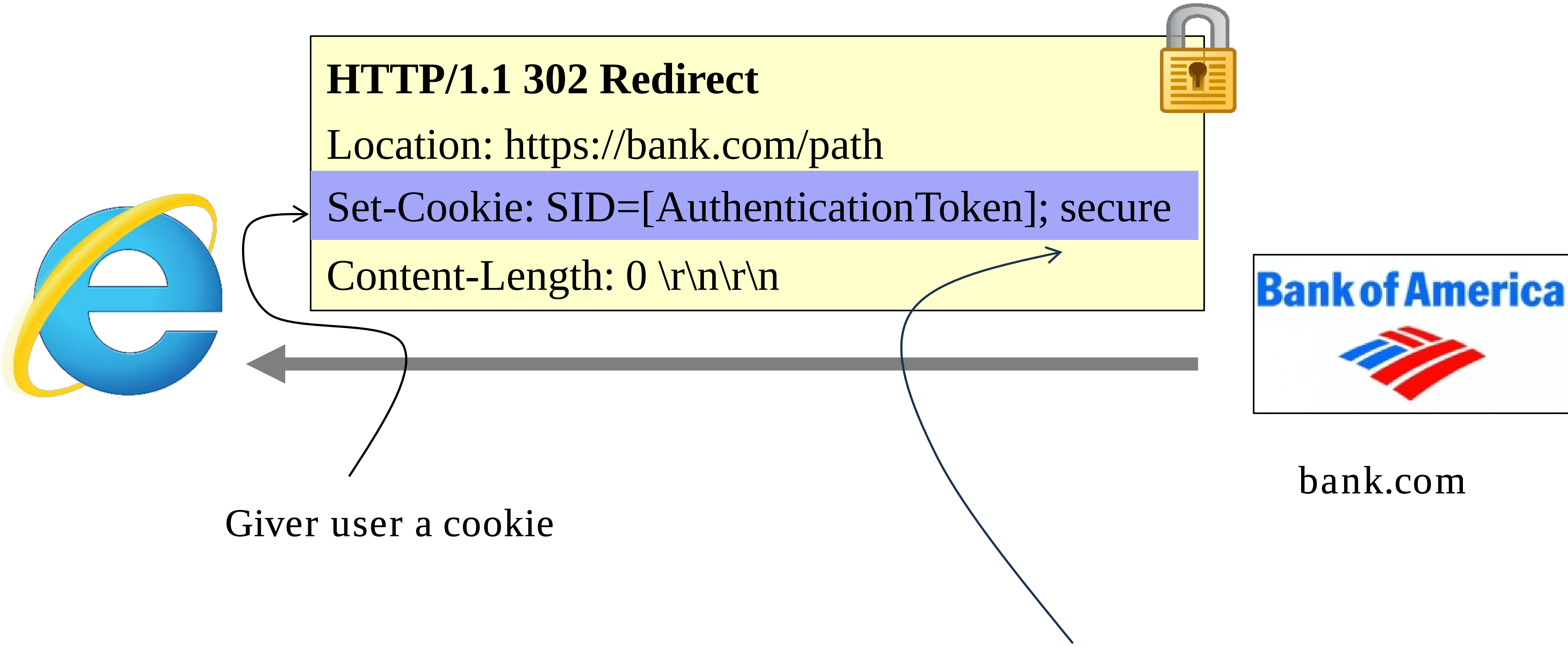
redirect

bank.com

visit

attacker.com

Cookie Cutter Attack on TLS



HTTP/1.1 302 Redirect

Location: https://bank.com/path

Set-Cookie: SID=[AuthenticationToken]; secure

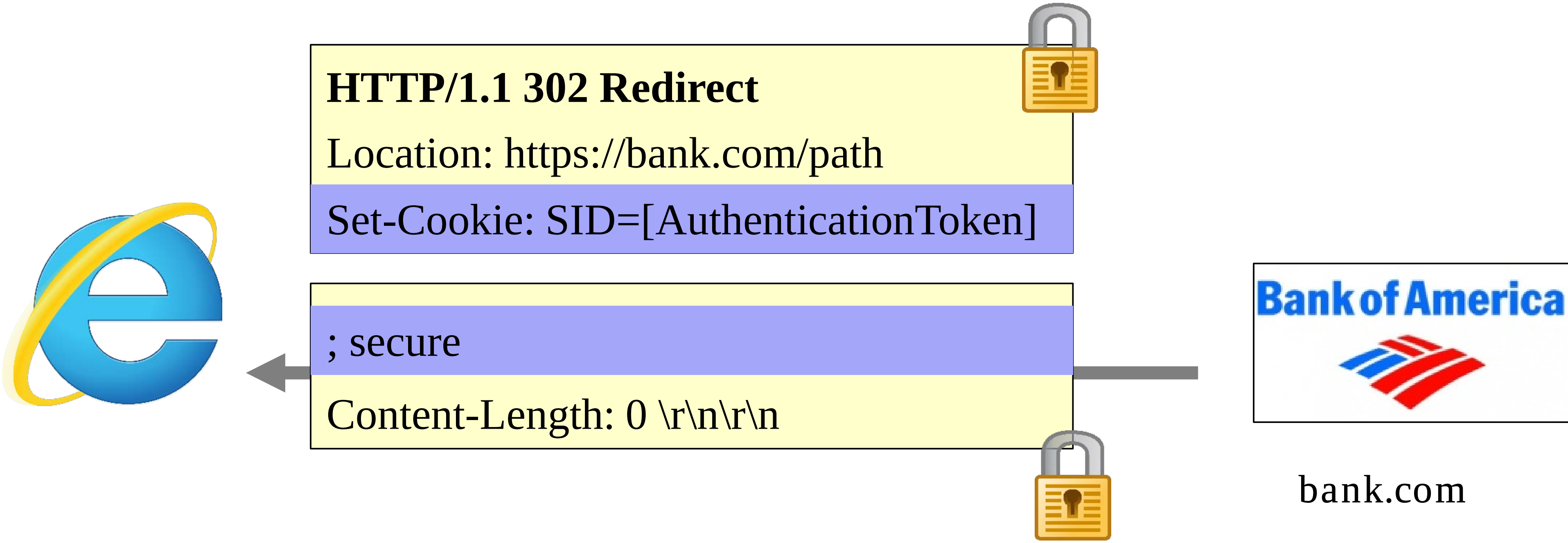
Content-Length: 0 \r\n\r\n

bank.com

Giver user a cookie

Cookie must be sent via HTTPS

Message Is Split If URL Path Is Too Long



HTTP/1.1 302 Redirect

Location: https://bank.com/path

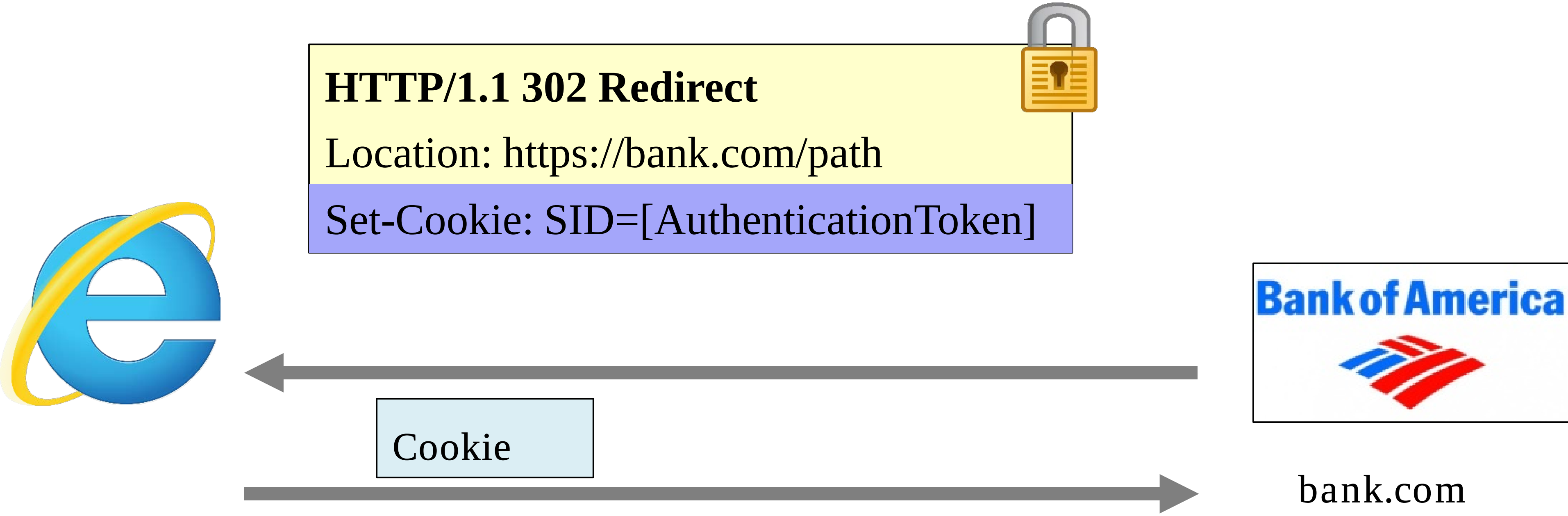
Set-Cookie: SID=[AuthenticationToken]

; secure

Content-Length: 0 \r\n\r\n

bank.com

What Happens If Second Frame Is Blocked?



HTTP/1.1 302 Redirect

Location: https://bank.com/path

Set-Cookie: SID=[AuthenticationToken]

Cookie

bank.com

Cookie is sent in the clear via standard HTTP

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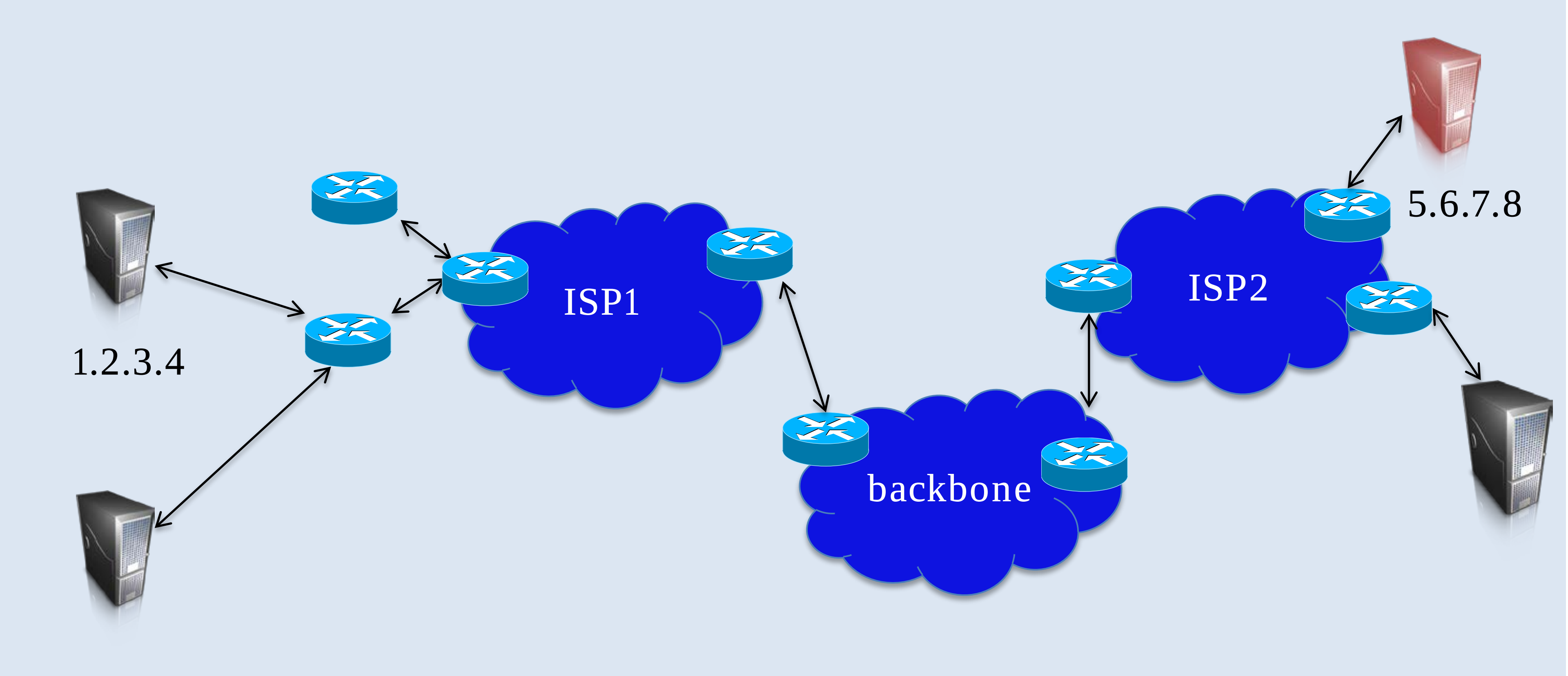
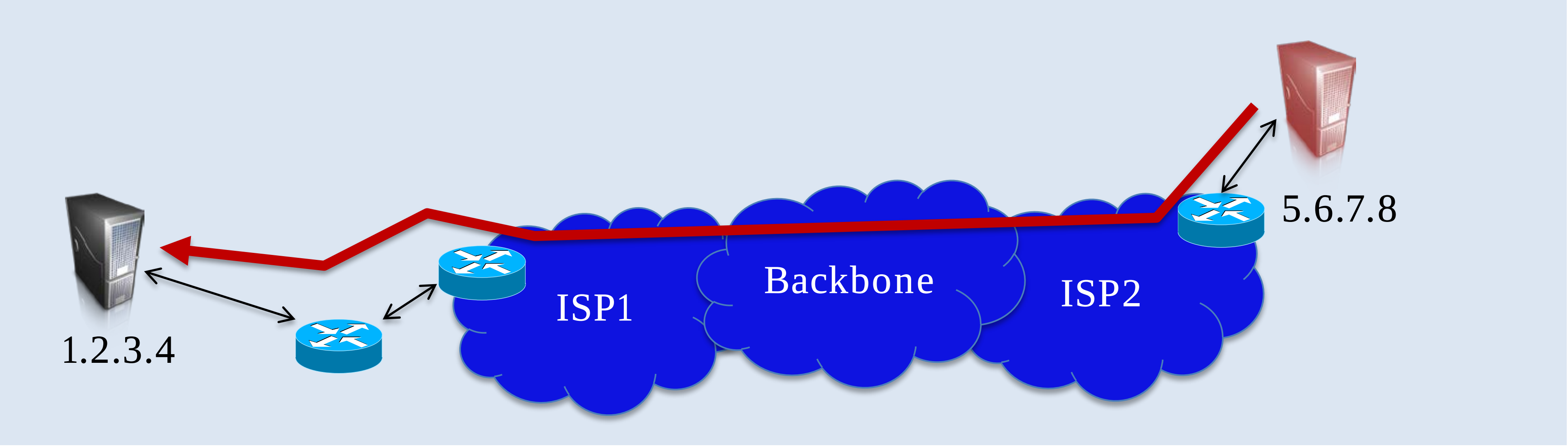
Security Issues with IP



Anyone can talk to any one

No source address authentication in general (spoofing)

Denial of Service (DoS) Attacks



Goal: prevent legitimate users from accessing victim (1.2.3.4)

Example: ICMP ping flood

ICMP = Internet Control Message Protocol, used to relay control/error/ diagnostic message, on top of IP

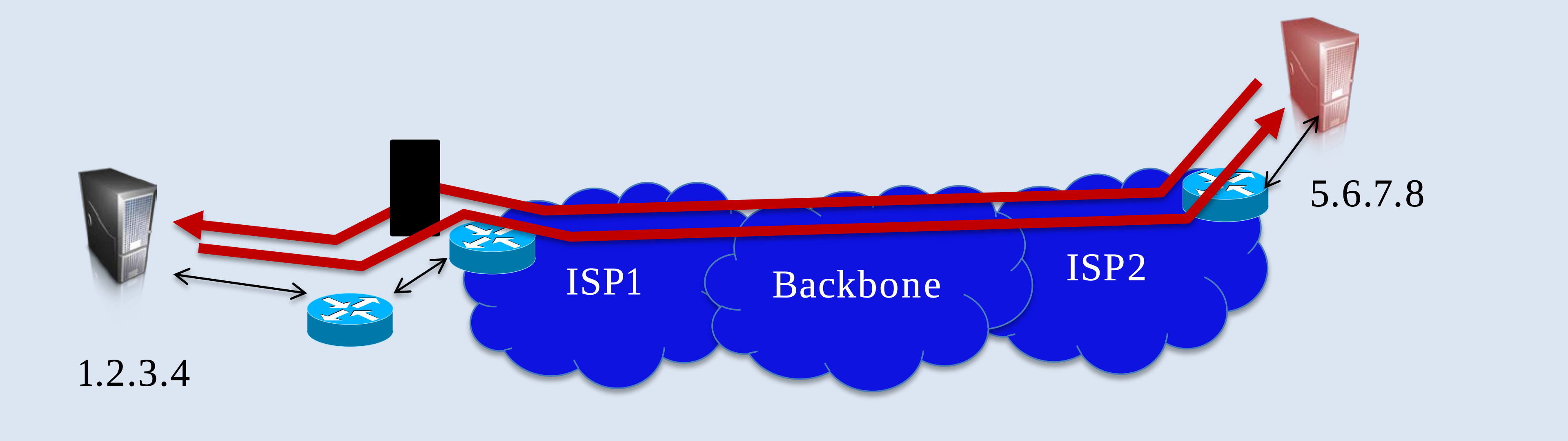
```
$ ping www.example.com
PING www.example.com (93.184.216.119): 56 data bytes
64 bytes from 93.184.216.119: icmp_seq=0 ttl=56 time=11.632 ms
64 bytes from 93.184.216.119: icmp_seq=1 ttl=56 time=11.726 ms
64 bytes from 93.184.216.119: icmp_seq=2 ttl=56 time=10.683 ms
64 bytes from 93.184.216.119: icmp_seq=3 ttl=56 time=9.674 ms

--- www.example.com ping statistics ---
4 packets transmitted, 4 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 9.674/10.929/11.726/0.831 ms
```

Send ICMP “ping” message

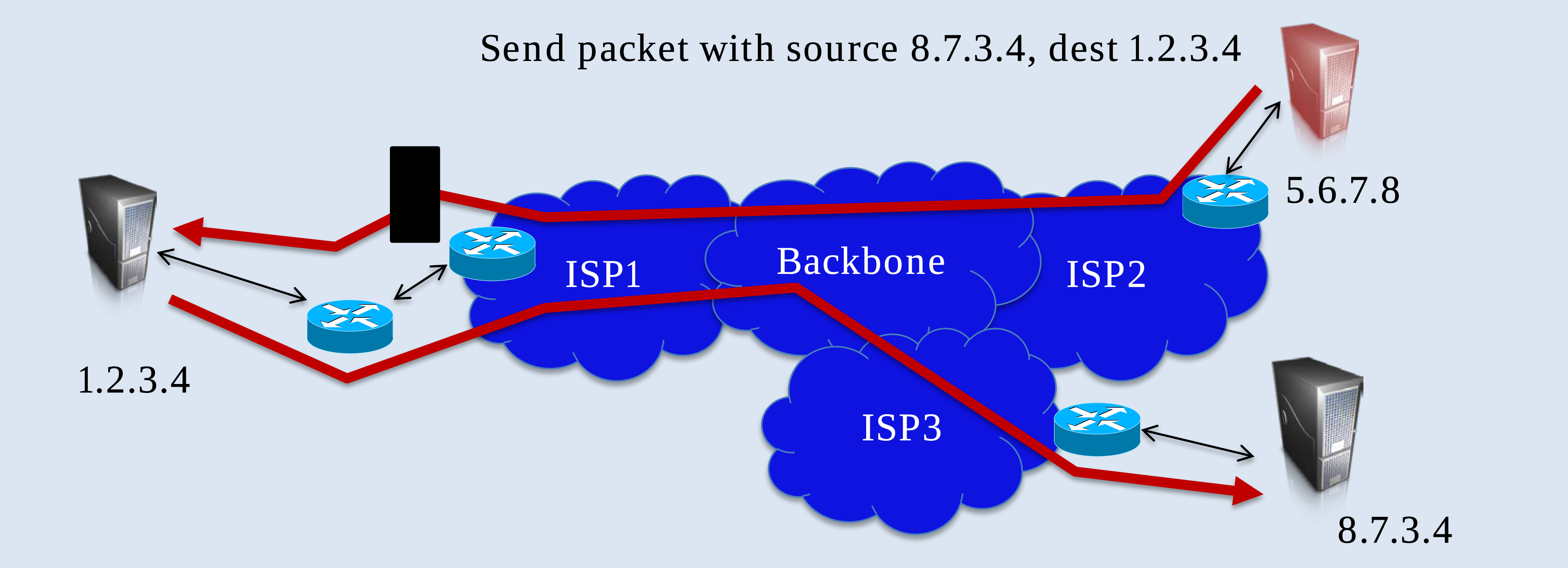
- Host must respond to all ping requests with a pong reply containing the exact data received in the request message.

A Possible DoS Attack: ICMP Ping Flood



- Attacker sends ICMP pings as fast as possible to victim
- When will this work as a DoS? Attacker resources > victim's
- How can this be prevented? Ingress filtering near victim

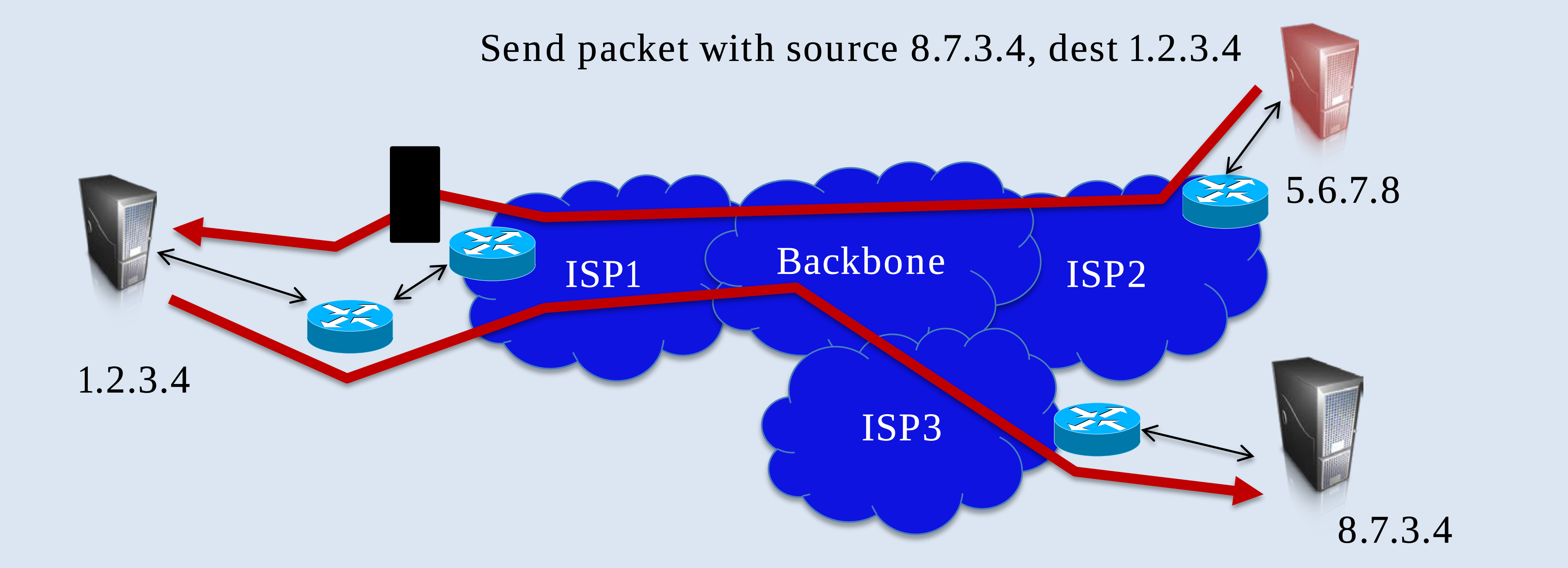
How Can Attacker Avoid Ingress Filtering?



Send packet with fake source IP

Packet will get routed correctly, but replies will not

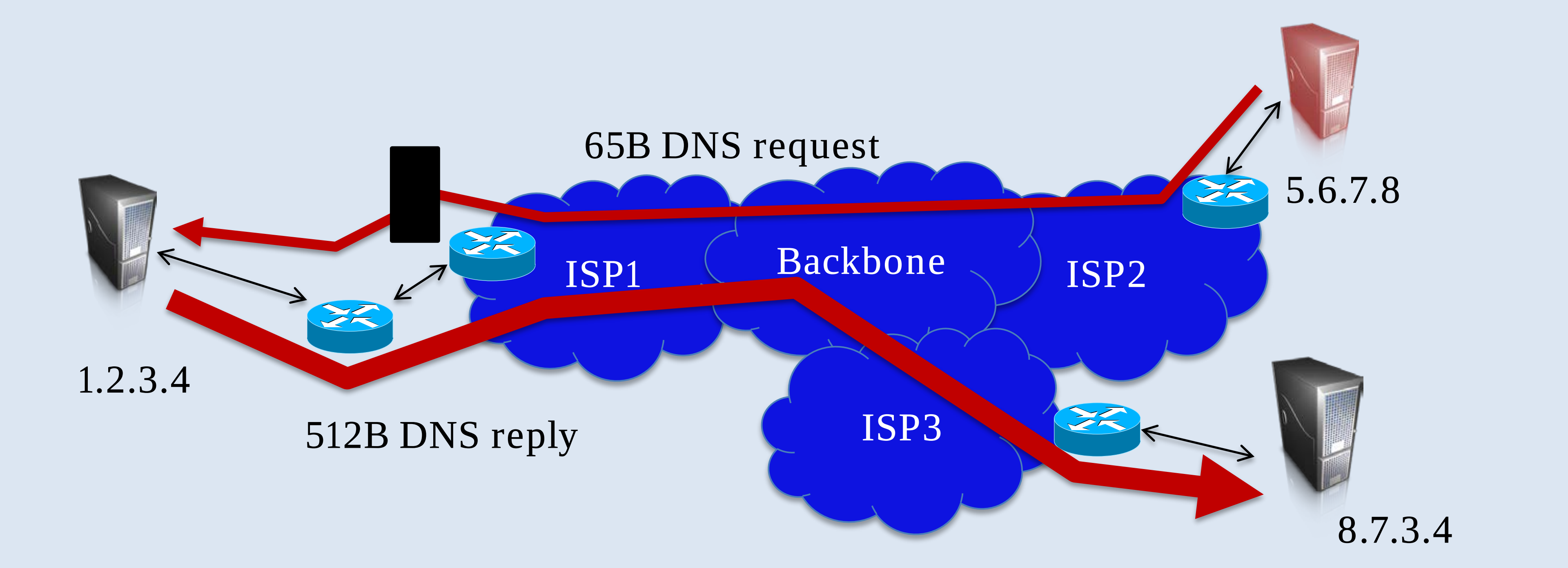
DoS Reflection Attacks



Attacker can attack 8.7.3.4 by bouncing packets from 1.2.3.4

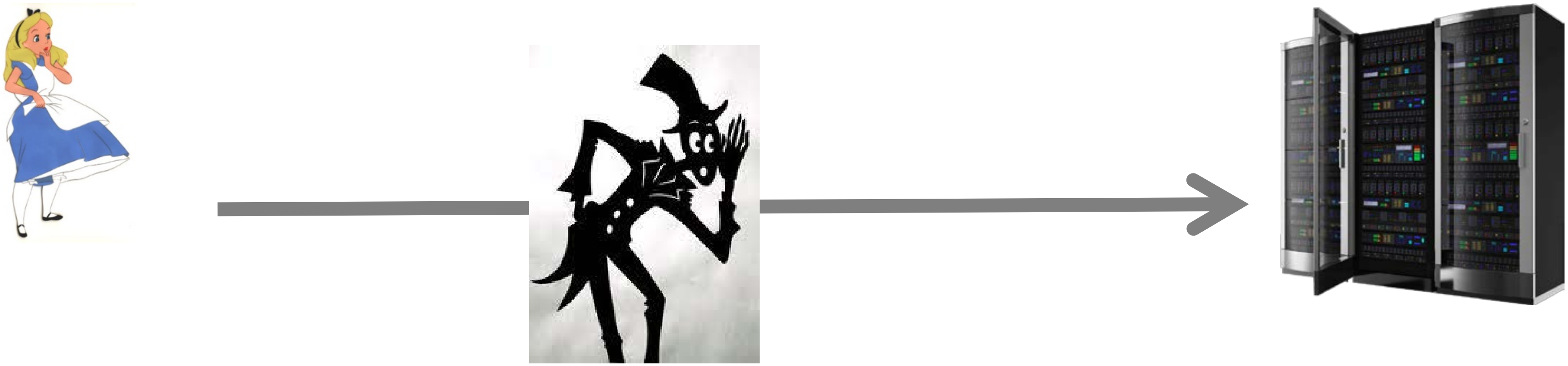
“Frame” 1.2.3.4

DoS Amplification Attacks



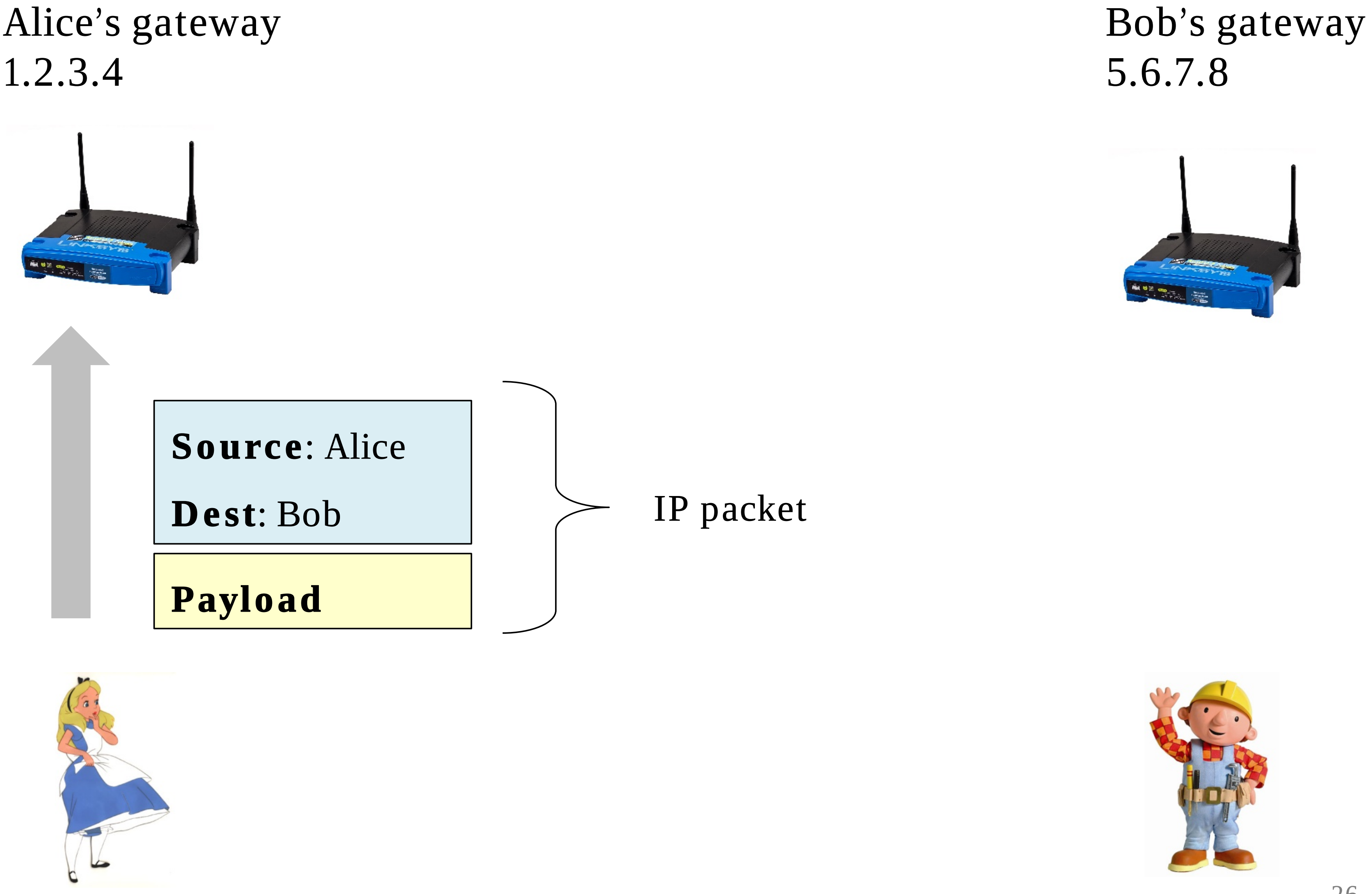
DNS works better if attacker spends much less resource than the victim

Another Issue of IP



IP packets are sent in the clear, leading to privacy and authenticity issues

A Solution: IPSec



Alice’s gateway
1.2.3.4

Bob’s gateway
5.6.7.8

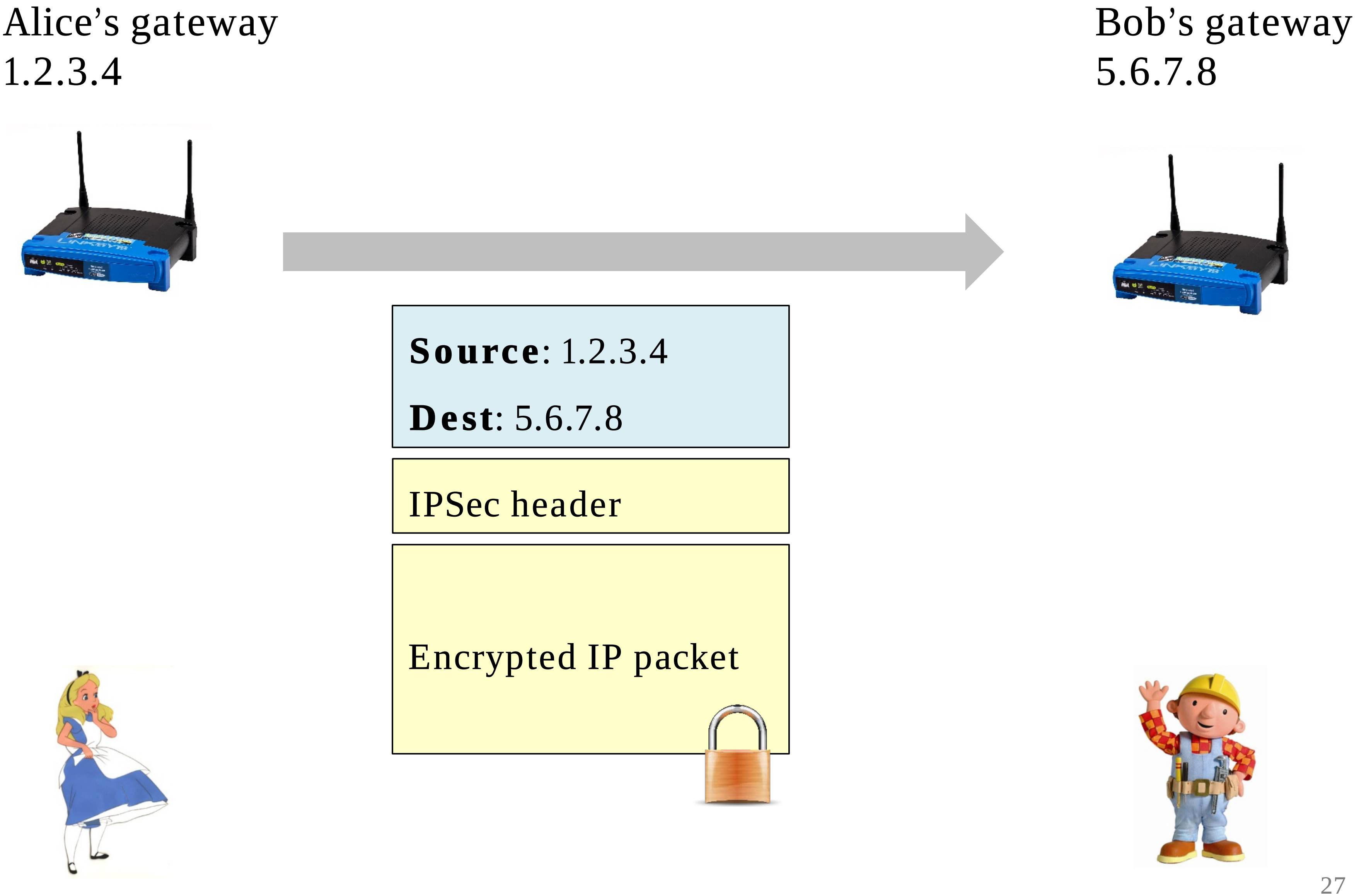
Source: Alice

Dest: Bob

Payload

IP packet

A Solution: IPSec



Alice's gateway
1.2.3.4

Bob's gateway
5.6.7.8

Source: 1.2.3.4

Dest: 5.6.7.8

IPSec header

Encrypted IP packet

A Solution: IPSec

Alice's gateway
1.2.3.4

Bob's gateway
5.6.7.8

In Hw4 you'll break IPSec (for some configuration choice)

Source: Alice

Dest: Bob

Payload

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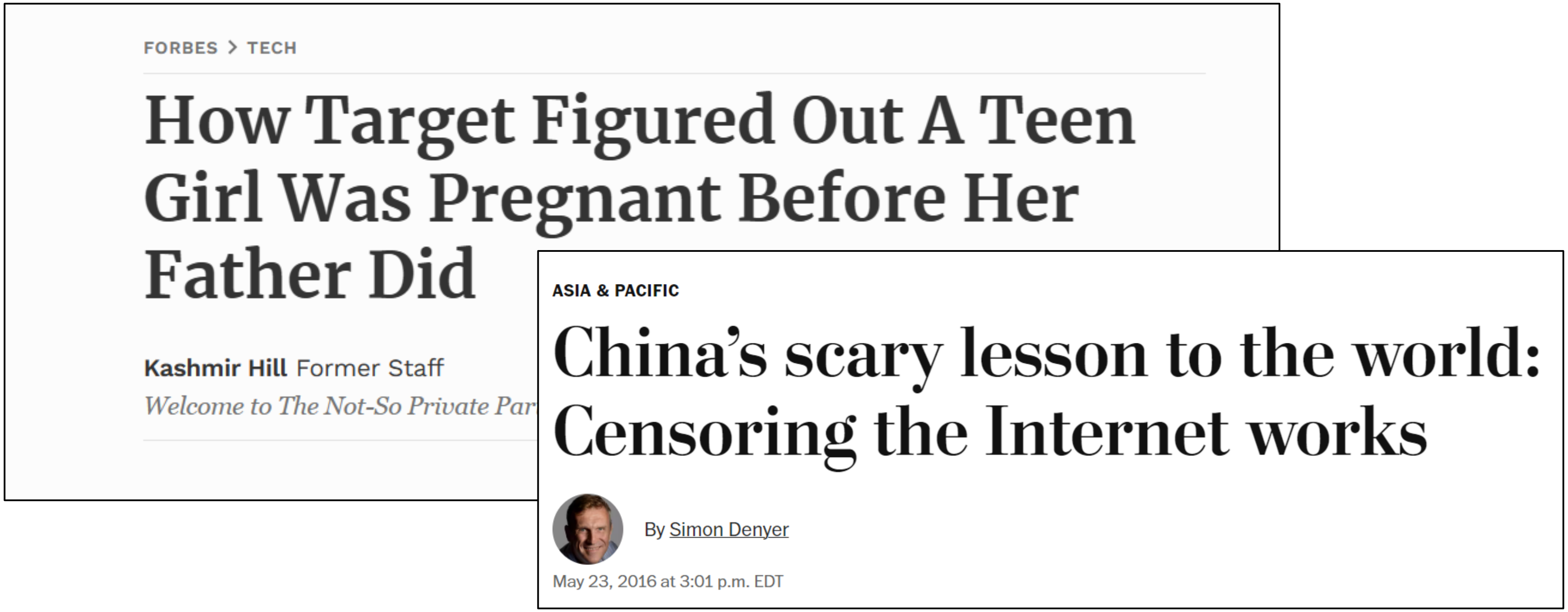
The End Of Privacy



FORBES > TECH

How Target Figured Out A Teen Girl Was Pregnant Before Her Father Did

Kashmir Hill Former Staff

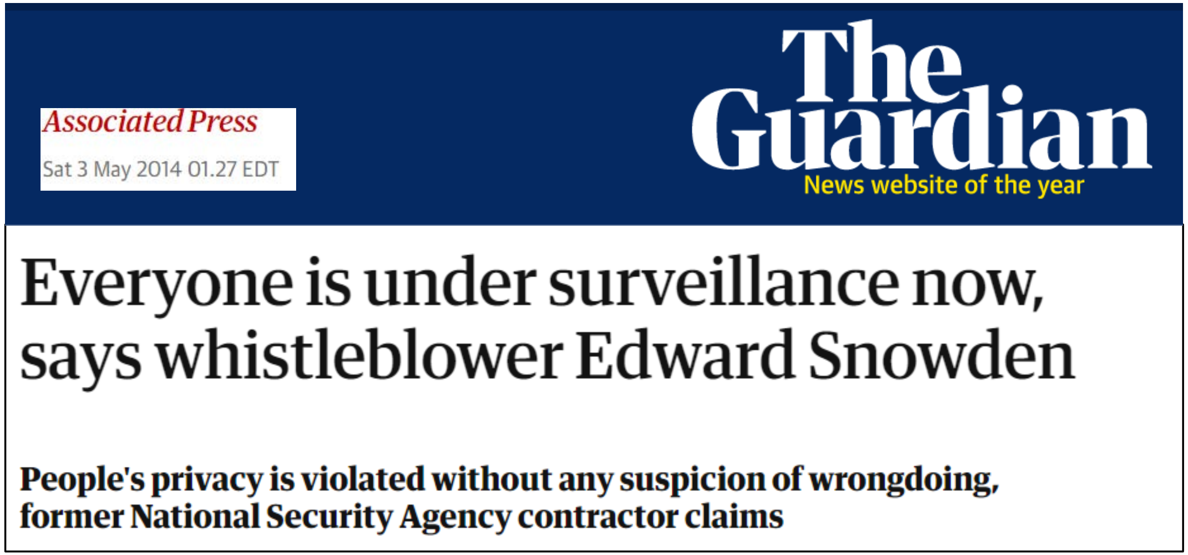
Welcome to The Not-So Private Par

ASIA & PACIFIC

China's scary lesson to the world: Censoring the Internet works

By Simon Denyer

May 23, 2016 at 3:01 p.m. EDT



Associated Press

Sat 3 May 2014 01.27 EDT

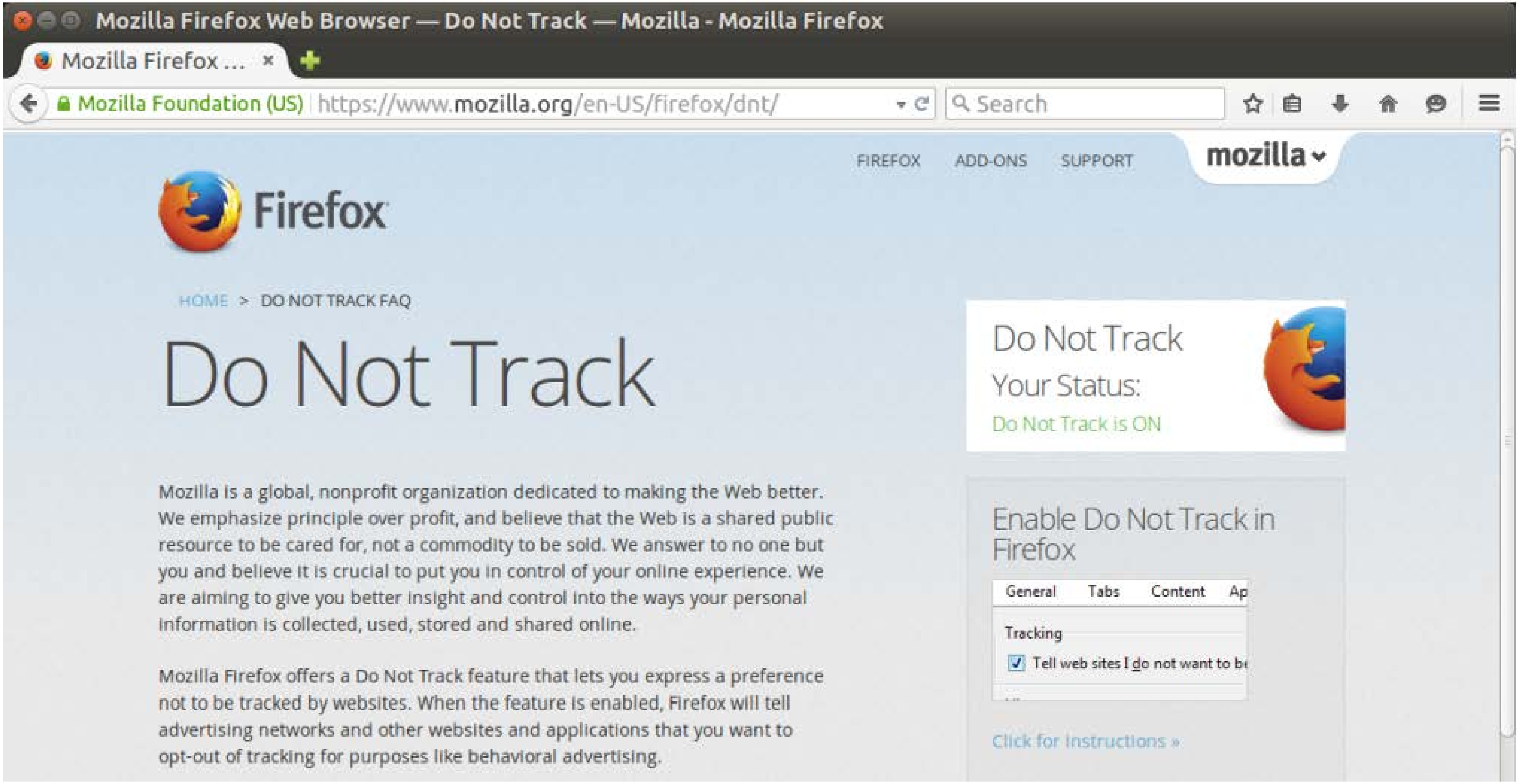
The Guardian

News website of the year

Everyone is under surveillance now, says whistleblower Edward Snowden

People's privacy is violated without any suspicion of wrongdoing, former National Security Agency contractor claims

Stop Third-Party Tracking



Mozilla Firefox Web Browser — Do Not Track — Mozilla - Mozilla Firefox
Mozilla Firefox ...
Mozilla Foundation (US) https://www.mozilla.org/en-US/firefox/dnt/
Search
FIREFOX
ADD-ONS
SUPPORT
mozilla
Firefox
HOME > DO NOT TRACK FAQ

Do Not Track

Mozilla is a global, nonprofit organization dedicated to making the Web better. We emphasize principle over profit, and believe that the Web is a shared public resource to be cared for, not a commodity to be sold. We answer to no one but you and believe it is crucial to put you in control of your online experience. We are aiming to give you better insight and control into the ways your personal information is collected, used, stored and shared online.

Mozilla Firefox offers a Do Not Track feature that lets you express a preference not to be tracked by websites. When the feature is enabled, Firefox will tell advertising networks and other websites and applications that you want to opt-out of tracking for purposes like behavioral advertising.

Do Not Track

Your Status:

Do Not Track is ON

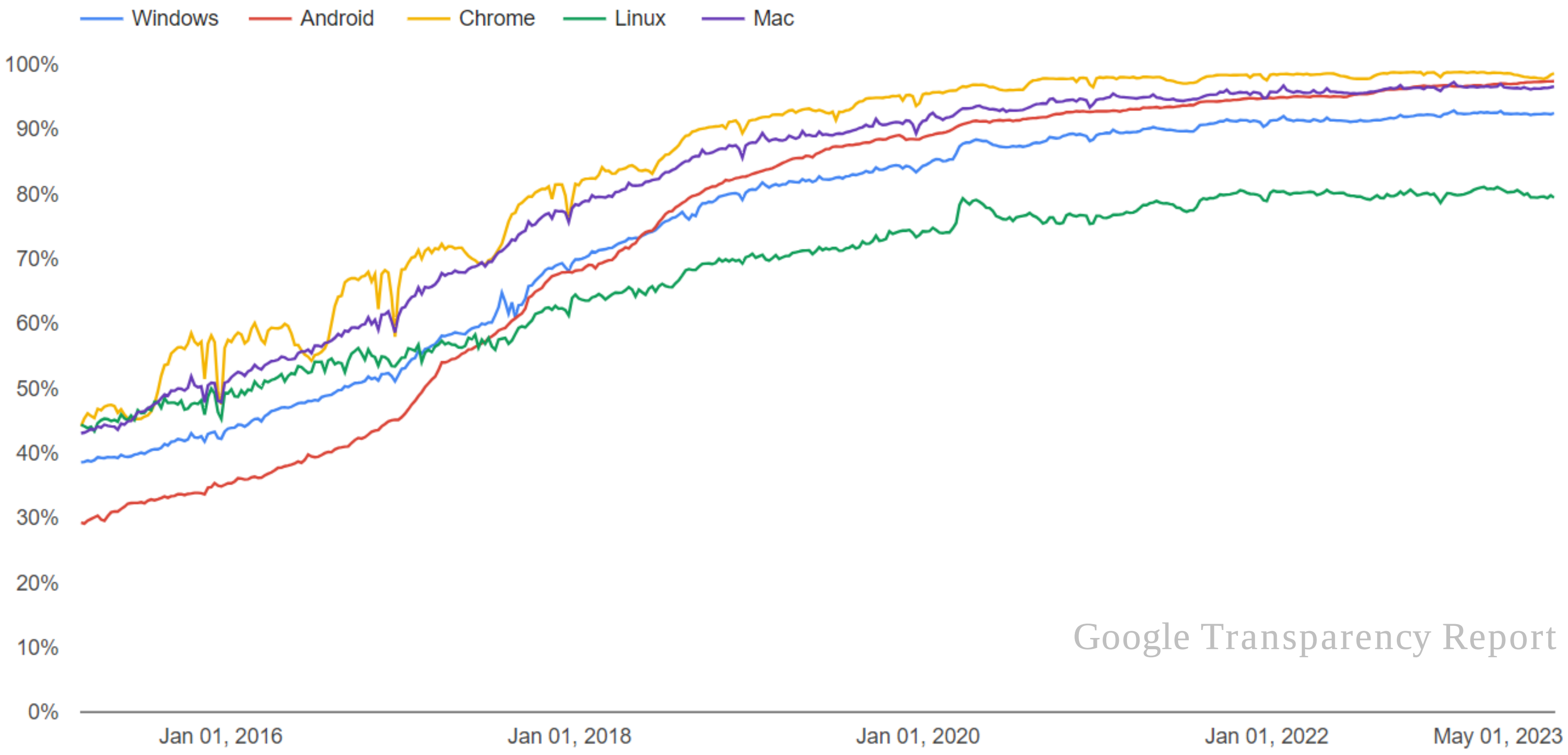
Enable Do Not Track in Firefox

Tracking

☑ Tell web sites I do not want to be

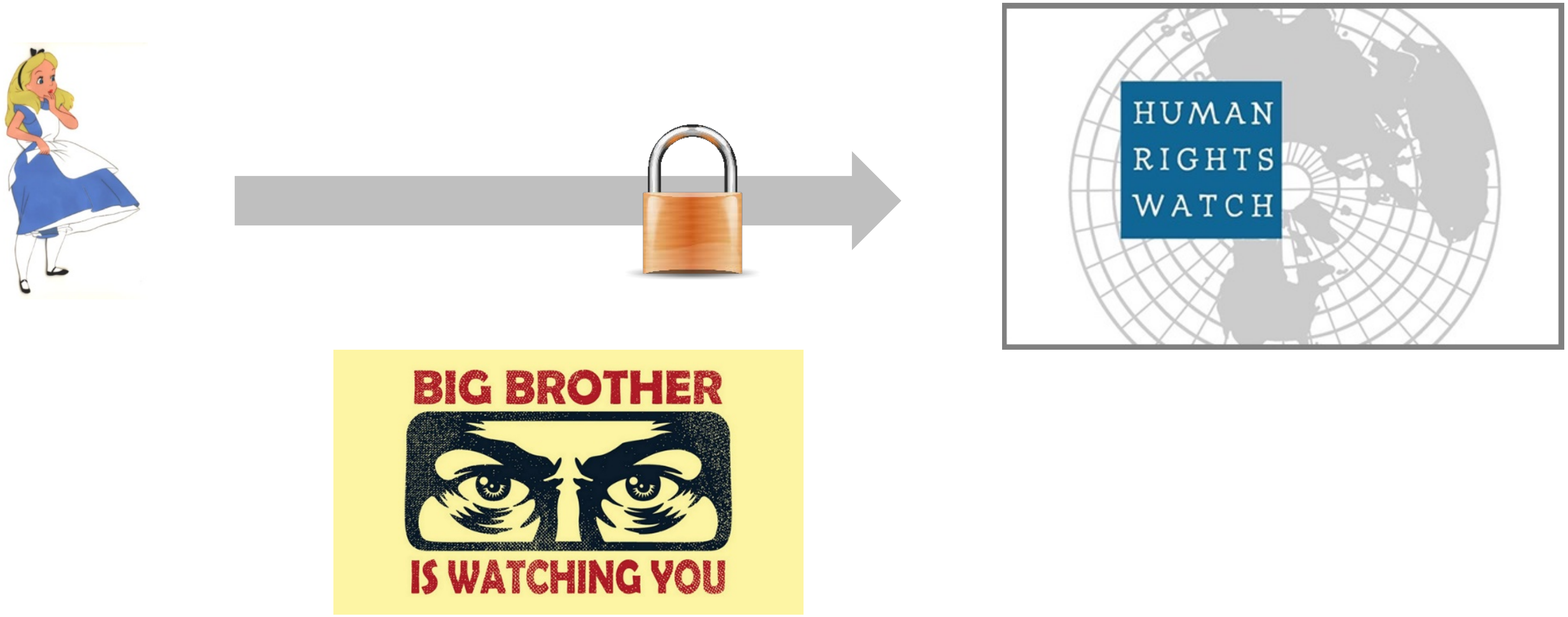
Protect <u>Content</u> Of Your Web Surfing: HTTPS

Chrome Page Loads over HTTPS



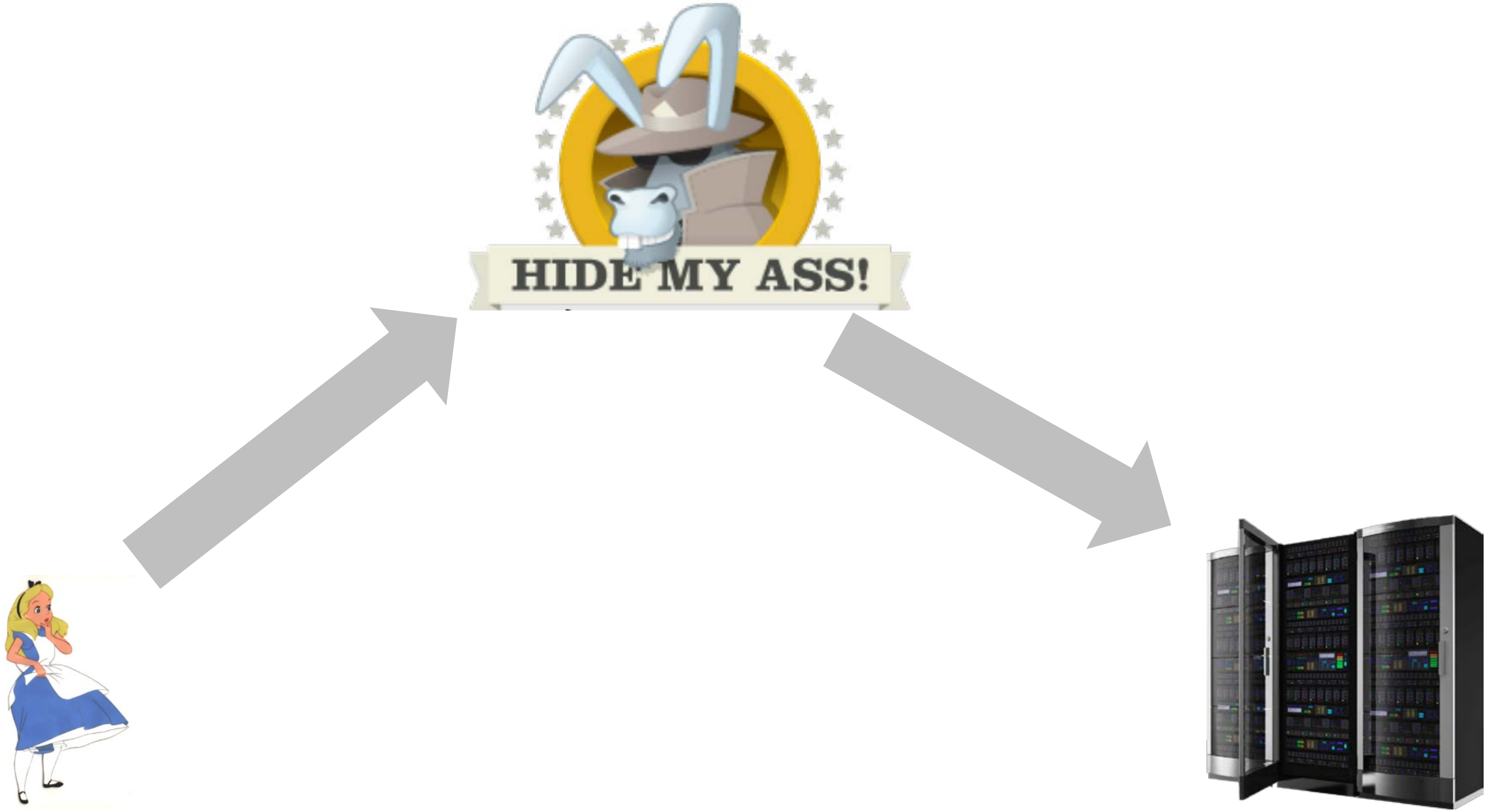
Google Transparency Report

But HTTPS Doesn’t Protect Metadata

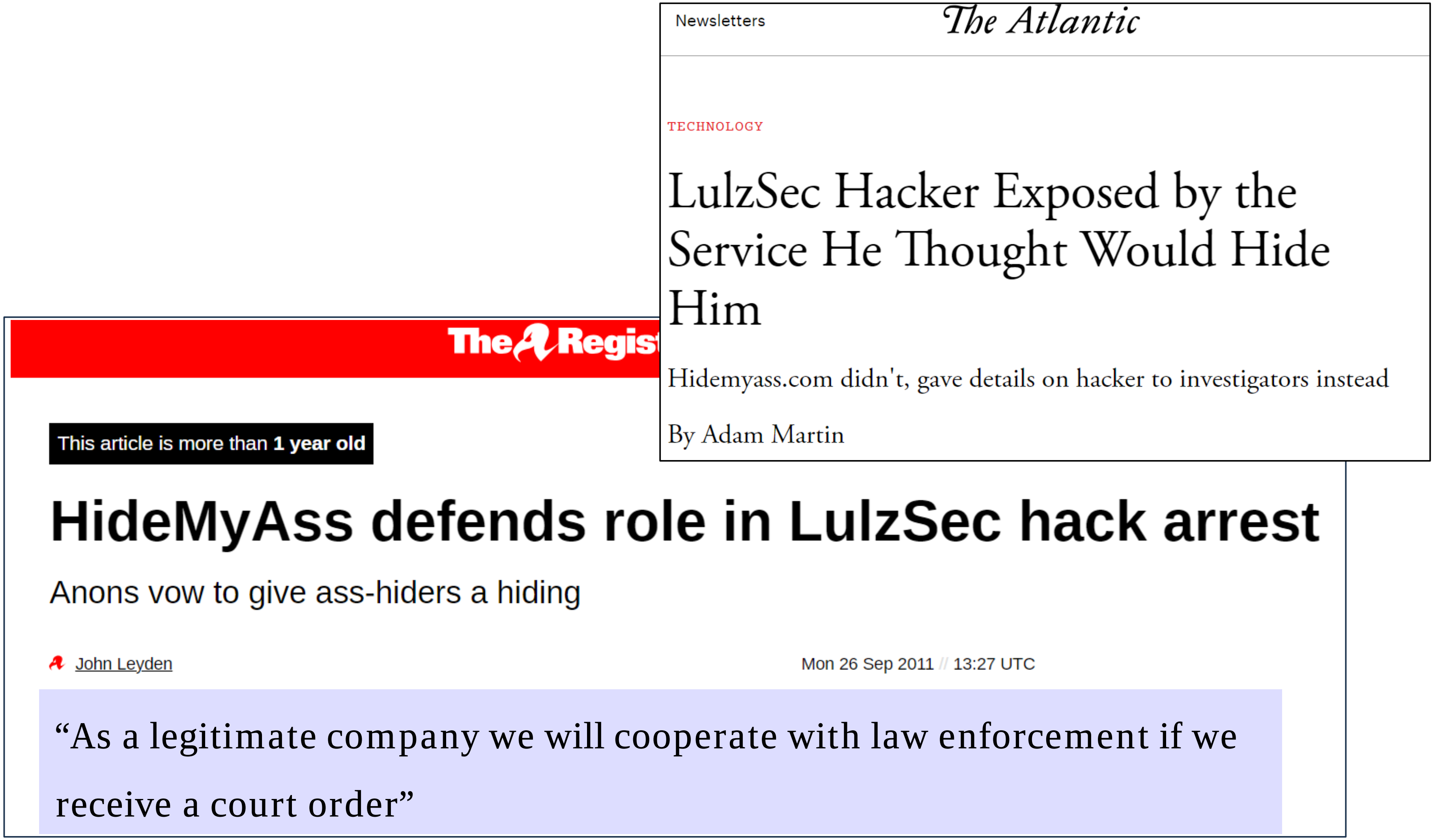


Big Brother knows Alice sent an encrypted message to Human Rights Watch

Naïve Approach To Protect Metadata: VPN



Naïve Approach To Protect Metadata: VPN



Newsletters

The Atlantic

TECHNOLOGY

LulzSec Hacker Exposed by the Service He Thought Would Hide Him

Hidemyass.com didn't, gave details on hacker to investigators instead

By Adam Martin

The Regis

This article is more than **1 year old**

HideMyAss defends role in LulzSec hack arrest

Anons vow to give ass-hiders a hiding

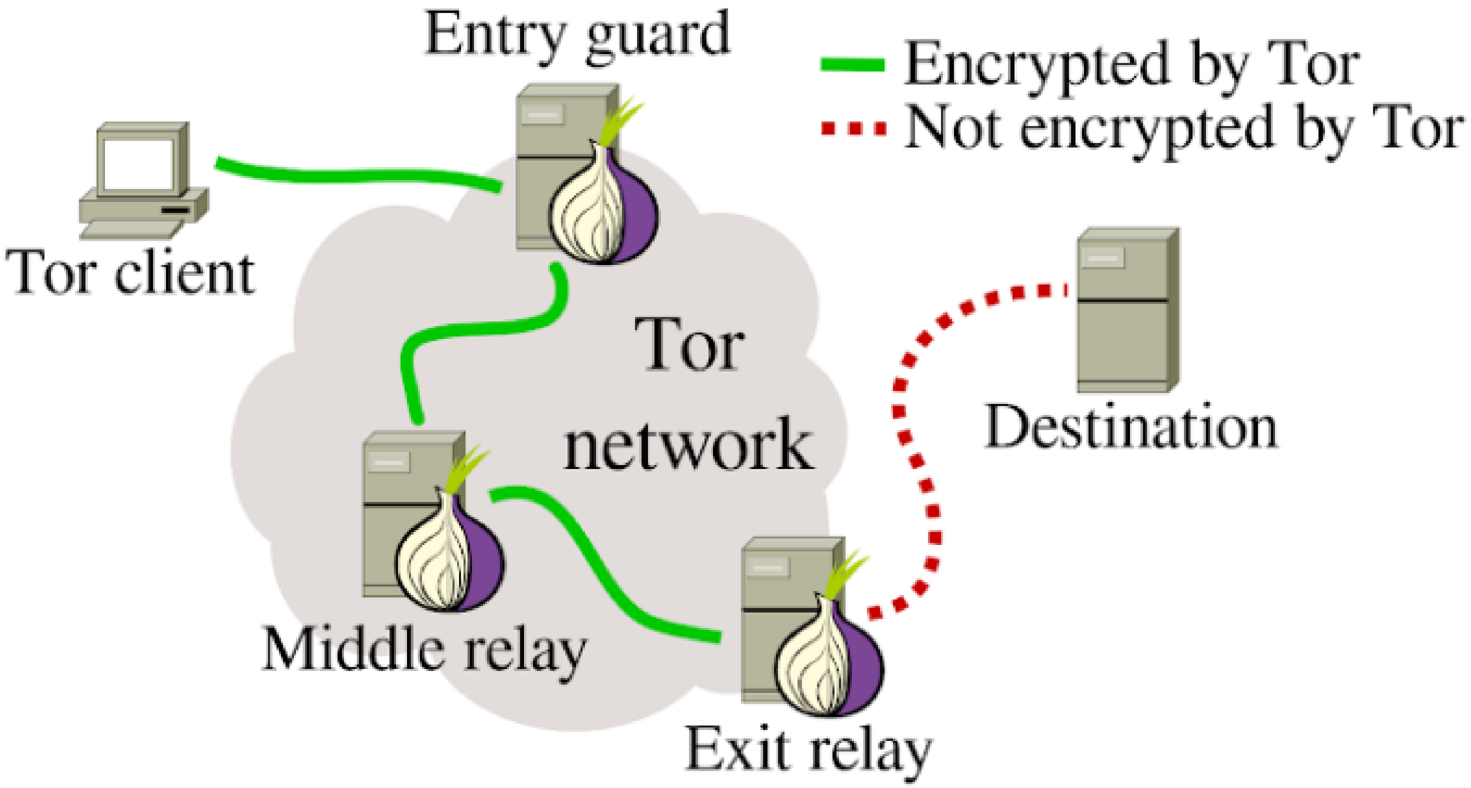
John Leyden

Mon 26 Sep 2011 // 13:27 UTC

“As a legitimate company we will cooperate with law enforcement if we receive a court order”

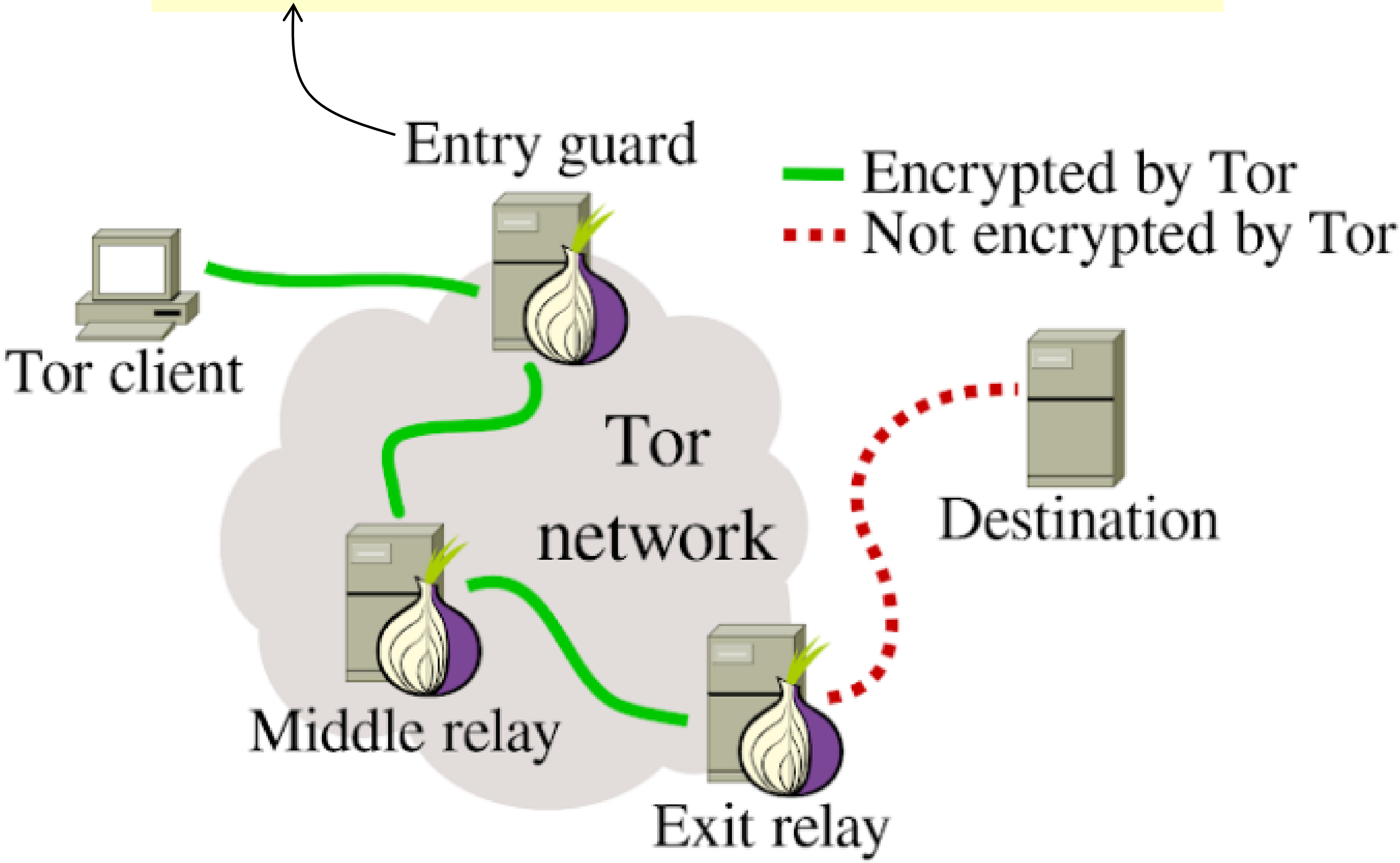
Tor ("The Onion Router")

Tor operates by tunnelling traffic through three **random** "onion routers"

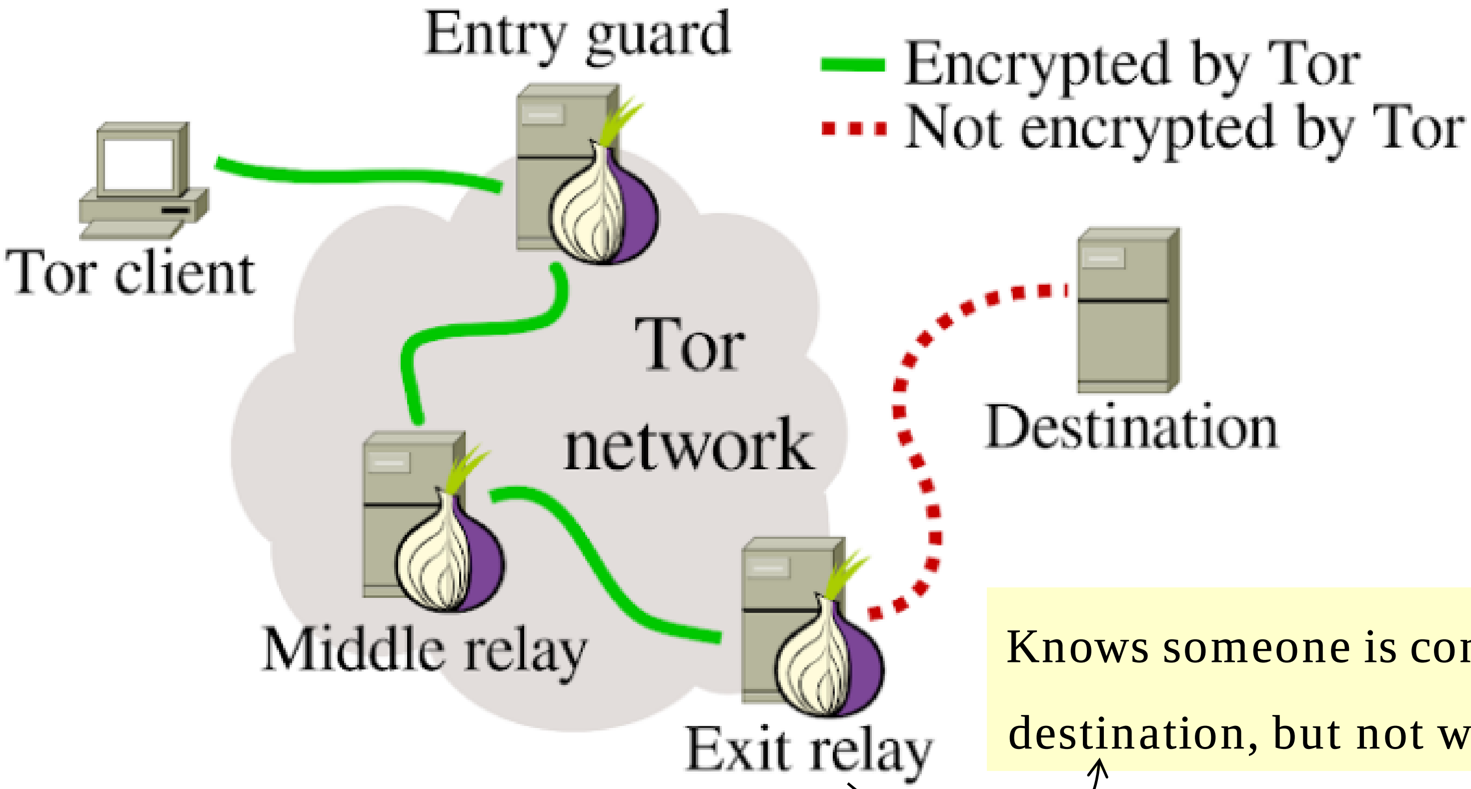


Who Knows What

Knows Alice is using Tor and the identity of the middle node, but not the destination



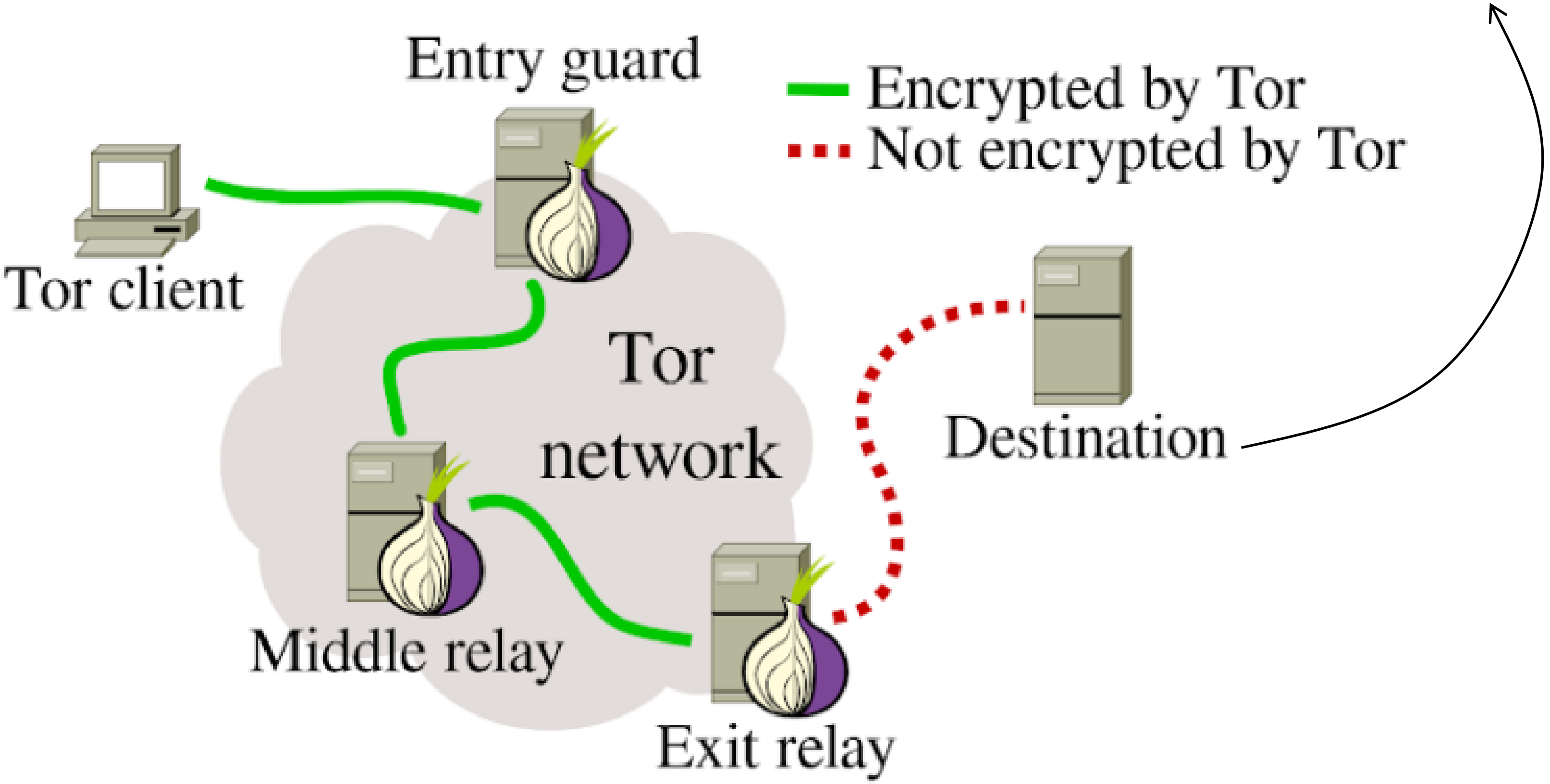
Who Knows What

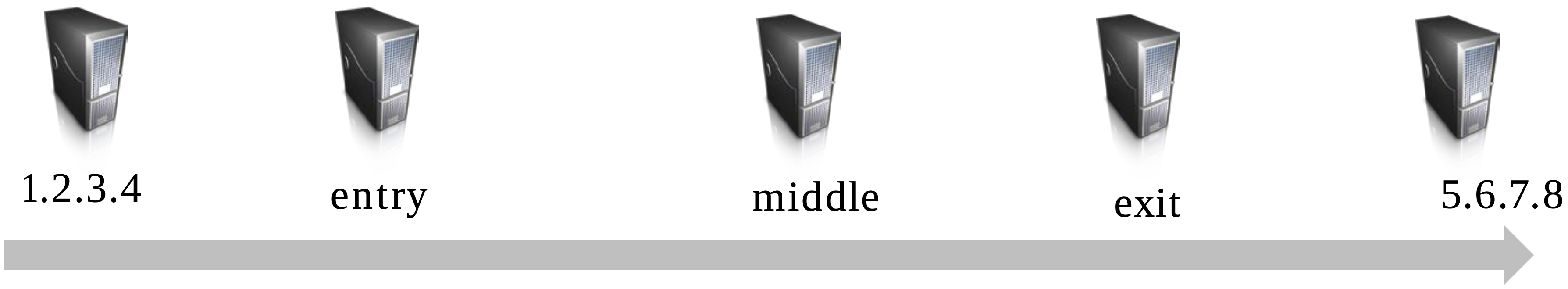


Knows someone is connecting to destination, but not which user

Who Knows What

Knows a Tor user is connecting to it via the exit node





Onion routing

Src: exit	Dest: 5.6.7.8	HTTP packet

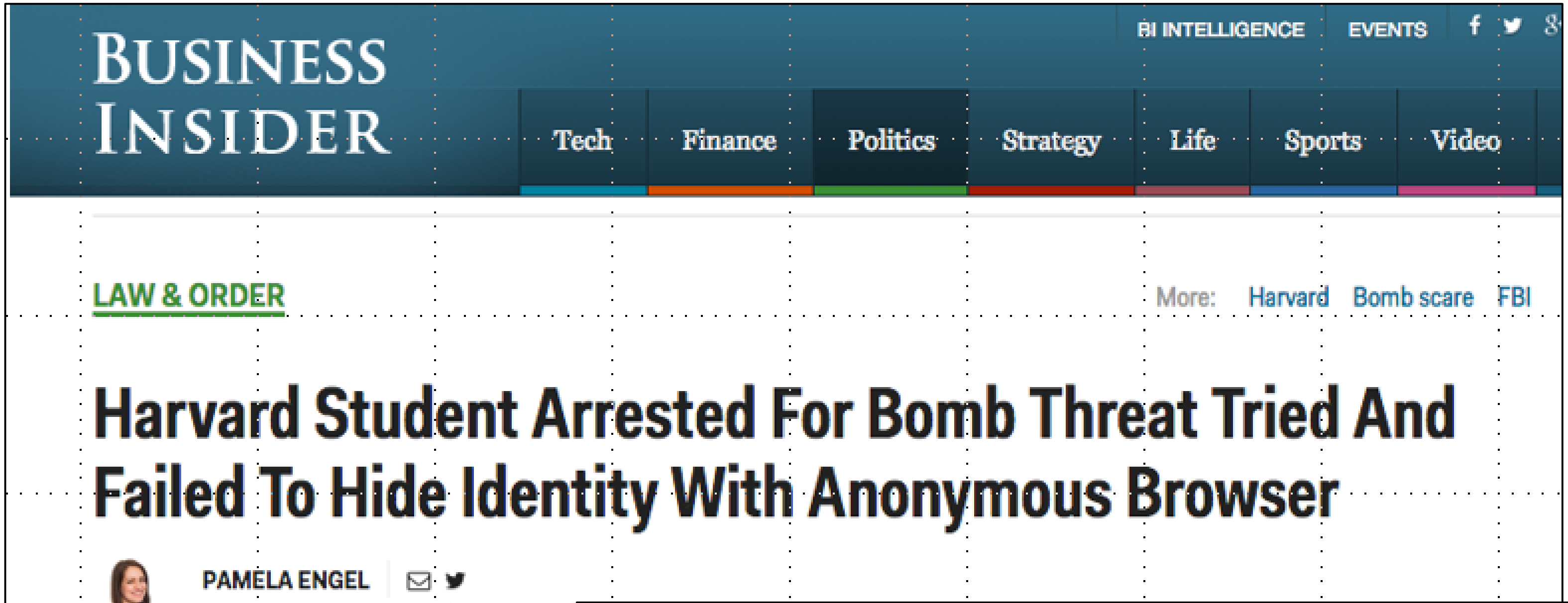
Src: middle	Dest: exit	Encrypted with exit's key

Src: entry	Dest: middle	Encrypted with middle's key

Src: 1.2.3.4	Dest: entry	Encrypted with entry's key

Tor implements more complex version of this basic idea

Tor Is Not A Panacea



BUSINESS INSIDER

BI INTELLIGENCE EVENTS

Tech Finance Politics Strategy Life Sports Video

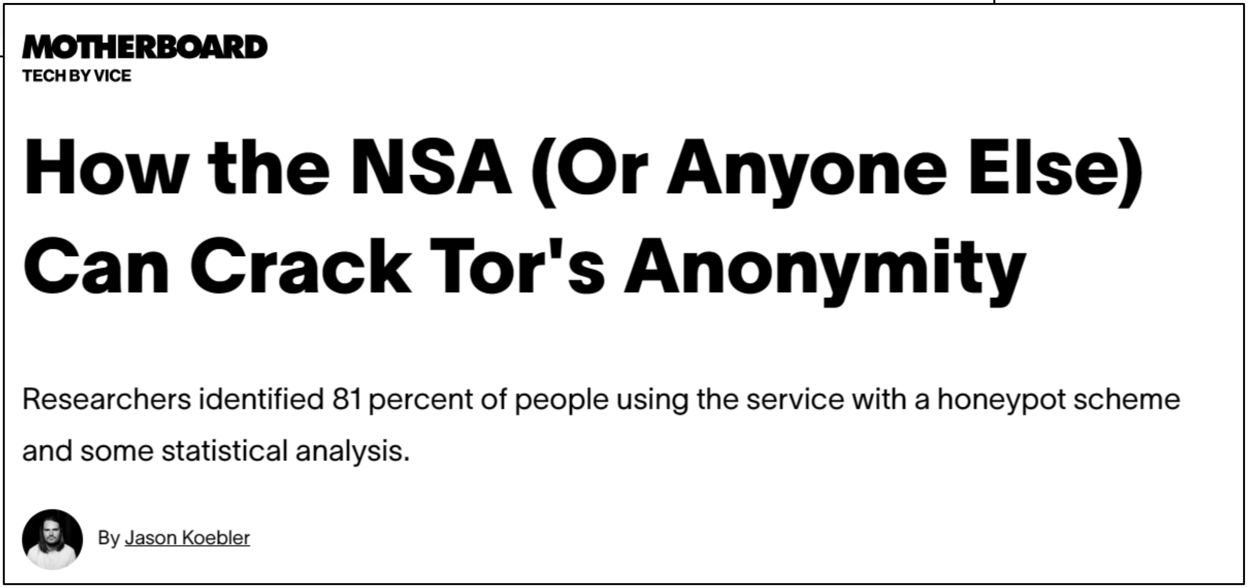
LAW & ORDER

More: Harvard Bomb scare FBI

Harvard Student Arrested For Bomb Threat Tried And Failed To Hide Identity With Anonymous Browser

PAMELA ENGEL

DEC. 18, 2013, 3:03 PM 57,643



MOTHERBOARD

TECH BY VICE

How the NSA (Or Anyone Else) Can Crack Tor's Anonymity

Researchers identified 81 percent of people using the service with a honeypot scheme and some statistical analysis.

By Jason Koebler

We'll later learn how to break Tor