



Advanced Network Security

Lecture 1: Introduction

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08.09.2022

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Internet and Web Security



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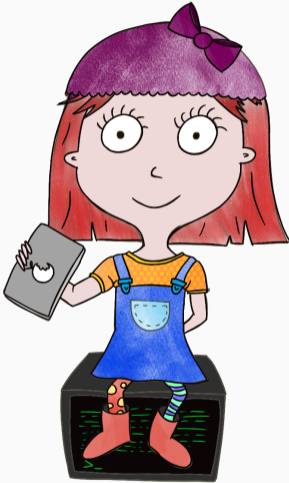
Mobile Network Security

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2	Mobile Networks	15.09.2022
3	3 Attacks on L2	22.09.2022
4	ReVoLTE Attack	29.09.2022
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10	Botnets and DDoS	24.11.2022
11	Routing Security, BGP, DNS over HTTPS 1	01.12.2022
12	Routing Security, BGP, DNS over HTTPS 2	08.12.2022
13	Presentations 2	15.12.2022
14	Wrapup	22.12.2022

Structure:

- ▶ Topics follow the content of the lectures
- ▶ Work in groups
- ▶ Pick a topic for the presentations
- ▶ Project is worth 1 EC

Grading: 5/6 exam + 1/6 project



Why projects?

- ▶ Get hands-on experience
- ▶ Do practical stuff (programming, measuring)
- ▶ Related to the lectures

Why presentations?

- ▶ Practice!
- ▶ Do your own wrapup

What will be the format?

- ▶ Online exam on Cirrus
- ▶ Mostly knowledge questions
- ▶ Everything close to the lectures

Exam: 18.01.2023 12:45

Brightspace is the answer:

- ▶ Before each lecture, we upload the next set of slides there
- ▶ Homework assignments will be uploaded here
- ▶ Use the discussion forum!

Activities → **Discussions**

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Discussions

[Settings](#) [Help](#)

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New

More Actions

Filter by: [Unread](#) [Unapproved](#)

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Questions and Discussions

Please share your questions and thoughts here so that everyone can benefit!

Topic	Threads	Posts	Last Post
General Questions Regarding the Course			
Everything that in general is related to the course	0	0	
Questions Regarding Lectures			
If something remains unclear, if you have further questions, if you are looking for resources or examples, ...	0	0	

Motivation

Safety vs. Security

Safety and Security are both about protection, still different:

Safety: against (unintentional) accidents or disasters

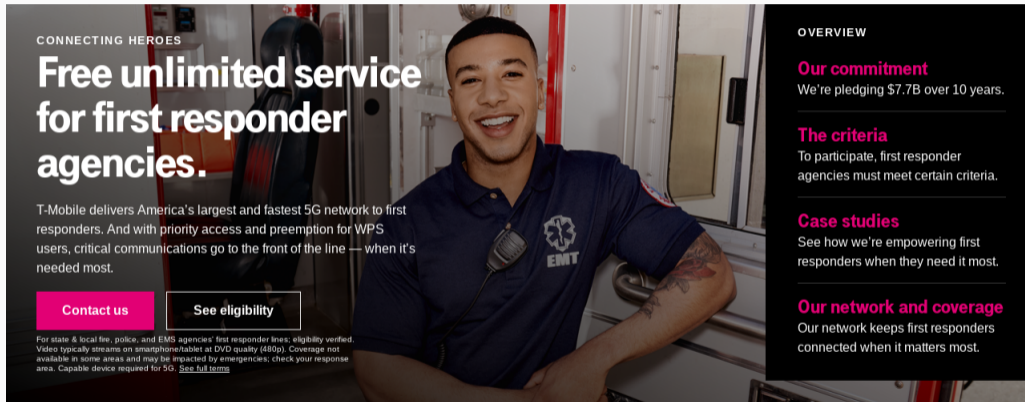
- ▶ anticipate what can go wrong
- ▶ also the unexpected
- ▶ *forces of nature*: tsunamis, fire, biohazard, flood, polar bears, etc.
- ▶ *bad things happening*: nuclear accidents, panic, power outage, traffic, etc.
- ▶ providing safety is hard



Why do we repeat this?

**Because secure networks
enable safety!**

How do networks protect public safety?



CONNECTING HEROES

Free unlimited service for first responder agencies.

T-Mobile delivers America's largest and fastest 5G network to first responders. And with priority access and preemption for WPS users, critical communications go to the front of the line — when it's needed most.

[Contact us](#) [See eligibility](#)

For state & local fire, police, and EMS agencies' first responder lines; eligibility verified. Video typically streams on smartphone/tablet at DVD quality (480p). Coverage not available in some areas and may be impacted by emergencies; check your response area. Capable device required for 5G. [See full terms](#)

OVERVIEW

Our commitment
We're pledging \$7.7B over 10 years.

The criteria
To participate, first responder agencies must meet certain criteria.

Case studies
See how we're empowering first responders when they need it most.

Our network and coverage
Our network keeps first responders connected when it matters most.

<https://www.t-mobile.com/business/government/first-responders-connecting-heroes>

How do networks protect public safety?

- ▶ Emergency communication
- ▶ Report an emergency



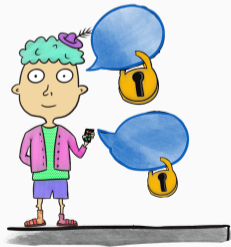
Law enforcement

- ▶ Monitor communications
- ▶ Localize individuals
- ▶ User registration



Security: against malicious activities by people

- ▶ anticipate war, terrorism, fraud, theft, abuse, etc.
- ▶ also the unexpected
- ▶ providing security is harder!
- ▶ ... because the harm is *intentional*



- ▶ Hackers can exploit protocol weaknesses to get cleartext

ReVolTE Attack Allows Hackers to Listen in on Mobile Calls

Author:
Elizabeth Montalbano
August 13, 2020
/ 9:06 am

2:30 minute read

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Rare attack on cellular protocol exploits an encryption-implementation flaw at base stations to record voice calls.

- ▶ Numerous other examples: WIFI's WPA2, TLS, ...

By organizations that claim to be legitimate:

- ▶ for profit: Google, Facebook, device vendors, etc.
- ▶ for *law enforcement*: governments
- ▶ using smartphone, TV, *smart speakers* ...



How did it get so bad?

On the Internet, nobody knows you're a dog.



"On the Internet, nobody knows you're a dog."

©The New Yorker Collection 1993 Peter Steiner
From cartoonbank.com. All rights reserved.

- ▶ **1994:** SSL 1.0¹
- ▶ **1995:** SSL 2.0
- ▶ **1996:** SSL 3.0
- ▶ ...
- ▶ **1998:** Traffic Analysis of SSL Encrypted Web Browsing²

It didn't take long until encryption could be circumvented!

¹Secure Socket Layer, deprecated predecessor of TLS: Provides encryption for network connections.

²Heyning Cheng & Ron Avnur

What happened since then?

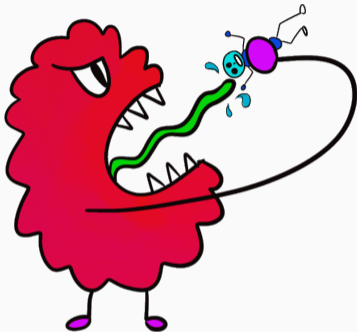


yahoo!



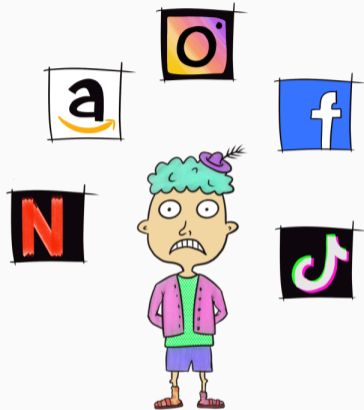
- 2014** "You could read anyone's email. Any website:
You can watch traffic to and from it." (Edward Snowden)
- 2016** Biggest data breach in history, likely by "a state-sponsored actor,"
revealing information of 500 million users.
- 2018** Google is probably tracking your location, even if you turn it off, says report.
While your location history is paused, some services still store your location data.

So... Who are the bad guys here?



Official Bad Guys

- ▶ Companies with bad security
- ▶ NSA, intelligence services



Unofficial Bad Guys

- ▶ Order all the stuff!
- ▶ Stream all the series!

3



O.K., go ahead
I'm on a private network.

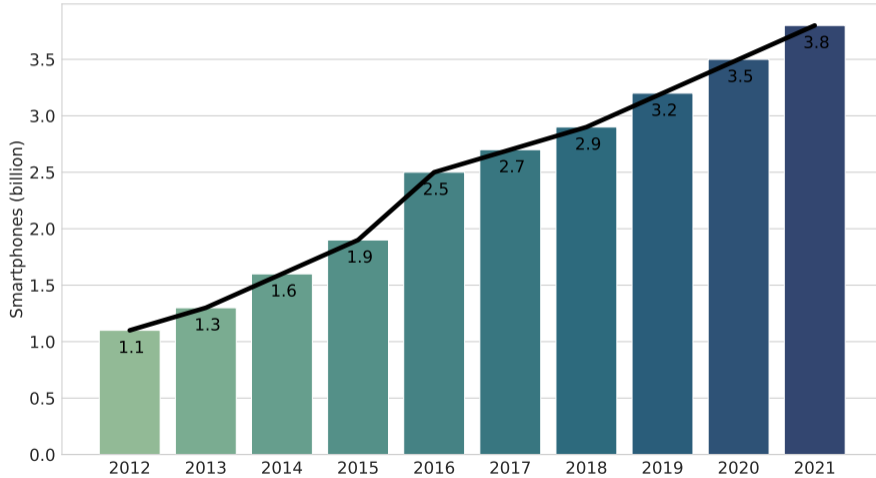


I do all my browsing on Tor.

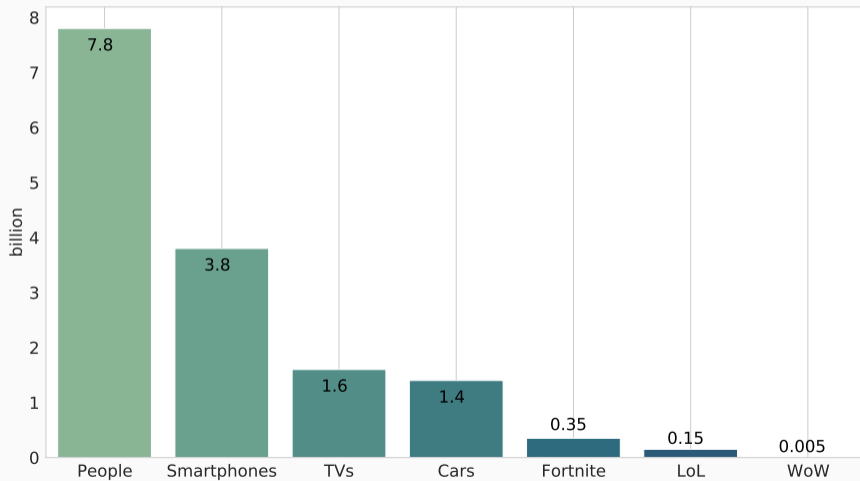
Kaamran Hafeez, **2018**, The New Yorker

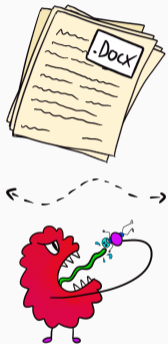
Mobile Network Security

Why Mobile Network Security?

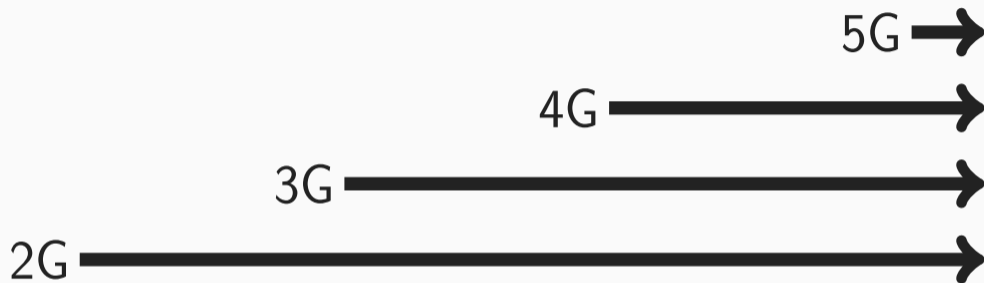


How much is that?





- ▶ Mobile networks have a complex specification
- ▶ In comparison to the Internet, they are relatively young
- ▶ Wireless connections are more problematic
- ▶ Flaw in the specification?
Affects 3.8 billion mobile users!



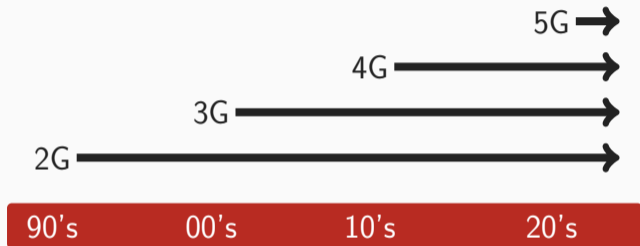
90's

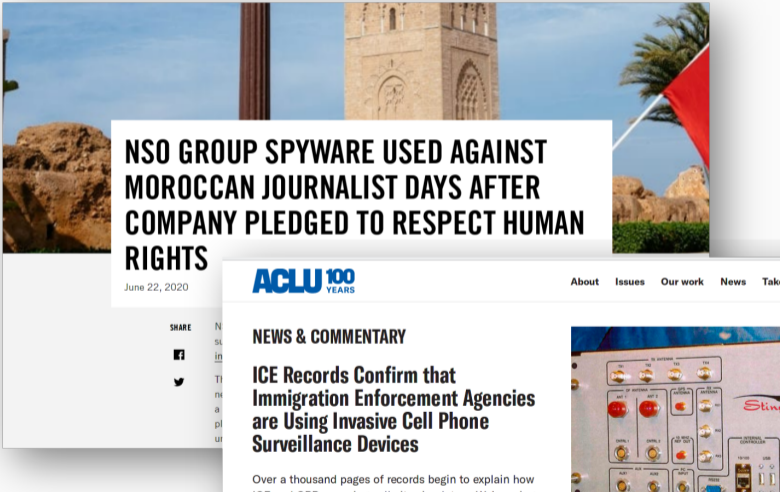
00's

10's

20's

- ▶ 2G is completely broken
- ▶ 3G has many known vulnerabilities
- ▶ 4G improved but still ...
- ▶ 5G is highly similar to 4G





The image is a screenshot of a web browser displaying an article on the ACLU website. The background of the article header features a photograph of a tall, ornate stone tower, likely a mosque minaret, under a clear blue sky. A red flag is partially visible on the right side of the image. The main headline is in large, bold, black capital letters: "NSO GROUP SPYWARE USED AGAINST MOROCCAN JOURNALIST DAYS AFTER COMPANY PLEDGED TO RESPECT HUMAN RIGHTS". Below the headline, the date "June 22, 2020" is displayed. To the right of the date is the ACLU logo, which includes the text "ACLU 100 YEARS". A navigation menu with the items "About", "Issues", "Our work", "News", and "Take" is located at the top right of the article content area. Below the navigation menu, the text "NEWS & COMMENTARY" is centered. The main title of the article is "ICE Records Confirm that Immigration Enforcement Agencies are Using Invasive Cell Phone Surveillance Devices". Below this title, the beginning of the article text is visible: "Over a thousand pages of records begin to explain how". On the left side of the article, there is a "SHARE" section with icons for Facebook and Twitter. On the right side, there is a photograph of a piece of electronic equipment, possibly a Stuxnet worm controller, with various buttons, switches, and labels like "INTERNAL CONTROLLER" and "USB".

NSO GROUP SPYWARE USED AGAINST MOROCCAN JOURNALIST DAYS AFTER COMPANY PLEDGED TO RESPECT HUMAN RIGHTS

June 22, 2020

ACLU 100 YEARS

About Issues Our work News Take

NEWS & COMMENTARY

ICE Records Confirm that Immigration Enforcement Agencies are Using Invasive Cell Phone Surveillance Devices

Over a thousand pages of records begin to explain how

There are different types of attacks:

- ▶ Realistic: Real-world incidents
- ▶ Scientific: Controlled setting, artificial scope
- ▶ Borderline: Feasible but with many limitations/requirements

In the first part of the course:

- ▶ Required background on 4G and 5G
- ▶ Attacks:
 - DNS Redirection, Website Fingerprinting, Identification
 - Decrypting calls
 - SUCI Catcher

Internet and Web Security



This is the second part of the course.