

CS7NS5/CSU44032

Security & privacy

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Course materials:

<https://down.dsg.cs.tcd.ie/cs7053/>

<https://github.com/sftcd/cs7053>

Slideware + some papers

Computer and Network Security is...

- ...a good thing to study (“one born every minute”, and some of those are programmers!)
- ...something with more and more impact (scaling factor is about the same as the Internet)
- ...a part of risk management

Privacy is...

- ...nowhere near as well understood
- ...an issue for people and not companies
- ...not clearly a part of risk management, but related
 - I'm unsure if risk analysis is a good approach to address privacy

So-called “consent”

- Web sites/services/licensed things (like s/w) impose terms and conditions and require you “consent” to those (maybe via a “click-through”)
 - Legal fiction, everyone knows people do not read T&C documents designed to obfuscate
 - Apparently, that legal fiction is still considered non-fiction by courts
- So-called “consent” is an awful model that only pretends to address privacy
- Good presentation on the so-called “consent” problem, with IMO less good (but worth exploring) ideas on HOWTO fix
<https://datatracker.ietf.org/meeting/105/materials/slides-105-ietf-sesse-privacy-modern-concerns-steven-m-bellovin-00.pdf>

Privacy

- RFC 6973 - In addition to “normal” security threats we need to care about
 - Correlation
 - Identification
 - Secondary use
 - Disclosure
 - Exclusion
 - **Re-identification**
- Aside: we’ll refer to Internet RFCs a lot, the above can be found at:
<https://datatracker.ietf.org/doc/html/rfc6973>

Privacy Puzzle

- Emails can contain a Received header field which can contain the mail user agent IP address
 - What consequences?
 - Overall good or bad from a privacy perspective?
- Redacted example:

```
Received: from localhost (ip-xxx-xxx-xxx-xxx.bb.vodafone.cz. [xxx.xxx.xxx.xxx])  
by smtp.gmail.com with ESMTPSA id  
h16-yyyyyyyyyyyyyy.40.2023.01.30.05.40.25  
(version=TLS1_3 cipher=TLS_AES_256_GCM_SHA384  
bits=256/256);  
Mon, 30 Jan 2023 05:40:25 -0800 (PST)
```

Privacy Processes

- Various have been proposed or are in use, but this is not a mature space (IMO)
- Privacy by design
 - https://en.wikipedia.org/wiki/Privacy_by_design
- Data protection by design and default
 - <https://ico.org.uk/for-organisations/guide-to-data-protection/guide-to-the-general-data-protection-regulation-gdpr/accountability-and-governance/data-protection-by-design-and-default/>
- Data protection impact assessments
 - <https://dataprotection.ie/en/organisations/know-your-obligations/data-protection-impact-assessments>
- A fairly good OWASP-person's slide deck from 2018
 - https://owasp.org/www-pdf-archive/TOREON_Adding_Privacy_by_Design_in_Secure_Application_Development_v20180412.pdf

Irish Covidtracker example

- In 2020 the HSE (with developer Nearform) produced a GAEN covid tracking application
 - <https://www.hse.ie/eng/services/news/newsfeatures/covid19-updates/covid-tracker-app/>
- Way more information than you need on the Google/Apple Exposure Notification (GAEN) system:
 - <https://down.dsg.cs.tcd.ie/tact/>
- Original DPIA:
 - <https://github.com/HSEIreland/covidtracker-documentation/blob/master/documentation/privacy/Data%20Protection%20Impact%20Assessment%20for%20the%20COVID%20Tracker%20App%20-%2026.06.2020.pdf>
- While (I believe) they wanted to do all the right things, in a space that was very “foreign” for the HSE, the end result wasn’t wonderful from a privacy perspective:
 - Dependency on Google Play Services (not HSE’s fault, inherent in GAEN)
 - Super-cookie: JWT token required for TEK download – most other GAEN apps have no such token
- Note: the above is only about privacy, the efficacy of these apps is another question entirely (spoiler: I don’t think they were useful), but that wasn’t known (for sure) at that time

Privacy by design (PbD) Principles

7 "foundational principles":

- Proactive not reactive; preventive not remedial
- Privacy as the default setting
- Privacy embedded into design
- Full functionality – positive-sum, not zero-sum
- End-to-end security – full lifecycle protection
- Visibility and transparency – keep it open
- Respect for user privacy – keep it user-centric

Not clear (to me) that incentives align here such that result will be a privacy “win.”

A few more thoughts on privacy

- Who cares? About what?
 - Many governments, marketers and large corporates do “care deeply” about your (lack of) privacy
- How can designers/implementers improve/protect privacy?
 - Behave as if your entire family will all be users – minimise!
 - Encrypt things in transit and storage
 - Short-lived dynamic identifiers are better than long-lived static identifiers
 - Just don't require identification
 - Your idea here...
- How can you help yourself as a user?
 - Don't create more accounts
 - Target diversity
 - Your idea here...
 - Also see <https://down.dsg.cs.tcd.ie/witidtm/>

Risk Management

- Risks (bad things)
 - Disclosure of trade secrets
 - Sabotage (information or hardware)
 - Denial of service
 - Accidents (fire, flooding, earth quakes, ...)
- Solutions (not always good things)
 - Security policies and mechanisms
 - Physical security (locks, guards, CCTV, ...)
 - Formal specification/verification of software
 - Halon, UPS, off-site backups

Vulnerabilities

- Many risks arise due to the existence of vulnerabilities in computer systems
- All systems have vulnerabilities, our goal is not to remove absolutely all of them, but to control their impact
 - Reducing numbers is good
 - Can also isolate parts of the system (e.g. Firewalling)

Vulnerabilities

- Very common:
 - Scripting user agents
 - Buffer overruns
 - XSS & Injection (e.g. SQL injection)
 - <https://owasp.org/www-community/attacks/xss/>
 - Insecure default settings
- Uncommon, but interesting:
 - Acoustic side-channel key extraction,
 - Genkin, Shamir & Tromer
 - <https://eprint.iacr.org/2013/857.pdf>



Figure 6: Parabolic microphone (same as in Figure 5), attached to the portable measurement setup (in a padded briefcase), attacking a target laptop from a distance of 4 meters. Full key extraction is possible in this configuration and distance (see Section 5.4).

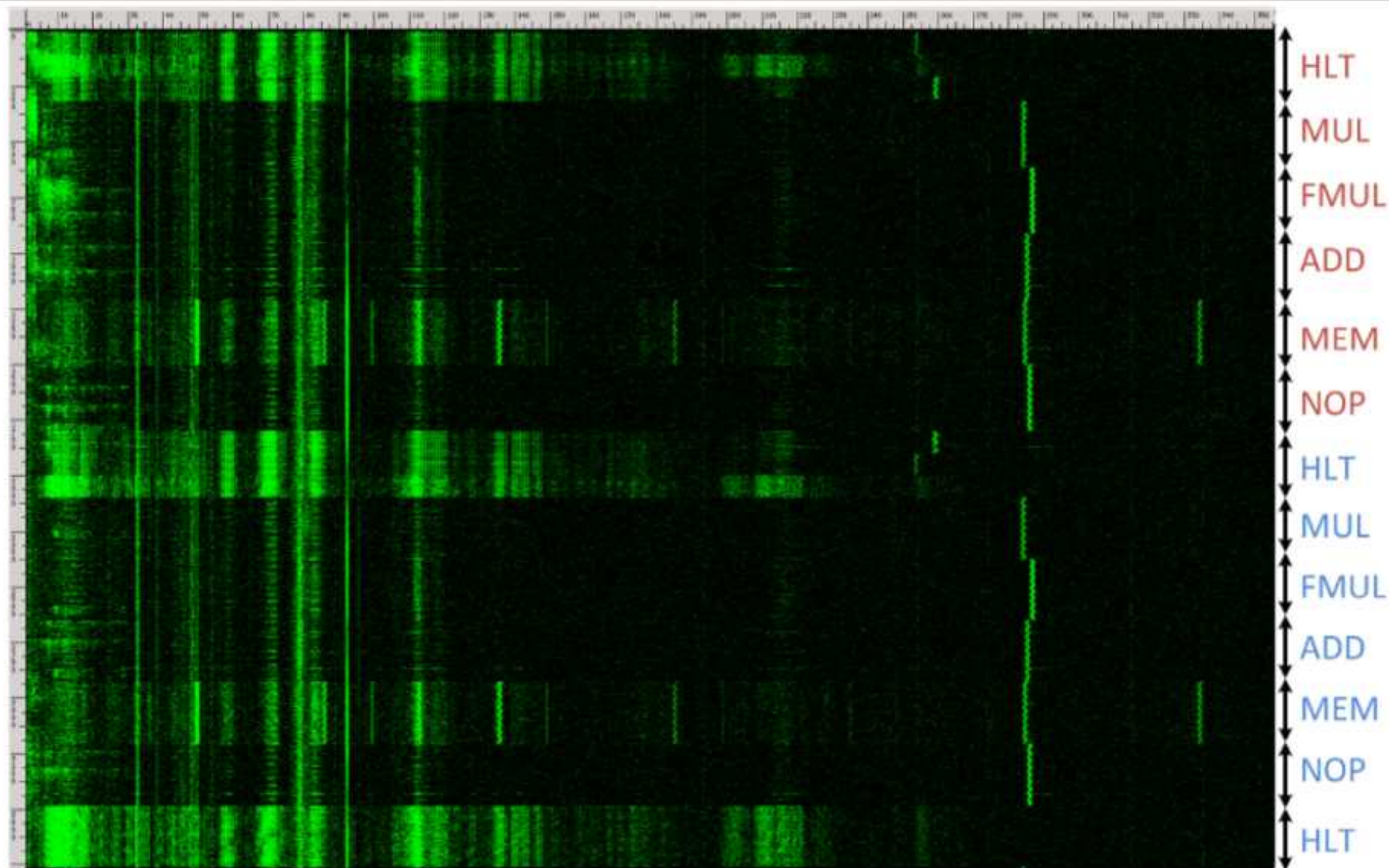


Figure 7: Acoustic measurement frequency spectrogram of a recording of different CPU operations using the Brüel&Kjær 4939 microphone capsule. The horizontal axis is frequency (0–310kHz), the vertical axis is time (3.7sec), and intensity is proportional to the instantaneous energy in that frequency band.

Good/Bad Actors

- Systems have users
 - Normal, administrative, “root”
- Networks have nodes
 - “Inside”, “outside”, trusted...
- Attackers
 - Can be one of the above, **or not**...
 - Hijacked ISP router, compromised SIM card factory, bot etc.

Possible Bad Actors

- Disgruntled employees (*plenty*)
- Crackers (*hackers*)
- Script-Kiddies (*cracker wannabes*)
- Spies (*industrial and military*)
- Criminals (*thieves, organized crime*)
- Terrorists
- Governments
- Bait'n'switchers (service providers who change business model)

Possible Exploits

- Force legitimate user to reveal passwords
- Social engineering
- Recruit legitimate user
- Sabotage (*fire, electricity, ...*)
- Sifting through garbage
- Attacking the network (*network threats*)
- Install malware

Active/Passive Attacks

- Active attacks
 - Fabrication, modification, deletion, replay of messages
- Passive attacks
 - Eavesdropping/traffic analysis
 - Can be off-line (e.g. if weak encryption)
- Different protocol mechanisms are used to counter these

Risk Analysis Process

Many variations exist, mostly they resemble:

- Identify assets
- Identify risks and vulnerabilities
- Consider probabilities
- Consider consequent costs/losses
- Rank risks
- Develop mitigation(s) for highest ranked risk(s)
- Iterate, until effort exhausted or time up
 - All the time recording what you've done

Summing up risk

- Risk is a function of the cost of threats and their probability of occurrence
 - Which function can be debated
 - High/Medium/Low
 - For both costs and probabilities
- Threats occur when a vulnerability is exploited