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Having Our Cake And Eating It Too: Are Safety, Security and Privacy Possible Simultaneously?

EPFL Elephants in the Technology Room Symposium

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Defining Our Terms

In the limited context of the ICT systems that people use

Safety: Freedom from risk of injury, damage or destruction

- Of the system itself and/or of its users

Security: Only authorized entities can access or modify assets of a system

- Usually defined in terms of properties like confidentiality, integrity, availability, …

Privacy: Freedom to control how information about oneself is used

Two observations:

- No safety without security
- Systems people use are often treated as representative of those individuals

Safety in the Small, Safety in the Large

Example: Safety of railway signaling systems

https://d.newsweek.com/en/full/61730/high-speed-trains-ta05-wide.jpg

- Older notions of safety were defined in a narrow context
  - The safety system only addressed trains, not the people in them
- The safety system did not explicitly need to have security
- Obscurity as security
  - “Nobody would interfere with operation of a train”
  - “It's a proprietary protocol, nobody can figure it out”

Inherent Tension Between Safety & Security

What's the safe response, what's the secure response?

https://www.hseblog.com/wp-content/uploads/2018/04/Difference-Between-Safety-and-Security-2.jpg

- “Mixed Criticality”: use security to establish the conditions for safety, let the safety system dominate
- In future highly-connected distributed safety systems, this becomes less clear
- What's the meaning of an authentication error?
- Fallback modes of operation are needed
- Largely a technical solution and discussion
- But with societal and potentially legal implications
- Classic example: Avoid a crash that kills the people in a car, but kills a pedestrian

Identity: Foundation of Trust & Security

https://images.idgesg.net/images/article/2018/08/8_authentication-basics_password_identity_protected_security-100768041-large.jpg

- With few exceptions (e.g. PGP), transitive trust is the basis for identity
- “I trust Google/Apple/ Vodaphone/US Gov’t”
  - Ergo: “I trust your identity as attested by them”
- Having an identity means submitting to the authority of the identity issuer
- Having an identity means you can be tracked when presenting it

Safety in the Public Realm

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https://data.nextshark.com/wp-content/uploads/2017/09/chinasurveli-768x408.jpg

- Ubiquitous surveillance as a public safety tool
- If every utterance, movement, action is permanently recorded, can we still have free speech & association?
  - Is this evidence of incitement or conspiracy?
- Massive AIs distill & identify threats
  - Bias, misinterpretation?
- Right to forget?
- What about the AI tools themselves?
  - They can become vectors for leaks and subject to manipulation

Following Breadcrumbs: Can I Collect Enough Information to Track & Monitor You?

https://www.anomali.com/images/made/images/uploads/blog/Artificial_Intelligence_Data_Privacy__1000_500.jpg

- Ubiquitous video surveillance may be obvious, but is it the only way?
- Model: the browser “fingerprint”
- SIGINT: what can I learn just by watching you in relation to others I track?
- Strong identity in my devices & on my person become power tools to do this
- The amount of these data increases over time
- As does the ability to store, fuse & correlate it

Social Media and Societal Norms

In a social media age, do privacy & anonymity even matter?

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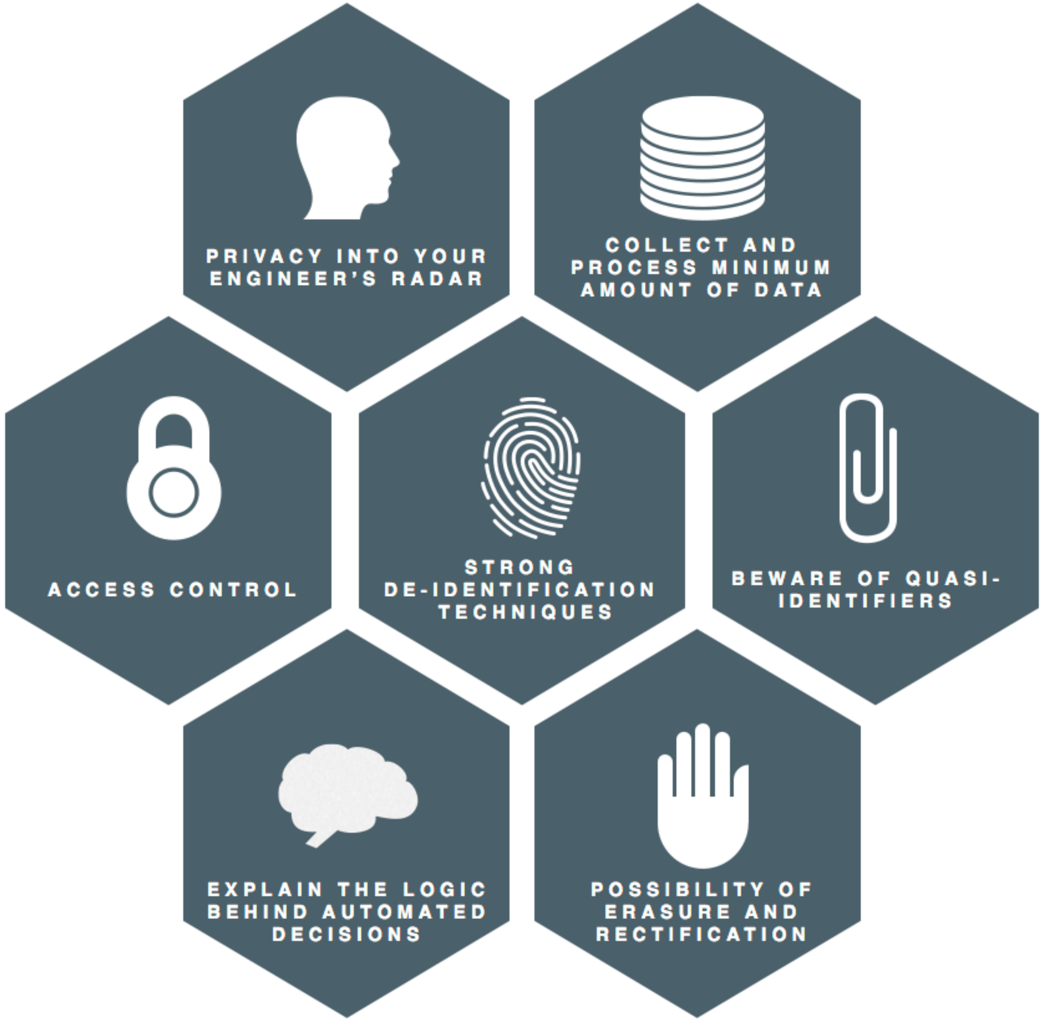
- Is this just the concern of an old and dying generation?
- How do youth think about privacy?
  - Will they lament their loss of privacy in future?
  - Do they even think of their use of social media as a loss of privacy?
- Can it be regained?

Policy and Legislative Solutions

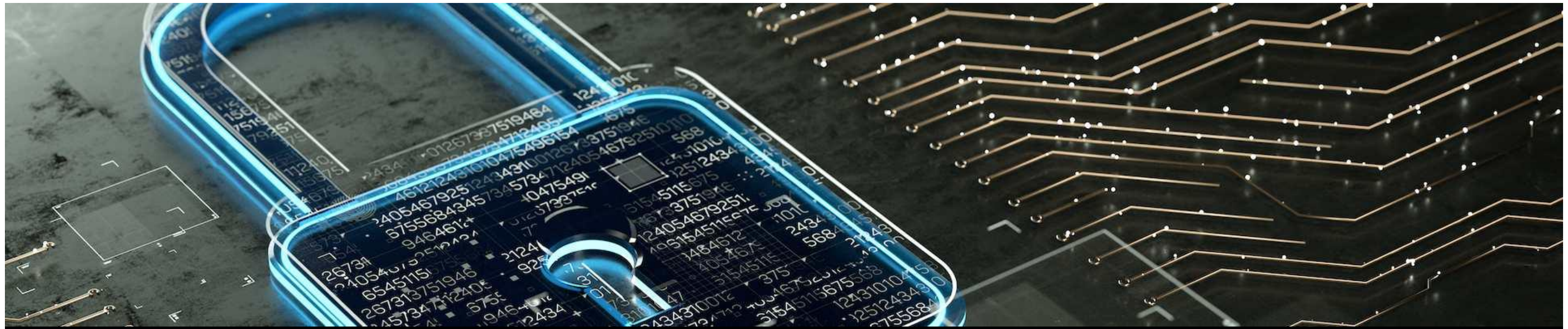

PRIVACY INTO YOUR ENGINEER'S RADAR
COLLECT AND PROCESS MINIMUM AMOUNT OF DATA
ACCESS CONTROL
STRONG DE-IDENTIFICATION TECHNIQUES
BEWARE OF QUASI-IDENTIFIERS
EXPLAIN THE LOGIC BEHIND AUTOMATED DECISIONS
POSSIBILITY OF ERASURE AND RECTIFICATION

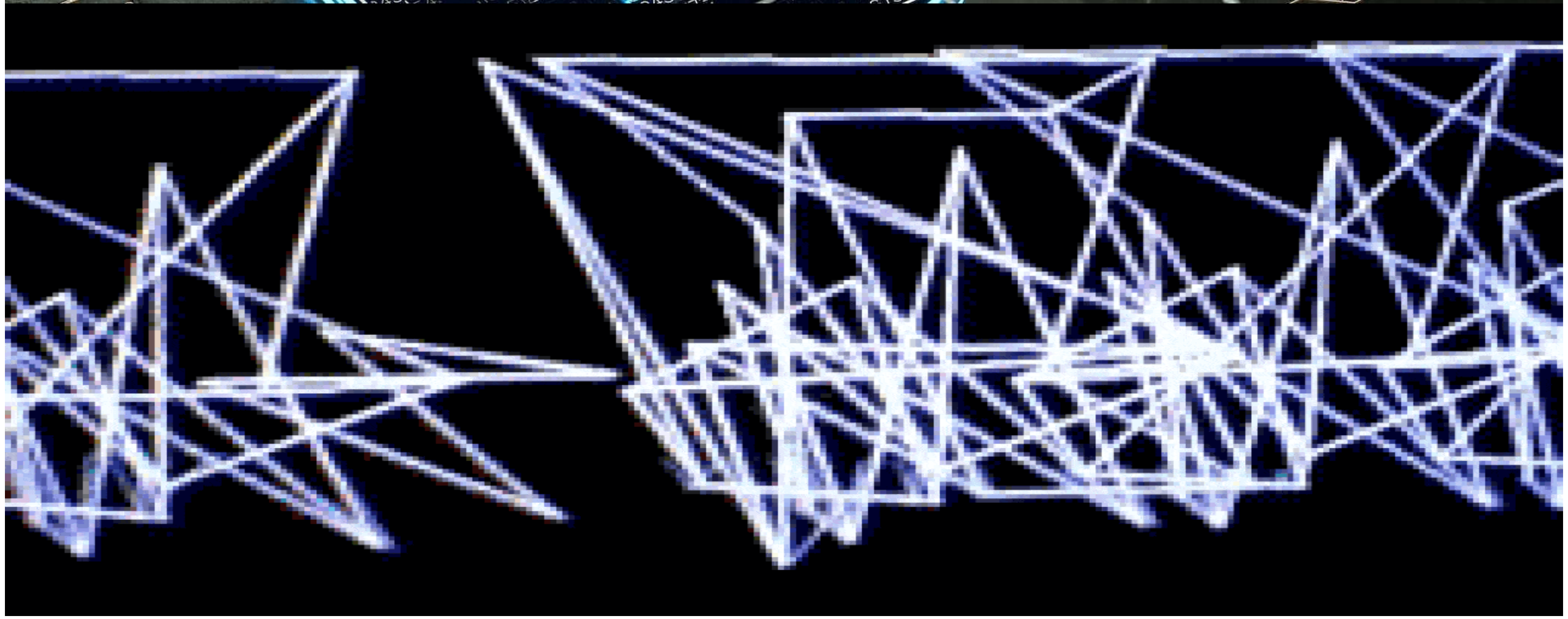
https://miro.medium.com/v2/resize:fit:1720/0*30IhOknPZyACOSlC.png

- Are they sufficient?
- Are they (or can they be) effective?
- GDPR is the broadest and best-known example
  - Viewed as quite effective
  - But its slow and necessarily reactive
- Are big fines just a cost of doing business?
- What to do about the fact that technical circumvention is always possible?

The Big Challenge: Can We Build Strong Technical Privacy Solutions?

And make them ubiquitous?





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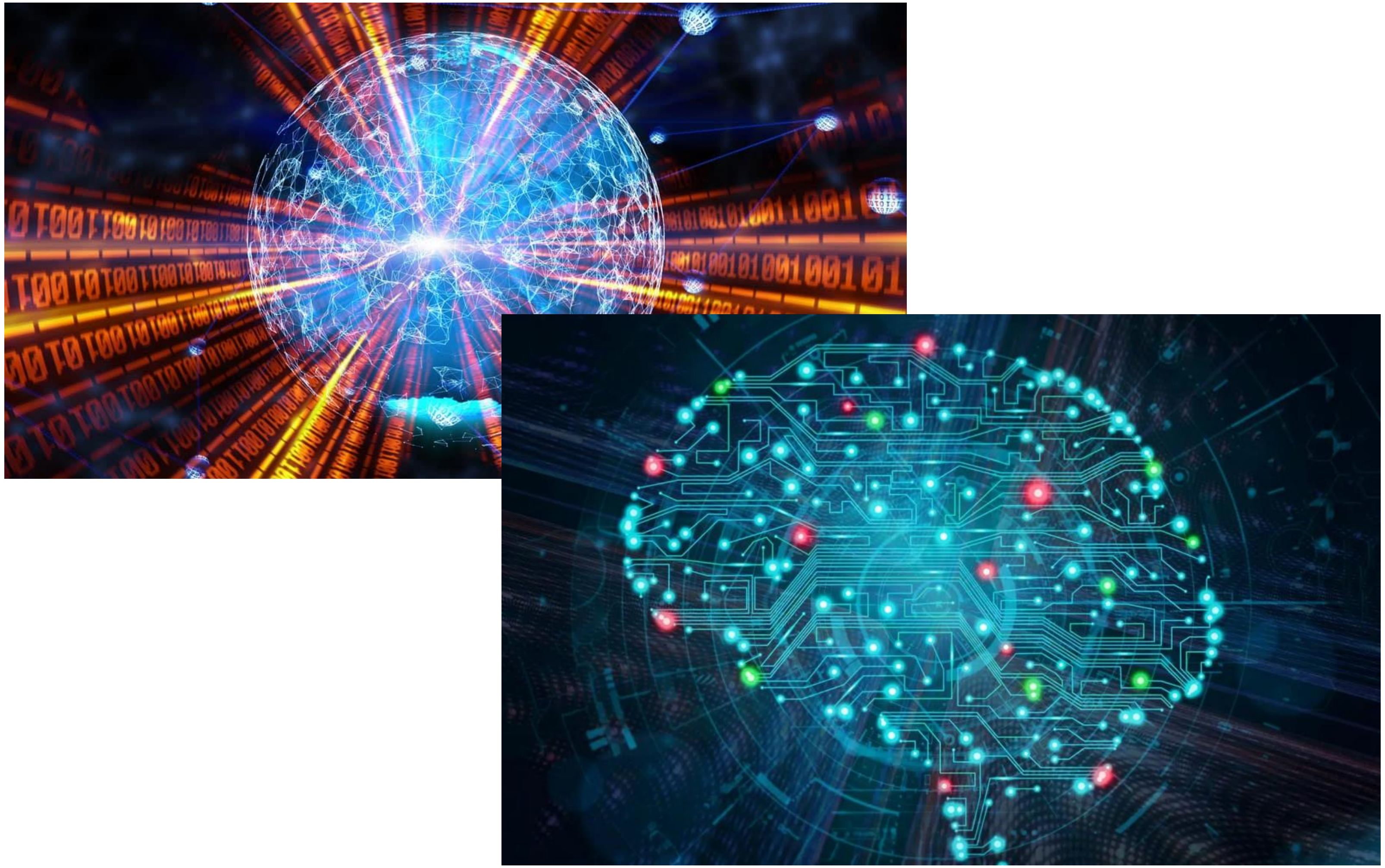
https://www.arm.com/-/media/global/resources/newsletter/arm-cca-1920x390.jpg?revision=9d674748-e9c0-4405-9a45-476cb57c8cb5

- We might…
- Confidential computing actively advancing & backed by hyperscalers
  - But it is still a kind of trust model without guarantees
  - Widespread deployments will take years
- Fully homomorphic encryption (compute over encrypted data) is becoming feasible
  - This does provide strong guarantees of privacy
  - Likely a big part of an eventual solution
- Improved zero-knowledge identity proofs

Looking Forward to the 30’s



https://scitechdaily.com/images/Artificial-Intelligence-Quantum-Mechanics-1536x1024.jpg
https://physicsworld.com/wp-content/uploads/2020/11/quantum-computing-or-comms-1008154320-iStock_johnason.jpg

- 2 major development threads
  - AI, especially including neuromorphic processing
  - quantum computing (QC)
- AI+quantum computing
  - Wide availability & inherent parallelism afforded by QC matches the needs of neuromorphic AI
  - Human neurology teaches us that the presence of noise need not prevent useful work
  - Learn how to exploit this
- These advancements mostly work against privacy
  - Need that be true?

Beyond the 30’s

https://btlaw.com/-/media/images/btlaw/content/artificial-intelligence_detail.ashx?h=1280&w=1920&la=en&hash=7A40BECA760B75FF9DD39D5A9C46FC91BDA5AC50

- Our current progress creates the ingredients for our successor “species”
- Artificial General Intelligence: a machine that learns & evolves
  - At electronic speed, not biochemical speed
- Competing AGIs will consolidate to a single global AGI
- This will mark the start of transition to “Silicon life”

Thank You

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