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Privacy

Computer forensics

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Agenda

- What is privacy?
  - → The basic right
  - → Giving "consent"
  - → Exclusions
- Personal data in computer forensics
  - → Web, networks, E-Mail
- Anonymisation proxies
  - → Web
  - → E-Mail
- Secure data deletion
  - → Wiping hard disks
- Countermeasures against data retention

Introduction: Why privacy?

- "Why privacy? I don't have anything to conceal!"
  - → In theory, yes, but actually….
    - » See film stars: Every photo of a private activity will be published
      - – Whether it is scratching your nose or kissing someone
  - → Harmless activity can easily be misunderstood or misused!
- A constant thought of "I'm being watched…" builds up
  - → Psychologically this produces constant pressure and a general fear
    - – "I don't trust you, because you are being watched!"
    - » This breeds conformity and prevents any kind of open discussion etc. if taken too far
    - » Example: Who will discuss politics if every word is recorded, stored, and later perhaps used against you?
      - – Therefore politicians always contradict themselves!
- Constant supervision treats humans as objects
  - → Reversal of "innocent until proved"

Why the need for personal data?

- Large, but unfocused, desire for privacy by individuals
  - → "The right to be left alone" (Warren/Brandeis, 1890; **USA!!!**)
    - » Today extended: To self-determine information about you
    - » From passive ("don't talk about me") to active ("You have to guard the information about me")
  - → Privacy is usually not important, unless concrete personal drawbacks are experienced
- Large desire for information by companies
  - → Know your customers, advertising, credit rating, …
    - » Key word: "Personalisation" → Talk to the customer as an individual (or member of a certain group) instead of as a generic human being
      - – Small local store → supermarket → combination of both

Some balance must be found!

Data: Protection / Security / Privacy / … ?

- Terminology is important here!
- Data Protection: Protection against disclosure
  - → Data should be kept secret
  - → (Data) Privacy = Data Protection
    - » Note: Generally, this would be data "security"!
      - – Preventing unauthorized access
  - → German: "Datenschutz"
- Data Security: Protection against loss
  - → Data should be available (to the subject and the owner)
  - → German: "Datensicherheit"

- Both aspects are important
  - → Here only the first one is discussed!

Privacy vs. terrorism

- But in some cases monitoring is necessary
  - → This has already been acknowledged by privacy laws
  - → The important discussion is: Where to draw the line!
- Terrorism is a very "public" crime: Although the number of people dying by it in western countries is negligible compared to car accidents, it is an excellent "reason"
  - → Nobody fears being hit by a car,
    … but (almost) everyone is in panic of bombs!
- Terrorism is a problem, as "modern" terrorism is almost impossible to stop by surveillance. It only helps afterwards to identify terrorists and perhaps some of their associates
  - → This is still important, but one step less than prevention
  - → This area is currently hotly disputed, and politics (not necessarily the police!) request lots of additional options

The basic right to privacy

- The right to privacy is "the right to be let alone"
  - → Not everything a person does may be observed, noted, used, stored, calculated with etc.
  - → Today seen more extensive: That a person may decide what is known about him/her by others
- This includes the prohibition to obtain personal data!
  - → The problem is not necessarily what happens with the data, but that data exists at all: It might be (un-)intentionally disclosed; and if data exists it will be used sometimes!
    - » See the highway toll in Germany as an example
- Sometimes personal data is "known" inevitably
  - → Example: Doctor's secretaries/aides
  - → Then privacy refers to the prohibition to disclose the information to third persons or use it for any other task

Who is protected?

- EU directive: Only natural persons
  - » Austria: Extended to legal persons (might change!)
  - → The intention is to protect humans from everything/-one else
    - » Children in relation to their parents
    - » Employees in relation to their employer
  - → Legal entities are often protected only to a lesser degree
    - » See e.g. publishing financial data; or environmental pollution
    - » **Included** in directive on privacy and el. communications!
- Only persons which are identified or identifiable
  - → If nobody can say who the person is the data is related to, there is no danger at all (purely statistical data)
  - → Identification can be possible directly or indirectly
    - » E.g. one/more factors specific to physical, physiological, mental, economic, cultural, social identity
      - – "The blonde girl working in the accounting department", if there is only one a) young woman, with b) blond hair, c) in that department

What is protected?

- All data relating to a protected person
  - → Example: Hair colour, voice, letters, personal habits or preferences, income, sexual orientation, last breakfast meal, creditworthiness, …
  - → Regardless whether it is "important" or not
    - » Together with other data it might become important
    - » Everyone can determine the importance for them autonomously
- Result: If there is a list of "person" (identified somehow) and "attribute(s) of this person", the list is protected!
  - → Note: There is one additional data hidden here :Being on the list!
  - → Example: List of name and address
    - » Public data (taken from phone book)
      - – Practically unprotected and completely harmless
    - » Add the heading: "AIDS patients"
      - – Suddenly this list becomes much more dangerous!

What is protected?

- Only data that is processed
  - → Gathered, related to other, transferred, …
  - → But **NOT** the data as such("Facts are free")!
    - » There is no restriction on hair colors, only on gathering, sorting, storing, adding to other data, etc.!
- "Public" data might still be protected!
  - → Especially if known only to a restricted public
- Data must be either
  - → automatically processed, or
    - » Computer systems in any form
  - → contained (or intended to be contained) in a filing system
    - » Criteria related to individuals necessary
    - » Unimportant: local or distributed / functionally or geographically
    - » E.g. Database, filing cabinet with index

"Consent" in the context of privacy

- Must be "informed consent"
- This includes three aspects:
  - → Must be given freely ("Freedom")
  - → Must be specific ("Specificity")
  - → Subject must be informed ("Information")
- Can be given explicitly or implied
  - → What is needed depends on the category of data
    - » "Normal" data: Implied consent sufficient
    - » "Sensitive" data: Consent must be given explicitly
  - → Usually there is no need for consent in "writing"
    - » At least not in the EU directive
    - » Germany previously required "written consent", which was a problem in the Internet, although el. signatures did exist then
      - – But nobody used them, so this was abolished!

Freedom

- No duress or compulsion
  - → Denial of contract (if not unethical) possible if not given!
    - » BUT: Effective monopolies; e.g. all banks do it ???
    - » In practice quite a lot is possible under such a condition
- But these are necessary conditions for every legal act?!?
  - → Then there must be a bit **more** freedom here!
- One typical example are work contracts
  - → In the contract usually quite a lot of conditions can be added
    - » Everyone is free to accept this contract or decline
      - – Which is perhaps not that true in practice….
  - → But for an employee there is almost no possibility to give valid consent to his employer later!
    - » "You **will** allow this or I'll **sack** you!"…

Information

- Information necessary on
  - → That some personal data is used
    - » "We will collect, store, …. your personal data …"
  - → What data is used
    - » "We collect your IP address, web sites visited, and all information on the forms filled in"
  - → Who is the person using it
    - » "We are the ACME Inc."
  - → Whom it will be transferred to (if applicable)
    - » NOT “to everybody we want to”
- Especially important for implied consent
  - → Consent is only possible to the things actually disclosed!

Specificity

- Consent cannot be given for unlimited applications
  - → Only (a list of) single applications, but not a "general" consent
- Specificity means:
  - → For a certain purpose: A closed list/described set
    - » **NOT** “we are allowed to do with it what we want”
    - » This is the most important part!
      - – Example: "Advertisements" is not specific enough
    - » However, no absolutely closed list is required
      - – "Marketing our own products" could be sufficient
  - → For a certain controller
    - » **NOT** “we may transfer it to everyone we like”
  - → Of certain data
    - » **NOT** "whatever we know or find out about you"

Exclusions: Overview

- The basic right prohibits any use of personal data
  - → See above: This will not work in society
- Several exclusions exist, when personal data may be collected, used, stored etc.
  - → Typically, transferring the data is much more restricted!
  - → Fewer exclusions exist for the more "dangerous" subsets of data: sensitive and criminal data
- In the EU directive the exclusions are very general
  - → National law can either define them in more detail, like in Austria, or leave it up to the courts
- In general, there is a weighing of interests between the person the data is about, and the person wanting to use it
  - → Some decision of this weighing have been included in the directive as a pre-determined result!

Normal data may only be processed if (1)

- the subject has unambiguously given consent
  - → See definition of consent!
    - » "Unambiguous" → Implied consent is possible here
  - → Everyone can do with his data as he wants
    - » The freedom not to use the protection of the law
    - » See e.g. television talkshows!
- it is necessary for the performance of a contract
  - → Data subject must be party to contract, or
  - → for taking steps at request of subject prior to contract
    - » E. g. checking creditworthiness, calculating shipping costs, …
  - → Otherwise this could be used as a right of withdrawal!
    - » If later you do not want the contract any more and prohibit the seller to use your address ⇒ He couldn't ship the goods!

Normal data may only be processed if (2)

- it is necessary for compliance with a legal obligation
  - → Obligation of the controller, i.e. the one processing the data!
  - → Examples: Archiving invoices, processing data of the employee by the employer (holidays, payment, ...)
- it is necessary to protect vital interests of the subject
  - → E.g. looking up her own blood group on serious injuries
  - → "Vital" must be seen narrowly
    - » "Of interest" or "possibly beneficial" is not enough!
- it is necessary for tasks of public interest/official authority
  - → To avoid having to explicitly grant all processing by law
  - → Must be an important or indispensable requirement, not just a reduction of work
- it is necessary for legitimate interests of the controller, third parties, or those to whom data is disclosed
  - → **EXCEPT** where the interests of the subject are stronger!

Weighing the interests

- **Weighing of interests required**
  - → This is an "opening clause": You may do whatever you want with any "normal" personal data, but you need to have:
    - » Some interests: Easy!
    - » They must be legitimate: Usually no problem!
    - » They must outweigh the interest of the person to keep the data private: Most important and typically difficult aspect!
  - → Examples:
    - » Vital interests of thirds: Searching DBs to find suitable blood donors
      - – To contact them to ask, whether they would be willing to donate blood
    - » Required for pursuing a claim before public authorities
    - » Cooperation through official channels to improve public admin.
  - → May **not** be **just** a monetary comparison
    - » Gain for processor vs. damage to subject → Always insufficient!
  - → General clause for all other uses!

Sensitive data may only be processed if (1)

- the data subject has given explicit consent
  - → Countries can define some areas, where even consent is not enough, i.e. where the person is protected from itself!
- processing is necessary for carrying out obligations/specific rights of the controller in employment law
  - → If this is authorized by national law
  - → Adequate safeguards must be ensured
  - → Example: Accounting includes health information
    - » AT: Trade-union membership fee is partly collected by employer!
- processing is necessary to protect the vital interests of the subject or another person
  - → Only if subject is physically/legally incapable of giving consent
    - » Otherwise: The subject must be asked!
  - → No denying possible regarding vital interests of others!

Sensitive data may only be processed if (2)

- processing occurs by a foundation, association, … with a political, philosophical, religious or trade-union aim for their members or persons with regular contact connected with their purpose
  - → I.e., churches may have lists of members and supporters
  - → Only for legitimate activities and with appropriate guarantees
  - → This data may not be disclosed to thirds without consent!
- the processing of data manifestly made public by the subject
  - → After a "coming-out" the sexual orientation may be stored
- the processing is necessary for the establishment, exercise or defense of legal claims
  - → You may use personal data in courts to prove your case
    - » Illegally collecting data for (possible) later use in courts?

Sensitive data may only be processed if (3)

- the processing regards preventive medicine, medical diagnosis, the provision of care or treatment or the management of health-care services
  - → Data must be processed by a health professional with an obligation of professional secrecy (or persons with equivalent obligation of secrecy)
- Other national legal exemptions with suitable safeguards are possible for reasons of substantial public interest
  - → Examples: Private use, scientific research, statistics, informing the data subject, catastrophes etc.

Personal data in computer forensics

- Almost all data in computer forensics is personal data
  - → This is typically the interesting part: Data as evidence what a certain person did do (or did not do!)
- So care must be taken to only search for/extract/recreate data for which there is sufficient legal reason
  - → Otherwise sanctions may be imposed
    - » Including criminal proceedings!
  - → Attention: Several tools used for forensics are "dangerous"
    - » Already the simple possession may be illegal if combined with a certain intention (even more its distribution, making available, …)
- Obtaining permission is therefore paramount
  - → Either from all persons, which data may be about
    - » Attention: E.g. E-Mail → Consent of recipient **and sender**!
  - → Or from someone else, for instance the court
  - → Or some other justification (→ weighing of interests!)

Personal data on hard disk

- Files may contain any, including sensitive, personal data
  - → So potentially a hard-disk as a complete unit is subject to the strongest restrictions
  - → Inspecting a file therefore needs also the strongest exception
    - » However, the file **name** may be a guide for the content
- Attributes can also contain personal data:
  - → Who created/accessed the file (last)
  - → When was the file created/accessed (+ login times → user)
- Restrictions are possible to certain shares, partitions etc.
  - → If the owner of this partition gives consent → No problem
  - → This does not apply to partition slack or general partitions!
    - » Boot partition, swap partitions, … → System owner
- Not all data is personal data: Program code, OS
  - → But: Configuration files (Registry) etc. do contain such!

Personal data in network transmissions

- Observing network data also refers to personal data
  - → Typically the content of the communication
    - » Files transferred, E-Mails being sent/received, ….
  - → The recipient/sender address
    - » IP addresses can be personal data
      - – WLAN: Typically only local, so with other data (DHCP server etc.) the person can be identified
        → Almost everything becomes personal data!
      - – Germany: Problem for webserver logs
        - » No storing of IP addresses because of privacy (disputed!)
- But there is also technical data
  - → Protocol overhead, system communication, etc.
- Criminal sanctions of intercepting communication exist, too!
  - → Convention on Cybercrime, national laws, …

Personal data in E-Mails

- E-Mails are very typical personal data
  - → Both recipient and sender need to be protected
- Personal data:
  - → The actual textual content (or images, …)
  - → The subject line
  - → The recipient/sender address
  - → The sender IP-address
    - » Provides information on the location of the sending
      - – Not necessarily where the E-Mail was written!
  - → The time stamp(s): When the E-Mail was sent
  - → Other headers: The software used, …
- E-Mail, subject, and addresses can even be sensitive data
  - → Example: helpline@drugabuse.com, "The pains in my leg", …

Anonymisation proxies

- Basic principle of anonymisation is routing the traffic across one or several different computers, so it appears to be coming from there instead of the real origin
  - → I.e., hiding your IP address!
  - → Additionally, there no logs on the "real" source may be kept
- Problem: Communication must be secured, otherwise interception on the source side provides all the information!
  - → Solution: Encrypted communication with the proxy and its secure identification
- Problem: Correlating input and output still possible
  - → Solutions: Random delays, network of proxies
    - » Requires lots of users to prevent this ("hiding in the masses")!
- Problem: The fact that a proxy is used can be interesting
  - → Solution: Currently none (at least useful; → steganography)!

Web surfing anonymisation

- Problems:
  - → Delays are not possible – "Realtime" forwarding necessary
  - → Format of HTML requests is very simple and well-known
    - » Starting text is known, size of request can provide information
      - – E.g. file upload, comparing to known URLs
  - → High throughput needed (binary downloads!)
- Security: The anonymisation does not apply to the proxy!
  - → It can log all usernames, passwords, create copies of files, …
    - » Note: Data retention in Germany requires this!
    - » Cascading: Only the first and last one; others may be encrypted
- Locking out: Some servers reject requests from known anonymisation proxies!
  - → To avoid legal problems (and especially sending SPAM!)

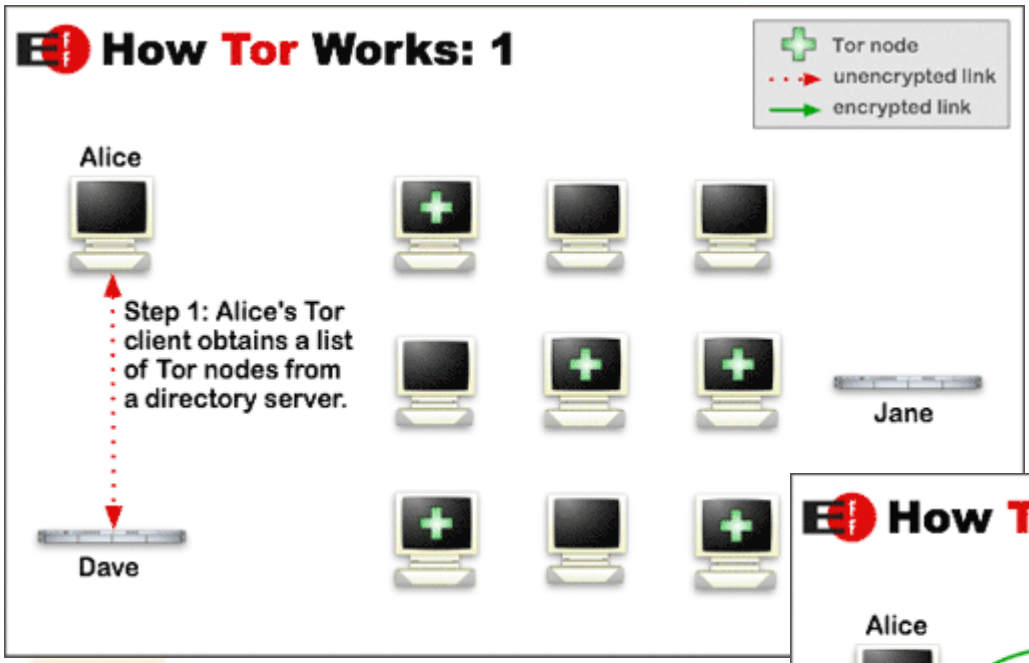
TOR (The Onion Router)

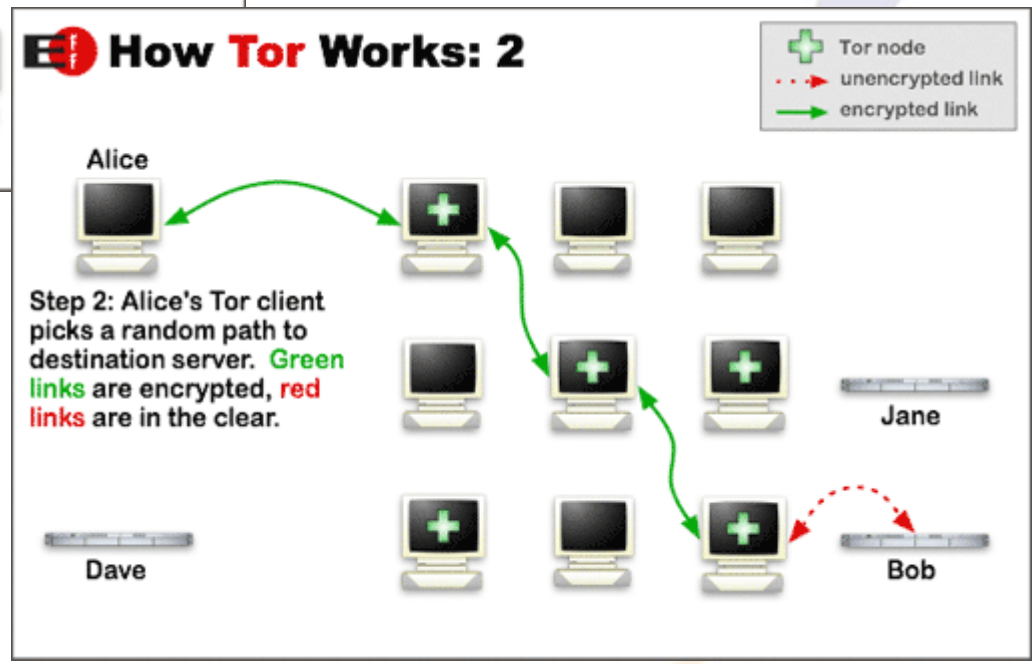
- TOR is a free TCP proxy
  - → All TCP traffic can be anonymized, not only web browsing!
    - » But E-Mail usually forbidden (proxy can decide, what to accept)
- How does it work:
  - → Each connection takes a random way over several nodes
    - » The next connection may use a different route!
  - → Each hop is encrypted separately
- See also the tool "Tork":
  - → Based on TOR (UI/configuration helper for it)
  - → Allows in-/excluding servers/countries from the proxy network
  - → Supports web-browsing, E-Mail, IRC

TOR (The Onion Router)

- Problems:
  - → The last hop has (and always must have) access to cleartext!
    - » Unless using TLS or something similar
      - – Log-ins and password of ≈100 embassies sniffed by adding 5 exit nodes (which anyone can add!)
      - – TLS proxies do exist (man-in-the-middle attacks), as certificate warnings are usually ignored by users
    - » Some nodes only forward the unencrypted protocols …
      - – Government agencies might be involved!
  - → DNS is not TCP but UDP → No anonymisation
    - » DNS for "google.at" → later anonymous request is known!
      - – Use additionally the tool "Privoxy"; or the (current) 0.2 branch
  - → Traffic analysis: A paper showed, that even with only a partial view of the network anonymisation can be reduced/broken

TOR (The Onion Router)

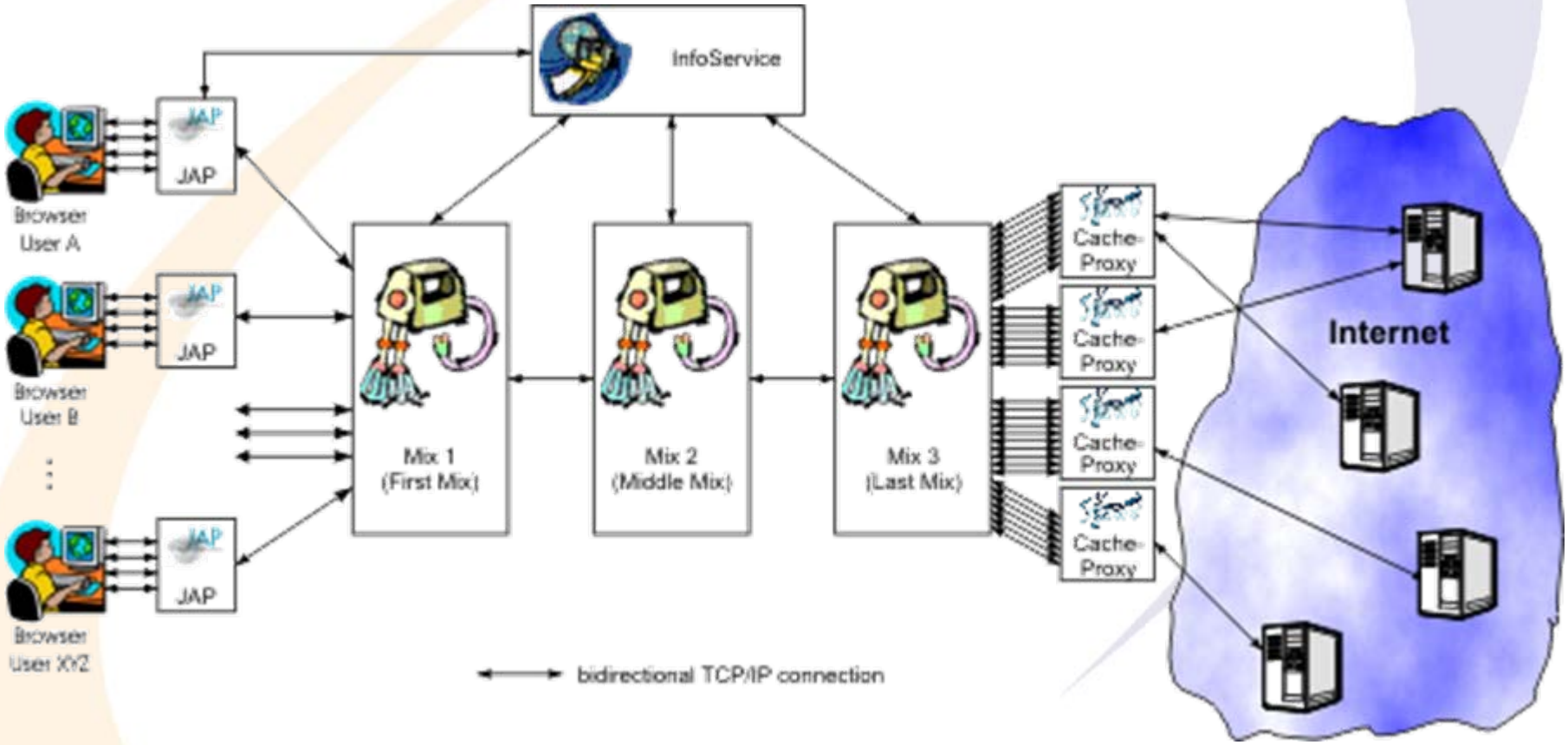




JonDonym/JAP/AN.ON

- Commercial successor of the Java anonymisation proxy JAP
- Consists of several features:
  - → Mixing: Several proxies after each other, randomly selected
    - » Also mixes/combines the requests of several users
  - → Mix cascades: Proxies from different operators are used
    - » Only a single one must be trusted to be anonymous
    - » The proxies are known to the end user, who can also select them
      - – But how do you find them and whether you can trust them?
    - » In different countries, so court orders to log traffic of certain users will not work
      - – Occurred with the predecessor JAP in Germany!
- Client program needed: Redirects the requests to the proxies and encrypts them
- Special functionality to avoid blocking the service:
  - → Other "normal" users may act as forwarders to the network

JonDonym/JAP/AN.ON



E-Mail anonymisation

- Intention is especially hiding the sender address, not only the IP it was sent from
  - → Chaining remailers increases privacy
  - → Encryption can be used to render eavesdropping useless
    - » Encryption can be hop-by-hop or layered
  - → Random delays are possible here (asynchronous comm.!)
- Problems:
  - → Length attacks (correlating input and output length) possible
    - » 756 Bytes in and 756 Bytes out → Same message
      - – Random padding can be used
  - → E-Mail content can render the anonymisation meaningless
    - » "Send products to …", signatures, metadata in attached files etc.

E-Mail anonymisation: Replies

- Depending on the system, answers might be possible
  - → Some systems: Reference lists (Sender ⇔ pseudonym)
    - » But these are then in danger of break-ins or official searches!
  - → Staged encryption
    - » Sender encrypts it three times, each forwarder "removes" one level of encryption
    - » Works for replies as well: Each stage adds one encryption layer
    - » Problem: Last hop still must know the original sender
      - – But: This need not be the same computer who was sending the original message this is the reply to
      - – No intermediate server knows the final destination E-Mail address
      - – There is no association between message and its reply
    - » Still:: Controlling the "exit" node allows some information leaks
      - – Note: The content may still be encrypted!
      - – But: "Forward" messages will usually/often be unencrypted!

Secure deletion of data

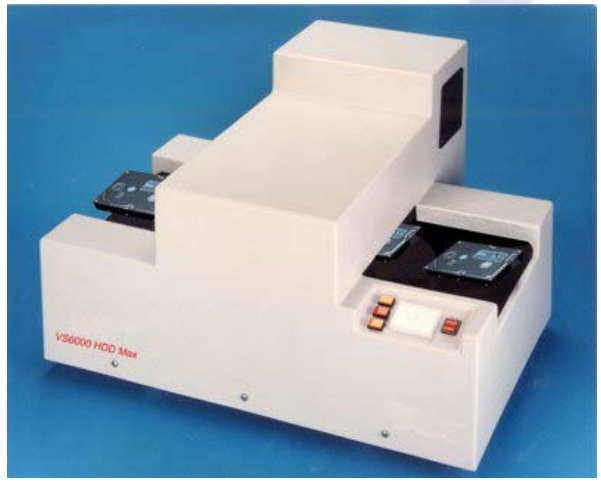
- Possible according to various intentions:
  - → Just not visible: Delete with any file program
  - → Actually removed: Overwrite content with special programs
  - → Removed without traces: Overwrite also directory and slack
    - » Even better: Also overwrite remapped sectors
  - → Really deleted: Remove all traces of the previous magnetic orientation on the disk
    - » Degaussing (difficult for modern disks), physical destruction
- RAM content can also be recovered
  - → The longer a memory cell holds the same value, the better and the longer it will retain it after power-off
    - » Extreme cooling necessary; more a theoretical attack!
- CD-Roms, tapes: Shredding is the best method
- Note: Usually it is still detectable, **that** a drive was wiped!

Secure deletion of data

http://www.flickr.com/photos/gmccarroll/341892350/in/set-72157594453290733/

http://www.ontrack.at/degausser/

http://www.periphman.com/degaussing/degaussers/PD8400.shtml



http://www.degausser.co.uk/degauss/6000.htm

Wiping disks

- To avoid "normal" recovery by software tools, overwriting all data on the disk a single time is sufficient
  - → Magnetic Force Microscopy (MFM), etc. → Much more difficult to protect against, but also rather rare and expensive
    - » New article: Actually impossible (except very old/floppy disks)
- Different approaches to wiping exist:
    - » Attention: "All bits" need not be the same on physical surface!
  - → Single pass: Random data, all zeros, or all ones
  - → Triple pass: All Zeros, all ones, random data
    - » DoD standard 5220.22 M ("NISPOM")
  - → Seven passes: 1, 0, 1, 0, 1, 0, random
    - » Canadian standard
  - → 35 passes: 4 random, 27 special for RLL, 4 random
    - » "Gutmann standard"

http://www1.umn.edu/oit/security/assureddelete.html
http://www.cs.auckland.ac.nz/~pgut001/pubs/secure_del.html

Selecting the correct privacy level

- Privacy can be enhanced significantly in various ways
  - → But they are typically costly (money, time, effort, …)
- So not everything possible makes sense
- Typical tradeoffs include:
  - → Use secure wiping of disks with 1 pass
    - » Everything more is probably not useful: Are your systems so secure that there is no danger of infiltration by the secret service through other avenues (trojans, bribes, etc.)?
    - » Important for private persons and companies!
  - → There is no need for E-Mail anonymisation
    - » Only special cases: Tipping off press, repressive countries,…
      - – Special care needed to be really anonymous (beside anon-proxy!)
  - → Web anonymisation might be useful in rare cases
    - » Difficulty not to forget it: A single time without → No anonymity!
      - – Various plugins are also dangerous → Can reveal the local IP!
    - » In general, there should be no need!

Data retention

- Data retention according to the EU directive is rather "weak"
- It ensures the identifiability if the IP address is known
  - → Through the provider the computer can be identified
    - » Or at least the calling number for dial-in
      - – Which must be identifiable too!
  - → Not necessarily the actual user, i.e. within companies (NAT!)
- Internet E-Mail and Telephony
  - → Information to retain:
    - » Sender and recipient (caller and callee) are identified
    - » Date and time of checking/sending a mail respectively logging into the VoIP system are stored
    - » The Internet service used (i.e. provider, kind of service)
  - → Both is possible through the E-Mail/VoIP provider
    - » But **only this** provider must store, **not** the access provider!

Countermeasures against data retention

- Several general approached exist:
  - → Hide the IP address
    - » Impossible: Every computer MUST have one!
    - » But we can make it look like coming from a different one …
  - → Use "anonymous" sender/recipient IDs for E-Mail and VoIP
    - » Sender is no problem: Leave it out or invent it!
    - » Recipient: Not really possible; but we might masquerade …
  - → Use providers, where data retention doesn't apply
    - » The EU directive applies to the **EU** only …
      - – "Bullet proof" web hosting/ISP
  - → "Hide" the communication from the retention
    - » E-Mail and VoIP are the only ones under surveillance
    - » So use different ones!
- On the following pages various concrete examples are given
  - → Other are possible!
  - → These are just a few trivial ones!

Non-standard ports

- SMTP and VoIP traffic uses standardized ports
  - → But they can be changed manually to any other number!
- Problem: This only works within a closed user group
  - → No communication to or from "outsiders"
- Problem: These protocols can easily be recognized according to their content (HELLO - handshakes)
  - → But this would mean inspecting the content!
    - » Typically illegal (unless: police, secret service, …)
    - » Compared to just logging the "normal" ports this requires an extreme increase in computing power!
      - – Every single TCP connection must be checked!
- Note: This helps against "monitoring" E-Mail/VoIP by the access provider, which is NOT required!
  - → The closed group **MIGHT (legally!)** have to retain the data …

Alternative software

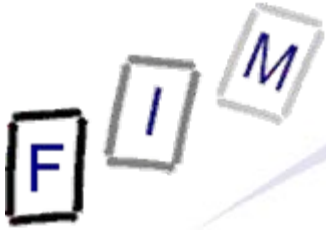
- Alternative software can be used:
  - → This might still qualify as "E-Mail" or "Internet telephony", but with direct communication between the participants there is no provider who would have to retain this information …
    - » Might also be excluded, as only defined protocols are probably stated to be monitored in the national laws
- Note: Chat is not E-Mail and not Internet telephony!
  - → No obligation for data retention at all …
- Problem:
  - → Not trivial to create
    - » But only some programming skills are required
  - → Complete traffic analysis would be necessary to detect

Encryption

- Use encryption to communicate with other persons
  - → This only works if there is no intermediate provider
  - → Direct communication to the recipient or outside the EU
  - → Result: No identification of the content possible at all
    - » Only that a certain communication took place →Alternative ports!
- Problems:
  - → Online searches can subvert this, as they are before/after the en-/decryption takes place

Conclusions

- Privacy is an important aspect in a free society
- Computer forensics must take great care, as very often the intention is to uncover personal data, the person it relates to explicitly wanted to keep secret
  - → Verification of the "permission" is very important
- Data retention will come to a certain degree
  - → But it is unrealistic that it will ever reach its goal: Terrorism!
  - → However, even very small misdemeanours could be included
  - → Additionally, data collected is data misused
- So there is sufficient reason for everyone to take some care and perhaps try to reduce the personal "footprint"!



Questions?

Thank you for your attention!