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Ensuring privacy

Computer forensics

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Agenda

- Personal data and computer forensics
  - → Disks, networks, …
- Anonymisation
  - → TOR
  - → JonDonym
- Secure data deletion
- Countering data retention

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-Mail → Perhaps 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!)

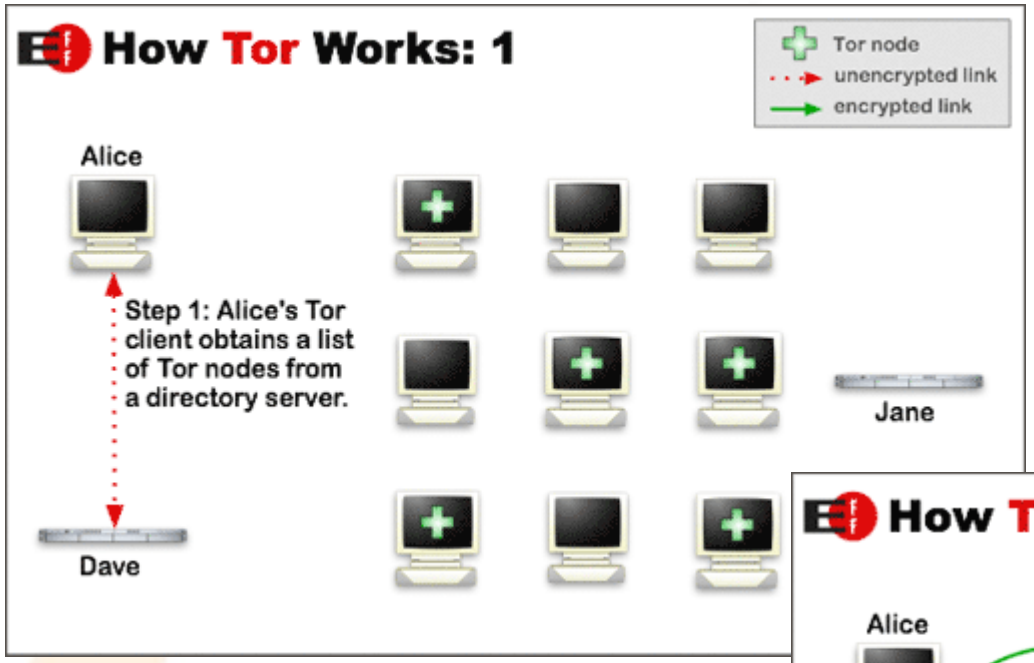
TOR (The Onion Router)

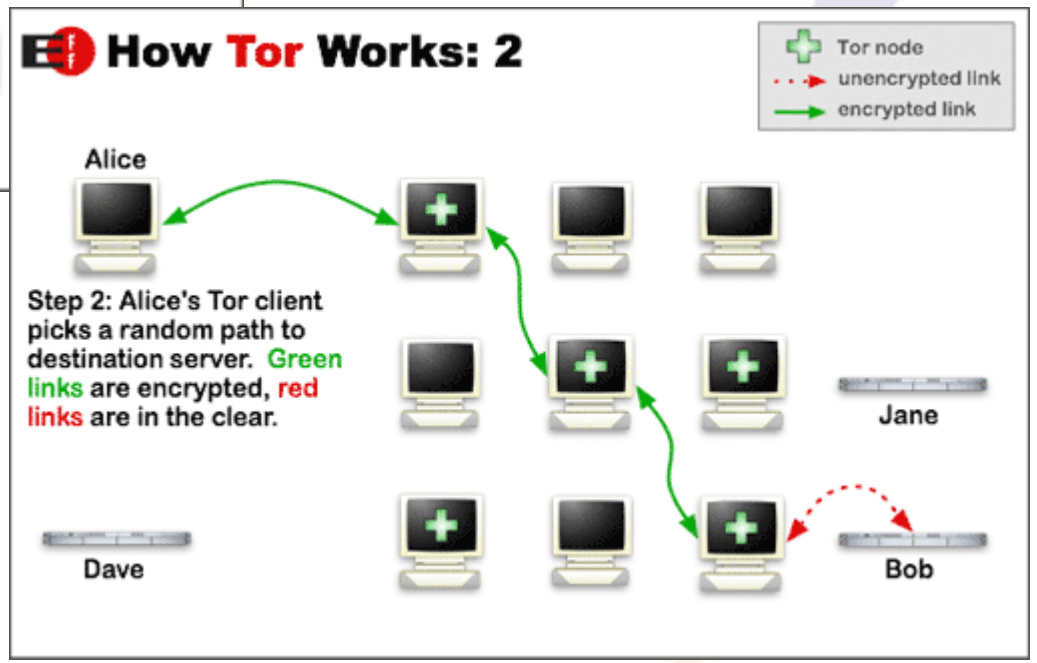
- TOR is a free TCP proxy
  - → All TCP traffic can be anonymized, not only web browsing!
    - » But E-Mail usually forbidden (proxy can decide, what to accept)
- How does it work:
  - → Each connection takes a random way over several nodes
    - » The next connection may use a different route!
  - → 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!
    - » Any proxy can modify the data which it forwards …
  - → 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)

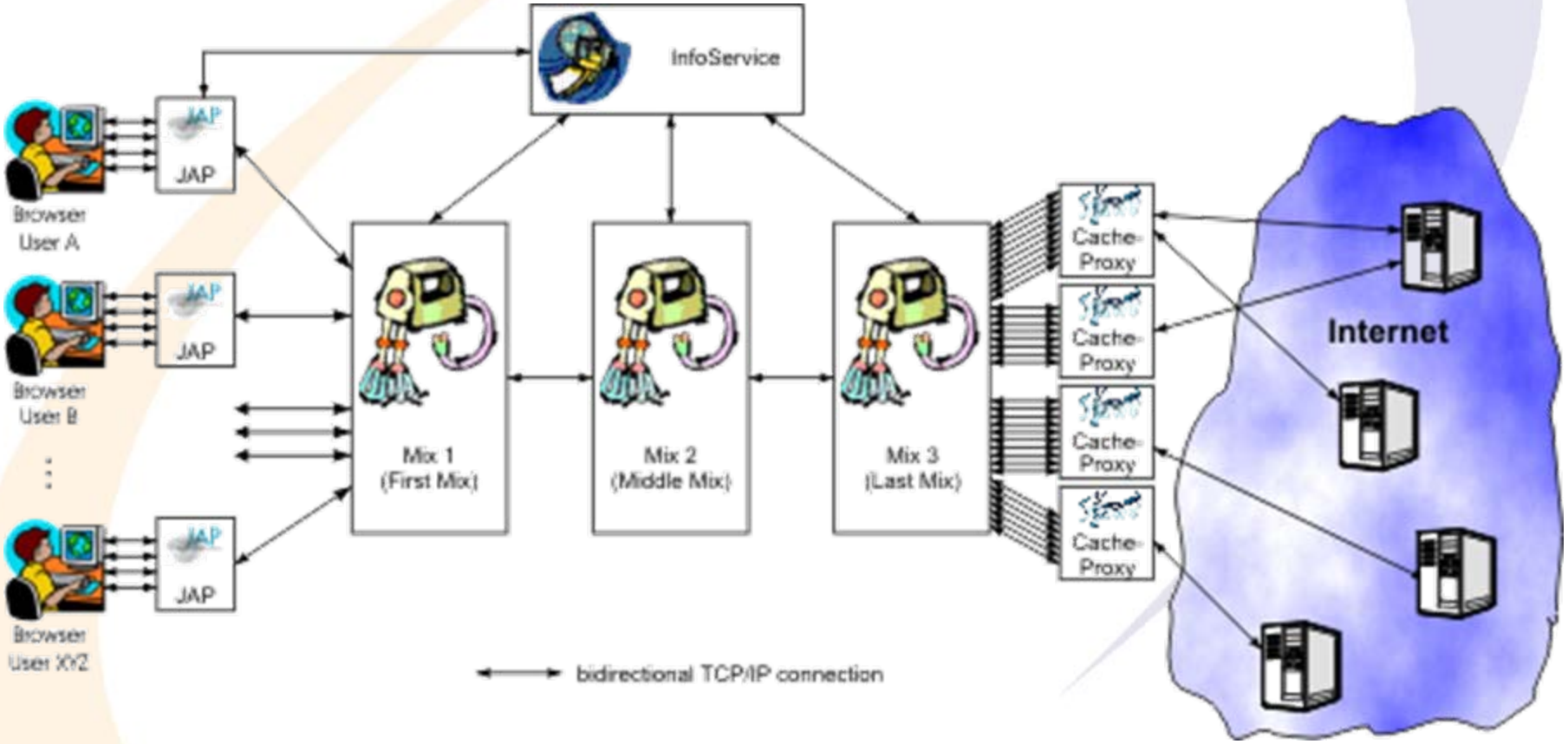




JonDonym/JAP/AN.ON

- 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!
- DVDs, 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, cookies, JavaScript can reveal the local IP as well!
    - » 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

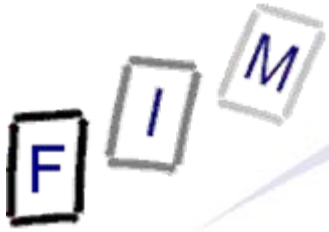
- Alternative software can be used:
  - → This might still qualify as "E-Mail" or "Internet telephony", but with direct communication between the participants there is no provider who would have to retain this information …
    - » Might also be excluded, as only defined protocols are probably stated 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

- 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 = data misused at some time
- 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!