Embeded security
MAC Address Anonymization

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10 December 2024

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- This project explores the implications of MAC address usage from both a privacy and legal perspective, focusing on potential risks and protection mechanisms.
- The goal is to understand how MAC addresses can be anonymized and what legal measures are in place to ensure data protection and respect for privacy.

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  - Used for communication within a network

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Bluetooth and MAC Addresses

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- BD ADDRs are also unique and can be used to track devices

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- Privacy protection techniques, such as MAC address anonymization

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  - Helps route data packets to the correct destination

What Does the Law Say?

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GDPR and MAC Addresses

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- Anonymized data is excluded from the scope of the GDPR, but anonymization must be irreversible

European Convention on Human Rights

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- Protection of personal data and the absence of violation of privacy are paramount

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- Re-identification of data requires suitable technical means and must avoid any risk to privacy

Belgian Law on Data Protection

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- Personal data must be anonymized before being consulted for historical, scientific, or statistical purposes
- Consultation of data is subject to strict conditions to prevent any breach of confidentiality and data protection

Risks Related to MAC Address

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- The main risk arises when a MAC address is tied to a specific location or time, such as connecting to a Wi-Fi network.
- The privacy risk increases when this data is recorded over time, enabling the tracking of individuals.

Internet Service Providers (ISPs)

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- This data can be used for network management, troubleshooting, and advertising.
- The use of MAC addresses for tracking or profiling purposes is generally prohibited under data protection regulations.

Audience Measurement Companies

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- Concerns arise when data is used for unethical purposes, such as surveillance or tracking without consent.

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- This type of profiling is often invisible to users but constitutes a significant invasion of privacy.

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- Usage patterns such as connection duration or frequency can link a temporary address to its original one.
- This compromises the effectiveness of anonymization and exposes users to risks if data is leaked or poorly secured.

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- Spoofing illustrates the limitations of using MAC addresses as secure identifiers.

Anonymizing a MAC Address

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  - May not be sufficient for higher anonymity as the remaining address part may still enable tracing.

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Salt: A random value added to the MAC address before hashing to enhance security, preventing attackers from using precomputed hashes.

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- **Recommended Encryption Scheme: DHIES**
  - Diffie-Hellman Integrated Encryption Scheme (DHIES) combines Diffie-Hellman key exchange and symmetric encryption (e.g., AES).
  - Suitable for systems needing high security with controlled access to the original MAC address.

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  - Key management can be challenging, especially in large systems.
  - Performance overhead due to encryption/decryption processes.

Notable Incidents

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Privacy Violation: Nordstrom

Nordstrom implemented technology to track customer movements in its stores through their Wi-Fi connections. The goal was to enhance the customer experience and optimize operations, such as adjusting staffing levels and rethinking department layouts. Sensors in stores collected information on the time customers spent in departments. However, after testing the technology, Nordstrom discontinued it in 2013 due to customer feedback, even though the data was intended to be anonymous and aggregated.

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- **Impact:** Although the technology aimed to be anonymous, it raised privacy concerns regarding the collection of customer movements.
- **Outcome:** Nordstrom decided to halt the use of the technology following the trial.

Google Street View: Data Collection

Since 2007, Google's Street View cars inadvertently collected data from open Wi-Fi networks while photographing streets. This raised concerns about the security of personal data transmitted over these networks. In an audit, Germany's data protection authority found that Google had gathered fragments of personal web activity. Although the data was never used in products, it highlighted vulnerabilities in unsecured Wi-Fi networks.

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- **Impact:** Google admitted to collecting personal data unintentionally.
- **Outcome:** Google halted the data collection and plans to delete the data under third-party supervision.

Phones with Wi-Fi On: Renew London Project

In the Renew London project, data was collected from over 530,000 unique devices to analyze movement patterns, directions, and speeds. The collected data was aggregated and anonymized, but it raised concerns about privacy violations under the Data Protection Act, as MAC addresses could be considered personal data.

- **Impact:** The project demonstrated the potential for targeted advertising based on location and behavior.

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- **Impact:** The project demonstrated the potential for targeted advertising based on location and behavior.
- **Outcome:** It is still unclear whether this data collection violated privacy laws, as the devices were not tracked individually.

WhatsApp Security Vulnerability

In 2012, a vulnerability in WhatsApp allowed attackers to impersonate users by obtaining their MAC address. The app relied on the MAC address for authentication, and attackers could exploit this by acquiring the MAC address via public Wi-Fi networks or malicious apps. Once in possession of the MAC address, attackers could log into WhatsApp as the victim and send messages.

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- **Impact:** The use of static identifiers like MAC addresses for authentication posed significant security risks.
- **Outcome:** WhatsApp strengthened its security by implementing end-to-end encryption and ceasing to use MAC addresses for user authentication.

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- Legal frameworks such as the GDPR and European Convention on Human Rights aim to protect individuals from misuse of their data.
- Various anonymization techniques, like truncation, hashing, and encryption, offer ways to mitigate these risks.
- Ensuring the security and privacy of data requires both effective technical measures and adherence to legal standards to safeguard users' rights.

Thank you for your attention

Questions?