HC3 Intelligence Briefing
Wearable Device Security

OVERALL CLASSIFICATION IS
TLP:WHITE

March 5, 2020
Agenda

- Overview
- Wearables in Healthcare
- Threats to Wearable Devices
- SweynTooth
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- Wearable Device Vulnerabilities Examples
- Application Vulnerabilities – Walkie Talkie
- Application Vulnerabilities - MyFitnessPal
- Wearable Device Best Practices
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- Conclusion

Slides Key:

Non-Technical: managerial, strategic and high-level (general audience)

Technical: Tactical / IOCs; requiring in-depth knowledge (sysadmins, IRT)
Overview

Wearable Technology (Wearable devices, wearables): electronic technologies or computers that are incorporated into items of clothing and accessories with can be comfortably worn on the body

- Can perform many of the same computing tasks as mobile phones and computers
- Considered part of Internet of Things (IoT) technology
- Often provides sensory and scanning features, such as biofeedback and tracking of physiological function
  - Features makes wearable technology particularly useful for health related activity
- Examples of wearable devices include watches, glasses, contact lenses, e-textiles and smart fabrics, headbands, beanies and caps, jewelry such as rings, bracelets, and hearing aid-like devices that are designed to look like earrings.

Wearable Technology Statistics

- Wearable technology and the health app market grew 84 million units in 2015 to 245 million units in 2019
- Revenue in the Wearables segment amounts to US$15,376m in 2020.
- Revenue is expected to show an annual growth rate (CAGR 2020-2024) of 3.8%, resulting in a market volume of US$17,856m by 2024.
- The average revenue per user (ARPU) currently amounts to US$43.09.
- In global comparison, most revenue is generated in China (US$4,800m in 2020).

Source: Statista, Wearabledevices, smartercx
The convenience and real-time data that wearable technology provides allows many medical industry, insurers, providers, and technology companies to incorporate them into their processes.

- Wearables store and transmit PHI-related data that is covered under HIPAA
- Despite security concerns, support for wearable usage in healthcare is overwhelmingly positive:
  - 90% of consumers would be willing to share personal data from a wearable device or app with a doctor
  - 63% would be willing to share data with their health insurance provider
  - 58% agree that wearables with feedback and alerts will provide personalized care
  - 62% agree that wearables will put people in control of their own health
  - 60% believe that wearables will lead to healthier lifestyles

Source: Medicaldevice-network, Businessinsider, wearable technologies, raconteur
Wearable benefits in Healthcare

**Personalization.** The doctor, with the help of a software can quickly create a program based on the needs of the patient

**Early diagnosis.** Precise medical parameters in the wearable devices allow early detection of symptoms

**Remote patient monitoring.** Healthcare professionals can monitor patients remotely and in real-time through the use of wearable devices

**Adherence to medication.** Wearable devices help patient to take medications on time and even inform medical professionals if the patient fails to adhere to medications

**Information registry.** The data are stored in real-time, allowing a more exhaustive analysis of the information. Results in a more complete and precise report on the patient’s medical history, which can be shared with other medical specialists.

**Optimum decision by the doctor.** The doctor is able to compare and analyze data to make a sharper clinical decision to enhance the patient’s quality of life.

**Saving healthcare cost.** Remote healthcare via wearable devices mean saving time and mobility, as it removes the need for the patient to be continuously transferred to the medical center.

**Health related wearable technology examples:**

**Fitness Tracker** – tracks physical activities and heart rate

**Electrocardiogram (ECG) monitors** – records electric signals in the heart to monitor heart disease, anxiety, etc.

**Blood pressure monitors** – can measure blood pressure and daily activity

**Wearable biosensors** (skin patches) – self-adhesive patch that collects data on movement, heart rate, respiratory rate, and temperature

**Smart glasses** – eyeglass that incorporate first person imaging, facial recognition, enhanced turn-wise directions, healthsensing, etc.

**Hearables** – hearing aids that incorporate functions such as sleep monitoring, brain wave analysis, and virtual assistant support.
Researchers disclosed the existence of 12 potentially severe security vulnerabilities, collectively named SweynTooth.

- The vulnerabilities specifically impact Bluetooth-enabled devices.
  - Caused by poor implementation of Bluetooth Low Energy technology on devices.
  - Used on 480 distinct products from vendors including blood glucose meters and MRIs
  - Consumer goods affected include consumer electronics, smart home devices, and wearables
  - Many used in the healthcare industry
- According to the report, hackers in close physical proximity to vulnerable devices can abuse this vulnerability to remotely trigger deadlocks, crashes, and even bypass security in BLE products, allowing them to arbitrary read or write access to device's functions that are otherwise only allowed to be accessed by an authorized user.

"The most critical devices that could be severely impacted by SweynTooth are the medical products. VivaCheck Laboratories, which manufacture Blood Glucose Meters, has many products listed to use DA14580,“ - Singapore University of Technology and Design Report

List of SweynTooth vulnerabilities
- Link Layer Length Overflow (CVE-2019-16336, CVE-2019-17519) — These allow attackers in radio range to trigger a buffer overflow by manipulating the LL Length Field, primarily leading to a denial of service attacks.
- Link Layer LLID deadlock (CVE-2019-17061, CVE-2019-17060) — These trigger deadlock state when a device receives a packet with the LLID field cleared.
- Truncated L2CAP (CVE-2019-17517) — This flaw results due to a lack of checks while processing an L2CAP packet, causing a denial of service and crash of the device.
- Silent Length Overflow (CVE-2019-17518) — A buffer overflow occurs when a certain packet payload with higher than expected LL Length is sent, the peripheral crashes.
- Invalid Connection Request (CVE-2019-19195) — When devices do not properly handle some connection parameters while the central attempts a connection to the peripheral, they could lead to Deadlock state.
- Unexpected Public Key Crash (CVE-2019-17520) — This bug is present in the implementation of the legacy pairing procedure, which is handled by the Secure Manager Protocol (SMP) implementation and can be used to perform DoS and possibly restart products.
- Sequential ATT Deadlock (CVE-2019-19192) — This flaw lets attackers deadlock the peripheral by sending just two consecutive ATT request packets in each connection event.
- Invalid L2CAP fragment (CVE-2019-19195) — Improper handling of the PDU size of the packets can lead to deadlock behavior.
- Key Size Overflow (CVE-2019-19196) — This overflow in the device memory issue is a combination of multiple bugs found during the pairing procedure of devices, resulting in a crash.
- Zero LTK Installation (CVE-2019-19194) — This critical vulnerability is a variation of one of the Key Size Overflow. It affects all products using Telink SMP implementation with support for secure connection enabled.
Wearable Devices Data Path

- PII Owner
- Healthcare Worker

Wearable Apps

Application Cloud

Healthcare Organization
(Patient Perspective)

Healthcare Organization
(Personnel Perspective)

EHR Cloud

Lack of Authentication
Lack of Encryption
Patching/Updating
Inadequate MDM Policies
No Regulation and Compliance
Poor Asset Management
Wireless/Bluetooth Weakness
Cloud Application Threats

PII Owner
Healthcare Worker

- Lack of Authentication
- Lack of Encryption
- Patching/Updating
- Inadequate MDM Policies
- No Regulation and Compliance
- Poor Asset Management
- Wireless/Bluetooth Weakness
- Cloud Application Threats
### Wearable Device Vulnerability Examples


<table>
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<tr>
<th>Wearable Devices</th>
<th>Security Vulnerabilities</th>
<th>Attacks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google Glass</td>
<td>Unsecure PIN system or authentication in place [11]-[12]</td>
<td>The gesture-based authentication scheme easily be recorded by people nearby</td>
</tr>
<tr>
<td></td>
<td>Privacy: pictures and videos can be recorded without user’s consent [11] and unauthorized eye movement tracking [13]</td>
<td>Eavesdropping and spyware</td>
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<td></td>
<td>It relies on QR codes for Wi-Fi setup [14]</td>
<td>QR photobombing malware.</td>
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<td></td>
<td>Unsecure network and hostile environment [15]</td>
<td>Wi-Fi-hijacking, man-in-the-middle attacks such as session hijacking or sniffing</td>
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<tr>
<td>Fitbit Devices [16]</td>
<td>Lack of authentication [17]-[23]</td>
<td>Data injection attack [22], Denial of Service (DoS) and battery drain hacks</td>
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<td></td>
<td>Leaky BTLE (Bluetooth Low Energy) technology [20-21]</td>
<td>It can be easily tracked.</td>
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<td></td>
<td>Privacy: Users location or places visited can be tracked [19]</td>
<td>Phishing.</td>
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<tr>
<td>Samsung Smartwatch</td>
<td>Authentication mechanism not secure enough [22]-[23]</td>
<td>Brute force attack [22]</td>
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#### Vulnerabilities found on medical wearable devices (2018)

**Digitsole Warm Insoles**

Vulnerabilities found:
- Exposes personal information
- Accesses location even when turned off
- Collects data about your Facebook profile.

Hackers could connect to the Insoles via Bluetooth and change the heat on the insoles to a hot temperature.

**Modius Headband**

Vulnerabilities found:
- Accesses location and fingerprint
- Reveals personal information about your body

Hackers could control the device to alter the electric current, causing nausea and general sickness.

**Ivy Health Kid’s Thermometer**

Vulnerabilities found:
- Exposes personal information
- Stores this information over insecure HTTP
- Collects data about names, data of birth, gender, temperature, etc.

Hackers could find and expose information about relationship of each child’s family.

Source: Semantic Scholar, Researchgate, VPN Mentor
In 2019 Web application security experts reported the presence of a vulnerability in the Apple Watch

- if exploited, allowed threat actors to spy on users of iPhone devices.
- The vulnerability was exploitable through Walkie-Talkie, an app installed on Apple Watch; due to this flaw, people could listen to calls on other users’ iPhone.
  - The **Walkie-Talkie app** allows two users to send and receive short audio messages; you need to accept an invitation before receiving the messages.
  - Apple disclosed that a user reported a vulnerability that allowed other users to listen through other people’s iPhone without their consent or knowledge.

When discovered, Apple disabled the function then released a security update to fix this issue.

- Apple also stated it was not aware of any use of the vulnerability against a customer and specific conditions and sequences of events were required to exploit it.

Source: Threatpost, Security Newspaper
In 2018, data of more than 150 million users of the MyFitnessPal app were stolen by hackers.

- MyFitnessPal is advertised as an app that tracks diet and exercise.
- The breached data includes usernames, email addresses, and hashed passwords.
  - It is still unknown who the breach is attributed to
- Under Armour, the owner of the app, claims no user financial information was compromised due to the breach.
  - The company also assesses the damage of the breach as moderate, as the app/company does not collect any government-issued identifiers.
- A year later, it was reported that the stolen credentials from the breach were showing up for sale on the darkweb.
  - The entirety of the breaches data along with stolen data from other websites was offered for sale.
    - Hacker’s price for all the data: Less than $20,000 in bitcoin

Source: Csonline, Fortune
Mitigation Practices: Wearable Devices

The HHS 405(d) Program published the Health Industry Cybersecurity Practices (HICP), which is a free resource that identifies the top five cyber threats and the ten best practices to mitigate them. Below are the practices from HICP that can be used to mitigate vulnerabilities in wearable devices.

<table>
<thead>
<tr>
<th>DEFENSE/MITIGATION/COUNTERMEASURE</th>
<th>405(d) HICP REFERENCE</th>
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<tbody>
<tr>
<td>Automate provisioning of endpoints and maintain mobile device management program.</td>
<td>[2.L.B]</td>
</tr>
<tr>
<td>Develop/maintain asset management program to include initial procurement through decommissioning.</td>
<td>[5.S.A - C], 5.M.A – D</td>
</tr>
<tr>
<td>Apply patches/updates immediately after release/testing; Develop/maintain patching program if necessary.</td>
<td>[7.S.A], [7.M.D]</td>
</tr>
<tr>
<td>Implement automated device discovery/maintenance program along with network access control.</td>
<td>[5.L.A - B]</td>
</tr>
<tr>
<td>Implement/maintain intrusion detection/incident response program covering wearable devices when possible</td>
<td>[1.S.A], [1.M.A]</td>
</tr>
<tr>
<td>Implement whitelisting technology to ensure that only authorized software is allowed to execute.</td>
<td>[2.S.A], [2.M.A], [2.L.E]</td>
</tr>
<tr>
<td>Conduct system hardening to ensure proper configurations.</td>
<td>[7.S.A], [7.M.D]</td>
</tr>
<tr>
<td>Implement medical device specific security endpoint protection and network access management program.</td>
<td>[9.S.A], [9.M.A and E]</td>
</tr>
</tbody>
</table>

Background information can be found here:
References

- Statista – Wearable Worldwide Statistics
  https://www.statista.com/outlook/319/100/wearables/worldwide

- Wearable Technology and Wearable Devices: Everything you need to know
  http://www.wearabledevices.com/what-is-a-wearable-device/

- Top Wearable Technology Trends and Health Apps to Look for in 2020

- Wearable Technology in Healthcare: What are the Leading Tech Themes Driving Change?

- Latest trends in medical monitoring devices and wearable health technology

- The State of Wearable Technology in Healthcare: Current and Future

- Wearable Healthcare Tech

- Electronic Pickpocket: Security Risks of Wearable Devices
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- 7 Potential Security Concerns for Wearables
  https://www.csoonline.com/article/3054584/7-potential-security-concerns-for-wearables.html

- 8 Security Threats Wearables Pose to Companies and Individuals
  https://www.vipre.com/blog/8-security-threats-wearables-pose-companies-individuals/

- A Dozen Vulnerabilities Affect Millions of Bluetooth LE Powered Devices
  https://thehackernews.com/2020/02/hacking-bluetooth-vulnerabilities.html

- SweynTooth: Unleashing Mayhem over Bluetooth Low Energy

- Assessment of Security Vulnerabilities in Wearable Devices
  https://pdfs.semanticscholar.org/c96a/9f626ef760ed2abe108a0ba8b020722cace5.pdf

- Wearable Technology Devices Security and Privacy Vulnerability Analysis
  https://www.researchgate.net/publication/303870892_Wearable_Technology_Devices_Security_and_Privacy_Vulnerability_Analysis

- Security and Privacy Flaws Discovered on Popular Wearable Devices

- Apple Disables Walkie-Talkie App Due to Eavesdropping Flaw
References

- Apple Watch Vulnerability Allows You To Spy On Your Friend's iPhone

- 150 Million MyFitnessPal Accounts compromised by a massive data breach

- Hacked MyFitnessPal Data Goes on Sale on the Dark Web – One Year After the Breach

- HHS 405d Program Health Industry Cybersecurity Practices
Questions

Upcoming Briefs

• SweynTooth
• Multifactor Authentication

Product Evaluations

Recipients of this and other Healthcare Sector Cybersecurity Coordination Center (HC3) Threat Intelligence products are highly encouraged to provide feedback to HC3@HHS.GOV.

Requests for Information

Need information on a specific cybersecurity topic? Send your request for information (RFI) to HC3@HHS.GOV or call us Monday-Friday, between 9am-5pm (EST), at (202) 691-2110.