# Zero-Day Attacks

## 11/18/2021

- What are Zero-Day Attacks?

- Famous Attacks Leveraging Zero-Days

- Zero-Day Trends

- Bug Bounty Programs

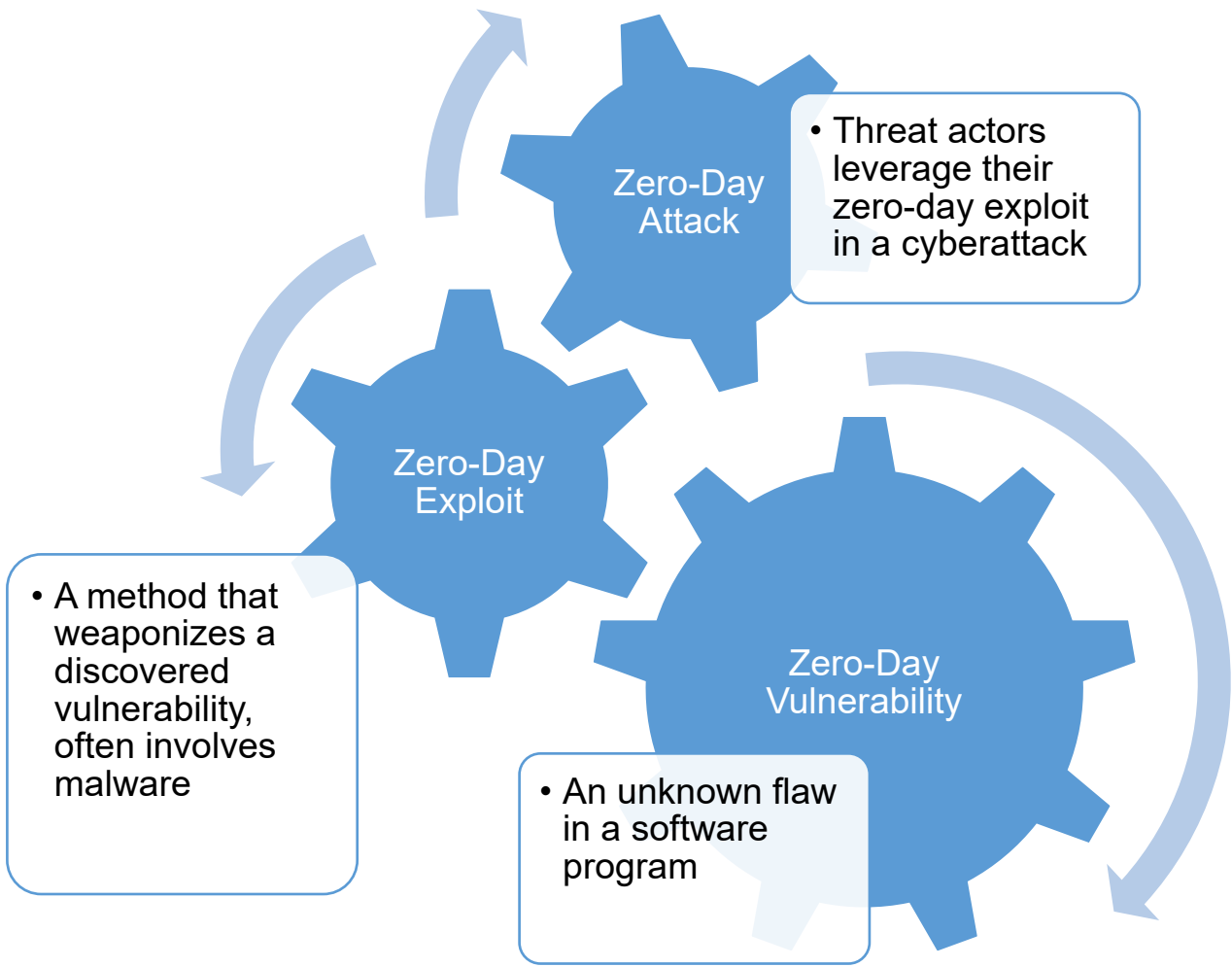- Impact on the HPH sector

- Mitigations

**Slides Key:**

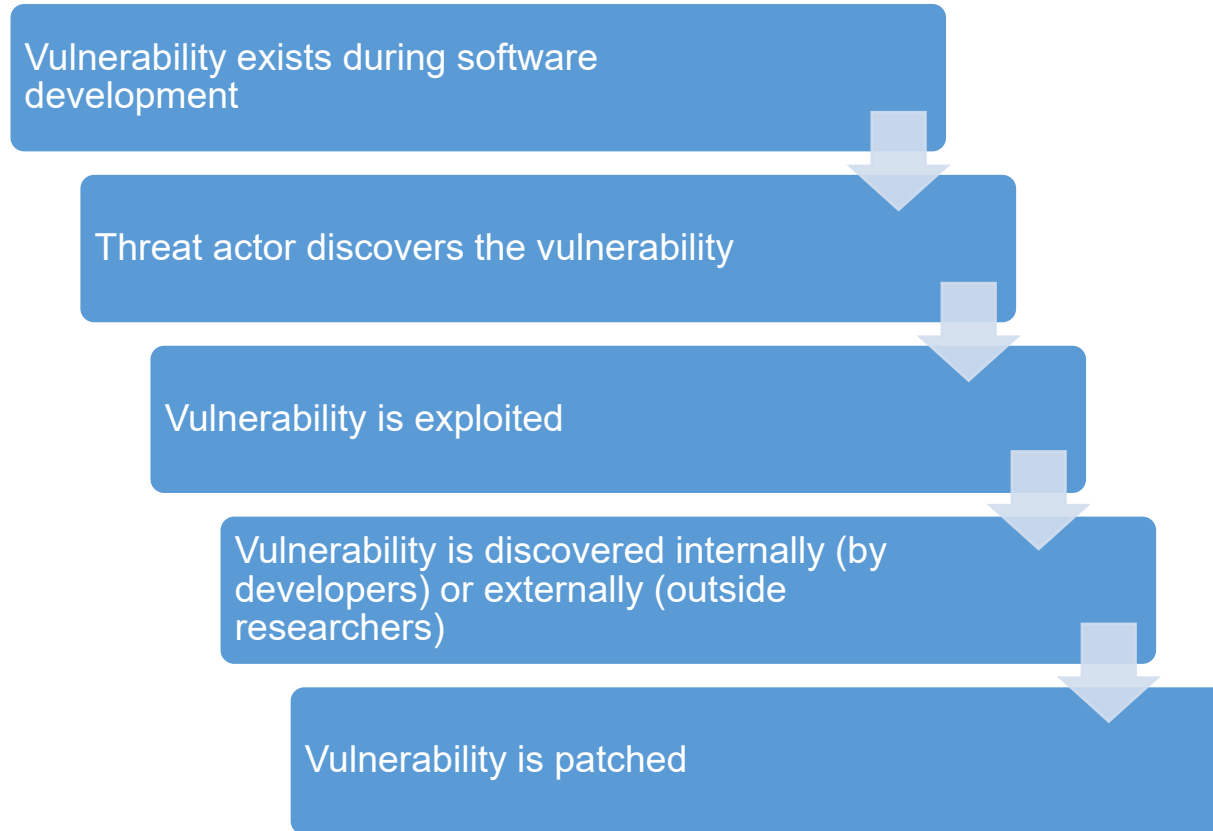**Non-Technical:** Managerial, strategic and high-level (general audience)

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

Zero-Day Attack
- Threat actors leverage their zero-day exploit in a cyberattack

Zero-Day Exploit
- A method that weaponizes a discovered vulnerability, often involves malware

Zero-Day Vulnerability
- An unknown flaw in a software program

- Collectively, a zero-day attack is a vulnerability that is exploited by threat actors before a patch is developed and applied.

- Because no time exists between when the vulnerability is discovered by developers and when it is exploited by threat actors, these vulnerabilities are called "zero-days".

Vulnerability exists during software development

Threat actor discovers the vulnerability

Vulnerability is exploited

Vulnerability is discovered internally (by developers) or externally (outside researchers)

Vulnerability is patched

- 2010 Stuxnet attack on Iranian nuclear program
  - Four zero-days
  - Successfully caused Iranian centrifuges to self-destruct, damaging Iran's nuclear program

- 2017 Dridex Trojan
  - Emails in this campaign used an attached Microsoft Word RTF (Rich Text Format) document and led to installation of the Dridex botnet on devices
  - Avoided common malware-blocking mitigations and did not require user interaction beyond opening the document
  - Patched on April 11, 2017

- 2021 SonicWall zero-day ransomware attack
  - UNC2447 used vulnerability in SonicWall SMA 100 Series VPN to deploy FiveHands ransomware
    - FiveHands, HelloKitty, and DeathRansom ransomwares are in the same family
  - Later exploited indiscriminately in the wild
  - SonicWall released mitigations in February 2021

- January 2021 HAFNIUM attack on Microsoft Exchange servers
  - Collection of four zero-days
    - Threat actors look for internet-accessible Microsoft Exchange servers using Outlook Web Access (OWA), then create a web shell to gain remote control of the compromised server
    - Once compromised, threat actors can steal an organization's data, gain unauthorized access to critical systems, elevate privileges, and move laterally to other systems and environments
  - Originally accomplished by Chinese state-sponsored group
    - Expanded to at least ten APT groups by mid-March, including six groups exploiting the vulnerability before a patch was created
    - Possible convergent discovery, more likely purposeful distribution
  - Affected over 100,000 mail servers
    - Targeted organizations included biotechnology, pharmaceutical, and healthcare entities
  - Patched in March 2021
    - Patch prevents new organizations from being compromised, does not solve existing infiltration

Surveyed approximately 400 IT and IT security practitioners located in the United States in 2019

**100%**
- The amount that new or unknown zero-day attacks were expected to increase from 2019 to 2020

**80%**
- The percentage of successful breaches that are new or unknown zero-days
- These attacks either involved the exploitation of undisclosed vulnerabilities, or the use of new malware variants that detection solutions do not recognize

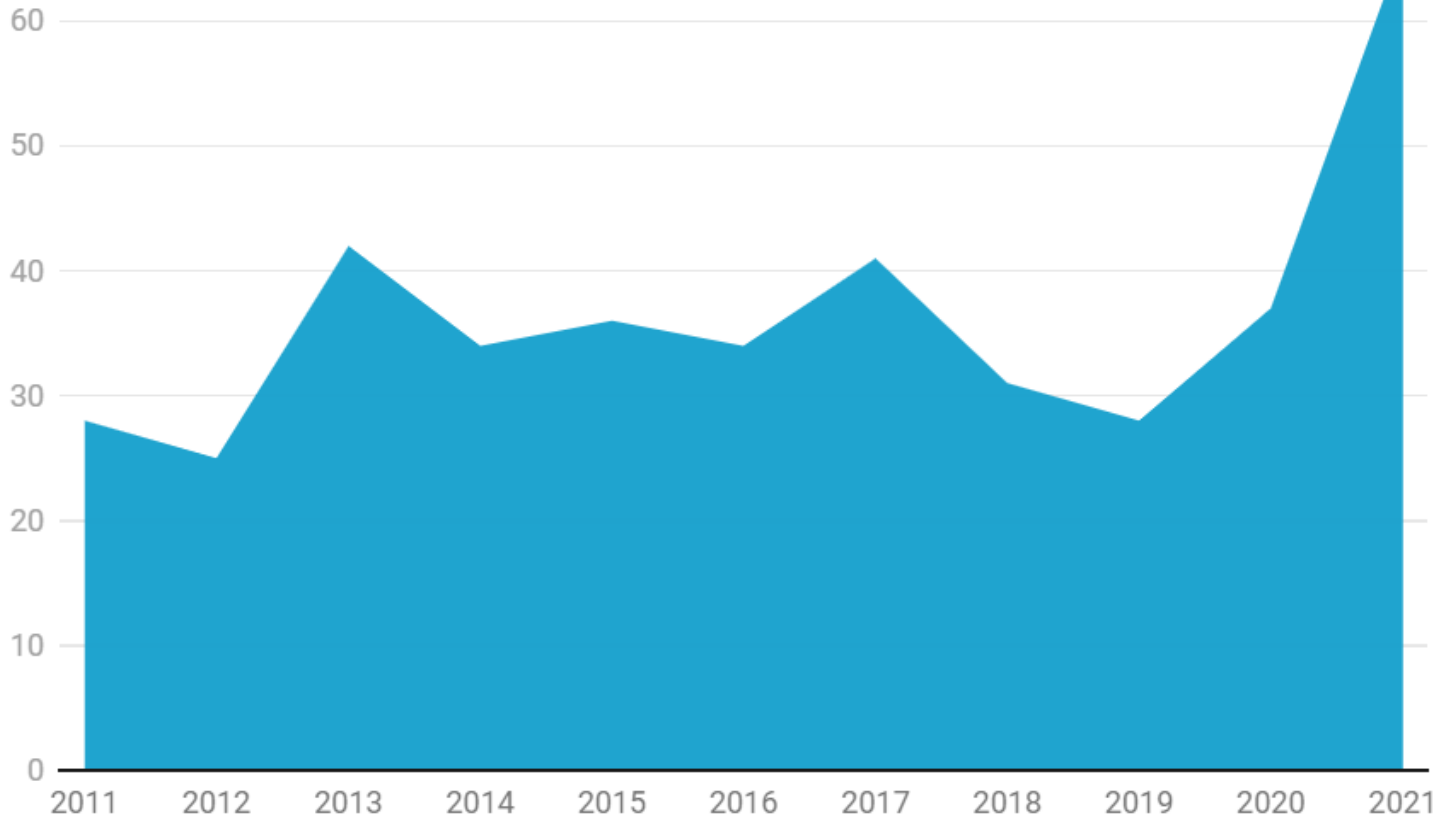**97 Days**
- The average time to apply, test and fully deploy patches

Chart: Patrick Howell O'Neill • Source: Zero-day tracking project • Get the data • Created with Datawrapper

More Zero-Days Used

More Zero-Days Identified

**More Used:**

- Zero-day exploits are incredibly valuable
  - >$1 million on open market
  - Zerodium's public zero-day prices shows as much as a 1,150% rise in the cost of the highest-end hacks from 2018-2021

- Market for zero-days is opening up
  - Previously limited to groups with deep pockets
  - "If you can't develop your own zero-days, store-bought is fine"

- **"Financially motivated actors are more sophisticated than ever. One-third of the zero-days we've tracked recently can be traced directly back to financially motivated actors."** – Jared Semrau, Director of Vulnerability and Exploitation at FireEye Mandiant
  - Zero-days can be leveraged into lucrative attacks, such as ransomware

- A single vulnerability can put millions of customers at risk

**More Identified:**

- Consensus of security researchers is that increased rate of detection is driving at least part of this trend

- **"Defenders have clearly gone from being able to catch only relatively simple attacks to detecting more complex hacks."** – Mark Dowd, founder of Azimuth Security.

- Increase in quality and availability of detection tools

- Private sector groups devote massive resources to the problem
  - Google's Threat Analysis Group (TAG)
  - Kaspersky's Global Research & Analysis Team (GReAT)
  - Microsoft's Threat Intelligence Center (MSTIC)

- Bug bounty programs provide financial rewards for turning in vulnerabilities rather than exploiting them

- Vendors may reward hackers directly for flaws with their products
    - In October 2021, blockchain technology company Polygon paid 2 million USD to an ethical hacker for his discovery of a flaw that would have allowed a hacker to make repeated double-withdrawals from their network

- Third parties may act as intermediaries between hackers and software companies
    - Examples: Zerodium and Zero Day Initiative
    - Can preserve security researcher anonymity and privacy
    - Acquiring company owns the rights to the zero-day exploit and any intellectual property
    - Resells information to affected vendors

- August 2021 discovery of zero-day vulnerability "PwnedPiper" affecting the pneumatic tube systems used by hospitals to transport medication, bloodwork, and test samples
  - Attackers could exploit flaws in the control panel software
    - Control panel allowed unsigned, as well as unauthenticated and unencrypted, firmware updates
    - Hard coded credentials could allow attackers access
    - Required physical access to the panel
  - "The Nexus Control Panel powers the stations on-premises. Once you compromise a station, without [needing] credentials, you can harvest any employee credentials to access these systems." – Ben Seri, Vice President of Research at Armis
  - Network segmentation can mitigate this vulnerability

- Zero-day attacks can be used both to target specific, high value targets or affect wide swathes of organizations through commonly used software
    - o Both pose substantial dangers to the HPH sector

- The most effective mitigation for zero-day attacks is patching, which can be difficult on medical IOT or legacy systems

- August 2020: Zero-day vulnerabilities in healthcare records application OpenClinic exposed patients' test results
    - o Developers were unresponsive to reports of four zero-days
    - o Due to lack of developer action, users were urged to stop using the open-source program
    - o Unauthenticated attackers could successfully request files containing sensitive documents from the medical test directory, including medical test results
        - ▪ Files must be requested by name

- Mitigating zero-day attacks completely is not possible – by nature, they are novel and unexpected attack vectors

- **Patch early, patch often, patch completely**
  - Security resources like HC3 can provide insight into active zero-days and available patches

- Implementing a web-application firewall to review incoming traffic and filter out malicious input can prevent threat actors from reaching security vulnerabilities
  - Analyzes traffic to and from applications, but not activity within applications
  - Requires considerable effort to monitor and "tune" to correctly identify malicious and non-malicious inputs

- Runtime application self-protection (RASP) agents sits inside applications' runtime
  - RASP's ability to detect anomalous behavior can prevent threat actors from executing zero-days

# Reference Materials

# References

- "What is a Zero-Day Exploit?" FireEye. October 28, 2021. https://www.fireeye.com/current-threats/what-is-a-zero-day-exploit.html

- "Dridex Campaigns Hitting Millions of Recipients Using Unpatched Microsoft Zero-Day," Proofpoint. April 11, 2017. https://www.proofpoint.com/us/threat-insight/post/dridex-campaigns-millions-recipients-unpatched-microsoft-zero-day

- Gatlin, Sergiu. "New ransomware group uses SonicWall zero-day to breach networks," Bleeping Computer. April 29, 2021. https://www.bleepingcomputer.com/news/security/new-ransomware-group-uses-sonicwall-zero-day-to-breach-networks/

- Abrams, Lawrence. "SonicWall SMA 100 zero-day exploit actively used in the wild," Bleeping Computer. February 1, 2021. https://www.bleepingcomputer.com/news/security/sonicwall-sma-100-zero-day-exploit-actively-used-in-the-wild/

- Deuby, Sean. "Timeline of a Hafnium Attack," Security Boulevard. May 5, 2021. https://securityboulevard.com/2021/05/timeline-of-a-hafnium-attack/

- Flesher, Michael. "Healthcare's Microsoft Exchange Critical Exposure," Meditology Services. March 15, 2021. https://www.meditologyservices.com/healthcares-microsoft-exchange-critical-exposure/

- Ponemon, Larry. "The state of endpoint security risk: it's skyrocketing," Ponemon Institute. May 2020. https://ponemonsullivanreport.com/2020/05/

- Ponemon Institute. "The Third Annual Study on the State of Endpoint Security Risk," Morphisec. January 2020. https://www.morphisec.com/hubfs/2020%20State%20of%20Endpoint%20Security%20Final.pdf

- O'Neill, Patrick. "2021 has broken the record for zero-day hacking attacks," MIT Technology Review. September 23, 2021. https://www.technologyreview.com/2021/09/23/1036140/2021-record-zero-day-hacks-reasons/

- O'Neill, Patrick. "This US company sold iPhone hacking tools to UAE spies," MIT Technology Review. September 15, 2021. https://www.technologyreview.com/2021/09/15/1035813/us-sold-iphone-exploit-uae/

- Haworth, Jessica. "Bug Bounty Radar // The latest bug bounty programs for November 2021," Port Swigger. November 1, 2021. https://portswigger.net/daily-swig/bug-bounty-radar-the-latest-bug-bounty-programs-for-november-2021

- "What Is Runtime Application Self-Protection (RASP)?" CheckPoint Security. November 1, 2021. https://www.checkpoint.com/cyber-hub/cloud-security/what-is-runtime-application-self-protection-rasp/

- "Zero-day (0day) exploit," Imperva. November 1, 2021. https://www.imperva.com/learn/application-security/zero-day-exploit/

- Goodin, Dan. "There's a vexing mystery surrounding the 0-day attacks on Exchange servers," Ars Technica. March 11, 2021. https://arstechnica.com/gadgets/2021/03/security-unicorn-exchange-server-0-days-were-exploited-by-6-apts/

- Bannister, Adam. "Zero-day vulnerabilities in healthcare records application OpenClinic could expose patients' test results," PortSwigger. December 2, 2020.

- Jackson Higgens, Kelly. "Multiple Zero-Day Flaws Discovered in Popular Hospital Pneumatic Tube System," Dark Reading. August 2, 2021. https://www.darkreading.com/vulnerabilities---threats/multiple-zero-day-flaws-discovered-in-popular-hospital-pneumatic-tube-system/d/d-id/1341584

# Questions

**Upcoming Briefs**

- 12/2 – FIN12 as a Threat to Healthcare

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## Products

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