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HHS CYBERSECURITY PROGRAM

OFFICE OF INFORMATION SECURITY



Unix/Mac/Linux OS Malware

10/15/2020



- Executive Summary
- Origin of Modern Operating Systems
- Overview of Operating Systems
 - Desktop
 - Servers
 - Super Computers
 - Mobile
 - Attack Surface and CVEs
- Malware Case Studies
 - Drovorub
 - Hidden Wasp
 - Operation Windigo
 - MAC Malware
- Defending Against Malware
- Summary

Slides Key:



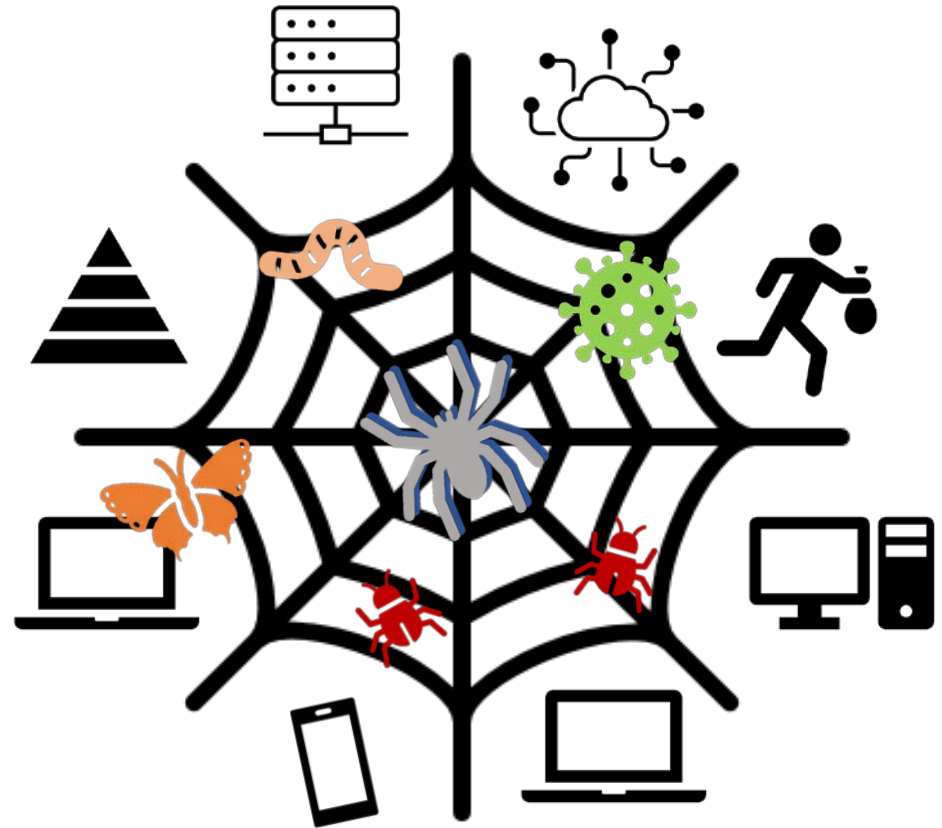
Non-Technical: Managerial, strategic and high-level (general audience)



Technical: Tactical / IOCs; requiring in-depth knowledge (system admins, IRT)



- Unix and Unix-like systems drive most of today's computer systems.
- Vulnerabilities and malware
- Threat mitigation
 - Comprehensive security policies
 - Access control
 - Regular updates and backups
 - Training employees
 - Improving posture and maturity





"Determining the operating system on which the server runs is the most important part of hacking. Mostly, hacking is breaking into the target's system to steal data or any such purpose. Hence, the security of the system becomes the thing of prime importance." Source: Parikh, K. (2020, August) *The Hackers Library*

Functions of Operating Systems

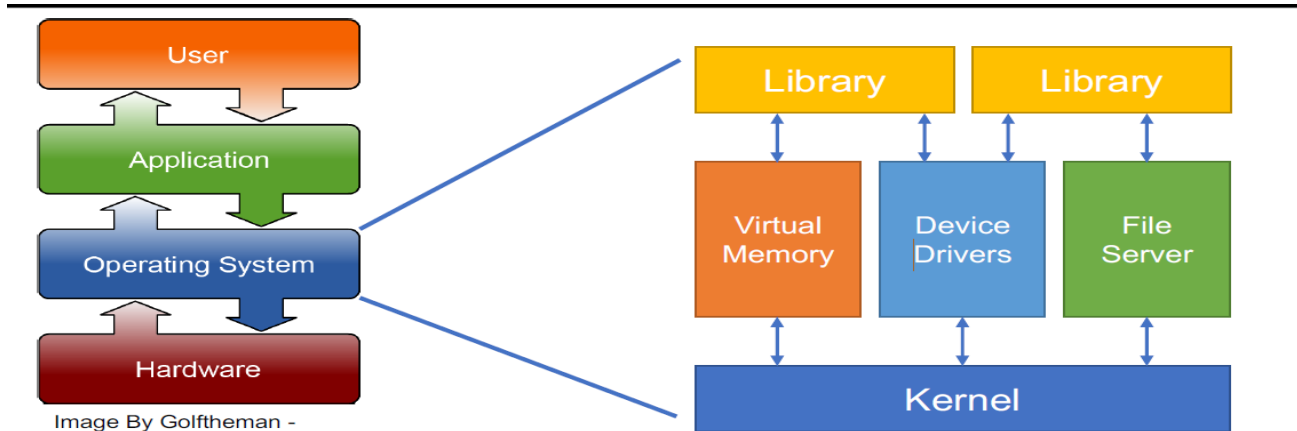
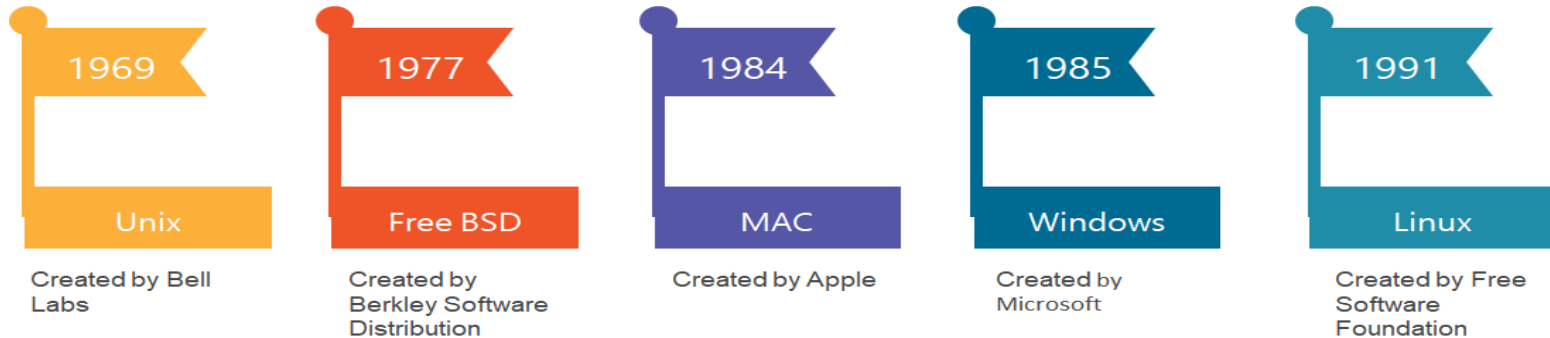


Image By Golftheman - <https://commons.wikimedia.org/w/index.php?curid=4558519>

Timeline of the Origins of Operating Systems





Unix

- Derived from Original AT&T Unix
- Command-line input
- Very popular among scientific, engineering and academic users
- Considered more stable than Windows
- Main frames, workstations, and supercomputers

Chrome OS

- Free and open-source
- Graphical user interface
- Based on Linux
- Efficient and easy to maintain
- Chromebooks, tablets, and Google Enterprise Network

BSD

- Free and open-source
- Based on Unix OS
- Most popular variant of BSD is Free BSD
- Not designed for personal computers
- Servers, workstations, gaming and embedded systems

Linux

- Free and open-source, but has proprietary variants
- Command-line input
- Based on Unix OS
- More efficient than Windows
- Supercomputers, workstations, web servers, endpoint security, embedded systems

macOS

- Proprietary to Apple
- Graphical user interface
- Based on Unix OS
- Second most-used OS for personal computers
- Apple computers and other products, some medical devices

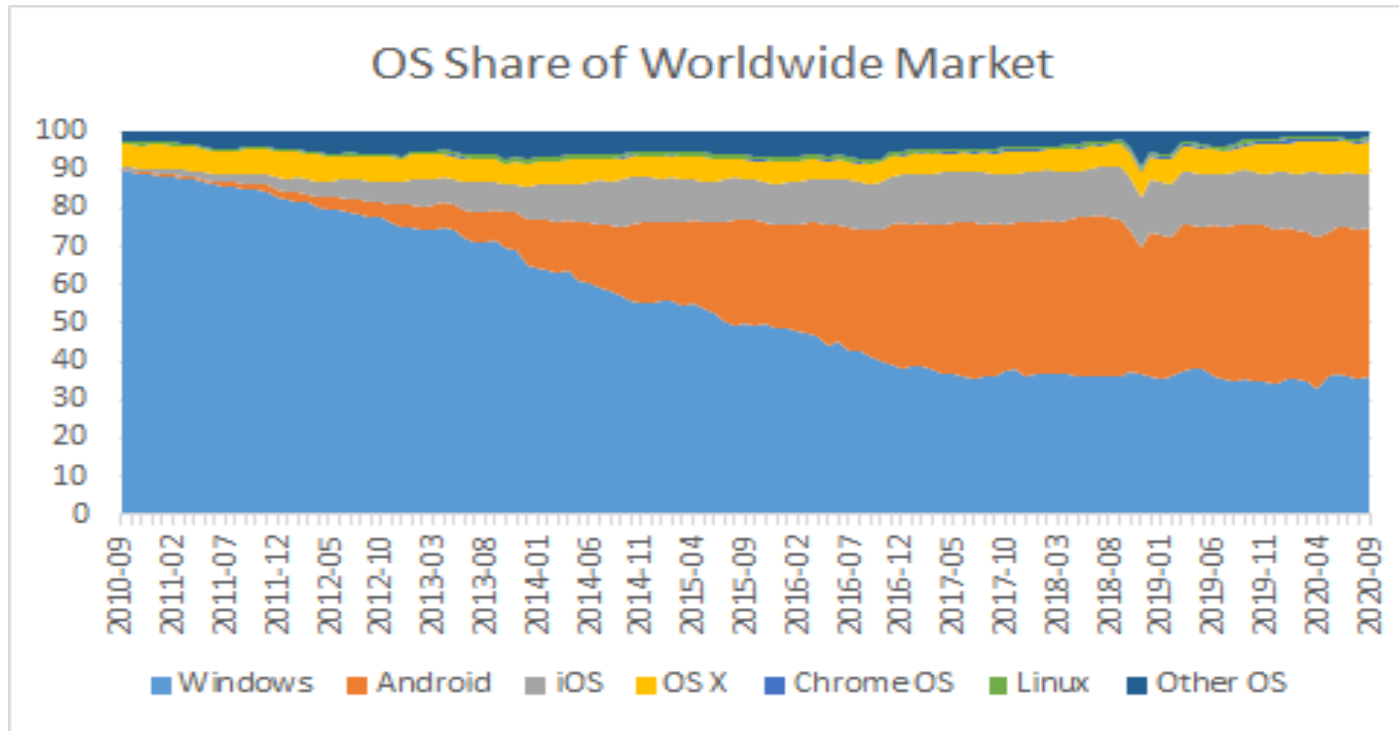
Windows

- Proprietary to Microsoft
- Graphical user interface
- Most-used OS for personal computers
- Computers, workstations, servers, endpoint security, embedded systems



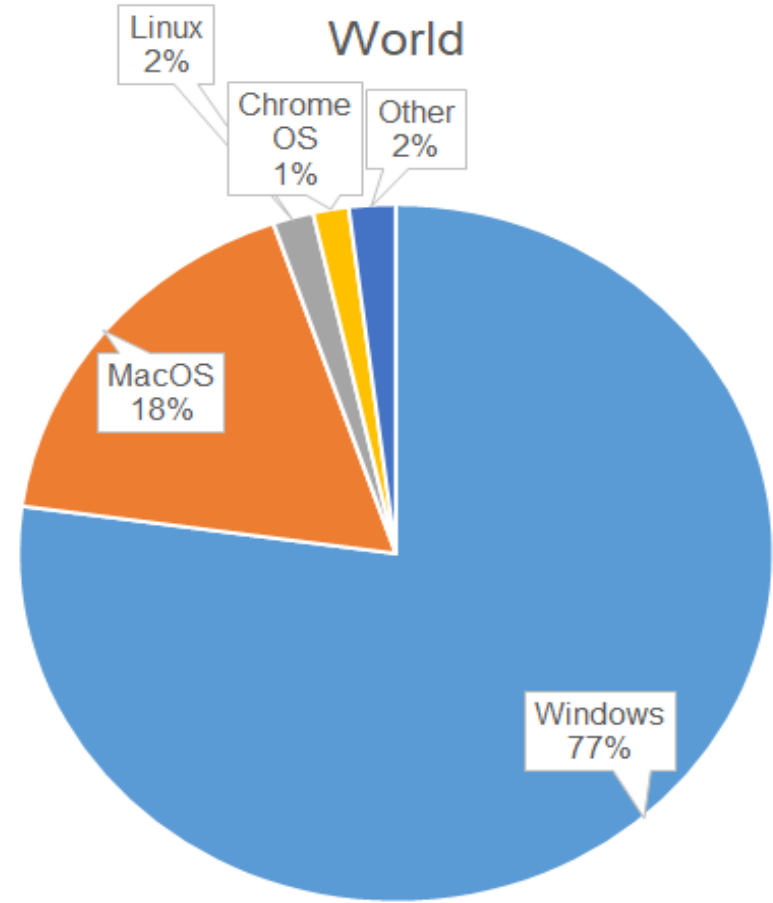
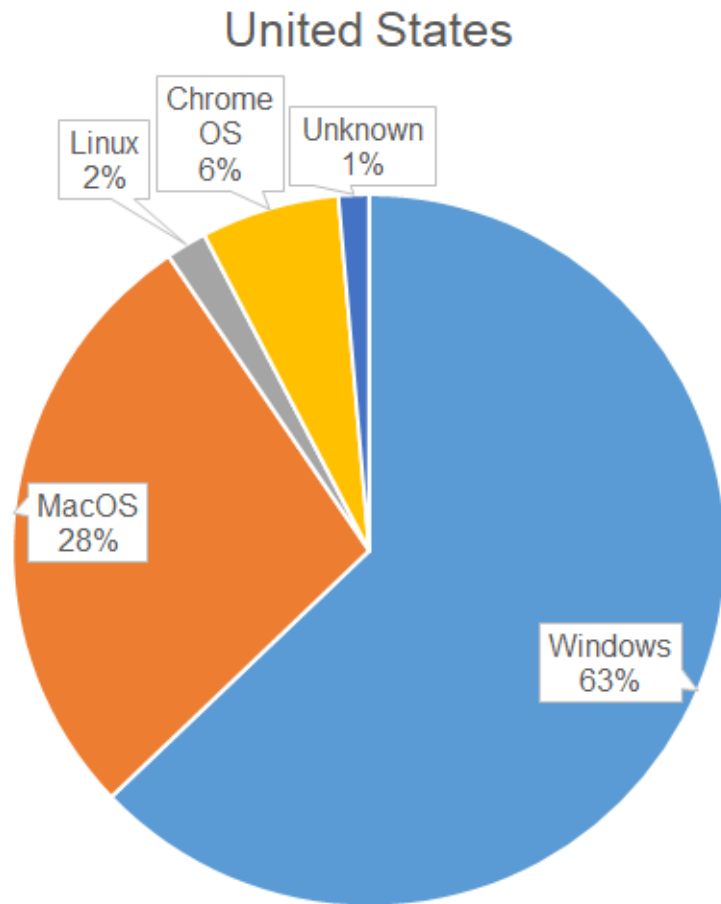


- Linux attack surfaces are growing with Linux/Unix, and BSD variants are used in about 66% of Internet web servers.
- Sales of Chromebooks, which run the Linux-based Chrome OS, grew in the U.S. by 127% between March and June 2020 compared to just 40% for Windows and Mac laptops.
- The Mobile Operating System market share is growing rapidly, as 76% of Internet users are expected to access the web solely via smartphone by 2025.



(Statcounter GlobalStats, 2020)



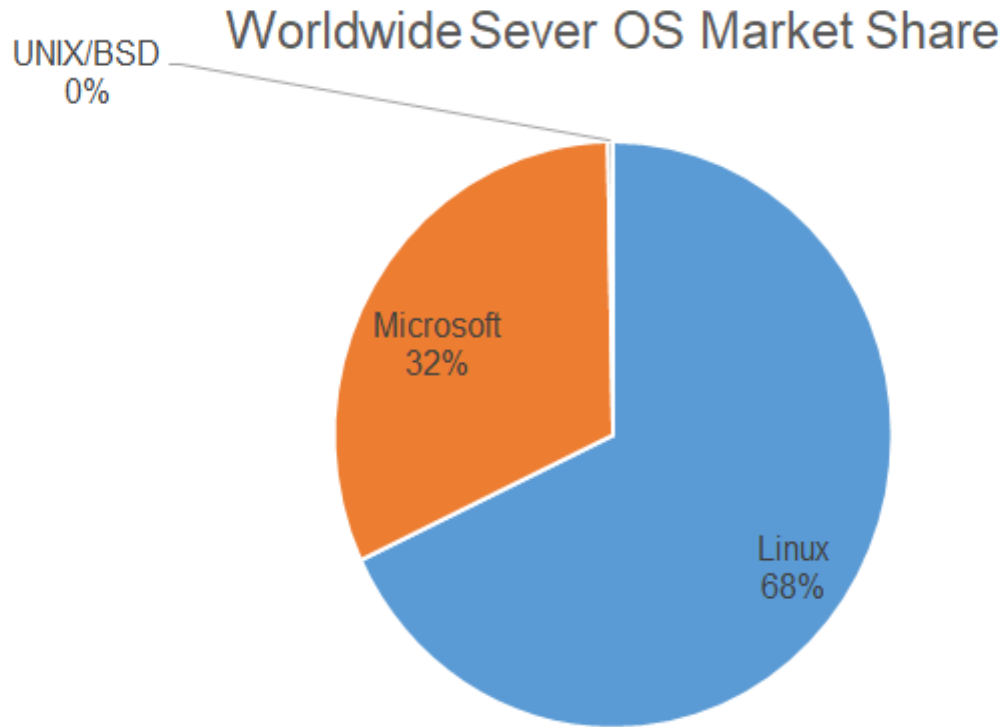


(Statcounter GlobalStats, 2020)





- Linux dominates the server market.
- Many web servers like Unix/BSD, Google Enterprise and Microsoft Azure Cloud use a Linux OS.
- Although Linux is free and open source, many Linux-based variants are not.
- Some paid-for variants include: Red Hat, CentOS and Gentoo. The variants Ubuntu and Fedora are free. Debian has a free version and a paid-for version.

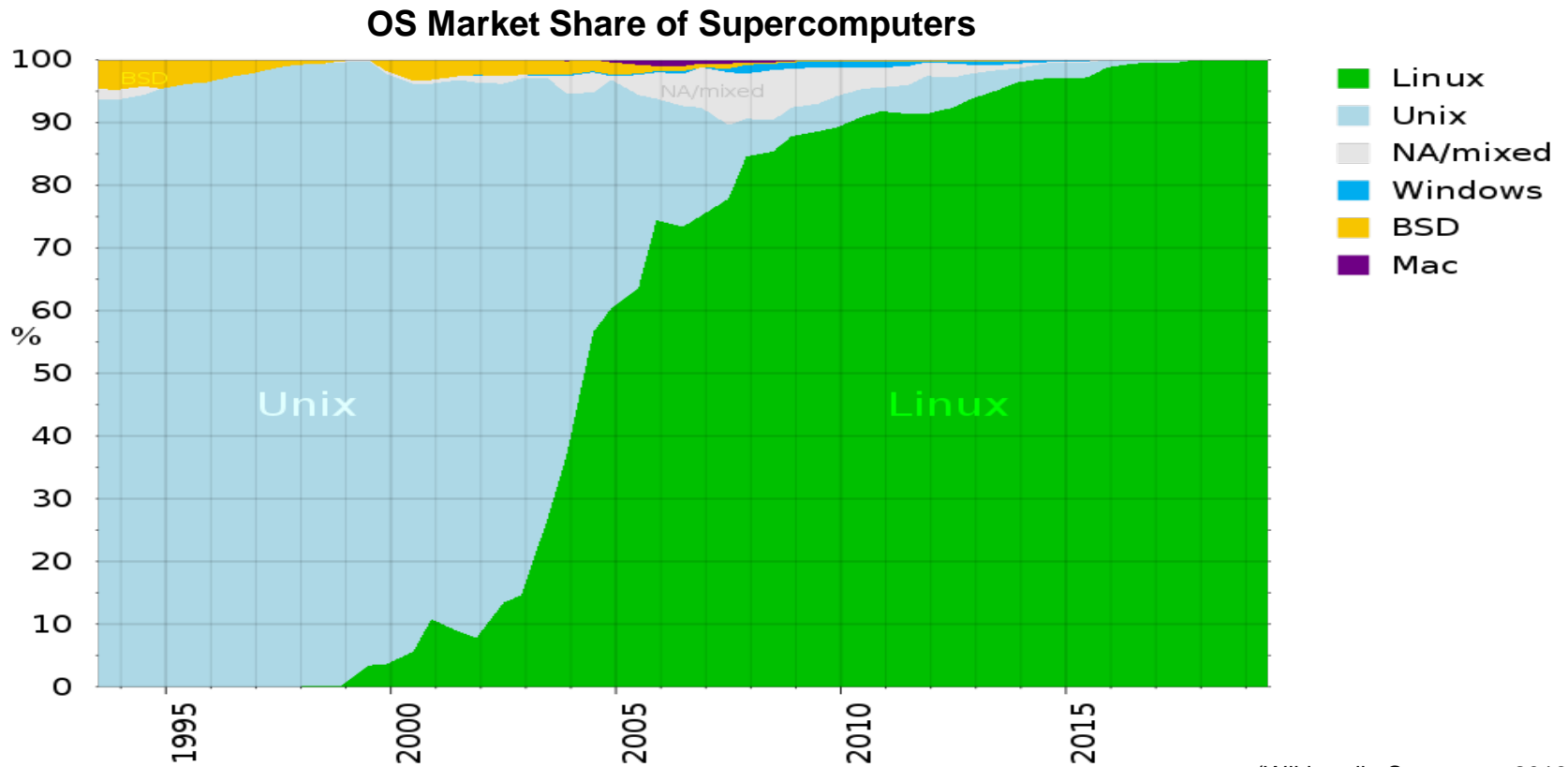


(Team, 2018) Source: Worldwide Operating Systems and Subsystems Market Shares, 2017, IDC, 2018 #U44150918





- Linux-based operating systems account for almost 100% of the supercomputer market; a market formerly dominated by Unix operating systems.



(Wikimedia Commons, 2019)





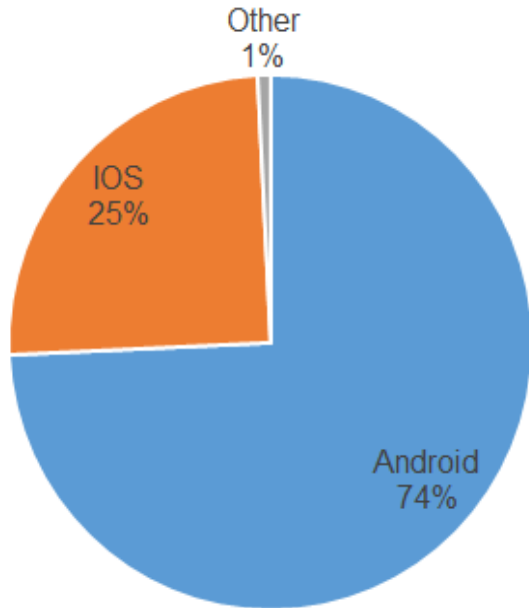
Android

- Established in 2008
- Google and the Open Handset Alliance
- Open source
- Based on the Linux kernel

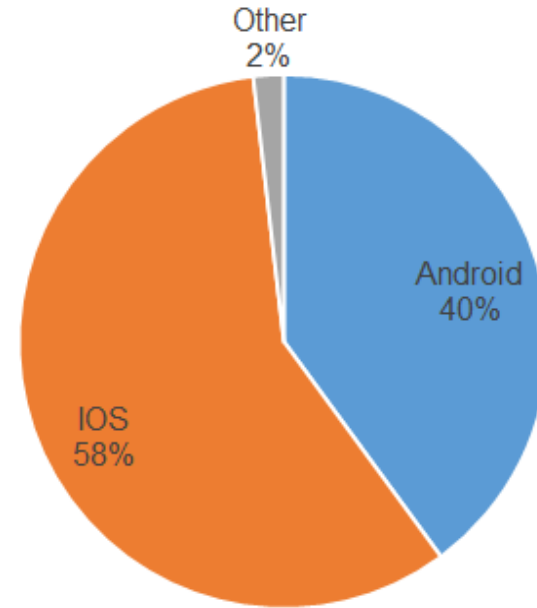
IOS

- Established in 2007
- Apple
- Proprietary
- Based on Apple's Darwin, a Unix and BSD variant

Worldwide Mobile OS Market Share



US Mobile OS Market Share

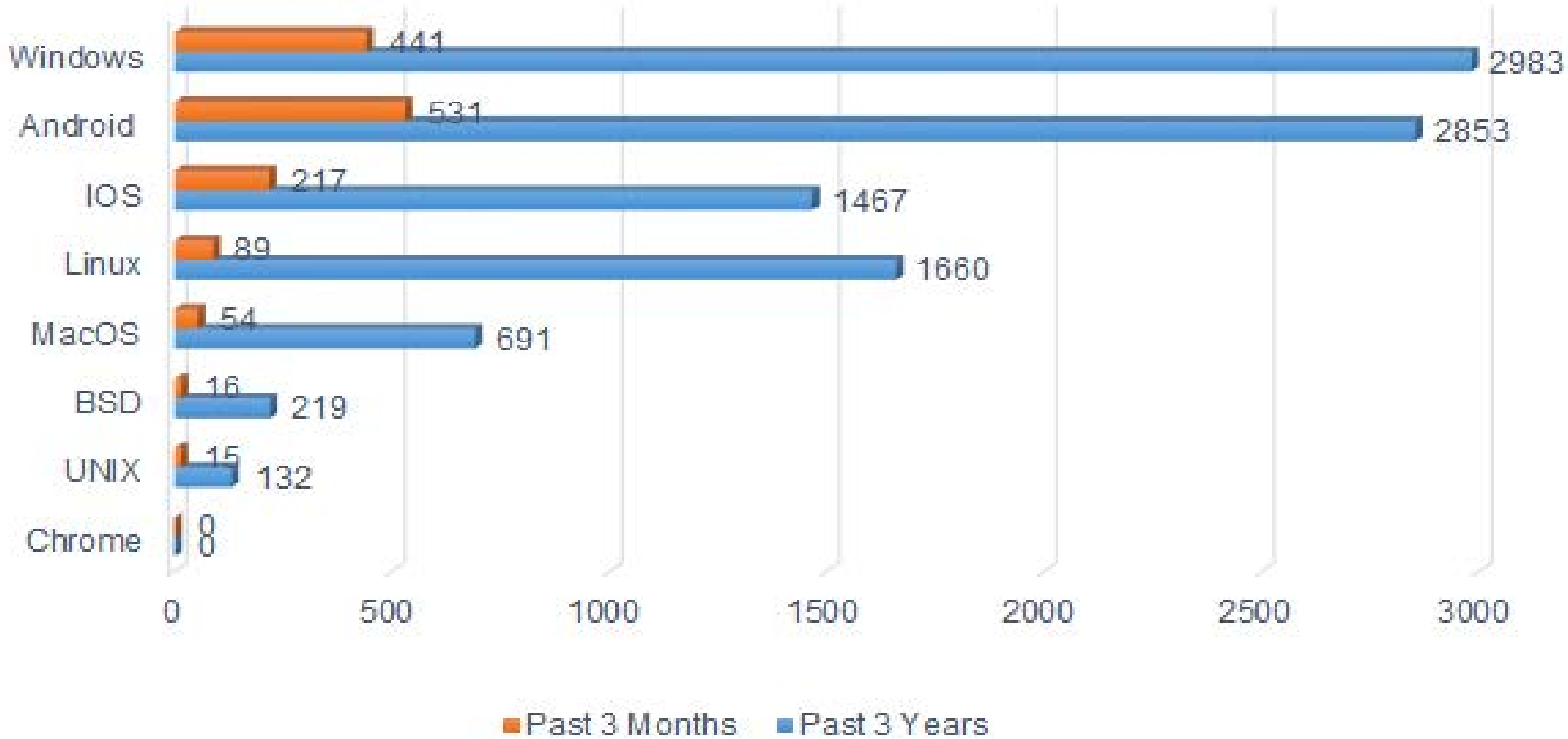


(Statcounter GlobalStats, 2020)





Number of CVEs

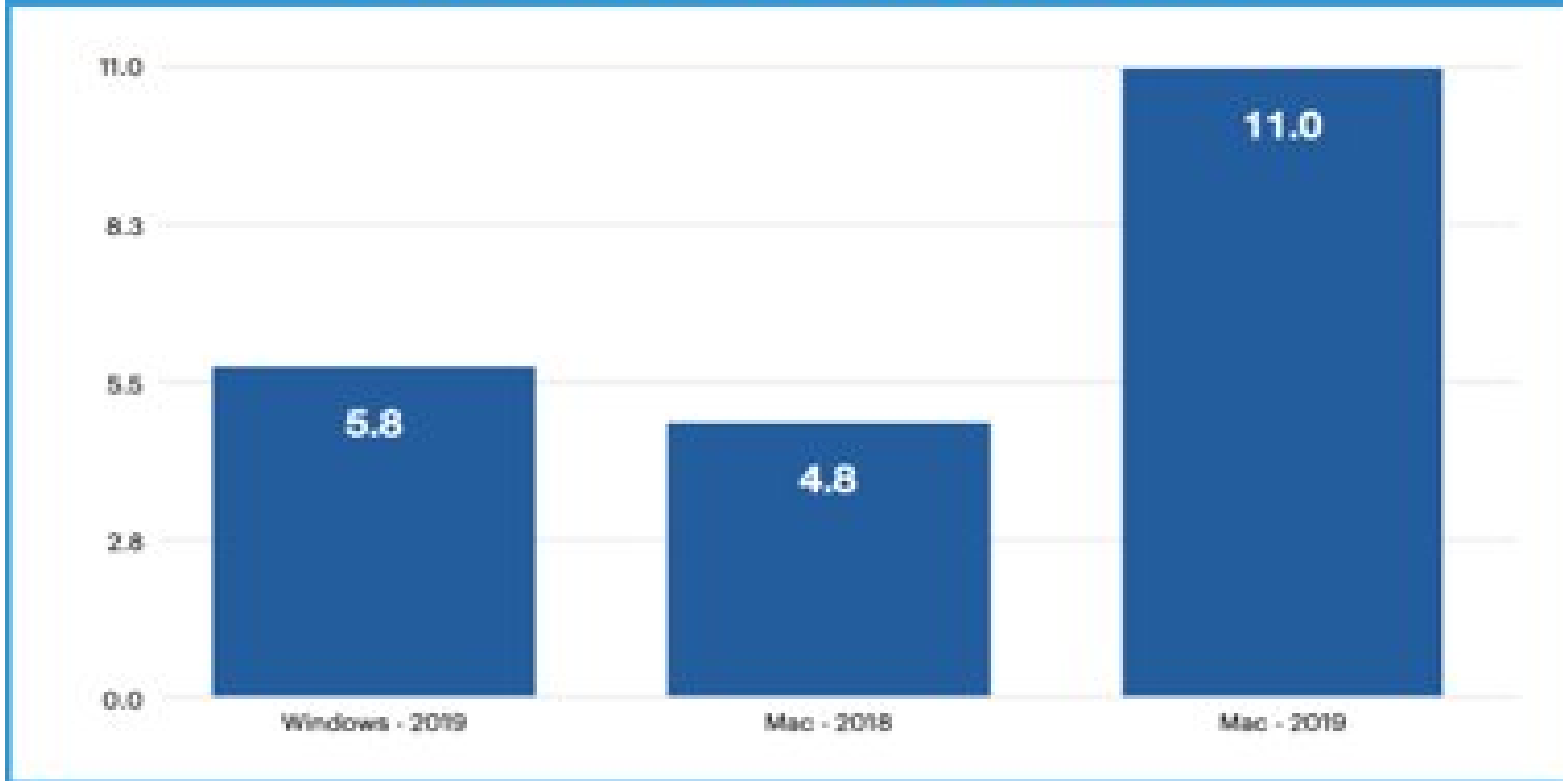


(National Institute of Standards and Technology, 2020)





Detections per endpoint 2018-2019

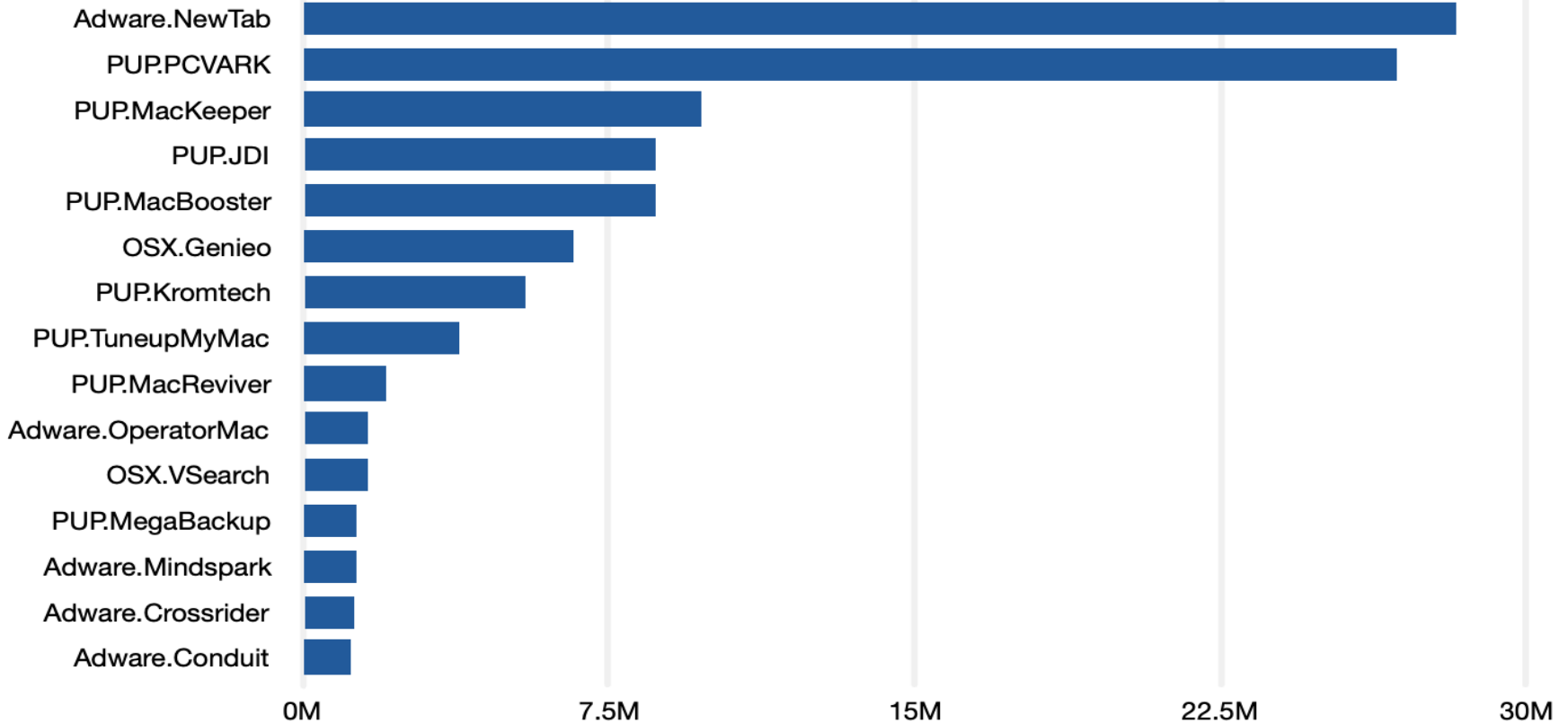


Malwarebytes 2020





Top Mac detections 2019



Malwarebytes 2020





Top Mac Malware Detections 2019

OSX.Generic.Suspicious

OSX.FakeFileOpener

OSX.FakeAV

OSX.BirdMiner

0K

100K

200K

300K

400K

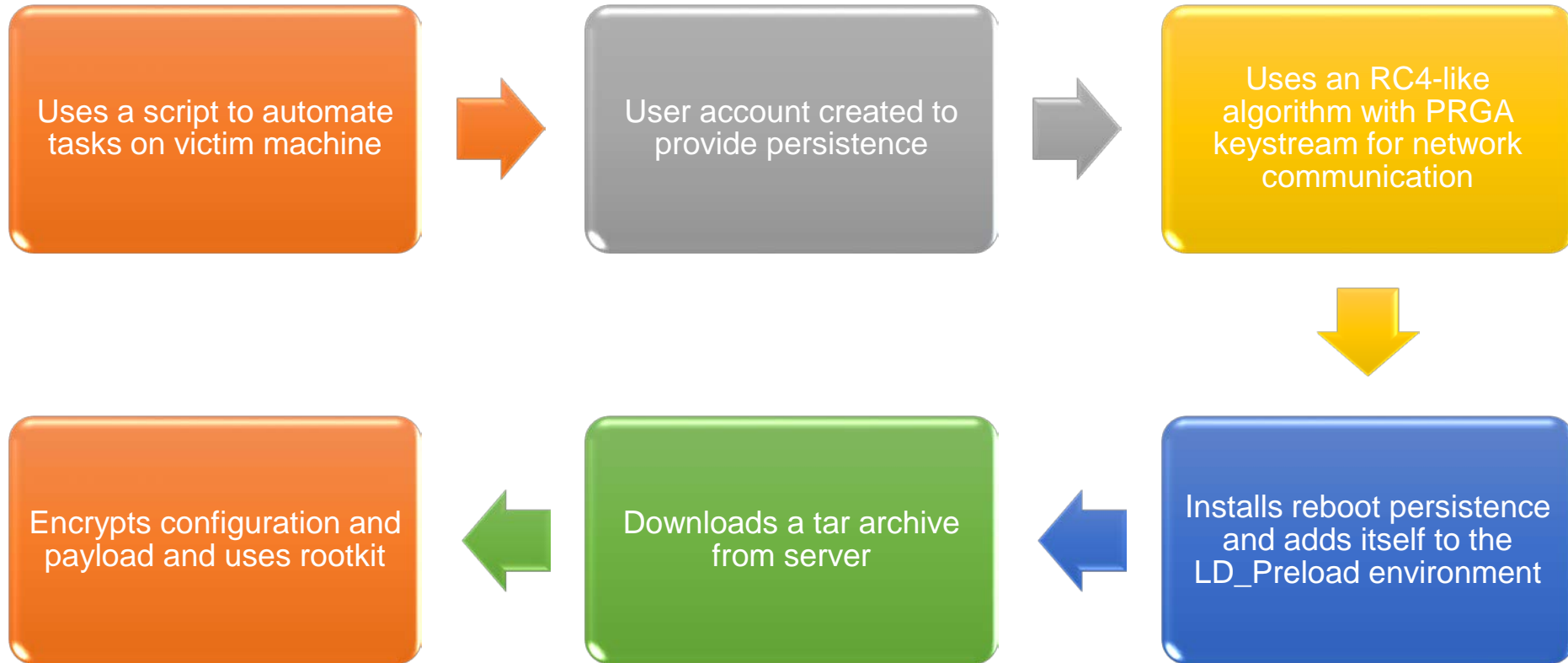
Malwarebytes 2020

iOS

- Nation-state malware, such as NSO Group's Pegasus spyware
- Zero-day vulnerability: Checkm8









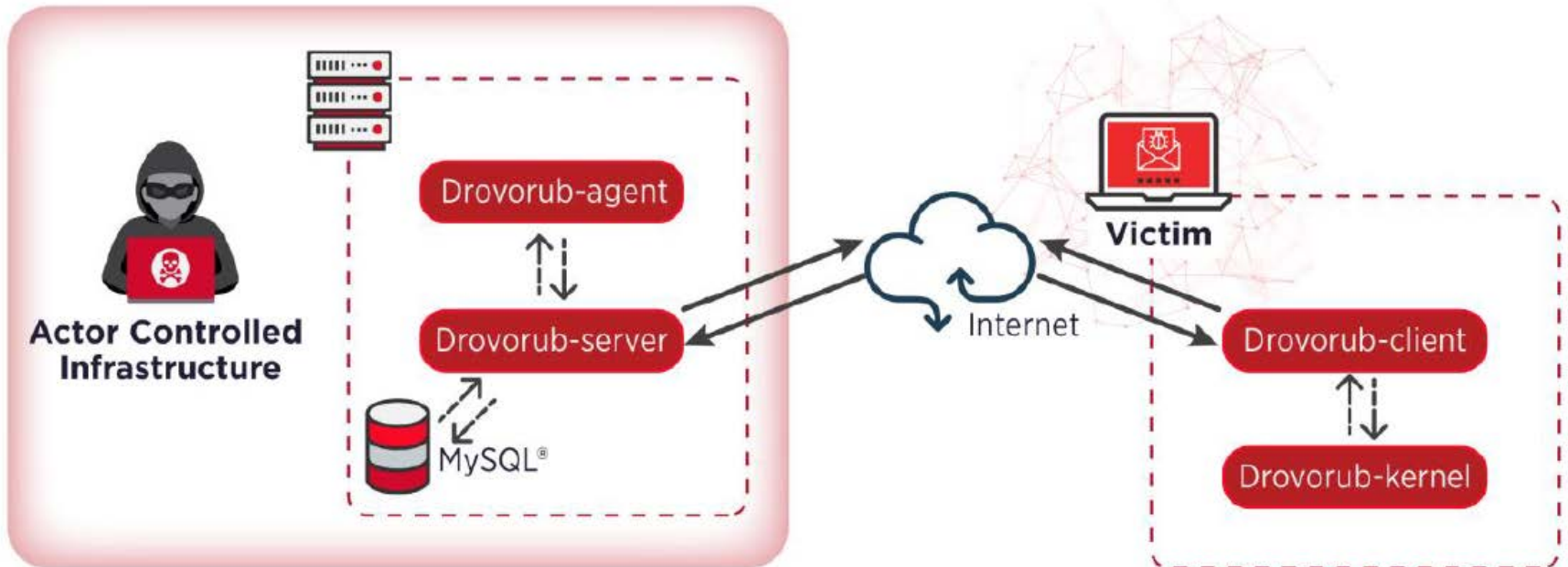
Linux malware attributed to Russian military group APT28

Requires the attackers to gain root privileges using another vulnerability before successful installation

Consists of an implant, rootkit, C&C server and a file transfer and port forwarding tool

Persists through a reboot of an infected machine





National Security Agency 2020



Key Findings

- Began in 2011
- Infected more than 500,000 computers and 25,000 servers
- Average of 35 million spam messages sent daily
- Over a half-million visitors to legitimate websites redirected to an exploit kit every day

Systems Compromised

- Apple OS X
- OpenBSD
- FreeBSD
- Microsoft Windows
- Linux

Malicious Activity

- Spam
- Drive-by download
- Advertisement fraud
- Credential stealing

Malware Used

- Linux/Onimiki: Resolves domain names to IP addresses
- Linux/Ebury: OpenSSH backdoor used to keep control of servers and steal credentials
- Linux/Cdorked: HTTP backdoor used to redirect web traffic
- Perl/Calfbot: Perl script used to send spam





- Windigo Suite (Eburl, Cdorked, Onimiki and Perl/Calfbot):
 - Disable direct root login in your OpenSSH daemon
 - Disable password-based logins and use an SSH key
 - Use multi-factor authentication on your servers
 - Use SSH agent forwarding from server to server instead of copying your SSH private keys on servers
 - On GNU/Linux, use SSH-agent
 - GNOME Keyring with ForwardAgent under a trusted host entry in your `.ssh/config` file⁶
 - On Windows, PuTTY's Pageant supports SSH agent forwarding
- Use an up-to-date antivirus solution





- Apply system updates to:
 - Operating system
 - Programs
 - All browsers
- Properly configure network detection and prevention systems/devices/firewalls/proxies
- Prevent untrusted kernel modules and load only modules with a valid digital signature
- Utilize a combination of system-hardening techniques and network-based controls
- Update Mac cybersecurity or anti-malware program from a reputable vendor
- Common tools such as rkhunter and chrootkit may be used to detect Linux rootkits
- Application control and software restrictions tools such as SELinux, KSPP, grsecurity MODHARDEN, and Linux kernel-tuning can aid in restricting kernel module loading
- Limit access to the root account and prevent users from loading kernel modules and extensions through proper separation
- Limit privilege escalation opportunities
- Restrict web-based content



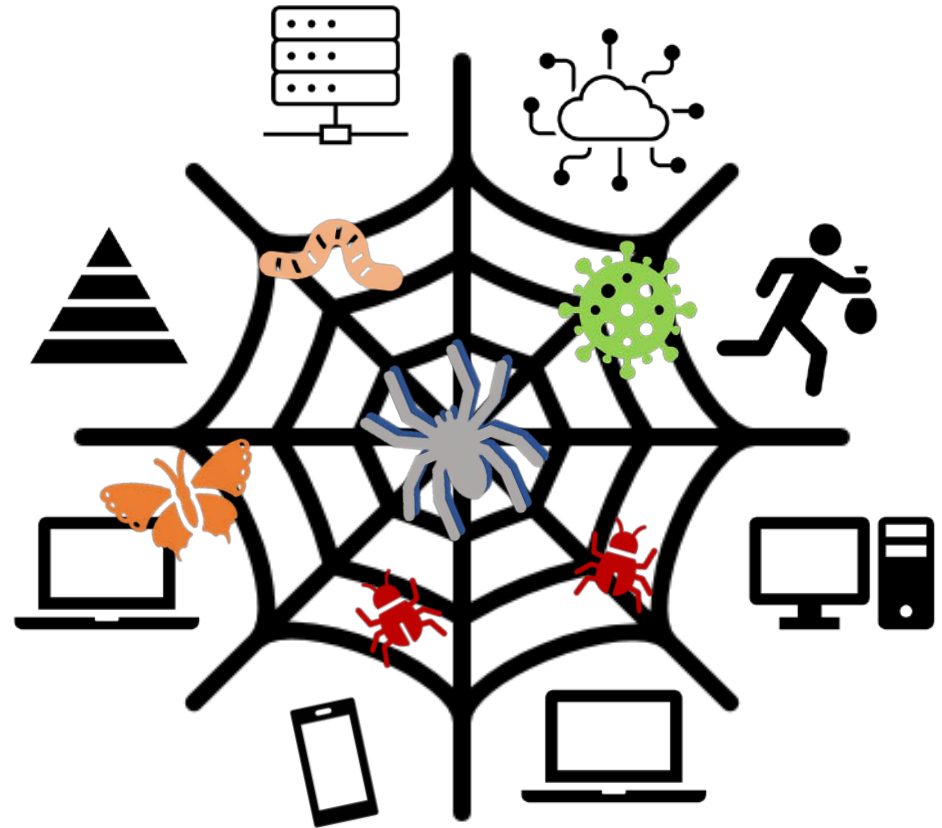
Recommendations and Mitigations

- Restrict PowerShell execution policy to administrators
- Block Command-and-Control IP addresses
- Use multifactor authentication for user and privileged accounts
- Limit the use of local administrator accounts
- SSL/TSL inspections to see the contents of encrypted sessions and look for network-based indicators
- Restrict file and directory permissions
- Do not allow loading of remote DLLs and enable Safe DLL Search Mode
- Ensure proper registry permissions are set





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Questions



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- Next briefing
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