CrowdStrike IT outage affected 8.5 million Windows devices, Microsoft says

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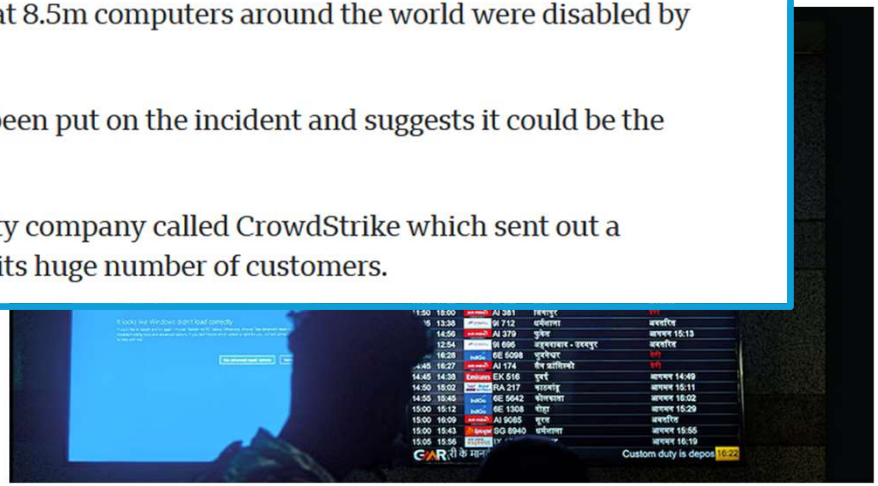
Cyber correspondent, BBC News

Microsoft says it estimates that 8.5m computers around the world were disabled by the global IT outage.

It's the first time a figure has been put on the incident and suggests it could be the worst cyber event in history.

The glitch came from a security company called CrowdStrike which sent out a corrupted software update to its huge number of customers.



What does CrowdStrike do?

Security systems primer

- **Intrusion detection**: Raises alerts on suspicious activity
  - Network-based: Based on network traffic
    - Malicious packets
    - Exfiltration activity
    - Command & Control (C2) presence
  - Host-based: Based on scanning/monitoring systems
    - Anti-viruses based on scanning files are the most basic kind
- **Intrusion prevention**: Drops malicious network packets
  - Firewalls are a basic kind of network filter

Endpoint Detection & Response

- Developed from anti-viruses
- **Telemetry**: instead of only scanning system files, also includes:
  - Registry changes
  - Process memory, including DLLs
  - Function hooking
  - Connections, ports
  - etc.
- Sends data from endpoints to **centralized processing**
- Provides visualization tools
- Gives alert score; can be configured to automatically respond
- **Live** instead of requiring regular scans

Endpoint Detection & Response

Function Hooking

- Redirecting a library function (usually syscall) to your program so that *all calls to the function go to your program first*
  - Use an event hook API, or just overwrite the library function
- Example:
  - Malware: Reads the process memory of another process to steal a password
  - If we hook the ReadProcessMemory function, we can catch this behavior
- Userland hooking can be **bypassed**… (Hitchins MalwareTech blog)
  - Malware can simply revert what you wrote (but you can scan files to detect it)
  - Malware can perform the syscall or the library function itself (but you can scan process memory to detect it)
  - Malware can call your hook in a clever way to jump over your code

Function Hooking

- Simply overwrite machine instructions with a jump to your code, then re-align the assembly code
- Replicate necessary functionality in your own code

Cat and mouse security game

- Key issue: malware and userland EDRs live on the **same (escalated) privilege**
  - They can overwrite each other's memory, including library calls
- However, EDR is the mouse…
  - EDR must be a *publicly* sold product
  - Malware is written *privately* and often only used once, especially in APTs
  - Malware author can test their code against known EDR, but EDR cannot test their code against future malware
- How can we break the cat and mouse game?

Kernel Mode EDR

- Instead of hooking functions from userland, EDRs can live in the **kernel** directly
  - Much harder to unhook/corrupt EDR functionality
- Write EDR as a kernel driver
  - Windows: since 2022, Early Launch Antimalware (ELAM) drivers can be run as Protected Process Light to ensure code integrity
- Downsides:
  - Application crashes become *system crashes*
  - EDRs also want to be **boot-start**, so a restart causes a permanent crash…
  - *What if the EDR is malware?*

Kernel Mode EDR, but Agile!

- ELAM drivers require a lengthy testing/certification process
  - WHQL release signature required for any **patching**
- **Agile** workaround for patching:
  - Write machine instructions (**p-code**) into configuration files
  - Our EDR is effectively just an interpreter for our configuration file p-code, so it does not need to be patched
  - We can arbitrarily change our EDR's behavior by changing configuration files
- We have circumvented lengthy kernel mode testing, with no potential downsides at all

Disaster

- Analysis according to Dave Plummer:
  - Channel File 0000291
  - Instruction: Read memory pointer in register r8, write to r9
  - Memory pointer was *corrupted*, appears to be caused by a file type mismatch
- Simple workaround: boot into **safe mode** and delete the channel file
  - But safe mode requires physical access, and nowadays a lot of IT support is done remotely…

Why CrowdStrike?

- IDC Reports of market cap and market share:
  - 2020: 756m, 9.2%
  - 2021: 1302m, 12.6%
  - 2022: 1527m, 17.7%
  - 2023: 2279m, 18.1%
    - Overtaken by Microsoft
- CrowdStrike was the first to utilize Microsoft's PPL service to write their product as an ELAM kernel driver

Could this have happened to anyone else?

- This did not happen in macOS
  - Apple Endpoint Security Framework offers API to EDRs, does not allow them to run in kernel
- This *did* happen in Linux
  - kernel panic in RedHat, due to an error in the eBPF
  - eBPF loads programs from user mode to extend kernel capabilities
    - So they don't have to run as kernel modules
  - This requires tight input validation
    - And the input validation had a bug

Kernel Mode EDR why?

- Both Linux and macOS keep third-party kernel drivers at bay - *but why not Windows*?
  - PatchGuard in 2005 prevents patching the kernel, so Microsoft clearly understands that kernel drivers are dangerous
  - Windows does offer similar solutions, e.g. Windows Defender Application Control
- Microsoft software licensing expert Rich Gibbons: 2009 EU anti-competition ruling is to blame
  - *"Microsoft shall ensure that third-party software products can interoperate with Microsoft's Relevant Software Products using the same Interoperability Information on an equal footing as other Microsoft Software Products."*
- Crowdstrike claims scalability issues