TECHNIQUE T881: SERVICE STOP

CyOTE Use Case(s)	MITRE ATT&CK for ICS® Tactic
Alarm Logs, HMI	Inhibit Response Function
Data Sources	
Potential Data Sources	Kernel Mode eBPF, kprobe, Kernel Trace, bcc, bpftrace, Network Traffic, File IO
Historical Attacks	Industroyer/CRASHOVERRIDE[1]

TECHNIQUE DETECTION

The Service Stop technique[2] (Figure 1) may be detected when critical services are halted or rendered unavailable to users.

To augment commercial sensor gaps, the CyOTE program has developed capabilities such as Proof of Concept tools[3] and Recipes[4] for asset owners and operators (AOO) to identify indicators of attack within their operational technology (OT) networks. However, for the Service Stop technique, the CyOTE program recommends the use of the Extended Berkley Packet Filter (eBPF) technology to develop a capability for identifying Service Stop in an AOO's OT environment. Additionally, by referencing CyOTE Case Studies[5] of known attacks, AOOs in both small and large organizations can utilize CyOTE's Use Case analyses to tie operational anomalies and observables to cyber-attack campaigns resulting in ever-decreasing impacts.

PERCEPTION: OBSERVABLES FROM HISTORICAL ATTACKS

The Service Stop technique was used in the Industroyer attack in the Ukraine in 2016.[6,7] In this attack, the following observables were identified:

- Firmware updates to SIPROTEC relays causing them to fail to perform functions
- New processes being created or terminated

[1] MITRE, Software: Industroyer, CRASHOVERRIDE, https://collaborate.mitre.org/attackics/index.php/Software/S0001

[2] MITRE ATT&CK for ICS, T881: Service Stop, https://collaborate.mitre.org/attackics/index.php/Technique/T0881

[3] A Proof of Concept tool is a representative implementation of a set of steps and methods for identifying techniques. A Proof of Concept tool is defined as a script(code) or using capabilities of existing tools (e.g., Splunk, Gravwell), to demonstrate the capability to identify adversarial activity for a selected technique. A Proof of Concept tool is not ready for implementation in an AOO's environment as its major focus is to a specific instance (device, vendor, protocol, scenario) in order to prove a concept.

[4] A Recipe is a set of steps and methods for identifying techniques. Recipes can be used to develop a Proof of Concept or operational tool in an AOO's OT environment.

[5] Visit https://inl.gov/cyote/ for all CyOTE Case Studies.

[6] https://www.welivesecurity.com/wp-content/uploads/2017/06/Win32_Industroyer.pdf

[7] https://www.dragos.com/wp-content/uploads/CRASHOVERRIDE.pdf

- Modified Windows Registry keys

Disclaimer: Past occurrences are not guaranteed to occur in future attacks.

COMPREHENSION

In the Industroyer attack, the adversary used the Service Stop technique in conjunction with forcing devices to shut down/restart to render devices unresponsive, stop them from performing intended functions, and execute further control of the system. They were able to do this once they had gained access to the Data Historian to initiate the compromise and had begun issuing malicious commands to devices. They were then able to take control of the system and manipulate it to cause impactful and damaging changes.[8] By understanding the nature and possible origins of this attack, as well as how the adversary used the Service Stop technique to execute the attack, an AOO can better comprehend how this technique is used with others and enhance their capabilities to detect attack campaigns using this technique and decrease an attack's impacts.

CURRENT CAPABILITY

As previously noted, the CyOTE program recommends the use of the eBPF technology to develop a capability for identifying Service Stop in an AOO's OT environment. The eBPF technology, located in the Linux kernel, allows for visibility of service stops and provides a monitoring capability. This capability allows an AOO to monitor for potentially malicious activity, and software/service stops in the operating system, without affecting normal operations.

POTENTIAL ENHANCEMENTS

Future enhancements of the published process monitor software are envisioned to include network logging that is triggered by an anomaly, located in Kernel process space, and running outside the operating system.

ASSET OWNER DEPLOYMENT GUIDANCE

For operational technology (OT) deployment, users should consult the code examples and documentation provided by the Linux Foundation as part of the *IO Visor*[9] and *bcc suite*[10] of tools. These tools provide example *eBPF* functionality and working frameworks for use.

AOOs can refer to the CyOTE Technique Detection Capabilities report (visit https://inl.gov/cyote/) for more information on the background and approach of CyOTE's technique detection capabilities.

AOOs can also refer to the CyOTE methodology for more information on CyOTE's approach to identifying anomalies in an OT environment, which, when perceived, initiates investigation and analysis to comprehend the anomaly.

[8] CyOTE Case Study: CRASHOVERRIDE/Industroyer. Visit https://inl.gov/cyote/ for more information.
[9] https://www.iovisor.org/technology/bcc
[10] https://github.com/iovisor/bcc

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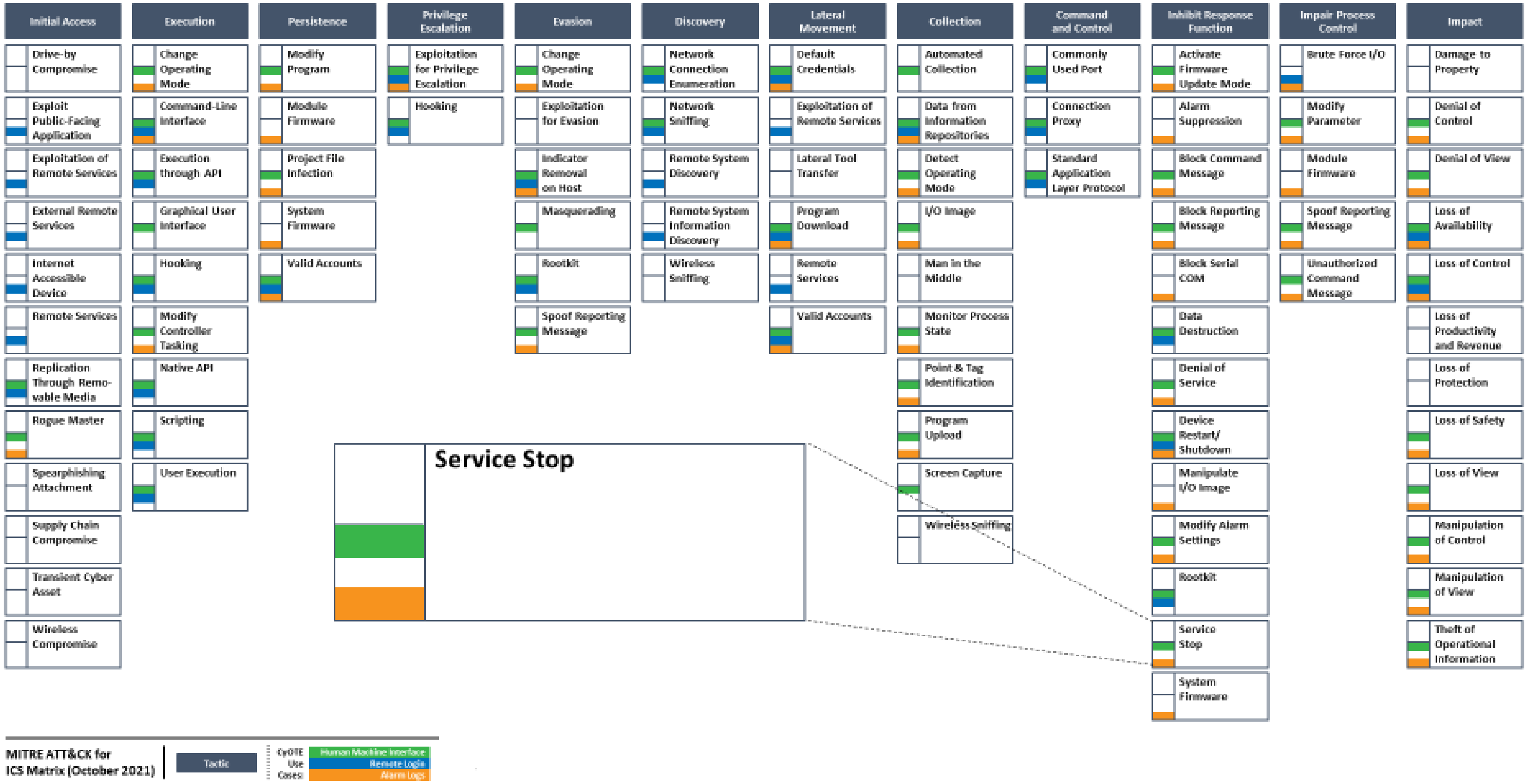

Initial Access	Execution	Persistence	Privilege Escalation	Evasion	Discovery	Lateral Movement	Collection	Command and Control	Inhibit Response Function	Impair Process Control	Impact
Drive-by Compromise	Change Operating Mode	Modify Program	Exploitation for Privilege Escalation	Change Operating Mode	Network Connection Enumeration	Default Credentials	Automated Collection	Commonly Used Port	Activate Firmware Update Mode	Brute Force I/O	Damage to Property
Exploit Public-Facing Application	Command-Line Interface	Module Firmware	Hooking	Exploitation for Evasion	Network Sniffing	Exploitation of Remote Services	Data from Information Repositories	Connection Proxy	Alarm Suppression	Modify Parameter	Denial of Control
Exploitation of Remote Services	Execution through API	Project File Infection		Indicator Removal on Host	Remote System Discovery	Lateral Tool Transfer	Detect Operating Mode	Standard Application Layer Protocol	Block Command Message	Module Firmware	Denial of View
External Remote Services	Graphical User Interface	System Firmware		Masquerading	Remote System Information Discovery	Program Download	I/O Image		Block Reporting Message	Spoof Reporting Message	Loss of Availability
Internet Accessible Device	Hooking	Valid Accounts		Rootkit	Wireless Sniffing	Remote Services	Man in the Middle		Block Serial COM	Unauthorized Command Message	Loss of Control
Remote Services	Modify Controller Tasking			Spoof Reporting Message		Valid Accounts	Monitor Process State		Data Destruction		Loss of Productivity and Revenue
Replication Through Removable Media	Native API						Point & Tag Identification		Denial of Service		Loss of Protection
Rogue Master	Scripting						Program Upload		Device Restart/Shutdown		Loss of Safety
Spearphishing Attachment	User Execution						Screen Capture		Manipulate I/O Image		Loss of View
Supply Chain Compromise							Wireless Sniffing		Modify Alarm Settings		Manipulation of Control
Transient Cyber Asset									Rootkit		Manipulation of View
Wireless Compromise									Service Stop		Theft of Operational Information
									System Firmware		

Figure 1: ICS ATT&CK Framework[11] – Service Stop Technique

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