TECHNIQUE T875: CHANGE PROGRAM STATE – EXECUTION

CyOTE Use Case(s)	MITRE ATT&CK for ICS® Tactic
Alarm Logs, HMI, Remote Login	Execution
Data Sources	
Potential Data Sources	Data Historian points, Application Logs, OS Stack Logs, Packet Captures, Network Protocol Analysis
Historical Attacks	Triton Attack at Petro Rabigh[1]

TECHNIQUE DETECTION

The Change Program State technique[2] (Figure 1) may be detected when a device's program state is changed without warning or reason.

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 for techniques like Change Program State within their operational technology (OT) networks. 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 Change Program State technique was used in the Triton attack at Petro Rabigh in 2017.[6] In this attack, the following observables were identified:

- Increased internet traffic
- Increased DMZ traffic between information technology (IT) and OT networks

[1] MITRE, *Software: Triton, TRISIS, HatMan*, https://collaborate.mitre.org/attackics/index.php/Software/S0013

[2] MITRE ATT&CK for ICS, T875: Change Program State, https://collaborate.mitre.org/attackics/index.php/Technique/T0875. Note that this technique has been deprecated, and its content merged into T858, Change Operating Mode: https://collaborate.mitre.org/attackics/index.php/Technique/T0858

[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.eenews.net/stories/1060123327

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

COMPREHENSION

In the Triton attack at Petro Rabigh, the adversary first gained access through an engineering workstation to map the network; once they gained control of the workstation, they moved through the network and deployed the malware, changing program states and device logic to issue malicious command messages that shut down part of the plant.[7] By understanding the nature and possible origins of this attack, as well as how the adversary used the Change Program State 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

The CyOTE Recipe describes how to develop a capability that will regularly pull or receive logs from the data historian, collection server, or security information and event management (SIEM) to parse, analyze, and compare changes. This capability monitors for basic operational state changes (e.g., PLC main program is started, stopped, or reset). A state change log entry will trigger an alert for further evaluation. A configuration file is used to define which logs to pull and identify log entries containing potential observables. The capability's output provides statistics about observables, number of times triggered, which PLC caused the trigger, and the log where the entries were found.

POTENTIAL ENHANCEMENTS

Additional research is needed to monitor and compare data historian, collection server, or SIEM logs to identify potential operational state changes and integrate a calendar for maintenance windows (emergency or planned). The calendar will be used to reduce triggerable events during maintenance windows. If an observable is found, the calendar will be checked; if the observable occurred outside of maintenance, it is flagged as unauthorized, and an alert is generated. To further reduce alert generation, the process environment will be baselined by the capability, looking for traffic norms, command usage frequency, and other baselines.

ASSET OWNER DEPLOYMENT GUIDANCE

Deploying this capability in a continuously running state will require asset owners to configure data historian, collection server, or SIEM to send logs to this capability which will alert when log entries match patterns in the configuration file for potential state changes. If a log does not match, an alert is received. Alerts can be customized for output to a JSON log or a STIX 2.1 format.

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.

[7] CyOTE Case Study: Triton in Petro Rabigh. https://inl.gov/wp-content/uploads/2021/09/Triton-CyOTE-Case-Study.pdf

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.

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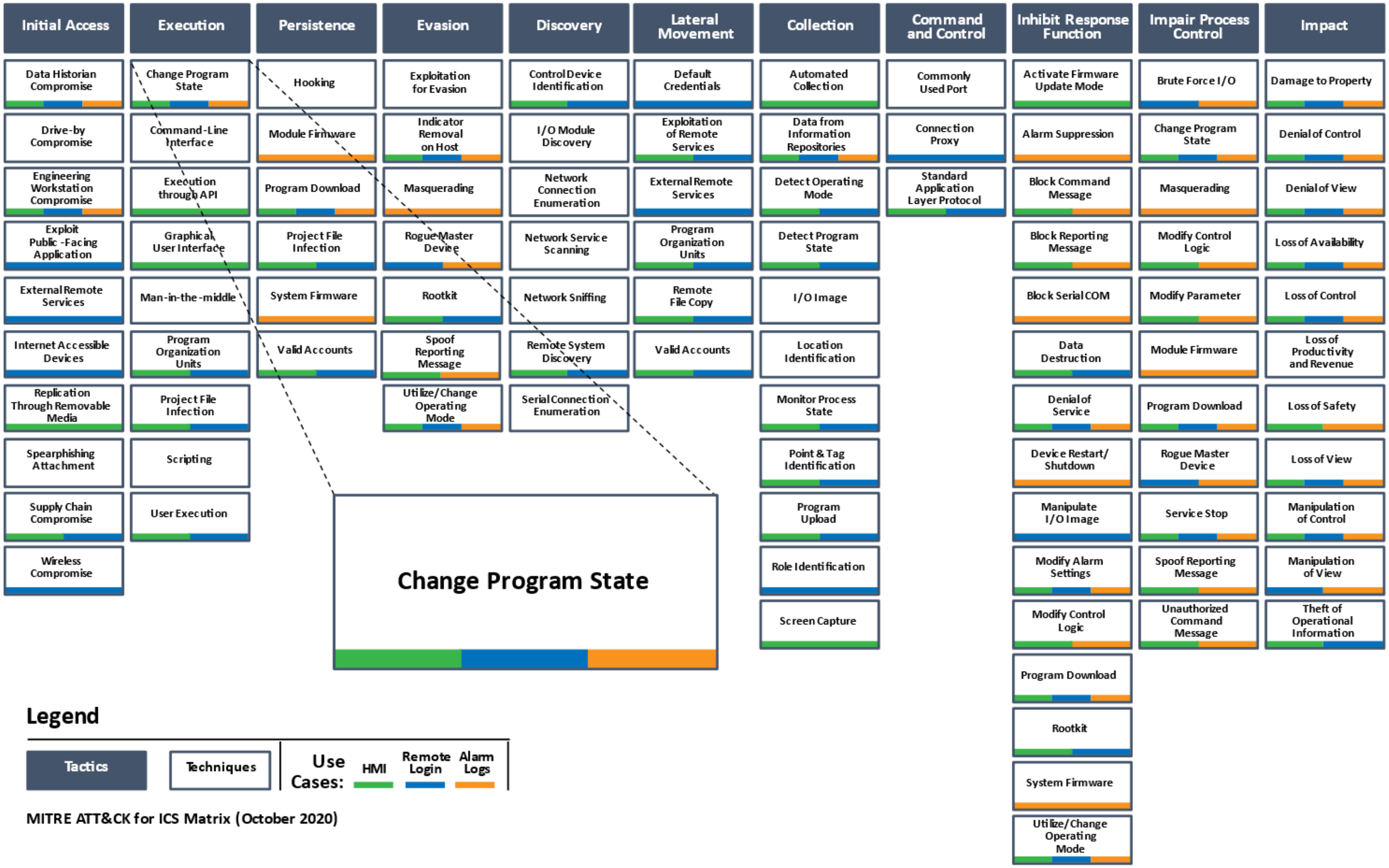

Initial Access	Execution	Persistence	Evasion	Discovery	Lateral Movement	Collection	Command and Control	Inhibit Response Function	Impair Process Control	Impact
Data Historian Compromise	Change Program State	Hooking	Exploitation for Evasion	Control Device Identification	Default Credentials	Automated Collection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

Change Program State

Legend

Tactics | Techniques | Use Cases: HMI 🟩 Remote Login 🟦 Alarm Logs 🟧

MITRE ATT&CK for ICS Matrix (October 2020)

Figure 1: ICS ATT&CK Framework[8] – Change Program State Technique – Execution

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