SE Labs

INTELLIGENCE-LED TESTING

EDR

DETECTION

Enterprise Advanced Security

CrowdStrike Falcon

June 2022

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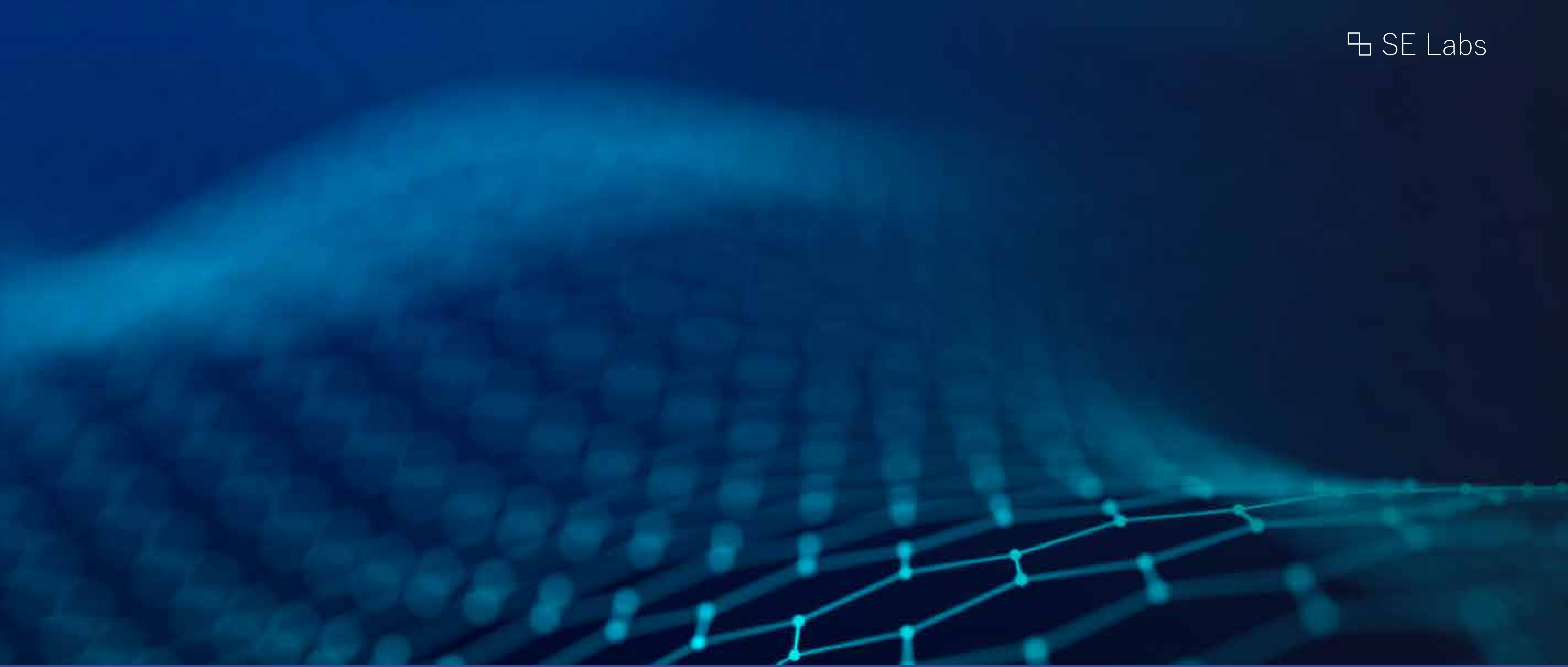

SE Labs tested **CrowdStrike Falcon** against a range of hacking attacks designed to compromise systems and penetrate target networks in the same way as criminals and other attackers breach systems and networks.

Full chains of attack were used, meaning that testers behaved as real attackers, probing targets using a variety of tools, techniques and vectors before attempting to gain lower-level and more powerful access. Finally, the testers/ attackers attempted to complete their missions, which might include stealing information, damaging systems and connecting to other systems on the network.

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SE Labs is ISO/IEC 27001 : 2013 certified and BS EN ISO 9001 : 2015 certified for The Provision of IT Security Product Testing.

SE Labs is a member of the Microsoft Virus Information Alliance (VIA); the Anti-Malware Testing Standards Organization (AMTSO); and NetSecOPEN.

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INTRODUCTION

Endpoint Detection and Response is more than anti-virus

Understand cybersecurity testing with visible threat intelligence

An Endpoint Detection and Response (EDR) product is more than anti-virus, which is why it requires advanced testing. This means testers must behave like real attackers, following every step of an attack.

While it's tempting to save time by taking shortcuts, a tester must go through an entire attack to truly understand the capabilities of EDR security products.

Each step of the attack must be realistic too. You can't just make up what you think bad guys are doing and hope you're right. This is why SE Labs tracks cybercriminal behaviour and builds tests based on how bad guys try to compromise victims.

The cybersecurity industry is familiar with the concept of the 'attack chain', which is the combination of those attack steps. Fortunately the MITRE organisation has documented each step with its ATT&CK framework. While this doesn't give an exact blueprint for realistic attacks, it does present a general structure that testers, security vendors and customers (you!) can use to run tests and understand test results.

The Enterprise Advanced Security tests that SE Labs runs are based on real attackers' behaviour. This means we can present how we run those attacks using a MITRE ATT&CK-style format.

You can see how ATT&CK lists out the details of each attack, and how we represent the way we tested, in **4. Threat Intelligence**, starting on page 13. This brings two main advantages: you can have confidence that the way we test is realistic and relevant; and you're probably already familiar with this way of illustrating cyber attacks.

If you spot a detail in this report that you don't understand, or would like to discuss, please contact us via our Twitter account. SE Labs uses current threat intelligence to make our tests as realistic as possible. To learn more about how we test, how we define 'threat intelligence' and how we use it to improve our tests please visit our website and follow us on Twitter.

Executive Summary

CrowdStrike Falcon was tested against a range of hacking attacks designed to compromise systems and penetrate target networks in the same way as criminals and other attackers breach systems and networks. Legitimate files were used alongside the threats to measure any false positive detections or other sub-optimum interactions.

We examined its abilities to:

- Detect the delivery of targeted attacks
- Track different elements of the attack chain…
- …including compromises beyond the endpoint and into the wider network

CrowdStrike Falcon was able to detect every targeted attack and tracked each of the hostile activities that occurred during the attacks.

With five minor exceptions, detection was complete and deep, tracking malicious behaviour from the beginning to the end of the attack. It generated no false positives, which should lighten the load on security operatives using the product.

Executive Summary

Products Tested	Attacks Detected (%)	Detection Accuracy (%)	Legitimate Accuracy Rating (%)	Total Accuracy Rating (%)
CrowdStrike Falcon	100%	94%	100%	97%

Products highlighted in green were the most accurate, scoring 85 per cent or more for Total Accuracy. Those in yellow scored less than 85 but 75 or more. Products shown in red scored less than 75 per cent.

For exact percentages, see 2. Total Accuracy Ratings on page 10.

Endpoint Detection and Response Award

The following product wins the SE Labs award:

CrowdStrike Falcon

1. How we Tested

Testers can't assume that products will work a certain way, so running a realistic advanced security test means setting up real networks and hacking them in the same way that real adversaries behave.

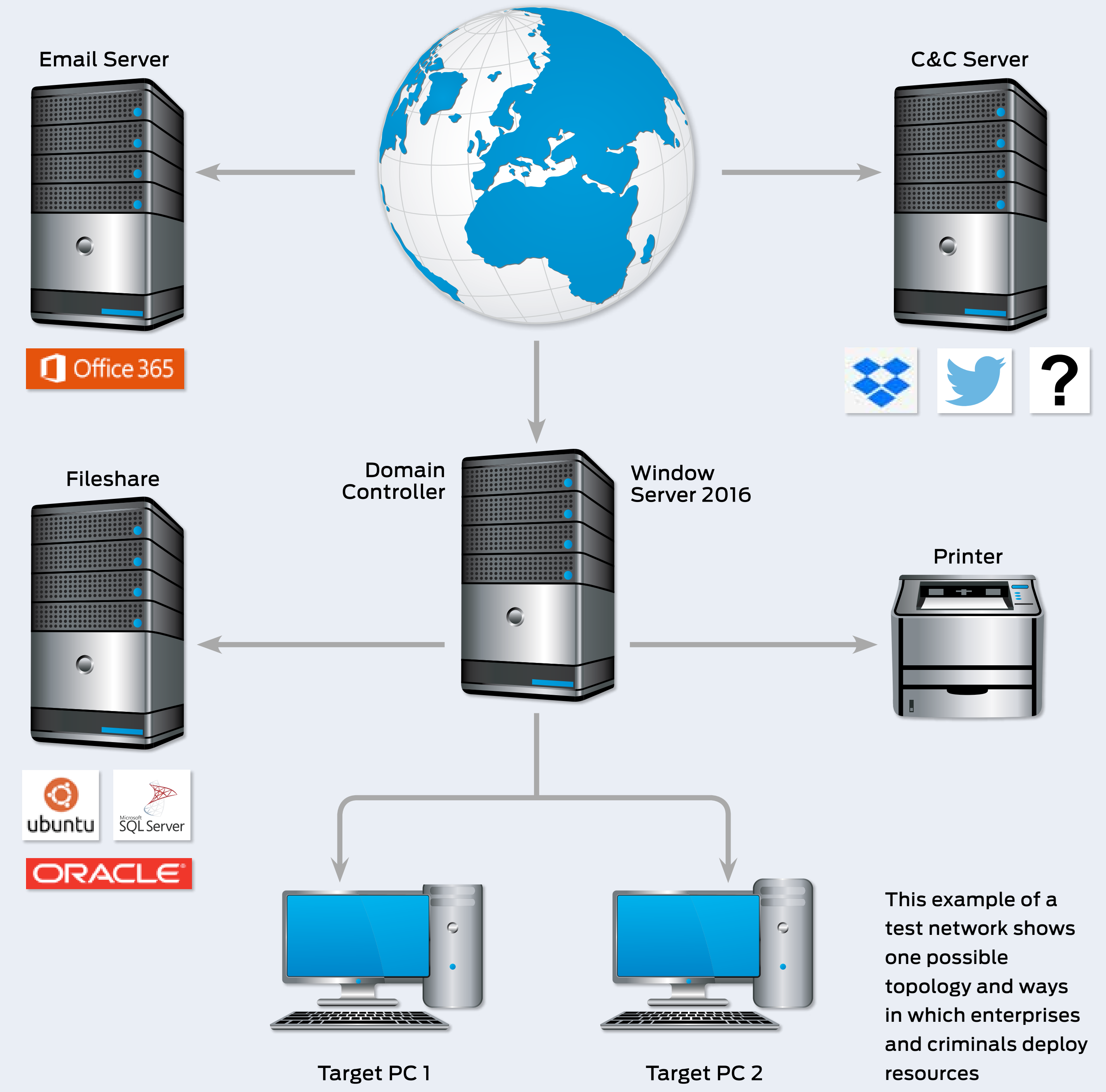
In the diagram on the right you will see an example network that contains workstations, some basic infrastructure such as file servers and a domain controller, as well as cloud-based email and a malicious command and control (C&C) server, which may be a conventional computer or a service such as Dropbox, Twitter, Slack or something else more imaginative.

As you will see in the **Threat Responses** section on page 7, attackers often jump from one compromised system to another in so-called 'lateral movement'. To allow products to detect this type of behaviour the network needs to be built realistically, with systems available, vulnerable and worth compromising.

It is possible to compromise devices such as enterprise printers and other so-called 'IoT' (internet of things) machines, which is why we've included a representative printer in the diagram.

The techniques that we choose for each test case are largely dictated by the real-world behaviour of online criminals. We observe their tactics and replicate what they do in this test. To see more details about how the specific attackers behaved, and how we copied them, see **Hackers vs. Targets** on page 9 and, for a really detailed drill down on the details, **4. Threat Intelligence** on pages 13 to 15 and **Appendix C: Attack Details.**

Test Network Example



This example of a test network shows one possible topology and ways in which enterprises and criminals deploy resources

Threat Responses

Full Attack Chain: Testing every layer of detection and protection

Attackers start from a certain point and don't stop until they have either achieved their goal or have reached the end of their resources (which could be a deadline or the limit of their abilities). This means, in a test, the tester needs to begin the attack from a realistic first position, such as sending a phishing email or setting up an infected website, and moving through many of the likely steps leading to actually stealing data or causing some other form of damage to the network.

If the test starts too far into the attack chain, such as executing malware on an endpoint, then many products will be denied opportunities to use the full extent of their protection and detection abilities. If the test concludes before any 'useful' damage or theft has been achieved, then similarly the product may be denied a chance to demonstrate its abilities in behavioural detection and so on.

Attack stages

The illustration (below) shows some typical stages of an attack. In a test each of these should be attempted to determine the security solution's effectiveness. This test's results record detection and protection for each of these stages.

We measure how a product responds to the first stages of the attack with a detection and/ or protection rating. Sometimes products allow threats to run but detect them. Other times they might allow the threat to run briefly before neutralising it. Ideally they detect and block the threat before it has a chance to run. Products may delete threats or automatically contains them in a 'quarantine' or other safe holding mechanism for later analysis.

Should the initial attack phase succeed we then measure post-exploitation stages, which are represented by steps two through to seven below. We broadly categorise these stages as: Access (step 2); Action (step 3); Escalation (step 4); and Post-escalation (steps 5-7).

In figure 1. you can see a typical attack running from start to end, through various 'hacking' activities. This can be classified as a fully successful breach.

ATTACK CHAIN STAGES

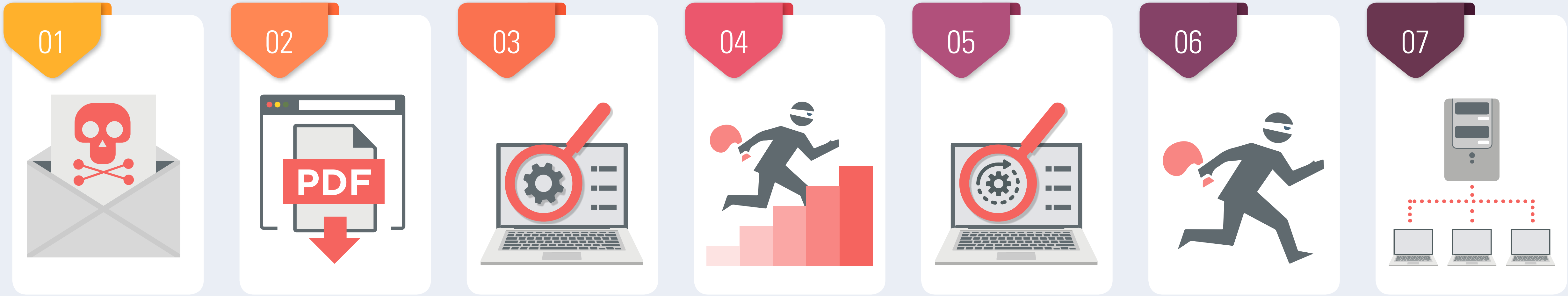


Figure 1. A typical attack starts with an initial contact and progresses through various stages, including reconnaissance, stealing data and causing damage.

In figure 2. a product or service has interfered with the attack, allowing it to succeed only as far as stage 3, after which it was detected and neutralised. The attacker was unable to progress through stages 4 and onwards.

It is possible for an attack to run in a different order with, for example, the attacker attempting to connect to other systems without needing to escalate privileges. However, it is common for password theft (see step 5) to occur before using stolen credentials to move further through the network.

It is also possible that attackers will not cause noticeable damage during an attack. It may be that their goal is persistent presence on the systems to monitor for activities, slowly steal information and other more subtle missions.

In figure 3. the attacker has managed to progress as far as stage five. This means that the system has been seriously compromised. The attacker has a high level of access and has stolen passwords. However, attempts to exfiltrate data from the target were blocked, as were attempts to damage the system.

ATTACK CHAIN: How Hackers Progress

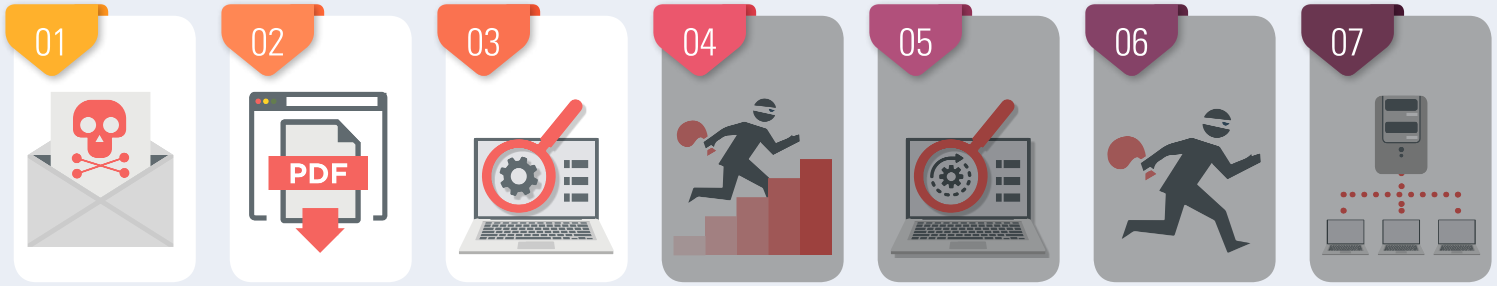


Figure 2. This attack was initially successful but only able to progress as far as the reconnaissance phase

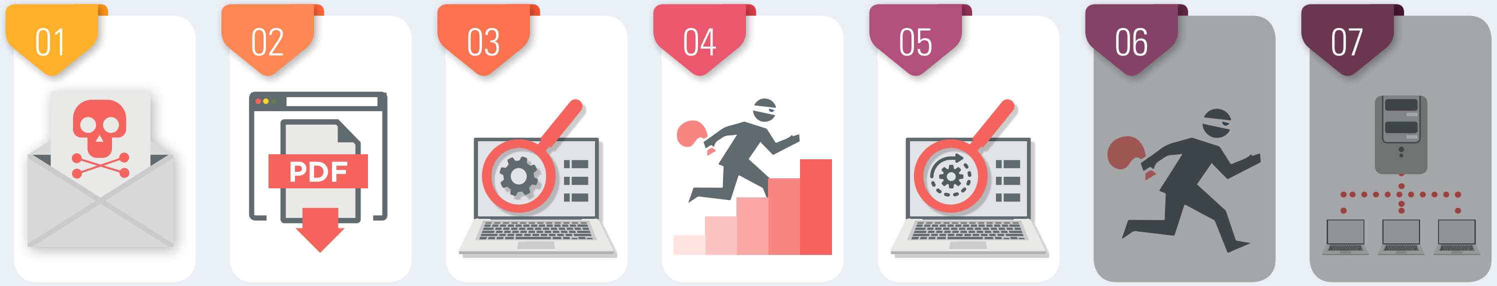


Figure 3. A more successful attack manages to steal passwords but wholesale data theft and destruction was blocked

Hackers
CYBER CRIME: 'WE'RE ALL TARGETS'
Only 13% cybercrime solved in two years
Cyber crime surges in C
ransomware
CYBER HACKERS CRIPPLE THE NHS
English h divert ambulan
ransom
cyber at
Three U.S. Hospitals Hit in String of Ransomware Attacks
Ransomware attack hits
highlights dilemma for fight against malware
UK rail network hit by multiple cyber attacks
DON'T BE HELD TO RANSOM
Banks to face 10 attacks experts

Hackers vs. Targets

When testing services against targeted attacks it is important to ensure that the attacks used are relevant. Anyone can run an attack randomly against someone else. It is the security vendor's challenge to identify common attack types and to protect against them. As testers, we need to generate threats that in some way relate to the real world.

All of the attacks used in this test are valid ways to compromise an organisation. Without any security in place, all would succeed in attacking the target. Outcomes would include systems infected with ransomware, remote access to networks and data theft.

But we didn't just sit down and brainstorm how we would attack different companies. Instead we used current threat intelligence to look at what the bad guys have been doing over the last few years and copied them quite closely. This way we can test the services' abilities to handle similar threats to those faced by global governments, financial institutions and national infrastructure.

The graphic on this page shows a summary of the attack groups that inspired the targeted attacks used in this test. If a service was able to detect and protect against these then there's a good chance they are on track to blocking similar attacks in the real world. If they fail, then you might take their bold marketing claims about defeating hackers with a pinch of salt.

For more details about each APT group please see **4. Threat Intelligence** on page 13.

Hackers vs. Targets

Attacker/APT Group	Method	Target	Details
Wizard Spider	@ C:\	🏦	Credential harvesting, cryptomining and implementation of ransomware.
Sandworm	@ C:\	🏛	Obtain sensitive network data via encryption and system data wiping.
Dragonfly & Dragonfly 2.0	@ W	🏭	Phishing & supply chain methods used to gain access

Key

✈ Aviation	🏦 Banking and ATMs	🏭 Energy	$ Financial
🃏 Gambling	🏛 Government Espionage	⊕ Healthcare	⚖ Law
🛢 Natural Resources	🛒 US Retail, Restaurant and Hospitality		

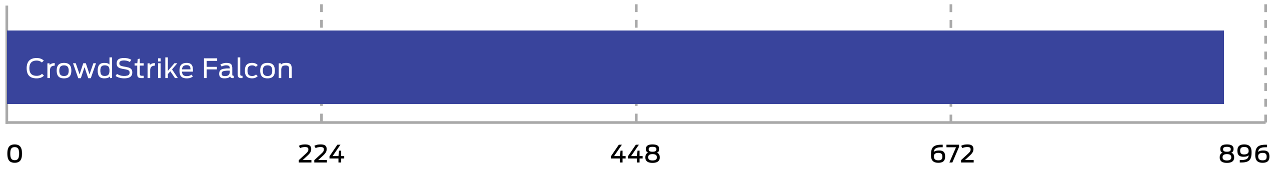
2. Total Accuracy Ratings

This test examines the total insight a product has, or can provide, into a specific set of attacking actions. We've divided the attack chain into chunks of one or more related actions. To provide sufficient insight, a product must detect at least one action in each chunk.

If you look at the results table in **3. Response Details** on page 11 you'll see that Delivery and Execution are grouped together into one chunk, while Action sits alone. Escalation and Post-Escalation (PE) Action are grouped, while Lateral Movement and Lateral Action are also grouped.

This means that if the product detects either the threat being delivered or executed, it has coverage for that part of the attack. If it detects the action as well as the escalation of privileges and an action involved in lateral movement then it has what we consider to be complete insight, even if it doesn't detect some parts of some chunks (i.e. Lateral Movement, in this example).

Total Accuracy Ratings			
Product	**Total Accuracy Rating**	**Total Accuracy (%)**	**Award**
CrowdStrike Falcon	866	97%	AAA



Total Accuracy Ratings combine protection and false positives.

3. Response Details

In this test security products are exposed to attacks, which comprise multiple stages. The perfect product will detect all relevant elements of an attack. The term ‘relevant’ is important, because sometimes detecting one part of an attack means it’s not necessary to detect another.

For example, in the table below certain stages of the attack chain have been grouped together. As mentioned in **2. Total Accuracy Ratings**, these groups are as follows:

Wizard Spider

Incident No:	Detection	Delivery	Execution	Action	Escalation	PE Action	Lateral Movement	Lateral Action
1	✓	✓	✓	✓	✓	✓	✓	✓
2	✓	✓	✓	✓	✓	✓	✓	✓
3	✓	✓	✓	—	✓	✓	✓	—
4	✓	✓	✓	✓	✓	✓	✓	✓

Sandworm

Incident No:	Detection	Delivery	Execution	Action	Escalation	PE Action	Lateral Movement	Lateral Action
5	✓	✓	✓	✓	✓	✓	✓	✓
6	✓	✓	✓	✓	✓	✓	✓	✓
7	✓	✓	✓	—	✓	✓	—	✓
8	✓	✓	✓	—	✓	✓	—	✓

Dragonfly & Dragonfly 2.0

Incident No:	Detection	Delivery	Execution	Action	Escalation	PE Action	Lateral Movement	Lateral Action
9	✓	—	✓	✓	✓	✓	✓	—
10	✓	✓	✓	✓	✓	✓	✓	✓
11	✓	—	✓	✓	✓	✓	✓	✓
12	✓	✓	✓	✓	✓	✓	✓	✓

Delivery/ Execution (+10)

If the product detects either the delivery or execution of the initial attack stage then a detection for this stage is recorded.

Action (+10)

When the attack performs one or more actions, while remotely controlling the target, the product should detect at least one of those actions.

Privilege escalation/ action (+10)

As the attack progresses there will likely be an attempt to escalate system privileges and to perform more powerful and insidious actions. If the product can detect either the escalation process itself, or any resulting actions, then a detection is recorded.

Lateral movement/ action (+10)

The attacker may attempt to use the target as a launching system to other vulnerable systems. If this attempt is discovered, or any subsequent action, a detection is reported.

The Detection Rating is calculated by adding points for each group in a threat chain that is detected. When at least one detection occurs in a single group, a ‘group detection’ is recorded and 10 points are awarded. Each test round contains one threat chain, which itself contains four groups (as shown above), meaning that complete visibility of each attack adds 40 points to the total value.

A product that detects the delivery of a threat, but nothing subsequently to that, wins only 10 points, while a product that detects delivery and action, but not privilege escalation or lateral behaviours, is rated at 20 for that test round.

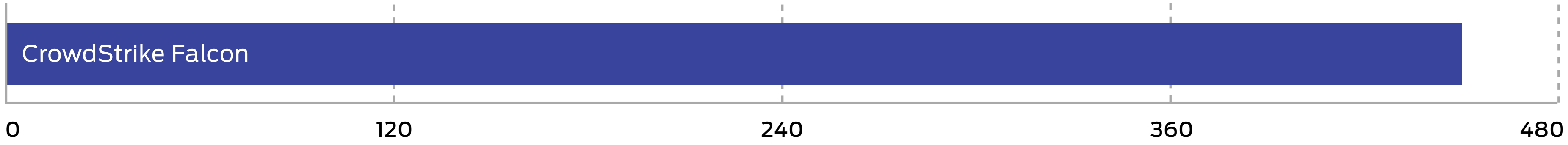
Response Details						
Attacker/APT Group	Number of Test Cases	Attacks Detected	Delivery/ Execution	Action	Privilege Escalation/Action	Lateral Movement/Action
Wizard Spider	4	4	4	3	4	4
Sandworm	4	4	4	2	4	4
Dragonfly & Dragonfly 2.0	4	4	4	4	4	4
Total	12	12	12	9	12	12

This data shows how the product handled different group stages of each APT. The Detection column shows the basic level of detection.

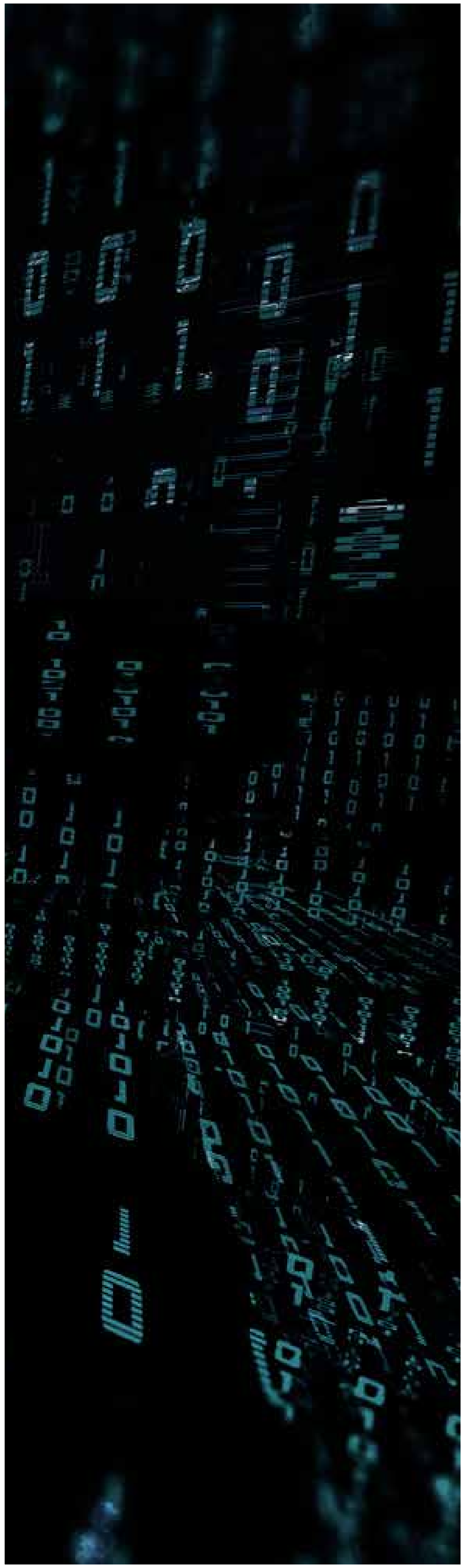
Detection Accuracy Rating Details				
Attacker/APT Group	Number of Test Cases	Attacks Detected	Group Detections	Detection Rating
Wizard Spider	4	4	15	150
Sandworm	4	4	14	140
Dragonfly & Dragonfly 2.0	4	4	16	160
Total	12	12	45	450

Different levels of detection, and failure to detect, are used to calculate the Detection Rating.

Detection Accuracy Ratings		
Product	Detection Accuracy Rating	Detection Accuracy Rating %
CrowdStrike Falcon	450	94%



Detection Ratings are weighted to show that how products detect threats can be subtler than just ‘win’ or ‘lose’.

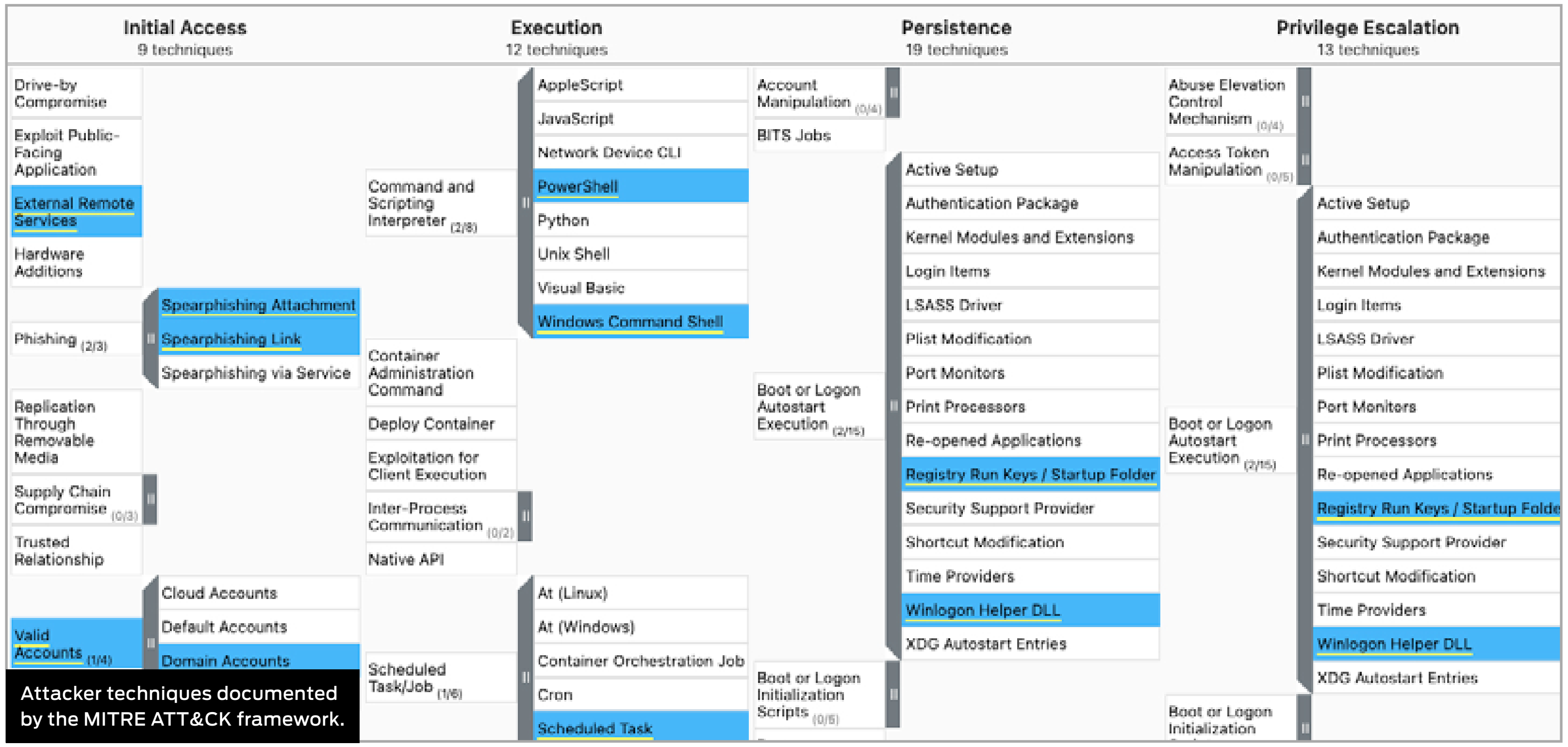


4. Threat Intelligence

Wizard Spider

Known to have operated since at least 2016, Wizard Spider is considered to be a threat group based in and around St. Petersburg, Russia. It is most notable for developing the TrickBot banking malware. Wizard Spider has infected over a million systems worldwide predominantly by using this malware.

Reference Link:
https://attack.mitre.org/groups/G0102/



Initial Access 9 techniques

Drive-by Compromise
Exploit Public-Facing Application
External Remote Services
Hardware Additions
Phishing (2/3): Spearphishing Attachment; Spearphishing Link; Spearphishing via Service
Replication Through Removable Media
Supply Chain Compromise (0/3)
Trusted Relationship
Valid Accounts (1/4): Cloud Accounts; Default Accounts; Domain Accounts

Execution 12 techniques

Command and Scripting Interpreter (2/8): AppleScript; JavaScript; Network Device CLI; PowerShell; Python; Unix Shell; Visual Basic; Windows Command Shell
Container Administration Command
Deploy Container
Exploitation for Client Execution
Inter-Process Communication (0/2)
Native API
Scheduled Task/Job (1/6): At (Linux); At (Windows); Container Orchestration Job; Cron; Scheduled Task

Persistence 19 techniques

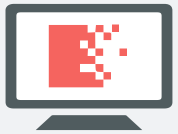
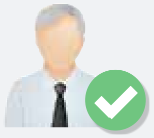
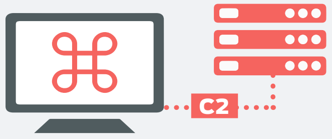
Account Manipulation (0/4)
BITS Jobs
Boot or Logon Autostart Execution (2/15): Active Setup; Authentication Package; Kernel Modules and Extensions; Login Items; LSASS Driver; Plist Modification; Port Monitors; Print Processors; Re-opened Applications; Registry Run Keys / Startup Folder; Security Support Provider; Shortcut Modification; Time Providers; Winlogon Helper DLL; XDG Autostart Entries
Boot or Logon Initialization Scripts (0/5)

Privilege Escalation 13 techniques

Abuse Elevation Control Mechanism (0/4)
Access Token Manipulation (0/5)
Boot or Logon Autostart Execution (2/15): Active Setup; Authentication Package; Kernel Modules and Extensions; Login Items; LSASS Driver; Plist Modification; Port Monitors; Print Processors; Re-opened Applications; Registry Run Keys / Startup Folde; Security Support Provider; Shortcut Modification; Time Providers; Winlogon Helper DLL; XDG Autostart Entries
Boot or Logon Initialization

Attacker techniques documented by the MITRE ATT&CK framework.

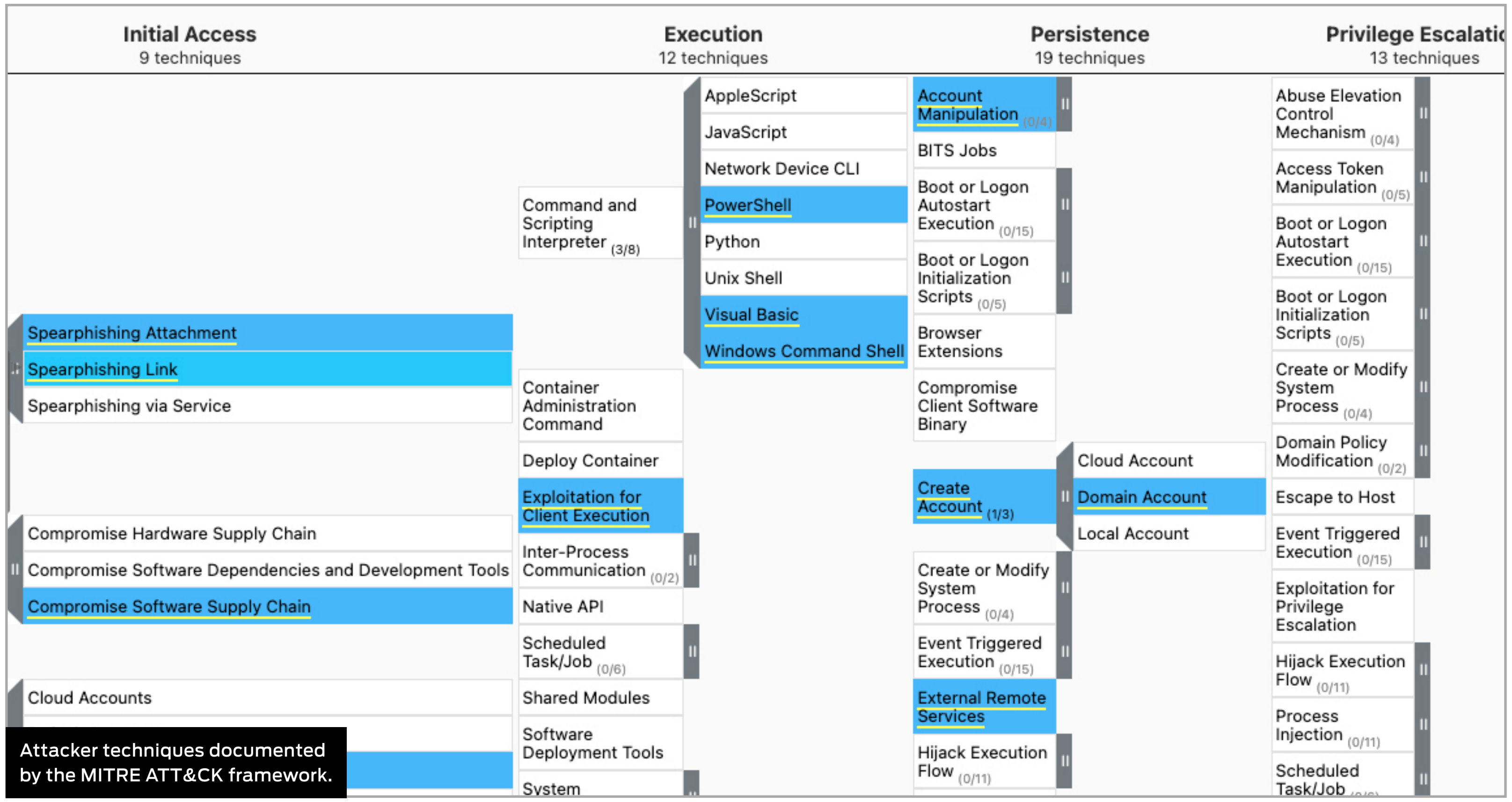
Example Wizard Spider Attack

Delivery	Execution	Action	Privilege Escalation	Post-Escalation Action	Lateral Movement	Lateral Action
Spearphishing Attachment	Windows Command Shell	File and Directory Discovery	Bypass User Account Control	Remote System Discovery	Service Execution	Archive Collected Data
	Malicious File	Process Discovery	Valid Accounts	Security Software Discovery	Domain Accounts	Data Staged
	Obfuscated Files or Information	System Information Discovery		LLMNR/NBT-NS Poisoning and SMB Relay		Data from Local System
	Powershell	System Network Configuration Discovery				Exfiltration Over C2 Channel
		System Owner/User Discovery				
Spearphishing Attachment	 Obfuscated Files or Information	System Information Discovery	 Valid Accounts	Security Software Discovery	Domain Accounts	 Exfiltration over C2 Channel

Sandworm

In operation since around 2009, Sandworm Team is threat group that has been connected to Russia's Main Intelligence Directorate of the General Staff of the Armed Forces of the Russian Federation (GRU). It is believed to be the GRU's Unit 74455. Notable campaigns include a targeted attack on the 2017 French Presidential campaign, as well as the worldwide NotPetya ransomware attack in the same year.

References:
https://attack.mitre.org/groups/G0034/



Initial Access
9 techniques

- Spearphishing Attachment
- Spearphishing Link
- Spearphishing via Service
- Compromise Hardware Supply Chain
- Compromise Software Dependencies and Development Tools
- Compromise Software Supply Chain
- Cloud Accounts

Execution
12 techniques

- Command and Scripting Interpreter (3/8)
  - AppleScript
  - JavaScript
  - Network Device CLI
  - PowerShell
  - Python
  - Unix Shell
  - Visual Basic
  - Windows Command Shell
- Container Administration Command
- Deploy Container
- Exploitation for Client Execution
- Inter-Process Communication (0/2)
- Native API
- Scheduled Task/Job (0/6)
- Shared Modules
- Software Deployment Tools
- System

Persistence
19 techniques

- Account Manipulation (0/4)
- BITS Jobs
- Boot or Logon Autostart Execution (0/15)
- Boot or Logon Initialization Scripts (0/5)
- Browser Extensions
- Compromise Client Software Binary
- Create Account (1/3)
  - Cloud Account
  - Domain Account
  - Local Account
- Create or Modify System Process (0/4)
- Event Triggered Execution (0/15)
- External Remote Services
- Hijack Execution Flow (0/11)

Privilege Escalati
13 techniques

- Abuse Elevation Control Mechanism (0/4)
- Access Token Manipulation (0/5)
- Boot or Logon Autostart Execution (0/15)
- Boot or Logon Initialization Scripts (0/5)
- Create or Modify System Process (0/4)
- Domain Policy Modification (0/2)
- Escape to Host
- Event Triggered Execution (0/15)
- Exploitation for Privilege Escalation
- Hijack Execution Flow (0/11)
- Process Injection (0/11)
- Scheduled Task/Job

Attacker techniques documented by the MITRE ATT&CK framework.

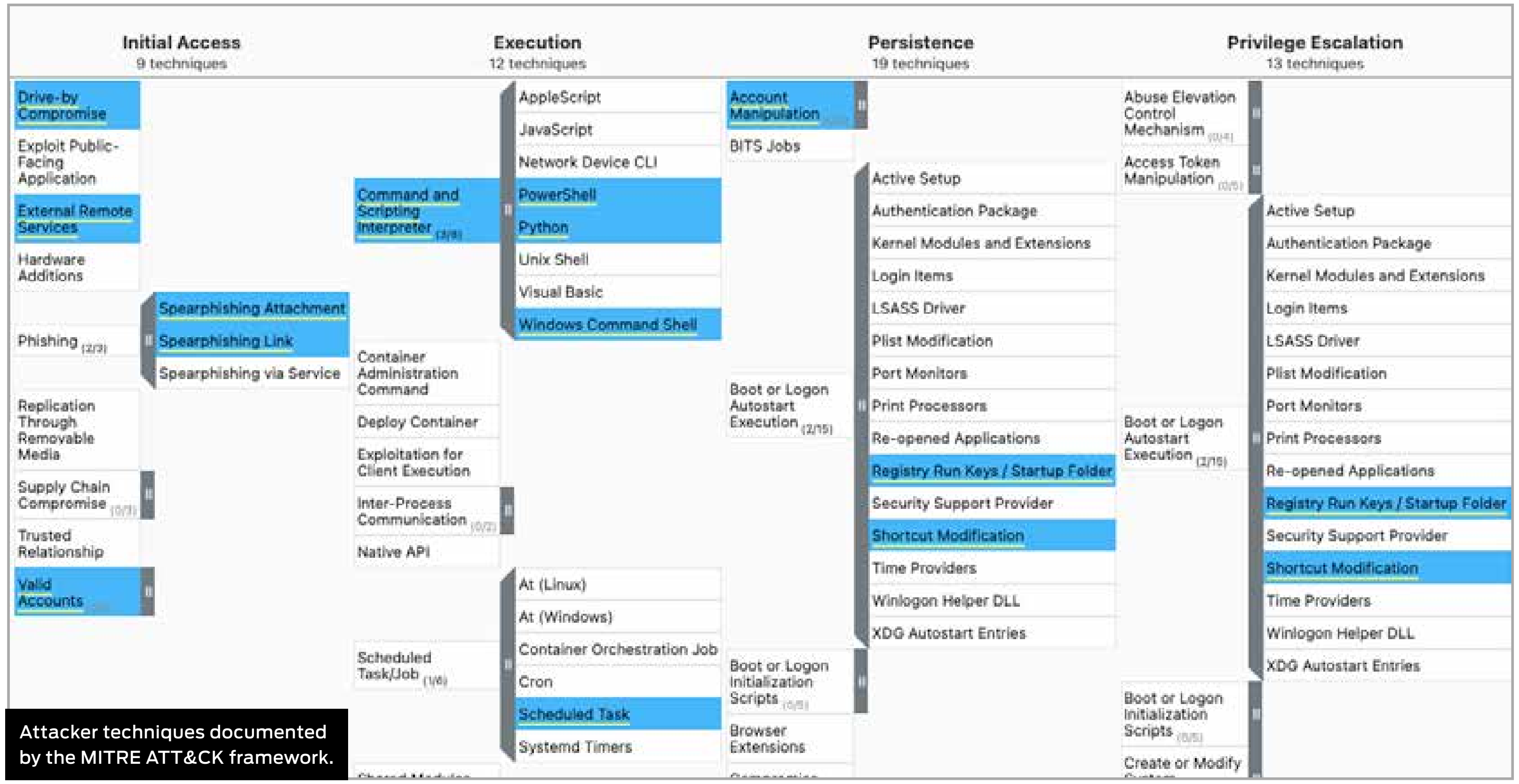
Example Sandworm Attack

Delivery	Execution	Action	Privilege Escalation	Post-Escalation Action	Lateral Movement	Lateral Action
Spearphishing Link	Windows Command Shell	File and Directory Discovery	Domain Accounts	Remote System Discovery	Lateral Tool Transfer	Data from Local System
	Powershell	System Information Discovery	Bypass UAC	LSASS Memory	SMB/Windows Admin Shares	Local Data Staging
	Malicious Link	System Owner/User Discovery				Exfiltration Over C2 Channel
	File Deletion	Data from Local System				Network Sniffing
	Obfuscated Files or Information	Local Data Staging				
		Exfiltration Over C2 Channel				
Spearphishing Link	File Deletion	Data from Local System	Bypass UAC	LSASS Memory	SMB/Windows Admin Shares	Exfiltration Over C2 Channel

Dragonfly & Dragonfly 2.0

These two groups are sometimes tracked separately. Dragonfly has been active for approximately 10 years with their targets shifting from defense and aviation companies to the energy sector after 2013. Dragonfly 2.0 has kept the focus on the energy sector in it's operations.

References:
https://attack.mitre.org/groups/G0035/
https://attack.mitre.org/groups/G0074/



Initial Access
9 techniques

- Drive-by Compromise
- Exploit Public-Facing Application
- External Remote Services
- Hardware Additions
- Phishing (2/3)
  - Spearphishing Attachment
  - Spearphishing Link
  - Spearphishing via Service
- Replication Through Removable Media
- Supply Chain Compromise (0/3)
- Trusted Relationship
- Valid Accounts

Execution
12 techniques

- Command and Scripting Interpreter (3/8)
  - AppleScript
  - JavaScript
  - Network Device CLI
  - PowerShell
  - Python
  - Unix Shell
  - Visual Basic
  - Windows Command Shell
- Container Administration Command
- Deploy Container
- Exploitation for Client Execution
- Inter-Process Communication (0/2)
- Native API
- Scheduled Task/Job (1/6)
  - At (Linux)
  - At (Windows)
  - Container Orchestration Job
  - Cron
  - Scheduled Task
  - Systemd Timers

Persistence
19 techniques

- Account Manipulation
- BITS Jobs
- Boot or Logon Autostart Execution (2/15)
  - Active Setup
  - Authentication Package
  - Kernel Modules and Extensions
  - Login Items
  - LSASS Driver
  - Plist Modification
  - Port Monitors
  - Print Processors
  - Re-opened Applications
  - Registry Run Keys / Startup Folder
  - Security Support Provider
  - Shortcut Modification
  - Time Providers
  - Winlogon Helper DLL
  - XDG Autostart Entries
- Boot or Logon Initialization Scripts (0/5)
- Browser Extensions

Privilege Escalation
13 techniques

- Abuse Elevation Control Mechanism (0/4)
- Access Token Manipulation (0/5)
- Boot or Logon Autostart Execution (2/15)
  - Active Setup
  - Authentication Package
  - Kernel Modules and Extensions
  - Login Items
  - LSASS Driver
  - Plist Modification
  - Port Monitors
  - Print Processors
  - Re-opened Applications
  - Registry Run Keys / Startup Folder
  - Security Support Provider
  - Shortcut Modification
  - Time Providers
  - Winlogon Helper DLL
  - XDG Autostart Entries
- Boot or Logon Initialization Scripts (0/5)
- Create or Modify

Attacker techniques documented by the MITRE ATT&CK framework.

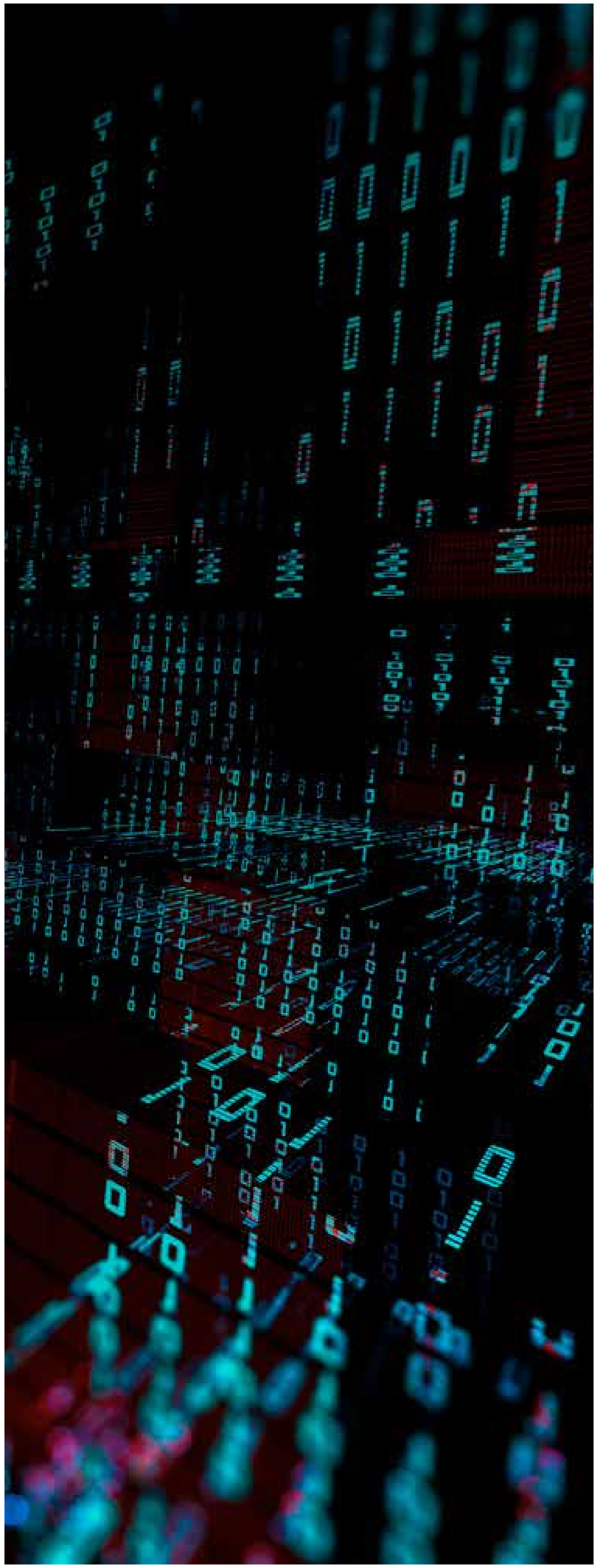
Example Dragonfly & Dragonfly 2.0 Attack

Delivery	Execution	Action	Privilege Escalation	Post-Escalation Action	Lateral Movement	Lateral Action
Spearphising Attachment	Application Layer Protocol	System Information Discovery	Valid Accounts	Scheduled Task	Remote Desktop Protocol	Automated Exfiltration
Malicious File	Command and Scripting Interpreter	Process Discovery		Clear Windows Event Logs		Screen Capture
	Windows Command Shell	System Owner/User Discovery		File deletion		Exfiltration Over C2 Channel
	Powershell			Ingress Tool Transfer		
				Local Account		
				Domain Account		
				Shortcut Modification		
Malicious File	Powershell	System Owner/User Discovery	Valid Accounts	Scheduled Task	Remote Desktop Protocol	Screen Capture

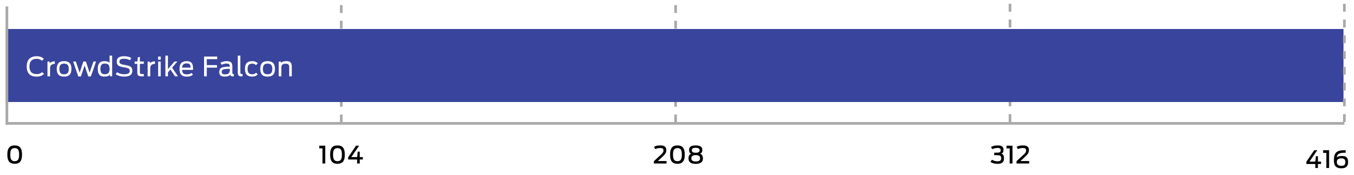
5. Legitimate Software Rating

These ratings indicate how accurately the product classifies legitimate applications and URLs, while also taking into account the interactions that the product has with the user. Ideally a product will either not classify a legitimate object or will classify it as safe. In neither case should it bother the user.

We also take into account the prevalence (popularity) of the applications and websites used in this part of the test, applying stricter penalties for when products misclassify very popular software and sites.



Legitimate Software Ratings		
Product	Legitimate Accuracy Ratings	Legitimate Accuracy (%)
CrowdStrike Falcon	416	100%



Legitimate Software Ratings can indicate how well a vendor has tuned its detection engine.

6. Conclusions

This test exposed **CrowdStrike Falcon** to a diverse set of exploits, file-less attacks and malware attachments, comprising the widest range of threats in any currently available public test.

All of these attack types have been witnessed in real-world attacks over the previous few years. They are representative of a real and present threat to business networks the world over. The threats used in this are similar or identical to those used by the threat groups listed in **Hackers vs. Targets** on page 9 and **4. Threat Intelligence** on pages 13 – 16.

It is important to note that while the test used the same types of attacks, new files were used. This exercised the tested product's abilities to detect and protect against certain approaches to attacking systems rather than simply detecting malicious files that have become well-known over the previous few years. The results are an indicator of potential future performance rather than just a compliance check that the product can detect old attacks.

The product detected all of the threats on a basic level, in that for each attack it detected at least some element of the attack chain. Even better, it also detected in depth, capturing details as each threat proceeded down the attack chain from the initial introduction to the system through to execution and subsequent behaviour by the attacker.

In three cases it failed to detect actions by the attackers. However, in those specific test cases it detected the delivery of the attack to the targets and the subsequent actions of the attacker, including gaining greater access to the target (privilege escalation) and either moving to new targets or interacting with them in other ways.

In two other cases the threats were delivered quietly, without detection, but were then noticed as they ran and committed almost all further actions. In the real world all these attacks would be detected at multiple stages.

The results are strong, and all attacks were detected in a comprehensive way. Sometimes products are overly aggressive and detect everything, including threats and legitimate objects. In this test **CrowdStrike Falcon** generated no such false positive results, which is as hoped. **CrowdStrike Falcon** wins a AAA award for its excellent performance.

Appendices

Appendix A: Terms Used

TERM	MEANING
Compromised	The attack succeeded, resulting in malware running unhindered on the target. In the case of a targeted attack, the attacker was able to take remote control of the system and carry out a variety of tasks without hindrance.
Blocked	The attack was prevented from making any changes to the target.
False positive	When a security product misclassifies a legitimate application or website as being malicious, it generates a 'false positive'.
Neutralised	The exploit or malware payload ran on the target but was subsequently removed.
Complete Remediation	If a security product removes all significant traces of an attack, it has achieved complete remediation.
Target	The test system that is protected by a security product.
Threat	A program or sequence of interactions with the target that is designed to take some level of unauthorised control of that target.
Update	Security vendors provide information to their products in an effort to keep abreast of the latest threats. These updates may be downloaded in bulk as one or more files, or requested individually and live over the internet.

Appendix B: FAQs

A full methodology for this test is available from our website.

- The test was conducted between 26th January to 7th February 2022.
- This test was conducted independently by SE Labs with similar testing made available to other vendors, at the same time, for their own standalone reports.
- The product was configured according to its vendor's recommendations.
- Targeted attacks were selected and verified by SE Labs.
- Malicious and legitimate data was provided to partner organisations once the test was complete.
- SE Labs conducted this endpoint security testing on physical PCs, not virtual machines.

Q What is a partner organisation? Can I become one to gain access to the threat data used in your tests?

A Partner organisations benefit from our consultancy services after a test has been run. Partners may gain access to low-level data that can be useful in product improvement initiatives and have permission to use award logos, where appropriate, for marketing purposes. We do not share data on one partner with other partners. We do not partner with organisations that do not engage in our testing.

Q We are a customer considering buying or changing our endpoint protection and/ or endpoint detection and response (EDR) product. Can you help?

A Yes, we frequently run private testing for organisations that are considering changing their security products. Please contact us at info@selabs.uk for more information.

Appendix C: Attack Details

Wizard Spider

Delivery	Execution	Action	Privilege Escalation	Post-Esclation Action	Lateral Movement	Lateral Action
Spearphishing Attachment	Powershell	File and Directory Discovery	Bypass User Account Control	Remote System Discovery	External Remote Services	Archive Collected Data
Spearphishing Link	Windows Command Shell	Process Discovery	Valid Accounts	Security Software Discovery	Domain Accounts	Data from Local System
	Service Execution	System Information Discovery		Windows Service	Exploitation of Remote Services	Data Staged
	Malicious File	System Network Configuration Discovery		Scheduled Task	Lateral Tool Transfer	Exfiltration Over Unencrypted/ Obfuscated Non-C2 Protocol
	Malicious Link	System Owner/User Discovery		Winlogon Helper DLL	Remote Desktop Protocol	Exfiltration Over C2 Channel
	Obfuscated Files or Information	Permission Groups Discovery		Registry Run Keys / Startup Folder	SMB/Windows Admin Shares	Service Stop
	Code-Signing			Dynamic-link Library Injection	Windows Remote Management	
	Web Protocols			Windows File and Directory Permissions Modification	Windows Management Instrumentation	
	Non-Standard Port			Masquerade Task or Service		
				Modify Registry		
				LLMNR/NBT-NS Poisoning and SMB Relay		
				NTDS		
				Security Account Manager		
				Kerberoasting		

Sandworm

Delivery	Execution	Action	Privilege Escalation	Post-Esclation Action	Lateral Movement	Lateral Action
Spearphising Attachment	Powershell	File and Directory Discovery	Domain Accounts	Credentials from Web Browsers	SSH	Cron
Spearphishing Link	Visual Basic	System Information Discovery	Bypass User Account Control	Keylogging	External Remote Services	Boot or Logon Initialization Scripts
	Windows Command Shell	System Owner/User Discovery	Setuid and Setgid	LSASS Memory	Remote Access Software	RC Scripts
	Unix Shell	System Network Configuration Discovery		Email Account (Discovery)		Systemd Service
	Malicious File	System Network Connections Discovery		Domain Account (Discovery)		Kernel Modules and Extension
	Malicious Link	Data from Local System		Remote System Discovery		SSH Authorized Keys
	Exploitation for Client Execution	Local Data Staging		Network Sniffing		/etc/passwd and /etc/shadow
	Valid Accounts	Exfiltration Over C2 Channel		Security Software Discovery		Bash History
	Web Shell			Ingress Tool Transfer		Clear Linux or Mac System Logs
	Deobfuscate/Decode Files or Information					
	File Deletion					
	Obfuscated Files or Information					
	Rundll32					
	Standard Encoding					
	Non-Standard Port					
	Proxy					
	Web Protocols					
	Bidirectional Communication					

Dragonfly & Dragonfly 2.0

Delivery	Execution	Action	Privilege Escalation	Post-Escalation Action	Lateral Movement	Lateral Action
Spearphishing Attachment	Application Layer Protocol	System Information Discovery	Valid Accounts	Scheduled Task	Remote Desktop Protocol	Automated Exfiltration
Malicious File	Command and Scripting Interpreter	Process Discovery		Clear Windows Event Logs		Screen Capture
	Windows Command Shell	System Owner/User Discovery		File deletion		Exfiltration Over C2 Channel
	Powershell			Ingress Tool Transfer		
				Local Account		
				Domain Account		
				Shortcut Modification		
Spearphishing Link	Command and Scripting Interpreter	Domain Groups	Valid Accounts	Modify Registry	Remote Desktop Protocol	Archive Collected Data
Malicious Link	Windows Command Shell	Remote System Discovery		Query Registry		Data from Local System
	Powershell	System Information Discovery		Registry Run Keys / Startup Folder		Local Data Staging
		Process Discovery		Disable or Modify System Firewall		Screen Capture
		System Owner/User Discovery		Forced Authentication		Exfiltration Over C2 Channel
Spearphishing Link	Command and Scripting Interpreter	System Information Discovery	Valid Accounts	System Network Configuration Discovery	Remote Desktop Protocol	Archive Collected Data
Malicious Link	PowerShell	Process Discovery		Archive Collected Data		Automated Exfiltration
		System Owner/User Discovery		Data from Local System		Exfiltration Over C2 Channel
		File and Directory Discovery		Local Data Staging		
		Network Share Discovery		Exfiltration Over C2 Channel		
				Credentials from Password Stores		
				LSA Secrets		
Spearphishing Attachment	Command and Scripting Interpreter	System Information Discovery	Valid Accounts	NTDS	Remote Desktop Protocol	Archive Collected Data
Malicious File	Windows Command Shell	Process Discovery		Ingress Tool Transfer		Data from Local System
		System Owner/User Discovery		Security Account Manager		Local Data Staging
		Process Injection		Local Account		Screen Capture
		File and Directory Discovery		Domain Account		Exfiltration Over C2 Channel

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