Vulnerability Management

Breach and Attack Simulation

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WP8-T1

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The Road Ahead: Breach and Attack Simulation

- What is Breach and Attack Simulation?
- Modelling Attacks
- Adversary Emulation
- Live Demonstration
- Wrapping Up

Motivation

- Also/better called: *“Adversary Emulation”*
- Marketing: *Breach and Attack Simulation (BAS) goes beyond vulnerability assessments, penetration testing, and red teaming by offering **automated and advanced** breach simulation*
- *"… proactively predict attacks, validates security controls and improves SOC analyst response"*
- Lots of phrases that don’t help if you don’t know about it already
- What **does** it do then? And how?
  - How does it compare to Penetration Tests and Vulnerability Assessments?
  - Or high-level (table-top) exercises (like CLAWS)?

First

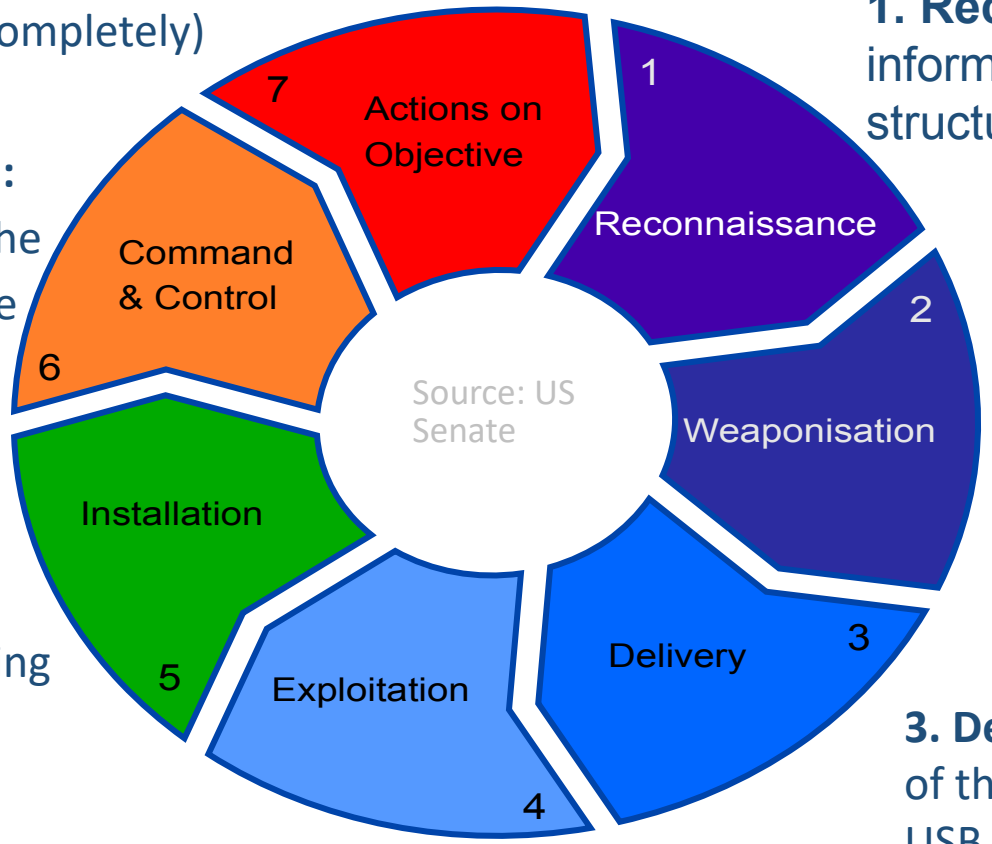
- To emulate an attacker, we have to know how an attacker behaves
  - I. e. we have to observe real adversaries and their attacks on real networks
- Then, we need abstract the observations to a formal model
- Then, we can use this model to emulate adversaries on our network

Modelling Attacks

(Intrusion|Cyber) Kill Chain

7. Actions or Objections: The attacker meets his/her goal (e.g. stealing information, gaining elevated privileges or damaging the host completely)

6. Command & Control: Setting up controls so the attacker can have future access to the host's network



1. Reconnaissance: Collecting information and learning about the internal structure of the host organization

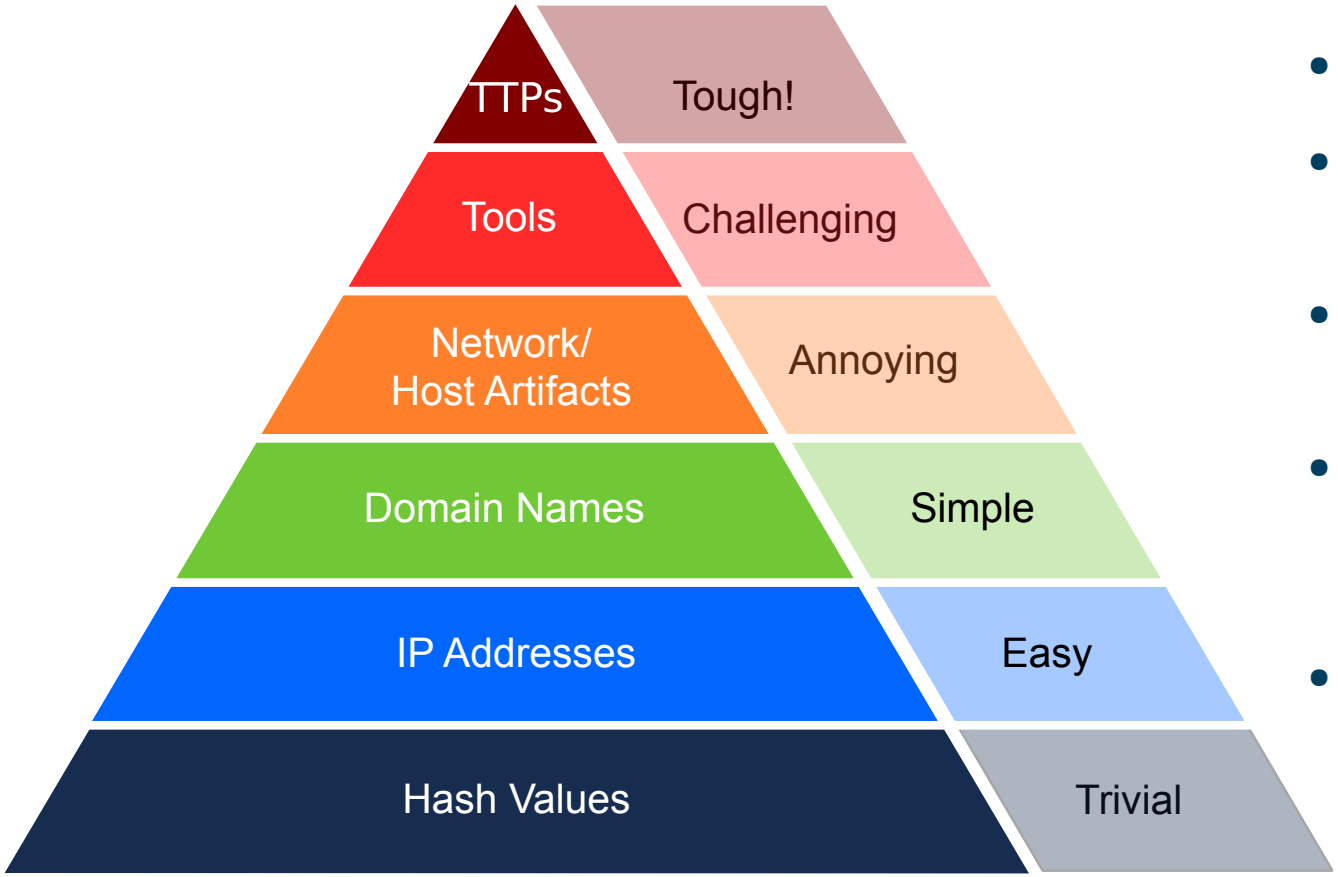
2. Weaponization: How the attacker packages the threat for delivery

3. Delivery: The actual delivery of the threat (via email, web, USB, etc.)

4. Exploitation: Once the host is compromised, the attacker can take advantage and conduct further attacks

5. Installation: Installing the actual malware

Pyramid of Pain



- Threat Intelligence Concept
- Values low in the pyramid are easy to observe/counter
- But also easy to change for the adversary
- The higher up in the pyramid, the harder it is for adversaries to change
- Conversely, the effort needed to observe/deduce goes up also

Mitre ATT&CK

- An effort to document common tactics, techniques and procedures (TTPs) used in APTs
  - ***A**dversarial **T**actics and **T**echniques based on **C**ommon **K**nowledge*
- A knowledge base of adversary behaviour based on observations of real incidents
- Broken down into
  - Tactics: What an attacker tries to accomplish at a given phase (goals)
    - See Kill Chain for comparison
  - Techniques: Behaviour that is used to accomplish the attackers target
- Also: A common taxonomy (compare CVE, et. al.)

ATT&CK Matrix (Enterprise)

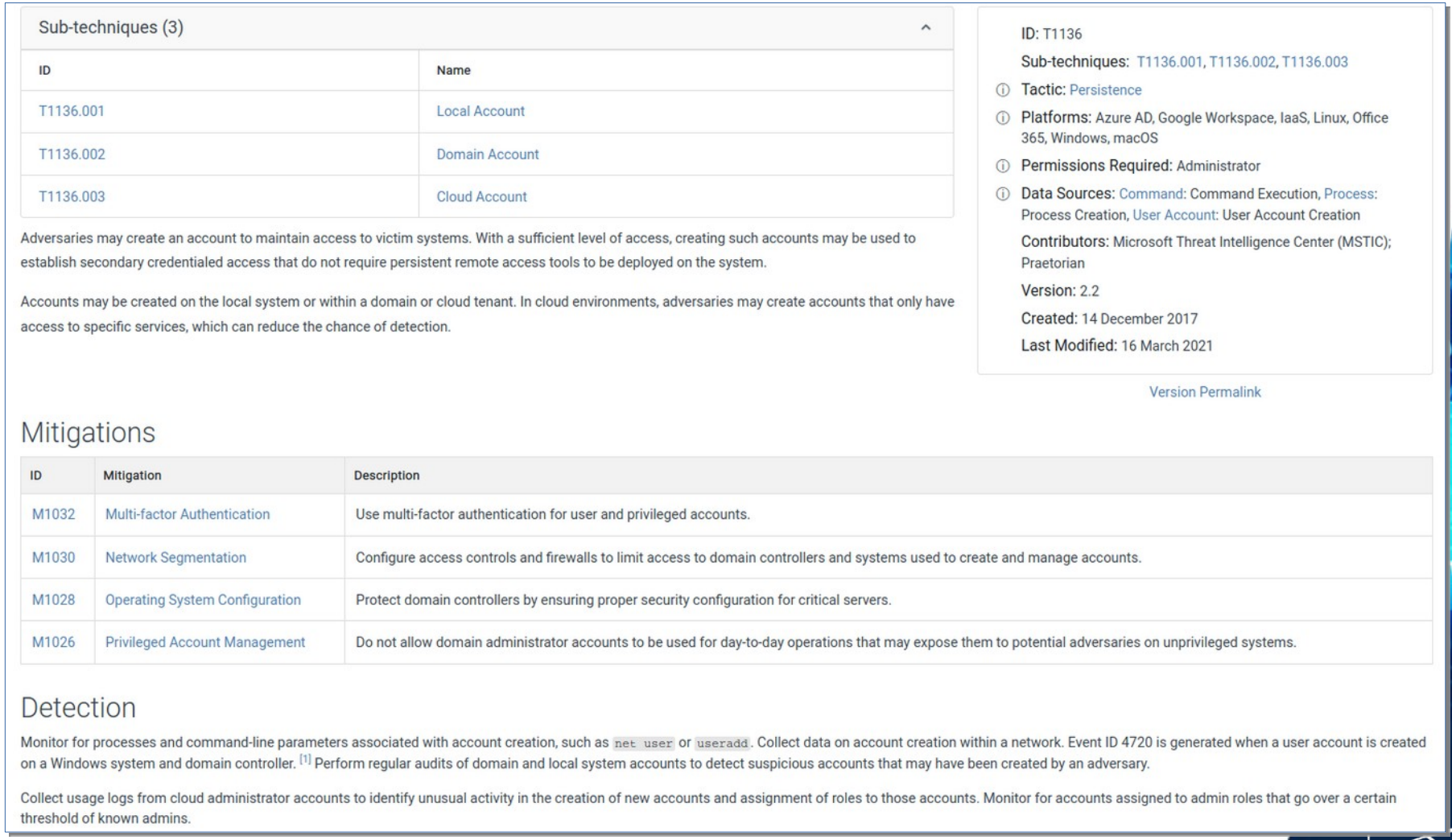
Source: https://attack.mitre.org/docs/attack_matrix_poster_2021_june.pdf

ATT&CK and the Kill Chain

- Data in the knowledge base is organized in a matrix
- Tactics: Column (header)
- Corresponds roughly to a phase of the kill chain
- The objective the attacker tries to reach (the “why”)
- Rows of a column: List of typical techniques used (the “how”)
- There are different matrices covering different environments
  - Enterprise systems, Mobile, Industrial Control Systems
- Techniques are covered in detail on separate web pages
  - Including mitigations - against a technique

Sample ATT&CK Technique

T1136:
Create Account



Sub-techniques (3)

ID	Name
T1136.001	Local Account
T1136.002	Domain Account
T1136.003	Cloud Account

Adversaries may create an account to maintain access to victim systems. With a sufficient level of access, creating such accounts may be used to establish secondary credentialed access that do not require persistent remote access tools to be deployed on the system.

Accounts may be created on the local system or within a domain or cloud tenant. In cloud environments, adversaries may create accounts that only have access to specific services, which can reduce the chance of detection.

ID: T1136

Sub-techniques: T1136.001, T1136.002, T1136.003

Tactic: Persistence

Platforms: Azure AD, Google Workspace, IaaS, Linux, Office 365, Windows, macOS

Permissions Required: Administrator

Data Sources: Command: Command Execution, Process: Process Creation, User Account: User Account Creation

Contributors: Microsoft Threat Intelligence Center (MSTIC); Praetorian

Version: 2.2

Created: 14 December 2017

Last Modified: 16 March 2021

Version Permalink

Mitigations

ID	Mitigation	Description
M1032	Multi-factor Authentication	Use multi-factor authentication for user and privileged accounts.
M1030	Network Segmentation	Configure access controls and firewalls to limit access to domain controllers and systems used to create and manage accounts.
M1028	Operating System Configuration	Protect domain controllers by ensuring proper security configuration for critical servers.
M1026	Privileged Account Management	Do not allow domain administrator accounts to be used for day-to-day operations that may expose them to potential adversaries on unprivileged systems.

Detection

Monitor for processes and command-line parameters associated with account creation, such as `net user` or `useradd`. Collect data on account creation within a network. Event ID 4720 is generated when a user account is created on a Windows system and domain controller. [1] Perform regular audits of domain and local system accounts to detect suspicious accounts that may have been created by an adversary.

Collect usage logs from cloud administrator accounts to identify unusual activity in the creation of new accounts and assignment of roles to those accounts. Monitor for accounts assigned to admin roles that go over a certain threshold of known admins.

Source: https://attack.mitre.org/wiki/Technique/T1136

Sample Attack Technique in a Simulation Tool

```yaml
attack_technique: T1136.001
display_name: 'Create Account: Local Account'
atomic_tests:
- name: Create a user account on a Linux system
  auto_generated_guid: 40d8eabd-e394-46f6-8785-b9bfa1d011d2
  description: |
    Create a user via useradd
  supported_platforms:
  - linux
  input_arguments:
    username:
      description: Username of the user to create
      type: String
      default: evil_user
  executor:
    command: |
      useradd -M -N -r -s /bin/bash -c evil_account #{username}
    cleanup_command: |
      userdel #{username}
    name: bash
    elevation_required: true
```

...

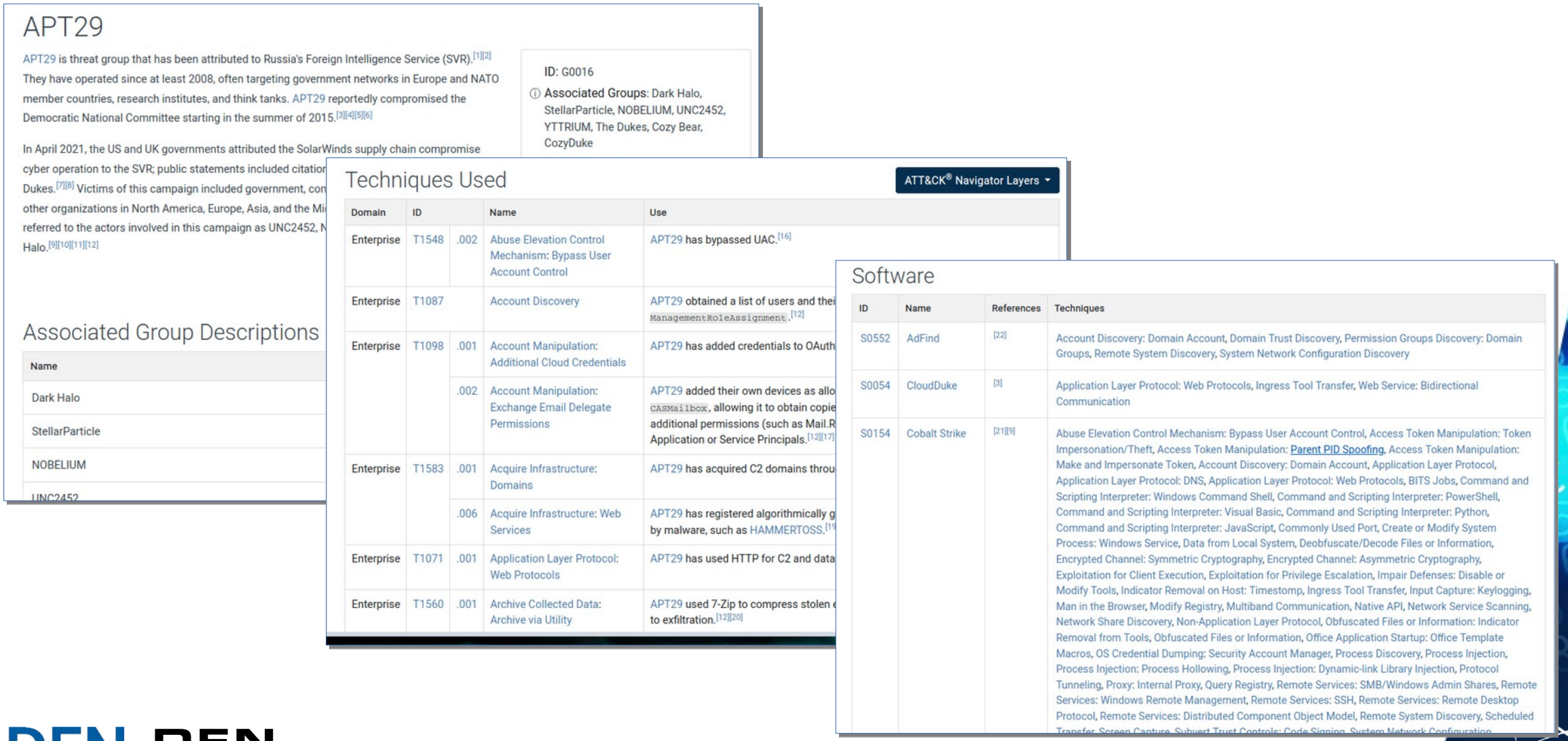
```yaml
- name: Create a new Windows admin user
  auto_generated_guid: fda74566-a604-4581-a4cc-fbbe21d66559
  description: |
    Creates a new admin user in a command prompt.
  supported_platforms:
  - windows
  input_arguments:
    username:
      description: Username of the user to create
      type: String
      default: T1136.001_Admin
    password:
      description: Password of the user to create
      type: String
      default: T1136_pass
  executor:
    command: |
      net user /add "#{username}" "#{password}"
      net localgroup administrators "#{username}" /add
    cleanup_command: |
      net user /del "#{username}" >nul 2>&1
    name: command_prompt
    elevation_required: true
```

Source: https://github.com/redcanaryco/atomic-red-team/tree/master/atomics/T1136.001

Mitre ATT&CK Threat Actors

- Database stores also Information about Threat Actor Groups
  - Like APT29, etc. - some (but not all) well known APT groups
  - Open source information - don’t expect something new here
- Using this information allows to mimic the behaviour of this groups in adversary emulation
  - ATT&CK is used by many, but not all, adversary emulation tools
- Caveat: Threat Actors change and adapt, information may thus may not always be accurate
  - Outdated
  - Not commonly known (yet)

Mitre ATT&CK Threat Actors



APT29

APT29 is threat group that has been attributed to Russia's Foreign Intelligence Service (SVR).[1][2] They have operated since at least 2008, often targeting government networks in Europe and NATO member countries, research institutes, and think tanks. APT29 reportedly compromised the Democratic National Committee starting in the summer of 2015.[3][4][5][6]

In April 2021, the US and UK governments attributed the SolarWinds supply chain compromise cyber operation to the SVR; public statements included citation Dukes.[7][8] Victims of this campaign included government, con other organizations in North America, Europe, Asia, and the Mi referred to the actors involved in this campaign as UNC2452, N Halo.[9][10][11][12]

ID: G0016

Associated Groups: Dark Halo, StellarParticle, NOBELIUM, UNC2452, YTTRIUM, The Dukes, Cozy Bear, CozyDuke

Associated Group Descriptions

Name
Dark Halo
StellarParticle
NOBELIUM
UNC2452

Techniques Used

ATT&CK® Navigator Layers

Domain	ID		Name	Use
Enterprise	T1548	.002	Abuse Elevation Control Mechanism: Bypass User Account Control	APT29 has bypassed UAC.[16]
Enterprise	T1087		Account Discovery	APT29 obtained a list of users and thei `ManagementRoleAssignment`.[12]
Enterprise	T1098	.001	Account Manipulation: Additional Cloud Credentials	APT29 has added credentials to OAuth
		.002	Account Manipulation: Exchange Email Delegate Permissions	APT29 added their own devices as allo `CASMailbox`, allowing it to obtain copie additional permissions (such as Mail.R Application or Service Principals.[12][17]
Enterprise	T1583	.001	Acquire Infrastructure: Domains	APT29 has acquired C2 domains throu
		.006	Acquire Infrastructure: Web Services	APT29 has registered algorithmically g by malware, such as HAMMERTOSS.[19
Enterprise	T1071	.001	Application Layer Protocol: Web Protocols	APT29 has used HTTP for C2 and data
Enterprise	T1560	.001	Archive Collected Data: Archive via Utility	APT29 used 7-Zip to compress stolen to exfiltration.[12][20]

Software

ID	Name	References	Techniques
S0552	AdFind	[22]	Account Discovery: Domain Account, Domain Trust Discovery, Permission Groups Discovery: Domain Groups, Remote System Discovery, System Network Configuration Discovery
S0054	CloudDuke	[3]	Application Layer Protocol: Web Protocols, Ingress Tool Transfer, Web Service: Bidirectional Communication
S0154	Cobalt Strike	[21][9]	Abuse Elevation Control Mechanism: Bypass User Account Control, Access Token Manipulation: Token Impersonation/Theft, Access Token Manipulation: Parent PID Spoofing, Access Token Manipulation: Make and Impersonate Token, Account Discovery: Domain Account, Application Layer Protocol, Application Layer Protocol: DNS, Application Layer Protocol: Web Protocols, BITS Jobs, Command and Scripting Interpreter: Windows Command Shell, Command and Scripting Interpreter: PowerShell, Command and Scripting Interpreter: Visual Basic, Command and Scripting Interpreter: Python, Command and Scripting Interpreter: JavaScript, Commonly Used Port, Create or Modify System Process: Windows Service, Data from Local System, Deobfuscate/Decode Files or Information, Encrypted Channel: Symmetric Cryptography, Encrypted Channel: Asymmetric Cryptography, Exploitation for Client Execution, Exploitation for Privilege Escalation, Impair Defenses: Disable or Modify Tools, Indicator Removal on Host: Timestomp, Ingress Tool Transfer, Input Capture: Keylogging, Man in the Browser, Modify Registry, Multiband Communication, Native API, Network Service Scanning, Network Share Discovery, Non-Application Layer Protocol, Obfuscated Files or Information: Indicator Removal from Tools, Obfuscated Files or Information, Office Application Startup: Office Template Macros, OS Credential Dumping: Security Account Manager, Process Discovery, Process Injection, Process Injection: Process Hollowing, Process Injection: Dynamic-link Library Injection, Protocol Tunneling, Proxy: Internal Proxy, Query Registry, Remote Services: SMB/Windows Admin Shares, Remote Services: Windows Remote Management, Remote Services: SSH, Remote Services: Remote Desktop Protocol, Remote Services: Distributed Component Object Model, Remote System Discovery, Scheduled Transfer, Screen Capture, Subvert Trust Controls: Code Signing, System Network Configuration

Adversary Emulation

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How Adversary Emulation Works

- It takes a formal model of adversary behaviour
  - I. e. the tactics and groups from ATT&CK
- And carries out activities of that model
  - I. e. the techniques
- On systems of your network
  - Executing element: Agent
- An emulation consists of a series/group of activities
  - Aka Operation/Scenario/Campaign/Profile
  - Selected part of infrastructure = Application, system, network, etc.
- End result is a report/visualization (usually a web page)

Agents

- Used to gather Information
  - Vulnerabilities
  - System information
  - Sensible information (stuff that adversaries want to exfiltrate)
- And carrying out other activities
  - May be run persistently or uninstall after the emulation
  - Privilege level depends on deployment, i. e. root/admin or unprivileged user
- Combination with other tools
  - Import of vulnerability data from other tools, like Nmap
  - Post-exploitation tool together with pentest tools like Metasploit

Adversary Emulation Demo

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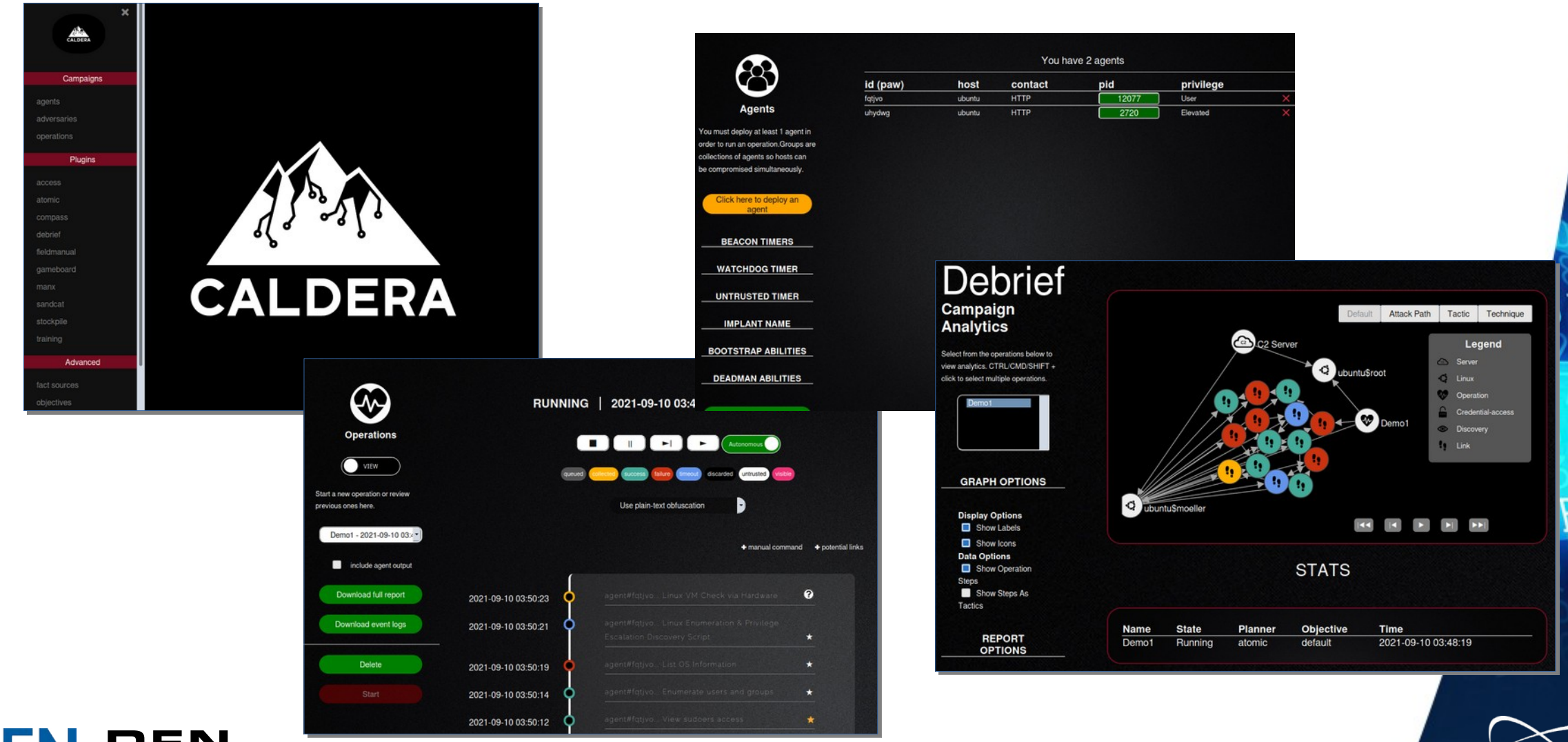
Mitre Caldera



Wrapping Up

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Critique

- ATT&CK as a general model for adversary behaviour
  - No all emulation tools use it, others may use their own model
  - If you want/need a specific model, check with the vendor
  - Better on the vulnerability side, CVE is almost universally accepted
- Import of vulnerability data from other tools limited
  - Like OpenVAS, OWASP ZAP, …
- Security
  - **Agents are Remote Access Trojans!**
  - Deployment on production networks?
- Privacy protection (need we say more?)
  - This **is** vital (esp. under GDPR)

Adversary Emulation vs.

- **Penetration Tests**
  - Penetration tests are usually more limited in scope, i.e. finding vulnerabilities in one application or network
  - Adversary (the penetration tester) is not bound to tactics or techniques
  - Creativity is the distinguishing element
- **High-level tabletop exercises** (e. g. CLAWS)
  - Focuses on the procedural/human level of incident response
  - Blue/Purple team exercises can be carried out with (some) tools
  - However, they focus more on the technical level
  - Like: *“Did the SOC notice a given technique/tactic?”*

Finally

- Scans, detection, emulation do **not** make a network more secure!
- The real work is
  - **Closing the vulnerabilities**, and
  - **Changing operating procedures (i. e. human behaviour)**
- Which is as hard as before
- Besides that …
  - Campaign/Operation has to be planned carefully in advance
    - That's work too!
  - Purchasing and maintaining a tool takes effort also
  - Planning and execution needs in-house cooperation

What have you learned?

- Adversary Emulation can be an additional tool for
  - Testing your detection mechanisms
  - Raising awareness
- Takes careful planning
- Start small, expand later - you will never be 100% perfect

What's Next?

- Next module: ***Forensics for Admins***
  - How to aquire forensic evidence on compromised systems
- Coming soon on GÉANT WP8

Thank you

Any questions?

Next Module: ***Forensics for Admins***

Coming soon:)

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References:

- Mitre ATT&CK: https://attack.mitre.org/
- Meta Attack Language (MAL) (used by foreseeti)
  - https://mal-lang.org
  - https://github.com/mal-lang
  - https://docs.foreseeti.com/docs
- Pyramid of Pain: https://detect-respond.blogspot.com/2013/03/the-pyramid-of-pain.html
- OVAL/SCAP, CVE, CVSS, CPE, … https://oval.mitre.org/adoption/usecasesguide.html#vulnerability

Open Source Adversarial Emulation Tools

- InfectionMonkey (Guardicore)
  - https://www.guardicore.com/infectionmonkey/
  - https://github.com/guardicore/monkey
- Metta adversarial simulation tool (Uber)
  - https://github.com/uber-common/metta
- CALDERA (Mitre)
  - https://github.com/mitre/caldera
- AlphaSOC: FlightSIM tool for generating malicious network traffic
  - https://github.com/alphasoc/flightsim
- Red Canary: Atomic Red Team tests
  - https://github.com/redcanaryco/atomic-red-team
- Endgame: Red Team Automation (RTA) Scripts
  - https://github.com/endgameinc/RTA

Commercial Adversarial Emulation Tools

- SafeBreach
- foreseeti: SecuriCAD
- AttackIQ
- Scythe
- XM Cyber: HaXM
- Randori
- Picus Security: Picus
- Cymulate
- CyCognito
- FireEye: Mandiant SIEM, enthält ex Verodin
- FireMon: Risk Analyzer
- Qualys: VMDR (Vulnerability Management, Detection, and Response) platform

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