black hat
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Real-Time AD Attack Detection: Detect Attacks Leveraging Domain Administrator Privilege

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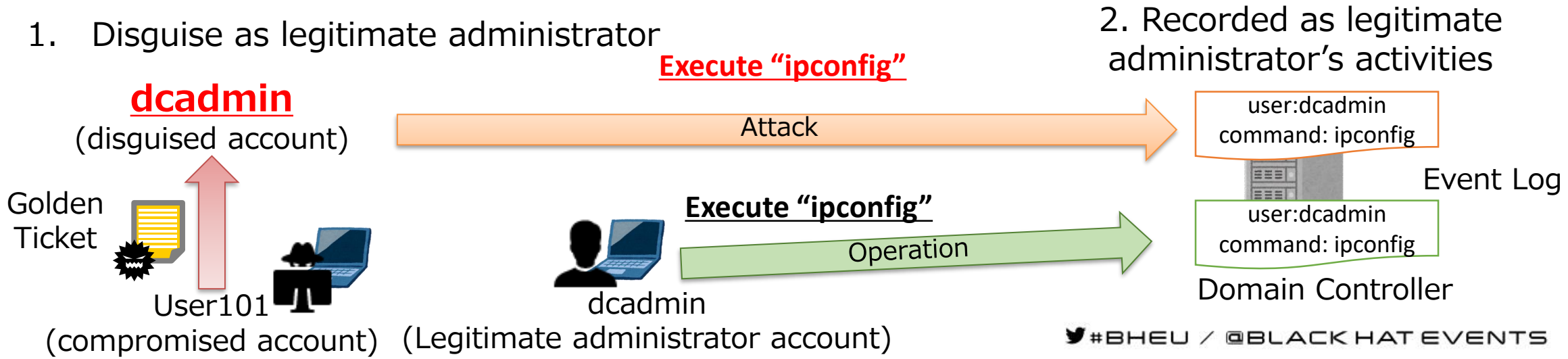
Introduction

- In targeted attacks, attackers tend to attack Active Directory (AD) in order to expand infections
- Attackers try to take over **Domain Administrator privileges** and create a backdoor called the "**Golden Ticket**"
- Attackers leverage the Golden Ticket to disguise themselves as **legitimate administrator accounts** to avoid detection **for a long period** of time
- We've implemented a real-time detection tool combining **signature-based** and **machine learning** detection that utilizes **Domain Controller Event Logs** in order to detect attack activities including the use of Golden Tickets

Difficulty of detecting Golden Ticket attacks

- **Golden Ticket** is a Kerberos authentication ticket created by the attackers that has a **legitimate signature** and **a long term of validity** (e.g. ten years)
- Attackers use some **built-in windows commands** in addition to attack tools
- It is difficult to identify attackers' activities if legitimate administrators often use commands in daily operations



Summary of our tool

- We've implemented a real-time detection tool to detect attack activities that abuse Domain Administrator privileges such as the use of Golden Tickets
- It analyzes Event Logs with **signature-based and machine learning detection** to yield high detection rate

Methods	Advantages	Disadvantages
Signature-based detection	It yields **high recall rate**.	A lot of **false positive** can occur depending on the daily operations.
Machine learning detection	It can find **unusual activities** compared with daily operations.	False negative can occur in some situations.

Signature-based detection

- We pick up several useful existing methods, and organize specific detection signatures

	Signature
A	Monitor **unexpected use of administrative privilege** using Event ID: 4672
B	Monitor execution of **CLI tools** that attackers tend to use from Event ID: 4688, 4674
C	Monitor Use of **administrative shared** resources (e.g. ¥c$) using Event ID: 5140
D	**Service Ticket request without a prior TGT request** using Event ID: 4768, 4769

Signature B) Execution of tools attackers tend to use

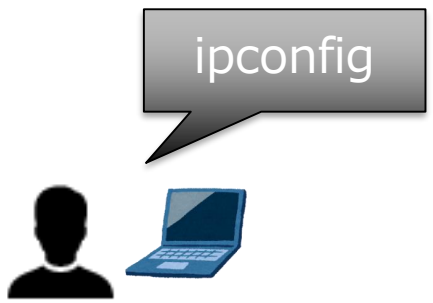
- We register the following commands into the blacklist, since they tend to be used by attackers

Command	
tasklist.exe	type
ver	at.exe
ipconfig.exe	reg.exe
systeminfo.exe	wmic.exe
net.exe	wusa.exe
netstat.exe	netsh.exe
whoami.exe	sc.exe
qprocess.exe	rundll32.exe
query.exe	schtasks.exe
dir	ping.exe

Reference: https://blog.jpcert.or.jp/2016/01/windows-commands-abused-by-attackers.html

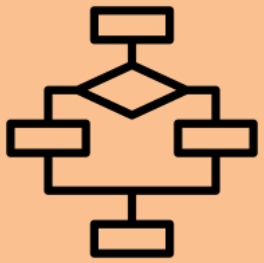
Machine learning detection

- For signature B (CLI tools), a lot of **false positives** can occur when the legitimate Domain Administrator uses the commands included in the blacklist for daily operations
- To solve the problem, we re-analyze the results of signature-based detection using **machine learning**



Legitimate Domain Administrator

Signature -based detection



This is “Attack” since “ipconfig” is on the blacklist.

False positive

Machine learning detection

This is **not an ”Attack”** since “ipconfig” is used in daily operations.

True Negative

Implementation of our tools

Launch Detection programs

Logstash (Log parser)

Winlogbeat (Log transfer agent)

Logs are sent in real-time

If matches signature A, C or D

Signature-based detection

Visualize with Kibana

Send alert mail

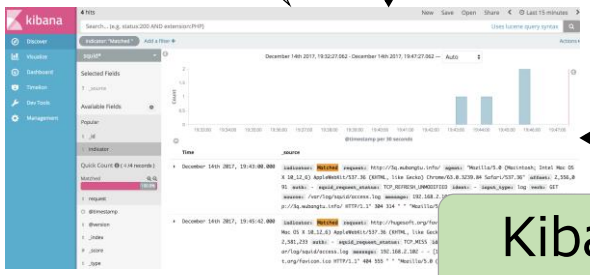
If matches signature B (suspicious commands)

Machine learning detection

Domain Controller

Elastic Search

Preserve logs

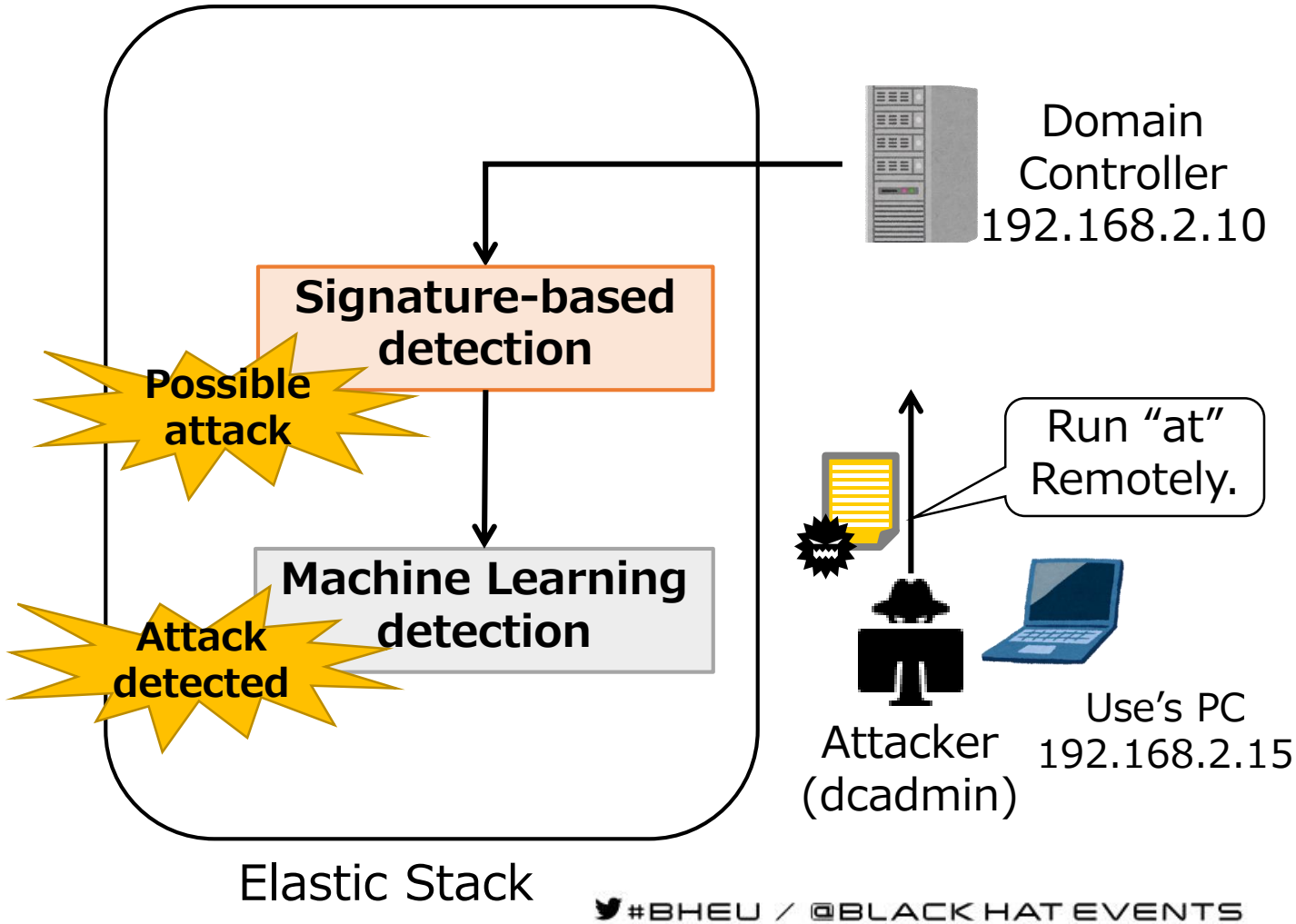


Kibana

Elastic Stack

Demonstration scenario

1. Attacker take over Domain Administrator privilege leveraging **privilege escalation** vulnerability (MS14-068)
2. Mount C drive of Domain Controller using **administrative share**
3. Create Golden Ticket for dcadmin
4. Accesses the DC using remote access tool "**PsExec**" with a **Golden Ticket** and run **"at" command**
5. Signature-based detection detects attack since "at" is on the blacklist
6. Machine Learning also detects attack since "at" command is not used in daily operations



We published the sample code of our tool.

https://github.com/sisoc-tokyo/Real-timeDetectionAD

Thank you for your attention!

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Input data

- Input data is the **Domain Controller's Event Logs**
- Focus on detecting **attacks against the Domain Controller**

Event ID	Description	The point for detection
4672	Special privileges assigned to a new login	Information of accounts that use administrative privileges are recorded.
4674	An operation was attempted on a privileged object	Specific commands and process executed with administrative privilege are recoded.
4688	A new process has been created	All processes information including attack commands are recorded.
4768	A Kerberos authentication ticket (TGT) was requested	When a Golden Ticket is used, this event is not recorded.
4769	A Kerberos service ticket was requested	When a service is accessed using a TGT including the Golden Ticket, this event is recorded.
5140	A network share object was accessed	This event is recorded when a file sharing service is accessed.

Required audit policy setting

	Sub category	Default setting	Required setting (*)
Account Logon	Audit Credential Validation	Success	Success **Failure**
	Audit Kerberos Authentication Service	Success	Success **Failure**
	Audit Kerberos Service Ticket Operations	Success	Success **Failure**
Logon/Logoff	Audit Logon	Success Failure	Success Failure
	Audit Special Logon	Success	Success **Failure**
Object Access	Audit File Share	Not configured	**Success** **Failure**
Detailed Tracking	Audit Process Creation	Not configured	**Success** **Failure**
Privilege Use	Audit Sensitive Privilege Use	Not configured	**Success** **Failure**

*: Audit settings written in bold red letter are not enabled by default.