DEVCORE

LeakLess?
Another Leak Way
in Windows Kernel DFSC

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Introduction

Why do we need Elevation of Privilege ?

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```
ruct group_info init_groups = { .usage = ATOMIC_INIT(2) };
ruct group_info *groups_alloc(int gidsetsize){
  struct group_info *group_info;
  int nblocks;
  int i;

  nblocks = (gidsetsize + NGROUPS_PER_BLOCK - 1) / NGROUPS_PER_BLOCK;
  /* Make sure we always allocate at least one indirect block pointer */
  nblocks = nblocks ? : 1;
  group_info = kmalloc(sizeof(*group_info) + nblocks*sizeof(gid_t *), GFP_USER);
  if
  gro
  gro
  ato

  if (gidsetsize <= NGROUPS_SMALL)
      group_info->blocks[0] = group_info->small_block;
  else {
      for (i = 0; i < nblocks; i++) {
          gid_t *b;
          id *)__get_free_page(GFP_USER);
          if (!b)
              goto out_undo_partial_alloc;
```

ACCESS DENIED

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Why?

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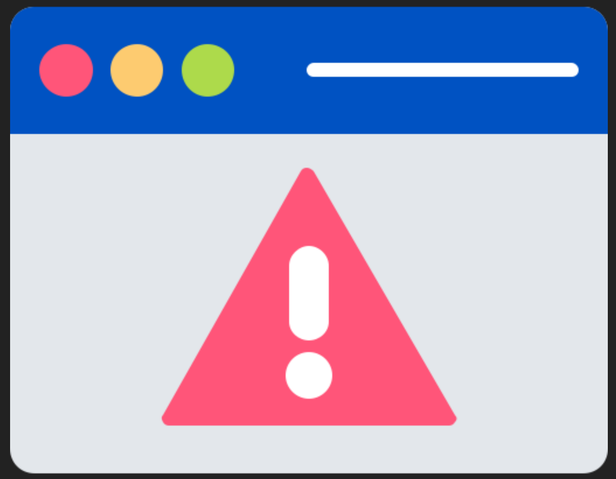
- 在執行紅隊過程中，經常取得一台機器控制權後，權限過低無法獲取機密資訊
  - 現階段已知提權方法越來越難用，條件越來越嚴苛



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- Pwn2Own
  - 有機會的話還是會想要能在 Pwn2Own 上能攻下 Windows

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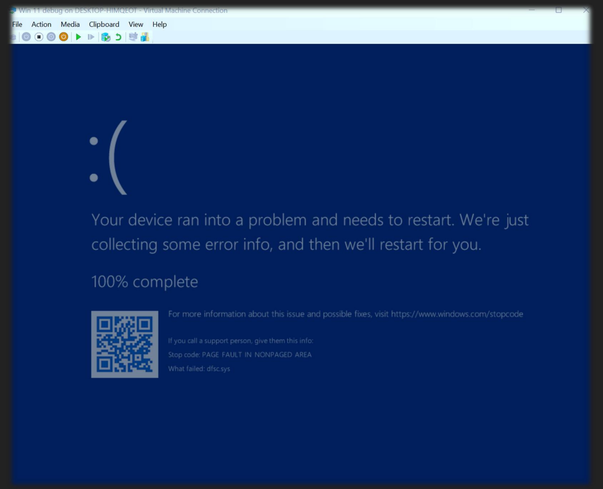
- 個人興趣



How to choose a target ?

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How to choose a target ?

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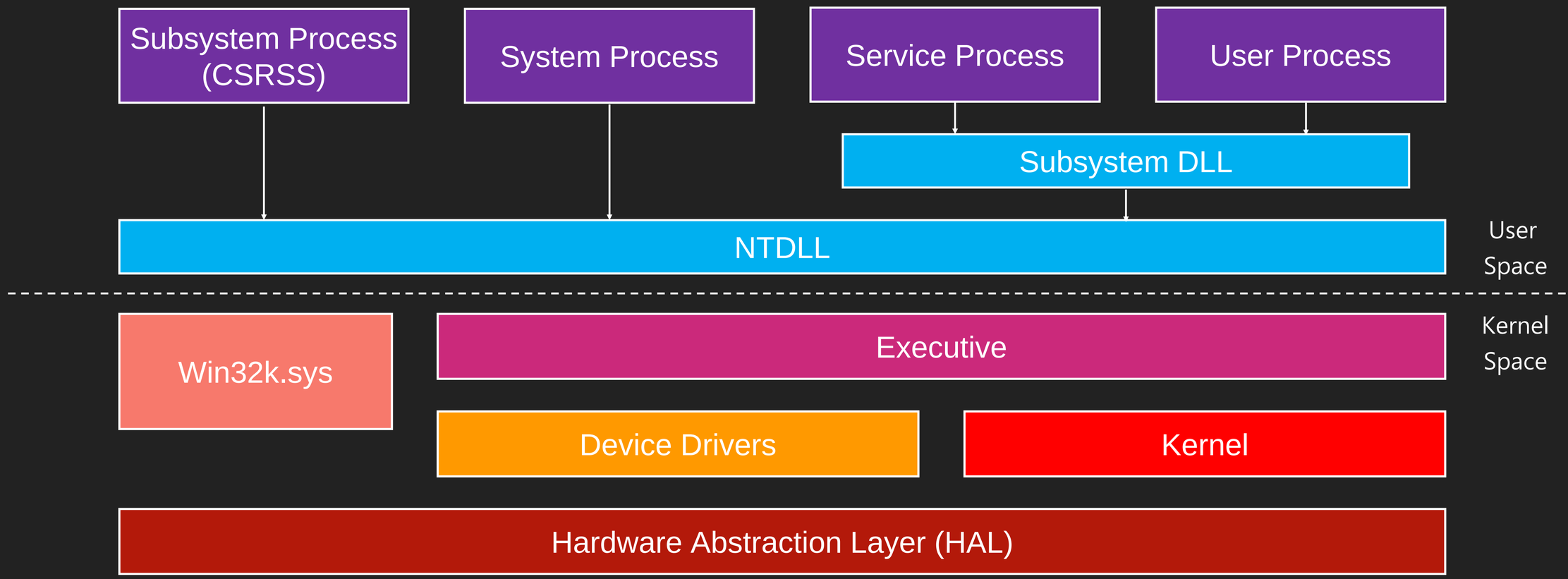
Windows 架構圖



How to choose a target ?

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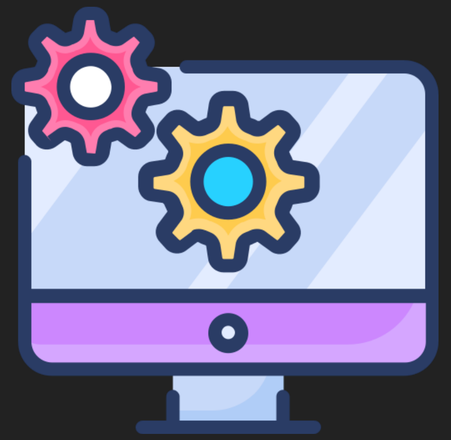
- 提權主流
  - Service
  - Potato 系列
  - Windows Kernel



README GPL-3.0 license

Juicy Potato (abusing the golden privileges)

A sugared version of RottenPotatoNG, with a bit of juice, i.e. ***another Local Privilege Escalation tool, from a Windows Service Accounts to NT AUTHORITY\SYSTEM***

How to choose a target ?

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- 提權主流
  - Service
  - ~~Potato 系列~~
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How to choose a target ?

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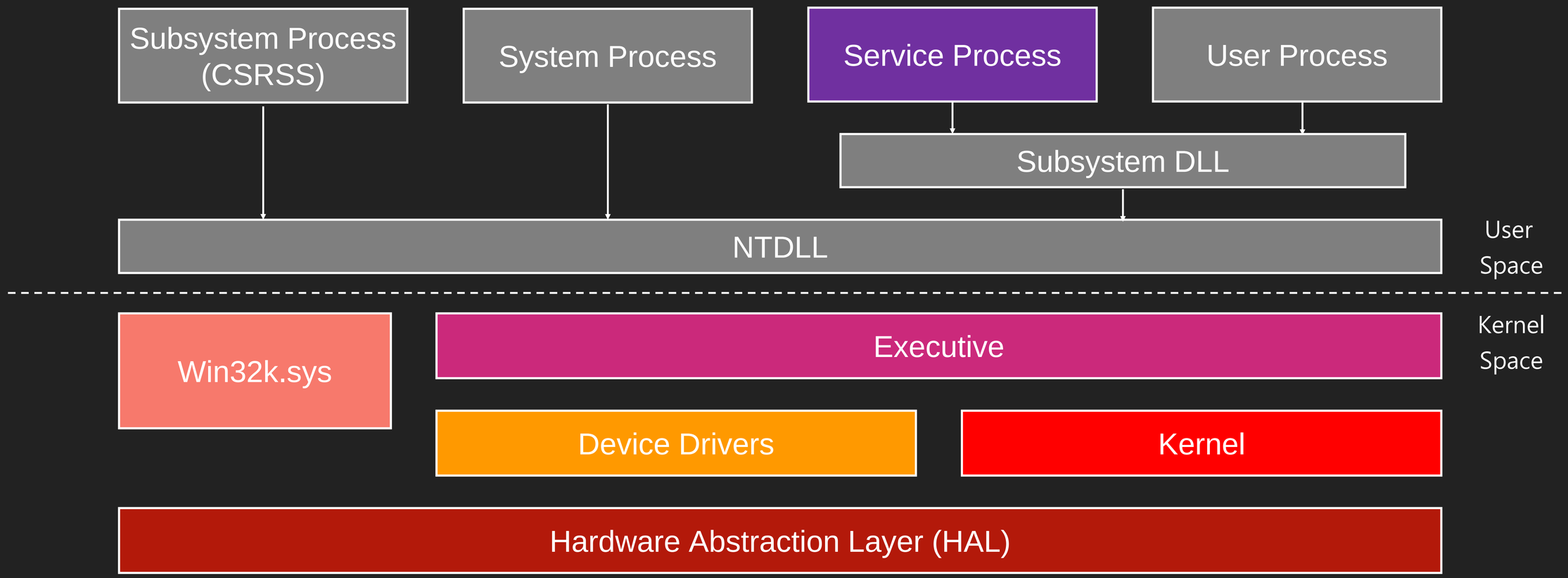
Windows 架構圖



How to choose a target ?

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- 提權主流
  - ~~Service~~
  - Windows Kernel
    - Pwn2Own 中只允許 Windows Kernel 的漏洞

Local Escalation of Privilege Category
An attempt in this category must be launched from within the target under test from a non-admin and non-root account. In this category, the entry must leverage a kernel vulnerability to escalate privileges.

Targets:

Target	Prize	Master of Pwn Points
Ubuntu Desktop	$20,000	2
Microsoft Windows 11	$30,000	3
Apple macOS	$40,000	4

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Windows Kernel Elevation of Privilege

Find Vulnerability in Windows Kernel

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Windows Kernel EoP

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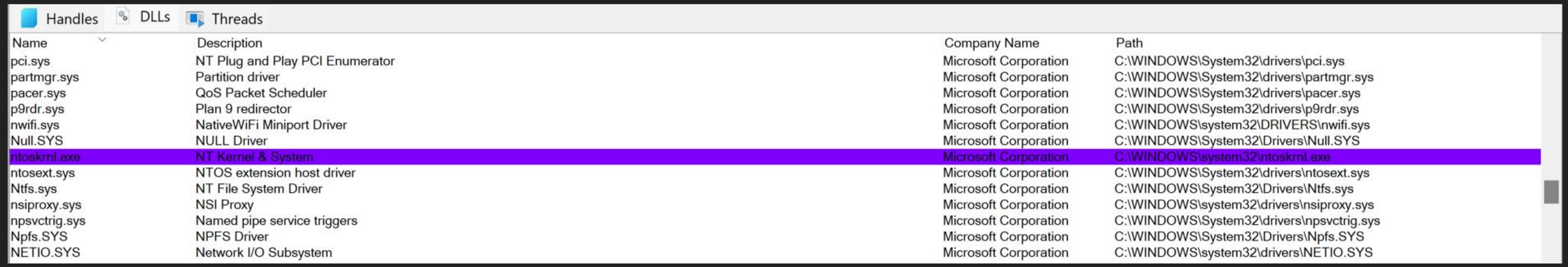
Find Vulnerability in Windows Kernel

- Ntoskrnl.exe
- Device driver



Name	Description	Company Name	Path
pci.sys	NT Plug and Play PCI Enumerator	Microsoft Corporation	C:\WINDOWS\System32\drivers\pci.sys
partmgr.sys	Partition driver	Microsoft Corporation	C:\WINDOWS\System32\drivers\partmgr.sys
pacer.sys	QoS Packet Scheduler	Microsoft Corporation	C:\WINDOWS\System32\drivers\pacer.sys
p9rdr.sys	Plan 9 redirector	Microsoft Corporation	C:\WINDOWS\System32\drivers\p9rdr.sys
nwifi.sys	NativeWiFi Miniport Driver	Microsoft Corporation	C:\WINDOWS\system32\DRIVERS\nwifi.sys
Null.SYS	NULL Driver	Microsoft Corporation	C:\WINDOWS\System32\Drivers\Null.SYS
ntoskrnl.exe	NT Kernel & System	Microsoft Corporation	C:\WINDOWS\system32\ntoskrnl.exe
ntosext.sys	NTOS extension host driver	Microsoft Corporation	C:\WINDOWS\System32\drivers\ntosext.sys
Ntfs.sys	NT File System Driver	Microsoft Corporation	C:\WINDOWS\System32\Drivers\Ntfs.sys
nsiproxy.sys	NSI Proxy	Microsoft Corporation	C:\WINDOWS\system32\drivers\nsiproxy.sys
npsvctrig.sys	Named pipe service triggers	Microsoft Corporation	C:\WINDOWS\System32\drivers\npsvctrig.sys
Npfs.SYS	NPFS Driver	Microsoft Corporation	C:\WINDOWS\System32\Drivers\Npfs.SYS
NETIO.SYS	Network I/O Subsystem	Microsoft Corporation	C:\WINDOWS\system32\drivers\NETIO.SYS

Windows Kernel EoP

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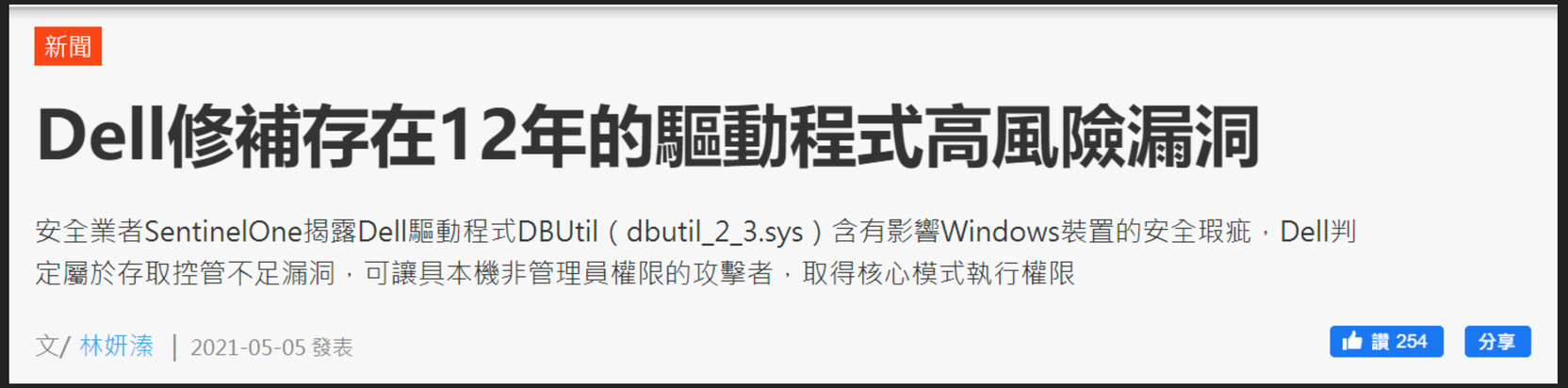
Find Vulnerability in Windows Kernel

- 第三方 driver
  - AMD
  - NVIDIA
  - Dell
  - ...


新聞

Dell修補存在12年的驅動程式高風險漏洞

安全業者SentinelOne揭露Dell驅動程式DBUtil（dbutil_2_3.sys）含有影響Windows裝置的安全瑕疵，Dell判定屬於存取控管不足漏洞，可讓具本機非管理員權限的攻擊者，取得核心模式執行權限

文/ 林妍溱 | 2021-05-05 發表

讚 254 分享

https://www.ithome.com.tw/news/144199

Windows Kernel EoP

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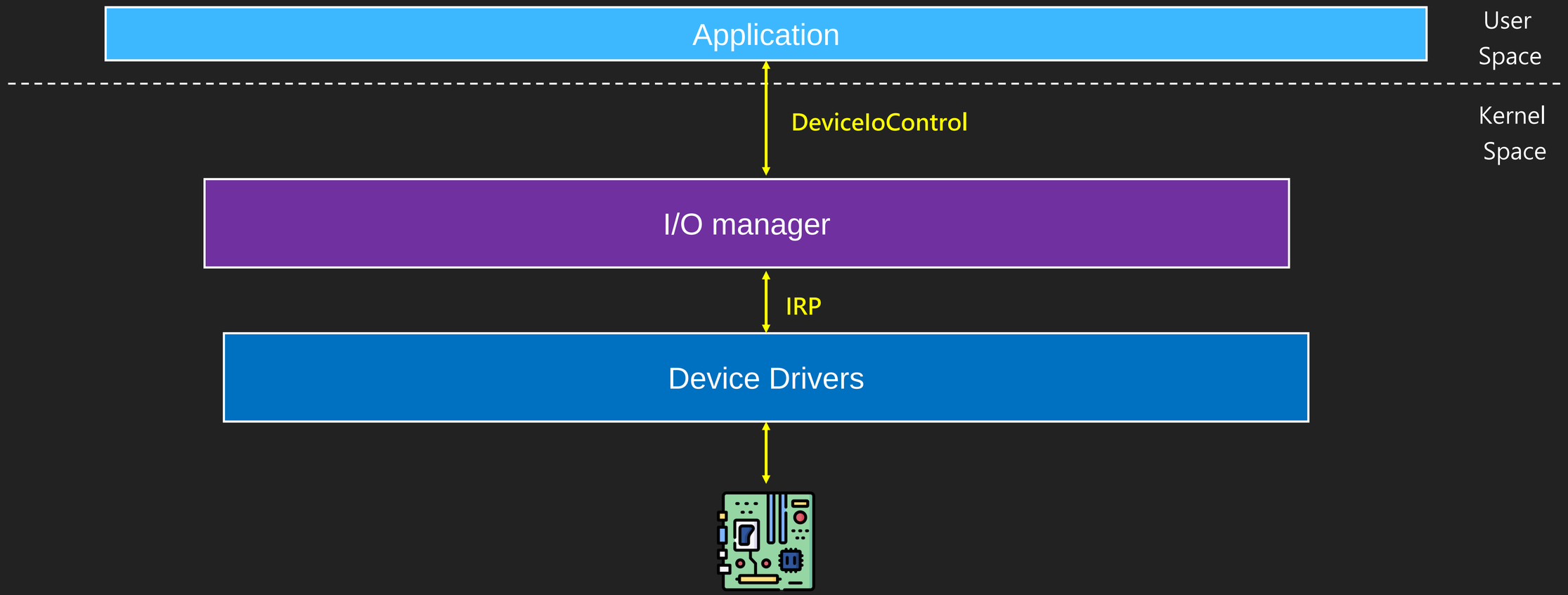
Find Vulnerability in Windows Kernel

- User 透過 DeviceIoControl/NtFsControlFile 等 API 與 kernel 互動



Windows Kernel EoP

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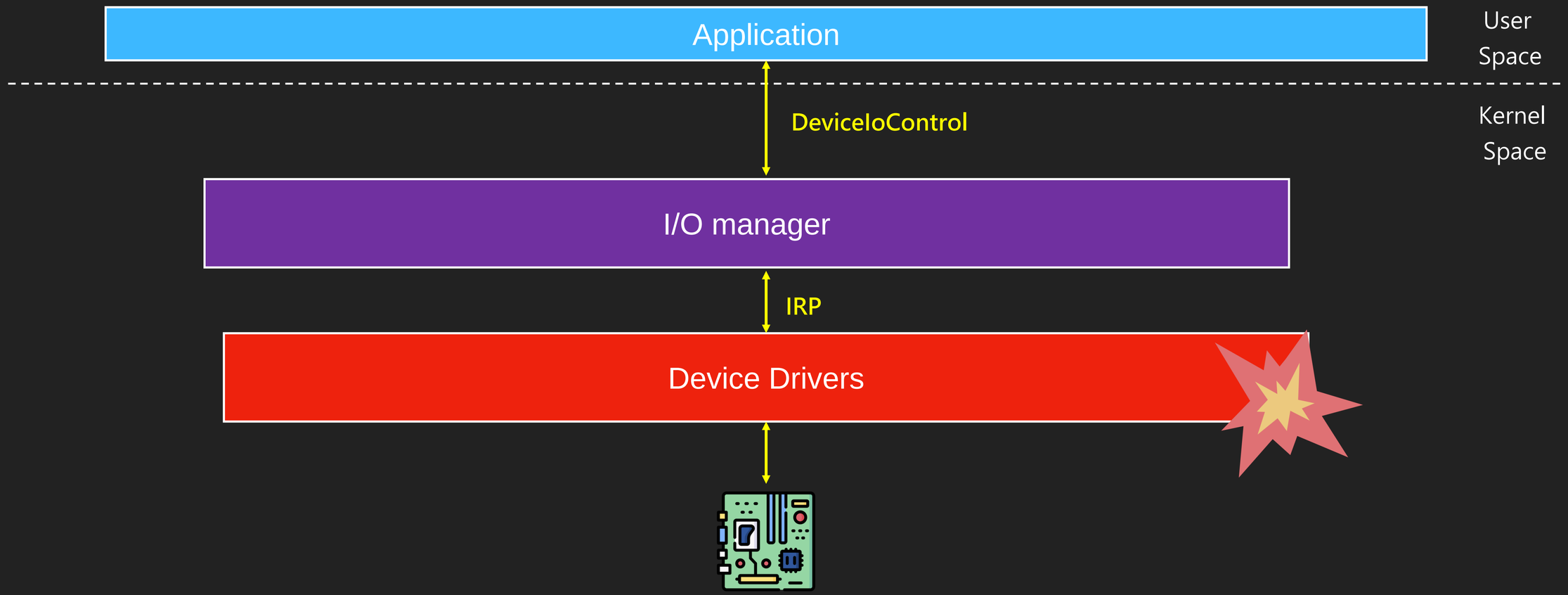

Use Windows API to leak kernel address

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Windows Kernel EoP

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Use Windows API to leak kernel address

- Use NtQuerySystemInformation with SystemModuleInformation can get ntoskrnl address.

C++ Copy

```
__kernel_entry NTSTATUS NtQuerySystemInformation(
  [in]            SYSTEM_INFORMATION_CLASS SystemInformationClass,
  [in, out]       PVOID                    SystemInformation,
  [in]            ULONG                    SystemInformationLength,
  [out, optional] PULONG                   ReturnLength
);
```

But …

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Windows Kernel EoP

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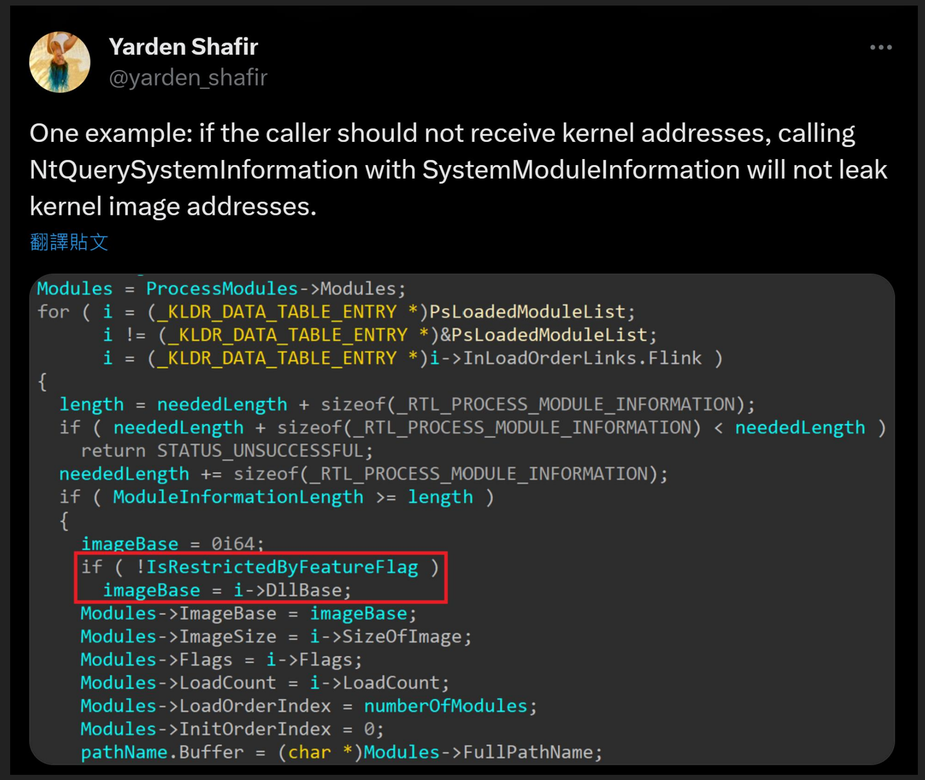
KASLR Leak Restriction

- Windows NtQuerySystemInformation 系列的 leak kernel pointer 方法已無法在沒有 SeDebugPrivilege 情況下使用 (24H2)



Yarden Shafir
@yarden_shafir

One example: if the caller should not receive kernel addresses, calling NtQuerySystemInformation with SystemModuleInformation will not leak kernel image addresses.

翻譯貼文

```
Modules = ProcessModules->Modules;
for ( i = (_KLDR_DATA_TABLE_ENTRY *)PsLoadedModuleList;
      i != (_KLDR_DATA_TABLE_ENTRY *)&PsLoadedModuleList;
      i = (_KLDR_DATA_TABLE_ENTRY *)i->InLoadOrderLinks.Flink )
{
  length = neededLength + sizeof(_RTL_PROCESS_MODULE_INFORMATION);
  if ( neededLength + sizeof(_RTL_PROCESS_MODULE_INFORMATION) < neededLength )
    return STATUS_UNSUCCESSFUL;
  neededLength += sizeof(_RTL_PROCESS_MODULE_INFORMATION);
  if ( ModuleInformationLength >= length )
  {
    imageBase = 0i64;
    if ( !IsRestrictedByFeatureFlag )
      imageBase = i->DllBase;
    Modules->ImageBase = imageBase;
    Modules->ImageSize = i->SizeOfImage;
    Modules->Flags = i->Flags;
    Modules->LoadCount = i->LoadCount;
    Modules->LoadOrderIndex = numberOfModules;
    Modules->InitOrderIndex = 0;
    pathName.Buffer = (char *)Modules->FullPathName;
```

Windows kernel leak 漏洞
開始變得不可或缺

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Use Vulnerability to create arbitrary memory write primitive

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Windows Kernel EoP

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Use Vulnerability to create arbitrary memory write primitive

- 想辦法使用漏洞做到任意記憶體寫入
  - Overwrite kernel object
    - IoRing
    - Windows Notification Framework
    - Previous mode
  - ……

Modify or create a high privilege Token

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Windows Kernel EoP

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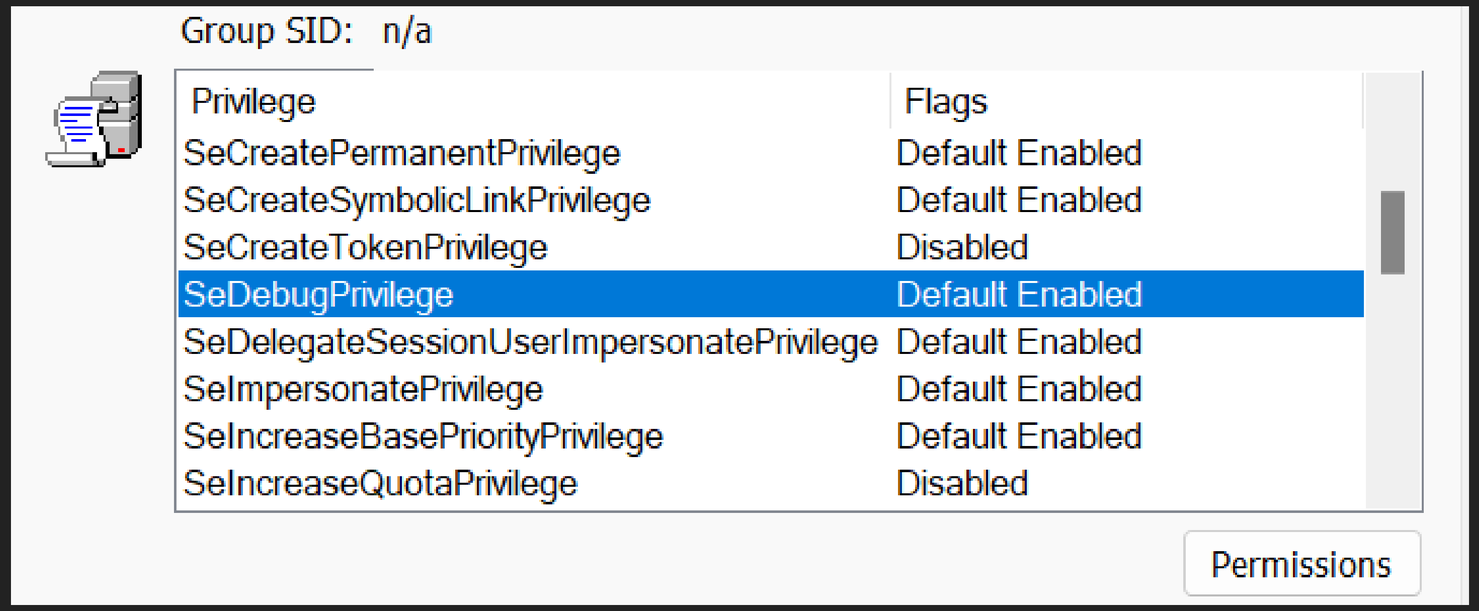
Modify or create a high privilege Token

- 置換或修改當前 Process Token
  - 變成具有高權限的 Privilege 或直接變成 System Token



Create Process with Token

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Windows Kernel EoP

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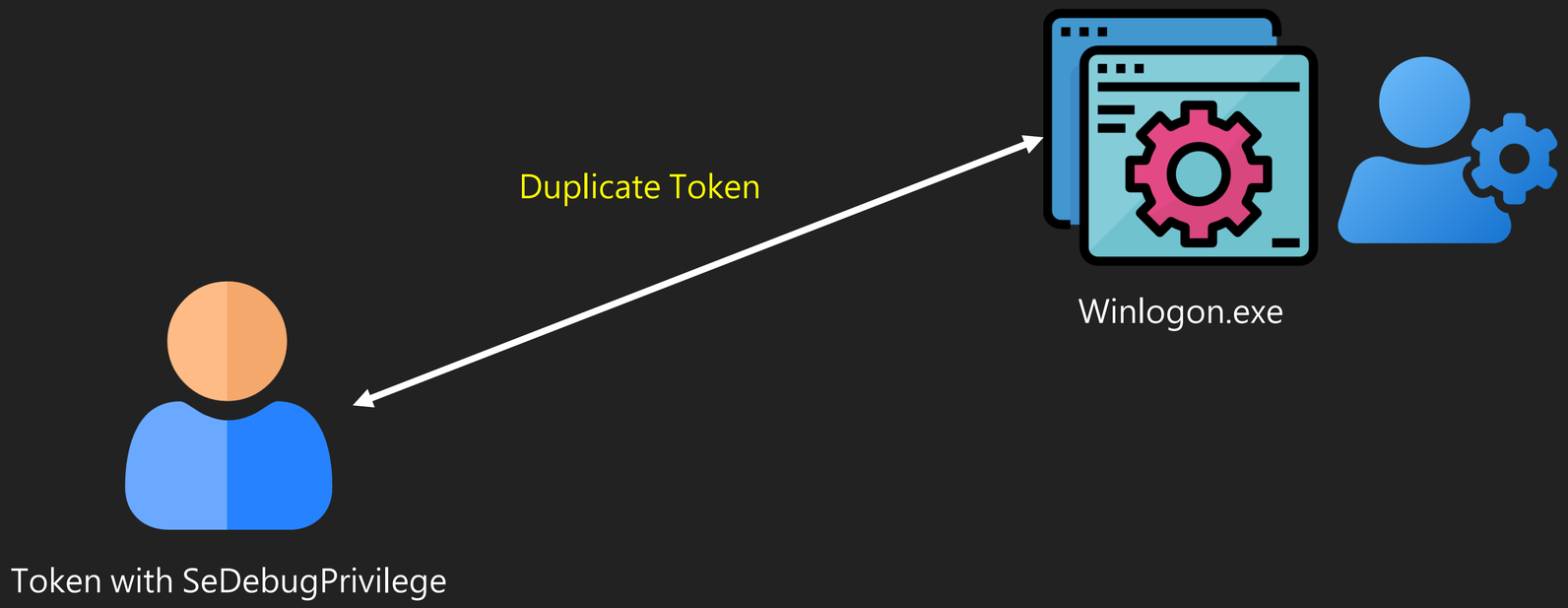
Create Process with Token

- 利用 DuplicateToken 去 Duplicate 高權限 Process 的 Token



Windows Kernel EoP

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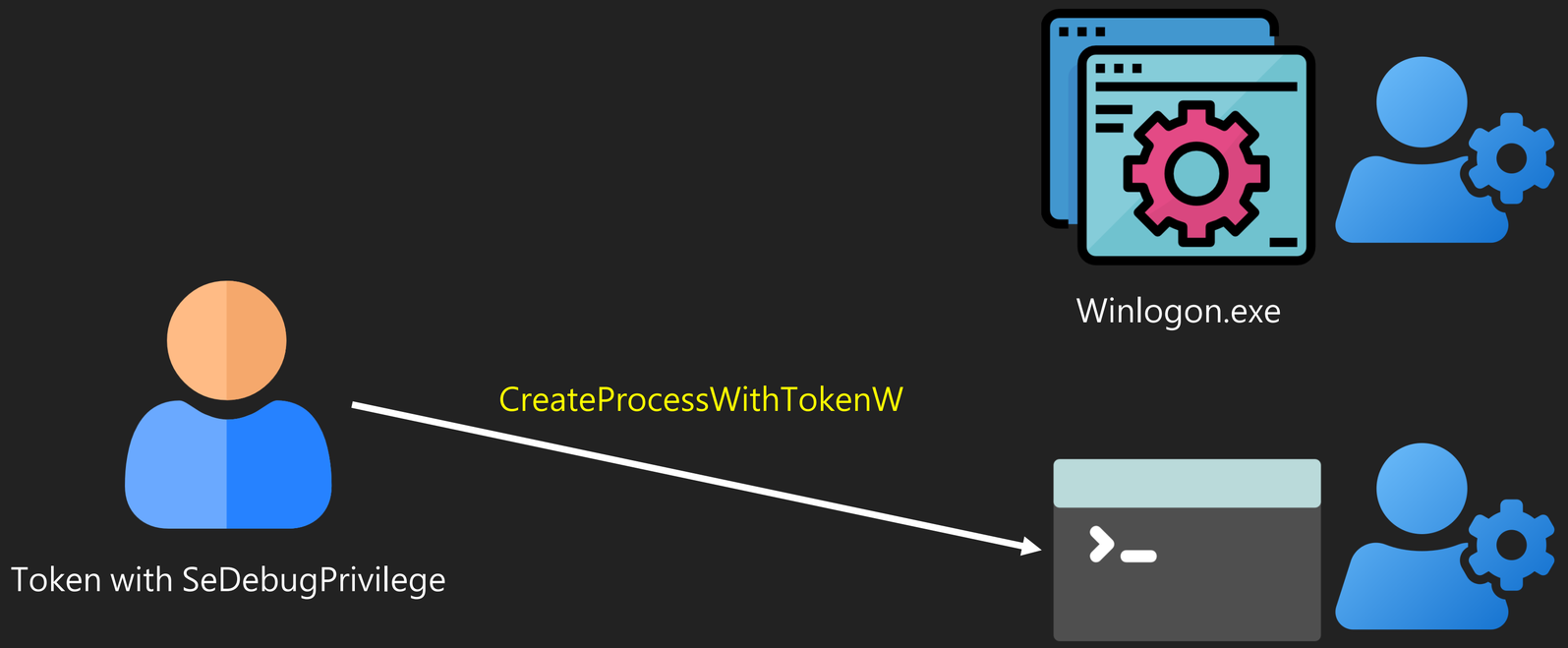
Create Process with Token

- 利用 CreateProcessWithTokenW 創建高權限的 Process



Windows Kernel EoP

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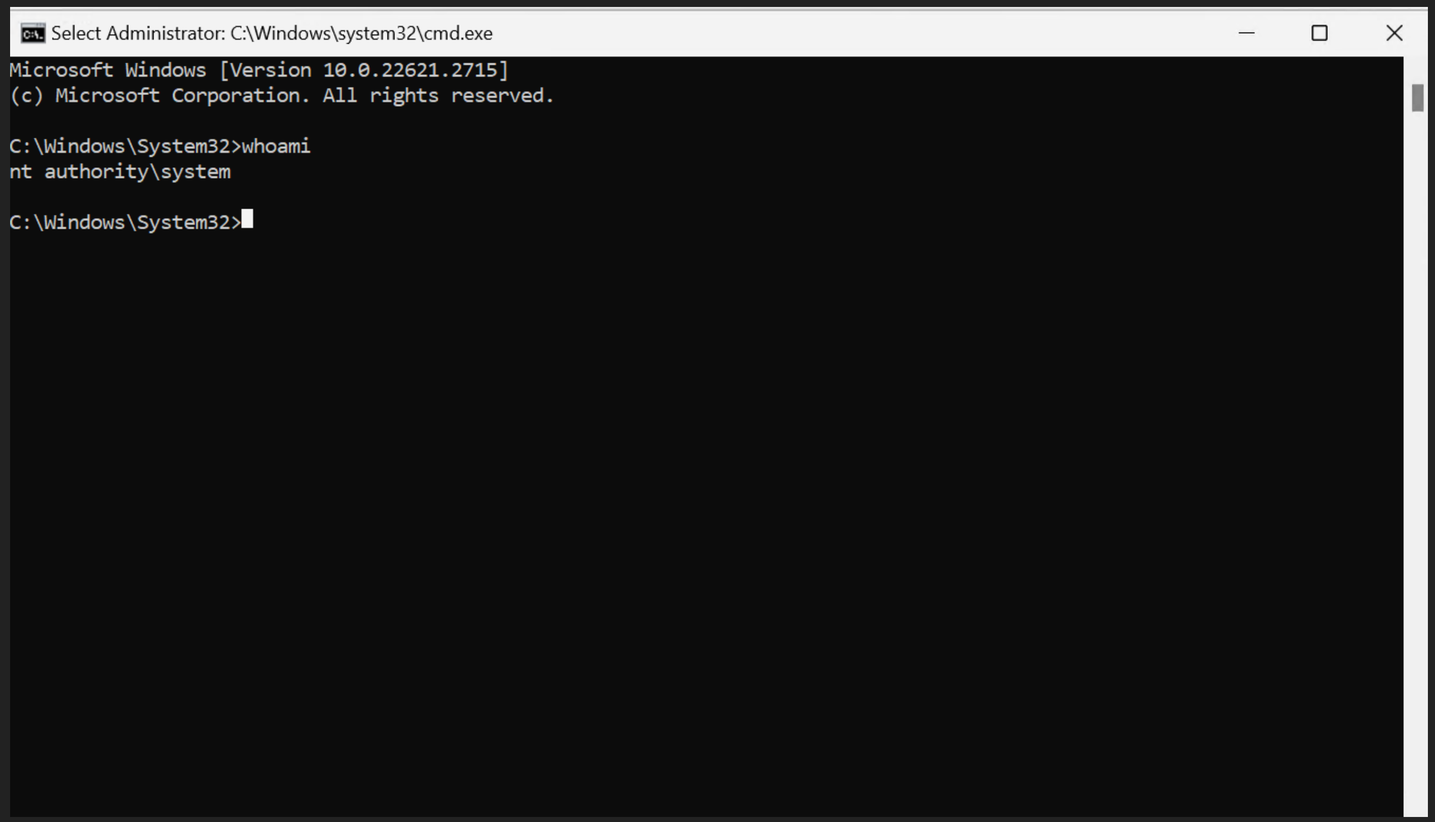
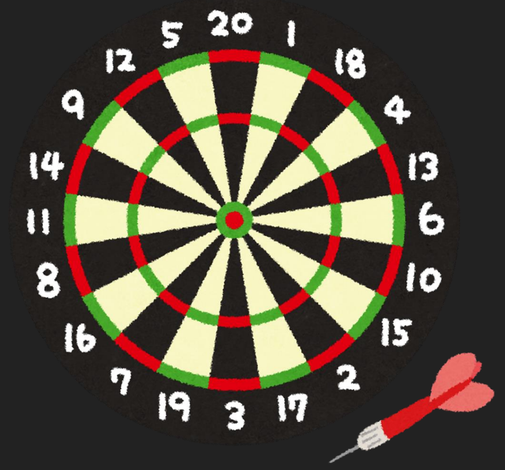
Create Process with Token

- 利用 CreateProcessWithTokenW 創建高權限的 Process





Pick up a target

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Pick up a target

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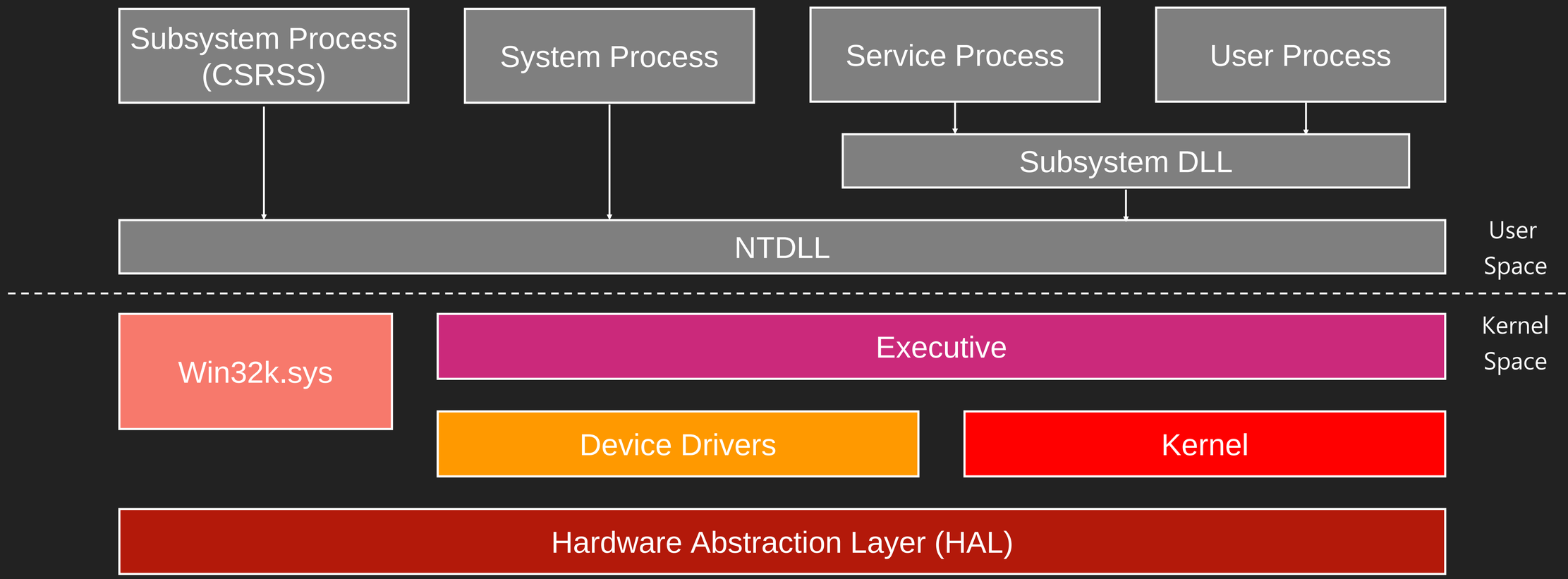
Windows 架構圖



Pick up a target

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- 過去漏洞多不多
  - 程式碼品質如何

Name	
CVE-2024-21346	Win32k Elevation of Privilege Vulnerability
CVE-2024-20686	Win32k Elevation of Privilege Vulnerability
CVE-2024-20683	Win32k Elevation of Privilege Vulnerability
CVE-2023-41772	Win32k Elevation of Privilege Vulnerability
CVE-2023-36776	Win32k Elevation of Privilege Vulnerability
CVE-2023-36743	Win32k Elevation of Privilege Vulnerability
CVE-2023-36732	Win32k Elevation of Privilege Vulnerability
CVE-2023-36731	Win32k Elevation of Privilege Vulnerability
CVE-2023-36011	Win32k Elevation of Privilege Vulnerability
CVE-2023-35631	Win32k Elevation of Privilege Vulnerability
CVE-2023-35337	Win32k Elevation of Privilege Vulnerability
CVE-2023-29336	Win32k Elevation of Privilege Vulnerability
CVE-2023-28274	Windows Win32k Elevation of Privilege Vulnerability

Pick up a target

- 過去漏洞多不多
- 太多人看的目標不選
  - 容易撞洞

Pick up a target

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- 過去漏洞多不多
- 太多人看的目標不選
  - 容易撞洞
- 有興趣的目標

Pick up a target

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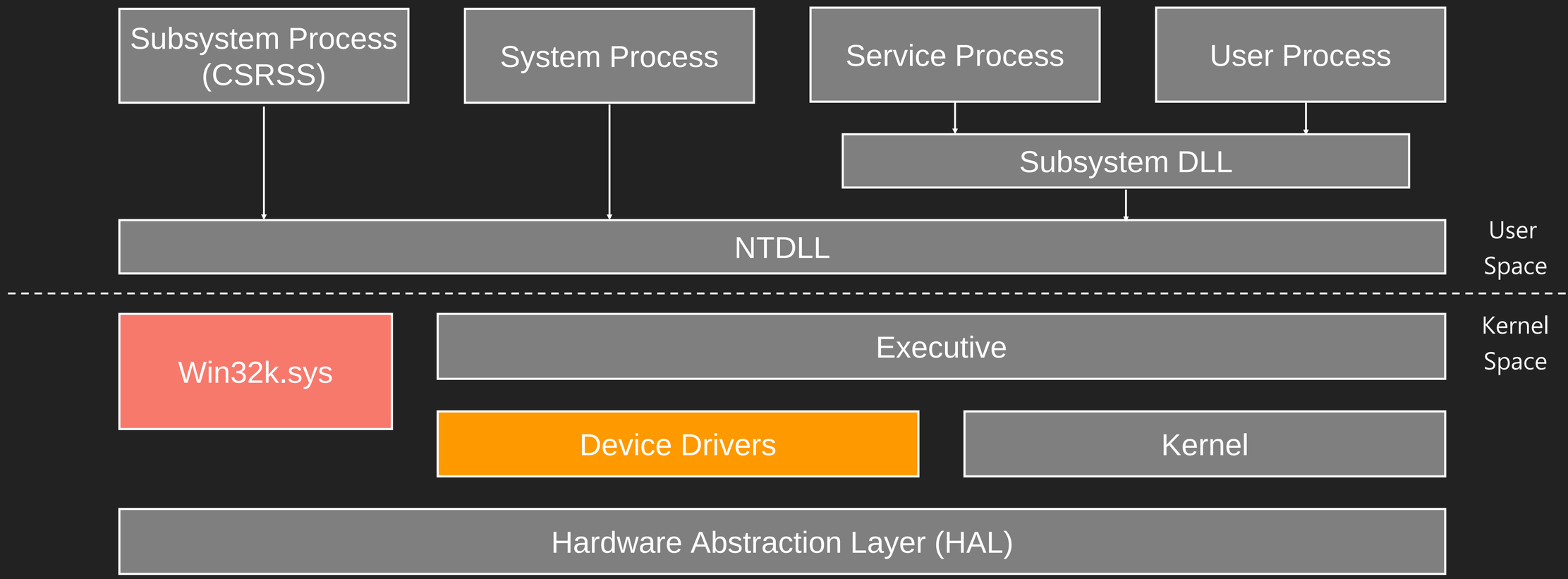
Windows 架構圖



Pick up a target

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- Win32k
  - 每個月都有洞，但需要花不少時間搞懂機制，資源很多

Pick up a target

DEVCORE

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Pick up a target

DEVCORE

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  - 但以目標為 Pwn2Own 來說，可能會來不及
  - 之後會改 Rust 寫

Pick up a target

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- Device Driver
  - 相對單純很多
  - 大部分都出現過不少漏洞
    - Afd.sys
    - Ntfs.sys
    - cldflt.sys
    - clfs.sys
    - …

https://securityintelligence.com/x-force/patch-tuesday-exploit-wednesday-pwning-windows-ancillary-function-driver-winsock/

Pick up a target

- 可以從每個月的 Patch Tuesday 看看哪個比較軟

File System 系列好像不錯看

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Pick up a target

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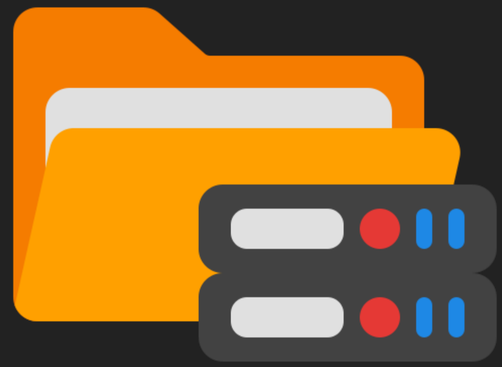
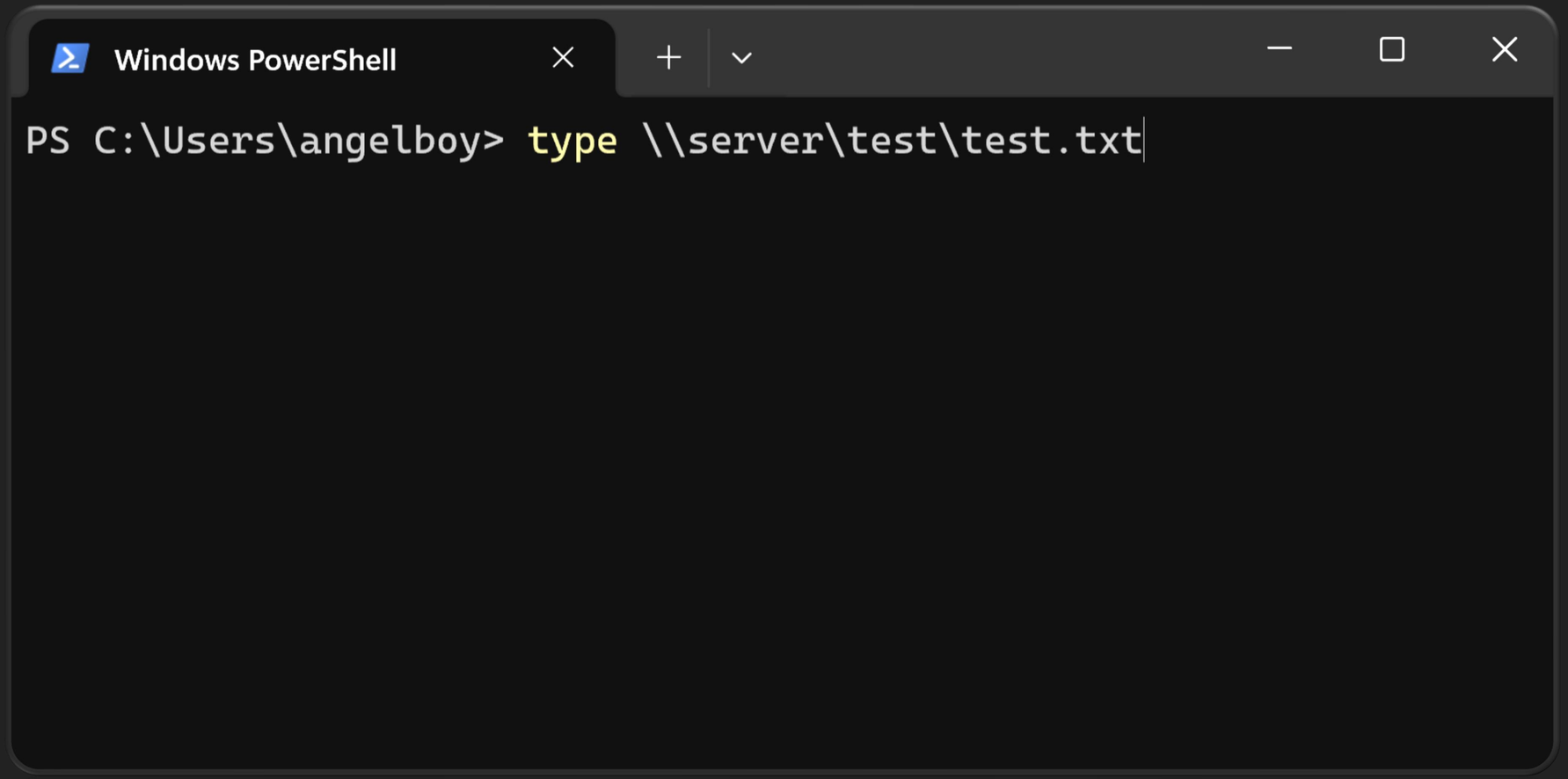
File System Driver

- Local
  - Ntfs
  - Fastfat
  - …
- Remote (Server、Client)
  - RDP
  - SMB
  - …




Windows PowerShell
PS C:\Users\angelboy> type \\server\test\test.txt

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Pick up a target

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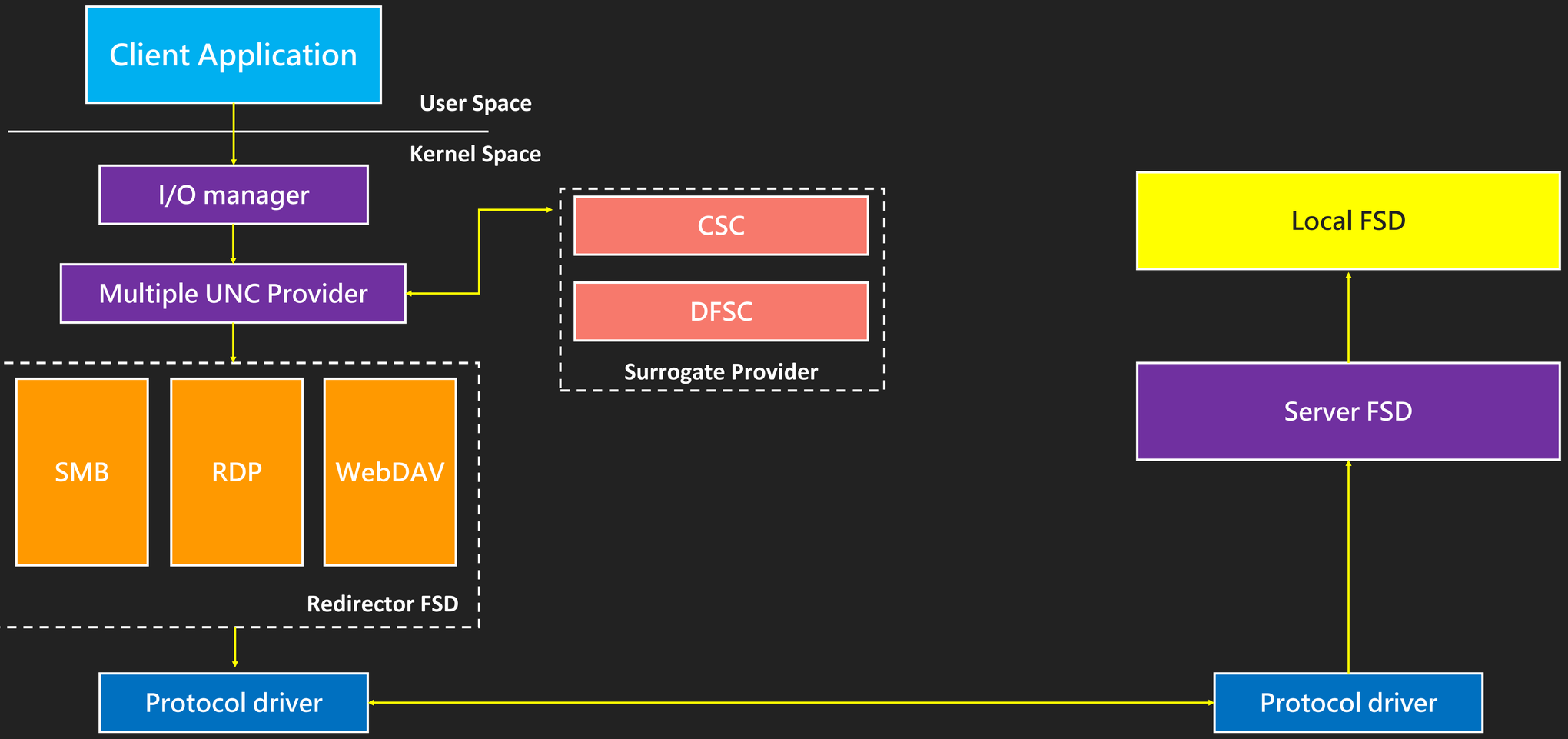
File System Driver



Pick up a target

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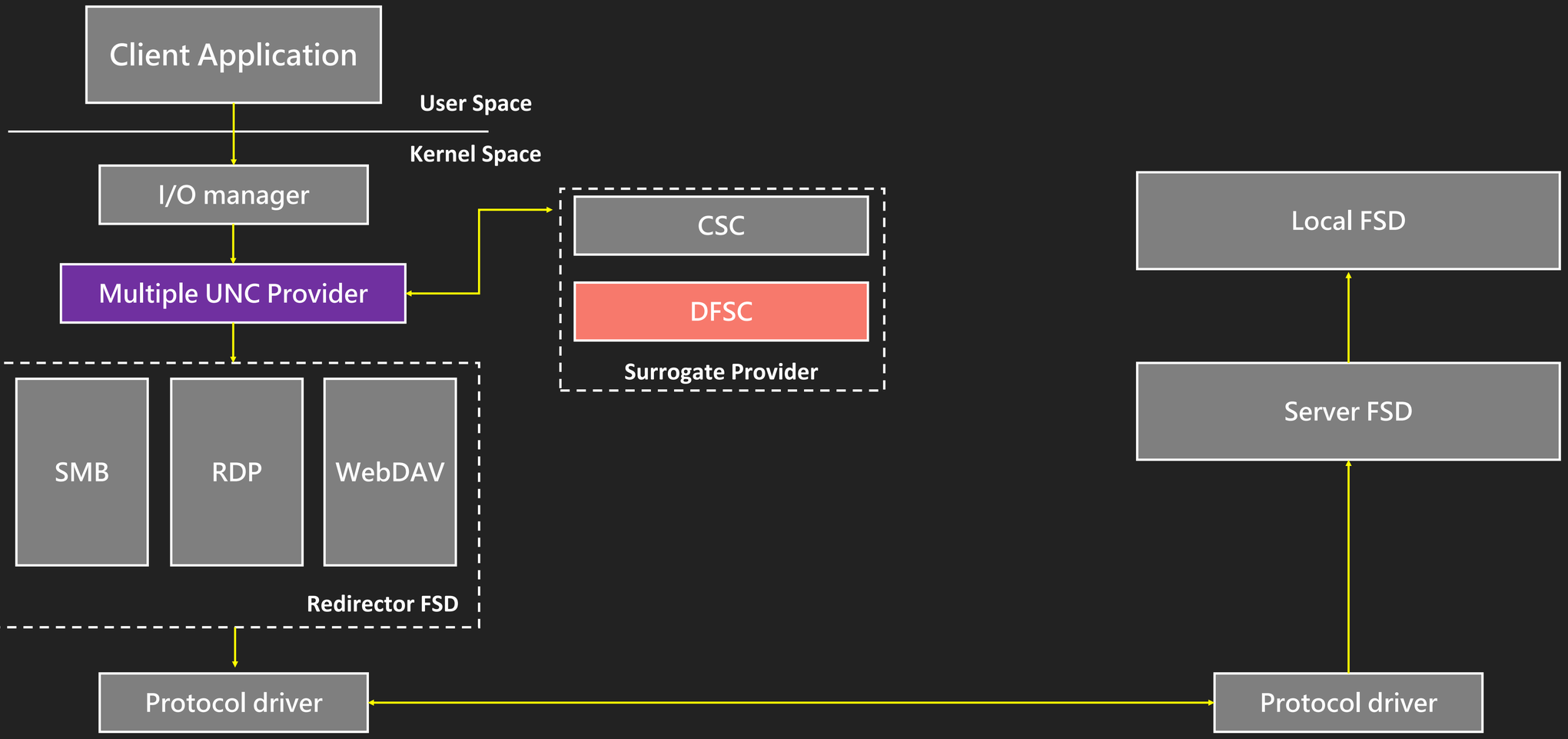
File System Driver



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Distributed File System

Distributed File System

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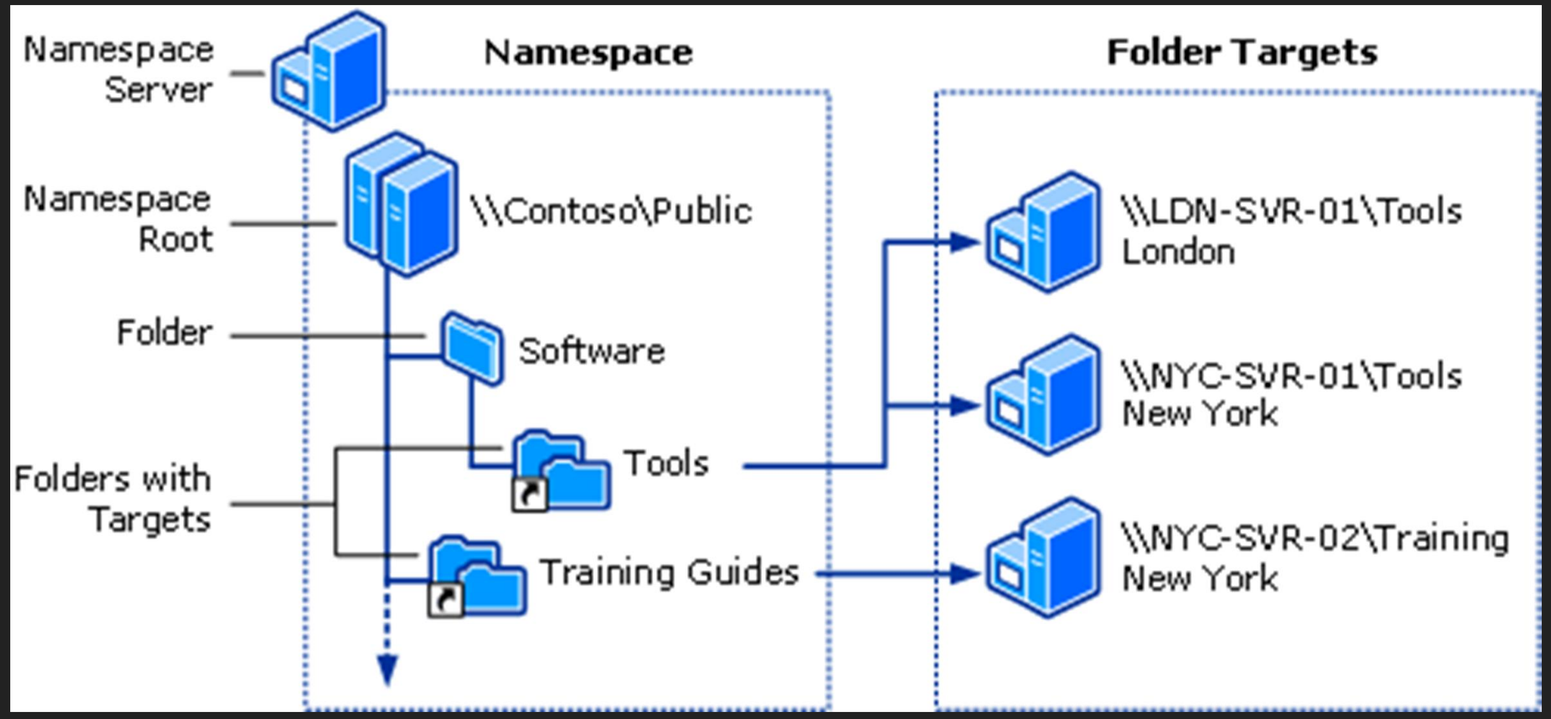
- 當我們在域中 access 一個 UNC 路徑時，DFS server 會將 domain 解出真正的路徑後，再讓他去 access 真正位置，可用來做為 Load balance 用



Distributed File System

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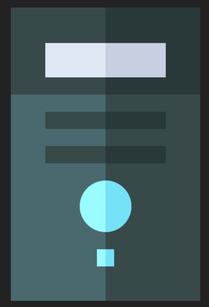
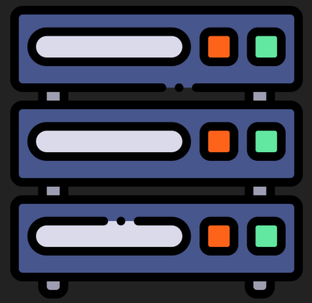
- Communication

\\DFSServer\Myshare\test

DFSServer





Distributed File System

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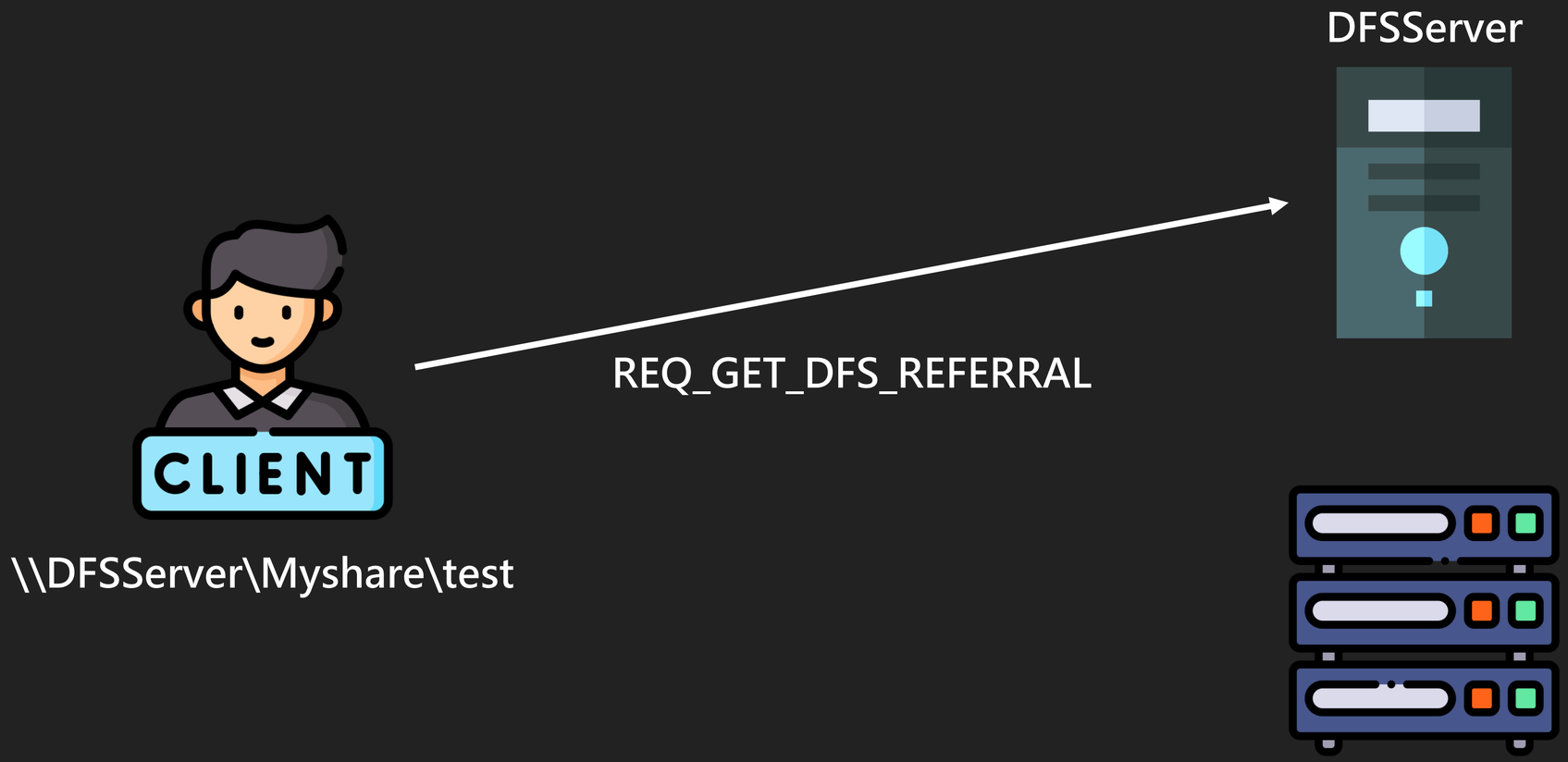
- Communication



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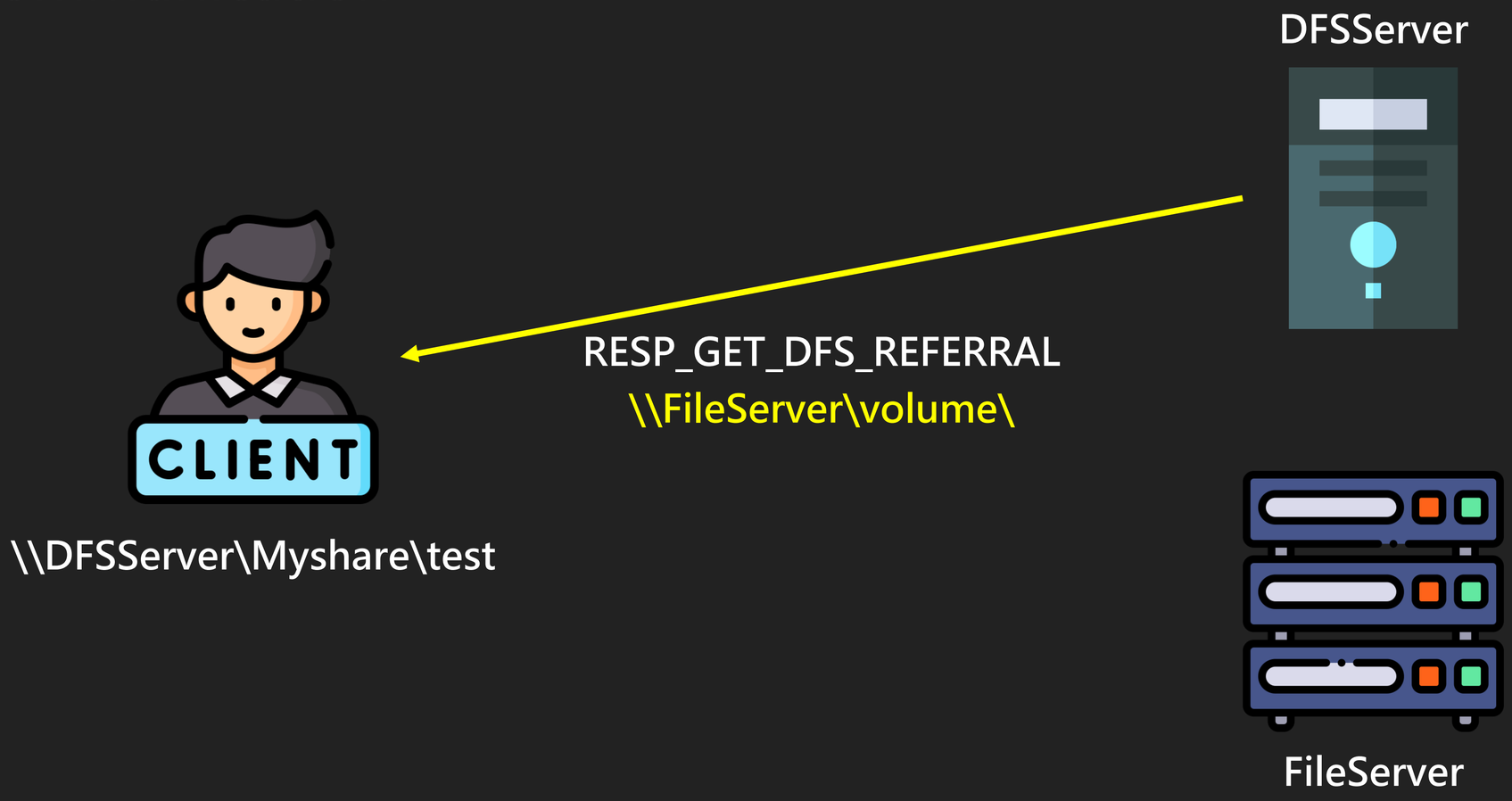

Distributed File System

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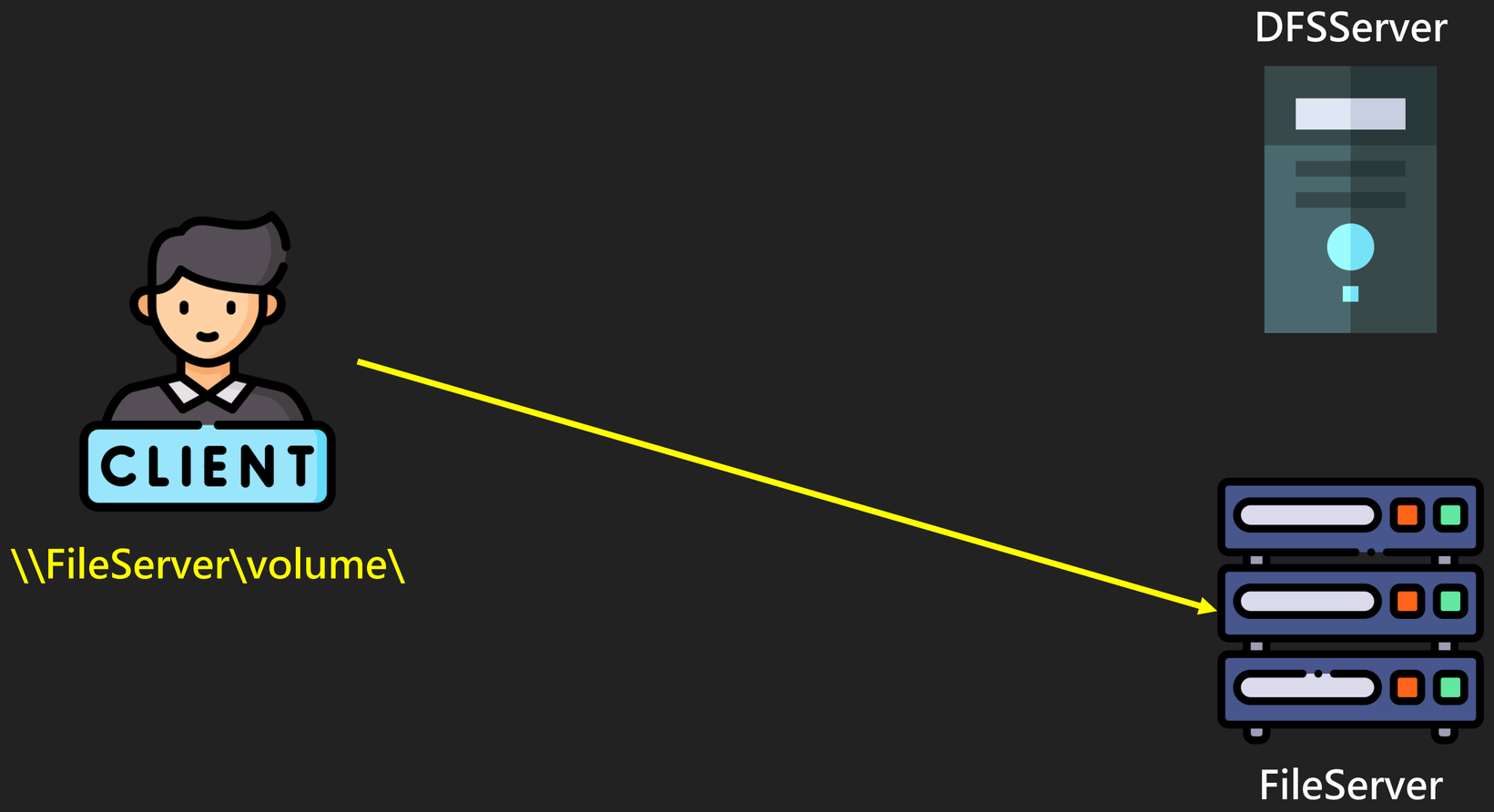
- Communication



Distributed File System

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- Component
  - dfs.sys
    - Server 端， 通常只會存在 Windows Server
  - dfsc.sys
    - Client 端，一般的 Windows 電腦環境中都會有

Pick up a target

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過去漏洞

- CVE-2016-7185
  - Found by James Forshaw
  - DFS Client Driver Arbitrary Drive Mapping EoP
  - The DFS Client driver and running by default insecurely creates and deletes drive letter symbolic links in the current user context leading to EoP

Distributed File System

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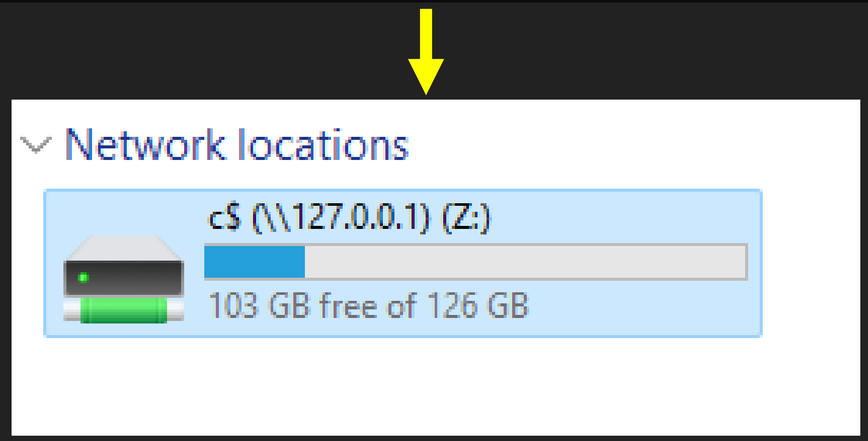
Create Drive Letter

- net use 網路磁碟機功能

```
C:\Users\angelboy>net use z: \\127.0.0.1\c$
The command completed successfully.
```



Distributed File System

DEVCORE

Create Drive Letter

- DfscFsctrlCreateDriveLetter
  - FSCTL - 0x601E0
  - FILE_ANY_ACCESS
- 直接對 \\Device\\DfsClient 送 FSCTL 及相對應的 input 就可以使用該功能

Distributed File System

DEVCORE

Create Drive Letter

- Create Drive Letter Request (Input Buffer)

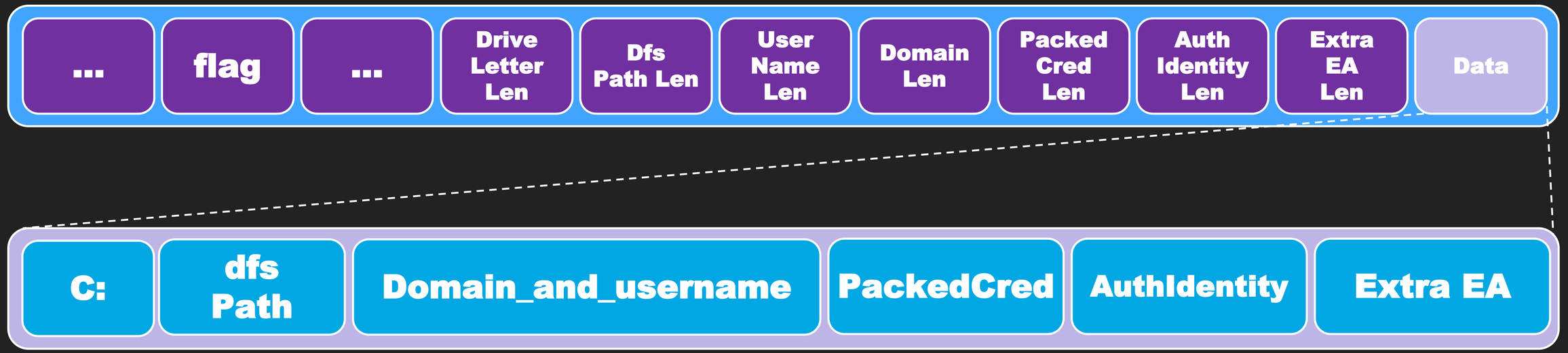
```
struct createdrive_req
{
    char w[2];
    unsigned short flag;
    int dword4;
    unsigned short driveLetter_len;
    unsigned short dfs_path_len;
    unsigned short username_len;
    unsigned short domain_len;
    unsigned short PackedCreadentialsString_len;
    unsigned short AuthIdentity_len;
    unsigned short extra_ea_len;
    wchar_t data[0x10];
}
```

Distributed File System

DEVCORE

Create Drive Letter

- Create Drive Letter Request (Input Buffer)

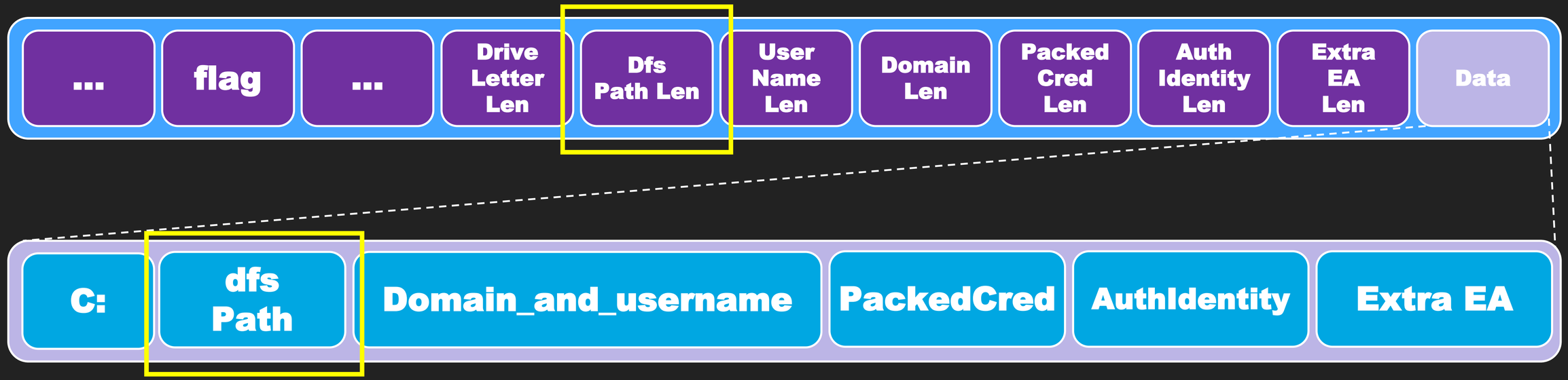


Distributed File System

DEVCORE

Create Drive Letter

- Create Drive Letter Request (Input Buffer)



Distributed File System

DEVCORE

Create Drive Letter

- 當 dfsc driver 收到 Create Drive Letter Request 後，會直接與 target 嘗試建立 Symbolic Link 及建立連線
  - 根據你 LUID/Driver Letter/dfs path 來串接 Symbolic Link及要連去 remote 的路經
  - Z <-> \Device\Mup\DfsClient\;c:LogonId\FileServer\xxx

Distributed File System

DEVCORE

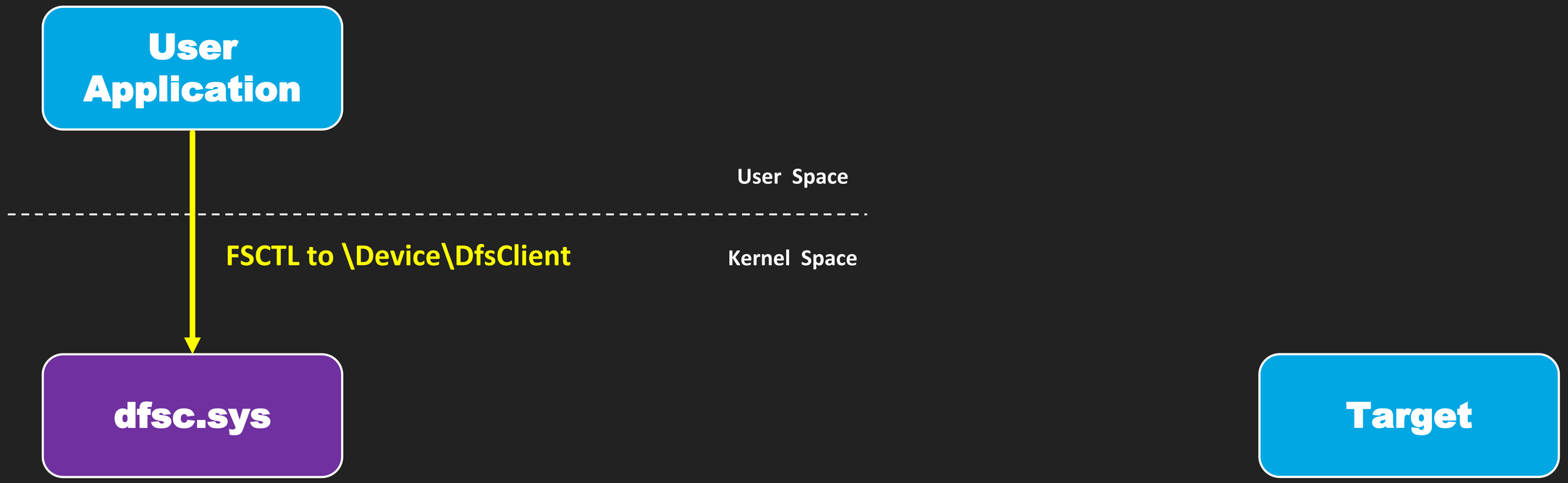
Create Drive Letter

- DfscCreateTreeConnectName
  - 後續就會丟給 CreateFile 來去跟 Server 建立連線
    - IPC$

Distributed File System

DEVCORE

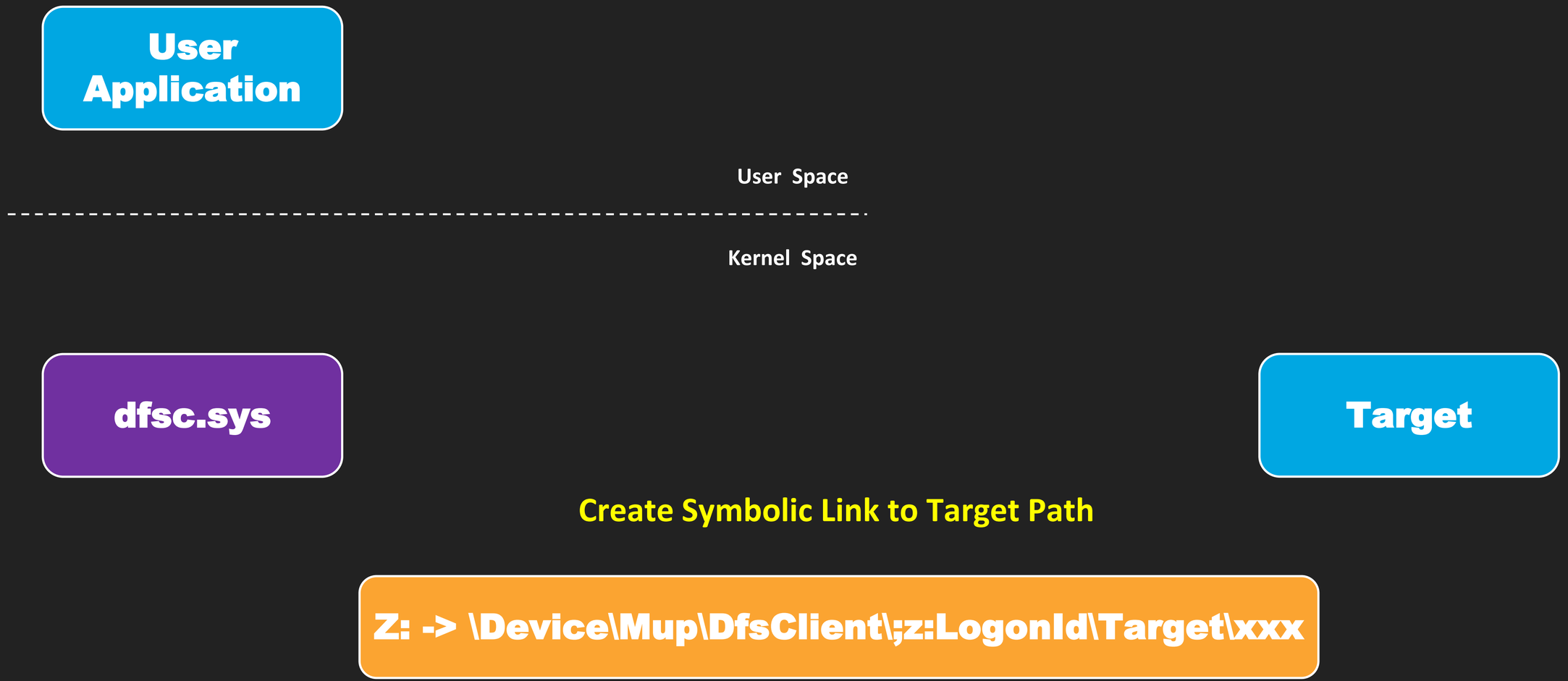
Create Drive Letter



Distributed File System

DEVCORE

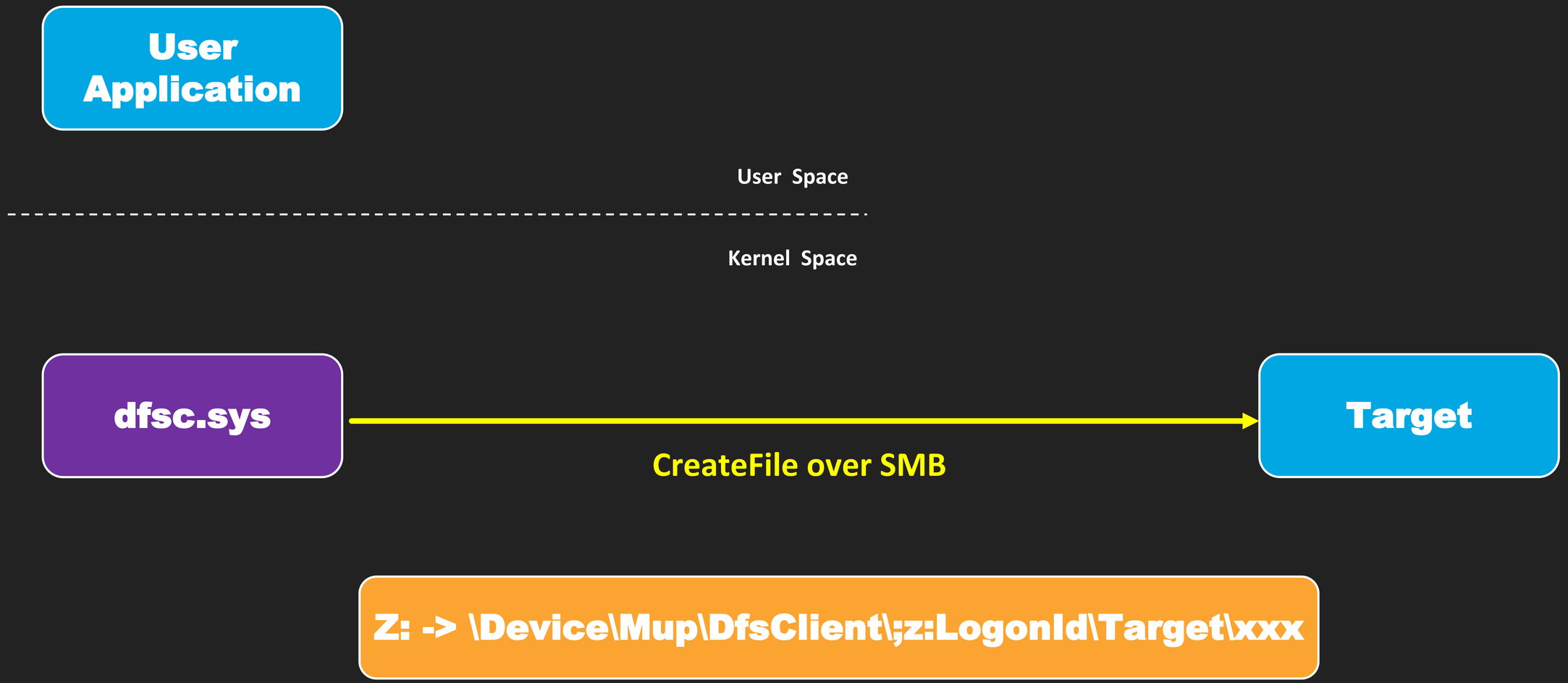
Create Drive Letter



Distributed File System

DEVCORE

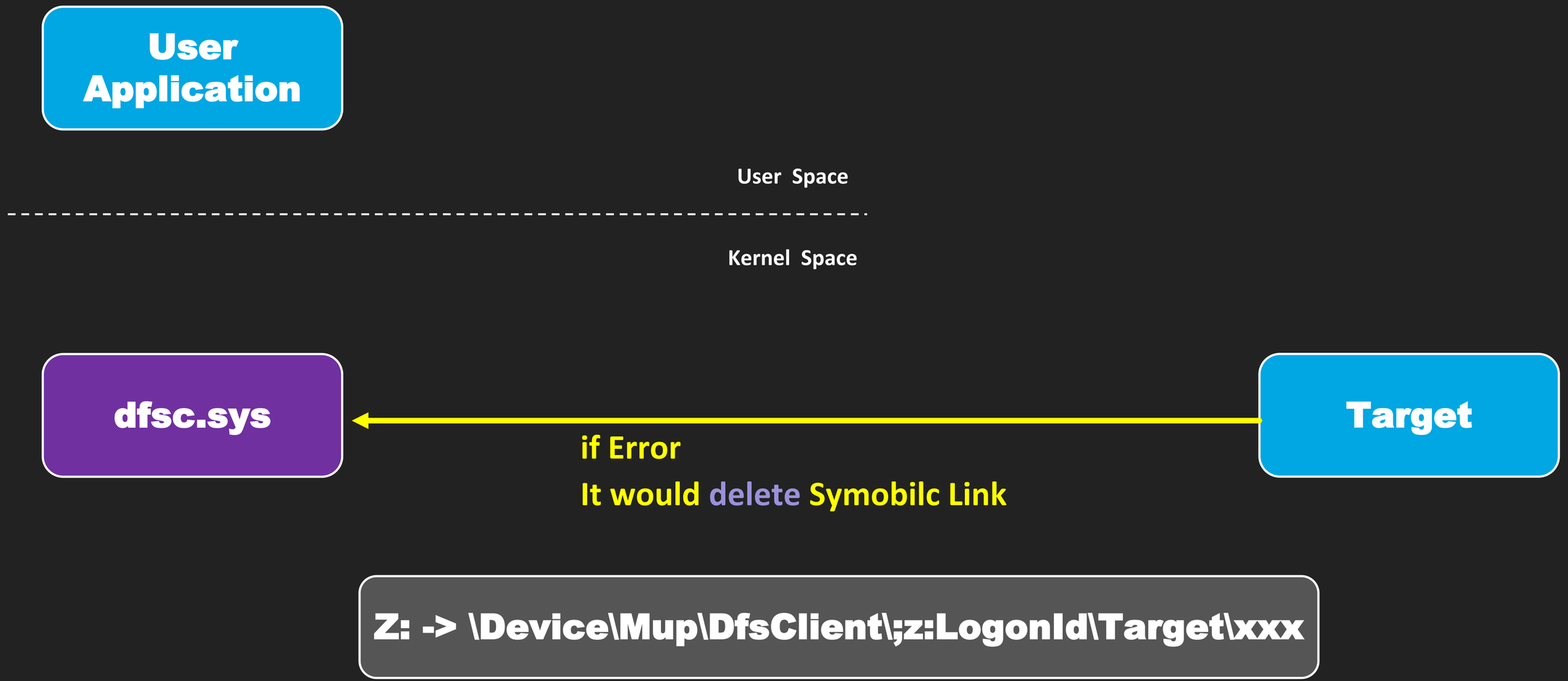
Create Drive Letter



Distributed File System

DEVCORE

Create Drive Letter



DEVCORE

Useless Vulnerability

Useless Vulnerability

DEVCORE

CVE-2022-34719

Windows Distributed File System (DFS) Elevation of Privilege Vulnerability

CVE-2022-34719
Security Vulnerability

Released: Sep 13, 2022

Useless Vulnerability

DEVCORE

CVE-2022-34719

- 在 DfscCreateTreeConnectName 中
  - 並沒有對 UNICODE_STRING 的長度做檢查且使用 USHORT 來分配方字串的空間，造成 integer overflow

```
totallen = LogonIdString.Length + DevicePath.Length + original_path->Length + 0x1E;
dest->MaximumLength = totallen;
Pool2 = ExAllocatePool2(0x102i64, totallen, 0x74436644i64);// totallen is USHORT
dest->Buffer = (PWSTR)Pool2;
if ( !Pool2 )
  return -1073741670;
dest->Length = 0x16;
*(_OWORD *)Pool2 = *(_OWORD *)L"\\Device\\Mup";// overflow if totot1len = 0
*(_DWORD *)(Pool2 + 0x10) = *(_DWORD *)L"Mup";
*(_WORD *)(Pool2 + 0x14) = SourceString[0xA];
```

Useless Vulnerability

DEVCORE

CVE-2022-34719

- 在 DfscCreateTreeConnectName 中
  - 後續則直接將字串寫到分配出來的 buffer 中，造成 heap overflow

```
totallen = LogonIdString.Length + DevicePath.Length + original_path->Length + 0x1E;
dest->MaximumLength = totallen;
Pool2 = ExAllocatePool2(0x102i64, totallen, 0x74436644i64);// totallen is USHORT
dest->Buffer = (PWSTR)Pool2;
if ( !Pool2 )
  return -1073741670;
dest->Length = 0x16;
*(_OWORD *)Pool2 = *(_OWORD *)L"\\Device\\Mup";// overflow if totot1len = 0
*(_DWORD *)(Pool2 + 0x10) = *(_DWORD *)L"Mup";
*(_WORD *)(Pool2 + 0x14) = SourceString[0xA];
```

Useless Vulnerability

DEVCORE

CVE-2022-34719

- 在 DfscCreateTreeConnectName 中
  - Windows 中字串大多都以 UNICODE_STRING 存
    - 長度都是 USHORT，常常有 integer overflow 發生

```
typedef struct _UNICODE_STRING {
  USHORT Length;
  USHORT MaximumLength;
  PWSTR  Buffer;
} UNICODE_STRING, *PUNICODE_STRING;
```

Useless Vulnerability

DEVCORE

CVE-2022-34719

- Exploitation?
  - 只能蓋 Pool Header 四個 Bytes

Useless Vulnerability

DEVCORE

CVE-2022-34719

- Exploitation?
  - 只能蓋 Pool Header 四個 Bytes
  - 蓋的內容不可控

Useless Vulnerability

DEVCORE

CVE-2022-34719

- Exploitation?
  - 只能蓋 Pool Header 四個 Bytes
  - 蓋的內容不可控
  - Useless

- Meh @ DEVCORE CONF 2023

DEVCORE

DEVCORE

LeakLess Vulnerability

LeakLess Vulnerability

DEVCORE

CVE-2022-38025

Windows Distributed File System (DFS) Information Disclosure Vulnerability

CVE-2022-38025
Security Vulnerability

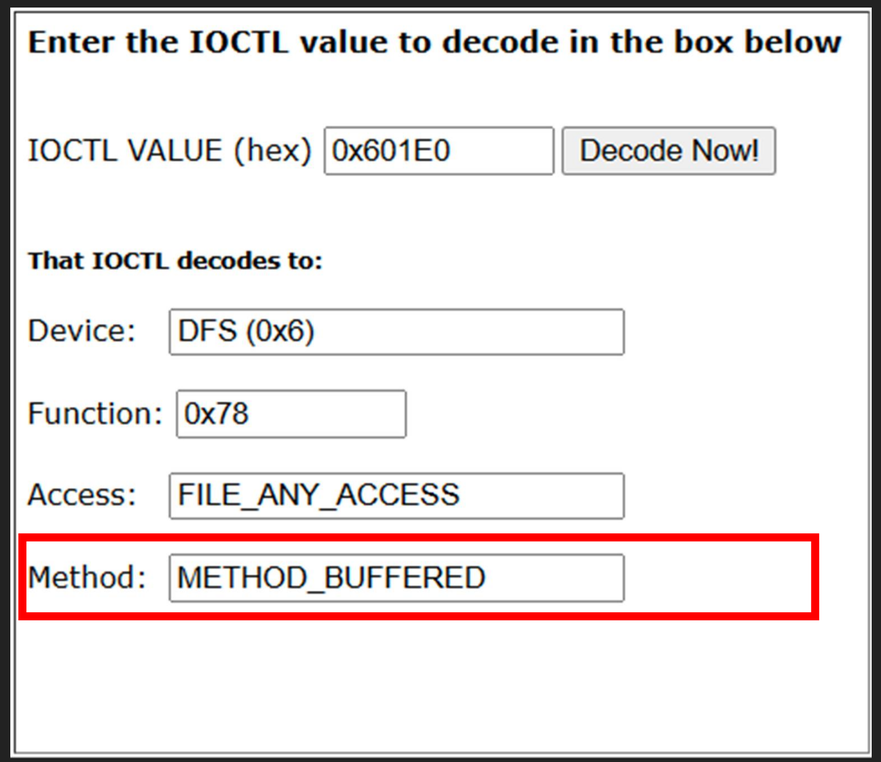
Released: Oct 11, 2022

LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- 漏洞又是在 Create Drive Letter 功能中
  - FSCTL 0x601e0 Buffer 傳遞方式

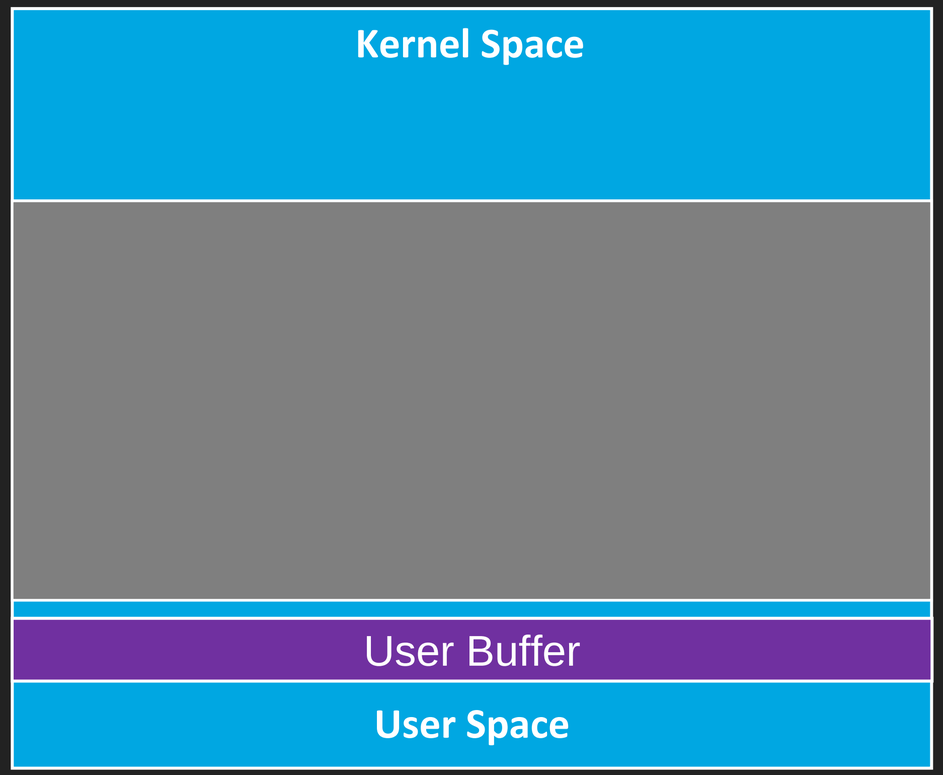


LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Buffered I/O

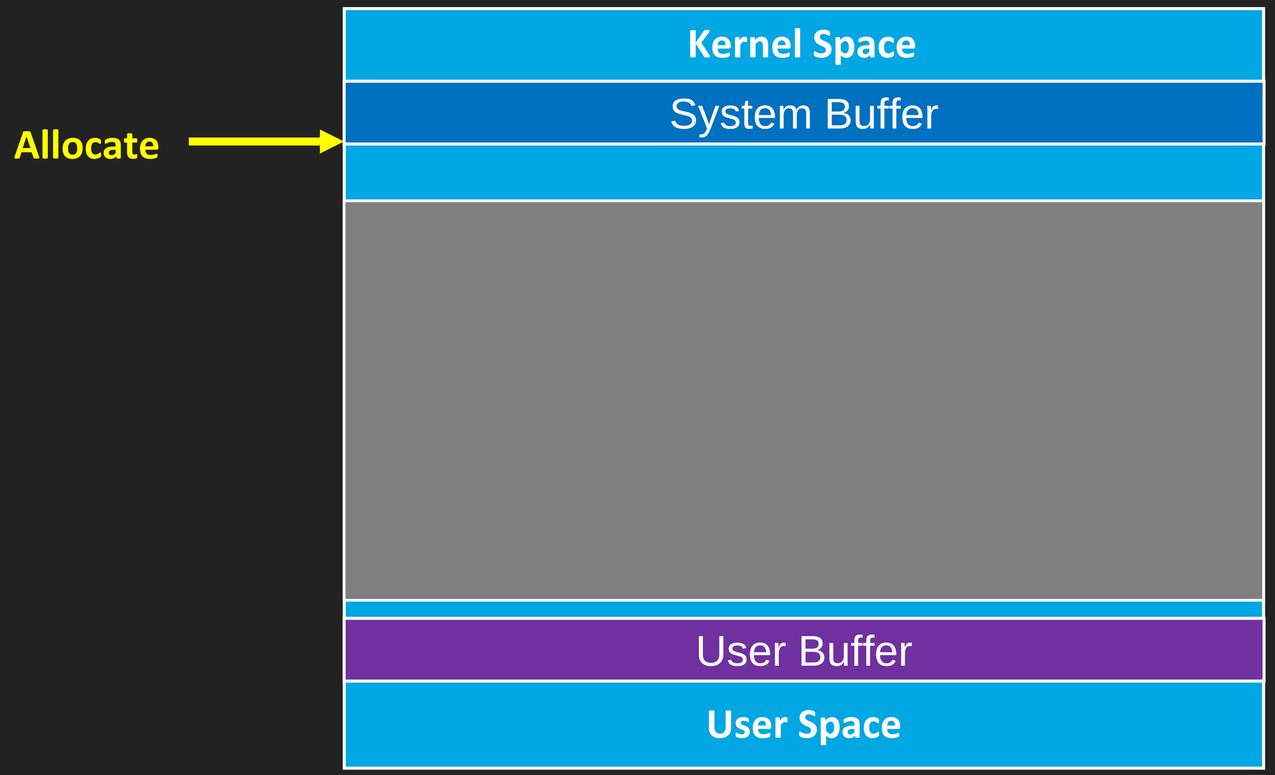


LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Buffered I/O

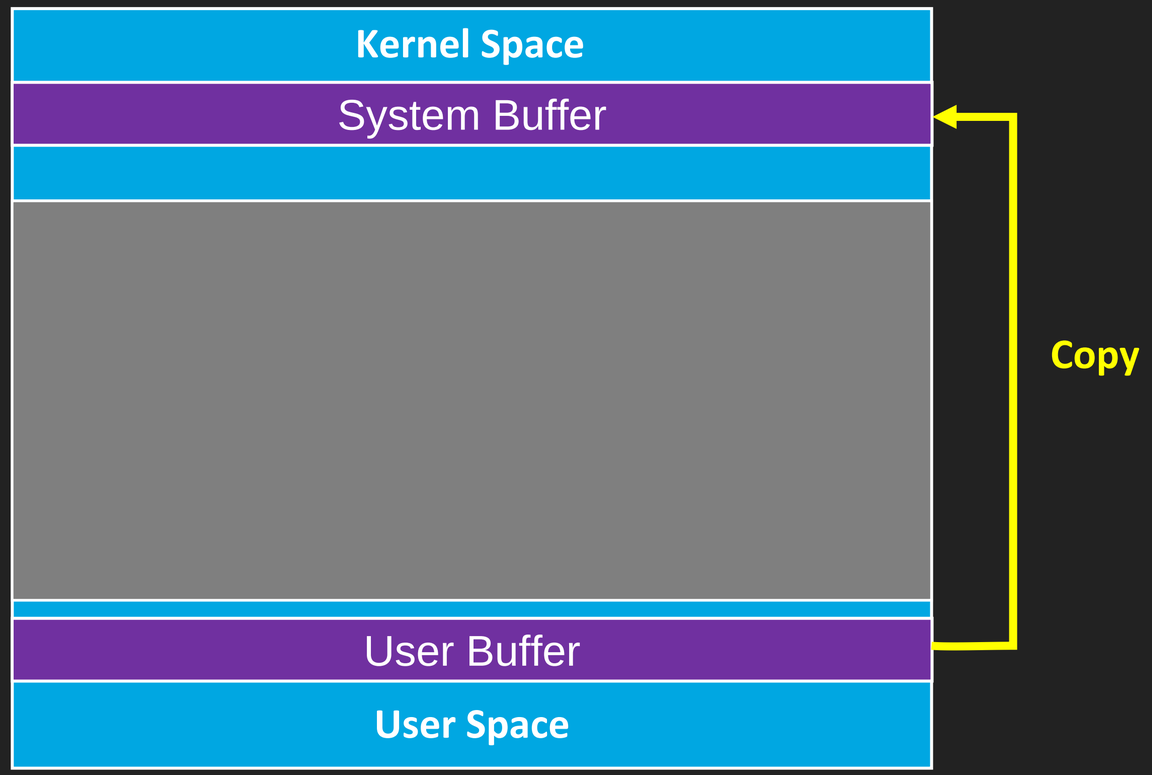


LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Buffered I/O

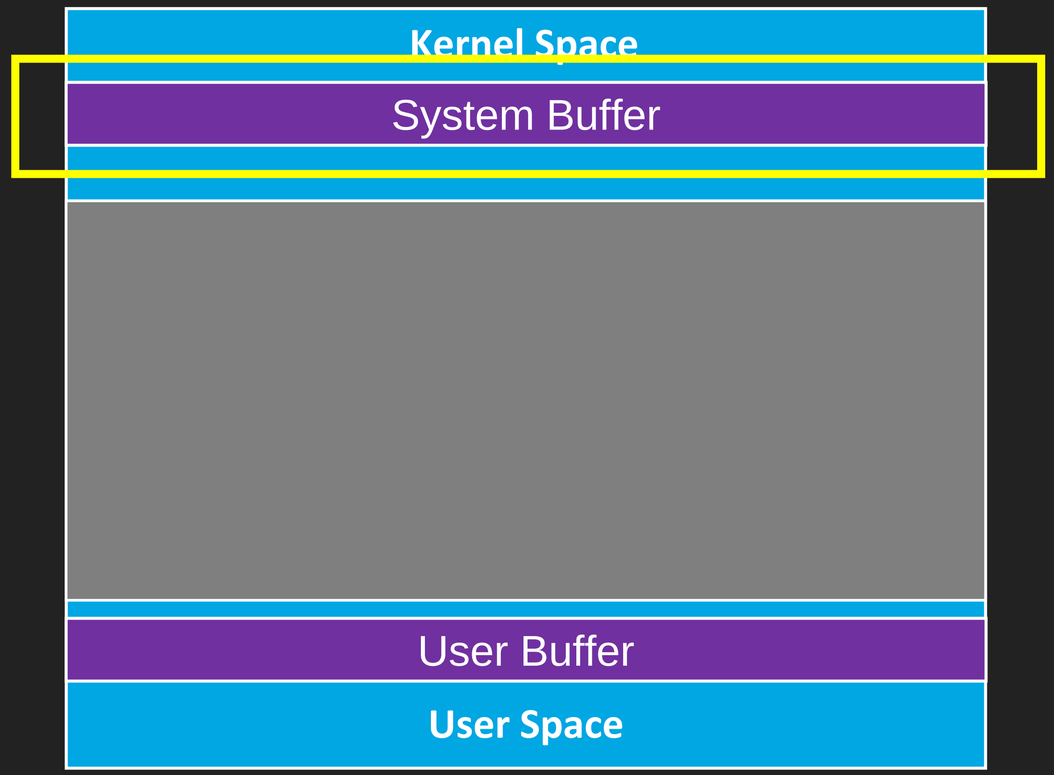


LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Buffered I/O



LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Buffered I/O

```
__kernel_entry NTSYSCALLAPI NTSTATUS NtFsControlFile(
  [in]             HANDLE           FileHandle,
  [in, optional]   HANDLE           Event,
  [in, optional]   PIO_APC_ROUTINE  ApcRoutine,
  [in, optional]   PVOID            ApcContext,
  [out]            PIO_STATUS_BLOCK IoStatusBlock,
  [in]             ULONG            FsControlCode,
  [in, optional]   PVOID            InputBuffer,
  [in]             ULONG            InputBufferLength,
  [out, optional] PVOID             OutputBuffer,
  [in]             ULONG            OutputBufferLength
);
```

Systembuffer = ExAllocatePool(…,InputBufferLength,…)

LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- DfscFsctrlCreateDriveLetter 會根據 Request 給的 Length 來決定要從 buffer 的哪邊來取 data 如 : Username、Domain 等

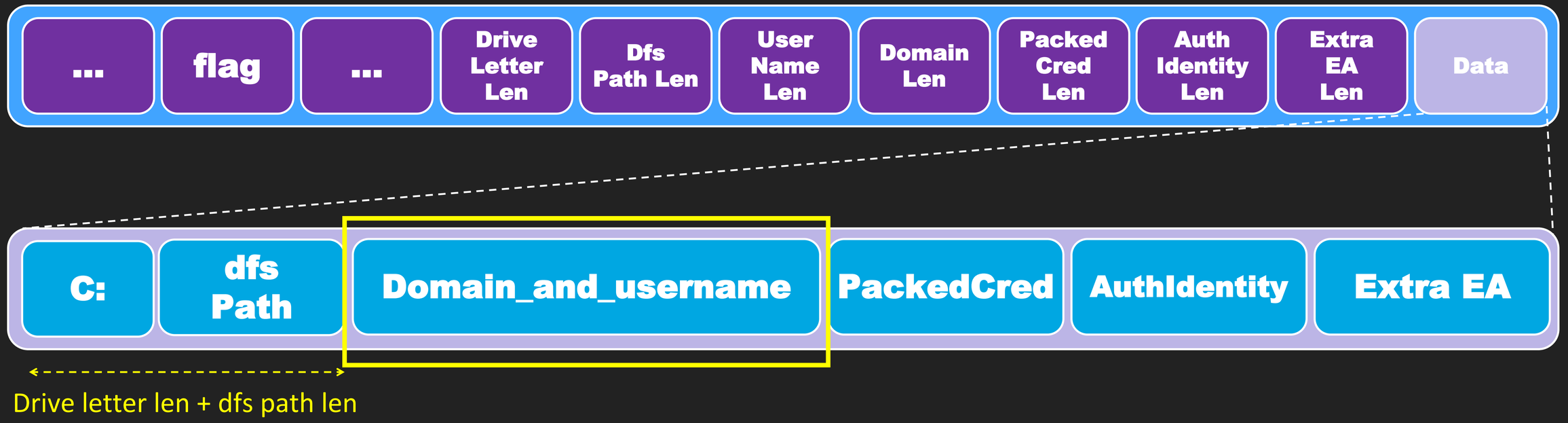
```
driverletter_dfspath_len = driverletter_len + dfs_path_len_1;
unamelen = sysbuf->usernamelen;
v21 = &data[driverletternLen];
v60 = v21;
if ( (_WORD)unamelen )
  UserName = &data[(unsigned __int64)driverletter_dfspath_len >> 1];
```

LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Username = data[DriverLetterLen+DfsPathLength]

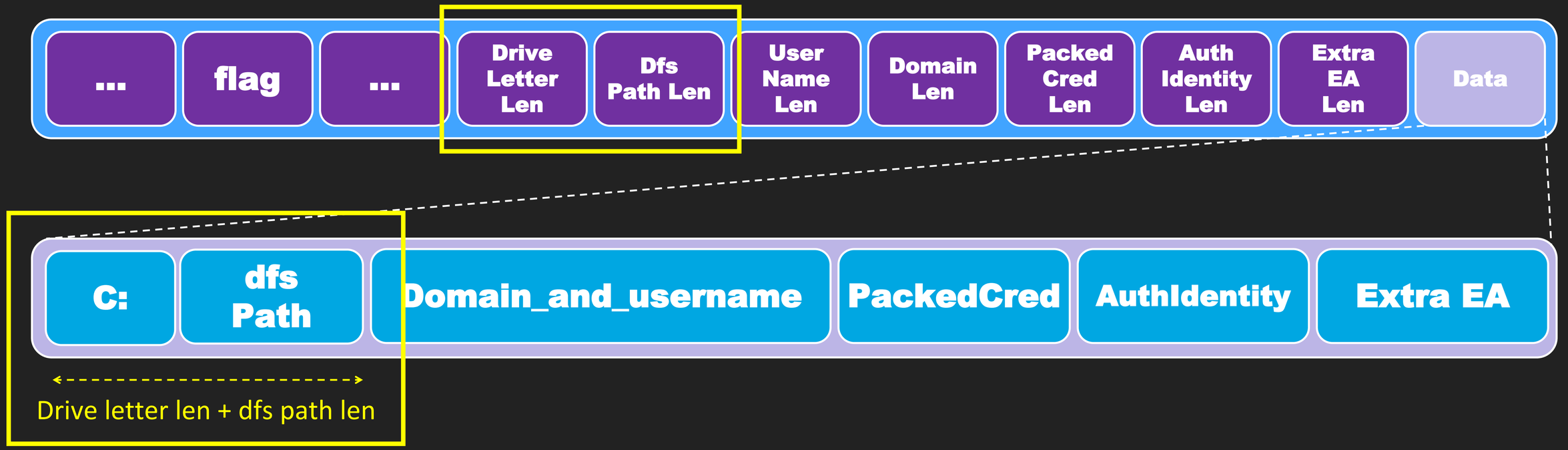


LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Username = data[DriverLetterLen+DfsPathLength]



LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- 直覺上會直接看有沒有 Out of bounds ，但實際上對所有的長度都有相對應檢查，乍看下並沒有直接的 Out of bounds

```
DataLen = dfs_path_len
        + driveLetter_len
        + usernamelen
        + PackedCredentialsStringlen
        + sysbuf->extra_ea_len
        + sysbuf->AuthIdentity_len;
if ( DataLen > iputbuflen - 0x16 || (_WORD)domanlen && domanlen + 2 >= usernamelen )
  return (unsigned int)STATUS_INVALID_PARAMETER;
```

LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- 直覺上會直接看有沒有 Out of bounds ，但實際上對所有的長度都有相對應檢查，乍看下並沒有直接的 Out of bounds

```
DataLen = dfs_path_len
        + driveLetter_len
        + usernamelen
        + PackedCredentialsStringlen
        + sysbuf->extra_ea_len
        + sysbuf->AuthIdentity_len;
if ( DataLen > iputbuflen - 0x16 || (_WORD)domanlen && domanlen + 2 >= usernamelen )
  return (unsigned int)STATUS_INVALID_PARAMETER;
```

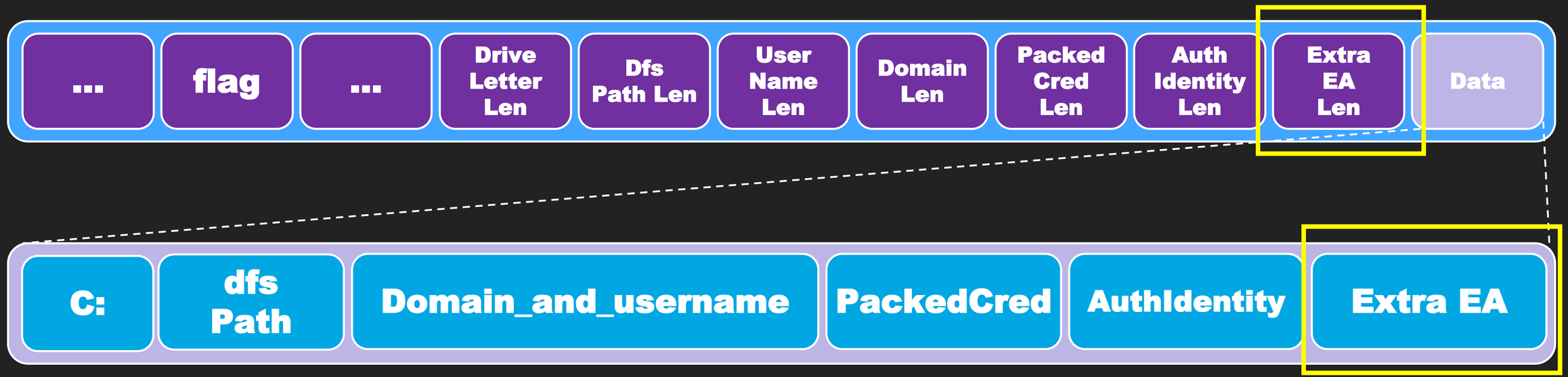
Sizeof(struct create req)

LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Extra EA (Extra Extend Attribute)



LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Extra EA (Extra Extend Attribute)
  - 對於檔案操作會根據不同 File System 會有不同的處理，可額外給定其它屬性

```
__kernel_entry NTSTATUS NtCreateFile(
  [out]          PHANDLE            FileHandle,
  [in]           ACCESS_MASK        DesiredAccess,
  [in]           POBJECT_ATTRIBUTES ObjectAttributes,
  [out]          PIO_STATUS_BLOCK   IoStatusBlock,
  [in, optional] PLARGE_INTEGER     AllocationSize,
  [in]           ULONG              FileAttributes,
  [in]           ULONG              ShareAccess,
  [in]           ULONG              CreateDisposition,
  [in]           ULONG              CreateOptions,
  [in]           PVOID              EaBuffer,
  [in]           ULONG              EaLength
);
```

LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Extra EA (Extra Extend Attribute)
  - FILE_FULL_EA_INFORMATION
    - 以 Key & Value 型式儲存

```
typedef struct _FILE_FULL_EA_INFORMATION {
  ULONG  NextEntryOffset;
  UCHAR  Flags;
  UCHAR  EaNameLength;
  USHORT EaValueLength;
  CHAR   EaName[1];
} FILE_FULL_EA_INFORMATION, *PFILE_FULL_EA_INFORMATION;
```

LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Extra EA (Extra Extend Attribute)
  - 可提供而外的 Extend Attribute，後續 CreateFile 建立連線時，會將該 Extend Attribute 給 CreateFile，dfsc.sys 會根據 extra_ea_len 來取得該結構，不過這邊是給 extra_ea 如下這個結構

```
struct extra_ea {
    ULONG offset;
    ULONG size;
    int createoption;
    int fileattributte;
};
```

LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Extra EA (Extra Extend Attribute)
  - 再根據這個 extra_ea 結構的 offset 來指向，真正 EA 結構

```
struct extra_ea {
    ULONG offset;
    ULONG size;
    int createoption;
    int fileattributte;
};
```

LeakLess Vulnerability

DEVCORE

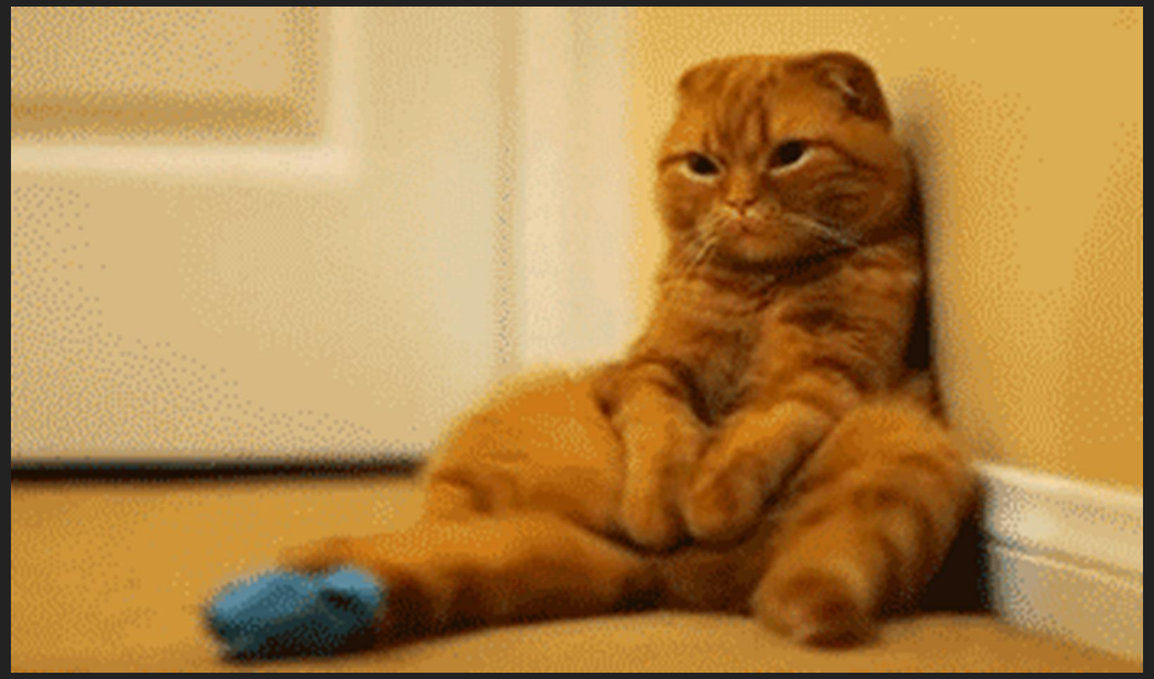
CVE-2022-38025

- Extra EA (Extra Extend Attribute)
  - 有好好檢查

```
if ( extra_eaoff > 0x10 && ULongAdd(DataLen, extra_eaoff - 0x10, &DataLen) < 0 )
{
  KeymgrCredentials = STATUS_INTEGER_OVERFLOW;
  v34 = WPP_GLOBAL_Control;
  if...
  v35 = 20i64;
  goto LABEL_56;
}
if ( ULongAdd(DataLen, dfsaddea_->size, &DataLen) < 0 )
{
  KeymgrCredentials = STATUS_INTEGER_OVERFLOW;
```

```
if ( DataLen <= maxlen )
{
ABEL_66:
  v68.Buffer = UserName;
  v68.MaximumLength = unamelen;
```

這時我們一度以為沒洞了



DEVCORE

LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Extra EA (Extra Extend Attribute)
  - 來看看怎麼取得 extra_ea 結構
    - 有沒有問題?

```
AuthIdentity_len_25h = AuthIdentity_len + 0x25;
extra_ea_len = sysbuf->extra_ea_len;
extra_ea_offset = ((cred_uname_driverletter_dfspath_len + AuthIdentity_len_25h) & 0xFFFFFFF0) - 0x16;
if...
if...
dfsaddea_ = (extra_ea *)&data[extra_ea_offset >> 1];
extra_eaoff = dfsaddea_->offset;
```

LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Extra EA (Extra Extend Attribute)
  - 來看看怎麼取得 extra_ea 結構
    - 有沒有問題?

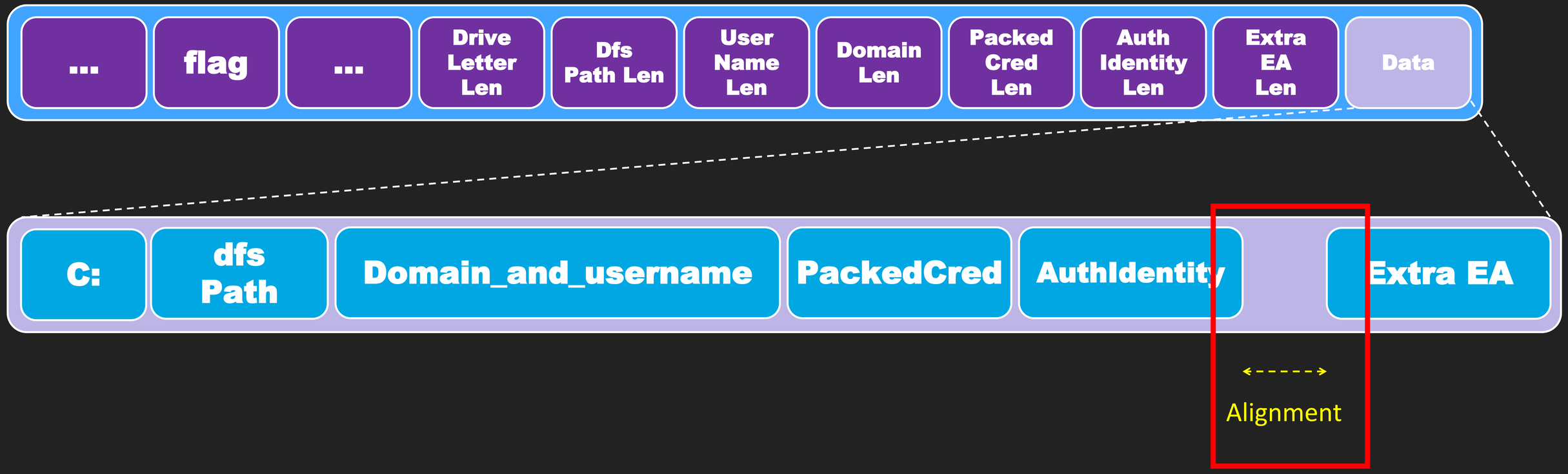
```
AuthIdentity_len_25h = AuthIdentity_len + 0x25;
extra_ea_len = sysbuf->extra_ea_len;
extra_ea_offset = ((cred_uname_driverletter_dfspath_len + AuthIdentity_len_25h) & 0xFFFFFFF0) - 0x16;
if...
if...
dfsaddea_ = (extra_ea *)&data[extra_ea_offset >> 1];
extra_eaoff = dfsaddea_->offset;
```

LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Extra EA (Extra Extend Attribute)



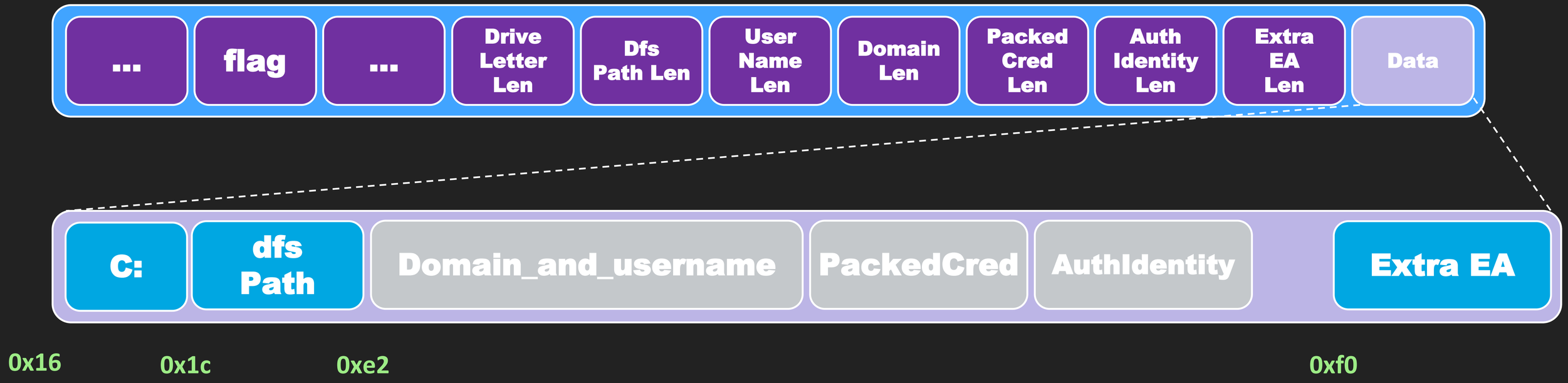
LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Extra EA (Extra Extend Attribute)

Drive letter len = 6
Dfs Path = 0xc6



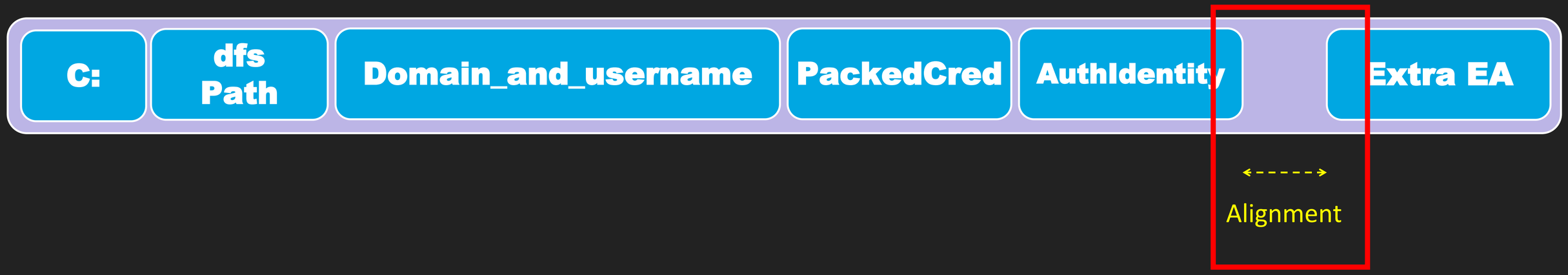
這邊為了 aligment 會多補 0xe bytes

LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Extra EA (Extra Extend Attribute)
  - 長度檢查並沒有包含 alignment 部分!
    - Out of bounds Read !
      - 最多能越界讀 0xe bytes

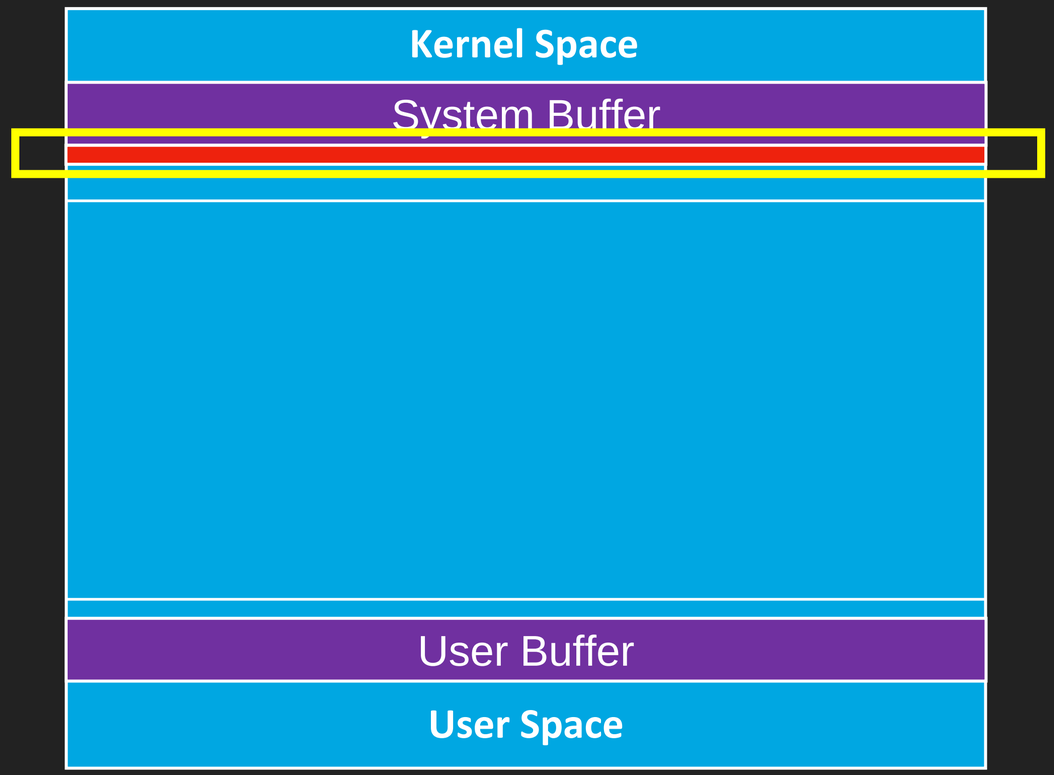


LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Buffered I/O



LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Extra EA (Extra Extend Attribute)
  - 長度檢查並沒有包含 alignment 部分!
    - Out of bounds Read !
      - 最多能越界讀 0xe bytes
    - 微軟很常忘記算 alignment 長度，但也不太容易發現就是了

LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Exploitation ?
  - 只能越界讀 0xe bytes

LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Exploitation ?
  - 只能越界讀 0xe bytes
  - 後面多數都是 heap chunk header 沒有位置資訊

LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Exploitation ?
  - 只能越界讀 0xe bytes
  - 後面多數都是 heap chunk header 沒有位置資訊
  - 廢洞?
    - 近一兩年如果沒有可以證明 kernel pointer leak 很常被 MSRC 算成 DoS

回顧一下 Windows Kernel Segment Heap

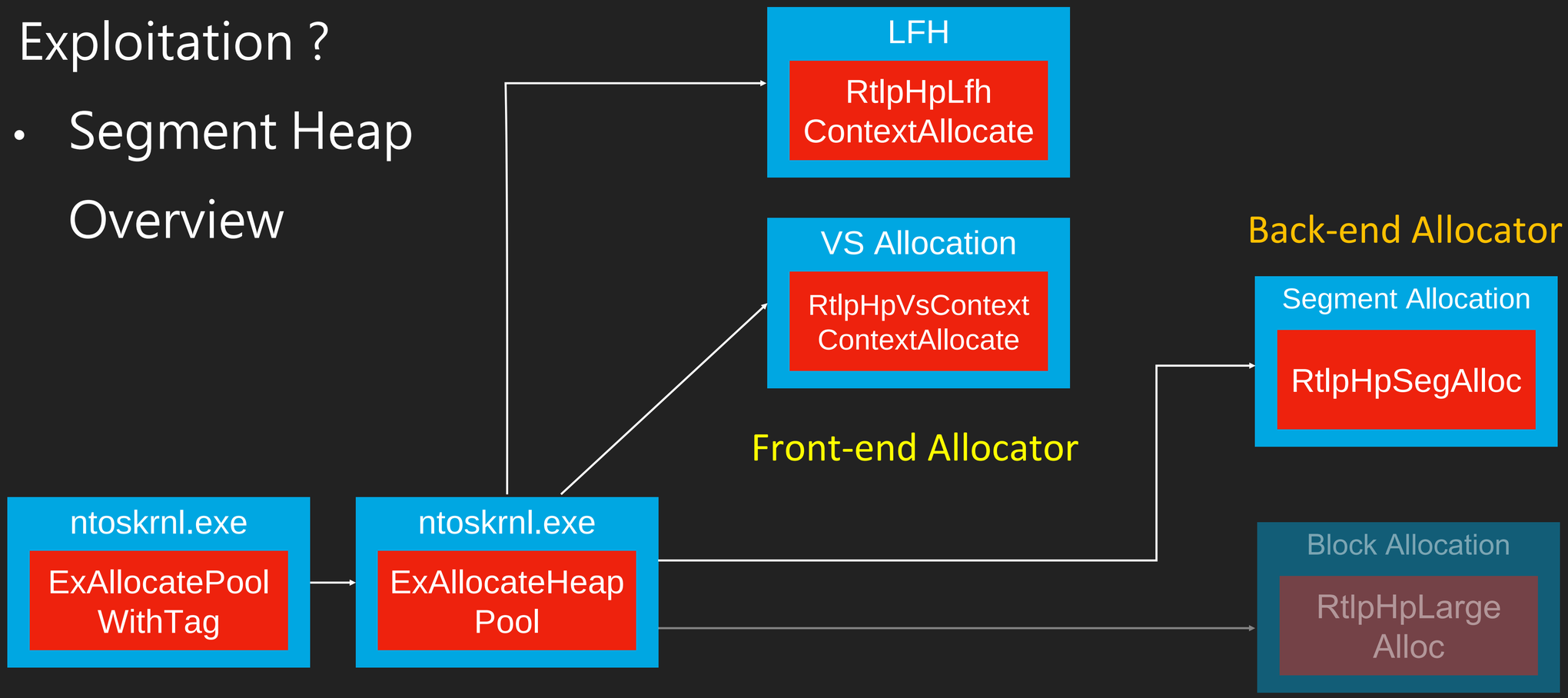
DEVCORE

LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Exploitation ?
  - Segment Heap Overview

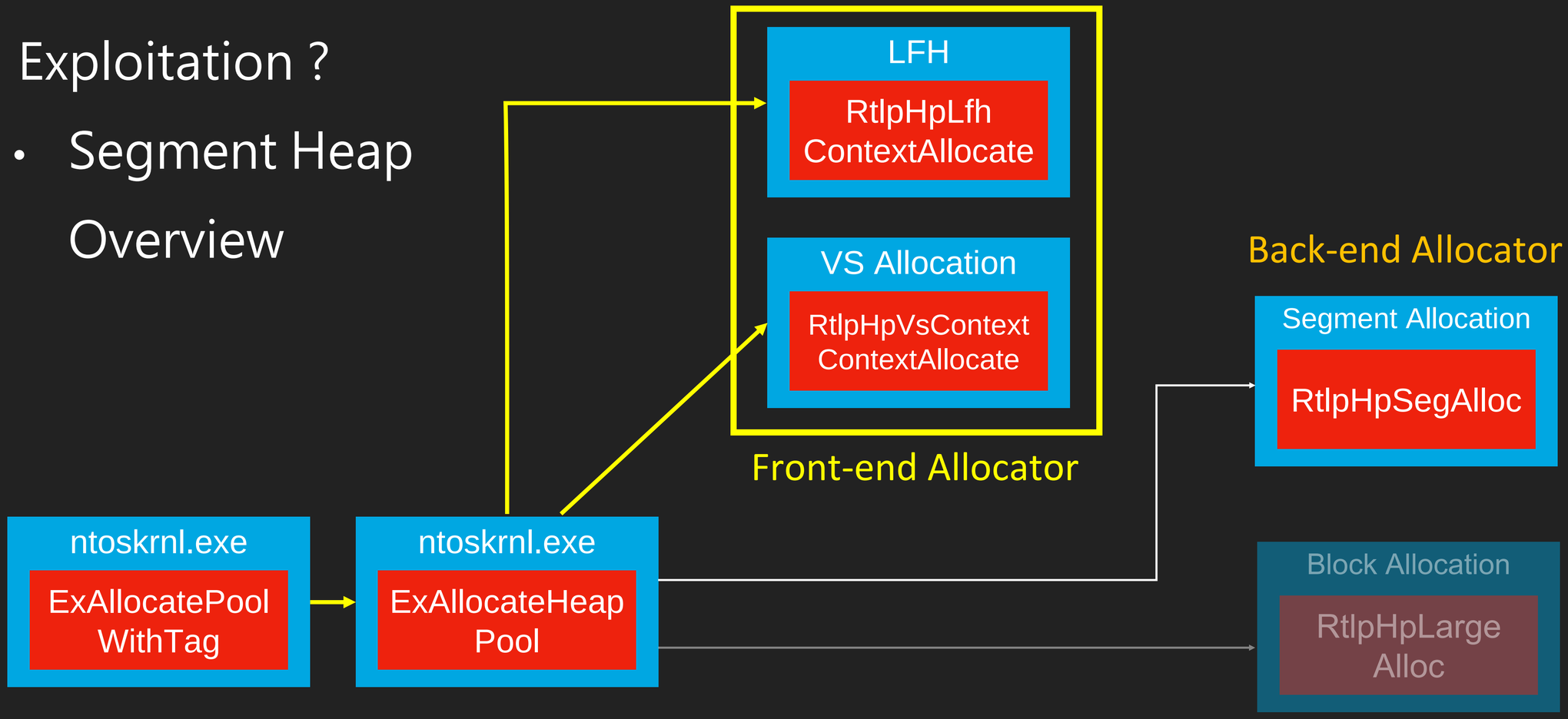


LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Exploitation ?
  - Segment Heap Overview

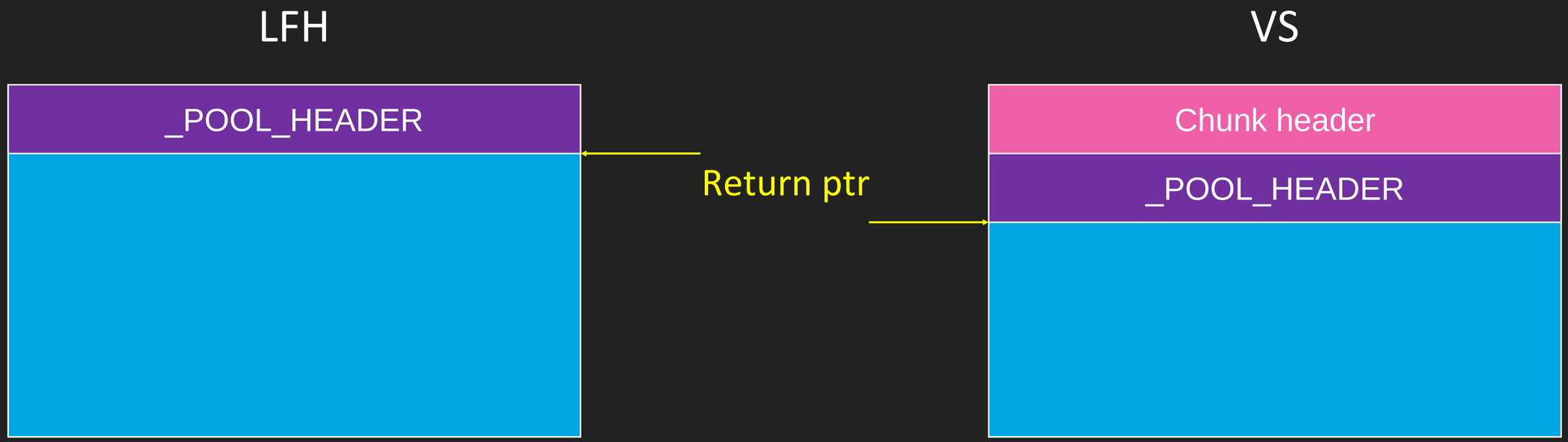


LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- LFH and Variable Size Allocation Pool Chunk



LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Exploitation ?
  - 兩大 Frontend Allocation 都只能
    - Leak Encode 過的 Header 資訊
    - 只少要有 RtlpHpHeapGlobals.HeapKey 才有可能獲得 Kernel Pointer Address

LeakLess Vulnerability

DEVCORE

CVE-2022-38025

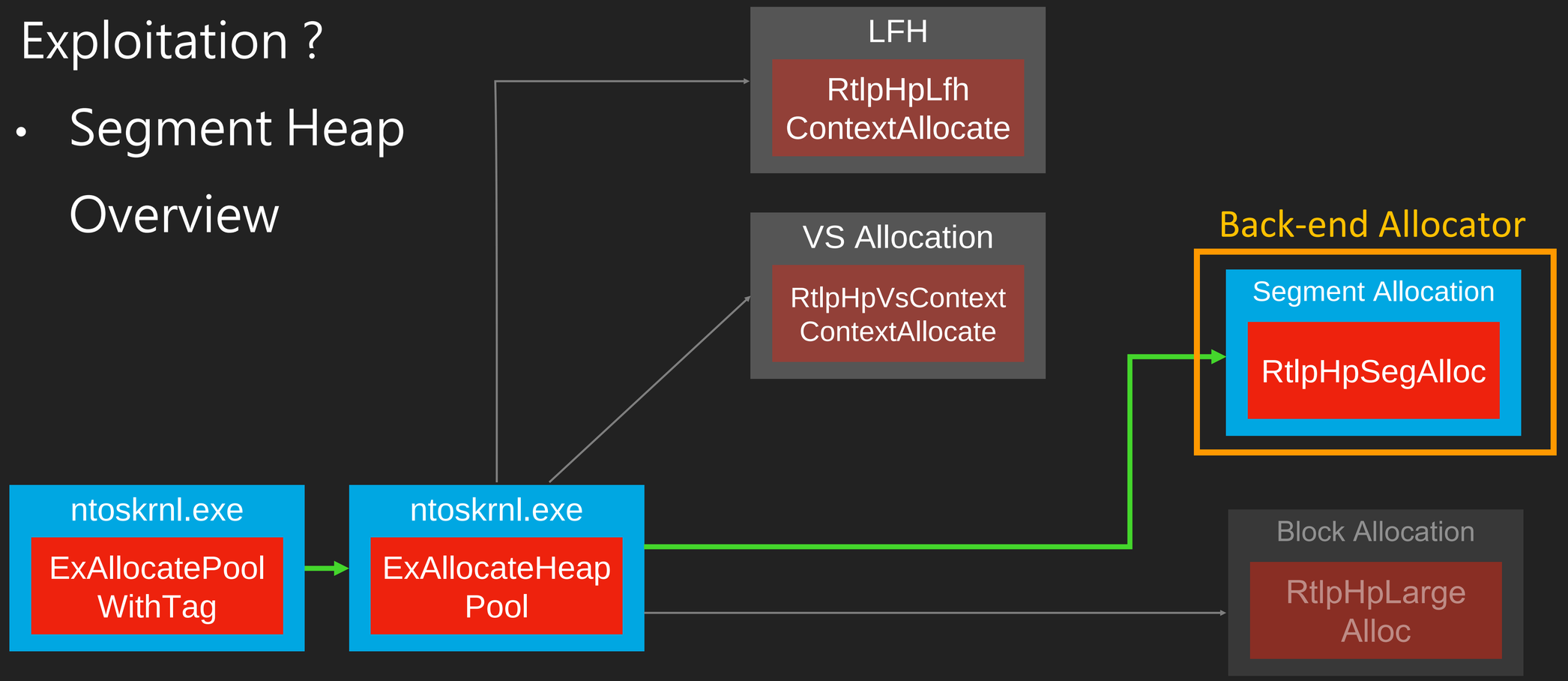
- Exploitation ?
  - 兩大 Frontend Allocation 都只能
    - Leak Encode 過的 Header 資訊
    - 只少要有 RtlpHpHeapGlobals.HeapKey 才有可能獲得 Kernel Pointer Address
  - How about backend Allocation ?

LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Exploitation ?
  - Segment Heap Overview



LeakLess Vulnerability

DEVCORE

CVE-2022-38025

- Exploitation?
  - Segment Allocation
    - 0x20000 < Size < SegContexts[1].MaxAllocationSize (0x7f0000)
    - Size & 0xfff == 0

LeakLess Vulnerability

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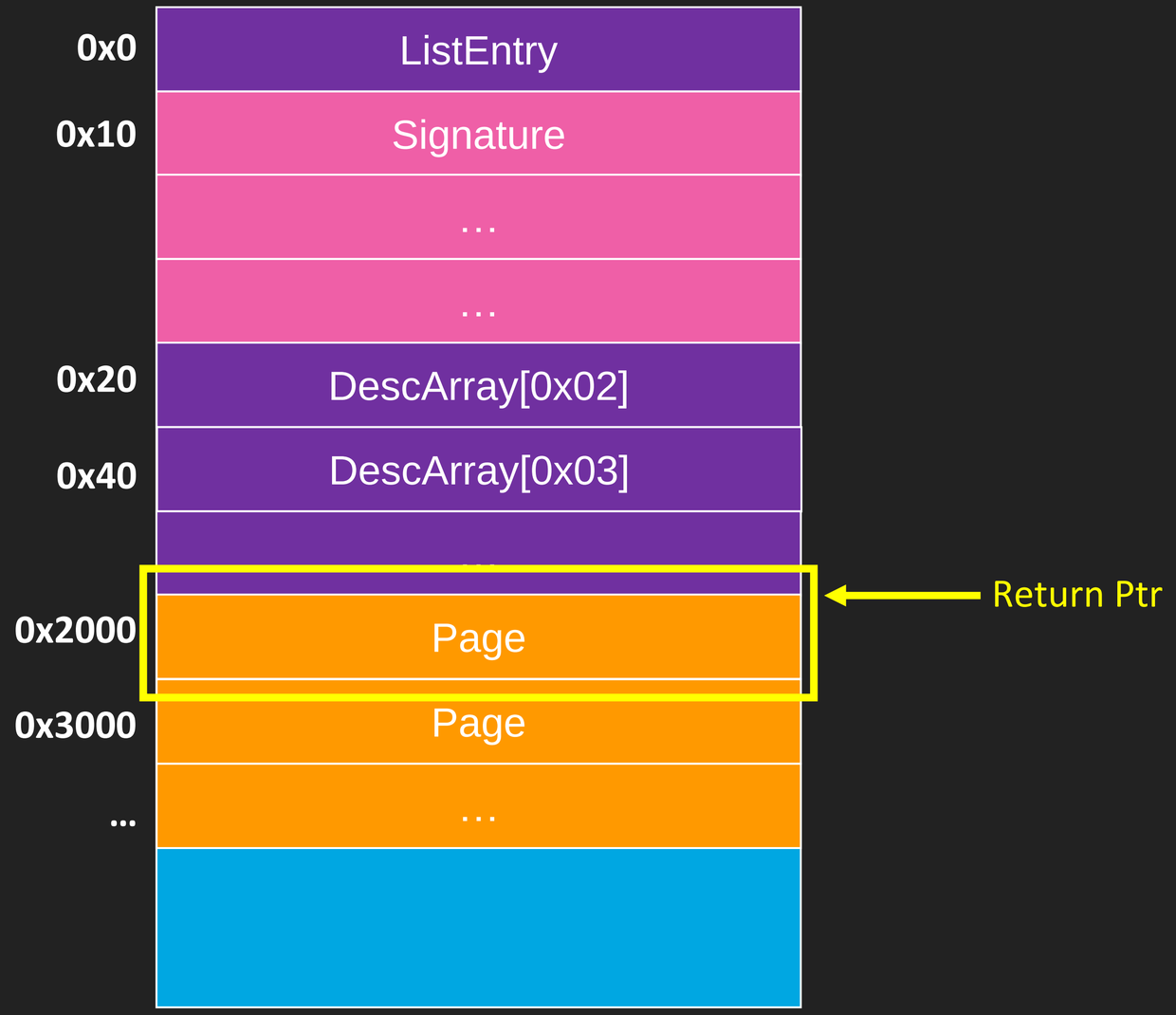
CVE-2022-38025

- Exploitation?



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- Exploitation?
  - Segment Allocation
    - Page
      - No any meta data !

LeakLess Vulnerability

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CVE-2022-38025

- Exploitation?
  - Segment Allocation
    - Page
      - No any meta data !
    - 可以放一些 Kernel Object 在 input buffer 後面，就有機會 leak kernel 資訊

LeakLess Vulnerability

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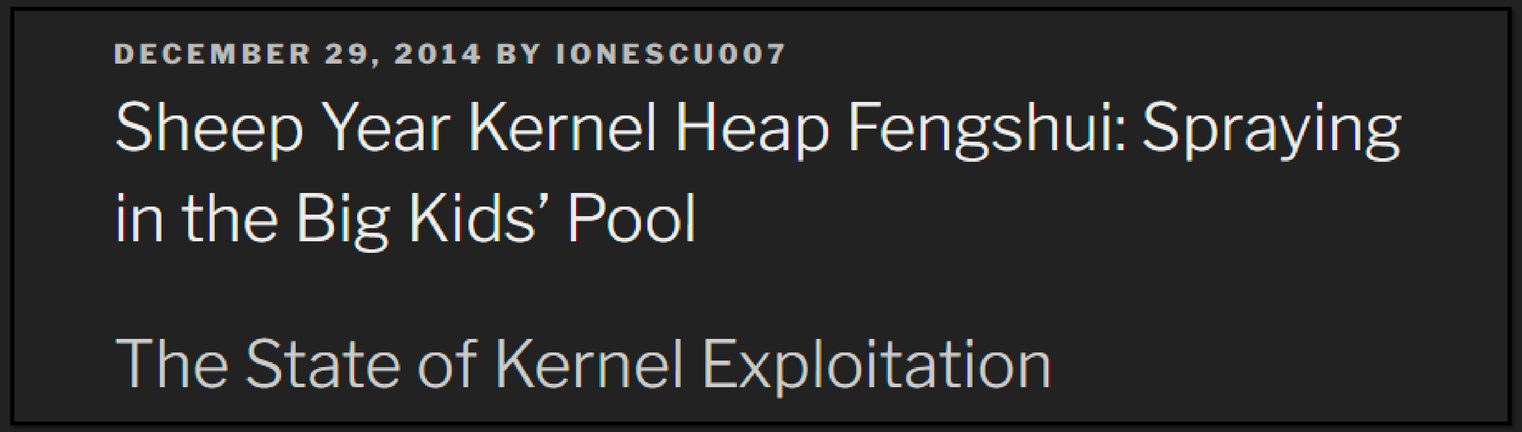
- Exploitation?
  - There are many good object for it.
    - Named Pipe
    - LFH Subsegment
    - …



https://www.alex-ionescu.com/kernel-heap-spraying-like-its-2015-swimming-in-the-big-kids-pool/

LeakLess Vulnerability

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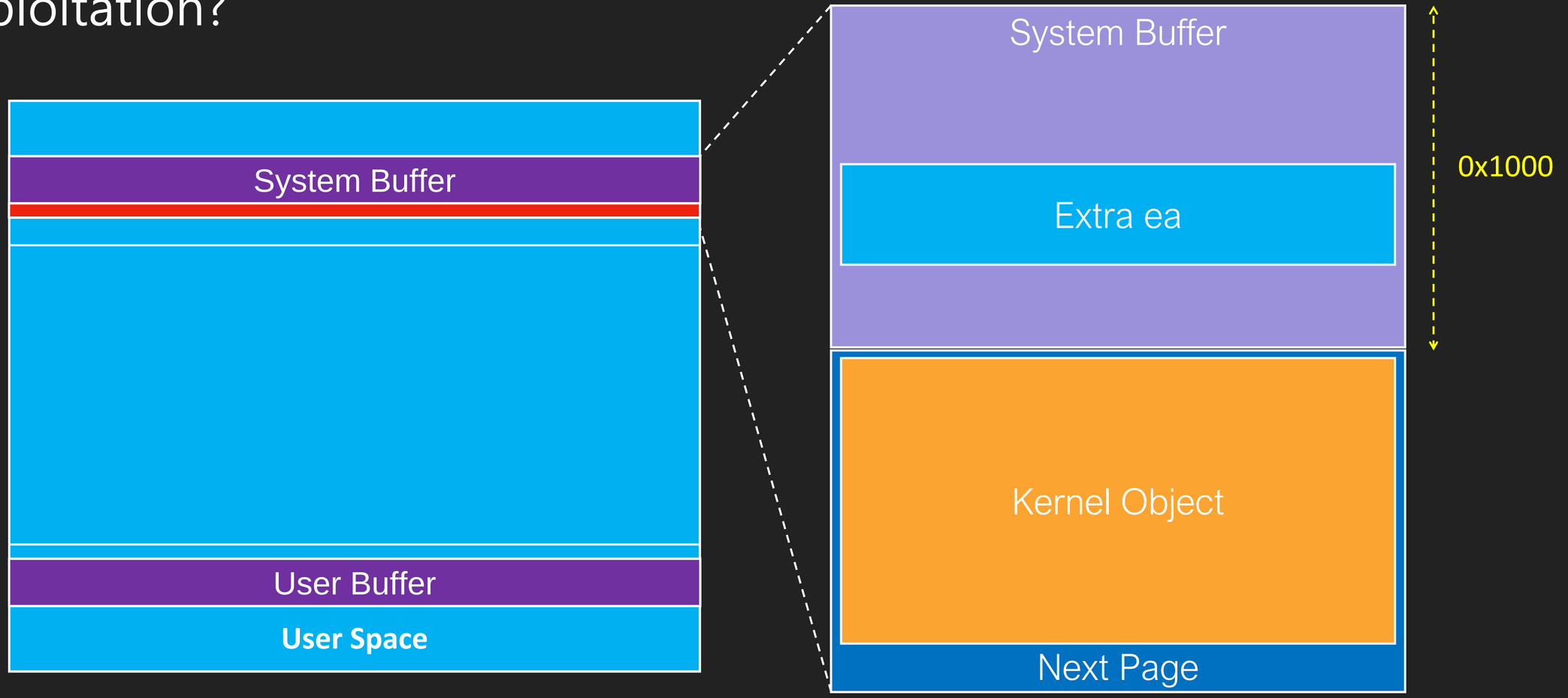
- Exploitation?



LeakLess Vulnerability

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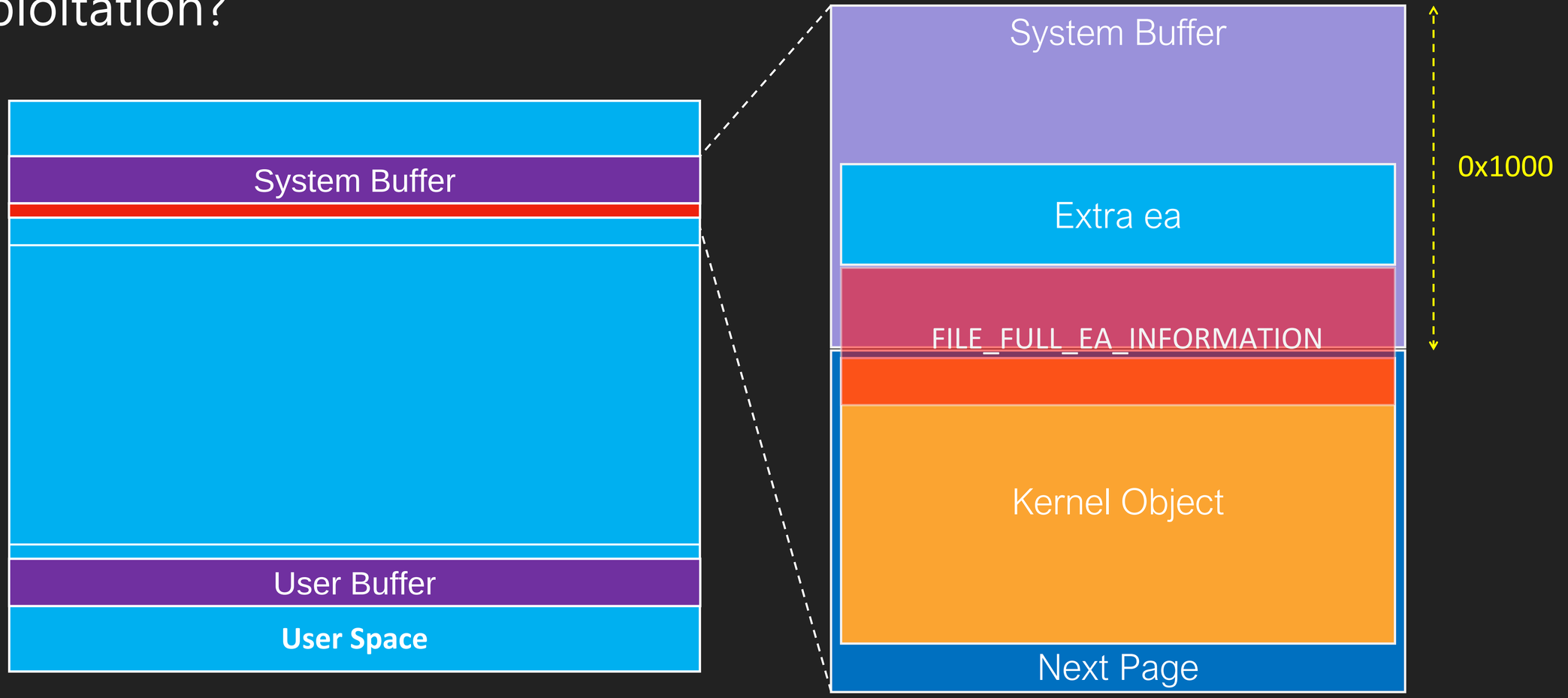
CVE-2022-38025

- Exploitation?



LeakLess Vulnerability

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CVE-2022-38025

- Exploitation?
  - 可以越界讀把資料讀到 Extend Attribute 裡面了
  - 那麼要怎麼讀出來?

LeakLess Vulnerability

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CVE-2022-38025

- Exploitation
  - Extra EA (Extra Extend Attribute) in DfscFsctrlCreateDriveLetter
    - 可提供而外的 Extend Attribute，後續 CreateFile 建立 SMB 連線時，會將該 Extend Attribute 給 CreateFile

LeakLess Vulnerability

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CVE-2022-38025

- Exploitation
  - AuthIdentity Extend Attribute
    - 主要儲存認證資訊
    - 當 CreateFile 用 smb 向 Remote server 溝通，此時如有給 AuthIdentity Extend Attribute 就會用 AuthIdentity 中的 Cred 來向 Remote Server 認證

LeakLess Vulnerability

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CVE-2022-38025

- Exploitation
  - AuthIdentity Extend Attribute structure

```
Offset Size struct authstruct
       0000 {
       0000 0004   ULONG version;
       0004 0004   ULONG xxxoffset;
       0008 0004   ULONG useroffset;
       000C 0004   ULONG usernamelen;
       0010 0004   ULONG domainoffset;
       0014 0004   ULONG domainlen;
       0018 0004   ULONG packoffset;
       001C 0004   ULONG packlen;
       0020 0004   ULONG flag;
       0024 0004   ULONG PackageListOffset;
       0028 0004   ULONG PackageListLen;
       002C 0001   char data[1];
            0030 };
```

LeakLess Vulnerability

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CVE-2022-38025

- Exploitation
  - AuthIdentity Extend Attribute structure
    - 這邊只要把 User offset 或 Domain offset 指向越界讀的 offset 就可
      - 長度不可超過越界讀的大小

```
Offset Size struct authstruct
       0000 {
       0000 0004   ULONG version;
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       0008 0004   ULONG useroffset;
       000C 0004   ULONG usernamelen;
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```

LeakLess Vulnerability

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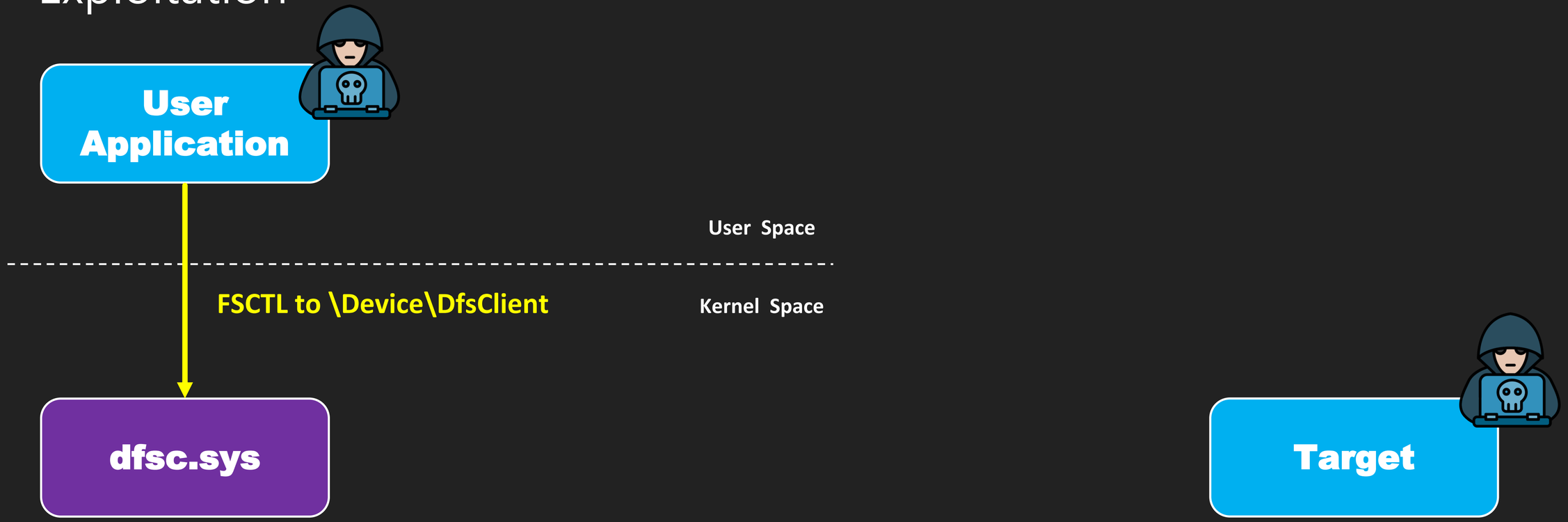
CVE-2022-38025

- Exploitation



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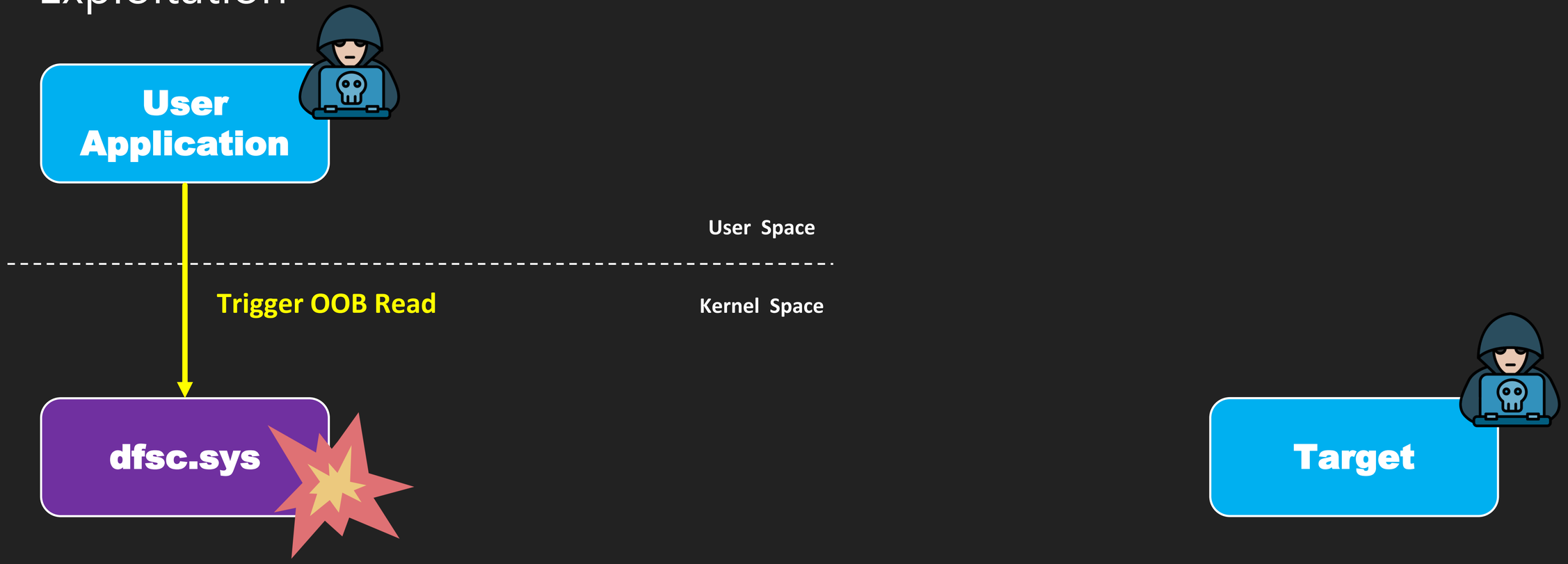
CVE-2022-38025

- Exploitation



LeakLess Vulnerability

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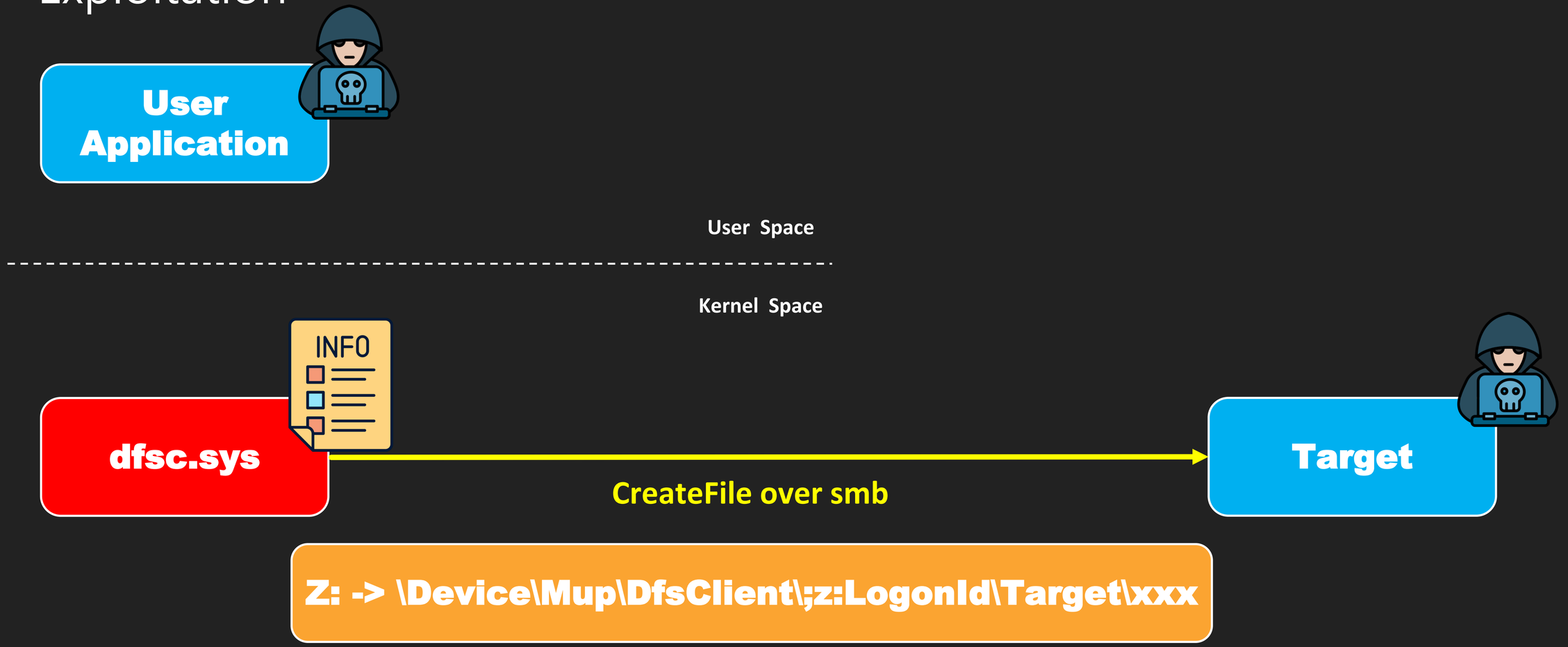
CVE-2022-38025

- Exploitation



LeakLess Vulnerability

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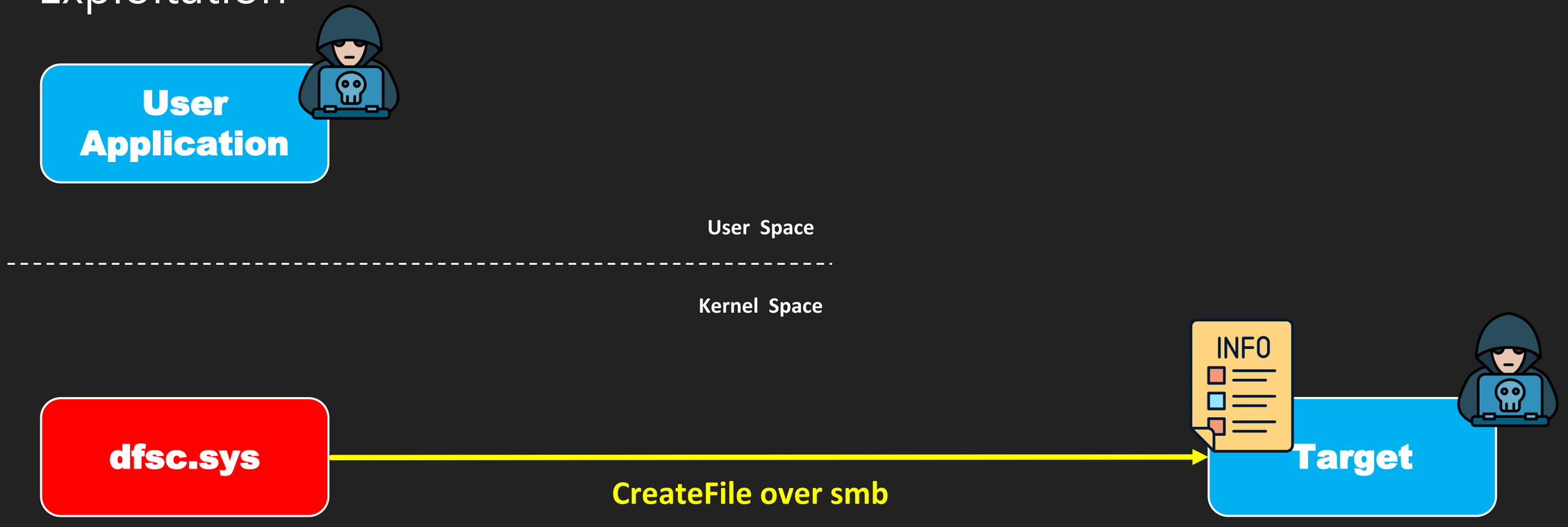
CVE-2022-38025

- Exploitation



LeakLess Vulnerability

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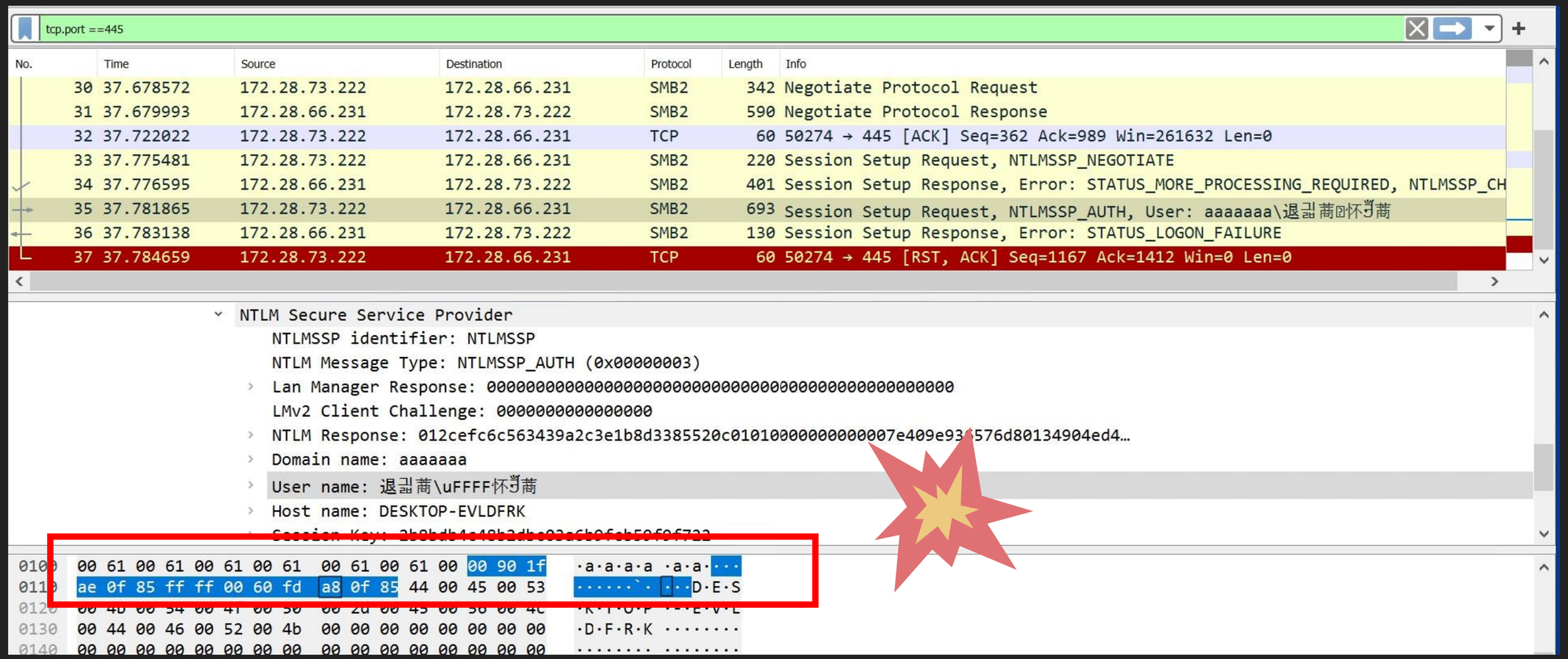
CVE-2022-38025

- Exploitation



~~LeakLess?~~

Leak Vulnerability in DFSC

DEVCORE

orange 🍊 1 year ago

排 heap 還是有用的(跑

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Summary

Summary

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- 在做 Alignment 時也要注意 buffer 大小計算

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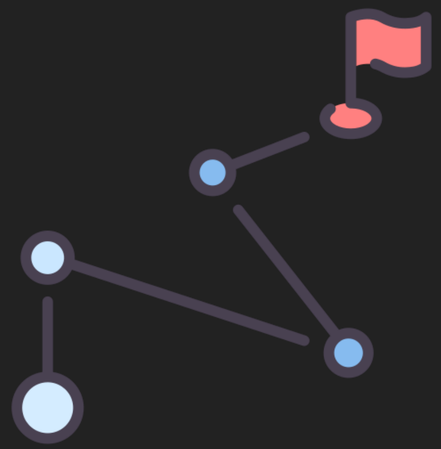
- 在做 Alignment 時也要注意 buffer 大小計算
- 任何微小的漏洞都可能造成危害

Summary

DEVCORE

- 在做 Alignment 時也要注意 buffer 大小計算
- 任何微小的漏洞都可能造成危害
- 也許可以繼續研究的方向
  - mup.sys
  - rdbss.sys

當找不到洞時，不妨休息一下
也許哪天回頭看
你可能會有不同的新發現



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Thanks

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Thanks

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