JUL 15, 2018 - 8 MINUTE READ - COMMENTS - REVERSE ENGINEERING DVTA WRITEUP

DVTA - Part 1 - Setup

Who am I?

I am Parsia, a security engineer at Electronic Arts.

I write about application security, reverse engineering, Go, cryptography, and (obviously) videogames.

Click on About Me! to know more.

Collections

I have written a lot about thick clients. However, I have not done more than a few practical examples that I can show my co-workers or anyone else asking questions. Recently, I came across the Damn Vulnerable Thick Client Application by SecVulture at https://github.com/secvulture/dvta.

I am not going to use the original version of the application. Someone has created a fork and added more protections. We will use this fork instead:

- https://github.com/nddmars/dvta

Neither fork's setup instructions worked for me. As a result, the first part is actually setting up the application and the necessary back-end in only one VM. But don't worry, we will do a bit of reverse engineering with dnSpy to fix an issue.

Thanks to SecVulture for creating the app and maintainers of the second repository for adding protections.

Existing Setup Instructions

There are no instructions in the original repository at:

- https://github.com/secvulture/dvta

But author's has some post on Infosec Institute with setup and solutions at[1]:

Thick Client Proxying

Go/Golang

Blockchain/Distributed Ledgers

Automation

Reverse Engineering

Crypto(graphy)

CTFs/Writeups

WinAppDbg

AWSome.pw - S3 bucket squatting - my very legit branded vulnerability

- https://resources.infosecinstitute.com/practical-thick-client-application-penetration-testing-using-damn-vulnerable-thick-client-app-part-1

The fork has a Word document file with pictures and setup instructions. I still could not make it work.

Setup Instructions 2: Electric Boogaloo

I know setup is boring and you want to "hack." But this is necessary to have fun later.

0. Ingredients and Price

Hint: Everything is free.

1. Windows 7 (or 10) VM. I used a 32-bit Windows 7 VM from https://modern.ie: Free.
2. Microsoft SQL Server 2008 Express: Free.
3. Microsoft SQL Server 2008 Management Studio Express: Free.
4. FileZilla FTP Server: Free.
5. Microsoft Sysinternals Suite: Free.
6. dnSpy: Free.

1. Get the Code and Binary

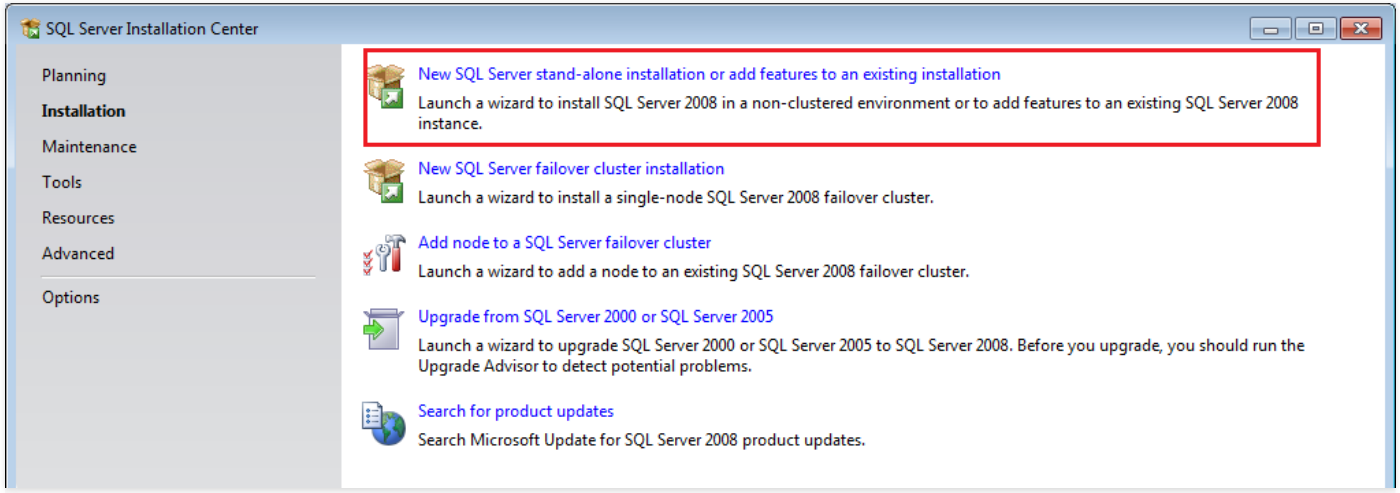
Download the whole repository as a zip file (because you don't want to install git on a disposable VM like me) from:

- https://github.com/nddmars/dvta

Extract it to a location of your choice. I named mine `dvta-master`.

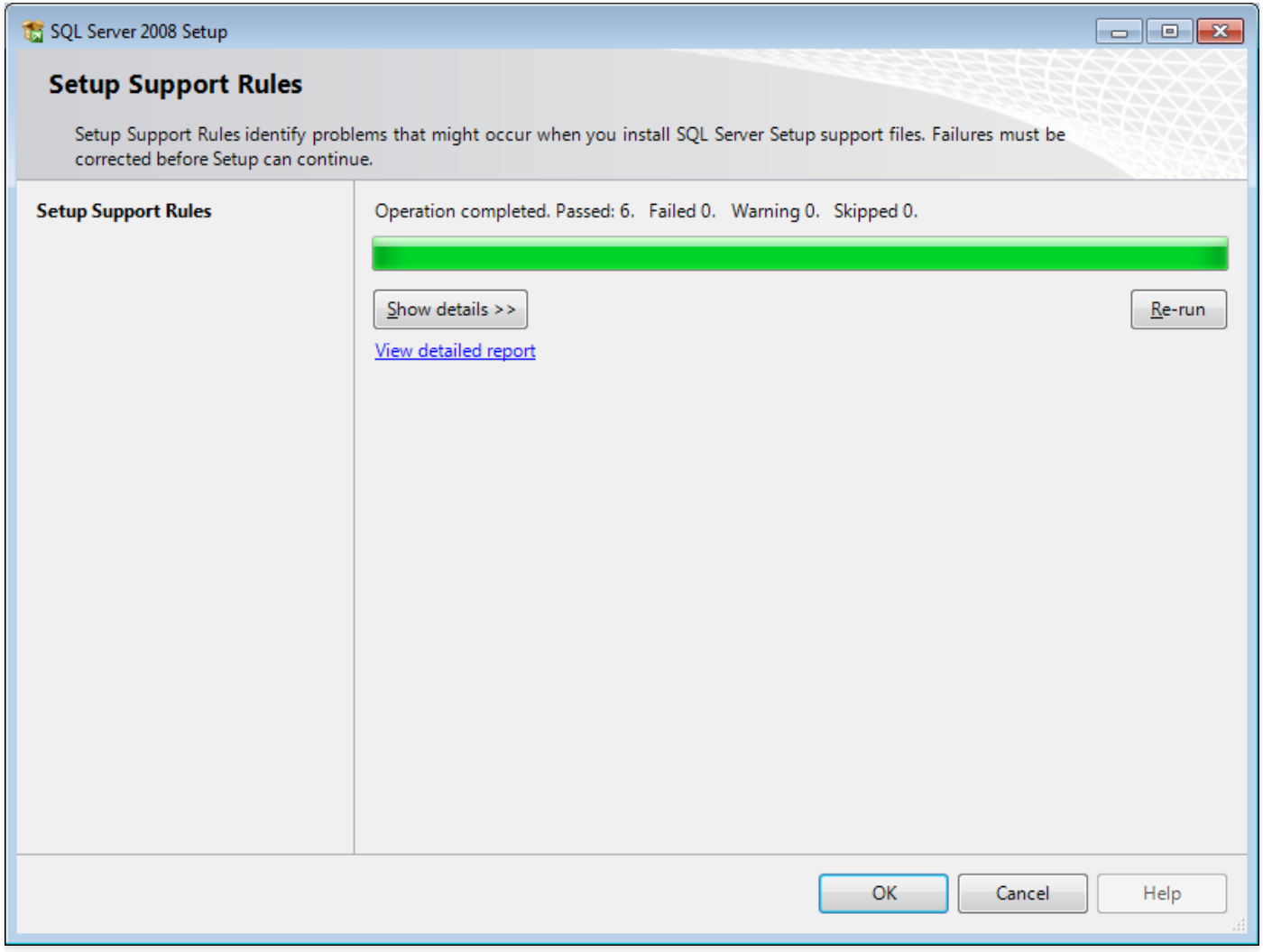
2. Install Microsoft SQL Server 2008 Express

- Download it from https://www.microsoft.com/en-us/download/confirmation.aspx?id=1695.
- Click on `Installation` to the left and select `New SQL Server stand-alone ...`.



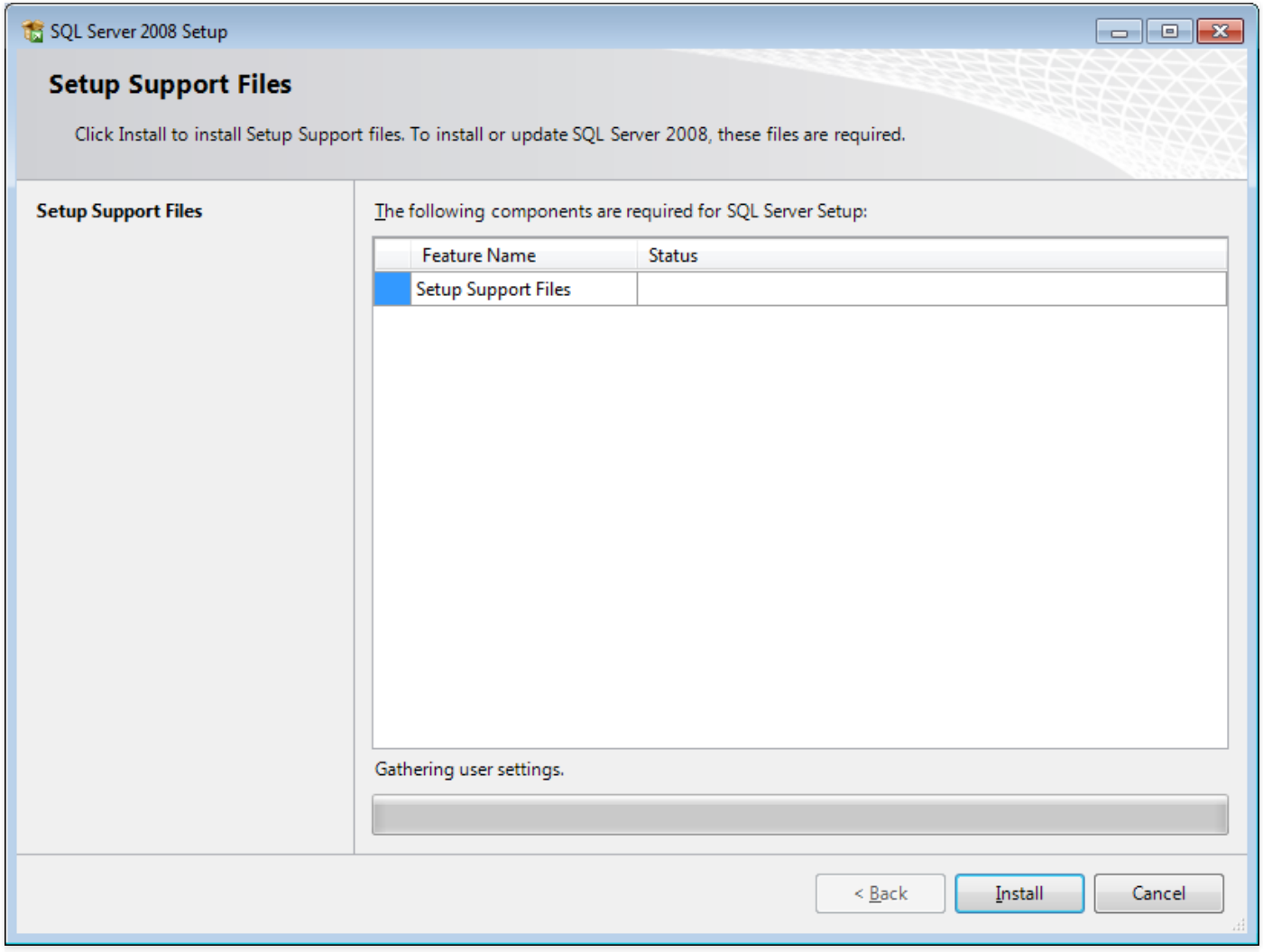
Select New SQL Server stand-alone

- `Setup Support Rules` : `OK`.



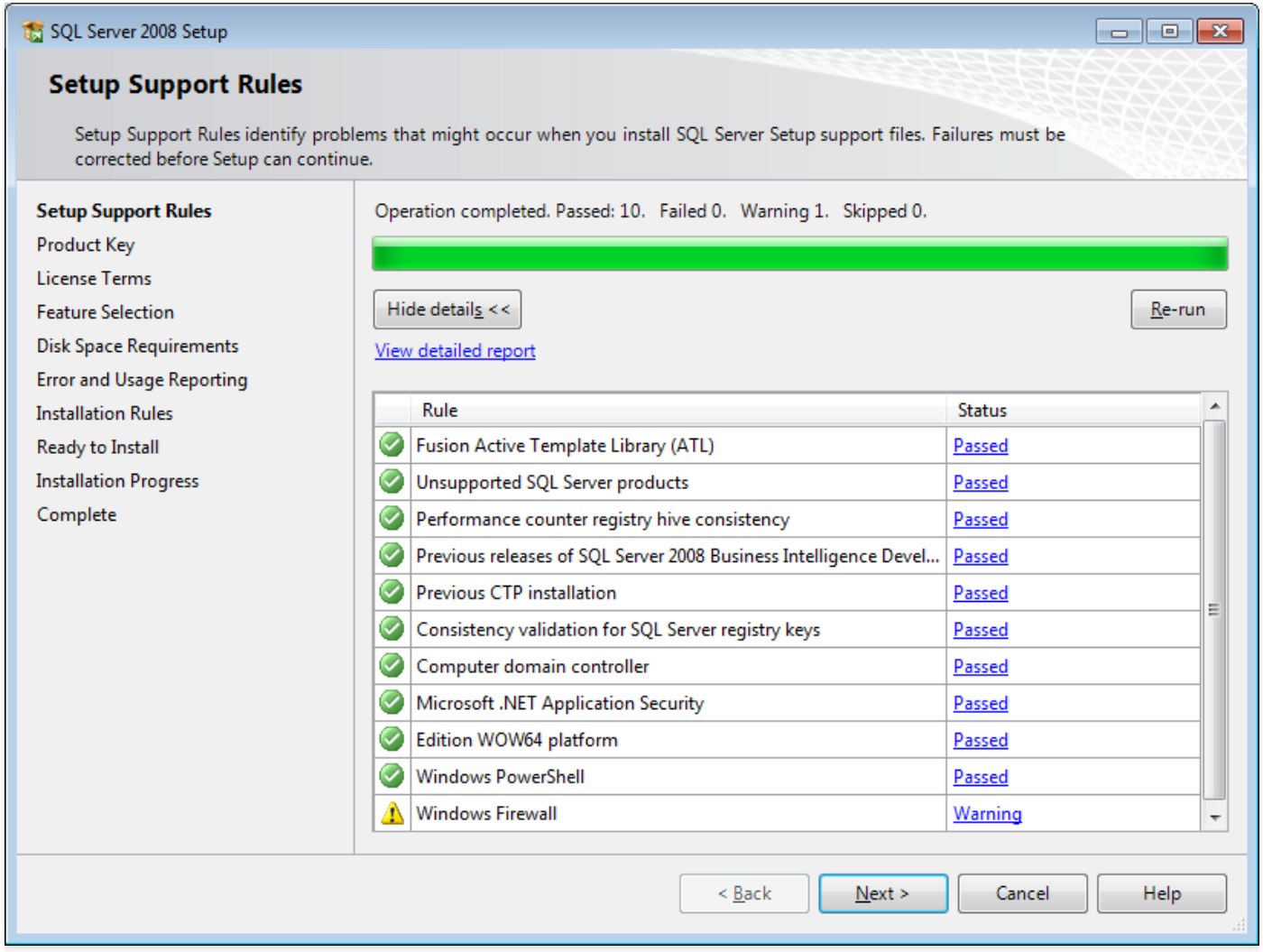
Support Rules will Run

- `Setup Support Files` : `Install` .



Select install to get setup support files

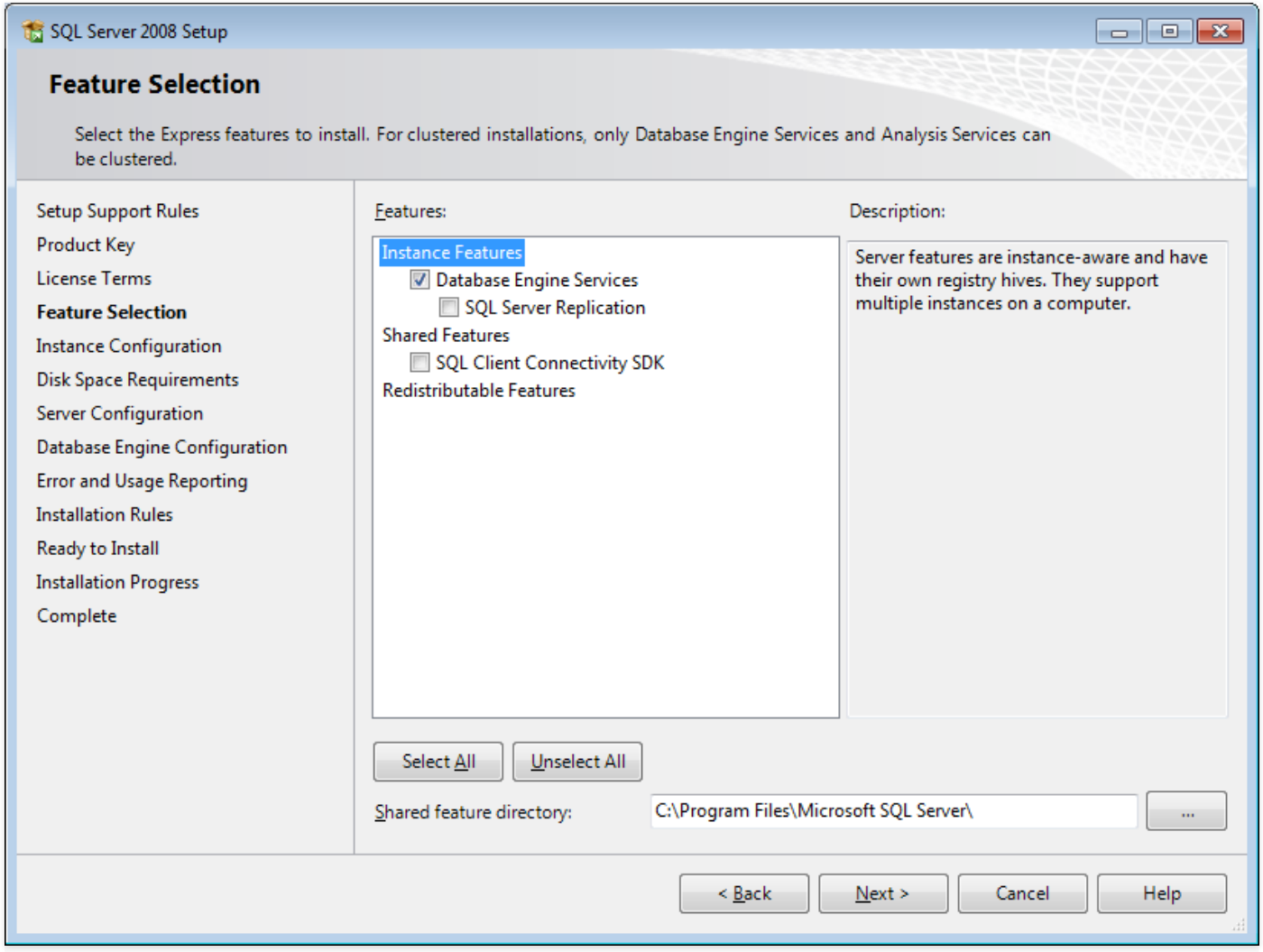
- Again in `Setup Support Files`: `Next`.



Ignore the Firewall warning, our back-end is local

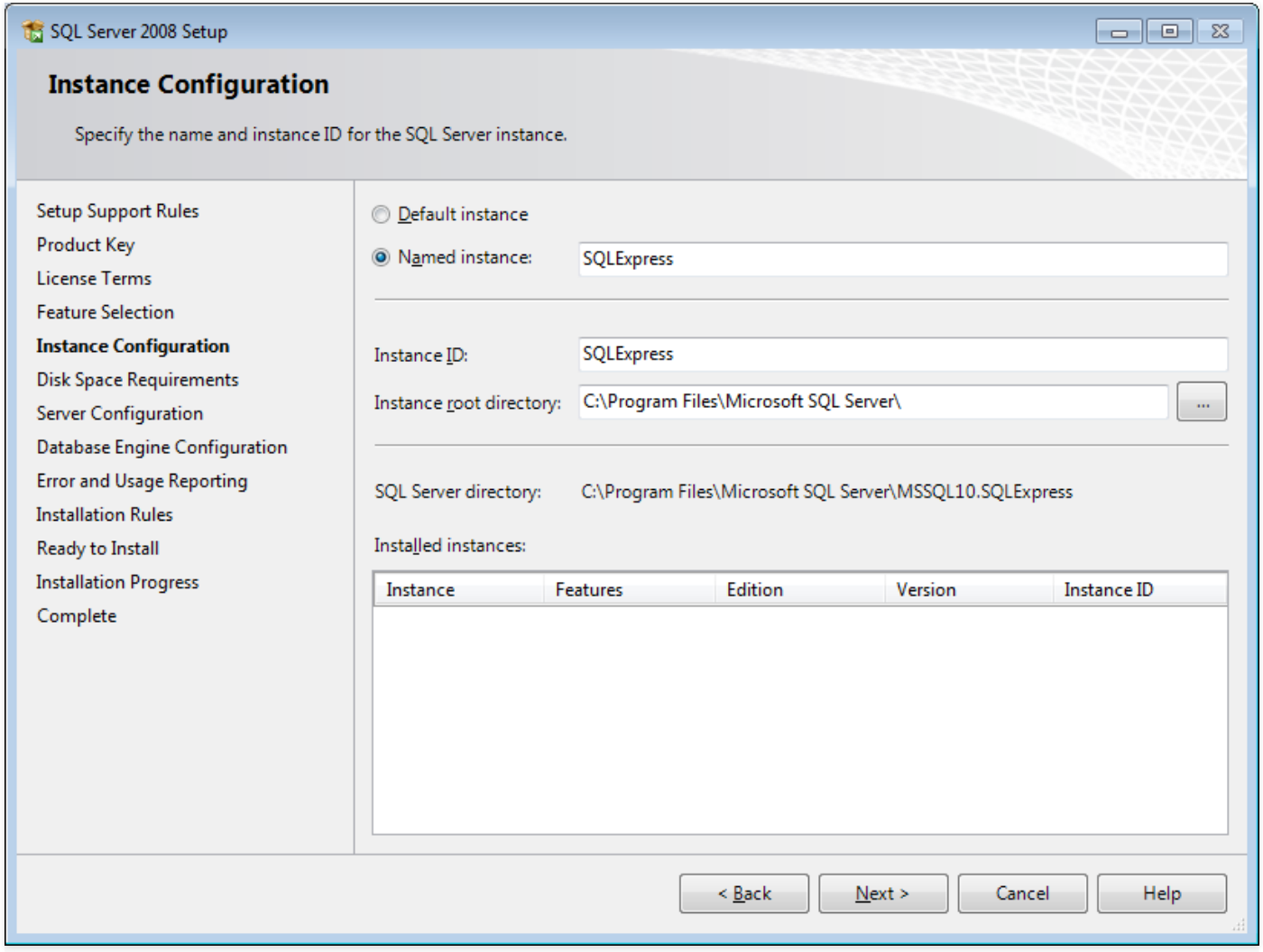
- `Product Key`: Continue with free edition.
- `License Terms`: `Accept`.

- `Feature Selection`: Under `Instance Features` select `Database Engine Services`.



We do not need the SDK

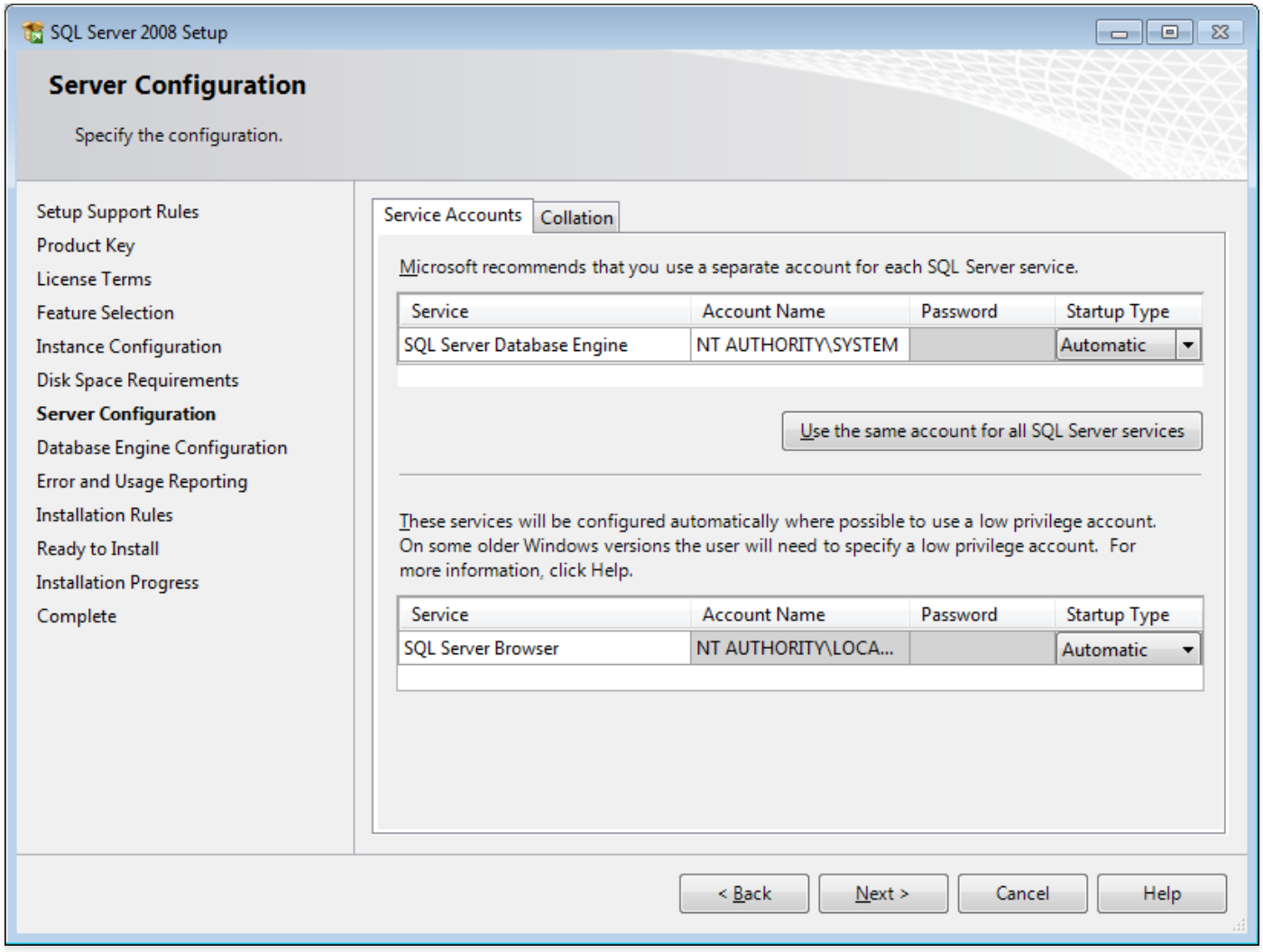
- `Instance Configuration`: Keep the default instance name `SQLExpress`.



If you change the default instance name, replace it in the rest of the instructions.

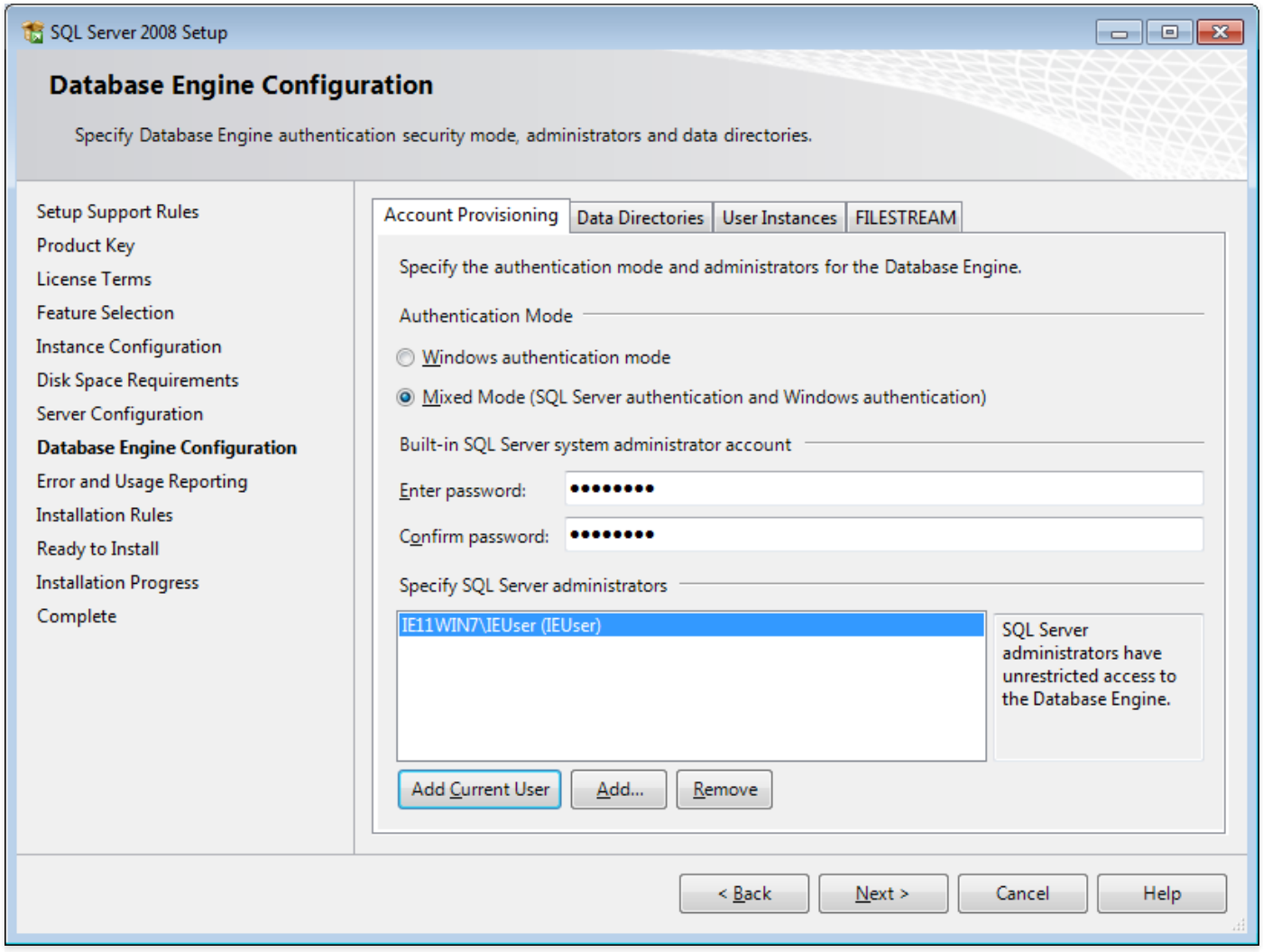
- `Disk Space Requirements` `Next`.

- `Server Configuration`: I selected the `SYSTEM` account for `SQL Server Database Engine`. Change `SQL Server Browser` to `Automatic`.



Doesn't really matter if we use a privileged account in a VM

- `Database Engine Configuration`: Under `Authentication Mode` select `Mixed Mode ...` and enter `p@ssw0rd` as password. Then `Add Current User`.



It appears adding another user is mandatory during setup

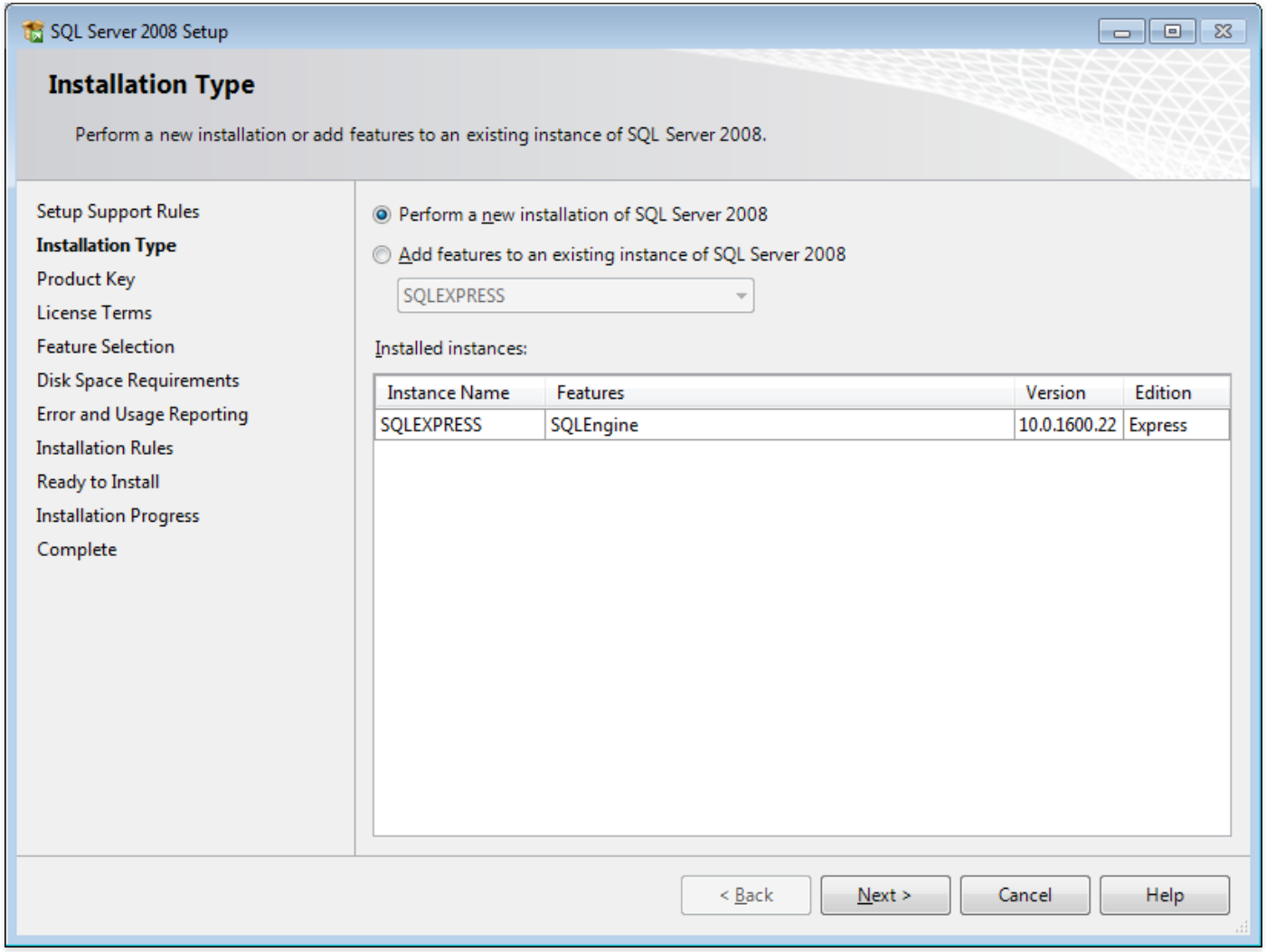
- `Error and Usage Reporting`: Keep boxes unchecked or don't.

- `Installation Rules`: `Next`.
- `Ready to Install`: `Install`.
- Finally `Close`.

3. Install Microsoft SQL Server 2008 Management Studio Express

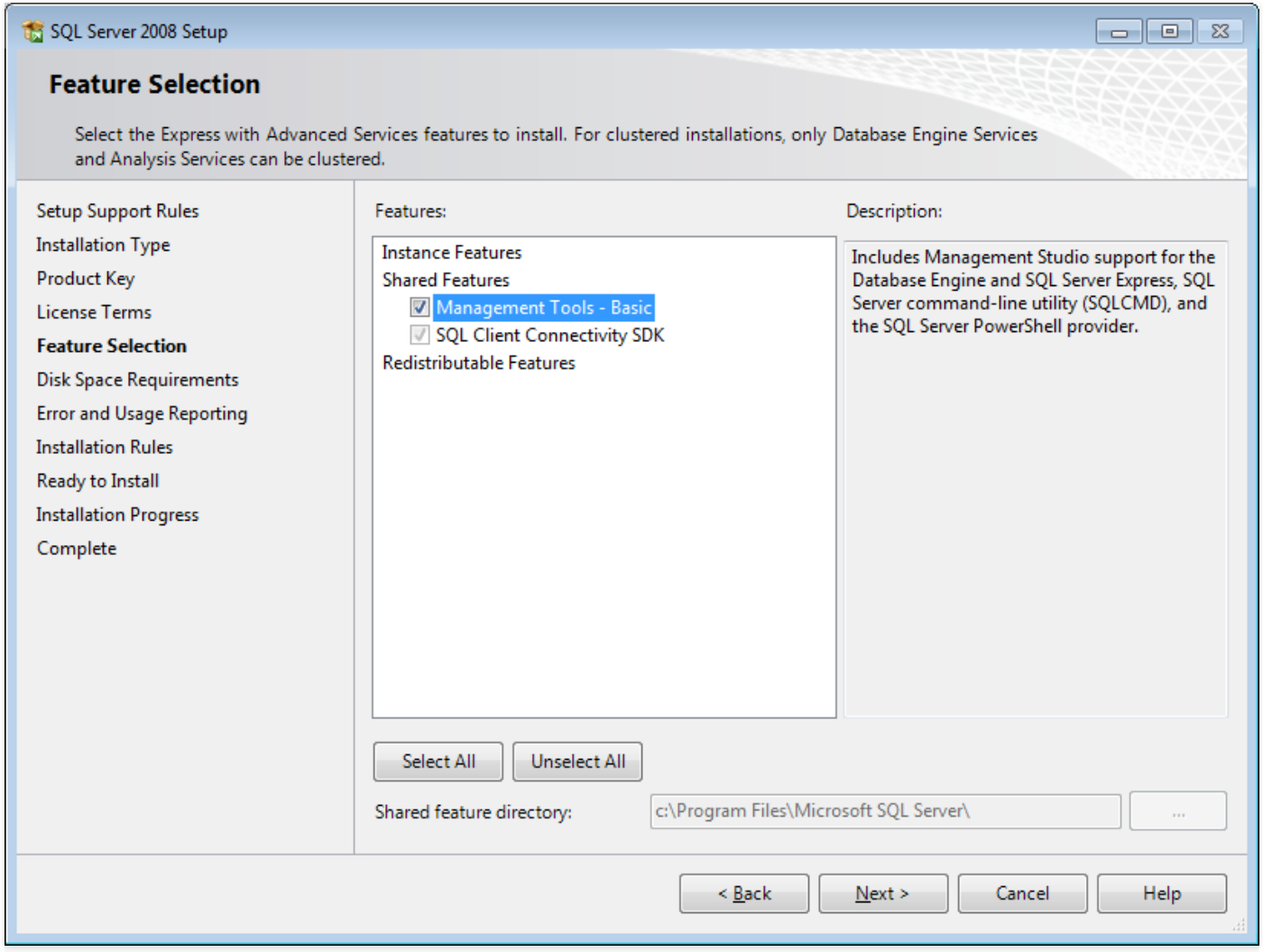
We need management studio to set up our database and tables.

- Download from: https://www.microsoft.com/en-us/download/details.aspx?id=7593.
- Ignore the error about Service Pack.
- Click on `Installation` to the left and select `New SQL Server stand-alone ...` (this looks very similar to last wizard).
- `Installation Type`: Select `Perform a new installation ...`, otherwise the management tools will not show up.



Don't worry, it will not install a new instance

- `Feature Selection` and select `Management Tools - Basic` under `Shared Features`.



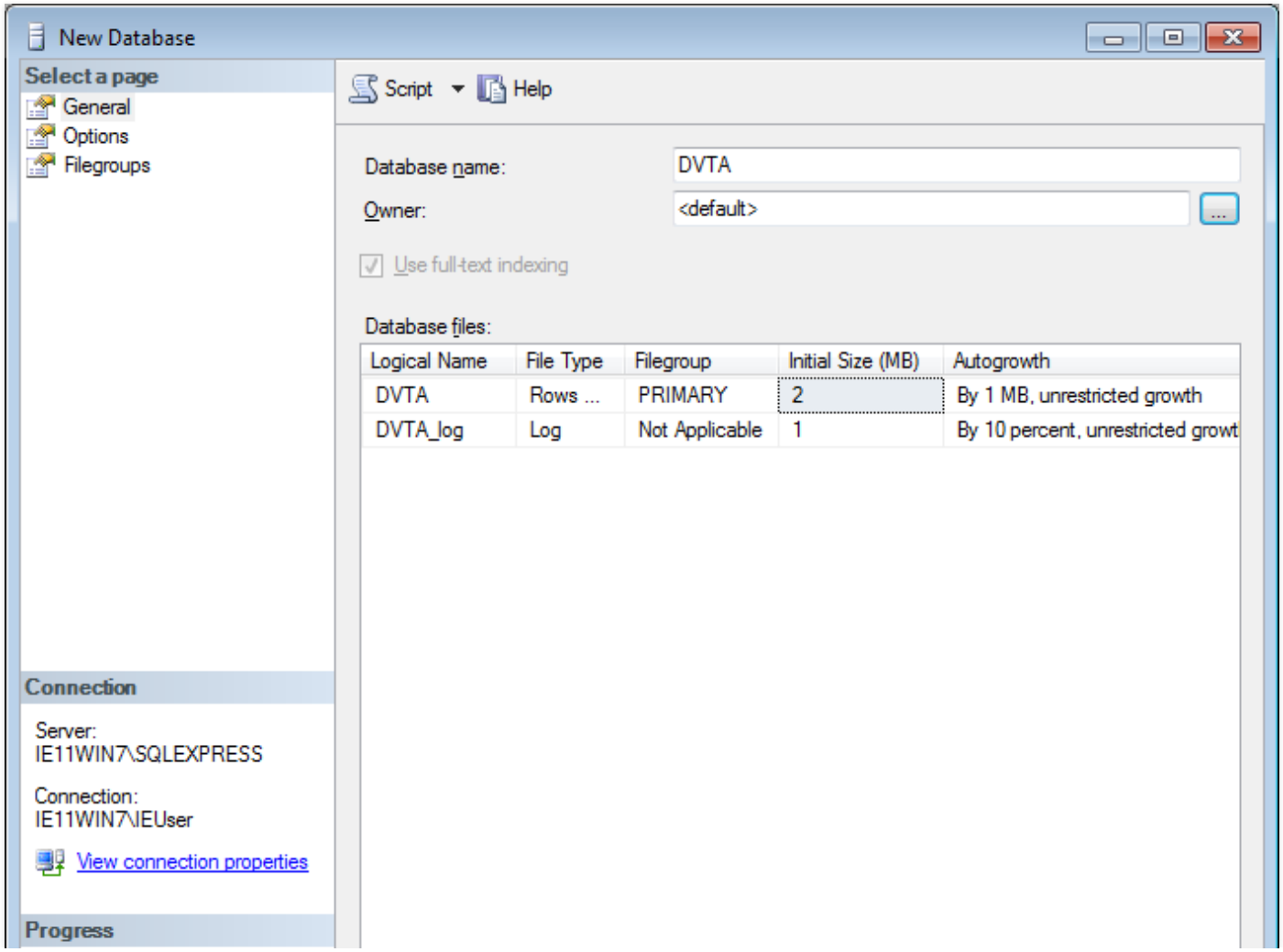
Add Management Studio here

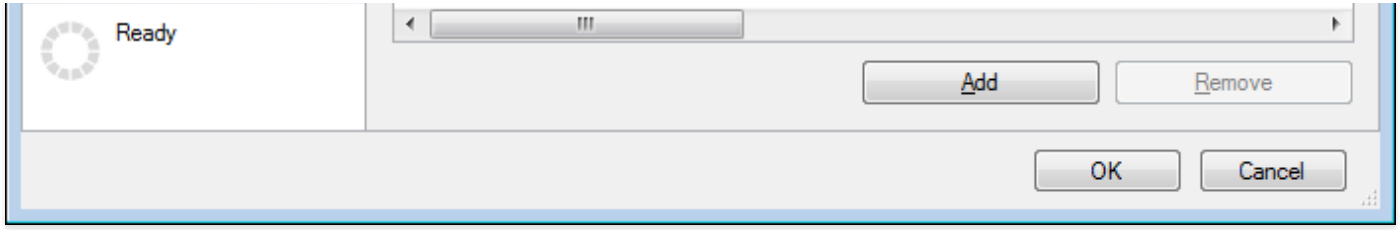
- Complete the installation.

4. Create the DVTA Database

Now we can use the management studio to create the database and populate it.

- Start `SQL Server Management Studio` and connect to the `SQLExpress` instance.
- Right-click on `Databases` to the left and select `New Database`.
- Enter `DVTA` in the database name and press `OK`. Don't change anything else.



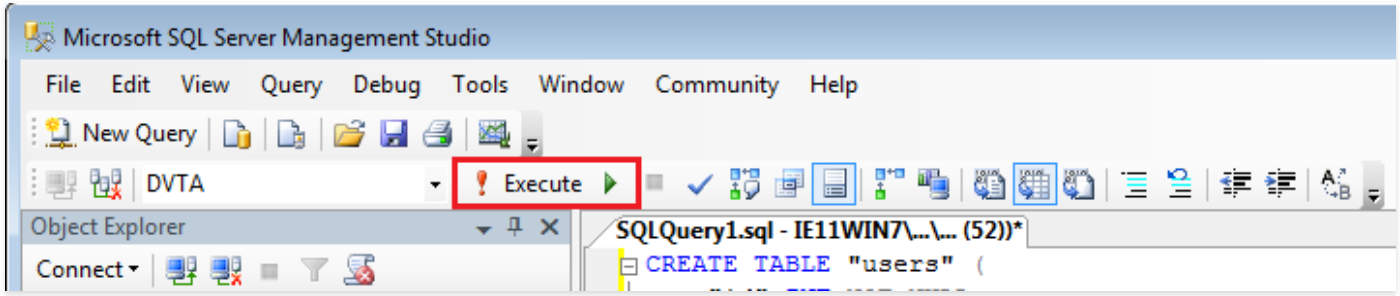


Only change the database name

- Right-click on `DVTA` under `Databases` and select `New Query`.
- To create the `users` table, enter this query and select `Execute` (note this is different from the original instructions, we are setting the `id` column to auto-increment by `1` starting from `0`). Without auto-increment, registration will not work:

Creating the users table

```
CREATE TABLE "users" (
    "id" INT IDENTITY(0,1) NOT NULL,
    "username" VARCHAR(100) NOT NULL,
    "password" VARCHAR(100) NOT NULL,
    "email" VARCHAR(100) NULL DEFAULT NULL,
    "isadmin" INT NULL DEFAULT '0',
    PRIMARY KEY ("id")
)
```



Execute button is a bit hard to find

- Next create the `expenses` table (I have set the `id` column to auto-increment):

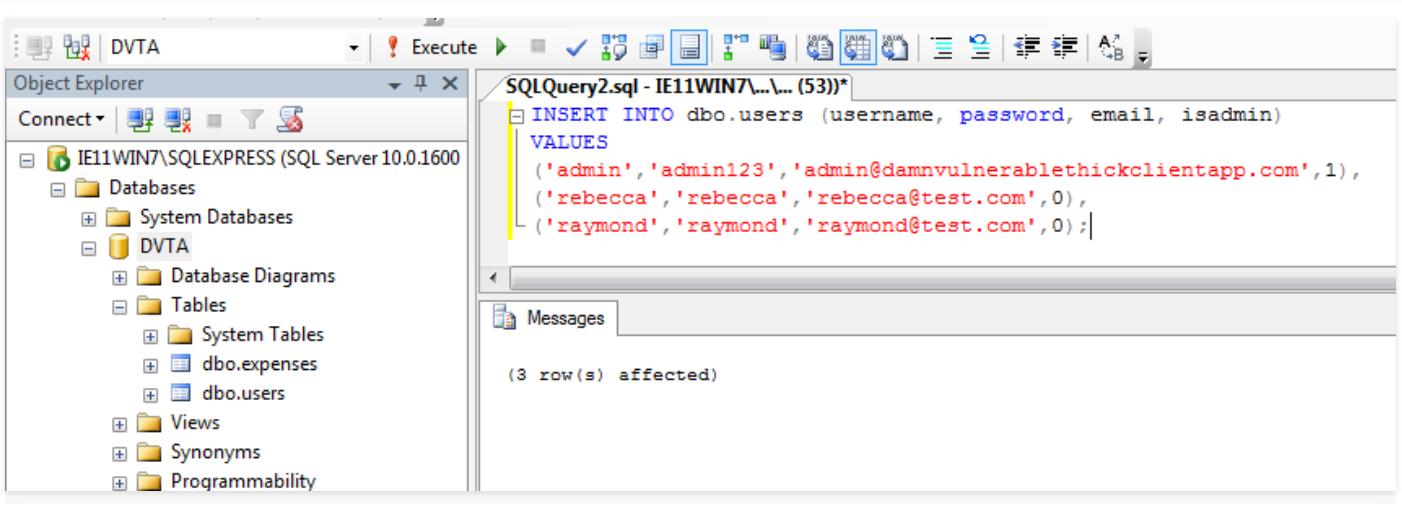
Creating the expenses table

```
CREATE TABLE "expenses" (
    "id" INT IDENTITY(0,1) NOT NULL,
    "email" VARCHAR(100) NOT NULL,
    "item" VARCHAR(100) NOT NULL,
    "price" VARCHAR(100) NOT NULL,
    "date" VARCHAR(100) NOT NULL,
    "time" VARCHAR(100) NULL DEFAULT NULL,
    PRIMARY KEY ("id")
)
```

- Populate the users table with some test data. The non-admin users can be added through the application later but admin needs to be setup manually.

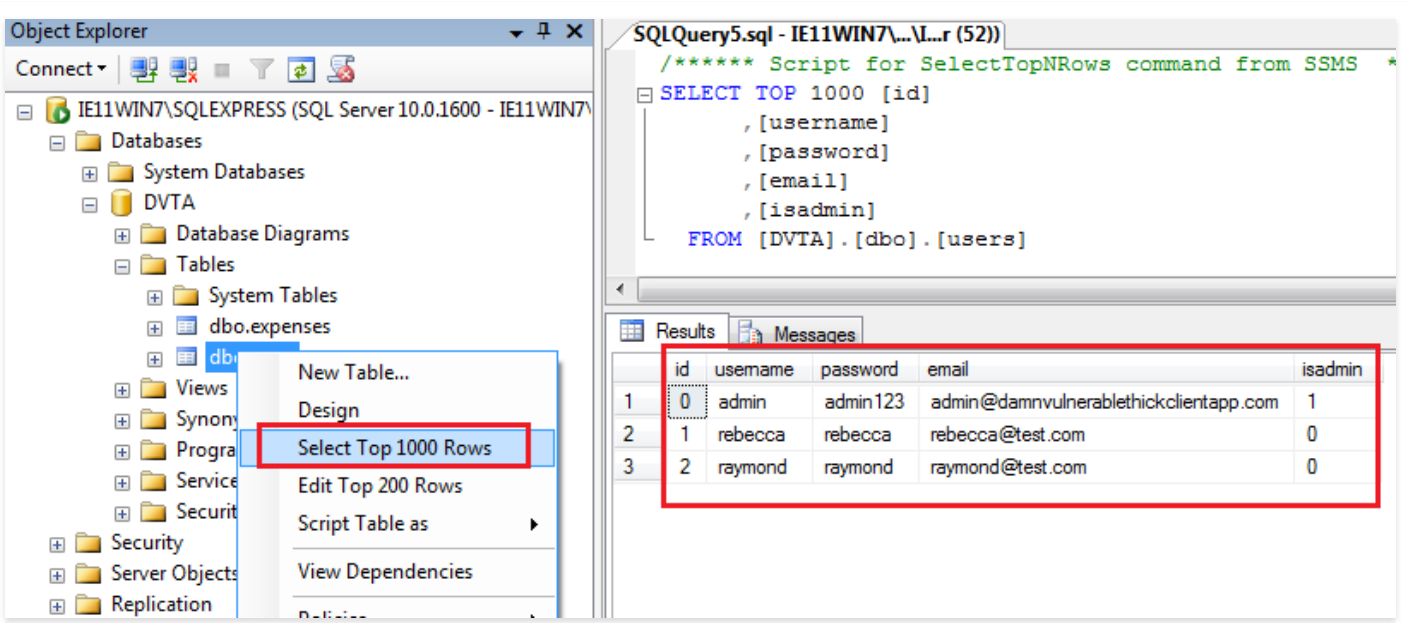
Adding test users

```
INSERT INTO dbo.users (username, password, email, isadmin)
VALUES
('admin','admin123','admin@damnvulnerablethickclientapp.com',1),
('rebecca','rebecca','rebecca@test.com',0),
('raymond','raymond','raymond@test.com',0);
```



Three test users added

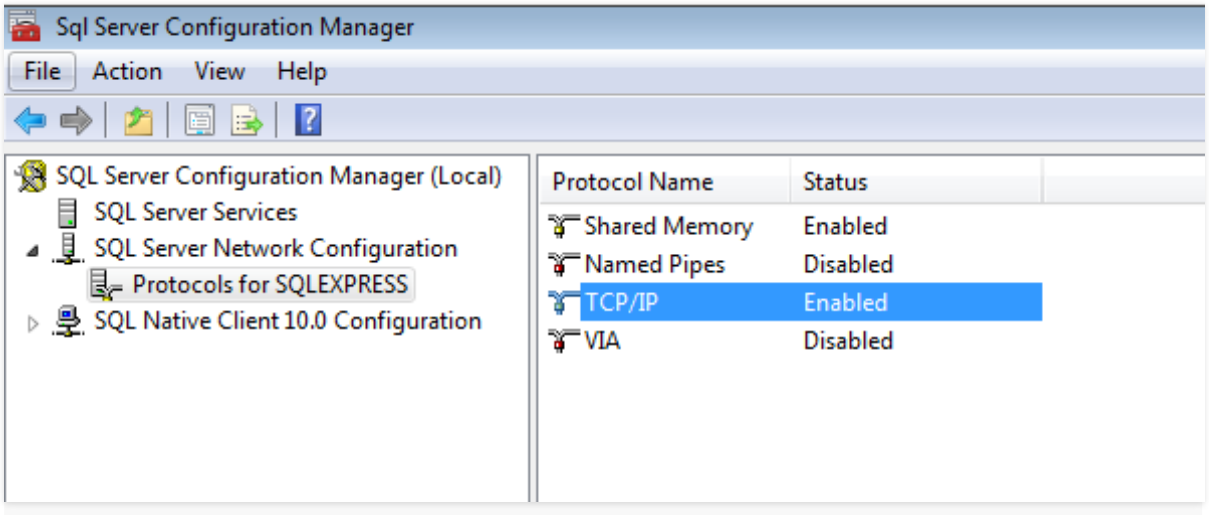
- Now we can right click on `dbo.users` and select `Select Top 1000 Rows` to see the test data.



Test users in the database

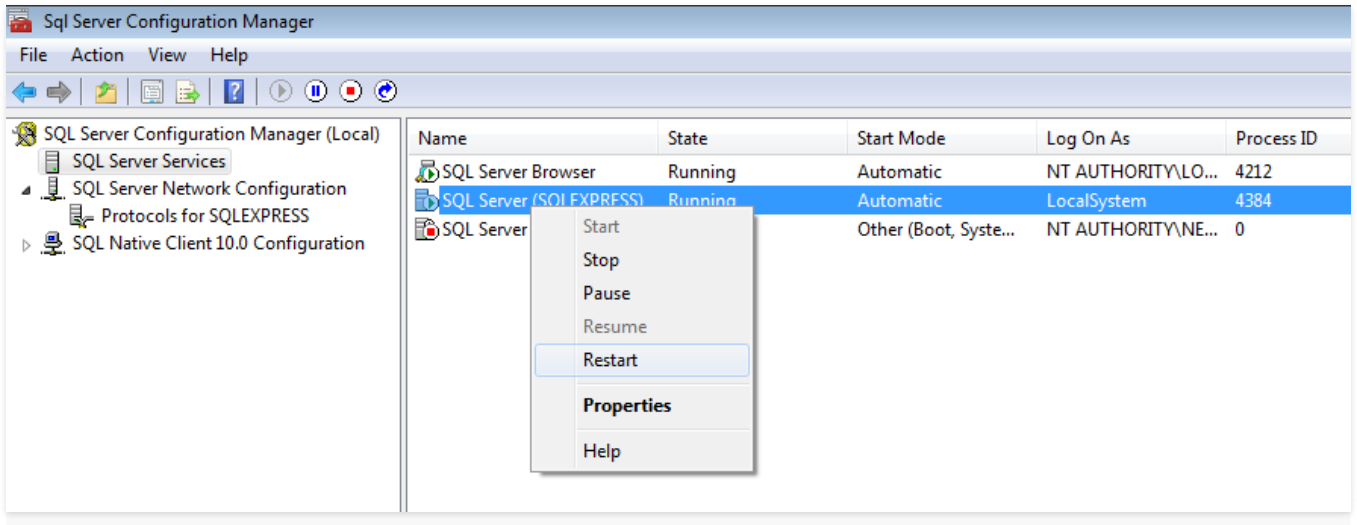
- Open `SQL Server Configuration Manager` and click on `SQL Server Network Configuration > Protocols for SQLEXPRESS`

- Enable `TCP/IP`.



TCP/IP enabled

- After enabling `TCP/IP`, you need to restart the `SQL Server (SQLEXPRESS)` service under `SQL Server Services`.

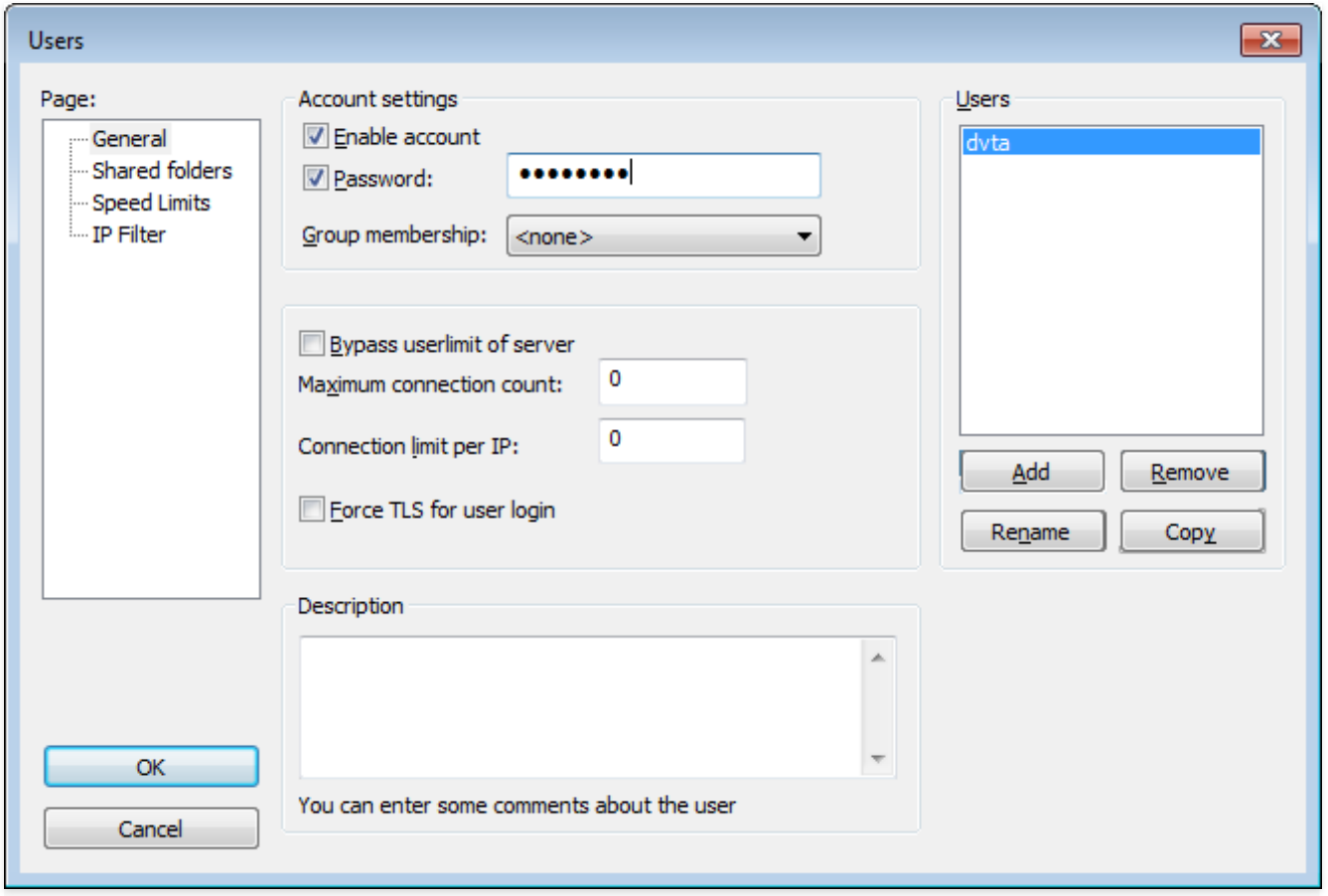


Restarting the service

5. Setup the FTP Server

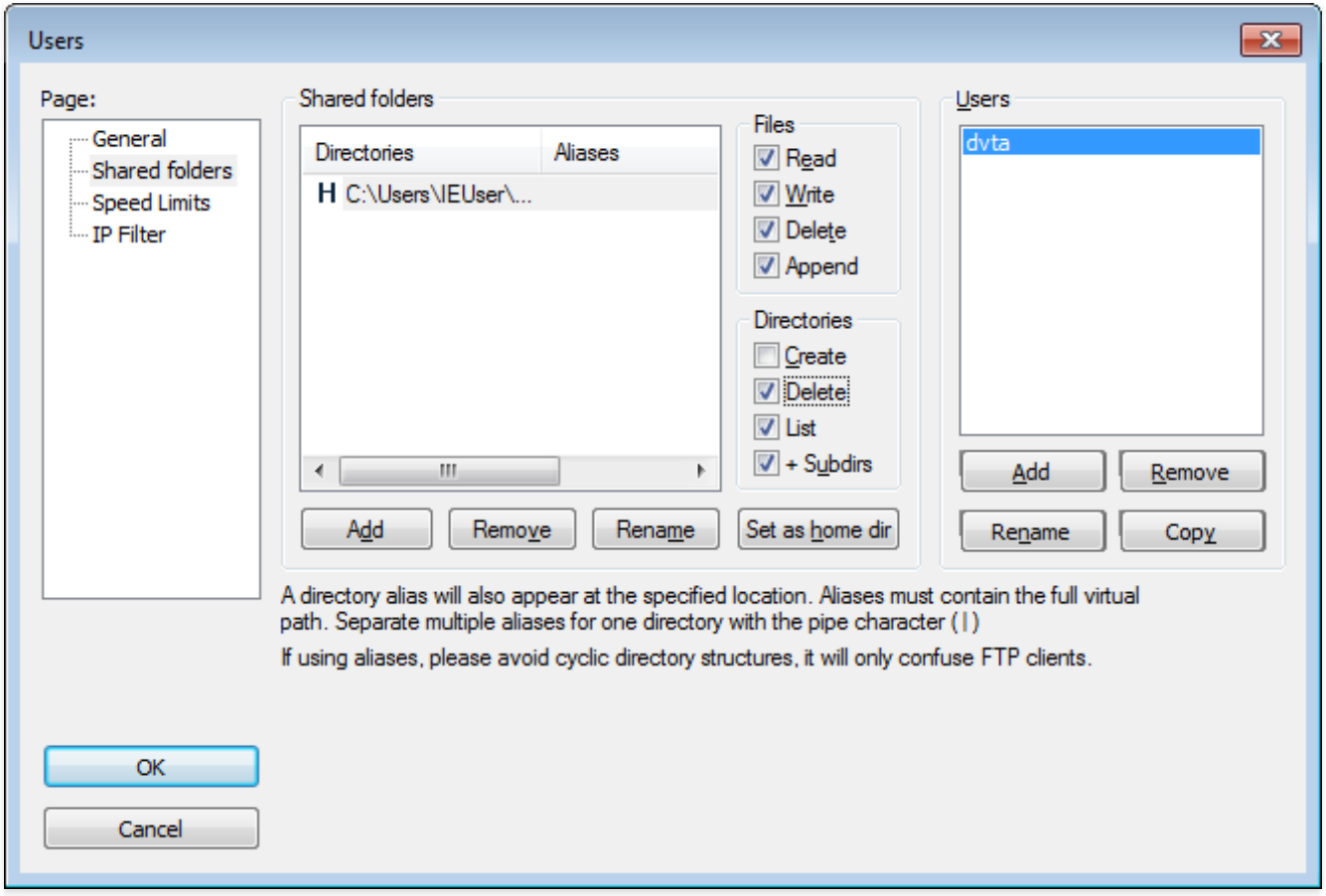
There's no need to install XAMPP. Manually install and use FileZilla FTP server.

- Create a directory (this will be the FTP root directory), I named it `dvta-ftp` and put in on desktop.
- Download and install the Filezilla FTP server (or any other server of your choice).
  - https://filezilla-project.org/download.php?type=server0
- Use `Edit (menu) > Users`
  - Under `General`, create a new user called `dvta` (no need to add it to a group). Then check the password checkbox and enter `p@ssw0rd`.



Creating the "dvta" user

- Click on `Shared folders`, add the FTP directory from before (`dvta-ftp`), and select ACL.



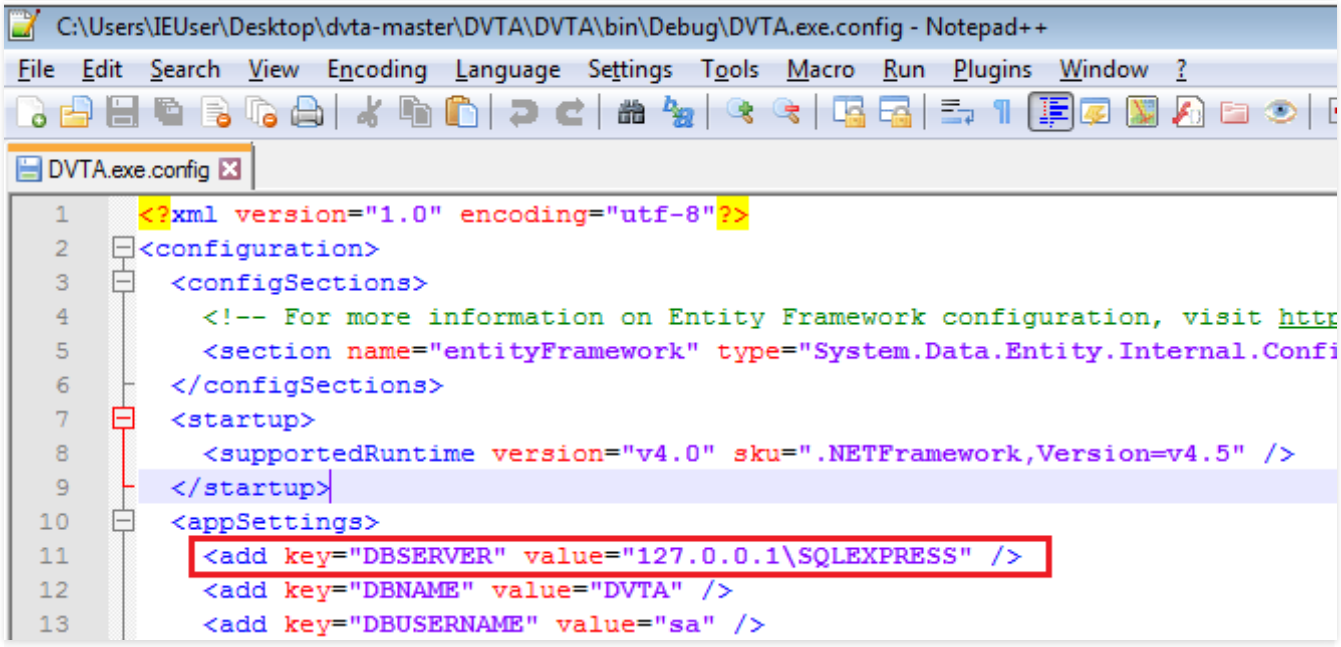
Giving access to the FTP user

Now our FTP server is ready and runs as a Windows service.

6. Modify DVTA to Connect to Our Local SQL Server

The binary is configured to look for the SQL and FTP servers at a hardcoded IP address. The SQL Server address is in the .NET config file (which is just an XML file).

- Open `dvta-master\DVTA\DVTA\bin\Debug\DVTA.exe.config` (by default extensions are hidden on Windows so the extension might not be visible).
  - Under `appSettings` change value of `DBSERVER` to `127.0.0.1\SQLEXPRESS`.



Modified config file

  - Note: The `Release` version in this fork has extra protections (the login button is disabled by default). We will use the `Debug` version for testing the connection to our SQL Server. Be sure to do the same for the `Release` build later.
- Now we can login with any of the test users and also register new users.
- Notes:
  - The `Fetch Time` button will return an error regardless. I think it is the cert pinning protection that we need to bypass later.

7. Fix the FTP Connectivity

Admin can backup server files to an FTP server. But the FTP's address is hardcoded. It's `192.168.56.110`. We can see this in the source code at `\dvta-master\DVTA\DVTA\Admin.cs` (search for `Upload("ftp://192.168.56.110", "dvta", "p@ssw0rd", @pathtodownload+"admin.csv");`). We want to change it to localhost.

- We can fix it in different ways:
  1. Modify the source code and recompile the app. That involves installing Visual Studio and I don't wanna do that.
  2. Modify the binary with dnSpy.
  3. This is not the case here but if the application used a hostname, we could redirect using the `hosts` file. This is a common approach with real world software.

7.1 Use dnSpy to Modify the Hardcoded FTP Address

Let's assume we do not know the FTP address. That means we need to:

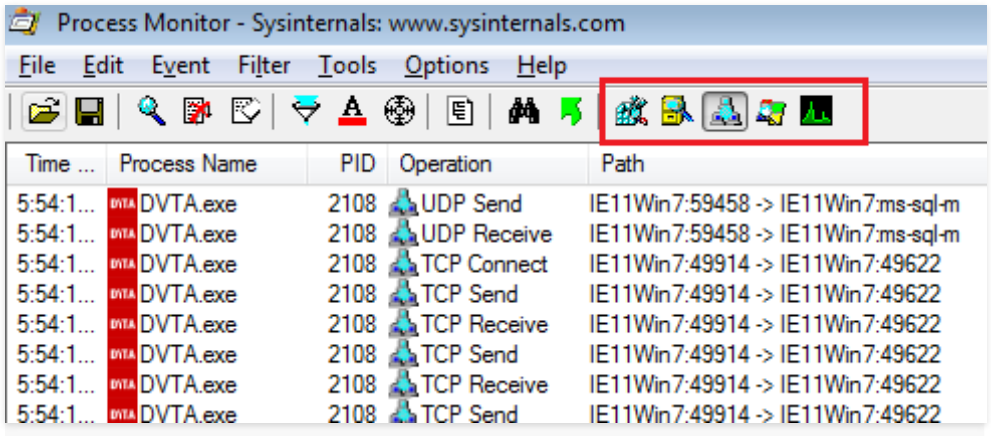
1. Discover the address.
2. Change the address in binary.

Discover the FTP Address

Use whatever method you are comfortable with. I used Procmon.

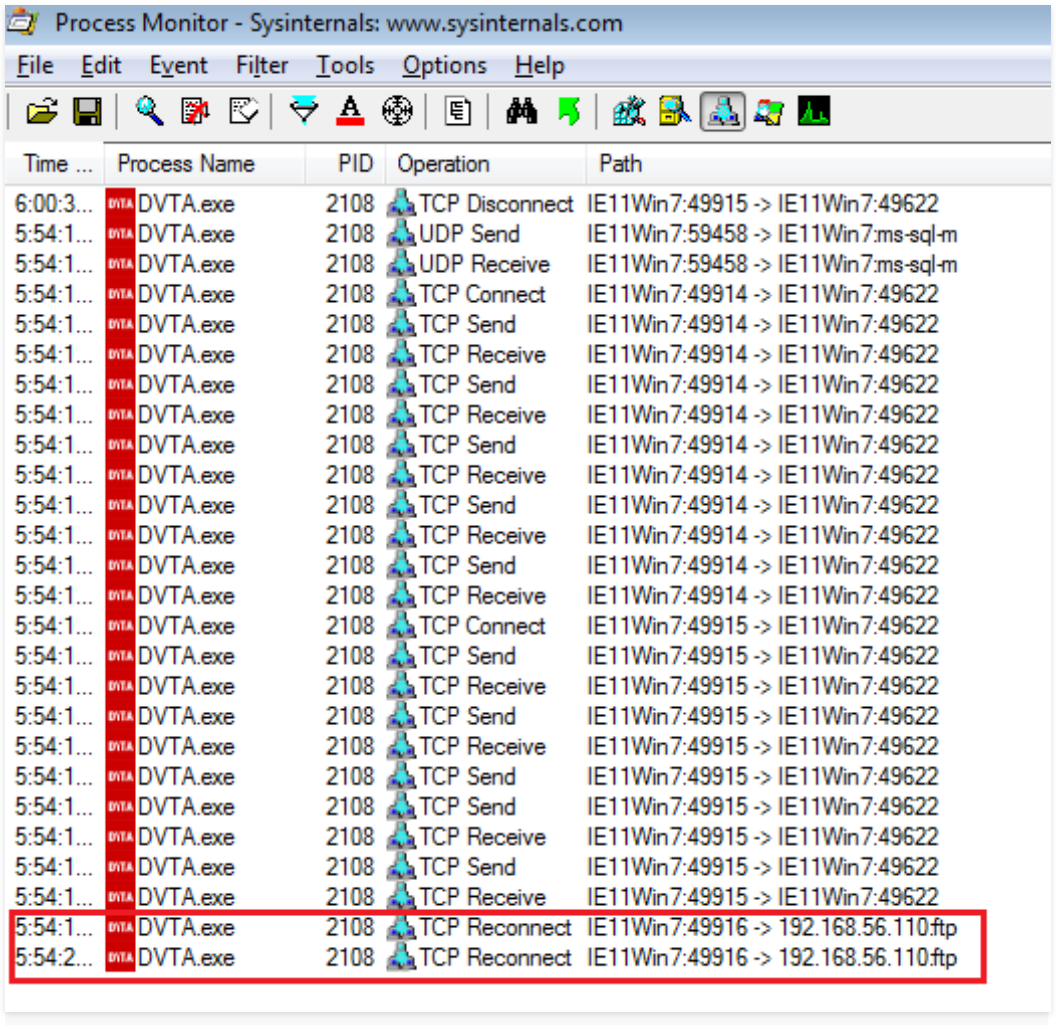
1. Start Procmon.
2. Run the application, login as admin and try to use the backup functionality.
3. Wait until you get the error message.

4. Set this filter in Procmon `Process Name is DVTA.exe`.
5. Remove all activities other than network by clicking on the buttons in the picture. Only keep the middle button enabled to display network activity.



Hover over each button to see what it does

6. ???
7. Profit[2].



Time ...	Process Name	PID	Operation	Path
6:00:3...	DVTA.exe	2108	TCP Disconnect	IE11Win7:49915 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	UDP Send	IE11Win7:59458 -> IE11Win7:ms-sql-m
5:54:1...	DVTA.exe	2108	UDP Receive	IE11Win7:59458 -> IE11Win7:ms-sql-m
5:54:1...	DVTA.exe	2108	TCP Connect	IE11Win7:49914 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Send	IE11Win7:49914 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Receive	IE11Win7:49914 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Send	IE11Win7:49914 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Receive	IE11Win7:49914 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Send	IE11Win7:49914 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Receive	IE11Win7:49914 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Send	IE11Win7:49914 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Receive	IE11Win7:49914 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Send	IE11Win7:49914 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Receive	IE11Win7:49914 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Connect	IE11Win7:49915 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Send	IE11Win7:49915 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Receive	IE11Win7:49915 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Send	IE11Win7:49915 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Receive	IE11Win7:49915 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Send	IE11Win7:49915 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Send	IE11Win7:49915 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Receive	IE11Win7:49915 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Send	IE11Win7:49915 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Receive	IE11Win7:49915 -> IE11Win7:49622
5:54:1...	DVTA.exe	2108	TCP Reconnect	IE11Win7:49916 -> 192.168.56.110:ftp
5:54:2...	DVTA.exe	2108	TCP Reconnect	IE11Win7:49916 -> 192.168.56.110:ftp

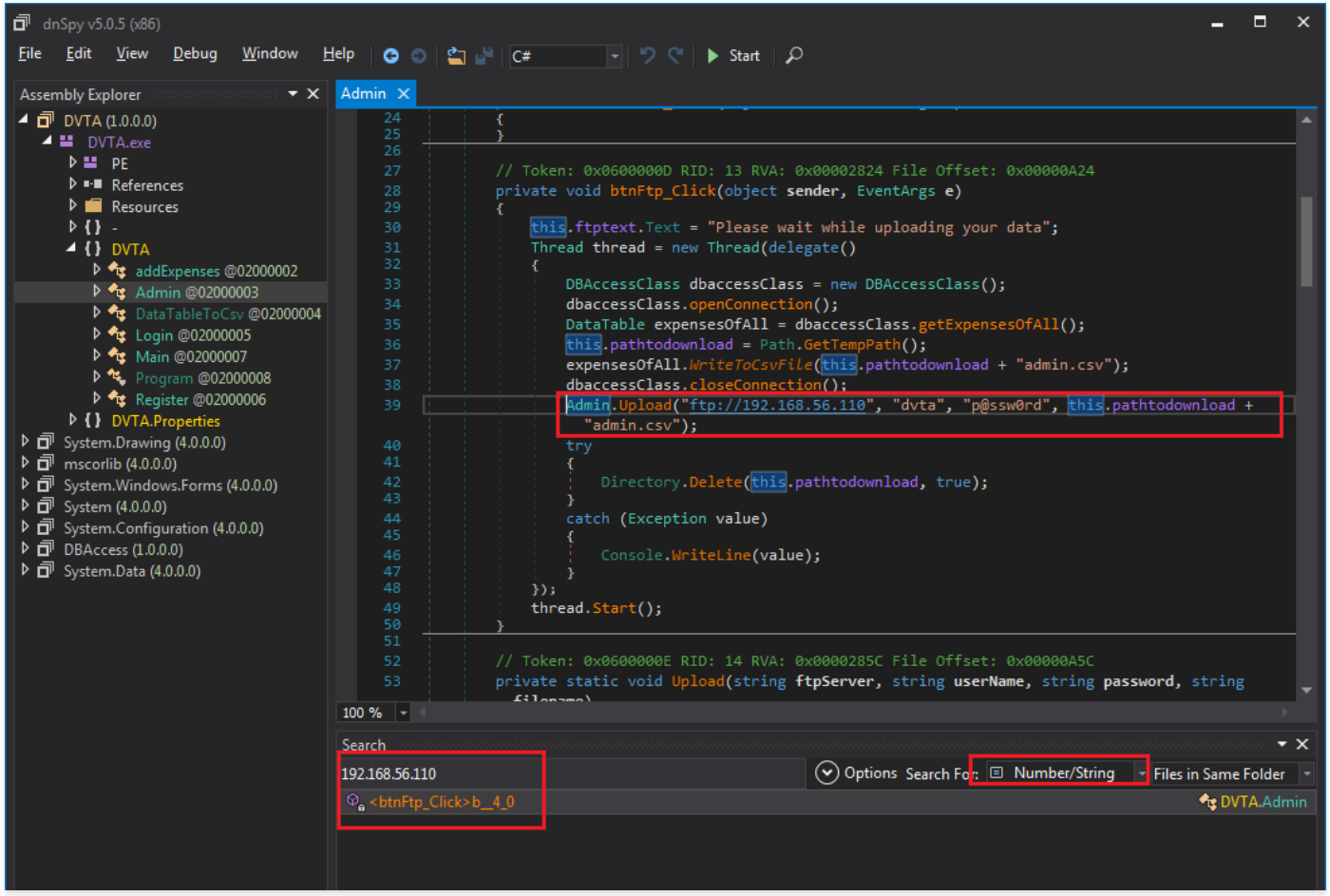
FTP address discovered

Modify the Address in Binary

Now we can use dnSpy to modify this address in the application.

- Create a backup of the original `dvta.exe`.
- Start dnSpy.
- Select `Edit (menu) > Search Assembly` and search for `192.168.56.110`. Choose `Number/String` for the `Search For` combo box. `All of the Above` does not search for text (unfortunately).

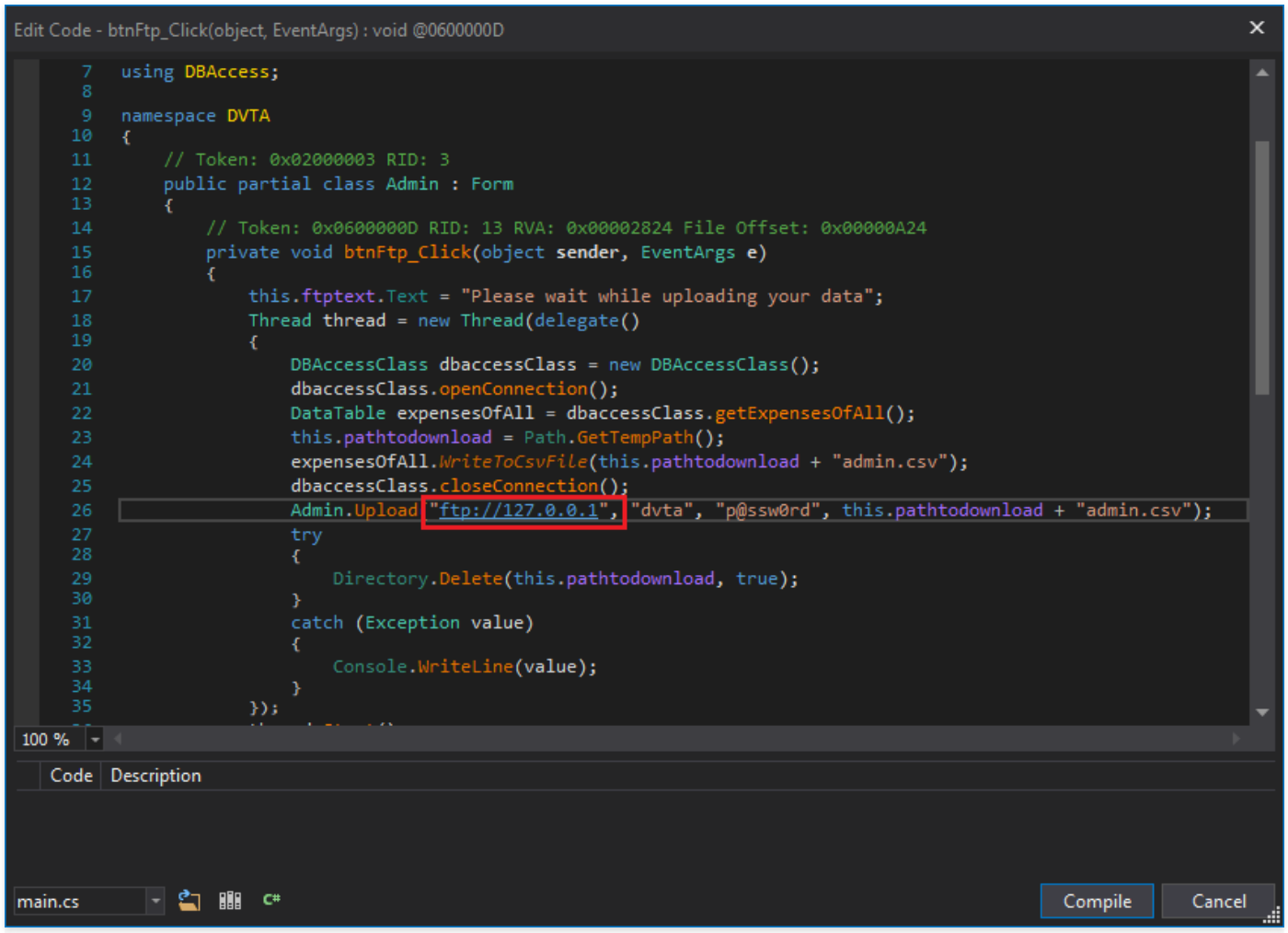
- Click on the search result and Voila! We have our FTP address (and password).



FTP address in code

- Right-click and select `Edit Method`. Now we can edit the C# source code.
  - Now listen kids. Back in my day we didn't have such nice things, we had to hand-craft CIL instructions walking uphill in the snow.

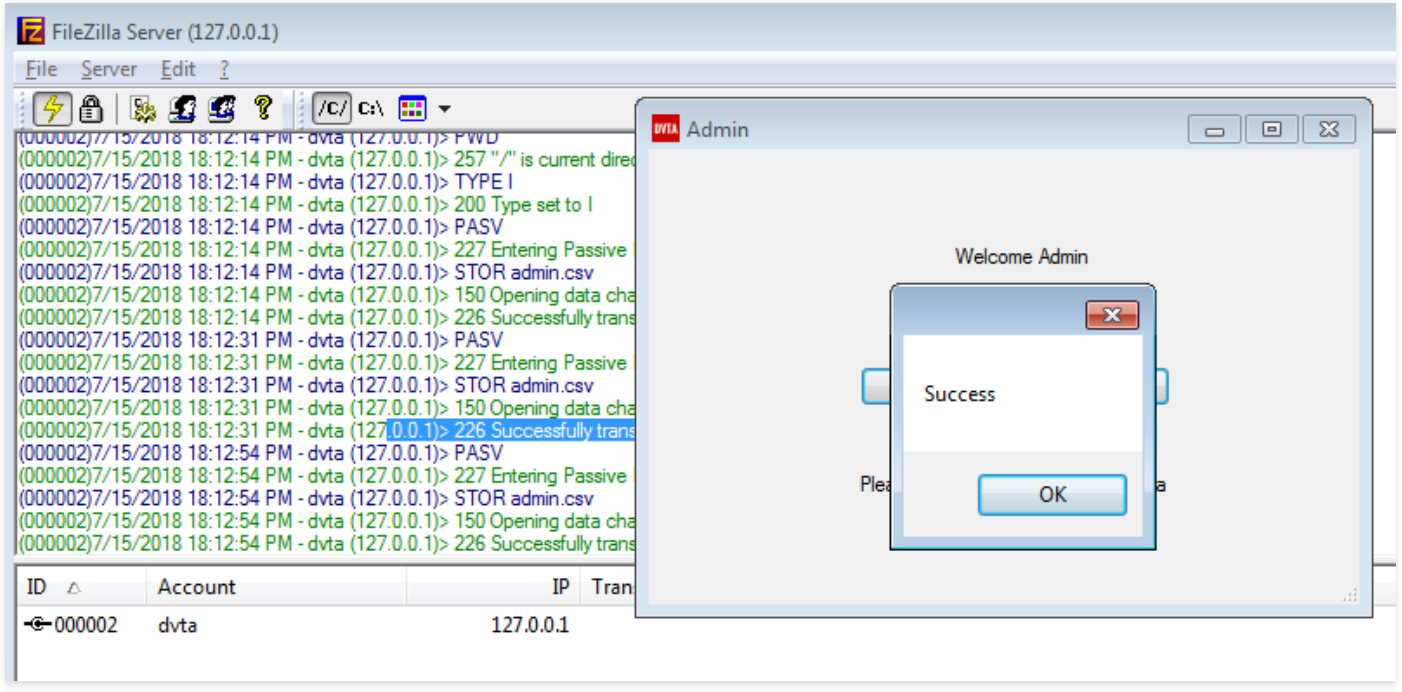
- Modify `192.168.56.110` to `127.0.0.1`.



Modified FTP address

- Click on `Compile` and now the code has changed **but it's not saved to any file yet.**
- Select `File(menu) > Save Module` to save the executable.

- Now you can run the patched binary and use the FTP functionality.



FTP works!

Conclusion

We setup DVTA in a VM and patched it to connect to our local FTP server. Now things are ready to go and we can start hacking the application. In the next post I will start working on the application.

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1. I did not read the solution because I wanted to do things my own way and learn. [return]

2. I am not sure why the application is trying to do reconnect instead of normal `TCP Connect` . [return]

Posted by Parsia • Jul 15, 2018 • Tags: dnSpy

Istanbul Tips and Tricks

DVTA - Part 2 - Cert Pinning and Login Button