Using Windows 8.1 as a Server at Home or in a Small Business

Third Edition
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INTRODUCTION

This guide describes how to setup a home or small business network using a file server based around Windows 8.1. Windows 8.1 is a great choice in such environments as it offers the everyday ease and convenience of Windows, but without the additional cost and complexity of Windows Server or the unfamiliarity of Network Attached Storage (NAS) boxes. This guide is succinct but authoritative, based around techniques that work in the real world and is written in a friendly and understandable style, along with plenty of illustrations and screenshots. It is aimed at the home, home office or small business user who has some knowledge and experience but who would not necessarily consider themselves to be an expert or enthusiast. It has been written according to the Goldilocks Principle: not too much information, not too little information, but just the right amount.

Chapter 1 – *Getting Started* – describes the benefits of networking, makes the case for using Windows 8.1 as a server and covers hardware, software and infrastructure considerations. Chapter 2 covers the detailed installation of Windows 8.1 and the necessary settings for successful networking. Chapters 3 and 4 describe how to setup users and shared folders, whilst Chapter 5 reviews the different methods for accessing the server from connected computers. Chapter 6 discusses multimedia and streaming – a common use for a home network. Chapters 7 and 8 look at Cloud services such as Dropbox and Google Drive and what is involved in using iPads and other portable devices. Chapter 9 is concerned with the important topic of backups. Chapter 10 looks at what is involved in keeping the server in a healthy state and Chapter 11 describes how to access it remotely.

Some notes about this book:

- Most references are explicitly to Windows 8.1, but there may be some instances where the term 'Windows 8' is used interchangeably.
- Screenshots for connected computers reflect a mixture of Windows 8 and Windows 7 as these are the most widely used clients; any differences in their behaviours are described.
- Spellings use a mixture of International and American English and should hopefully be acceptable and understandable to most readers.

1 GETTING STARTED

1.1 The Benefits of a Server-based Network

Home and small business computer networks come in two basic types: *peer-to-peer* and *centralized*. In a peer-to-peer network, any or all of the computers may store the shared data. In this example there are five computers in a small organization, with the accounts on one machine, the supplier details on another, the customer list on a third and so on:
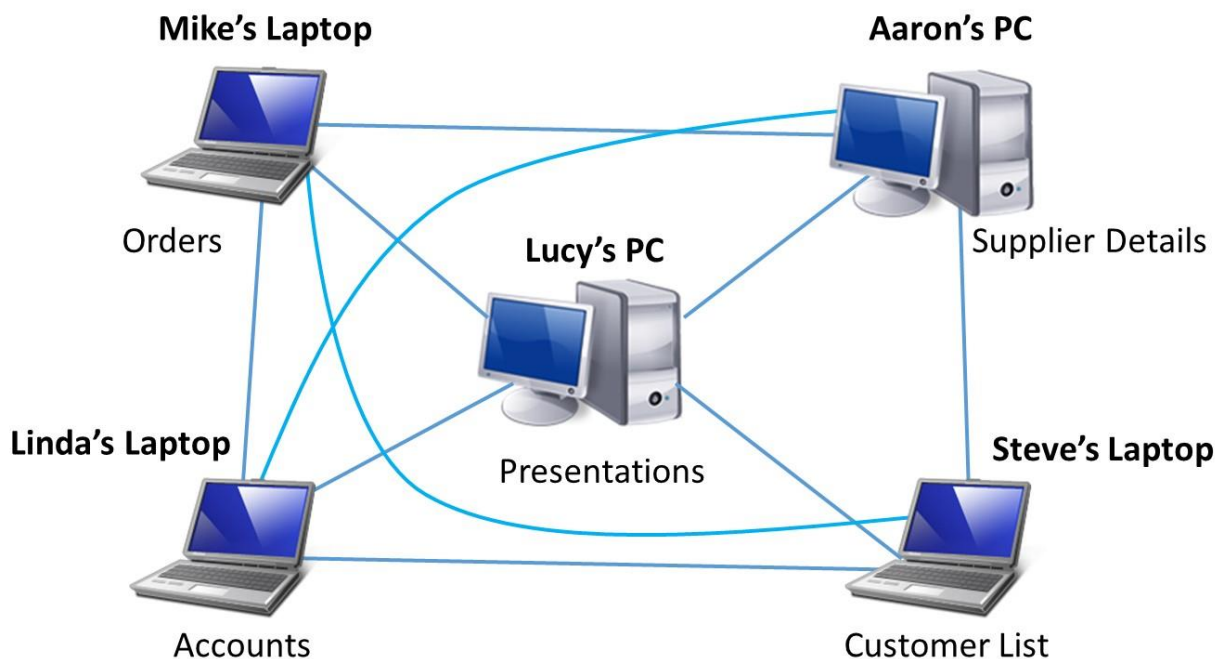
Figure 1: Peer-to-peer network

The computers have been configured so that they can connect to each other to access data as required. For instance, if Linda wants to check the orders she connects to Mike's laptop, or if Steve wants a copy of the latest marketing presentation he connects to Lucy's PC. This method of working was developed when the company consisted of just two people and has grown with it. In the early stages it was satisfactory, but with time has become increasingly problematic. For instance, Mike is often out of the office and takes his laptop with him. When this happens nobody can access the latest order status; to try and work around it the others have taken to keeping copies of the orders file on their own computers, but this leads to confusion over which is the most up-to-date version. Additionally, Aaron has put a power-on password on his computer as a security measure and if he is late into the office no-one can access the data on his computer. Recently, the company had to hire a temporary worker after one of the team went on extended leave; it proved very problematic trying to get them to understand where everything was stored.

Such peer-to-peer arrangements were the norm in households and in small businesses a decade ago and can still work well in some very small environments, but quickly become untenable as the number of computers and users rises. At such a point a centralized network becomes a much more practical method of working. Here all the data is held on a single, dedicated machine – known as a *server* or *file server*. This is not used as a general purpose computer and may not even have a mouse, keyboard and screen. Rather, it acts as a repository of all of the data, whether that is business information or the sort of data that may be found in a typical household, such as photos, music and videos. Being a dedicated machine it is always there and there are single master copies of the most important files. Crucially, the contorted methods of working dictated by a peer-to-peer network are avoided.
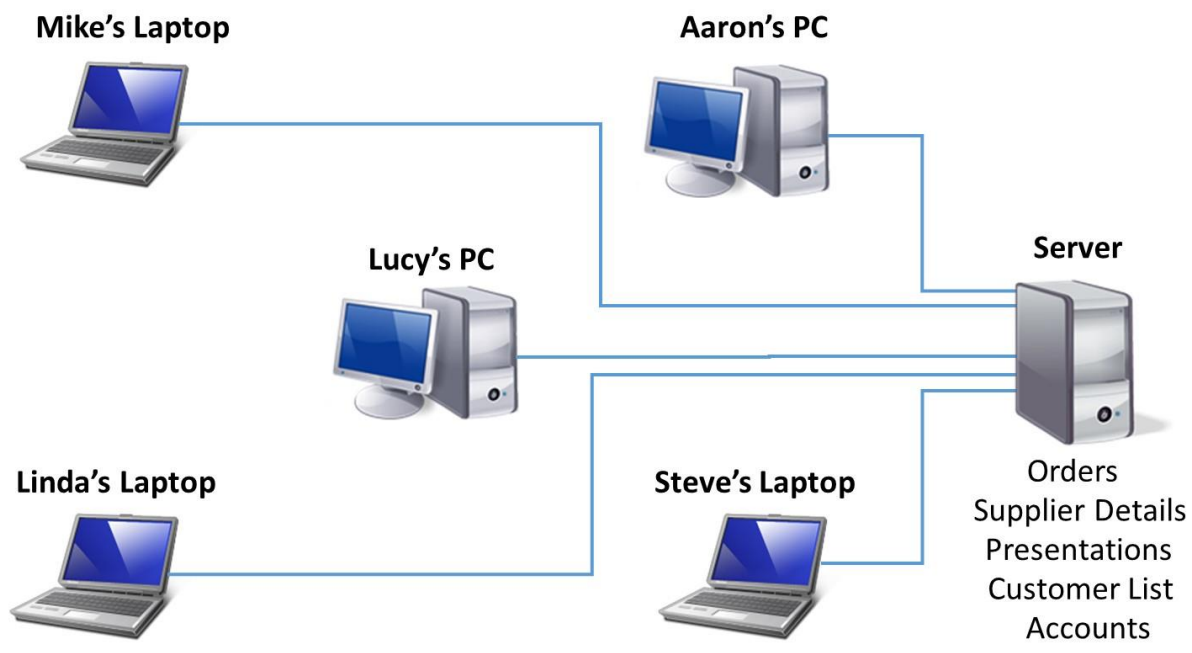
Figure 2: Centralized (server based) network

Besides the benefits of data always being accessible and in a known place, it becomes much easier to back it up and to administer things. Compare the links between the computers as shown in the two diagrams above then imagine the implications if another 3 or 4 machines were added in each case: the first example becomes nightmarish but the second remains straightforward and understandable.

1.2 The Case for Windows 8.1 as a Server

Once the decision has been taken to use a server, there are several possible solutions. Microsoft have a full server product – *Windows Server 2012 R2* – that can cater for any business from the smallest up to the largest of enterprises comprising tens of thousands of users. It is a great product but has the following possible downsides:

- It is not aimed at home users
- It is relatively expensive for small systems
- It requires that the connected computers run the more expensive, Professional editions of Windows. Small businesses often purchase their computers from high street and other retail outlets and they are usually supplied with the Home edition of Windows, which does not connect to Windows Server 2012 R2
- It is more complicated to setup and maintain than regular Windows, requiring skills and experience that people who do not work in IT do not usually have

Another solution is to use *Network Attached Storage* (NAS). A NAS drive is an external hard drive, but it connects through an Ethernet cable to a router rather than to a single PC using an USB cable, thus making it shareable. NAS drives can be relatively cheap and are a good solution in many situations, but have the following downsides:

- They use proprietary operating systems and methods of working that are unfamiliar to many people
- There may be limited access to expertise available in the event of difficulties
- There are many brands to choose from, some from unfamiliar companies, making the market confusing and giving the risk of investing in "the wrong one"

Both of the above alternatives suffer from the problem that they are just not "regular Windows". Many people are familiar with Windows through experience and by using it they can operate within their comfort zone. In recognition of this, Microsoft actually launched a dedicated "home server" version some years ago. It was not successful for a variety of reasons, but many of the pioneering features subsequently made their way into standard versions of Windows (most notably a feature called *Storages Spaces* in Windows 8.1 is derived from the highly regarded Drive Extender of Windows Home Server Version 1).

Using Windows 8.1 as a server does involve some compromises. In particular, it is not suitable for larger setups. A typical use might be in a household, a home business or a small business or organization with up to say, an absolute maximum of 10 computers. However, the combination of prices, features and familiarity do make it an attractive proposition in such scenarios.

1.3 Hardware Considerations for the Server

When it comes to the server there are four basic possibilities:

Standard desktop computer with Windows pre-installed - Desktop computers that have Windows pre-installed are readily available from retail and other outlets. They represent the easiest and often cheapest option for creating a Windows 8.1 server and are suitable for use in home, home office and very small business networks (say up half-a-dozen users). The following factors should be considered:

- It should preferably be a desktop computer. Laptop computers are unsuitable whilst all-in-one computers with built-in screens have no additional benefits
- It does not need to be particularly powerful. The most important requirement is that it has plenty of disk storage e.g. 1TB, 2TB or better
- It should be running Windows 8.1

Standard desktop computer with Windows purchased separately - Computers that do not come with a copy of Windows are available, usually from smaller retailers, suppliers and mail order. They are often more customizable; for instance, a unit with plenty of spare drive bays can be purchased or one that allows the user to add their own, separately purchased hard drives. This approach often appeals to enthusiasts. The copy of Windows 8.1 will need to be purchased separately, either retail or possibly as a so-called OEM edition with the hardware.

Build your own – This approach often appeals to enthusiasts although computers are made with such standardised components these days that putting one together is well within the capabilities of many people. Doing so may or may not save any money, but it will provide a great deal of flexibility. For instance, if you wanted a tiny, totally silent server you could use something like a Gigabyte Brix or Intel NUC with a solid state drive (SSD). Alternatively, you may wish for a conventional tower unit with multiple drive bays, capable of providing many terabytes of storage. Some considerations:

- The processor does not need to be particularly powerful
- In most circumstances, 4GB RAM will be sufficient
- It is possible to purchase hard drives that have been optimized for server use, offering greater reliability and MTBF (*Mean Time Between Failures*). Examples include Western Digital Red and Seagate NAS lines
- Windows 8.1 can be installed on a relatively small SSD (64GB will be sufficient) with conventional hard drives used for the main data storage
- RAID is not required as the Storage Spaces feature provides similar functionality

Micro Server - One consideration with a standard desktop PC is that it is not really designed for 24x7 operation. In contrast, there is a category of computer specifically designed for use as a server and which is intended to be more reliable and better able to cope with the demands of continuous operation. Such servers are more expensive than regular PCs, usually more so than a small business can justify. However, it is possible to purchase relatively low cost but still full-featured and reliable *micro servers*, specifically aimed at smaller organizations. As their name suggests, these servers are smaller than usual. They also tend to use less energy, which is useful for a device that is never powered off. Examples of micro servers include the HP ProLiant MicroServer and the Dell T20. In a small business setting, the use of a micro server is recommended.

1.4 Editions of Windows 8.1

Windows 8.1 comes in a variety of editions: *Windows 8.1*; *Windows 8.1 Professional*; *Windows 8.1 Enterprise*. In practice there is very little difference between them – the Professional and Enterprise editions have a few more tweaks and features to assist with their usage in corporate environments, but nothing which will unduly affect what we are trying to achieve here, with the possible exception of remote access. If you purchase a computer from a retail outlet then it will probably have the standard or home version of Windows 8.1 already installed on it. If you have a choice or are buying a copy of Windows 8.1 to install on a computer then it is suggested you go for the Professional version.

If you are using a computer that is running the original version of Windows 8, you should first update it to Windows 8.1. The upgrade is free from the Windows Store. Some people have reported problems trying to download and install it; if you experience this, make sure that all previous updates have been applied first and keep trying.

1.5 Infrastructure

The term *infrastructure* is used here to describe the physical network, basically the boxes and wires that connect everything together and to the outside world. In a home or small business system, a device called a combined wireless router is commonly used. This connects to the internet, which may be a cable, fiber or ADSL service, directly or possibly via a separate box (usually referred to, albeit incorrectly, as a modem). It has wireless capabilities for linking laptops, tablets and smartphones. There will be several Ethernet ports, used for connected wired devices such as desktop PCs. The server needs to be wired directly to one of these ports. There may, optionally, be a wireless extender or switch to extend the network to other parts of the premises.

The above description is generic but should bear some resemblance to your infrastructure. Some key points are:

- The server PC should be connected to the main network switch or combined wireless router using an Ethernet cable.
- Use wired connections whenever possible as performance is so much better than wireless. Wired devices should be of Gigabit specification.
- For wireless devices such as laptops and tablets, make sure they operate at 801.11n or 801.11ac specification.
- Check the specification of the combined wireless router if you are using one. Many ISPs (Internet Service Providers) supply relatively low-cost models, often free of charge when you sign-up with them. These are often of average quality, for instance the Ethernet ports may not be Gigabit or the latest wireless standards may not be supported. Spending money on professional or prosumer ("professional consumer") routers and switches will usually give better performance and reliability.
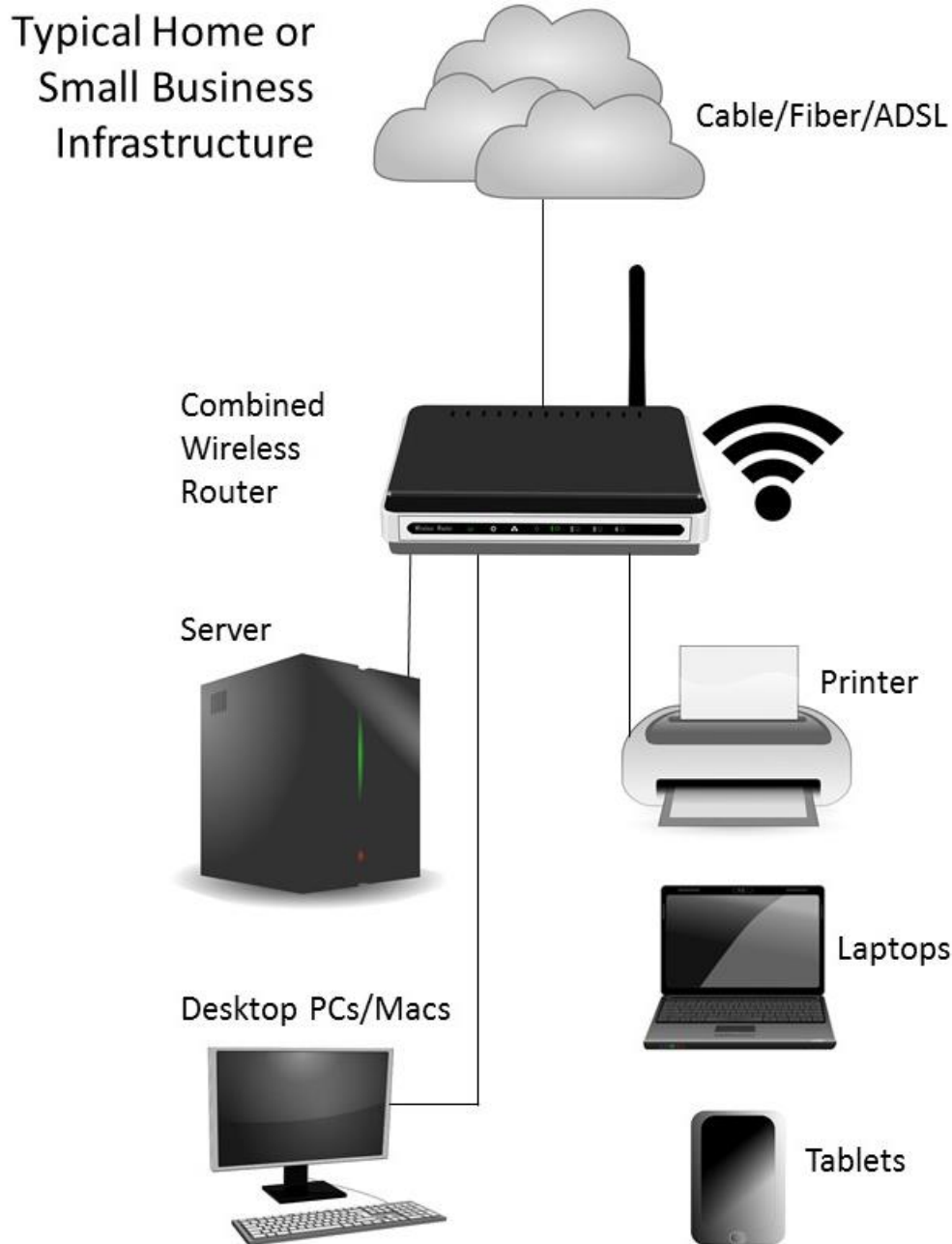
Figure 3: Typical Home/Small Business Infrastructure

1.6 Location

The server should be attached to the network via a Gigabit Ethernet connection, preferably by plugging it directly into the router. Do not connect it wirelessly. It should be placed away from direct sunlight and any source of heat, such as a radiator. Avoid locations that are wet or damp. As little physical access is required the unit can be located out of sight and reach, for instance in a cupboard or a locked room or otherwise out of reach.

1.7 Electrical Considerations

It is possible that data loss and damage can occur if the electrical mains power fails whilst a server is running. The best way to mitigate against this is to use an intelligent UPS (Uninterruptible Power Supply) with it; in the event of power problems this will enable it to continue operating normally for a short period and then to shut it down in an orderly manner if necessary. In a business environment, the use of an UPS should be considered mandatory. Suitable UPS units are made by companies such as APC, CyberPower, Powercom. Make sure that any software supplied with it is Windows 8-compatible.

If an UPS is not used - which is commonly the case in a domestic environment - then the unit should at least be connected to a clean electrical power supply via a surge protector.

1.8 Printers

An additional advantage of networking is that it allows printers to be shared, thus potentially saving money as well as physical space. One rather old fashioned method of sharing a printer is to plug it directly into the server and configure it using sharing features built-in to Windows, but it can be difficult to get this working and diagnose when it doesn't, such that it is not even worth bothering with in the first instance. Fortunately, most modern printers have built-in Ethernet or wireless connections, giving them an existence on the network totally independent of any server or computers and this is by far the best approach.

2 INSTALLATION AND CUSTOMIZATION OF WINDOWS 8.1

Some of the steps vary here depending on whether the server is a standard desktop computer that has been purchased with Windows already installed, such as one obtained from a retail outlet, or if it is a micro server or desktop computer that has been purchased as a blank machine and on which a legitimately obtained copy of Windows 8.1 will be installed.

2.1 Standard desktop computer with Windows pre-installed

It is assumed here that this is a brand new, out-of-the-box computer that has never been used before. If this is not the case then it should first be reset to that condition: take backups of any data on it then use the 'Factory restore' option. This procedure varies depending on the vendor: it may an option on the Start Screen; there may be an icon on the Desktop; it may be an option when the computer starts up; alternatively launch **PC Settings** (Windows Key + I) and choose **Update and Recovery** followed by **Recovery**. After the reset is complete proceed to section 2.3 Personalization and Settings.

2.2 Blank desktop computer or Micro server

With these computers it will be necessary to install Windows 8.1 from scratch. Usually Windows is purchased in the form of a DVD ROM; alternatively, it can be downloaded as an executable from Microsoft and transferred to DVD or USB using a separate computer. Once the hardware is ready (e.g. all hard drives connected), insert the media and set the computer to boot from DVD or USB as appropriate. This is usually done from the BIOS by pressing a key as the computer starts up (e.g. F2, F10, F12 or Escape – it depends upon the vendor). After a short while the following screen appears; choose the correct regional settings then click **Next**:
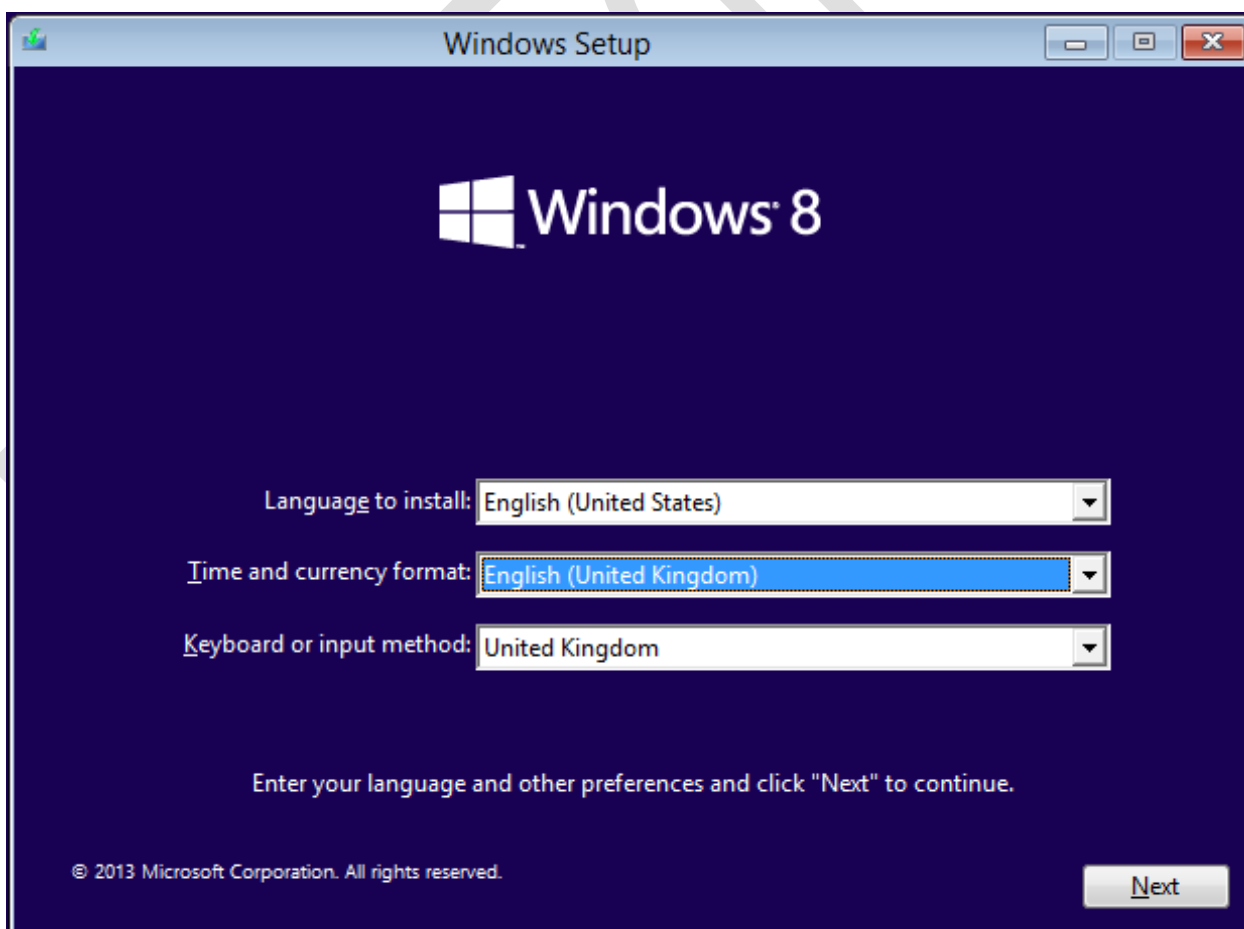
Figure 4: Specify the regional settings

On the following screen click **Install now** then accept the subsequent license agreement:
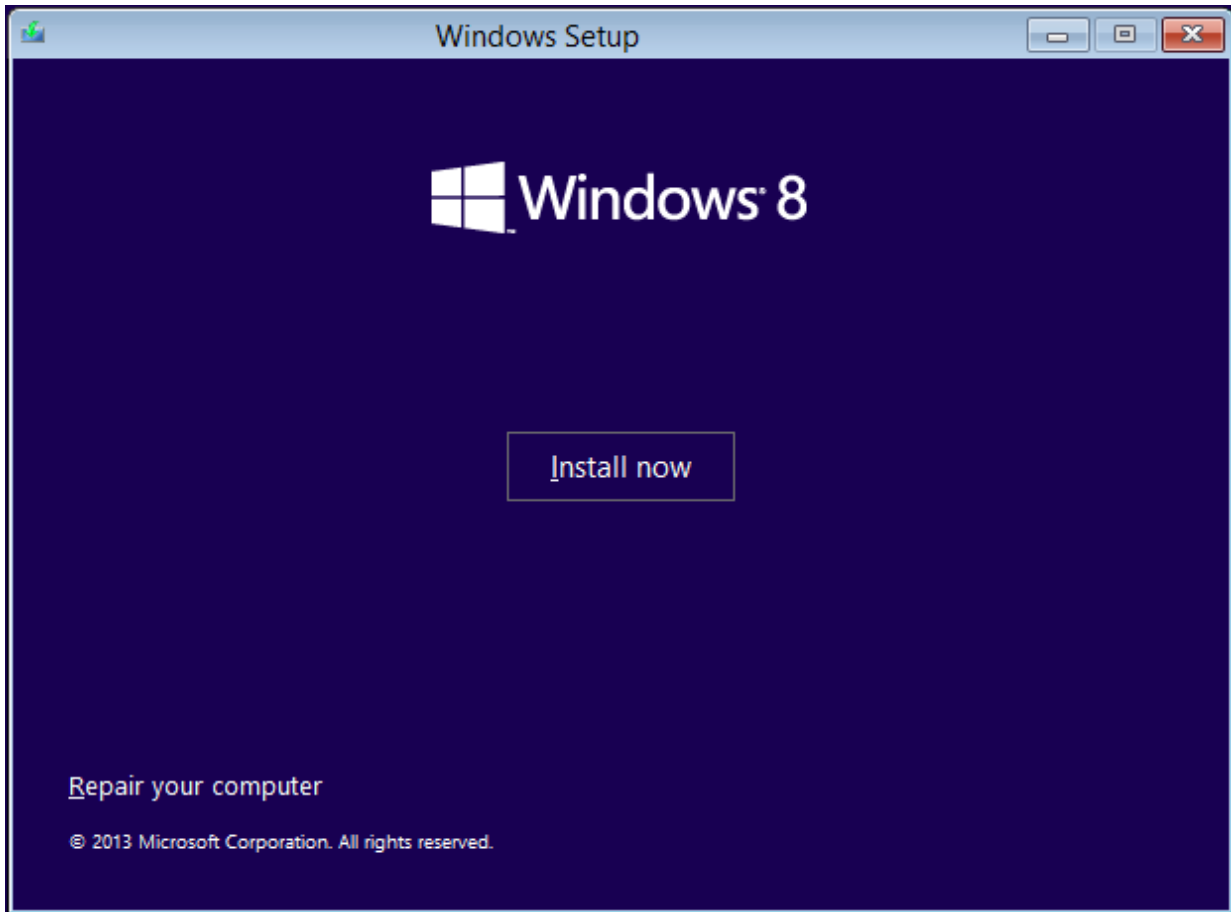
Figure 5: Install now

On the next screen choose **Custom: Install Windows only (advanced)**:
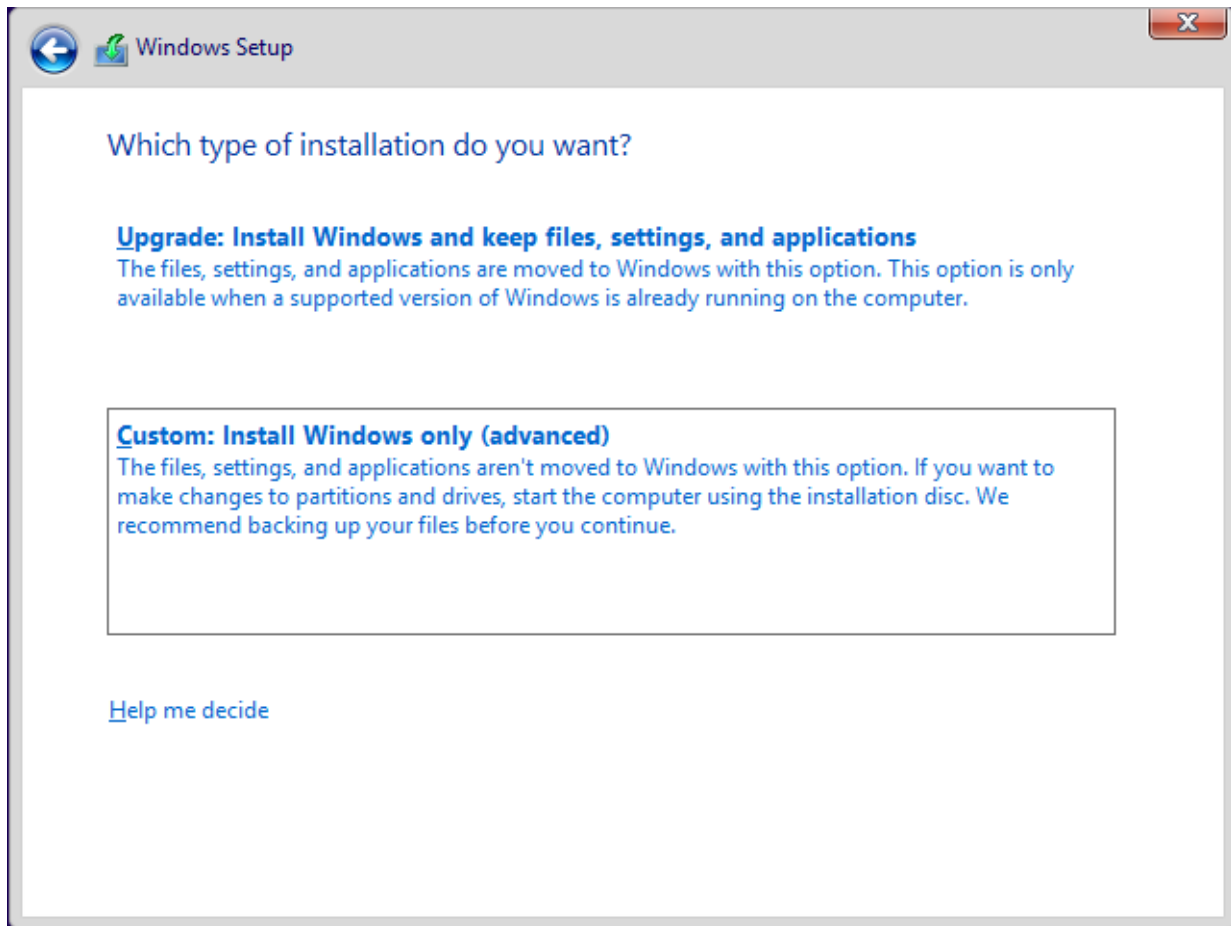
Figure 6: Choose Custom Install

This is followed by a screen that asks where Windows is to be installed. What appears here depends upon what hard drives are in the computer; in this example there is a 1TB (1000 GB) drive so we will choose it. Click **Next**:
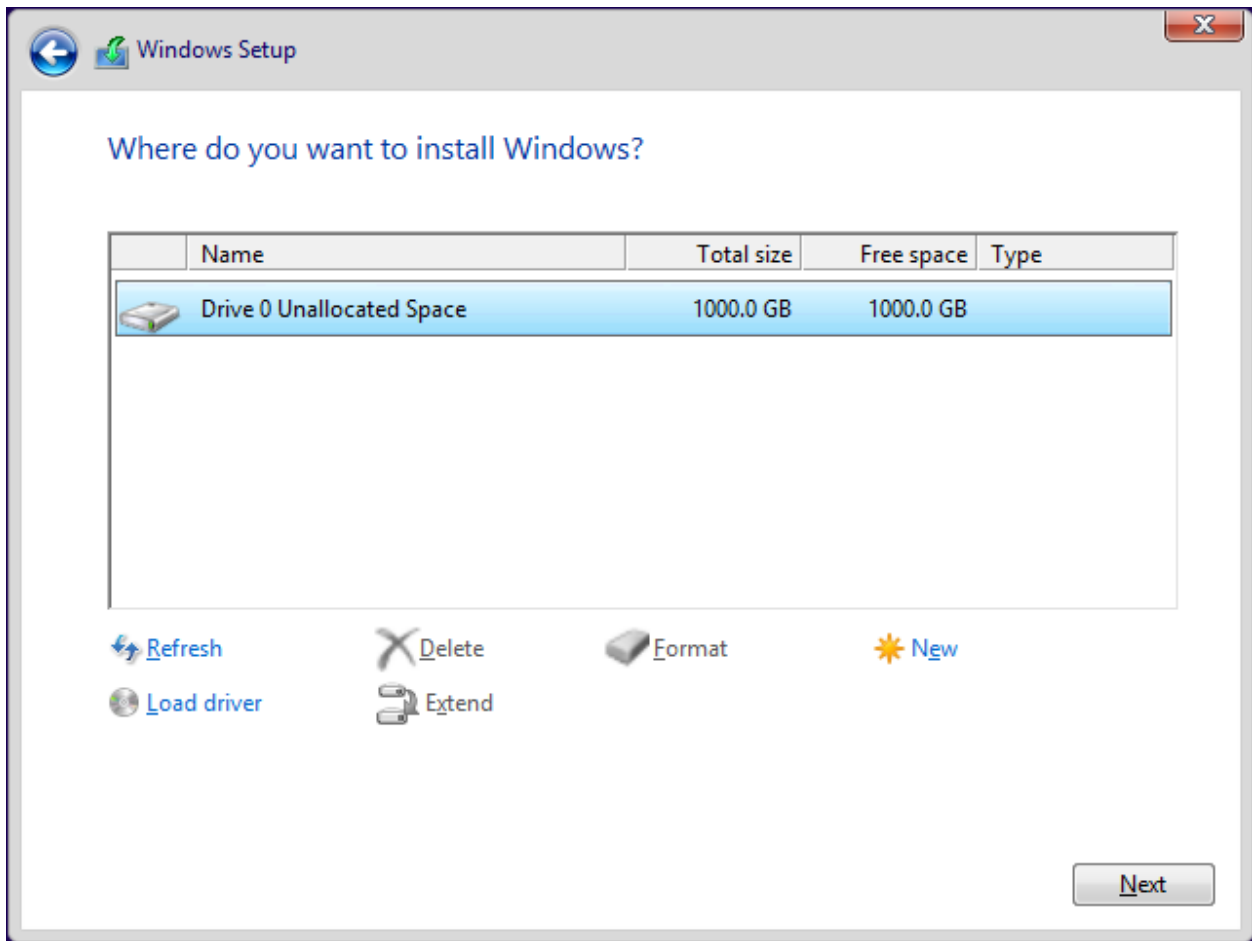
Figure 7: Choose the installation drive

At this point the installation proper begins. This will take a little while, typically 10 or 15 minutes and whilst it runs a status screen is displayed. The computer may restart several times during this stage:
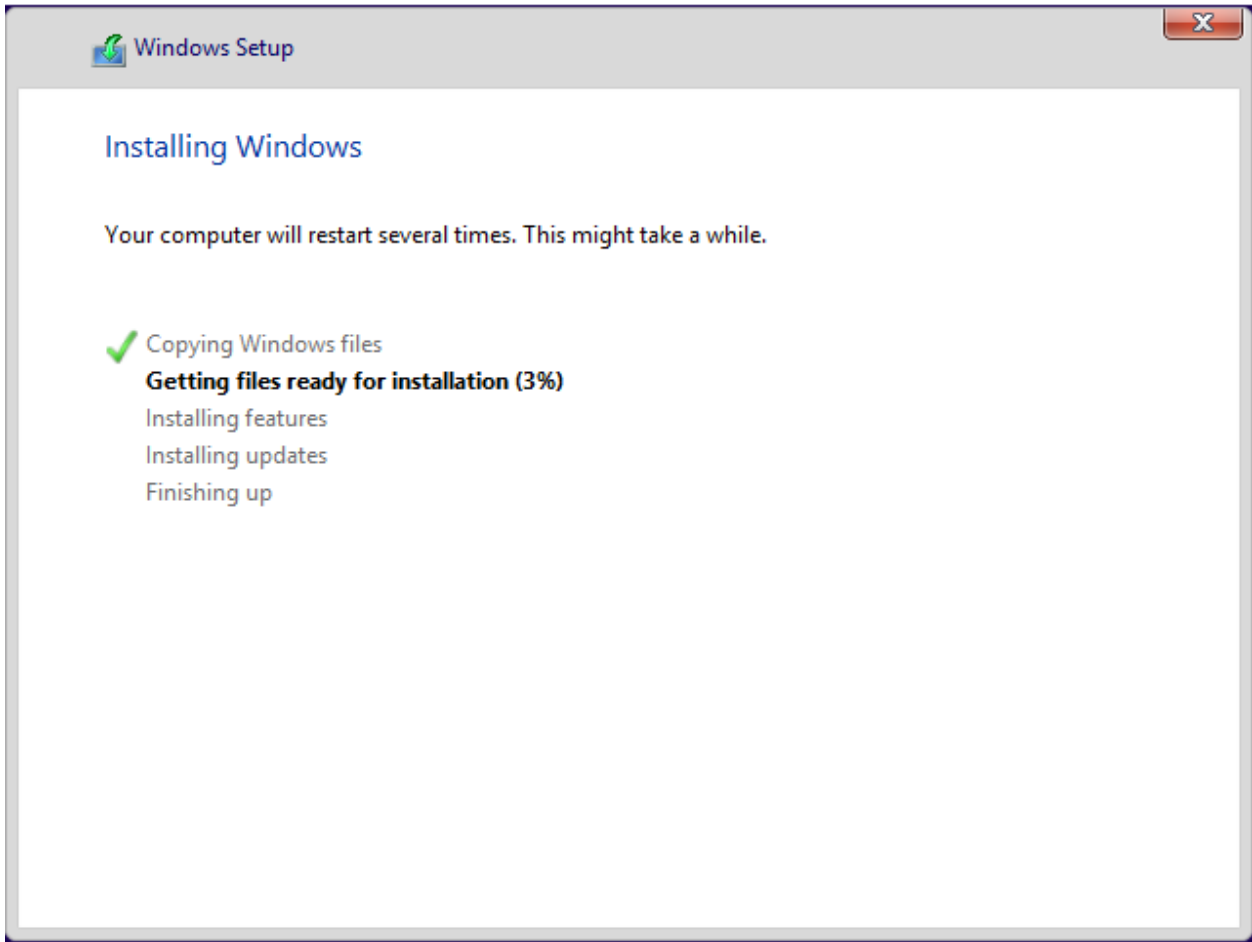
Figure 8: Installation progress screen

2.3 Personalization and Settings

After the computer restarts the *Personalize* screen is displayed. Choose a colouring scheme and give the computer a name. Unless you have a good reason to do otherwise, call it *server*, because that is what it is! Click **Next**:
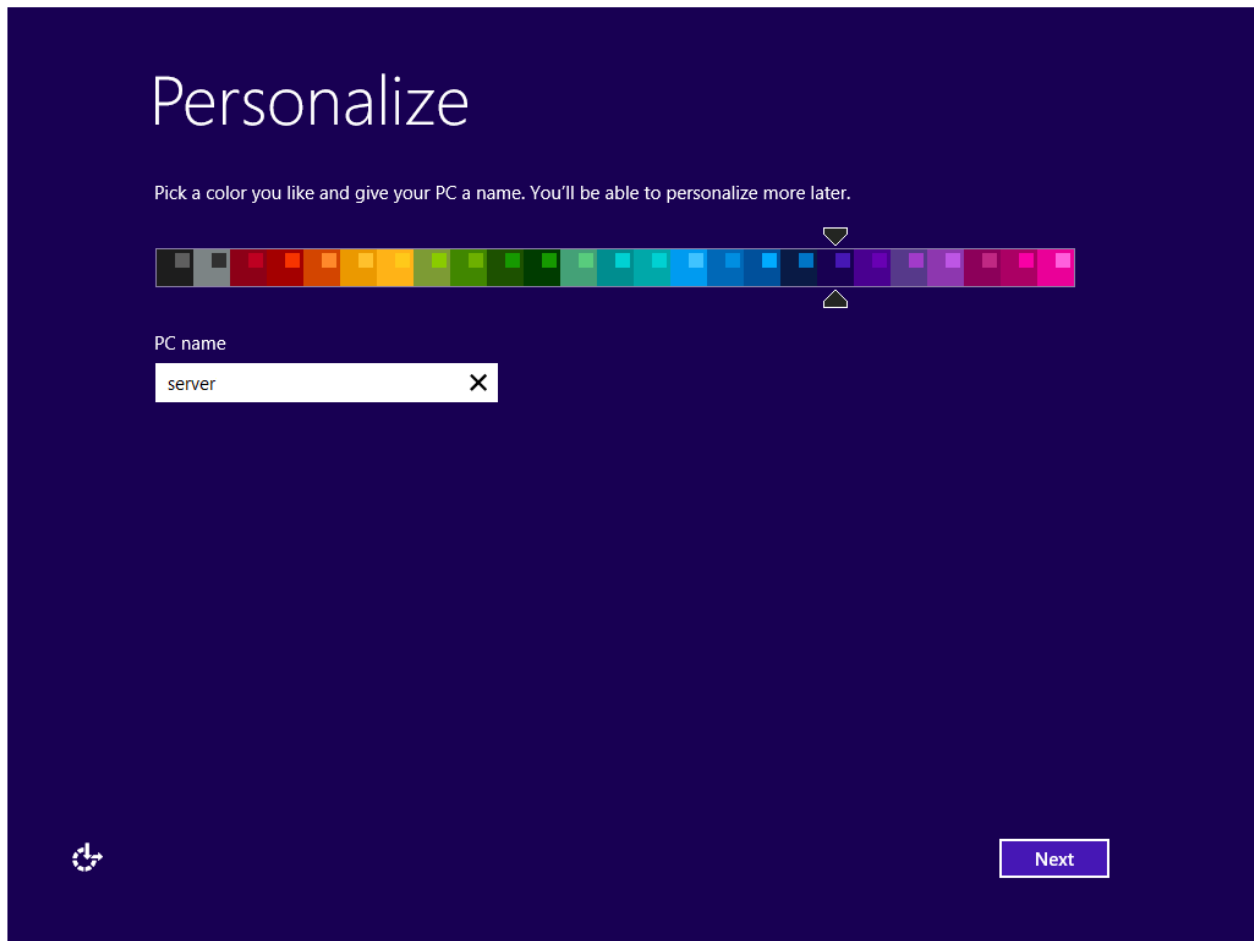
Figure 9: Personalization screen

The follow-on screen is entitled *Settings*. The choice is *Express* – which is quicker to setup but which benefits them (Microsoft) – or *Customize*, which is a bit slower to setup but which benefits you. Choose **Customize**:

Figure 10: Choose Customize screen

On the next screen choose **Yes**. This is *very* important, as it will cause Windows to configure the most appropriate network settings:

Figure 11: Choose 'Yes – For home or work networks'

On the next screen you want:

- Windows Update **not** set up
- Automatically get device drivers **On**
- Automatically update my apps **Off**
- SmartScreen online services **Off**
- Send a Do Not Track request **On**.

Then click **Next**:
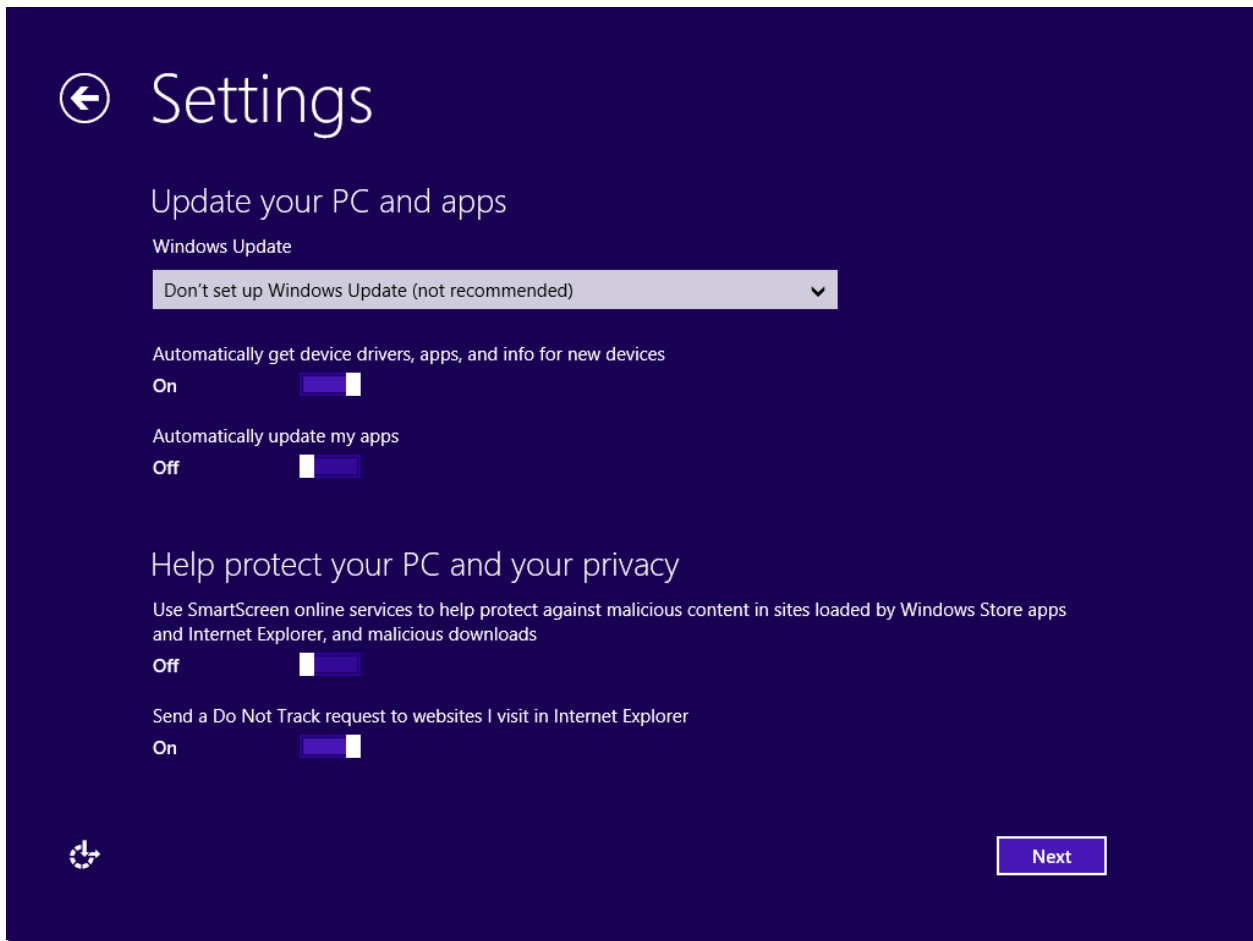
Figure 12: Various settings

On the subsequent screen you want:

- Use Windows Error Reporting **On**
- Use compatibility lists for Internet Explorer **Off**
- Send some location data to Microsoft **Off**
- Send info to Microsoft about how you use your PC **Off**
- Send info to Microsoft about how you use Help to **Off**

Then click **Next**:

Figure 13: More settings

The endless questions continue. Set everything on the next screen to **Off**. Click **Next**:

Figure 14: Even more settings

The next screen is one that many people find confusing and misleading as it implies that you need something called a *Microsoft Account* in order to use the computer. This is typically a Hotmail, Windows Live or Outlook email account, which many people will have anyway. However, it is *not* necessary at all and *not* recommended here:
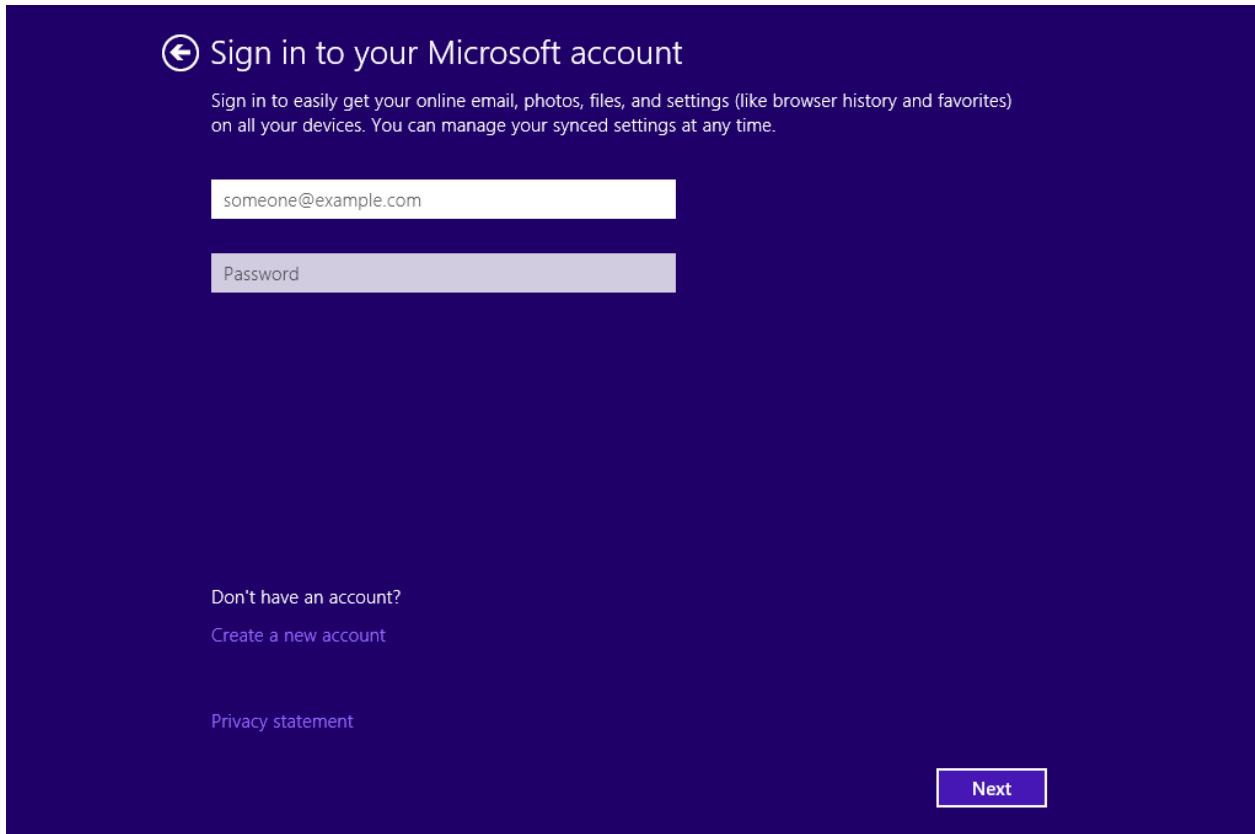
Figure 15: Click 'Create a new account'

Do not enter any details. Instead, click the **Create a new account** option. This will display a form; do not complete it, instead click the **Sign in without a Microsoft account** option at the bottom of the screen:
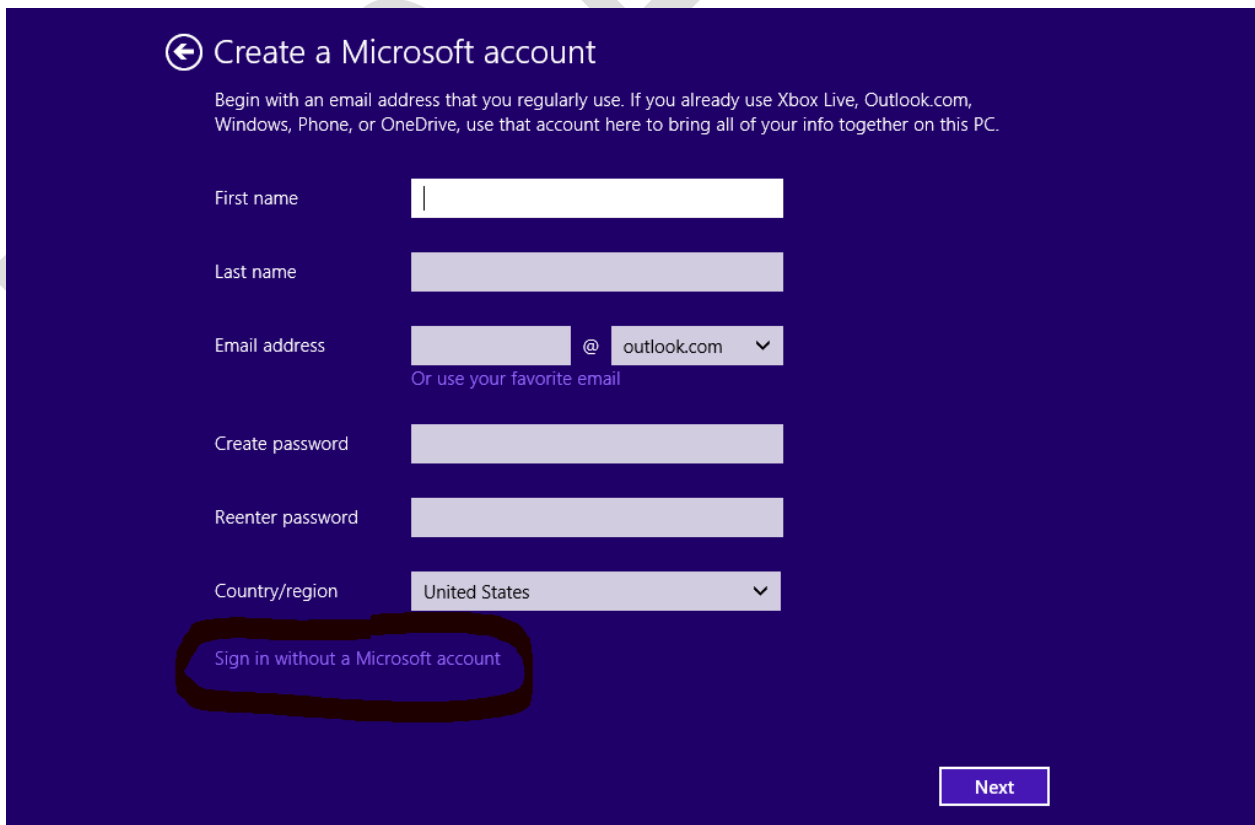
Figure 16: Click 'Sign in without a Microsoft account'

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The screen that is now shown allows you to create a local account on the computer (i.e. one that is nothing to do with Microsoft) which will be used for managing the server. For the **User name** specify *systemadmin*. Enter and re-enter a **password**, along with a hint. The best passwords are non-obvious, not too short and contain a mixture of letters and numbers. Do not use words like 'password', 'secret', 'admin' or 'server'. Then click **Finish**:
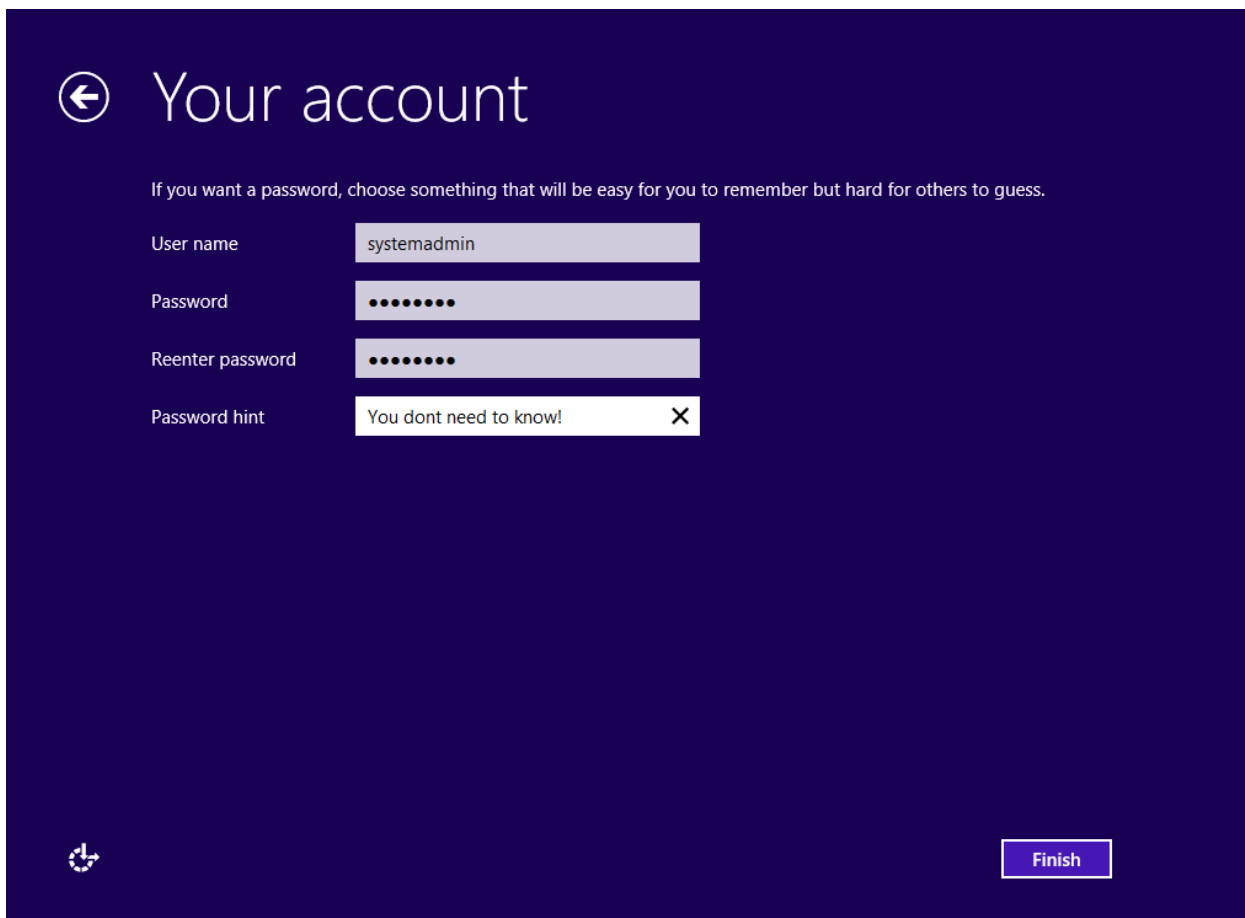
Figure 17: Create the systemadmin account

There will now be a wait whilst Windows installs a number of apps and generally sets things up, during which time the screen color constantly changes and displays messages intended to entertain and inform. Eventually the installation will complete and you will be presented with the Desktop or the Start Screen, from where you can access the Desktop. Note that you may have more icons and a different coloring scheme to that shown below:

Figure 18: Standard Windows Desktop

If you are using a computer that came with Windows pre-installed on it, chances are, depending on the vendor, that it has *bloatware* on it – unnecessary programs, trials, games and demo's – that will slow it down and sap resources. These need to be removed. The standard way to do this is go into the **Control Panel** (right-click the **Start** button) and choose **Programs and Features**. Unfortunately it is a matter of having to know what to look for, although trial versions of anti-virus and security programs are an immediate target as they simply duplicate something already built-in to Windows 8.1 in the form of Windows Defender. Alternatively, there are utility programs available for download that claim to do much of the job for you e.g. look at http://pcdecrapifier.com/download.

Note: this paragraph applies to computers that do not come with Windows pre-installed on them and if this does not apply to you skip to the next section. Windows 8.1 does a very good job of identifying the hardware inside a computer and installing appropriate drivers for it. However, in some instances it will fail to do so and in such cases it will be necessary to go to the computer manufacturer's website and locate and download suitable drivers for Windows 8.1 (this may have to be done from a different PC). In the case of a micro server, they may not be listed under Windows 8.1, in which case ones for Windows Server 2012 R2 will usually be suitable. It may not be strictly necessary to download every driver, for instance, sound is not really needed on a server. The most important ones are: the network (Ethernet) driver; general chipset support (which will be from Intel or AMD); video graphics; anything pertaining to SATA.

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2.4 Windows Product Key and Activation

Depending on the version of Windows 8.1 you have – but certainly with retail versions – you may be prompted to enter a product or license key at some stage. This may occur early on during the installation process or after you have completed the installation and been running the system for a little while. The product key is usually located on a sticker that came with the Windows 8.1 packaging, stuck on the side of the computer or in an email if you purchased and downloaded your copy online.

2.5 Windows Updates

It is important to check for and apply the updates to Windows that Microsoft makes available on a regular basis. Such updates may provide improved or additional functionality, but more typically address security issues that could potentially compromise the system. On regular desktop and laptop computers, Windows updates are often applied automatically; however, it is suggested that automatic Windows updates are *not* enabled on a computer used as a server. The reason for this is to ensure control over the process and prevent the risk of the server rebooting on its own accord following an update. Also, in a business environment it is suggested that updating is done out of hours so as to avoid any disruption to service, perhaps on a monthly basis.

Go into **Control Panel**. If it is currently set to view by Category, change it to view by **Large Icons**. Click the **Windows Update** icon followed by the **Turn on Automatic updates** button, which will force the system to check for updates. After a couple of minutes the screen will refresh and display a message that *"nn important updates are available"* (where *nn* is the number of such updates). Click the message and on the next screen click the **Install** button at the bottom of the screen. The updates will download and install; this may take some time and may necessitate the server having to restart to complete the process.

Once the server is up-to-date, go back into **Windows Update** and click **Change Settings**. Set it to a value other than 'Install updates automatically' and click **OK**.

Figure 19: Windows Update settings

2.6 Power Management

Windows 8.1 has power management features to help reduce power consumption, for instance by putting the computer to sleep or in hibernation mode when it has not been used for any length of time. Whilst useful on a laptop, such features are less so on a computer being used as a server. For instance, if the server has gone to sleep you do not want the delay and inconvenience of having to wait until it starts up again when you want to save or retrieve a file – you expect it to be instantly available. For this reason, the power management features in Windows 8.1 need to be adjusted.

To do this go into **Control Panel**. Make sure the view is large icons and click **Power Options** to display the following panel (note that there may be some minor variations to the following screenshots depending upon the brand of computer):
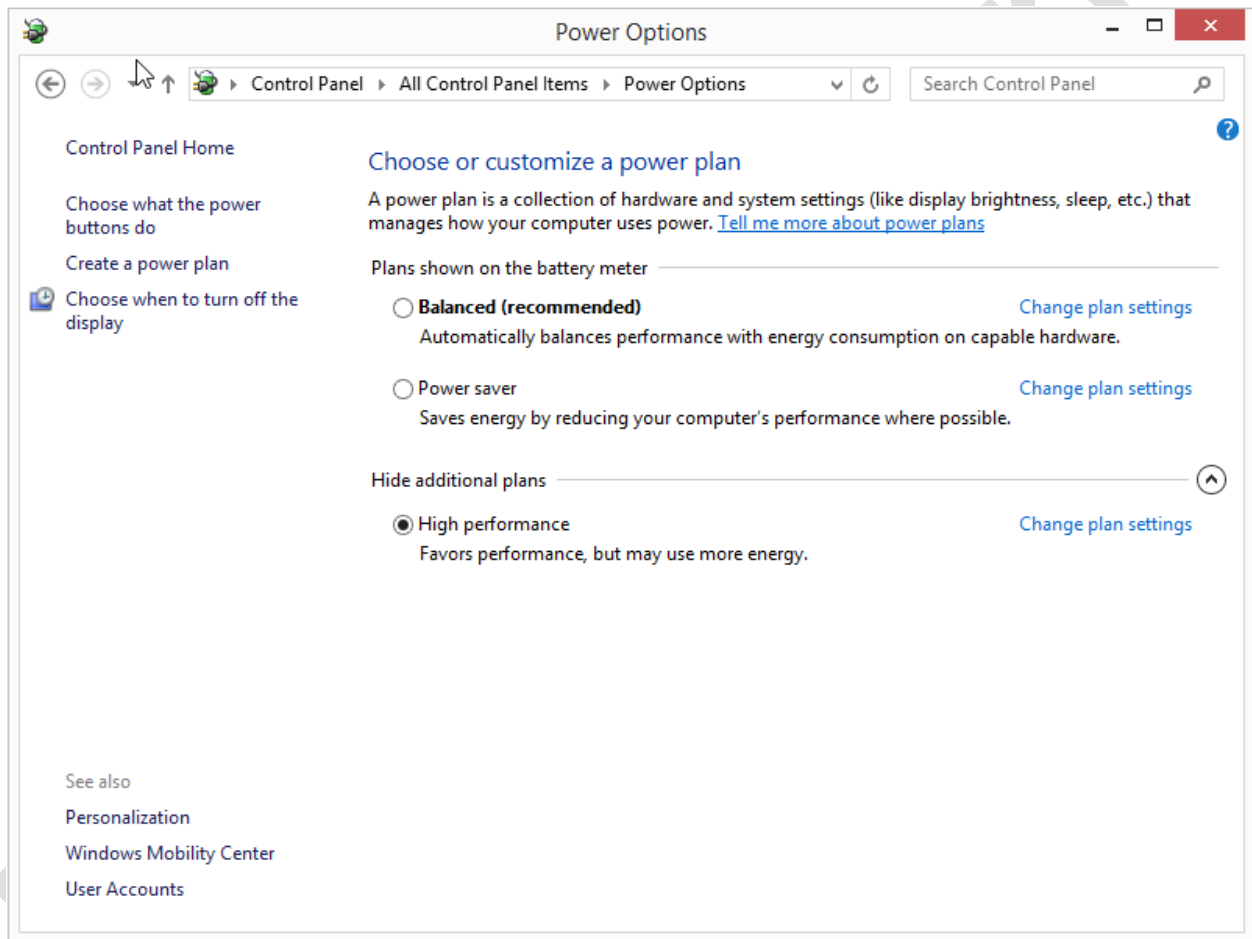
Figure 20: Power options

A selection of power plans are listed; we want **High performance** (if it is not listed click **Show addition plans**). Against High performance click **Change plan settings**. The key attribute is *Put the computer to sleep*, which should be set to **Never**:
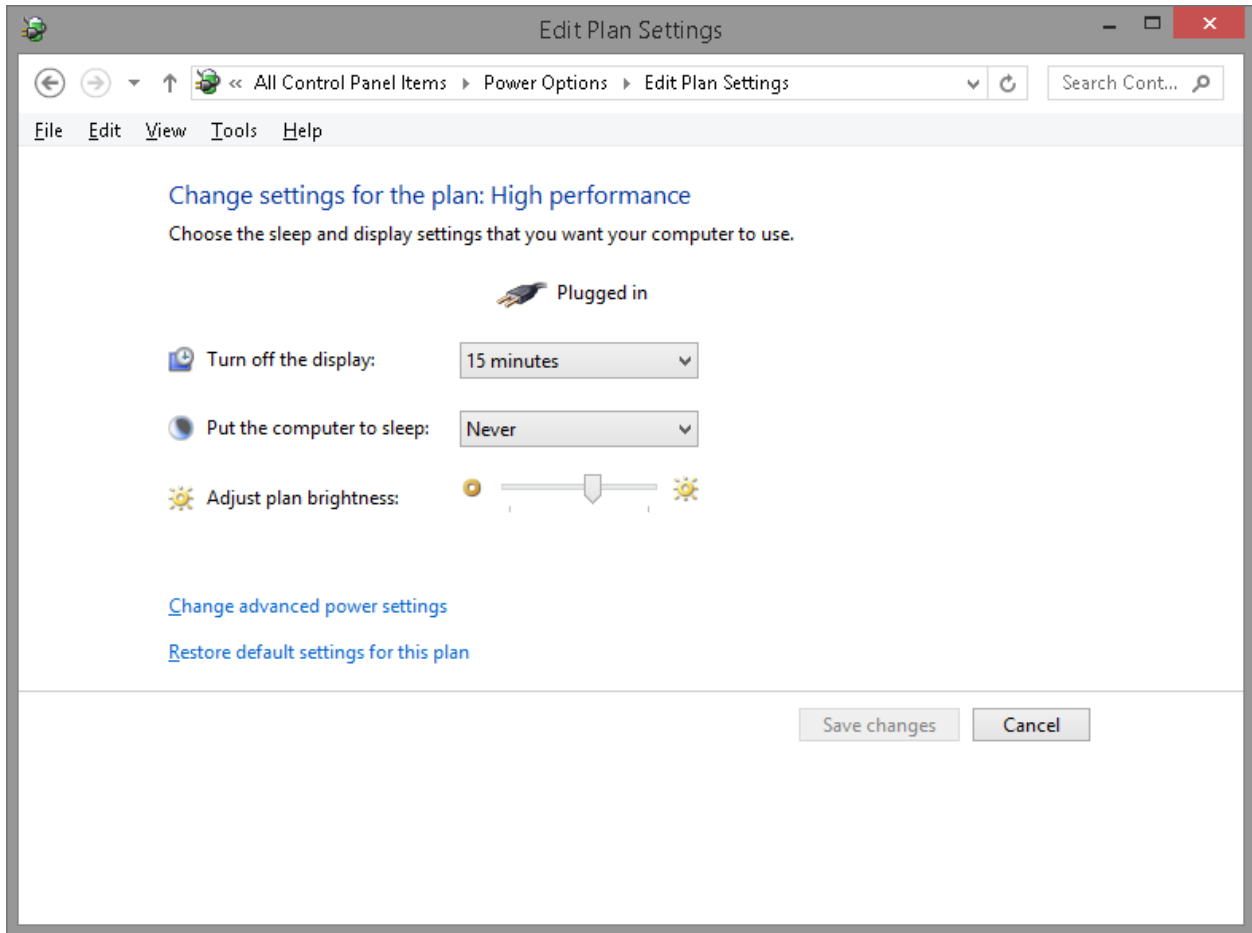
Figure 21: High performance power plan

Returning to the main Power Options panel, click **Choose what the power buttons** do. Your choices here depend on your local circumstances; if you are the only person that uses the server then you may not want to bother about this panel too much. But if, for example, the server is being used in a small business environment and is readily accessible by other people then you may choose to disable the power buttons plus insist on a password as below:
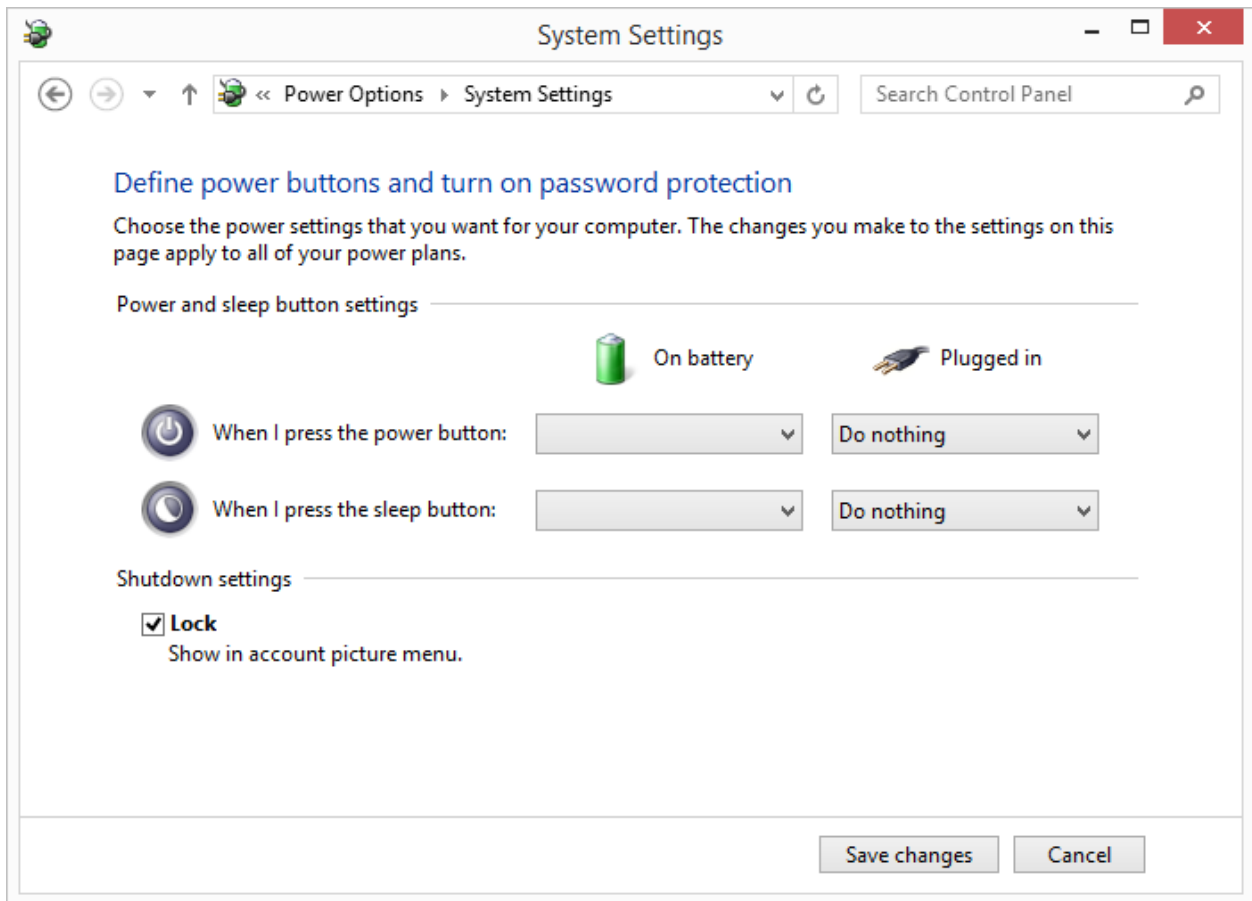
Figure 22: Power Options, System settings

2.7 Network Settings

The next step is to change network settings on the server, such that users can share folders and resources. There are three types of networking available in Windows 8.1: *Domain*, *HomeGroup* and *Workgroup*. Domain networking refers to corporate networking, where a Windows 8.1 Professional client connects to a server running a variant of the Windows Server operating system, such as Windows Server 2012 R2. This is not applicable here. *HomeGroup* is a simplified form of networking that was first introduced with Windows 7. It certainly has some merits, but also some limitations plus it only works for Windows 7 and Windows 8 computers. Workgroup networking can be thought of as a more flexible, universal approach, which can also handle other versions of Windows, Apple Macs, tablets and other devices, so this is the solution we will use.

Launch the **Control Panel** and choose **Network and Sharing Center**. Click **Change advanced sharing settings**. The settings required are as follows:

- Under Network discovery you want **Turn on network discovery** and **Turn on automatic setup of network connected devices**
- Under File and printer sharing, **Turn on file and printer sharing**
- Under Homegroup connections, **Use user accounts and passwords to connect to other computers**
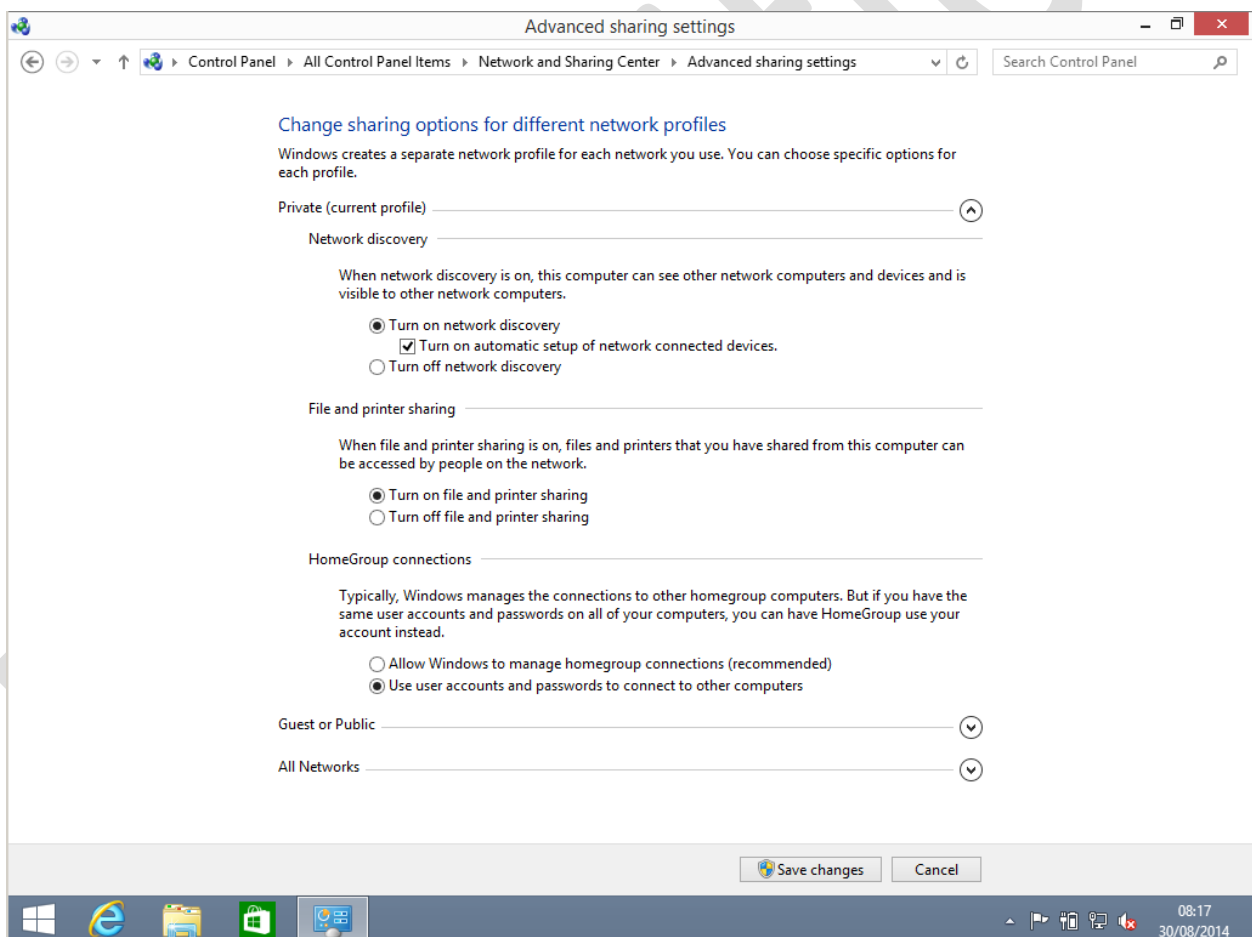
Figure 23: Advanced sharing settings

Having made the changes, click **Save changes**.

2.8 Disk Storage

Most desktop and laptop computers have one physical hard drive, configured as a single volume and commonly referred to as 'the C: drive', upon which everything is stored. However, in a server there are often several disks or volumes to provide greater amounts of storage and improve reliability. It is also good practice to store Windows on a separate volume to the data. Why? Should there ever be a need to reinstall or upgrade Windows then it is possible to do so without affecting the data. It is also easier to manage and backup the data.

If you are using a computer with a single hard drive, you can achieve some of this by dividing it into two volumes and how to do so is described in the section below. If you are using a computer with multiple hard drives you should make use of Windows 10's Storage Spaces feature as described in section 2.10 Storage Spaces (Multiple Drive System) instead.

2.9 Storage in a Single Drive System

Right-click **Start** and launch *File Explorer*. Right-click **This PC** and choose **Manage** from the pop-up menu. Click on **Disk Management** to display this screen:
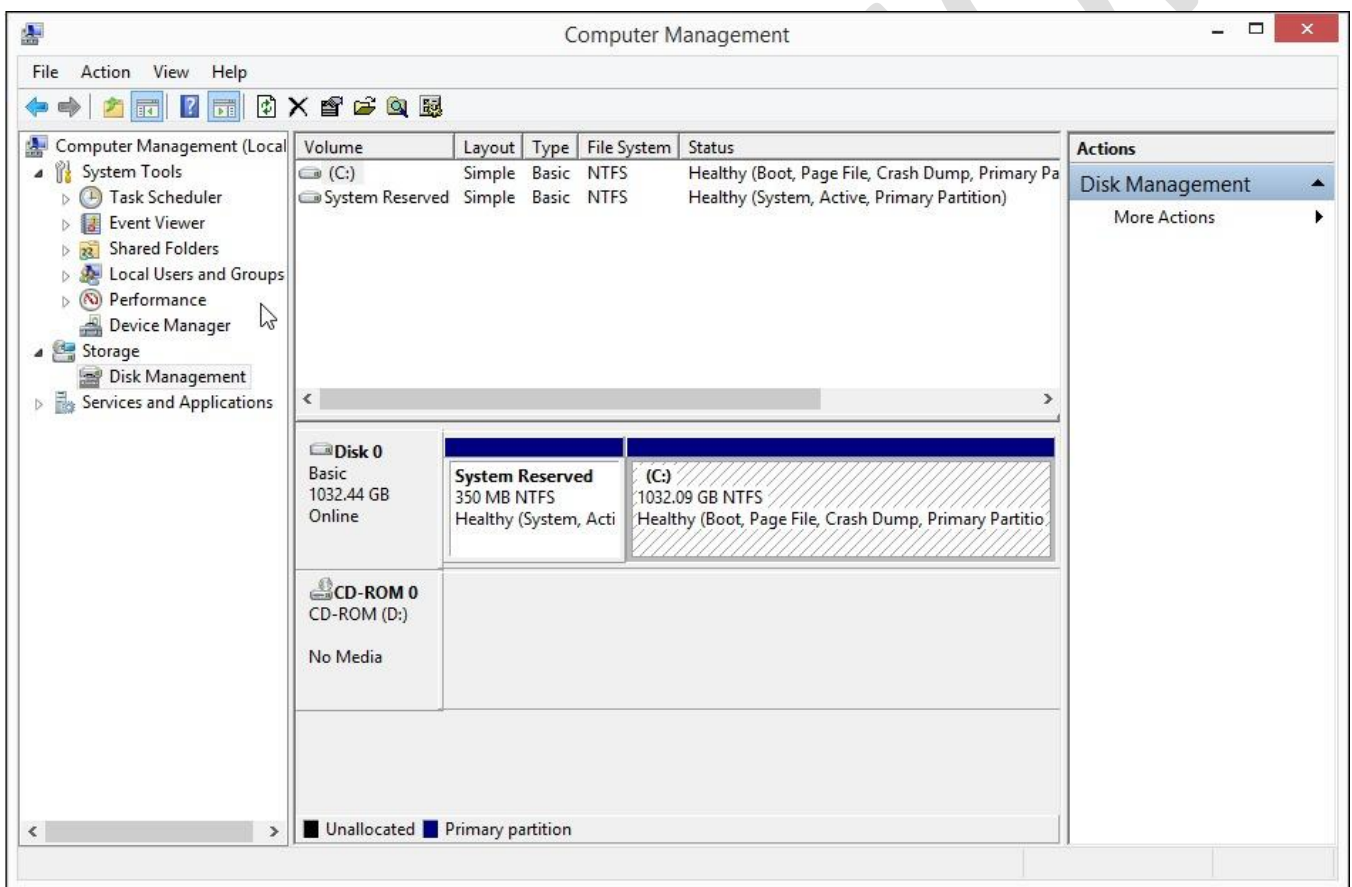
Figure 24: Disk Management screen

Right-click the C: drive and choose **Shrink Volume**. After a few seconds a panel appears advising by how much you can shrink C: in order to make some space for what will become our data volume. It defaults to the maximum permissible value, meaning you could choose to shrink by a smaller amount but not by a larger amount, although in practice you would normally accept what is being proposed by just clicking the **Shrink** button:
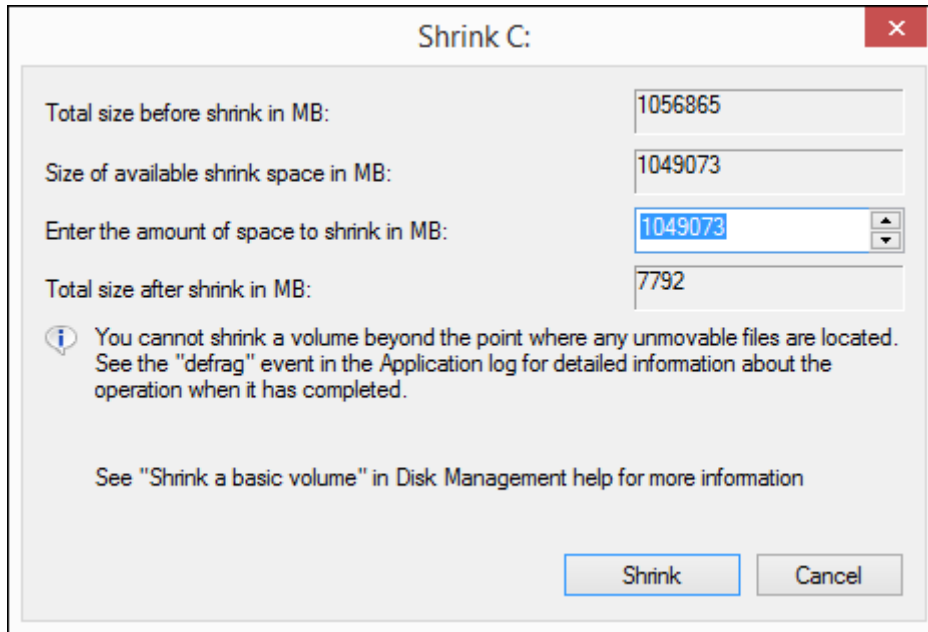
Figure 25: Shrinking a volume

It may take a few moments to shrink the volume; when complete you will be returned to the main screen. Right-click on the *Unallocated* area which has appeared and choose **New Simple Volume**:
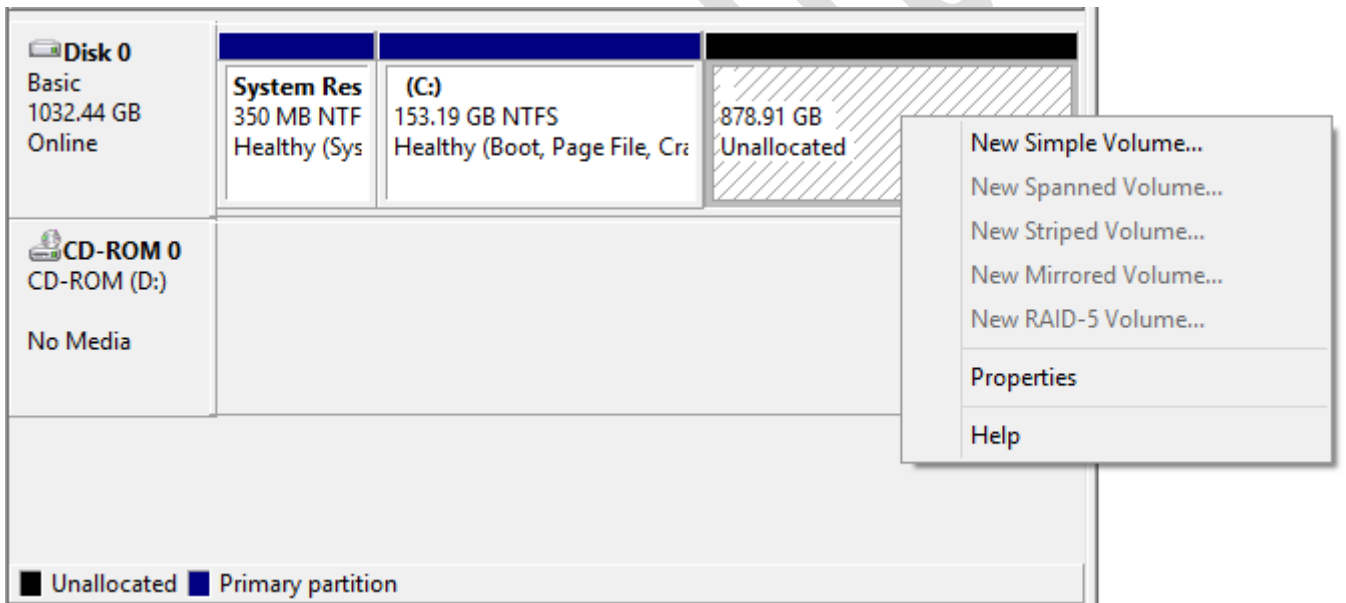
Figure 26: Choose New Simple Volume

The *New Simple Volume Wizard* will be invoked. Click **Next** on the first two panels. The third one is used for assigning a drive letter to the new volume; typically in a single drive system it will propose E: as the new drive, on the basis that the main drive is C: and the DVD drive is D:, which is fine. Things could be different on your system, although it doesn't actually matter what the new drive letter is. Click **Next**:
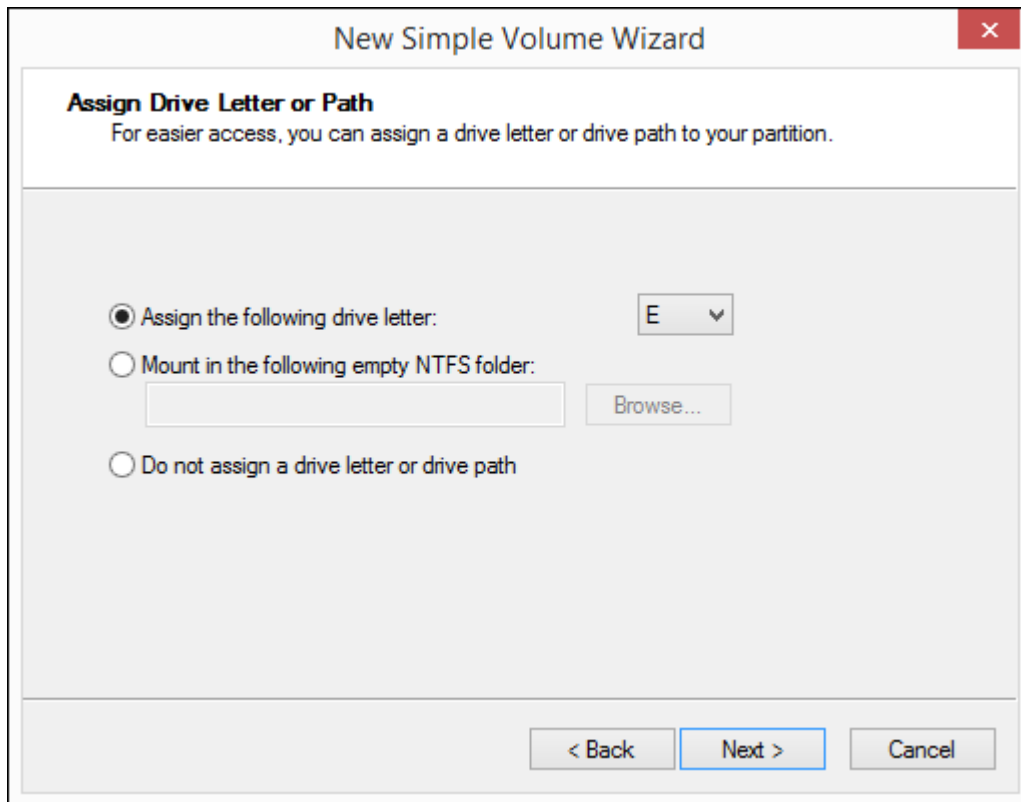
Figure 27: Assigning a drive letter

On the subsequent panel the defaults are fine, although you may optionally wish to change the *Volume label* to a more meaningful name, such as *Data*. Click **Next**:
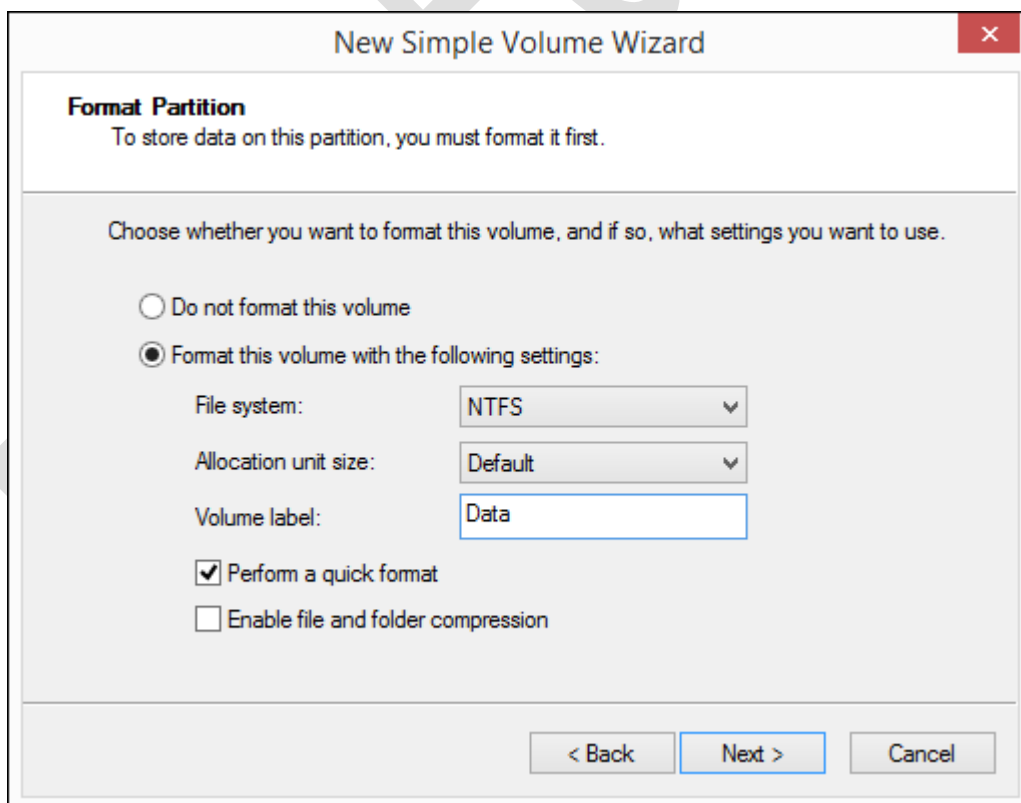
Figure 28: Format Partition

The final panel is just a summary screen – click **Finish**. The new volume may take a few moments to format and after it has done so a notification message will pop-up in the corner of the screen – it can be ignored. Close down the Computer Management screen and go to section 3 USERS.

2.10 Storage Spaces (System with Multiple Drives)

Storage Spaces is a feature of Windows 8.1 that allows systems with multiple hard drives to be better utilized and managed. It is designed to address three aspects of storage:

Firstly, on a Windows computer each hard drive normally has a separate drive letter to identify it. For instance, the first drive is the C: drive, the second is the D: drive, the third is the E: drive and so on. However, it is more convenient, particularly in a network, if drives can be pooled together to appear as a single large volume. This makes it easier to find things by removing the requirement to know upon which physical drive a particular file or folder is located:
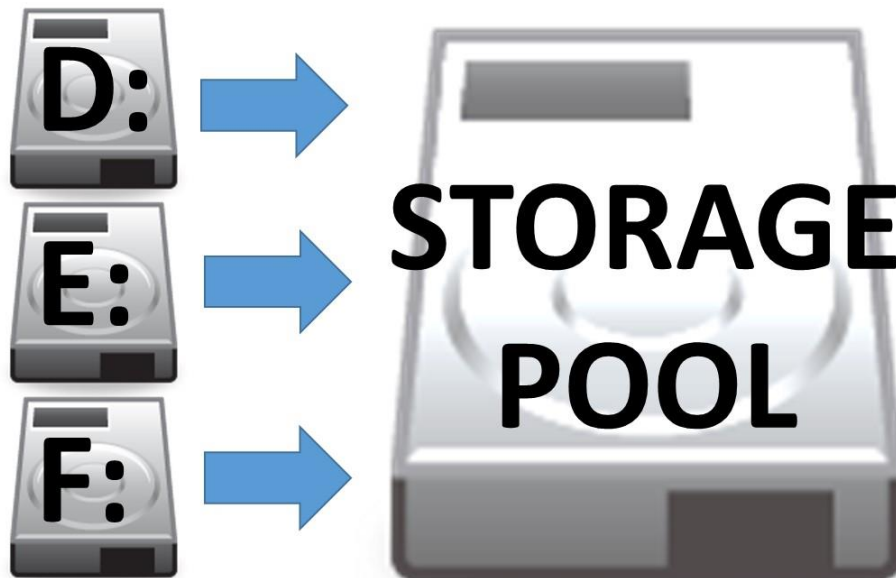
Figure 29: Storage Pool aggregates the hard drives

Secondly, Storage Spaces provides a degree of protection against data loss in the event of a drive failing. Multiple copies of files are stored on different drives; if a drive fails then a copy from a different one is automatically used. The failed drive can then be replaced and added back to the storage pool. This technique is analogous to RAID (Redundant Array of Inexpensive Drives), a technology commonly found on corporate file servers, but here it is implemented as a software rather than hardware solution.

Finally, the pool can easily be added to in order to provide more storage space, without excessive disruption or reconfiguration. One important thing to note is that the drives can largely be of any type; for instance, external USB hard drives can be connected to the computer and added to the storage pool.

In this example, the computer already had a hard drive, upon which Windows is installed. Two further drives, each of 2TB have been added; now, Storage Spaces will be used to join them together to create a protected volume.

Go to **Control Panel** and click **Storage Spaces**. Click **Create a new pool and storage space** (if User Access Control is invoked answer **Yes**). A panel listing the available drives is shown:
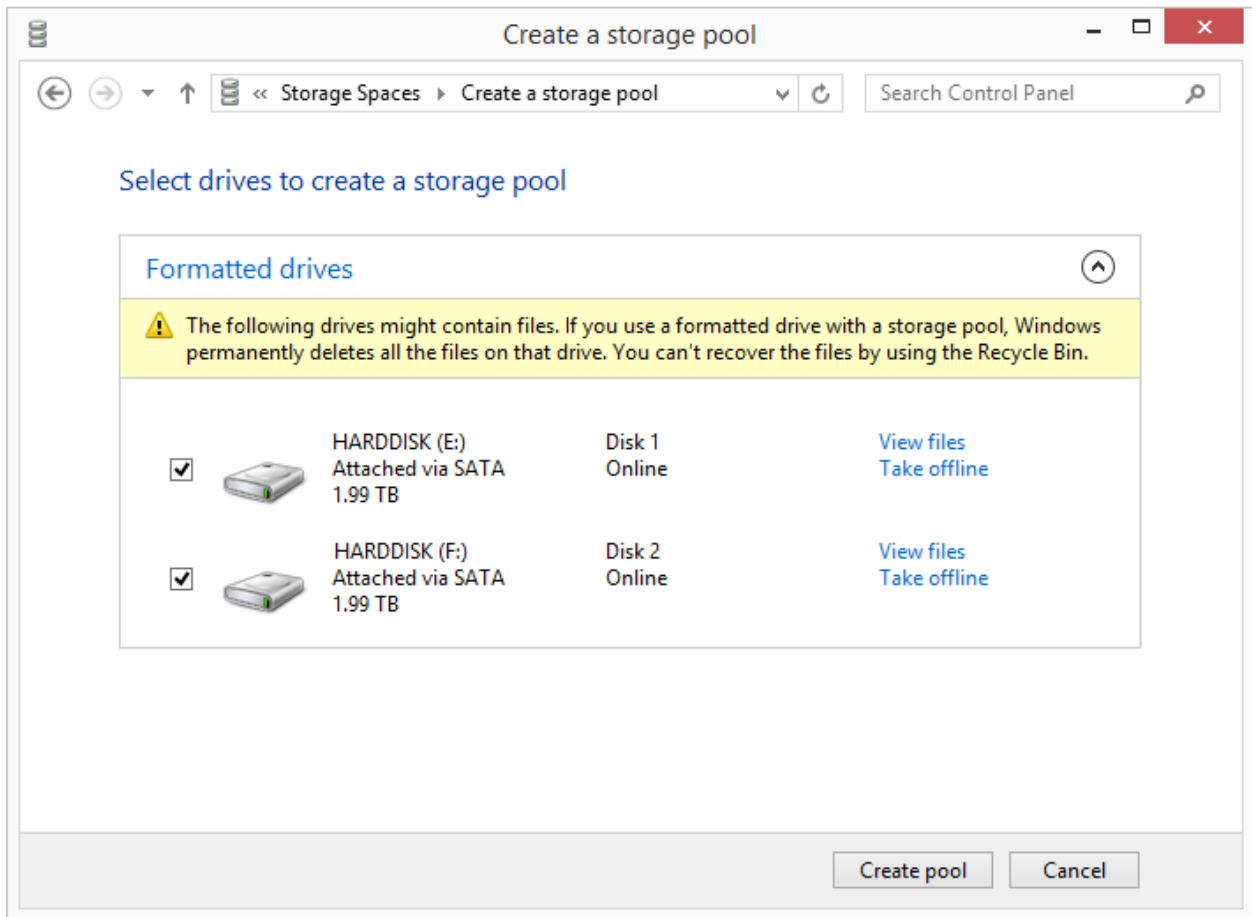
Figure 30: Select the drives to create a storage pool

Tick each drive and click the **Create pool** button. The options which then appear depend upon the number of drives being added. If two drives are being used, the options are:

- *Simple* - in which the drives are aggregated to create a single large volume (sometimes known as JBOD or *Just a Bunch of Disks* in other computing environments)
- *Two-way mirror* – in which data is duplicated on each drive in order to provide redundancy (analogous to RAID 1 in other computing environments)

If three or more drives are being used then two more options become available:

- *Three-way mirror* – in which data is triplicated across the drives to provide even more redundancy
- *Parity* – here data is stored across all the drives. Additional information (known as *parity*) is used by the system, such that data is preserved in the event of a drive failure (analogous to RAID 5 in other computing environments)

The amount of storage space available depends upon the option selected. In our example, we are using a pair of 2TB drives. If these are configured in Simple mode then the total amount of storage is 4TB; if configured in Two-way mirror mode then the amount of available storage is 2TB.

Note that when creating a storage space you can name it and give it a drive designation e.g. E: in this example. This drive designation replaces the existing ones and only applies to the server, not to any connected computers.
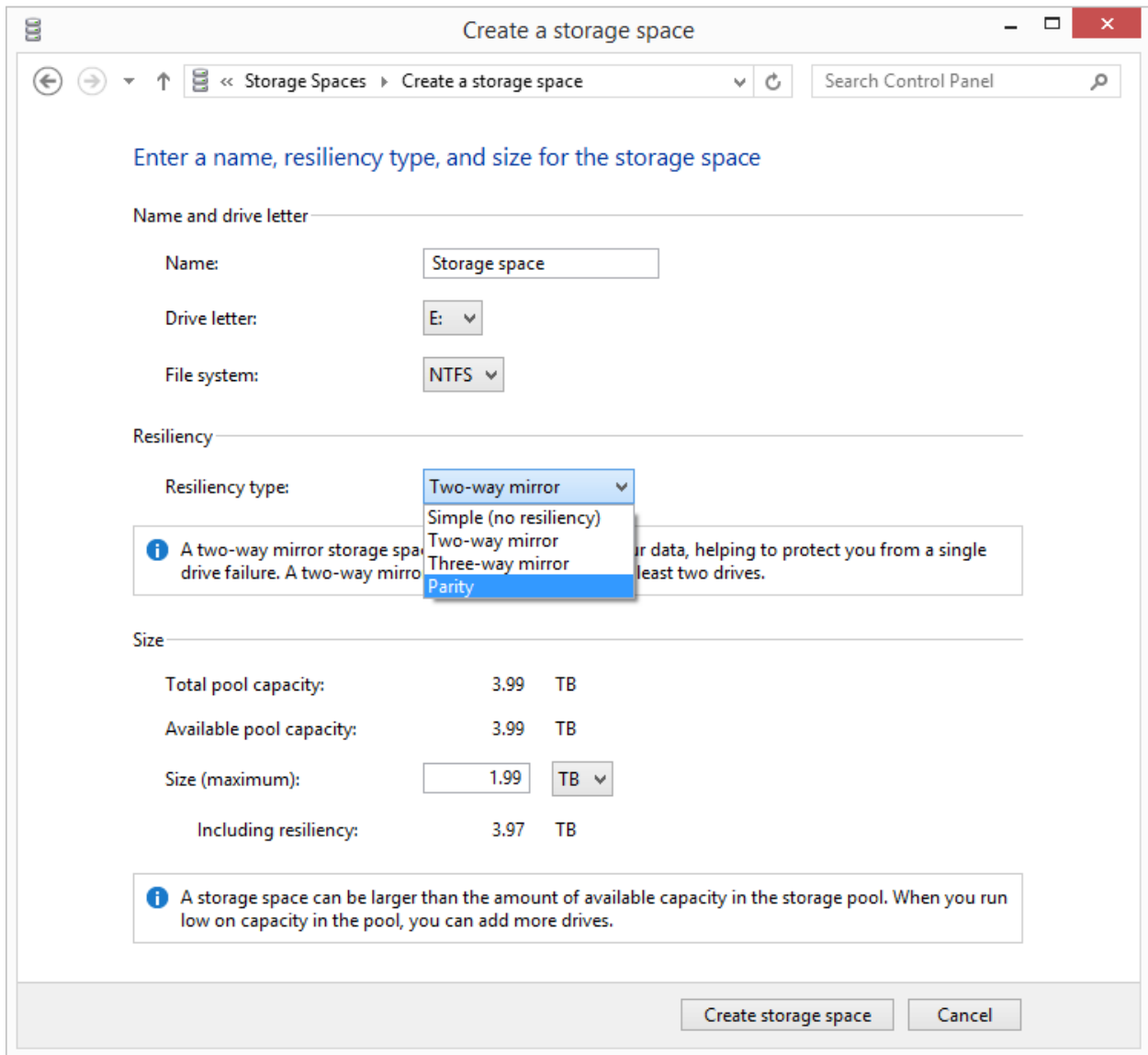
Figure 31: Creating a storage space

After the Storage Space has been created, a summary screen is displayed. The Storage pool can also be managed from this screen:
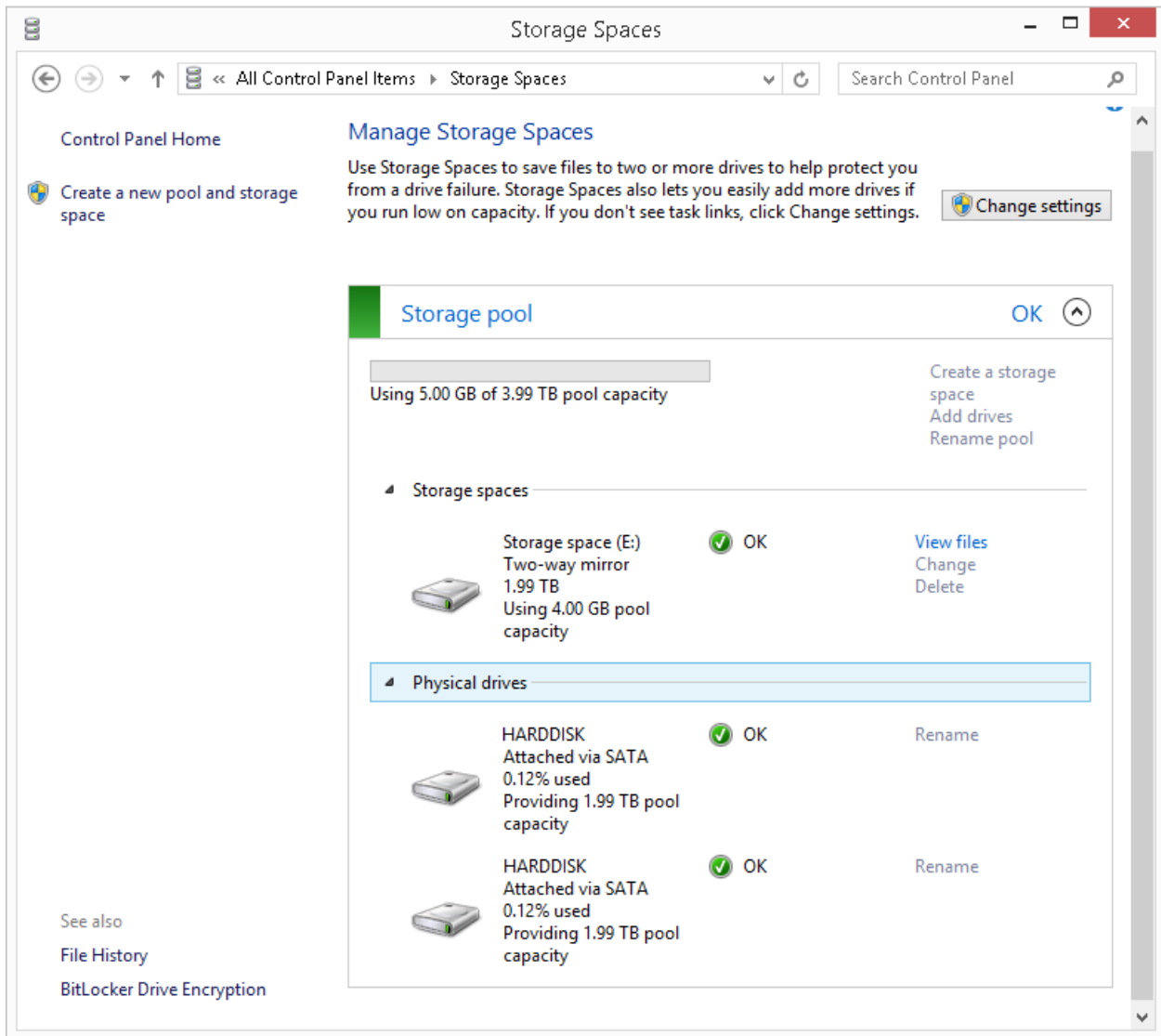
Figure 32: Managing Storage Spaces

3 USERS

In order to access the Windows 8.1 server from another computer, it is necessary to enter the details of an account name that exists on the server, along with a password. The use of account names and passwords provides the most basic degree of control and management in a networked computer system.

The user names should first be created on the server and there are several approaches that can be taken here, depending on your requirements. The user names can be just about anything you want, although there is considerable merit in following a scheme of some sort. Note that the user names on the server do not have to be the same as any local accounts that exist on the individual computers.

For example:

- In a home network you could use the first names of the family or household members e.g. David, Mary, Mike
- In a very small business (3-4 people) you could do likewise
- In a business you could follow a convention of using the first name plus the initial of the surname, or the initial of the first name plus the surname, although in some parts of the world other conventions might be more appropriate e.g. *aarong*, *nishap*, *johns*, *sarahj* or *agoldberg*, *npatel*, *jsmith*, *sjones*
- Alternatively, in an organization where there is a higher turnover of staff you could use abstract names such as *user1*, *user2*, *user3*, *user4* and so on

There are two methods of creating a new user in Windows 8.1.

3.1 Creating a User with PC Settings

*PC Settings* is the modern alternative and eventual replacement to the Control Panel. To invoke it, hold down the Windows key in conjunction with the letter I ("aye"). On the bottom right-hand corner of the screen click **Change PC Settings** (alternatively, go the Start Screen, click the downward arrow to view all program and find and launch PC Settings from there). On PC Settings, choose **Accounts**, **Other accounts**, **Add an account**, **Sign in without a Microsoft account**, **Local account**. Specify the user name and password, repeat the password, enter a hint, click **Next** then **Finish**.

3.2 Creating a User from the Command Prompt

Some people are wary of working using the command prompt, but it is a very efficient way of doing some things. Right-click the Start button and choose **Command Prompt (Admin)**. You may get a warning from User Account Control – click **Yes**. A command prompt window is displayed. Type: **net user *username password* /add** and press **Enter**, where username is the name of the user to be created and password will be their password e.g. **net user jsmith secret123 /add.** Whilst the command prompt box is open, create all the remaining users.

Note that having created the users – regardless of technique – it is not necessary to login to the server to test them or customize them in any way, as they will never need to work directly on the server and the act of doing so will create some extraneous files. In fact, it is recommended that you do not do so.

3.3 Deleting a User from PC Settings

Should it be necessary to delete a user – for instance, when somebody leaves the organization – it can be done as follows. Click **Start** followed by **Settings**, else hold down the Windows key in conjunction with the letter I ("aye"). Click **Accounts**, **Other Users**. Click the user's name then click **Remove** button. Acknowledge the warning message about data being deleted.

3.4 Deleting a User from the Command Prompt

Right-click the **Start** button and choose **Command Prompt (Admin)**. You may get a warning from *User Account Control* – click **Yes**. A command prompt window is displayed. Type: **net user *username* /del** and press **Enter**, where username

is the name of the user to be deleted. Note that the user is deleted immediately – there is no warning or 'Are you sure?' type of message.

4 SHARED FOLDERS

The main purpose of a network is to provide an environment for users to store and share information. This is done by creating folders on the server, some shared and some private, then defining access rights to control who sees what. The structure of these folders will depend upon the requirements of the household or organization, but a typical starting arrangement might be:

- A shared documents folder that everyone has access to
- Shared folders for music, photos and videos (particularly so for a home system)
- Individual home folders for each user

4.1 Setting up the Shared Folders

Using *File Explorer* navigate to the storage location, which is the E: drive on our system. Create a folder called *Shared*, which can be done by clicking the *New Folder* icon on the *Home* tab of the *Quick Access Toolbar* or Ribbon, or by right-clicking and choosing **New** > **Folder**, or by pressing **Shift Ctrl N** simultaneously:
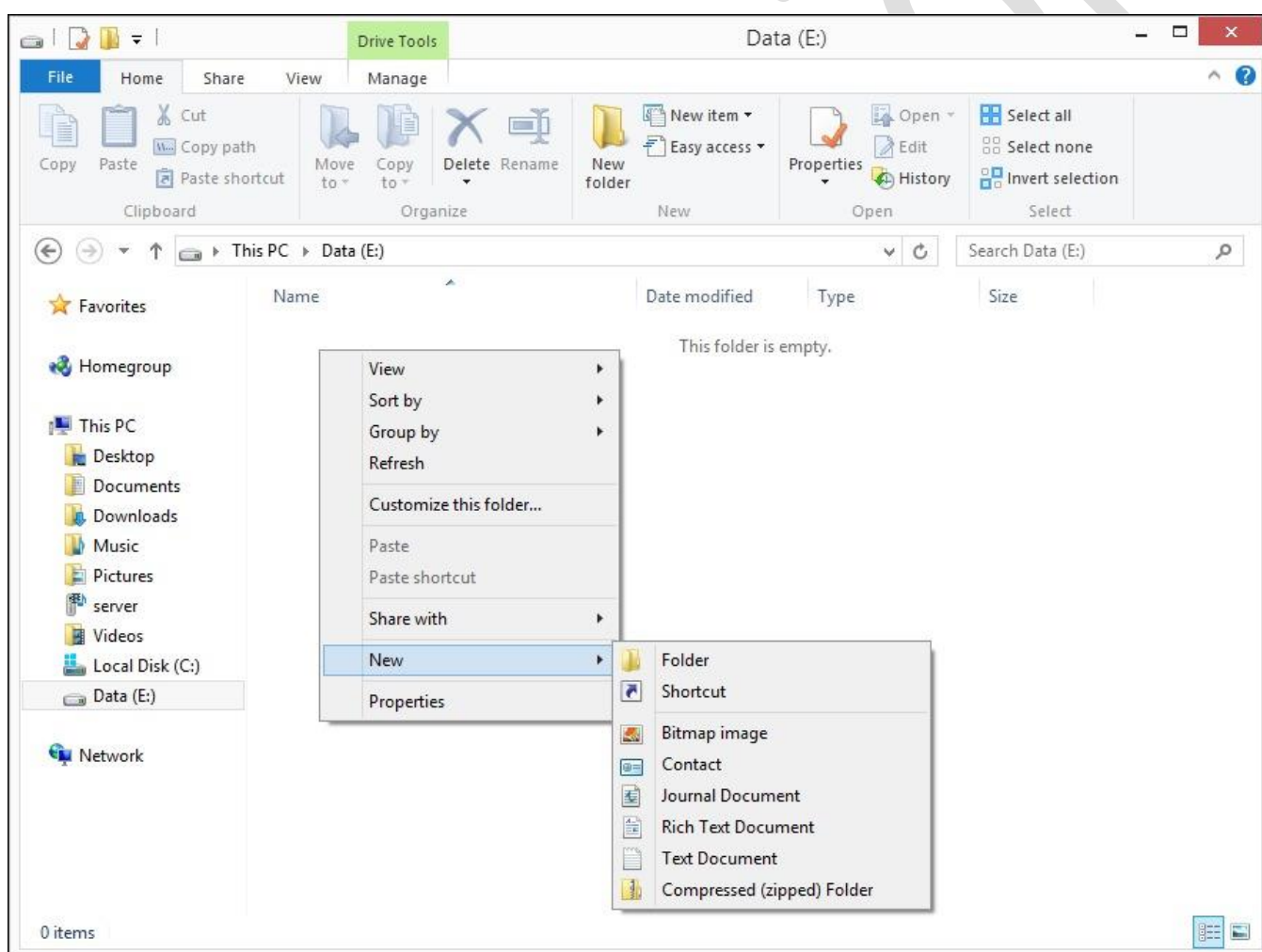
Figure 33: Creating a folder

Having done so, right-click it and choose **Share with** > **Specific people**. On the resultant panel click the down-pointing chevron (arrow) and click on *Everyone* followed by the **Add** button. *Everyone* will appear in the bottom panel; against it is a chevron; click it and change the *Permission Level* from Read to **Read/Write**:

Figure 34: Specifying permissions for the Shared folder

Click the **Share** button. If you receive a message 'Do you want to turn on network discovery and file sharing for all public networks?' choose **No**. After a short while a confirmation screen will be shown – click **Done**.

Returning to the *Shared* folder within File Explorer, open it and create four sub-folders within it, called: *Documents*; *Music*; *Pictures*; *Videos*. These are just regular folders and it is not necessary to go into the sharing settings.

It should now be possible to view the shared folders from another computer on the local network. Go into File Explorer/Windows Explorer, expand the Network section and drill-down to the *Server > Users* section (alternatively hold down the **Windows** and letter **R** keys simultaneously and enter *server**shared*). Expand the *Shared* folder and it should look something like this (there may be cosmetic variations to this screen depending upon which version of Windows you are using):

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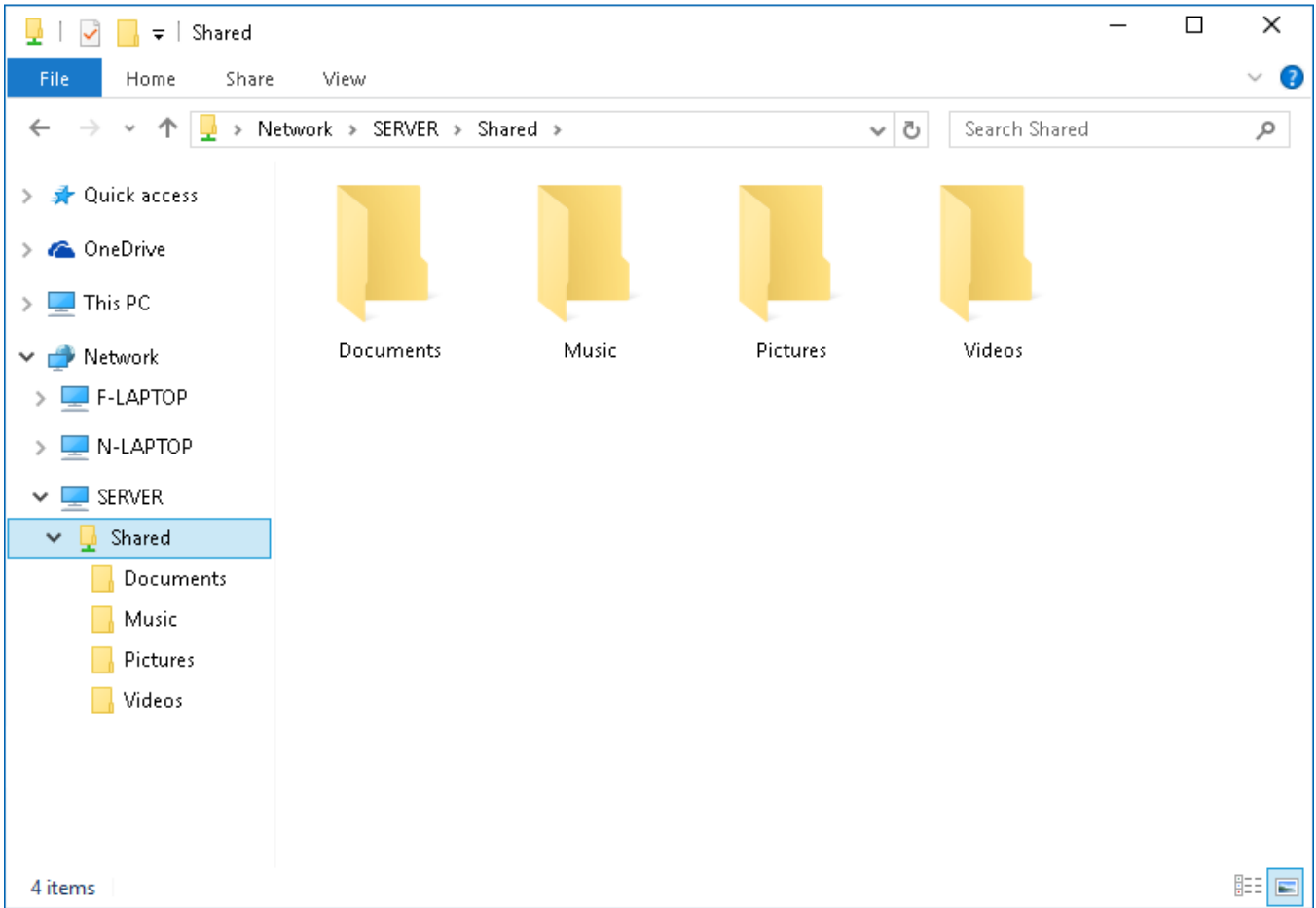
Figure 35: View of shared folders

4.2 Home Folders

It is now necessary to create individual *home folders* for each user. A home folder is a personal folder for storing work on the network that does *not* need to be shared with other users. It is analogous to the 'Documents' or 'My Documents' folder that each user normally has on their own computer, but with two advantages. Firstly, it can be accessed from any computer on the network. Secondly, it will be backed up courtesy of the server (assuming a backup has been setup and how to do so is described in section 9.1 Server Backups).

Begin by creating a new shared folder called *Homes* on your data drive (in our example it is the E: drive, but it may be different on yours). Having done so, right-click it and choose **Share with** > **Specific people**. On the resultant panel click the down-pointing chevron (arrow) and click on *Everyone* followed by the **Add** button. *Everyone* will appear in the bottom panel; against it is a chevron; click it and change the *Permission Level* from Read to **Read/Write**:
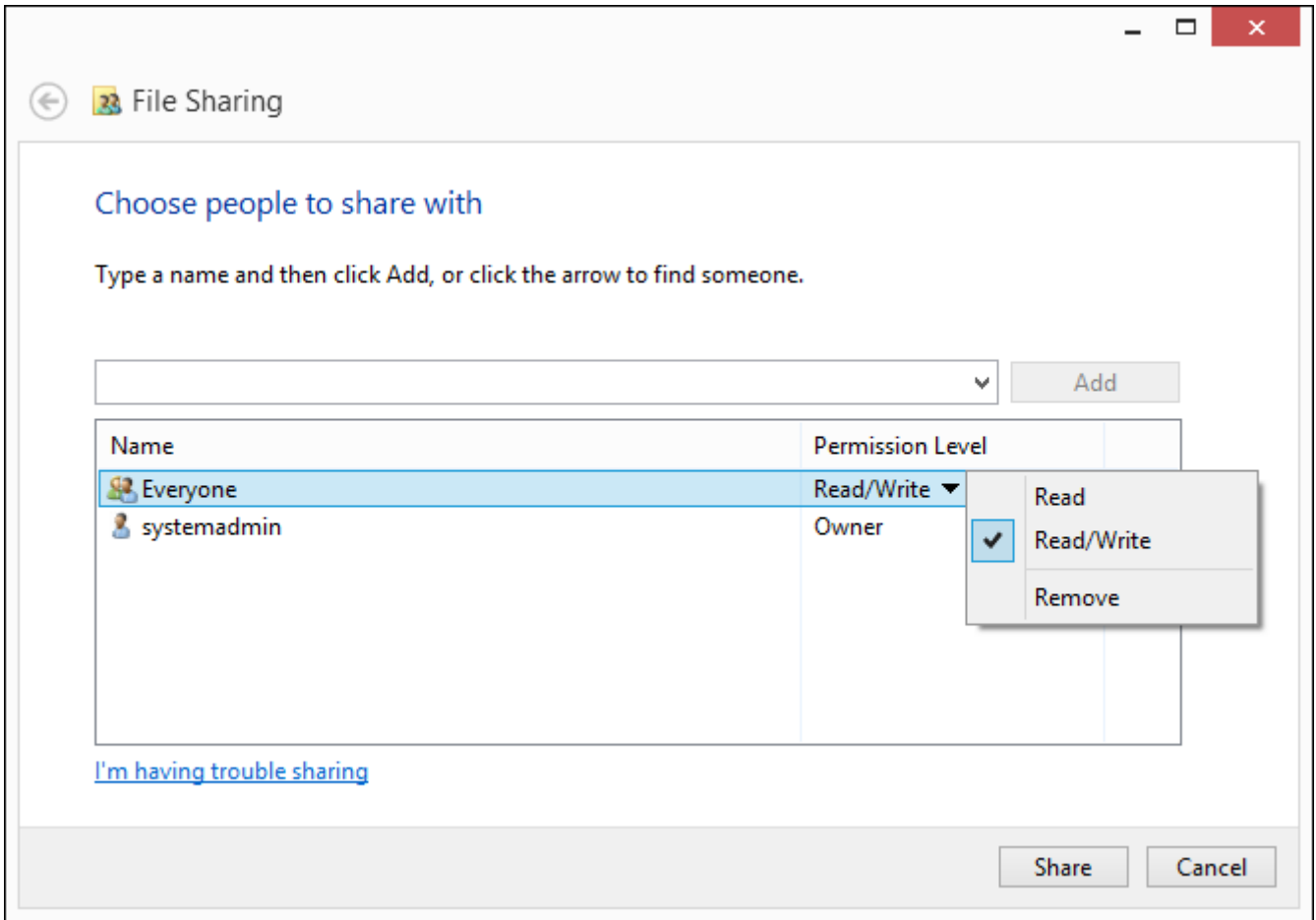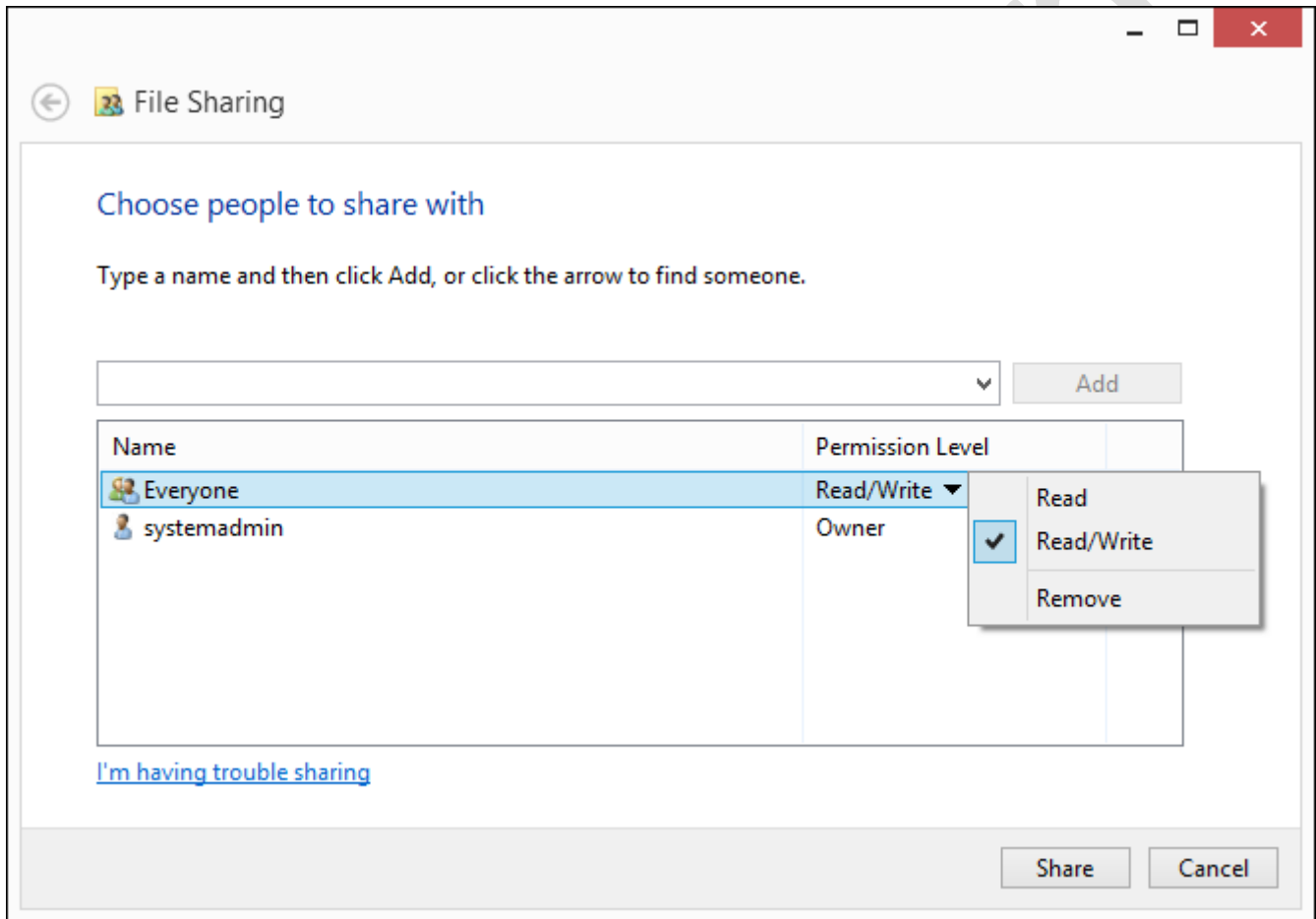

Figure 36: Specifying permissions for the Shared folder

Click the **Share** button. After a short while a confirmation screen will be shown – click **Done**.

Within the *Homes* folder, create individual folders for each user – the names of the folders should correspond **exactly** to the names of the users as created in section 3 USERS.

The question of security needs to be considered. As things stand, any user can access any other user's home folder; in other words, the folders are *personal* but they are not *private*. In a home or very small business setting this might not be an issue, in which case you can skip to the next chapter. But if it is then access to the home folders can be controlled and this is done as follows:

Right-click on a particular user's home folder and choose **Share with** followed by **Specific people**. On the panel that appears click the chevron on the drop-down (as indicated by large arrow in below illustration), select the user's own name and click **Add**. Now that they are included, click on **Permission Level** and change it from 'Read' to 'Read/Write'.

Now click on *Everyone* and change their Permission Level to Remove. Click the **Share** button. After a few seconds there will be a confirmatory message that the folder is now shared – acknowledge it by clicking **Done**. **Repeat** this step for all the users in turn, so that each user is sharing just their own individual folder:
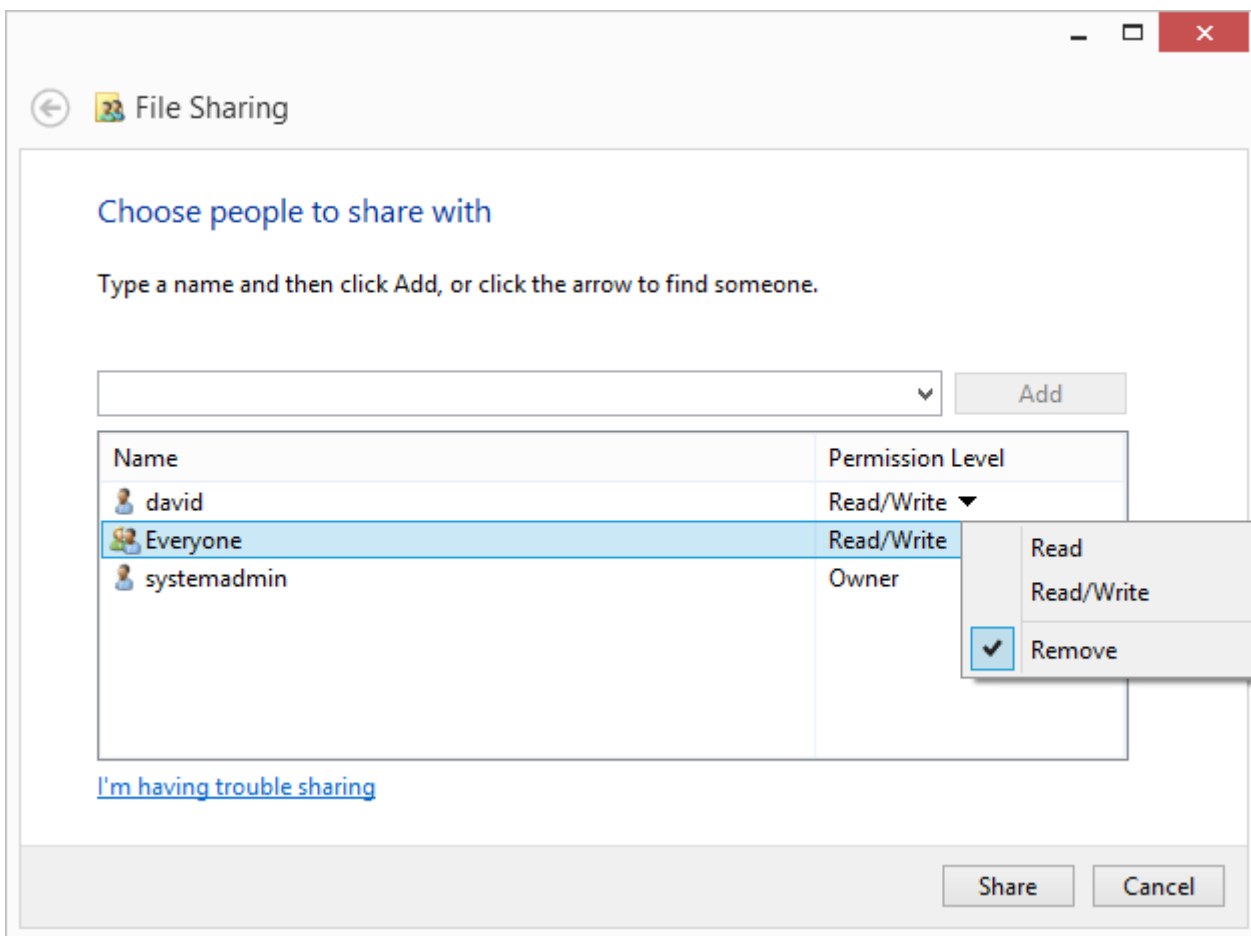
Figure 37: Specifying the permissions

You may have spotted that when you right-clicked on a home folder and chose *Share with*, a list of users was displayed, so why did we not just click on a name rather than choose the *Specific people* option? The reason is that it would have made the share Read only, necessitating an additional step to then change the Permission Level to Read/Write just so that the user could save files in their own home folder!

5 ACCESSING THE SERVER

There are multiple methods for accessing the server and each approach has its own merits:

- Method 1 – Using Windows Explorer/File Explorer
- Method 2 – Accessing a shared folder using the Run command
- Method 3 – Mapping drives manually
- Method 4 – Using a batch file
- Method 5 – Connecting a Mac

For accessing the server using a portable device such as a tablet, see section 8 USING IPADS AND OTHER PORTABLE DEVICES.

5.1 From Windows Explorer/File Explorer

The simplest way to access the server from another computer is by going into Windows Explorer (called File Explorer in Windows 8, 8.1 and 10). Expand the left-hand panel to view the Network and down the left-hand side the server should be visible. Click on it and the list of shared folders will be displayed. Note: you may be prompted to enter a valid user name and password as previously defined on the server (if you wish, tick the option box to remember the login details, although you should only do this if you are the sole user of the computer) Although many shared folders may be visible, you can only access the ones to which you have privileges. Also note that this screen will vary cosmetically depending on which version on Windows you are using:
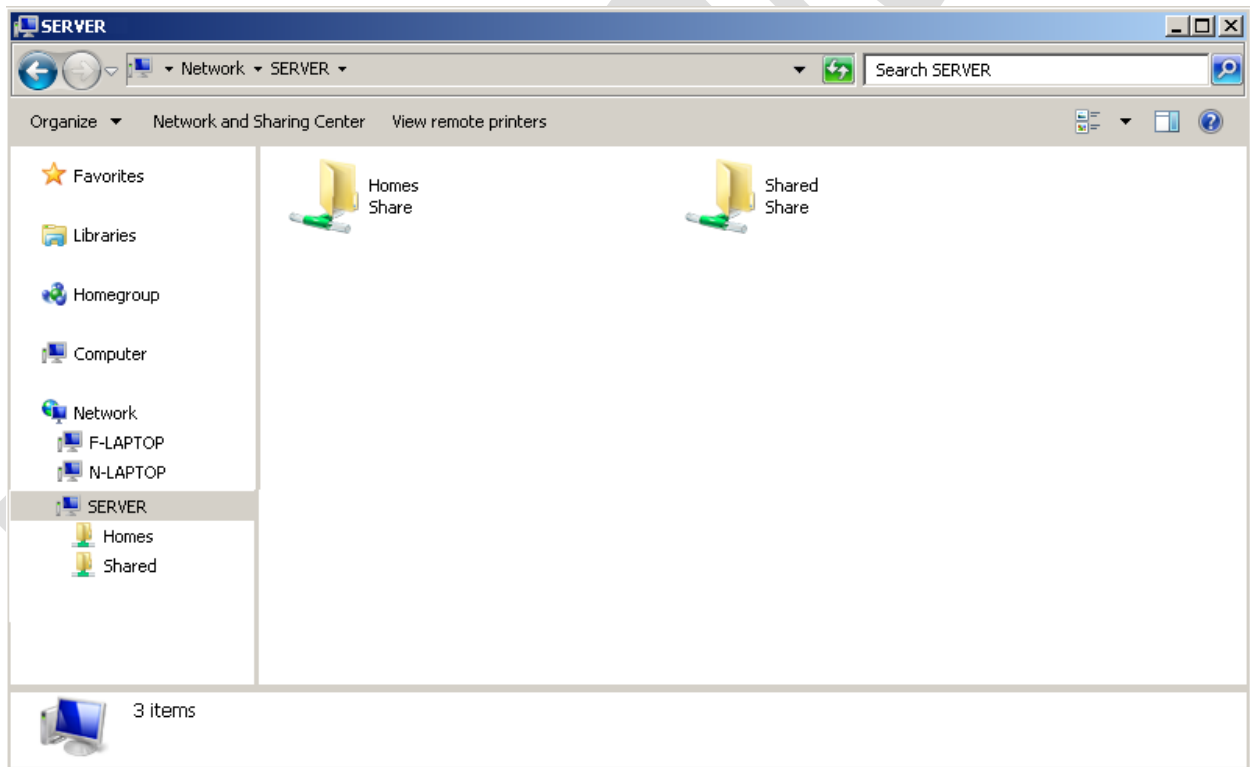
Figure 38: List of folders from Windows Explorer

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5.2 Accessing a Shared Folder Using the Run Command

To access a shared folder from a Windows PC click **Start** then choose **Run** (in the case of Windows 8.1 right-click the **Start** button then choose **Run**). Alternatively, hold down the **Windows key** and press the letter **R**. In the small dialog box that appears, type in the name of the shared folder e.g. *server**shared* and click **OK**.
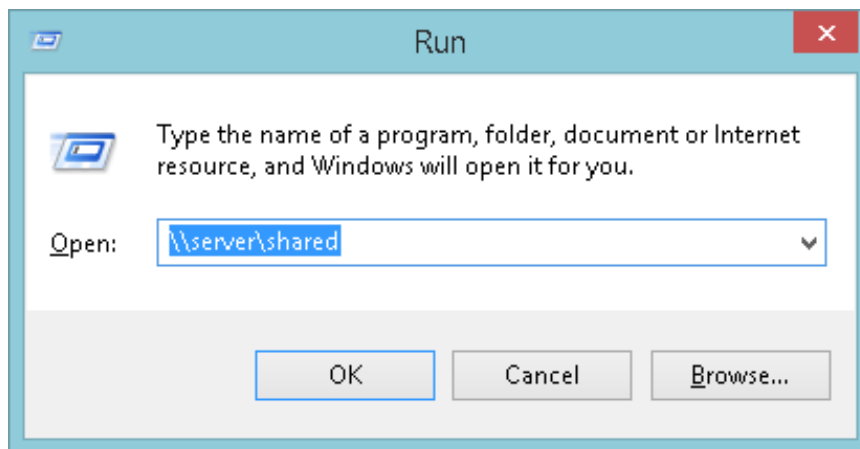
Figure 39: Accessing a shared folder

The contents of the folder will be displayed in Windows Explorer, from where the files can be accessed and used in the standard way:
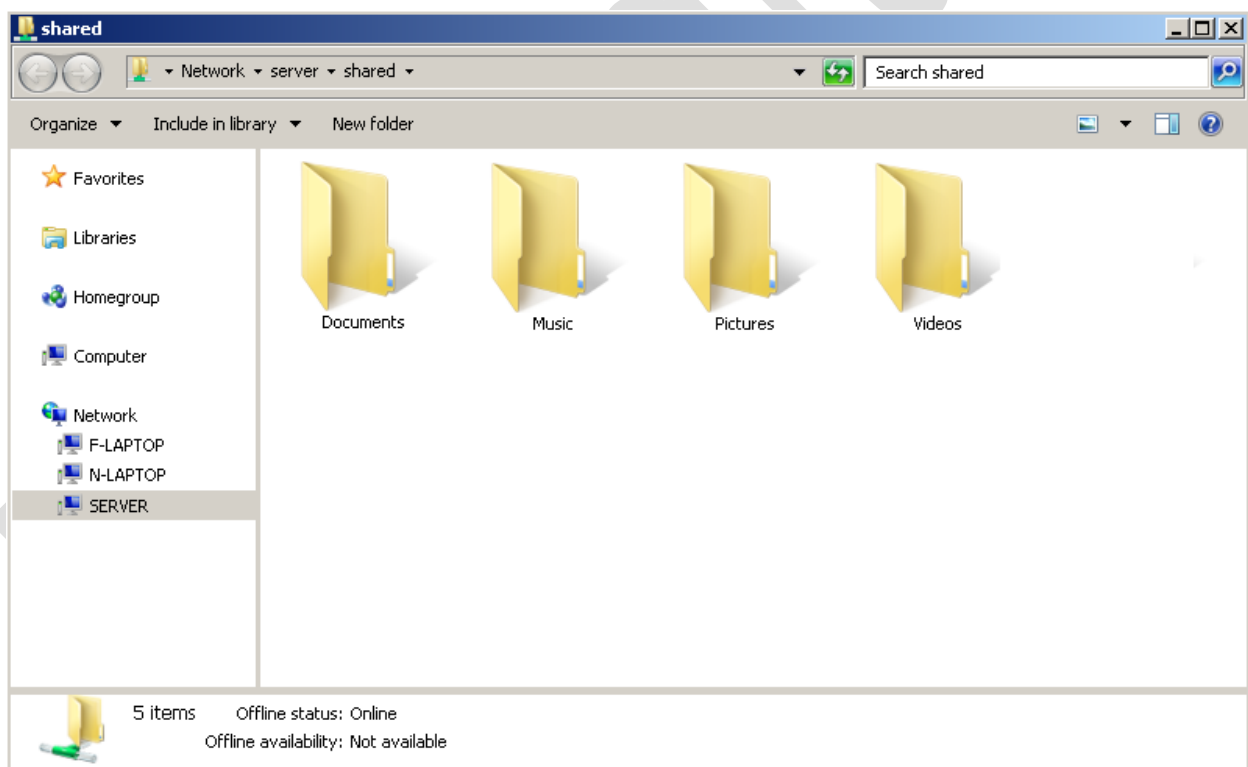
Figure 40: List of shared folders

5.3 Mapping Drives Manually

The techniques considered so far provide access to shared folders by referring to them using what are called UNC or *Universal Naming Convention* names e.g. *server**shared*. However, many people are accustomed to and prefer to use drive letters such as C:, D: and so on. The process by which a UNC name can be turned into a drive letter is known as *mapping* and there are several ways to go about, discussed in the following sections.

Network drives can be mapped manually using Windows Explorer/File Explorer:

- If using Windows 10 open File Explorer, which usually appears on the Taskbar by default (you can also click the **Start** button and launch it from there). Click on the shared folder to highlight it. On the menu bar click **Home** followed by the **Easy Access** icon and then **Map as drive**.
- If using Windows 8 or Windows 8.1, open File Explorer, which usually appears on the Taskbar by default (in Windows 8.1 you can also right-click the Start button and launch it from there). On the menu bar click **This PC** then click the **Map network drive icon** on the ribbon, followed by **Map network drive** on the dropdown.
- If using Windows 7, open Windows Explorer, which usually appears on the Taskbar by default, else click **My Computer** on the **Start** menu. If the menu bar is not displayed, click **Organize** > **Layout** > **Menu bar** to display it. From the Menu bar choose **Tools** > **Map Network Drive**.
- If using Windows Vista, run Windows Explorer by clicking **Start** > **All Programs** > **Accessories** > **Windows Explorer**, else click **Computer** on the **Start** menu. If the menu bar is not displayed, click **Organize** > **Layout** > **Menu bar** to display it. From the Menu bar choose **Tools** > **Map Network Drive**.
- If using Windows XP, run Windows Explorer by clicking **Start** > **All Programs** > **Accessories** > **Windows Explorer**, else click **My Computer** on the **Start** menu. From the menu bar choose **Tools** > **Map Network Drive**.

On the resultant panel choose a drive letter from the drop-down. For the Folder, click on the **Browse** button and navigate through the network to find the server and the desired folder. Or, simpler still, just type in the name of the folder:
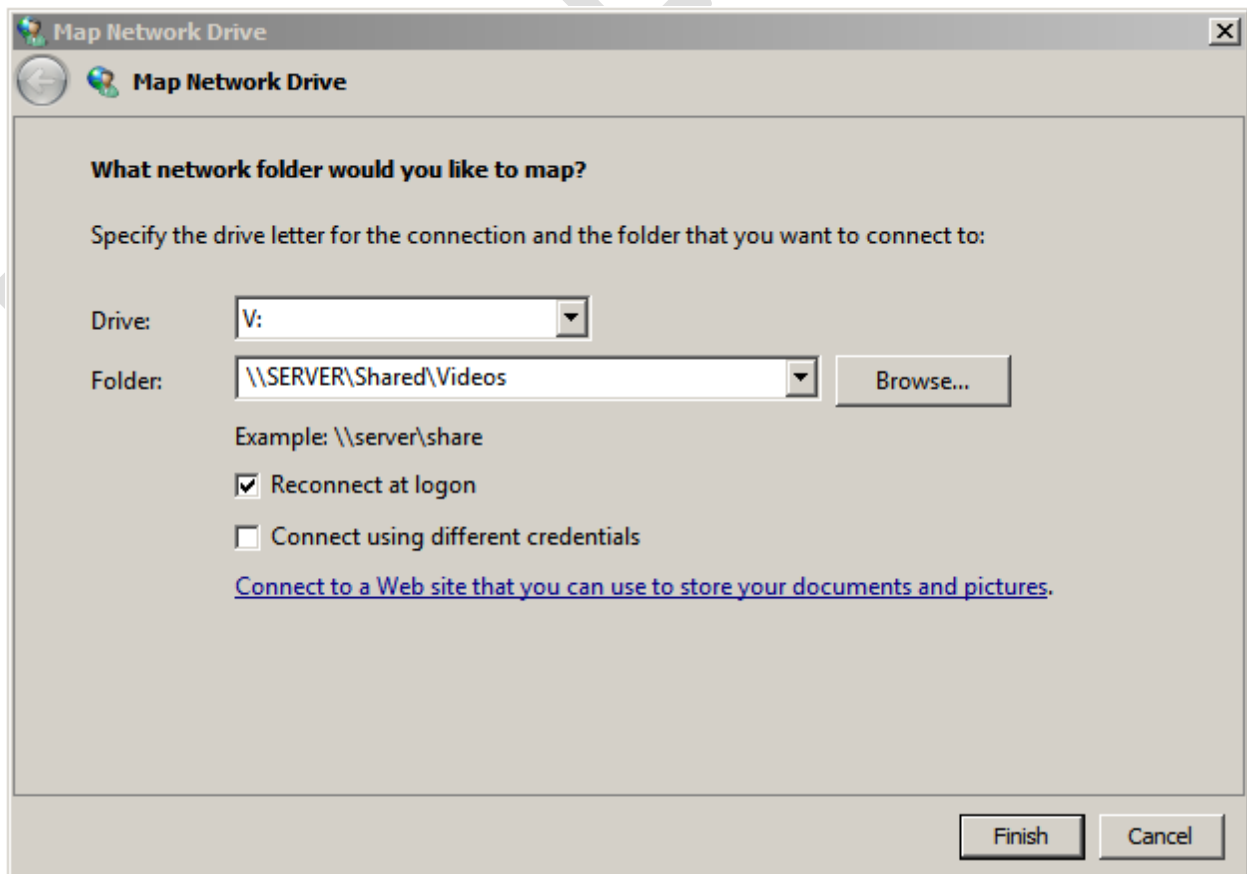
If the computer is only ever used by one person tick the **Reconnect at sign-in** box – this will cause Windows to remember the mapping. Then click **Finish**. You may be prompted to enter the user's name and password that were defined earlier. If the computer is used just by one person tick the **Remember my credentials** box. Then click **OK**.
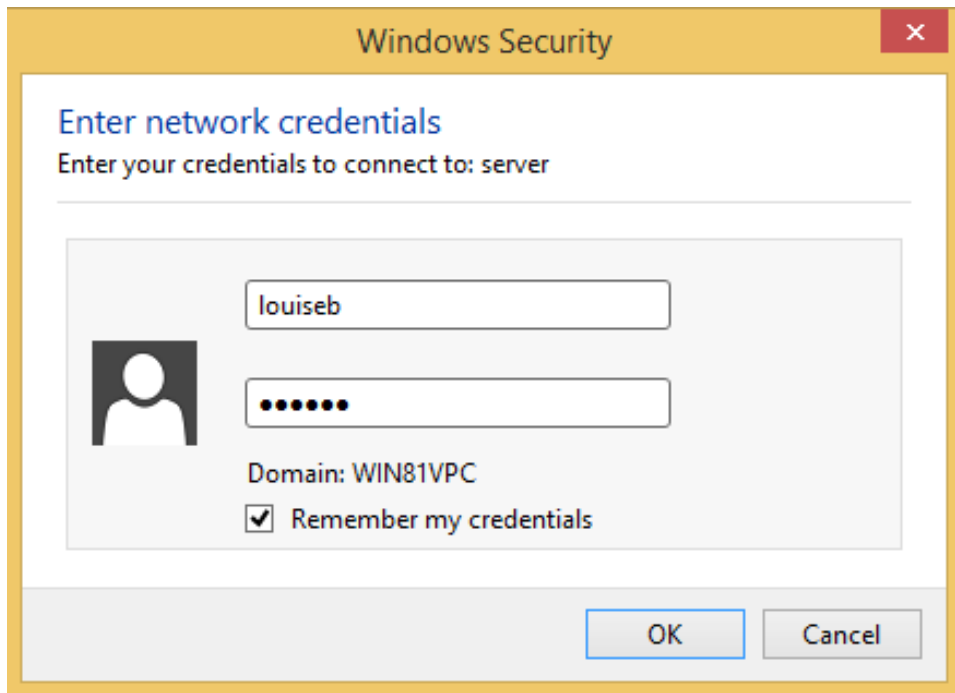
Figure 42: Entering network credentials

Upon a successful connection, the contents of the newly mapped drive will be displayed. The process now needs to be repeated for each folder that the user needs access to. In the case of the home folder, map to \\server\homes*username*, where *username* is the name of the user e.g. *server\homes\louiseb*

Note that you can use whatever drive letters you wish, as long as they are not already in use (for instance you cannot use C as that is always in use on the local computer). However, using sensible letters makes things easier. For example, map *music* to M, *pictures* to P and *videos* to V. Here are some suggested mappings:

Drive   Folder

H   \\server\homes*username*
M   \\server\shared\music
P   \\server\shared\pictures
S   \\server\shared
V   \\server\shared\videos

5.4 Using a Batch File

Setting up a batch file is a more advanced technique for use on Windows PCs but can be useful when a computer is used by more than one person; as such it is probably of more relevance in a small business environment than in a home system. Start off by using Notepad or WordPad to create a plain text file called *Connect-to-Server*. The contents of the file will vary depending on the folders to be mapped; in this example the four shared folders we created plus the user's personal *home* folders are mapped. Note: this file can also be downloaded from the Windows 8 section of the www.serverinstallationguides.co.uk website.

```
@echo off
ping server -n 1 > nul
if errorlevel 1 goto offline
:online
: remove any drive mappings already present
net use * /delete /y > nul
: prompt for server username and password
set /p sname=Enter Username: %=%
set /p spwd=Enter Password: %=%
: map the drives
net use h: \\server\homes\%sname% %spwd% /persistent:no /USER:%sname%
net use m: \\server\shared\music /persistent:no
net use p: \\server\shared\pictures /persistent:no
net use s: \\server\shared\documents /persistent:no
net use v: \\server\shared\videos /persistent:no
goto end
:offline
cls
echo You are not connected to the network.
echo If you are outside the office then this is expected.
echo If you are inside the office then it means there is a problem.
echo Data stored on the network is not currently available.
pause
:end
```

The file should be placed on the Desktop of the computer. After the computer starts up, the user should run it by double-clicking on its icon. A window is displayed prompting for the user name, followed by a prompt for the password:
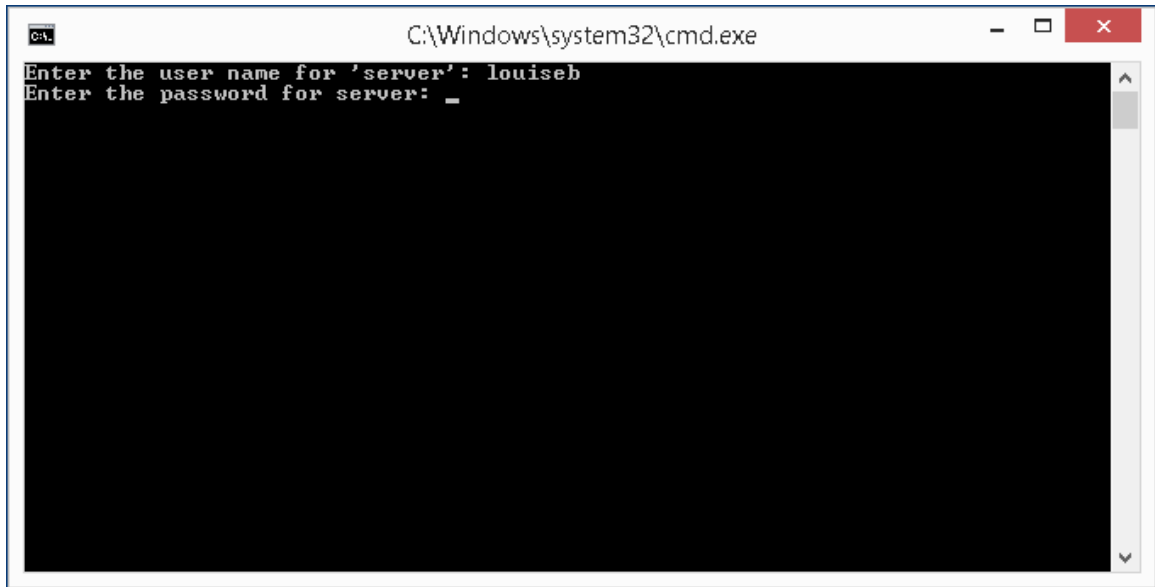
Figure 43: Enter user name and password

After the user has successfully entered their details, the mapped drives will be available until the computer is shutdown or the user logs off. The drive mappings can be viewed by launching Windows Explorer/File Explorer, which appears by default on the Taskbar in Windows 7 and later versions:
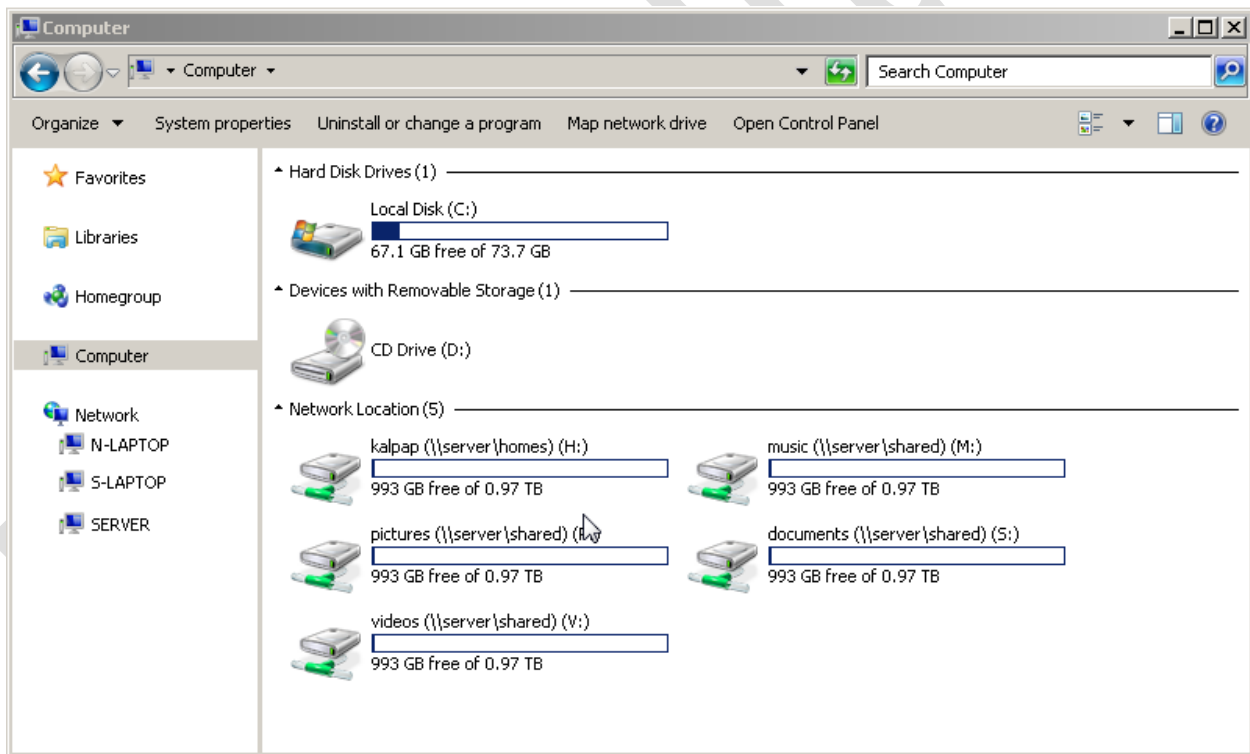
Figure 44: Display of mapped drives

If the server is not available, rather than mapping the drives a warning message is displayed instead:
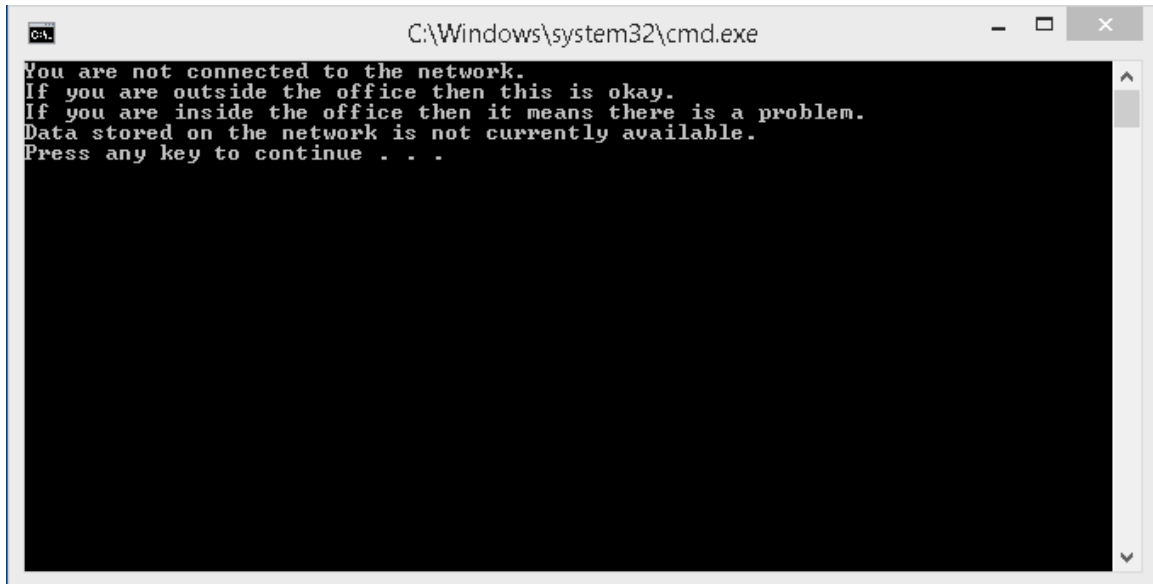
Figure 45: Warning message when not connected

It is to be expected that this message will appear if using, say, a laptop computer outside of an office, but if it appears inside then it indicates a problem. This could be a connectivity issue on the computer e.g. Ethernet cable unplugged or wireless disabled. If everyone is experiencing problems then it would suggest that the server is powered off or otherwise out of action.

When a particular user has finished with a computer, they should logoff or restart the computer.

Ideally, computers should be setup with only one Windows user defined on them. If this is not the case, then the *Connect-to-Server.cmd* file needs to be placed on the Desktop for each individual user. More efficiently, it can be placed in the following location where it will appear on the Desktop for all users:

Windows 10   C:\Users\Public\Public Desktop
Windows 8.1/8   C:\Users\Public\Public Desktop
Windows 7   C:\Users\Public\Public Desktop
Windows Vista   C:\Users\Public\Public Desktop
Windows XP   C:\Documents and Settings\All Users\Desktop

Note that the Public Desktop folder is a hidden folder on Windows 10, 8, 7 and Vista and will therefore first need to be made visible before it can be used. To do this, go to **Control Panel** on the computer and choose **Folder Options**. Click on the **View** tab, enable **Show hidden files, folders and drives** and click **OK**:
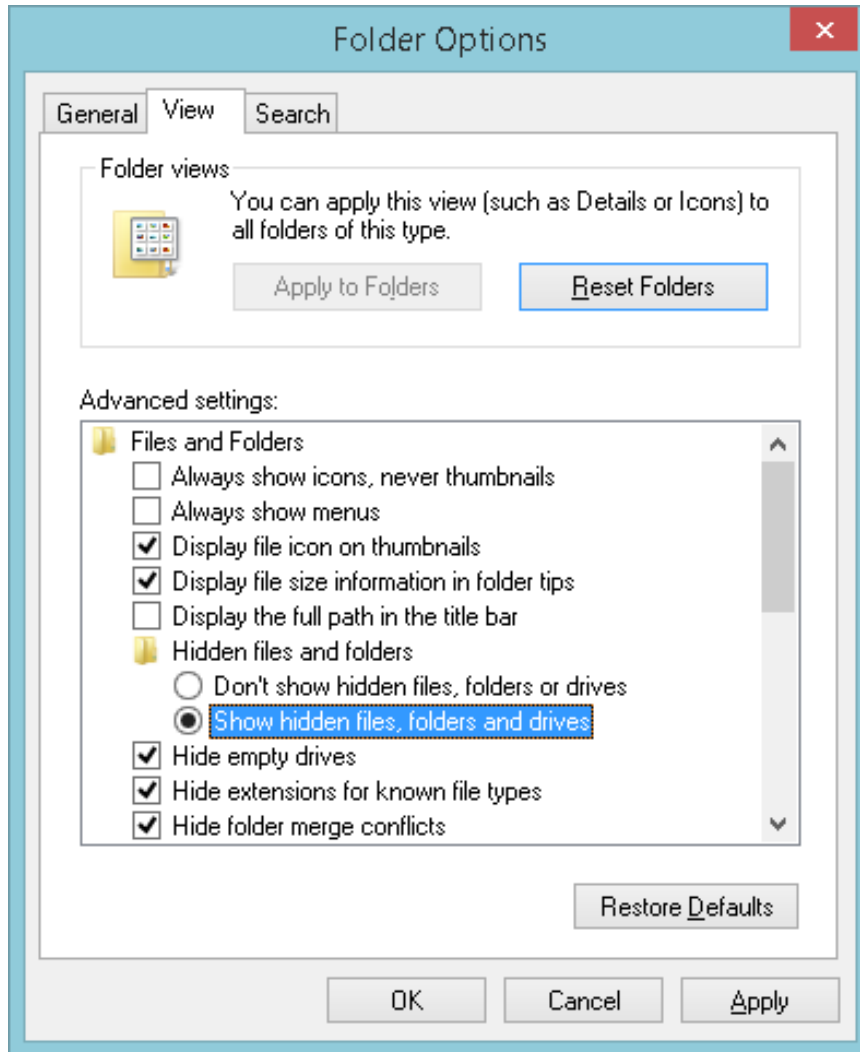
Figure 46: Folder options to view hidden files

Copy the *Connect-to-Server.cmd* file to the Public Desktop folder, then make the Public Desktop folder hidden again.

Unfortunately, *Connect-to-Server.cmd* is not very tolerant of errors. If the user enters the wrong logon details there will be a brief error message and the drives will fail to map. The user will need to run the file and try again.

5.5 Connecting a Mac

There are numerous iterations of the OS X operating system and some subtle differences between them. However, the following technique should work with all versions. If you encounter difficulties, make sure that the default workgroup name – which should be *workgroup* – has not been changed on the Mac (**System Preferences** > **Network**. Highlight the active network connection, click the **Advanced** button followed by **WINS**).

On the menu bar of the Mac, click **Go** followed by **Connect to Server**. Alternatively, press **Command K**. A dialog box is displayed. Enter the name of the Windows 8.1 preceded with smb*://* e.g. *smb://server*. To add the server to your list of Favorites for future reference click the **+** button. Then click **Connect**:
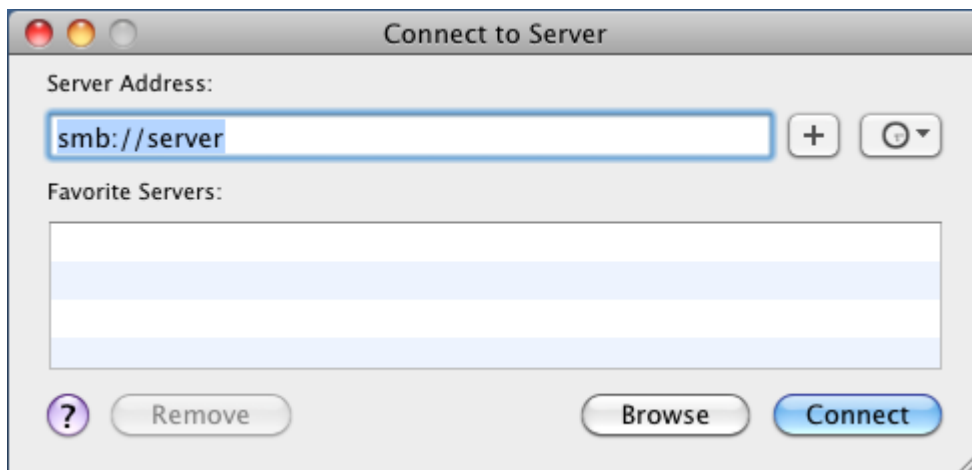
Figure 47: Connect to server

Enter a user name and password as previously defined on the server and click **Connect**. You can also tick the **Remember this password in my keychain** box if desired:
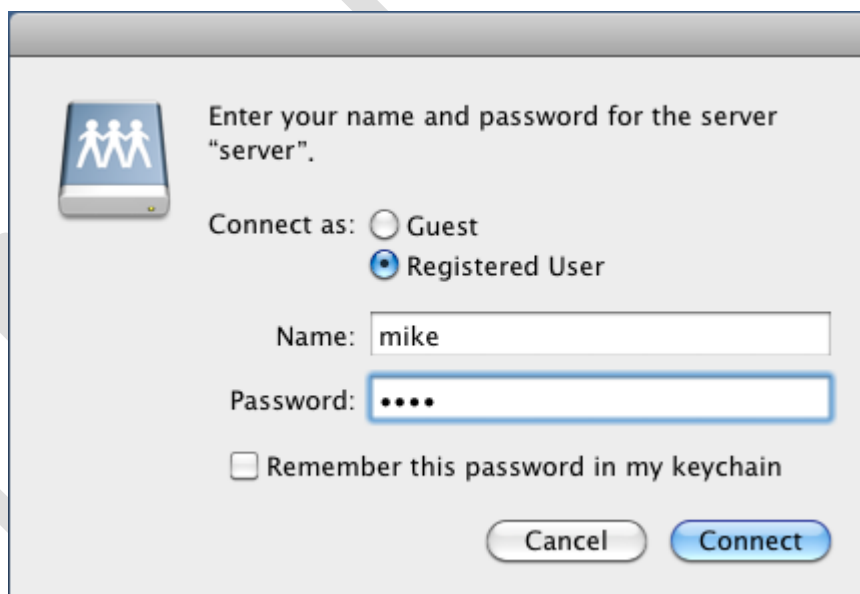
Figure 48: Enter the user name and password

A list of shared folders is displayed, referred to as *volumes* in Apple parlance. Choose the volume to mount and click **OK.** Note: to mount multiple volumes in one go, hold down the **Command key** and click on the required folders in turn:
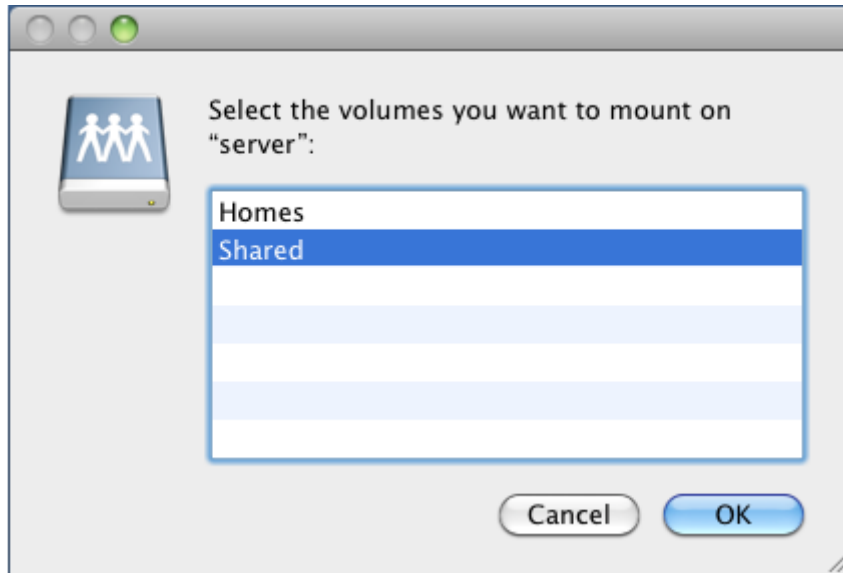
Figure 49: Select the volume(s) to mount

An icon for the volume will appear on the Desktop - click it to display the contents. It behaves like any standard OS X folder:
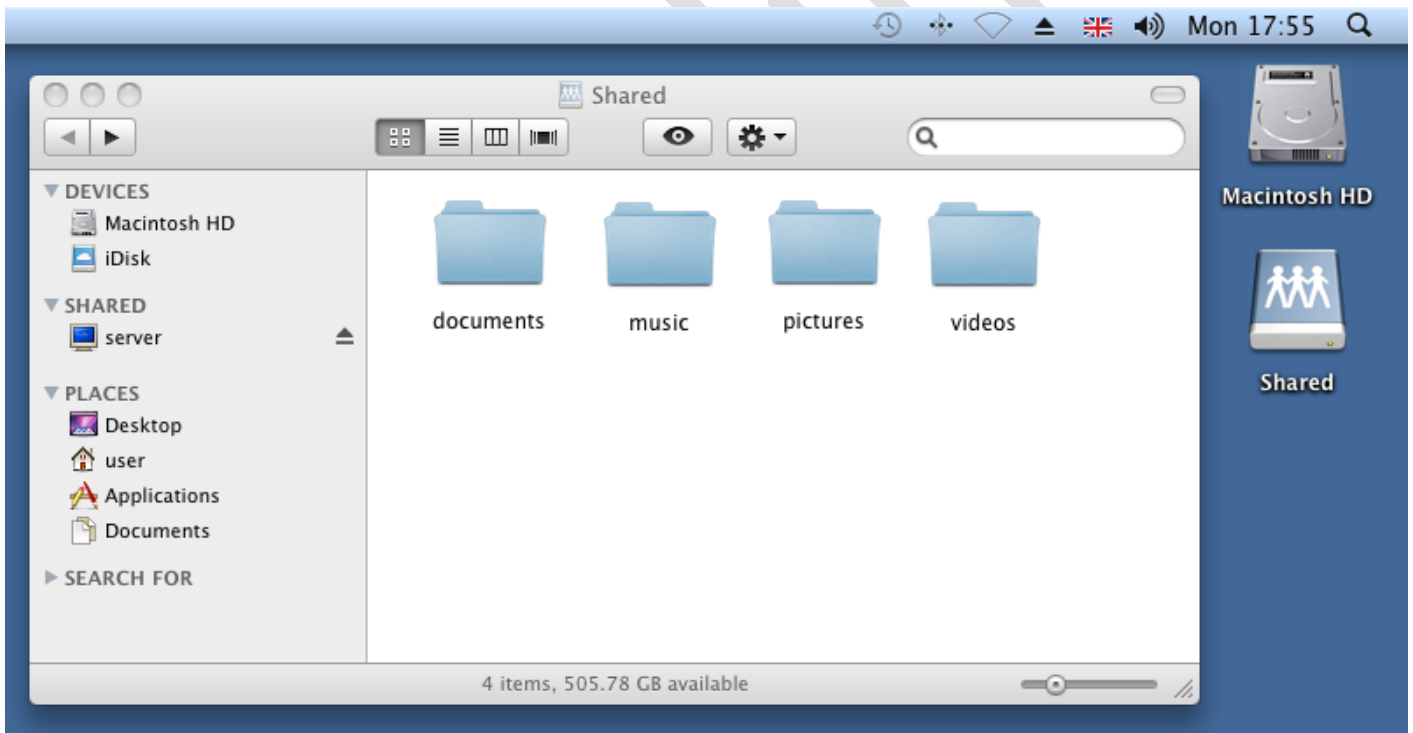
Figure 50: Example of mounted folder

6 MULTIMEDIA & STREAMING

One of the most popular uses of a home network is for the storage and playback of media such as music, videos and photos, which are held in a centralized library on the server. CDs and DVDs can be "ripped" into formats such as MP3 and MP4 and these copies played back or *streamed* from the server, thus protecting the originals against wear and tear. They can then be accessed from other devices in the household including computers, gaming consoles, tablets, smartphones and streaming TV devices.

6.1 Setup Streaming

It is fair to say that getting streaming working is possibly more complicated than it needs to be and a number of steps are required.

The first thing to do is copy your music, photos and videos onto the server. Music should be in MP3 format; most online services do or can provide it in this format, whereas Windows Media Player or iTunes can be used to convert existing audio CDs into MP3. Copy the music to the *shared\music* folder on the server. Video DVDs can be converted using tools such as *DVDFab* or *Handbrake*; generally speaking, keep things as simple as possible (e.g. MP4 with stereo sound) for best results. The resultant rips should be copies to the *shared\videos* folder. Note that the unauthorized copying of commercial CDs and DVDs is prohibited in most countries.

Photographs and pictures should be copied to *shared\pictures*. These are usually in JPG/JPEG format, which is fine.

Next, launch Windows Media Player. This can be found on the Windows 8.1 Start Screen – click on the downward-pointing arrow to view all applications and it will be listed in the Windows Accessories section. On the menu within Windows Media Player, click **Stream** followed by **Turn on media streaming**. A panel from the Network and Sharing Center section within Control Panel will be displayed – click the **Turn on media streaming** button. The following panel is displayed; the defaults are all fine, but you may wish to give the media library a different name (it will be *systemadmin* – below we have changed it to *homemedia*). Click **OK**:
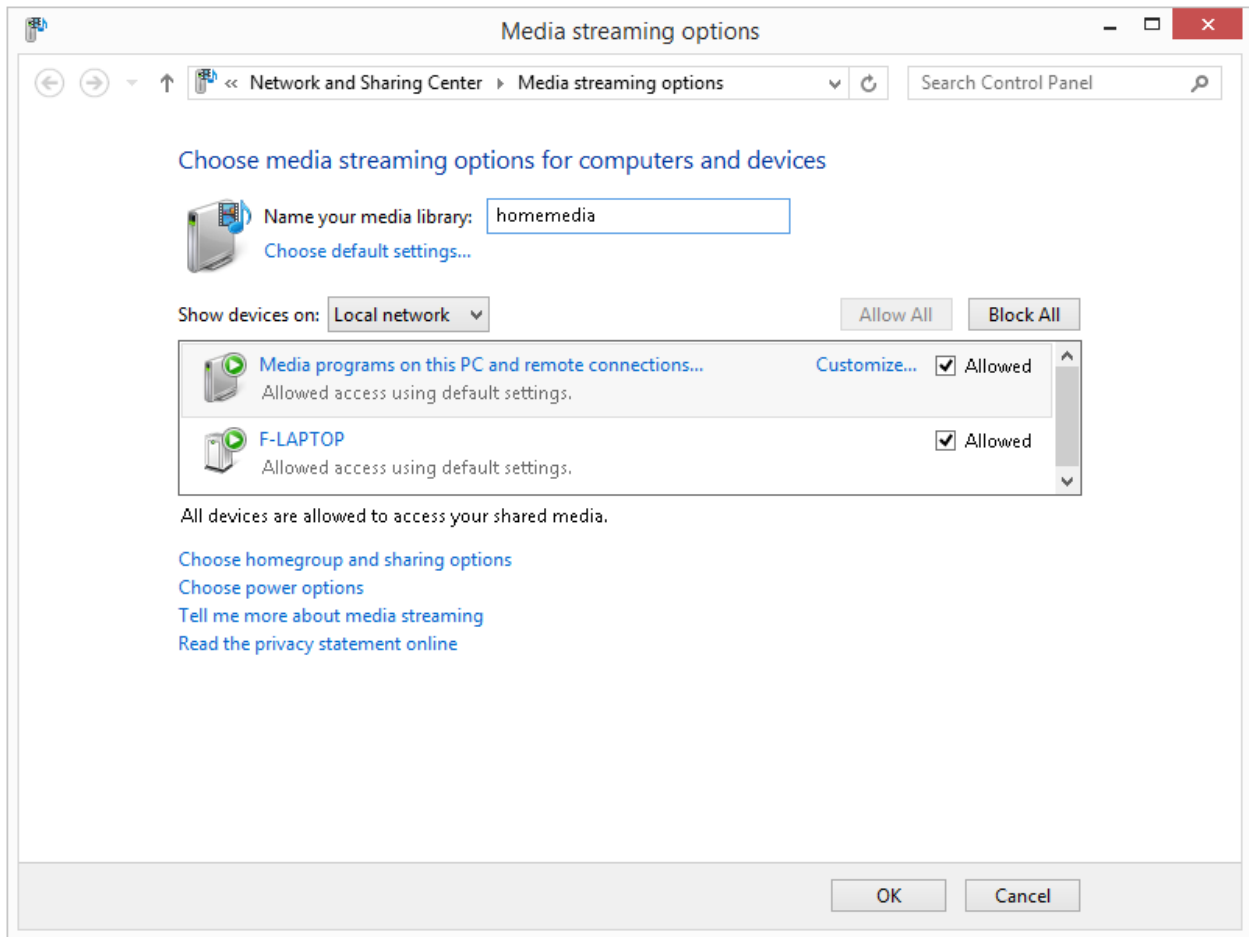
Figure 51: Configuring media streaming options

Windows Media Player expects to find files in certain pre-defined locations. These locations make sense on a personal system, but not necessarily on a networked one so we need to make some changes. Within Windows Media Player, right-click on the entry for Music and choose **Manage Music library**. Click the **Add** button. Navigate to the *shared* folder, highlight the *music* sub-folder and click **Include folder**.
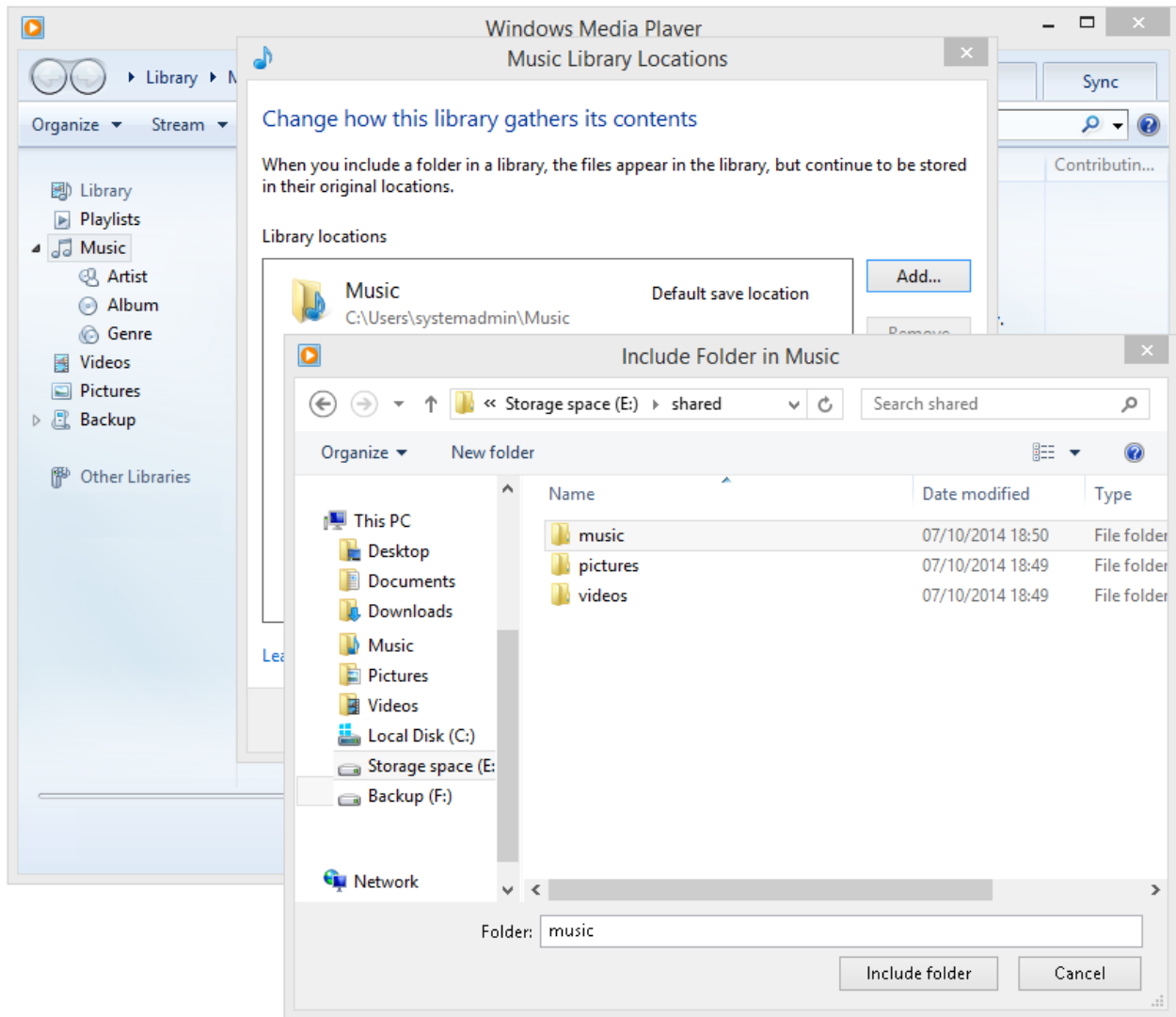
Figure 52: Specify location of the shared music folder

This procedure should now be repeated for videos by adding *shared\videos* to it and for pictures by adding *shared\pictures* to it.

6.2 Playback Media on Other Devices

It should now be possible to playback the shared media from other devices on the network. For instance, go to a computer and launch Windows Media Player on it. On the left-hand side of the screen, under 'Other Libraries', the server should now be visible. Click on a section i.e. Music, Videos or Pictures, to view what is available on the server. Double-click on a file to view/play/listen as appropriate:
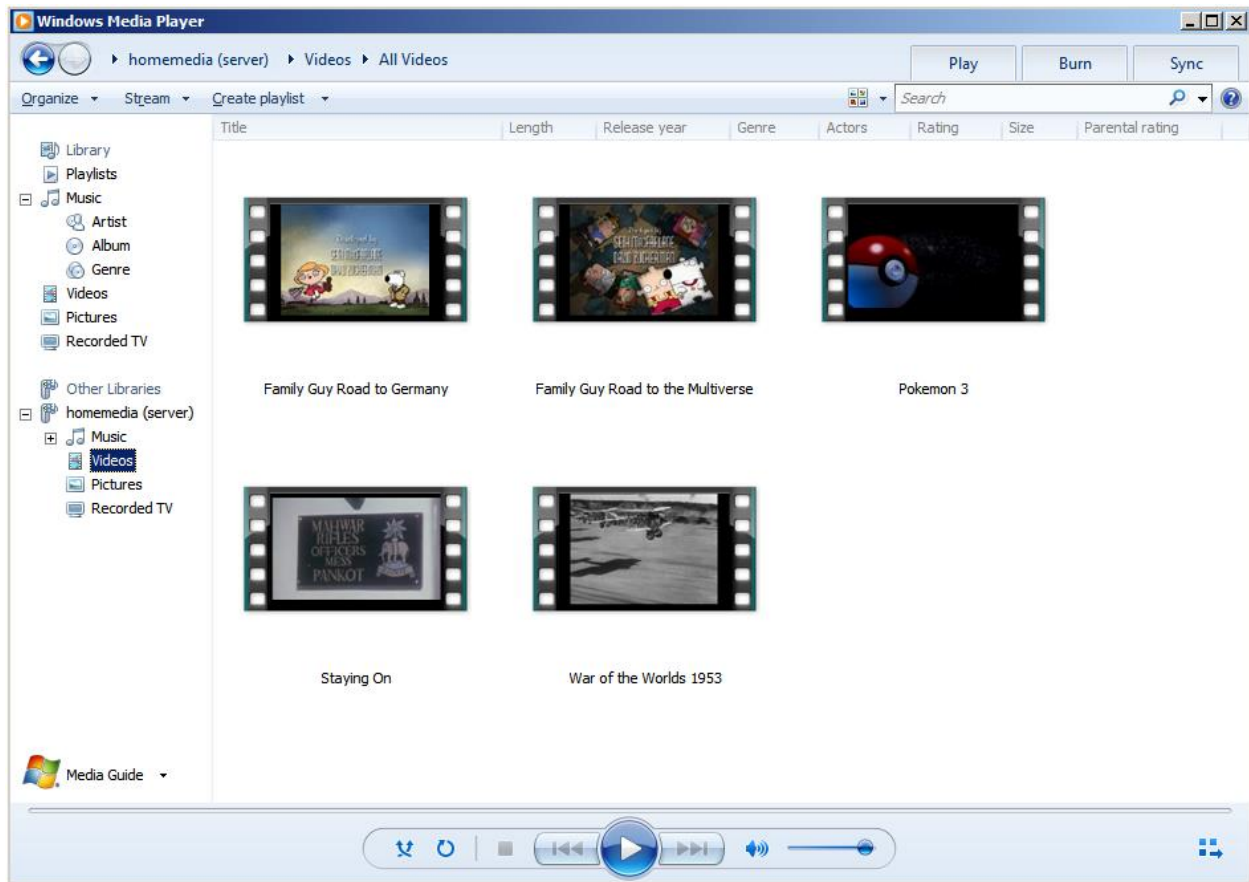
Figure 53: Accessing shared media

As the media server in Windows 8.1 is DLNA-compliant – a sort of universal standard for such things – it is usually possible to access the server from other DLNA-compliant devices including Smart televisions and set-top boxes, Blu Ray players, mobile phones and more. Also, DLNA clients are available for the Apple iPhone and iPad from the App store. Note that Microsoft do not actually use the term DLNA in any of their software, using instead the term *Plug'n'Play*.

7 USING CLOUD STORAGE SERVICES

Windows 8 has some rudimentary features to enable remote access and working, plus it is also possible to obtain third party products that can improve on them. However, a simple and popular method to provide remote access to data is by using a Cloud-based file sync service. These services can provide remote access to data in a simpler method with less effort and on a wider range of devices, plus provide controlled access to selected files for third parties via emailed links. They can also or alternatively be used as a way of backing up data from the server, providing offsite storage to complement the internal backup. Examples of popular file sync services include Dropbox and Google Drive.

There are five main considerations when using a cloud file sync service with a Windows 8-based server:

1. A single account has to be used for everyone.
2. The account should have sufficient space. Some services only have a small amount of free space, for instance Dropbox only gives 2GB (plus any additional space gained through referrals). This is unlikely to be enough in a business environment so it may be necessary to consider a paid account.
3. Whether it will be used for additional backups or as a means of providing remote access to data when out of the office.
4. Who has access to it (if used for backups only, then only the server administrator needs access).
5. Who will be responsible for managing it (usually the person who administers the server).

7.1 Dropbox

Dropbox is a hugely popular service that works very well – client programs are available for PCs, Macs, iOS, Android tablets and phones and more.

Begin by installing the Dropbox client on the server. This is best done by downloading it directly from the Dropbox home page. Immediately after installation, click the **Advanced Settings** option as this allows you to specify the location of the Dropbox folder. For the location, choose the *Shared* folder that we created in section 4 SHARED FOLDERS:
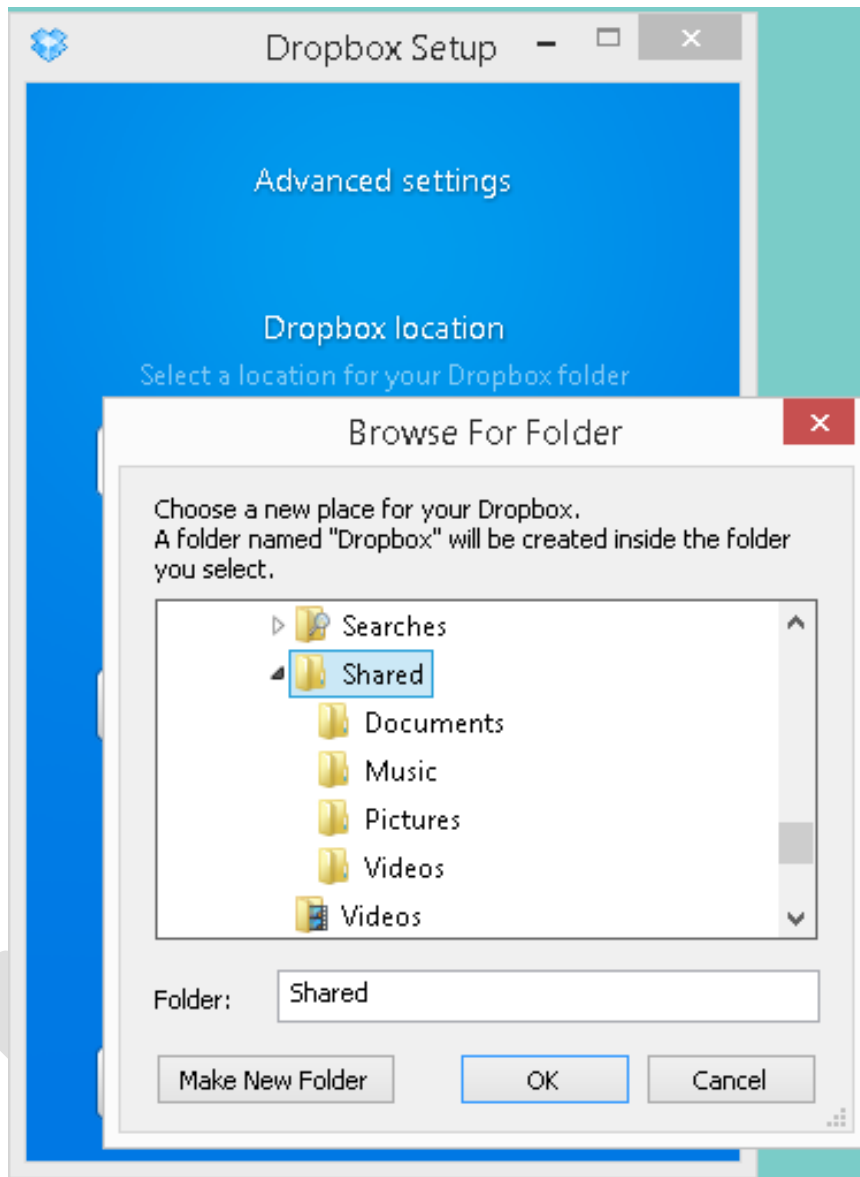
Figure 54: Dropbox folder location on server

To gain access, users should now install the Dropbox client on the devices they use outside of the office, downloadable from *www.dropbox.com* or from the Apple and Android app stores. To do so, they will need to know the common Dropbox account (login and password) details. At the time of writing, Dropbox is available for: Windows, Mac OS X, iPad & iPhone, Android, Windows Phone, Blackberry and selected Linux distributions.

One thing to consider is what happens when people leave the organization, as if they have Dropbox installed on a home computer or phone or tablet they will continue to have access to whatever is stored on the server's Dropbox folder. In such circumstances it will be necessary for the administrator to change the password of the Dropbox account and advise remaining staff of the new password.

7.2 Google Drive

Google Drive provides 15GB free storage; optional paid plans are available to increase this amount. Begin by going to the Google website and downloading and installing the Google Drive client on the server. When you reach Step 4 pause and click on the **Advanced setup** button:
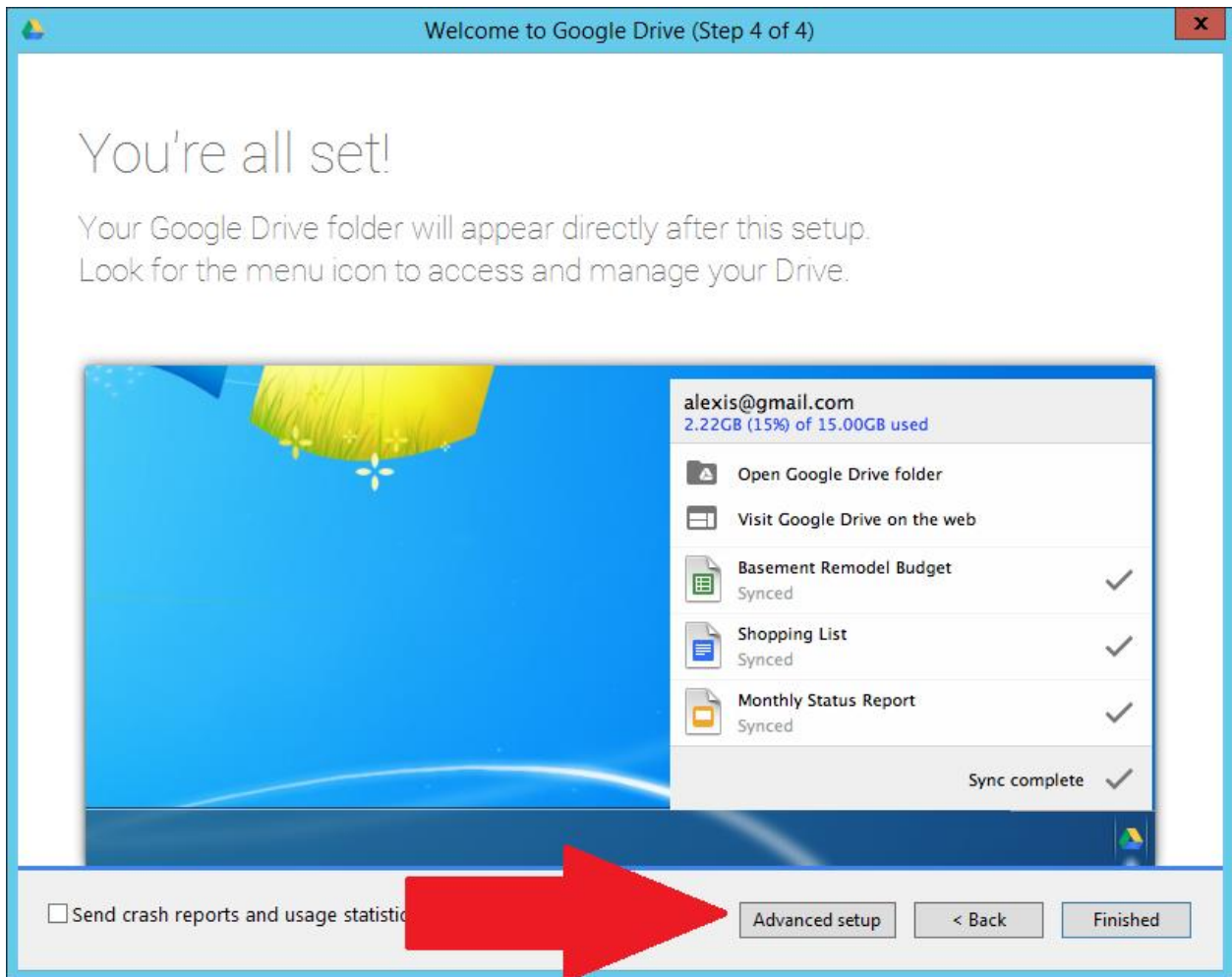
Figure 55: Installing Google Drive

This will display a panel where you can specify the location for Google Drive, which is necessary as the default location is unsuitable for our purposes. Click the **Change** button and navigate to the *Shared* folder that we created in section 4 SHARED FOLDERS. Click **Make new folder** and create one called *Google Drive* within the *Shared* folder (it does not actually need to be called *Google Drive* but it is as good a name as any). Then click **OK** and **Start Sync**:
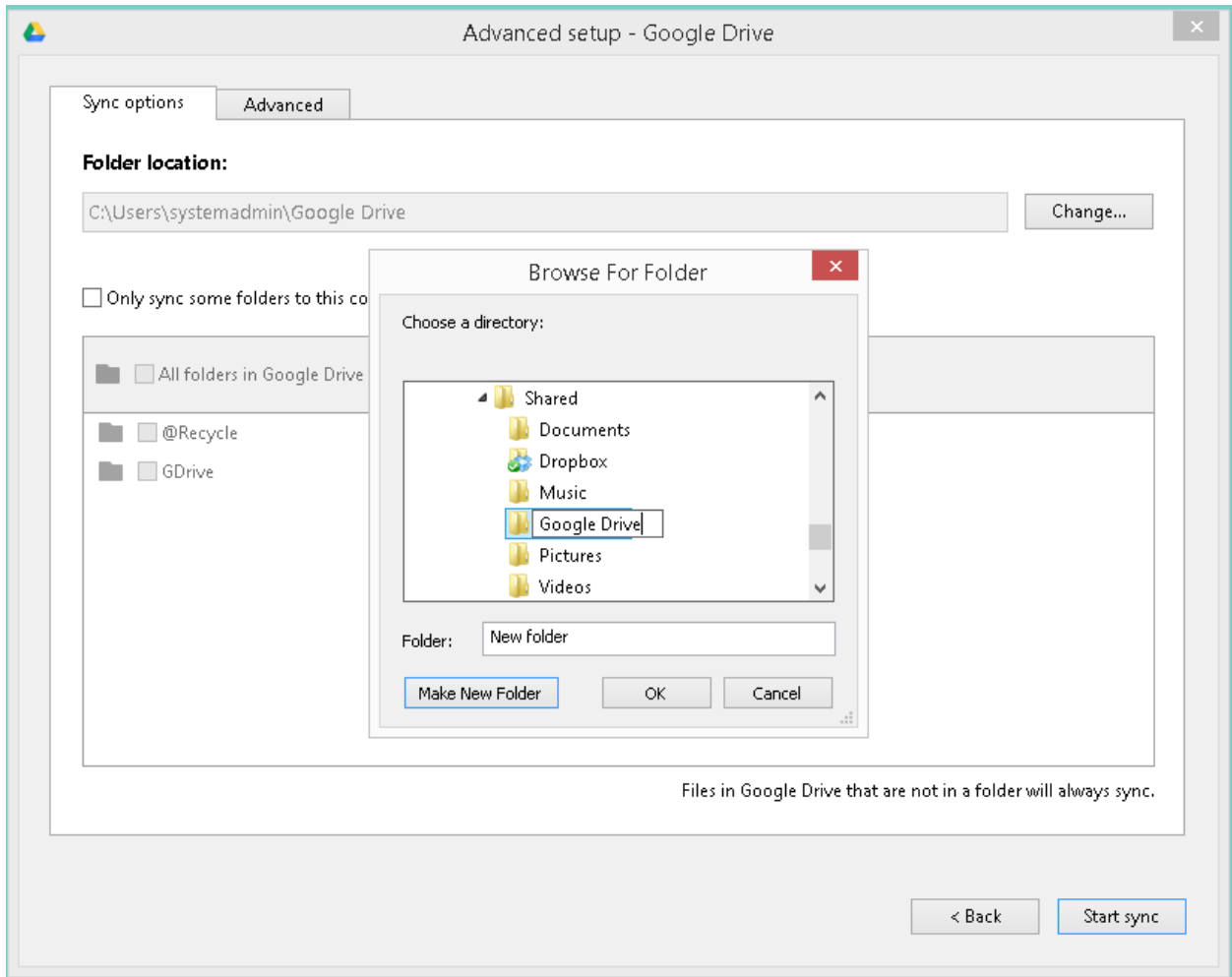
Figure 56: Specifying a folder for Google Drive

To gain access, the permitted users should now install the Google Drive client on the devices they use outside of the office, downloadable from Google or the Apple and Android app stores. To do so, they will need to know the common Google account (login and password) details. At the time of writing, Dropbox is available for: Windows, Mac OS X, iPad & iPhone and Android.

One thing to consider is what happens when people leave the organization, as if they have Google Drive installed on a home computer or phone or tablet they will continue to have access to whatever is stored on the server's Google Drive folder. In such circumstances it will be necessary for the administrator to change the password of the Google account and advise remaining staff of the new password.

7.3 Box

Box offers 10GB of free space with personal accounts, with paid subscriptions available for larger amounts of storage. The Box Sync client is available for many platforms including Windows, Mac OS X, iOS, Android, BlackBerry and Windows Phone.

Begin by downloading and installing the Box Sync client for Windows. When it runs for the first time, click where it reads **Customize Folder Settings** at the bottom of the Welcome screen:
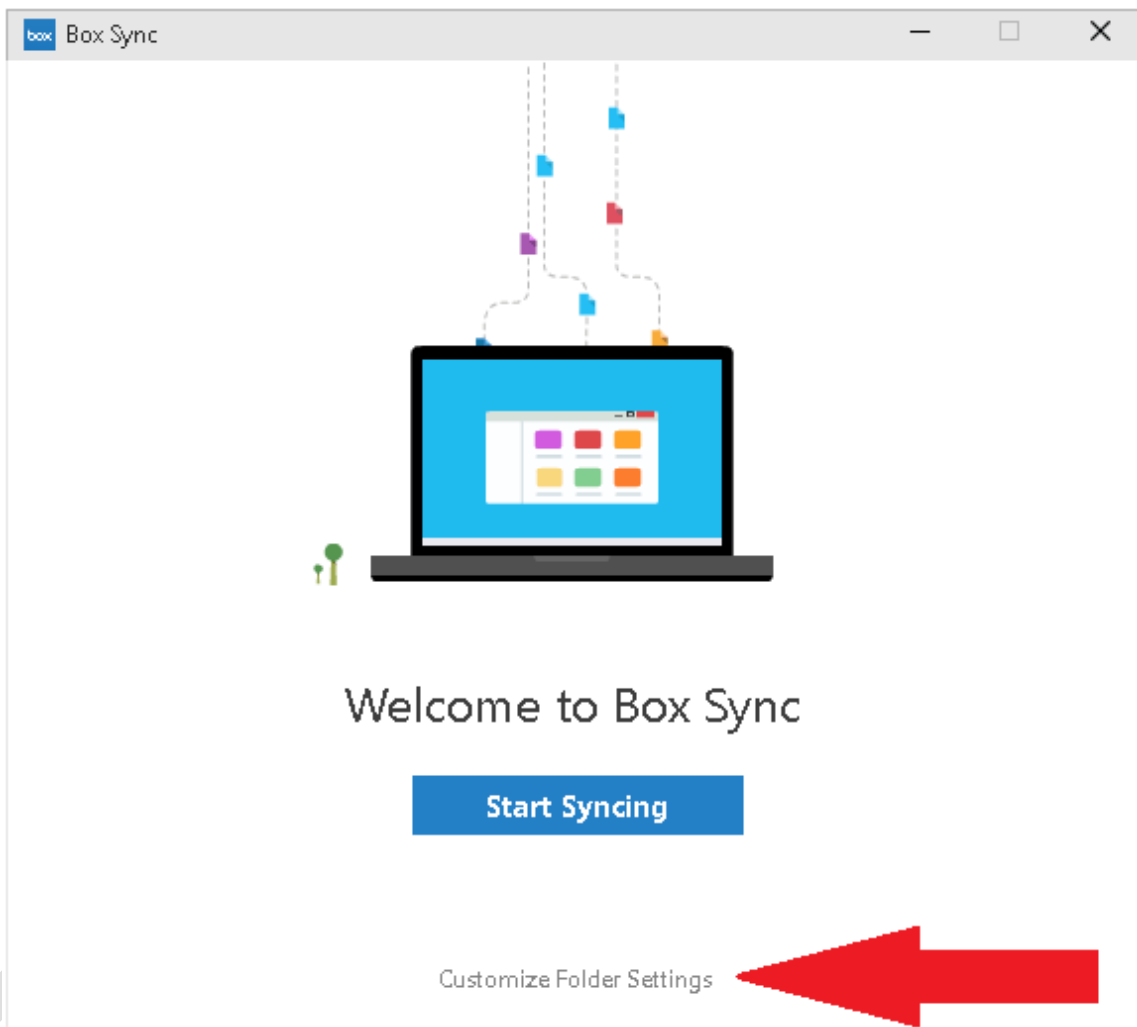
Figure 57: Box Sync Welcome screen

On the screen that appears click the **Change** button. Navigate through the resultant panel and choose the Shared folder (in this particular example it is located on the Storage Space E: drive) and click **OK** – this will cause the Box Sync folder to be created where all users can easily access it. Click **Done** and you will be returned to the initial Welcome screen, where you should click the blue **Start Syncing** button.
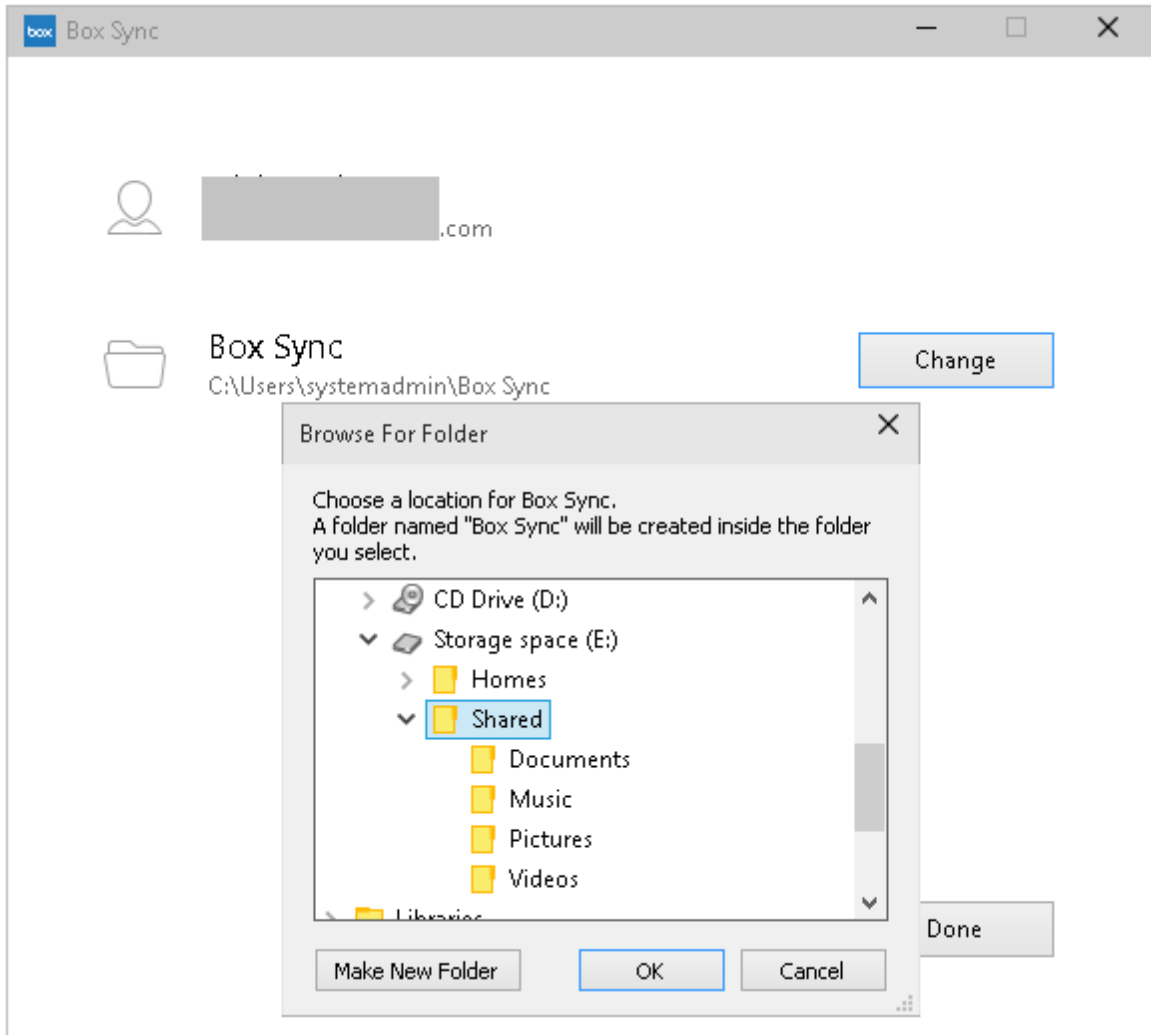
Figure 58: Choose location for Box Sync folder

To gain access, the permitted users should now install the Box Sync client on the devices they use outside of the office, downloadable from the Box website or the various app stores. To install they will need to know the common Box account (login and password) details.

One thing to consider is what happens when people leave the organization, as if they have Box Sync installed on a home computer or phone or tablet they will continue to have access to whatever is stored on the server's Box folder. In such circumstances it will be necessary for the administrator to change the password of the Box account and advise remaining staff of the new password.

7.4 Comments about OneDrive and iCloud

OneDrive is Microsoft's own file sync service. The OneDrive client is built-in to Windows 8.1 and, on the face of it, would seem to be an ideal choice; however, the tight integration between OneDrive and Windows 8.1 can also be considered a disadvantage. The reason for this is that OneDrive requires a Microsoft ID, which also becomes the main user login name for the computer. When we installed Windows 8.1 we specifically chose to use a local ID (*systemadmin*) - if a Microsoft ID is used it will be necessary to always run the server logged using it. Additionally, it will be necessary to provide these login details for the server to the users. In a household this may or not be an issue, but it is not recommended in a business environment due to the risk of the server being compromised. For this reason, the use of OneDrive in this scenario is not recommended.

iCloud is Apple's file sync service. Many people, even if ardent Windows users, will have an iPad or iPhone and hence an Apple ID and iCloud access and may be interested in using their space on the server. Although the Windows client

works on Windows 8.1, it is difficult to relocate the iCloud folder from its default location to somewhere more suitable i.e. the shared folder. For this reason it is suggested that iCloud is not used.

8 USING IPADS AND OTHER PORTABLE DEVICES

Most portable devices such as iPads, iPhones and Android tablets and cell phones are not able to directly connect to networks in the sense that Windows PCs or Macs can. However, this does not mean that they cannot access data and be used in a productive manner. A variety of apps and techniques are available to both access data and administer the server and some of the main ones are discussed below.

8.1 Accessing the File System with File Browser

For iOS users, *File Browser* from Stratospherix is a good way of accessing folders and files on the server. It is a commercial product obtainable from the App Store, but is inexpensive and well worth buying. It is not specifically designed for accessing Windows computers, rather it is a generic tool for accessing any networked computer. To use, enter the name of the server (i.e. "*server*" in our case) along with a valid user name and password; the user can then see any of the folders to which they have been granted access (for example, the *shared* folder). To access their home folder, double-click the *Homes* folder then double-click the folder that has the same name as their own user name. Note that they can see the names of other people's home folders, but will not be able to access them because of security restrictions. Files can be viewed, but not edited, and many media types played.
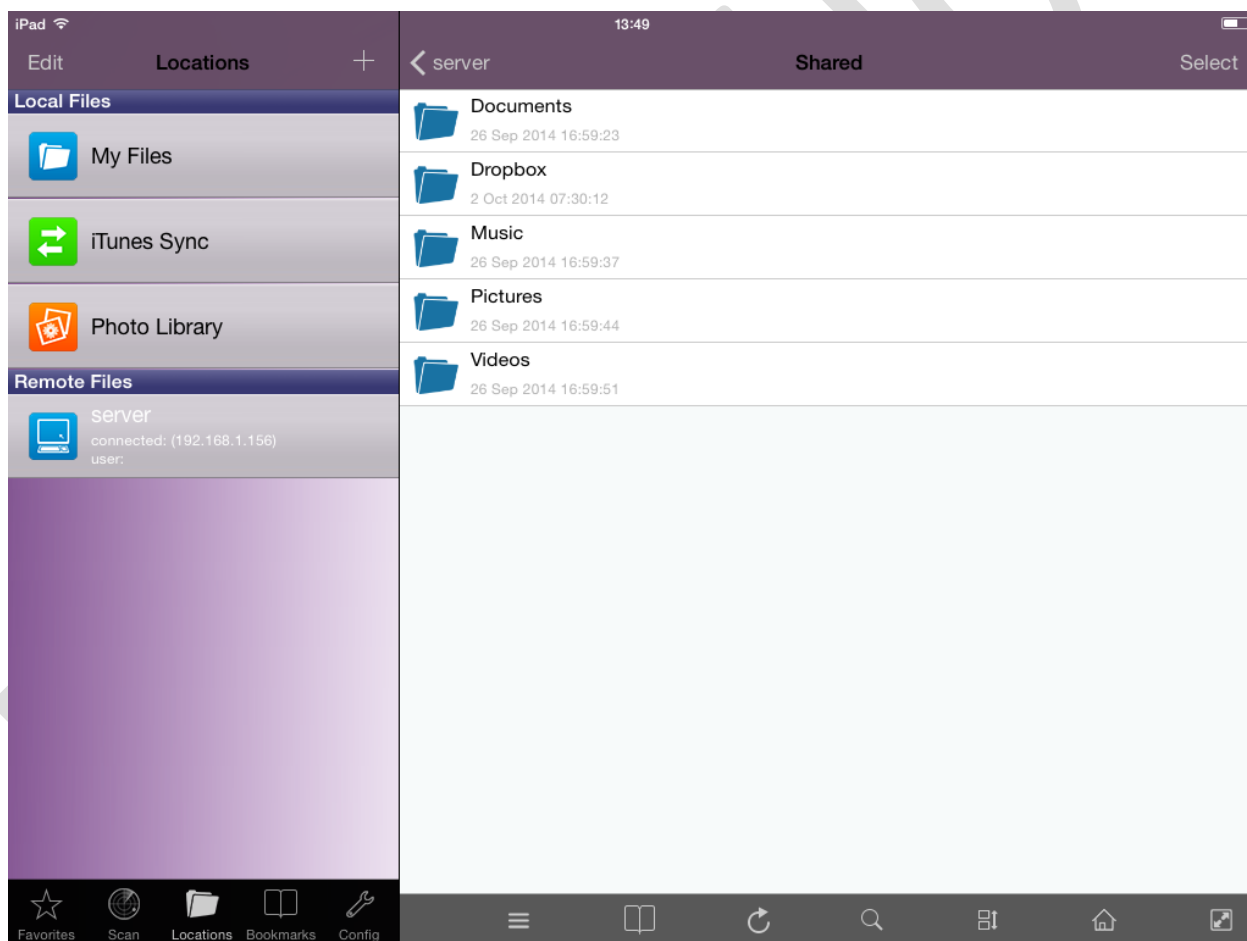

Figure 59: File Browser from Stratospherix running on iPad

8.2 Using a Cloud Sync Service

Cloud sync services such as Dropbox, Google Drive and Box provide a means of remotely accessing data on the server. They have a number of advantages: they are available on a wide range of portable devices including those running iOS, Android, Windows Phone and Blackberry. Secondly, they require minimal knowledge to get them up and running on the client devices. Thirdly, they are free (or rather can be, depending on the amount of storage the organization requires). The installation of Dropbox, Google Drive and Box is covered more comprehensively in 7 USING CLOUD STORAGE SERVICES.

8.3 Multimedia Playback

If streaming has been enabled on the server (see 6 MULTIMEDIA & STREAMING) then music, photos and videos can be played back on portable devices such as tablets and mobile phones. To do this, the portable device needs to be DLNA-compliant. Some already are, else, for instance in the case of iOS devices, a DLNA client can be downloaded from the App store.

8.4 Microsoft Remote Desktop app for iOS

Microsoft have an official app for iOS that enables a Windows computer to be accessed remotely. It is basically an RDP client and can be downloaded free of charge from the App Store. On the Windows 8 server make sure that Remote Desktop is enabled (go into **Control Panel** > **System** > **Remote Settings**. Click the Remote tab; in the *Remote Desktop* section make sure that the only option enabled is **Allow remote connections to this computer**. On the iPad or iPhone run the app and enter the name of the server plus the user details for *systemadmin*.

Whilst working on a small screen with no keyboard imposes some restrictions, Microsoft have done a good job with this tool. To improve usability, the Remote Desktop app has a virtual keyboard and a screen zoom facility. Pressing down with a finger for a couple of seconds is equivalent to a right-hand button mouse click, which is very useful.
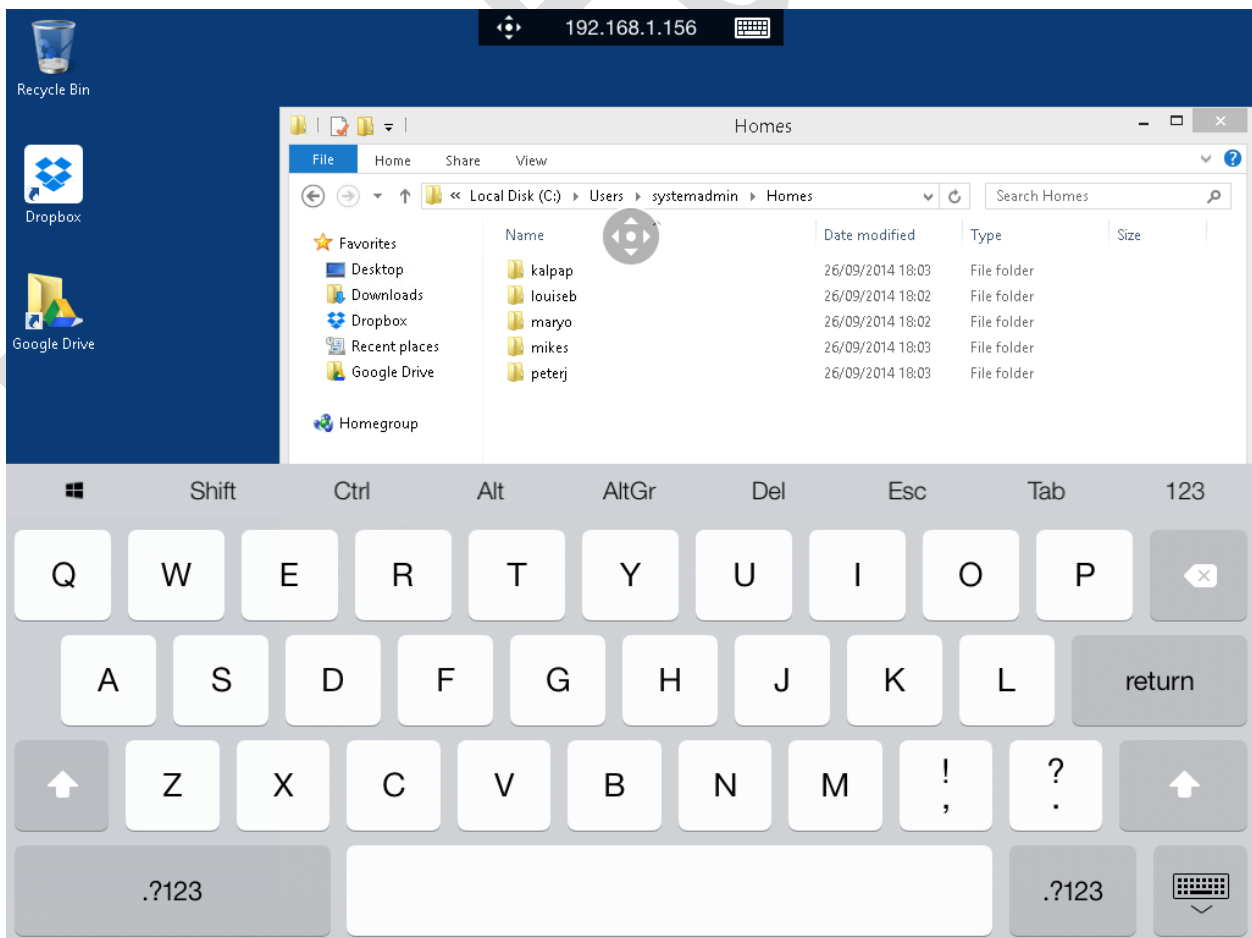
Figure 60: Microsoft Remote Desktop app running on iPad

8.5 Chromebooks

Chromebooks are an increasingly popular computing choice for many people. In essence a Chromebook is a laptop that only runs a browser; the underlying operating system is very minimalist compared to Windows and this means it does not currently understand networks and servers. As such it is only possible to do things that can be done within a browser, however, this still gives some possibilities. For instance, a Chromebook can be used to remotely administer the server. To do so requires RDP client software. There are several examples available, but one that works quite well is *Chrome RDP* from Fusionlabs.net. This is available from the Chrome Store; it is a commercial application but the license is only US $9.99 (a 7 day trial version is available for those who want to try-before-they-buy).

If a Cloud-based file sync service such as Dropbox, Google Drive or Box is being used with the server, then it will be possible to access the data from the Chromebook by logging in to the appropriate website. Of these services, Google Drive is probably the most useful because of the tight integration with Chrome and the ability to edit files using Google Docs.

9 BACKUPS

9.1 Backing up the Server

Servers have to be backed up on a regular basis so that data can be recovered in the event of loss or other problems. The easiest and most common method is to use a dedicated backup program in conjunction with a plug-in external USB hard drive. Windows 8.1 features a built-in backup program known as *File History* which, on the face of it, would appear to be the obvious choice. However, File History has a number of limitations which restrict its usefulness when Windows 8 is being used as a server. Most crucially, it does not understand the normal concept of drives and folders, being based instead around the concept of Libraries. Adding specific folders or Storage Spaces to the default Windows 8 Library so they can be backed up is an inflexible and unintuitive process and for this reason the use of a more conventional, third party program is suggested. There any many to choose from; the one we will use here is *FBackup* from Softland, which is totally free both for commercial as well as private use (see www.fbackup.com). When downloading it, take care not to download any additional unrequired programs such as toolbars and other utilities.

The USB drive used for the backups should be at least equal in capacity to the total amount of storage in the server e.g. if the server has 2TB disc storage then the backup drive should be at least 2TB as well. Preferably it should be a USB 3.0 drive, as the performance is much better than with USB 2.0. Most newly purchased USB drives will come ready-to-use and preformatted as NTFS, but if an existing drive is being reutilised you may wish to format it. To do so, right-click the **Start** button and choose **Disk Management**. Find the USB drive in the panel that appears, right-click it and choose **Format**. The default values are fine in most circumstances, although you may want to give the drive a meaningful Volume Name, such as *backup*.

Launch FBackup and click the **New** icon to define a new backup task. Give it a meaningful name (e.g. *CompleteBackup*). Specify the destination for the backup – in this example we have an F: drive called *Backup*. Click **Next**:
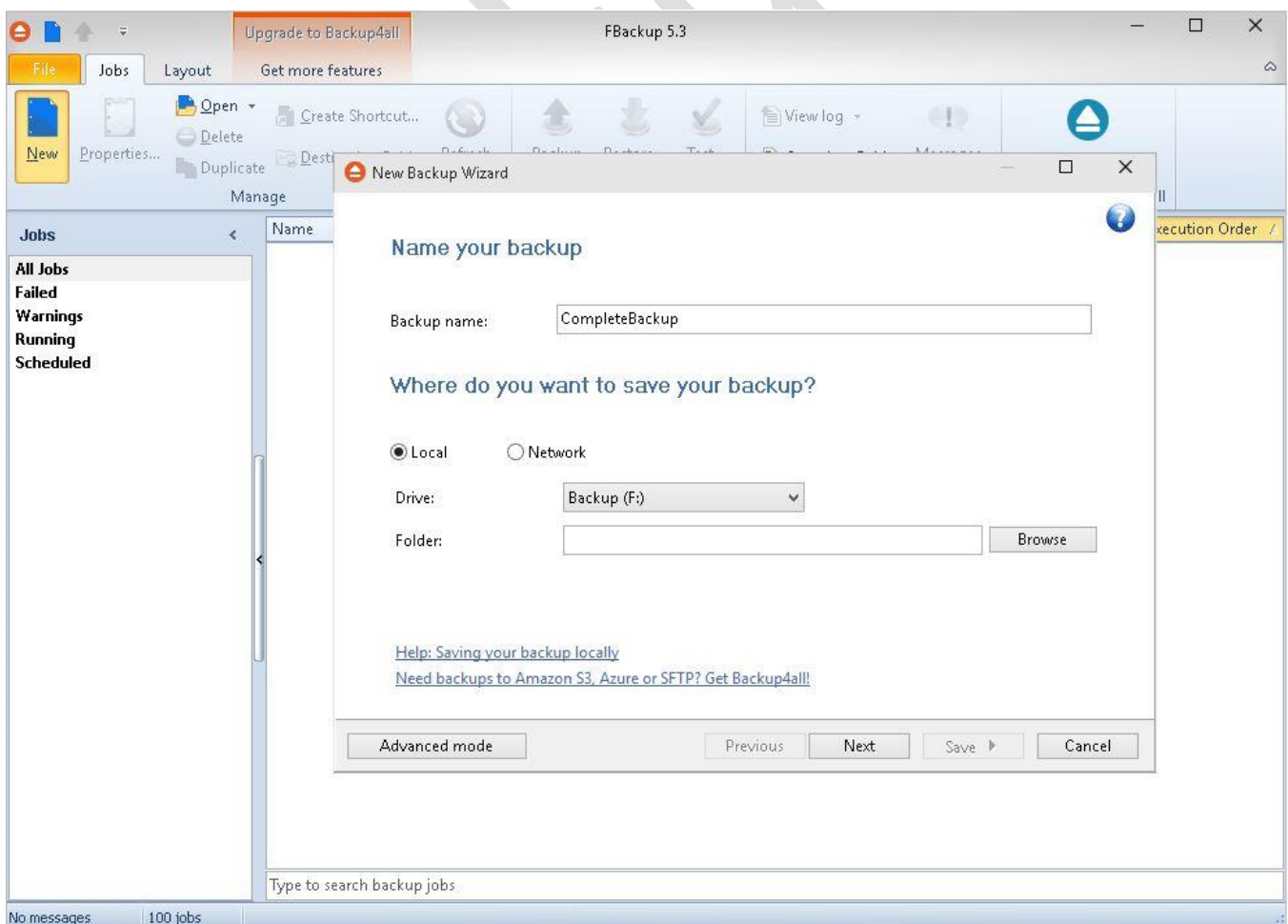
On the subsequent screen choose the folder(s) or drive(s) to be backed up by clicking the **Add folder** button. In our example we are backing up the Storage Space volume E:
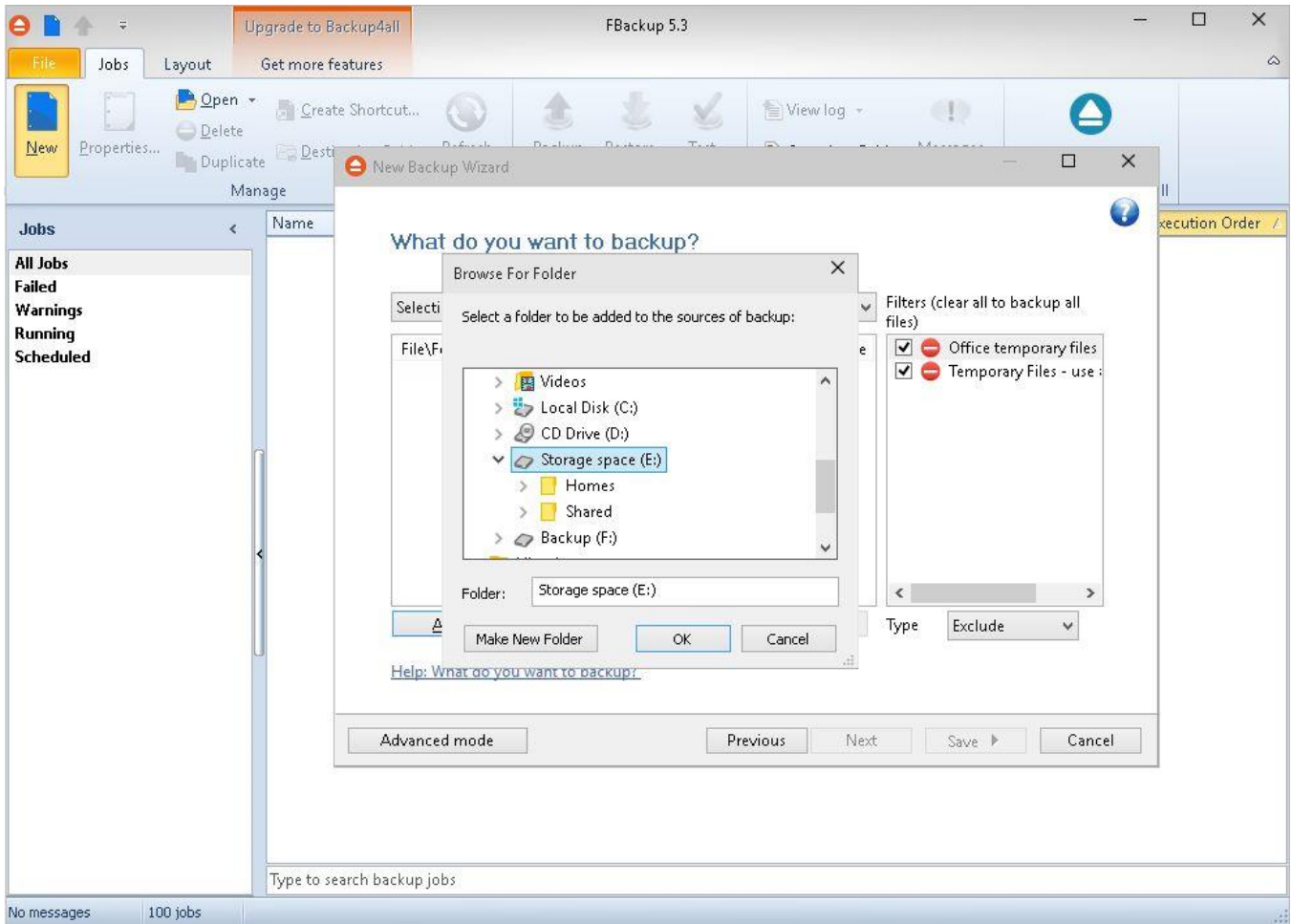
Figure 62: Choosing folder(s) to be backed up

Click **OK** and **Next**. The next screen is for specifying the type of backup and the choices are *Make full* or *Make mirror*. Choose the latter as this stores the backup in a standard file format that can be read with Windows File Explorer. It is not necessary to encrypt the backup unless there are specific security requirements. Click **Next**.

Figure 63: Encryption option

The subsequent screen allows the backup to be scheduled to run on an automatic basis. In most scenarios a daily backup is suitable, but it can be more or less frequent as required. Schedule the backup to run at a time when the server is not normally busy as it can impact performance, for instance at the end of day or overnight. In this example the backup runs daily at 6:00pm.
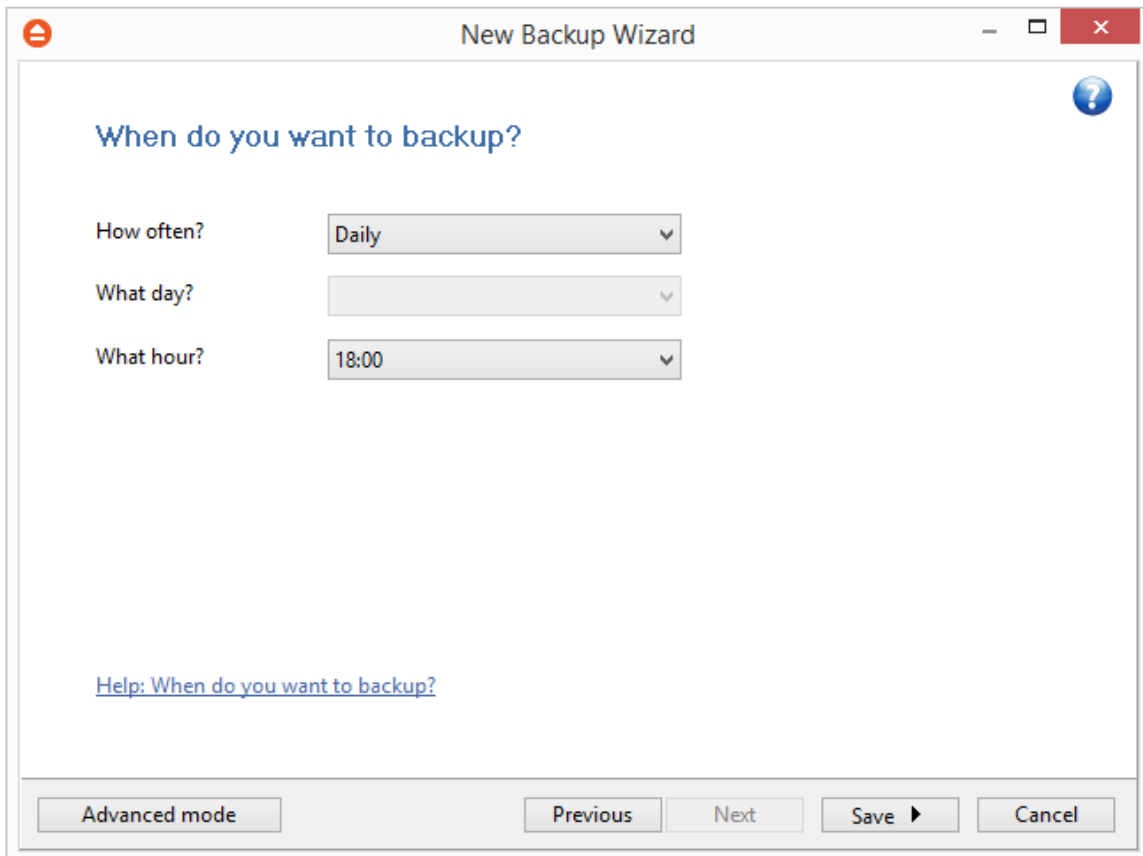
Figure 64: Specify the backup schedule

Having specified the schedule click the **Save** button. There is a choice of just *Save* or *Save and Run*; the latter option is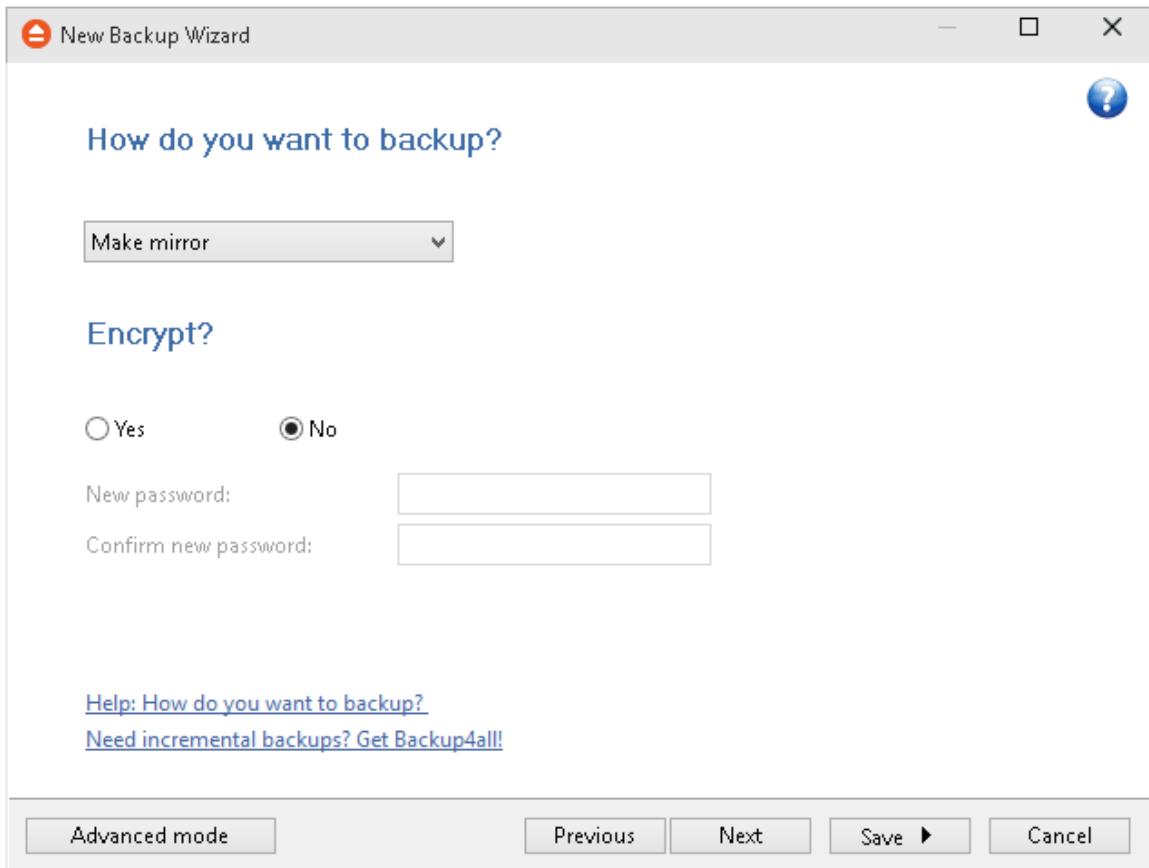 useful as it will cause the newly created backup job to run immediately, constituting a useful test and first backup. When the backup is complete a logfile and message are generated – on subsequent occasions these should be checked to confirm that the scheduled backups are working.

FBackup is a good backup program that works well. If additional features are required – for instance, the ability to backup to cloud services such as Amazon S3 or Microsoft Azure and advanced encryption capabilities – these are available in a paid for product called *Backup4all Pro* from the same company.

9.2 Restoring Data to the Server

If a file or folder is lost (for instance, a user has accidentally deleted it) or it is required to revert to an earlier version, then it can be restored using *FBackup*. Launch the program and click the **Restore** icon to start the *Restore Wizard*. There are several options but in this example a folder has been deleted and needs to be put back. Click **Use original location** and **Choose files and restore the latest version**:
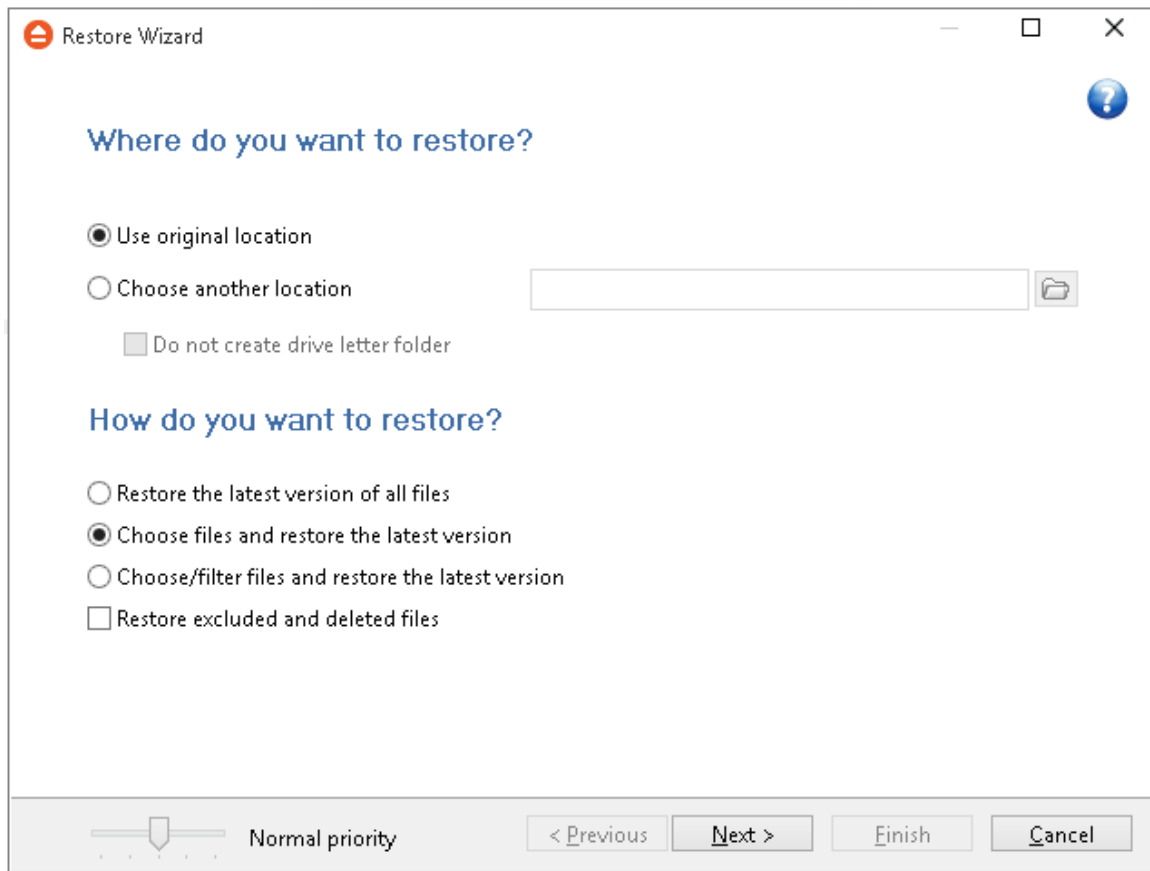

Figure 65: Restore Wizard

Click **Next**. On the following panel choose the file(s) or folder(s) to be restored then click **Finish** (in this example we are restoring the *Pictures* folder on *Shared*):
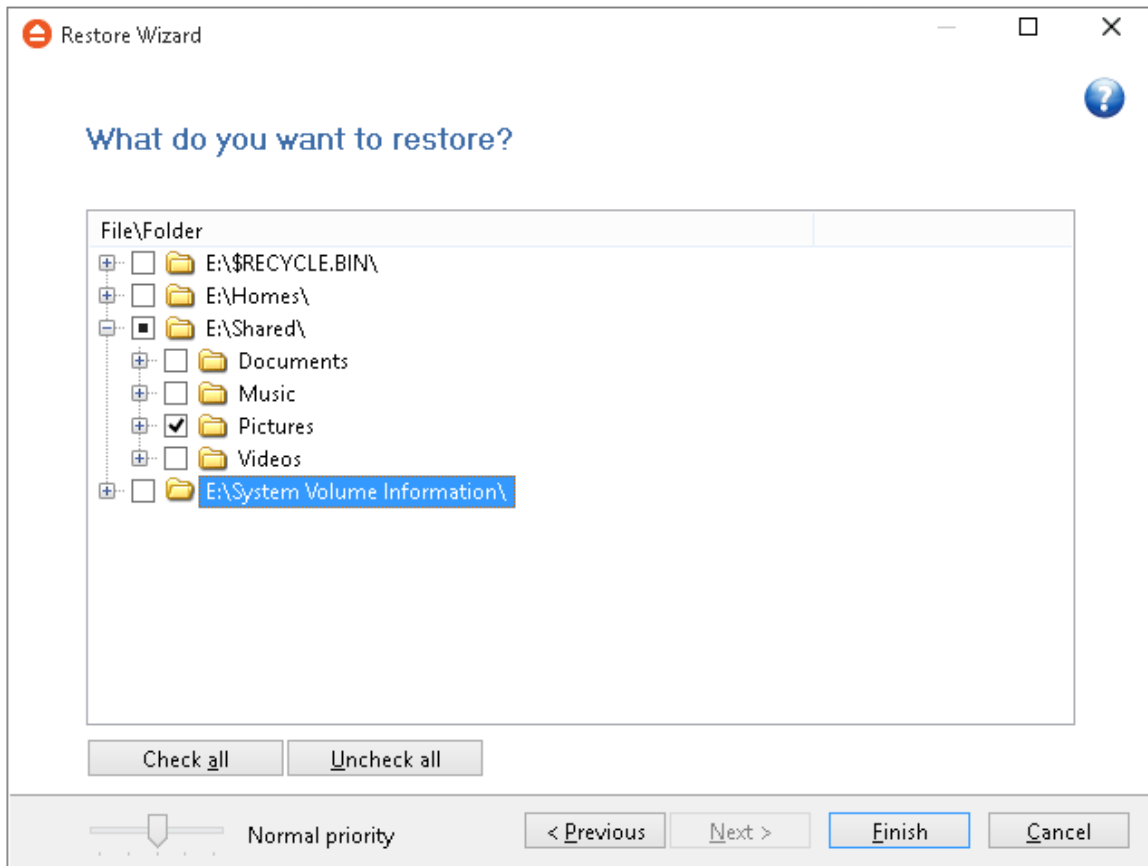
Figure 66: Choose the files/folders to be restored

9.3 Backing up PCs to the Server

If users store data on their computers rather than on the network, then there is probably a requirement to be able to backup that data. This can be done using the built-in backup programs in Windows 7 and Windows 8 clients, with the actual backups stored on the server. As the server itself is being backed up, this will ensure multiple copies of the data, hopefully enough to cope with any eventuality.

9.4 Backing up Windows 7 Computers to the Server

Click **Start**, followed by **All Programs**, **Maintenance** then **Backup and Restore**. Click on **Set up Backup**:
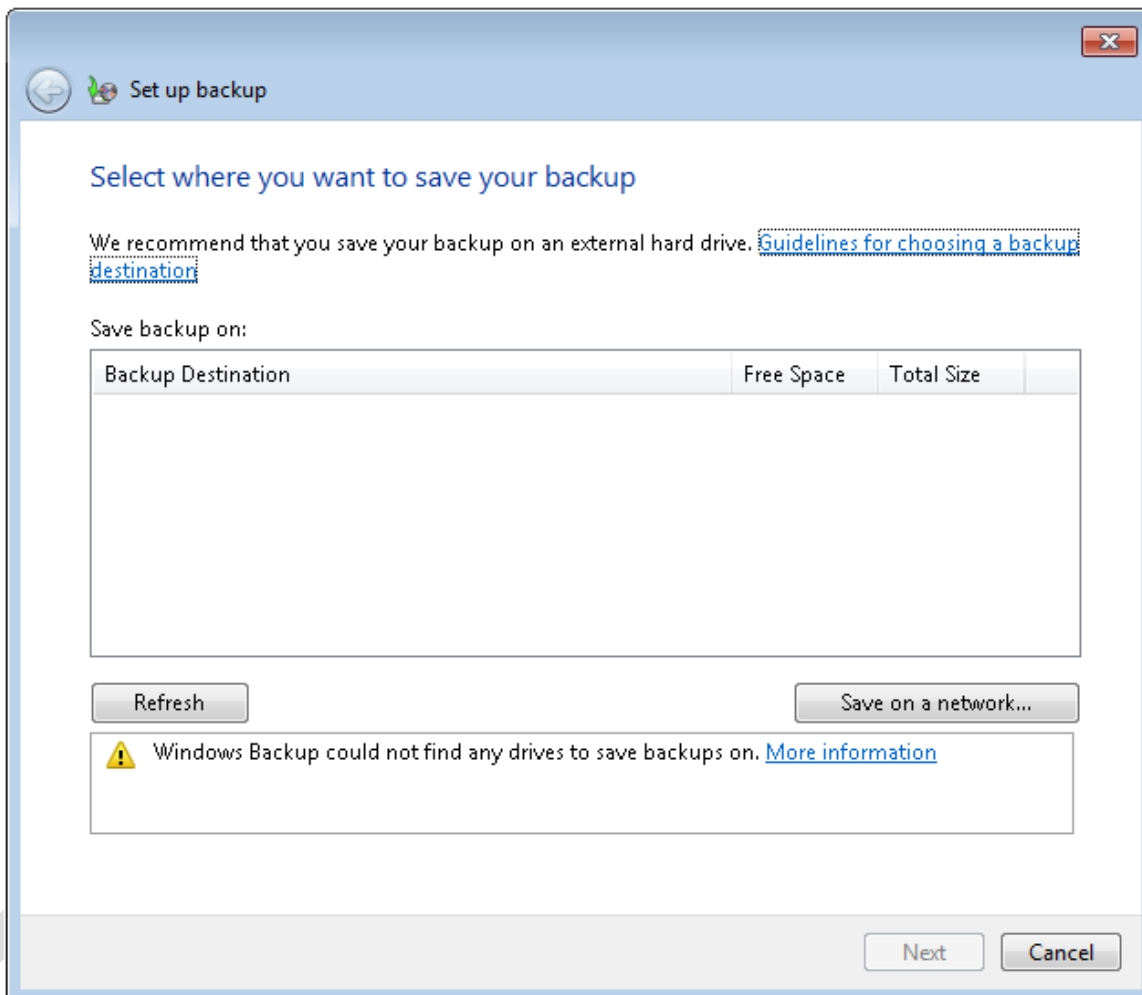
Figure 67: Select destination for backup

Click the **Save on a network** button. On the next panel, enter the **Network Location**. Specify the user's home folder, using the format *server**homes**username* (or click the **Browse** button to navigate to it). You may be prompted to login - enter the user name and password as defined on the server then click **OK**:
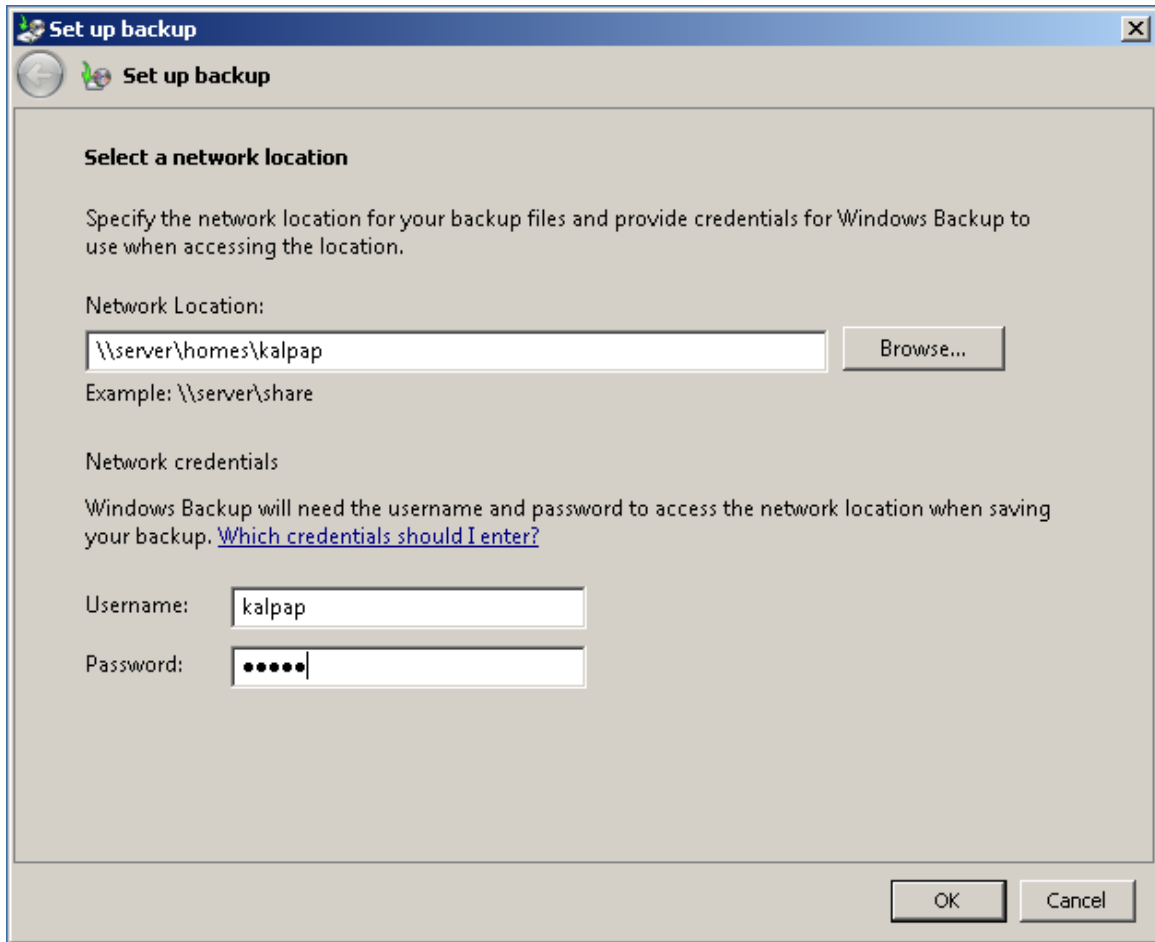
Figure 68: Enter network details

The subsequent screen is for choosing what data files are backed up. The default option of **Let Windows choose (recommended)** is fine in most cases so just click **Next**:
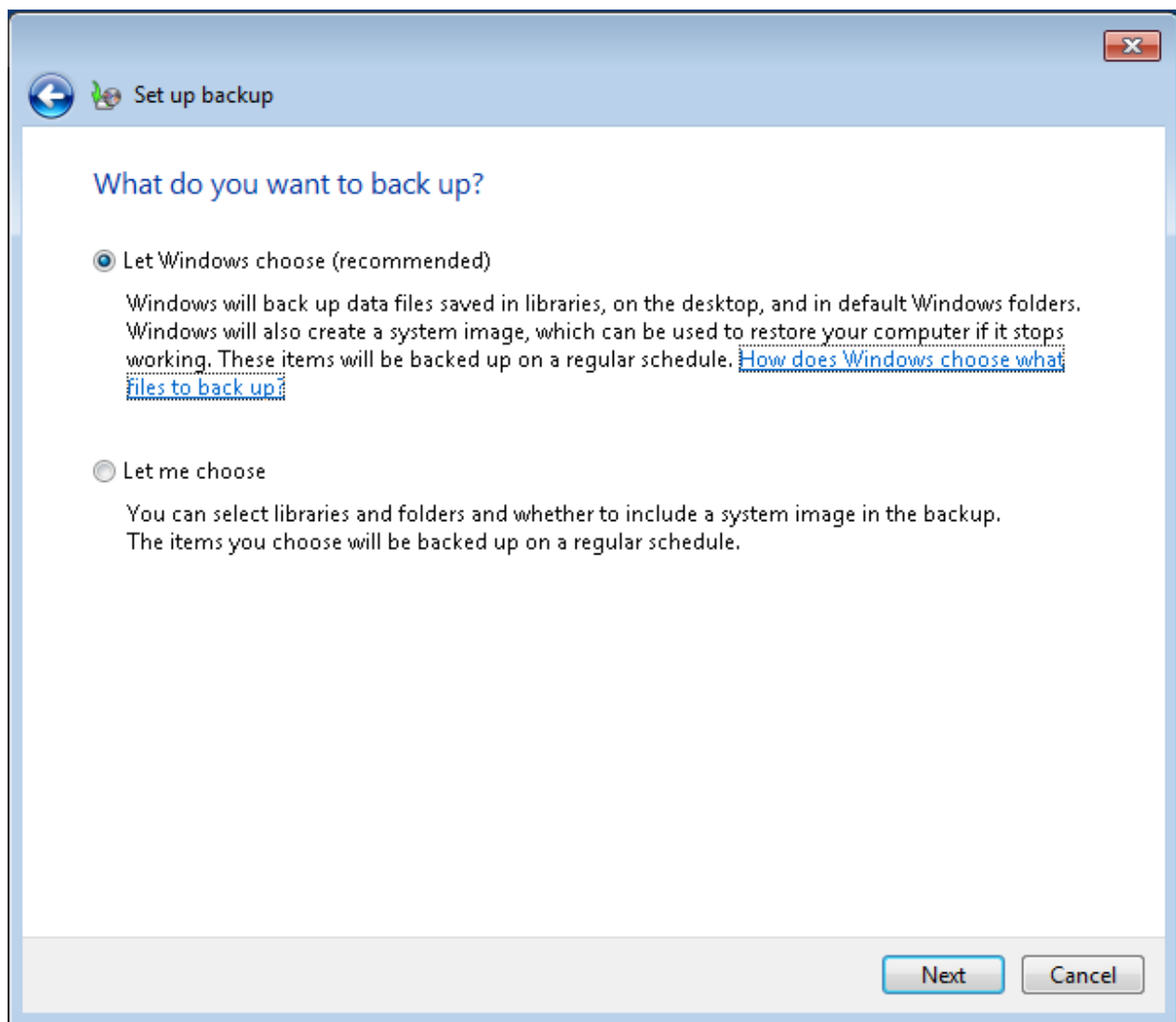
Figure 69: Choose the items to backup

The follow-on screen is a summary of settings; click **Save settings and run backup**:
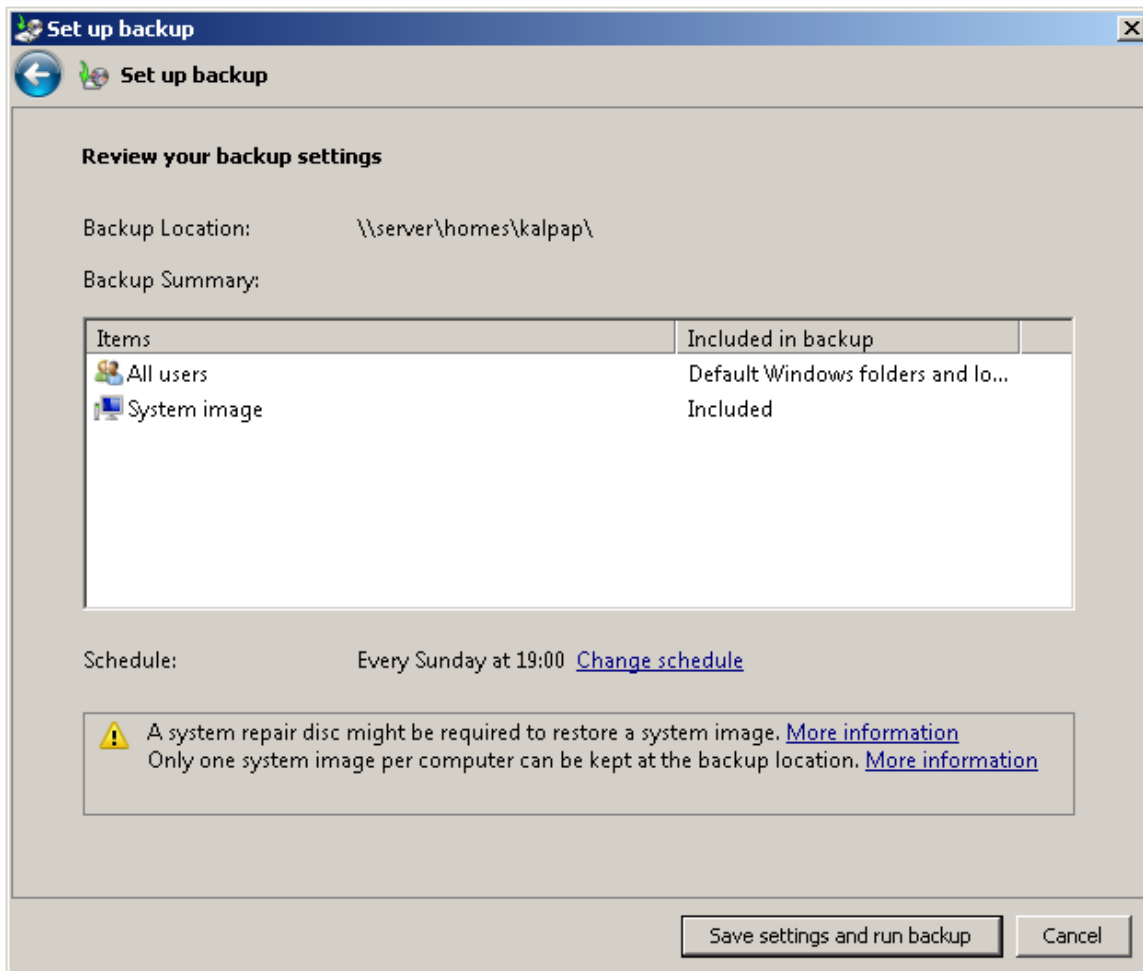
Figure 70: Review backup settings

The backup will then run for the first time, during which the status is displayed. By default Windows has defined a schedule to subsequently run backups automatically on a regular basis (in this case, every Sunday at 7:00pm). If this setting is not suitable it can be changed by clicking **Change settings**.

Figure 71: Backup in progress

9.5 Backing up Windows 8/8.1 Computers to the Server

Begin by mapping the user's home drive on the network drive using one of the techniques described in section 5 ACCESSING THE SERVER. Then go into the **Control Panel** and click **File History** (remember that in Windows 8.1 you can right-click the **Start** button to locate the Control Panel):
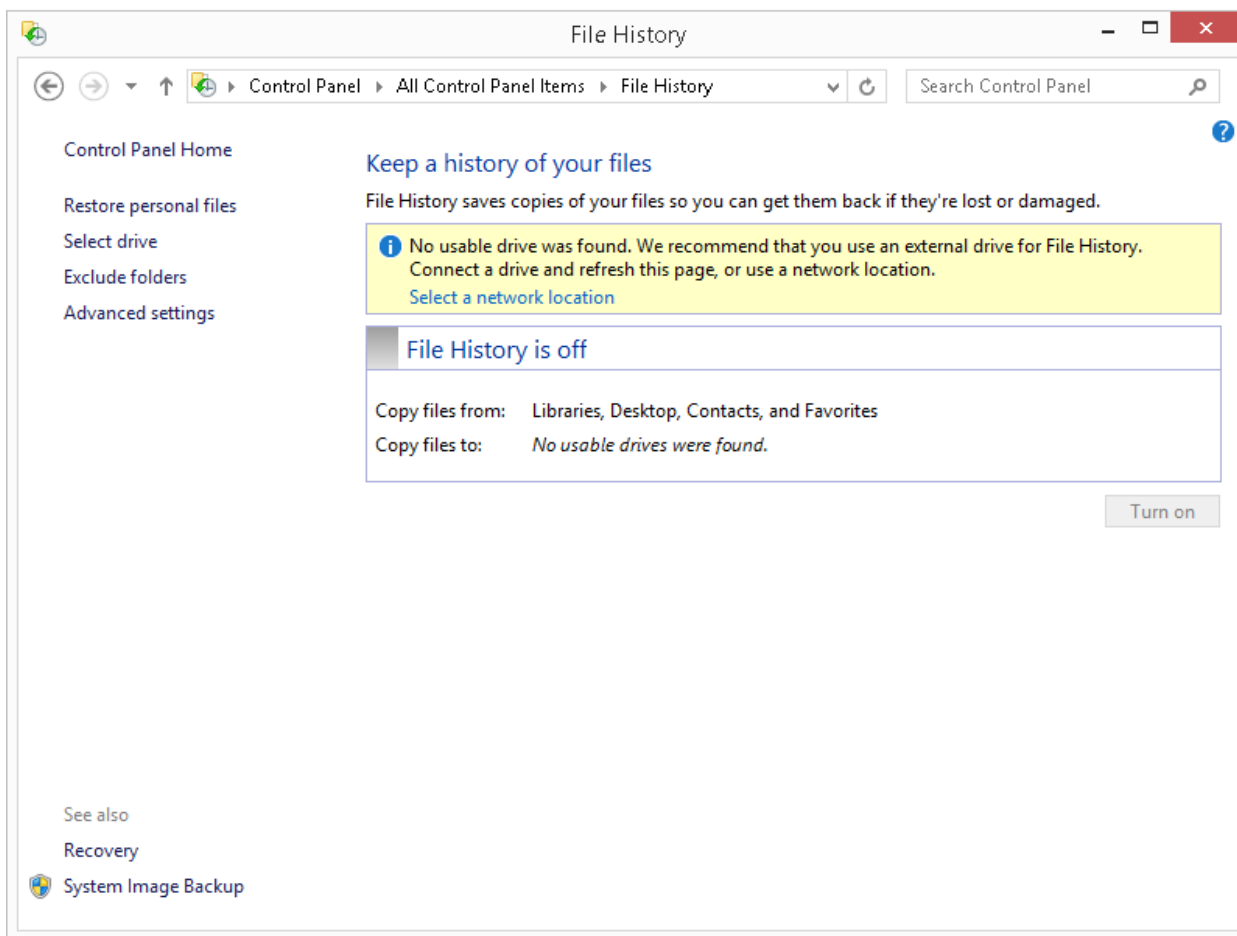
Figure 72: Initial screen in File History

Click **Select a network location**. On the screen that is displayed click **Show all network locations**. From the list, choose the user's home folder and click **Verify your credentials**. Enter the user name and password as defined on the server if prompted; if the computer is only ever used by one person you can tick the **Remember my credentials** box:
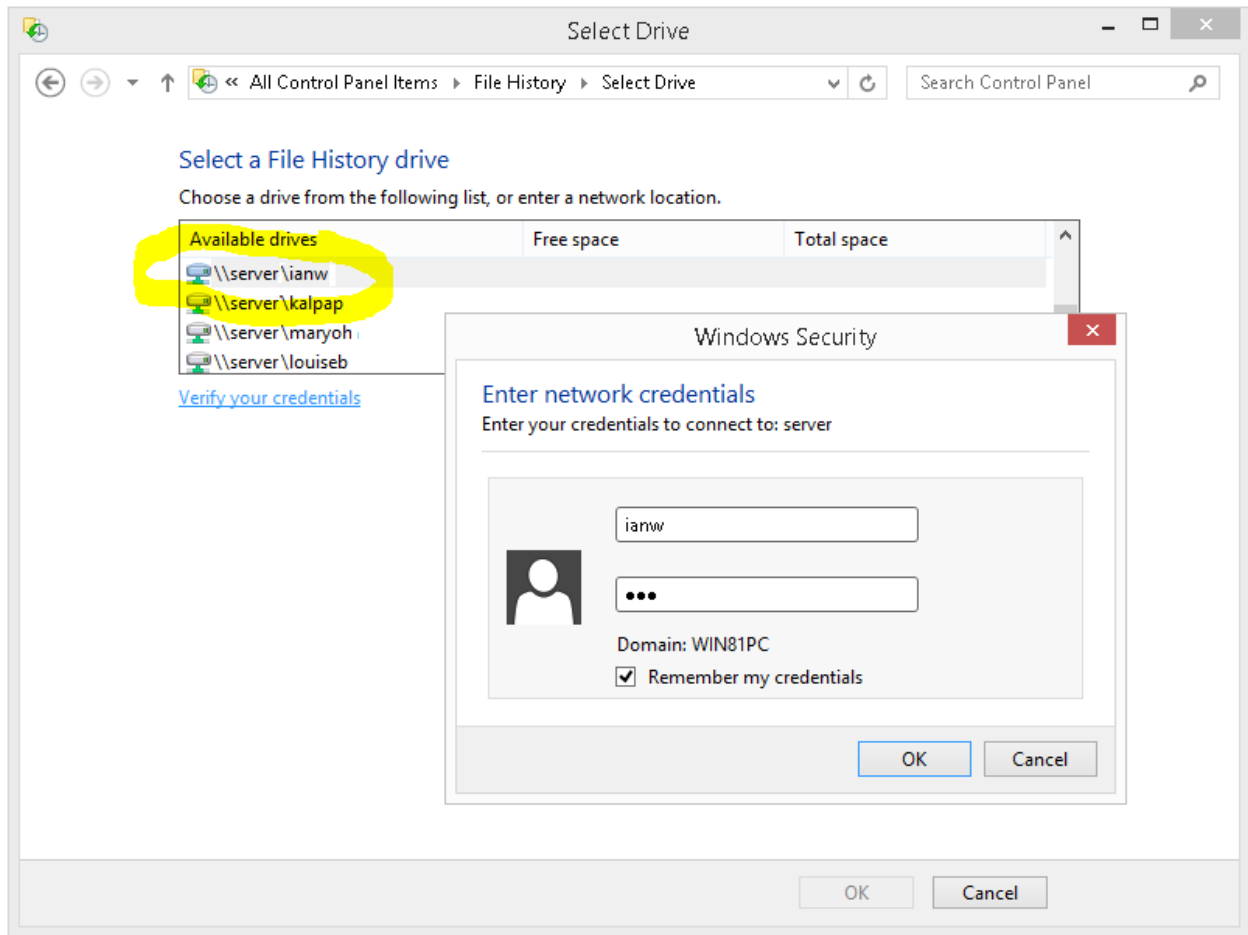
Figure 73: Specify network credentials

Click **OK** to return to the initial File History screen and click the **Turn on** button. After a few seconds, the backup will run for the first time. Thereafter, it can be run at any point by clicking **Run now**.

For greater control over the process, such as controlling the frequency at which the backup runs, click **Advanced settings**:
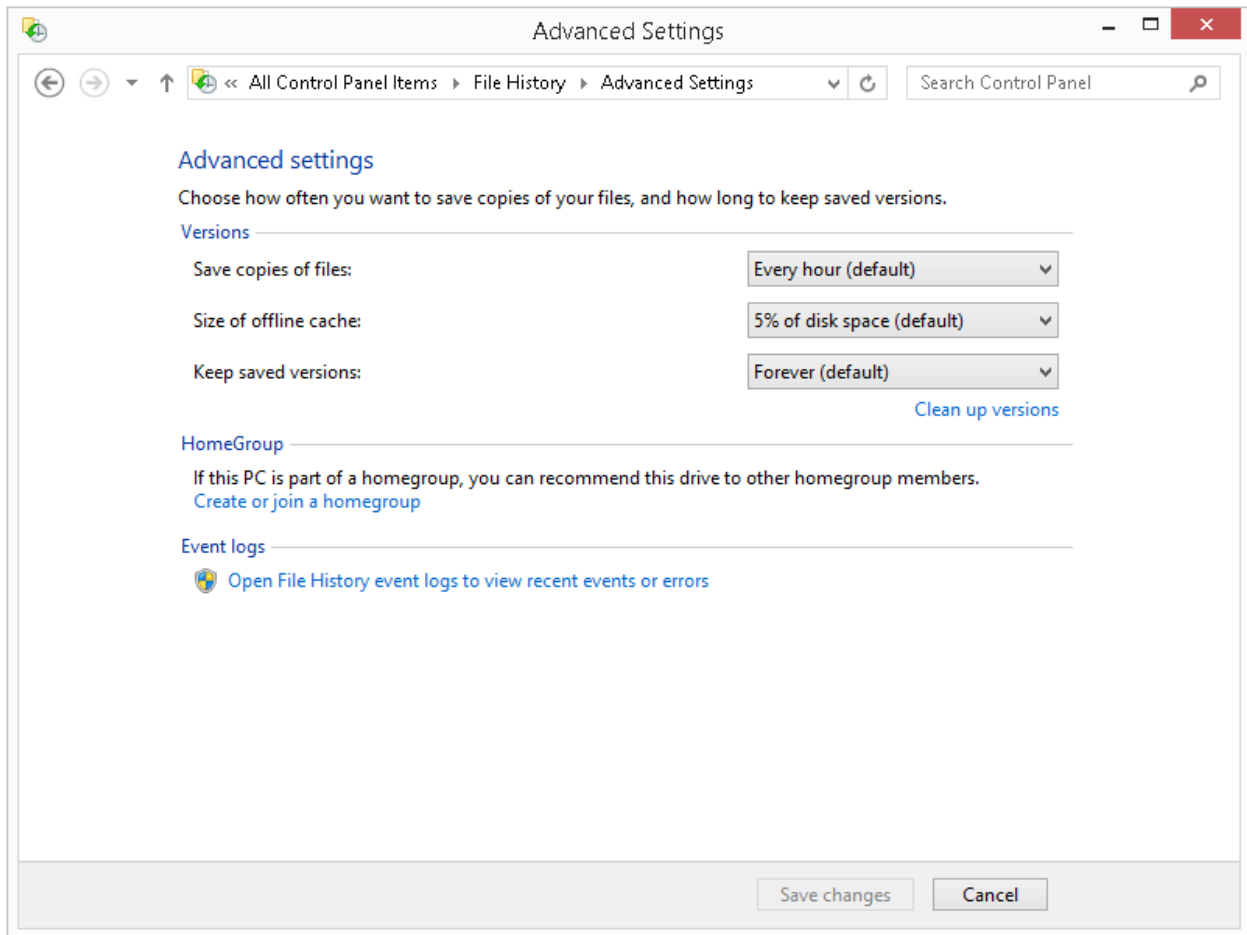
Figure 74: File History Advanced settings
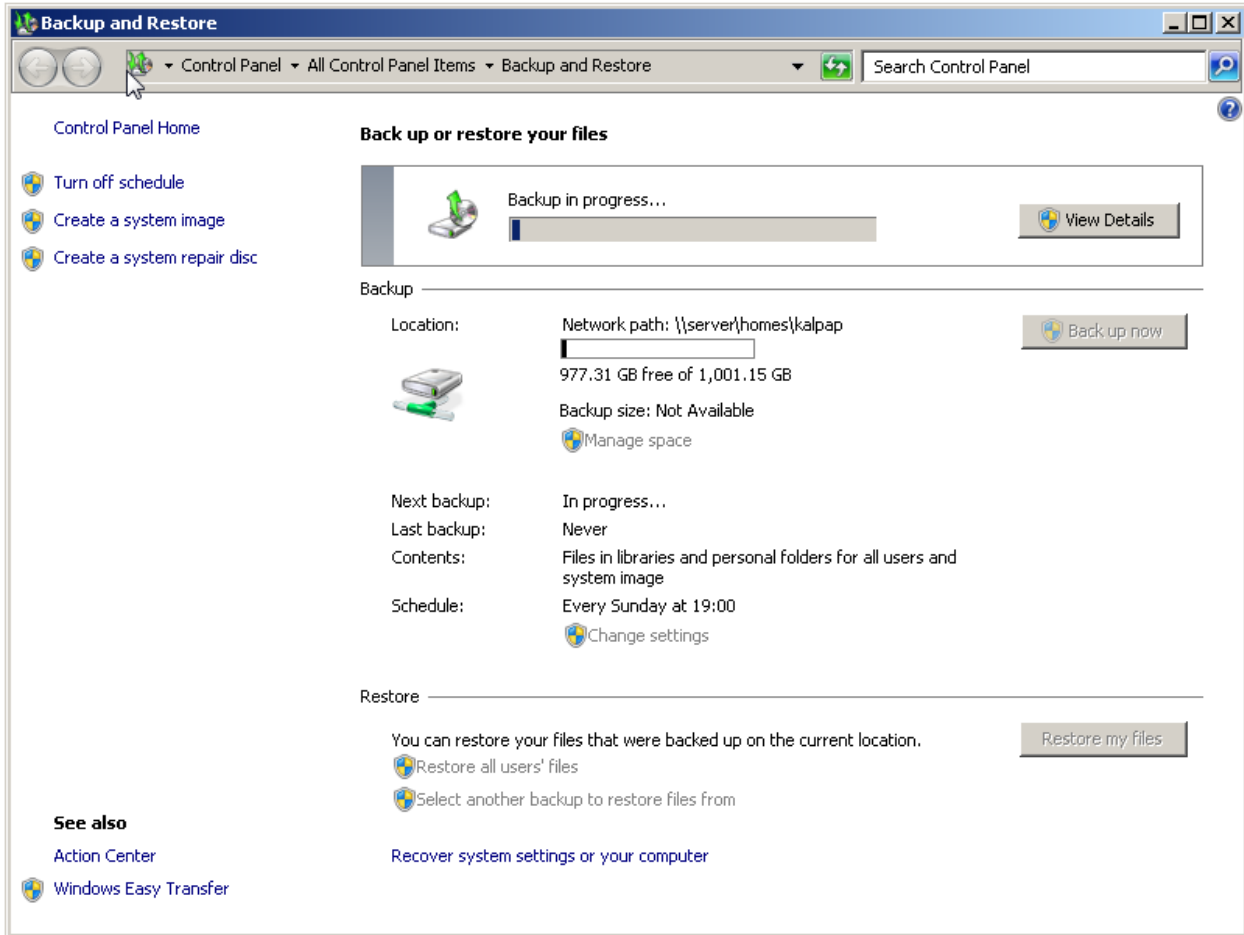
9.6 Backing up Windows 10 Computers to the Server

Begin by mapping the user's home drive on the network drive using one of the techniques described in section 5 ACCESSING THE SERVER (if not already mapped). Then click **Start** > **Settings** > **Update & security** > **Backup**. Click **Add a drive** and after a few seconds the list of mapped drives will be displayed – click on the user's home drive:
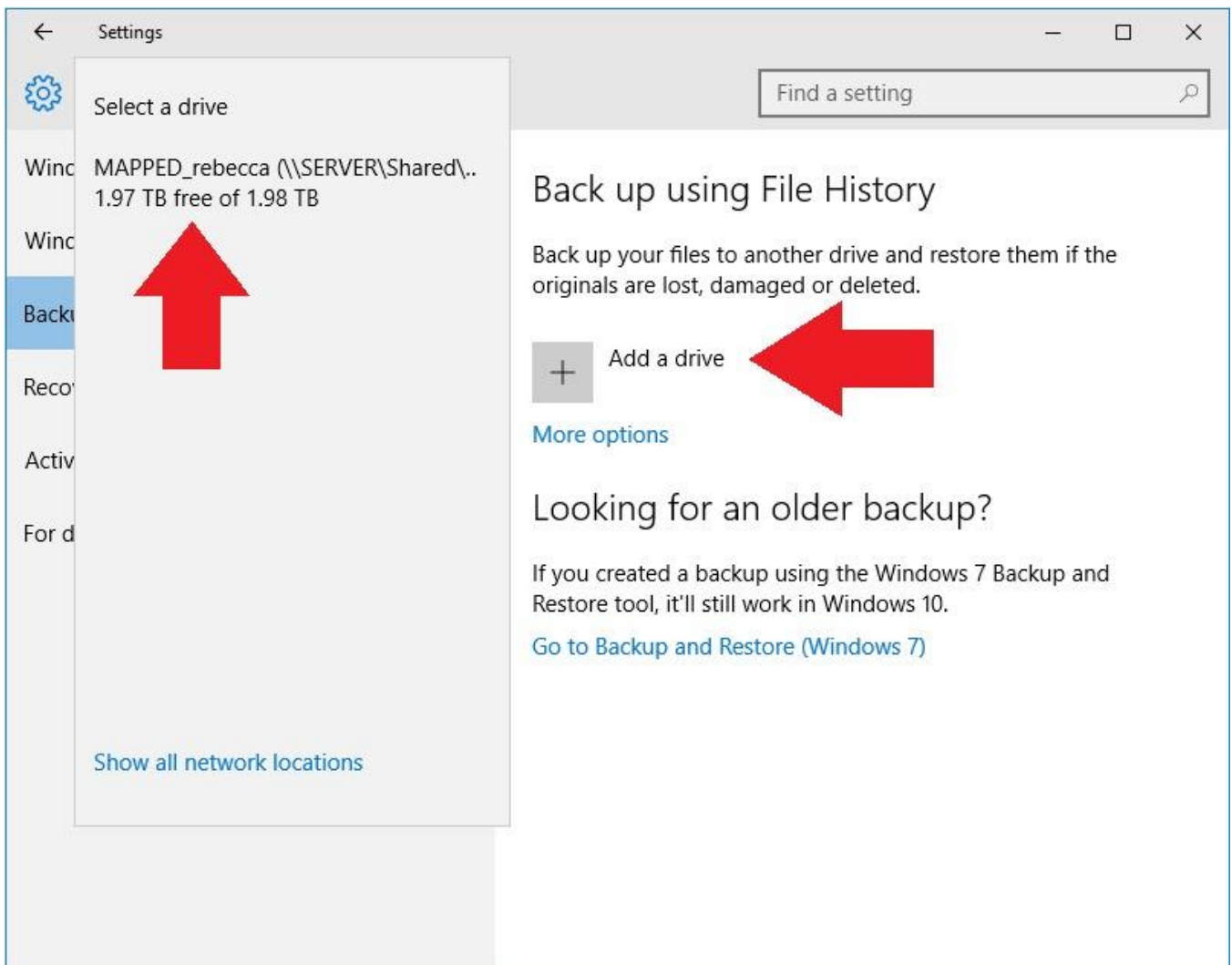
Figure 75: Specify the home folder as the backup drive

Having done so you will be returned to the main Backup panel, where an option to *Automatically back up my files will have appeared* and been set to **On**. That's it – a backup will now run on an hourly basis, copying the user's files from the computer to their home drive on the server.

For greater control over the process, such as controlling the frequency at which the backup runs, click M**ore options**. From here you can: review the backup status; make the backup run immediately; achange the backup frequency (anything from every 10 minutes through to 1 day); change the retention period for the backed-up data:
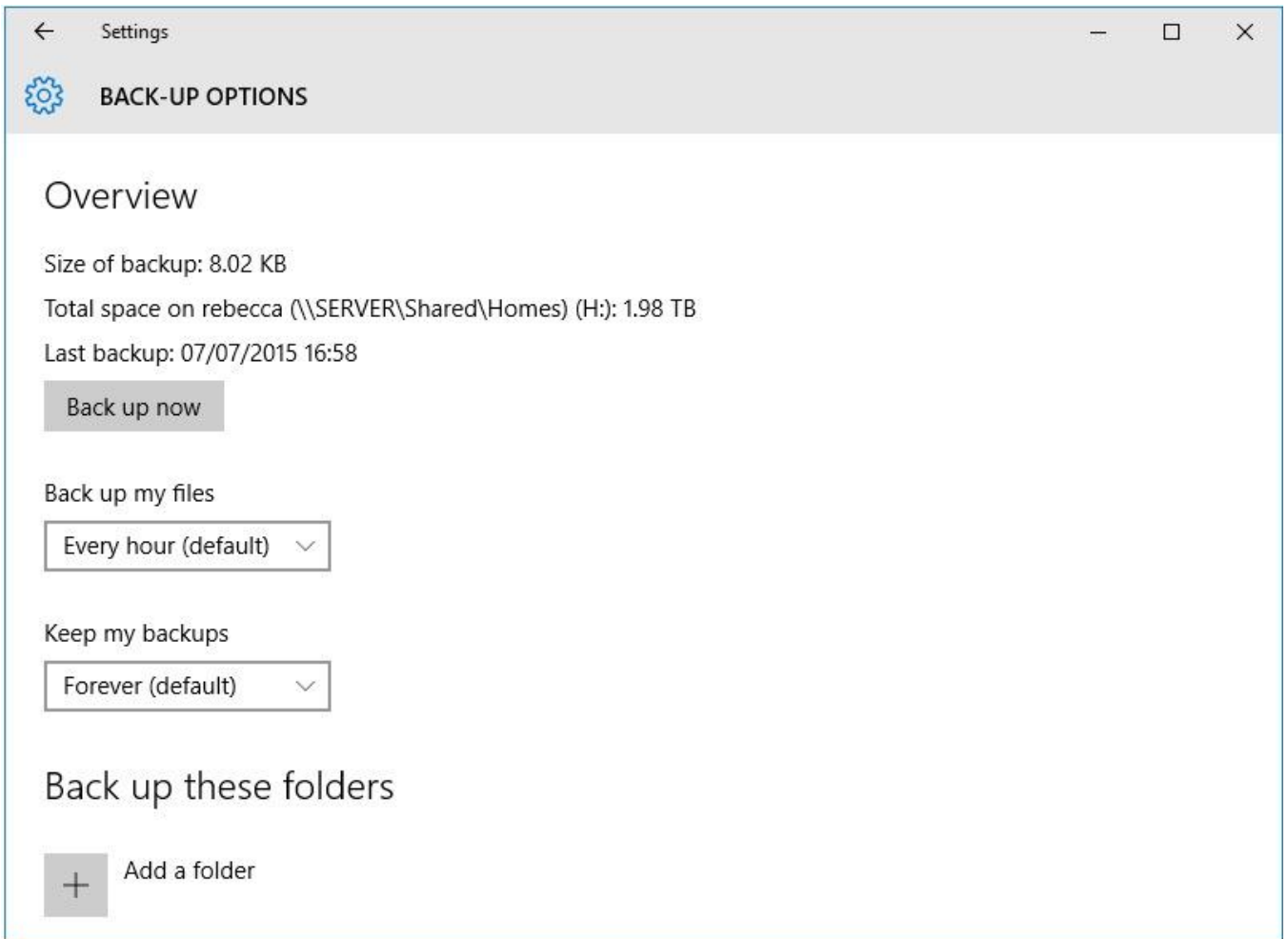
Figure 76: Additional backup options

10 HOUSEKEEPING AND MONITORING THE HEALTH OF THE SERVER

Servers need to be checked on a regular basis to ensure that there are no problems and that they are in good health. Clearly some type of problems will be immediately apparent, for example if the server is powered down for whatever reason then nobody will be able to use it. But there are plenty of other things that need to be monitored; for instance: Has the backup completed successfully? Is the server running out of storage space? Additionally, there are some housekeeping tasks that need to be carried out on an occasional basis. This section also include some ideas for making the server more convenient to work with for the person who administers it.

10.1 Applying Windows Updates

It is important to check for and apply the updates to Windows Server that Microsoft makes available on a regular basis. Such updates may provide improved or additional functionality, but more typically address security issues that could compromise the system. On regular desktop and laptop computers, Windows updates are often applied automatically; however, it is suggested that automatic Windows updates are not enabled on servers. The reason for this is to ensure total control over the process and stop the risk of the server rebooting on its own accord following an update. Also, it is suggested that updating is done out of hours so as to avoid any disruption to service, perhaps on a monthly basis.

Go into **Control Panel**. If it is currently set to view by Category, change it to view by **Large Icons**. Click the **Windows Update** icon followed by the **Turn on Automatic updates** button, which will force the system to check for updates. After a couple of minutes the screen will refresh and display a message that *"nn important updates are available"* (where *nn* is the number of such updates). Click the message and on the next screen click the **Install** button at the bottom of the screen. The updates will download and install; this may take some time and may necessitate the server having to restart to complete the process.

Once the server is up-to-date, go back into Windows Update and click **Change Settings**. Set it to a value other than 'Install updates automatically' and click **OK**.
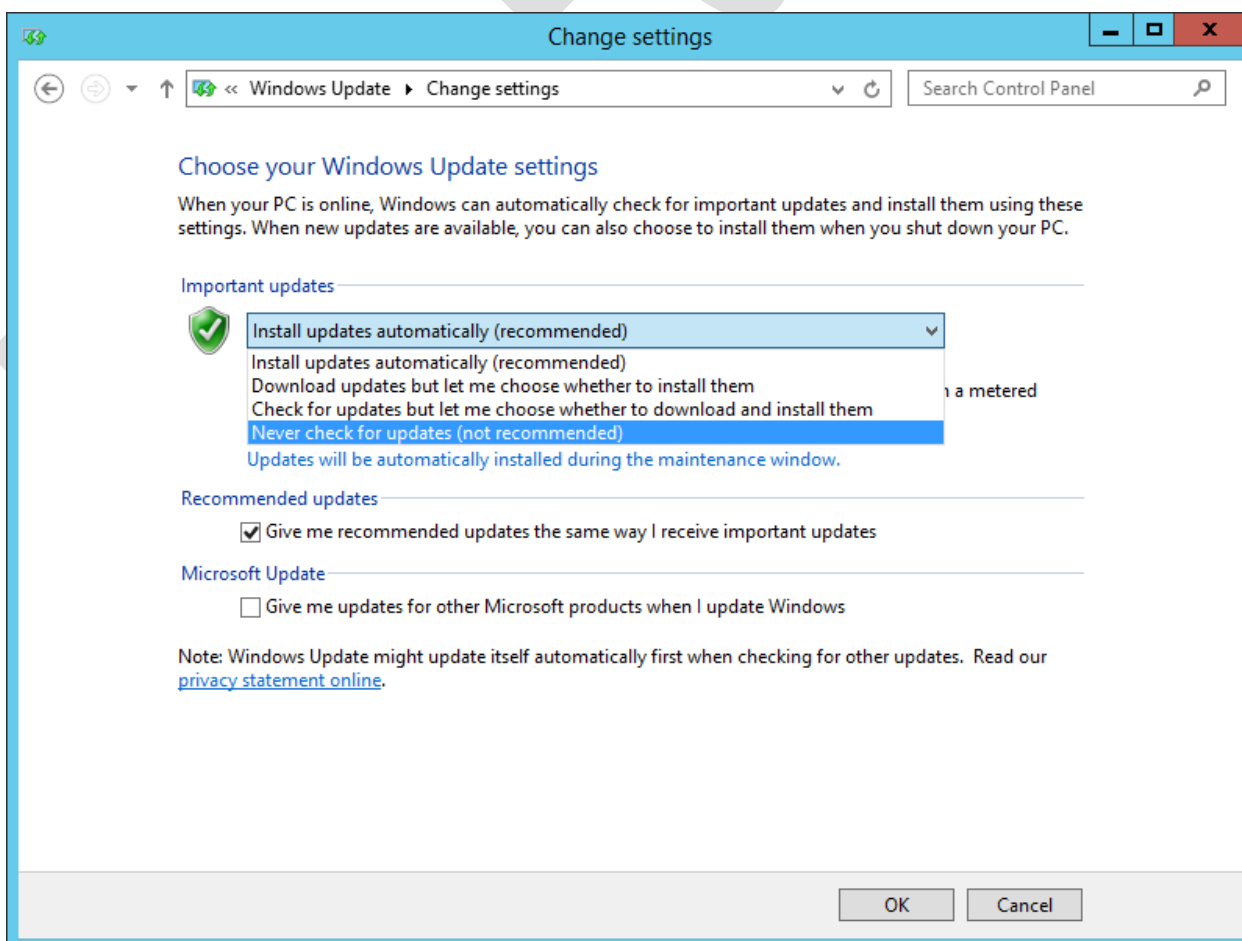
Figure 77: Windows Update settings

10.2 Check Disk Space

The amount of free space on the hard drive(s) should be checked on a regular basis, which can be done by simply going into File Explorer. If the amount of free space drops below 25% then housekeeping should be performed to free up more space, for instance by deleting old and unwanted files and/or archiving them to a separate drive. If the server is persistently short of space then consider adding more storage. If Storage Spaces are being used - see section 2.10 Storage Spaces (System with Multiple Drives) - then another drive can be added to the Storage Pool.

10.3 Optimizing the Hard Drives

The hard drives on a computer should be optimized (also known as *defragmented*) on a regular basis to reduce file fragmentation and maximise performance. With Windows 8.1 this takes place automatically on a weekly basis. To verify that it is configured correctly and operating, open **File Explorer**, right-click on any drive, click **Properties** then **Tools** followed by **Optimize** to show the following panel:
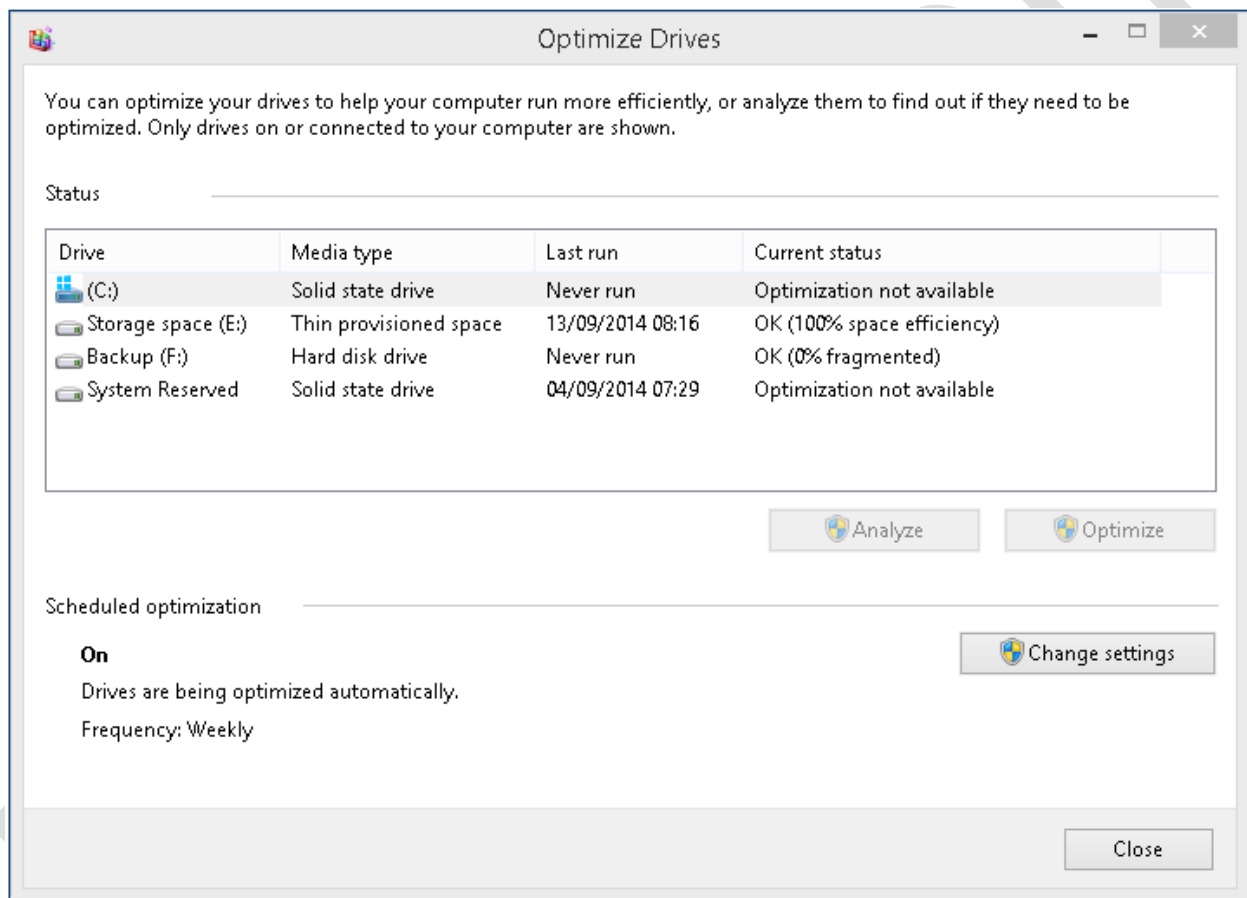
Figure 78: Optimize the hard drives

Towards the bottom left-hand corner it should read that Scheduled optimization is 'On' and that the drives are being optimized automatically on a weekly frequency. If this is not the case, click the **Change settings** button and adjust the settings accordingly.

Important: if the server includes any Solid State Drives (SSDs) then they should never be optimized – it is not necessary and will shorten their lifespan. Windows 8.1 should have automatically detected them but if it has not then turn off scheduled optimization and optimize any conventional hard drives on a manual basis every couple of weeks. This can be done using the panel displayed above: highlight the drive, click **Analyze** to determine its status then click **Optimize** if necessary.

10.4 Checking the Event Viewer

Windows 8.1 maintains comprehensive records of the myriad events that take place during the operation of the computer. Some of these are simply records of normal usage whereas others are generated in response to specific errors and can be used to help diagnose problems. The events are categorised into several main types and recorded in log files, which should be specifically checked in the event of problems and otherwise on an occasional basis. However, note that diagnosing such problems is a relatively advanced topic.

To access the Event Logs, right-click the **Start** button and choose **Event Viewer**. A screen along the following lines is displayed (note that it may take some seconds to fully populate):
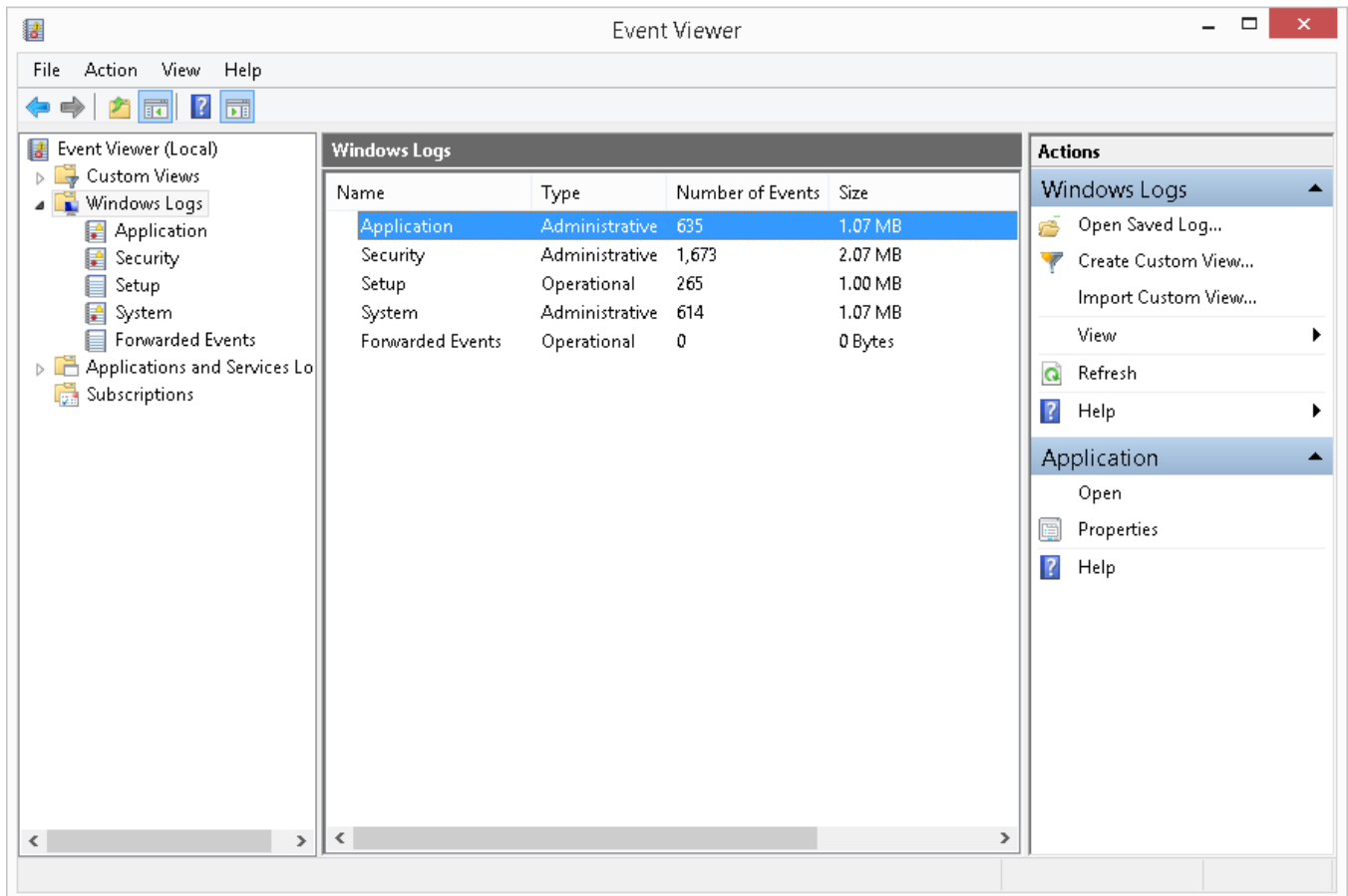
Figure 79: The Event Viewer

Some of the event logs are more useful than others. In the left-hand panel, expand the tree to display the **Windows Logs** section. There are five separate logs: *Application*, *Security*, *Setup*, *System* and *Forwarded Events*. To view a particular log, click on it. Each event is categorized as an Error, a Warning or Information, along with a timestamp plus a short description. The listing can be sorted by clicking on the heading for a column:
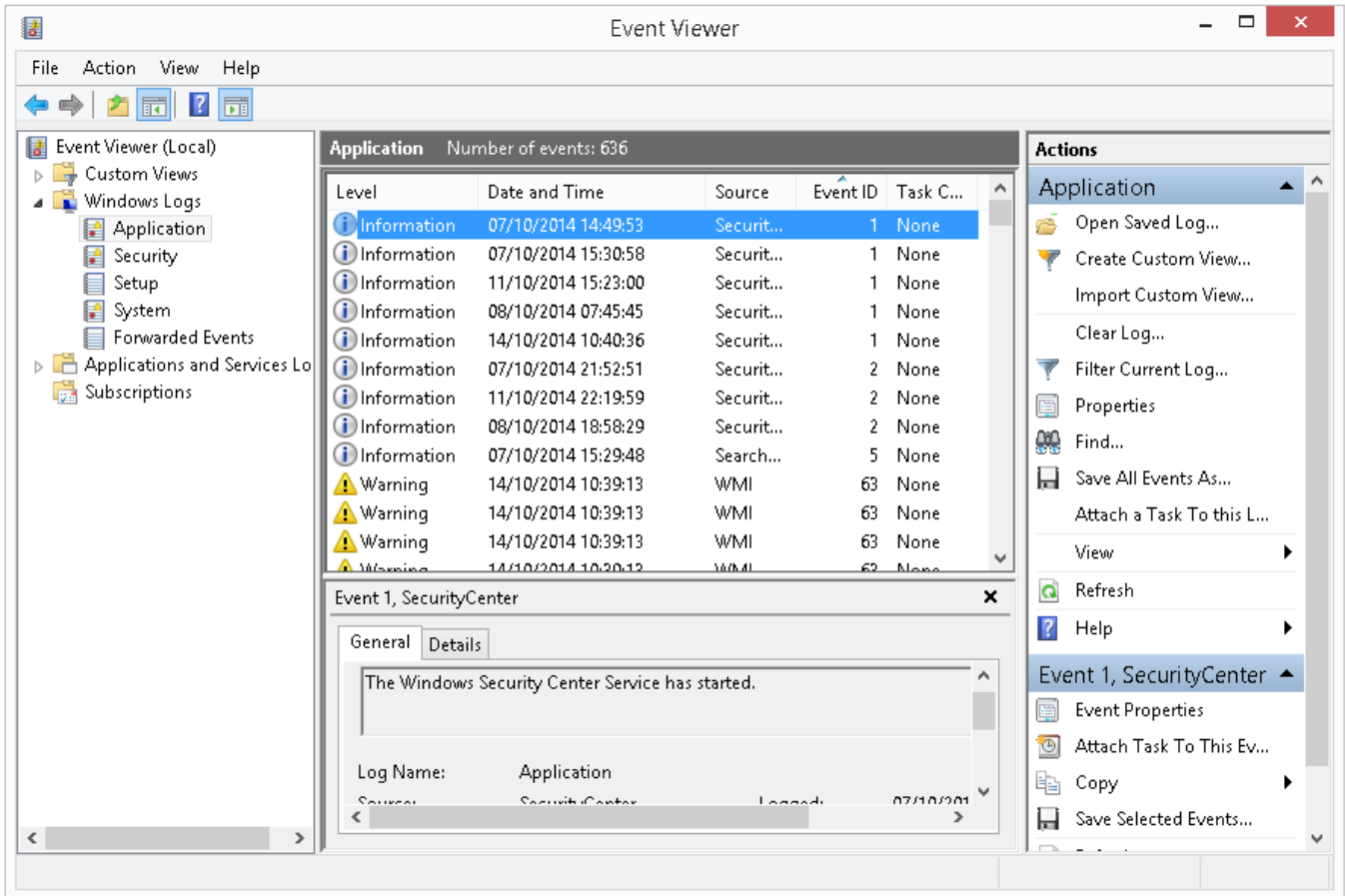
Figure 80: Example of an Event log

For most purposes the System and Application logs contain the most useful information. If a server crashes or freezes – which is a very rare occurrence – there may well be clues in the System log. If there are suspected security violations then the Security log may contain details. However, note that the Security log is very "noisy" and may generate thousands of events every hour, making it difficult to sort out the important entries.

The Event logs will eventually overwrite when they are full. If required, they can be archived as permanent records or to preserve evidence. To do so, right-click on an Event Log and from the pop-up menu choose **Clear Log**. A message is displayed offering three choices – click the **Save and Clear** button. In the resultant dialog box specify a name for the file: a good choice is its name plus the date e.g. *setup-12092015*.

10.5 Anti-Virus & Anti-Malware Software

As with any computer, the server is susceptible to viruses and malware and for this reason an anti-virus program should be used. Fortunately, Windows 8.1 includes a credible built-in and free anti-virus program in the form of *Windows Defender* (previously known as Windows Security Essentials) and this is usually sufficient for most people. It is not necessary to use or purchase a separate anti-virus program, although this remains an option for those who prefer it (some people think a paid program is automatically better than a free one although there is no evidence to support this). If you are using a computer that was supplied with a third party anti-virus, perhaps in the form of a limited trial version, you should remove it and make sure that Windows Defender has been restored. To check the status of Windows Defender, go into the **Control Panel** and click the **Windows Defender** icon.

Also consider using *Malwarebytes*, a highly regarded piece of software for protecting against and cleaning up malware on computers. It will often sort out the 'nasties' that even the best anti-virus software misses, providing a valuable second line of defence. It is available in both free and paid versions; the paid version is very low cost and has the advantage that scans can be scheduled to take place automatically, as opposed to run manually. It is best obtained by downloading from the *www.malwarebytes.org* website.
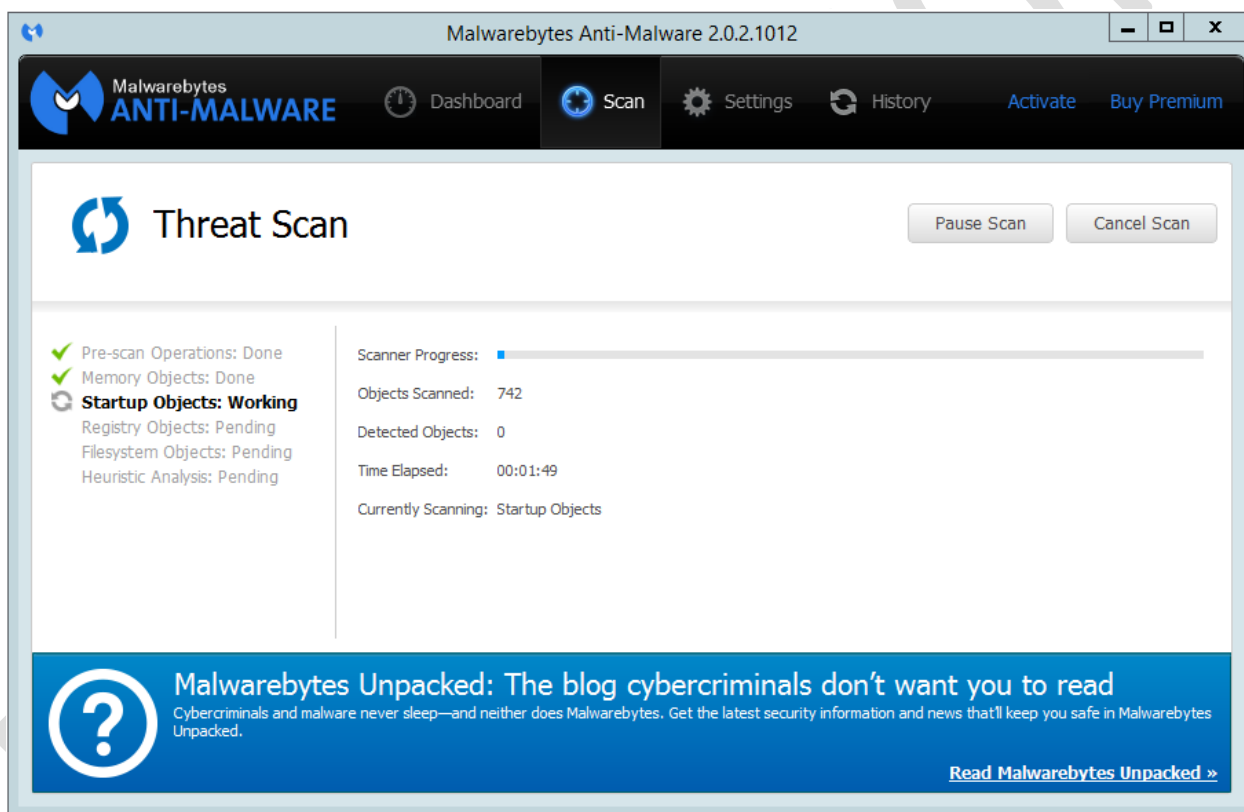

Figure 81: Main Malwarebytes scan screen

10.6 Remote Desktop

Note: this section is only applicable if you are using Windows 8.1 Professional edition or better.

When setting up the server a standard monitor, keyboard and mouse need to be used. However, once the server is up and running these can be dispensed with and it can be run in so-called *headless* mode. To access it for support purposes, the *Remote Desktop* capability of Windows is used. This has several advantages: firstly, the server can be accessed from any computer on the network and it is not necessary to have physical access to the server, which may be a consideration if it is situated in a secure, locked or otherwise inaccessible location. Secondly, dispensing with a physical screen, keyboard and mouse saves space (and possibly a small amount of electrical power). Thirdly, in some small organizations the server may have to be physically located in a general purpose office; not having a keyboard and screen will reduce the temptation for staff to treat it as just another computer.

During installation, Windows 8.1 should have automatically enabled Remote Desktop. This can be verified (or if necessary, corrected) by going into **Control Panel** and clicking the **System** icon. Click **Remote Settings** and the Remote tab of System Properties will be displayed. Make sure that the **Allow remote connections to this computer** and **Allow connections only from computers running Remote Desktop with Network Level Authentication** options are enabled. It is not necessary to use the **Select Users** button. Click **OK**.
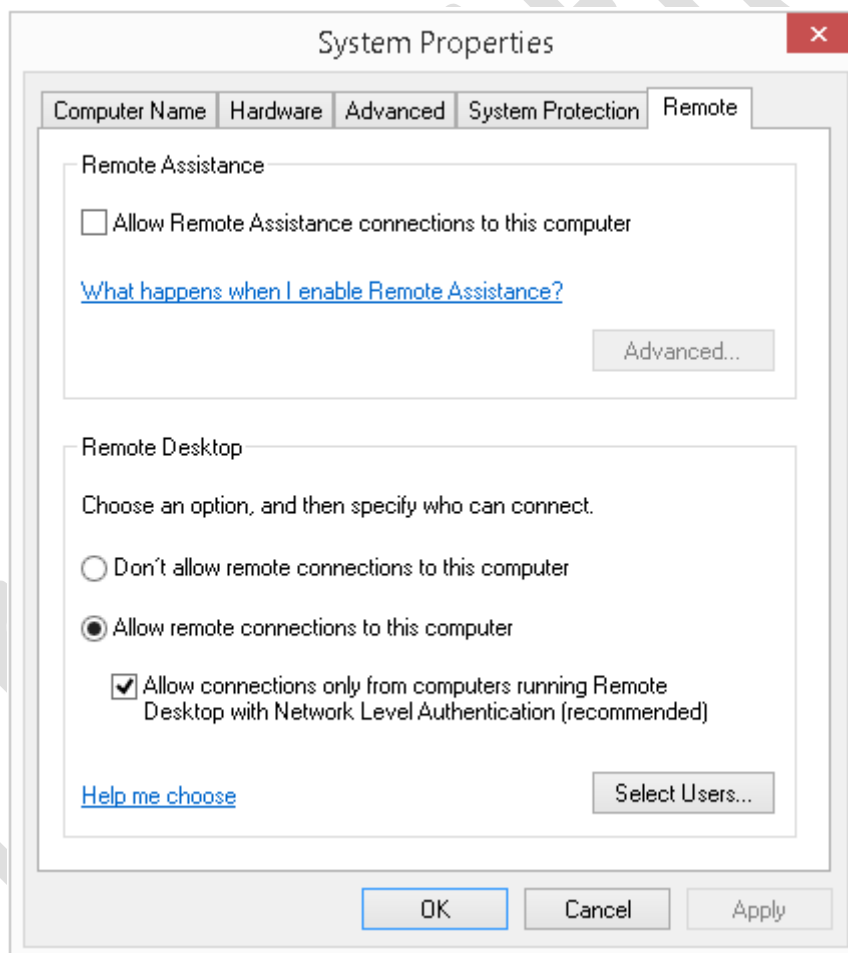
Figure 82: Enabling remote connections on the server

Test the facility by going to a computer on the network and launching the *Remote Desktop Connection* program, which is a standard part of Windows (located in **Start** > **All Programs** > **Accessories**). Enter the name of the server (i.e. *"server"*) and logon as *systemadmin*. A warning message along the following lines may be displayed – it can safely be ignored. Once everything has been tested, the physical screen, keyboard and mouse of the server can be dispensed with.

Figure 83: Certificate warning message from Remote Desktop

11 ACCESSING THE SERVER REMOTELY

Note: this facility requires the use of Windows 8.1 Professional edition or better.

The Remote Desktop facility described in [10.6 Remote Desktop](#) can also be used to access the server truly remotely i.e. from anywhere in the world, using the internet. This is very useful in a small business environment as the person responsible for looking after the server may not be permanently located in the office, or there may be a need to do support out-of-hours. To set this up it is necessary to first change the server to use a fixed IP address internally, configure a feature called *port forwarding* on your internet router, plus obtain a Dynamic DNS (DDNS) name. Note: this topic requires some technical knowledge.

11.1 Fixed IP Address

Every device within a network has a number to uniquely identify it, known as the *IP address*. The router itself will have a default fixed IP address decided by the manufacturer, for instance 192.168.1.1 is a common choice. It will then allocate numbers to computers and devices as they connect, for example the first computer might become 192.168.1.101, the second computer might become 192.168.1.102 and so on. A piece of software inside the router – known as a *DHCP server* – handles this process. The 'D' in DHCP stands for dynamic and indicates that the IP addresses are handled dynamically and recycled. So, for example, the next time the first computer is switched on it might be allocated a different number, say 192.168.1.108. The fact that the numbers change does not make any difference to computers but some devices prefer a fixed address, which is why routers have them. During normal usage the server will have received an IP address from the router's DHCP server. However, to use it remotely we need to change it to a fixed IP address.

Right-click the **Start** button and choose **Network Connections**. Right-click the network adapter and choose **Properties**. Highlight **Internet Protocol Version 4 (TCP/IPv4)** and click **Properties**. Change it to use a specific IP address. The address depends upon how the router is configured; typically they use a 198.168.nnn.nnn addressing scheme with the router itself on, say, 192.168.1.1 or 192.168.1.254. The server should be given a nearby address. You may have to refer to the router manufacturers documentation for its address but some common ones include: TalkTalk 192.168.1.1; Belkin 192.168.2.1; Buffalo 192.168.11.1; D-Link 192.168.0.1; BT 192.168.1.254; Billion 192.168.1.254; Linksys 192.168.1.1; Netgear 192.168.0.1; Apple 10.0.1.1. Another method to determine the IP address of the router on a Windows PC is as follows:

Right-click the **Start** button then choose **Run.** Alternatively, hold down the **Windows key** and press the letter **R**. In the small dialog box that appears, type in *cmd* and press **Enter**. In the black box that appears type **ipconfig** and hit **Enter**. Look for the entry that reads *Default Gateway*, which is another name for router.

In this example, the router is 192.168.1.1 so the server is being set to 192.168.1.2. The Default gateway is the address of the router; the subnet mask should be 255.255.255.0 and the Preferred DNS server set to the address of the router:
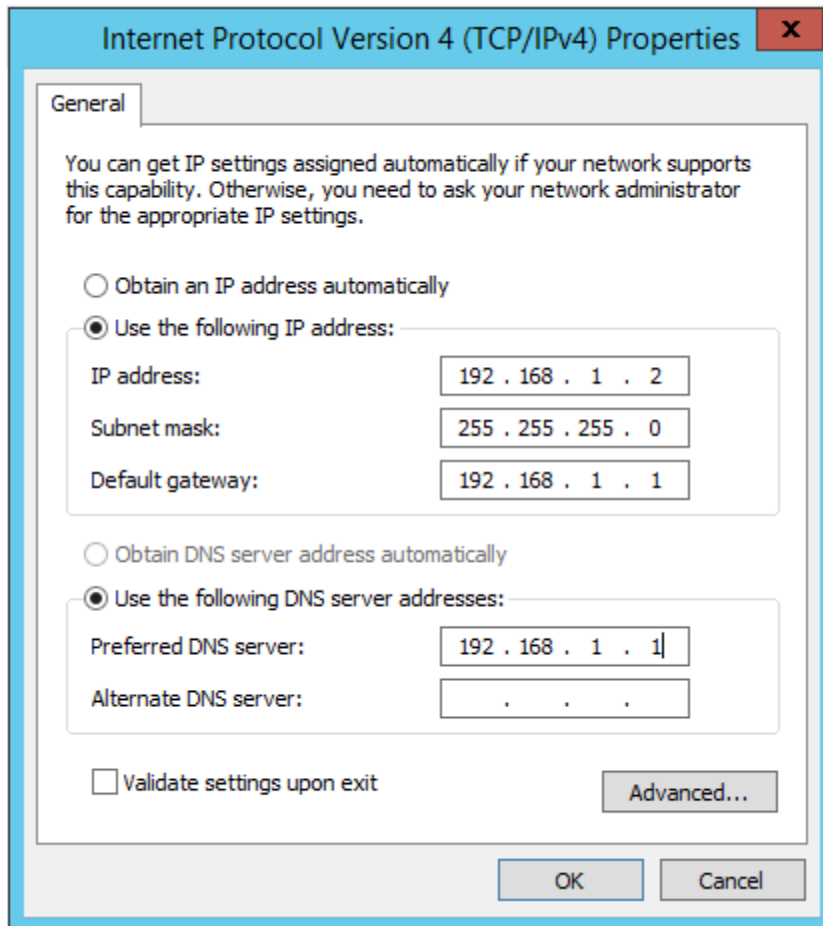
Figure 84: Specify the IP address

Make the change, click **OK** and **Close.** Restart the server. If any computers were connected to the server whilst you were doing this then they will probably have lost the connection and may need to be restarted themselves.

11.2 Port Forwarding

Port Forwarding is a technique that enables internet "traffic" to be directed at a particular device within a network. The internet is most commonly used for accessing web sites but is also used for many different types of traffic or protocols, such as Skype, email, FTP and so on. Each of these protocols has a particular number associated with it and in the case of remote desktop it is called RDP and has a (port) number of 3389. So, from a technical perspective the requirement is to forward port 3389 to the internal IP address of the Windows 8 server e.g. 192.168.1.2.

How to actually do this varies according to the individual router. In most cases it consists of: entering the internal IP address of the router (e.g. 192.168.1.1) into a browser; logging in as the admin user; finding the section concerned with port forwarding (which may in an 'Advanced section') and specifying that port 3389 should be forwarded to the server (192.168.1.2 in our example). There are a few exceptions to this; for instance, Apple AirPort routers are configured using the AirPort app that is available for Mac OS X and iOS. Refer to the instruction manual supplied by the manufacturer. Alternatively, instructions for configuring most popular routers can be found at the *www.portforward.com* website.

11.3 Dynamic DNS (DDNS)

It is easy to find a website on the internet – you simply enter its name e.g. *www.ctacs.co.uk*, *www.microsoft.com* or whatever you are interested in. But what is the name ("hostname") of your Windows 8 server on the internet? The answer is: it doesn't have one - it just has a number in the form of an external IP address provided by your ISP (internet service provider) and you need to know what this IP address is in order to access the server. To find out what your external IP address is go to a website such as *www.whatismyipaddress.com*. If you now enter this address into the

Remote Desktop Connection software as described in section you will be able to connect to the server.

However, there is a potential problem. In the same way that internal IP addresses can be fixed or dynamic, so can external IP addresses. Fixed IP addresses – usually called *static* IP addresses – are preferable as by definition they do not change and if you have or can obtain one from your ISP then you are home and dry. However, most ISPs, particularly those in the home or small business markets, usually provide a dynamic IP address. As such, your external address can change at any time. In fairness, with some ISPs the dynamic addresses are "sticky", in that they only usually change when the router is rebooted. In such cases, you may well have the same IP address for months on end; it might be an inconvenience when it does change, but if it's only a few times a year you might be able to live with it. But what if you cannot?

The answer to this is something called *Dynamic Domain Naming System* or *DDNS* (Dynamic DNS). DDNS services give you a unique name on the internet and automatically update what goes on behind the scenes when the underlying IP address changes. Numerous organisations provide DDNS services, some on a free basis and others on a commercial basis. Examples of suppliers include *No-IP*, *DynDNS* and *FreeDNS*. Most routers are able to work with DDNS – the account details have to be entered into them – although some will only work with a limited number of DDNS providers, fortunately the most popular ones. How to actually do this varies according to the individual router. In most cases it consists of entering the internal IP address of the router (e.g. 192.168.1.1) into a browser, logging in as the admin user and finding the section concerned with DDNS. The terminology can vary – the section may be called 'DDNS', 'Hostname' or 'Dynamic Global Hostname'

11.4 Using the Remote Desktop Client

Once everything has been configured you can test the remote access facility – it is best to do this from outside the home or office using a different internet connection. Launch the *Remote Desktop Connection* program, which is a standard part of Windows (located in **Start** > **All Programs** > **Accessories**). Enter the external IP address of the service, or the hostname if you have setup a DDNS account. Logon as *systemadmin*. A warning message along the following lines may be displayed – it can safely be ignored:

Figure 85: Certificate warning message from Remote Desktop

At this point you can use the server in much the same way as if you were sitting in front of it, although the quality of the experience will be depend upon the speed of the internet connection at each end.

Thank you!

We hope that you have found this guide helpful and interesting. Supplementary and supporting information can be found at the following website: www.serverinstallationguides.co.uk

If you have any suggestions or have found areas for improvement, please let us know at *enquiry@ctacs.co.uk*