

Starter Guide for Windows 10 IoT Enterprise 2nd Edition, Addendum 1

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Annabooks – www.annabooks.com

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OS: Windows 10 IoT Enterprise LTSC 2021 and Windows 11 IoT Enterprise LTSC 2024

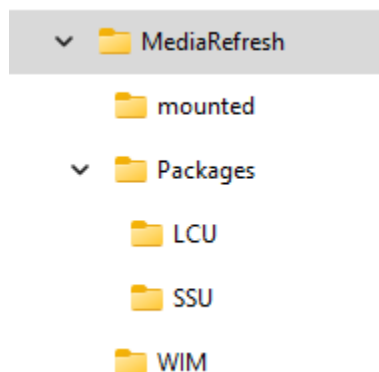
1.1 Introduction

Since the release of [Starter Guide for Windows 10 IoT Enterprise 2nd Edition \(annabooks.com\)](http://www.annabooks.com), Microsoft continues to make improvements to Windows 10 IoT Enterprise to help OEMs deliver best-in-class cloud edge devices. Chapter 5 covered footprint reduction from the OS background to tips and tricks to reduce the footprint. One of the tips is the feature package removal based on Microsoft's efforts to componentize the operating system. To run the removal PowerShell script, the May 24th, 2022 cumulative update (KB5014023 or later) needs to be installed. As discussed in the book, Microsoft is going to continue to refactor the operating system to create more feature packages that can be removed in future cumulative updates. A year later, Microsoft has made a big improvement in this area of reducing the footprint. This first addendum to the book will cover a new process to add the latest cumulative update and the new mechanism to remove packages.

1.2 Exercise 201B: Update the Install.wim

Microsoft has outlined generic steps to include the latest cumulative update as part of the Windows installation process: [Refresh IoT Enterprise Installation Media | Microsoft Learn](https://learn.microsoft.com/en-us/windows/iot/refresh-iot-enterprise-installation-media). The steps provided are a little more than what is needed for Windows 10 IoT Enterprise LTSC on x64. Chapter 2 covers all the basics to set up the development process and create an image. EX201 discussed extracting the files from the ISO and creating the catalog. This new EX201B builds on EX201 to include the cumulative update in the install.wim file. The update process works for both Windows 10 IoT Enterprise and Windows 11 IoT Enterprise.

1. Under the c:\WinData folder, create a folder called MediaRefresh.
2. Under c:\WinData\MediaRefresh, create three new folders: mount, Packages, and WIM.
3. Under c:\WinData\MediaRefresh\Packages, create two more folders: LCU and SSU.



4. Copy the install.wim file to the c:\WinData\MediaRefresh\WIM folder.
5. On the [Microsoft Learn Page](https://learn.microsoft.com/en-us/windows/iot/refresh-iot-enterprise-installation-media), click on the Show x64 updates under the links that are under "Gather servicing packages" for Windows 10 IoT Enterprise LTSC 2021. Using the October 2023 update as an example, the link for these updates located in the Windows Update Catalog is as follows: <https://www.catalog.update.microsoft.com/Search.aspx?q=->

[Dynamic%20Cumulative%20Update%20for%20Windows%2010%20Version%2021H2%20for%20x64](https://www.catalog.update.microsoft.com/Search.aspx?q=Dynamic%20Cumulative%20Update%20for%20Windows%2010%20Version%2021H2%20for%20x64)

The updates for Windows 11 IoT Enterprise LTSC 2024 (24H2):

<https://www.catalog.update.microsoft.com/Search.aspx?q=Dynamic%20Cumulative%20Update%20for%20Windows%2011%20Version%2024H2%20for%20x64>

- Download two MSU files that are associated with Windows 10 21H2 LTSC and put them into the LCU sub-folder. There is a cumulative update and there are 3 options for the .NET update. The one with the .NET 3.5, 4.8, and 4.8.1 is the one that will be selected for this example, since there are two downloads to select from; but you can choose the one that matches your system.

Updates: 1 - 25 of 100 (page 1 of 4)								Previous Next
Title	Products	Classification	Last Updated	Version	Size	Download		
2023-11 Cumulative Update for Windows 10 Version 21H2 for x64-based Systems (KB5032189)	Windows 10, version 1903 and later, Windows 10 LTSC	Security Updates	11/14/2023	n/a	779.0 MB	Download		
2023-11 Cumulative Update for .NET Framework 3.5 and 4.8.1 for Windows 10 Version 21H2 for x64 (KB5032005)	Windows 10, version 1903 and later, Windows 10 LTSC	Security Updates	11/14/2023	n/a	64.1 MB	Download		
2023-11 Cumulative Update for .NET Framework 3.5, 4.8 and 4.8.1 for Windows 10 Version 21H2 for x64 (KB5032338)	Windows 10, version 1903 and later, Windows 10 LTSC	Security Updates	11/14/2023	n/a	133.7 MB	Download		
2023-11 Cumulative Update for .NET Framework 3.5 and 4.8 for Windows 10 Version 21H2 for x64 (KB5031988)	Windows 10, version 1903 and later, Windows 10 LTSC	Security Updates	11/14/2023	n/a	69.7 MB	Download		
2023-10 Cumulative Update for Microsoft server operating system version 21H2 for x64-based Systems (KB5031364)	Microsoft Server operating system-21H2	Security Updates	10/10/2023	n/a	358.0 MB	Download		
2023-10 Cumulative Update for Windows 10 Version 21H2 for x64-based Systems (KB5031356)	Windows 10, version 1903 and later, Windows 10 LTSC	Security Updates	10/10/2023	n/a	767.8 MB	Download		
2023-10 Cumulative Update for .NET Framework 3.5, 4.8 and 4.8.1 for Windows 10 Version 21H2 for x64 (KB5031223)	Windows 10, version 1903 and later, Windows 10 LTSC	Updates	10/10/2023	n/a	133.8 MB	Download		

LCU:

- windows10.0-kb5032189-x64_0a3b690ba3fa6cd69a2b0f989f273cfeadba745f.msu
- windows10.0-kb5031988-x64-ndp48_cf8f8281813f1474b04a83398f4615c08786c2db.msu
- windows10.0-kb5032005-x64-ndp481_0348ffa856ec170b373c9e7edd580cb1f01a1f01.msu

- The cumulative update requires the latest servicing stack. In the catalog website, click on the cumulative update for Windows 10 Version 21H2.
- A separate window opens with information about the update. Click on more information to go to the support page.

Microsoft Update Catalog - Profile 1 - Microsoft Edge

<https://www.catalog.update.microsoft.com/ScopedViewInline.aspx?updateid=fb123f81-754e-4841-aa0...>

Update Details

2023-11 Cumulative Update for Windows 10 Version 21H2 for x64-based Systems (KB5032189)
 Last Modified: 11/14/2023
 Size: 779.0 MB
 UpdateID: fb123f81-754e-4841-aa0d-fec5f840dae

Details:

Overview | Language Selection | Package Details | Install Resources

Description: Install this update to resolve issues in Windows. For a complete listing of the issues that are included in this update, see the associated Microsoft Knowledge Base article for more information. After you install this item, you may have to restart your computer.

Architecture: AMD64
Classification: Security Updates
Supported products: Windows 10 LTSC, Windows 10, version 1903 and later
Supported languages: all

MSRC Number: n/a
MSRC severity: Critical
KB article numbers: 5032189

More information:
<https://support.microsoft.com/help/5032189>

Support Uri:
<https://support.microsoft.com/help/5032189>

9. At the bottom of the support page is a link to download the servicing stack update (SSU). Click on the link to get the details of the SSU. For November 2023 this is KB5014032.

How to get this update

Before installing this update

Microsoft now combines the latest servicing stack update (SSU) for your operating system with the latest cumulative update (LCU). For general information about SSUs, see [Servicing stack updates](#) and [Servicing Stack Updates \(SSU\): Frequently Asked Questions](#).

Prerequisite:

Based on your installation scenario, choose one of the following:

- For offline OS image servicing:

If your image does not have the March 22, 2022 (KB5011543) or later LCU, you **must** install the special standalone May 10, 2022 SSU (KB5014032) before installing this update.
- For Windows Server Update Services (WSUS) deployment or when installing the standalone package from Microsoft Update Catalog:

If your devices do not have the May 11, 2021 (KB5003173) or later LCU, you **must** install the special standalone August 10, 2021 SSU (KB5005260) before installing this update.

10. Search the Microsoft Update Catalog and download the .msu file to the SSU sub-folder.

SSU:

- ssu-19041.1704-x64_70e350118b85fdae082ab7fde8165a947341ba1a.msu

Note: For Windows 10 cumulative updates starting around May 2024 will need a new SSU msu file for the cumulative update to install without error. The new ssu file is in in [KB5031539](#):

ssu-19041.3562-x64_de23c91f483b2e609cec3e4a995639d13205f867.msu

and it can be downloaded from here: [Microsoft Update Catalog](#).

Note: Windows 11 IoT Enterprise doesn't require a ssu as of July 2024. Windows 11 24H2 cumulative update msu files can be injected into the install.wim without servicing stack update.

11. In the Chapter 2 folder of the [book file downloads](#) is a MediaRefresh.ps1 script. Copy the MediaRefersh.ps1 file to the c:\WinData\MediaRefresh folder. The file contains the PowerShell cmdlets to update the install.wim and split the resulting large install.wim into smaller .swm files that can be put on a FAT32 USB flash disk.

```
#updates the install.wim with the latest cumulative update
Set-ItemProperty -Path c:\WinData\MediaRefresh\WIM\install.wim -Name IsReadOnly -Value $false
Mount-WindowsImage -ImagePath c:\WinData\MediaRefresh\WIM\install.wim -Index 2 -Path c:\WinData\MediaRefresh\mounted
Add-WindowsPackage -Path c:\WinData\MediaRefresh\mounted -PackagePath c:\WinData\MediaRefresh\Packages\SSU
Add-WindowsPackage -Path c:\WinData\MediaRefresh\mounted -PackagePath c:\WinData\MediaRefresh\Packages\LCU
Dismount-WindowsImage -path c:\WinData\MediaRefresh\mounted -save
Split-WindowsImage -ImagePath c:\WinData\MediaRefresh\WIM\install.wim -SplitImagePath c:\WinData\MediaRefresh\WIM\install.swm -FileSize 4000 -CheckIntegrity
```

12. Option: Edit the MediaRefresh.ps1 file to update the root path for your development system.
13. Open PowerShell with administrative privileges.

14. Change directory to c:\WinData\MediaRefresh.
15. Run the MediaRefresh.ps1 file.

Note: If the mount point doesn't completely unmount you can run this cmdlet: *Clear-WindowsCorruptMountPoint*. You will have to reboot the host system to complete the clearing of the mount points.

```
PS C:\WinData\MediaRefresh> powershell -executionpolicy bypass -file .\MediaRefresh.ps1

Path           : c:\WinData\MediaRefresh\mounted
Online         : False
RestartNeeded  : False

Path           : c:\WinData\MediaRefresh\mounted
Online         : False
RestartNeeded  : False

Path           : c:\WinData\MediaRefresh\mounted
Online         : False
RestartNeeded  : False

LogPath        : C:\WINDOWS\Logs\DISM\dism.log
ScratchDirectory : 
LogLevel       : WarningsInfo

ImagePath      : c:\WinData\MediaRefresh\WIM\install.wim
Name           : 
LogPath        : C:\WINDOWS\Logs\DISM\dism.log
ScratchDirectory : C:\WINDOWS\temp\
LogLevel       : WarningsInfo

PS C:\WinData\MediaRefresh>
```

16. Copy the resulting .swm files to the c:\WinData\image\Sources folder.
17. Delete the install.wim found in the c:\WinData\image\Sources folder. Setup will use the install.swm files instead.

1.3 Warning: Product Life Cycle

I am not a big fan of injecting things in the install.wim or boot.wim files unless it is absolutely necessary, but adding the updates helps to make sure you have the latest support in the image. Embedded/IoT products last a long time. What I have seen over 2 decades is that the person building the image moves on to other projects or another company, which leaves a knowledge gap for the next individual who is tasked with building or updating the image. Once a driver, update, or application has been injected into the install.wim, there is no way to tell, by looking at the .wim file, what is or isn't updated. The new developer will not have any knowledge if the install.wim is good or bad when problems arise. It is important to document all development steps to create the image, which is something I do for every client who hires me as a consultant. I recommend that you create a folder system to store each install.wim, install.swm file, and catalog file for each update starting with the Windows installer ISO as the base.

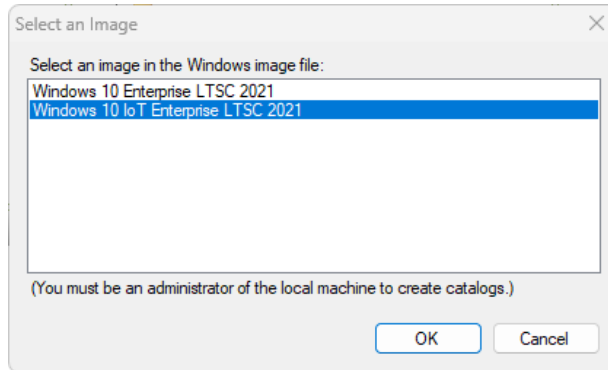
Windows 10 LTSC 2021 - ISO
Windows 10 LTSC 2021 – October 2023
Windows 10 LTSC 2021 – November 2023

The folder system provides a fallback for future developers and can assist with troubleshooting with older image. The big impact is in how and where to store all these very large files.

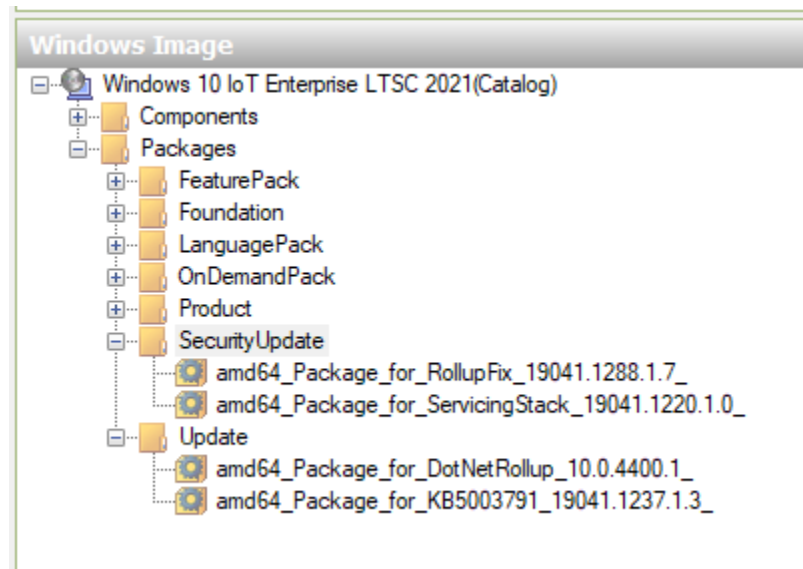
1.4 EX201C: Generate a New Catalog file

With the install.wim updated, it is possible to generate a new catalog file to create answer files.

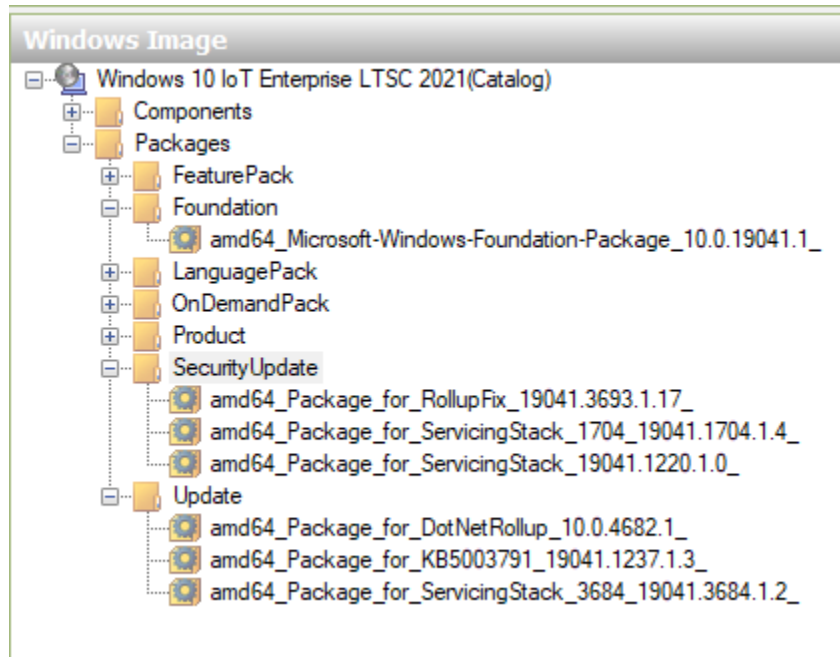
1. Open SIM.
2. From the menu, select Tools->Create Catalog...
3. Open the newly updated c:\WinData\MediaRefresh\WIM\install.wim.
4. A dialog appears. You will have to select Windows 10 IoT Enterprise LTSC 2021 and click OK. A CLG file will be created and placed next to the install.wim.



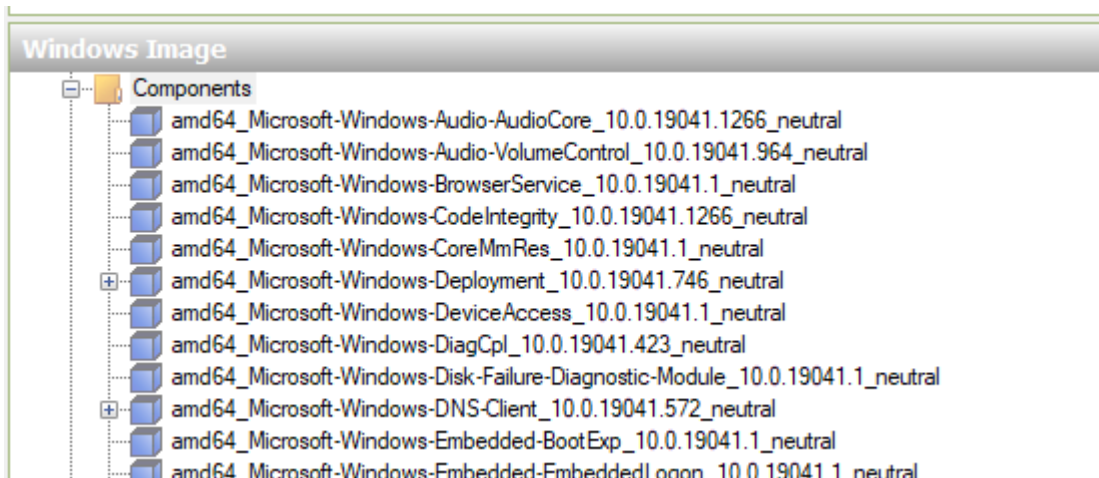
The difference between the old and new catalogs can be seen in SIM. First, the SecurityUpdate and Update folder branches look like this:



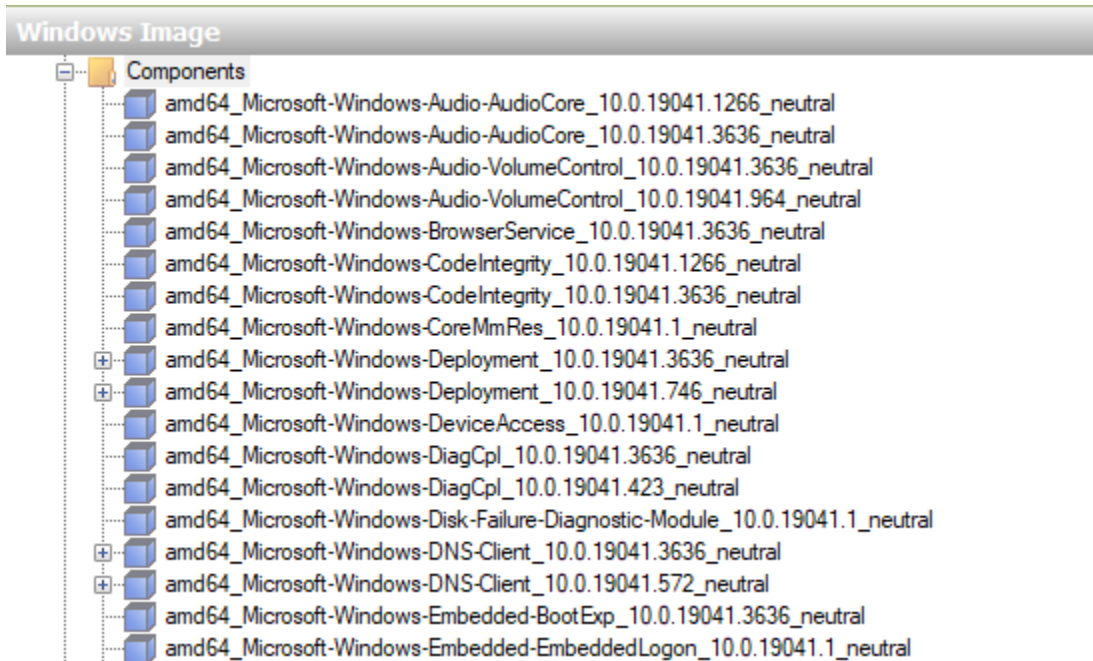
The updated version adds the servicing stack.



Second, the components with updates have the 10.0.19041.3636 in the name for November 2023 Cumulative Updates. Here are the original components:



Here are the update components:



Note: Any answer files created with the old catalog will have to be updated to the new catalog.

1.5 Windows Installation Disk Space Requirements

Injecting the cumulative update into the install.wim affects the installation partition size. Without the update you could get away with a C partition of around 24GB, but the updated install.wim will require 32GB to install. The more items added to the install.wim, the more the size of the C partition will have to increase. The final C partition can always be shrunk to a smaller size after Windows has been installed and cleaned up.

How the Windows installer works is the reason why so much space is required. When Windows installs, all the internal cab files are copied to the disk and then expanded on the installation partition. Once everything has been expanded, the install puts the files into their correct location in the file system, and some space is given back. I have noted the installation process in the past with Windows Embedded Standard 7.

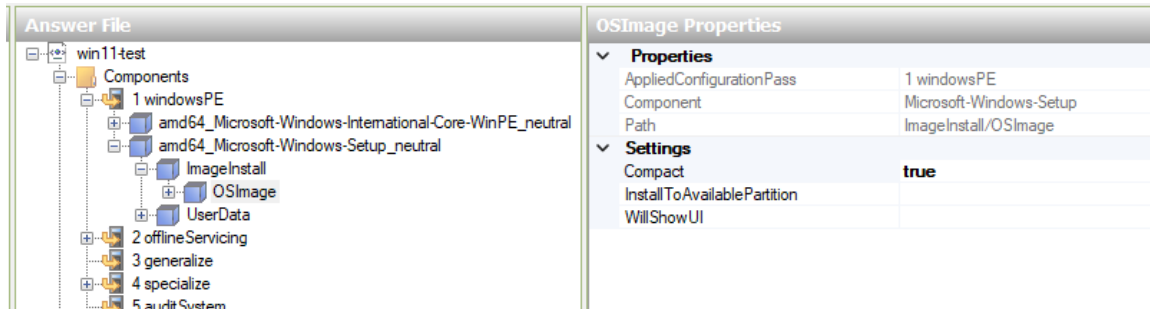
1.6 Chapter 5 Footprint Reduction Update

Now, we come back to Chapter 5's footprint reduction topic. With the cumulative update included in the install.wim, removing packages based on the cumulative update becomes a little easier. This page: [Removable Packages Overview | Microsoft Learn](#) lists the available packages that can be removed. Instead of running a PowerShell script, as described in the book, you can now run a DISM.exe command to remove each feature. For example, the following command removes Media Foundation:

```
Dism.exe /Online /NoRestart /Disable-Feature /FeatureName:Microsoft-Media-Foundation /PackageName:@Package
```

There are about 18 packages that can be removed. You can click on each package description on the page to get the DISM command line to remove the feature. All of the commands can be put into a batch file and run as a pass 7 synch command, which makes EX501 and EX502 easier to implement. As called out in the book, removing features doesn't really have a big impact on the size of the image, but at least the unneeded features are not in the image. Please be aware that Microsoft is continuing to improve Windows and the listed packages will change over time.

Section 5.7.4 calls out setting the compact OS to true. This is still a valid step to help reduce the overall footprint.



There is an advantage to including the cumulative update. With the install.wim that comes with the ISO, the image size is around 10GB after installation. In the book, I recommend installing Windows Update so you get the latest update and device drivers into the image. With the cumulative update added to install.wim, the image size will be around 14 to 16GB after installation. Based on the size, you might say that nothing has changed, but there is a difference. After the packages have been removed, you will still need to run the following command to clean up the WinSXS folder:

```
Dism.exe /online /Cleanup-Image /StartComponentCleanup /Resetbase
```

You will also need to run the Disk Clean-up utility that is in Control Panel. Combining these operations with the Compact OS option, I observed that the image with the cumulative update included in the install.wim shrinks down to ~9GB, whereas adding the cumulative update after Windows installation results in an image size that is 3 to 5GB larger. With the image size smaller, diskpart.exe can be used to shrink drive C to a smaller size to make room for a secondary data partition on the same disk.

1.7 Summary: Getting Smaller, but Still Big

Windows XP could get down to 100MB to perform something basic, and Windows 7 was less than 1GB. Windows 10 IoT Enterprise is still a big operating system. When calculating the footprint for your system, 9GB is going to be the minimum. The new process of including the cumulative update into the install.wim requires a large partition to perform the installation, but removing packages becomes much easier and image cleanup gets the size back down to something more reasonable. When including the cumulative update in the install.wim, make sure you document everything for the next person to be able to support the product.