

# Starter Guide for Windows 10 IoT Enterprise 2<sup>nd</sup> Edition, Addendum 2 – Windows 11

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OS: Windows 11 IoT Enterprise LTSC 2024

With the release of Windows 11 IoT Enterprise LTSC 2024, the question has been asked if is there going to be a new book. The answer is not at this time for x64. Other than the interface and a big change to device driver inclusion, there is not enough change to warrant a whole new book; but as time moves on, a new book could be in the works. For now, the objective is to release addendums to the current book to cover new topics and minor changes. This addendum will cover what is new and different for Windows 11 IoT Enterprise.

## 1.1 Windows 11 Moving Forward

Windows 10 IoT Enterprise LTSC 2021 is the last release of Windows 10 for the Embedded/IoT market. Windows 11 IoT Enterprise LTSC release will be the Windows OS moving forward and for the foreseeable future. The first of these releases is Windows 11 IoT Enterprise LTSC 2024. Any related Language Package DVD ISOs or Feature-on-Demand DVD ISOs need to match with the Windows 11 24H2 release.

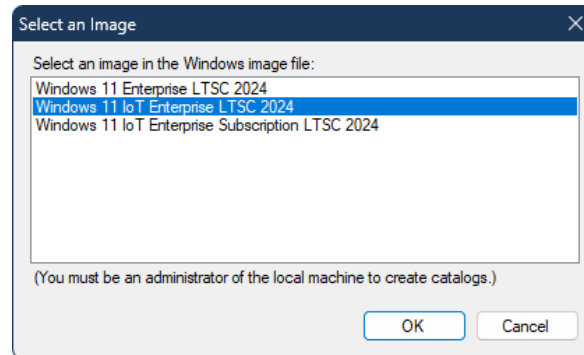
Microsoft has a bit of a history of product offerings coming and going in the Embedded/IoT market space, such as Windows CE, .NET Micro Framework, and Azure RTOS. The desktop operating systems have been the mainstay in the marketplace for some time. Windows 11 IoT Enterprise LTSC 2024 continues the long line of desktop operating systems for the Embedded/IoT marketplace.

| Desktop Operating System            | Year Released | Publications by Sean D. Liming and John R. Malin                              |
|-------------------------------------|---------------|---|
| MS-DOS 3.31                         | 1987          |   |
| MS-DOS 5                            | 1991          |   |
| MS-DOS 5.0 ROM Version              | 1991          |   |
| MS-DOS 6.22                         | 1994          |   |
| Windows 95                          | 1995          | Article: "Shrinking Windows 95"   |
| Windows NT Embedded                 | 1999          | <i>Windows NT Embedded Step-by-Step</i>                                       |
| Windows XP Embedded                 | 2001          | <i>Windows XP Embedded Advanced Windows XP Embedded Supplemental Toolkit.</i> |
| Windows Embedded Standard 7         | 2010          | <i>Professional's Guide to Windows Embedded Standard 7</i>                    |
| Windows Embedded 8 Standard         | 2013          | <i>Professional's Guide to Windows Embedded 8 Standard</i>                    |
| Windows Embedded 8.1 Industry       | 2013          | <i>Starter Guide for Windows® System Image Manager</i>                        |
| Windows 10 Enterprise LTSB 2015     | 2015          |   |
| Windows 10 Enterprise LTSB 2016     | 2016          | <i>Starter Guide for Windows® 10 IoT Enterprise</i>                           |
| Windows 10 IoT Enterprise LTSC 2019 | 2019          |   |
| Windows 10 IoT Enterprise LTSC 2021 | 2021          | <i>Starter Guide for Windows® 10 IoT Enterprise 2nd Edition</i>               |
| Windows 11 IoT Enterprise LTSC 2024 | 2024          |   |

## 1.2 Create the New Catalog and Recreate the Answer Files

The book [Starter Guide for Windows® 10 IoT Enterprise 2nd Edition](#) introduced the best practice development process to customize Windows 10 IoT Enterprise for a device. There is one change to the development process for Windows 11 IoT Enterprise LTSC 2024, which is discussed in the next section; but all the other steps are the same. System Image Manager (SIM) from the Windows ADK is still the best tool to assist in creating customizable images.

Per the book, one of the first steps is to create a catalog file from the install.wim file. The Windows 11 Enterprise LTSC 2024 DVD ISO has three supported versions. You will want to choose the middle version, Windows 11 IoT Enterprise LTSC 2024



When installing the OS, this dialog appears asking which version to choose. You can pre-answer this dialog in the answer file by setting the InstallFrom using /IMAGE/INDEX for the key and 2 for the value.

| Answer File   | MetaData[Key="/IMAGE/INDEX"] Properties  |                          |             |           |                         |         |     |      |   |        |                     |     |                     |       |          |
|---|--|--------------------------|-------------|-----------|-------------------------|---------|-----|------|---|--------|---------------------|-----|---------------------|-------|----------|
| <ul style="list-style-type: none"> <li>win11-Lang-test           <ul style="list-style-type: none"> <li>Components               <ul style="list-style-type: none"> <li>1 windowsPE                   <ul style="list-style-type: none"> <li>amd64_Microsoft-Windows-International-Core-WinPE_neut</li> <li>amd64_Microsoft-Windows-Setup_neutral                       <ul style="list-style-type: none"> <li>ImageInstall                           <ul style="list-style-type: none"> <li>OSImage                               <ul style="list-style-type: none"> <li>InstallFrom                                   <ul style="list-style-type: none"> <li>MetaData[Key="/IMAGE/INDEX"]</li> </ul> </li> </ul> </li> </ul> </li> </ul> </li> <li>UserData               <ul style="list-style-type: none"> <li>2 offlineServicing</li> </ul> </li> </ul> </li> </ul> </li> </ul> </li></ul> | <ul style="list-style-type: none"> <li>Properties           <table border="1"> <tr><td>AppliedConfigurationPass</td><td>1 windowsPE</td></tr> <tr><td>Component</td><td>Microsoft-Windows-Setup</td></tr> <tr><td>KeyName</td><td>Key</td></tr> <tr><td>Path</td><td>ImageInstall/OSImage/InstallFrom/MetaDa</td></tr> </table> </li> <li>Settings           <table border="1"> <tr><td>Action</td><td><b>AddList Item</b></td></tr> <tr><td>Key</td><td><b>/IMAGE/INDEX</b></td></tr> <tr><td>Value</td><td><b>2</b></td></tr> </table> </li> </ul> | AppliedConfigurationPass | 1 windowsPE | Component | Microsoft-Windows-Setup | KeyName | Key | Path | ImageInstall/OSImage/InstallFrom/MetaDa | Action | <b>AddList Item</b> | Key | <b>/IMAGE/INDEX</b> | Value | <b>2</b> |
| AppliedConfigurationPass  | 1 windowsPE  |                          |             |           |                         |         |     |      |   |        |                     |     |                     |       |          |
| Component   | Microsoft-Windows-Setup  |                          |             |           |                         |         |     |      |   |        |                     |     |                     |       |          |
| KeyName   | Key  |                          |             |           |                         |         |     |      |   |        |                     |     |                     |       |          |
| Path  | ImageInstall/OSImage/InstallFrom/MetaDa  |                          |             |           |                         |         |     |      |   |        |                     |     |                     |       |          |
| Action  | <b>AddList Item</b>  |                          |             |           |                         |         |     |      |   |        |                     |     |                     |       |          |
| Key   | <b>/IMAGE/INDEX</b>  |                          |             |           |                         |         |     |      |   |        |                     |     |                     |       |          |
| Value   | <b>2</b>   |                          |             |           |                         |         |     |      |   |        |                     |     |                     |       |          |

If you are migrating from Windows 10 IoT Enterprise LTSC, you can re-use the distribution share; but you will need to create a new answer file using the new Windows 11 IoT Enterprise LTSC 2024 catalog. The effort is a simple copy and paste from the Windows 10 answer file to the Windows 11 answer file. The rest of the development process stays the same.

## 1.3 The Big Device Driver Change or Undocumented Feature

The biggest change is regarding device drivers in Distribution Share's Out-of-Box Folder. Per the book, the captured drivers get put into the Out-of-Box Folder and a link is made into the answer file Pass 2 offlineServicing. During installation, the drivers get installed into the image during Windows OS installation. The driver install is either broken or not supported in Windows 11 IoT Enterprise. There are three solutions that can be used to get around this issue:

- a. Hardcode the AutoUnattend.xml to the path of the installation USB drive. The main problem is that the IBW doesn't set the %configsetroot% path variable. As a result, the installation of the Out-of-box drivers fails since there is no correct path.

```

    <component name="Microsoft-Windows-PnpCustomizationsNonWinPE"
processorArchitecture="amd64" publicKeyToken="31bf3856ad364e35" language="neutral"
versionScope="nonSxS" xmlns:wcm="http://schemas.microsoft.com/WMIConfig/2002/State"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
    <DriverPaths>
        <PathAndCredentials wcm:keyValue="bb979dbc" wcm:action="add">
            <Path>%configsetroot%\AutoUnattend_Files\WE-11-IoT-E\DS64\Out-of-Box
Drivers\Asrock-i9</Path>
        </PathAndCredentials>
    </DriverPaths>
</component>

```

- b. Boot the installer to IBW.
- c. Hit SHIFT+F10 to open a command window.
- d. Locate the root drive letter for the installation USB disk.
- e. Run notepad and edit the AutoUnattend.xml
- f. Save the changes and reboot to start the installation process over again.

```

    <component name="Microsoft-Windows-PnpCustomizationsNonWinPE"
processorArchitecture="amd64" publicKeyToken="31bf3856ad364e35" language="neutral"
versionScope="nonSxS" xmlns:wcm="http://schemas.microsoft.com/WMIConfig/2002/State"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
    <DriverPaths>
        <PathAndCredentials wcm:keyValue="bb979dbc" wcm:action="add">
            <Path>d:\AutoUnattend_Files\WE-11-IoT-E\DS64\Out-of-Box Drivers\Asrock-
i9</Path>
        </PathAndCredentials>
    </DriverPaths>
</component>

```

1. Put the device drivers in a c:\setup\drivers folder, and use a pass 4 or 7 synchronous command that installs the drivers:

```
pnputil.exe /add-driver c:\setup\drivers\*.inf /subdirs /install
```

**Note:** Some drivers will force a reboot.

2. Inject the drivers into the install.wim. Per Addendum 1, Windows Updates can be injected into the install.wim. The same can be performed for device drivers. Building on Addendum 1, a drivers folder can be added to the Packages subfolder:

```
C:\WinData\MediaRefresh\Packages\Drivers
```

The MediaRefresh.ps1 script can be modified with a call to DISM.exe to install the drivers in the subfolder:

```
#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
```

```
Dism.exe /Image:C:\WinData\MediaRefresh\mounted /Add-Driver
/Driver:C:\WinData\MediaRefresh\Packages\Drivers /Recurse
```

```
Add-WindowsPackage -Path c:\WinData\MediaRefresh\mounted -PackagePath
c:\WinData\MediaRefresh\Packages\LCU
Dismount-WindowsImage -path c:\WinData\MediaRefresh\mounted -save
```

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```
Split-windowsImage -ImagePath c:\WinData\MediaRefresh\WIM\install.wim -
SplitImagePath c:\WinData\MediaRefresh\WIM\install.swm -FileSize 4000 -
CheckIntegrity
```

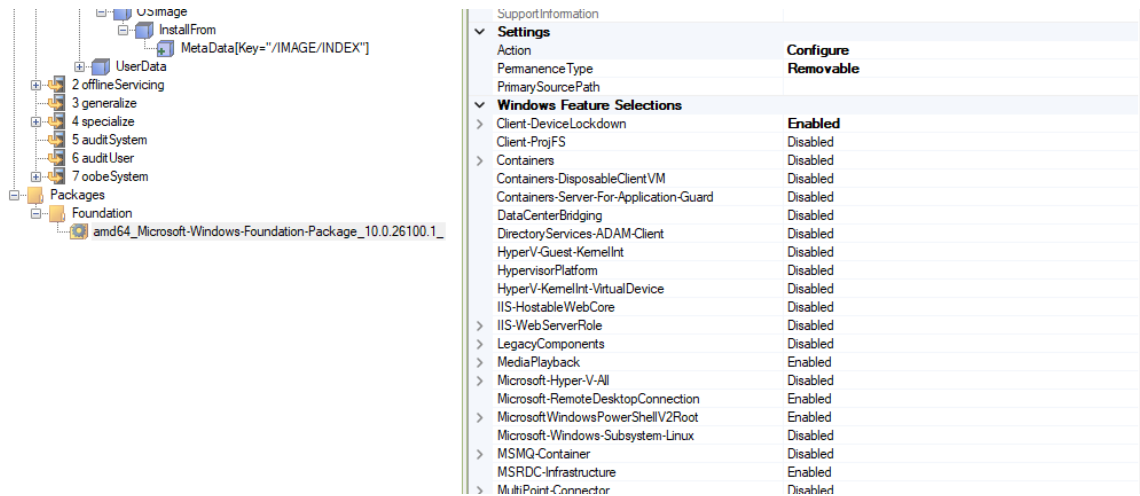
The solution choice is up to you, but keep in mind the full development life cycle of your project. The need to maintain a proper build process for customer support and future releases is very important.

## 1.4 Security

Windows 11 has hardware-specific requirements: TPM chip, UEFI BIOS with Secure Boot, and specific supported processors. Windows 11 IoT Enterprise LTSC 2024 still has the processor requirement but is a little more forgiving on the rest of the requirements. Regardless, security is a big concern in the industry, so you should consider using hardware with a TPM and UEFI BIOS with Secure Boot.

## 1.5 No Internet Explorer But there is Edge

Internet Explorer is officially gone. The option to Enable or Disable Internet Explorer in the answer file is gone. Unfortunately, Edge browser is locked into the Windows OS and there is no way to remove it. All the little registry and setup.exe removal tricks do not work. Edge will now be part of medical devices, industrial controls, POS systems, etc., whether anyone likes it or not.



The image shows a screenshot of a Windows installation catalog. On the left, a tree view displays the installation process steps: 1. UserData, 2. offlineServicing, 3. generalize, 4. specialize, 5. auditSystem, 6. auditUser, 7. oobeSystem, Packages, and Foundation. The 'Foundation' package is expanded to show 'amd64\_Microsoft-Windows-Foundation-Package\_10.0.26100.1\_'. On the right, a table titled 'Support Information' lists various Windows features and their status.

| Feature                                 | Status   | Action    |
|---|----------|-----------|
| Settings                                |          | Configure |
| Action                                  |          | Removable |
| PermanenceType                          |          |           |
| PrimarySourcePath                       |          |           |
| <b>Windows Feature Selections</b>       |          |           |
| Client-DeviceLockdown                   | Enabled  |           |
| Client-ProjFS                           | Disabled |           |
| Containers                              | Disabled |           |
| Containers-DisposableClientVM           | Disabled |           |
| Containers-Server-For-Application-Guard | Disabled |           |
| DataCenterBridging                      | Disabled |           |
| DirectoryServices-ADAM-Client           | Disabled |           |
| Hyperv-Guest-KernelInt                  | Disabled |           |
| HypervisorPlatform                      | Disabled |           |
| Hyperv-KernelInt-VirtualDevice          | Disabled |           |
| IIS-HostableWebCore                     | Disabled |           |
| IIS-WebServerRole                       | Disabled |           |
| LegacyComponents                        | Disabled |           |
| MediaPlayback                           | Enabled  |           |
| Microsoft-Hyper-V-All                   | Disabled |           |
| Microsoft-RemoteDesktopConnection       | Enabled  |           |
| Microsoft-Windows-PowerShellV2Root      | Enabled  |           |
| Microsoft-Windows-Subsystem-Linux       | Disabled |           |
| MSMQ-Container                          | Disabled |           |
| MSRDC-Infrastructure                    | Enabled  |           |
| MultiPoint-Connector                    | Disabled |           |

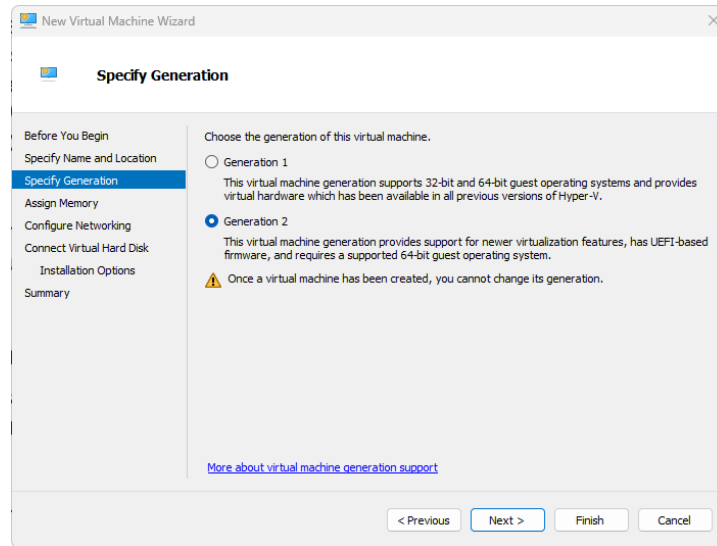
## 1.6 Device Lockdown and Annabooks Utilities

Since the release of Windows 10 Enterprise LTSC 2015, the Shell Launcher and Unified Write Filter components in the catalog do not work. If you add the components to the answer file and set the settings, the settings never get applied to the installed Windows OS. There is only one change to this with Windows 11 IoT Enterprise LTSC 2024. You can set up the default shell in the Shell Launcher Component, but you cannot set up user-specific shells. Fortunately, [Shell Launcher](#), [Keyboard Filter](#), and [UWF GUI utilities](#) from Annabooks work with Windows 11 IoT Enterprise LTSC 2024. The Shell Launcher command line utility can be called via a synchronous command in the answer file to pre-set different settings.

## 1.7 Hyper-V

Nothing beats working with real hardware, but virtual machines provide a nice way to learn the development process. Keep in mind that the image created in Hyper-V cannot be transferred to

real hardware. When setting up the virtual machine in Hyper-V, please create the virtual machine with Generation 2 VM with UEFI support.



The only way to install Windows in the VM is to use an ISO file. Windows ADK comes with the `oscdimg.exe` utility to generate an ISO file from a folder. The boot file required for Generation 2 VM is the `efisys.bin` file that is found in the Windows ADK and not in the Windows 11 IoT Enterprise installer. The following is a batch file to generate the ISO with the installer files found in the `D:\WE-11-IoT-E\OS-Files` folder:

```
"C:\Program Files (x86)\windows kits\10\Assessment and Deployment
Kit\Deployment Tools\amd64\oscdimg\oscdimg.exe" -b"C:\Program Files
(x86)\windows kits\10\Assessment and Deployment Kit\Deployment
Tools\amd64\Oscdimg\efisys.bin" -pEF -u1 -udfver102 "D:\WE-11-IoT-E\OS-
Files" "D:\WE-11-IoT-E\OS-Files\win11IoT.iso"
```

## 1.8 Summary

The only major change between Windows 10 IoT Enterprise and Windows 11 IoT Enterprise is the device driver installation. The rest of the development process outlined in the book is still good. A new catalog needs to be created along with new answer files that use the new catalog. There are some minor items that we discussed in this addendum; and as time goes on with new releases, we will keep an eye out for any interesting topics or features to cover.

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