# **Module 6**

**Configuring Printing**

|  |
| --- |
| **At a Glance** |

#### Instructor’s Manual Table of Contents

* Overview
* Objectives
* Teaching Tips
* Quick Quizzes
* Class Discussion Topics
* Additional Projects
* Additional Resources
* Key Terms

|  |
| --- |
| Lecture Notes |

# **Overview**

In this module, your students will learn how printing works in Windows Server 2019, including network and Internet printing. They will learn how to configure and monitor a print server using the Print and Document Services role. As server administrators, they will learn how to install, configure, and use the Print Management tool to add and configure shared printers. Additionally, your students will learn how to simplify the addition of printers on client computers within their organization by using Group Policy to automatically add SMB shared printers to computers that are joined to the domain, provided that the appropriate printer drivers for the computers are installed on the print server. Finally, they will learn how to troubleshoot a range of printing problems.

# **Module Objectives**

* Describe the process for printing documents to a print device or shared printer
* Configure and monitor a print server using the Print and Document Services role
* Use the Print Management tool to add and configure shared printers
* Deploy shared printers using Group Policy
* Manage print jobs
* Troubleshoot common printing problems

# **Teaching Tips**

**Windows Printing Basics**

1. Introduce this topic by mentioning that setting up a physical printer on a Windows client or server system is a relatively straightforward process.
2. Explain how physical printers that are PnP-capable connect to a system and are configured in a system.
3. Explain how physical printers that are not PnP-capable, as well as printers that have a network interface, connect to a system and are configured in a system.
4. Refer to Figure 6-1 and explain that after being installed, each printer will be represented by a printer name and icon within the Devices and Printers utility. Mention that this allows an administrator to select this same printer name within the Print window of a software application to print a document to the physical printer.
5. Explain that as with folders, an administrator can configure printers on a Windows Server 2019 system as a shared resource that grants access to users on the network. Review the advantages this provides.

|  |  |
| --- | --- |
| ***Teaching***  ***Tip*** | Take the time to explain the terms for locally attached printers and network-attached printers. Similarly, review the definitions for locally attached print devices and network-attached print devices. |

**The Printing Process**

1. Introduce this section by explaining that after a locally attached or network-attached printer has been configured on a Windows system, several events must occur before a document can be successfully printed. Review the five steps involved in the printing process and all of the related terms.
2. Explain that in step one, the user of a software application, such as Microsoft Word, chooses to print their document to a printer that is installed on the system.
3. Explain that in step two, the software application contacts a print application programming interface (API) within the Windows operating system that stores the document within a spool folder located under C:\Windows\System32\spool\PRINTERS. Review the two different print APIs that are available: Graphics Device Interface (GDI) and XML Paper Specification (XPS).

|  |  |
| --- | --- |
| ***Teaching***  ***Tip*** | Mention that the spool folder is also called the print queue. Also, note that the process of converting a document to EMF or XPS format and storing it within a spool folder is called spooling or queuing. |

1. Explain that in step three, the documents within the spool folder are converted to a format that the print device can accept using instructions within the printer driver. Note that this process is called rendering, and often results in a much larger file within the spool folder compared to the original document. Emphasize that at this point, the document is called a print job.
2. Explain that in step four, the print job is then sent to the locally attached or network-attached print device after the print device acknowledges that it is ready to receive it.
3. Explain that in step five, the print device proceeds to print the document and notifies you when the print job has completed.

|  |  |
| --- | --- |
| ***Teaching***  ***Tip*** | Discuss how storage and memory affect print capabilities. |

|  |  |
| --- | --- |
| ***Teaching***  ***Tip*** | The Print Spooler service within Windows provides for the functionality described within steps one through five. |

**Printing to a Shared Printer**

1. Introduce this topic by explaining why nearly all network-attached print devices within organizations today are configured to only accept print jobs from a print server.
2. Review the advantages a print server provides.

* Allows users to submit print jobs from across the network
* Provides the storage capacity and processor capabilities to handle print jobs from a large number of users
* Can be used to share locally attached print devices to users across the network that would otherwise not be able to contact the print device
* An organization can manage and control access to the network-attached and locally attached printers that are shared by the print server

1. Explain that an administrator must specify the print server that is sharing the printer, as well as the name of the shared printer to which the administrator has permission to print.
2. Explain that the format an administrator specifies when connecting to a shared printer depends on the protocol that is used. Review the three printer sharing protocols Windows systems support:

* Server Message Block (SMB)
* Internet Printing Protocol (IPP)
* Line Printer Daemon (LPD)

1. Emphasize that a computer must have the Internet Printing Client feature installed in order to print to a shared IPP printer, and the LPR Port Monitor feature installed in order to print to a shared LPD printer.
2. Mention that these features can be installed within the Add Roles and Features wizard on a Windows Server 2019 system.
3. Refer to Figure 6-2 and explain that to install these features on a Windows 8 or later system, an administrator can access the Programs and Features tool within Control Panel, click *Turn Windows features on or off*, and select them under the Print and Document Services.
4. Mention that an administrator can use the Devices and Printers utility on a Windows system to add a printer that prints to a shared printer on the network.
5. Refer back to Figure 6-1 and explain that if an administrator clicks Add a printer, the Add a device wizard will first attempt to locate a locally attached print device, a network-attached print device that advertises its presence on the network, or a shared printer that is published in Active Directory. Mention that if the print device or shared printer is listed, you can select it from the list to start the Add Printer wizard.
6. Refer to Figure 6-3 and explain that if the shared printer is not listed, an administrator can click *The printer that I want isn’t listed* to manually specify the location to the shared printer. Explain that this selection opens the Add Printer wizard.
7. Refer to Figure 6-4 to illustrate the Add Printer wizard. Note that to add an SMB or IPP shared printer, an administrator can select *Select a shared printer by name* and supply the correct format in the text box for the shared printer. Review the example in Figure 6-4.
8. Refer to Figure 6-4 again, and explain that to add an LPD shared printer, an administrator must select *Add a local printer or network printer with manual settings* and click Next.
9. Refer to Figure 6-5 and explain that an administrator can create a new LPR port using the options shown in the figure and then click Next.
10. Refer to Figure 6-6 to illustrate the window where an administrator is prompted for the LPD server name and printer name.
11. Mention that after an administrator specifies the location of an SMB, IPP, or LPD shared printer within the Add Printer wizard and clicks Next, the printer driver will be downloaded from the hidden PRINT$ share on the print server.
12. Note that if the printer driver for the print device is not available on the print server for the operating system, the Add Printer wizard will prompt the administrator to select the appropriate printer driver from a list, or supply the printer driver files manually.
13. Explain that following this action, the Add Printer wizard will prompt an administrator to optionally:

* Modify the default printer name
* Share the printer to other computers
* Print a test page

|  |  |
| --- | --- |
| ***Teaching***  ***Tip*** | Computers that print to a shared printer on a print server are commonly called print clients. |

**The Printing Process for a Shared Printer**

1. Introduce this topic by explaining that the process used by a print client when printing to a shared printer across the network starts with the same three steps used when printing to a locally attached or network-attached printer. Review those three steps if necessary.
2. Note that after the print job has been rendered, it is sent to, and spooled on, the print server before being sent to the print device.
3. Review the nine steps used in the printing process.

* On the print client, the user of a software application, such as Microsoft Word, chooses to print their document to a shared printer.
* The software application contacts a print API (GDI or XPS) on the print client, which stores the document within a spool folder (under C:\Windows\System32\spool\PRINTERS) using the appropriate format, such as EMF or XPS.
* The documents within the spool folder on the print client may be converted between EMF and XPS formats (to match the requirements of the print device) and rendered using the printer driver to produce a print job.
* The print job is sent from the print client to the print server across the network using the correct protocol (SMB, IPP, or LPD).
* The print server stores the print job within a spool folder under C:\Windows\System32\spool\PRINTERS.
* The print server sends the print job to the locally attached or network-attached print device after the print device acknowledges that it is ready to receive it.
* The print device proceeds to print the document and notifies the print server that the print job has completed.
* The print server notifies the print client that the print job has completed.
* The print client notifies the user that the print job has completed.

**Configuring a Windows Server 2019 Print Server**

1. Introduce this topic by explaining that by default, all Windows client operating systems have the ability to add locally attached or network-attached printers, as well as share them to other computers on the network using SMB.
2. Explain that an administrator can perform these tasks in Windows 10 using the Devices and Printers utility.
3. Discuss why an administrator should use the Print Management tool that is part of the Print and Document Services server role to add and share locally attached or network-attached printers.

**Installing Print and Document Services**

1. Introduce this topic by explaining that to install the Print Management tool, as well as the IPP and LPD printer sharing protocols, you must first install the Print and Document Services server role.
2. Refer to Figure 6-7 to illustrate the components that can be installed when an administrator selects the Print and Document Services server role within the Add Roles and Features Wizard in Server Manager and progress through the wizard.

* Print Server
* Internet Printing
* LPD Service

|  |  |
| --- | --- |
| ***Teaching***  ***Tip*** | Remind students that if they do not select Internet Printing or LPD Service in Figure 6-7, all printers they configure will be shared using SMB only. |

**Configuring a Print Server**

1. Refer to Figure 6-8 to illustrate an example of the Print Management tool that appears after the Print Server component of the Print and Document Services server role has been installed and the administrator has selected Print Management from the tools menu of Server Manager.
2. Point out that by default, an organization’s local server is listed under the Print Servers section within the navigation pane.
3. Mention that other print servers that are part of the organization’s Active Directory domain can be added to the Print Management tool by highlighting Print Servers within the navigation pane and clicking More Actions, Add/Remove Servers from the Actions pane.
4. Discuss the other nodes that should be configured before an administrator adds additional printers that are shared to users on the network.

* Drivers
* Forms
* Ports

|  |  |
| --- | --- |
| ***Teaching***  ***Tip*** | USB ports are added automatically when a USB print device is connected to the system. The first USB port is called USB001, the second USB port is called USB002, and so on. |

1. Refer to Figure 6-9 and Figure 6-10 to illustrate the prompts an administrator is presented with to enter the processor type and to select the associated printer driver files.
2. Refer to Figure 6-11 and explain that if an administrator highlights a print server (e.g., SERVERX) within the navigation pane of the Print Management tool and clicks More Actions, Properties from the Actions pane, the administrator will be able to modify the location of the spool folder, or display notifications for printers.

|  |  |
| --- | --- |
| ***Teaching***  ***Tip*** | Because print servers use a large amount of storage when processing print jobs, it is good practice to ensure that the spool folder is located on a separate storage device (e.g., D:\) that has a large capacity for storing print jobs. |

1. Refer to Figure 6-12 and explain that if an administrator highlights the Security tab, the administrator can allow groups and users the ability to view or configure the print server, manage print jobs or printer settings for printers on the print server, and submit print jobs to printers on the print server.
2. Refer to Table 6-1 to illustrate the permissions that are available to the printers on the print server, as well as to the print server itself. Explain that permissions that apply to printers are stored within the DACL of the printer object within the Print Management console, whereas permissions that apply to the print server are stored within the DACL of the print server object.
3. Point out that if an organization has an email account configured for their print server on an email server, an administrator can configure the Print Management console to email printer notifications to an email address, or run a script. Explain how to accomplish this.
4. Refer to Figure 6-13 to illustrate the Set Notifications window that is used to configure email notifications.

**Adding Printers to a Print Server**

1. Refer to Figure 6-14 to illustrate the Network Printer Installation Wizard window that appears after an administrator highlights the Printers node under a server within the navigation pane and clicks More Actions, Add Printer from the Actions pane to add a new printer to a print server within the Print Management tool.
2. Refer to Figure 6-14 again, and explain that the default option will search the network for shared printers that are published within Active Directory, and network-attached print devices that use the HP JetDirect or AppSocket protocols, as well as network-attached printers that support Web Services for Devices (WSD).
3. Explain that print devices that use HP JetDirect or AppSocket respond to TCP broadcast packets to announce their presence, whereas WSD-enabled print devices use Web Services Discovery (WS-Discovery) packets to advertise their presence, status information, and print capabilities to computers on the network.
4. Refer to Figure 6-14 again and mention that an administrator can select *Add a TCP/IP or Web Services Printer by IP address or hostname*.
5. Refer to Figure 6-15 to illustrate how an administrator enters the location of a network-attached print device that is to be manually added. Explain that specifying the host name or IP address for a network-attached printer will automatically create a new TCP port of the same name. Additionally, emphasize that the type of network-attached printer (TCP or WSD) and printer driver will be automatically detected by default.
6. Refer to Figure 6-14 again and discuss how to add a locally attached print device by selecting *Add a new printer using an existing port* and choosing the appropriate port from the associated drop-down box.
7. Refer to Figure 6-14 again and discuss how to create a printer that prints to another shared printer on the network by choosing *Create a new port and add a new printer* and selecting either Local Port or LPR Port from the associated drop-down box. Note that if an administrator selects Local Port from this drop-down box and clicks Next, he or she can supply the location of an existing SMB or IPP printer.
8. Refer to Figure 6-16 to illustrate how an administrator can supply the location of an existing SMB or IPP printer.
9. Point out that after an administrator has selected or specified the location of the print device within the Network Printer Installation Wizard, he or she will be prompted for the printer driver.
10. Refer to Figure 6-17 and mention that an administrator can click Windows Update to search for available drivers online, or click Have Disk to supply the appropriate drivers from files obtained from the print device manufacturer.
11. Point out that after the printer driver information has been detected or specified, the Network Printer Installation Wizard prompts allow an administrator to specify the printer name and sharing settings.
12. Refer to Figure 6-18 to illustrate how the printer name and sharing settings are provided.

**Configuring Printer Properties**

1. Introduce this topic by mentioning that after adding a shared printer to the system, an administrator can perform additional configuration tasks by accessing the properties of the printer within the Print Management console.
2. Refer to Figure 6-19 to illustrate how an administrator can change the printer name, location, and comment for an installed printer using the properties window.
3. Discuss other options that may be modified by using the Preferences button. These might include default paper size, layout (portrait or landscape), paper source, or print resizing options.
4. Explain that an administrator can also click the Print Test Page button to print a sample print job to the printer in order to verify that the print process is working.

|  |  |
| --- | --- |
| ***Teaching***  ***Tip*** | If your classroom has a live network with a printer installed, perform a live classroom demonstration of these options. |

1. Introduce the tabs that are available in the printer properties window in Figure 6-19.

* Sharing
* Ports
* Advanced
* Security
* Device Settings

1. Refer to Figure 6-20 and describe the features the Sharing tab provides. Explain that this is where an administrator controls whether the printer is shared to other systems on the network and the share name that is used for the SMB, IPP, and LPD sharing protocols.
2. Refer to Figure 6-21 and describe the features the Ports tab provides. Describe how to configure the ports used to contact the print devices. Note that this tab allows an administrator to add, delete, and configure the properties of ports. Define bidirectional printing and explain how to configure a printer to use this feature. Note that a printer pool allows multiple print devices (of the model) to be used by a single printer to increase the speed at which print jobs are printed.
3. Refer to Figure 6-22 and describe features the Advanced tab provides. Explain that an administrator can configure the times that a printer is available to users, the printer priority, the printer driver, and spooling options.
4. Explain how printer availability can be configured in the Advanced tab. Discuss the various spooling options that are available and how to configure them.
5. Explain that the Printing Defaults button in Figure 6-22 allows an administrator to specify default settings for print jobs. Note that these can include the print layout, page print order (e.g., front to back or back to front), and paper source, depending on the print device. Point out that the Print Processor button can also allow an administrator to modify the default format used by print APIs when storing documents within the spool folder. Review the various formats that may be available.
6. Discuss how the Separator Page button in Figure 6-22 is used. Review the four separator page files that are available in Windows Server 2019 and mention they are located in the C:\Windows\System32 folder.
7. Refer to Figure 6-23 and describe features the Security tab provides. Emphasize that by default, printer permissions applied to the print server are inherited by each printer added to the print server. Explain how to configure the available security permissions. Note that an administrator can modify or remove inherited permissions or click Add to add additional groups and users to which you can assign permissions to a printer.
8. Remind student that like folders, printers contain a SACL that provides auditing capabilities, provided that the Audit object access policy has been configured within a Group Policy that applies to the print server.
9. Refer to Figure 6-24 and explain how to add the appropriate entries to the Auditing tab.
10. Refer to Figure 6-25 and describe the features the Device Settings tab provides. Explain that this tab allows an administrator to configure the standard features that are provided by your printer driver.

**Using Group Policy to Deploy Shared Printers**

1. Introduce this topic by mentioning that to simplify the addition of printers on client computers within an organization, an administrator can use Group Policy to automatically add SMB shared printers to computers that are joined to the domain, provided that the appropriate printer drivers for the computers are installed on the print server.
2. Explain that to do this, the administrator right-clicks a printer within the Print Management console and selects *Deploy with Group Policy*. Note that this will open the Deploy with Group Policy window.
3. Refer to Figure 6-26 to illustrate the Deploy with Group Policy window that an administrator can use to select an existing Group Policy and define whether to add a shared printer to user or computer objects that receive the group policy.

**Configuring Branch Office Direct Printing**

1. Introduce this section by informing your students that some organizations have branch offices that contain a network-attached print device that users within the branch office can print to after contacting the associated shared printer on a print server within the main office.
2. Discuss the advantages and disadvantages of this structure.
3. Explain how enabling Branch Office Direct Printing (BODP) on a shared printer can help resolve the problem of a slow printing process and congestion on the Internet connection for a branch office.
4. Explain how to enable BODP by right-clicking a printer within the Print Management console and clicking *Enable Branch Office Direct Printing*.

**Quick Quiz 1**

1. Which term refers to a printer that prints to a print device connected to a physical port (e.g., USB) on an administrator’s or user’s computer?
2. logically attached printer
3. branch office directly attached printer
4. locally attached printer
5. network-attached printer

Answer: c. locally attached printer

1. Which term refers to the process of converting a document to EMF or XPS format and storing it within a spool folder?
   1. spooling
   2. rendering
   3. sharing
   4. queuing

Answer: a. spooling

1. True or False: Permissions that apply to printers are stored within the DACL of the printer object within the Print Management console.

Answer: True

1. A \_\_\_\_\_\_\_\_\_\_ allows multiple print devices to be used by a single printer to increase the speed at which print jobs are printed.
   1. printer spool
   2. printer pool
   3. queue
   4. spool folder

Answer: b. printer pool

**Managing Print Jobs**

1. Open this topic by emphasizing that during the time a print job is waiting within the spool folder on the print server before the print device is ready to accept it, there are several options available for managing that print job.
2. Explain that users with Print permission to a printer can view and manage their own print jobs, while users with Manage Documents permission can view and manage the print jobs of other users.
3. Describe two ways the print queue window can be opened. First, on a print client, users can view and manage their print jobs by clicking the printer icon within their notification area (the right side of the Windows taskbar) to open the print queue window for the associated printer. Second, administrators can right-click the printer name within the Print Management console and select *Open Printer Queue* to obtain the print queue window.
4. Refer to Figure 6-27 to illustrate a print queue window for an associated printer. Review the actions that a user can take for a document waiting to be printed.

* Pause
* Resume
* Restart
* Cancel
* Properties

1. Refer to Figure 6-28 to provide an example of the print job properties window where an administrator can modify the print job layout, paper type, user to notify upon print job completion, print job priority, and schedule (to prevent a print job from being printed until a certain time).

|  |  |
| --- | --- |
| ***Teaching***  ***Tip*** | Increasing the priority of a print job will allow that print job to print before other print jobs submitted by other users. As a result, users must have Manage Documents permission to modify the priority of a print job. |

1. Refer to Figure 6-27 again, and review the Printer menu options that are available to a user who has Manage Documents permissions for a printer.

* Pause Printing
* Cancel All Documents

|  |  |
| --- | --- |
| ***Teaching***  ***Tip*** | Pausing all documents within a print queue is often performed prior to performing routine maintenance on a print device, such as changing toner or refilling paper trays. After the maintenance has been completed, the printer can be configured to resume printing the documents within the print queue. |

1. Explain that if an administrator has the Internet Printing component of Print and Document Services installed on his or her print server, users can instead access a website (http://printservername/printers) to manage their print jobs.
2. Refer to Figure 6-29 to illustrate a print queue webpage where a user can select their own documents and click the links under the DOCUMENT ACTIONS section (Pause, Resume, Cancel) to manage them.
3. Explain that if a user is granted Manage Documents permission, he or she can click the links under the PRINTER ACTIONS section (Pause, Resume, Cancel All Documents) to perform the same actions for all print jobs within the print queue for a printer. Note that under the VIEW section, a user can click:

* *Document List* to refresh the list of print jobs within the print queue.
* *Properties* to view printer properties, such as location, comment, IPP name format, and features.
* *All Printers* to return to the website that lists all available printers on the print server.

**Monitoring and Troubleshooting Printers**

1. Introduce this topic by discussing the importance of printing within organizations today.
2. Explain that as server administrators, your students will need to troubleshoot printing problems within their organization, as well as monitor shared printers to identify printing problems before they affect users.
3. Mention that the Print Management tool provides custom filters that an administrator can use to quickly check the status of printers in order to identify any problems.
4. Refer to Figure 6-30 to illustrate the *Printers Not Ready* custom filter that displays printers that cannot complete the print process and provides the status of the printer within the Queue Status column.
5. Point out that the Queue Status column may indicate that the printer is offline or paused, or it may display a notification from the print device.
6. Refer to Figure 6-30 again and point out that the Queue Status for the HPLaserJet\_6MP printer shown in the figure is Paused, which is why print jobs are not completing. Explain how to resolve the problem.

|  |  |
| --- | --- |
| ***Teaching***  ***Tip*** | Printers must have bidirectional printing enabled in order to display notifications from the print device within the Queue Status column shown in Figure 6-30. |

1. Point out that if the Queue Status column displays *Processing* or *Waiting*, a print job destined for the associated print device may be pausing the print process because it is not formatted correctly, is corrupted, or was interrupted by a print device action (such as a toner replacement).
2. Explain that an administrator can highlight the Printers Not Ready node and select More Actions, Show Extended View to display the Jobs tab. Review the possible status options that can be listed within the Job Status column of the Jobs tab.

* Paused
* Stopped
* Error

1. Explain that if the Queue Status column displays *Attention Required*, *Not Available*, *Error*, or *Ready* (but no print jobs are printing), an administrator may need to restart the Print Spooler service on the print server to remedy the problem. Explain how to do this.
2. Explain that there are other custom filters available by default within the Print Management console that can be used to list all printers and printer drivers, as well as printers that have jobs within their print queue.
3. Explain that an administrator can also create additional custom filters that display printers that have different criteria, such as a specific location, print server, or status (value within the Queue Status column) in order to simplify printer monitoring and troubleshooting.
4. Refer to Figure 6-31 and Figure 6-32 to illustrate how to do this by starting the New Printer Filter Wizard and selecting the custom filter criteria.
5. Point out that viewing the status of printers and print jobs using the custom filters within the Print Management console may not always help identify and troubleshoot printer problems. Explain why this may be the case.
6. Explain that an administrator may solve additional problems by researching error codes on a print device manufacturer’s website, configuring the print settings within third-party software, modifying print device settings, restarting the Print Spooler service on the print server and print clients, trying different printer settings, or reinstalling printer drivers.
7. Emphasize that it is very likely that server administrators from two different organizations will use different printer troubleshooting steps that correlate to the documents, print servers, and print devices within their respective environments.
8. Refer to Table 6-2 to illustrate various common printing problems and their possible solutions.

**Quick Quiz 2**

1. True or False: Users with Print permission can view and manage the print jobs of other users.

Answer: False

1. What component of the Print and Document Services needs to be installed on your print server so that users can access a website to manage their print jobs?
   1. Internet Printing
   2. Website Linking
   3. Graphical Services
   4. Internet Linking

Answer: a. Internet Printing

1. The Print Management tool provides \_\_\_\_\_\_\_\_\_\_ that an administrator can use to quickly check the status of printers in order to identify any problems.
   1. custom filters
   2. document lists
   3. spreadsheets
   4. error codes

Answer: a. custom filters

1. Which tool can be used to restart the Print Spooler service?
   1. Programs and Features tool
   2. Devices and Printers tool
   3. Graphical Services tool
   4. Print Management tool

Answer: c. Graphical Services tool

# **Class Discussion Topics**

1. What are the main characteristics of XML Paper Specification (XPS)?
2. What are the advantages of using a Separator Page?
3. Why is it advantageous to use Group Policy to automatically add SMB shared printers to computers that are joined to the domain?

# **Additional Projects**

1. A PostScript printer is a printer that has special firmware or cartridges to print using a page-description language (PDL). Ask your students to read more about PostScript and write a report explaining how it works. Use the following link as a starting point: <http://www.tailrecursive.org/postscript/postscript.html>.
2. Ask your students to read the article comparing Adobe PDF with Microsoft XPS at <http://www.differencebetween.com/difference-between-pdf-and-vs-xps> and write a report summarizing the differences between the two file formats.

# **Additional Resources**

1. XML Paper Specification (Short Definition)

<https://www.pcmag.com/encyclopedia/term/xml-paper-specification>

1. Internet Printing Protocol (IPP) RFC

<https://tools.ietf.org/html/rfc2911>

1. Graphics Device Interface

<http://en.wikipedia.org/wiki/Graphics_Device_Interface>

1. Print and Document Services

<https://technet.microsoft.com/en-us/library/cc731636(v=ws.10).aspx>

1. Branch Office Direct Printing (BODP)

<https://docs.microsoft.com/en-us/previous-versions/windows/it-pro/windows-server-2012-r2-and-2012/jj134156(v=ws.11)>

**Key Terms**

* **ADSI edit** A low-level AD editor that lets you view, change, and delete AD objects and object attributes.
* **application programming interface (API)** A set of routines, protocols, and tools for building software applications. Basically, an API specifies how software components should interact. Additionally, APIs are used when programming graphical user interface (GUI) components.
* **AppSocket** A protocol that was developed by Tektronix. It is considered “the simplest, fastest, and generally the most reliable network protocol used for printers” though “it also offers no security and is often an attack vector with printers.”
* **bidirectional printing** A printer communications mode that is capable of transmitting data in both directions (send and receive), but not at the same time.
* **Branch Office Direct Printing (BODP)** A feature designed to reduce network traffic on expensive WAN links and potentially reduce the workload on busy print servers centrally located in your datacenter.
* **custom filters** Print Management tool filters that can be used to quickly check the status of printers.
* **Enhanced Metafile (EMF)** A term representing a spool file format used in printing by the Windows operating system. When a print job is sent to the printer, if it is already printing another file, the computer reads the new file and stores it, usually on the hard disk or in memory, for printing at a later time.
* **Graphics Device Interface (GDI)** An API that is supported by both legacy and modern Windows systems and applications. It normally stores documents within a spool folder using Enhanced Metafile (EMF) format, which contains document content as well as formatting instructions (e.g., font, color, positioning).
* **HP JetDirect** A technology sold by Hewlett-Packard that allows computer printers to be directly attached to a Local Area Network.
* **Internet Printing Client** A feature required in order to print to a shared IPP printer.
* **Internet Printing Protocol (IPP)** A specialized Internet protocol for communication between client devices and printers. It allows clients to submit one or more print jobs to the printer or print server, and perform tasks such as querying the status of a printer, obtaining the status of print jobs, or cancelling individual print jobs.
* **Line Printer Daemon (LPD)** A UNIX printer sharing protocol that uses TCP/IP to print documents to a shared printer on a server that has the LPD print service installed. When printing to an LPD shared printer, you must specify a line Printer Request (LPR) port type and supply the server name and shared printer name when prompted.
* **Line Printer Request (LPR)** A port type required when printing to an LPD shared printer.
* **locally attached print devices** Print devices that provide a physical port connection.
* **locally attached printers** Printers that print to a print device connected to a physical port (e.g., USB) on your computer.
* **LPR Port Monitor** A feature required in order to print to a shared LPD printer. LPR sends print commands and queries.
* **network-attached print devices** Print devices that contain a network interface.
* **network-attached printers** Printers that print to the network interface of a print device across a network connection (e.g., Ethernet).
* **page description language (PDL)** A computer language that describes the appearance of a printed page in a higher level than an actual output bitmap.
* **Portable Document Format (PDF)** A file format that provides an electronic image of text or text and graphics that looks like a printed document and can be viewed, printed, and electronically transmitted.
* **PostScript** A page description language that is an industry standard for outputting high-resolution text and graphics.
* **Print and Document Services** A server role within Windows 2019.
* **print client** Computer that prints to a shared printer on a print server.
* **print device** The term Microsoft uses to refer to a physical printer.
* **print job** A unit of work to be run on a printer, which can consist of printing one or more files.
* **Print Management** The process of outsourcing your print work to a company that will project manage your printing from proofing to print, from finishing to stocking, through distribution and everything in-between.
* **print processor** User-mode DLLs that are responsible for converting a print job's spooled data into a format that can be sent to a print monitor. They are also responsible for handling application requests to pause, resume, and cancel print jobs. The print job's spooled data is contained in a spool file.
* **print queue** A folder within the Windows operating system located under C:\Windows\System32\spool\PRINTERS that holds the document that a user has submitted for printing. The print queue is also called the spool folder.
* **print server** A device that connects printers to client computers over a network. It accepts print jobs from the computers and sends the jobs to the appropriate printers, queuing the jobs locally to accommodate the fact that work may arrive more quickly than the printer can actually handle.
* **Print Spooler** A small application that manages the paper printing jobs sent from a computer to a printer or print server. It enables storing multiple print jobs within a print queue or a buffer where a job is retrieved by the printer or print server.
* **printer** A device that accepts text and graphic output from a computer and transfers the information to paper, usually to standard size sheets of paper.
* **Printer Control Language (PCL)** A page description language developed by Hewlett-Packard as a printer protocol; it has become a de facto industry standard.
* **printer driver** A piece of software on a computer that converts the data to be printed to a format that a printer can understand. The purpose of printer drivers is to allow applications to do printing without being aware of the technical details of each printer model.
* **printer pool** Allows multiple print devices (of the model) to be used by a single printer to increase the speed at which print jobs are printed.
* **queuing** The process of converting a document to EMF or XPS format and storing it within a spool folder. Also known as spooling.
* **rendering** Converting the documents within the spool folder to a format that the print device can accept using instructions within the printer driver.
* **separator page** A page representing an information page at the beginning of each printed document that lists the document name and user that printed it.
* **Services tool** A graphical tool within Server Manager used to restart the Print Spooler service.
* **shared printer** A printer created by a print server representing a print device that users can submit print jobs to from across the network, which has the storage capacity and processor capabilities to handle print jobs from a large number of users.
* **spool folder** A folder within the Windows operating system located under C:\Windows\System32\spool\PRINTERS that holds the document that a user has submitted for printing. The spool folder is also called the print queue.
* **spooling** The process of converting a document to EMF or XPS format and storing it within a spool folder. Also known as queuing.
* **Web Services Discovery (WS-Discovery)** A technical specification that defines a multicast discovery protocol to locate services on a local network. It operates over TCP and UDP port 3702 and uses IP multicast address 239.255.255.250. As the name suggests, the actual communication between nodes is done using web services standards, notably SOAP-over-UDP.
* **Web Services for Devices (WSD)** A Microsoft API to enable programming connections to web service-enabled devices, such as printers, scanners, and file shares. Such devices conform to the Devices Profile for Web Services.
* **Windows Presentation Foundation (WPF)** A free and open-source graphical subsystem (similar to WinForms) originally developed by Microsoft for rendering user interfaces in Windows-based applications. WPF, previously known as "Avalon," was initially released as part of .NET Framework 3.0 in 2006.
* **XML Paper Specification (XPS)** The XML Paper Specification format is a new electronic document format supported natively by Microsoft Windows and Office. The XPS format is designed for high-quality printing.