

Infrastructure Planning   
and Design

Windows Server® 2008 and Windows Server 2008 R2

Print Services

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# The Planning and Design Series Approach

This guide is one in a series of planning and design guides that clarify and streamline the planning and design process for Microsoft® infrastructure technologies.

Each guide in the series addresses a unique infrastructure technology or scenario. These guides include the following topics:

* Defining the technical decision flow (flow chart) through the planning process.
* Describing the decisions to be made and the commonly available options to consider in making the decisions.
* Relating the decisions and options to the business in terms of cost, complexity, and other characteristics.
* Framing the decision in terms of additional questions to the business to ensure a comprehensive understanding of the appropriate business landscape.

The guides in this series are intended to complement and augment the product documentation. It is assumed that the reader has a basic understanding of the technologies discussed in these guides. It is the intent of these guides to define business requirements, then align those business requirements to product capabilities, and design the appropriate infrastructure.

## Benefits of Using This Guide

Using this guide will help an organization to plan the best architecture for the business and to deliver the most cost-effective Windows Server® 2008 Print Services technology.

Benefits for Business Stakeholders/Decision Makers:

* Most cost-effective design solution for an implementation. IPD eliminates over-architecting and over-spending by precisely matching the technology solution to the business needs.
* Alignment between the business and IT from the beginning of the design process to the end.

Benefits for Infrastructure Stakeholders/Decision Makers:

* Authoritative guidance. Microsoft is the best source for guidance about the design of Microsoft products.
* Business validation questions to ensure the solution meets the requirements of both business and infrastructure stakeholders.
* High integrity design criteria that includes product limitations.
* Fault tolerant infrastructure, where necessary.
* Proportionate system and network availability to meet business requirements.
* Infrastructure that is sized appropriately to meet business requirements.

**Benefits for** Consultants or Partners:

* Rapid readiness for consulting engagements.
* Planning and design template to standardize design and peer reviews.
* A “leave-behind” for pre- and post-sales visits to customer sites.
* General classroom instruction/preparation.

Benefits for the Entire Organization:

Using this guide should result in a design that will be sized, configured, and appropriately placed to deliver a solution for stated business requirements, while considering the performance, capacity, manageability, and fault tolerance of the system.

# Introduction to the Windows Server 2008 Print Services Guide

This guide provides an architectural approach to designing the infrastructure for Windows Server 2008 Print Services. It describes an approach that analyzes printing needs, designs printer pools, and then designs print servers with enough memory and spooler capacity to avoid performance bottlenecks and serve print clients accurately and reliably. The guide leads the reader through the design process, first examining and assessing print services that are already in place, then using the print requirements of the organization to produce an infrastructure design that will deliver the desired performance and availability using only the infrastructure that is necessary.

## Assumptions

All tasks and decisions covered in this guide assume that Windows Server 2008 or Windows Server 2003 is installed and providing print services for the organization.

Active Directory® directory service is assumed to be designed and in place in order to allow printers to be published and discoverable.

For additional information on proper design and planning of these services, refer to the appropriate guide in the Infrastructure Planning and Design Series or resources on Microsoft TechNet.

## What’s New in Windows Server 2008 R2

This guide’s design process is valid for both Windows Server 2008 and Windows Server 2008 R2 environments.

Windows Server 2008 R2 introduces new functionality and enhancements to Windows printing and scanning services that provide improved performance, increased reliability, and greater flexibility for users, including the following:

* Print migration enhancements
* Printer driver isolation
* Print administrator delegation
* Print Management snap-in improvements
* Client-Side Rendering (CSR) performance improvements
* XML Paper Specification (XPS) print path improvements
* Location-aware printing
* Distributed Scan Server role service
* Improvements to the Add Printer Wizard

For more details on the changes, see <http://technet.microsoft.com/en-us/library/dd878502.aspx>.

The goal of this guide is to present an architectural approach to designing a Print Services infrastructure. Print Services is a mature technology and is often underemphasized in infrastructure planning. As a result, printing infrastructures often grow in piecemeal fashion, without the benefit of a holistic, bottom-up approach to planning. This can result in issues with print server and print device management, resource starvation, and even a significant business impact due to unplanned print outages.

Using this guide, an IT pro can design a Print Services infrastructure that is optimized for a new or existing printing environment, while ensuring that a good foundation is established for future expansion.

This guide addresses the following planning decisions and/or activities that need to occur in preparing for a Windows Server 2008 Print Services implementation. The three steps below represent the most critical design elements required for a well-planned Windows Server 2008 Print Services design:

* Step 1: Determine the Scope of the Print Services Project
* Step 2: Determine the Printers, Servers, and Clients That Will Be Included
* Step 3: Design the Print Services Infrastructure

Some of these items may include decisions that must be made. Where this is the case, a corresponding list of common response options will be presented.

Other items in this list represent tasks that must be completed. These types of items are addressed because their presence is significant in order to complete the infrastructure design.

Figure 1 provides a graphical overview of the steps in designing a Windows Server 2008 Print Services infrastructure.

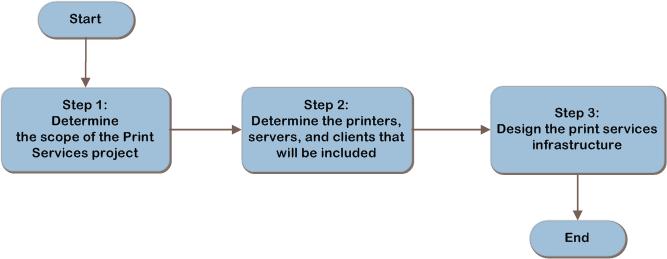


Figure 1. The Windows Server 2008 Print Services infrastructure decision flow

## Applicable Scenarios

This guide addresses considerations related to planning and designing the necessary components for a successful Windows Server 2008 Print Services infrastructure:

* Establishing Print Services for a new business group.
* Integrating Print Services from an acquired company.
* Moving corporate headquarters and redesigning Print Services for the new facility.
* Taking advantage of an opportunity to redesign Print Services for optimum usability and throughput.

## Out of Scope

The following list of services is out of scope for this discussion of Windows Server 2008 Print Services:

* Client-attached printing
* Printer hardware selection and design
* Third-party Print Services clients

# Step 1: Determine the Scope of the Print Services Project

Before designing a Print Services infrastructure, an organization needs to determine which parts of its environment to include in the design and the objectives for the project.

The focus of this step is to understand and clearly define the goals of the project so that these can be applied to the design to ensure its applicability and success. This is the opportunity to align the business needs with the infrastructure design.

By clearly understanding the motivation behind the Print Services project, priorities can be established for the planning steps.

Although all of the principles used in this guide are applicable to a new infrastructure, the guide has been created with the assumption that some existing print services infrastructure is already in place.

The output from this step will be used in Step 2 to define which printers, servers, and clients will be included in the project, and in Step 3 to design the new Print Services infrastructure.

## Task 1: Determine the Scope of the Project

Understanding the full extent of the work to be performed enables the designer to begin visualizing the tasks and roles that will be needed to successfully implement the infrastructure plan.

Record information that defines the overall scope of the project in Table A-1 in Appendix A: “Job Aids”:

* Which parts of the organization will be participating.
* Which geographic areas within the organization will be included.

## Task 2: Assess Special Printing Needs

It is important to know about any special circumstances that exist in the Print Services infrastructure. Special requirements may affect the architectural design in the following ways:

* Requirements for secure printing may need to be met by local printers, rather than to the Print Services infrastructure.
* Requirements for fault tolerance may necessitate the design of printer pools, or even duplicate print locations.
* Requirements for encryption may limit the network segments over which print streams can flow.

For each server listed in Table A-2 in Appendix A, record any special requirements.

## Validating with the Business

To get a good idea of project scope, the requirements of the business need to be thoroughly understood. Work with business stakeholders to obtain the following information:

* Prioritization of print workloads. Ask each business unit about the importance of its print workload. For example, in a billing department, printing invoices is likely to be mission critical; whereas, for IT, printing is more of a convenience. The answers to these questions should map to the requirements for fault tolerance.
* Compliance with government regulations. Compliance with government regulations (for example, HIPAA, SOX, and so on) often includes requirements for encryption or more stringent security. Are there any requirements that may affect the Print Services design, such as secure print queues or priority print queues, conservation standards to reduce pages printed, or privacy requirements?
* Commitments to the business. Many organizations use service level agreements (SLAs) and operational level agreements (OLAs) to define print services that one department provides to another. What are the commitments to uptime and metrics for performance and recovery that have been agreed to by business and IT stakeholders?
* Fault tolerance. Is the Print Services project part of a larger effort to improve infrastructure fault tolerance? If so, increased emphasis should be given to fault-tolerant server and printer design.
* Changes to the print workload in the future. Will there be growth or reductions in personnel count or in departmental workload that may be reflected as changes in printing demand? Are there plans to eliminate or reduce the use of paper documents within the enterprise, or are there regulations that in the near future may require paper copies of materials that today are online-only?

Before launching the planning phase of the project, share the scope information with business stakeholders. Verify that the proposed project scope is acceptable to the business and that business stakeholders are agreeable to the timelines and to their own responsibilities, if any.

## Step Summary

In this step the goals of the project were understood and clearly defined, and this information was recorded in Table A-1 in Appendix A: “Job Aids” so that they can be applied to the design to ensure its applicability and success. By clearly understanding the motivation behind the Print Services project, priorities can be established for the planning steps.

Any special requirements for each server listed in Table A-2 in Appendix A were recorded as well. The output from this step will be used in Step 2 to define which printers, servers, and clients will be included in the project, and in Step 3 to design the new Print Services infrastructure.

# Step 2: Determine the Printers, Servers, and Clients That Will Be Included

The goal of this step is to document the number and type of printers, as well as the servers and clients, in the existing Print Services infrastructure that will be included in the project scope, and to compile a list of clients that will use these printers.

Taking inventory of these resources will help the architect understand how they interact and how to incorporate them in the overall design. This inventory will be used in Step 3 as the Print Services infrastructure is designed.

## Task 1: Inventory Existing Print Servers

As part of the information collection phase of the project, an inventory of current print server assets should be made. This is an important element of understanding the details of the project. The architect will use this information to determine where adequate server coverage exists, where additional server resources are required, and whether the server configuration is adequate for the expected demand.

Important information to collect:

* Server name
* Server location
* Server storage capacity (used and free)
* Whether the server uses a separate spool drive to improve performance

Windows Server 2008 provides Windows Management Instrumentation (WMI) scripts that can be used to automate the collection of this information. Inventory the print servers within the organization and record their information in Table A-2 in Appendix A.

## Task 2: Inventory Existing Print Devices

To ensure that all factors are taken into account during the planning and design of a Print Services infrastructure, it is important to collect information about the print devices in use. This information aids the planning process by informing architects regarding server placement, device choices, network throughput requirements, and server sizing.

Inventory print devices in the organization and record the following information in Table A-3 in Appendix A:

* Location. Physical location of the printer.
* Printer. The printer name.
* Make/model. Manufacturer and model can provide features and capabilities, if necessary.
* Printer type. Color laser, black and white laser, inkjet, and so on.
* Server. The name of the print server.

## Task 3: Inventory Clients

The print server clients and operating systems in use can influence the print server performance and capacity. Inventory the clients that will be printing and record the following information in Table A-2 in Appendix A.

* **Number of Print Server Clients.** Print Server clients are those client computers and applications that have established connections to a print server.
* **Client Operating Systems in Use.** Client computers running Windows® operating systems earlier than Windows 2000 performed more of the print processing on the client computer than those clients running Windows 2000 or later versions of Windows. As a result, Windows 2000 or later clients will shift some of the print processing to the print server, which will place an additional workload on the server.
* **Print job characteristics.** Assess the number, size, frequency, and types of print jobs sent to the print server. In general, more complex print jobs, such as those containing detailed graphics, PDF files, or many different fonts, will require more CPU processing and network bandwidth on the print server.

## Validating with the Business

Share the data recorded in Table A-2 in Appendix A with business decision makers to ensure that all business requirements and special considerations are thoroughly documented and understood, based on the information that has been discovered during this inventory.

The principal question for the business at this stage is:

Is the current Print Services infrastructure meeting the needs of the business, or is more capacity/performance required?

## Step Summary

This step documented the number and type of print devices, as well as servers and clients, in the existing Print Services infrastructure in Table A-2 in Appendix A that will be included in the project scope. A list of clients that will use these printers was compiled and recorded in Table A-3 in Appendix A.

This inventory will be used in Step 3 as the Print Services infrastructure is designed.

# Step 3: Design the Print Services Infrastructure

With the information regarding the business goals and scope from Step 1 and the printer inventory data collected in Step 2, the Print Services infrastructure can now be designed.

Take into account any additional roles that the server will be supporting. Often, File Services and Print Services are combined on one system. If this is the case, use the requirements of both roles when designing the server. See the *Infrastructure Planning and Design Guide for* Windows Server 2008 and Windows Server 2008 R2 File Servicesat <http://go.microsoft.com/fwlink/?LinkId=160976> for guidance on designing File Services for Windows Server 2008.

The first task is to determine how many servers will be deployed in each location, then to determine in which locations servers will be placed. Once that has been done, the server hardware will be designed. Servers and printers may then be added to the design to provide fault tolerance, if required. In addition, if there has been a decision to use printer pools, then the printer pools will be designed.

## Task 1: Determine How Many Print Servers Will Be Needed

This task will assist with determining how many print servers will be required to serve the organization’s needs.

Capacity and scalability are key factors in planning the deployment of print servers. While there is not a predictive formula to determine the printing throughput of a given configuration, some of the factors that influence print server performance and capacity include:

* The number of print server clients.
* The operating system version or versions on each client’s machine.
* The number, size, and frequency of print jobs.
* The types of print jobs sent to the printer.
* The number and types of printers served by the print server and the types of printer drivers each printer uses.

Start the design with a single server and then add more servers if any of the following requirements are necessary:

* Scaling. There is no published limit for the number of print queues on a server, the number of printers that can be attached to a server, or the number of printer pools on a server. As a conservative estimate, Microsoft has tested a Windows Server 2003 reference system, a workgroup-class server like the HP DL560 with 1.5 gigabytes (GB) of RAM, high-performance disks, and sufficient network throughput, and found it could host approximately 1,500 printers, serving 5,000-10,000 clients. It can be expected that the performance under Windows Server 2008 R2 will exceed these limits.
* Performance. The best printing performance will be experienced when the client, print server, and print devices are on the same local area network (LAN), but this must be balanced against the costs. Locations separated across wide area network (WAN) connections may need a local print server.
* Regulatory. Corporate policies or government regulations may require separate print servers for certain types of data or for certain parts of the organization. Add the servers necessary to comply with these requirements.
* Organizational requirements. In organizations with multiple business units, some of those units may choose to maintain their own Print Services infrastructure. Add servers to support this division of responsibility if required by the business.

## Task 2: Determine Print Server Placement

In this task, the placement of each print server will be determined. For each print server, determine:

* The location of the print server. Decide in which office or geographical location the instance will be placed.
* Whether the instance will be on a physical or virtual server. Virtualization introduces flexibility into an environment by allowing virtual machines to be moved easily between hosts. Services that may not be compatible with each other can run on the same host because of the isolation that virtual machines provide. However, virtualization overhead may decrease the number of clients that a given virtual machine can support.
* Whether the instance will be on existing hardware or new hardware. It will be important to ensure in either case that the performance requirements are met.

If virtualization is selected, additional planning is required for the physical computers that will host the virtual machines. The Infrastructure Planning and Design Guide for Windows Server Virtualization at <http://go.microsoft.com/fwlink/?LinkID=147617> provides the planning process for server virtualization.

Record the print server locations in Table A-4 in Appendix A.

## Task 3: Design Server Hardware

The goal of this task is to determine the most appropriate server hardware on which to deploy the print servers, including these characteristics:

* Processor architecture (This is available in 32-bit or 64-bit for Windows Server 2008. Windows Server 2008 R2 is available only in 64-bit.)
* Number of CPUs and their speed
* Amount of memory installed
* Disk storage capacity
* Disk subsystem design
* Number of network card ports configured

The organization should design the server hardware keeping in mind there are two main strategies to accomplish this. The organization can decide to either scale up or scale out. Fewer servers with large memory and high performance CPUs can be easier to manage and can be more cost-efficient for some infrastructures but may be a single point of failure. Using smaller commodity servers with lower capacity can involve a smaller capital investment but often requires additional management effort. Determine whether the organization has a strategy guiding the selection of one model over another, and then proceed to determine the server sizing.

### Sizing the Servers

Now that the base requirements have been determined, expand the print server configuration to handle the expected workload. It is difficult to predict the exact load on the server and, therefore, to accurately size it. The most effective approach may be to observe existing print server performance. Use the performance counters available in Windows Server 2008 or Windows Server 2003 as detailed in each of the sections below to understand the load on the server in order to arrive at an appropriate sizing. If necessary, set up a performance test using real print workloads to increase accuracy.

#### CPU

Use the performance monitor counters for % Processor Time on the Spoolsv.exe process to determine the print process demand on the CPU. Select a CPU form factor that matches the organization’s purchasing preferences. If the standard form factor is deemed insufficient for the needs of print serving, compare the relative costs of using a form factor with more CPUs with that of deploying additional servers of the standard form factor.

#### Memory

Use the performance monitor counters for Virtual Bytes and Virtual Bytes Peak on the Spoolsv.exe process to determine the amount of memory that the print process is using. Design physical memory that exceeds the peak value in order to minimize paging and to optimize performance.

#### Disk Capacity

Print spools store documents while they are printing. A large number of queued documents can exhaust disk space and stop the print spooler service on the server. It is important to design sufficient disk capacity to avoid this, or to limit the number of clients that can access a particular server.

The print volume requirements were determined by the inventory collected in Step 2. To ensure that sufficient capacity is configured for Print Services, use Table A-5 in Appendix A to calculate the expected storage required for print spooling.

The size of the existing print queues can also be used to provide some input to determine the storage requirements. The Windows Server Print Queue Object tracks activity in the print server queues and includes a counter for the number of jobs in the queue. If the number of jobs in the queue is steady over time, the size of the existing print queue is adequate for that workload and can be used to size the queue for that workload in the new design.

#### Disk Subsystem Design

The print spooler receives jobs from clients and then outputs them to the physical printers. The most likely bottleneck in this will be the rate at which the physical printers can work. This can be checked by looking at the number of spooling jobs in the print queue. If the printer is the bottleneck, there will be jobs in the queue.

See Performance Tuning Guidelines for Windows Server 2008 at <http://download.microsoft.com/download/9/c/5/9c5b2167-8017-4bae-9fde-d599bac8184a/Perf-tun-srv.docx> for clear guidance on choosing a storage array for Windows Server 2008 print servers. Use that to determine the most appropriate disk subsystem design.

Record the server hardware decisions in Table A-4 in Appendix A.

## Task 4: Design Server Fault Tolerance

Refer to the requirements for fault tolerance that were identified in Steps 1 and 2. Where fault tolerance is required, it can be implemented by providing redundancy in each of the layers of the print server infrastructure:

* Server clustering. For physical print servers, server clustering provides fault tolerance when one server in a cluster is lost. However, it requires a server form factor that supports clustering and can be complex to set up and maintain. Both physical and virtualized print servers may be clustered.

For print servers hosted in a virtual machine, clustering can occur on the virtual machine or host level. Refer to the Infrastructure Planning and Design Guide for Windows Server Virtualization guide at <http://go.microsoft.com/fwlink/?LinkID=147617>, for more information.

* Fault-tolerant storage. Fault-tolerant storage systems such as those using a redundant array of independent disks (RAID) can protect data by maintaining the ability to operate even when one disk fails. Most storage arrays provide some hardware RAID capabilities. There are a number of different RAID levels, and each level involves trade-offs. To select the most appropriate RAID level to meet the fault-tolerance requirements, refer to the section “Choosing a Storage Array” in *Performance Tuning Guidelines for Windows Server 2008* at <http://download.microsoft.com/download/9/c/5/9c5b2167-8017-4bae-9fde-d599bac8184a/Perf-tun-srv.docx>.
* Redundant network connections. Having more than one adapter improves throughput during normal operation and maintains connectivity during loss of one adapter, thus offering fault tolerance.

Determine if additional fault tolerance should be added to the design for each server in the Print Services infrastructure. This determination should come from knowledge of the business value of the particular server and requirements such as SLAs that might be in place for the resources on the server.

## Task 5: Determine Whether Printer Pools Will Be Used for Fault Tolerance

Organizations often encounter areas of printing demand that outpace the capacity of individual print devices. In addition, higher capacity print devices might be prohibitively expensive. A solution to both of these problems can be to establish printer pools. These collections of identical print devices function as one large, distributed printer, meeting client demand by distributing the print workload across all devices in the pool. To the end user, they appear as a single printer.

Review the following benefits and limitations of printer pools in order to assess whether the use of printer pools may be appropriate. Complete this task for each print server.

### Benefits

Printer pools can simplify administration and provide fault tolerance in the following ways:

* Identical print devices can be consolidated as if they were one.
* Print capacity can be increased gradually as demand increases, or large demand can be met without investing in a single high-capacity printer. Increasing print capacity without use of printer pools will result in the need to acquire higher capacity printers, which tend to be more expensive.
* Printer pools increase scalability by allowing the addition of new printers to the pool at any time.
* Increased fault tolerance by eliminating the print device as a single point of failure.

### Limitations

Printer pools can increase complexity, both for administrators and for users in the following ways:

* Can cause confusion. Users can experience difficulty locating printouts.
* Increased expense. Additional print devices can raise maintenance costs.
* Choosing to deploy printer pools will increase complexity due to the need to configure printer pools and administer a larger number of printers.
* All printers in the pool must use the same driver.
* Printers in a printer pool should be in close proximity to enable users to locate their printed documents.

## Evaluating the Characteristics

Technical criteria are not the only factors that should be considered when making an infrastructure design decision. The decision should also be mapped to appropriate operational criteria or characteristics. The following tables compare each option according to the characteristics that are applicable to this decision-making topic.

|  |  |  |  |
| --- | --- | --- | --- |
| Complexity | Justification | | Rating |
| Printer pools will not be used | | A choice not to use printer pools will not affect complexity of Print Services. | Medium |
| Printer pools will be used | | Choosing to deploy printer pools will increase complexity due to the need to configure printer pools and administer a larger number of printers. | High |

|  |  |  |
| --- | --- | --- |
| Cost | Justification | Rating |
| Printer pools will not be used | Increasing print capacity without use of printer pools will result in the need to acquire higher-capacity printers, which tend to be more expensive. | Medium |
| Printer pools will be used | Use of printer pools allows the use of inexpensive printers, some of which may already be in place, to increase capacity and fault tolerance. | Low |

|  |  |  |  |
| --- | --- | --- | --- |
| Fault Tolerance | Justification | | Rating |
| Printer pools will not be used | | Choosing not to deploy a printer pool will not affect fault tolerance of the existing Print Services infrastructure. | → |
| Printer pools will be used | | Printer pools increase fault tolerance by eliminating single points of failure. | ↑ |

|  |  |  |
| --- | --- | --- |
| Scalability | Justification | Rating |
| Printer pools will not be used | Choosing not to deploy a printer pool will not affect scalability of the Print Services infrastructure. | → |
| Printer pools will be used | Printer pools increase scalability by allowing the addition of new printers to the pool at any time. | ↑ |

## Validating with the Business

Work with the business to assess the need for printer pools. Good results can be achieved by use of printer pools in areas where printers can be arranged in close proximity to each other and where users can be educated to locate their documents on one of a number of printers. The business will need to buy into this approach.

This decision can be made to increase fault tolerance. It requires buy-in from the business and will slightly increase administration overhead for the Print Services infrastructure.

## Task 6: Design Printer Pools

Although creation of printer pools is mainly an operational task, certain aspects of printer pool design require planning for best results:

* Use identical print devices. Print devices in a pool all use the same print driver. As a result, the printers must all be supported by the driver used.
* Place print devices in close proximity to each other. Users cannot control which device in a printer pool will service their print job. It is important, therefore, to place the print devices close to each other to help users locate their documents.

Choose two or more printers that, when aggregated, will accommodate the printing capacity needs for the location. There is no limit to the number of printers that can be in a pool. Select identical devices to allow use of a single driver for the entire pool. Windows Server 2008 will allocate print jobs to the print devices in the pool in a round robin fashion, skipping devices that report an offline status.

To enable users to locate printed documents, choose a location for the printer pool where a number of devices can be collocated for this purpose.

Record fault-tolerance selections in Table A-4 in Appendix A.

## Step Summary

In this step, the number of servers to be deployed in each location were determined, as well as the locations where servers will be placed. The server hardware was designed and then servers and printers were added to the design to provide fault tolerance, if that was determined to be required. In addition, if it was decided that printer pools would be used for fault tolerance, the printer pools were designed. The data gathered in this step was recorded in Table A-4 and Table A-5 in Appendix A.

## Additional Reading

* “Print Server Scalability and Sizing Technical Overview (Windows 2003)”: <http://download.microsoft.com/download/d/e/7/de76d778-0392-4cb0-b3aa-d7ca202271b5/Print%20Server%20Scalability%20and%20Sizing%20Technical%20Overview%20White%20Paper.doc>
* “Printer Connectivity Technical Overview”:   
  <http://technet.microsoft.com/en-us/library/cc759626.aspx>
* Windows Server 2008 Print Services Role: <http://technet2.microsoft.com/windowsserver2008/en/library/c1c37346-96f2-47c5-a918-4615342e651d1033.mspx>
* Windows Server 2008 Print Services TechCenter:   
  <http://technet.microsoft.com/en-us/windowsserver/dd448602.aspx>
* Microsoft Online Training Course 6420: Fundamentals of a Windows Server 2008 Network Infrastructure and Application Platform: <https://www.microsoftelearning.com/eLearning/offerDetail.aspx?offerPriceId=224183>

# Conclusion

This guide followed a step-by-step approach to design a Windows Server 2008 Print Services infrastructure. The steps in this guide led the reader through the following activities:

* Assessing a current Print Services infrastructure.
* Designing printer pools.
* Designing a new Print Services infrastructure.

This guide presented readers with a decision regarding the use of printer pools, evaluating the possible choices against characteristics such as cost and complexity. This enabled readers to make informed decisions relative to the design of their infrastructure.

By following this guidance, an organization can create a robust, fault-tolerant Print Services infrastructure. This can lead to enhanced productivity through easier discovery of resources, reduced downtime, and lower costs through more effective administration and infrastructure management.

# Appendix A: Job Aids

Use the job aids in this appendix to enhance the success of the Print Services planning and design process. Copy the job aid to a separate Microsoft Word document file or to Microsoft Excel® and complete according to the requirements of the infrastructure. Add rows to the tables as necessary to accommodate a full inventory.

This job aid can be used to record elements of the Print Services design project to ensure that all participants understand the nature of the work being performed and that they understand their role in making the project a success.

Table A-1. Project Scope

|  |  |
| --- | --- |
| Which parts of the organization will be participating? | Which geographic areas within the organization will be included? |
|  |  |
|  |  |
|  |  |

Use this job aid to record print server statistics for use in the Print Services planning and design process.

Table A-2. Print Server Inventory

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Location | Server name | Storage (used/free) | Separate spool disk | Special features1 |
| Phoenix, AZ | Phoenix-PS1 | 43 GB/57 GB | Y | S,P,I,M |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

1(E)ncryption, (S)ecure Print, (C)ompliance archive, (P)oint and Print, (I)nternet printing, (M)anaged output

Table A-2. Print Server Inventory (Continued)

|  |  |  |
| --- | --- | --- |
| Number of print server clients | Client operating systems in use | Print job characteristics |
| Phoenix, AZ | Phoenix-PS1 | 43 GB/57 GB |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

1(E)ncryption, (S)ecure Print, (C)ompliance archive, (P)oint and Print, (I)nternet printing, (M)anaged output

Use this job aid to record all relevant data regarding existing printers in the organization.

Table A-3. Printer Information

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Location | Printer | Make/model | Printer type | Capacity |
| Phoenix, AZ | HQHR12 | HP/LaserJet 2100DTN | B/W Laser | 32ppm |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Table A-3. Printer Information (Continued)

|  |  |  |  |
| --- | --- | --- | --- |
| Demand | Server | Share | Clients1 |
| 5,678 pp/mo | Phoenix-PS1 | HQHR12 | W |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

1Windows (W), Macintosh (M), UNIX/Linux/LPR (U)

Use this job aid to record print server configuration and placement.

Table A-4. Print Server Design

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Location | Server name | Configuration | Server hardware | Fault tolerance | Point- and print-enabled? |
| Phoenix, AZ | Phoenix-DC1 | 1U, Dual-Xeon, 2 GB of RAM | DAS/1 terabyte | RAID 1 | Y |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

Use this job aid to calculate storage requirements for print servers. Assumptions used in this job aid are:

* Clients will print on average once each 10 minutes.
* Documents will take approximately 30 seconds to spool to print device.

Table A-5. Print Server Storage Calculator

|  |  |
| --- | --- |
| Number of clients accessing server at a given time | 450 |
| Average print job size in megabytes | 2.3 |
| Storage required for spooling  (‘Number of clients’ \* ‘job size’) / 20 | 51.75 MB |

# Appendix B: IPD in Microsoft Operations Framework 4.0

Microsoft Operations Framework (MOF) 4.0 offers integrated best practices, principles, and activities to assist an organization in achieving reliable solutions and services. MOF provides guidance to help individuals and organizations create, operate, and support technology services, while helping to ensure the investment in technology delivers expected business value at an acceptable level of risk. MOF’s question-based guidance helps to determine what is needed for an organization now, as well as providing activities that will keep the organization running efficiently and effectively in the future.

Use MOF with IPD guides to ensure that people and process considerations are addressed when changes to an organization’s technology services are being planned.

* Use the Plan Phase to maintain focus on meeting business needs, consider business requirements and constraints, and align business strategy with the technology strategy. IPD helps to define an architecture that delivers the right solution as determined in the Plan Phase.
* Use the Deliver Phase to build solutions and deploy updated technology. In this phase, IPD helps IT pros design their technology infrastructures.
* Use the Operate Phase to plan for operations, service monitoring and control, as well as troubleshooting. The appropriate infrastructure, built with the help of IPD guides, can increase the efficiency and effectiveness of operating activities.
* Use the Manage Layer to work effectively and efficiently to make decisions that are in compliance with management objectives. The full value of sound architectural practices embodied in IPD will help deliver value to the top levels of a business.



Figure B-1. The architecture of Microsoft Operations Framework (MOF) 4.0

# Appendix C: Windows Server 2008 Print Services in Microsoft Infrastructure Optimization

The Infrastructure Optimization (IO) Model at Microsoft groups IT processes and technologies across a continuum of organizational maturity. (For more information, see <http://go.microsoft.com/fwlink/?LinkId=229236>.) The model was developed by industry analysts, the Massachusetts Institute of Technology (MIT) Center for Information Systems Research (CISR), and Microsoft's own experiences with its enterprise customers. A key goal for Microsoft in creating the Infrastructure Optimization Model was to develop a simple way to use a maturity framework that is flexible and can easily be applied as the benchmark for technical capability and business value.

IO is structured around three information technology models: Core Infrastructure Optimization, Application Platform Optimization, and Business Productivity Infrastructure Optimization. According to the Infrastructure Optimization Model, migrating Print Services to Windows Server 2003 or later can move an organization from a Basic to a Standardized maturity level. By implementing fault-tolerant print services and Group Policy-based automated printer assignment and provisioning, an organization can move significantly farther into the Dynamic level.

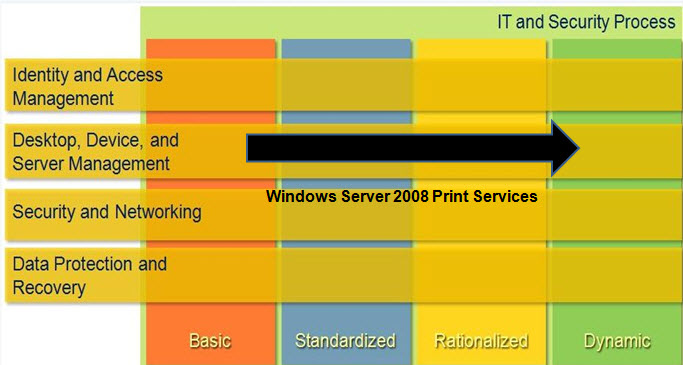


Figure C-1. Mapping of Windows Server 2008 Print Services technology into the Core Infrastructure Optimization Model

# Version History

|  |  |  |
| --- | --- | --- |
| Version | Description | Date |
| 2.1 | Minor updates to put document in current template/format. | November 2011 |
| 2.0 | Added “What’s New in Windows Server 2008 R2” section. Minor updates to this guide to reflect current IPD template.  Revised Step 2 to include new Task 3: “Inventory Clients.”  Revised Step 3, Task 1: “Determine How Many Print Servers Will Be Needed” to include more quantified data.  Revised Step 3, Task 2 (formerly Task 1): “Determine Print Server Placement” to include physical versus virtual machines and other minor edits.  Renamed Step 3, Task 3 from “Select a Form Factor for the Servers” to “Design Server Hardware.”  Revised Step 3, Task 4: “Design Server Fault Tolerance” to include clustering of virtual machines. | July 2009 |
| 1.0 | First release. | October 2008 |

# Acknowledgments

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## Feedback

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