

## The Ultimate Citrix Printing internals Cheat Sheet - Key takeaways

- 1 There are two main (Microsoft) print file formats, EMF and XPS.
- 2 EMF print output is first rendered by the GDI - Graphical Device Interface - before being handed over to the spooler service.
- 3 XPS was introduced as of Windows Vista. EMF development ended with Windows XP and Server 2003.
- 4 EMF data is not compressed. XPS data does get compressed.
- 5 With EMF each image needs to be redrawn over and over again, even if the same image is used multiple times. XPS can reference a single image multiple times, think company logo's, watermarks etc.
- 6 To be able to use XPS both your print device as well as the print driver need to support the XPS print file format. If not, it will fall back to EMF.
- 7 High level Print Spooling: Print output is received by the spooler service, print driver renders Meta file into raw data readable by print device (the actual print-job), spooler service sends print-job to physical print device.
- 8 When spooled locally, local resources (CPU, Memory) are leveraged. No network traffic generated.
- 9 When spooled remotely (print server) remote resources are leveraged. This will also produce additional network traffic between the XenApp and print server. Might be something to consider depending on your print architecture.
- 10 Most print issues can be lead back to badly written drivers. Not tested and/or optimized for multi user environments.
- 11 Main problems used to be (or still are): Spooler service crashes, CTX print manager service crashes, blue screens, auto print creation failures, high CPU loads and more.
- 12 Do NOT make use of kernel mode (version2) print drivers.
- 13 Use user mode (version 3 and 4) print drivers exclusively.
- 14 Consider isolating your print drivers a.k.a. Print Driver Isolation introduced with Windows Server 2008 R2.
- 15 But... only apply Print Driver Isolation where it makes sense.
- 16 There are three isolation modes available: None, Shared and Isolated.
- 17 When the Isolated mode is used a separate isolated run-space (PrintIsolationHost) on a per driver basis will be created, completely isolating the driver from all other drivers on the same machine, including the print and spooler services.
- 18 The same happens with the Shared mode, a separate isolated run-space will be created but this 'space' will be shared with multiple (selectable) drivers.
- 19 When Isolation mode gets applied to multiple drivers (isolating each driver separately) it will demand more resources (CPU, Memory) from the local machine when compared to 'Shared' and 'None'.
- 20 If a isolated driver fails or get corrupted it can only affect itself or the other drivers as part of Shared isolation model for example. All other drivers on the same machine would be unaffected including the print and spooler services.
- 21 Use isolated mode for testing purposes only, use shared mode in production.
- 22 Version 4 modes print drivers: Designed for Metro style applications (XPS), enhanced printer sharing, easier to install, maintain, manage etc.
- 23 When a Citrix session starts, the user logs in, it will, by default, try to map all printers known to the client device within that session.

- 24 Change this behavior to map the clients default printer only. Configure the 'Auto-create client printers' policy for this. Of course you have multiple options to choose from.
- 25 The system will use the Windows version of the printer driver if it is available on the Server OS machine (it will try to match the driver found on the client device). If the printer driver is not available, the system attempts to install the driver from the Windows operating system. If the driver is not available in Windows it will try and use the Citrix Universal print driver (it will need to be enabled for this to work).
- 26 Configure the 'Automatic installation of in-box printer drivers; to change this behavior.
- 27 Think about implementing 'printer driver mapping compatibility'. Print driver mapping is useful in situations where the print driver on the client is named differently than the print driver on the server (these need to match) but do offer the exact same functionality. It can also be configured to create a whitelist, this way you tell the system that it is ok to auto install print drivers when not found on the system, but only if those drivers are on the list.
- 28 Use 'signed' drivers exclusively and always thoroughly test your print architecture setup, no matter how convinced you may be it will work.
- 29 Limit the number of print drivers installed, less is more!
- 30 When comparing print drivers (client / server) make sure to look at the version numbers as well, they need to match a 100%.
- 31 Avoid upgrading print drivers. Always uninstall the old driver and install the new one.
- 32 Contact the print driver vendor if and when needed. For example, if they only have version 2 print drivers, or their drivers are not tested / signed for multi user environments.
- 33 Always try to match the print server OS to that of the XenApp server OS.
- 34 The Citrix Print Management Service was introduced around 2005, which is around the same time as the EMF based UPD.
- 35 It communicates with the spooler service and the local ICA client, it compresses print data before send over the ICA channel and it also manages the ICA virtual channel for client print mapping.
- 36 Both services, print manager and spooler, can be configured to automatically restart when needed.
- 37 Printing preferences (user) and properties will be stored on the client device by default. If this is not supported they will be stored in the user profile within the server Operating System.
- 38 Configure the 'Printer properties retention' policy to change this default behavior. You have multiple options.
- 39 A printing pathway defines how print traffic can or will be routed throughout your environment. It also tells us where a job gets processed, spooled, rendered etc.
- 40 There are two Citrix printing pathways, the client printing-pathway and the network-printing pathway.
- 41 Besides these pathways there is also a setup named 'Server local printers', which is basically a physical print device directly attached to a XenApp server.
- 42 With the 'Server local printers setup' spooling takes place locally from a client perspective.

- 43 When using the client printing-pathway, application print output is spooled / rendered on the XenApp server (again, local from a client perspective) before it is send back (leveraging the ICA protocol) to the client device. From there the print job will be delivered to the physical print device.
- 44 With the client printing-pathway the traffic send between the XenApp server and the client device is send over the ICA protocol, meaning it can be managed / compressed.
- 45 When a (fat) client device has a local printer provisioned the client-printing pathway will always be used.
- 46 When TCP/IP direct printers are added manually or by using / applying Group Policy Preferences, the printer is seen and treated as a locally attached printer. As such, print traffic will flow through the client printing-pathway.
- 47 Thin client devices (often Linux based) do not support the client-printing pathway. They lack local printing capabilities. The network printing-pathway (session printers for example) will need to be used instead.
- 48 The network printing-pathway will send the application print output from the XenApp server to the print server where it will be spooled / rendered. So spooling will take place remotely. From there it will send the print job to the physical print device.
- 49 Using the network printing-pathway all traffic send between the XenApp server and the Print server will be uncompressed / unmanaged, non-ICA.
- 50 When these machines are physically close together (fast LAN) this won't be an issue. When, for example, the print server is located in the branch office and the XenApp server is located back in the data center this could form a potential problem. Think about your setup.
- 51 The Universal Print Server can help compress / manage traffic send between the XenApp server and the Print server.
- 52 When a client device has a network provisioned (print server) printer, Citrix will always try and route print traffic over the network printing-pathway.
- 53 I say try, because if the print server and the XenApp server are in different domains and they are unable to communicate, the client printing-pathway will be used instead. The same applies when both machines are unable to communicate for other reasons.
- 54 By disabling the 'Direct connection to print servers' policy, we can force the client printing-pathway to be used, even when network provisioned printers are leveraged.
- 55 For example, print server in the branch office and the XenApp server in the data center, clients have network-provisioned printers (so network printing-pathway will be used by default). By forcing the client printing-pathway print traffic will be send back (from the XenApp server) to the client device leveraging the ICA protocol, from the client device to the print server, over to the physical print device.
- 56 If both the XenApp server and print server are located in the datacenter, then do NOT apply / force the client printing-pathway. Traffic will need to travers the WAN / LAN multiple times, in an uncompressed format.
- 57 Before anything, it's important to understand the differences between both pathways and how they can, and by default will, be applied.
- 58 There is no one size fits all, period!
- 59 Keeping the XenApp and print server close together isn't always the best

solution.

- 60 All this applies to XenApp as well as XenDesktop and isn't IMA or FMA specific.
- 61 The Universal Print Driver (UPD) is disabled by default.
- 62 The UPD is installed as part of the VDA.
- 63 There is an EMF as well as an XPS print file format UPD.
- 64 EMF was first. It got introduced around 2005.
- 65 The EMF UPD will be used by default. This can be changed through policy.
- 66 Both the Universal Print Server as well as the Universal Printer use the Universal Print Driver by default.
- 67 Ideally you would like to use the UPD exclusively. Remember, less is more!
- 68 It can be used combined with native print drivers. In most cases this is necessary since the UPD only supports stapling and sorting as far as enhanced printing features go.
- 69 Configure the system to use the UPD when no native print driver is available.
- 70 The Universal Printer is a logical / generic object created at the beginning of a session. It will be mapped to the client's default printer but this can be changed to any printer known to the client device.
- 71 When using the Universal Printer no print mapping / enumeration takes place, speeding up the logon / login process.
- 72 The Universal Printer only works for Windows devices.
- 73 It is potentially useful when the 'Wait for printer to be created' policy is used or when you need access to multiple printers, local & network.
- 74 The Universal Print Server (UPS) consists out of a client (UPClient) and server (UPServer) component.
- 75 Make sure to check the e-docs pages to see which protocols are used and which accompanying network ports need to be opened.
- 76 Uses the UPD by default but can be paired with Windows Native print drivers, again, for more enhanced printing capabilities.
- 77 It's optimized for network printers and offers some additional compression and QoS options.
- 78 It supports both EMF and XPS based print drivers.
- 79 It also works for thin client devices and tablets, based on network (session) printers.
- 80 The UPS does not support client side rendering / spooling. Meaning that all application print output will be sent over to the print server (which has the UPServer component installed) right away, which will take over from there.
- 81 All traffic sent between the XenApp (UPClient component) and print server (UPServer component) can be managed / compressed when enabling the UPS.
- 82 When installed it will be disabled by default. Needs to be enabled by configuring the 'Universal Print Server enable' policy.
- 83 Network printer will leverage the UPS automatically through a process called auto-discovery.
- 84 As of XenDesktop Tech Preview 3 (TP3) the Universal Print Server is fully supported on Windows Server 2012 (R2) as well as Server 2008 R2.
- 85 It can handle up to 50 print jobs per minute, max.
- 86 Recommended for remote office scenarios. Please note that testing will be necessary to see if education compression ratios are achieved.
- 87 Helps in managing a large amount of network printers.
- 88 Can be used for proximity printing. The UPS is a prerequisite.

- 89 The ICA protocol is build up out of multiple (32) virtual channels. Each virtual channel has it's own purpose. There is also a printing virtual channel.
- 90 ICA channels have different priorities, ranging from 0 to 3, with 0 being the highest / most important.
- 91 The prio 0 virtual channels are also referred to as Thinwire (sound familiar)?
- 92 The printing virtual channel, by default, has a priority of 3, the lowest. It's treated as a background process.
- 93 Virtual channel priorities can be changed by editing the accompanying registry key and changing the value number.
- 94 Think this through. When giving more, or a higher priority to a specific VC it also means that you are taking away priority somewhere else.
- 95 HKLM\System\CurrentControlSet\Control\TerminalServer\Wds\icawd\Priority is the registry key that goes with the printing VC.
- 96 We can accelerate ICA traffic in general, including print traffic, by implementing a Citrix Cloudbrigde for example.
- 97 Allocate / configure printing bandwidth through Citrix policies and apply them on a per user, per server or per Site basis.
- 98 Use session (network) printers on fast(er) networks.
- 99 Session printers are network printers that can be assigned and mapped to a specific user or user groups.
- 100 With proximity printing session are filtered based on IP addresses or subnets (there are some more options). This way a user will always connect to the closest printer (UPS is needed).
- 101 When dealing with slow printing remember that it's not all about network bandwidth. Also check for congestion and latency.
- 102 The 'simpler' the print driver the less traffic will be generated. Use vendor drivers only when specific functionality is needed.
- 103 Last minute edition from the e-docs pages: XenApp and XenDesktop 7.6 FP3 includes an Always-On logging feature for the print server and printing subsystem on the VDA. In order to collate the logs as a ZIP for emailing, or to automatically upload to Citrix Insights Services, use the PowerShell cmdlet (Start-TelemetryUpload) supplied with the VDA installer in 7.6 FP3.
- 104 Last updated: 15 May 2015. Citrix Printing Tool 3.1 helps configuring and troubleshooting the Citrix Printing subsystem on XenApp, XenApp Online Plugin, and XenDesktop.
- 105 Last updated: 15 May 2015. Print Detective is an information gathering utility that can be used for troubleshooting problems related to print drivers. It enumerates all printer drivers from the specified Windows machine, including driver specific information. It can also be used to delete specified print drivers. It allows for log file capabilities and provides a command-line interface as well.
- 106 Last updated: 13 November 2015: All purpose troubleshoot tool - Run Citrix Scout from a single XenDesktop controller (DDC) or XenApp server to capture key data points and CDF traces for selected computers followed by secure and reliable upload of the data package to Citrix Technical Support.
- 107 Last updated: 31 August 2015. The Citrix UPS Print Driver Certification Tool can be used to test the compatibility of a print driver with the Citrix Universal Print Server.
- 108 Last updated: 15 May 2015. Not sure? Test your print drivers thoroughly using StressPrinters.

- 109 Check out Microsoft's (MSDN) webpage to find out more about Print Driver Isolation.
- 110 Release data: February 2012, primarily focused on XenApp 6.5: XenApp Printer Driver Manager. Manage your XenApp print drivers. Update the Automatic Printer Replication List with a GUI. Have a overview of what drivers are installed on what servers.
- 111 A collection of Citrix troubleshoot and diagnostic tools. CtxAdmTools.

I hope you found this somewhat informative. Thanks for reading, downloading and hopefully sharing!