

Microsoft Office 365 for Citrix XenApp and XenDesktop 7.x

Microsoft Office 365 ProPlus is a bundled software plus subscription-based offering focused on user productivity-based applications. Office 365 ProPlus includes a combination of online-based applications that are accessed from anywhere via a web browser, in addition to the latest traditional, locally installed version of Microsoft Office. Included with Office 365 ProPlus is an online email account that has 50 GB of mail storage and 1 TB of file storage per user licensed for OneDrive for Business.

Office 365 is a great solution for any organization, but due to user, application and business requirements, there is often a requirement for a locally installed version of the Office applications in addition to the online versions. Typically, organizations require the locally installed versions for the following reasons:

- Require full application functionality that may not be available with the online version
- Line-of-business applications installed locally have a dependency on locally installed versions of an Office application

These challenges are relevant for most organizations.

Historically, Microsoft Office is one of the most common applications delivered via Citrix XenApp, due to its ability to provide the user with the latest version of Office with the best user experience for a wide range of use cases. With Office 365 ProPlus, the value of Citrix XenApp has not changed. To deliver Office 365 to users properly, we provide the following recommendations to enable an optimized user experience while minimizing the potential impact to the underlying infrastructure.

Outlook

As part of an Office 365 implementation with Citrix XenApp or XenDesktop, organizations can use Exchange Online instead of managing and maintaining Exchange servers installed on-premises. As part of an Exchange Online implementation, the deployment of the Outlook client requires a choice between two options: Cached Exchange Mode or Online Mode. The decision impacts the user experience and infrastructure. (Table 1)

Table 1 Online Mode vs. Cached Exchange Mode

	Online Mode	Cached Exchange Mode
Description	Requires a constant network connection to the back-end Exchange server.	Continuously synchronizes the user mailbox and address book to a local file, eliminating service disruptions caused by sporadic or latent network connectivity. Cached mailbox content is stored locally for mail received within a configured window of time and reverts to Online Mode for older content.
When to use	Constant, always-on, very low latency network connection to Exchange Online.	Users require more responsive email for recent items, especially if network conditions between the Outlook client and Microsoft Exchange Online are considered to be suboptimal.
User Experience Considerations	Initial startup is faster for the user because no synchronization is required. Ongoing user experience is directly related to the quality of the network link (bandwidth/latency) to Exchange Online.	In general, a better user experience is afforded to the user within an established session.
Infrastructure Considerations	Each user is allocated a 50 GB of mailbox storage	Storage capacity and throughput must be adequate to service the requests to the cached file.

Recommendation: Based on Citrix in-house test data, as available in Appendix A of this document, with optimal user experience as the goal, Citrix recommends using Outlook Cached Exchange Mode. For XenApp or non-persistent VDI models the Cached Exchange Mode .OST file is best located on an SMB file share within the XenApp local network. The following section outlines the recommended Microsoft configuration settings required to enable Outlook Cached Mode for a typical on-premises XenApp environment.

Active Directory Group Policy Configuration (shown in Figure 1)

- **File | Cached Exchange Mode:** Included in the Outlook 2016 Active Directory group policy template. This policy specifies the default Cached Exchange Mode for new profiles. The options are **Download Headers**, **Download Full Items**, and **Download Headers and then Full Items**. For our tests, we used **Download Full Items**.
- **Sync Settings:** Included in the Outlook 2016 Active Directory group policy template. This policy allows an administrator to configure the amount (by date) of user email Outlook synchronizes locally using Cached Exchange Mode. Initially, these policies can be set to one month, although depending on your specific implementation a longer amount of time may be required for your use case.
- **Disable Fast Access:** Included in the Outlook 2016 Active Directory group policy template. When Exchange Fast Access is enabled, Outlook 2016 connects to Exchange in Online Mode while simultaneously building an offline cache file as part of the Cached Exchange Mode. As the latency increases between Outlook and Exchange, Outlook seamlessly utilizes the local cache file. **Note:** By default, the **Disable Exchange Fast Access** policy is disabled, which means Exchange Fast Access is enabled by default. Our guidance is to ensure that this policy is disabled.
- **Use Cached Exchange Mode:** Included in the Outlook 2016 Active Directory group policy template. This policy enables Cached Exchange Mode for new and existing Outlook profiles. Without this policy enabled, Outlook will be configured in

Online Mode. This policy should be set to **Enabled**.

- **Cache File:** According to this [Microsoft knowledgebase article](#), the cache file can be located on a network drive if the following three criteria are met:

- A high bandwidth/low latency network connection is used.
- There is single client access per file (one Outlook client per .pst or .ost).
- Either Windows Server 2008 R2 or later Remote Desktop Session Host (e.g. XenApp), or Windows 7 or later virtual desktop infrastructure (e.g. XenDesktop VDI) is used to run Outlook remotely.

Although Microsoft supports a network mapped cache file, Microsoft may not agree to troubleshoot performance-related issues in this configuration. Regardless of this caveat, a network attached cache file is the

recommended approach for a XenApp and XenDesktop implementation to provide a better user experience. To create a network cache file mapping, use Outlook 2016 Active Directory group policy template.

Citrix Policy Configuration

- **Logon Performance:** The user profile might become large due to the Outlook cache file, it is important to mitigate this risk by implementing the Citrix Profile Management functionality. The following settings are recommended:
 - Enable Profile management: Policy should be enabled so Citrix profiles are used.
 - Path to user store: Policy should specify the unique path for the user profile location.

Based on this configuration, the user profile share includes:

Figure 1

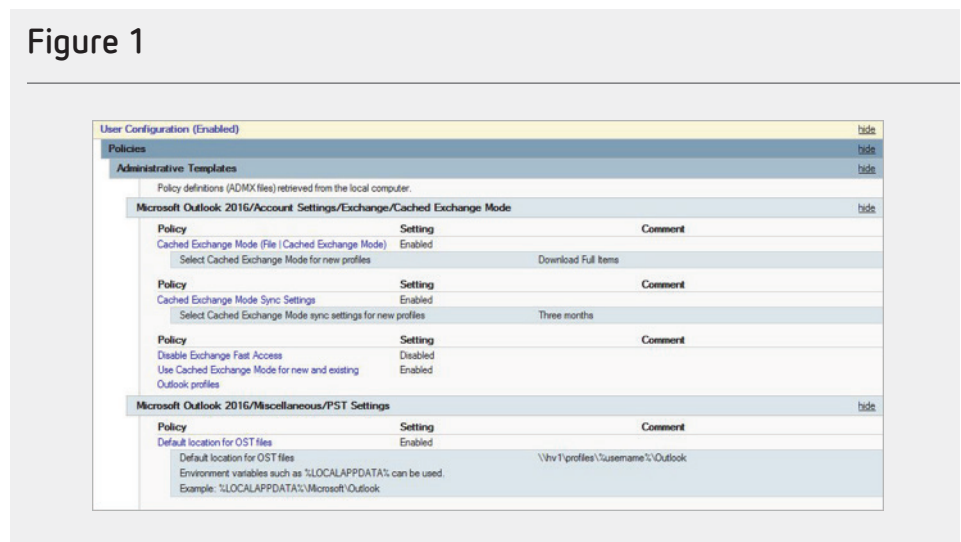
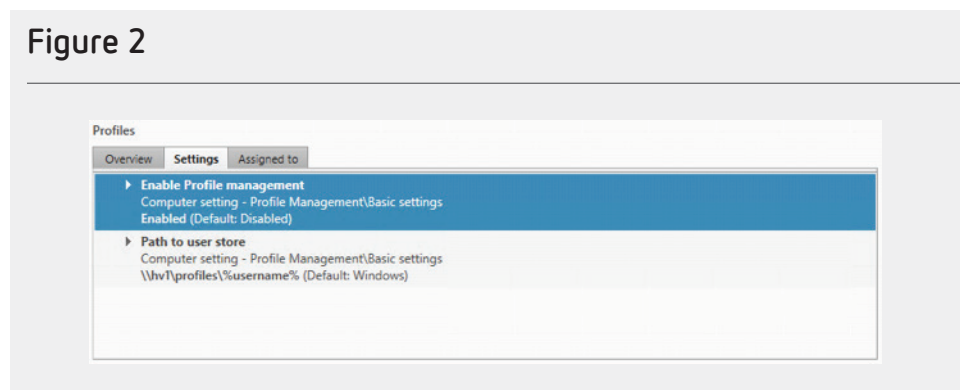


Figure 2



- **UPM_Profile:** Contains the Citrix universal profile files and folders (Documents, Favorites, ntuser.dat, and so on).
- **Outlook:** Contains the Outlook cached file.

Because the Outlook folder is outside of the universal profile folder, it is not copied to and from the RDS and VDI instances. Outlook connects to the cache file directly, across the network. (Figure 3)

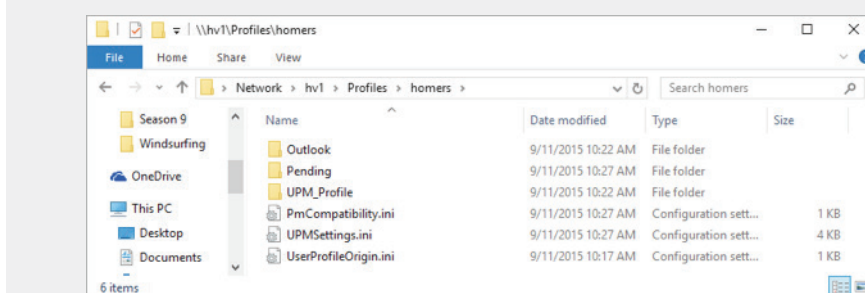
Together, these configuration settings help to ensure a better user experience for Outlook 2016 on XenApp with Office 365 Exchange Online.

Skype for Business

As part of an Office 365 implementation within a XenApp or XenDesktop solution, organizations that do not depend on the direct voice and third-party unified communications application integration, or multi-regional controls for enterprise voice can use Skype for Business Online instead of managing and maintaining their own private (on-premises or otherwise) installation of Skype for Business Server 2016 or Lync Server 2013.

For more Microsoft guidance regarding Lync feature differences between Lync Server and Lync Online, see [“Deciding how to deploy Lync Server 2013”](#).

Figure 3



For more Microsoft guidance regarding differences in Skype for Business Server and Online capabilities, the tables in the [“Desktop client comparison tables for Skype for Business”](#) are a great resource.

For organizations that choose to use Skype for Business Online, there are more considerations to ensure you achieve the best balance of user experience and infrastructure impact trade-offs. Most Skype for Business presence and IM features work seamlessly within a Citrix XenApp or XenDesktop solution with no significant impact to user density per server. For Skype for Business solutions requiring Video and Audio VoIP capabilities, Citrix supports multiple options for delivering the best user experience within different network conditions and end-point device scenarios. A comprehensive list of

Citrix options for Skype for Business Server features can be found in the document [“Feature Matrix for Alternative Methods of Delivering the Skype-for-Business/Lync Client from XenApp/XenDesktop”](#).

A condensed overview of the Citrix supported options valid in a Skype for Business Online solution are outlined in Table 2.

Recommendations: For the most seamless Skype for Business Online experience for administrators and end users, across multiple Flexcast models and Citrix Receiver enabled end-points, Citrix recommends that the following options be employed.

Table 2 Citrix Supported Options

Feature	Citrix Generic HDX RealTime	Citrix HDX RealTime Optimization Pack 2.2	Citrix HDX RealTime Optimization Pack 1.8	Microsoft Lync 2013 VDI plug-in	Citrix Local App Access
Server offload for high scalability	×	✓	✓	✓	✓
Zero added latency	×	✓	✓	✓	✓
Windows Receiver support	✓	✓	✓	✓	✓
*Windows versions are detailed in the HDX RealTime Optimization Pack – System Requirements documentation .					
Linux Receiver support	✓	✓	✓	×	×
Mac Receiver support	✓	✓	✓	×	×
VDI-compatible	✓	✓	✓	✓	✓
RDS-compatible (published desktop)	✓	✓	✓	✓	✓
RDS-compatible (published app)	✓	✓	✓	×	N/A
Lync 2010 client support	✓	×	✓	×	✓
Lync 2013 client support	✓	×	×	✓	✓

Feature	Citrix Generic HDX RealTime	Citrix HDX RealTime Optimization Pack 2.2	Citrix HDX RealTime Optimization Pack 1.8	Microsoft Lync 2013 VDI plug-in	Citrix Local App Access
Skype for Business 2015 client support	✓	✓	Lync UI	✓	✓
Skype for Business Online (Office 365) authentication	✓	✓	✓	✗	✓
Skype for Business Online (Office 365) AD Federation	✓	✓	✓	✗	✓
Webcam support	✓	✓	✓	✓	✓
Support for selected webcams with built-in H.264 encoder	✓	✓	✓	✓	✓
Fallback to server if no local media engine	N/A	✓	✓	✗	N/A
Instant Messaging	✓	✓	✓	✓	✓
Presence	✓	✓	✓	✓	✓
Screen Sharing (full desktop)	✓	✓	✓	✓	✓
App sharing (for example, hosted PowerPoint) if Lync client is part of full virtual desktop	✓	✓	✓	✓	✗
App sharing (hosted apps)	✓	✓	✓	✓	✗
Enterprise Voice Support	✓	✓	✓	✓	✓
Call transfer (bind/unannounced)	✓	✓	✓	✓	✓
Meet Now join via IP voice-video	✓	✓	✓	✓	✓
Location Services (for emergencies)	✗	✗	✗	✗	✓
USB phone support for Win devices	LAN Only	✓	✓	✓	✓
USB phone support for Linux	LAN Only	✓	✓	✗	✗
USB phone support for Mac	✗	✗	✗	✗	✗
IP sets w/Better Together over USB	LAN Only	✗	✗	✗	✓
Windows theme set by virtual desktop	✓	✓	✓	✓	✗
Microsoft Edge Server for remote access	N/A	✓	✓	✓	✓
NetScaler Gateway media transport	✓	✗	✗	✗	✗
Support for 32-bit Skype/Lync client	✓	✓	✓	✓	✓
Support for 64-bit Skype/Lync client	✓	✗	✗	✓	✓
Support for 64-bit Office	✓	✗	✗	✗	✓

- The **Citrix HDX RealTime Optimization Pack** enables the broadest set of capabilities across Windows and non-Windows-based end-points, in addition to integration with Skype for Business Online Active Directory Federation capabilities. Details for the installation and configuration of the Optimization Pack are available in Citrix product documentation under [HDX RealTime Optimization Pack 2.2](#).
- **Lync Online Active Directory Federation** should be enabled when a seamless logon experience is desired for corporate users, or when a Skype for Business on-premises and Skype for Business Online Hybrid environment is to be considered. Details

for integrating Skype for Business Online with your corporate Active Directory can be found on the Microsoft Office 365 site under [Office 365 integration with on-premises environments](#).

OneDrive for Business

Included with the Office 365 subscription is access to OneDrive for Business, allowing a user to store, sync, and share their work files. OneDrive for Business lets users update and share files from anywhere and work on Office documents with others at the same time. In environments that use RDS/VDI type implementations like XenApp and XenDesktop,

simply installing the OneDrive for Business agent can cause some unexpected challenges.

- **Supportability:** Based on the [Microsoft knowledgebase article](#), the OneDrive for Business sync agent is not supported on a Terminal Services based implementation. To gain access to OneDrive for Business files, users have to use a web browser.
- **Consumer vs Business:** There are two flavors of OneDrive: OneDrive and OneDrive for Business. Both solutions are different. OneDrive uses a personal account for user file storage in the cloud. OneDrive for Business uses a business account with a SharePoint back-end infrastructure,

allowing for joint collaboration and greater administration capabilities. OneDrive for Business can be hosted in the cloud or on-premises, while OneDrive is entirely hosted in the cloud. The OneDrive and OneDrive for Business sync agents are different.

- **Sync:** The synchronization tool, included with OneDrive for Business, syncs the user's entire library to a local, non-network folder. Performing this action on a XenApp or non-persistent VDI machine results in significant amount of data being copied during each logon. The large amount of data copied is one of the reasons why the sync agent is not supported on a multi-user solution like Terminal Services.
- **Storage Space:** Each OneDrive for Business user is granted 1 TB of storage space for their personal library. Synchronizing the user's entire library across multiple devices consumes a significant amount of storage.
- **Network Sync:** OneDrive for Business does not support syncing to a network drive.

Recommendation:

- **Option 1:** Continue to use OneDrive for Business but require users to access their files via the web browser.
- **Option 2:** Use Citrix ShareFile for file storage because it includes selective sync capabilities, which only synchronizes the files accessed by the user. With selective sync, users see their entire ShareFile directory structure in Windows Explorer, but none of those files are physical present on the system until they are requested.
- **Option 3:** Continue to use OneDrive for Business for user file storage and utilize the ShareFile Desktop App, a stand-alone Windows app, to access the user's files and folders.

Licensing

Initially, Office 365 ProPlus licensing was set up on a per user basis, where each user required a single license, allowing them to use Office 365 ProPlus on up to 5 different machines. However, this licensing solution does not work in an RDS/VDI type deployment where a single machine hosts multiple unique users.

In the second half of 2014, Microsoft added a Shared Computer Activation method to the

Office 365 ProPlus licensing, meant to solve the RDS/VDI challenge. The Shared Computer Activation approach occurs as follows:

1. User logs on to a machine and starts an Office 365 ProPlus application (Microsoft Word)
2. Office 365 ProPlus contacts the Office Licensing Service via the internet to obtain a license token for the user-machine combination. If the environment is configured correctly, the user does not see an activation wizard.
3. When properly licensed, the license token is stored in the user profile.
4. The steps are repeated for each user-machine combination. If the same user logs on to another machine, they must activate Office 365 ProPlus on that machine, too.
5. If the user logs on to a shared machine where they have already gone through the activation process, the token, stored in the user profile, is reused.

To install Office 365 with Shared Computer Activation, use the Office Deployment Toolkit, as explained in following [TechNet article](#).

However, the Shared Computer Activation method has a few caveats:

- **Licensing renewal:** Each user license token for a particular machine only last a few days before they must relicense.
- **Connectivity:** During license renewal, there must be an internet connection to the Microsoft Office Licensing Service, hosted by Microsoft.
- **Reduce functionality:** If the user skips activation, they go into reduced functionality mode, which allows them to only view and print documents.

In a Citrix Service Provider model, licensing Office 365 includes a few other caveats:

- Citrix Service Providers who are also [Tier-1](#) Microsoft Cloud Solution Providers can use Microsoft Shared Computer Activation to host Office 365 ProPlus for multiple tenants within the service provider's data centers on shared compute infrastructure. Refer to the [Microsoft Partner Center](#) or contact your Microsoft representative for more information.

- Service Providers can also use Microsoft Azure hosted XenApp and XenDesktop server VDI instances for hosting Office 365 ProPlus to deliver Office 365 Services to their tenants.

Note: The Shared Computer Activation does not impact the user's ability to install Office 365 ProPlus on 5 different machines.

Note: Microsoft allows a single user to activate Office 365 Pro Plus on a "reasonable" number of computers in a given time period (1 day) before activation fails. Unfortunately, there is no documented value for "reasonable" number of activations.

Note: To use Shared Computer Activation, the Office Deployment Toolkit must be used as explained in the following Microsoft TechNet article. A minimum of Office 365 Enterprise E3 or higher is highly recommended - not only to enable the Microsoft Shared Activation requirements on the RDS-based XenApp servers, but also for the broader analytics and other capabilities found in the E3 and higher subscriptions.

Appendix A: Cached Exchange Mode Considerations and Test Results

Testing Outlook 2016 via XenApp with Exchange Online

The decision to move to Office 365 (with Exchange Online mailboxes) impacts Outlook performance for non-persistent, and hosted shared desktops in addition to Outlook served as a seamless application via XenApp. The objective of our tests is to compare performance of the different deployment options available for Office 365 Exchange Online, and to make a recommendation for the best observed approach.

In our tests, we used multiple unique users, going through a prescribed set of procedures on an identical set of email messages of various sizes. We measured the time to start Outlook, to load, display and send messages. To assess the potential impact to on-premises infrastructure we measured the CPU, disk, network, and memory usage while interacting with Outlook. The times and performance numbers over multiple test iterations were averaged together for each unique user.

Test platform:

Windows Server 2016
XenApp 7.12
Citrix Profile Management enabled
Office 365 (click-to-run)
User mailbox size approximately 5 GB

Tested Deployments:

An on premises deployment of Microsoft Exchange Server 2016 integrated with Microsoft Outlook 2016 running within a Citrix XenApp 7.12 execution environment. (Figure 4)

Microsoft Office 365 Exchange Online with Microsoft Outlook 2016 running in **Online Exchange Mode**. (Figure 5)

Microsoft Office 365 Exchange Online with Microsoft Outlook 2016 running in **Outlook Cached Exchange Mode**. (Figure 6)

Microsoft Office 365 Exchange Online with Microsoft Outlook 2016 running in **Online Exchange Mode** within a XenApp Server hosted on Microsoft Azure Cloud. (Figure 7)

Results of testing

End user experience (Performance)

Our tests focused on two aspects of user experience.

- **Receiving Mail:** The time it takes to display an array of different-sized emails with graphics attachments (in MB),
- **Sending Mail:** The time it takes to send emails of different sizes (in MB).

Figure 4

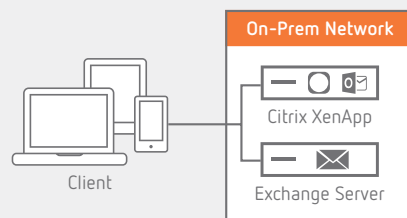


Figure 5

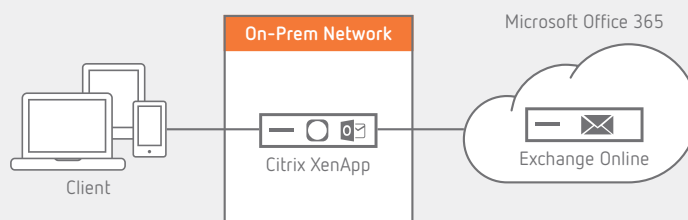


Figure 6

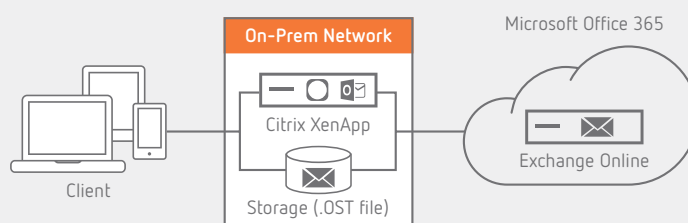
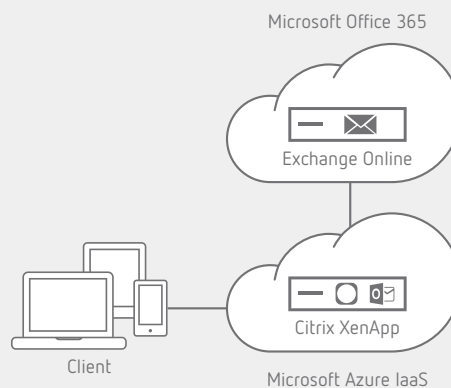


Figure 7



As presented in the chart in Figure 8, our tests across all four implementations conclude that user experience is significantly enhanced by configuring Outlook 2016 to use Cached Exchange Mode. When configuring Outlook to use Online Mode, the best end-user experience is achievable when an Exchange Server is available within the on premises network closest to the XenApp servers.

More details regarding Online Mode versus cached Exchange Mode are available in the graphs that follow.

In Figure 9, we can see that there is a significant impact to the load time of new emails when Exchange Online, Online Mode is implemented in comparison to our On Premises Exchange baseline. In contrast, implementing Outlook Cached Exchange Mode can actually reduce the display time in comparison to the baseline, sometimes by as much as 49%.

In Figure 10, we can see that an equally significant impact is demonstrated while sending email from either Online Mode, or Outlook Cached Exchange Mode in comparison to the baseline.

These tests indicate, the advantages of implementing Outlook Cached Exchange Mode are compelling from a user perspective. There are however, infrastructure impacts to consider, to determine the proper balance of performance and cost trade-offs that are made within your particular implementation. We discuss these impacts in the next section.

Impacts to on premises infrastructure

These tests measured four infrastructure components in 3 areas while Outlook was running within a XenApp session. These three areas were: starting Outlook, reading mail, and sending mail.

Launching Outlook:

When starting Outlook, we measured the following:

- Average CPU time consumed per user. (Figure 11)
- Percentage of Logical Disk Time. (Figure 11)

Figure 8

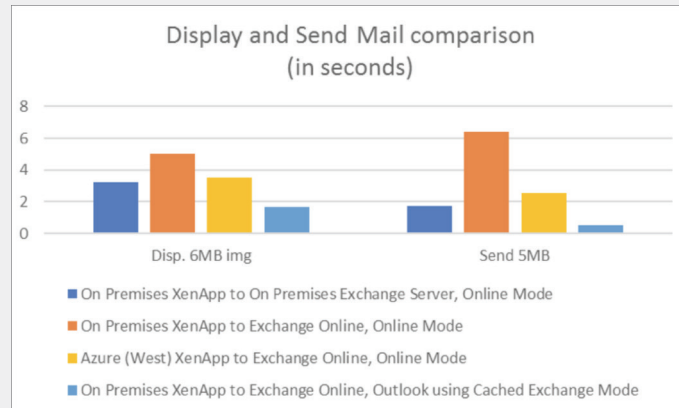


Figure 9

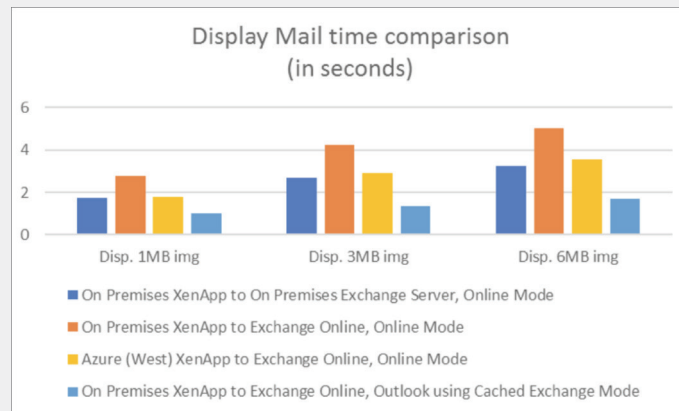
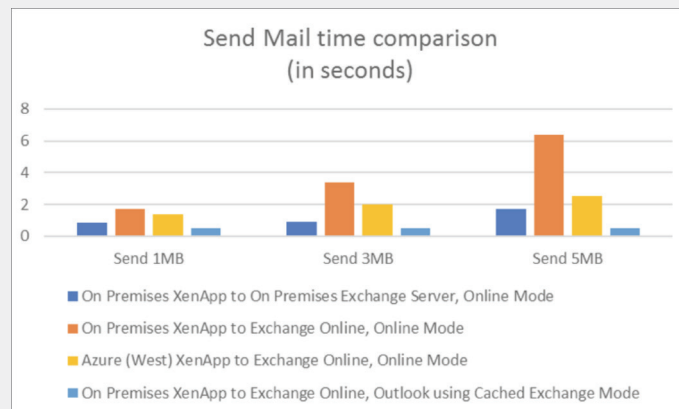


Figure 10



- The amount of committed memory. (Figure 11)
- The total number of Bytes/Second transmitted over the network. (Figure 12)

In Figure 11, we can make the following observations.

- Average CPU time is decreased most significantly when configured for Exchange Online, Online Mode. The decrease makes sense, because fewer cycles are used to fetch and display email within the local system. The back-end cloud service handles these cycles. A point of interest is that Exchange Online / Cached Exchange Mode (OST in Network Share) consumes less CPU than On-Premises, Online Mode.
- XenApp server Logical Disk Time (%) impact is greatest for Exchange Online, Online Mode, and least for Exchange Online (OST in Network share). The latter being about 67% less time than the former, and approximately 50% less time than the Exchange Online, Online Mode implementation.
- Memory Committed is relatively the same across all three implementations, with Exchange Online / Online Mode being the slightly costlier of the set.

In Figure 12, when starting Outlook, the network impact during our tests was most significant when using Exchange Online / Cached Exchange Mode (OST in Network Share).

Reading Mail:

Looking at Figure 13, we can make the following observations.

- Average CPU time is decreased most significantly when configured for Exchange Online / Online Mode. The decrease makes sense because fewer cycles are used to fetch and display email within the local system, and because the back-end cloud service handles these cycles.
- XenApp server Logical Disk Time (%) impact is greatest for On-Premises, Online Mode, and least for Exchange Online (OST in Network share). The latter being about 70% less time than the

Figure 11

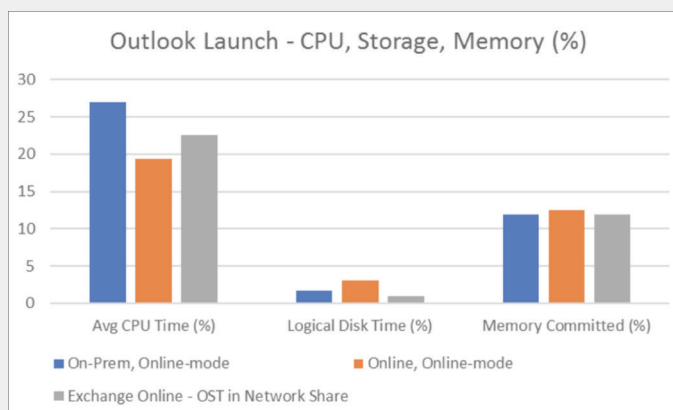


Figure 12

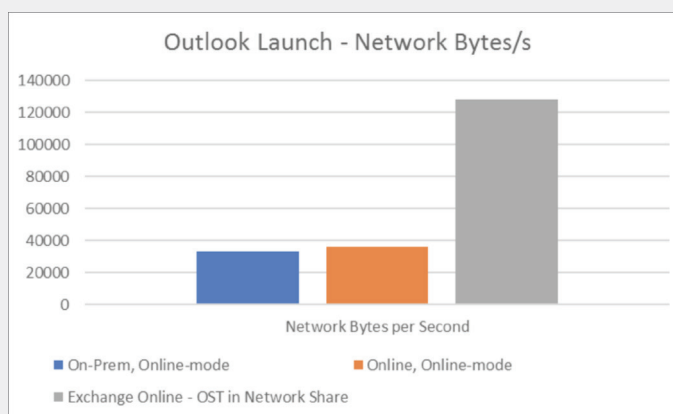
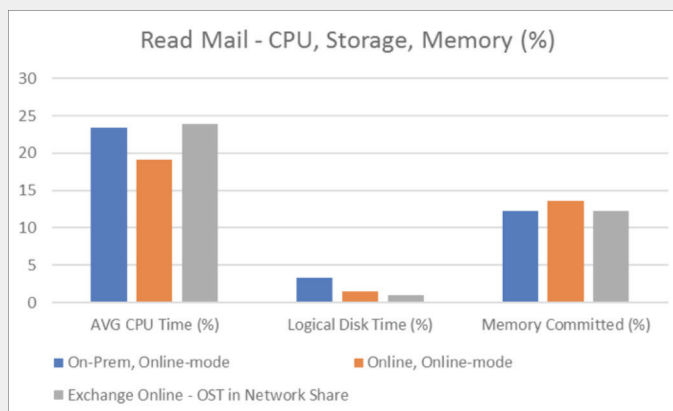


Figure 13



former, and approximately 33% less time than the Exchange Online / Online Mode implementation.

- Memory Committed is relatively the same across all three implementations, with Exchange Online, Online Mode being the slightly costlier of the set.

In Figure 14, when reading mail in Outlook the network impact during our tests was most significant when using Exchange Online / Cached Exchange Mode (OST in Network Share).

Sending Mail:

The following send mail characteristics are observed in Figure 15.

- Average CPU time is decreased most significantly when configured for Exchange Online On-Premises / Online Mode.
- XenApp server Logical Disk Time (%) impact is greatest for On-Premises / Online Mode, and least for Exchange Online / Online Mode. The latter being approximately 40% less time than the former, and slightly less time than the Exchange Online, Cached Exchange Mode (OST in Network Share).
- Memory Committed is relatively the same across all three implementations, with Exchange Online / Online Mode being the slightly costlier of the set.

In Figure 16, when sending mail in Outlook the network impact during our tests was most significant when using Exchange Online / Cached Exchange Mode (OST in Network Share).

Planning for Cached Exchange Mode

As discussed earlier, Cached Exchange Mode appears to be the better solution to overcoming the latency challenges when migrating to Exchange Online. However, transitioning the mailbox cache to a network share can impact your storage and network infrastructure.

Note: The amount of data that is cached can be controlled by group policy.

In planning our tests, Citrix used the Microsoft Whitepaper titled [“Cached Exchange Mode in a Remote Desktop Session Host environment: planning considerations”](#) as a reference.

Figure 14

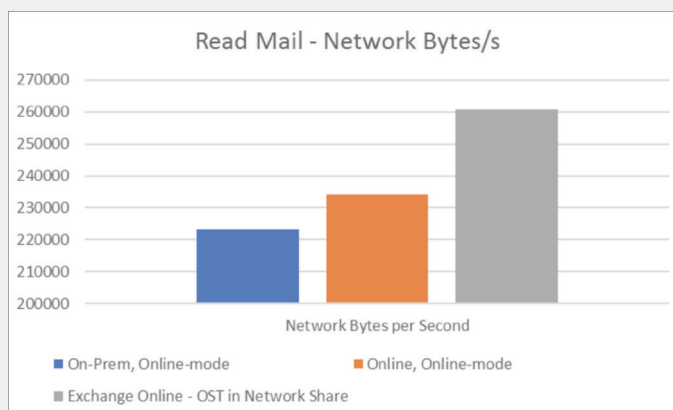


Figure 15

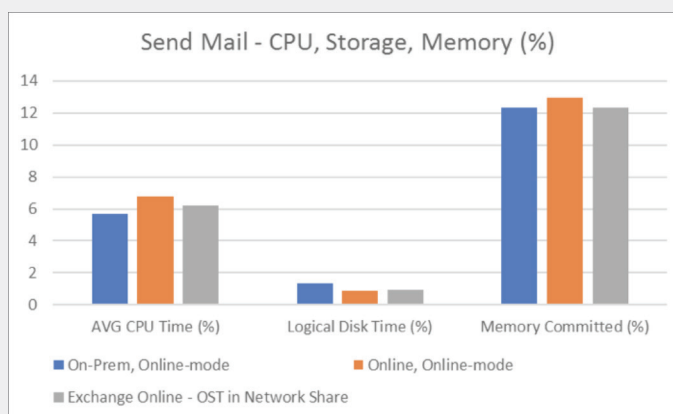
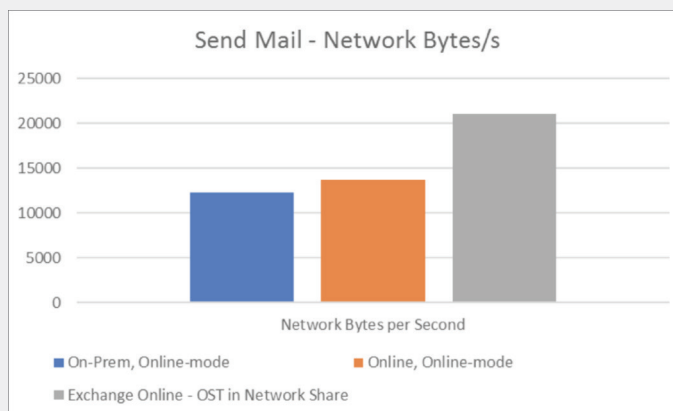


Figure 16



The Citrix generated chart in Figure 17 shows the (per user) disk I/O of the file server when hosting the cache file. These results were generated when Outlook is at rest.

Although Citrix tests used more recent versions of Outlook and the underlying Windows operating system, the results appear to parallel those documented by Microsoft in the whitepaper referenced on page 9.

Methodology and test details

Outlook 2016 with Exchange on-premises (as a baseline measure)

Outlook 2016 in Online Mode, using an on-premises Exchange Server was used to establish a baseline. (Table 3)

Outlook with Exchange Online, Outlook in Online Mode (No Cache File)

A second set of tests were executed using Online Mode connecting to the Office 365 Exchange Online cloud service. The test results demonstrate that added latency in the public network connection between the on-premises XenApp server session and the Exchange Online service resulted in a large increase in Outlook start times in addition to mail read and send times. In general, these increased times are not within a range where most users would experience acceptable performance. (Table 4)

Figure 17

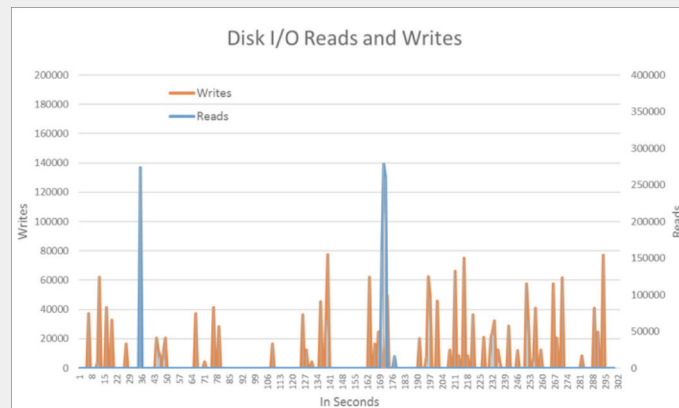


Table 3 Outlook 2016 with Exchange On-Premises (Baseline Measure)

Function	Online Mode On-Premises Exchange (in seconds)		
Outlook 2016 start time (preview pane fully loaded)	5.36 sec		
Mail display time, 1 MB inline image	1.76 sec		
Mail display time, 3 MB inline image	2.68 sec		
Mail display time, 6 MB inline image	3.26 sec		
Mail send time, local 1 MB attachment	0.82 sec		
Mail send time, local 3 MB attachment	0.90 sec		
Mail send time, local 5 MB attachment	1.74 sec		
Function	Outlook Start	Read Mail	Send Mail
Avg CPU	27.0%	23.4%	5.7%
Logical Disk	1.8%	3.4%	1.3%
Network Bps	33,400.1%	223,164.2%	12,213.2%
Memory	11.9%	12.2%	12.3%

Table 4 Outlook with Exchange Online, Outlook in Online Mode (No Cache File)

Function	Online Mode On-Premises Exchange (Baseline)		Online Mode Exchange Online		Percent Increase/Decrease from baseline	
Outlook 2016 start time (preview pane fully loaded)	5.36 sec		16.08 sec		+200%	
Mail display time, 1 MB inline image	1.76 sec		2.76 sec		+57%	
Mail display time, 3 MB inline image	2.68 sec		4.24 sec		+58%	
Mail display time, 6 MB inline image	3.26 sec		5.02 sec		+54%	
Mail send time, local 1 MB attachment	0.82 sec		1.70 sec		+107%	
Mail send time, local 3 MB attachment	0.90 sec		3.38 sec		+276%	
Mail send time, local 5 MB attachment	1.74 sec		6.40 sec		+268%	
Function	Outlook Start	Outlook Start Baseline	Read Mail	Read Mail Baseline	Send Mail	Send Mail Baseline
Avg CPU	19.3%	-28%	19.1%	-18%	6.8%	+19%
Logical Disk	3.1%	+73%	1.5%	-55%	0.9%	-33%
Network Bps	36,337.7%	+9%	234,086.3%	+5%	13,735.4%	+12%
Memory	12.5%	+5%	13.6%	+11%	13.0%	+5%

Outlook with Exchange Online, Outlook in Cached Exchange Mode

For the third set of tests, Cached Exchange Mode was enabled and configured. Using Group Policy, we configured the OST (Cache file) location to be on a network share in the XenApp server's local network. In our tests, we ran Outlook once to build the .OST file completely, then we tested the times for subsequent starts. The tests demonstrated a

decrease in subsequent Outlook mailbox load times, mail read times and mail send times. This decrease was evident over all scenarios including the baseline.

Table 5 shows Outlook launch times are about 25% less than those without a cache file. However, there is now greater need for network storage and its ability to handle the added burden of Outlook cache files. [See Figure 17.](#)

Table 5 Outlook with Exchange Online, Outlook in Cached Exchange Mode

Function	Online Mode On-Premises Exchange (Baseline)		Cached Exchange Mode Exchange Online		Percent Increase/Decrease from baseline	
Outlook 2016 start time (preview pane fully loaded)	5.36 sec		4.38 sec		-18%	
Mail display time, 1 MB inline image	1.76 sec		1.00 sec		-43%	
Mail display time, 3 MB inline image	2.68 sec		1.36 sec		-49%	
Mail display time, 6 MB inline image	3.26 sec		1.68 sec		-48%	
Mail send time, local 1 MB attachment	0.82 sec		0.50 sec		-39%	
Mail send time, local 3 MB attachment	0.90 sec		0.50 sec		-44%	
Mail send time, local 5 MB attachment	1.74 sec		0.50 sec		-71%	
Function	Outlook Start	Outlook Start Baseline	Read Mail	Read Mail Baseline	Send Mail	Send Mail Baseline
Avg CPU	22.6%	-16%	23.9%	+2%	6.2%	+9%
Logical Disk	0.9%	-47%	1.0%	-69%	1.0%	-28%
Network Bps	128,151.9%	+284%	260,855.8%	+17%	21,043.6%	+72%
Memory	11.8%	-1%	12.3%	+1%	12.3%	+0%

Testing Outlook with Exchange Online, XenApp hosted in Microsoft Azure

In our fourth set of tests, we configured two XenApp environments in Azure. One in the U.S. East region (Table 6), and one in the U.S. West region (Table 7).

We did not use Cached Exchange Mode in this configuration. Our results show that there is an improvement for Exchange Online / Online Mode when XenApp is hosted in Azure as compared to the same scenario in an on-premises datacenter. (Table 6)

As expected, the results show an improvement when the XenApp server is hosted in Azure. But the results were still slightly behind baseline results.

Summary

Summarizing the metrics from best to worst, the following is confirmed:

- Baseline: On-Premises XenApp hosted Outlook using Online Mode with On-Premises Exchange
- On-Premises XenApp hosted Outlook using Cached Exchange Mode with Exchange Online
- Azure-based XenApp hosted Outlook using Online Mode with Exchange Online
- On-Premises XenApp hosted Outlook using Online Mode with Exchange Online provides an unsatisfactory user experience and should be avoided.

Table 6 Outlook with Exchange Online, XenApp hosted in Microsoft Azure (U.S. East Region)

Function	XenApp in On-Premises Datacenter Online Mode Exchange Online	XenApp in Azure (East) Online Mode Exchange Online	Percent Increase/Decrease from On-Prem XenApp Exchange Online
Mail display time, 1 MB inline image	2.76 sec	1.74 sec	-37%
Mail display time, 3 MB inline image	4.24 sec	3.20 sec	-25%
Mail display time, 6 MB inline image	5.02 sec	3.64 sec	-27%
Mail send time, local 1 MB attachment	1.7 sec	1.54 sec	-9%
Mail send time, local 3 MB attachment	3.38 sec	2.74 sec	-19%
Mail send time, local 5 MB attachment	6.40 sec	3.78 sec	-41%

Table 7 Outlook with Exchange Online, XenApp hosted in Microsoft Azure (U.S. West Region)

Function	XenApp in On-Premises Datacenter Online Mode Exchange Online	XenApp in Azure (West) Online Mode Exchange Online	Percent Increase/Decrease from On-Prem XenApp Exchange Online
Mail display time, 1 MB inline image	2.76 sec	1.78 sec	-36%
Mail display time, 3 MB inline image	4.24 sec	2.90 sec	-32%
Mail display time, 6 MB inline image	5.02 sec	3.54 sec	-29%
Mail send time, local 1 MB attachment	1.7 sec	1.38 sec	-19%
Mail send time, local 3 MB attachment	3.38 sec	2.02 sec	-40%
Mail send time, local 5 MB attachment	6.40 sec	2.54 sec	-60%



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