ICA Client Bandwidth Analysis

By Citrix Consulting Services

Citrix Systems, Inc.

Disclaimer

The objective of this white paper is to provide recommendations for ICA Client settings based on network environment configuration. The testing performed concentrated on the most common ICA Client setting scenarios and the most common network environment configurations. The intent of this paper is not to provide a complete list of recommendations for all network environments, but to provide a guideline on which to base further analysis in unique network environments.

Notice

The information in this publication is subject to change without notice.

November 28, 2001	Melissa Hopkins, Citrix Consulting Services	Version 0.8
December 5, 2001	Melissa Hopkins, Citrix Consulting Services (Feedback from Doug Dobson)	Version 0.9
December 6, 2001	Melissa Hopkins, Citrix Consulting Services (Feedback from Anatoliy Panasyuk)	Version 1.0

Table of Contents

Table of Figures

Overview

The Citrix Win32 ICA Client provides functionality to maximize ICA bandwidth performance and enhance the end-user experience. This functionality can be configured through the following ICA Client settings:

- **Use Data Compression:** Data compression reduces the amount of data that needs to be transferred by utilizing additional processor resources to compress and decompress the data.
- **Use Disk Cache for Bitmaps:** Bitmap caching to disk uses local hard disk space to store commonly- used graphical objects such as bitmaps in a local disk cache on the client.
- **Queue Mouse Movements and Keystrokes:** Queuing causes the client to send mouse and keyboard updates less frequently to the Citrix server.
- **SpeedScreen Latency Reduction:** Latency reduction is a collective term used to describe the functionality that helps enhance user experience on slower network connections.
  - **Mouse Click Feedback:** Displays instant feedback for mouse clicks on the client device.
  - **Local Text Echo:** Accelerates the display of input text on the client device.

Citrix Consulting Services is frequently confronted with the task of recommending the optimal configuration of the above ICA Client settings based on a customer's network environment.   The purpose of this document is to detail the effects of ICA client settings on network bandwidth when executing both typing-intensive and graphics-intensive processes. An isolated network was created to perform scripted tests using the ICA Client release 6.20.985 and MetaFrame XP 1.0 with Feature Release 1 on Windows 2000 Terminal Services. Optimal configurations of ICA Client settings for several network environment scenarios are described in this document based on the test results.

ICA Client Settings

The ICA client has a number of settings that can be manipulated to alter the way in which data travels across the network.   These settings are configured depending on the type of connection as follows:

- Application Set – When connecting to a published application through an application set, right-click on the application set icon or right-click in the white space next to the published application icons, click **Application Set Settings** and switch to the Default Options tab in the Application Set Settings dialog box. Application Set settings are stored in the following location: %USERPROFILE%\Application Data\ICAClient\pn.ini.

- Custom Connections – When initiating an ICA session through a custom connection, right-click on the icon for the custom ICA connection, click **Properties** and switch to the Options tab in the Custom Connection Properties dialog box. Custom Connection settings are stored in the following location: %USERPROFILE%\Application Data\ICAClient\APPSRV.ini. The Options tab from the Custom Connections dialog box, which is very similar to the Application Set Settings dialog box, is shown below:
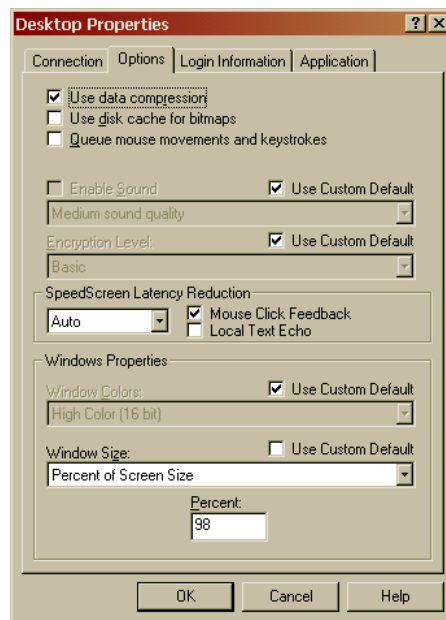
Figure 1 - Options Tab

- ICA file – When using an ICA file to access an ICA session (either custom or dynamically generated through NFuse), the associated file parameters that are set automatically in pn.ini and APPSRV.ini when choosing options from the user interface must be included in the ICA file. These parameters are discussed in further detail in the following sections.

Each ICA Client setting affects bandwidth usage and end-user experience differently. Additional details about each ICA Client setting are described in the following sections.

Use Data Compression

Data compression reduces the amount of data that needs to be transferred and therefore the amount of bandwidth used for ICA traffic by utilizing additional processor resources on both the client and server to compress and decompress the data as shown in the figure below:
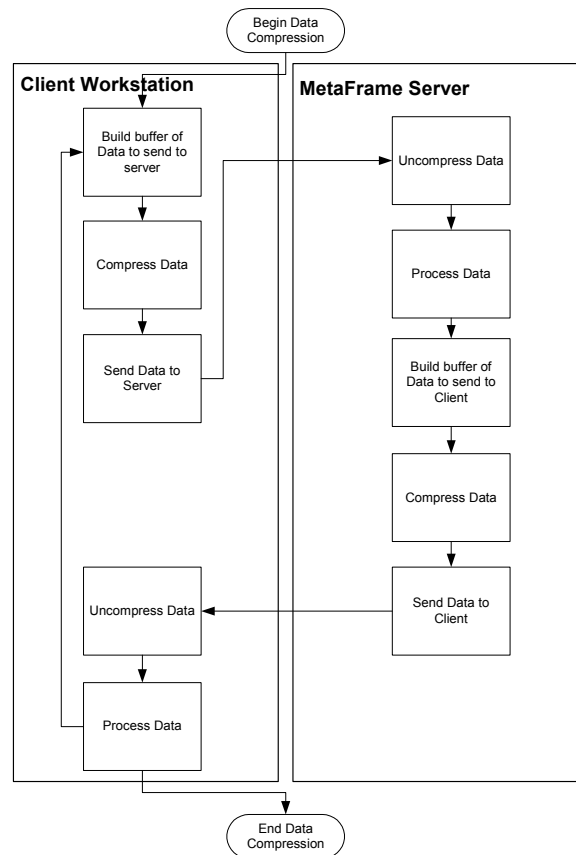
Figure 2 - Use Data Compression Process Flow

Data Compression is enabled through the ICA Client user interface by checking **Use data compression** on the Options tab of the Custom Connections dialog box (for custom connections) or the Application Set Settings dialog box (for Application Set connections). The corresponding ICA file parameter is as follows:

ICA Client Setting	ICA file Parameter	Description	Default Value
Use Data Compression	Compress	Enables (On)/Disables (Off) data compression	On (Enabled)

When enabled, the ICA protocol uses a compression algorithm to compress the ICA data into smaller packets, thus requiring less bandwidth between the client and the server.

Use Disk Cache for Bitmaps

Use Disk Cache for Bitmaps utilizes local hard disk space to store commonly- used graphical objects such as bitmaps in a local disk cache on the client. When a server application identifies a bitmap to be displayed, the server sends the bitmap through the ICA session over the network to the ICA Client. The ICA Client then stores the bitmap locally for future use. When the ICA Client requires this same bitmap again, the locally cached bitmap is used, as shown in the diagram below:

Figure 3 - Use Disk Cache for Bitmaps Process Flow

Use Disk Cache for Bitmaps is enabled through the ICA Client user interface by checking **Use disk cache for bitmaps** on the Options tab of the Custom Connections dialog box (for custom connections) or the Application Set Settings dialog box (for Application Set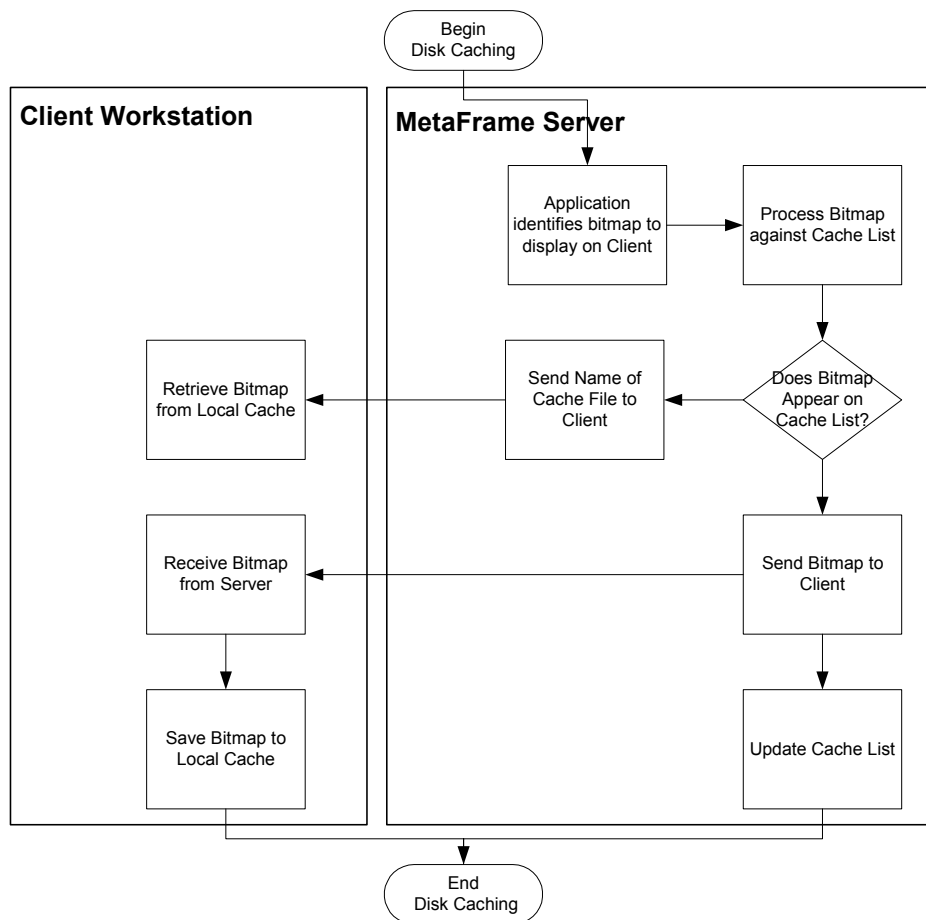 connections). Additional disk cache settings such as the maximum disk space to be used for cached files, the minimum size bitmap to cache, and the path to the cached files are configured on the **Bitmap Cache** tab of the ICA Settings dialog box (accessed by choosing the **ICA Settings** option from the **Tools** menu of the ICA Client). The Bitmap Cache tab is shown below:

Figure 4 - Bitmap Cache Tab

The corresponding ICA file parameters are as follows:

ICA Client Setting	ICA file Parameter	Description	Default Value
Use Disk Cache for Bitmaps	PersistentCacheEnabled	Enables (On) / Disables (Off) Disk Caching	Off (Disabled) when connection type is LAN On (Enabled) when connection type is WAN
	PersistentCacheSize	Sets the maximum disk space in bytes allowed for caching bitmaps	10 MB (10485760 bytes)
	PersistentCacheMinBitmap	Defines the minimum size in bytes a bitmap must be before it will be cached	8KB (8192 bytes)
	PersistentCachePath	Specifies the directory path to the disk cache	%UserProfile%\ Application Data\ICAClient\Cache

When Use Disk Cache for Bitmaps is enabled, one additional parameter, MaximumCompression, is automatically enabled. This parameter controls the size of the buffer used by the data compression process. When MaximumCompression is enabled, the buffer is maximized to produce larger, and therefore most likely fewer, ICA packets. The Use Disk Cache for Bitmaps setting is typically enabled when bandwidth resources are limited. Enabling MaximumCompression further reduces the amount of bandwidth required by reducing the total number of ICA packets.

The Use Disk Cache for Bitmaps setting requires some additional bandwidth overhead because on session initialization the ICA Client must send a list of cached files to the MetaFrame server and the MetaFrame server must keep track of what is already cached. The biggest advantage to this setting occurs when the same graphical

objects are required multiple times, for example when repeatedly reviewing the same PowerPoint presentation or when repeatedly opening the same customer search screen in a Customer Relationship Management application. The first display of the graphical object requires the image to be downloaded from the server; however, subsequent displays are much faster and do not require additional bandwidth since the image is displayed from the locally cached file.

Queue Mouse Movements and Keystrokes

Queuing mouse movements and keystrokes causes the ICA Client to send mouse and keyboard updates less frequently to the Citrix server. Separate mouse and keyboard timers track the number of milliseconds that pass and send the mouse and keyboard events at the end of a specified time period. By default this time period is 100 milliseconds for mouse movements and 50 milliseconds for keystrokes. All keyboard events are batched up during this time period, while the ICA Client processes multiple mouse movements and only the latest mouse movement is kept and sent to the server. This process is shown in the diagram below:
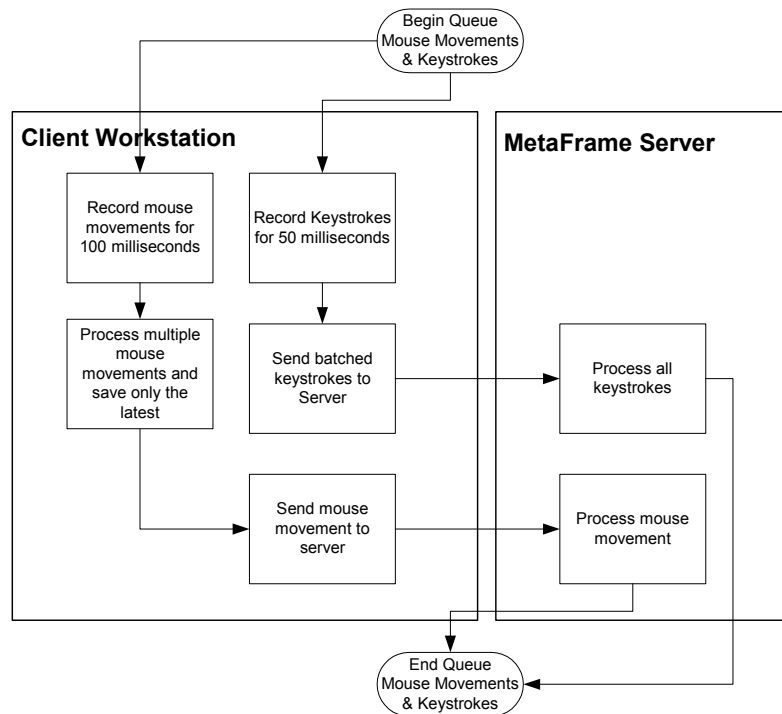
Figure 5 - Queue Mouse Movements and Keystrokes Process Flow

Queue Mouse Movements and Keystrokes is enabled through the ICA Client user interface by checking **Queue mouse movements and keystrokes** on the Options tab of the Custom Connections dialog box (for custom connection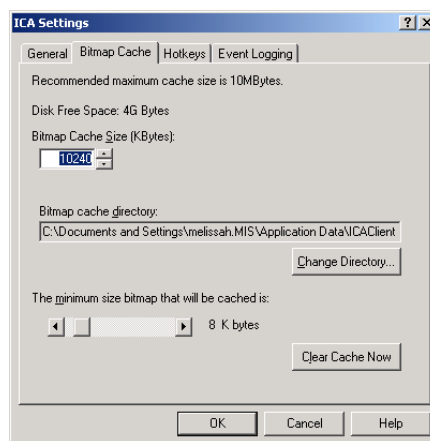s) or the Application Set Settings dialog box (for Application Set connections). The corresponding ICA file parameters are as follows:

ICA Client Setting	ICA file Parameter	Description	Default Value
Queue Mouse Movements and Keystrokes	MouseTimer	Time interval in milliseconds during which mouse input is collected before being sent to the MetaFrame server	0 (Disabled) for LAN connection types 100 (Enabled) for WAN connections types
	KeyboardTimer	Time interval in milliseconds during which keyboard input is collected before being sent to the MetaFrame server	0 (Disabled) for LAN connection types 50 (Enabled) for WAN connections types

When Queue Mouse Movements and Keystrokes is disabled, each mouse click or keystroke is sent immediately to the server. When this setting is enabled, the ICA Client is forced to wait the specified number of milliseconds before sending mouse clicks and keystrokes to the server. The result is that fewer ICA packets are sent from the client to the server less frequently.

SpeedScreen Latency Reduction

SpeedScreen Latency Reduction is a collective term used to describe the functionality that helps enhance user experience on slower network connections. SpeedScreen Latency Reduction is enabled through the ICA Client user interface by choosing Enabled, Disabled, or Auto on the Options tab of the Custom Connections dialog box (for custom connections) or the Application Set Settings dialog box (for Application Set connections). When set to Auto, SpeedScreen settings are only enabled when the MetaFrame server detects network latency to be higher than the configured High latency threshold setting. SpeedScreen settings are disabled again when network latency falls below the configured Low latency threshold setting.

Note: The SpeedScreen Latency Reduction Manager utility must be configured on the MetaFrame server to enable SpeedScreen settings before the ICA Client can take advantage of this functionality. SpeedScreen settings can be enabled at the server level for all applications on the server, or at the application level for each application on a server.   The SpeedScreen Server Properties dialog box, accessed by double-clicking on the server name within the SpeedScreen Latency Reduction Manager utility, is shown below:
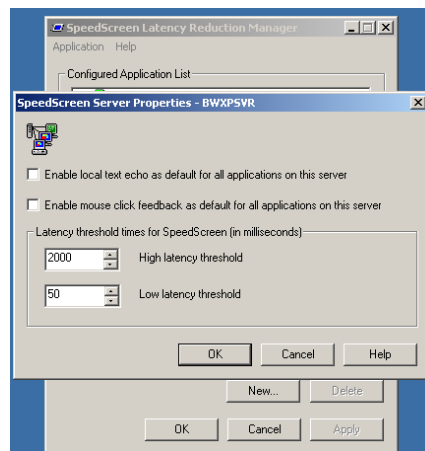
Figure 6 - SpeedScreen Latency Reduction Manager Settings

SpeedScreen Latency Reduction includes two ICA Client settings, Mouse Click Feedback and Local Text Echo. The Mouse Click Feedback SpeedScreen setting displays instant feedback for mouse clicks on the client device. When the mouse is clicked, the ICA Client immediately changes the mouse pointer to an hourglass indicating that the user's mouse click input is being processed. The ICA Client sends a special ping packet to the server along with the mouse click packet. Once the server receives the ping packet, it returns an acknowledgement packet back to the ICA Client. When the ICA Client receives this acknowledgement, the hourglass is changed back to its previous form as shown in the figure below:
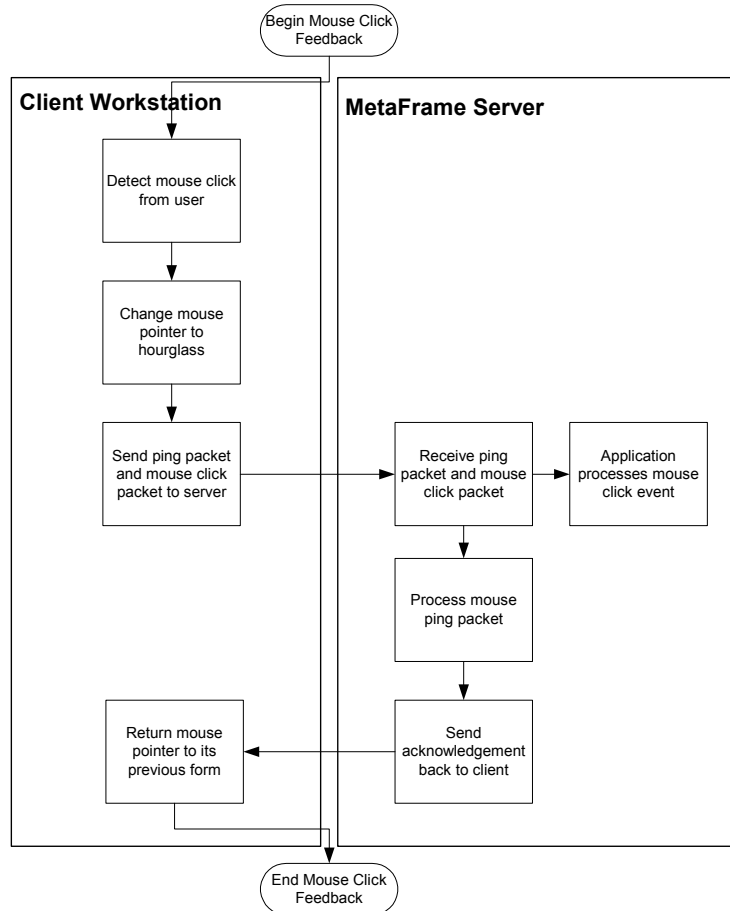
Figure 7 - SpeedScreen Latency Reduction: Mouse Click Feedback Process Flow

The Local Text Echo SpeedScreen setting accelerates the display of input text on the client device.   The ICA Client detects input keystrokes from the keyboard, makes a "best guess" at the font type and content, and echoes the information locally on the client. At the same time, the keyboard input is still sent to the MetaFrame server as usual, and the server responds with an updated screen image. When the ICA Client finally receives the updated screen image from the server, the updated image replaces the local client image so the ICA Client and the server are once again in sync. This process is summarized in the diagram below:
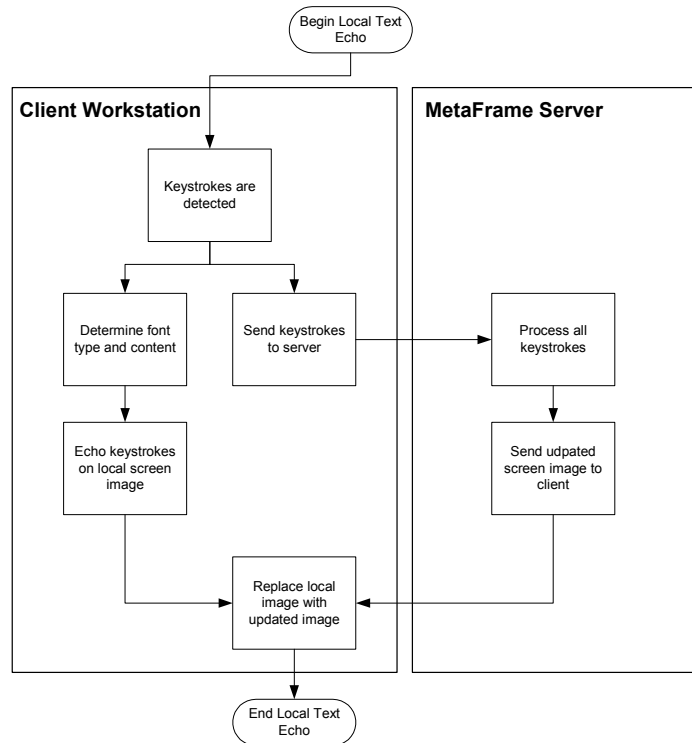
Figure 8 - SpeedScreen Latency Reduction: Local Text Echo Process Flow

Once SpeedScreen Latency Reduction has been enabled or set to Auto as described above, Mouse Click Feedback and Local Text Echo are enabled through the ICA Client user interface by checking **Mouse Click Feedback** and **Local Text Echo** respectively on the Options tab of the Custom Connections dialog box (for custom connections) or the Application Set Settings dialog box (for Application Set connections). The corresponding ICA file parameters are as follows:

ICA Client Setting	ICA file Parameter	Description	Default Value
Mouse Click Feedback	ZLMouseMode	Configures the Mouse Click Feedback setting.	0 (Disabled)
Local Text Echo	ZLKeyboardMode	Configures the Local Text Echo setting.	0 (Disabled)

The Mouse Click Feedback and Local Text Echo settings are dependent on the configuration of the SpeedScreen Latency Reduction setting, as follows:

SpeedScreen Latency Reduction	Mouse Click Feedback / Local Text Echo check box	ZLMouseMode / ZLKeyboardMode value
Enabled	Checked	1
Enabled	Unchecked	0
Auto	Checked	2
Auto	Unchecked	0
Disabled	Checked	0
Disabled	Unchecked	0

SpeedScreen Latency Reduction settings have a small negative impact on bandwidth use. However, the purpose of these settings is to improve user perceptions of latency by providing instant feedback, which is extremely critical in high-latency network environments.

Test Results and Observations

Extensive testing was performed using the latest Win32 ICA Client (9.20.985) and the latest version of MetaFrame (MetaFrame XP 1.0 with Feature Release 1) to determine bandwidth usage for various configurations of ICA Client settings. Testing was performed on an isolated network, and network capture software was used to capture bandwidth data. The following sections describe the tested configurations of ICA Client settings, test results and observations, and recommended ICA Client setting configurations for several different network environment scenarios based on the test results. For more detailed information about the testing environment including hardware specifications and testing procedures, refer to the *ICA Client Bandwidth Analysis Test Environment* document.

Tested Configurations

The following combinations of ICA Client settings were tested:

ID	Use Data Compression	Use Disk Cache for Bitmaps	Queue Mouse Movements and Keystrokes	Speed Screen Latency Reduction	
				Mouse Click Feedback	Local Text Echo
Data_01	(No Settings Configured – Baseline Test Case)				
Data_02	X				
Data_03*	X	X			
Data_04	X	X			
Data_05	X		X		
Data_06	X	X	X		
Data_07**	X			X	X
Data_08	X			X	X
Data_09	X	X		X	X
Data_10	X		X	X	X
Data_11	X	X	X	X	X

*Data_03 is a duplicate of Data_04, but it is executed without a baseline cache for only the PowerPoint test (executing the typing test with Use Disk Cache for Bitmaps enabled does not produce any cache files).

**Data_07 is a duplicate of Data_08, but it is executed without a baseline cache for both the typing test and the PowerPoint test.

These combinations were selected based on their ability to best identify the impact on network bandwidth of each ICA Client setting by itself as well as in combination with all other ICA Client settings.

Test Results

Each test combination identified above was executed using both a text-based typing test script using Microsoft Word and a graphic-rich test script using Microsoft PowerPoint. The test scripts were created using WinBatch. The following table summarizes the captured bandwidth usage (the test names of TypeData_xx refers to the results of the test-based test script for each combination, and PPData_xx refers to the results of the graphic-rich test script):

Test Name	Total Packets	Total Bandwidth	Total Seconds	Average Bandwidth / second	Avg Packet Size	Total CtoS Packets	Total CtoS Bandwidth	Avg CtoS Packet Size	Total StoC Packets	Total StoC Bandwidth	Avg StoC Packet Size
TypeData_01	25,537	3,387,794	907	3,732	132	13,485	812,981	60	12,052	2,574,812	213
TypeData_02	25,321	1,795,639	907	1,979	70	13,453	850,496	63	11,867	945,142	79
TypeData_04*	25,255	1,786,757	910	1,961	70	13,426	848,853	63	11,829	937,904	79
TypeData_05	25,345	1,794,045	908	1,974	70	13,449	850,258	63	11,895	943,786	79
TypeData_06	25,373	1,798,557	911	1,973	70	13,428	848,960	63	11,945	949,597	79
TypeData_07	31,405	2,174,899	911	2,387	69	15,130	951,385	62	16,275	1,223,514	74
TypeData_08	31,351	2,168,708	908	2,387	69	15,091	949,027	62	16,260	1,219,680	74
TypeData_09	31,215	2,159,427	910	2,371	69	15,086	948,756	62	16,129	1,210,670	75
TypeData_10	31,254	2,160,625	908	2,377	69	15,100	949,570	62	16,155	1,211,055	74
TypeData_11	31,352	2,170,437	909	2,386	69	15,109	950,100	62	16,243	1,220,336	74
PPData_01	22,377	19,374,627	653	29,669	865	7,880	477,834	60	14,496	18,896,793	1,303
PPData_02	17,546	14,899,021	654	22,781	848	6,277	381,971	60	11,269	14,517,049	1,287
PPData_03	17,718	14,387,064	656	21,931	811	6,797	413,325	60	10,920	13,973,739	1,279
PPData_04	10,160	7,430,344	656	11,326	730	4,067	252,201	61	6,093	7,178,143	1,177
PPData_05	17,561	14,902,642	654	22,786	848	6,276	381,925	60	11,285	14,520,716	1,286
PPData_06	10,901	8,110,714	656	12,364	743	4,342	268,748	61	6,559	7,841,966	1,194
PPData_07	17,735	14,923,235	653	22,841	841	6,356	387,158	60	11,379	14,536,076	1,276
PPData_08	17,686	14,915,785	653	22,829	843	6,334	385,836	60	11,352	14,529,949	1,279
PPData_09	10,610	7,744,715	655	11,817	729	4,237	262,763	61	6,373	7,481,952	1,173
PPData_10	17,671	14,898,327	654	22,779	842	6,329	385,533	60	11,341	14,512,794	1,279
PPData_11	11,439	8,479,732	656	12,918	740	4,553	281,838	61	6,885	8,197,893	1,189

*TypeData_03 was not captured since no baseline disk cache is created during execution of the text-based test script.

Observations

The above test results were analyzed for key observations based on the type of test executed, either graphic-rich or text-based. These observations are described in detail below.

Text-Based Observations

The following observations were made about each ICA Client setting based on the above test results summary of the text-based test script using Microsoft Word:

- **Data Compression** reduces bandwidth by approximately 50%, but slightly increases processor usage on the client workstation by approximately 0.5% as shown in the graphs below:
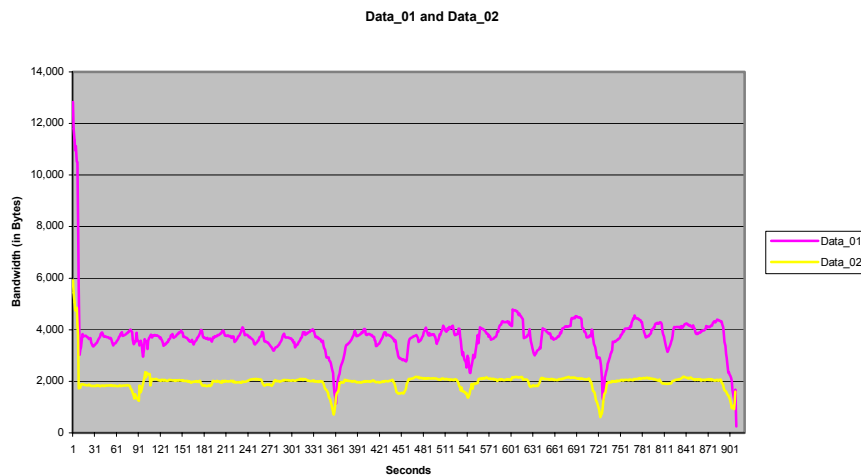
Data_01 and Data_02

Figure 9 - Text-based Test Results: Bandwidth Usage for Data_01 and Data_02
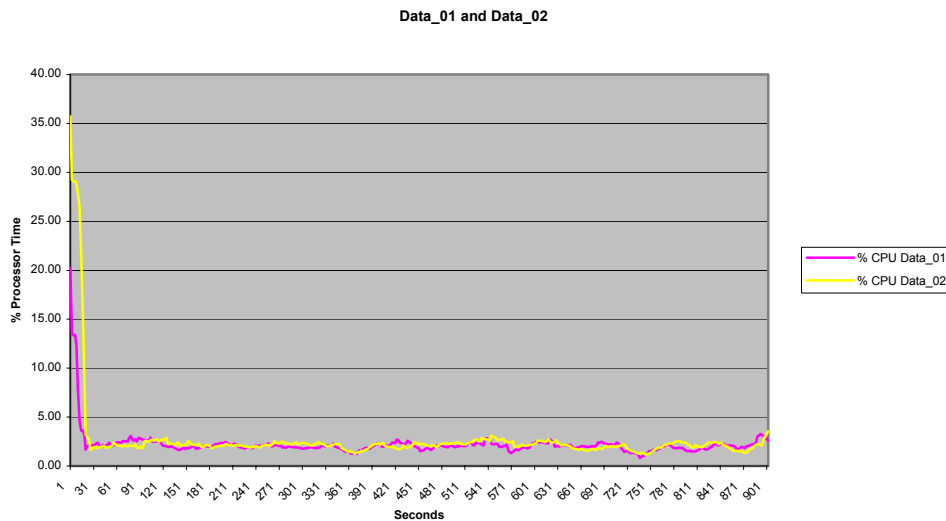
Data_01 and Data_02

Figure 10 - Text-based Test Results: %Processor Usage for Data_01 and Data_02

- **Use Disk Cache for Bitmaps** (Data_04) does not have an impact on bandwidth usage when compared to Data Compression alone (Data_02) as shown below:
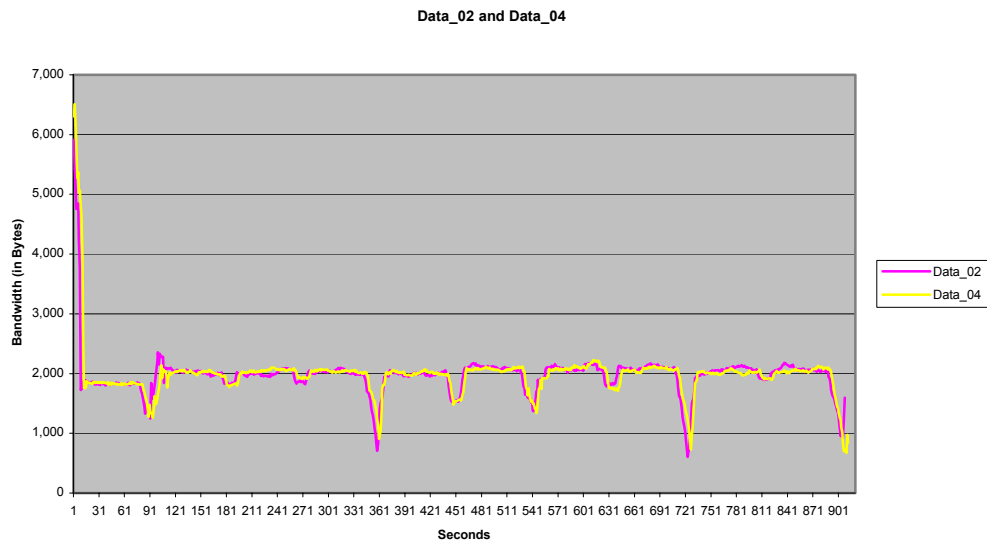
Data_02 and Data_04

Figure 11 - Text-based Test Results: Bandwidth Usage for Data_02 and Data_04

The Use Disk Cache for Bitmaps setting does not use any hard disk space on the client workstation.

- **Queue Mouse Movements and Keystrokes** (Data_05) does not have an impact on bandwidth when compared to Data Compression alone (Data_02). Queue Mouse Movements and Keystrokes slightly

increases bandwidth usage by approximately 1% when used together with Use Disk Cache for Bitmaps (Data_06) when compared to Use Disk Cache for Bitmaps alone (Data_04). These observations are illustrated in the following graph:
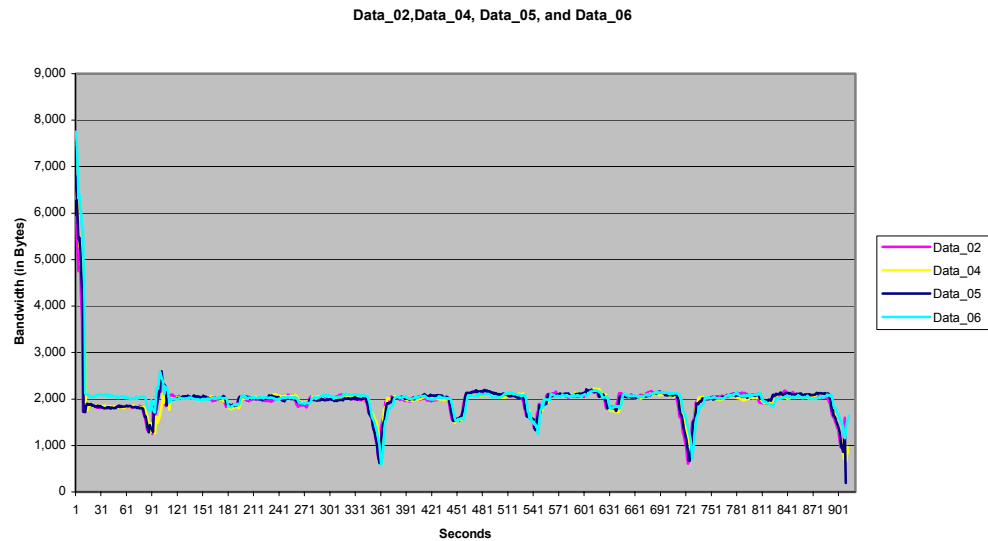
Data_02,Data_04, Data_05, and Data_06

Figure 12 - Text-based Test Results: Bandwidth Usage for Data_02, Data_04, Data_05 and Data_06

- **SpeedScreen Latency Reduction** settings do not show a significant difference in bandwidth, whether (Data_08) or not (Data_08) a baseline cache is present. SpeedScreen Latency Reduction settings increase bandwidth usage by approximately 17% when compared to the results of using Data Compression alone (Data_02) as shown in the following graph:
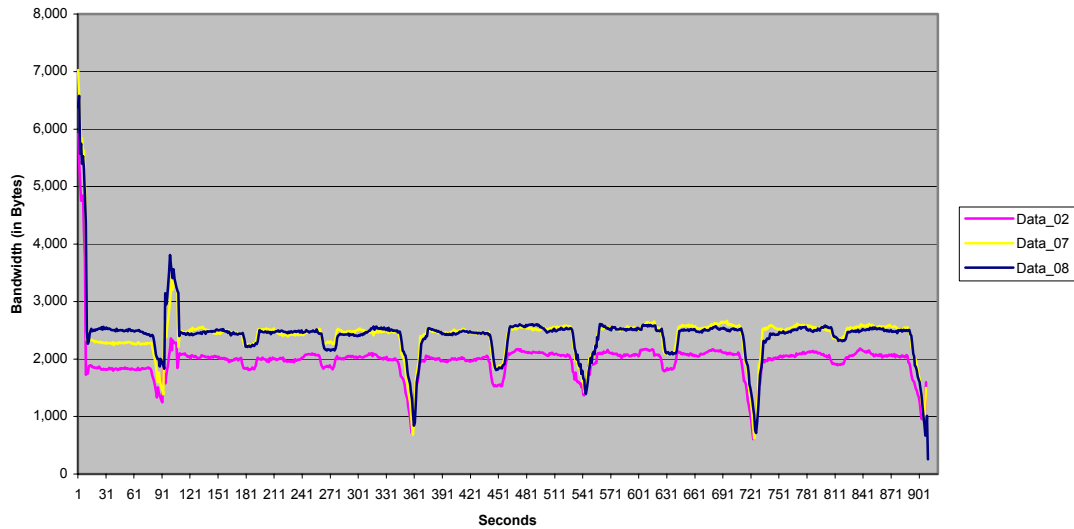
Data_02, Data_07 and Data_08

Figure 13 - Text-based Test Results: Bandwidth Usage for Data_02, Data_07 and Data_08

SpeedScreen Latency Reduction settings use approximately 10KB of hard disk space on the client workstation.

Graphic-Rich Observations

The following observations were made about each ICA Client setting based on the above test results summary of the graphic-rich test script using Microsoft PowerPoint:

- **Data Compression** reduces bandwidth by approximately 25%, but slightly increases processor usage on the client workstation by approximately 1.5% as shown in the graphs below:
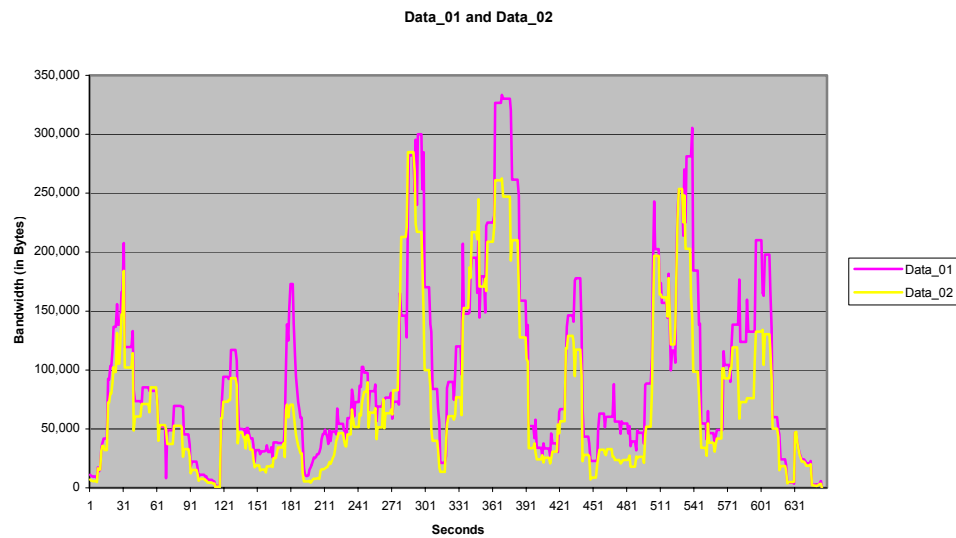

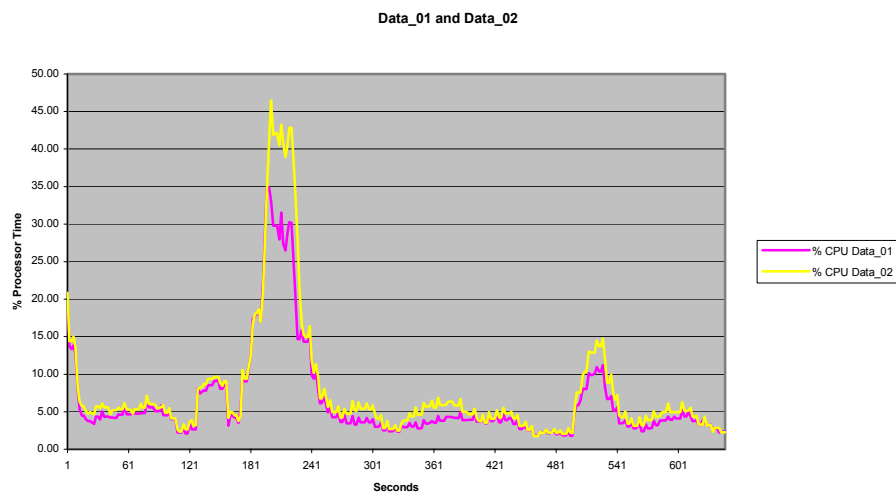**Figure 14 - Graphic-Rich Test Results: Bandwidth Usage for Data_01 and Data_02**

Figure 15 - Graphic-Rich Test Results: %Processor Usage for Data_01 and Data_02

- **Use Disk Cache for Bitmaps** without a baseline cache (Data_03) reduces bandwidth by approximately 4%, and with a baseline cache (Data_04) significantly reduces bandwidth by approximately 50% as illustrated in the graph below when compared to testing with Data Compression alone (Data_02):
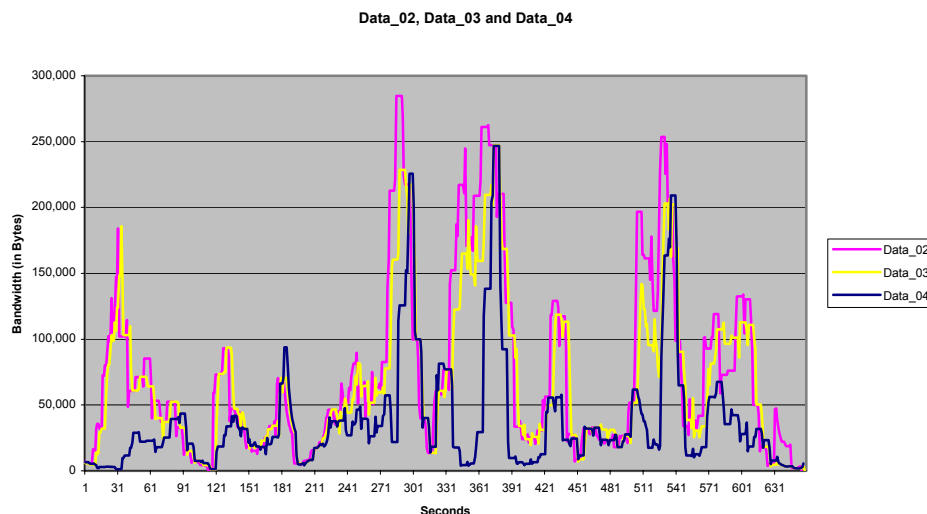
Data_02, Data_03 and Data_04

Figure 16 - Graphic-Rich Test Results: Bandwidth Usage for Data_02, Data_03 and Data_04

Use Disk Cache for Bitmaps uses approximately 8MB of hard disk space on the client workstation.

- **Queue Mouse Movements and Keystrokes** (Data_05) does not have an impact on bandwidth when compared to Data Compression alone (Data_02), and increases overall bandwidth usage by approximately 8% when used together with Use Disk Cache for Bitmaps (Data_06) over Use Disk Cache for Bitmaps alone (Data_04). These observations are depicted in the following graph:
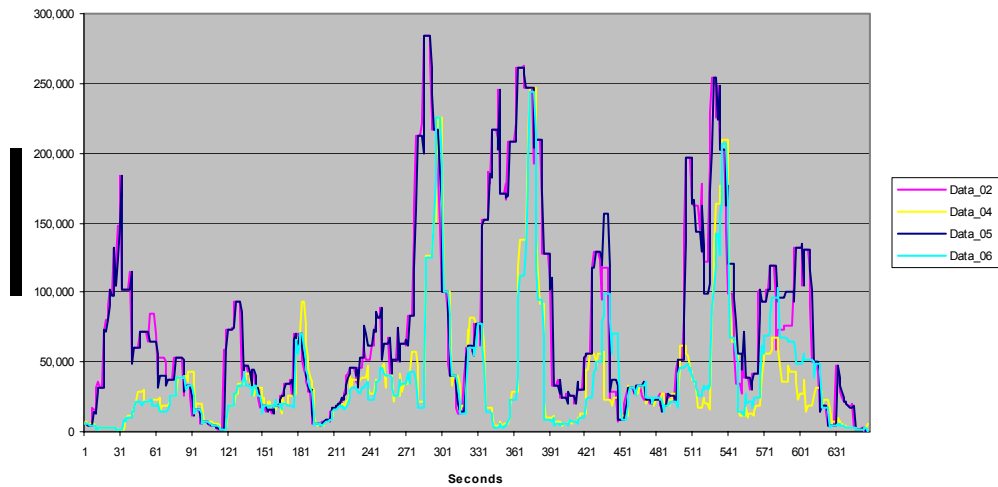
Data_02, Data_04, Data_05, and Data_06

Figure 17 - Graphic-Rich Test Results: Bandwidth Usage for Data_02, Data_04, Data_05 and Data_06

- **SpeedScreen Latency Reduction** settings do not show a significant difference in bandwidth, whether (Data_08) or not (Data_07) a baseline cache is present. There is a slight increase in bandwidth of approximately 0-4% when SpeedScreen Latency Reduction settings are compared to the results of using Data Compression alone (Data_02) as shown in the following graph:
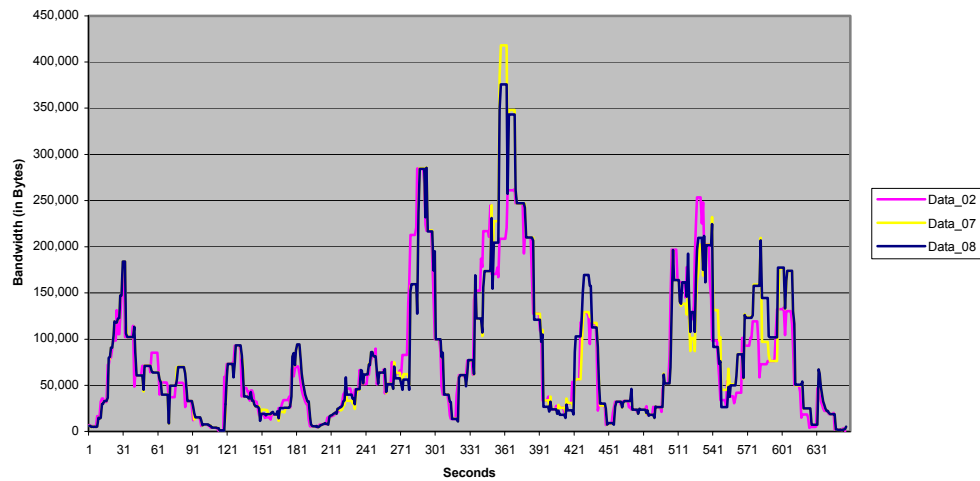
Data_02, Data_07 and Data_08

Figure 18 - Graphic-Rich Test Results: Bandwidth Usage for Data_02, Data_07 and Data_08

SpeedScreen Latency Reduction settings use approximately 10KB of hard disk space on the client workstation.

Recommended ICA Client Setting Configurations

Based on the above test results and observations, the following table identifies three network environment scenarios with recommended configurations for the tested ICA Client settings:

Network Environment Scenario	Use Data Compression	Use Disk Cache for Bitmaps	Queue Mouse Movements and Keystrokes	SpeedScreen Latency Reduction
LAN	Yes	No	No	No
Minimum Bandwidth Usage	Yes	Yes	No	No
WAN	Yes	Yes	No	Yes

Each network environment scenario is described in further detail below.

LAN

The LAN network environment scenario describes a network where latency is low and no bandwidth constraints exist. In this environment, only Data Compression should be used. This recommendation provides the following benefits:

- No client workstation hard disk resources are used – By not selecting Use Disk Cache for Bitmaps and SpeedScreen Latency Reduction, no hard disk space on the client workstation is used.

- Smooth mouse movements and keystrokes – When SpeedScreen Latency Reduction is disabled, all mouse movements and keystrokes are sent to the server, creating a smoother experience for the end user.

While not an issue in this environment, the following additional resources are required:

- Higher bandwidth requirements - Additional network bandwidth is required when the Use Disk Cache for Bitmaps setting is not enabled. Since in this network environment scenario bandwidth constraints are not an issue, this is not a problem.

- Client workstation processor resources - While Data Compression requires some additional processor usage on the client workstation, the impact is minimal.

Minimum Bandwidth Usage

The Minimum Bandwidth Usage network environment scenario describes a network where latency is low but bandwidth constraints exist that necessitate ICA sessions to limit bandwidth used. In this environment, the Data Compression and Use Disk Cache for Bitmaps settings should be used. This recommendation provides the following benefits:

- Reduced bandwidth usage – The Use Disk Cache for Bitmaps and Use Data Compression settings reduce the amount of network bandwidth required for each ICA session.

- Faster response due to disk caching – Cached files are used to render images on the client workstation, eliminating the time it takes to request and receive an image.

- No additional bandwidth increase due to SpeedScreen Latency Reduction – The SpeedScreen Latency Reduction settings slightly increase bandwidth. Therefore, not using this setting will keep network bandwidth requirements at a minimum.

The following potential drawbacks must be considered:

- Client workstation processor resources - While Data Compression requires some additional processor usage on the client workstation, the impact is minimal.   However, if client resources are a priority, this should be monitored closely.

- Client workstation hard disk resources – The Use Disk Cache for Bitmaps and SpeedScreen Latency Reduction settings require hard disk space on the client workstation. Test results indicate that the Use Disk Cache for Bitmaps setting requires approximately 10MB of hard disk space for the graphic-rich tests (no hard disk space was used for the text-based tests), and the SpeedScreen Latency Reduction settings required approximately 10KB of hard disk space for both types of tests. The client workstation must have suitable hard disk space available before enabling these settings.

WAN

The WAN network environment scenario describes a network where latency is high and bandwidth constraints exist that require the most efficient bandwidth usage possible. In this environment, the Data Compression, Use Disk Cache for Bitmaps, and SpeedScreen Latency Reduction settings should be used. This recommendation provides the following benefits:

- Enhanced user experience – SpeedScreen Latency Reduction provides additional user experience benefits, including instant mouse click feedback and keystrokes that are displayed based on cached data instead of waiting for a server response.

- Reduced bandwidth usage – The Use Disk Cache for Bitmaps and Use Data Compression settings reduce the amount of network bandwidth required for each ICA session.

- Faster response due to disk caching – Cached files are used to render images on the client workstation, eliminating the time it takes to request and receive an image.

The following potential drawbacks must be considered:

- Client workstation processor resources - While Data Compression requires some additional processor usage on the client workstation, the impact is minimal.   However, if client resources are a priority, this should be monitored closely.

- Client workstation hard disk resources – The Use Disk Cache for Bitmaps and SpeedScreen Latency Reduction settings require hard disk space on the client workstation. Test results indicate that the Use Disk Cache for Bitmaps setting requires approximately 10MB of hard disk space for the graphic-rich tests (no hard disk space was used for the text-based tests), and the SpeedScreen Latency Reduction settings required approximately 10KB of hard disk space for both types of tests. The client workstation must have suitable hard disk space available before enabling these settings.

- Bandwidth increase due to SpeedScreen Latency Reduction - The SpeedScreen Latency Reduction settings slightly increase bandwidth. However, the benefits to the user experience outweigh the minimal impact of the bandwidth increase.

Note: The Queue Mouse Movements and Keystrokes setting is not recommended in any of the above network environment scenarios. Based on the above test results, the Queue Mouse Movements and Keystrokes setting either had no impact or a slightly negative impact on network bandwidth.

Summary

The optimal configuration of ICA Client settings depends significantly on the type of network environment in place and the overall goal of optimization. For example, when the goal is to minimize bandwidth, a different configuration of ICA Client settings is required than when the goal is to minimize use of client workstation resources. Three network environment scenarios were described as a guideline for recommending optimal ICA Client setting configurations based on the type of network environment in place. When choosing the optimal configuration for any environment, both the benefits and drawbacks to each ICA Client setting and its impacts on other settings must be considered carefully.

CITRIX®

6400 NW 6ᵗʰ Way   **Fort Lauderdale, FL 33309**   **954-267-3000**