Optimizing Controller Download Performance for Studio 5000 Logix Designer

Introduction

The purpose of this document is to discuss best practices to employ when downloading a project file from Studio 5000 Logix Designer® to an Allen-Bradley® controller. As new and enhanced features, functionality, and hardware components have been added to controllers over time, some users have experienced prolonged download times. Mitigation efforts have been developed to reduce the impact that these enhancements have on the download time. Following the practices outlined in this document will minimize the time it takes for the project download to complete. Achieving a reduced controller download time will improve user experience and minimize production downtime during a download.

The topics that will be discussed include:

- Controller Core Platform Differences
- Impact of Enhanced Functionality
- Overview of a Project Download
- Download Improvements
- User Options
- Suggested Network Architecture
- Test Environment Results
- Summary of Optimal Environment for Minimal Download Time

It is assumed that the reader is familiar with the topics covered in the following design guides:

- The ControlLogix® 5580 and GuardLogix® 5580 Controllers User Manual

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'Controller' is used throughout the document and refers to a ControlLogix 5580, GuardLogix 5580, CompactLogix 5380, Compact GuardLogix 5380, or a CompactLogix 5480 controller unless otherwise stated.

Controller Core Platform Differences

Modern controllers have upgraded hardware, which allows the processor to dramatically reduce scan time. These controllers put more of a burden on firmware execution as opposed to hardware execution, the primary execution method on legacy controllers. As a result of this change, more files are required to be transferred during a download, which can contribute to longer download times.

Impact of Enhanced Functionality

Since the introduction of RSLogix 5000®, each new sequential major release of software has added functionality to the product. These enhancements have continued in Studio 5000 Logix Designer and can provide great value in terms of productivity, configurability, and security among other considerations. Some of the notable additions include Automatic Diagnostics, Extended Tag Properties, Tag-based Alarming, and Language Switching. While these feature additions have important benefits, some of the additions have impacted the controller project size and require additional time to download the project. Even if a user is not taking advantage of it, a new feature may impact the download time as it is now available within the project and controller firmware.

Overview of a Project Download

A project download involves several steps to transfer the program to the controller.

When a user selects a download, the following occurs:

1. Controller project is built - as needed
2. Components and Logic are moved over in packets – each packet includes a reply
3. Database is committed on controller – several items go into this

For a controller to execute a project created in Studio 5000 Logix Designer, the project contents must be built. During the download process, the software compiler compares the project contents to the last build. Any components (logic, tags, configuration, and so on) which are identified within the project that is not present/identical in the last build will be built. If the project has not been built yet, a full build will be performed. It is important to understand that the build process during a download occurs while the controller is in program mode meaning the controller execution has ceased.

To save time, the build step can be performed offline for the controller and have little to no impact to the controller downtime if the user manually performs a controller project build before the download. This is highly recommended if the project has not been built before and is also recommended if significant code changes have been made offline.

To build the controller project offline, select the following button within Studio 5000 Logix Designer.
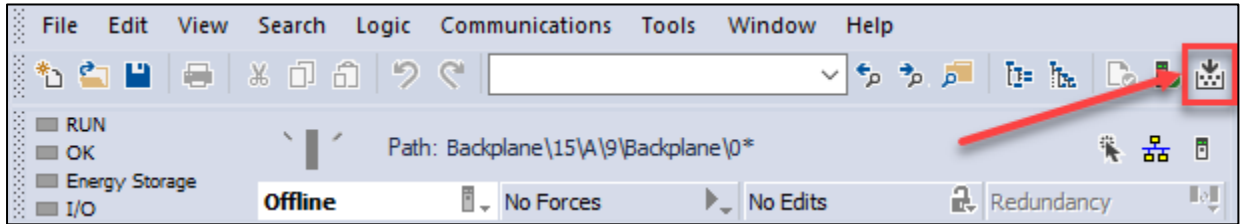
When this button is selected, a project verification occurs and any components, which have been changed, will be built. Building the project via this button may take anywhere from a few seconds to several minutes to complete but will not impact a running controller. Subsequent builds will be faster than the first build of the controller project.

Note that a project file will need to be rebuilt after:

- Changing controller versions in Studio 5000 Logix Designer.
- Exporting/importing the project via saving the project as a non-.ACD type (such as .L5K or .L5X) and reopening the exported file.

The next step, as described above, is a simplified explanation of this part of the download process. This step is included to explain that increasing network latency between the PC and the controller has an exponential impact on the time it takes to download a project to the controller. The communication response time is felt for each packet sent – potentially hundreds of thousands of times based on project size and content.

Download Improvements

Rockwell Automation has released several recent improvements which can greatly reduce the download time required to a controller. Below is a summary of those improvements that can be used together to ensure you are configured for optimal download performance.

Architectural Improvement

An architectural improvement in the software/firmware has been introduced in Studio 5000 Logix Designer Version 34. For ControlLogix 5580, GuardLogix 5580, CompactLogix 5380, Compact GuardLogix 5380, and CompactLogix 5480 controllers, this improvement is always enabled and working in the background. It was developed to significantly reduce the number of packets required to download a project to a controller. This can greatly reduce download time by limiting the number handshakes and readbacks over the network. A significant improvement during downloads has been observed for connections over remote networks where high latency is observed.

Until the release of this improvement, many users have observed significant controller performance increases for simplex applications during runtime compared to legacy controllers yet simultaneously observe decreased performance regarding the download to a controller.

Communication Software

FactoryTalk® Linx was first available in Studio 5000 Logix Designer version 31 and was made the default communication software in version 33. It is recommended to use FactoryTalk Linx as the communication software (default) in Studio 5000 Logix Designer Version rather than selecting RSLinx® Classic when optimizing download time. Enhancements were made in FactoryTalk Linx Version 6.21 in terms of how it handles the data between Logix Designer application and the controller. FactoryTalk Linx is backwards compatible, meaning that Version 6.21 can be leveraged with Logix Designer application version 31 and above.
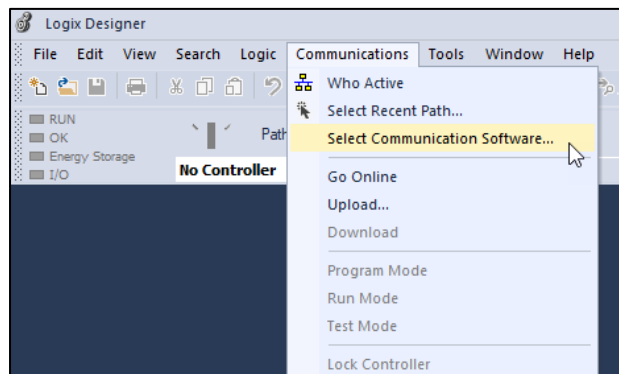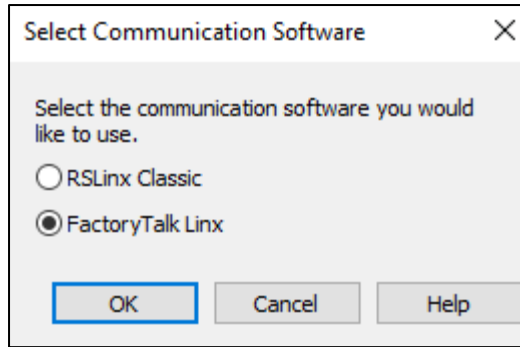
User Options

This section describes settings which users should evaluate based on their needs. The content provided describes the optimal configuration to reduce download time. However, there are scenarios when the configuration should be set differently, which will be described.

Verbose Messaging

Verbose messaging is a detailed description of the actions being performed during the download and can be turned off during the download as of Studio 5000 Logix Designer Version 34. Verbose messaging is disabled by default but can be re-enabled if desired. The recommendation for optimal download time is to leave verbose messaging disabled unless the user has a need for it. The below diagrams depict the difference in messaging during the download for a relatively small program.
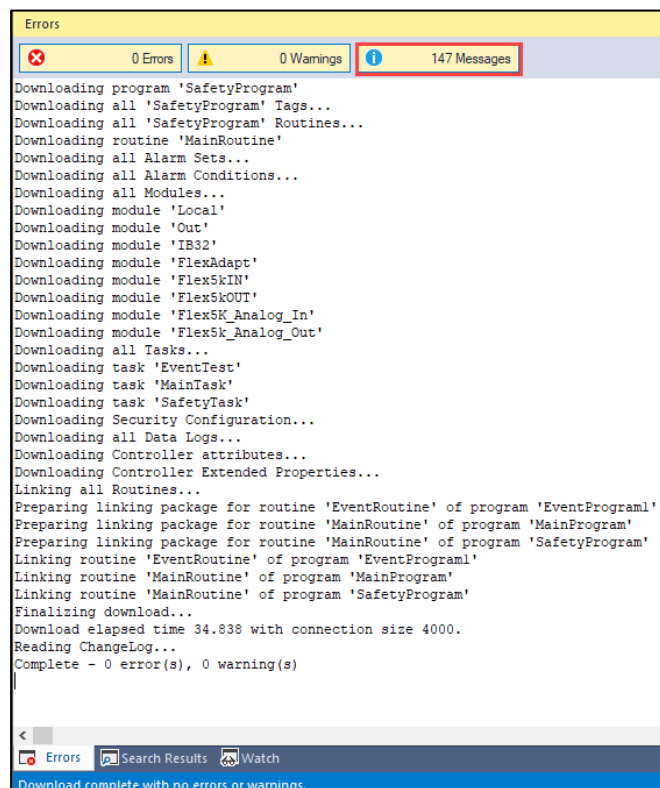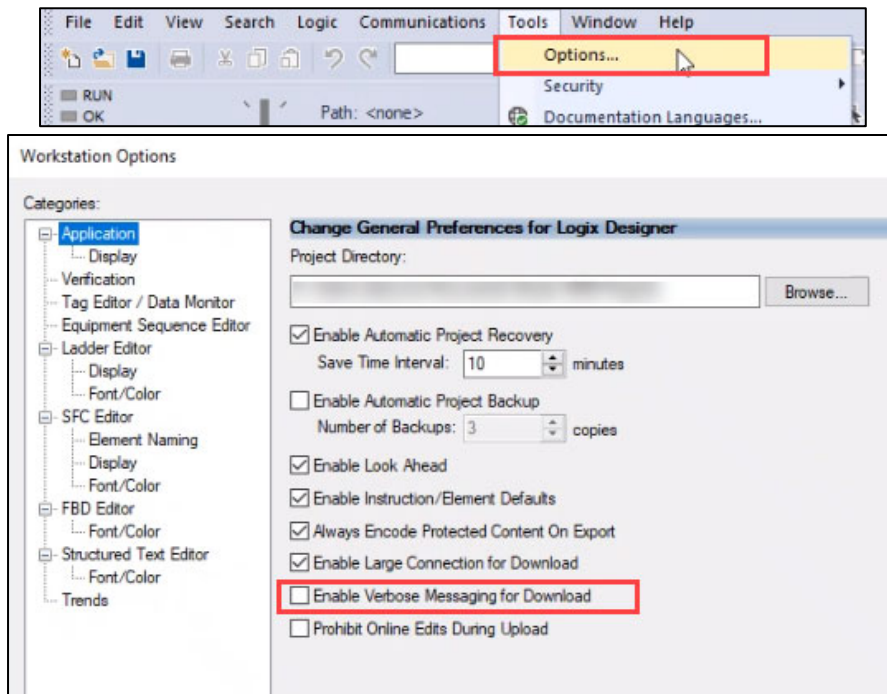

Example of Verbose messaging enabled.
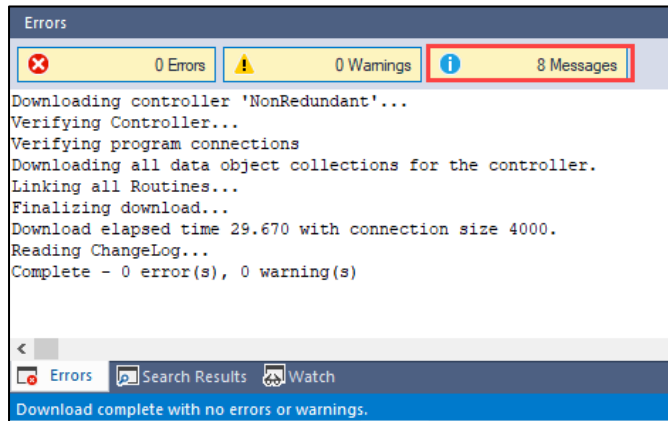
Example of Verbose messaging disabled.

To enable or disable verbose messaging, access the following option in Studio 5000 Logix Designer:

Large Connections

As of version 31 of Studio 5000 Logix Designer, large connections are available for download. The connection size in RSLinx Classic is always 500 bytes. Now in Studio 5000 Logix Designer and FactoryTalk Linx, a user can choose to use the 500 byte connection or a 4 kb connection for the download. The 4 kb sized connection is considered the large connection and is enabled by default.

It is recommended to use the large connection when possible but please note that your architecture must support this. Rockwell Automation Technote IN8795 outlines the devices and versions, which support large connections. If an unsupported module is present between the downloading PC and the target controller, the large connection attempt will fail and a smaller connection size will be attempted. This can be verified in the Logix Designer application messages following a download. A successful download over a large connection will display a message similar to this:
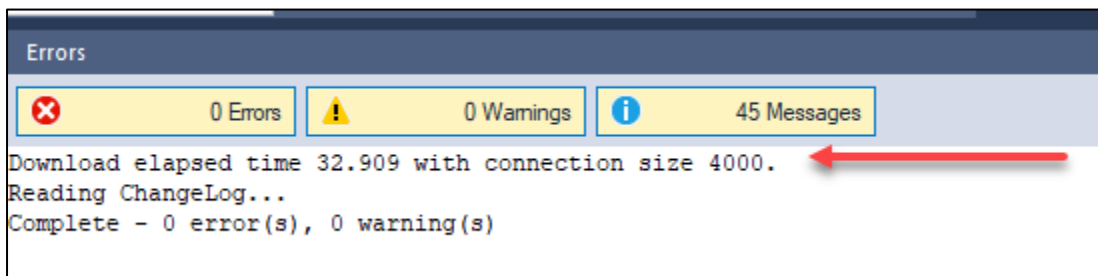
Caution should be used, when considering whether to use a large connection or not. The release notes for Studio 5000 Logix Designer version 33 and above note that applications, which use motion axes, may not be recommended to use the large connection as it could cause network jitter during an upload (download not an issue because controller goes into Program mode regardless). Excessive clock jitter can lead to unintended motion and motion control sync faults.

To utilize the large connection, confirm that the following option is selected in Studio 5000 Logix Designer:
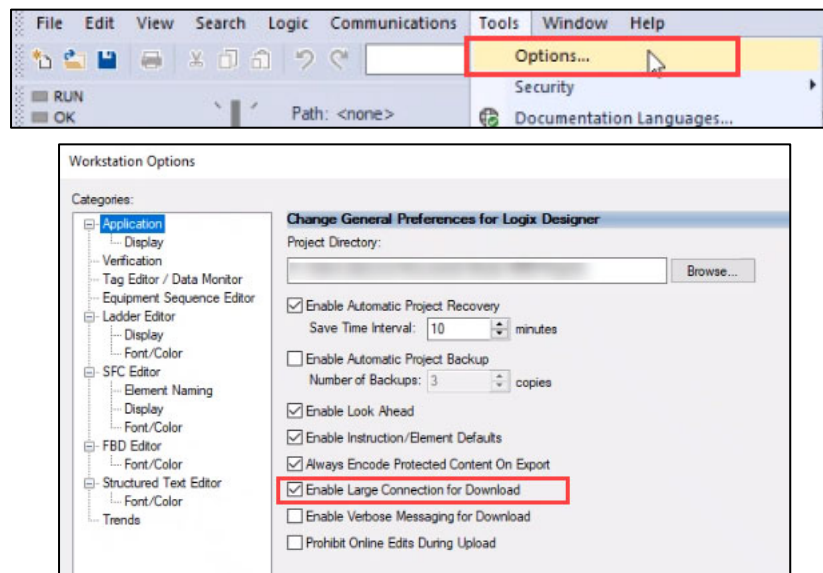
Project Documentation and Extended Properties

For a Studio 5000 Logix Designer project, a user can decide whether to include the project documentation (rung comments, tag, descriptions, and so on) and the extended properties (tag engineering units, minimum and maximum values, and so on) data with the downloaded project. Rockwell Automation's recommendation is to enable Project Documentation and Extended Properties as this feature provides the best experience for upload and multiple online user workflows.

This setting must be enabled if extended properties are used in the program and is recommended to download this information with the project in instances where the user chooses to make the controller as the master storage location for this information. Users may also want to use this simply for convenience and ease of troubleshooting with an upload to a blank project file.

Users may evaluate their need for this feature and its impact on download time for their application. Downloading project documentation and extended properties to the controller can increase the amount of time it takes to download a project, especially if a project is heavily documented. If prolonged download times are experienced, make provisions to avoid use of extended properties and confirm required users have access to a copy of the Studio 5000 Logix Designer project, which has the project documentation, included. It is recommended that customers maintain project file backups in a solution such as FactoryTalk® AssetCentre, regardless. Starting in Studio 5000 Logix Designer version 34, users can make bulk documentation updates while online with the controller, which provides the opportunity to add the documentation at a later point without impact to the initial download time.

To enable or disable the download of project documentation and extended properties, access the following option within Studio 5000 Logix Designer:
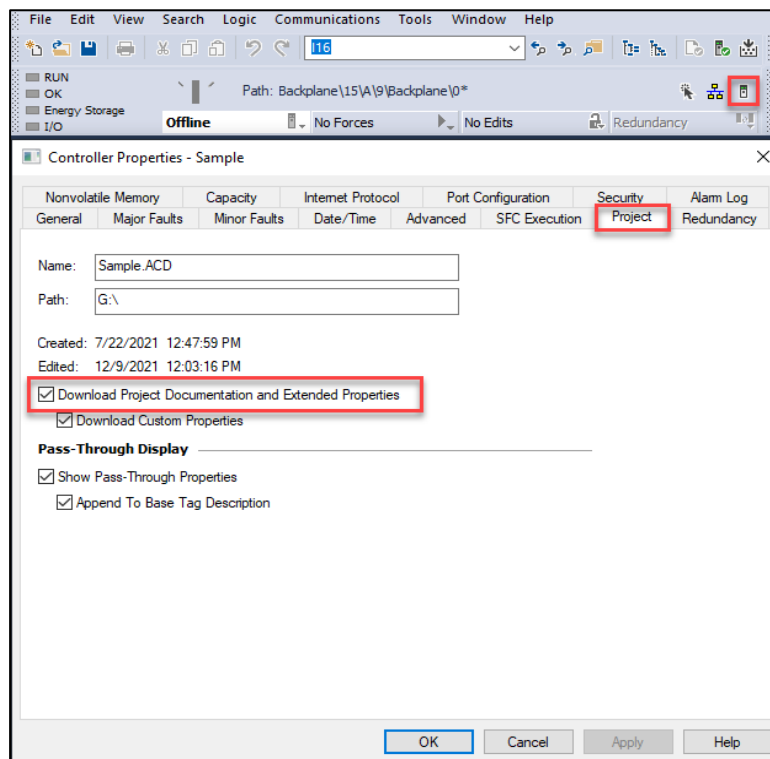
Suggested Network Architecture

While the availability of recent download improvements and correct selection of user options can improve download performance, the most critical aspect to consider for download time is the latency of the connection to the controller.

If available, a local connection from a PC on the plant network to the controller is optimal for minimizing download time to a controller. A local connection can be achieved by being directly connected to the plant network but can also be attained remotely by accessing a PC or server, which has local connectivity to the plant network. This can be accomplished via a Remote Desktop (RDP) session or similar method.

Rockwell Automation offers a secure remote connection solution via FactoryTalk® Remote Access™ and a Stratix® 4300 switch. Similar remote connections could be achieved over a VPN connection, which connects a remote PC into a secured plant network. Users who have controller projects in Studio 5000 Logix Designer Version 33 or below have reported prolonged download times to the controller when performed over remote connections. The enhancements to Rockwell Automation software, which are now available as of Studio 5000 Logix Designer Version 34 result in vastly improved performance for remote connections. However, even with these improvements, it is recommended to gain access remotely to a local connection for fastest download times, rather than downloading directly from the remote PC when possible.

As mentioned in *User Options*, large (4k) connections are available and should be used if applicable. A 1 GB Link speed should also be used when possible, to perform a download to a controller. This requires all components in the communication path to be configured for 1 GB (switches, communication modules, front port, and so on). While download time is typically not dominated by link speed, the link speed does become more important for busy networks as faster link speed allows more packet throughput. It is recommended to avoid bridging across a controller backplane to download to a controller. Be conscious of the number of switches and network bridging used to connect to a controller. Using the most direct path to a controller possible is optimal for reducing download time.

One additional consideration when downloading to a controller is to evaluate if there are multiple connection paths available. For some customers, multiple VLANs may be able to access the same chassis and controller on a plant network. If unsure of which route to download over, a traceroute test can be useful in determining how many network hops exist and a ping test can measure the response time.

Again, reducing network latency is the key when evaluating the connection to leverage when downloading to a controller.
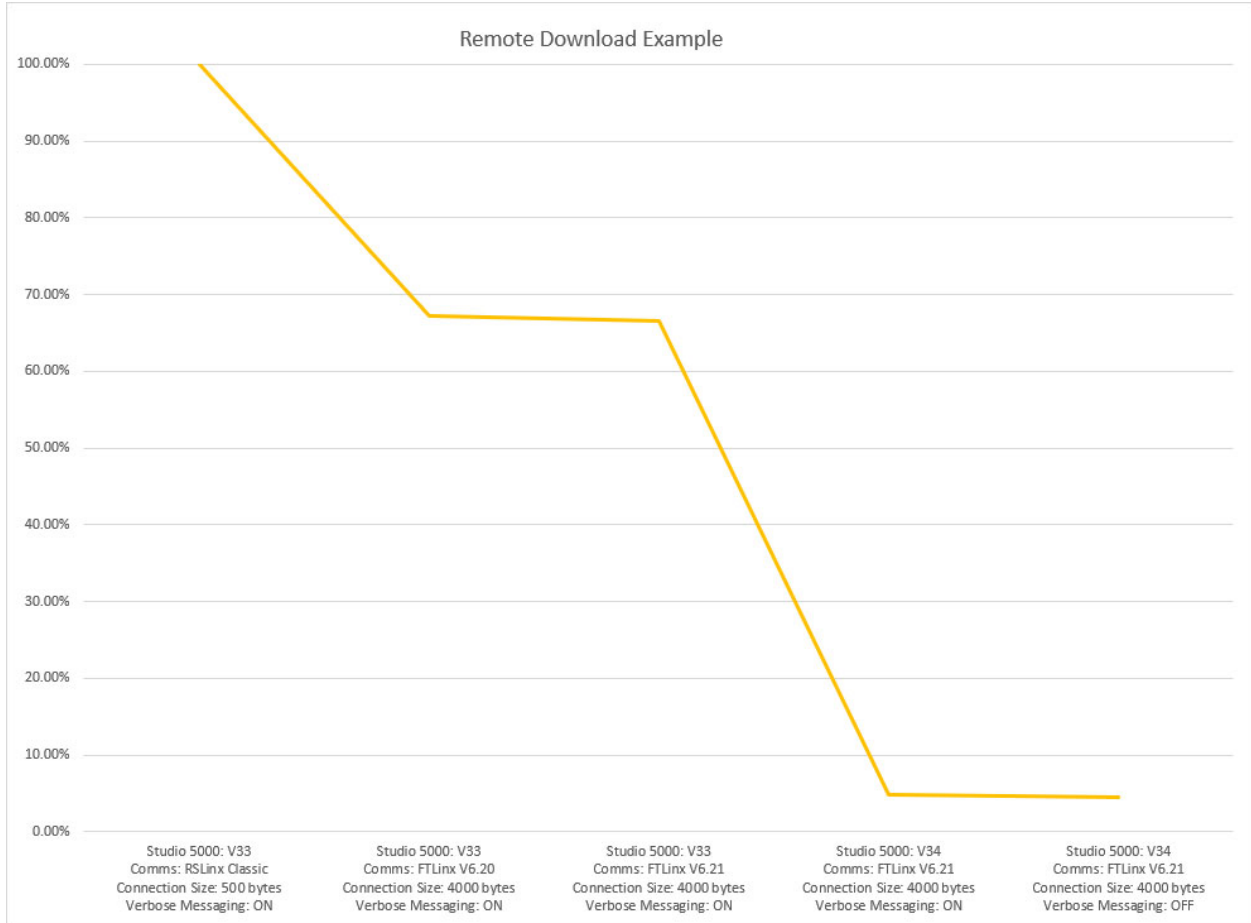
Test Environment Results

Several tests were performed by Rockwell Automation to determine what had the biggest impacts on download time and helped drive and confirm improvements to the process. The results of this testing are depicted in the charts below.

While these results SHOULD NOT be assumed to be typical for customer applications, they depict extreme but potential conditions.
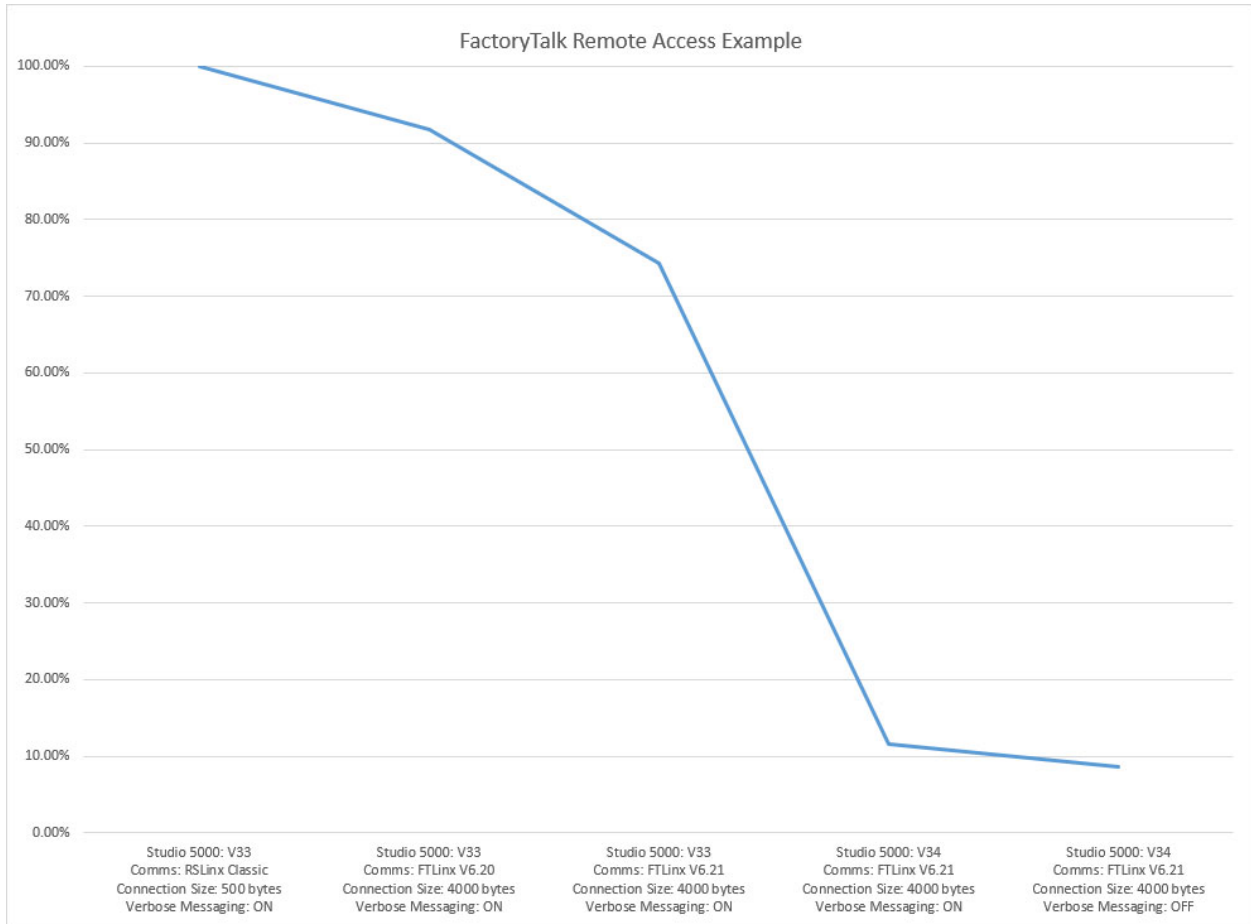
The first chart provided compares several available enhancements and their impact on reducing download time when used over a local connection. The local connection in this test scenario was an Ethernet cable wired directly from a PC to a controller. In this chart, 100% represents the worst-case download time observed during testing for this environment. A best-case local download will likely still take several minutes to complete and depends on the application size.
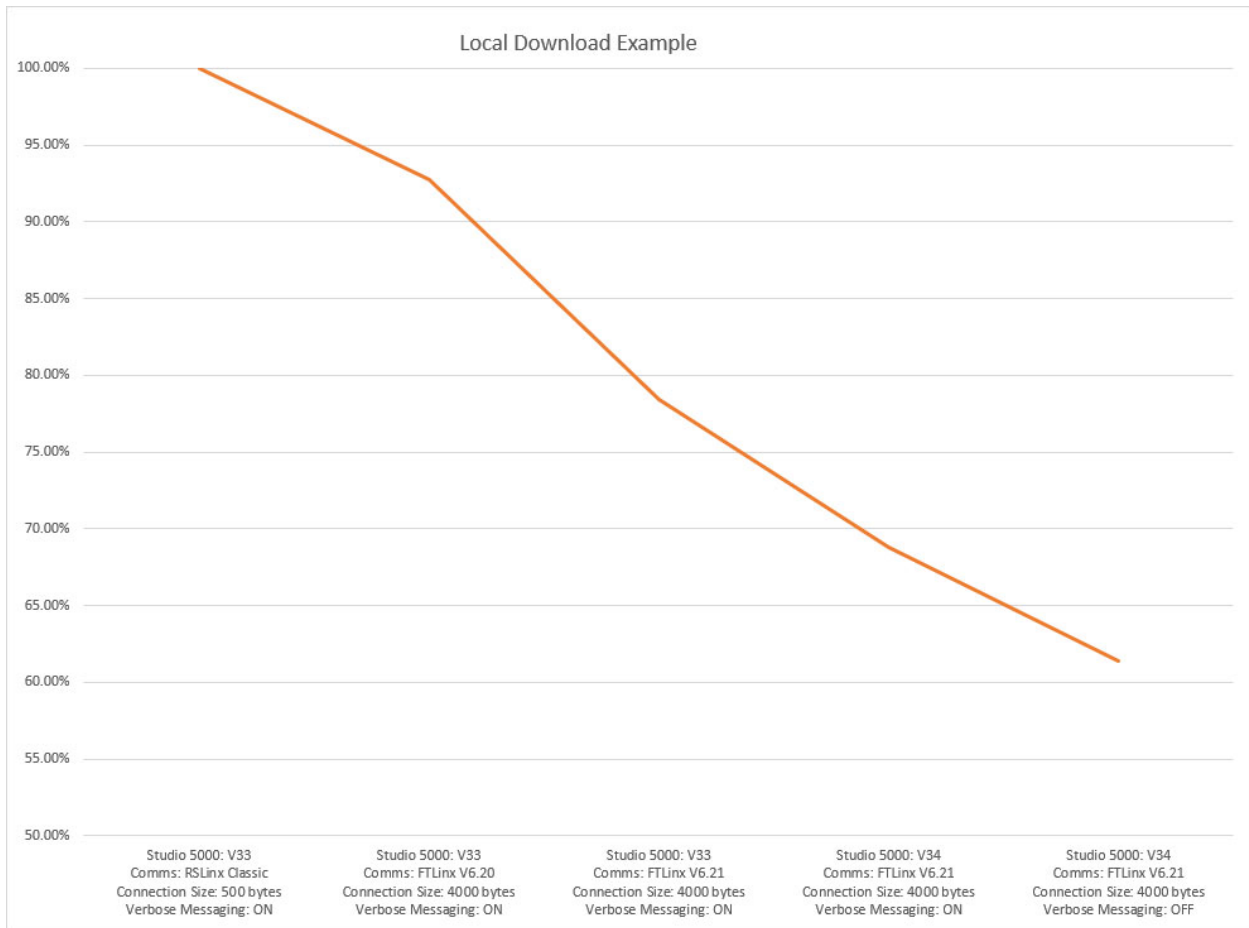
Second, is a chart analyzing the impact the effect on download time when utilizing a remote connection between the PC and the controller. The remote connection used for this test was across a long physical distance and through a complicated network architecture. The key is that the remote connection environment resulted in a high latency connection between the PC and the controller. The same enhancements are compared as in the local test, but the impact is even more pronounced when a remote connection is used. For this chart, 100% represents the worst-case download time observed during testing for this environment only.

Remote Download Example

| | Studio 5000: V33 Comms: RSLinx Classic Connection Size: 500 bytes Verbose Messaging: ON | Studio 5000: V33 Comms: FTLinx V6.20 Connection Size: 4000 bytes Verbose Messaging: ON | Studio 5000: V33 Comms: FTLinx V6.21 Connection Size: 4000 bytes Verbose Messaging: ON | Studio 5000: V34 Comms: FTLinx V6.21 Connection Size: 4000 bytes Verbose Messaging: ON | Studio 5000: V34 Comms: FTLinx V6.21 Connection Size: 4000 bytes Verbose Messaging: OFF |

The final test results shown depict the controller download times observed when utilizing the Rockwell Automation offered secure remote connection solution via FactoryTalk® Remote Access™ and a Stratix 4300 switch. The same enhancements were compared again as in the previous tests. A relatively high latency connection is common when a FactoryTalk® Remote Access™ solution is used. This increased latency is similar in magnitude to the latency observed during the remote connection test scenario. As a result, leveraging the available enhancements results in a significant reduction in controller download time. For this chart, 100% represents the worst-case download time observed during this test.

FactoryTalk Remote Access Example

Studio 5000: V33	Studio 5000: V33	Studio 5000: V33	Studio 5000: V34	Studio 5000: V34
Comms: RSLinx Classic	Comms: FTLinx V6.20	Comms: FTLinx V6.21	Comms: FTLinx V6.21	Comms: FTLinx V6.21
Connection Size: 500 bytes	Connection Size: 4000 bytes	Connection Size: 4000 bytes	Connection Size: 4000 bytes	Connection Size: 4000 bytes
Verbose Messaging: ON	Verbose Messaging: ON	Verbose Messaging: ON	Verbose Messaging: ON	Verbose Messaging: OFF

Summary of Optimal Environment for Minimal Download Time

For absolute best-case download results for a Studio 5000 Logix Designer project to a controller, the following are recommended:

- Use Studio 5000 Logix Designer Version 34+ (includes improved architecture).
- Use FactoryTalk Linx Version 6.21+ (default Communication Software as of Studio 5000 Logix Designer Version 33).
- If the project file has not been downloaded to a controller yet OR if significant code changes have been implemented offline, perform a Build of the project file offline before attempting the download. This reduces the time in which the controller will be placed into program mode during the download. If unsure of the history of the project file, a Build is recommended before download.
- Select large (4k) connection (default).
- Disable verbose messaging (default).
- Connect directly from the PC hosting Studio 5000 Logix Designer to the controller if possible.
- If not connecting directly from PC to the controller port, minimize the latency between the PC and controller.
- Leverage a 1 GB network connection from PC to controller and all devices in between.
- Avoid remote connections if possible – leverage RDP or similar if remote to establish a local network connection to the controller. If a remote connection is required, be sure to leverage all enhancements available, which have been designed to increase download speed.

PLEASE CONTACT THE FOLLOWING PEOPLE FOR MORE INFORMATION.

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