

**The Shepherd Color Company
Remote Office Network Application**

By

Christopher J. Buelter

Submitted to
the Faculty of the Information Engineering Technology Program
in Partial Fulfillment of the Requirements for
the Degree of Bachelor of Science
in Information Engineering Technology

University of Cincinnati
College of Applied Science

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Date

Professor Mark Stockman

Date

James F. Sullivan, Department Head

Date

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Abstract

The Remote Office Network Application is a terminal-based network used to connect from a site in Europe to the Shepherd Cincinnati office through a frame-relay connection. The current setup involves just an HMI solution for our plant and equipment. The current solution in Cincinnati uses Allen Bradley equipment to control kilns, mixers, and blenders. The new plant will consist of these types of equipment, but will need to connect in a quick way to the Shepherd network. I created the network to accomplish the idea of a frame-relay connection between the equipment at the Czech Republic site and the Cincinnati office. The Shepherd Color Company will use this idea at a future site in the Czech Republic to enable the plant manager and plant workers to connect to custom-built databases and email residing on the Cincinnati network. I created the network using Siemens MP370 terminals for the plant workers to launch the Citrix ICA client. The ICA client connects to a Windows 2000 server that resides in the Cincinnati plant. I decided to use Citrix because the Cincinnati office is already using it, and in the future the remote office server will be a part of the Citrix web farm in Cincinnati. The Siemens S7300 programmable logic controller will be used to control the new equipment in the plant. This paper summarizes the completed project, and the work done to accomplish the project. Finally, this paper discusses problems and lessons I have learned in completing the project.

1. Description and Intended Use

The Shepherd Color Company would like to develop a network that will access the Cincinnati domain from any remote office in the world that they may build in the future. The network application will be used to make a connection from the remote office to the network that resides at the Cincinnati site of The Shepherd Color Company. The bulk of this application is a terminal-based network. The network includes a Windows 2000 Server (designated CzechMate) installed with Citrix Metaframe XP. The remote office network will be a multi-user environment.

The main element of this application will be the network, but will also consist of Siemens MP370 terminals interfacing with programmable logic controllers over a frame relay connection. The following is the setup between the MP370 terminal and the S7000 programmable logic controller:



Figure 1. Siemens MP370 Panel and S7000 PLC

The MP370 terminals will provide the interface to a user's Citrix session in Cincinnati, so the users may access databases and files from the Cincinnati network. The CzechMate server holds a published application that the terminals will be able to log into. The most important aspect of the project is the terminals serve two purposes. The first is that the MP370 holds the Siemens application that controls the PLC equipment in the future plant. This aspect will be shown in the proof of design of the paper. The second purpose is the terminal serves as a means to log into the Shepherd Cincinnati network. The terminal allows for a plant worker to log into the Cincinnati Exchange server and databases they input data into.

1.1 Statement of the Problem

The Shepherd Color Company has had the idea to build a new site somewhere in Europe for the past couple of years. This will enable them to produce a few simple pigments there to satisfy customer bases in Europe. After the building of the plant is finished, the company would like to have a way for the plant employees to access the Cincinnati domain. Currently, the company's Belgium site uses a frame relay connection to connect to the domain. They use Neoware thin terminals to open a connection that is published to launch applications from the Citrix web farm residing in Cincinnati. The new plant will be different in that there will be required outside equipment from Siemens to work with the different processes that will be implemented in the plant to produce the pigments. These processes will include mixing, firing in a kiln, blending, and packaging. The processes will be controlled by a Siemens programmable logic controller.

Currently, the company does not have the capability to access the domain in Cincinnati from a site in Europe when it gets built. The company would like the plant workers to use a Citrix session to access any custom databases, and email on the Cincinnati domain. The company

would like to use technology that will be able to run a Citrix session, and still work with the Siemens PLC.

1.2 Solution

A terminal services network completes the company's needs for the remote plant project. The plant workers log into a Citrix Metaframe XP session to access information from the Cincinnati network. I decided to use Citrix because the Cincinnati office is already using it, and in the future the remote office server will be a part of the Citrix web farm in Cincinnati. After doing analysis at work using Citrix, I decided it was the best way to go for the availability to connect with users in any location, on any device. This was important to me since the plant workers will be using the Siemens MP370 terminal to connect to the network. The network works over frame relay technology, and uses MP370 terminals instead of a standard thin terminal used at the Cincinnati site. The MP370 terminals provide a way for the new plant employees to access email and use databases from the Cincinnati domain.

1.2.1 Design Protocols

The main focus of this project is networking. There is some interaction with custom-built databases. These databases are already created, and will be accessed by the new Europe plant employees to input data about the paint pigments that are being created.

1.2.1.1 Networking

Networking plays the most vital role in the project. The Shepherd Color Cincinnati site houses the Citrix server, and the Siemens equipment will reside in the plant being built in Europe.

1.3 User Profile

There are two categories of network users: the plant workers and the administrators working from Cincinnati.

1.3.1 Plant Workers

The plant workers are the primary users of the Remote Office network application. These employees are responsible for logging on to the Czechmate server, using the published application, which is called CzechMate Desktop. The plant workers are also responsible for entering data for recipes of paint pigments into custom-built databases on the Cincinnati network.

The plant workers are from Europe, and consist of the manager of the plant and four assistants at the most. They are salary employees, which means they are paid a set salary for the year, as opposed to hourly wages. The manager has at least a chemical background or a degree in the chemical field. The manager is an experienced computer user. The company would prefer the assistants to have a chemical background and minimal computer experience, but it will not be required. The assistants can and will be shown how to log into the network, and how to use the custom databases to input recipes for pigments that need to be created.

1.3.2 Administrators

The second users of the network are the administrators. The administrators include Chris Buelter, Eric Kushon, Rich Lindner, John Montgomery, and Jeff Lane. All of the administrators are advanced computer users, except for Eric Kushon. Eric has a degree in electrical engineering, but does have some computer experience. The administrators, excluding Eric, possess all of the skills of a network administrator. The administrators take care of any maintenance work that needs to be done in the network or on the frame relay connection. Eric takes care of any changes that need to be made to the PLC's remotely through the frame relay connection. Using the Step 7 programming software from Siemens, Eric makes the changes, and

then downloads the changes from his laptop in the Cincinnati plant to the PLC residing in the Europe plant.

2. Deliverables

The following are the deliverables that were met in the completed project:

1. Connection to Shepherd Color Remote Office.
2. Ability to log into Cincinnati Network from new plant in Europe.
3. Ability for Administrators to shadow the plant workers' Citrix session for troubleshooting.
4. Ability for Shepherd's head engineer to remotely make changes to Siemens PLC.
5. Siemens MP370 will host the workers' Citrix session, and the HMI application used to communicate to the S7300 PLC.
6. Ability for the plant manager to make changes to the S7300 PLC by logging into the Step7 programming software published application.

Proof of Design

The means for sharing data between offices outside the US and Cincinnati is to have the users use VPN or Citrix's NFUSE option to access the Cincinnati domain. These options are very time consuming, and the speed in transmitting data is not always reliable or quick.

3.1 Shepherd Color Cincinnati

After doing analysis of the project, it was decided that Cincinnati will house the Citrix server that the plant employees in Europe connect to from the MP370 terminals. A separate server was used in the testing of this terminal service network. To begin testing, I simply wanted to find out if a connection could be made between the Citrix server and the Siemens MP370

terminal over the Cincinnati network. The first step in this process was building the Citrix server. The following information pertains to building the server:

3.1.1 Building the ‘CzechMate’ Server

Using a Compaq Proliant 800 from the Shepherd Color Company, I installed Windows 2000 server on it. The install of Windows 2000 server was done in Application mode. This was done so that other users can connect remotely; otherwise, remote administration will be able to function on it. The server has 327M of RAM, and its IP address for the test in Cincinnati was 10.4.1.24. The next step to building the server was to install Citrix on the server. To begin the install, I put the server in install mode by going to a command line and typing *change user /install*. Next, I ran the executable to install Citrix Metaframe XP on the CzechMate server. The executable is called autoroot.exe, and I chose Metaframe XP from the install window. I then chose Join an existing server farm, since the server will be joining our existing Citrix farm here in Cincinnati. I also chose Data Store type as the Direct data store connection. I used the default zone name by just leaving it checked. I was then prompted for the SQL Connection Server that we use here. Going with our Star Wars theme that exists here, the server that handles the SQL Connection here is called Sith, and that is what I pointed the connection to. To make the connection to Sith, I had to use the SA password for SQL authentication. After this was taken care of, the CzechMate server found a published application that exists here called Red Squadron Desktop. I used an older version of the client from a CD that our Citrix Administrator had in house. The distribution, when installed, allows for clients to automatically get an updated version of the client behind the scenes when they log on. The next step was to install Citrix SP2, and this is called XPFR2—XP Feature Release 2. The install began, and I accepted Yes when it asked to upgrade. I then activated the license for the install, and then created a published application similar to the application we have here called Red Squadron Desktop. I called the

new published application CzechMate Desktop. I then created a group called CzechSiemens, and also created a user called CzechUser1. I made the user part of the new CzechSiemens group. Next, I went into the Citrix Connection Configuration and disabled the RDP connection for the CzechMate server. I also right-clicked and entered the properties for the Citrix ICA 3.0 connection. In the properties, I made sure that the permissions were set properly for the NT policy that is given to users logging in here (they do not get any administrative tools). The final step that I did to the server was to install the Siemens Step7 software. This is the software that will be used to interface with the MP370 terminal and to the PLC. The server was now ready to accept connections from a thin terminal, or from the MP370 terminal.

3.2 Siemens MP370 Terminal

My research showed that it would be possible for the MP370 terminal from Siemens to run the Citrix ICA client. Meetings with a couple of the engineers from Siemens made for promising ideas of how the terminal can work in a Citrix environment. The Citrix ICA client needs to be installed on the MP370 terminal for it to be able to make a connection to the CzechMate server, and the CzechMate Desktop published application. The MP370 has a MIPS R4000 processor, and uses Windows CE Version 3.0 for the operating system. I have a CE client install available here to me. The MP370 will be a great tool for the plant workers to use to log into their Citrix session to access email, custom databases here in Cincinnati to insert recipes for the pigments being created. The plant workers may also use the Step7 software in their Citrix session if they have the knowledge to make changes to the PLC. I also chose to use this device for its functionality with the PLC from Siemens. Applications can be created with the Step7 programming software to run on the MP370, and the applications are used to interface with the PLC.

3.1.2 Connecting the MP370 to Shepherd Network

First and foremost, I wanted the MP370 to recognize the network here in Cincinnati. The MP370 does have a NIC, and so I plugged a known-good CAT5 patch cable into the MP370. I then went into the Control Panel on the MP370 device and opened the Network menu. In the Properties, I set the IP address to 10.4.1.25. Under the Identification tab, I set the username, password, and the domain that I wanted to log into. In this case, I used CzechUser1 as the user, and our domain here in Cincinnati is called SPECTRUM. Also in the Control Panel, there is an option called Communication, and this is where the device can be named. I went ahead and gave the device the name CzechBoy. This will later be used when I will want to use ping to find out if the device is connected to the network. This is handy at times when you cannot recall the IP address right away, and the name of the device can be pinged. Once all the settings were made, I went into the OP option, and pressed the Save Registry button. The reason this is done is so all new setting changes get written to memory, and they will hold when the MP370 goes through a power-cycle. After these steps were taken care of, I was able to connect to the network just fine. I went back into the Identification tab, and logged in as the domain administrator so that I could access the proper servers with the install files for the ICA client.

4. ActiveSync

When installing software on Windows CE devices, it is not as easy as just installing the software. The first step I tried was to copy the executable down to the MP370 terminal, and then install with the setup executable, but it did not work properly. I did research about Windows CE out on Microsoft's website to find out that you install software using .cab files in Windows CE. I then noticed an executable on the device that when run it asked you to double-click a .cab file to install something. There was a .cab file in the install files for CE, but it

would not work. After spending a day thinking about it, I did a search on the Siemens web site and found an article on how to use Microsoft ActiveSync on a workstation to download the install files to the MP370. ActiveSync is just synchronization software that is used for Pocket PC's and other PDA devices. When you run the ActiveSync executable, this is the dialogue window that can be seen:

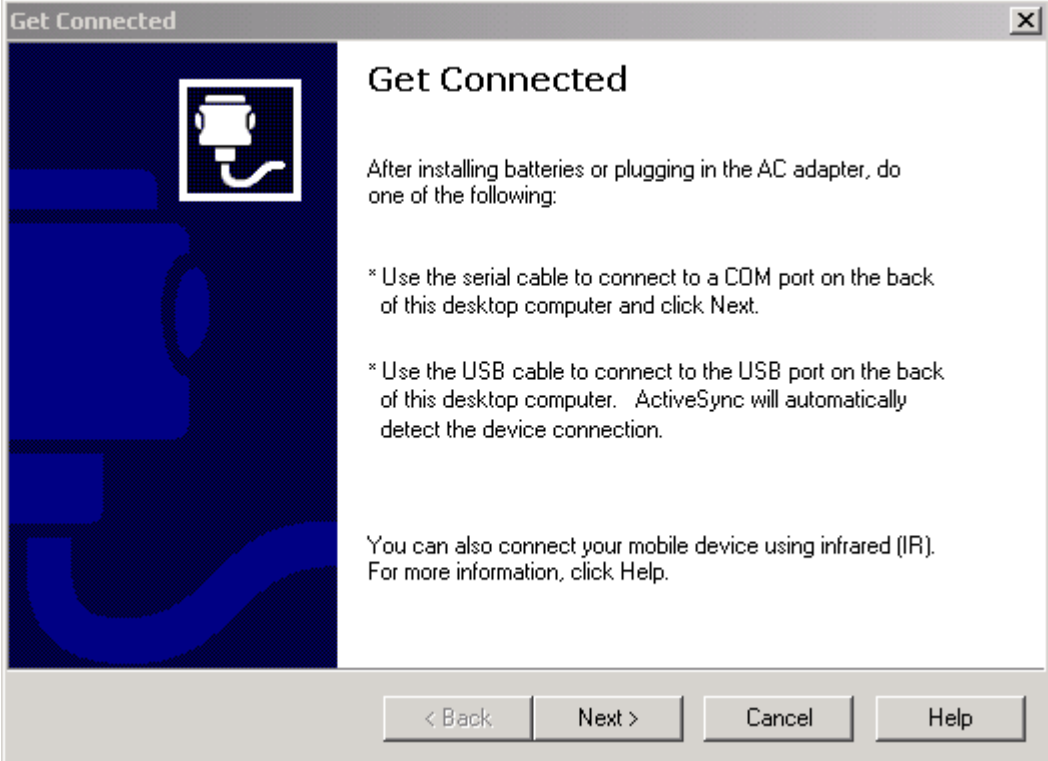


Figure 2. ActiveSync Start Window

At this point, I press Next, and the following window will appear to show that the attempt is being made to connect to the device:

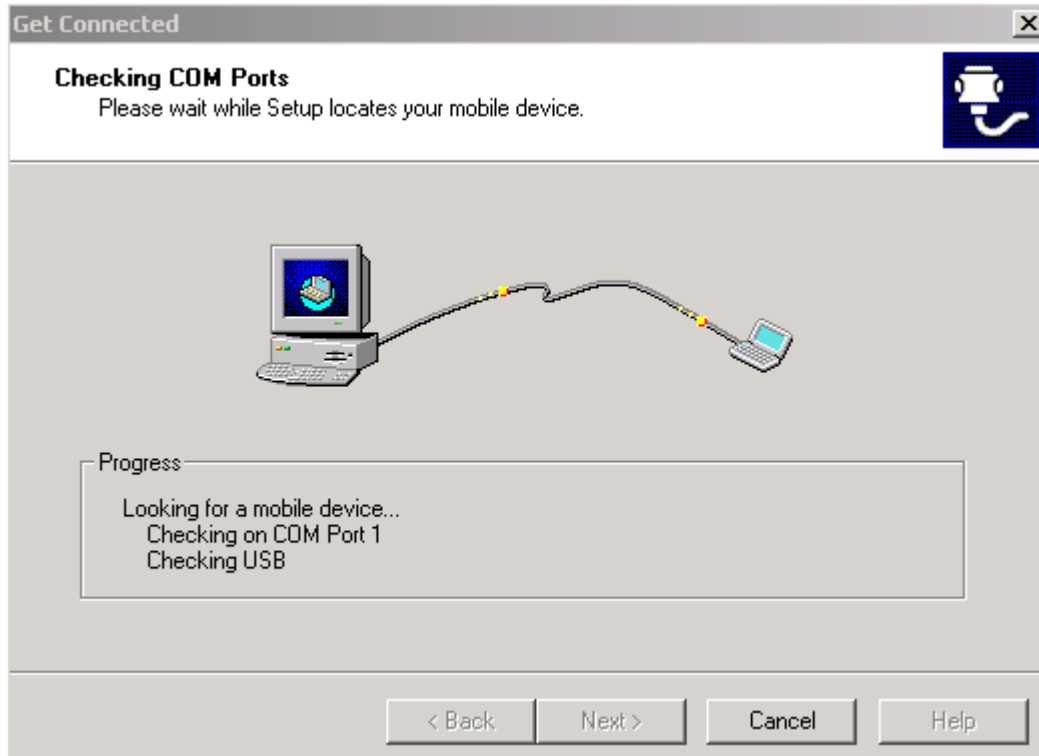


Figure 3. ActiveSync Process

The following sections explain what needs to be done on both the MP370 and the laptop or PC to use Microsoft ActiveSync.

4.1 Steps for Using Active Sync with MP370

Before beginning these steps, I had to make sure that I had a direct connection serial cable to interface between the laptop I am using here and the MP370 terminal. The cable has two female DB9 (nine pin) ends.

4.1.1 On the MP370 terminal

The first step I took to prepare the MP370 for the ActiveSync connection was to press Start, then Communications, and Remote Networking. Here, I made a new connection called Active Sync. The properties for the connection were COM2 Serial, and a Baud Rate of 19,200. Next, I went into the Control Panel, and opened Communications. In Communications, I went to the PC Connection tab, and checked Enable direct connection to PC. There is a textbox showing

the connection that will be used to communicate to the PC. I pressed the Change button next to the textbox, and chose the ActiveSync connection that I created in the above directions.

4.1.2 On the PC or laptop

The first step that I performed on the laptop was to install ActiveSync (Version 3.6). To make the connection to the MP370 device, there are two steps that have to be performed. The first step was to launch ActiveSync on the laptop, and choose Get Connected. The second step was to press Start on the MP370, and point to Programs, Communication, and choose PC Link. Following this step, the panel will make contact with the laptop. The connection was made, and on the laptop I saw ActiveSync showing the connection to the Guest. The final step was to install the Citrix software on the MP370. To finish this, I had to run the CE executable on the laptop while ActiveSync was still running. In doing this, Add/Remove Programs will open up in ActiveSync. I said Yes to install the client on the MP370 terminal, and the install then took place.

After the install was complete, I created a connection through the Remote Connection Manager. I had created a published application on the CzechMate server, and it is called CzechMate Desktop. The connection that I created on the terminal was to this published application. When I would try to launch the executable for the connection from the desktop of the MP370, it would error out each time with a Fatal Application Error. I spent eight days trying many different setting changes, and uninstalling, and reinstalling, but nothing changed. I made calls to Siemens and Citrix, and neither of them could help me. Using Active Sync, I installed the Citrix RDP client on the terminal, and this client worked just fine. Finally, on the ninth day our Citrix Administrator and I were taking a look at the connection settings, and we started to change them one by one. We changed the window size setting from relative to absolute, and the

executable took right off. The published application worked fine from here, and a connection could be made to the server. I made a phone call to Siemens to let them know the problem that I had found, and they were very happy for me. I was actually forwarded to speak with Paul Shelton about my project, and he was very impressed with my progress. Mr. Shelton is the Open Platforms Manager for Siemens in the United States. He told me that The Shepherd Color Company was the first company to get the Citrix ICA client working on any type of Siemens device. I felt that this was a great accomplishment for my company. He would like for me to send him the Citrix executable for CE devices that I have here. I told him that I might just wait and send him the executable along with this final report that I will do for Senior Design.

5. Frame Relay Work

The test frame relay connection is set up in a co-workers basement in Milford, Ohio. The frame connection is therefore called Milford Frame, and this site is being used to house the Citrix server as if the basement is the Shepherd Color Cincinnati site. The Citrix server (CzechMate) was taken out to Jeff Lane's basement.

Once the CzechMate server was connected to the test frame relay connection, I had to make a few changes to the server's Network Properties. The first one I made was to change the IP address to 192.168.50.10. I also changed the Preferred DNS address to 10.4.1.32, and the Alternate DNS address to 10.4.1.35. I then clicked on the Advanced button, and on the WINS tab, and added the addresses 10.4.1.32 and 10.4.1.35. Finally, I rebooted the server, and logged on as administrator. I went into Network Neighborhood, and saw that the server was part of the Spectrum domain in Cincinnati. Next, I had to create a Custom Citrix connection on the MP370 at the Shepherd Color Company. This connection allowed me to put in the IP address of the

CzechMate server. Once the connection was created, I logged in as CzechUser1 into the CzechMate Desktop. These steps showed that the proposed way of logging into the domain with a frame relay connection works as expected.

6. Controls and Siemens Equipment

The controls section of the project was all done in the Senior Design III quarter. The controls equipment from Siemens was quite a learning curve for me, since I had never used Siemens equipment in the past. My background and first few years of school at the College of Applied Science were in Electrical Engineering, and I have an Associate's degree in the field. This experience was paramount in my completing the project, since I am the person to come to about design work for the project. Eric Kushon, Shepherd's head engineer, reports to me for now about any questions about the project. As time goes on, he will be the lead person when it comes to the controls portion. I am currently, and will be the lead for the network portion of the project.

Before going over the controls portion, I would like to stress the importance of this project by showing the current setup of our Cincinnati plant:

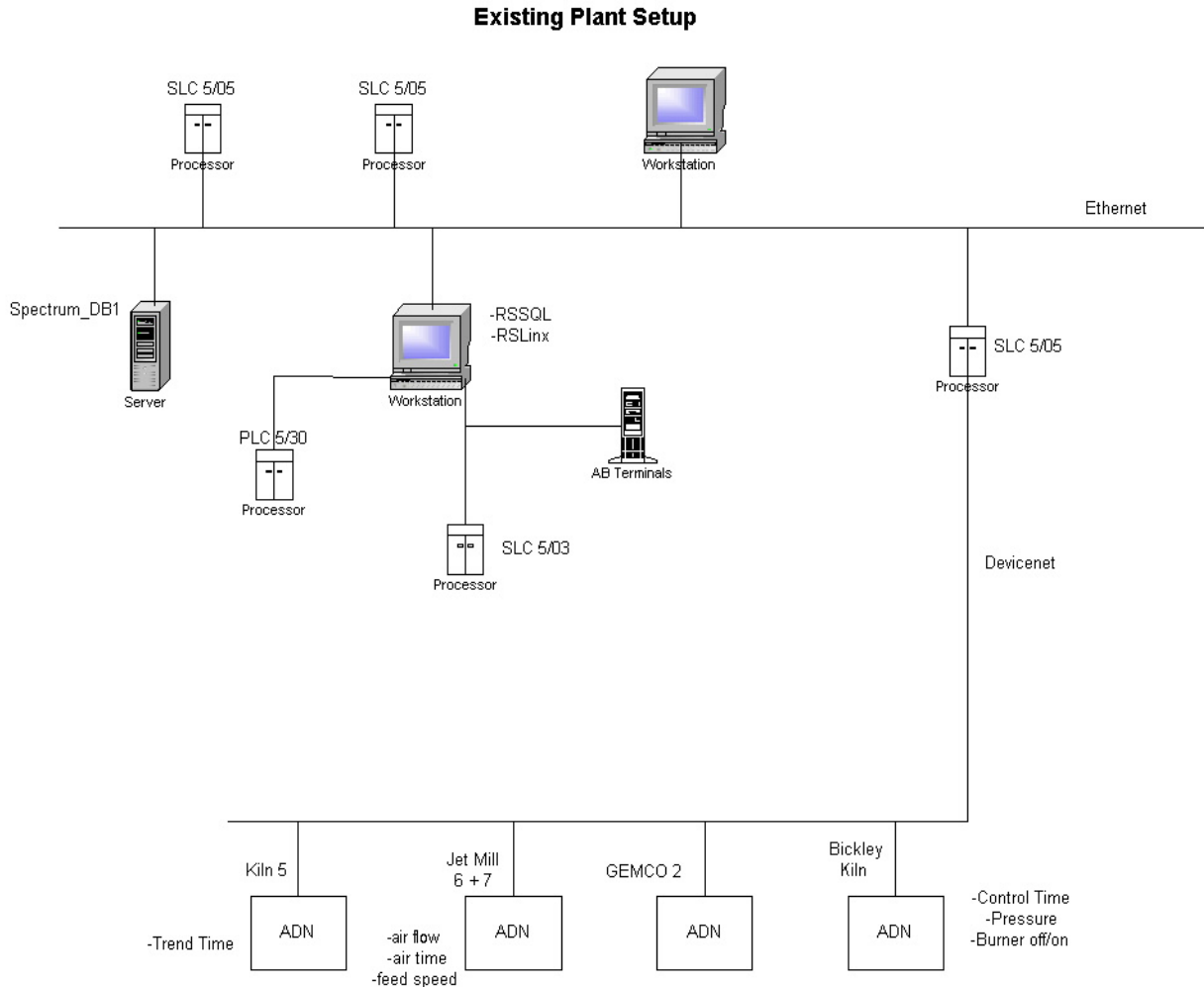


Figure 4. Existing Plant Setup

Figure whatever shows how the Allen-Bradley equipment works with in our existing setup. Allen-Bradley terminals run the application that is used to communicate with the SLC PLC's. The PLC's control the equipment that we use in our plant, which includes kilns, jet mills, and GEMCO machines. These are just pieces of equipment that are used to complete the needed processes in producing our paint pigments in Cincinnati. The problem with the current setup is the terminals will only run the application to communicate to the PLC. When the plant workers want to input data or log into the network, it must be done on another terminal or workstation.

The figure shows the workstations in the setup, and how they are connected to the rest of the equipment.

The following figure shows the processes that will be involved in the new plant when it is built in Europe:

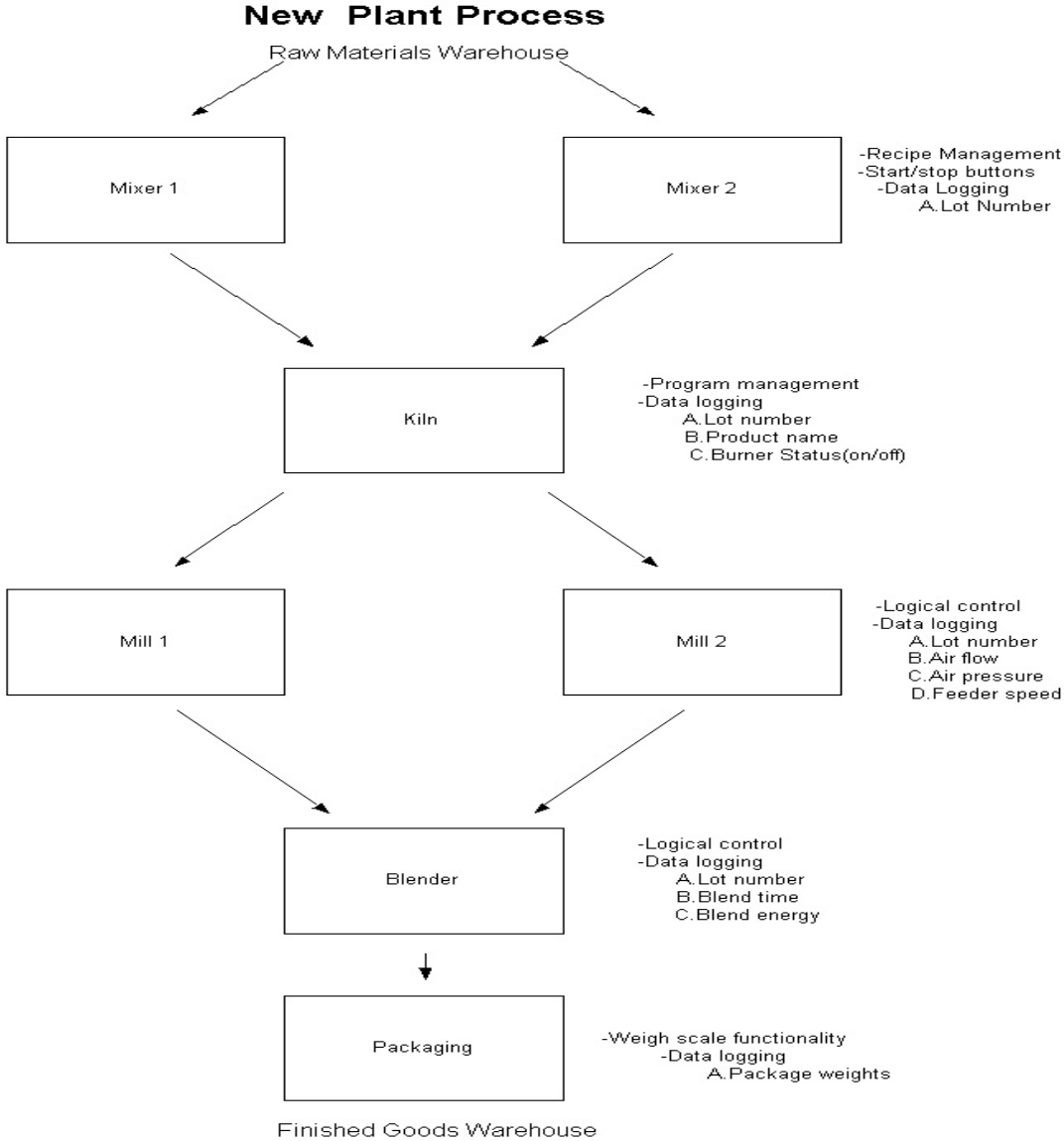


Figure 5. New Europe Plant Process Flowchart

The diagram shows the processes in creating the new pigments of the plant, moving from top to bottom. The raw materials warehouse refers to the product in Cincinnati, before it is

shipped to the new plant. Once the product arrives at the new plant, it is taken through the above processes to make the paint pigments, and they are then packaged, and sent out to the customer for use.

6.1 Controls Environment

The controls environment consists of three major sections that I worked in during the completion of the project: Siemens Simatic Manager, Siemens ProTool Software, and variable tables.

6.1.1 Simatic Manager

The first step in completing the application with Siemens equipment was using the Simatic Manager software to download the hardware configuration into the S7000 PLC. Most control products require this to be done with their PLC, so the PLC knows exactly how it functions.

The following shows the PLC used in the project:



Figure 6. Siemens S7000 PLC

Moving from left to right on the PLC, there is the power supply, the CPU, and then the two modules that serve as connection points to the equipment that will be used in the new plant.

The order just described needs to be input in the hardware configuration within Simatic Manager in the same order. If this is not done, the hardware configuration will be wrong, and the application will not work properly if this is the case. The following shows the environment of the Simatic Manager:

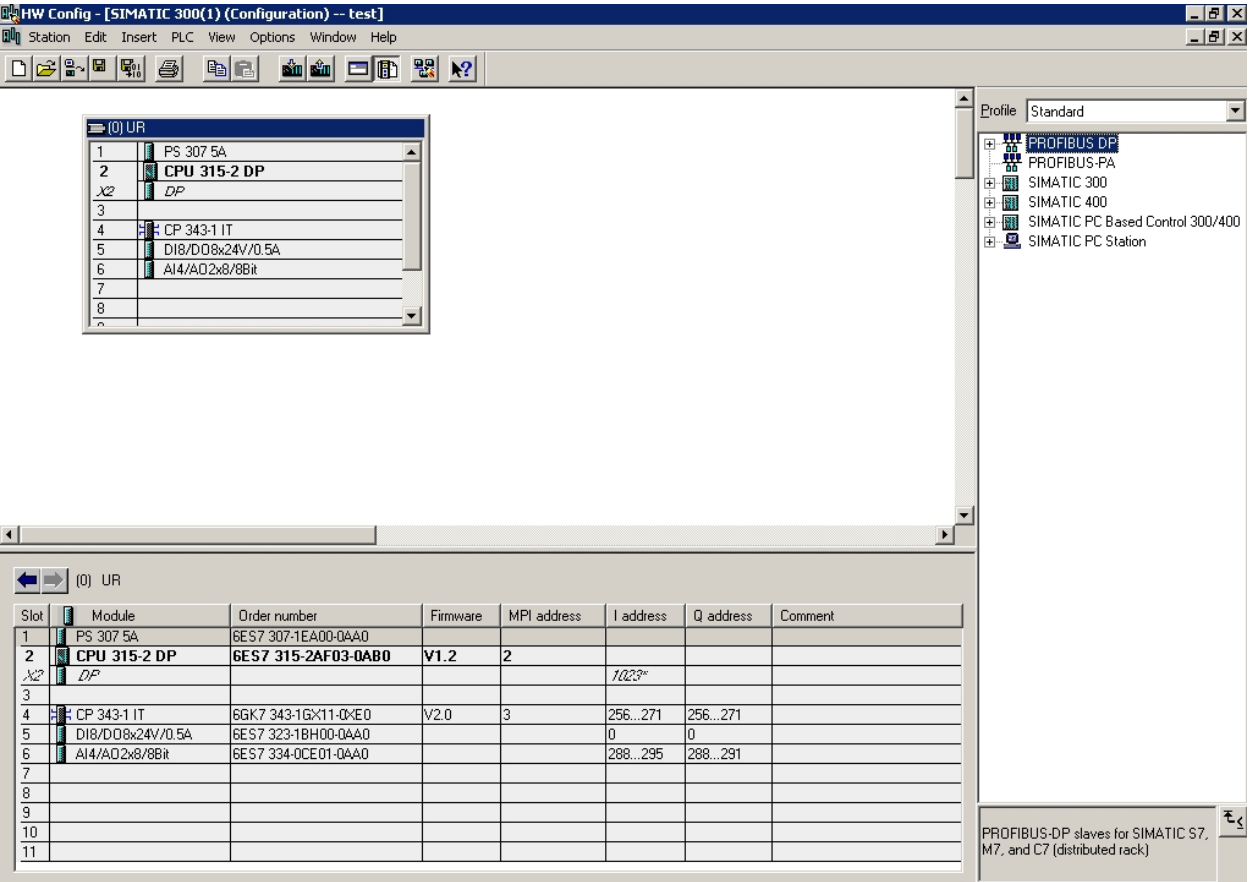


Figure 7. Simatic Manager Environment

On the PLC, there are part numbers on the actual faceplates of the parts of the PLC, and the developer uses the part numbers to take care of the configuration. Using the part numbers, I use the right side, and actually just pull over the parts of the PLC. The diagram shows the list of the parts in order, and down at the bottom shows the part number for those parts.

The next step in the process consists of downloading ladder logic into the PLC, so that it knows how to function with the application on the MP370 terminal. The Simatic Manager is

also used to accomplish this task. I set up just a simple application to run on the MP370 terminal, and the following shows the ladder logic I used:

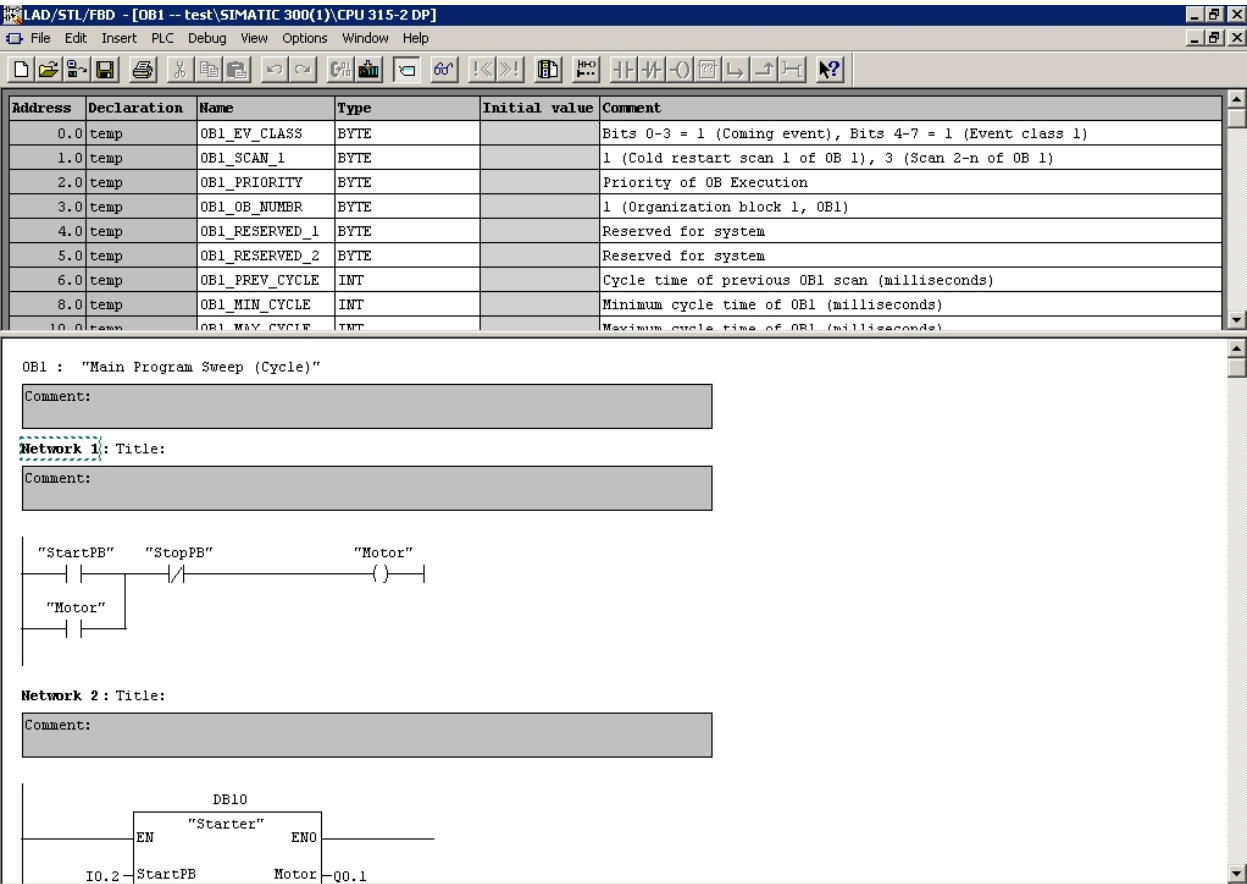


Figure 8. Ladder Logic Environment

The environment above shows the buttons on the top right for the different options for logic that is available, such as normally open contacts, normally closed contacts, and coils. These can easily be dragged right down into the logic shown under the comment box. This logic shown is downloaded directly into the PLC.

6.1.2 ProTool Software

Siemens ProTool software is used to develop the application that resides on the MP370 terminal. The application will be used by the plant operators to control machinery in the new

plant. ProTool allows the developer to build screens with push buttons, indicators, and text and numeric fields to interface with the S7000 PLC. Push buttons can be used to turn machines on or off; indicators can be used to show when equipment is being used, and text and numeric fields may be used to input data from the application. The following shows the ProTool environment:

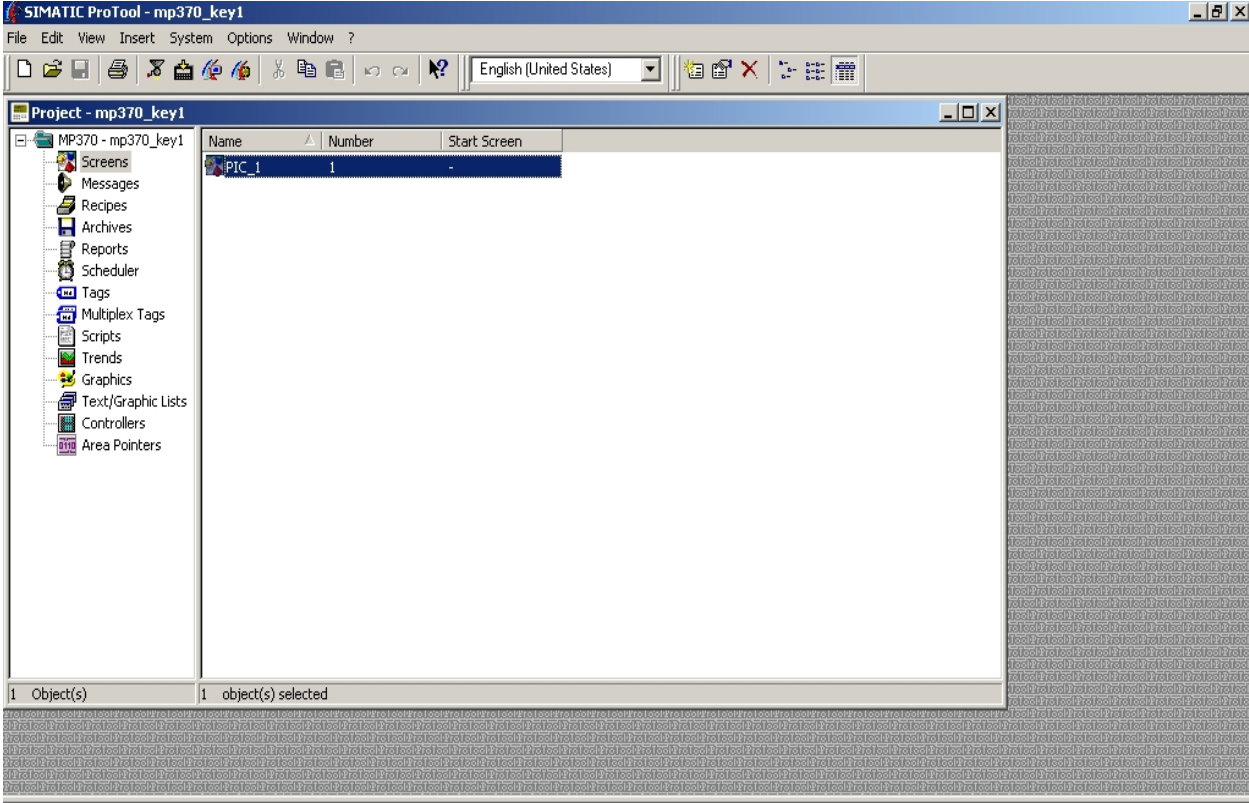


Figure 9. Siemens ProTool Environment

I began to use the software, and I was able to choose a name for the screen that I built. I used the default name of PIC_1. One of the first questions that the software asks when building screens is what terminal the application will be interfaced with. This is very important, since many of the Siemens panels have a variety of faceplates. The software will allow you to interface the push buttons available on many of the faceplates with functions within the application, such as the push button. The following diagram shows the simple application I built for the project:

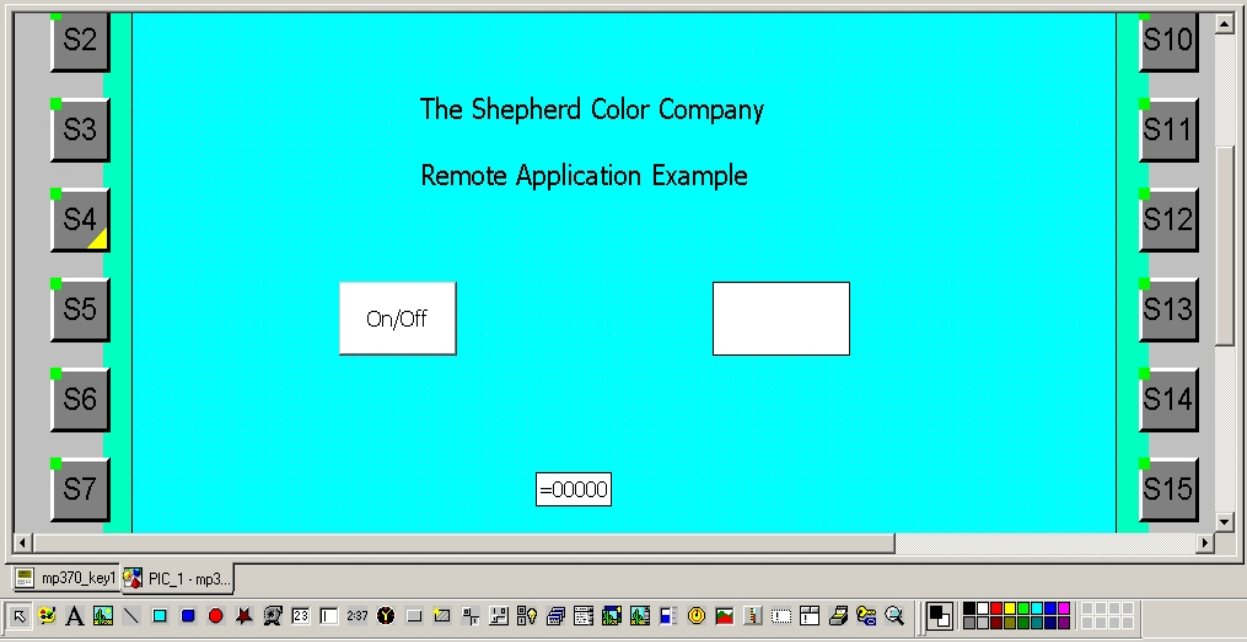


Figure 10. Custom-built Application in ProTool

Notice the S4 function button has a yellow tag on it. This signifies that it is tied into a function within the application. In the case of my application, I tied the S4 button to the On/Off button in the application. Since most of the plant workers will be using the function buttons on the faceplate of the MP370 terminal, I wanted to show how the buttons could be used. During the demonstration of my project, the S4 button was pressed, which initiated the On/Off button, and turned a bit on in the PLC. The PLC is connected to a machine, so in that example, a machine would be turned on. The numeric field shown above will be explained in the final process of the project. An important aspect that I found out in downloading the application to the MP370 was that the first initial download must be done with a direct or serial connection. Once this is done, then any future downloads can be done through an Ethernet connection over the frame relay. When we receive the equipment, Eric Kushon and I will complete the initial download, and then the equipment can be shipped to the new plant. Any changes that need to be made to the project in the future can be done over frame relay. The application was shown to Professor

Stockman, and he witnessed the functional application working over frame relay to communicate to the S7000 PLC.

6.1.3 Variable Table

Another function that I used in the project is the variable table, which is a monitoring tool available in the Simatic Manager. This is a very slick tool that can be used by Eric Kushon, the head engineer. The variable table allows the engineer to monitor live variables from an application running on the MP370 terminal. This allows the engineer to follow any changes that a plant worker makes in our plant. For example, if a plant worker turns a machine on with the push button I used in my example application, the variable table can be setup to monitor when the bit holds true or false, which just means on or off. This idea works over the frame relay connection, which means that the head engineer in the Cincinnati plant may monitor changes being made to the application residing on the terminal in the Europe plant. The setup was shown to Professor Stockman, but I have also included an .avi file on the project CD included with this paper. The video shows how the variable table accepts changes to the application. The .avi file was done with Camtasia Studio, which allows you to record live screen shots.

7. Testing Procedures

The project was tested by the head engineer, and by several of our production workers that resemble the abilities that the plant workers in Europe will possess. The head engineer also tested the Simatic Manager and ProTool software, and the downloading processes. I made sure that Eric Kushon thoroughly tested the software portion since he will be dealing with the application side the most. He agreed that the project worked successfully, and he looks forward to working with me in the future.

8. Conclusion and Recommendations

I would like to conclude with a small section to explain just how the project does function, and a major lesson learned while completing the project. To explain the function in better detail, please refer to the following diagram:

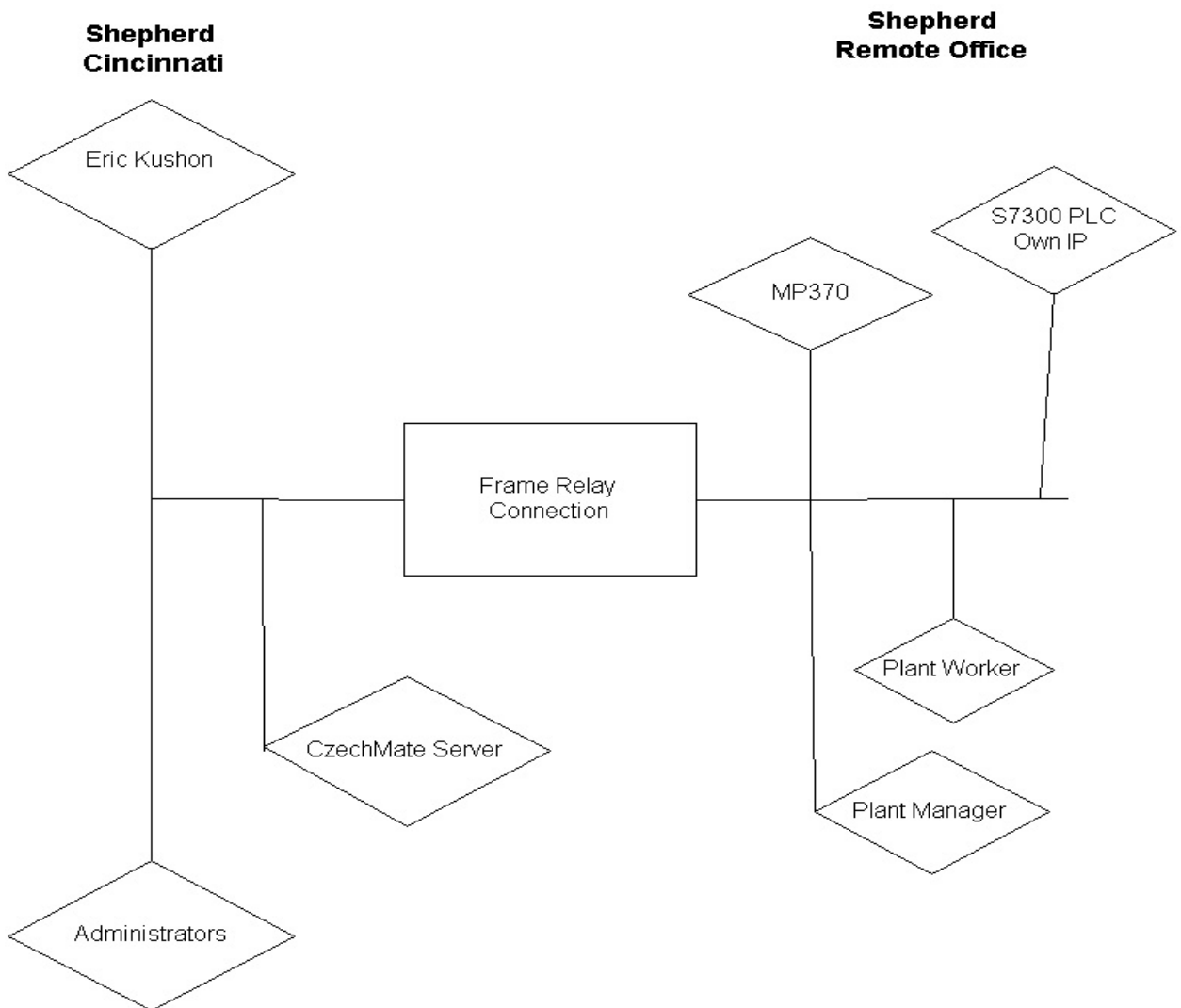


Figure 11. Flowchart of Working Project

The project focuses on two major functions:

1. The MP370 terminal will house the application used to communicate to the PLC.

2. The MP370 terminal will also allow plant workers to connect to the Cincinnati network.

As is seen in the diagram above, the plant worker will be able to use the terminal to connect to the Cincinnati network via the frame relay connection. From Cincinnati, Eric Kushon can make changes to the application on the MP370 and to the PLC over the frame relay. He can make changes to the PLC alone for it has it's own IP address. Also, the group of administrators can make any changes remotely to the MP370 if needed.

The most important lesson I learned from this project is to never believe what salesmen say without some kind of proof. The first time that I talked with anyone from Siemens, it was with two salesmen, and one engineer. When asked if a Citrix client would work on the MP370 device, they all chimed in that it would work. They all refused to tell me that no other company had ever tried this, or if they did, it never worked properly. I am the first person to get the ICA client to function properly on the MP370 terminal. I can guarantee this lesson to me will not be taken lightly in the future. The second lesson that I learned from the project is to make sure I know who has used or tested the equipment that is involved in my project. I spent an entire weekend troubleshooting why I could not connect to the CzechMate server with the MP370 terminal after I had it already functioning properly. I thought there might have been a problem with the server, but that was not the case. I finally checked the Network settings on the MP370, and I noticed that the default gateway was off by one number in the address. I later found out that other workers here in Production were testing the equipment for their purposes, and were making changes to the terminal's settings. After this occurrence, I created a sheet for workers to sign as to when they used the equipment, and what changes they made while working on it.

I will recommend the Siemens equipment for future projects over the Allen-Bradley solution used in our Cincinnati plant currently. The equipment and software was a huge learning curve, but the power and functionality overrule any negatives. The support was okay when it was needed, aside from the white lie the salesmen told in the initial meeting. I also recommend using Camtasia Studio for great screen-capture software. This was used to show the variable table functionality.

Appendix A.

Shepherd Color Remote Office Budget Includes Hardware and Software

Product	Price
Frame Relay Connection	\$2200/mth
Cisco Catalyst 3500 24-port switch	\$2179
Citrix Servers x12	\$3500/per
Siemens MP370 HMI	\$3890.25
Siemens Protocol v 6.0	\$653.30
Siemens 24V DC power supply	\$246.40
Siemens S7300 PLC	\$1472.24
Siemens mounting rail	\$27.28
Siemens terminal block	\$23.76
Siemens Step 7 PLC software	\$3055
Siemens MPI cable	\$30.40
Siemens Flash EPROM	\$168.08
Siemens backup battery for PLC	\$14.08
Siemens PCMCIA card for Profibus	\$945.25
Siemens softnet connect software	\$1306.25
Siemens Ethernet connector	\$119.70
Siemens Ethernet card for S7300 PLC	\$2042.50
Siemens twisted pair patch cable	\$32.30
Total:	\$60,405.79

Appendix B.

Shepherd Project Timeline

Timeline

Senior Design I

Feasibility Study	09/15/02	Thru	12/06/02
Interviews	09/20/02	Thru	10/05/02
Research	09/15/02	Thru	11/13/02
Report – Proposal	11/15/02	Thru	12/05/02
Rough Draft	11/15/02	Thru	11/20/02
Final Draft	11/21/02	Thru	12/05/02
Presentation	11/25/02	Thru	12/05/02
Slide Preparation	11/25/02	Thru	12/01/02
Final Presentation			12/05/02

Senior Design II

Test Siemens Equipment	01/09/03	Thru	03/20/03
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Develop Test Network

Build Win2000 Server	01/10/03	Thru	01/17/03
Terminal Services (Citrix) Install	01/18/03	Thru	01/21/03
Active Sync Install on Laptop			01/22/03

Draft of Project Description

First Draft	01/19/03	Thru	01/30/03
Final Draft	01/27/03	Thru	01/30/03

ICA Client Install on MP370

ICA Client (1 st Attempt)	02/03/03	Thru	02/17/03
RDP Client	02/10/03	Thru	02/13/03
ICA Client (2 nd Attempt)	02/13/03	Thru	02/17/03

Progress Report I

Work on Network Prototype	02/13/03	Thru	03/13/03
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Move Server to Frame

			02/17/03
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Test Connection to Server

	02/18/03	Thru	02/19/03
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Connection from MP370

	02/19/03	Thru	02/24/03
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Familiarize self with Siemens Software

	02/25/03	Thru	03/03/03
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Draft of Design Freeze

Rough Draft	02/05/03	Thru	03/13/03
Final Draft	02/05/03	Thru	02/20/03

Presentation

Slide Preparation	02/24/03	Thru	03/13/03
Final Presentation			03/10/03

Senior Design III

Begin learning software – Simatic Manager	03/24/03	Thru	05/15/03
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Begin learning software – ProTool	03/24/03	Thru	04/18/03
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MP370 application interface with PLC	04/21/03	Thru	05/09/03
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	05/12/03	Thru	05/23/03
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Design Working Product	05/24/03	Thru	05/30/03
Final Product Testing	04/18/03	Thru	05/30/03
Develop Documentation	04/18/03	Thru	05/30/03
Final Presentation			05/29/03
Final Report			06/12/03

References

1. Siemens.com <Http://www.siemens.com>
2. Citrix.com <Http://www.citrix.com>
3. Shelton, Paul. Open Platforms Manager-U.S., Siemens. Personal Interview.
September 13, 2002.
4. Kushon, Eric. Head Engineer, The Shepherd Color Company. Personal Interview.
September 17, 2002.
5. Henry, Scott. PLC Application Specialist, C&E Sales, inc. Personal Interview.
May 7, 2003.