Vision and Scope

for

ABC Utility Company

Plant Control Network Upgrade Project

Version 1.0 approved

Prepared by

Creative Networks Unlimited

Charles Smith (Team Lead)
Sreeja Sasidharan (Associate Team Lead)
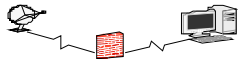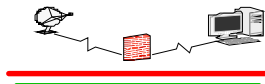**Dorothea Lightfoot**
Debbie Jackson

October 11, 2009

Table of Contents

Revision History

| Name	Date	Reason For Changes	Version
Team 5	10/03/09	Vision and Scope document creation	0.1
Charlie Smith	10/04/09	Created Sections 1 & 2	0.2
Dorothea Lightfoot	10/04/09	Created Section 7	0.3
Debbie Jackson	10/05/09	Created Sections 5 & 6	0.4
Sreeja Sasidharan	10/05/09	Created Sections 3 & 4	0.5
Team 5	10/07/09	Edited and revised the rough draft	0.6
Team 5	10/11/09	Final Draft sent for approval	0.7
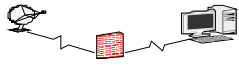
1. Business Requirements

The ABC Utility Company is dealing with an aging infrastructure and needs to implement newer technology to realize future benefits. Currently, the system is utilizing a combination of 10 Base T and Thick net technologies to connect their plant control systems. The requirement to implement this new system is to organize a system that meets the current IT system standards and can be managed by plant personnel. The system needs to have at a minimum 20 percent future growth potential. It must be realized that many of these systems are in a highly electrical inductive noise area, so thought needs to be given to the selected equipment. The backbone of the system needs to be installed using fiber optic medium. The distances that are being covered would be best covered with multi-mode fiber. While completing this infrastructure project, it has been decided that now would be a good time to upgrade all of the plant control system computers and peripheral equipment to a standard product. This standardization will help with future planning and put the system on a life cycle that can be managed properly.

1.1. Background

The ABC Utility Company has been using a combination of technologies to form a basic peer to peer network. This network topology has served them well through the early days of the systems life cycle. As technology has evolved and the process control industry utilization contains more IT standard products, the peer to peer solution is no longer well suited for this application. The existing network the process controller uses is a proprietary serial communication protocol called Modbus Plus. This RS-485 protocol is very well suited for small short distance applications, although it could be used for larger applications if additional equipment such as repeaters and bridges were installed. The ABC Utility Company did purchase and install several bridges and repeaters but this proprietary hardware is very expensive and the total cost of ownership does not lend itself well to future use.

This backbone system is also very susceptible to EFI noise and is critical to the plants process functionality. It should also be noted that this Modbus Plus installation was intended not to exceed 4500ft even with the addition of bridges and repeaters. ABC has pushed the envelope and installed a system that is in excess of 7200ft. In the near future ABC plans on upgrading their process control controller and intends on utilizing several new features being offered by the new product. In order to achieve that goal, a new network infrastructure must be installed.

ABC would also like to switch from a peer to peer network to client server architecture. This will improve system security and patch management. The implementation of a Windows 2008 Sever package will help with group policy and security implementation. New federal regulation being driven by the North American Electric Reliability Corporation (NERC) is mandating the implementation security standards and traceability of patch and software management. It should also be noted that the computer platform that this current infrastructure supports is a mixed bag of products. The computers range in age from a few years old to very old. The operating systems that currently reside on this network are Windows NT and Windows 2000.
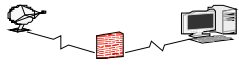
1.2. Business Opportunity

ABC is a medium to large scale organization that has an aging equipment problem. The majority of ABC's equipment was installed in the early 1970's. The systems that were installed during those times were all proprietary and often had system life cycle time lines that exceeded the 20 year time frame. That time line has long since expired and now is the time to implement a system that offers off the shelf technology that is not only cost effective but maintainable by plant personnel.

1.3. Business Objectives and Success Criteria

Currently with network analyzing equipment it can be measured that at times the signal to noise ratio is 1:2, this is unacceptable. With this ratio, the noise overwhelms the signal and the system fails. This situation has caused networking equipment to have catastrophic failure. In order for this portion of the project to be seen as a success, the elimination of this signal to noise ratio is mandatory. Another success criterion is the elimination of the proprietary hardware that is mandatory for the Modbus Plus network to function. With this hardware elimination, the reduced cost of ownership will be realized immediately and any equipment that is removed can be resold into the process control industry to regain some of the costs.

With the standardization of computer hardware, the maintenance costs can be rolled into a maintenance agreement that many hardware providers offer. This will help offset any of the budgetary costs that past hardware maintenance issues caused.

This project can be installed in parallel to the existing system and tested without having any impact on the existing process. Once the system is tested and ready for implementation, it should be noted that the cut over time line is only one week in length. Once the system is transferred to the new system, all troubleshooting and debugging needs to be complete and turned back over to the customer. Without this system the customer cannot operate their processes. The cost to that impact is significant. Depending upon time of year and system needs, the costs for additional downtime can be measured in the tens of thousands of dollars an hour.

1.4. Customer or Market Needs

The needs of ABC are not unique to the rest of the process control industry. Some of the issues that these type of customers encounter are as follows:

- Proprietary hardware and software that is expensive to maintain
- Older technology not capable of handling increased throughput of new equipment
- Security vulnerabilities are not maintainable on the older equipment
- Future growth of older system not justifiable in comparison to replacement
- Knowledge level of older equipment becoming scarce with aging workforce retirement
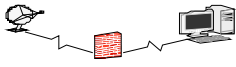
1.5. Business Risks

The risks to the business for a project of this scope are diverse. This project is directed as solving many problems that the business faces. The immediate risk upon failure of this project is the lack of control of plant process equipment. This would cause the business to lose revenue. This risk can be mitigated with thorough testing and troubleshooting in parallel to the existing system. Leaving the existing system intact once the new system is put in place will also help mitigate some of this risk. This provides an alternative to switching back to the older system in a worst case scenario. Implementing the new system will open the ABC Utility Company to vulnerabilities that many of the IT systems currently face. Using off the shelf technology and placing it into a process control industry creates opportunity for malware and malicious operations to have a more dramatic impact. Care should be given to thoroughly lock down the system and mitigate these types of scenarios.

2. Vision of the Solution

This project needs to incorporate standard IT infrastructure products that can be supported by plant personnel. The computers need to run with a new Windows operating system, XP Professional, and be configured in Server Client architecture. One domain controller needs to be installed with the implementation of group policies. Network analyzing software will be installed and utilized to monitor network traffic and notify plant staff of network troubles. Since this network has no interconnectivity to the internet, the design of the infrastructure will be able to incorporate the possibility of interconnecting this system to other networks. This includes firewalls and routers with access control lists.

The network will be installed to support 100Mbs throughput and the installed cabling will accommodate 1Gbs to allow for future upgrades. The network will be capable of operating with minimal network errors. The network analyzing software will help troubleshoot and monitor this requirement.

2.1. Vision Statement

The vision of this project is to help standardize the infrastructure of a local utility company. By doing this, it will help this electric cooperative move into the future bringing affordable electricity to the rural community.

2.2. Major Features

- Fiber optic backbone
- Redundant ring that offers a diverse route
- Network analyzing software
- Network security through software and hardware
- Standardized computers with maintenance contract
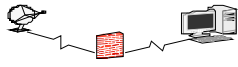
2.3. Assumptions and Dependencies

This project has many dependencies; a partnership must be formed between Creative Networks and the ABC plant staff. A good working relationship with those individuals that are closest to the process is important for project success. It is also assumed that the implementation of a complete hardware solution from a vendor such as Dell or HP will help minimize hardware configuration problems and any maintenance or warranty issues that might arise. It is also assumed that the ABC plant personnel have a working knowledge of Cisco networking equipment. Since they are requesting these vendors for the networking equipment, this assumption is necessary to achieve the requirement that ABC plant personnel be able to support.

Dependencies for this project are contingent upon network and plant outage schedules. Troubleshooting the new equipment and networking capabilities is necessary to ensure that collisions and network noise problems are addressed before the switch over to the new equipment.

It is the intent of this project scope to have a fully operational application of Wonderware already installed and only needing to be transferred over to the new system. No configuration or additional application development time is being considered or quoted in the scope of this project.

3. Scope and Limitations

The new plant control network upgrade system will have the capability to secure the network from outside intruders as well as other abilities. The current peer to peer network will be transferred to a client server environment, which will allow group policies and remote administration. The network infrastructure devices will use Cisco networking equipment with redundant systems to maximize network uptime of the environment. The Windows 2008 server will ensure high security and easy patch implementation. There will be an easy back up policy as part of disaster recovery requirements. The operating system in all the client desktops will be replaced with Windows XP Professional. In the future, the system will be able to expand easily for more programming capabilities. The development team will have a Web site/folder specific for this project, which will include upcoming meetings, past meetings and other relevant information related to the project.

3.1. Scope of Initial Release

- Design and develop a plan for infrastructure
- Increase bandwidth and network length for more reliable response time
- Interconnectivity with other networks
- Upgrade all workstations
- Standardize all workstations operating systems and other hardware devices
- Make the future expansion quick and easy
- Protect the network from outside intruders
- Disaster recovery plan
- Documentation and training
- This initial release will also include installation and configuration of the network
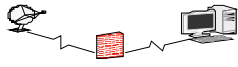
3.2. Scope of Subsequent Releases

The completion of the network upgrade project will deliver a reliable and secure network infrastructure complete with future expansion capabilities for supplying other network applications and systems. The network bandwidth will be more adequate, plus easy and cost effective programming will be available.

3.3. Limitations and Exclusions

This project will switch a peer to peer network to secure client server architecture. It will have the capability to perform regular back ups. All workstations will be upgraded with a new operating system. There will be at least two network printers for printing all reports. The programmable logic controllers and implementation of RSA type devices are not in the current scope. If there is any technical or non technical issue that needs to be addressed, which is not mentioned in the document, ABC Utility Company will handle this responsibility and notify Creative Networks Unlimited.

4. Business Context

The primary stakeholders of this project are the management, IT, operations staff and the customers of the ABC Utility Company. The completion of this project will help the company switch from a peer to peer network to a client server network. This project will also assist in an easy expansion upgrade in the future.
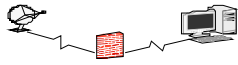
Furthermore, the existing network does not allow for any upgrades because it is spread across different platforms. The existing network has been having some problems and causing frequent network outages. These outages could cost the company up to $75,000.00/hour depending on the month and time of the outage. Upgrading the network infrastructure will help ABC in a significant cost savings in repairs and boost the network up time, thus providing an increased productivity and higher revenue.

4.1. Stakeholder Profiles

Stakeholders are important to a project and are responsible in defining the need and affects by the success or failure of the project.

Table 4.1: Stakeholder Profiles

| Stakeholder	Major Value	Attitudes	Major Interests	Constraints
ABC Utility Company Management	Increase productivity/ improve issue tracking	Reduce network downtime and increase production	Implementation of the new network with less black out time	Maximum budget is $500,000.00

Operations Staff	Staff will have a more enhanced network with less down time	Looking forward to the new system, but concerned about training and support issues	Implementation of the new network with less black out time	Staff will need to get training on the new network and its benefits
IT Staff	Staff will maintain and trouble shoot the network more effectively	IT will trouble shoot easier with a standard platform and failures will be reduced due to upgrade on the hardware and software	Implementation of the new network with minimum black out time	The IT staff will be able to provide any support needed for the consulting group to integrate the new network with the other systems within the company
Customer	Customers will receive improved service from ABC	The upgrade will not effect or impact customers in any negative way	Implementation of the new network with minimum black out time	There are no anticipated constraints

4.2. Project Priorities

Table 4.2: Project Priorities

Dimension	Driver	Constraint	Degree of Freedom
Overall Schedule Creation	Project deadline	Completion date of 12/15/2009	+3 days
Site Analysis and sign off	Must be completed before network infrastructure design	Upon approval of vision and scope document	Oct. 11 to Oct. 18, 2009
Design network platform	Platform design must be completed before ordering fiber cables and hardware devices	Within two weeks of delivery of this vision and scope document	Oct. 18 to Oct. 25, 2009
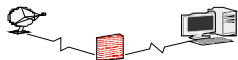
| Order hardware and software	According to design specifications	As soon as possible	Oct. 25 to Nov. 08, 2009
Installation of fiber, hardware and software	Determined by project schedule	Risks	Nov. 01 to Nov. 22, 2009
Network Testing	Upon network upgrade completion	The installation of network and upgrade of workstations needs to be completed	Nov. 22 to Dec. 06, 2009
Staff	ABC's existing staff	Training	Nov. 29 to Dec. 13, 2009
Cost	Available funding by the ABC Utility Company	Allotted funding: Hardware = $250,000 Labor = $150,000 Total Cost $400,000	Up to 10% budget overrun Acceptable without management review

4.3. Operating Environment

The network upgrade includes many improvements over the existing network: including client server network, improved security, reliability, availability, backup and easy maintenance. Replacing the current 10base T and Thick net technology with the latest Cisco routers, firewalls and switches will provide remote management capability. Additionally, the upgrade of all workstations to a common operating system will help with more efficient trouble shooting and will boost the network up time to approximately 99.999%.

The security and interconnection to other networks were another issue. The firewalls and routers will help to protect the information asset of the company from any outside intrusion. The Windows 2008 server is more secure and helps to control the network remotely.

5. Human Resources

The human resources required for successful project completion includes an accomplished organizational structure which identifies each individual's contribution to the project. The team charter describes how decisions are fulfilled and conflicts are resolved. The team skills include both personal and technical attributes of each team member. Roles and responsibilities express the team's professional contribution to the project and the communication strategy establishes the communication channels necessary for effective team interaction. These sections create the basis required to coordinate the human resources needed to acknowledge the project goal.
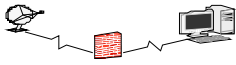
5.1. Team Charter

The project team members have been assembled in a hierarchical order beginning with a project team leader to guide and assist all other members. This individual oversees all project developments and implementations and provides the final decision on all aspects of the project. The associate team leader aids in ensuring pertinent information is available to all other team members and makes certain each requirement is understood. Each member will equally be responsible for their particular section of the project through completion.

If a conflict should arise, decisions will be made on a team consensus first and if the conflict is irresolvable, the team leader will mitigate. In the case of a member's removal, the team leader will assign their project responsibilities to another professional within the organization. The team leader is responsible for assuring submission of each team member's deliverable as described.

5.2. Technical Skills and Attributes

Table 5.2 lists team member's skills and attributes

Name	Skills	Attributes
Charlie Smith	Network specialist, CISCO Certified professional, programming	Leadership, guidance, entrepreneur, organized,
Sreeja Sasidharan	Database develop and design, project management, server development and support	Self-motivated, open-minded, patient
Dorothea Lightfoot	Editing, web development, technical support	Reliable, trust-worthy, structured
Debbie Jackson	Application development, programming, technical writing	Detail oriented, professional, orderly
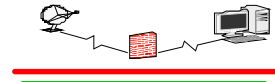
5.3. Roles and Responsibilities

**Table 5.3** lists team member's roles and responsibilities for the project

Name	Role	Responsibilities
Charles Smith	Team Leader, Network Administrator	Oversees detailed network design and all project deliverables. Manages the project structure and mentors team development.
Sreeja Sasidharan	Database Administrator, Server Administrator	Develop database design, end user and administrative documentation. Record meeting minutes. Assists in project research.
Dorothea Lightfoot	Web Developer, Technical Consultant	Design the web site, assembles all information and edits the material. Configures hardware devices. Assists in project research.
Debbie Jackson	Application Developer, Technical Writer	Utilize all application development, application trainer, and technical writing design. Assists in project research.

5.4. Communication Strategies

Various tools are used for project communication. Team meetings are held on a weekly basis every Tuesday; communicating through phone conferencing and discussing upcoming goals, responsibilities, and individual project statuses. Response time for each team meeting is held until each goal is discussed. The team is in constant contact with one another on a daily basis through email and occasional FranklinLive sessions. All documents are posted in Google docs and DropBox to assist in synchronous collaboration.

6. Project Management

The project management section describes the details about each team member's deliverable, including all dependencies and individual project schedules for the network upgrade project. A list of resources and requirements is documented to describe the objectives of each member's responsibility in the project. Each deliverable is essentially important with a stringent time schedule in order to complete the appropriate work needed for each dependency. Delivery deadlines can be revised in the event a problem should arise, but it is expected for the team leader to ensure complete delivery of the final project within the complete required timeframe of the entire project. This shall be accomplished by other team members assisting with other responsibilities besides what is assigned to them. This type of teamwork ensures a successful and transferable development for the customer.
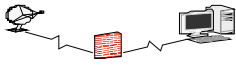
6.1. Deliverables

Creative Networks Unlimited will provide ABC Utility Company will the following professional services required to design a complete network upgrade project.

Following planning deliverables:
- Detailed project plan and time schedule
- Weekly project status reports
- Discuss hardware configuration and security
- Physical network design chart
- Test plan development

Following design deliverables:
- Client/Server architecture analysis
- Upgrade backbone to fiber optic ring network to incorporate redundancy and provide 99.999% availability
- Star topology utilizing Cat 5e cabling for 100mb throughput
- Install multiple hardware devices; DELL computers, Windows 2008 server, Cisco network hardware, domain controller, HP printers
- Install network analyzing software
- Security configuration; firewall interfaces, routers with access control lists
- Removal and disposal of old hardware devices

6.2. Dependencies

The following are crucial dependencies in chronological order:
- Detailed project requirements
- Electrical power upgrades
- Installation of hardware and configuration
- Installation of software and customization
- New network testing and success criteria
- Training
- Migration cut-over
- Final documentation delivered
- Remove and dispose of old equipment
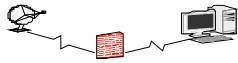
6.3. Schedule

Table 6.3 Schedule

Tasks	September				October				November				December			
	9/06	9/13	9/20	9/27	10/4	10/11	10/18	10/25	11/01	11/08	11/15	11/22	11/29	12/06	12/13	12/20
PLANT CONTROL NETWORK UPGRADE PROJECT		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Identify and determine objectives			■	■												
Project Kick-off upon Purchase Order				■												
Product Design and Development					■	■	■	■	■	■	■	■	■	■	■	■
Produce Vision and Scope document					■											
Infrastructure Analysis and preparation						■										
Analyze and design Network Platform							■									
Selection of harware and software architecture								■	■							
Power Upgrades									■							
Install Cabling									■							
Install and commission hardware									■	■	■					
Install software and customize										■	■					
Develop Backout Plan												■				
Network testing													■	■		
Go/Nogo Approval													■			
System validation													■			
Produce detailed training events													■	■		
Conversion to new network														■		
Survey															■	
Removal of old equipment															■	
Project Closure																■

7. Educational/Program Outcomes

The purpose of our program is to upgrade ABC Utility Company's network infrastructure to a more efficient and stabilized network operating on a single platform. The result of this upgrade will be a more secure and effective network in which the multiple users of the network will have more programming capabilities.
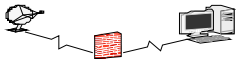
7.1. General Education

This project requires a complete infrastructure analysis of the current plant control network system and thorough research of upgrading to a more efficient and reliable network topology. This will allow for the project team to investigate and demonstrate the best fit from a wide range of technologies. Staying in contact with ABC will provide Creative Networks Unlimited with a clear understanding of what the client needs. When necessary, documents containing highly technical methodologies will be simplified to allow for any unfamiliar terms, problems, or solutions so all parties know the proposed project solution. Success for this objective will be measured by a complete understanding of each project requirement and an acceptance from all involved parties.

7.2. Information Technology

Creative Networks Unlimited goal is to transfer to a client server architecture and offer group policy as well as user accounts. This restricting will promote remote administration, backup reliability, and patch management. The project requires Creative Networks Unlimited to redesign ABC Utility Company's current IS to be able to accommodate more efficient programming capabilities with the unused ports being shutdown.

The project encompasses a network redesign and implementation to handle multiple programming aspects in a more convenient and reliable manner. Restructuring ABC's current network will bring together several different functions that will allow the staff to improve productivity; while ensuring that the application is still performing as expected. The success of this project will be measured by implementation of the upgrade in a timely fashion; therefore, ensuring minimal downtime. Success will also be measured through the effectiveness of the enforced security of the network. Implementing the solution will also require developing the proper administration procedures for remote support, nightly backs, and implementation of hot fix patches when necessitated.

Design and develop a plan for infrastructure:

a. This includes a fiber optic ring for the backbone of the system; this ring will use multi-mode fiber and offer a diverse route that can withstand a system catastrophic event and stay up.
b. The fiber optic ring will form the central hub for a Star topology. Currently the system has many available locations for placing switches. From these switches, connections to the peripheral devices will be made.
c. The use of an industrial fiber optic ring switch is being considered. A product offered by Sixnet provides for a redundant ring and alarming capability in the event the switch develops a problem.

The remaining network devices will use Cisco networking equipment, a port density of no less than 24 should be considered. This will allow for ample expansion in the future.
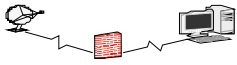
8. Annotated Bibliography

Cisco. (2007). Network System. Retrieved October 6, 2009 from Cisco Systems Web site:
http://www.cisco.com/en/US/netsol/ns726/networking_solutions__solution_
segment_home.html

> This Web site provides information relevant to the project's networking design requirements; including routers, switches, firewalls, as well as VPN equipment. Cisco offers a wide range of different hardware devices containing features and functions for all types of capacity requirements and will be used for the development and design phase.

Dell. (2009). Workstations. Retrieved October 6, 2009 from
http://content.dell.com/us/en/enterprise/large-enterprise.aspx?c=us&l=en&s=biz

> This Web site was used to research information and specifications on the new workstations being installed for the computer upgrade. It will also be used to obtain pricing information as well as features and functions.

Globalspec. (2009). An engineering search engine. Retrieved October 8, 2009 from http://optical-
components.globalspec.com/Industrial-Directory/fiber_multi_mode

> This Web site is a trusted source for determining the type of engineering fiber optic cables and accessories that will be used for the development of the new network. Reducing electrical inductive noise is a top priority.

Houston Wire & Cable Company. (n.d.). Link to supplier of fiber optic cables. Retrieved October 8, 2009 from http://www.houwire.com/products/products.asp?catid=169&parentcatid=158

> This link is a specification and configuration guide containing all the necessary information needed to properly quote and price the networking cables required for the project.

HP (Hewitt-Packard). (2009). Printers. Retrieved October 7, 2009 from
http://www.hp.com/sbso/busproducts_printing.html

> This Web site provides specifications, functions, features and pricing for the network printers implemented once the upgrade to the network infrastructure has been made. Good site for researching all hardware needs.
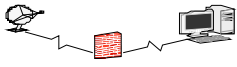
ModBus. (2006). MODBUS over Serial Line Specification and Implementation Guide. Retrieved October 5, 2009 from Mod.org/ docs/Modbus_over_serial_line_V1_02.pdf

> This paper offered a better understanding of the current protocol that is being used and the implementation of that protocol. Helps enlighten the team as to why the protocol was chosen and still being supported throughout the upgrade.

North American Electric Reliability Corporation (NERC). (n.d). Compliance. Retrieved October 7, 2009 from http://www.nerc.com/page.php?cid=3

> This article provided information that is needed to ensure the changes being made in the implementation are within the regulations that are put both forth by the organization.

Sixnet. (2009). Solutions for Industrial Networking Challenges. Retrieved October 5, 2009 from http://www.sixnet.com/

> Use of this Web site aided in the focus on the challenges that may be encountered when taking on a network project containing challenges for industries. It provided some viable solutions as well.

Windows XP Professional. (2009). Retrieved October 7, 2009 from http://www.microsoft.com/windowsxp/pro/evaluation/overviews/default.mspx

> This Web site provided interesting excerpts regarding the reliability and performance of XP Professional software. Upgrading of ABC's current network is going to need an operating system that is both reliable and performs to the utmost quality.

Windows 2008 Server Package. (n.d). Retrieved October 7, 2009 from http://technet.microsoft.com/en-us/windowsserver/bb310558.aspx

> This article provides the customer and the team with information as to why Creative Networks Unlimited chose to use this server package to help support the upgrade. The Windows 2008 Server package will assist with the security and group policy as well.

Wonderware Software Package. (2009). Retrieved October 7, 2009 from http://global.wonderware.com/EN/Pages/default.aspx#

> This Web site provided relevant information for the software package that allows for man machine interface to be done utilizing personal computer architecture.