A PROCESS CONTROL NETWORK ANALYSIS FOR INDUSTRY

Wilfredo Tovar Hidalgo Lukeman Hakkim Ramy Maarouf

School of Information Technology Dep. of Systems and Computer Engineering School of Information Technology

Carleton University Carleton University Carleton University

Ottawa, Canada Ottawa, Canada Ottawa, Canada

[wilfredotovarhidalgo@cmail.carleton.ca](mailto:wilfredotovarhidalgo@cmail.carleton.ca) [lukemanhakkimsheikal@cmail.carleton.ca](mailto:lukemanhakkimsheikal@cmail.carleton.ca) ramymaarouf@cmail.carleton.ca

ABSTRACT

An interface linking a remote communications network and a process control system involves a storage device, a communication software stack and a user software layer. The user software layer empowers interfacing between the remote communications network and the process control system by addressing the communication software stack to operate in the process control system employing a process communication protocol, by monitoring the message traffic on the communication software stack, and by copying requested message traffic to the storage device.

This paper presents an industrial control system review to the development of a monitoring and infrastructure solutions with existing technology and infrastructure to aid the reliability and maintainability of large Process Control Networks (PCNs), to reduce production downtime attributed to intricate industrial network designs.

∗ A PROCESS CONTROL NETWORK ANALYSIS FOR INDUSTRY.

†Wilfredo Tovar Hidalgo ; Lukeman Hakkim ; Ramy Maarouf

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the owner/author(s).

KEYWORDS

Process Control Networks (PCNs), Industrial control system, Industrial Network Design.

1. INTRODUCTION

Large Corporations contain and rely on many mechanical and electronic devices for industry production use. The original design of these older plants allowed the devices to work together without any remote-control capabilities, with monitoring and adjustment performed locally by operators. The introduction of, electronic circuits, Programmable Logic Controllers (PLC), and Programmable Automation Controllers (PAC) allowed operators to monitor and control mechanical devices or even personal performance remotely using point-to-point communication. As a result, defined communication protocols were developed for each vendor's requirements, leading to an introduction of a variety of standards and protocols for industrial communications. Examples of such industrial protocols are Common Industrial Protocol (CIP), Ethernet Industrial Protocol (EtherNet/IP), DeviceNet, ControlNet, and Modbus. Transmission Control Protocol (TCP) emerged with the introduction of Ethernet to industrial sites and has become widely popular throughout the industry as it continues the simple, robust application layer protocol encapsulated in the industrial Ethernet standard. Ethernet-based has inherited handshake and timeouts from the serial communication protocols and utilize port 502 of the TCP/IP protocol.

This project is focused on a TCP based Process Control Network at a large industrial processing facility and presents an industrial control system review to the development of a monitoring and infrastructure solutions with existing technology and infrastructure to aid the reliability and maintainability of large Process Control Networks (PCNs), to reduce production downtime attributed to intricate industrial network designs.

1. BACKGROUND AND PROBLEM STATEMENT

The rapid development of communication technologies has significantly accelerated the application of networked control systems (NCSs) in industrial processes [1] due to their economic productivity and flexibility in modularization. Elements of industrial processes like sensors, controllers, and other components are often connected over industrial Ethernet, and communicated by exchanging packetbased messages. Because of the extensive data exchange over the Ethernet, there is a strong possibility that random packet dropouts and network-induced delays happen [2][3]. Thus, it is necessary to incorporate such effects into the overall consideration in the industrial processes.

“TCP/IP is the common transport protocol of the Internet and is a set of layered protocols, providing a reliable data transport mechanism between machines” [x1]

REFERENCES

[1] S. Yin, X. Li, H. Gao, and O. Kaynak, “Data-based techniques focused on modern industry: An overview,” IEEE Trans. Ind. Electron., vol. 62, no. 1, pp. 657–667, Jan. 2015.

[2] L. Zhang, H. Gao, and O. Kaynak, “Network-induced constraints in networked control systems—A survey,” IEEE Trans. Ind. Informat., vol. 9, no. 1, pp. 403–416, Feb. 2013.

[3] Y. Tang, H. Gao, W. Zhang, and J. Kurths, “Leader-following consensus of a class of stochastic delayed multi-agent systems with partial mixed impulses,” Automatica, vol. 53, pp. 346–354, 2015.

[x1] Modbus.org, 2017. Modbus Messaging Implementation Guide V1, s.l.: s.n.