

# Development of a Profibus Network and WinCC SCADA environment for Educational Purposes

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*"A report submitted to the School of Engineering and Energy, Murdoch University in  
partial fulfilment of the requirements for the degree of Bachelor of Engineering"*

**Brenton Walker**

**Student Number: 30713991**

*Bachelor of Engineering*

*Department of Engineering and Energy*

*Supervisor: A/Prof Graeme Cole*

*Associate Supervisor: Dr. Linh Vu*



**MURDOCH  
UNIVERSITY**  

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**PERTH, WESTERN AUSTRALIA**

## **Executive Summary**

Through the course of the Industrial Computer Systems degree students are exposed to fieldbus technologies and SCADA systems through research projects without the use of practical componentry. This thesis summarises the work completed to provide students with a working fieldbus infrastructure as well as to educate the reader on the development, implementation and testing of such networks.

During this thesis various Profibus networks were designed to be implemented into the Industrial Computer Systems Facility PS2.027 (ICSE). Four networking examples to be implemented in PS2.027 were created to demonstrate various Profibus data exchange arrangements. These examples were then scaled down and simulated on a testing platform built for this project, to demonstrate the network operates as designed. By utilising Profibus diagnostic equipment and techniques the network examples were then verified to be as per the designed arrangements.

In addition to the designed Profibus infrastructure this thesis briefly investigated the development of a small WinCC SCADA environment for one of the scaled Profibus examples. The WinCC SCADA environment designed functioned as required and provided a template to be used as an educational tool.

A large part of this thesis focused on the development of suitable documentation, such as the development of laboratory guides. These guides were designed to be used for the education of future ENG345 – SCADA students. These guides provide the process behind establishing various types of Profibus networks. The documentation developed was also created to outline the use of the various technologies utilised throughout this project.

It was discovered through the research and development of this thesis that many opportunities to further develop this project existed. These advancements could be made after the installation of the Profibus architecture into the Industrial Computer Systems Facility over the summer period.

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## Terminology and Acronyms

**Active Termination:** The term 'active termination' is used to describe a termination that requires a live voltage source.

**Baud Rate:** The speed at which data transmission for networks occurs at.

**Direct Data Link Mapper:** Provides access between the user interface and Layer 2 of the OSI model.

**DP Master Class 1 (MC1):** Classified as the central control unit of the Profibus DP Network and is responsible for communication and data exchange with configured DP slaves. The class 1 master is typically a PLC and sets the baud rate of the network which the slaves automatically detect.

**DP Master Class 2 (MC2):** These devices can be used for configuring, maintenance, diagnostics, monitoring and/or operation of a bus network. DP master class 2 devices can be a Human Machine Interface, a computer or a specialised diagnostic device and are capable of communicating with a master class 1 device on the network.

Communication between a master class 1 devices and master class 2 devices always originate from the MC2 not the other way around.

**DP Master System:** The DP master system can be thought of as the DP master's slave polling list. Each slave device is placed on the system and when the master has possession of the token it polls each slave for the data that has been configured.

**Fieldbus:** Fieldbus is a generic term derived from the combination of words Field and Bus. The word '*field*' can be defined as the area were equipment is located in the plant and '*bus*', which originates from computer science, is defined as a set of common lines that connects equipment to transfer data along them.

**GSD:** Used to identify the operational characteristics of PROFIBUS devices and is used to load 3rd party devices onto Profibus master devices.

**Master:** A Profibus master can be either a DP Master Class 1 (MC1) or DP Master Class 2 (MC2).

**Node:** Addressable devices connected to the bus network, in the case of Profibus networks this refers to master and slave devices.

**Network Telegrams:** A network telegram is a type of data packet that is forwarded from device to device over a network. The telegram contains the address of the destination device as well as the address of sender and contains information requested/sent by a Profibus master.

**OSI model:** Open System Interconnection reference model is an established model used by the international standards organisation to define communication for data transfer over a network.

**PLC:** A Programmable Logic Controller (PLC) is a device used to carry out logical operations required from a control point of view.

**Poll:** The act of a master device fetching information from a slave device.

**RxD/TxD-P:** Receive/Transmit Data Positive Line

**RxD/TxD-N:** Receive/Transmit Data Negative Line

**Slave:** A slave is a passive device that reads process information and/or delivers output data over the network. Slaves can only respond to a request made by a master.

**Telemetry:** The ability to take process measurements from remote locations and transport the data to a local location.