

Introduction to PROFIBUS and PROFINET

Andy Verwer

Technical Officer for PROFIBUS UK
Verwer Training & Consultancy Ltd



PROFIBUS Characteristics



- ⇒ PROFIBUS is a bi-directional digital communication network for field devices.
 - ✓ Multi-drop network, many devices on one cable
 - ✓ communicates not only process values but also diagnostics, device parameters, calibration and performance data etc.
- ⇒ The data can represent analogue values and/or discrete (on/off) values.
 - ✓ But all data is digitally encoded and transmitted.
- ⇒ PROFIBUS is extensively specified.
 - ✓ All PROFIBUS devices are interoperable.
 - Multi vendor systems are easily constructed.
 - Best of breed devices can be selected.
 - Common set of tools for maintenance and engineering.

- ⇒ PROFIBUS is the world's leading fieldbus system:
 - ✓ Over 40 million devices installed world wide.
 - ✓ Approximately 3,000 products from over 300 different suppliers.
- ⇒ PROFIBUS has been around for almost 25 years.
 - ✓ Over that period the specification has been extended and refined (in a backwardly compatible way) so that new application areas have been opened up.
 - High speed synchronised servo applications (Robotics and NC machines).
 - Functional safety systems (process safety, interlocking).
 - Operation in hazardous environments (intrinsic safety).
 - High availability systems (reliability and redundancy).
 - Etc.

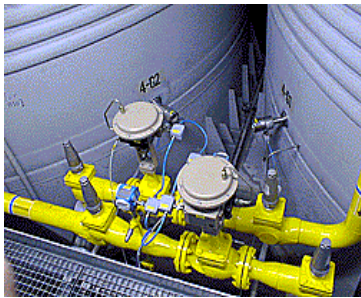
⇒ PROFIBUS DP - Decentralised Periphery

- ✓ Low cost, simple, high speed field-level communications.
- ✓ Generally designed for internal use (cabinet mounting).



⇒ PROFIBUS PA - Process Automation

- ✓ Developed specifically for the process industry to replace 4-20mA transmission.
- ✓ Two-wire connection carrying both power and data.
- ✓ Generally designed for external use (field mounting).



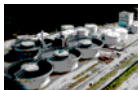
⇒ PROFINET

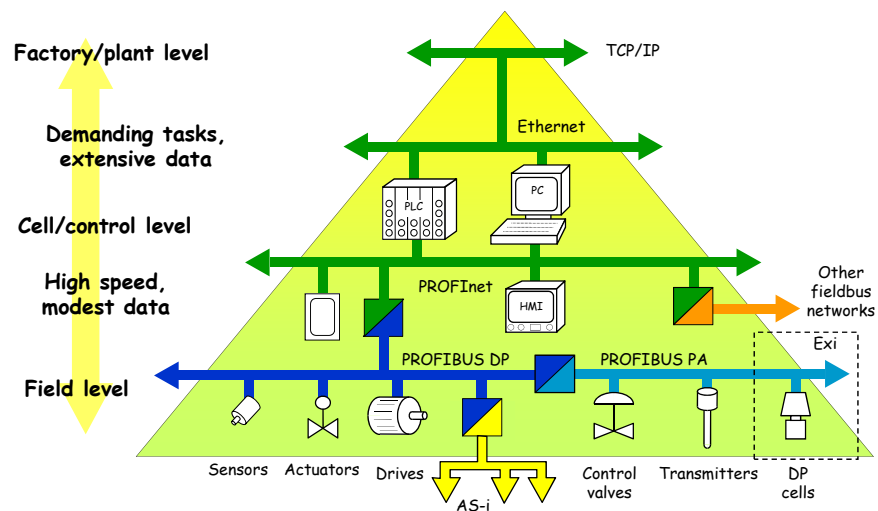
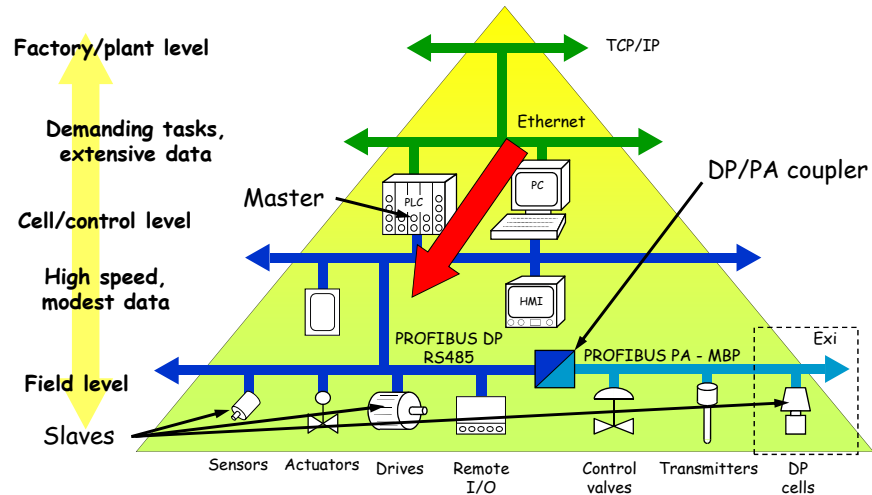
- ✓ Standardised Industrial Ethernet
- ✓ High speed highly deterministic and capable networking.
- ✓ Generally designed for internal use (just like DP)

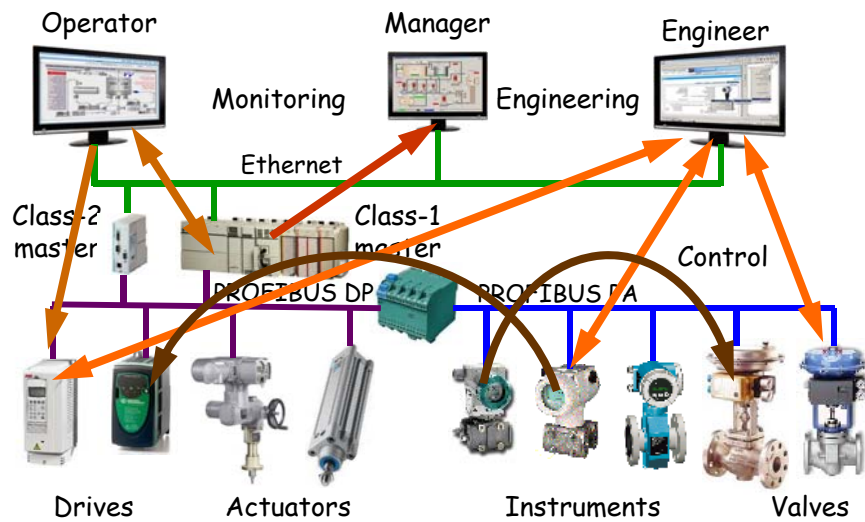


- ⇒ PROFIBUS DP uses 2-core RS485 screened twisted pair wiring.
 - ✓ 9-pin sub-D or M12 connectors extensively used.
- ⇒ DP can also use plastic or glass fibre optic cabling.
 - ✓ BFOC (ST) connectors widely used
- ⇒ PROFIBUS PA uses "Manchester Bus Powered" (MBP) cabling over 2 cores.
 - ✓ Glanded screw or M12 connection normally used
- ⇒ PROFINET uses 4-core Ethernet screened twisted pair cabling.
 - ✓ RJ45 or M12 connectors universally used.



 Car manufacture	 Pipelines	 Bottling Plants	⇒ Manufacturing Automation - Car manufacturing - Bottling systems - Storage systems - Robotics ⇒ Building Automation - Traffic automation - Heating, air-conditioning ⇒ Process Automation - Water and sewage treatment - Chemical and petrochemical plant - Paper and textile industries ⇒ Power industry - Power plants - Switchgear ⇒ Functional safety systems ⇒ High reliability systems ⇒ Redundancy.	 Water Treatment and sewage	 Building Automation	 Gas & Oil	 Robotics	 Brewing industry	 Paper and Printing Industry	 Food Industry	 Polymer production and Storage
---	---	---	--	---	--	--	---	--	---	---	--





⇒ Control

- ✓ Requires regular cyclic update of process values.
- ✓ Deterministic timing (not necessarily fast).
- ✓ The most important - cannot be interrupted!

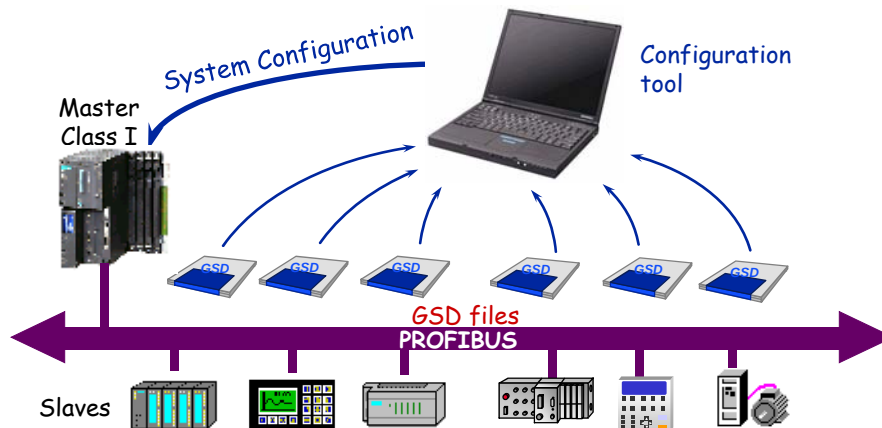
⇒ Monitoring

- ✓ Not necessarily regularly updated (cyclic or acyclic).
- ✓ Interruptions can be tolerated.

⇒ Engineering

- ✓ Active only when required (acyclic).
- ✓ Non-deterministic communication OK.
- ✓ But must not interrupt the above!

- ⇒ The Class-1 master is responsible for cyclic or regular data exchange. This provides all process values for control and monitoring.
- ⇒ The Class-1 master must be configured to communicate with the slaves.
- ⇒ Configuration is normally carried out using a proprietary software tool supplied for the PROFIBUS master station.
- ⇒ All PROFIBUS equipment suppliers provide standard General Station Description or *GSD files*.
- ⇒ GSD files can be read by the configuration tool to provide detailed information on the devices being used on the bus.
- ⇒ GSD files make integration of devices from different vendors in a bus system simple.



Every PROFIBUS device is given a unique *identification number* which identifies the type of device. The GSD file is specific to the ID number.

- ⇒ Class-2 masters can be used to access management and engineering information from devices (acyclic data).
- ⇒ This is particularly important in PA systems where extensive device information can be accessed in a standardised way.
- ⇒ Class-2 masters do not need configuration, however, they do need information on the devices that are to be accessed.
- ⇒ This information can be provided in two different ways:
 - ✓ Electronic Device Description (EDD) files.
 - ✓ Device Type Manager (DTM) software.

- ⇒ The PROFIBUS PA Profile provides a mandatory specification for all PA devices.
- ⇒ It specifies the organisation of the cyclic data so that the process value for every device is standardised.
- ⇒ The Process Value is always communicated in a standardised format:
 - ✓ Standard floating point format for analogue values.
 - ✓ Standard digital format for discrete values.
 - ✓ Plus a standardised status value which encodes the quality of the measurement (good, bad, usable etc.)
- ⇒ The profile also specifies the organisation of the acyclic data so that standard tools can be used to access this data.

- ⇒ PROFINET is an open Industrial Ethernet standard developed by the PROFIBUS Organisation.
- ⇒ PROFINET
 - ✓ is completely standard Ethernet (IEEE802.3).
 - ✓ operates at 100Mbit/s over twisted-pair copper or fibre-optic cables,
 - ✓ makes use of TCP/IP and other IT standards for non-real-time communications (i.e. configuration and parameters).
 - ✓ Provides a "real-time" channel for time-critical communications (i.e. process data)
- ⇒ **PROFINET is NOT PROFIBUS over Ethernet!**
- ⇒ However, PROFINET is well thought out to incorporate the requirements of modern systems based on the lessons learned from PROFIBUS.

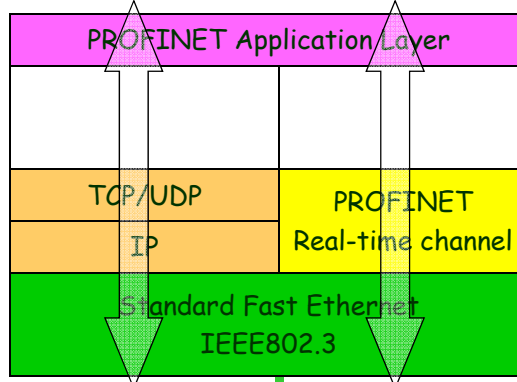
- ⇒ PROFINET IO provides remote IO using Ethernet connection and the PROFINET communication protocol.
- ⇒ PROFINET IO uses Real-Time and Non Real-Time communications.
- ⇒ PROFINET makes use of relevant TCP/IP protocols for setup, configuration and maintenance functions:
 - ✓ DHCP - Dynamic Host Configuration Protocol,
 - ✓ DNS - Domain Name Service,
 - ✓ SNMP - Simple Network Management Protocol,
 - ✓ ARP - Address Resolution Protocol,
 - ✓ HTTP - Web page access, and lots more!

PROFINet stack
(OSI model):

- 7 - Application Layer
- 6 - Presentation Layer
- 5 - Session Layer
- 4 - Transport Layer
- 3 - Network Layer
- 2 - Data Link Layer
- 1 - Physical layer

Non time-critical
communication

Real-time
communication



Network

⇒ The TCP/IP channel is used for non-time critical tasks.

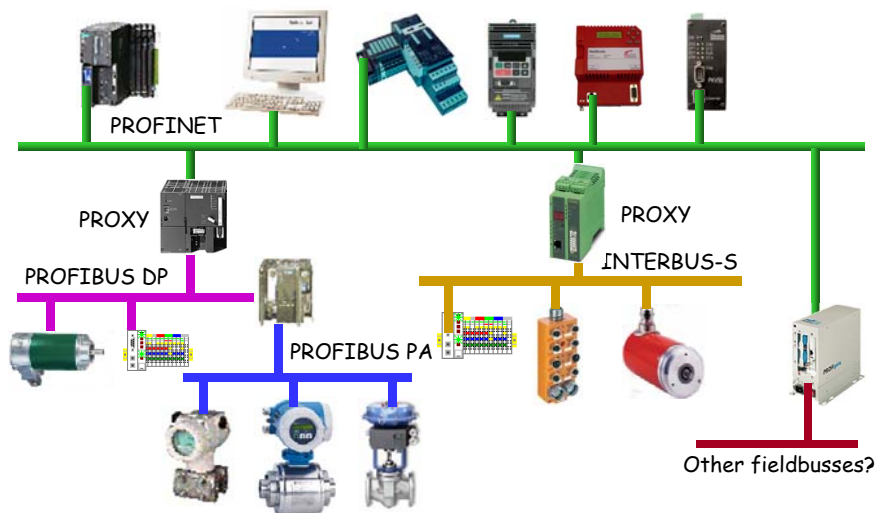
- ✓ Downloading of configuration, parameters,
- ✓ Diagnostics,
- ✓ Device management information, etc.

⇒ The Real-Time channel is used for time-critical data:

- ✓ Cyclic process data,
- ✓ Alarms and critical messages,
- ✓ Communication monitoring.

- ⇒ Many features that have been developed for PROFIBUS devices have been directly incorporated into PROFINET:
- ✓ Standardised module and channel-related diagnostics,
 - ✓ Alarm and status information,
 - ✓ Identification and Maintenance (I&M) functions,
 - ✓ Time stamping,
 - ✓ Highly deterministic process cycle timing (Isochronous),
 - ✓ Device description file (GSD) with configuration data for the device and available modules - PROFINET uses XML.

- ⇒ PROFIBUS devices are widely used in many different application areas.
- ⇒ This investment is protected with PROFINET for both manufacturers and end-users.
- ⇒ PROFINET provides a transparent interface with PROFIBUS via a standardised gateway or "Proxy".
- ⇒ The Proxy is a PROFINET IO device on one side and a PROFIBUS master on the other.
- ⇒ PROFIBUS Configuration is integrated into the PROFINET configurator and is downloaded via Ethernet.



⇒ PROFIBUS runs at up to 12Mbit/s, whereas PROFINET runs at 100Mbit/s. Therefore PROFINET is about 8 times faster than PROFIBUS.

NOT TRUE!

✓ PROFINET gives similar performance to PROFIBUS.

⇒ PROFINET will replace PROFIBUS in the next five years.

NOT TRUE!

✓ PROFINET will replace some PROFIBUS DP devices, but PROFIBUS PA will continue.

✓ Both DP and PA will be supported for many years to come.

⇒ PROFINET is not standard Ethernet

NOT TRUE!

- ✓ PROFINET always uses completely standard Ethernet. It just doesn't always use TCP/IP protocols - only used for non time critical communications.

⇒ PROFINET systems can be maintained by our IT people.

TRUE, BUT NOT A GOOD IDEA!

- ✓ PROFINET is much more than just an IT network. Real time determinism, reliability, device diagnostics and security are all much more important than on IT systems

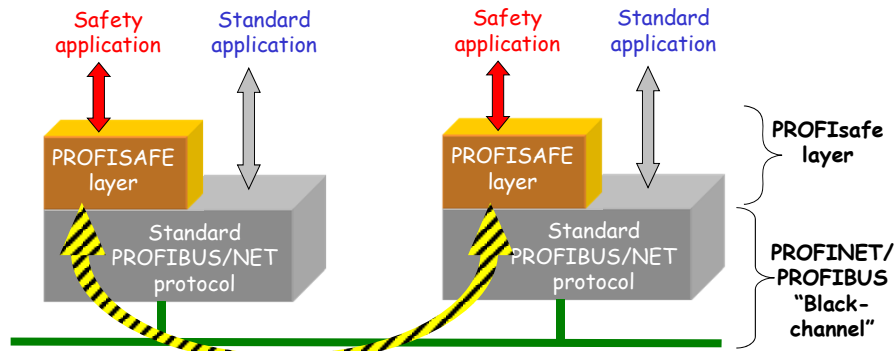
⇒ PROFIBUS and PROFINET also offer safety oriented communication that allows for integrating safety oriented components.

⇒ A second 'safety fieldbus' is not necessary.

⇒ ProfiSafe V2 can be used in systems that are certified according to IEC61158 to Safety Integrity Level 3 (SIL3).

⇒ ProfiSafe is used in a wide range of applications:

- ✓ Factory Automation, Robotics, Materials storage.
- ✓ Process Automation, Gas & Oil



- PROFISafe V2 provides functional safety for both PROFIBUS and PROFINET systems.
- Suitable for use in SIL3 applications.

- ⇒ Totally standardised and interoperable.
 - ✓ Choose best of breed devices.
 - ✓ Ensures compatibility.
 - ✓ Protects your investment.
- ⇒ Flexible connection technologies.
 - ✓ Systems for internal or external use
 - ✓ Saves wiring - but things often go wrong!
 - ✓ Training in design and installation is essential.
- ⇒ Levels of access.
 - ✓ Control & monitoring.
 - ✓ Engineering and management information.

- ⇒ A wide range of PROFIBUS and PROFINET training is available including:
- ⇒ Certified Installer Courses
 - ✓ basic courses for anyone involved in PROFIBUS or PROFINET technology
- ⇒ Commissioning & Maintenance training
 - ✓ Practical troubleshooting for PROFIBUS & PROFINET.
- ⇒ Certified PROFIBUS or PROFINET Engineer
 - ✓ In depth training for experts.
- ⇒ Certified System Design Course
 - ✓ Covers essential and optimal design of all networked control and automation systems

- ⇒ Certified PROFIBUS and PROFINET training is available from the UK's accredited training centres:
- ✓ PROFIBUS International Competence Centre
- ✓ Manchester Metropolitan University.
 - in Manchester, or a location of your choice.
 - (www.sci-eng.mmu.ac.uk/ascent/).
- ✓ PROFIBUS International Training Centre
- ✓ Verwer Training & Consultancy Ltd
 - On-site training.
 - (www.VerwerTraining.com)