

Comparative Survey Between Industrial Communication Protocols Applied in Hazardous Areas

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EXTENDED ABSTRACT

With the advancement of technology and the integration of industrial systems, communication between devices has been playing an increasingly fundamental role in the efficiency, monitoring and control of processes in manufacturing environments. Consequently, choosing a network protocol is a crucial decision since it requires a careful analysis of each one. The analysis must take into account the nature and features of the industry, the number and type of equipment, the distance between them and the type of industrial environment.

However, there are significant challenges in these applications, such as the presence of explosive atmospheres and flammable materials. These areas, known as Hazardous Areas, are categorized based on the duration that flammable substances, vapors, gases, or dust are present, as well as the potential for these substances to escape or leak, which raises concerns about the safety and operation of these environments.

In order to mitigate these risks, industrial plants must be managed to minimize the likelihood of accidents. In this context, understanding the relationship between network protocols and the safety requirements of hazardous areas is crucial for ensuring the safe operation of industrial systems.

For improved integration between devices and to meet the safety measures required in Hazardous Areas, several industrial network protocols can be employed. In this paper, three protocols will be highlighted: PROFIBUS PA, Fieldbus Foundation, and Ethernet-APL.

This paper aims to present a theoretical study of those protocols applied to Hazardous Areas and to perform a comparative analysis, highlighting their main characteristics, applications, functionalities, and limitations within those environments.

PROFIBUS PA is a protocol profile within the PROFIBUS family, designed to meet the specific demands of automation and process control while offering intrinsically safe transmission for use in hazardous areas [6, 7].

Its protocol architecture is based on the Open Systems Interconnection – OSI reference model as defined by the

international standard ISO 7498. OSI model comprises seven layers; however, PROFIBUS PA utilizes only three levels: the physical layer (layer 1), the data link layer (layer 2), and the application layer (layer 7).

Fieldbus Foundation is a bidirectional multipoint communication protocol that enables real-time control between instruments and systems. This protocol stands out for its interoperability among field devices from different manufacturers. It was developed based on the OSI model, although it does not implement all of its layers. Instead, it is structured into physical and communication layers, which handle digital communication between devices.

Ethernet-APL is a physical layer network protocol based on IEEE and IEC standards that employs Ethernet technology for communication between devices and the controller network. It was designed to operate in hazardous areas and was developed to meet all the requirements for using Ethernet in industrial environments [9, 10].

TABLE I.
COMPARISON BETWEEN THE PROTOCOLS [2, 3, 9, 10].

	PROFIBUS PA	Fieldbus Foundation – HI	Fieldbus Foundation – HSE	Ethernet-APL
Communication rate	31.25kbps	31.25kbps	100Mbps	10Mbps
Total network distance	100m in intrinsically safe areas	1900 m in intrinsically safe areas.	100m	Trunk: 1000m
Application in hazardous areas	Possible	Possible	Possible	Drop-offs: 200m
Maximum number of devices	32 devices	12 devices	Up to 254 per network created	Possible
Power supply range of devices	Intrinsically safe areas: 13.5V	Intrinsically safe areas: 13.5V	Intrinsically safe areas: 13.5V	50 devices
Type of cable used	Non- intrinsically safe areas: 24V	Non- intrinsically safe areas: 24V	Non- intrinsically safe areas: 24V	9 >= 15 V, but the standard allows <= 17.5 V