

HART Protocol

H A R T P R O T O C O L

a Practical Digital Communication Tool for Analog Installations



A brief overview

Communications protocols are defined as computing standards that control connections and data transmissions. Technologies range from copper wires to infrared light to digital streams. What do protocols have in common with online interactive learning experiences, innovative sales opportunities, online shopping and iTunes? A great deal; communications protocols allow the internet to be functional and expandable in its scope of functions and services.

As with any good tool, the most well thought-out protocol is impractical without information delivery, correct implementation, and the means to retrieve discarded data. Three network protocol design principles have been developed to maximize communication protocol usefulness and consistency: effectiveness, reliability, and resiliency.



Software architecture

Communications protocol **effectiveness** is achieved through layering; sectioning directives into smaller related functions or sub-tasks that send and receive information via pathways to layers above and below. "Software architecture" arose from the need for protocol layering consistency, also known as reference models.

Some common reference models include the Simple Mail Transfer Protocol (SMTP) used as an email protocol, the TCP/IP protocol suite (Transmission Control Protocol and Internet Protocol) used for internet communications and for many commercial networks and the Open Systems Interconnection (OSI) model, developed by the American National Standards Institute (ANSI) in 1977.

Since it's assumed that data transmission errors may occur, transmission **reliability** involves both the quantity of lost or discarded data as well as the means to detect and correct errors. This process uses data summary packets, which are included along with larger transmissions to detect omissions, corruptions, and degradation of data, and then resend this information. High overall transmission performance is achieved primarily through fiber network connections.

Resiliency concerns network failure, where communication links degrade significantly or crash altogether. Links are tested often and sometimes rerouted when failure is detected.




Digital protocols in industry

Industrial automation protocols present their own challenges. 4-20 mA analog current loop wiring systems have been used for industrial process control instruments since the 1950s and are still commonplace today. Industry found its implementation to be practical and cost-efficient, as its noise rejection ability allows cables to run over relatively long lengths. Analog current loops use conductors in pairs to monitor or operate automation devices remotely.

Fieldbus all-digital industrial network systems were widely implemented in the late 1990s for process control. Fieldbus technology is an open system and designs are not necessarily interchangeable. Fieldbus technology's advantages over 4-20mA analog systems, such as transmission speed, and use of both multiple analog and digital points at times was offset by its complexity, as it required additional user training, more costly system components, and lacked compatibility among fieldbus vendors.






Addressing the analog/ digital gap


HART (Highway Addressable Remote Transducer) Communications Protocol grew out of fieldbus as a practical way to bridge the analog/digital gap. HART communicates by sharing wires used by legacy 4-20 mA analog installed systems. As a result, HART Protocol is used widely, as many 4-20 mA systems continue to function on a global scale.

HART was developed in the mid-1980s as a proprietary protocol, but in 1986 was released as an open design. There are two main operational modes of HART instruments:

- analog/digital, the 4-20 mA loop current holds overlaid signals and allows for only one instrument for each cable signal pair.
- multidrop, which uses only digital signals, as the analog loop current is fixed at 4 mA. Multidrop mode allows for up to 15 instruments per signal cable.



The core of HART's worldwide acceptance is based upon its practicality; simultaneous analog and digital compatibility that makes use of existing wired systems. Additional advantages factor in as well, such as HART-smart devices that assist with operational efficiency, and system problem-detection capability. HART's advanced diagnostics help to increase safety integrity levels (SIL). HART provides cost-effective communication technology for many process automation control systems, as many device types are available and its usage training requirements are minimal.



HART 7.0 Specification was released in September 2007; users must upgrade to HART 7.0 to use HART-enabled devices. Retrofit adapters are available for existing 4-20mA HART devices. HART 7.0 Specification enhances communication through new key features including:

- expansion of Manufacturer ID Codes from 8-bits to 16-bits.
- Time Stamping of process variable values at the Field Device.
- New Common Practice Commands support set-up and operation of I/O Systems, expedite Device Configuration upload, and setting the time of day, among others.
- burst mode communication allowing for bursting of multiple HART messages
- improved time interval/frequency specificity.

Practical advantages of HART are many; among them are savings achieved from reductions in new hardwiring costs and opportunities for a cost-effective asset management plan. HART Protocol provides convenient setup, calibration, and diagnostic options within existing 4-20mA installed systems. It is well-suited to process industry needs due to its versatility in linking several generations of communication technologies.

HART 7 Specification



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For much more information visit the HART Communication Foundation at www.hartcomm2.org/.

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