Introduction

As the world entered the computer age, many saw the potential of using them to easily control machines and automation. Methods of programming the computers were one obstacle, but the challenge of physically connecting the computer to the targeted device proved difficult. This led to many competing standards, each with their own benefits and shortfalls. This paper focuses on one such standard for inter-device communication commonly used in computer serial ports, RS-232. The original technology is nearly 40 years old, but there have been many advances made available through the modern prevalence of computers and advances in wired and wireless technologies.

Commercial Applications

Being as old and ubiquitous as it has become, RS-232 has been used in a myriad of commercial applications. The original intent of RS-232 was to facilitate the connection of a terminal to a modem for inter-network data communication. At this point, this technology was rarely used outside of the academic realm, but in the following years industry largely picked it up for use with computers, printers, and test equipment. With the rise of personal computers, RS-232 gained even more popularity, yielding even more commercial uses. When Microsoft decided to apply Plug and Play capabilities to COM port data communication, a port which uses a nine pin serial RS-232 connection, the standard gained significant momentum, opening the doors for a flood of new consumer products utilizing it [1]. However, with the heavy adoption of USB in the past few years, RS-232 use is fading quickly. It is still frequently used by hobbyists, by industry with legacy equipment, and in a few new applications of it. The Digi XStream™ RS-232/485 RF Modem, for example, uses wireless RS-232 technology which gives it many advantages over the traditional wired method such as convenience and increased range [2].

Underlying Technology

The technology beneath RS-232 primarily lies in the field of electromagnetics,

chiefly in transmission line theory. One of the primary concerns in proper operation is maintaining reliable data transmission through the connectors and across the cable. The original Electronic Industries Alliance specification was designed for a baud rate of around 20 kbps and listed a maximum cable length of 50 feet or a length equivalent to a total cable capacitance of 2500 pF [3]. Texas Instruments later discovered through a series of experiments that the cable length can be reliably increased if the baud rate through the line was decreased [4]. For instance, at 2.4 kbps, the cable can be nearly 3000 feet long and still handle data well. One way around this, is the use of new proprietary wireless RS-232 systems. These allow greatly increased range at low throughput and relatively low power consumption. A 2.4 GHz wireless RS-232 module can transmit up to 20 miles with clear line of sight, and up to one fourth of a mile in noisy industrial applications [5].

RS-232 specifies not only the physical specifications of the transmission line, but also the physical specifications of the pin-out and the protocol to be used for handshake, transmission, and error checking. The connector can come in two primary forms: the 25-pin D-type or the 9-pin DB9S, the former allowing greater complexity with a secondary communication channel and basic clocking [6]. The second communication channel can be used to query a modem while it is busy communication, but this feature is rarely used so the DB9S form is much more prevalent than its 25-pin counterpart. At low level, the data transmission is simple binary with the idle line being a ‘mark’, or 1. The onset of a ‘space’, or 0, denotes the beginning of a data word. The standard operates in either the 5 V or 12 V range and higher output voltage tends to yield more reliable transmissions [4]. One oddity of RS-232 is that when the channel is on, in a mark state, it is operating at negative voltage, while the off state is positive [7]. The fact that RS-232 still continues to maintain a userbase despite far newer competing technology is a testament to its quality and simplicity.

References

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