IASET: Journal of Electronics and
Communication Engineering (IASET: JECE)
ISSN(P): Applied; ISSN(E): Applied
Vol. 1, Issue 1, Jan - Jun 2016, 61-66

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

AN OVERVIEW ON IEEE 1451.7 SMART SENSOR STANDARD

M. B. LIMKAR[1] & VAISHALI BAGADE[2]

[1]Assistant Professor, Department of Electronics, Terana College Engineering, Nerul, Navi Mumbai, Maharashtra, India

[2]PG Student, Department of Electronics, Terana College Engineering, Nerul, Navi Mumbai, Maharashtra, India

ABSTRACT

This paper is focused on the standard which has been designed to facilitate communication between radio frequency identification (RFID) system & smart RFID tags with integral transducer in data format. As this standard is one of the part of IEEE 1451 standard so it has developed new set of Transducer Electronic Data Sheet (TEDS), & a command set for smart RFID tags.

KEYWORDS: Network Capable Application Processor (NCAP), Radio Frequency Identification Tag (RFID), Transducer Electronic Data Sheet (TEDS), Transducer Interface Module (TIM)

INTRODUCTION

The proliferation of sensor and instrument busses has introduced new ways to interface and communicate with transducers. The widespread availability of microelectronics, computers, and networks provide a good opportunity to network large arrays of transducers to measure, characterize, model, and monitor many large structures, machinery, and mechanical systems. Nevertheless, these new ways have been useful only to segments of the transducer community. In addition, the increased use of large number of transducers has also created a need for keeping track of the transducers and their associated manufacturer data. The availability of economical off-the-shelf memory chips has help to implement built-in electronic data sheets in small transducers. This has significant contribution in building smart transducers with self-identification capability through the use of electronic data sheets. The transducer community also recognized the need for a common way of connecting these smart transducers and thus began the work on the IEEE 1451 Smart Transducer Interface Standard. When these standardized interfaces are in place, transducer producers can design their devices to a single set of specification for transducers and networks connectivity. This will hopefully alleviate the uncertainty and allow for the rapid development of smart sensors and actuators for use with the networks [1].]. In the long run, it will most likely lead to a lower development cost for the smart sensor producers and a proliferation of smart devices in the market. Thus, the emergence of smart devices and control networks will make available a wide variety of products for users to choose from based on their merits. If this trend continue, it will eventually lower the total system cost and broaden the application domain for distributed control applications for the users [2].

The IEEE 1451 provides a set of common interfaces for connecting transducers (sensors and actuators) to existing instrumentation and control networks and lays a path for the sensor community to design systems for future growth. It is intended to provide an easy upgrade path for connectivity of products from any manufacturer of transducers or networks. The IEEE 1451 Standard can be basically viewed as a software and hardware oriented interfaces. The software portion is an information model defining the behaviors of a smart transducer using object model approach and the path for network connectivity. This work has been completed and become the IEEE 1451.1-1999 Standard [1]. The sensor usage crosses various industries; therefore the hardware portion of the IEEE 1451 Standard is divided into

1451.2, 1451.3, and 1451.4 to meet their specific needs. The first one, focused on an interface for transducers with lower signal bandwidth requirements, has been completed and designated as the IEEE 1451.2-1977 Standard [2].

This standard is seventh member of IEEE 1451 family which was sponsored by the TC9 sensor technology (IM/ST) committee of the IEEE instrumentation & Measurement Society and approved on 25 March 2010. Basically, in this Family of IEEE1451, transducer are connected to transducer interface module (TIM) and this TIM is connected to Network Capable Application Processor to grant network access to transducer data. The standard is developed to provide methods for interfacing transducers and RFID tags, and for reporting transducer data within the RFID infrastructure. It is designed in such manner, it reduce the cost and time required to integrate transducer and RFID systems.

TRANSDUCER AND RFID SYSTEM INTERFACE

The technique of employing RFID system in this standard has set a feature that allows smart transducer to communicate with the outside world. This standard consists of four essential design elements which approve to this standard. They are listed below

- Communication Protocol
- Command Structure
- Transducer Electronic Data Sheet
- Transducer data

The communications protocol provides the direct link between the outside world and the smart transducer.

This standard identifies a number of the ISO/IEC Air Interface specifications that are essential for supporting this standard & along with this it also support other air interface. The command structure is the language with which the actions of the smart transducer are controlled. The TEDS contains the capability and configuration information for each particular smart transducer. The transducer data constitute the results of sensor measurements.

Figure 1 provides an example of the minimum components required in a system interfaced with an IEEE 1451.7-compliant transducer. The elements common to all IEEE 1451.7-compliant systems are shaded.

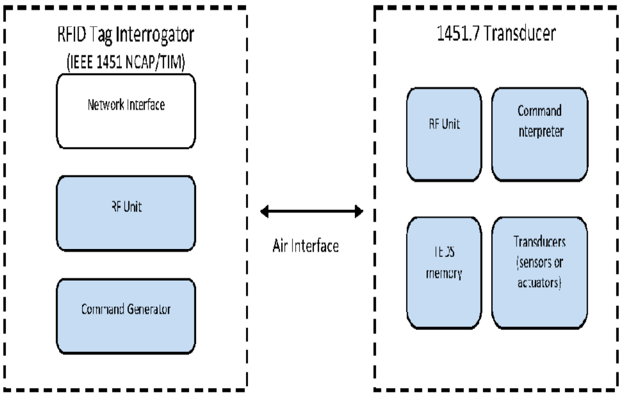

Figure 1: RFID System Interface with Smart Transducer

The input from RFID Tag interrogator or network interface is processed by the command generator and then transmitted to its RF Unit. Within the IEEE 1451.7 Transducer, the Command Interpreter processes radio signals sent to it from the RF Unit, into low-level control signals. These signals are required for the various functions of which the particular smart transducer is capable. The IEEE 1451.7-compliant Transducer retrieves data from the TEDS memory, and all data records transmitted by its RF Unit.

AIR INTERFACE APPLICABILITY [RFID AND REAL-TIME LOCATING SYSTEM (RTLS)]

The IEEE 1451.7 command structure supports the air interface communications protocols described in the following ISO/IEC standards; additional air interface protocols may be added by declaring compliance with this standard:

- ISO/IEC 18000-2:2009 [B9],3 Information Technology—Radio Frequency Identification for Item Management—Part 2: Parameters for Air Interface Communications below 135 kHz.
- ISO/IEC 18000-3:2009 [B10], Information Technology—Radio Frequency Identification for Item Management—Part 3: Parameters for Air Interface Communications at 13.56 MHz.
- ISO/IEC 18000-4:2008 [B11], Information Technology—Radio Frequency Identification for Item Management—Part 4: Parameters for Air Interface Communications at 2.45 GHz.
- ISO/IEC 18000-6:2006 [B12], Information Technology—Radio Frequency Identification for Item Management—Part 6: Parameters for Air Interface Communications at 860 MHz to 96 MHz.
- ISO/IEC 18000-7:2009 [B13], Information Technology—Radio Frequency Identification for Item Management—Part 7: Parameters for Active Air Interface Communications at 433 MHz.
- ISO/IEC 24730-2:2006 [B14], Information Technology—Real-Time Locating Systems (RTLS)—Part 2: 2.4 GHz Air Interface Protocol.
- ISO/IEC 24730-5:2000 [B15], Information Technology Automatic Identification and Data Capture Technique

SENSOR SECURITY STRUCTURES

This standard is designed in such manner that it consist of two level in hierarchy structure. The levels are:-

- The physical design of sensor is used to determine the type of sensor
- The measured or derived data from sensor is used to define the data type.

Basically, it specifies sensor type & scaling for RFID sensor data acquisition, files that control data acquisition and hold desired sensor data, and command for accessing data files. The extracted data available at each sensor consist of the following:

- Sensor identifier
- Sensor characteristics record
- Sample and configuration record
- Event administration record
- Event record

The standard provides the optional security in two forms Air Interface Security & Direct Sensor Security.

Air interface provides methods for the sensor to utilize the security built on RFID air interface which operates by the tags passing a security status code to the informing the sensor of the tag. The sensor then appropriately limits its command execution according to a security function code programmed by the user. If the sensor is deeply embedded within the tag electronics, then this method of sensor security is as secure as the air interface security.

The direct sensor security can be as simple as the reader authenticating itself to the sensor via a simple password. This standard provides a structure and a command set that can allow for "Two-Way Authentication," meaning that both Reader and Sensor can privately authenticate that the other has a secret key. Passwords may currently be 16, 32, 64, or 128 bits long. Keys may also be any of these lengths, and also they may be any number if a specific key length is specified as always associated with a particular encryption algorithm. An algorithm in this standard may also be left open with respect to length, and then the particular length specified in the TEDS.

COMMAND

The commands provide user-based instructions to the sensors, together with their associated responses. In order to implement the commands across the air interface then the structure of each command and response should not have additional overhead bits in terms of the preamble and trailer .The air interface command structure must be able to retrieve data concerning from multiple sensors. Often commands and responses have optional random number fields and security tokens attached and it may be of any length as allowed in the TEDS (currently 16, 32, 64, and 128 bits).

The commands support one of four means of addressing a sensor, as follows:

- Tag-level addressing such as port numbers, of which the sensor does not need to be aware.
- Using a subaddress number declared by the sensor.
- Using the 64-bit unique sensor identifier as a subaddress.
- Using the first three fields of the sensor characteristics TEDS, uniquely identifying the type of sensor, as a sub-address.

RFID COMMUNICATION

The commands and responses that are specified in this standard are designed to be encapsulated in an air interface command and response assigned to support this standard. Such air interface transport commands and responses shall be specified within the air interface protocol standard. The encapsulated IEEE 1451.7 command is passed to the sensor component for processing when the RFID tag receives the transport command. The sensor response only when the RFID component is encapsulated in the air interface transport response.

This basic procedure enables different air interface protocols to support sensors in a manner compatible with other RFID data-related processes, but leave the core IEEE 1451.7 commands, responses, and processes understandable for processing by the RFID interrogator, and other processes between the RFID tag and the application

INTEGRATION OF IEEE 1451.7 TRANSDUCER WITH OTHE 1451 DEVICES

The IEEE 1451 family of standards is designed to allow the interconnection of a variety of transducers (sensors and actuators) in a network, wired or wireless, with different physical configurations, such as point to point, distributed multidrop, and mixed mode. A transducer is connected to a transducer interface module (TIM), which is connected to a network capable application processor (NCAP) for network access. The TIM and NCAP can be implemented as an integrated unit illustrated in Figure 3

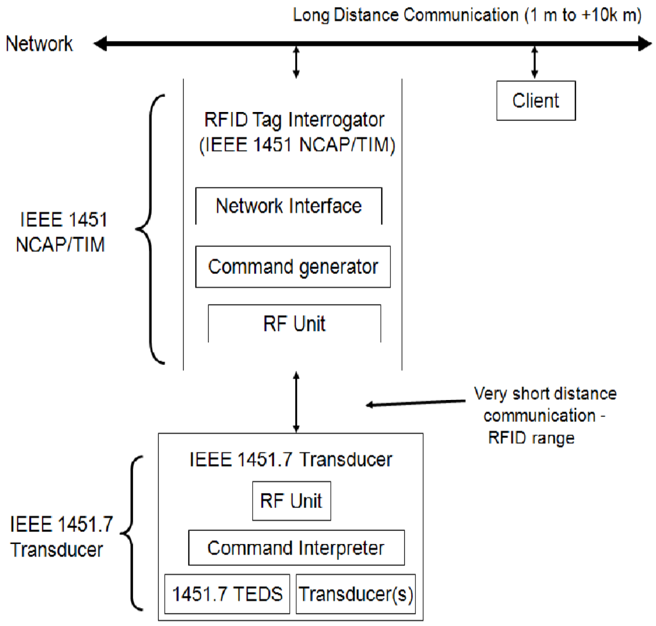

Figure 3: An Integrated Ieee 1451 Ncap/Tim Module with an IEEE 1451.7 Transducer in a Network

CONCLUSIONS

The paper is able to provide the brief idea about how transducer and RFID system interface works, RFID communication and how the IEEE 1451.7 standard is configured with other standard. The standard proves to reduce the cost & time required to integrate transducer & RFID system and also acts as means for the device & equipment interoperability

REFERENCES

1. Lee, Kang. "The Proposed Smart Transducer Interface Standard," Proceedings of the Instrumentation Measurement Conference (IMTC)' 98, St. Paul, MN, May 18-21, 1998, vol. 1, pp. 129-133A.

2. Travis, Bill. "Smart-Sensor Standard Will Ease Networking Woes," EDN, pp. 49-55, June 22, 1995, Cahners Publishing.

3. E. Y Sang and K. Lee, Understanding IEEE 1451 – Networked Smart transducer interface standard, April 2008.

4. "IEEE Std 1451.7-2010, Standard for a Smart Transducer Interface for Sensors and Actuators- Transducers to Radio Frequency Identification (RFID) Systems Communication Protocols and Transducer Electronic Data Sheet Formats," Institute of Electrical and Electronics Engineers, Inc., Piscataway, New Jersey 08855, 25 March, 2010.