ANALYSIS OF COMMUNICATION SYSTEMS AT DATA LINK LAYER

Radu GĂVRUŞ
"Transilvania" University of Brasov, Romania

Abstract. The present paper takes part from an enhanced scientific research developed by the author of this paper, which aims the hardware implementation of a reconfigurable system at data link level for communication on a structure of FPGA (Field Programmable Gate Array) type. The present paper approaches OSI-RM (Open System Intercommunication – Reference Model) System, which is an International Standard, especially the level number 2, OSI no.2. The paper also presents some aspects regarding the form of data frames, and a conceptual view of hardware architecture related to the data link layer (OSI – layer 2). Within the paper, the author also makes an analogy among the forms of different communication standards: 802.3, 802.4 and 802.5. The reason for doing this is that converging towards a unique standard or diminishing the number of protocols is very unlikely. The dynamic of the communication field and the market demand will determine in the near future the development of new standards, protocols, networks and services that are very different from the actual once.

Keywords: data link layer, OSI, FPGA, communication

1. Introduction

Now a days communication is vital for the entire world, nothing happens without communication. The cell radio communication and wireless computer networks of GSM (Global System Mobile), CDMA (Code Division Multiple Access) type are world wide communication systems. All these communication systems are based on the reference model OSI-RM (Open System Interconnection-Reference Model) [1, 2, 3].

1.1. OSI-RM System

OSI-RM is an International Standard ISO that defines a set of rules world wide valid for designing the communication protocols, with a view to facilitating the interconnection of the hardware and software devices, no matter their producer [1, 2]. The structure of this model is highlighted in figure 1. As this figure presents, this model allows the transfer of data flow among the clients from the network, which is hierarchically organized on seven layers. The first four layers care specific for communication equipments having specialized functions implemented on a hardware platform. The next three layers refer to any software network application existing on different servers, computers or specialized communication equipment. As the present paper is focused on the second layer of OSI System, the data link layer is next briefly presented.

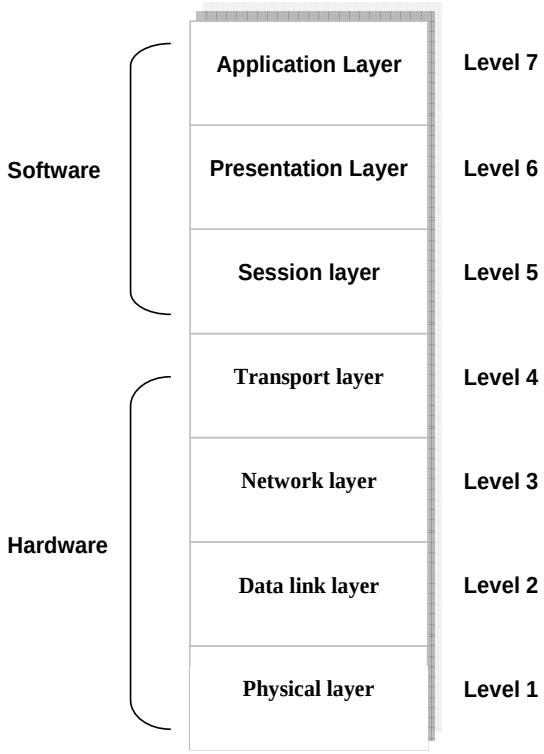

Figure 1. Layer Structure of OSI System

1.2. Data Link Layer

Within this part of this paper the second level of OSI, which is data layer link system is briefly explained and also some protocols of data link layer are presented.

The data layer link defines the ways of accessing the data transmission environment through more equipment and establishes the way of transferring the data between the superior layers and the physical model. The physical model has the role as transmitting a bits flow, but this is made without taking into consideration their meaning or structure. For this reason, the responsibility for marking and delimitating among different frames is assigned to data layer link, which is also responsible for transmitting data frames without errors that have not been detected. Because many times there is the possibility of overloading a slow receiver with data coming from a rapid broadcasting, the data layer link must implement control devices for data flow.

Data transmission is made possible through some protocols existing at data layer link, which establish the data frames and control the access to the network. The most used protocols within data networks are presented in figure 2.

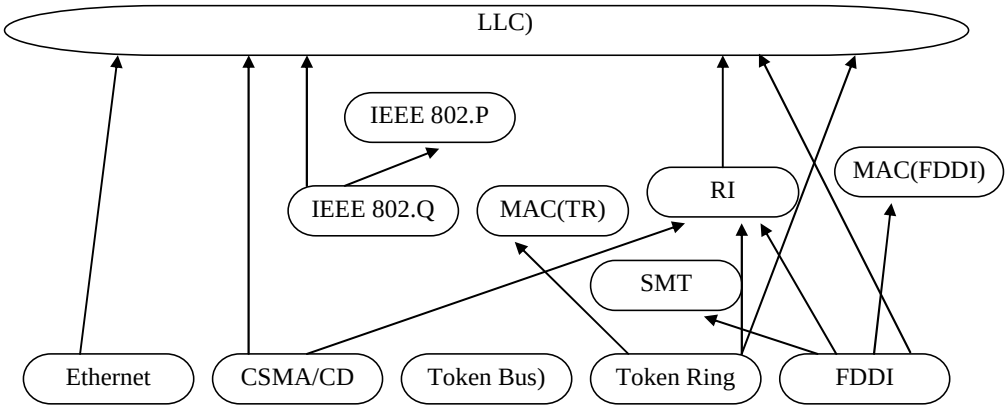

Figure 2. Protocols at Data Layer Link for LAN Networks

The data layer link has been divided by the IEEE Standardization Committee into two sub-layers: MAC – Media Access Control and LLC (Logical Link Control).

▪ Ethernet Protocol. Ethernet is also known as ANSI/IEEE 802.3 1933-00 [1-6] and it is the most used data communication protocol, which was developed by companies such as DEC, Intel and Xerox. The technology of the network is of bus type and uses as multiple access method protocols of CSMA/CD (Carrier Sense Multiple Access with Collision Detection) type. The structure of Ethernet frame is presented in figures 3, 4 and 5.

Destination	Source	Length	Data+Pad	FCS
6 bytes	6 bytes	2 bytes	46-1500 bytes	4 bytes

Figure 3. Ethernet Frame Form

I/G	U/L	Address Bits

Figure 4. Destination Address Structure

0	U/L	Address Bits

Figure 5. Source Address Structure

In figure 4 I/G is individual addressing (0) or group addressing (1) and U/L is local address (1) or global address (0).

In figure 5, in source address, the first bit is always 0.

The field length specifies the data length from the data field. The field can have an arbitrary length of 46 till 1500 bytes, but the protocol also allows a data field of 0 lengths. For distinguish between wrong frames and correct frames, Ethernet establishes the minimum length of 64 bytes. The frames having a smaller length than 64 bytes are completed till the minimum length using the completing field (pad).

FCS (Frame Check Sequence) field refers to control sum with standard cyclical redundancy.

▪ Token Bus Protocol. Token Bus is also known as IEEE 802.4 and describes a LAN (Local Area Network) with thoroughfare token [1, 2, 3, 5]. From physical point of view, this protocol is in fact a linear cable of shaft shape, to which there are added more stations. From logical point of view, the stations are organized in a ring shape, every station knowing the addresses of the neighbour stations. Data transmission is made through a special frame named token, which pass through the circular ring and only the station that holds the token has the right to transmit frames. The structure of Token Bus protocol is presented in figure 6.

Preamble	Starting Delimiter	Frame Control	Destination Address	Source Address	Data	CRC	Ending Delimiter
1 byte	1	2 or 6	2 or 6	2 or 6	0-8182	4	1

Figure 6. Frame Form of Token Bus Protocol

▪ Token Ring Protocol. This protocol is also known as IEEE 802.5 and it describes a LAN of ring token [1-3,5]. It is used in a physical network with point-to-point links having a ring shape. The token goes along the ring any time the stations are inactive. When a station wants to transmit a frame, it must overtake the token and eliminate it from the ring before transmission. The token can stay within a station maximum 10msec. The structure of Token Ring Protocol is shown in figures 7 and 8.

SD	AC	ED
1	1	1

Figure 7. Token Form

SD	AC	FC	Destination Address	Source Address	Data	CRC	ED	FS
1	1	1	2 or 6	2 or 6	unlimited	4	1	1

Figure 8. Token Ring Frame Form

The meaning of the fields is: SD – Starting Delimiter, ED – Ending Delimiter, they mark the beginning and end of the frame, FC - Frame Control, FS – Frame Status.

▪ FDDI (Fiber Distributed Data Interface) Protocol. This protocol is an interface of data distributed on optic fibre [1, 2, 3, 5]. It is also a high speed LAN of token ring type on optic fibre. It works at transfer speed of 100Mbs on distanced of 200km having more than 100 stations. FDDI uses multicode fibre and a led as lighting source for reducing the costs taking into consideration the home applications (connecting personal computers). The form of frames of FDDI type contains fields that are alike with the fileds of Token Ring Protocol and it is highlighted in figure 9.

Preamble	SD	FC	Destination Address	Source Address	Data	CRC	ED	FS
>8	1	1	2 or 6	2 or 6	unlimited	4	1	1

Figure 9. Frame Form for FDDI Protocol

▪ HDLC Protocol. This is a high level control protocol; bit oriented [1, 2, 3]. This protocol is among the oldest protocols and is derived from SDLC (Synchronous Data Link Control), standard-dized by ISO and ANSI. The two standardization organizations have given different names to this protocol over time: CCITT, LAP, LAB [5].

The form of frame for bit oriented protocols is mainly the same and a general structure is presented in figure 10 and HDLC structure is illustrated in figure 11.

01111110	Address	Control	Data	CRC	01111110
8 bits	8 bits	8 bits	>0	16 bits	8 bits

Figure 10. General Frame Form for Bit Oriented Protocols

01111110	Address	Control	Protocol	Information	CRC	01111110
1 byte	1	1	1 or 2	variable	2 or 4	1 byte

Figure 11. HDLC Protocol Structure

2. Reconfigurable Architectural Structure at Data Link

Having in mind the theoretical aspects previously presented, it is proposed a reconfigurable architectural structure at data link, which is illustrated in figure 12.

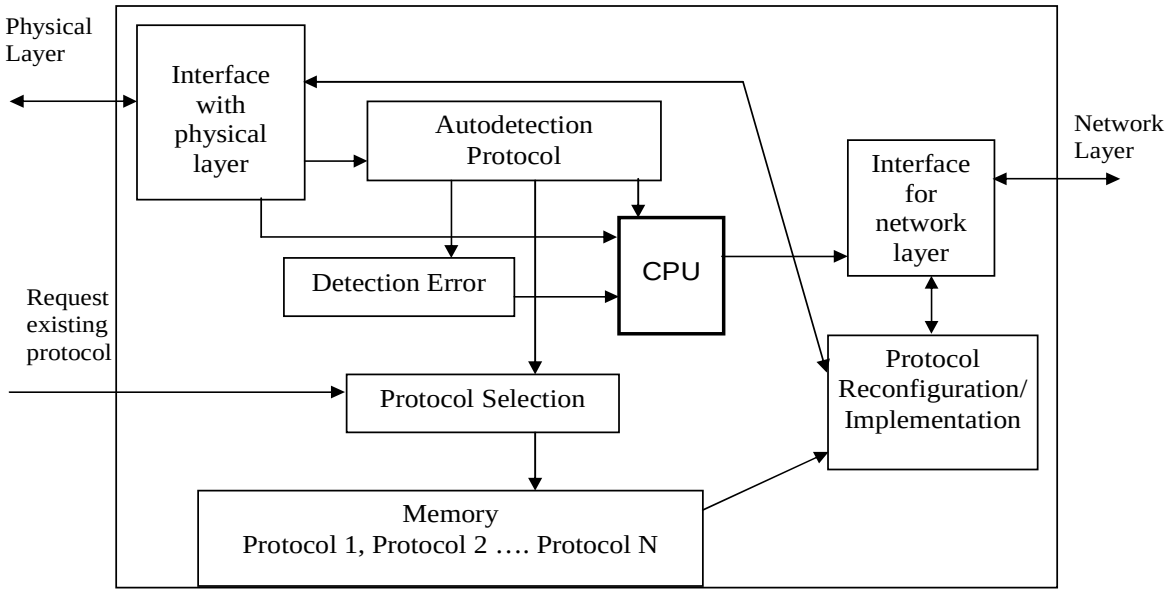

Figure 12. Generic Reconfigurable Architecture al Data Link Layer

The architecture presented in figure 12 involves the existence of a module of automated identification of the protocols that must be used, a reconfiguration module, a processor core, a memory that contains the reconfiguration information for every protocol, an error block for form identification and a comparison table with information specific for every protocol that helps for protocol identification [4].

Reprogramming the system can be made in a dynamic way or by request, being equipped in this way with selection enters.

In case that the frames are not in the identification table, the error identification block sends the frames for software identification. The algorithm implemented, that is a kind of microcode, can be adjusted any time in accordance with the requests of a new standard.

3. Conclusions

The use of a single communication channel involves special methods for its assignment in order to avoid collisions among different concurrent stations. Many schemes and algorithms were developed in this way. If the status of the channel can be identified the stations can avoid starting the transmission as long as the channel is busy. The detection of the bearer led to a great variety of protocols that can be used in CSMA/CD LANs are not properly functioning in case of wireless networks [1, 2, 3]. In this way, the architecture proposed within this paper has in mind the following aspects:

- architecture designing, evaluating, analysis and simulation of a reconfigurable chip for data link layer, capable of detecting the type of frames came from the physical layer in LAN networks;
- proposing a solution adaptable to wireless networks;
- covering as much existing standards as possible;
- an increased flexibility for implementing some new standards.

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