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Ad-Hoc Optical Network Protocol

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Abstract- Since the only switches used in the communicative networks so far have been the optical switches, the Ad-Hoc optical networks were introduced all of the elements of which are based on light and the reasons for using them are high speed, security, high intelligence, anti-noisability, ... The reason for introducing this network as Ad-hoc is its applicability and implementation in the critical situations and therefor giving it the ability to expand into a lasting network. In this article along with a brief introduction of Ad-Hoc network, a communicative network using OSI protocol and its different layers are presented. In this protocol the different ways of communication among the elements of the network are discussed.

Keywords- *Optical Network, Ad-Hoc, The Elements of Optical Network, Structure, Protocol* .

I. INTRODUCTION

An optical network is defined as a network in which the elements are based on light and light is used to transmit the information. If this network is used temporarily and in emergency situations for certain goals, it is called an Ad-Hoc optical network. This kind of network, uses optical and non-optical elements but the medium between all the elements is light and the reason for using it is that it is not jammed, disturbed, noised and doesn't need a frequency credit, a very high bandwidth,…[1] . In various articles optical networks are evaluated [2-4], but in all of them only the optical switches are used as navigators. In [2] reference the IP protocol in the optical networks is discussed. In this reference it is pointed out that the emerging optical networks provide the users with a very high bandwidth links and connection, so using protocols based on IP in optical networks has posed new challenges for the developers of the network.

For this reason in the present paper a suggestion for solving the problem for the developers is proposed. In reference [3] it is argued that in order to have a dynamic optical network, it is essential to consider the signaling protocols that can provide high speed connection and reduce the time of transferring date for the user. Therefor in this reference the signaling protocol of 3WHS (3 Way-Handshake) is introduced. In reference [4] the structure and layers of optical network and its management and controlling is discussed. Also considered in this reference is IP based protocol. As it is observed all the articles done are based on optical networks based on IP based protocol. This means that all the works done in an optical network were in order to transfer the information on the internet and the optical network is only a part of the communicative network.

In this article the optical network is discussed all of the elements of which is based on light and it has a distinct usage from the Internet. The elements of Ad-hoc optical network can be divided into three categories which are the sensors, medium and navigation nodes all of which has different classifications. The important issue is the reason why the Ad-Hoc network is used, that is the dissemination of light and laser in open spaces and not requiring a special, high security optical medium for sending information. What is discussed is a brief presentment of the elements, structure and topology of the Ad-Hoc optical network and then its communicative protocol is presented.

II. THE ELEMENTS AND THE STRUCTURE OF THE NETWORK

As it was mentioned and shown in figure 1, the elements of the Ad-Hoc optical network are divided into three categories each of which has their subdivisions. In the division of the sensors the goal is to observe the environment using the sensors in the network. This helps to identify any change in the environment and based on these observations the reactive decisions are made. In this category the lidars (light detecting and ranging) are of a very important role due to their ability to observe in different atmospheric conditions. These sensors also help transfer intelligent information [5]. The navigation nodes choose the best path to transfer data based on radiation, distortions, weakening … [6]. Medium is the mean of connection between the nodes that transfers the information given by the sensors to the central processing unit (CPU) and it should have high factor of security and also high transferring speed. For this reason the light is used to transfer the information (of the medium) in this network and in order to improve its data security, the theory of agitation could be used in transferring the data [7].

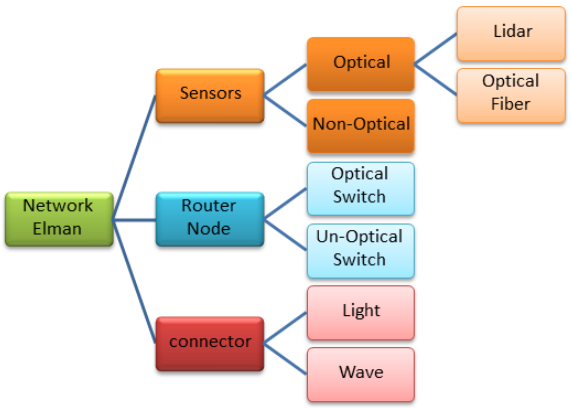

Figure 1. the elements of the Ad-Hoc optical network [1].

The general structure of the Ad-Hoc optical network as shown in figure 2 is that the information is received by the sensors is transmitted to the CPU and after processing and decision making, in order to reuse in similar cases the comparing processing the data exploration to know, … is saved in the database. In this network the sensors are transferred to the optical switches using optical medium and related protocol for navigation and from there by means of a special protocol are transferred to the processors. Therefor the architecture of this network has basic differences with the structures used before.

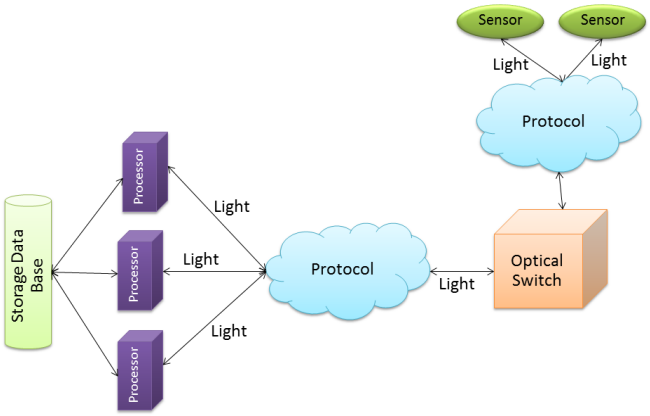

Figure 2. the structure of the Ad-Hoc optical network.

III. COMMUNICATION PROTOCOL

The Ad-Hoc optical network works as a switching circuit, for the switches in this network choose the nest path or circuit to transferring the data and carry the information to the receiver. This choosing of the path depends directly on parameters such as the radiance in each path (that reduces the transmitter's power or causes the disturbing of the information), the length of the existing paths that need power for the carrying signal, etc. First off in the communicative protocol the division of the different part of the message in the Ad-Hoc optical network is discussed. Therefor a frame from the message in the network is shown in figure 3.

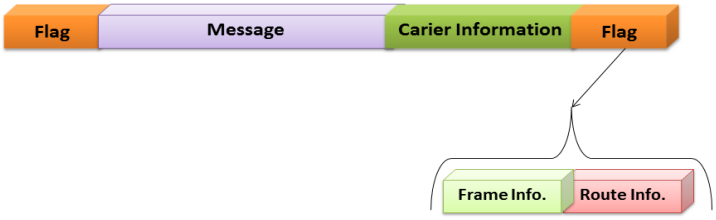

Figure 3. A frame from a message in the Ad-Hoc optical network.

The flag marks the beginning and the end of each message that is used when processing the information. In this case the CPU processes each frame separately and on the other hand we can link the frames to each other with the change of each one's flag. So the processor assigns the result of the process of each frame to the next. On the other hand the flag can carry the information of the path. Since the information of the path could be gathered with the help of Nano sensors [6], we can put this information in the flag of each frame's message to identify the best path. Because the network carries light no error occurs except in the processor or in the sensor during the transfer. So unlike the message frame in all the existing networks, there is no section for diagnosing error in this network, and this means the reduction of the length of the message and on the other hand it helps improve the speed of processing and is one of the important parameters of this network, the section for the information carrying the message, contains information about the light transmitter and information required for the separation of message, in this network each sensor can use a special optical wavelength or also all the sensors can choose one optical wavelength; in the latter case only the angle of reflection of each beam of light is important. The message section contains the information obtained by each sensor and is the most important part of the frame, so it could have special coding that is necessary to improve the security of the message. This part constitutes most of the message frame in the Ad-Hoc optical network because the information obtained by the sensors for decision making and also their length is highly important.

Now considering the frame of the message, the present author discusses the protocol layers of the Ad-Hoc optical network which are used to define layers from the base protocol of OSI. OSI protocol includes seven layers each of which has a special task in a communicative link (Figure 4) [8]. The only physically-functioning layer is the physical layer. In this layer optical fiber, open space (in order to disseminate light and laser in open space), … could be used. The Date layer does the classification of the information, diagnosis, correction and resending but since in the Ad-Hoc optical network as it was mentioned earlier the error occurs in processing or assembling the information, it could be ignored and the information assembled on light with the help of special modulation is transferred via the physical layer to the target. The Network layer in the OSI protocol is used to dedicate a path for transferring the message, which is called the Router layer in the Ad-Hoc optical network. Its task is to find the best path (with regards to the length, distortion, radiance, etc.) for transferring the message according to the information received from the flag of the message frame. The transport layer in the OSI protocol has the task of adjusting the field's address and destination of the message (target) and if the message is too long and couldn't be sent as one format, it divides the message into several parts, but in the Ad-Hoc optical network it only adjusts the point of departure and the destination address, because in this network there is no problem about the length of the message. The Session layer's task in the OSI protocol is to add some information to the message so that in case the link is disconnected, the transfer continues. Because in the Ad-Hoc optical network each sensor or node has to be connected to the processors, so the shared connection could be used and each sensor or Node could be connected to all nodes of the network. Therefor using Multipath we can send the information to the processors. But since the aim is to find the best path for transferring the information, the message is sent in a channel that has the least expense (distortion, power …) for the network. So we can remove the layer from the network protocol and choose the path according to the information acquired from the flag of frame's message. On the other hand when in optical networks a connective link is disconnected, the transfer is automatically cancelled. The Presentation layer's task like OSI protocol is to adjust the information and the Application layer is a requesting one and in this network is either the processor or the sensor. According to what has been said so far, the protocol layers of the Ad-Hoc optical network is shown in figure 5.

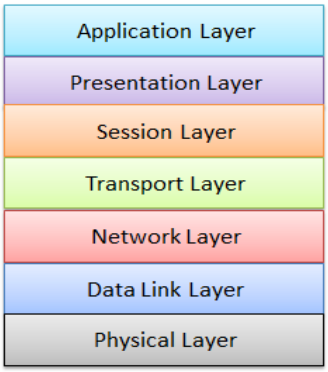

Figure 4. the layers of the OSI protocol [8].

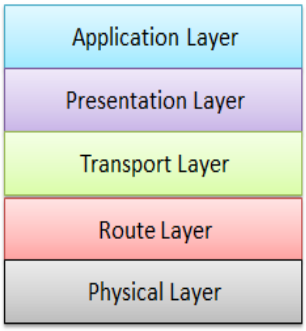

Figure 5. The layers of the Ad-Hoc optical network protocol.

Considering the protocol layers, the relation between three elements of this network is inspected: the sensor with the navigator; the navigator with the processor. We consider Node A as the sensor, Node B as the navigator and Node C as the processor, and the acquired information by the sensor (A) should be sent to the processor (C). Therefor a connective cycle should be inspected between these three nodes. At first the information acquired in Node A is modulated and carried by light, identified by the existing protocol and sent to the destination according to the acquired information. The relation between these three nodes shown in Figure 6.

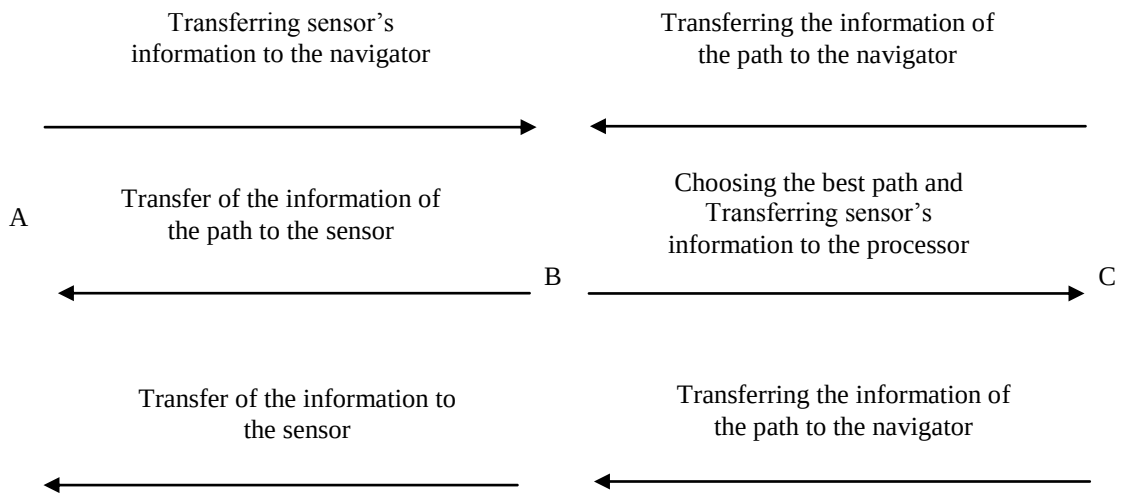

Figure 6. the relation between nodes in proposal protocol.

IV. CONCLUSION

In this paper, the Ad-Hoc optical network, communicative protocol and its layers were presented along with the discussing a simple communicative link between the three main nodes of this network. According to what said before, the advantages of the presented protocol are:

• Because no error occurs in the network (except for the processor or the modulator), there is no need for a special layer for the diagnosis of the error in the protocol.

• With the removal of the error diagnosis layer, the speed of the processing increases.

• The reduction of the protocol layers increases the processing speed and also sending and receiving the information causing instant connection.

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