Optimization of Energy in Wireless Sensor Networks

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Abstract - The stated goal was to achieve the maximum utilization of the resources offered by the set of nodes that forms the network, allowing simultaneously sending reliably and efficiently all types of content through them, and mixing conventional IP data traffic with multimedia traffic with stringent QoS and QoE requirements. Using the information gathered in the previous phase, we have developed a network architecture that improves overall network performance and multimedia streaming. In parallel, it has been designed and programmed a communication protocol that allows implementing the proposal and testing its operation on real network infrastructures. In the last phase of this thesis we have focused our work on sending multimedia in wireless sensor networks (WSN). Based on the above results, we have adapted both the architecture and the communication protocol for this particular type of network, whose use has been growing hugely in recent years.

Index Terms— Wireless Sensor Network, Quality of Service, QoE, video on demand

I. INTRODUCTION

The standardization of wireless technologies and the technological advances have enabled the fabrication of ever smaller, cheaper and more powerful devices. They have meant that, nowadays, wireless technology has become very popular and we can find it incorporated in virtually any electronic device. Smartphones, sensors and every kind of devices for personal or household use, such as watches or appliances include a wireless interface to communicate with other networked devices. We are moving towards a global network where people and devices share information.

Against this background of high wireless connectivity, new opportunities and new challenges show up. In particular, inside the wireless technology family, there has been a great proliferation of ad hoc wireless networks. This kind of wireless networks are built by some number of wireless devices scattered over a limited geographical area. These devices can use specific technologies and applications.

Fig. 1 Wireless Sensor Network[1]

They offer several advantages for a wide range of applications due to their ease of deployment, adaptability to environment, coverage control, and mobility of the devices, consumption restrictions and energy saving [3]. Applications of such networks are Wireless Sensor Network (WSN) [4], Vehicular Ad Hoc Network (VANET) [5] Vehicular Ad Hoc and Sensor Network (VASNET) [6] Mobile Ad Hoc Network (MANET) [7] and Wireless Mesh Network (WMN).

II.MULTIMEDIAORIENTEDARCHITECT URE DESCRIPTION

Our multimedia-oriented architecture and protocol is focused on providing the highest multimedia service quality in an ad hoc network. We will assume that lower layers of the communication stack are able to run properly, so we will not take care of the physical layer technology used in the ad hoc network (we will assume that the physical technology allows higher bandwidths than 1 Mbps), the medium access control protocol used to allow wireless links in a multiple access medium, and the network layer protocol, that allow having a multi hop network while allows delivering IP services over the ad hoc network.

We will use the protocol stack shown in figure 1.2. It shows a regular ad hoc protocol layer model, but there is a clear transport layer which allows the coexistence of different multimedia protocols with different requirements (connection oriented, connectionless oriented, etc.) and there is a protocol in the application layer which interacts with the regular multimedia protocols and allows making service access point calls.
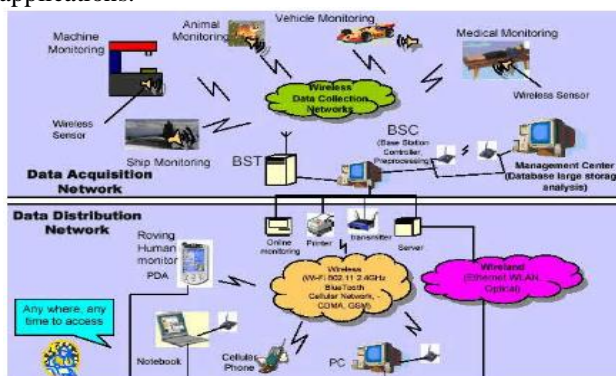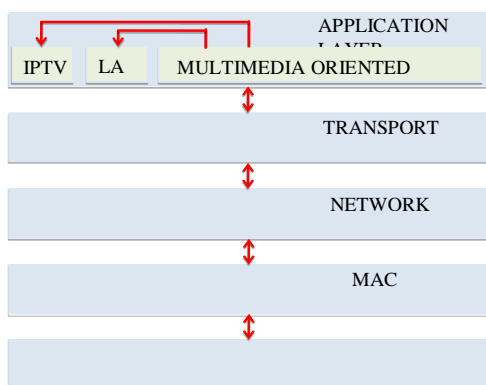
Figure 2 Multimedia-oriented protocol stack.

In our ad hoc network any node could be the gateway of the network and provide IPTV, VoIP or multimedia services from Internet. Thus nodes can appear in the network at will and even provide multimedia services at will, once they are in the ad hoc network. There is no base station or infrastructure in the wireless network to deliver multimedia services, so any communication is performed in a wireless ad hoc manner. In order to propose a protocol for a real environment, we will suppose that there is a heterogeneous network, where devices have different capabilities. Moreover, it will be asymmetric, because devices may have different bandwidth connection and offer different multimedia services (and thus different throughput needs). The ad hoc network is able to self organize and adapt to any change or event. It allows the spontaneous formation of the network. An explanation of how a network can be formed spontaneously is shown by us at. Moreover, this protocol can be secured by using trust techniques when users join the network and when the information is routed through the network.

III. RESULT

In order to join the architecture, the new node broadcasts a "Discovery" message. CHs will reply with a "Discovery ACK" message with their position and λ parameter. There could be 3 possibilities:
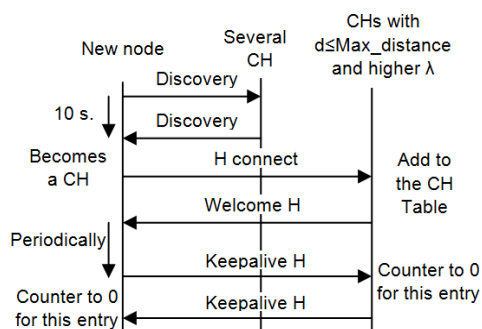

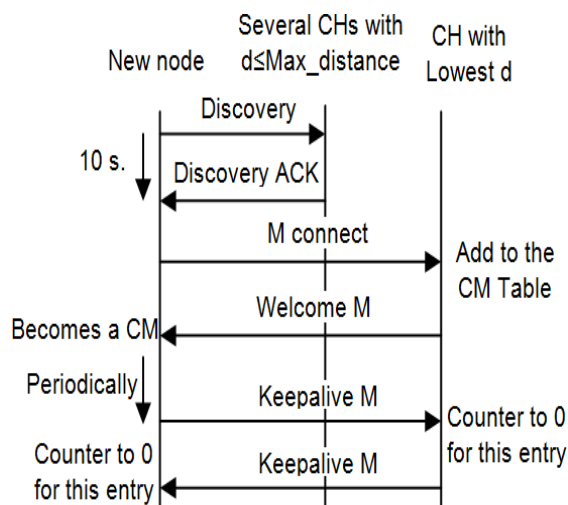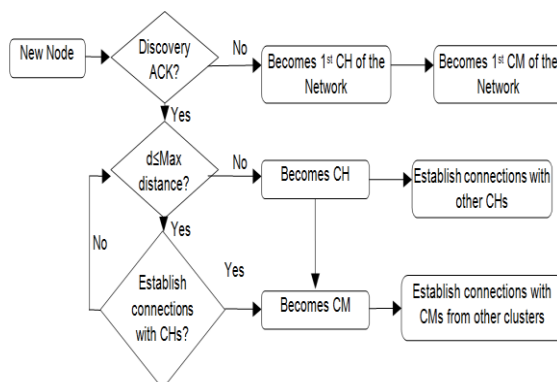Figure 3 Protocol operation for a new CH.

Figure 4 new CM protocol.

Figure 5 Flowchart of the architecture operation

Table 1 Nodes' position

Node number	Type of node	X	Y
1	a	0	0
2	b	50	0
3	a	100	150
4	b	50	100
5	c	25	50
6	c	100	75
7	a	200	25
8	b	150	100
9	a	200	175
10	c	150	50
11	d	125	125
12	b	175	175
13	c	200	75
14	d	125	25
15	d	50	25
16	d	150	200

Table 2 Neighbor connections.

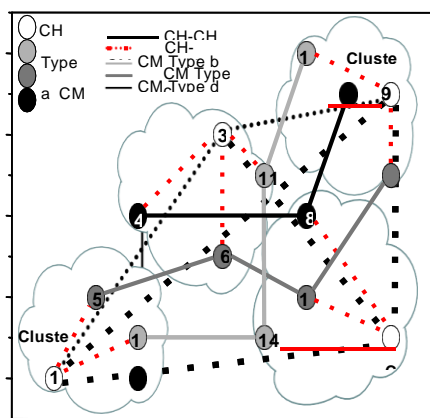| Node Number	Role	Connections With Ch	Connections With Cm
1	CH	3, 7, 9	2, 5, 15
2	CM	1	4
3	CH	1, 7, 9	4, 6, 11
4	CM	3	2, 8
5	CM	1	6
6	CM	3	5, 10
7	CH	1, 3, 9	8, 10, 14
8	CM	7	4, 12
9	CH	1, 3, 7	12, 13, 16
10	CM	7	6, 13
11	CM	3	14, 16
12	CM	9	8
13	CM	9	10
14	CM	7	11, 15
15	CM	1	14
16	CM	9	11

Figure 6 Nodes distribution and the connections established.

IV. CONCLUSON

From the results obtained in this work, can be extracted different research lines to improve the operation of the proposed architecture. Some of the possibilities are:

- Increase the number of variables included in the MIP container to improve decision algorithms. These factors include node mobility and energy consumption.
- Introduce mechanisms to manage dynamic queues in order to increase the number of concurrent multimedia connections that can be supported by nodes with high congestion level.
- Add security improvements at the protocol by using authentication, encryption and data integrity mechanisms on sent and received messages.
- Make more performance tests over data networks in production, both private and public, mainly when multimedia applications need to compete with other network applications for the available bandwidth.
- Moreover, results can be generalized in order to fit:
- Other kind of networks that ad hoc wireless that also show troubles for multimedia traffic transmissions, such as wired network with huge congestion level, long distance point to point links or heterogeneous mobile networks.
- Different applications in addition to multimedia traffic, such as signaling data, industrial traffic or real time traffic from personal devices.
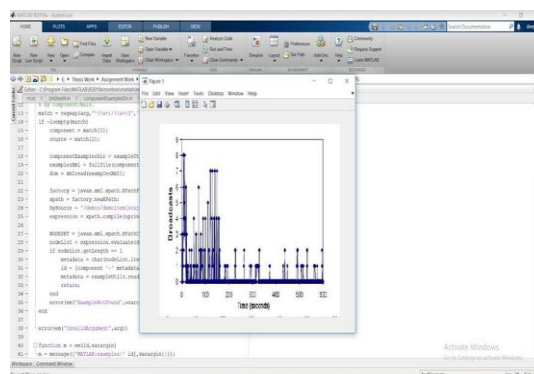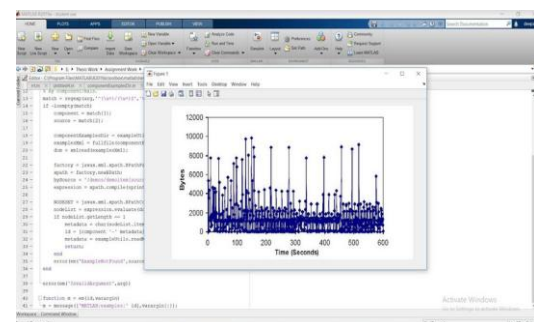

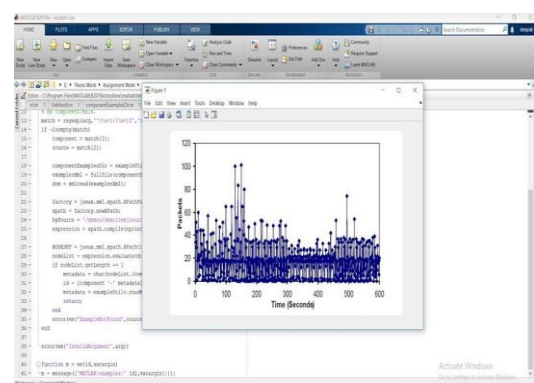Fig.7 Number of Broadcasts per second.

Fig. 8 Number of Bytes per second.

Fig. 9 Number of packets per second.

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