AN EXPERIMENT ON PERFORMANCE ASSESSMENT OF WPAN NETWORKS USING 802.15 STANDARD

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Abstract

The IEEE 802.15.4 defined wireless personal area network that can be further used to implement sensor networks. The sensor networks uses the same standard as the WPAN used. The main advantages to use WPAN operated according to MAC Layer structure and also to enhance the performance of bottlenecks. The WPAN can be used coordinators that interconnected to form larger networks. The bridging function is performed by the coordinator of the source Node, which periodically visits the child nodes as an ordinary node. The coordinator node within the time slots of the active portion of the super frame may reserve slots to allow dedicated access to other nodes. The bridge used by the coordinator can deliver its data to the child nodes and more adaptable to control overall traffic.

In this paper our work in modeling and performance assessment of the operation of the 802.15.4 MAC layer, we have identified a number of issues that enhanced the performance of WPAN when compared to previous work [2].we further analyze the performance of a personal area network operating under the IEEE Standard 802.15.4 in the beacon enabled mode, and derive the probability distribution of packet access delay and calculate the throughput.

Keywords: WPAN, PAN, 802.15, CSMA/CA, AODV

I. INTRODUCTION

The IEEE 802.15.4 standard shown in figure1, and is therefore able to support a wide variety of network topologies and routing algorithms. The IEEE 802.15.4 standard incorporates many features designed to minimize power consumption of the network nodes [3]. In addition to the use of long beacon periods and the battery life extension mode, the active period of a beaconing node can be reduced (again by powers of two), allowing the node to sleep between beacons.

Coexistence with other services using the unlicensed bands with IEEE 802.15.4 devices

was also a major factor in the protocol design, and is evident in many of its features. For example, dynamic channel selection is required; should interference from other services appear on a channel being used by an IEEE 802.15.4 network, the network node in control of the network (the personal area network [PAN] coordinator) scans other available channels to find a more suitable channel [4].

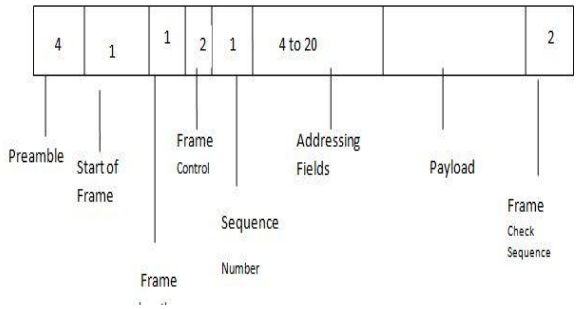

Figure 1: IEEE 802.15 Standard [6]

In this scan, it obtains a measure of the peak energy present in each alternative channel and then uses this information to select a suitable channel. This type of scan can also be used prior to the establishment of a new network. Prior to each frame transmission (other than beacon or acknowledgment frames), each IEEE 802.15.4 network node must perform two clear channel assessments (CCAs) as part of the CSMA-CA mechanism to ensure the channel is unoccupied prior to transmission.

I. (a) WPAN

WPAN is a generic term that refers to different technologies providing personal area networking. A WPAN [6] typically covers few meters around a user's location and provides the capacity to communicate and synchronize a wireless device to other computing equipments, peripherals, and a range of pocket hardware (e.g., dedicated media devices such as digital cameras and MP3 players). The goal is to allow seamless operation among home or business devices and systems. It is based on a technology that allows communication within a short range, typically around 10 m. A WPAN exists where the user/device is, that is, it does not depend on an access point to establish a communication among devices in the network. This leads to a concept known as plugging in. It means that when any two WPAN devices are close enough (within radio communication of each other), they can communicate directly as if they were connected by a cable. If there are many communications among devices, each equipment may stop communicating with specific devices, preventing needless interference or unauthorized access to information.

The physical layer is operating in the ISM band around 2.4 GHz. We assume that all nodes in the topology operate in beacon enabled, slotted CSMA-CA mode under the control of their respective cluster (PAN) coordinators.

In each node, the channel time is divided into super frames which are bounded by beacon transmissions from the coordinator [1].The PAN uses two types of channel access mechanisms based on slotted carrier sense multiple access with collision avoidance (CSMA-CA) algorithm and unslotted CSMA-CA algorithm. For the one based on slotted CSMACA algorithm, the slots are aligned with the beacon frames sent periodically by the PAN coordinator. While the other one based on unslotted CSMA-CA, there are no beacon frames. For the applications of sensor networks, since the central device manages the networks in general and the PAN coordinator can act as the network controller and the sink to collect the data from sensor nodes, the beacon enabled mode and the tree topology appear to be better suited for sensor network implementation than their non-beacon enabled mode and the peer-to-peer topology.

II. IMPROVED WORK

Wireless Personal Area Network (WPAN) is playing an important role in future of mobile adhoc wireless communications and information systems. WPAN can be viewed as another network such as 802.11 WLAN. IEEE 802.11a, b, and g which are 2.4 GHz and 5 GHz wireless LAN technologies, and Bluetooth is 2.4 GHz personal area network (PAN) standards to meet the needs of a data-hungry world for more speeds. IEEE 802.15 IEEE standards body designated to come up with wireless WPAN standards. Two main methodologies for master device selection are “Reachability” & “availability”. The intention here is to enhance the Master Device selection capability. Grid topologies consist of nodes that are evenly deployed in a two-dimensional grid throughout the simulation area. This configuration may be representative of static preplanned networks such as mesh network. Grids and tree topology also provide a level of control to experiments, due to the uniform density present throughout the network.

When a WPAN router loses its link to its parent, all its descendants have to rejoin the network. The rejoining procedure is time-consuming and may incur high communication overheads. The proposed network repair scheme consists of a regular repair and an instant repair schemes. Periodically, the network coordinator can issue regular repair to refresh the network (so as to keep the network in good shape). During normal operations, if a router loses its parent, it tries instant repair to reconnect to a new parent. Our design thus improves over WPAN in that nodes can continue their operations even during instant repair. The design of the WPAN routing

scheme is based on the Ad-hoc On-demand Distance Vector (AODV).

III. EXPERIMENTAL APPROACH

Let us consider the network which consists of source node also called PAN Coordinator connected to the child nodes as shown in Figure 2.

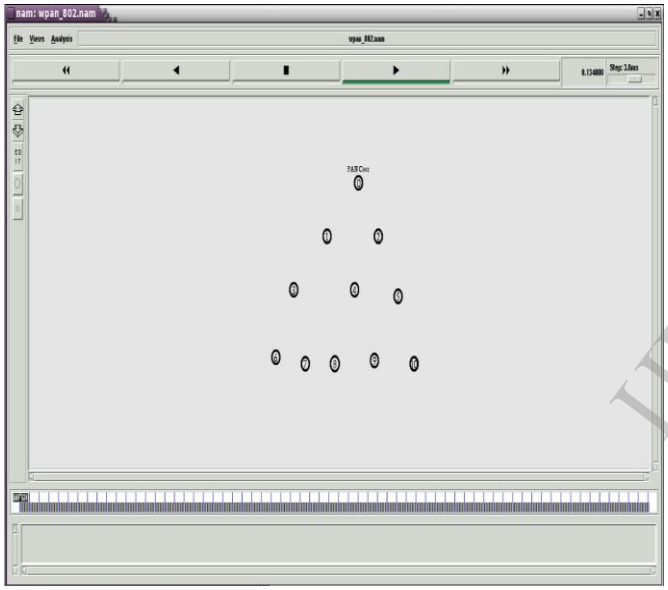

Figure 2: WPAN tree topology

Each source node has a separate interconnection device towards the child which we will introduce shortly. This is a reasonable assumption in sensor networks, where the most, if not all, of the traffic will be directed toward the network sink (child nodes).All communications in the cluster take place during the active portion of the super frame, the duration of which is referred to as the super frame duration (SD).

From this modeling when the buffer is empty, the device will not attempt any transmission; when the buffer is full, the device will reject new packets coming from the upper layers of the protocol stack. We assume that each network node accepts new packets through the buffer with a finite size of L packets and in our implementation say queue length 50. The new packets can arrive to the device queue at any time. If the buffer size is L, the buffer occupancy at arbitrary time can have values from 0 to L, while the buffer occupancy immediately after the packet departure time can have values from 0 to L-1 only. As we have seen, the packets that can complete transmission within the current super frame have to send the next packet as shown in figure 3 and 4.

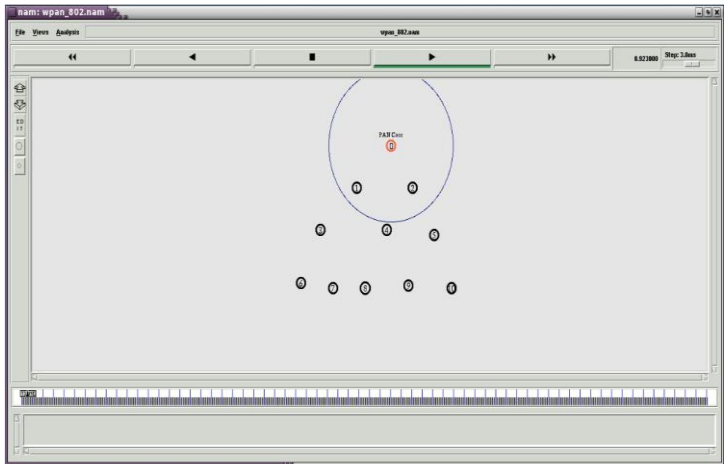

Figure 3: Transmission of Nodes

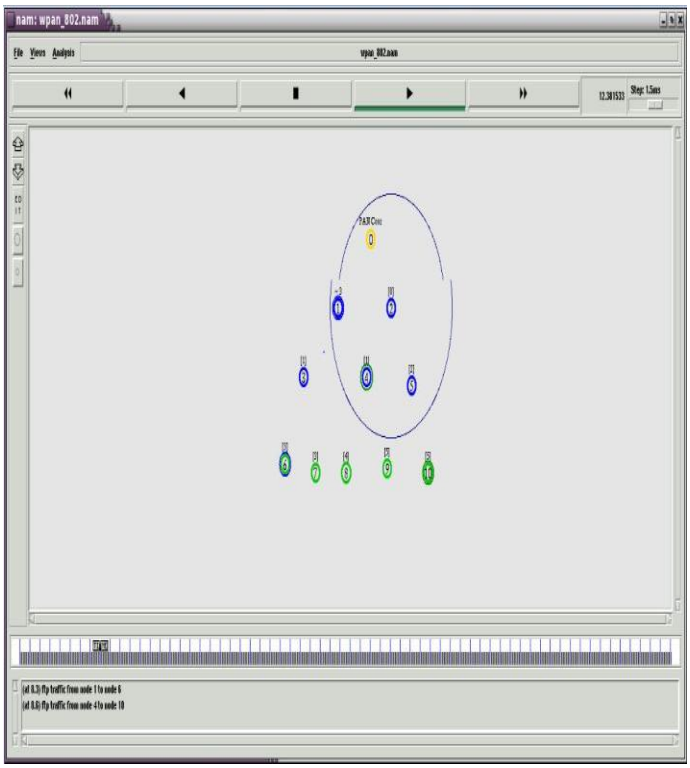

Figure 4: Send Packets by the Nodes

The duration of the super frame depends on the energy management policy of the network. In the figure 4 every transmitted packet has to be acknowledged, i.e. the packets that do not receive the positive acknowledgement have to be re-transmitted.

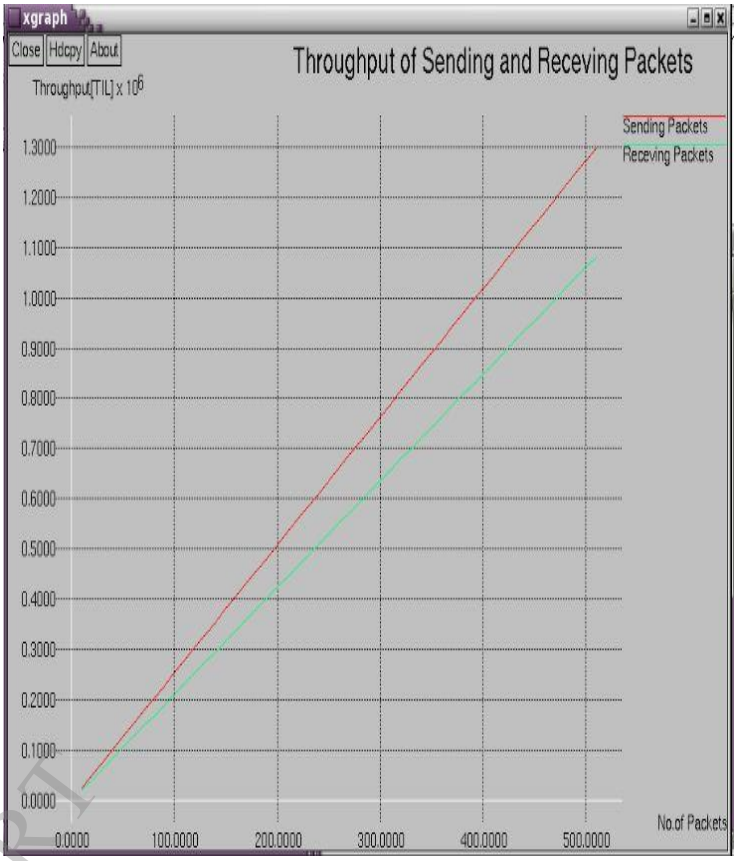

Figure 5: Throughput of sending and Receivng Packets

The node at the root is the PAN coordinator. All other nodes are in the radio transmission range of the coordinator, but not all nodes are in a single broadcast domain. All simulations are run independently. From the figure 5, the highest throughput is achieved when there is 1.3 time Interval Length (TIL) source, at around 500 Packets sent and equally received. There is no fluctuation in between the packets and the highest got from packet send and received. This means that packet is directed to the PAN coordinator with the PAN identifier as specified

in the source PAN identifier field. The buffer size L and the number of nodes, with packet arrival rate fixed.

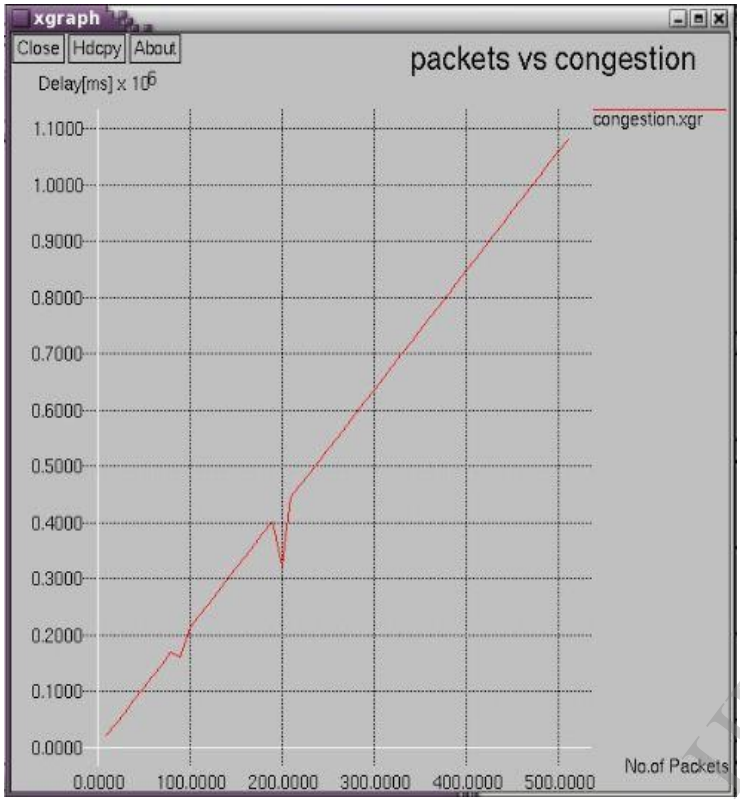

Figure 6: congestion in the Packets

We define congestion in the packets as the time from the packet arrival to the device queue until the successful packet departure from that queue (a successful packet departure is defined as the packet transmission which is successfully acknowledged).But if unsuccessful then delay more resulted congestion occurred in between the packets. To calculate congestion in the packets, we need the derived the joint probability distribution of the number of packets in the device queue and the remaining service time for the packet which is currently not being serviced.

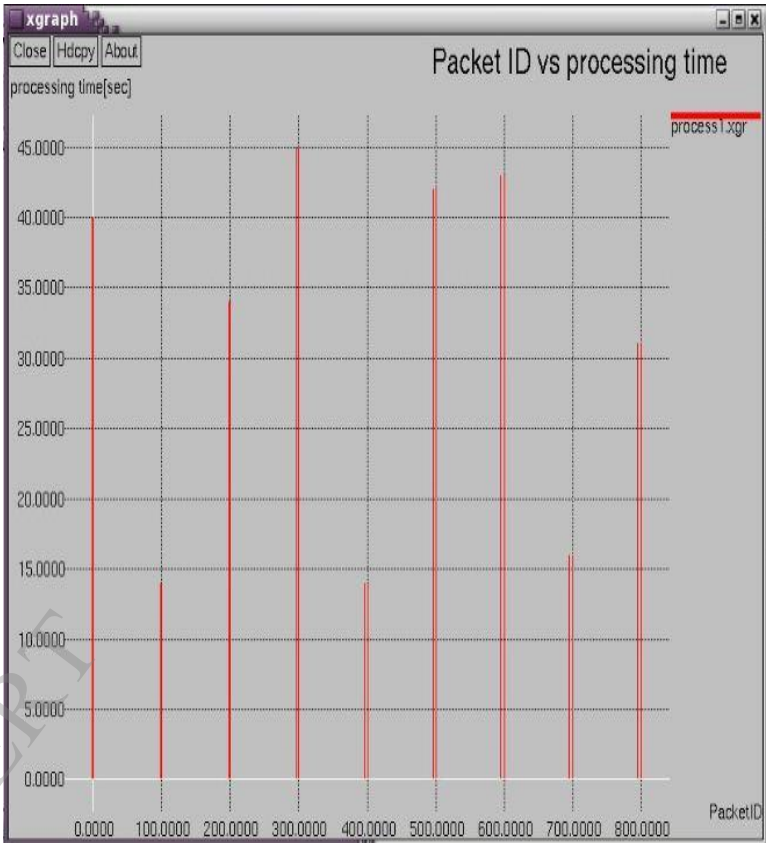

Figure 7: Processing time of Packets

From the figure 7 refers the required time to process a packet whether it succeeds or fails is the total time to processing a packets with simulation time. If the packet can't process than it assumes the packet not processed or the channel being busy. With the assumption packets shows higher processing then chances to retransmission of the packets.

CONCLUSION

Although the analytical model presented in this paper covers tree topology. Network consisted of source Node independently interconnected to the k ordinary nodes. The target of this work was to develop accurate analytical scenario of WPAN Nodes interconnected each other and performed better in respect of throughput and lesser congestion also improvement of processing packets. Results show that, under packet arrival rates and packet sizes, the use of the WPAN access mode outperforms. If the network is carrying low traffic and packet reliability is not an issue, non-acknowledged transfer appears as the best choice since it allows dynamic routing and better energy balancing. When attempting the transmission of a packet, each node will use the information obtained from the network to guide its further actions.

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