Pulse Switching: Hop-Distance Recovery In Wireless Routing Network

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***Abstract*— This paper presents a novel pulse switching protocol framework for ultra light-weight wireless network applications. The main thing is to use aa single Ultra Wide Band (UWB) pulse as the information switching granularity. The on-off style event monitoring is used in pulse switching model.Packet transferring for event monitoring is needed a large buffering overhead. Also the packets should be coded with data, header for synchronization.**

A joint MAC-routing protocol architecture for pulse switching with a novel hop-angular event localization strategy. Due to the discrete nature of hop count based coordinates, an effective recovery mechanism is needed because these protocols will frequently encounter failures at network local minimum sites. We propose a new connectivity-based routing protocol named Hop Distance Routing (HDR) along with the MAC-routing protocol architecture. The pulse switching can used for event monitoring networking, which can effectively to reduce the overlapping of the pulses by the HDR algorithm and used to find the event monitoring effectively.

***Keywords*— hop distance routing, Impulse radio, pulse switching, ultra wide band, sensor network, event monitoring, pulse routing.**

I. INTRODUCTION

Pulse switching is a new abstraction which replaces the traditional packet switching event monitoring. Pulse switching is used for monitoring the systems. Events such as indicate an intrusion, structural health monitoring for aircraft wings, bridges and other small structures. An ultra light pulse switching protocol framework for resource-constrained sensors in on-off style event monitoring applications is used to replaces the traditional packet switching for an event monitoring. The pulse switching uses a single pulse for an event to be coded. The event's localization information is preserved it through multihops. This will remove the overheads of buffering, addressing, collision, packet processing. But these sensors are resource constrained, sensor devices with operates on tight energy budgets. These tiny sensor nodes are capable of sensing the event, process the data and has communicating components.

The primary challenges of pulse switching networks are how a single pulse can transport the localization information, how to route a pulse multihop without being able to explicitly code any information within the pulse and finally how to cope with pulse loss and false-positive detection errors.

The key structure of the pulse switching protocol is to integrate a pulses' location of origin with MAC-routing protocol system. The sink can resolve the event location by the time of arrival of the pulse and the MAC-routing frame's interval.

The multihop pulse routing is done by the methodology called wave front routing protocol. To get delivered to the sink the synchronized pulses are moves in the wave form across different hop-distance nodes.

The architectural solutions are given by: pulse–switching protocol paradigm is associated to MAC routing syntaxes for multihop operations, a hop-angular framework for event localization, an implementation approach using Ultra Wide Band Impulse Radio technology. The pulse switching architecture is targeted to small sensor networks with few tens of sensors distributed within a restricted geographical area.

During hop-distance discovery, after the nodes at hop-distance 1 have discovered their own hopdistance, they send simultaneous discovery pulses in the same slot in the reconfiguration area. Unintended node cooperation due to the energy aggregation of all such pulses can cause them to reach nodes that are beyond hopdistance 2. If hop-distance recovered is faulty, then this will lead to pulse forwarding failures. These kind of hop-distance faulty recovery will happen due to the node cooperation except hop-distance1.

This paper suggests that the routing can be done along with the MAC-algorithm a hop distance routing algorithm is also applied. The HDR protocol provides guaranteed packet delivery and lower path stretch with lower communication over hear.

In recent years, ultra-wideband signal, face an increasingly important challenge. UWB-IR which uses sub-nanosecond pulses to transmit information, resulting is high resolution in, thereby leading to a large search space. The features of UWB radio which make it an attractive choice are its multiple access capabilities, lack of significant multipath fading, and ability to support high data rates and low transmitter power, resulting in longer battery life for portable devices. An ultra light pulse switching protocol framework is used for resource-constrained sensor in on-off style event monitoring application.

This paper is categorized as follows: Section 2 provides the background and existing work related to the pulse switching. Section 3 provides the pulse switching architecture. Section 4 provides the routing diversity. Section 4 provides the Greedy Hop Distance Routing algorithm. Section 5 summarizes the paper.

II. RELATED WORK

Majority of the event monitoring solutions in the literature use traditional packet switching. Packet aggregation is a natural and effective approach to reduce synchronization preamble and header overheads by aggregating the payloads from multiple short packets into a single large packet that is routed to a monitoring sink node. While being able to cut the energy costs, aggregation still requires the inherent packet overheads at the originating nodes for the short packets, and then end-to-end for fewer numbers of the large packets. The objective of our work is to develop protocols for fully eliminating such overheads required due to packet abstraction.

The partially mitigates the packet switching overhead by sending two very shorts packets for a sensed event, so that the arrival delay between those short packets represent a value corresponding to the event. The short packets serve only the purpose of start/stop delimitation and do not carry any data. Although there are a number of practical challenges as outlined in, it is an innovative approach for partially eliminating the need for packet PDU related overheads.

The control packets, includes start, stop, and intermediate bits along with the packet headers with node addresses and the per-packet preambles. The objective of our work is to develop pulse-based protocols for fully eliminating such overheads. Communication energy cost for pulse switching can be significantly smaller than those for packets due to the difference in the number of bits to be transported. Also, the processing and buffering costs of packets can be avoided using pulses.

The develop models for comparative energy and delay bounds for bit (i.e., packet-based) and pulse communications in single hop network scenarios. The main results are to demonstrate that the worst case energy performance of pulse communication can be substantially better than that of packet-based communication, although with a possibly worse delay performance. A notable limitation is that it does not provide mechanisms for scaling these results for multihop networks. Also, no protocol details are provided for MAC and routing syntaxes that would be needed for a practical implementation. Routing a pulse multihop can be particularly challenging given that no explicitly coded information can be carried in a single pulse. The objective of this paper is to design a MAC-routing framework that can be used for practical implementations of a pulse-based communication paradigm working in multihop environments.

A proposed MAC protocol that utilizes out-of-band contention pulses for packet collision detection. Pulses are of varying length, rendering technologies such as UWB-IR unusable. Traditional packets are still used for sending information.

Idling energy reduction in synchronous packet-based MAC protocols such as T-MAC is accomplished via interface sleeping in appropriately scheduled packet slots. Idling in asynchronous protocols such as B-MAC is reduced by relying on low power listening, also called preamble sampling, to link together a sender to a receiver that is duty cycling. Hybrid protocols also exist that combines a synchronized protocol like T-MAC with asynchronous low-power listening. Distributed TDMA protocols avoid idling consumption by turning interface off in all packet slots except when needed for transmissions and receptions. Joint MAC scheduling and route computation is proposed in for delay and energy optimization for event monitoring applications. In the cross-layer approach in is shown how reporting delay can be optimized in the presence of predefined sleep-wake MAC cycles.

Although the above MAC, routing and cross-layer solutions can improve idling energy expenditure in low duty-cycle networks, they still use packet switching, thus suffering from the overheads that a pulse-based system can avoid. It will be shown in this paper that by sending a single pulse, instead of a packet, the idling energy expenditure can be significantly reduced.

In hop-distance discovery, to minimize the impacts of node cooperation by reducing the chances of overlapping of pulses. The pulse is transmitted by two sinks on the same slot in the event sub frame, the receiver sink simply detects RF signals for a merged pulse in that slot. The hardware can detect the presence of the overlapped pulse, the routing continues. The pulse merges and route diversity provides inherent in-network aggregation for events from the same event area. Multiple pulses are transmitted by different nodes during the same slot.

III.1 UWB-IR WITH MAC ROUTING

Every node is synchronized with the sink for frame-by-frame time, also maintains a MAC Routing frame. In MAC routing each slot is used for sending a single pulse. An very small RF technology is used called UWB-IR whose frame size itself can be ultra short micro seconds for UWB, because the slots needs to include a guard time to accommodate the cumulative clock-drift during a frame. Two subframes, uplink and downlink are used, of which the downlink subframe contains a synchronization slot. The sink transmits the full re-config pulse to make all nodes frame-synchronized.

The two downlink slots and the reconfiguration part of the uplink control subframe are used for hop-distance discovery. The reconfiguration area has (H + 1) slots, where H is the maximum hop-distance. The H-slot routing area of the control subframe is for energy management. The event subframe contains H slot clusters, each containing 360/alpha slots, where alpha corresponds to the sector width. Each slot within a cluster corresponds to a specific {sector-id, hop-distance} tuple. Meaning, for each event-area, represented by {sector-id, hop-distance}, there is a dedicated slot in the event subframe. An event originating node transmits a pulse during the dedicated event subframe slot that corresponds to the {sector-id, hop-distance} of the node's event area.

While routing the pulse toward the sink, at all intermediate nodes it is transmitted at the same event subframe slot that corresponds to the {sector-id, hop-distance}. Joint MAC-Routing frame structure for multihop pulse switching.. Hop-distance event localization. of its event-area of origin. In other words, while being forwarded, the transmission slot for the pulse at all intermediate nodes does not change with respect to the frame.

This is how information about the location of origin of an event is preserved during routing. Upon reception, the sink can infer the event-area of origin from the {sector-id, hop-distance} value corresponding to the slot at which the pulse is received.

III.2 PERIODIC HOP-DISTANCE DISCOVERY

A network contains arbitrarily distributed sensors that send pulses to a sink. Depending on the node locations and the transmission range each node resides at a certain *hop-distance* from the sink. The sink initiates a reconfiguration phase by sending a full power *start-reconfig* pulse. In the MAC routing frame is having a reconfiguration area in its frame. A regular power pulse is transmitted along with the about pulse. The pulses received by the nodes are concluded that they are in one hop distance from the sink.

All hop-distance 1 nodes send a pulse in the second slot of the reconfiguration area during the next few frames. Nodes receiving these pulses conclude that they are in hop distance 2. This process continues, and all the nodes discover their individual hop-distance. The sink ends the reconfiguration process by sending a full power pulse in the *stop_reconfig* slot.

This discovery process is generalized architecture and there is no specific shape for the transmission coverage area. The transmission coverage of the nodes and the resulting hop-distances are expected to change over time. So the hop-distance discovery process needs to be periodically executed.

III.3 TRANSFERING PULSES USING WAVE FRONT ROUTING

When a pulse is transmitted by a node at hop-distance h, only its neighboring nodes at hop-distance (h-1) need to forward it toward the sink. Each node has transmits its hop distance by transmitting its pulse. But it can't be done if the MAC addressing is absent.

In wave front routing every synchronized transmission takes place in a frame by frame manner. They follow the order called Sleep (S)-Listen (L)-Transmit (T). This cycle enable the pulses move towards the sink in the forward form. Nodes with the same hop-distance is called that they are in-phase, and those are having different hop-distance is called that they are out-of-phase, but all are remains synchronized. So if the node with hop-distance x transmits, then the node with hop-distance x-1 will listen and the node with the hop-distance x+1 node sleeps.

This synchronized cycling ensures that pulses transmitted by nodes in hop-distance h are received by those at hopdistance h-1, but are ignored by nodes at hop-distance h + 1. This creates a wave front that carries pulses closer to the sink on a frame-by-frame basis. Immediately after the reconfiguration process is terminated, a node at hop-distance h decides its state phase by computing h modulo 3. The outcomes 0, 1, or 2 cause the node's state to be initialized as L, T, or S, respectively. During the subsequent frames, the state machine cycles in the sequence S-L-T.

In all states, a node wakes up at the end of a frame for receiving frame synchronization pulse from the sink. This pulse forwarding is termed as wave front routing, because the pulses simply "ride" the synchronized phase waves across different hop-distance nodes, and get delivered to the sink. No address-based forwarding is needed. The buffering need is drastically smaller than that of the packet based systems with variable queuing.

Also, the routing depends only on a node's knowledge of its own hopdistance, and not on the underlying event localization mechanism (e.g., hop-angular). Therefore, as long as the hopdistance information is known, the pulse routing can be implemented with other event-localization mechanisms.

III.4 SECTOR BASED ROUTING

Angle-based filtering can be activated so that the forwarding of a pulse remains constrained within a predefined number of sectors around that of its origin. While higher sector-constraints curtail route diversity and subsequent pulse duplications leading to better energy economy.

The extent of sector-constraints during wave front routing can be parameterized using delta, which represents the ratio of the angular resolution alpha and an angle gamma. The quantity gamma is the sector-width beyond which a pulse may not be flooded while routing. For a given alpha, the minimum and the maximum values of gamma are alpha and 180 degrees, respectively. The corresponding delta values are 1 and 180/alpha.

When delta is 1, routing is maximally constrained, indicating the minimum communication energy consumption, and the maximum susceptibility to errors due to the minimum route diversity beta. The hop-angular localization abstraction can be replaced by a generic flat area-coded mechanism in which a sensor field is divided into K event areas, and each node is preprogrammed with an area code (1 through K) at deployment time. The event subframe is contain K slots, each corresponding to an event area. The sink can map the event-area-id (implicitly derived from the slot of pulse reception) to a prebound geographical area.

III.5 TRANSMISSION ERROR

Pulses transferred to the sinks across the nodes only with the reducing hop distances. Say example if a node sends a pulse from one node and it is not transferred to the next node which is having the same hop distance, instead it is transferred to next node which is having one hop distance less. So if transmission takes place at the same slot, there is possibility of merging of pulses while being delivered to the next hop distance node. This makes the intermediate nodes to get overlapped and leads to transmission error.

III.6 ENERGY CONSERVATION

Energy efficiency mechanism is done in the pulse switching by three different ways: inter frame sleep, intra frame sleep and delay traded sleep. Normally the pulse transmission is done in three different states like sleep-listen-transmit. This mechanism leads that thirty three percentage of the transmission energy get wasted during the transmission. But this is also avoids the overlapping of the pulses when they transmitted at the same synchronized slots. In case of inter frame sleep it just follows the SLT format to transmit. In case of intra frame format, whenever a pulse is detected to be transmitted the sleep slot just removed and the pulse is just transmitted. But in case of delay traded sleep one more sleep slot is inserted in order to decrease of overlapping of pulses. This will lead to some extent of ideal energy consumption.

III.7 HOP DISTANCE ROUTING

A new routing protocol is introduced along with underlying MAC-protocol, called Hop Distance Routing protocol, which provides guaranteed delivery to the sink over the influences like node density, high volume of nodes, problem with the signal propagation, the data rate of the wireless interface and the sensing capability of the sink.

IV ROUTING ALGORITHM OF HDR

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inBranch(N, T) - true if T.Θ ⊆ N.Θ or T.Θ ⊇ N.Θ, else false
Dhop(N, T) - returns the hop distance between N and T
if p.m = Branch then _ mode is Branch
if ∃Ni, inBranch(Ni, T)=true and |N.hc−p.hc| < p.Hd then
p.Hd = |Ni.hc − p.hc|, nexthop = Ni.
else
drop packet p.
end if
else _ mode is Greedy or Fallback
if ∃Ni, inBranch(Ni, T) = true and |Ni.hc−p.hc| < p.Hd then
p.m = Branch, p.Hd = |Ni.hc − p.hc|, nexthop = Ni.
else if ∃Ni, Dhop(Ni, T) < p.dist then
p.m = Greedy, p.dist = Dhop(Ni, T), nexthop = Ni.
else
if S _= root then
p.m = Fallback, nexthop = parent.
else _ root reached during fallback
drop packet p.
end if
end if
end if
```

V CONCULSION

In this paper, we presented an event monitoring application systems with the new pulse switching protocol framework, which works in ultra lightweight networking. The Hop Distance Routing (HDR) protocol along with the underlying joint MAC routing protocol, the hop angular event localization carried out effectively. The main idea is the find the sensor's position by combining the hop distance with the angle of location of the sensor. This pulse switching is more effective when compared with the traditional packet transfer protocol. Thus it shows that the pulse switching protocol architecture is energy efficient for transferring information in overlapping of pulses that is binary in nature.

A. References

- The Pulse Switching: Toward a Packet-Less Protocol Paradigm for Event Sensing Qiong Huo ; Electr. & Comput. Eng. Dept., Michigan State Univ., East Lansing, MI, USA ; Rao, J. ; Biswas, S., Mobile Computing, IEEE Transactions on (Volume:12 , Issue: 1) Jan. 2013(35-50)
- Greedy Hop Distance Routing using Tree Recovery on Wireless Ad Hoc and Sensor Networks Shao Tao ; Sch. of Comput., Nat. Univ. of Singapore, Singapore ; Ananda, A.L. ; Mun Choon Chan(19-23 May 2008), Published in2008, IEEE Conference
- Channel-hopping Scheme and Channel-diverse Routing in Static Multi-radio Multi-hop Wireless Networks Computers, IEEE Transactions on (Volume:PP , Issue: 99) 08 October 2013 Sponsored by :IEEE Computer Society Lin, T. ; National Chiao Tung University, Hsinchu ; Wu, K. ; Yin, G
- Distributed Bayesian algorithms for fault-tolerant event region detection in wireless sensor networks, Krishnamachari, B. ; Dept. of Electr. Eng., Univ. of Southern California, Los Angeles, CA, USA ; Iyengar, S. Computers, IEEE Transactions on (Volume:53 , Issue: 3) March 2004 Page(s):241 – 250
- A cellular pulse switching architecture for binary event sensing Qiong Huo ; Bo Dong ; Biswas,S. Global Communications Conference (GLOBECOM), 2012 IEEE Publication. segments in thepartition.