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Latency Aware IPv6 Packet Delivery Scheme over IEEE 802.15.4

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Abstract:

IEEE 802.15.4 is a technical standard which defines the operation of low-rate wireless personal area networks (LR-WPANs). It specifies the physical layer and media access control for LR-WPANs, and is maintained by the IEEE 802.15 working group, which defined the standard in 2003. We consider a complex (i.e., nonlinear) road scenario where users aboard vehicles equipped with communication interfaces are interested in downloading large files from road-side Access Points (APs). We investigate the possibility of exploiting opportunistic encounters among mobile nodes so to augment the transfer rate experienced by vehicular downloader's. To that end, we devise solutions for the selection of carriers and data chunks at the APs, and evaluate them in real-world road topologies, under different AP deployment strategies. Through extensive simulations, we show that carry & forward transfers can significantly increase the download rate of vehicular users in urban/suburban environments, and that such a result holds throughout diverse mobility scenarios, AP placements and network loads.

Keywords — **Latency, AP, WSN and WPAN**

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I. INTRODUCTION

The IEEE 802.15.4 standard targets low-power personal area networks. It defines the frame format for transmission of IPv6 packets as well as the formation of IPv6 link-local addresses and statelessly autoconfigured addresses on top of IEEE 802.15.4 networks. Since IPv6 requires support of packet sizes much larger than the largest IEEE 802.15.4 frame size, an adaptation layer is defined. It also defines mechanisms for header compression required to make IPv6 practical on IEEE 802.15.4 networks, and the provisions required for packet delivery in IEEE 802.15.4 meshes. However, a full specification of mesh routing (the specific protocol used, the interactions with neighbor discovery, etc) is out of the scope of this document.

IEEE 802.15.4 defines four types of frames: beacon frames, MAC command frames, acknowledgement frames, and data frames. IPv6 packets MUST be carried on data frames. Data frames may optionally request that they be acknowledged. In keeping with, it is recommended that IPv6 packets be carried in frames for which acknowledgements are requested so as to aid link-layer recovery. IEEE 802.15.4 networks can either be non beacon-enabled or beacon-enabled. The latter is an optional mode in which devices are synchronized by a so-called coordinator's beacons. This allows the use of super frames within which a contention-free Guaranteed Time Service (GTS) is possible. This document does not require that IEEE networks run in beacon-enabled mode. In nonbeacon- enabled networks, data frames (including those carrying IPv6 packets) are sent via the contention-based channel access method of unslotted CSMA/CA. The mechanisms defined in this document require that both source and destination addresses be included in the IEEE 802.15.4 frame header. The source or destination PAN ID fields may also be included.

IEEE 802.15.4 defines several addressing modes: it allows the use of either IEEE 64-bit extended addresses or (after an association event) 16-bit addresses unique within the PAN .This document supports both 64-bit extended addresses, and 16-bit short addresses. It assumes that a PAN maps to a specific IPv6 link. This complies with the recommendation that shared networks support link- layer subnet broadcast. Strictly speaking, it is multicast not broadcast that exists in IPv6. However, multicast is not supported natively in IEEE 802.15.4. Hence, IPv6 level multicast packets MUST be carried as link-layer broadcast frames in IEEE 802.15.4 networks. This MUST be done such that the broadcast frames are only heeded by devices within the specific PAN of the link in question.

II. RELATED WORK

Reliable and Energy-Efficient [1] Multicast Based on Network Coding for Wireless Sensor Networks tackles the problem of providing end to end reliable transmissions in a randomly deployed wireless sensor network. It investigate the simultaneous use of gradient broadcast routing (for its inherent adaptability to any network topology and its changes), fountain codes (for their universal property) and intra-flow network coding. The impact of the proposed XLT-GRAB strategy on a realistic network. This work permits to highlight that compared to basic gradient broadcast routing, the strategy not only improves the reliability and the delay in the network but also clearly increases its lifetime.

An application-specific protocol architecture [2] for wireless micro sensor networking together hundreds or thousands of cheap micro sensor nodes allows users to accurately monitor a remote environment by intelligently. This system developed and analyzed low-energy adaptive clustering hierarchy (LEACH), protocol architecture for micro sensor networks. LEACH includes a new distributed cluster formation technique that enables self organization of large numbers of nodes. LEACH can improve system lifetime by an order of magnitude compared with general-purpose multi hop approaches**.**

TRW: An Energy Storage Capacity Model [3] for Energy Harvesting Sensors in Wireless Sensor Networks (WSNs) is shifted towards alternate sources by utilizing available ambient energy, of which solar irradiance harvesting is considered a viable alternative to fixed batteries. Trinomial Random Walk (TRW) model for the storage capacity of harvesting enabled sensors. It proposed model on a comprehensive solar radiation data set of four different locations around the globe energy harvesting scenario. This model better approximates the optimal load with probability of up to a maximum of 98%, compared to a maximum of 37% for the binomial random walk model.

RF-MAC: A Medium Access Control Protocol [4] for Re-Chargeable Sensor Networks Powered by Wireless Energy Harvesting, Wireless charging through directed radio frequency(RF) waves is an emerging technology that can be used to replenish the battery of a sensor node, albeit at the cost of data communication in the network. These studies are then used to design a MAC protocol called RF-MAC that optimizes energy delivery to sensor nodes, while minimizing disruption to data communication. First distributed MAC protocol for RF energy harvesting sensors, and through a combination of experimentation and simulation studies, we observe 300% maximum network throughput improvement over the classical modified unslotted CSMA MAC protocol.

III. PROPOSED SYSTEM

The proposed system focus on one of the latter tasks, namely the download of large sized files. We identified and proposed solutions to the problems of carrier's selection and chunk scheduling, and extensively evaluated them. The main contribution of this work lies in the demonstration that vehicular cooperative download in urban environments can bring significant download rate improvements to users traveling on trafficked roads in particular. Advantages of proposed system are 1. Improve the network capacity, 2. Download large-sized files and 3.There are good carry and forward transmission.

A. Architecture

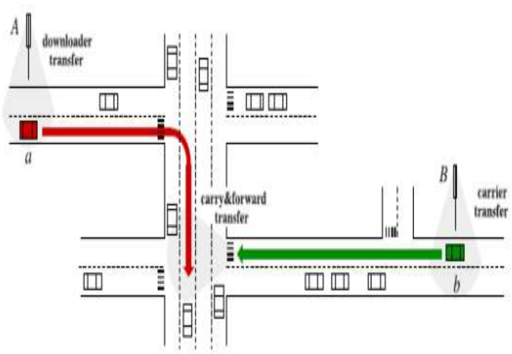

Fig 1: Architecture diagram

B. Co-operative Download

Let us first point out which are the major challenges in the realization of a Vehicular cooperative download system within complex urban road. Selection of the carrier(s): contacts between cars in urban/suburban environments are not easily predictable. Idle APs cannot randomly or inaccurately select vehicles to carry data chunks, or the latter risks to be never delivered to their destinations. Choosing the right carrier(s) for the right downloader vehicle is a key issue in the scenarios we target.

C. Chunk Scheduling

1. Global

The Global chunk scheduling assumes that APs maintain per vehicle distributed chunk databases, similar to the time databases introduced before. These databases store information on which chunks have already been scheduled for either direct or carry & forward delivery to each downloader.

2. Hybrid

The Hybrid chunk scheduling allows overlapping between carry & forward transfers scheduled by different APs.

3. Local

The Local chunk scheduling is similar to the Hybrid scheme, since different APs can schedule the same chunks when delegating data to carriers

C. AP Deployment

1. Random

Under the Random AP positioning scheme, each point of the road topology has the same probability of being selected for the deployment of an AP. The resulting placement may be considered representative of a completely unplanned infrastructure.

2. Density-based

The Density-based AP deployment technique aims at maximizing the probability of direct data transfers from APs to downloader vehicles. To that end, this technique places the APs at those crossroads where the traffic is denser.

3. Cross volume-based

The Cross volume-based AP placement is designed to favor carry & forward transfers, by increasing the potential for collaboration among vehicles. This technique exploits the predictability of large-scale urban vehicular traffic flows, which are known to follow common mobility patterns over a road topology.

IV. DESIGN

A. Input Design

The input design is the link between the information system and the user. It comprises the developing specification and procedures for data preparation and those steps are necessary to put transaction data in to a usable form for processing can be achieved by inspecting the computer to read data from a written or printed document or it can occur by having people keying the data directly into the system. The design of input focuses on controlling the amount of input required, controlling the errors, avoiding delay, avoiding extra steps and keeping the process simple. The input is designed in such a way so that it provides security and ease of use with retaining the privacy. Input Design considered the following things: 1.What data should be given as input? ,2. How the data should be arranged or coded? , 3. The dialog to guide the operating personnel in providing input.,4. Methods for preparing input validations and steps to follow when error occur.

Objectives

1. Input Design is the process of converting a user-oriented description of the input into a computer-based system. This design is important to avoid errors in the data input process and show the correct direction to the management for getting correct information from the computerized system.

2. It is achieved by creating user-friendly screens for the data entry to handle large volume of data. The goal of designing input is to make data entry easier and to be free from errors. The data entry screen is designed in such a way that all the data manipulates can be performed. It also provides record viewing facilities.

3. When the data is entered it will check for its validity. Data can be entered with the help of screens. Appropriate messages are provided as when needed so that the user will not be in maize of instant. Thus the objective of input design is to create an input layout that is easy to follow

B. Output Design

A quality output is one, which meets the requirements of the end user and presents the information clearly. In any system results of processing are communicated to the users and to other system through outputs. In output design it is determined how the information is to be displaced for immediate need and also the hard copy output. It is the most important and direct source information to the user. Efficient and intelligent output design improves the system's relationship to help user decision-making.

1. Designing computer output should proceed in an organized, well thought out manner; the right output must be developed while ensuring that each output element is designed so that people will find the system can use easily and effectively. When analysis design computer output, they should Identify the specific output that is needed to meet the requirements.

2. Select methods for presenting information.

3. Create document, report, or other formats that contain information produced by the system.

The output form of an information system should accomplish one or more of the following objectives, convey information about past activities, current status or projections, Future, Signal important events, opportunities, problems, or warnings, Trigger an action, Confirm an action.

V. EXPERIMENTAL RESULTS

A. Enter the IP and attach data

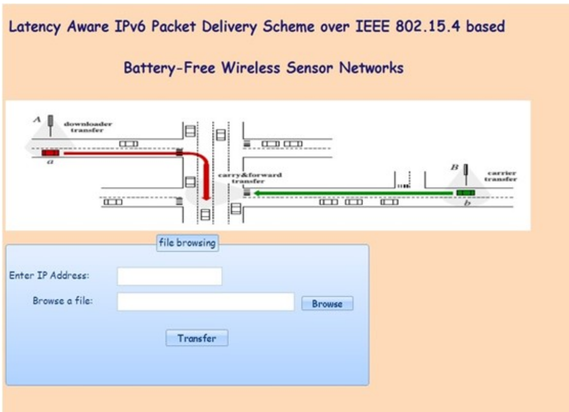

Fig 2: Enter the IP and attach data

B. Transfer the data each node

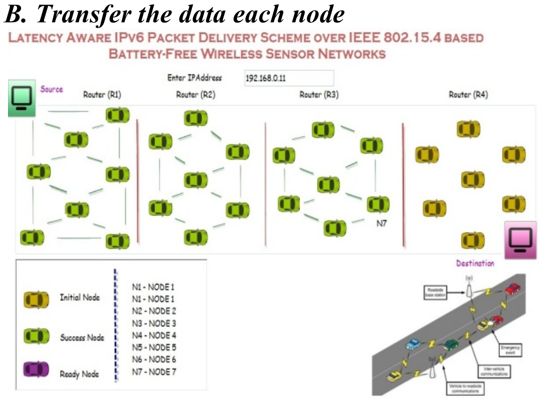

Fig 3: Transfer the data each node

C. Random Density Cross Volume

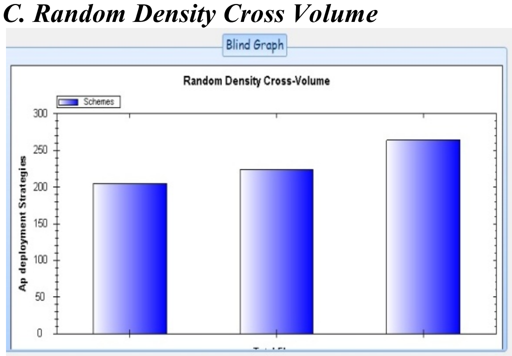

Fig 4: Random Density Cross Volume

D. Delay tolerant information

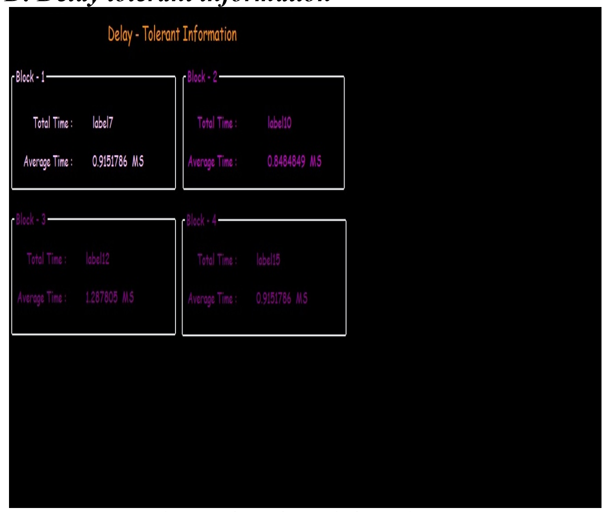

Fig 5: Delay tolerant information

VI. CONCLUSION

We considered a complex (i.e., nonlinear) road scenario where users aboard vehicles equipped with communication interfaces are interested in downloading large files from road-side Access Points (APs). We investigated the possibility of exploiting opportunistic encounters among mobile nodes so to augment the transfer rate experienced by vehicular downloader's. To that end, we devised solutions for the selection of carriers and data chunks at the APs, and evaluate them in real-world road topologies, under different AP deployment strategies. Through extensive simulations, we showed that carry & forward transfers can significantly increase the download rate of vehicular users in urban/suburban environments, and that such a result holds throughout diverse mobility scenarios, AP placements and network loads.

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