Design of Optimal ERS-based Advanced Smart Vehicle Adaptive Traffic Service

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Abstract. The Expanding Ring Search is a useful technique for reducing the overhead of the broadcast storm problem when searching in multi-hop wireless network for Adaptive Trajectory Service. The algorithm searches successively larger areas to find the needed vehicle location information, trajectory service, and wireless network traffic condition. We propose expanding ring search with multi-hop cooperative transmission and routing strategies to apply second part of CAAS Project. Accordingly, we suggest to Wireless Broadcasting Network with based Smart Vehicle Adaptive Traffic Service.

Keywords: Wireless Broadcasting Networks, ERS, SV Traffic Service.

1 Introduction

Broadcasting is an open operation to resolve many issues in networks. In multi-hop networks, when intermediate nodes receive different set of streams, they cooperatively forward streams toward the final destination [1]. In addition, they executed more frequently such as finding a route to a particular host, and sending an alarm signal particularly. Especially, for mobile network/communication of vehicle, the use of radio resources increases more significantly. However, widely network broadcasting in vehicle traffic environment incurs considerable overhead in terms of wireless bandwidth, node processing, and energy consumption. Also, deriving of smart vehicle and transportation system are basically to seek drivers which had road construction, collisions, debris in the roadway, and heavy traffic freeways particularly in a phenomenon known as traffic weaves. In order words, Techniques to reduce the extent of such broadcasting, therefore, are a key requirement in resource-constraint multi-hop wireless networks.

Expanding Ring Search, so called ERS, is a widely used technique that aims to avoid network-wide broadcasting by searching successively larger areas in the network centered on the source broadcast [2]. ERS can be used not only in multi-hop wireless networks, but also in other multi-hop networks, e.g., in Mesh Networks and peer-to-peer networks. Network-wide broadcast is initiated only if the information cannot be located in the local area, and one key parameter from the ERS is the...
threshold of local search before initiating a possible network-wide broadcast. Although, there is a large volume of work that use ERS to reduce broadcast over, this parameter must be selected to achieve the best possible performance.

Accordingly, in this research paper, we propose if there exists an optimal search threshold that would minimize the broadcast cost of ERS for the Advanced Smart Vehicle Traffic Service. Our mainly approach is a theoretical model to gain an insight of the performance dynamics of ERS as a function of the search threshold, and then we’re probably able to show that there exists an optimal threshold for any random network topology.

2 Network Model

In this section, we show our network of Smart Vehicle (SV) model and notations. Then we have some preliminary research on hop-counts. We make the following assumptions in our network of SV that we describe: i) We assume that the source node locates at the center of circular network distributed region randomly. ii) The query packet carries a TTL value and a sequence number. iii) We define the ‘Search Cost (SC)’ as the number of expected inter-broadcasts before the source node receives a SC-free acknowledgement from the intended destination of the inquiry packet. iv) Eventually, we assume the broadcast are collision-free, that is all broadcasts are conscientiously scheduled so that all neighbors of the sender will be able to overhead the message successfully [3]. We generalize a RS schema with a search set of \( R = \{r_1, r_2, ..., r_n\} \). In this schema, if the search does not locate the destination, a broadcast with TTL = \( r_1 \) is sent first. Otherwise, a new broadcast with TTL = \( r_2 \) is sent. A broadcast with TTL = \( r_n \) fails to locate the destination, a process is a continuous. Besides, we also consider the following notations: \( M \) is number of network nodes; \( H \) is the maximum hop that \( M \) nodes may spread from the source node at the center of the network; \( r \) is radio transmission range; \( n(i) \) is number of nodes that are exactly \( i \) hops away from the source node; \( k \) is the size of the search set, where \( 1 \leq r_1 < r_2 < ... < r_n \leq H \). We use the random distribute of nodes to estimate \( N(i) \) and \( n(i) \), the number of nodes within \( i \) hops from the source node and the number of node on the \( i \)-th hop ‘ring’, respectively, \( 0 \leq i \leq H \).

3 Performance Analytical Model (PAM)

As we known, the searching threshold is a key parameter that affects the performance of the ERS. There is some work related to finding an optimal value of the search threshold to obtain the best performance for the ERS. The network model has the following properties. There are \( N \) randomly placed wireless nodes that form a multi-hop wireless network based on the SV. Each node is equipped with an omni-directional wireless broadcast antenna and they communicate with other nodes in their radio coverage range [4]. The node that initiates the search is called the source node. All nodes that are on hop away from the source node form ring 1, nodes that are two hops away from ring 2, and so on means that the starting radius is 1 and the
incremental value is. Ring $i$ has $0 \leq n_i \leq N$ nodes and the distribution of $n_i$ depends on the network topology. In the end, when a limited radius search is initiated with a radius of $k$ (TTL), then the broadcast cost for the search is basically the number of nodes contained in all the ring up to $(s-1)$, which is given by $B_s = 1 + \sum_{i=1}^{s-1} n_i$ as shown Figure 1.

Fig. 1 is shown Ring Search (RS) with PAM of Smart Vehicle Adaptive Traffic Service. The motivation for this idea is that if there are some nodes that have the needed information or if the information is located near the source, then the network-wide broadcast can be avoided. So to speak, control the radius of the search, the source node sets the TTL parameter in the message to a specific value (Left). The other side is presented Smart Vehicle Adaptive Service (Right) [5].

4 SV Traffic Service based Experiments

In this section, we evaluate the performance of restrict ERS according to the calculated ideal value of searching threshold with traffic service. The effect of the searching threshold on the overhead of the ERS is analyzed for many networks with different sizes and node placement by the narrow environment [6]. We investigate the RS({$r_1$}) schemes with R in a more general form. The cost of the RS({$r_1$}) scheme is $C({r_1}) = C(\Phi) + [N(r_1-1) - N(r_1)] \leq C(\Phi)$. Therefore, when $n(r_1) = N(r_1) - N(r_1 - 1) > 0$, the RS({$r_1$}) scheme out-performances the RS(\Phi) scheme. This being so, we is equivalent to premise scheme in a place as following; (1) The cost of the RS(\Phi) scheme is given by $C(\Phi) = M$. (2) The cost of the RS({$r_1 < r_2, ...., <r_n$}) scheme decreases with the increase of $r_n \leq H$, i.e., $C({r_1 < r_2, ...., <r_n}) > C({r_1 < r_2, ...., <r_n})$, when $r_n < r_n \leq H$. (3) For a large position integer H and a real-valued variable z, $0 < z \leq H-2/H$, the function $f(z)$, that is $f(z) = \sqrt{1 + z^2} + H^2z^2 - [z(H+1)(H-1) / H]^2$, achieves minimum when $z$ takes a value close to $z^* = (H-1)^2 / (2H-1)H$. Accordingly, we have the RS({$1, (H-1)^2 / 2H-1), H$}) scheme is the optimum scheme that achieves lowest cost among all RS schemes as following in figure 2.

Fig.2 shows the performance of a class ERS schemes, the RS(R) scheme with $R = \{1, 2, 3, ...., L\}$ and a limit of $L \leq H$ is presented for different maximum hop-count of the network, H. From left figure, we could observe that the benefit of using these ERS scheme is extremely limited. In most of the scenarios of ITS system/SV traffic service
that we have shown, the ERS schemes have higher search cost than pure flooding ($n < 0$). We also show the performance of the $RS(r_1, r_2, r_3 = H)$ schemes with $H = 60$ by right figure. As observed from Fig. 2, the $RS(r_1, r_2, r_3 = H)$ scheme is more efficient.

![Fig. 2. Performance of a class ERS schemes](image)

5 Conclusion

We focus on the problem of locating a randomly chosen destination in a large multi-hop wireless network with ERS into RS schemes, in which a search set ($R$) is used to set the TTL field of the inquiry packet sequentially before network-wide flooding is initiated. We really a wishful thinking, smart vehicle and wireless network infrastructure (V2X) will hope to provide in next generation smart vehicle useful service, as well as improve many researcher to help.

References