A Channel Popularity Oriented Transmission Scheme in Vehicular IPTV Networks

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***Abstract*-IPTV services in vehicular networks are currently attracting increasingly more attentions. One essential challenge is to efficiently utilize the limited radio resources in vehicular access networks. This paper assumes that scalable video coding (SVC) is used to encode TV channels. Since TV channels usually possess different popularities, the paper proposes a novel transmission scheme, which employs differentiated modulation and coding scheme (MCS) profiles for channels of different popularities. The principle is to use more robust MCS profiles for more popular channels while to adopt higher efficient MCS profiles for less popular channels. Comparative simulation experiments are conducted and show that the proposed scheme can effectively and efficiently improve the gross channel availability (GCA) up to 10% compared to the baseline method.**

Key words: wireless multimedia networks, IPTV, vehicular networks, scalable video coding (SVC), channel popularity

I. INTRODUCTION

Intelligent transportation system (ITS) mainly focuses on two categories of applications, i.e., security related and entertainment related. The vehicular IPTV service is regarded as one of the most promising multimedia entertainment applications, since it can provide passengers with live TV access on-the-road. Communications in vehicular networks are classified into *vehicle-to-infrastructure* (V2I) and *vehicle-to-vehicle* (V2V) modes [1]. The V2I mode is implemented with a set of road-side units (RSUs) built-up along the roads and can be accessed by vehicles via wireless links. The common manner to establish V2V communications is to build MANET or VANET (in the context of vehicular networks).

Vehicular IPTV is a live video streaming service, which implies high bandwidth demands and strictly limited transmission delay. Service providers, therefore, prefer to transmit TV channels in pure V2I mode. However, radio resource on RSUs is usually quite restricted. When it cannot support the concurrent transmission of all the channels, users may consequently suffer from deteriorated channel availability, one of the most important QoE metrics. SVC is a solution to mitigate this problem. In particular, SVC is employed to encode TV channels. Due to the fact that a lower SVC layer typically takes more weight than a higher SVC layer from users' perspective, more robust *modulation coding schemes* (MCSs) are used for lower SVC layers, while higher efficient (less robust) MCSs are employed by higher SVC layers. By this means, differentiated robustness and radio resource utilization efficiency can be provided. Chen et al. [2] proposed a scheme to deliver layered video information through wireless heterogeneous vehicular networks, where the mobile stations failing to receive all layers can learn the layer information from neighbors and regain the information through relaying using VANETs. Xing et al. [3] derived an adaptive video streaming scheme for video streaming services in the highway scenario. Relying on cooperative relay among vehicles, a vehicle can download video data using a direct link or a multi-hop path to the RSUs. Momeni et al. [4] investigated the TV channel availability in vehicular IPTV services with different traffic intensities and a varying number of TV channels offered to find out the acceptable availability of TV channels or the CBP. Hu et al. [5] investigated the BPRA problem for the layered video multicast in VANETs.

This paper elaborates a novel TV channel transmission scheme to further enhance the radio resource utilization. The major contribution attributes to the fact that the proposed transmission scheme is TV channel popularity oriented, which has rarely been studied in previous literature. Comparative simulation experiments are conducted and illustrate that the proposed scheme can effectively improve the GCA up to 10% compared to the baseline method where all the provided TV channels are transmitted with the same MCS profile.

The remaining part of this paper proceeds as follows. Section II gives a brief on IPTV services in the vehicular networks. Then, as the paper's major contribution, a novel transmission scheme concerning channel popularity is elaborated in Section III, with the discussions on its advantages and disadvantages. After that, in Section IV, the performance of the proposed scheme is evaluated by means of simulation. Finally, conclusions are given in Section V.

II. IPTV SERVICES IN VEHICULAR NETWORK

A. Typical vehicular IPTV network architecture

A typical vehicular IPTV network has been illustrated in Figure 1, which hierarchically consists of three different levels, namely backbone, aggregation, and access networks. *Video head-end office* (VHO) is attached to the backbone network via very-high-speed fibers, and is the source of all the provided TV channels. It can also be the source of other *video-on-demand* (VoD) resources. The backbone and the aggregation levels are typically tree-topology-based; the underline physical links can be either wire-line or wireless depending on practical capacity demands and budgets. In the access network, a number of RSUs are linearly deployed along

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