Extensive Literature Survey on Architecture of FM0/Manchester Encoding Using SOLS Technique

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Abstract: Wireless vehicular communication has the potential to enable a host of new applications, the most important of which are a class of safety applications that can prevent collisions and save thousands of lives. The automotive industry is working to develop the dedicated short - range communication (DSRC) technology, for use in vehicle - to - vehicle and vehicle - to - roadside communication. The effectiveness of this technology is highly dependent on cooperative standards for interoperability.

Keywords: Dedicated short-range communication (DSRC), FM0, Manchester, VLSI.

I. INTRODUCTION

The vehicular ad hoc network (VANET) is a kind of wireless ad hoc network which deploys the concept of continuous varying vehicular motion. Here, the moving vehicles act as nodes. It is an active area research right now and emerging type of network aimed at improving safe driving, traffic optimization and some other services through vehicle to infrastructure communication (V2I) or vehicle to vehicle communication (V2V). It plays an important part in intelligent transportation system (ITS). Each vehicle communicate send and receive messages by On Board Unit (OBU) and equipped with Event Data Recorder, GPS, Trusted component etc. The Roadside Units (RSU) is responsible for broadcasting safety messages periodically.

With recent advances in the development of Wireless communications protocols and plummeting costs of hardware needed, along with the automobile industries desire to increase road safety and gain competitive edge in the market , Vehicles are equipped with latest communication hardwires, GPS etc. hence becoming Computers on Wheels or computers networks on wheels. But wireless communication is itself susceptible to various attacks; hence the security of VANET cannot be undermined. Some malicious vehicle may send false information into the network to gain unfair advantage on the road or to cause serious accidents. Hence the sender vehicles should be authenticated by the receiver before taking any action based on the received safety message. Normally origin authentication is provided by digital signature with the help of certification services. In VANET, a Trusted Authority (TA) serves the purpose, but it involves huge communication over-head and also a vehicle has to communicate with TA via RSUs. Now RSUs are fixed infrastructures along the road, which periodically broadcast safety related information, Typically RSUs placed over every 300m to 1 km and they broadcast at the interval of every 300ms. Hence placing RSUs along a long highway to provide omnipresent infrastructure is not feasible economically for now. Hence vehicle should be able to authenticate others with limited help from TA or fixed infrastructure. Also in VPKI, the public keys are bound to identity of the vehicles in certificates, hence an eavesdropper may track the sending vehicle, but we need to protect the privacy as well.

Intelligent Transportation System

In ITS, each vehicle acts as sender, receiver and router to broadcast the information to the vehicular network or transportation agency, which then used the information to ensure safe, free-flow of traffic. The vehicles must be configured with On Board Units (OBU), and the Road Side Units (RSU) must be present at fixed intervals for communication to occur. RSUs are connected to the backbone network which is assumed to be secure and free from security attacks. RSUs and Trusted Authority (TA) are static in nature and together forms the fixed infrastructure. The number and distribution of RSUs depends on the communication protocol to be used. The possible configurations in ITS are vehicle to vehicle, vehicle to infrastructure and routing based communications the following fig. 1 depicts a typical ITS.

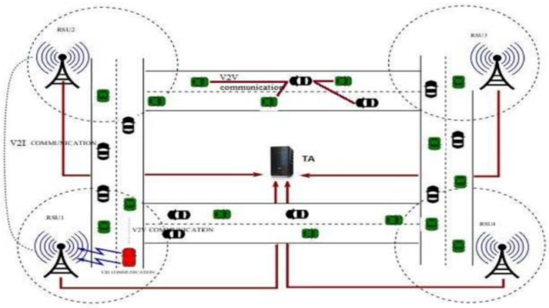

Fig. 1: Intelligent Transportation System

Vehicle to Vehicle Communication

It is multi-hop multicast/broadcast communication used to transmit traffic related information over multiple hops to a group of receivers. ITS is generally concerned with the road ahead and not on the road behind. ITS mainly used two types of message forwarding techniques, Nave Broadcasting and Intelligent Broadcasting.

Naive Broadcasting: believes in periodic broadcasting of messages at regular intervals. If the message comes from behind then the vehicle ignores the message, but if the message comes from a vehicle ahead then the receiving vehicle send its own broadcast message to the vehicles behind it. The limitations of naive broadcasting method are that large numbers of broadcast messages are generated, hence increases network overhead.

Intelligent Broadcasting: overcomes the above limitation by using acknowledgements, hence limiting the number of message broadcasts. If the event-detecting vehicle receives the same message from behind it, it assumes that at least one vehicle in the back has received it and will be responsible for further transmitting the message. Hence it ceases broadcasting.

Vehicle to Infrastructure Communication

Also known as V2I communication. Here the Road Side Unit (RSU) broadcasts message to the vehicles in the vicinity. This type of configuration provides ample amount of bandwidth link between communicating parties. Mostly used for traffic optimization messages.

Routing Based Communication

It's a multi-hop unicast method where a message is transmitted in a multi-hop fashion until it reaches the desired vehicle. It is combination of both V2V and V2I communication. Mostly used for both safety and non-safety message transmission, infotainment services etc.

Dedicated Short Range Communication (DSRC)

It is developed by USA and is a short to medium range communications service that is used for V2I and V2V communication. The United States Federal Communications Commission (FCC) had allocated 750 MHz of spectrum i.e. from 8.5 GHz to 9.25 GHz to be used by DSRC. DSRC spectrum has 7 channels with each channel 100 MHz wide. Out of 7 channels, six channels are used for service purpose and remaining one for control purpose. The following fig. 2 shows the bandwidth allocation of DSRC Spectrum.

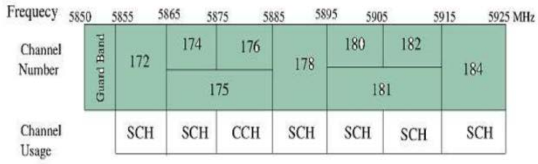

Fig. 2: DSRC Bandwidth Allocation

Components Needed for VANET Security Architecture

Event Data Recorder (EDR)

Similar to black-box in aeroplanes and responsible for storing the vehicles critical data, such as position, speed, time, received messages etc. during emergency events, which will help in crash reconstruction and the attribution of liability. It should be tamper-proof.

Trusted Component (TC)

All the cryptographic materials (keys) of a vehicle need proper hardware protection, namely TC. The TC stores all the cryptographic material and performs all the cryptographic operations. The TC can also include its own clock and battery that is periodically recharged from vehicles electric circuits.

Electronic Licence Plate (ELP)

These are unique ID of vehicles equivalent to the traditional license plates [16]. The advantage of ELPs is that they will automate the paper-based document checkup of vehicles, detection of stolen cars. An alternative approach to ELP is to use Electronic Chasis Number (ECN)

Vehicular Public Key Infrastructure (VPKI)

The large number of vehicles registered in different countries and travelling long distances requires a robust, inter-operable and scalable key management scheme. The involvement of legal authorities in vehicle registration indicates a certain level of centralization. Hence the need for Vehicular Public Key Infrastructure (VPKI), where Trusted Authority (TA) will issue certified public/private key pairs to vehicles. There will be several TAs corresponding to different regions; they should cross certify each other. Vehicle manufactures can also take the role of TAs.

Authentication

In order to prevent in-transit traffic tampering and impersonation attacks, authentication is needed of the origin of data packets. Currently ECC (elliptic curve cryptography), the most compact public key cryptosystem is used due to its less overhead. The overheads can further reduced by signing only critical messages.

Privacy

To conceal the vehicles identity, a set of anonymous keys which will change frequently according to different driving conditional are used. These are preloaded into vehicles TC until the next maintenance. Each key is certified by the issuing TA and has a short lifetime. It can be traced back to the real identity of the vehicle in liability issues.

II. LETERATURE SURVEY

Y. H. Lee and C. W. Pan, [1] the dedicated short-range communication (DSRC) is an emerging technique to push the intelligent transportation system into their daily life. The DSRC standards generally adopt FM0 and Manchester codes to reach dc-balance, enhancing the signal reliability. Nevertheless, the coding-diversity between the FM0 and Manchester codes seriously limits the potential to design a fully reused VLSI architecture for both. In this paper, the similarity-oriented logic simplification (SOLS) technique is proposed to overcome this limitation. The SOLS technique improves the hardware utilization rate from 57.14% to 100% for both FM0 and Manchester encodings. The performance of this paper is evaluated on the post layout simulation in Taiwan Semiconductor Manufacturing Company (TSMC) 0.18-μm 1P6M CMOS technology. The maximum operation frequency is 2 GHz and 900 MHz for Manchester and FM0 encodings, respectively. The power consumption is 1.58 mW at 2 GHz for Manchester encoding and 1.14 mW at 900 MHz for FM0 encoding. The core circuit area is 65.98 × 30.43 μm2. The encoding capability of this research can fully support the DSRC standards of America, Europe, and Japan. This paper not only develops a fully reused VLSI architecture, but also exhibits an efficient performance compared with the existing works.

J. B. Kenney, [2] Wireless vehicular communication has the potential to enable a host of new applications, the most important of which are a class of safety applications that can prevent collisions and save thousands of lives. The automotive industry is working to develop the dedicated short-range communication (DSRC) technology, for use in vehicle-to-vehicle and vehicle-to-roadside communication. The effectiveness of this technology is highly dependent on cooperative standards for interoperability. This paper explains the content and status of the DSRC standards being developed for deployment in the United States. Included in the discussion are the IEEE 802.11p amendment for wireless access in vehicular environments (WAVE), the IEEE 1609.2, 1609.3, and 1609.4 standards for Security, Network Services and Multi-Channel Operation, the SAE J2735 Message Set Dictionary, and the emerging SAE J2945.1 Communication Minimum Performance Requirements standard. The paper shows how these standards fit together to provide a comprehensive solution for DSRC. Most of the key standards are either recently published or expected to be completed in the coming year. A reader will gain a thorough understanding of DSRC technology for vehicular communication, including insights into why specific technical solutions are being adopted, and key challenges remaining for successful DSRC deployment. The U.S. Department of Transportation is planning to decide in 2013 whether to require DSRC equipment in new vehicles.

D. Jiang, V. Taliwal, A. Meier, W. Holfelder and R. Herrtwich, [3] The automotive industry is moving aggressively in the direction of advanced active safety. Dedicated short-range communication (DSRC) is a key enabling technology for the next generation of communication-based safety applications. One aspect of vehicular safety communication is the routine broadcast of messages among all equipped vehicles. Therefore, channel congestion control and broadcast performance improvement are of particular concern and need to be addressed in the overall protocol design. Furthermore, the explicit multichannel nature of DSRC necessitates a concurrent multichannel operational scheme for safety and non-safety applications. This article provides an overview of DSRC based vehicular safety communications and proposes a coherent set of protocols to address these requirements.

P. Benabes, A. Gauthier and J. Oksman, [4] A new Manchester code generator designed at transistor level is presented in this paper. This generator uses 32 transistors and has the same complexity as a standard D flip-flop. It is intended to be used in a complex optical communication system. The main benefit of this design is to use a clock signal running at the same frequency as the data. Output changes on the rising edge and falling edge of the clock. Simulations results show a correct behavior up to 1 Gbit/s data rate with a 0.35 μ CMOS technology within a commercial temperature range.

A. Karagounis, A. Polyzos, B. Kotsos and N. Assimakis, [5] A Manchester code generator designed at transistor level with NMOS switches is presented. This generator uses 26 transistors and has the same complexity as a standard D flip-flop. It is intended to be used in a complex optical communication system. The main benefit of this design is the use of a clock signal running at the same frequency as the data. Output changes on the rising edge and falling edge of the clock. The circuit has been designed in a 90 nm UMC CMOS technology to evaluate the efficiency of the proposed approach and experimental results show a correct behavior up to 5 Gbit/s data rate.

Y. C. Hung, M. M. Kuo, C. K. Tung and S. H. Shieh, [6] In this paper, authors propose a modified Manchester and Miller encoder that can operate in high frequency without a sophisticated circuit structure. Based on the previous proposed architecture, the study has adopted the concept of parallel operation to improve data throughput. In addition, the technique of hardware sharing is adopted in this design to reduce the number of transistors. The study uses TSMC CMOS 0.35-mum 2P4M technology. The simulation result of HSPICE indicates that it functions successfully and works at 200-MHz speed. The average power consumption of the circuit under room temperature is 549 muW. The total core area is 70.7 mumtimes72.2 mum. As expected, the circuit can be easily integrated into radio frequency identification (RFID) application

III. PROBLEM IDENTIFICATION

The coding-diversity between FM0 and Manchester encodings causes the limitation on hardware utilization of VLSI architecture design. A limitation analysis on hardware utilization of FM0 and Manchester encodings is discussed in detail. In this paper, the fully reused VLSI architecture using SOLS technique for both FM0 and Manchester encodings is proposed. The SOLS technique eliminates the limitation on hardware utilization by two core techniques: area compact retiming and balance logic-operation sharing. The area-compact retiming relocates the hardware resource to reduce 22 transistors. The balance logic-operation sharing efficiently combines FM0 and Manchester encodings with the identical logic components. This paper is realized in TSMC 0.18-μm 1P6M CMOS technology with outstanding device efficiency. The maximum operation frequency is 2 GHz and 900 MHz for Manchester and FM0 encodings, respectively. The power consumption is 1.58 mW at 2 GHz for Manchester encoding and 1.14 mW at 900 MHz for FM0 encoding. The core circuit area is 65.98 × 30.43 μm2. The encoding capability of this paper can fully support the DSRC standards of America, Europe, and Japan. This paper not only develops a fully reused VLSI architecture, but also exhibits a competitive performance compared with the existing works.

IV. CONCLUSION

With recent advances in the development of Wireless communications protocols and plummeting costs of hardware needed, along with the automobile industries desire to increase road safety and gain competitive edge in the market , Vehicles are equipped with latest communication hardware’s, GPS etc. hence becoming Computers on Wheels or computers networks on wheels.

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