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Editorial: Dependable and Real-time Vehicular Communication for Intelligent Transportation Systems (ITS)

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Transportation systems begin to receive widespread attention from scientific community and emerged towards Intelligent Transportation Systems (ITS), where there is closed loop interaction between vehicles/drivers and the transportation infrastructure empowered by cooperative V2X communications. While some of the enabling technologies are entering their mature phase, e.g., traffic flow sensors and IEEE 802.11p, there is still the need of a complete integrated solution that can take the most benefits from a real-time communication and analysis of the data gathered and appropriate reaction on the transportation system. Furthermore, safety, efficiency and comfort ITS applications exhibit tight latency and throughput requirements, for example safety critical services require guaranteed maximum latencies lower than 100ms while most infotainment applications require QoS support and high data rates. Besides latency and throughput, safety applications also require deterministic communications (real-time) and vehicles involved in accident should be granted timely access to the wireless medium to transmit warning messages, even in congested road scenarios.

Therefore, European Alliance for Innovation (EAI) took a step towards the realization of Future Intelligent Vehicular Technologies based on dependable and real-time communication and invite both academic and industrial research community by organizing Future 5V conference in Porto, Portugal. Future 5V is an annual international conference by EAI (European Alliance for Innovation) and co-sponsored by Springer. Future 5V received more than 50 research articles in field of Vehicular networks/communications covering theory and practices in the after mentioned field of study. The call-for-papers of this SI was an outcome of the 1st EAI International Conference on Future Intelligent Vehicular Technologies, IoT-BC workshop and open submission. We believe that the accepted papers have a good representation of the after-mentioned research field.

The first paper of this SI is "Centralized Group Key Establishment Protocol without a Mutually Trusted Third Party" by Chingfang Hsu et al. The authors have eliminated the need of a mutually trusted key generation center by assuming that each user only trusts himself. This is done by the process during the registration as each user acts as a KGC to register other users and issue sub-shares to other users. From the secret sharing homomorphism, all sub-shares of each user can be combined into a master share. The master share enables a pairwise shared key between any pair of users. A verification of master shares enables all users to verify their master shares are generated consistently without revealing the master shares. In a group communication, the initiator can become the server to select a group key and distribute it to each other user over a pairwise shared channel. The proposed design is unique since the storage of each user is minimal, the verification of master shares is efficient and the group key distribution is centralized.

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The second paper is "Mitigation of Packet Loss using Data Rate Adaptation Scheme in MANETs" by Muhammad Saleem Khan et al. In this paper, the authors proposed a data rate adaptation to avoid packet loss. The Proposed scheme is based on the analysis of queue length of the forwarding nodes, number of source nodes, and rate of link changes. Keeping in view the queue length of forwarding node, initially the intermediate nodes buffer the incoming data packets upto some threshold and then, gradually shift the effect of congestion to the source nodes. Then, the source node adapts its sending data rate to avoid congestion and to ensure reliable data communication. The simulation are performed by varying different network metrics such as data rate, number of source nodes, and node speed. Results show that proposed technique improves network performance in terms of packet delivery ratio upto 15 %, reduction of average end-to-end delay and packet loss due to interface queue overflow upto 25 % and 14 % respectively, as compared to the static rate adaptation scheme.

The next paper "Wireless Power Transfer and In-Vehicle Networking Integration for Energy-Efficient Electric Vehicles" by Wael Dghais et al. The design methodologies of ultra-low power (ULP) electronic module based on low leakage conditioning and processing device are detailed based on nanoscale transistor technology so that the WPT and hybrid EH can be implemented for self-powered devices in EVs. Moreover, in-vehicle network design verification based on a new power-aware behavioral model formulation and extraction for high speed and ULP transceivers that enables the transient prediction of power and ground currents and voltages when multiple drivers are simultaneously switching for signal-power integrity evaluation. The derivation of the proposed model is based on the analysis and extension of the input/output buffer information specification (IBIS). The analysis of the previous IBIS and Mpilog modelling approaches is followed by a new model formulation along with a well-designed characterization and parametric extraction procedure.

The next paper presents a global optimal path planning and controller design algorithm for intelligent vehicles by Hai-wei Wang et al. In this work, the target pursuit model for intelligent vehicles was presented. Then, the research work for global motion planning was carried out based on Stackelberg Differential Game Theory, and the global optimal solution was obtained by using the survival type differential game. Finally, to overcome errors, we use a polynomial method to achieve the smooth motion planning. So, based on Terminal Sliding Mode method, the Active Front Steering controller design was used to calculate the desired active wheel angle for intelligent vehicle path tracking. The simulation and experiment results demonstrate the feasibility and effectiveness of this method for intelligent vehicles' path planning and tracking.

The next paper is "Non-IP Multi-protocol Stack for Vehicular Communications" by Paulo Sousa et al. Due to the characteristics of the wireless communications in vehicular environment, e.g., high-speed mobility causing unpredictable time-varying changes in connectivity, IP protocols are not suitable for safety communications as they require channel scanning, authentication and association under strict time limits. Safety vehicular communications rely, instead on non-IP protocols, either the WAVE Short Message Protocol or the FAST Network and Transport Protocol. Therefore, this paper explore the challenges of implementing such protocols, and designed an architecture for a stack capable of handling both standards. The proposed architecture, including the communication and transport layers of the stack, was implemented and its performance was assessed using a prototype.

The last paper is by Syed Adeel Ali Shah et al. "Coverage Differentiation based Adaptive Tx-Power for Congestion and Awareness Control in VANETs". The paper presents Multi-metric Power Control (MPC) approach, which uses application requirements and channel states to determine a transmit power for safety messages. The MPC gives a best-effort approach to satisfy the coverage range requirement of a message as specified by the application. Moreover, the concept distinguishes among message types to provide coverage differentiation. The paper shows that the best-effort approach of providing coverage for different messages can control congestion and as a result improve awareness by minimizing beacon collisions. The performance analysis of MPC using discrete event simulation confirms its practicality.

Muhammad Alam holds a PhD degree in computer science from University of Aveiro, Portugal (2013 - 14). In 2009, he joined the Instituto de Telecomunicações - Aveiro (Portugal) as researcher and completed his Ph.D from University of Aveiro. He has participated in several European Union FP7 projects such as Hurricane, C2POWER, ICSI, PEACE and Portuguese government funded projects such SmartVision. Currently, he is working as senior researcher at Instituto de Telecomunicações and participating in European Union and Portuguese government funded projects. His research interests include Real-time wireless communication, 5G, Vehicular networks, Context-aware systems and Radio resource management in next generation wireless networks. He is the author of several journal and conference publications as well as book chapters. He is also the TPC member and reviewer for a number of reputed conferences, journals, and magazines. He is IEEE member. He served as general co-chair of future 5V conference and also served as session chairs in a number of conferences.

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