RELAY SUITABILITY BASED ROUTING PROTOCOL FOR VIDEO STREAMING IN VEHICULAR AD-HOC NETWORK

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis, and, in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Doctor of Philosophy.

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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Thesis submitted in fulfillment of the requirements
for the award of the degree of
Doctor of Philosophy

Faculty of Computing
UNIVERSITI MALAYSIA PAHANG

MAY 2022

ACKNOWLEDGEMENTS

All praises to Almighty Allah, the Most Merciful and the Most Benevolent for granting me the strength and courage to persevere throughout this painfully wonderful and fulfilling journey. This thesis would not have completed without the direct and indirect help extended to me by the various parties who warrant special mention.

In particular, I wish to express my sincere appreciation to my supervisor, Dr. Mohd Nizam Mohmad Kahar for encouragement, guidance, critics, and friendship. Without his continued support and interest, this thesis would not have been the same as presented here.

My appreciation goes to all the Professors who participated in the study, and for their support, encouragement, and advice. Finally, I extend my gratitude to my family for their patience, understanding, moral and emotional support.

ABSTRAK

Penstriman video dalam Rangkaian Ad Hoc Kenderaan (VANETs) boleh digunakan untuk tujuan kecemasan jalan raya dan perkhidmatan pengawasan video pintar. Rangkaian kenderaan telah muncul dengan konsep teknologi termaju tanpa wayar yang menyokong pemesejan keselamatan, kemas kini keadaan laluan dan perkongsian maklumat trafik video secara masa nyata. Walau bagaimanapun, penyediaan penstriman video berskala yang memenuhi kualiti video yang ketat tanpa gangguan video di bawah topologi rangkaian yang sangat dinamik adalah suatu tugas yang mencabar. Dalam rangkaian berketumpatan tinggi, pemindahan paket adalah terdedah kepada perlanggaran, terutamanya di bawah protokol penghalaan unicast.Penyelesaian kepada masalah di atas adalah dengan membangunkan teknik yang boleh menjamin QoS. Masalah ini boleh diselesaikan dengan memilih nod geganti yang sesuai untuk meningkat prestasi komunikasi dalam persekitaran VANET. Tesis ini mencadangkan teknik penyelesaian yang dirujuk sebagai *Enhanced Transmit Packet Coding (enhanced-TPC*) dan *weighted division algorithm* (WDA) yakni dirujuk sebagai WDA-RESP. RESP mengambil keputusan penghalaan berdasarkan kepada jarak kenderaan dengan destinasi, kiraan penghantaran yang dijangkakan (ETX), kebarangkalian perlanggaran kepadatan dan pengukuran kestabilan pautan berasaskan halaju relatif. RESP hanya mengambil kira rantau yang kecil dalam menganggarkan gerakan geografi dan kestabilan pautan kenderaan ke arah destinasinya. Tambahan lagi, bagi memastikan kebolehpercayaan rangkaian, RESP menggabungkan WDA untuk memilih nod pemajuan berkualiti tinggi untuk penstriman video. Teknik kedua untuk meningkatkan kualiti video VANET adalah dengan menggunakan *Transmit Packet Coding (TPC).* Di sini, metrik kesesuaian geganti mengambilkira parameter yang sesuai dalam pengekodan rangkaian dan memilih nod pemajuan yang berkualiti tinggi untuk penstriman video. Hasil eksperimen menunjukkan, WDA-RESP mengatasi *Lifetime-aware Beacon-less Routing Protocol (LBRP)* dan protokol penstriman berasaskan geografi lain di mana WDA-RESP menunjukkan hasil nisbah penghantaran paket yang tinggi dan kurang kelewatan paket untuk penstriman video. Dalam eksperimen TCP, keputusan menunjukkan keunggulan TCP jika dibandingkan dengan teknik sedia ada dari segi daya pemprosesan, kependaman, kelewatan hop, nisbah penghantaran paket, kebarangkalian terputus penyahkod rangkaian, dan kadar ralat blok. Kesimpulannya, WDA-RESP menyediakan protokol penghalaan geografi unicast berskala untuk penstriman video dalam VANET dan proses penyebaran video yang lebih baik dan dengan kebarangkalian $\gamma = 50\%$, berbanding dengan kaedah banjir, dan 25% berkesan terhadap skalabiliti dan 75% ke arah mengimbangi parameter QoS video seperti kebolehpercayaan, ketersambungan, kehilangan paket dan kelewatan dalam persekitaran kenderaan. Selain itu, TPC memastikan bahawa bilangan paket yang dihantar melalui rangkaian dapat dikurangkan sambil menyediakan penggunaan peranti dan sumber rangkaian yang cekap. Ia terbukti daripada keputusan eksperimen bahawa algoritma yang dicadangkan mampu menghasilkan keputusan yang lebih baik.

ABSTRACT

Video streaming in Vehicular Ad Hoc Networks (VANETs) can be utilize for roadside emergency and smart video surveillance services. Vehicular networking has emerged with advanced wireless technology concepts that support safety messaging, route condition updates, and real-time video traffic information sharing. However, the provision of scalable video streaming that meets the stringent video quality without video distortions under a highly dynamic network topology is a challenging task. In a high-density network, the transfer packet are prone to collision, especially under a unicast routing protocol. The potential solution to the aforementioned problems is the development of a technique that can guarantee QoS. This problem can be solve by efficiently selecting the suitable relay nodes for communication performance in the VANET environment. This thesis proposed a solution technique referred to as an Enhanced Transmit Packet Coding (enhanced-TPC) and weighted division algorithm (WDA) in Relay suitability-based routing protocol (RESP) term as WDA-RESP. In the RESP, this protocol takes routing decisions based on vehicle proximity to the destination, the expected transmission count (ETX), density-aware collision probability, and relative velocity-based link stability measurement. The RESP estimates the geographic advancement and link stability of a vehicle towards its destination in the small region. Additionally, to ensure reliability the RESP incorporate WDA to selects high-quality forwarding node for video streaming. The second technique for improving VANET video quality is using Transmit Packet Coding (TPC). Here, the relay suitability metric integrates the suitable parameters in the network coding and selects a high-quality forwarding node for video streaming. The experimental results of the WDA-RESP outperformed Lifetime-aware Beacon-less Routing Protocol (LBRP) and other traditional geographical streaming protocols in which WDA-RESP provide high packet delivery ratio and less packet delay for video streaming. In the TCP experiment, the results show superiority of enhanced-TCP when compared to the existing techniques in terms of throughput, latency, hop delay, packet delivery ratio, network decoder outage probability, and block error rate. In conclusion, the RESP provided a scalable unicast geographic routing protocol for video streaming in VANETs and improved video dissemination processes and with a probability of $\gamma = 50\%$, it was the best solution compared to flooding, 25% effective toward scalability and 75 % towards balancing video QoS parameters like reliability, connectivity, packet loss, and delay within vehicular environments. Also, the TPC ensures that the number of transmitted packets over the network can be reduced while providing an efficient utilization of network devices and resources. It is evident from the result that the proposed algorithm able to produced better result.

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