A group key agreement protocol for VANET based on Chinese Remainder Theorem and Blockchain

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Abstract

As a wireless ad hoc network, VANET is susceptible to various threats including eavesdropping and tampering, due to its insecure wireless channels. The group key agreement protocol is widely used in VANET due to its ability to allow participants to communicate securely in insecure network environments. However, excessive reliance on trusted authority (TA) in traditional group key protocols may cause single point of failure. Additionally, having a high computational and communication cost is a common phenomenon in existing protocols. To address the above issues, we have designed a lightweight group key agreement protocol using blockchain technology and Chinese remainder theorem(CRT). In our protocol, the blockchain technology is used to facilitate faster negotiation of group key between Roadside Units (RSUs) and vehicles within its communication range. To avoid Single point of failure, TA only provides services during the user joining and leaving phase. To reduce computational and communication costs during the identity authentication process, RSU can perform batch authentication on vehicles. At the same time, participating vehicles only need to obtain the correct session key from the return message broadcasted by the RSU. Our protocol also supports dynamic management of vehicles. We used formal security proof and performance analysis in our scheme, indicating that our scheme meets the basic security requirements of the block key protocol design in VANET. Meanwhile, the analysis of computational costs and communication burden shows that our scheme is more effective in VANET group scenarios.

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