

## **Formal Analysis of Trust and Reputation for Service Composition in IoT**

### **ABSTRACT**

The exponential growth in the number of smart devices connected to the Internet of Things (IoT) that are associated with various IoT-based smart applications and services, raises interoperability challenges. Service-oriented architecture for IoT (SOA-IoT) solutions has been introduced to deal with these interoperability challenges by integrating web services into sensor networks via IoT-optimized gateways to fill the gap between devices, networks, and access terminals. The main aim of service composition is to transform user requirements into a composite service execution. Different methods have been used to perform service composition, which has been classified as trust-based and non-trust-based. The existing studies in this field have reported that trust-based approaches outperform non-trust-based ones. Trust-based service composition approaches use the trust and reputation system as a brain to select appropriate service providers (SPs) for the service composition plan. The trust and reputation system computes each candidate SP's trust value and selects the SP with the highest trust value for the service composition plan. The trust system computes the trust value from the self-observation of the service requestor (SR) and other service consumers' (SCs) recommendations. Several experimental solutions have been proposed to deal with trust-based service composition in the IoT; however, a formal method for trust-based service composition in the IoT is lacking. In this study, we used the formal method for representing the components of trust-based service management in the IoT, by using higher-order logic (HOL) and verifying the different behaviors in the trust system and the trust value computation processes. Our findings showed that the presence of malicious nodes performing trust attacks leads to biased trust value computation, which results in inappropriate SP selection during the service composition. The formal analysis has given us a clear insight and complete understanding, which will assist in the development of a robust trust system.