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Standards and verification for fair-exchange and atomicity in e-commerce transactions

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Abstract

Electronic commerce can be defined as the conduct of commerce in goods and services, with the assistance of telecommunications and telecommunications-based tools. The economic growth potential of e-commerce is extraordinary—but so are the challenges that lie on the path toward success. One of the more pressing challenges is how to ensure the integrity and reliability of the transaction process: key aspects being fair-exchange and atomicity assurance.

This paper delineates an extended fair-exchange standard, which includes atomicity assurance, intended for a wide audience including e-commerce designers, managers, users, and auditors. We demonstrate how such a standard prevents or mitigates important e-commerce concerns. To bridge theory with practice, we illustrate how the

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application of model checking can be used to verify the correctness of the implementation of e-commerce protocols to prevent the failure of such protocols when unforeseen circumstances occur.

Keywords: E-business; E-commerce; Protocols; Model checking; Money atomicity; Goods atomicity; Valid receipt; Standards enforcement

1. Introduction

Development of protocols, or standards, for the exchange of electronic information between transacting parties has expanded from proprietary arrangements for each set of transacting parties (e.g., early EDI) to proprietary standards for communities of transacting parties (e.g., CommerceOne) to menus of public standards from which transacting parties choose (e.g., UDDI and SOAP). Notwithstanding their contributions to facilitating electronic exchanges, these standards focus primarily on facilitating the transaction process. In other words, current practice focuses on establishing methods to complete a transaction. Zhang et al. [1] observe that although this is an essential requirement for engaging in e-commerce, it is generally insufficient to warrant the integrity and reliability of the transaction process under all possible contingencies.

To prevent or mitigate these concerns, Zhou and Gollman [2] have identified conditions that e-commerce protocols must satisfy, which include:

1. Standards should ensure fair-exchange.
2. Standards should not require manual dispute resolution in case of unfair behavior by one party.
3. Standards should provide parties with assurance that the goods or assets they are about to receive are the correct ones, are undamaged, and are in the right quantity.
4. Standards should enable involvement of a trusted third party (TTP).
5. All transaction operations should be completed, or no operations should be completed.

Items 1, 2, 3, and 4 are characteristics of a fair-exchange standard whereas item 5 is a characteristic of atomicity. *Fair-exchange* ensures that the two parties obtain their respective items without allowing either party to gain an advantage by unexpectedly leaving the transaction or otherwise misbehaving [3]. *Atomicity* enables the linking of multiple operations associated with different parties to an e-commerce transaction such that either all necessary operations are executed or none of them are [4].