

Formalizing and Implementing Distributed Ledger Objects^{*} (Abstract)

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Despite the hype about blockchains and distributed ledgers, formal abstractions of these objects are scarce¹. To face this issue, in this paper we provide a proper formulation of a *distributed ledger object*. In brief, we define a *ledger* object as a sequence of *records*, and we provide the operations and the properties that such an object should support. Implementation of a ledger object on top of multiple (possibly geographically dispersed) computing devices gives rise to the *distributed ledger object*. In contrast to the centralized object, distribution allows operations to be applied concurrently on the ledger, introducing challenges on the *consistency* of the ledger in each participant. We provide the definitions of three well known consistency guarantees in terms of the operations supported by the ledger object: (1) *atomic consistency (linearizability)*, (2) *sequential consistency*, and (3) *eventual consistency*. We then provide implementations of distributed ledgers on asynchronous message passing crash-prone systems using an Atomic Broadcast service, and show that they provide eventual, sequential or atomic consistency semantics respectively. We conclude with a variation of the ledger – the *validated ledger* – which requires that each record in the ledger satisfies a particular *validation rule*.

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