Optimistic and Zero-Knowledge Rollups

Understanding blockchain

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1. Introduction

The emergence and widespread adoption of blockchain technology has revealed a fundamental structural limitation: scalability. This, along with the possible solutions to overcome it, will be the main focus of this document.

Scalability is one of the three fundamental components of the blockchain trilemma, along with decentralization and security. The Trilemma states that a blockchain system can only optimize two of these three properties at the same time, forcing designers to accept trade-offs in performance or trust assumptions.

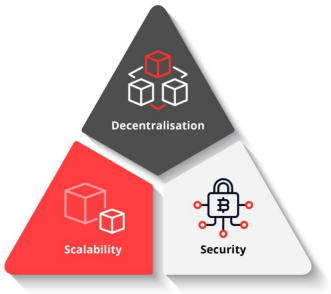

Figure 1: The blockchain trilemma

Interestingly, scalability challenges are not unique to blockchain systems. Traditional database architectures have long faced a comparable tension, often described as the CAP Theorem. Even though applied to different technologies, both frameworks highlight the same underlying idea: achieving perfect performance, resilience and correctness at the same time is structurally difficult, and often impossible.

Blockchain scalability can thus be understood not as an isolated limitation, but as the continuation of a broader historical challenge in distributed systems.