L09: Layer 2 & Scaling

BSc Blockchain Course

Digital Finance

2026

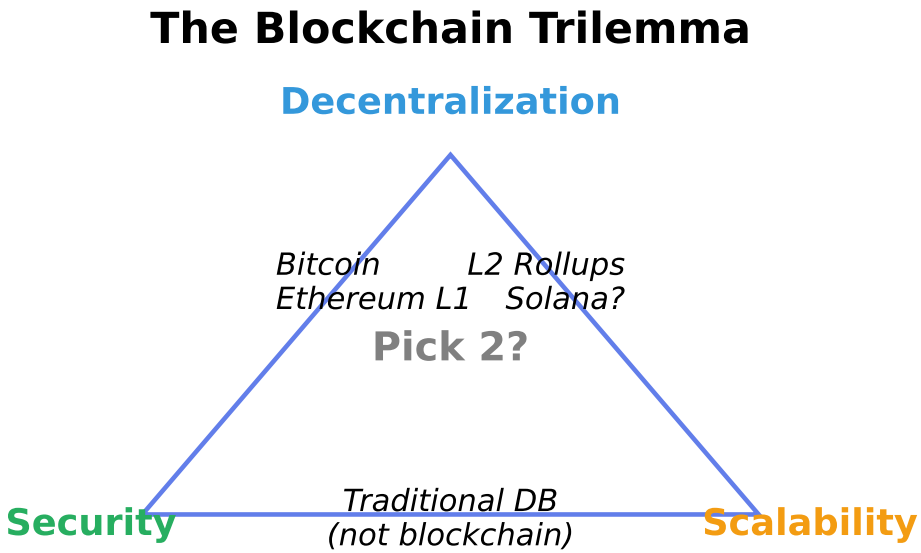
Learning Objectives

By the end of this lesson, you will be able to:

1. Explain the blockchain scaling trilemma
2. Compare optimistic and ZK rollups
3. Understand data availability and its importance
4. Analyze L2 cost and performance tradeoffs
5. Evaluate bridge security and risks

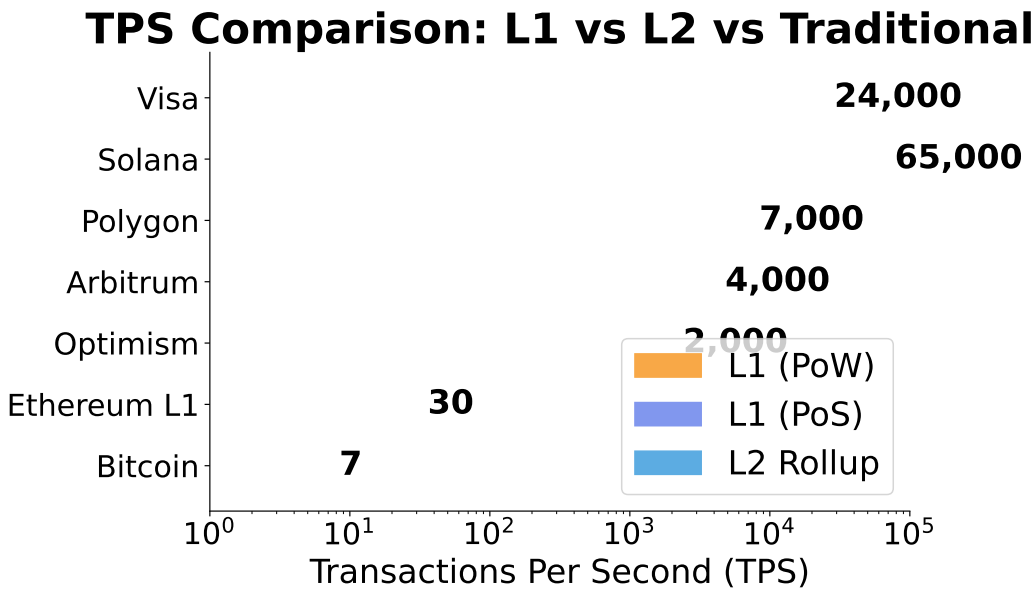
L2s enable Ethereum to scale without sacrificing security.

Scaling Trilemma



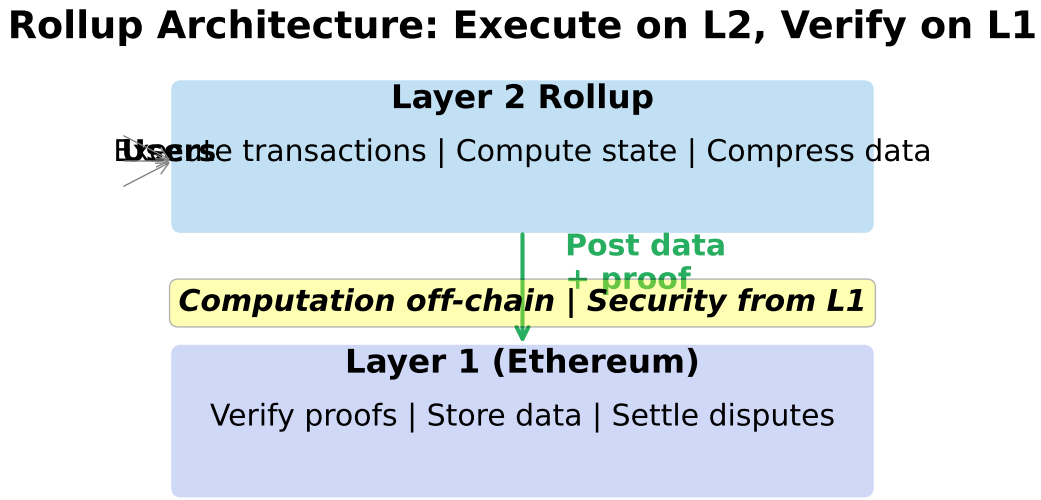
L2s aim to achieve all three by inheriting L1 security.

TPS Comparison



L2s achieve 100-1000x more TPS than L1.

Rollup Architecture



Execute off-chain, verify on-chain.

Optimistic vs ZK Rollups

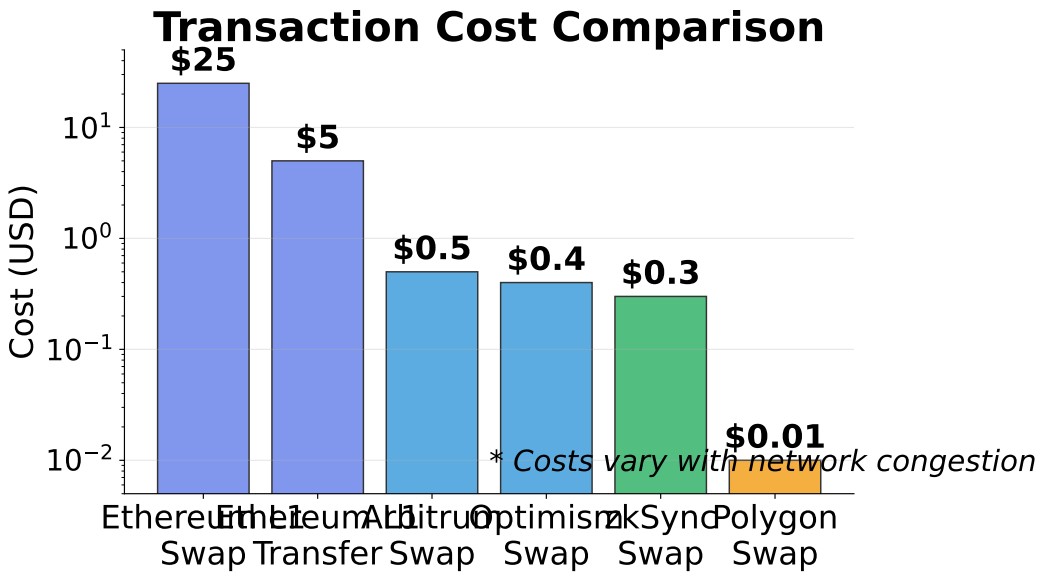
Optimistic vs ZK Rollups

Feature	Optimistic Rollup	ZK Rollup
Proof Type	Fraud proofs	Validity proofs
Finality	~7 days dispute	Minutes
Withdrawal	7-day wait	Fast (~hours)
Complexity	Simpler	Complex (ZK math)
Examples	Optimism, Arbitrum	zkSync, StarkNet

Optimistic: assume valid, prove fraud | ZK: prove validity mathematically

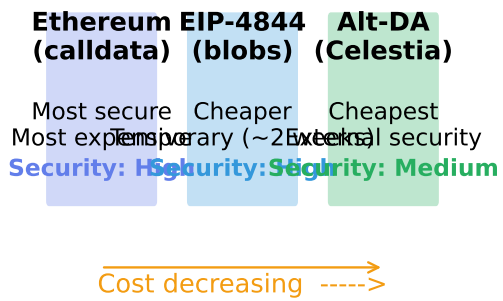
ZK: prove validity. Optimistic: assume valid, allow challenges.

Cost Comparison



L2s reduce costs by 10-100x compared to L1.

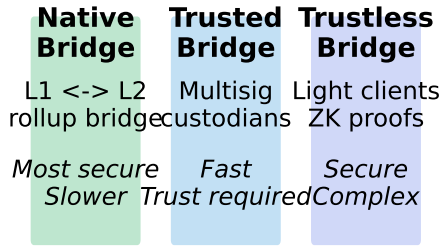
Data Availability



EIP-4844 dramatically reduces L2 data costs.

Bridge Types

Bridge Types: Moving Assets Between Chains



Bridge Risk: Billions lost to bridge hacks (Ronin, Wormhole, Nomad)

Native rollup bridges inherit L1 security; cross-chain bridges add risk

Native L2 bridges are safest; cross-chain adds risk.

Key Takeaways

Remember These Points

1. Rollups: execute off-chain, verify on-chain
2. Optimistic: fraud proofs, 7-day withdrawal
3. ZK: validity proofs, fast finality
4. Data availability: critical for security
5. Bridges: significant security risks

Next Lesson: Privacy Technologies.