Trustchain Mobile: A Low-Latency Smartphone Peer-to-Peer Transaction System

PERFORMANCE ANALYSIS AND BENCHMARKING

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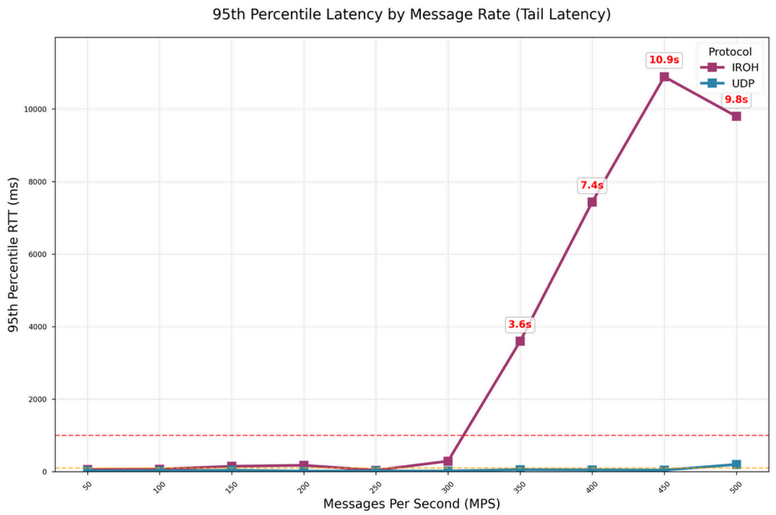
Introduction

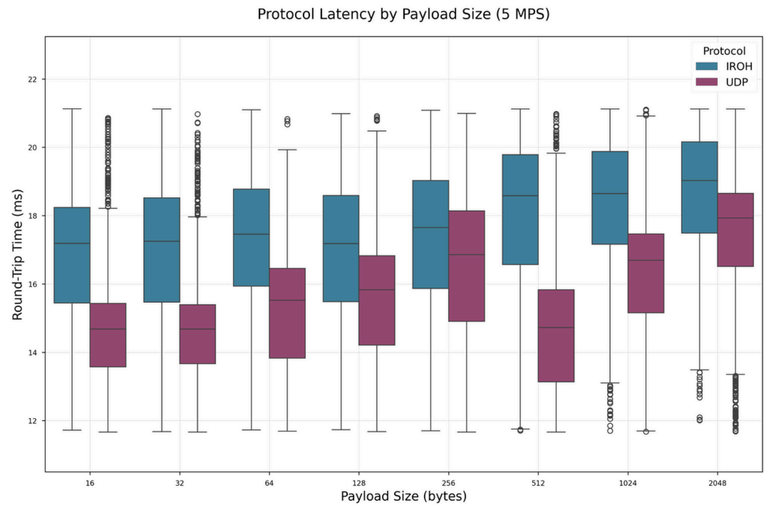
- Mobile blockchain faces critical latency challenges for practical deployment
- This research optimizes latency in a smartphone-native Trustchain implementation
- Part of collaborative 5-person team, each optimizing different metrics (latency, robustness, storage, throughput, battery)
- Built as open-source contribution to Tribler project

Research Question

How can a smartphone-native Trustchain implementation optimize transaction confirmation latency while preserving blockchain integrity under mobile hardware constraints?

Results





Methodology

System Architecture:

- Hybrid Stack: Rust core + Kotlin Android interface
- Two Protocol Implementations:
  - Iroh: Business-grade P2P with QUIC, peer discovery, connection management
  - UDP: Lightweight, custom connectionless implementation

Evaluation Approach:

- Benchmarking Range: 5-500 messages per second (MPS)
- Payload Sizes: 16-2048 bytes
- Measurement: Round-trip time (RTT) via payload-based message matching
- Dataset: 87,357 successful operations across 36 test runs

Future work and limitations

Limitations:

- Single-device testing (WiFi environment)
- Limited to Android platform
- Network conditions constrained to home WiFi

Future Work:

- **Network Diversity:** Cellular networks, varying connection qualities, edge cases
- **Platform Expansion:** iOS implementation, cross-platform compatibility
- **Integration Studies:** Combining with teammates' work on storage, energy, throughput, robustness

Analysis and Conclusion

Protocol Trade-offs:

- **UDP Advantages:** Consistent low latency, high-load resilience, predictable performance
- **Iroh Advantages:** Enterprise features, robust connection management, peer discovery

Analysis:

1. Low Load (5-50 MPS): Both protocols comparable (UDP: 11.8ms, Iroh: 18.2ms)
2. High Load Performance: UDP maintains stability, Iroh degrades beyond 300 MPS

Reliability Under Stress:

1. UDP: 98.8-100.2% success across all loads
2. Iroh: 46.1% success at 400 MPS, 24.3% at 450 MPS