A Note on Fault-tolerant Distributed Algorithms

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Abstract

This document list some problems that I have thought about and potentially have a solution to. We decided not to write a formal write-up about them for various reasons.

Asynchronous Distributed Key Generation

- ADKG with expected round complexity of $O(\log \kappa)$ and computation cost of $O(\kappa n^2)$. Here κ is the statistical security parameter.
- Low-threshold ADKG with expected round complexity of $O(1)$ and computation cost to $O(n^2)$.
- ADKG with expected round complexity of to $O(1)$.

Computational coin tossing protocol

- An one-shot partially synchronous coin-tossing protocol with $n = 3t + 1$ and expected $O(1)$ running time and expected communication cost of $O(c \cdot n^{2+1/c})$, where $c \in \mathbb{Z}^+$ and κ is the cryptographic security parameter. This protocol only assumes a Common Random String.
  - Current best known protocol incurs $O(\kappa n^3)$ communication cost and takes $O(n)$ running time.

Information-theoretic coin tossing protocol

- An information-theoretic one-shot asynchronous coin-tossing protocol with $n = 3t + 1$ and expected communication cost of $O(\kappa n^5)$. κ here is the statistical security parameter. This protocol can generate $O(n^2)$ common coins.
  - Current best known protocol incurs $O(\kappa n^6)$ communication cost for a single coin.

Reliable Broadcast (RBC)

- A balanced RBC protocol with good case latency of three-rounds and communication cost of $O(n|M|+\kappa n^2)$. Our protocol is not authenticated and takes five rounds in the worst case.
  - I do not know of any prior work on this problem.

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