Randomized Consensus Project Report

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Abstract

The FLP impossibility states that no deterministic algorithm can solve consensus in an asynchronous system where at least one process can crash. To circumvent this, we can relax the conditions and make a probabilistic algorithm for consensus. This report will give details on our implementation of Randomized Consensus.
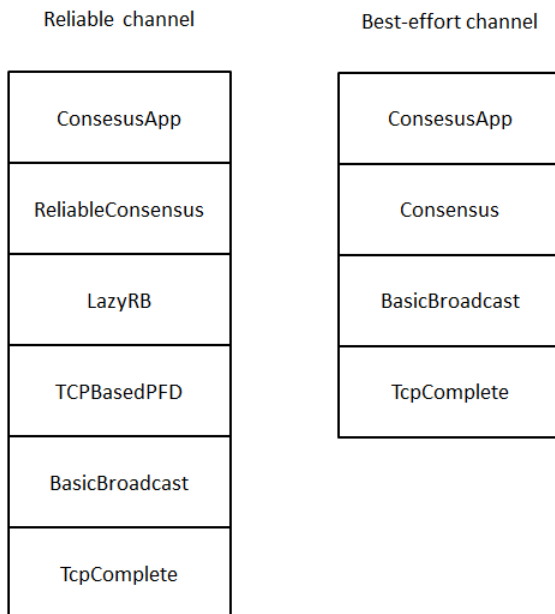
1. Stack

Figure 1: Applia layer stack

Two channels are required according to the Randomized Consensus algorithm. For the first phase of the protocol, it is sufficient to use *Best-effort Broadcast*. For the final part of the second phase, *Reliable Broadcast* is required. For this reason we used two separate stacks, which can be seen on figure 1.

For the reliable channel, we had to use Lazy Reliable Broadcast on top of a TCP-based Perfect Failure Detector. The best-effor channel is much simpler, only requiring a basic broadcast layer.

The implementation of the randomized consensus algorithm is in the *tfsd.consensus* package. *ConsensusLayer* is the layer for the session that uses the best-effort channel. *ReliableConsensusLayer* is for the reliable channel. ConsensusLayer requires ChannelInit and ProcessInitEvent. Above these, it accepts ProposeEvent and SendableEvent.

2. Code

This section contains a brief explanation of the code and its connection to the randomized consensus algorithm.

Figure 2 shows the basic outline of the architecture for our solution. The *ConsensusApp* sends SendableEvents to the ConsensusSession, where they are converted to ProposeEvents and broadcasted. When the algorithm reaches the end of phase 2, this session notifies the ConsensusApp, which in turn sends a SendableEvent to ReliableConsensusApp. This session will then reliably

SendableEvent — ConsesusApp — SendableEvent

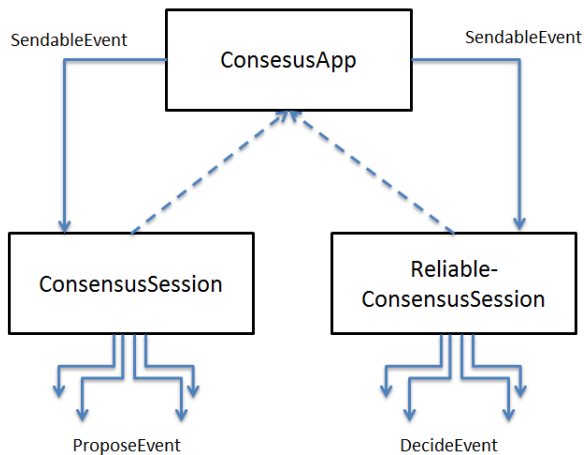ConsensusSession — Reliable-ConsensusSession

ProposeEvent — DecideEvent

Figure 2: Architecture of the application

broadcast the request to start the decision process.

The main part of the algorithm is implemented in ConsensusSession. *handleSendable* is the function responsible for converting SendableEvents into ProposeEvents which are then broadcasted.

After a ProposeEvent is received, its parameters are observed. It has three main parameters: phase, value and timestamp. The propose event is then processed according to its phase.

In phase one, the algorithm waits for a majority. This is handled by *handleProposePhase1*. When a majority is reached, we check if the values are the same. If they are, we enter phase two with this value - entering means we send a new ProposeEvent with the phase set to two. When the values are not the same, we enter phase two with the *bottom value*.

Phase two waits for all replies, minus the number of tolerated failures. When a quorum is reached, it tries to find f+1 occurences of the same v* value. When this is found, it issues a decide.

When a decision could not be made, we restart the algorithm from phase one, with a random value from the previously seen proposals. After the restart, the queues of the quorums are emptied.

Timestamps are used to differentiate between different proposals. There is a started and a decided timestamp. When we see a proposal with a timestamp that is less-than or equal to our decided timestamp, we can discard it.

3. Running the code

4. Evaluation