
MODULE *Blockchain*

This module defines network initial conditions to be used by the *p2p* algorithm.

EXTENDS *Integers, Sequences, TLC, Utils*

Create a network with given number of peers, the blocks and connections to be established.

```

CreateNetwork(numPeers, blockCounts, connections)  $\triangleq$ 
  [peer  $\in$  1 .. numPeers  $\mapsto$ 
    LET numBlocks  $\triangleq$  blockCounts[peer]
      Construct peer_set as a sequence of other peers, seeder nodes have no connections.
      peerSet  $\triangleq$  IF connections[peer] = TRUE THEN
        Remove(
          Add all peers to the list.
          [i  $\in$  1 .. numPeers  $\mapsto$  [
            address  $\mapsto$  "peer"  $\circ$  ToString(i),
            tip  $\mapsto$  blockCounts[i],
            established  $\mapsto$  FALSE
          ]],
          Remove the current peer from the list ...
          [
            address  $\mapsto$  "peer"  $\circ$  ToString(peer),
            tip  $\mapsto$  blockCounts[peer],
            established  $\mapsto$  FALSE
          ]
        )
      ELSE  $\langle \rangle$ 
    IN [
      peer  $\mapsto$  "peer"  $\circ$  ToString(peer),
      blocks  $\mapsto$  ToSet([height  $\in$  1 .. numBlocks  $\mapsto$  [
        height  $\mapsto$  height,
        hash  $\mapsto$  "blockhash"  $\circ$  ToString(height),
        block  $\mapsto$  "serialized block data "  $\circ$  ToString(height)
      ]]),
      peer_set  $\mapsto$  peerSet
    ]
  ]

```

2 peers network. 1 seeder with 1 block and no outbound connections and 1 peer with no blocks and an outbound connection to the seeder.

Blockchain1 \triangleq CreateNetwork(2, $\langle 1, 0 \rangle$, $\langle \text{FALSE}, \text{TRUE} \rangle$)

2 peers network. 1 seeder with 10 blocks and no outbound connections and 1 peer with no blocks and an outbound connection to the seeder.

Blockchain2 \triangleq CreateNetwork(2, $\langle 10, 0 \rangle$, $\langle \text{FALSE}, \text{TRUE} \rangle$)

3 peers network. 1 seeder with 1 block and no outbound connections and 2 peers with no blocks and an outbound connection to the seeder.

$Blockchain3 \triangleq CreateNetwork(3, \langle 1, 0, 0 \rangle, \langle FALSE, TRUE, TRUE \rangle)$

1 peer with or without connections or blocks is an assert

$Blockchain4 \triangleq CreateNetwork(1, \langle 0 \rangle, \langle TRUE \rangle)$

2 or more peers without connections is a deadlock

$Blockchain5 \triangleq CreateNetwork(2, \langle 0, 0 \rangle, \langle FALSE, FALSE \rangle)$

2 peers network. 2 connected to each other with the same amount of blocks.

$Blockchain6 \triangleq CreateNetwork(2, \langle 100, 100 \rangle, \langle TRUE, TRUE \rangle)$

2 peers network. 2 connected to each other with different amount of blocks.

$Blockchain7 \triangleq CreateNetwork(2, \langle 2, 1 \rangle, \langle TRUE, TRUE \rangle)$
