Distributed Primitive Library for Mobile Ad Hoc Networks of Android Devices
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Background
The computing power and mobility of smartphones make it attractive to build a distributed network using the phones and their sensors as its computing nodes. In such a system, basic middleware services, such as clock synchronization and mutual exclusion, are crucial for many applications to operate correctly.

Goals
Design and implement distributed primitive algorithms for multi-hop, mobile ad hoc networks consisting of a number of Android devices. The primitives include:
- Reliable Message Passing
- Multi-Hop Broadcast
- Leader Election
- Message Passing Mutual Exclusion
- Clock Synchronization

Research Plan
- Identify the limitations of the Android SDK (Software Development Kit) and their effects on the efficiency of the algorithms
- Develop adapted algorithms that work best under such constraints
- Implement the algorithms and compile them into a library for future use
- Create some applications using the implemented library and evaluate the performance

Reliable Broadcast
UDP Datagram service provided by Android SDK is not reliable, and is limited to single hop. To prevent packet loss and out-of-order delivery, we simulate MAC layer reliable broadcast on top of it:
- Buffer and retransmit packets using Selective Repeat ARQ (Automatic Repeat reQuest)
- Allow multi-hop broadcast by forwarding every accepted packet to neighbors.

Mutual Exclusion
This algorithm ensures each device’s exclusive entry into the critical section. We use a token-based algorithm that exploits broadcast medium to reduce communication complexity per critical section.

Clock Synchronization
The goal is to make all devices in the network agree on the same clock value. Structureless, opportunistic synchronization scheme is used to provide accurate logical time while minimizing energy consumption:
- Elect a node to be the reference node
- Opportunistically select the source with the least number of hops away from the reference node
- Record timestamps in two-way message exchanges
- Use NTP-based theorem to compute the clock offset and perform adjustments
- Execute periodically to alleviate clock drifting
- Apply randomized broadcast to avoid contention

Applications
AdHoc Walkie-Talkie: A half-duplex communication tool based on distributed mutual exclusion library
Ball Speed Estimator: An application that turns Android phones into velocity sensors, using camera service, JavaCV, and clock synchronization library