Distributed Monitoring Software for Android-based Mobile Devices
Problem Statement

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Description

Historically, networks of "processes" (devices) use some form of centralized server to maintain the state of the network in order to track a list of connected peers, facilitate discovery between peers, and marshal communications between peers. This approach is flawed, however, because it leaves the centralized server as a bottle neck or point of failure. If the network grows beyond the performance capabilities of the server, or if the server undergoes an external failure event such as a power outage, the entire network fails and must wait for the central server to reappear before the network can be re-established.

Decentralized networking is used in relatively few well-known networking protocols, the most well known of which may be the BitTorrent protocol. In this scheme, a centralized server is not strictly necessary (though one may be used in order to help increase the performance of the "swarm" in some scenarios), which removes the single point of failure problem. If any one peer leaves the network for any reason, the network remains active and the remaining peers can continue to intercommunicate. This requires a different approach to communication and co-ordination between peers, however, since there is no "central authority" to report to or from which to discover any sort of global state. A necessary and unavoidable side-effect of this decentralized approach is an inherent concurrency in the network – it becomes much more difficult to determine when events occur in the network when there is no central authority tracking the events.

The goal of this project is to implement a real-time monitoring system over top of a decentralized networking stack which allows for each peer in the "swarm" to reliably determine their own current state as well as the state of each other peer in the swarm, thus allowing each peer to maintain its own copy of a best-estimate snapshot of what the global state of the network looks like, much like a centralized server would naturally be able to form. This real-time monitoring system has applications in, for example, swarms of flying drones, or self-driving cars. The technology will allow resilient and persistent networks of devices powering these vehicles to form and co-ordinate, for example allowing a network of self-driving cars to perform co-operative collision avoidance or route themselves along routes which will reduce traffic delays on average.