Designing Infrastructure-less Disaster Networks by Leveraging the AllJoyn Framework

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Introduction

- Rise in global warming, the accelerated pace of climate change, and intense seismic activity, the frequency of natural disasters is increasing.
- Disaster-hit zones is often completely or partially damaged.
- Need infrastructure less framework for communication in these scenarios, like AllJoyn.

Objective

Design a basic AllJoyn application (DiNet App) capable of reliable file exchange between devices in proximity.

AllJoyn Framework

- An open-source framework designed by Allseen Alliance.
- Potential to be the platform for next-generation proximity centric disaster network.
- Designed for automatic discovery and communication between mobile devices.
- P2P Infrastructure-less.

AllJoyn Features

- Discover
- Identify
- Control
- Manage
- Interoperate
- Adapt
- Span
- Secure

Figure : Alljoyn Features

Key Components

- AllJoyn Router
- AllJoyn App
- AllJoyn Bus

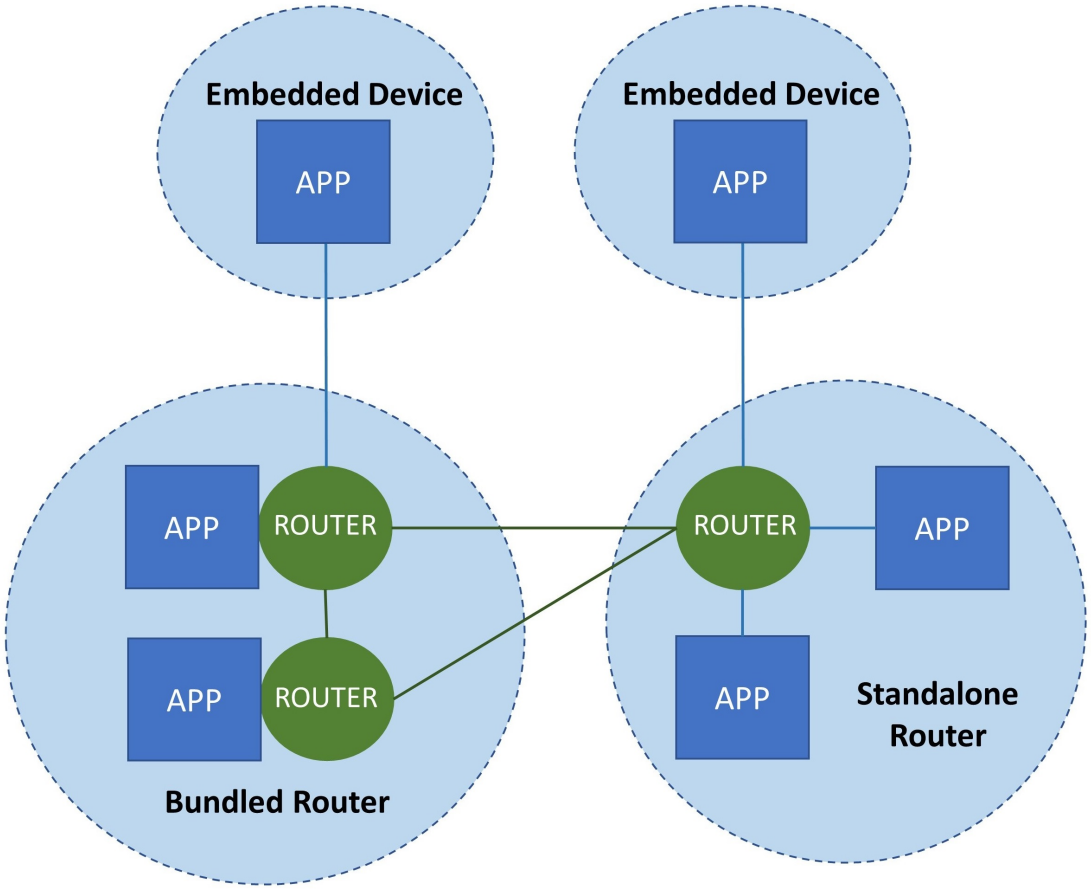


Figure : Key Components

Why AllJoyn?

- Advantages of AllJoyn:
  - Open Source framework.
  - Automatic device discovery and service advertisement mechanism
  - Allows dynamic configuration of the network.
  - Platform independant.
  - Can use C, C++, Java for developing applications.
  - Provides greater security (Simple Authentication and Security Layer (SASL)) by allowing access at the granularity of application-to-application communication.

DiNet App

- AllJoyn provides basic chat application.
- Modified the chat application to file transfer application (DiNet).
- Used ubuntu as a platform and C++ language for development.
- SCons (software construction) is used for generating the executables.
  Command at server side: ./filetransfer s -f test.jpg
  Command at client side: ./filetransfer c -t
- Analysed the performance of AllJoyn prototype in terms of end-to-end latency, throughput, signal strength, and battery consumption.
- Highlighted challenges in Multi-Hop scenario.

Single-Hop Scenario

- AllJoyn performs participant equipment discovery and attachment, session management and data transfer over a single hop between participant mobile devices.
- An advertising device (AD) initiates an AllJoyn PCN by creating a channel, which is a data sharing session in AllJoyn terminology.
- The mobile devices in its proximity receive the advertisement and may latch on to the channel to share data with the AD.

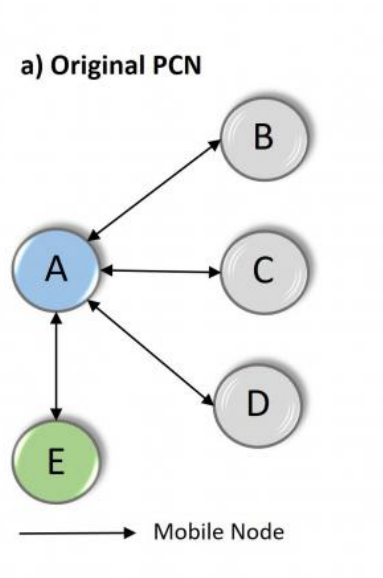


Figure : Single Hop Topology

Field Experiment for Single-Hop Topology

- Sender is sending 1, 4 and 10 MB file.
- Receiver is moving away from sender.
- The network metrics observed at every 5m interval are the Transfer Time (TT) of each file, Signal Strength, and Throughput.
- Considered 2 scenarios: HIS (High Interference Scenario) and LIS (Low Interference Scenario).

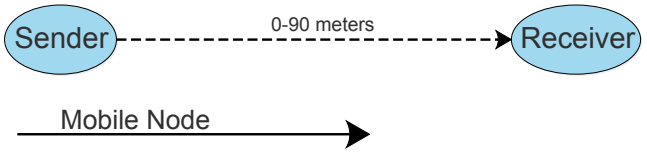


Figure : Topology for experiment

Results for HIS

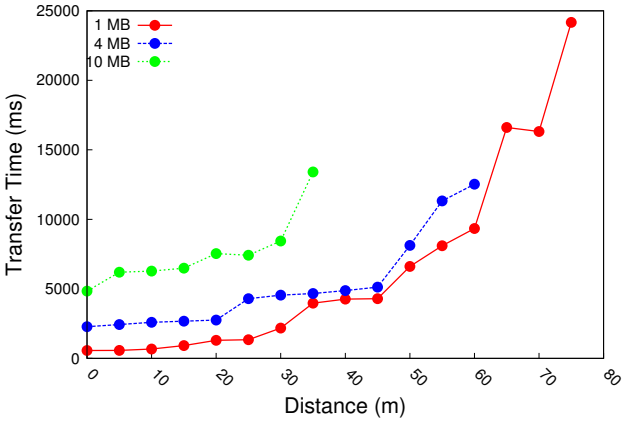
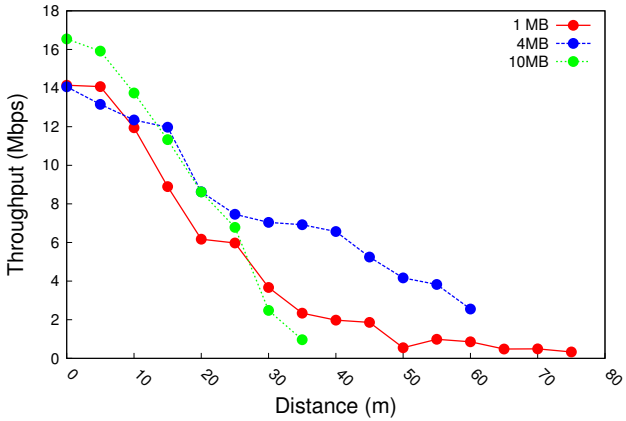


Figure : Transfer Time vs Inter-node distance (1, 4, 10 MB file transfer)



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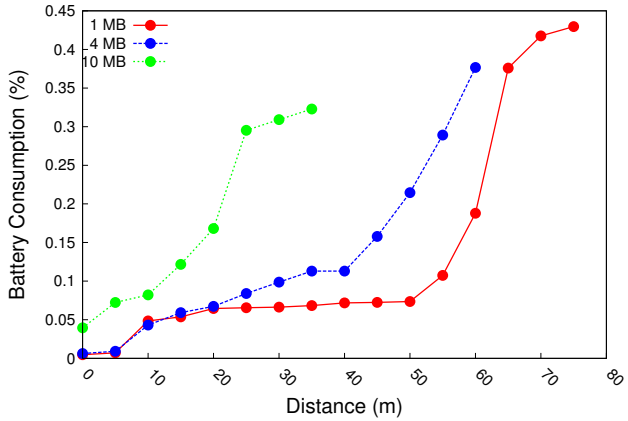
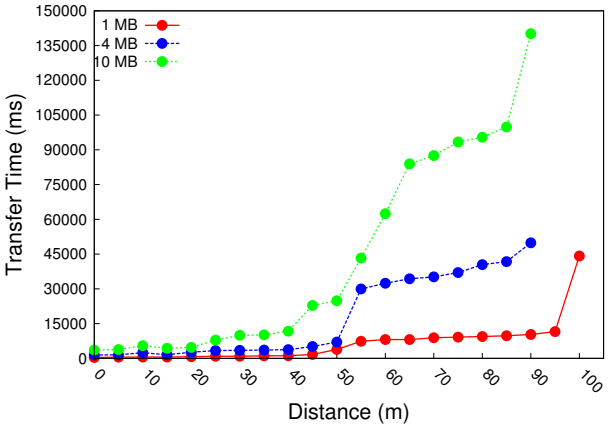


Figure : Battery Consumption vs Inter-node distance (1, 4, 10 MB file transfer)

- 4 MB file transfer fails beyond 60 meters and 10MB file transfer fails beyond 35 meters.
- As file size increases transfer time increases.
- Battery consumption is high for large files.

Results for LIS



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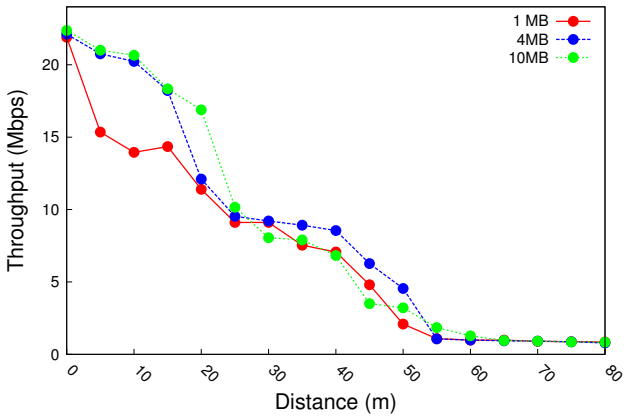

Figure : Throughput vs Inter-node distance (1, 4, 10 MB file transfer)

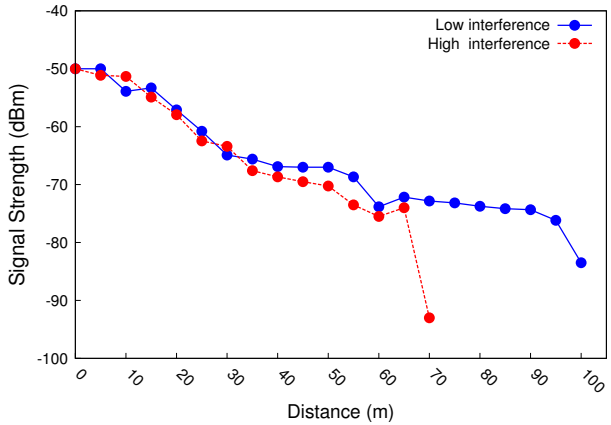

Figure : Signal Strength vs Inter-node distance (1, 4, 10 MB file transfer)

- 4 and 10MB file transfer fails beyond 90 meters and 1MB file transfer fails beyond 100 meters.
- Transfer time is less and throughput is more for LIS than HIS.

Multi-Hop Scenario

- However, a mobile device may move to a location which is beyond the direct transmission range of AD.
- A direct single-hop communication between the AD and PD(Participating Device) is necessary.
- Extended Proximity.

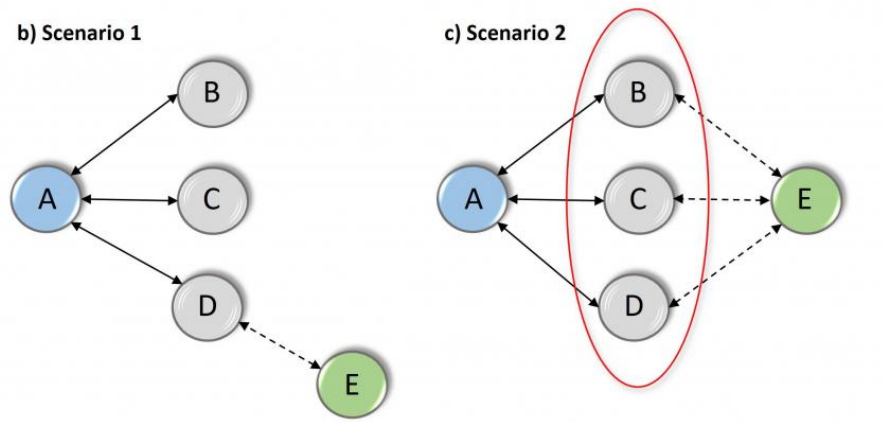

Figure : Multi-Hop Topology

Conclusions and Future Work

- Implemented an AllJoyn based DiNet application.
- Conducted field experiments to test the reliability and robustness of AllJoyn in two interference scenarios.
- Demonstrated the challenges of multi-hop routing in an AllJoyn PCN (Proximity Centric Network).
- Introduced the concepts of extended proximity.
- Support for multi-hop routing lacking in AllJoyn.
- Devise an optimal routing model for disaster network and build the app which will support multi-hop routing.

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Thank You

Queries ?