



Humanitarian Technology: Science, Systems and Global Impact 2015, HumTech2015

Supporting First-Responders in Infrastructure-less Environments

Aurelio Monarrez*, Gurminder Singh, Raymond Buettner

Department of Computer Science, Naval Postgraduate School, 1 University Circle Monterey, CA 93940

Abstract

During a large-scale disaster first responders face a number of different challenges. Their ability to communicate with one another is among the most critical challenges they face. If the disaster has wiped out the infrastructure that enables communications, it creates a serious issue for first responders. In such situations, infrastructure-less technology could enable first responders to establish a communications network independent of any existing operational or non-operational infrastructure. Wi-Fi Direct can enable such communication, but it is fraught with a few issues that need to be addressed to make it usable for first responders. We have developed an extension to Wi-Fi Direct that would address these issues. The extended Wi-Fi Direct protocol allows for a persistent communications network that involves zero user interaction. With our extensions, the protocol does not require any infrastructure or any human involvement to establish a communications network.

Disclaimer: The views expressed in this document are those of the authors and do not reflect the official policy or position of the Department of Defense or the United States Government.

Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review under responsibility of the Organizing Committee of HumTech2015

Keywords: Peer-to-Peer Communication; Mobile Ad-Hoc Networks; Humanitarian Assistance; Disaster Relief; Infrastructure Less Technology; Wi-Fi Direct

* Corresponding author. Tel.: 831-656-1135;
E-mail address: amonarre@nps.edu

1. Introduction

Large-scale disasters often destroy significant parts of the installed infrastructure, which makes the recovery operations very difficult. In 2005 during Hurricane Katrina communications infrastructure was among the most affected. Commercial power failed and forced 180 central office locations to run on generators. An estimated 100 commercial radio station towers were taken off the air. Land mobile radios were greatly degraded, and as many as 2000 cell towers were taken out. Most of the backbone conduit that supported landline services was flooded [1]. In such an environment, the first responders need to find alternate means of communication with each other for information sharing and safety purposes.

The use of mobile devices for communication has been growing rapidly. Altogether, there were a total of 6.5 billion mobile devices worldwide in 2012, and that number grew to 7 billion in 2013 [2]. The accessibility of mobile devices has revolutionized the way people use, access, and exchange information. One method for exchanging information over these devices is through the use of Wi-Fi Direct [3]. This relatively new protocol allows for Peer-to-Peer (P2P) mobile ad-hoc networking.

Wi-Fi Direct benefits from the strengths of the Wi-Fi standard – performance, security, and ease-of-use – and adds a number of new functionalities. These added functionalities include: automatic device discovery, a mutual awareness of capabilities between devices (inter-device capability awareness), sophisticated power management, and infrastructure-less connectivity. Connections between Wi-Fi Direct devices can happen anytime and anywhere. When devices come within range of one another, a connection request is sent. Upon request acceptance, a P2P Group is established and communication is enabled. To enable communication, one of the devices assumes the role of P2P Group Owner (Software Access Point) while the others become P2P Clients.

While Wi-Fi Direct has many advantages, it suffers from a serious drawback that impacts its utility. Once a Group Owner disconnects, there is a permanent disruption to the network. There are two methods in which a Group Owner can leave the network. In the standard method, a user must manually press the disconnect button. Once the disconnect button is pressed the Group Owner stops assuming the role of a software access point and connectivity among all devices stops. Another method through which the Group Owner leaves the network is a catastrophic failure to the device. In this case the device gets destroyed and connectivity between all the devices stops. In either case, once the Group Owner leaves, a permanent disruption to the network occurs [3].

To support communication among its clients, a device operating in the Group Owner mode consumes more power than its clients. In a team of first responders, it is best that the Group Owner functionality be shared among the members of the team. This way, no one device drains its power completely; everyone shares in supporting the communication within the team. This need to rotate the Group Owner functionality among the team members and the way Wi-Fi Direct works are in conflict – every time the Group Owner changes, a major reset takes place in the network.

1.1. Wi-Fi Direct Extension

We have extended the Wi-Fi Direct protocol to prevent serious disruption to the network when the Group Owner has to change. This extended protocol allows first responders to continue communicating with each other without having to re-establish the network when the Group Owner changes. The extended Wi-Fi Direct can be installed on any android device that supports Wi-Fi Direct. First responders can then use these android devices in infrastructure less environments to communicate with each other. The extended protocol is ideal for infrastructure less environments, but can also be used in limited infrastructure environments. The unique feature of Wi-Fi Direct allows for simultaneous connections to other peers and standard Wi-Fi access points.

Our key contributions are:

Download English Version:

<https://daneshyari.com/en/article/856703>

Download Persian Version:

<https://daneshyari.com/article/856703>

[Daneshyari.com](https://daneshyari.com)