Demo Abstract: A Research Platform for Real-World Evaluation of Routing Schemes in Delay Tolerant Social Networks

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I. INTRODUCTION

Over the past decade, online social networks (OSNs) such as Twitter and Facebook have thrived and experienced rapid growth to over 1 billion users [1]. A major evolution would be to leverage the characteristics of OSNs to evaluate the effectiveness of the many routing schemes developed by the research community in real-world scenarios. In natural disaster situations, Internet and cellular communication infrastructures can be severely disrupted, prohibiting users from notifying family, friends, and associates about safety, location, food, water, and other resources. Disasters typically damage infrastructure, which increases network traffic demands on any available undamaged infrastructure, causing congestion and delays.

Opportunistic communication can seamlessly supplement Internet connectivity when needed and keep communication channels open even during high-use and extreme situations. DTN routing has the ability to deliver data in an intermittent network, but a major challenge for DTN routing is assessing real-world performance [2]. To truly understand the reliability of DTNs and their ability to support social networks, it is imperative that DTN routing schemes are evaluated *in vivo* with use-cases that are replicable, comparable, and available to a variety of researchers.

In this demo, we showcase AlleyOop Social, a secure delay tolerant networking research platform that serves as a real-life mobile social networking application for Apple iOS devices. AlleyOop Social allows users to interact, publish messages, and discover others that share common interests in an intermittent network using Bluetooth, peer-to-peer WiFi, and infrastructure WiFi. The research platform serves as an overlay application for the Secure Opportunistic Schemes (SOS) middleware which allows different routing schemes to be easily implemented relieving the burden of security and connection establishment. AlleyOop Social is named after the basketball play known as an "alley oop". An "alley oop" occurs when one player throws the ball close to the basket, but it is not able to reach the final destination. While the ball is in flight, a teammate that is closer to the basket catches the ball and scores. In the same regard, AlleyOop Social enables wireless mobile users to communicate over longer distances by

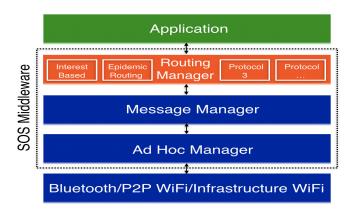


Fig. 1. SOS middleware system stack - green represents mobile applications created by developers, orange represents the modular routing layer consisting of multiple opportunistic schemes created by academic researchers, blue represents foundational layers in the middleware that consist of encryption, authentication, peer discovery, connection management, and data dissemination. Managers marked with the color "blue" cannot be modified by mobile application developers or academic researchers.

sending messages that cannot reach the final destination, but are "caught" by intermediate mobile devices, which continue to catch and pass the messages until they are delivered to the final destination.

II. ALLEYOOP SOCIAL RESEARCH PLATFORM

AlleyOop Social is designed to feel familiar to users of well-known social networking applications such as Twitter and Facebook. In addition, AlleyOop Social simultaneously operates as an online and offline delay tolerant mobile social network. Users download the app and create an account, enabling them to develop social circles, and then pass and publish messages to each other. AlleyOop Social is a research platform allowing users to select any DTN routing protocol available in the SOS middleware (discussed in Section III) to disseminate messages. Researchers can perform controlled studies by asking people to select various protocols in AlleyOop Social and post messages. AlleyOop Social gathers analytics about D2D encounters with friends and AlleyOop Social users. Unlike the Haggle project [3] which is not fully functional on iOS and prefers devices to be rooted on Android,

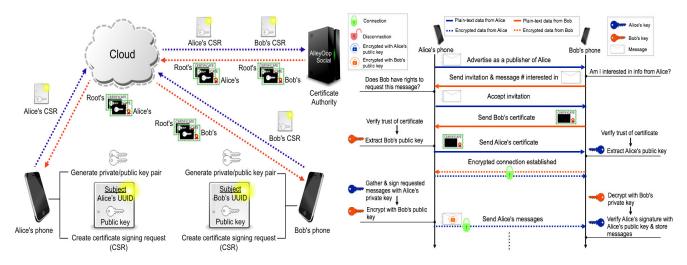


Fig. 2. (a) One-time infrastructure requirement, occurs during account creation to enable DTN security. (b) Decentralized communication between nodes.

AlleyOop Social gathers analytics about encryption/decryption duration, sign/verify duration, the app was in: foreground, background, and suspended, along with the size of data that was disseminated.

III. SECURE OPPORTUNISTIC SCHEMES (SOS) MIDDLEWARE

The SOS middleware is an underlying framework that turns the AlleyOop Social research platform into a delay tolerant mobile social network. The SOS middleware takes a modular approach to abstract away much of the complexity involved in implementing opportunistic routing schemes such as device dicovery, establishing D2D connections, and handling device security and privacy. DTNs are intended to provide an overlay architecture above the existing transport layer and ensure reliable routing during intermittency [4]. Building on the knowledge gained from other middleware, SOS hides the complexity of the network stack (session and presentation) within the ad hoc manager, message manager, and routing manager, allowing any mobile application to run at the application layer as depicted in Figure 1. Different from other middlewares such as the Haggle Project [3], a separate instance of the SOS middleware is intended to run within each mobile application as opposed to a daemon which often requires devices to be rooted or jailbroken. Designing SOS in this manner allows for the middleware to be integrated within individual mobile applications in iOS, enabling the overlaying applications to support opportunistic communication without jailbreaking devices along with being compliant with App Store regulations.

IV. PRIVACY AND SECURITY

In regard to network security there is no "one-size-fits-all" approach [5]. Security concerns may become exacerbated in delay tolerant and ad hoc applications where nodes are vulnerable to attacks such as eavesdropping, denial of service, and compromised devices. Providing secure communication that prevents an adversary from accessing and/or modifying data is

a fundamental requirement of any DTN application [6]. Previous research discusses security in opportunistic applications as a proof-of-concept, and makes no claim their implementations are secure [3]. As depicted in Figure 2, AlleyOop Social introduces a novel, but simple concept and implementation of an initial layer of security for opportunistic communication and enables the overlaying mobile application to detect the identity of its users, send encrypted information, verify the originating source of the information being forwarded, and ensure that data have not been modified — all with minimal dependence on centralized infrastructures.

V. DEMO SETUP

During the demonstration attendees will be able to down-load AlleyOop Social on their respective iOS devices via Apple TestFlight. Users can follow friends, post new messages, as well as toggle between DTN routing schemes inside the application. We will demonstrate both the online and offline modes by disconnecting mobile devices from cellular and WiFi networks. Details of what occurs on every mobile device when a user creates an account and disseminates messages is depicted in Figures 2a and 2b respectively.

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