REPORT DOCUMENTATION PAGE

Form Approved OMB NO. 0704-0188

1. REPORT DATE (DD-MM-YYYY)	2. REPORT TYPE	3. DATES COVERED (From - To)
25-04-2019	Final Report	1-Aug-2014 - 31-Jul-2016

4. TITLE AND SUBTITLE
Final Report: OHReST: Open Human-Robotic Mobile Networking and Security Testbed

5a. CONTRACT NUMBER
W911NF-14-1-0523

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER
611103

6. AUTHORS

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAMES AND ADDRESSES
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8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS (ES)
U.S. Army Research Office
P.O. Box 12211
Research Triangle Park, NC 27709-2211

10. SPONSOR/MONITOR'S ACRONYM(S)
ARO

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
65156-CS-RIP.1

12. DISTRIBUTION AVAILIBILITY STATEMENT
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES
The views, opinions and/or findings contained in this report are those of the author(s) and should not contrued as an official Department of the Army position, policy or decision, unless so designated by other documentation.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	15. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
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RPPR Final Report
as of 14-May-2019

Agency Code:

Proposal Number: 65156CSRIP **Agreement Number: W911NF-14-1-0523**
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DUNS Number: 943360412 EIN: 860196696
Report Date: 31-Oct-2016 Date Received: 25-Apr-2019
Final Report for Period Beginning 01-Aug-2014 and Ending 31-Jul-2016
Title: OHReST: Open Human-Robotic Mobile Networking and Security Testbed
Begin Performance Period: 01-Aug-2014 **End Performance Period:** 31-Jul-2016
Report Term: 0-Other
Submitted By: PHD Dijiang Huang Email: Dijiang.Huang@asu.edu
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Distribution Statement: 1-Approved for public release; distribution is unlimited.

STEM Degrees: 1 **STEM Participants:** 8

Major Goals: This project aims to create an open platform, called “OHReST”, involving human-robot interactions for research and education in the area of mobile networking and security. OHReST is designed to provide an open platform for both research experiments and education services. The requested equipment can greatly improve the PI’s current ARO project “Traffic Analysis Models for Wireless Mobile Ad Hoc Networks”.

Current research work in mobile networks, are mainly carried out using simulation tools. Mobility control, protocol and traffic analysis are important factors that can greatly influence research results. Existing MANET testbed services provide little support on research and education in terms of security, privacy and anonymity performance of MANET security protocols, and interactions between human and robots.

To address the above-described issues, a set of communication devices, servers, and a spectrum analyzer are requested to establish a user-friendly open MANET research and education system. A MANET testing platform based on human-robotic interaction and mobile computing devices will be established to implement privacy and anonymity schemes based on existing research results. A traffic monitoring system analyzing the dynamics in communication channels will be established based on fixed and mobile monitoring nodes to provide a MANET protocol evaluation and verification environment. A cloud-based management system provides researchers the ability to control the MANET’s mobility in the real mobile and networking environment, where a set of open interfaces and open source software provides researchers and educators the ability to design and deploy their experiments through a web-based portal. To facilitate education in the field of MANET networking and security, the OHReST will be integrated into an existing virtual lab system. Finally, further research initiatives and potentials can be developed through this testbed environment.

Accomplishments: Based on the DURIP equipment project, OHReST produced three three subsystems:
(1) The experimental MANET is designated to model the behaviors of MANETs under different application scenarios. The movements of human participants and robots controlled by computers model the network mobility. We implemented different mobility models in the laptop mounted on robots by either preloading programs or commanding the robots dynamically. We use WiFi ad hoc network as the communication channel.
(2) The traffic monitoring system is in charge of collecting relevant radio signals from the air channel and extracting information from the data. It is constituted with a set of monitoring nodes. These nodes are divided into static monitors and mobile monitors. We choose the Software Defined Radio (SDR) supporting devices as the functional component on the monitors. Another important part of the traffic monitoring system is a spectrum analyzer. This device is used to analyze radio spectrum pattern at a more sensitive and accurate level.
Finally, (3) the testbed management system is developed to provide necessary control and monitoring functions to

the testbed administrator. It also provides remote experiment management service for distant users of the testbed. In the following sections, we first describe the design of OHReST, and then we present the new research and educational capabilities that can be implemented by this new design.
The developed system has been used in PIs computer network and security class, allowing students to develop a traffic monitoring system to track mobile users.

Training Opportunities: During the project year, 2 capstone teams including 8 undergraduate students were worked in my research group to develop the traffic monitoring system and mobile ad hoc networks based on robots and their carried laptops. They studied the programming languages C, Java and use them to help establish the simulation of the MANET.
One PhD graduate had worked with undergraduate students as a mentor to develop the proposed mobile ad hoc network testbed.

Results Dissemination: The developed mobility models based on Qualnet were put in public domain for other researchers to download and use. The research work we propagated based on research publications of the associated main ARO project.

Honors and Awards: Nothing to Report

Protocol Activity Status:

Technology Transfer: Nothing to Report

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Participant Type: PD/PI
Participant: Dijiang Huang
Person Months Worked: 1.00 **Funding Support:**
Project Contribution:
International Collaboration:
International Travel:
National Academy Member: N
Other Collaborators:

Participant Type: Graduate Student (research assistant)
Participant: Zhijie Wang
Person Months Worked: 1.00 **Funding Support:**
Project Contribution:
International Collaboration:
International Travel:
National Academy Member: N
Other Collaborators:

ARTICLES:

RPPR Final Report
as of 14-May-2019

Publication Type: Journal Article Peer Reviewed: Y **Publication Status:** 1-Published
Journal: IEEE Transactions on Dependable and Secure Computing,
Publication Identifier Type: DOI Publication Identifier: 10.1109/TDSC.2013.33
Volume: 11 Issue: 2 First Page #: 181
Date Submitted: 4/25/19 12:00AM Date Published: 3/1/14 8:27AM
Publication Location:
Article Title: STARS: A Statistical Traffic Pattern Discovery System for MANETs
Authors: Yang Qin, Dijiang Huang, Bing Li
Keywords: Mobile ad hoc network, mobility, traffic analysis
Abstract: Many anonymity enhancing techniques have been proposed based on packet encryption to protect the communication anonymity of mobile ad hoc networks (MANETs). However, in this paper, we show that MANETs are still vulnerable under passive statistical traffic analysis attacks. To demonstrate how to discover the communication patterns without decrypting the captured packets, we present a novel statistical traffic pattern discovery system (STARS). STARS works passively to perform traffic analysis based on statistical characteristics of captured raw traffic. STARS is capable of discovering the sources, the destinations, and the end-to-end communication relations. Empirical studies demonstrate that STARS achieves good accuracy in disclosing the hidden traffic patterns.

Acknowledged Federal Support: **Y**

Nothing to report.