Philip B. Lundrigan

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Research Interests

My main research focuses are the Internet of Things, remote sensor deployments, and wireless network management. I am interested in building real systems that enhance and extend wireless networks. I am passionate about measuring and understanding air quality to help improve health. As part of an NIH grant, I designed, built, and deployed an IoT architecture for in-home environmental sensors for epidemiological studies.

Education

August 2018 **University of Utah**, *Ph.D., Computer Science*
4.0 / 4.0 GPA
Advisors: Sneha Kasera and Neal Patwari
Dissertation Title: Reliable Real-Time Data Upload for Wireless Networks

April 2012 **Brigham Young University**, *B.S., Computer Engineering*
3.89 / 4.0 GPA
Advisor: Daniel Zappala
Dean's List, College of Engineering, 2011
Full Academic Brigham Young Scholarship, 2009-2012

Research

October 2018 to Present **Brigham Young University**, *Assistant Professor*
Department of Electrical and Computer Engineering

October 2019 to Present **University of Utah**
Member of the Center of Excellence for Exposure Health Infromatics (CEEHI)
CEEHI is a multi-disciplinary center focused on the next generation of exposure health research through use and development of novel informatics methods and solutions.

January 2013 to October 2018 **University of Utah**, *Advanced Networks Systems Research Lab*
PRISMS
Designed and built a framework for easy deployment of IoT in-home sensor network for epidemiologists. The framework uses Raspberry Pis and open source software to interoperate with many different types of IoT sensors. It allows for easy experimentation and data collection. The system has been deployed in multiple homes in Utah as part of a pediatric asthma research study.

PRISMS Management Tools
As part of the PRISMS project, I wrote applications to manage live deployments. These tools include a sensor status dashboard, an easy to use tool to export data from the database, peak detect algorithm for anomaly detection, a participant text notifications system to alert and receive feedback from participants, and an API for external tools to query data.

STRAP
Built novel approach to securely share wireless network name and password with unassociated wireless sensors by encoding data into Ethernet source and destination addresses. This greatly speeds up the time it takes to connect IoT devices to a home's wireless network.

mobiLivUp
Designed and built a system for live streaming video by cooperatively using multiple cellular devices through WiFi Direct on Android devices. Created prototype Android application and tested in real world environment, showing improvements to traditional live video streaming. Paper published at ITC 28.

April 2011 to April 2012 **Brigham Young University**, *Internet Research Lab*
WiFu
Contributed to framework, "WiFu", for experimenting on wireless transport protocols. Designed new TCP variant protocol specific for wireless mesh networks. Used wireless mesh network to run experiments and benchmark performance of different protocols.

April 2010 to April 2011 **Brigham Young University**, *FPGA Lab*
HMFlow and RapidSmith
Helped develop HMFlow framework for rapid prototyping on FPGAs. Designed and developed fast loading and saving of serialized data structures. Created complex data structures to model FPGA designs.

Publications

Under Review
L. Alcantara, **P. Lundrigan**, Joseph Miera, B. Ariun-Erdene, C. Teng
The Hitchhiker's Guide to Successful Remote Sensing Deployments in Mongolia

Conferences
P. Lundrigan, N. Patwari, S. K. Kasera
On-off Noise Power Communication
The 25th Annual International Conference on Mobile Computing and Networking (MobiCom), 2019

S. Maheshwari, **P. Lundrigan**, S. K. Kasera
Scheduling Virtual WiFi Interfaces for High Bandwidth Video Upstreaming Using Multipath TCP
20th International Conference on Distributed Computing and Networking (ICDCN 2019)

P. Lundrigan, K. Min, N. Patwari, S. K. Kasera, K. Kelly, J. Moore, M. Meyer, S. C. Collingwood, F. Nkoy, B. Stone, and K. Sward
An In-Home IoT Architecture for Epidemiological Deployments
IEEE Workshop on Practical Issues in Building Sensor Network Applications (SenseApp), 2018

K. Min, **P. Lundrigan**, N. Patwari
Smart Home Air Filtering System: A Randomized Controlled Trial for Performance Evaluation
IEEE/ACM 3rd International Conference on Connected Health: Applications, Systems and Engineering Technologies (CHASE), 2018

P. Lundrigan, M. Khaledi, M. Kano, N. Subramanyam, and S. Kasera
Mobile Live Video Upstreaming
28th International Teletraffic Congress (ITC 28), 2016

R. Buck, R. Lee, **P. Lundrigan**, and D. Zappala
WiFu: A composable toolkit for experimental wireless transport protocols
9th IEEE International Conference on Mobile Ad-Hoc and Sensor Systems, 2012

C. Lavin, M. Padilla, J. Lamprecht, **P. Lundrigan**, B. Nelson, and B. Hutchings
HMFlow: Accelerating FPGA Compilation with Hard Macros for Rapid Prototyping
IEEE 19th Annual International Symposium on Field-Programmable Custom Computing Machines (FCCM), 2011

C. Lavin, M. Padilla, J. Lamprecht, **P. Lundrigan**, B. Nelson, and B. Hutchings
RapidSmith: Do-It-Yourself CAD Tools for Xilinx FPGAs
International Conference on Field Programmable Logic and Applications (FPL), 2011

C. Lavin, M. Padilla, **P. Lundrigan**, B. Nelson, and B. Hutchings
Rapid prototyping tools for FPGA designs: RapidSmith
International Conference on Field-Programmable Technology (FPT), 2010

Invited Papers

P. Lundrigan, N. Patwari, S. K. Kasera
STRAP: Secure TRansfer of Association Protocol
The 27th International Conference on Computer Communications and Networks (ICCCN), 2018

Journals

S. Hegde, K. Min, J. Moore, **P. Lundrigan**, N. Patwari, S. C. Collingwood, and K. E. Kelly
Household Indoor Particulate Matter Measurement Using a Network of Low Cost Sensors
Aerosol and Air Quality Research

J. Moore, P. Goffin, **P. Lundrigan**, N. Patwari, K. Sward, J. Weise, M. Meyer
Managing In-home Environments Through Sensing, Annotating, and Visualizing Air Quality Data
Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT), 2018

Tim Strayer, Samuel Nelson, Amando Caro, Joud Khoury, Bryan Tedesco, Olivia DeRosa, Carsten Clark, Kolia Sadeghi, Michael Matthews, Jake Kurzer, **Philip Lundrigan**, Vikas Kawadia, Dorene Ryder, Keith Gremban, Wayne Phoel
Content Sharing with Mobility in an Infrustructure-less Environment
Computer Networks, 2018

B. Mager, **P. Lundrigan**, and N. Patwari
Fingerprint-Based Device-Free Localization: Performance in Changing Environments
Journal on Selected Areas in Communications, 2015

Demos

Kyeong T. Min, **Philip Lundrigan**, and Neal Patwari
IASA - Indoor Air Quality Sensing and Automation
16th ACM/IEEE International Conference on Information Processing in Sensor Networks (IPSN), 2017

Service

2020 TPCs: IPSN, WoWMoM (co-publicity chair)

Talks

STRAP and Beyond
BYU Networking Club, December 2019, Provo, UT

Networking Research for Linux
BYU Linux Club, September 2019, Provo, UT

On-off Noise Power Communication
MobiCom 2019, October 2019, Los Cabos, Mexico

EpiFi: An In-Home IoT Architecture for Epidemiological Deployments
BYU CCL Lab, April 2018, Provo, UT
BYU IT Student Seminar, March 2018, Provo, UT

STRAP: Secure TRansfer of Association Protocol
The 27th International Conference on Computer Communications and Networks (ICCCN), July, 2018, China

An Infrastructure for Generating Exposomes: Initial Lessons from the Utah PRISMS Platform
27th Annual Meeting of the International Society of Exposure Science (ISES), October 2017, Research Park Triangle, NC

In-Home Real-Time Sensor Networks
33rd Annual Utah Conference on Safety & Industrial Hygiene, October 2016, Salt Lake City, UT

Mobile Live Video Upstreaming
ITC 28, September 2016, Wurzburg, Gemany
BBN Lunch Talk, July 2015, Cambridge, MA

Professional Experience

May 2015 to August 2015 **Network Scientist Intern**, *Raytheon BBN Technologies*
Worked on DARPA's Squad X project, designing an architecture for flexible distribution of content and information. Using ns3, built a framework to measure effectiveness of various content distribution approaches.

May 2014 to August 2014 **Network Scientist Intern**, *Raytheon BBN Technologies*
Worked on DARPA's Content-Based Mobile Edge Networking (CBMEN) project using Android phones. Improved, measured, and tested the design of the basic ad hoc networking functionality. Thoroughly studied the benefits of using asynchronous I/O compared to synchronous I/O for all network communication. Developed new method for managing multiple TCP connections with neighboring nodes. Built Android application and deployed on 15 devices in the field to measure the improvements. Collaborated closely with three other researchers to improve various components of the system.

July 2013 to January 2014 **Wireless Researcher**, *Xandem Technology*
Built system for fall detection and localization using wireless sensor network for elderly care. Lead development of small team to implemented real-time room-level localization algorithm using machine learning. Worked with raw wireless data to develop features for machine learning algorithm. Conducted experiments to evaluate and measure the accuracy of localization algorithm. Demonstrated working prototype to potential customers.

April 2012 to August 2012 **Software Engineering Intern**, *Ancestry.com*
Researched an alternative way to store and search large amounts of data using Apache Solr. Built testing framework to compare storage alternatives. Built a new wiki system for the development team to use.

Open Source Projects

2016 **Duplicate Image Finder**
Using perspective hashing, I built a tool that detects duplicate images in photo libraries. It has over 100 stars on GitHub and I have worked with contributors to make the project better.

2015 **Home Assistant**
Core contributor to open source home automation hub software. Allows for different third party home automation systems to be integrated easily and controlled from a centralized location.