

# PHILIP B. LUNDRIGAN

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## RESEARCH INTERESTS

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My main research focuses are mobile networks, mobile computing, and wireless network management. I am interested in building real systems that enhance and extend wireless networks. As part of my dissertation work, I designed, built, and deployed an IoT architecture for in-home environmental sensors for epidemiological studies.

## EDUCATION

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**Present** **University of Utah**, *PhD candidate, Computer Science*  
4.0 / 4.0 GPA  
Advisors: Sneha Kasera and Neal Patwari  
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

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**January 2013 to Present** **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** **Brigham Young University, *Internet Research Lab***

**April 2012** **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** **Brigham Young University, *FPGA Lab***

**April 2011** **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.

## PROFESSIONAL EXPERIENCE

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**May 2015 to** **Network Scientist Intern, *Raytheon BBN Technologies***

**August 2015** 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** **Network Scientist Intern, *Raytheon BBN Technologies***

**August 2014** 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** **Wireless Researcher, *Xandem Technology***

**January 2014** 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.

## PUBLICATIONS

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- Under Review** **P. Lundrigan**, N. Patwari, S. K. Kasera  
 On-off Noise Power Communication
- S. Maheshwari, **P. Lundrigan**, S. K. Kasera  
 Scheduling Virtual WiFi Interfaces for High Bandwidth Video Upstreaming Using Multipath TCP
- 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
- Conferences** **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  
*WiFiFu: 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** 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 Infrastructure-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

## TALKS

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

**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, Germany  
*BBN Lunch Talk*, July 2015, Cambridge, MA

## OPEN SOURCE PROJECTS

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**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.