

Tan Zhang

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Education: Ph.D. in Computer Sciences
University of Wisconsin-Madison, 09/2009 to present
Thesis: Dynamic Spectrum Access Networks for Next-Generation Mobile Systems
Advisor: Prof. Suman Banerjee
Doctoral Minor: Electrical Engineering
GPA: 3.9/4.0

B.S. in Electronic Engineering
Beijing Institute of Technology, 09/2005-06/2009
GPA: 3.7/4.0

Research Interests:

- Wireless networking – design and deployment of networked systems and measurement tools and infrastructures.
- Mobile systems – (i) design and implementation of mobile applications optimized for next-generation wireless networks; (ii) machine learning techniques to improve the intelligence and data efficiency of mobile applications.

Honors:

- Google US/Canada PhD fellowship 2015 – 2017 in Mobile Systems (Mentor: Dr. Matt Welsh)
- Best presentation award at ACM MobiCom 2014
- First place in ACM student research competition at MobiCom 2013
- Traveling award at ACM MobiSys 2013
- Best paper award at IEEE DySpan 2012
- Outstanding student scholarship awarded by Beijing Institute of Technology 2005 – 2009 (top 5%)

Skills:

- Software Languages: C++, C, Python, Go, C#, SQL, Shell, Perl, PHP
- System Programming: Linux kernel and driver programming (network stack)
- Embedded Platforms and Software: Soekris, Alix, OpenWRT based routers
- Hardware Description Languages: Verilog, VHDL
- FPGA Development Boards: WARP, SORA, GNU Radio
- Hardware Design Automation Tools: Quartus, Modelsim, Cadence, Synopsys

Internships:

- 6/15 to 9/15: Software Engineering Intern (with Drs. Matt Welsh and Michael Buettner)
Google Inc., Seattle, USA
Chrome Cloud Service Team
- Worked on a mobile web compression proxy running in Google production centers that has been serving millions of Chrome users worldwide. Optimized the service backend in Go and C++ to improve data savings through aggressive web transcoding techniques.
- 11/14 to 12/14: Visiting Researcher (with Prof. Kyle Jamieson, Drs. Victor Bahl and Aakanksha Chowdhery)
University College London, UK
Systems and Networks Research Group
- Developed a new scheduling framework for a wireless video surveillance system. The approach fuses vision analytics from multiple distributed camera sensors to avoid redundant uploading of camera images while improving surveillance accuracy. The work involves developing vision algorithms and camera scheduling protocols in C#. (**MobiCom'15**)

- 6/14 to 9/14: Research Intern (with Drs. Victor Bahl and Aakanksha Chowdhery)
Microsoft Research, Redmond, USA
Mobility and Networking Research Group
- Designed and deployed a wireless vision analytic system for ubiquitous intelligent video surveillance. The system leverages edge-computing nodes at distributed camera sensors to process camera feeds locally, while selectively uploading important video frames to the cloud over unlicensed spectrum (i.e., TV whitespaces) for deeper analysis. The remaining wireless bandwidth is further scavenged to provide Internet access. The work involves using OpenCV library to implement vision analytic functions, C# for end-to-end system, and C based driver hacks to configure wireless radios for joint optimization. (**MobiCom'15**)
The system is deployed across the Microsoft campus and a demo video is available at https://www.youtube.com/watch?v=2e6UHeW_xmE&feature=youtu.be.
- 6/12 to 9/12: Research Intern (with Dr. Milind M. Buddhikot)
Alcatel-Lucent Bell Labs, NJ, USA
Wireless Network Elements Group
- Designed and deployed a cross-ocean backhauling network using the unlicensed TV whitespaces. The system uses a channel bonding technique to aggregate traffic across multiple wireless radios to improve throughput and reliability. The system was implemented in C++.
- 6/11 to 9/11: Research Intern (with Dr. Milind M. Buddhikot)
Alcatel-Lucent Bell Labs, NJ, USA
Wireless Network Elements Group
- Designed and implemented a dual-band femto-cell architecture that primarily uses the unlicensed TV whitespaces spectrum to offload cellular traffic, but occasionally using the licensed cellular band to bridge connection outage. The system was implemented in C++.
(**DySpan'12 best paper**)

Research Experience:

- 5/10 to present: Research Assistant (with Prof. Suman Banerjee)
Wisconsin Wireless and Networking Systems Laboratory, UW-Madison, USA
- Snoopy:** Designed a smartphone-based spectrum measurement platform to enable off-the-shelf mobile devices to low-cost spectrum analyzers. The work involves C based driver hacks to collect spectral data from the WiFi radio of mobile devices, developing an Android App for spectrum analysis, and building a frequency translator. The WiSense App is featured as a *Geek* tool in Google play (<http://research.cs.wisc.edu/wings/projects/wisense/>). (**HotMobile'15**)
 - V-Scope:** Deployed a large-scale measurement infrastructure to improve commercial spectrum database in allocating unused TV channels for unlicensed communications. The system leverages Madison metro buses to carry spectrum sensors for wide-area measurements. The data is used to refine various propagation models to improve the accuracy of commercial whitespace spectrum databases. The work includes Python development of the measurement framework, SQL based data analysis, and a web front-end in javascript and Python CGI. The measurement system is currently used by Microsoft and FCC to collect spectral analytics over a 6GHz wide band. (**MobiCom'14, HotNets'13**)
Visualization front-end: <http://wisim-master.wings.cs.wisc.edu:4080/cp/whitespace/query2.py>
 - Scout:** Designed and deployed a city-wide vehicular network that uses the vacant TV channels (aka, TV whitespaces) to provide Internet access to metro buses at Madison, WI. The system uses a heterogeneous network architecture to extend network coverage where base stations mounted on road side use high-power whitespace radios to provide downlink coverage, whereas mobile gateways on vehicles use a cellular dongle for uplink communications. The work involves C++ development for the end-to-end system, using a fake networking device (Linux

Tun) for link aggregation, and C hacks in Ath5k Linux driver. The system has received multiple news reports. (**MobiSys'14, HotMobile'13**)

Demo available at http://www.youtube.com/watch?v=_rnzH7owtBw.

- **MOM:** Designed a wireless system for reliable file delivery. The system exploits some intrinsic signal modulation characteristics in the PHY layer of WiFi radios to combat bit errors. The work involves FPGA development on WARP software-defined radios in Verilog and Mac-layer design on a Power PC embedded processor in C.
- **APEX:** Designed an efficient wireless media delivery system that exploits some signal modulation characteristics to provide multiple levels of error protection for different types of MPEG4 frames. The PHY-layer of the system was implemented on the WARP software-defined radios in Verilog and the MAC-layer on their microprocessors in C. (**IEEE TON**)

11/08 to 7/09: Undergraduate Research Assistant
Beijing Institute of Technology, China
Microelectronic Laboratory

- Used Quartus2 and Modelsim to study the design trade-off in different Adder architectures.
- Built a behavioral model of a Folding and Interpolating ADC in Simulink.
- Designed the analog front-end of a folding and interpolating ADC in cadence.

7/08 to 11/08: Undergraduate Research Assistant
Peking University, China
Wireless Communication Laboratory

- Prototyped a short-wavelength radio transmitter on a Xilinx FPGA in VHDL with Synopsys.
- Designed an on-off model for long dependent traffic in broadband data networks.

Conference Proceedings:

1. **The Design and Implementation of a Wireless Video Surveillance System**
Tan Zhang, Aakanksha Chowdhery, Paramvir Bahl, Kyle Jamieson, Suman Banerjee
ACM MobiCom 2015
2. **A Wireless Spectrum Analyzer in Your Pocket**
Tan Zhang, Ashish Patro, Ning Leng, Suman Banerjee
ACM HotMobile 2015
3. **A Vehicle-based Measurement Framework for Enhancing Whitespace Spectrum Databases**
Tan Zhang, Ning Leng, Suman Banerjee
ACM MobiCom 2014, *Awarded best presentation*
4. **Enhancing Vehicular Internet Connectivity using Whitespaces, Heterogeneity and a Scouting Radio**
Tan Zhang, Sayandeep Sen, Suman Banerjee
ACM MobiSys 2014
5. **Inaccurate Spectrum Databases? Public Transit to its Rescue!**
Tan Zhang, Suman Banerjee
ACM HotNets 2013
6. **Scout: An Asymmetric Vehicular Network Design over TV Whitespaces**
Tan Zhang, Sayandeep Sen, Suman Banerjee
ACM HotMobile 2013
7. **A Dual Technology Femto Cell Architecture for Robust Communication using Whitespaces**
Sayandeep Sen, Tan Zhang, Milind Buddhikot, Suman Banerjee, Dragan Samardzija, Susan Walker
IEEE DySPAN 2012, *Awarded best paper*

Journal Articles:

1. **Design and Implementation of an ``Approximate'' Communication System for Wireless Media Applications**
Sayandeep Sen, Tan Zhang, Syed Gilani, Shreesha Srinath, Steve Schmitt, Suman Banerjee, Sateesh Addepalli
IEEE/ACM Transactions on Networking

Patents:

1. **Method and Apparatus for Wireless Communication using A Short-range Base Station with Multiple Radio Interfaces of Different Technologies**
Filed with Alcatel Lucent Bell Labs.
Application number: US 14/053,201 Publication number: US20140105134 A1
2. **Bandwidth Efficient Video Surveillance System**
Filing with Microsoft Research.
Microsoft Reference Number: 358094.01

Selected Posters and Demos:

1. **V-Scope: An Opportunistic Wardriving Approach to Augmenting TV Whitespace Databases** (Poster)
Tan Zhang, Suman Banerjee
ACM MobiCom 2013, *First place in ACM student research competition*
2. **Video Streaming Using Whitespace Spectrum for Vehicular Applications** (Video demo)
Tan Zhang, Sayandeep Sen, Suman Banerjee
ACM MobiSys 2013, *Awarded traveling grant*

Technical Reports:

1. **Sip: Speculative Insertion Policy for High Performance Caching**
Hongil Yoon, Tan Zhang, Mikko H Lipasti
TR-1676, Computer Sciences Department at UW-Madison, 2010

Professional Activities:

- Technical Program Committee Member (TPC) of S3 workshop in MobiCom 2015
- External Reviewer: IEEE TON, IEEE TMC, IEEE SECON, ACM MC2R
- ACM Student Member