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The purpose of ACM SIGMOBILE is to promote research and development by bringing together researchers and practitioners and fostering interest in the mobility of systems, users, data, and computing. SIGMOBILE will address the above spectrum of topics, sharing one common theme - mobility. The group's technical scope reflects the emerging symbiosis of portable computers and wireless networks, addressing the convergence of mobility, computing, and information organization, its access, services, management and applications.

With emphasis on the various areas of nomadic computing, data management, related technologies, and mobile user services, alongside more "classical" topics in wireless and mobile networking, the list of following areas can be considered to be representative of SIGMOBILE's activity:

- Nomadic computing, applications and services supporting the mobile user
- Design and analysis of algorithms for online and mobile environments
- Protocols to cope with mobility, limited bandwidth, and intermittent connectivity
- Data management issues in mobile environments
- Mobile and wireless networks and their architectures
- Mobility management, mobile agents and proxy architectures
- Mobile, location-dependent and sensitive applications
- Wearable computers and body area networks
- Systems and technologies for wireless and mobile environments
- Performance characterization of mobile/wireless and nomadic systems
- Design, management and operation of emerging wireless environments
- Mobile network planning and standardization
- Integration of wireline and wireless systems
- Security, scalability and reliability in wireless communication environments
- Service algorithms, emerging topics, etc.

SUBMISSION

ACM MC²R welcomes tutorial, survey, and research articles on topics outlined above. Submissions will normally be 4000 words, accompanied by several figures and/or tables, with a limited number of carefully selected references. Submission format and guidelines can be obtained from MC²R's web site (<http://www.acm.org/sigmobile/MC2R>)

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Sujata Banerjee, Milind Buddhikot, Imrich Chlamtac, Ravi Jain, Lili Qiu, Ram Ramjee, Andras Valko

Built on the first year's successful conference inaugural, Wireless Internet CONFERENCE (WICON) aims to become a premier international forum to discuss novel research results related to the emerging Wireless Internet. The conference addresses technologies aimed at providing seamless connectivity, richer services, and better quality for wireless data users while supporting heterogeneity in communication technologies, network architectures, and applications.

WICON 2006 took place at the Radisson Hotel Boston, Boston, Massachusetts, USA during August 2-5, 2006. It consisted of two-day regular track and one-day industry track. In addition, there were two one-day workshops on cutting edge topics: TAPAS (Workshop on Technology and Policy for Accessing Spectrum) and WITMEMO (Workshop on Wireless Traffic Measurements and Modelling). Approximately 70 people attended WICON this year. The presentations were very well delivered, and initiated lots of interactive discussions both online and offline.

I. Regular Track

The regular track contained two visionary keynote speeches, one thought-provoking panel, and seven interesting paper sessions.

The first keynote speech was given by Dr. Paul Kolodzy, who is from Advanced Wireless and Networking Technology and was a former DARPA Program Manager. As his speech title indicates, he articulated that the wireless Internet is all about access – access to the spectrum, access to the users, and secure access for the users. He also raised several important challenges, including how to define wireless interference, how to leverage the uniqueness of wireless channel to its advantage, what is the right abstraction for wireless networks. The second keynote speech was given by Rajiv Laroia from Qualcomm Flarion Technologies. He described several interesting lessons “unlearned” through his research experience. These unlearned lessons include: (i) all orthogonal bases are equivalent, (ii) channel model is $y = hx + n$, (iii) OFDM is physical technology.

The panel was organized by Dr. Sneha Kumar Kasera from University of Utah. The panel consisted of Dr. Milind Buddhikot (Bell Labs), Prof. Guevara Noubir (Northeastern University), Prof. Lili Qiu (University of Texas at Austin), Dr. Ram Ramanathan (BBN). They discussed research challenges and opportunities in spectrum management, wireless security, future wireless network management, and cognitive radios.

In addition to keynotes and panel, there were seven paper sessions in total including 20 papers from regular submissions and invited submissions. Each of the regular submissions was reviewed by at least three members of the TPC. Despite the relatively low number of submissions, the Program Chairs decided to stick to a very high standard and

finally accepted 10 out of the 30+ manuscripts. In addition, they invited 10 well known experts of the wireless Internet research area to submit papers. As a result of the rigorous review process and expert authors, we had an interesting, high quality program. Presentations were organized into the following seven sessions: wireless measurement, wireless mesh networks, congestion control, wireless performance, spectrum efficiency, wireless security, future wireless networks.

II. Industry Track

WICON'06 initiated an industrial research track for the first time with the hope of showcasing ongoing high quality research in the industry and fostering much needed dialog between industry researchers and academia. One full day of the conference was devoted to the industrial track. It was organized by Dr. Sujata Banerjee (HP Labs) and Dr. Milind Buddhikot (Lucent Bell Labs). The program covered topics on applications, infrastructure, and future wireless networks.

III. Workshops

There were two workshops on timely and important topics. Technology and Policy for Advanced Spectrum (TAPAS) was a new 1-day workshop organized by Dr. Milind Buddhikot from Lucent Bell Laboratories. TAPAS attracted technology and policy experts to disseminate cutting edge research in this field. It included two interesting keynotes: one titled “Grand Challenges in Dynamic Spectrum Access Networks”, delivered by Dr. Preston Marshall (Program Manager at DARPA ATO), and the other titled “Advances in RF MEMS and New RF Front-end Architectures” presented by Prof. Clark T. Nguyen (University of Michigan, former Program Manager at DARPA MTO). In addition, the program contained 17 papers, 6 posters, and 1 panel titled “The Multidisciplinary Research Challenges for Dynamic Spectrum Access Markets”. As these numbers indicate, the importance of the topic made TAPAS successfully attract high quality research work.

Second International workshop on Wireless Traffic Measurements and Modeling (WiTMeMo) was organized by Prof. Maria Papadopouli from University of North Carolina at Chapel Hill. WiTMeMo consisted of keynote speech by Prof. Henning Schulzrinne (Columbia), as well as invited and regular paper presentations on different aspects of wireless network measurements and modeling.

IV. Closing Remarks

In summary, WICON provides an opportunity for researchers from both academics and industry to present their

latest research results in wireless Internet and exchange their ideas. Most of the talk slides are available online at <http://www.wicon.org>.

We would like to express our gratitude to all the authors who contributed submissions, to all the TPC members who did a great work reviewing manuscripts, and to all the organizing committee members who devoted their time and effort. Thanks to their hard work, we had a very successful WICON'06.

Finally we are pleased to announce that WICON 2007 will be held in Austin, TX in October 2007. Imrich Chlamtac is Steering Committee Chair, Lili Qiu and Andras Valko are General Co-chair, Karoly Farkas and Xudong Wang are Technical Program Co-Chair. We hope to see you at WICON next year!

Workshop Report — CRAWDAD Workshop 2006

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Wireless network researchers are seriously starved for data about how real users, applications, and devices use real networks under real network conditions. CRAWDAD, the Community Resource for Archiving Wireless Data at Dartmouth, is an NSF-funded project that is building a wireless network data archive for the research community. We host wireless data, and provide tools and documents to make it easy to collect and use wireless network data. We hope that this resource will help researchers to identify and evaluate real and interesting problems in mobile and pervasive computing. This report outlines the CRAWDAD project and summarizes the second CRAWDAD workshop, held at MobiCom 2006.

I. Introduction

The second CRAWDAD workshop was held in conjunction with the MobiCom conference on September 25, 2006, in Marina del Rey, California. In all, 38 attendees from 29 institutions signed our attendee list. Thanks to our NSF support, the workshop was free and registration was not strictly policed, so a better gauge of participation might be the number of occupied seats. During parts of the workshop, all the 49 chairs in the room were full.

II. About CRAWDAD

If you are not familiar with the CRAWDAD project, we encourage you to visit the website¹ to learn more. Briefly, the NSF is funding an effort to build a true community resource: an archive with the capacity to store wireless trace data from many contributing locations, and with the staff to develop better tools for collecting, sanitizing, and analyzing the data. This Community Resource for Archiving Wireless Data At Dartmouth, CRAWDAD, works with community leaders to ensure that the archive meets the needs of the research community, works with the other leading centers that develop network tracing tools and metadata, and works with research organizations and corporations to ensure continuing support for the archive after

Jihwang Yeo is a staff member of the CRAWDAD project. Tristan Henderson was a Research Assistant Professor of Computer Science at Dartmouth College at the time of the workshop, and moved to the University of St Andrews in December 2006. David Kotz is a Professor of Computer Science at Dartmouth College. CRAWDAD is sponsored by the National Science Foundation under award number 0454062.

¹<http://CRAWDAD.cs.dartmouth.edu>

NSF's funding ends.

Our goal is to serve you, the researchers and educators, in collecting and using wireless data.

III. CRAWDAD Workshop 2006

The workshop began with a brief introduction and a demonstration of the CRAWDAD website. Following this were three invited talks by a CRAWDAD data contributor and two CRAWDAD users, one of who used our data for educational purposes. Finally, we brainstormed on the future of CRAWDAD with three breakout discussion groups covering tools, MANETs (Mobile Ad Hoc NETWORKS), and modeling. After hearing back from each group, the workshop concluded.

The following summarizes the presentations and discussions. Interested readers may visit the workshop website² for a detailed agenda and slides.

III.A. Welcome and CRAWDAD Website Demo

David Kotz, CRAWDAD Principal Investigator, welcomed the attendees and talked about the recent growth of the archive. He highlighted the growing numbers of users, data, and tools. The archive now includes 18 data sets, 10 tools, and 44 papers have used CRAWDAD data. At the time of the workshop, there were 346 users from 213 institutions, and this has since risen to 462 users from 280 institutions at the time of writing.

Jihwang Yeo, a CRAWDAD staffer, demonstrated the website, and gave an overview of the currently

²<http://CRAWDAD.cs.dartmouth.edu/workshop2006>

archived data and tools. He also discussed how to correctly cite the *CRAWDAD* resources in papers, and encouraged users to visit the wiki³ for “HOWTO” documentation and online discussion.

III.B. Invited Talks by *CRAWDAD* Community

In the first invited talk, Dr. James Scott from Intel Research Cambridge discussed the Haggie project, for which several traces have been collected. He mentioned the motivation and issues in collecting traces and gave useful tips for those who plan to collect traces. “*CRAWDAD* helps by handling requests for traces, and by generating citations to make it worth it”, said James, who has contributed two data sets to the *CRAWDAD* archive. He also made several excellent suggestions for the *CRAWDAD* archive: for example, adding summary characteristics to the metadata and allowing users to search data by application type, traffic volume, or file size.

The second invited speaker was Professor Mark Hansen from the Department of Statistics at UCLA. He talked about the use of *CRAWDAD* data in his graduate course in statistical computing. He gave an overview of the course, describing the goals of the course, the tools and data used for the course, and the assignments. He then detailed those assignments that used a big data set like the Dartmouth campus wireless LAN traces from in the *CRAWDAD* archive, describing the approach, interactions with the *CRAWDAD* team, and some results. He mentioned that a better documented back-story could help students interpret what they were doing, and that trace sanitization, although necessary, does remove some of the context useful in statistical analysis.

Professor Songwu Lu, from UCLA’s Computer Science Department, talked about his research on the behavior of wireless network traffic. He described his experience of using four *CRAWDAD* traces collected by different institutions, pointing out such problems as varying qualities of traces, difficulty in synthesizing traces, and missing data. He suggested that the community develop better tools, standard data and metadata formats, and standardized benchmarks.

III.C. Break-out Group Discussion

After a short brainstorming session, we selected three break-out topics that concern the future of *CRAWDAD*: Tools, MANETs, and Modeling. Three break-out groups discussed each topic for about 30 minutes.

³<http://CRAWDAD.cs.dartmouth.edu/wiki>

The Tools break-out group first agreed that the research community needs data collection standards and principles, such as common formats and metrics, and guidelines for data collection. Suggested guidelines include desirable collection practices, for instance identifying metrics for evaluating the data, and recording device failures and anomalous behavior. The group argued that such standards and principles are necessary because uniform formats and metrics can be a basis for developing tools, and can also be used for comparing different data. The group also agreed that one of the most needed tools is a tool for visualizing the measured network traffic.

The MANET break-out group members started the discussion on what would be a desirable data set. They agreed that the “dream” data set would be a multi-dimensional, multi-layer data set that includes mobility information. An example dream data set would be in three dimensions of time, spatial, and layers, contain multiple layer information over physical to application layer, and include mobility information such as locations or contact patterns. They discussed the challenges in developing MANET benchmarks, pointing out that the scenarios may depend on both environment and application. They also made a list of MANET test beds, which will shortly appear on the *CRAWDAD* MANET Area wiki.⁴ Furthermore, they suggested several ideas for the *CRAWDAD* website, for example, an online wish list and a forum.

The Modeling break-out group first defined a model as a “more tractable means of understanding data” or a “general method of simulating lots of different environments.” Based on the definitions, they discussed which data are needed for modeling. Various sorts of data were suggested, for example, always-on traces with GPS, multi-resolution traces, WiMax traces, or vehicular traces.

In addition, they discussed other modeling issues like meta-models, validation, and tools. They wondered if it is possible to develop a model that adapts to create the best model for a specific scenario. Another question they raised is how we can validate models, especially in the face of limited trace data. They also agreed on the need for tools that extract common characteristics from many traces.

IV. Conclusion

The workshop was a great success and resulted in many action items for us. We have begun preparing guidelines for data collection and tool development.

⁴<http://CRAWDAD.cs.dartmouth.edu/manet>

Next, we will enhance the metadata on our archive, and improve our search capabilities, by adding useful fields, including summary characteristics, application types, and file sizes.

We also plan to publish an e-newsletter that highlights users' activities, and add more special-interest areas, e.g., a "mobility modeling" area. Please contact us if you are interested in helping.

If you would like to learn more about *CRAWDAD*, please visit the the website. You can access our data and tool collection, view their metadata and relevant published papers, subscribe to a mailing list, and post your research experiences to the wiki. We also welcome suggestions and volunteers to help collect and organize data.



CRAWDAD.cs.dartmouth.edu