Report on the Third ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc 2002)

David B. Johnson[a]
dbj@cs.rice.edu

Jean-Pierre Hubaux[b]
Jean-Pierre.Hubaux@epfl.ch

[a]Computer Science Department, Rice University, Houston, TX, USA
[b]Swiss Federal Institute of Technology - Lausanne (EPFL), Lausanne, Switzerland

I. Conference Overview

MobiHoc 2002, the Third ACM International Symposium on Mobile Ad Hoc Networking and Computing, was held from Sunday, June 9, through Tuesday, June 11, 2002, in Lausanne, Switzerland on the campus of the Swiss Federal Institute of Technology Lausanne (EPFL). The Technical Program Co-Chairs were J.J. Garcia-Luna-Aceves of the University of California at Santa Cruz and David B. Johnson of Rice University, and the General Chair was Jean-Pierre Hubaux of EPFL.

MobiHoc has grown dramatically as a conference since its inception two years ago. In 2000, the first MobiHoc was held in Boston, Massachusetts, as a one-day workshop affiliated with MobiCom 2000; MobiHoc became a separate symposium in 2001 and was held in Long Beach, California, where it attracted about 160 participants. Leveraging on the success of these events, the MobiHoc Steering Committee decided to bring the symposium to Europe this year. The attendance this year reached a new record for MobiHoc, with over 200 ad hoc networking and computing enthusiasts participating in the event.

MobiHoc 2002 was indeed a truly international event. In addition to marking the first time the conference has been held outside the United States, the paper submissions and attendees came from all over the world. 21 countries were represented among those attending the conference, with about one third coming from the United States and one quarter from Switzerland; the next largest fractions came from throughout the rest of Europe and North America, Japan, India, Hong Kong, Singapore, and Australia. Submitted papers came from a total of 19 countries, spread throughout roughly the same areas around the world, although a larger fraction, roughly one half, came from the United States, with the next largest fractions coming from Germany, France, India, Canada, Taiwan, and Japan; in total, 134 papers were submitted to the conference, including papers from academia, industry, and government research labs. From these submissions, the technical program committee selected the best 22 papers, based on a rigorous review process and the merits of each paper. The resulting program of accepted papers presented at the conference included papers from 7 different countries.

The main conference opened on Monday morning with a welcome address by Stefan Catsicas, Vice President for Research of EPFL, followed by the keynote address by Martha Steenstrup of Stow Research. Martha's keynote, entitled *Think Globally, Act Locally: A Credo for Mobile Ad Hoc Networking*, vividly described many of the challenges of ad hoc networking. She stressed the importance of distributing control locally among the nodes in the ad hoc network, while understanding the algorithm's behavior within the context of a global network system. Among her other points included the need to construct a local view of global state and a local model of global behavior, choose actions based on local knowledge, and restrict the temporal and spatial locality of actions.

II. Research Paper Presentations

The main conference technical program on Monday and Tuesday was organized into a single track of presentations, divided into 6 sessions. The first session, on *Routing*, was chaired by Zygmunt Haas of Cornell University. The first paper in this session, by Panagiotis Papadimitratos, Zygmunt J. Haas, and Emin Gün Sirer, described the efficient selection of multiple redundant paths to mask link failures. The second paper, by Mahesh K. Marina and Samir R. Das, addressed the influence of unidirectional links on routing performance in ad hoc networks. Next, the paper by Subir Kumar Das, B.S. Manoj, and C. Siva Ram Murthy, presented the design of a dynamic core based multicast routing protocol and a comparison with the On-Demand Multicast Routing Protocol (ODMRP). The last paper in this session, by Hung-Yun Hsieh and Raghupathy Sivakumar, discussed the use of ad hoc networking within a cellular network and showed how this can significantly improve the overall performance of the network.

The second session of presentations was chaired by Victor Bahl of Microsoft Research and addressed the topic

Martha Steenstrup gave an excellent keynote address describing the challenges of ad hoc networking

of *Fairness and Scheduling*. The first paper in this session, by Zuyuan Fang, Brahim Bensaou, and Yu Wang, used an analytical model to evaluate the performance of a proposed fair backoff algorithm for IEEE 802.11 DFWMAC. In the second paper, Vikram Kanodia, Chengzhi Li, Ashutosh Sabharwal, Bahareh Sadeghi, and Edward Knightly tackled the problem of ordered packet scheduling in ad hoc networks, providing a description of appropriate mechanisms as well as a performance analysis. Finally, the paper by Xue Yang and Nitin Vaidya described a technique for priority scheduling in multihop wireless networks, based on narrow-band busy tone signals.

The next session, on *Performance Evaluation*, was chaired by Charles Perkins of Nokia Research. The first paper in this session, by Christian Bettstetter, examined the question of the minimum radio range required to achieve a connected ad hoc network, given a uniform number of nodes n per area A. Next, Chris Barrett, Martin Drozda, Achla Marathe, and Madhav V. Marathe described the interaction between routing and MAC protocols under different mobility models. The final paper in this session, by Yongguang Zhang and Wei Li, presented details of an integrated environment for testing mobile ad hoc networks through network emulation.

Tuesday, the second day of the main conference, began with a session on *Energy Awareness and Power Control*, chaired by John Heidemann of the USC Information Sciences Institute. The first paper, by Weifa Liang, showed that the problem of constructing minimum-energy broadcast trees in wireless ad hoc networks is NP-complete and presented an approximate algorithm for the problem. Next, Errol Lloyd, Rui Liu, Madhav V. Marathe, Ram Ramanathan, and S.S. Ravi presented a paper addressing algorithmic aspects of topology control problems for ad hoc networks, considering the problem under optimization objectives such as minimizing the maximum power and minimizing the total power. The third paper, by Curt Schurgers, Vlasios Tsiatsis, Saurabh Ganeriwal, and Mani Srivastava, showed how the path setup latency and the network density could be exploited to manage the topology of sensor networks. The last paper in this session, by Suman Banerjee and Archan Misra, discussed minimum energy routing in ad hoc networks, formulating the problem to include not just the energy required to transmit over each link but also the link error rates.

The fifth session of the conference was chaired by Adam Wolisz of the Technical University of Berlin and presented four papers on the topic of *Scalability*. The first two of these papers made use of connected dominating sets; the first, by Khaled M. Alzoubi, Peng-Jun Wan, and Ophir Frieder, showed how to construct message-optimal connected dominating sets in mobile ad hoc networks, and the second, by Yuanzhu Peter Chen and Arthur L. Liestman, developed an approximation technique to compute the minimum size of weakly-connected dominating sets for clustering mobile ad hoc networks. The next paper was by Lifei Huang and Ten-Hwang Lai, and studied the scalability of IEEE 802.11 ad hoc networks, focusing on the distributed clock synchronization algorithm specified by IEEE 802.11.

Finally, Mineo Takai, Jay Martin, Aifeng Ren, and Rajive Bagrodia presented their work addressing directional virtual carrier sensing for directional antennas, showing an improvement in network capacity by a factor of 3 to 4 for a 100-node ad hoc network.

The last session of paper presentations, on the topic of *Protocols*, was composed of four presentations each proposing or analyzing some area of protocols for ad hoc networks; this session was chaired by Joe Macker of the U.S. Naval Research Lab. The first paper, by Brad Williams and Tracy Camp, provided a comparison of broadcasting (flooding) techniques, used for example in many network layer protocols for ad hoc networks. In the second paper, Nitin H. Vaidya presented a mechanism for "weak" duplicate address detection that works even in the presence of network partitions and unbounded message delays. Next, Feng Wang and Yongguang Zhang described a technique for improving TCP performance over mobile ad hoc networks by detecting and responding to out-of-order packet delivery events. Finally, Sonja Buchegger and Jean-Yves Le Boudec described and evaluated a reputation system called CONFIDANT (Cooperation Of Nodes: Fairness In Dynamic Ad-hoc NeTworks) for making misbehavior in routing and forwarding unattractive.

III. Additional Events at MobiHoc

In addition to the paper presentations and keynote address, the main technical program also included a poster session on Monday afternoon and a panel discussion session on Tuesday afternoon. The poster session included 12 posters, and offered the opportunity for many discussions about the presented research efforts. The panel discussion, organized by David B. Johnson of Rice University, addressed the topic *On the Unsuitability of IEEE 802.11 and Bluetooth for Mobile Ad Hoc Networking*. This "open" format panel provided attendees a chance to volunteer to present their view for and against any aspect of this position, resulting in a lively discussion that was controversial, informative, and entertaining.

A new feature for MobiHoc this year was a full day of tutorials on the day before the main technical program began. On Sunday morning, Nitin Vaidya, Rajive Bagrodia, and Mineo Takai, presented a half-day tutorial on *Design and*

Traditional Swiss alphorns greeted attendees
to the gala dinner banquet at Château d'Oron

Modeling of Medium Access Control Protocols for Wireless Ad Hoc Networks, and on Sunday afternoon, Elizabeth Belding-Royer and Sung-Ju Lee presented a half-day on *Routing and Multicasting in Mobile Ad Hoc Networks*. Each of the tutorials was well received and attracted around 80 participants.

On Monday evening, MobiHoc participants were treated to a gala dinner banquet at the historic Château d'Oron, a 12th Century castle near Lausanne. This social event provided an opportunity to meet with one another in a relaxed setting and to learn something of the history of the region in which the conference was taking place. After a bus ride to the castle, participants were greeted by the melody of alphorns, followed by a dinner of local cuisine by a roaring fire inside the castle, topped off by a gigantic dessert buffet and coffee in the courtyard outside.

IV. Summary

MobiHoc 2002 was an excellent three days with a tightly packed program of state-of-the-art research papers, tutorials, a very interesting keynote address, and many other events. In addition to being the first time the conference has been held in a location outside the United States, we also set a new record for attendance and got to experience beautiful Lausanne, Switzerland on the shore of Lake Geneva in sight of the Alps.

We would like to thank all of the authors who submitted their research papers to the conference, and the participants who came from around the world to attend the conference; we also thank the volunteers who helped organize the conference, and the generous supporters whose financial contributions helped to ensure the success of the conference. All of these and others helped to make MobiHoc 2002 an an enjoyable and rewarding experience for all. Finally, we look forward to your participation again in next year's version of the conference; MobiHoc 2003 is planned for June in Annapolis, Maryland, USA.