

Edwin A. Hernandez, Ph.D.

Research Statement

My recent industry experience has shaped the way I plan and execute engineering projects. In research, the scientific method and project planning should go hand in hand. Results must be shown, research must be innovative, and collaboration with other faculty and students should be part of your results.

In general, engineering research must have three main goals a) The publication of Academic papers and reports, b) The technology and education transfer, and c) The creation of Intellectual Property for research sponsors.

In my philosophy, publications are a tool for knowledge dissemination, an instrument for independent judgment in academic journals that sometimes attract international interest to a research initiative. Publications are then the prefer mechanism to outreach our global academic community. Technology and Education transfer are initiatives in which other researchers, the community, and students get involved in an engineering research effort, this is how faculty and students connect. Students learn by doing, and undergraduate and graduate students master the art of communicating their knowledge to others. Finally, Intellectual Property (IP) is naturally generated in all original and novel research efforts. IP has a value and should be managed correctly; IP is an instrument to protect any new or more efficient way to solve a problem, any method or solution that's unique, as well as many other inventions. IP can then generate royalties that can fund more research initiatives or could become flagship university initiatives.

In my philosophy, any research project is just like any other engineering effort, novel or not, a well layout plan must be drawn, goals must be defined (Publications, a simple demo, proof of concept, or patents), and each research proposal should be clearly planned and a research roadmap developed.

For starters, there are many funding sources that might be difficult to tackle, however there are many existing research efforts that are slowly maturing and may need academic communities help, social networks with other members of our community and industry are key drivers at all research stages.

My engineering experience at Microsoft and Motorola will be of great help handling resources and efficiently manage my research, industry relationships, and drive funding. I believe that young engineers will learn by seeing other faculty mentors, and research labs should resemble what a potential job environment could be for them in the future.

What are then my research interests? I am very interested in communication networks and mobility. During my Ph.D. research, I envisioned a future with widespread deployment of WLAN Access Points and thousands of WLAN devices, laptops and PDAs, Voice and Data all integrated into PDAs and people freely moving handing off at different environments.

Today this a reality, WLAN is pervasive but also 3G and 4G networks have become part of our ecosystem and hence several problems arise.

Mobility is hence a feature but also a problem, in my dissertation so I narrowed it down to a simple question “How speed affects mobile nodes?” this question became my motivation and drove my goals. I started investigated network simulation (e.g. ns-2) looking for a way to visualized mobile nodes in rapid mobility conditions. I found out that simulation was not sufficient for real life wireless network deployments, especially at high speed. As we know, simulation requires a lot of computing power and results could be affected by the assumptions made. In the near future, mobile application developers, and wireless ISPs will require more realistic tools to deploy and study wireless networks. With this vision in mind, I developed RAMON or the Rapid Mobility Network Emulator. RAMON[1-4] is a platform where emulation and simulation are put together. RAMON provides a wireless emulation layer using real Access Points, signal attenuators, and custom-based logic controllers. RAMON requires a network topology to be fed in and as a result a mobile device (e.g. Laptop, Tablets, Mobile Phones, and Embedded devices) will perceive a real physical stimulation that the emulator will recreate in representation of a wireless network deployment.

In RAMON, a network emulation environment, I was able to identify several performance bottlenecks in Mobile IP, many of these issues were derived from the registration process and IP tunneling. Thru experimentation, modeling, and emulation, I determined that a proactive registration mechanism could easily improve Mobile IP performance at high speed. A Ghost Mobile IP protocol was then created. G-MIP uses Kalman filters to predict mobile host's trajectory and projected path. Once the projected path is determined, ghost "entities", Foreign Agents and Mobile Nodes are created along the projected path. Those entities allow IP tunnels to be created and registration to occur, pro-actively and not reactively. Our experiments showed a performance improvement of 30-50% at speeds up of to 80 m/s in the emulator.

RAMON is a live example of my research philosophy, a question was created and once completed it fructified into several publications, two patents pursued and academic collaboration in Harris Mobile Computing Lab were clearly achieved. RAMON produce all outputs on my research philosophy, a device capable of emulating mobility, as well as several publications, and several patents created and fostered with RAMON.

Today, RAMON is called MobileCAD and is currently implemented to support GSM and 2G/3G networks, a prototype can be seen at my lab in Boca Raton, FL as part of Rapid Mobile Technologies, Inc [4]. A recent effort in my part to commercialize the US Patents 7,231,330 and 7,697,508 are fructifying a research effort that I will be glad to improve and take it to the next level in an academic environment.

I feel motivated and currently looking for a university environment where to establish a research lab in Wireless and Telecommunication networks research.

References

- [1] E. Hernandez and A. Helal, "Predictive Mobile IP for Rapid Mobility", Proceedings of the fourth IEEE Workshop on Wireless Local Networks (WLN), November 2004, Tampa, Florida. [\(pdf\)](#)
- [2] E. Hernandez and Sumi Helal, "RAMON: Rapid Mobility Network Emulator," Proceedings of the 27th IEEE Conference on Local Computer Networks (LCN), Tampa, Florida, November 2002. [\(pdf\)](#)
- [3] J. Tian and A. Helal, "Speed Adaptive MIP over Wireless LAN," The International Journal on Wireless Communications and Mobile Computing, Wiley & Sons, Vol: 8, No: 10, 2009, pp. 1355-1364.
- [4] <http://www.ramobitech.com/>