iTiger Summary: Year end 2010

Contact: Jim Martin
School of Computing
Email: jim.martin@cs.clemson.edu
Internal web site: http://www.cs.clemson.edu/~jmarty/projects/iTiger/iTiger.html
External web site: http://webapps.itiger.clemson.edu/football/
Executive Summary

- **Original Goal:**
  - spark collaborative research projects across various campus involving students, faculty, CCIT staff, and Athletics.

- **Results:**
  - Equipment donations, funding from Cisco Research, publications, involved on over 20 students, established Creative Inquiry (see [http://itiger.clemson.edu/creativeinquiry.php](http://itiger.clemson.edu/creativeinquiry.php))

- **Status:**
  - The original three year project as described in the MOU signed by the three partners is complete.
  - The iTiger mission is now distributed across multiple groups/teams:
    - Lots of effort in CoES to get student’s engaged on research, industrial, and University projects
    - CyberInstitute/CCIT developing Mobile Apps and working with students and faculty

- **Commercialization:**
  - A company was spun off to pursue $250,000 in funds from South Carolina’s Upstate Carolina Angel Network (UCAN), however the window of opportunity was limited to 2009 (5/2009-12/2009). The company did not obtain the funding….and the company has been disbanded.
  - The concept presents a difficult business case. Huge investment required (200 APs required around a bowl). However, it appears that at least the large venues (professional events, popular collegiate programs) are high profile opportunities for cellular operators. This is the market Cisco Sports&Entertainment is going after (with AT&T).

- **For iTiger to go the next step (at the stadium):**
  - To become highly competitive for NSF grants we need a complete buildout at the stadium. Low hanging fruit is a research project that is at the intersection of Human-Computer Interface (HCI), CyberSystems, and Visualization.
  - Have the wireless operators who are investing in Clemson’s distributed antenna system build out the stadium- it is in their best interest to offload data traffic from their 3G/4G spectrum onto WiFi.
Agenda

- Introduction and Background
- 2008/2009/2010 Summary
- Project Results
- Acknowledgements
- Final Thoughts, Future Directions
• By 2014, 55% of all cell phones will be smartphones….they will likely support multiple radios each able to configure to operator over a number of communications modes.
• Future is for autonomous wireless networks to cooperate increasing the reach and capabilities any single operator can offer on their own.
• NSF is all over this - the Geni objective is how to blend production level systems with experimental systems. In 2012, there will be a rejuvenated FIND program that is intended to produce the next set of Internet protocols that can better meet the needs of ‘data centric’ networks that must operate over a broad set of diverse heterogeneous systems.

• One goal of the CS Division’s Networking Lab is to develop methods allowing independent wireless networks to cooperate in an effort to seamlessly extend the Intranet/Internet to mobile users.
Introduction

• Vision
  • Extend the scope of ‘cyberinfrastructure’ for devices connected by broadband wireless networks.
  • Create a student-run project ecosystem for sustaining the concept into the future.

• Objectives
  • Research: Provide an infrastructure for research which in turn drives publications and external funding.
  • Pedagogy: Engage undergrads and graduate students across all disciplines in projects that will help them get jobs.
2008 Accomplishments

- Developed an 802.11 research testbed with gifted equipment
- Improved prototype and network infrastructure
- Raised profile of the project
  - Increased awareness of the project
  - Provided an illustration of a Cyberinfrastructure Project
  - At the forefront of defining the “Connected Campus” concept
- Student engagement
  - 15 Student Volunteers representing Computer Science, DPA, Business, Graphics Communication, and Engineering majors
  - Student Advisory Board created to help guide the project on behalf of the student population
2009 Accomplishments

• Football stadium project
  • Further refinement of the system
  • Usage tracking capability
• Campus
  • CATBUS tracking system
• Creative Inquiry established
2010 Accomplishments:

- Football stadium project
  - System opened to all Wifi users in the stadium
  - Usage monitoring capability added
- Creative Inquiry went public, see http://itiger.clemson.edu/creativeinquiry.php
- Additional funding was the goal for the year:
  - Received a grant from Cisco Research (PIs: J. Martin, M. Westall, “Broadcasting Video Content in Dense 802.11g Sports and Entertainment Venues”, see http://www.cs.clemson.edu/~jmarty/projects/WiFi/CiscoWiFi.html)
  - A company was spun off to pursue $250,000 in funds from South Carolina’s Upstate Carolina Angel Network (UCAN), however the window of opportunity was limited to 2009 (5/2009-12/2009). The company did not obtain the funding….and the company has been disbanded
- NSF grants partially funding iTiger activities for 2010:
  - PI: Dr Jim Martin, “Towards a Unified Wireless Network Involving Reconfigurable Devices”, see http://www.cs.clemson.edu/~jmarty/projects/5GNets/5GNets.html
Project Results and Observations

- Most popular content: the virtual scoreboard by far!!!!
- Zipf’s law very much in play:
  - A large number of users connected with iTiger, only a very small number pulled more than a couple video streams
- System activity is highly correlated with crowd reactions
  - RF conditions can vary widely depending on crowd activities.
  - We refer to this system as a wireless crowd spot – like a WiFi hotspot, but several orders of magnitude greater in scale
iTiger Project: Publications, Articles, Proposals and Grants

- **Publications:**
  - J. Martin, W. Westall, R. Amin, “Video Broadcasting using Application FEC in Dense 802.11g Wireless Networks”, under development.

- **Press:**
  - Article in Clemson CES Ideas: [http://www.clemson.edu/ces/documents/ideas-spring09.pdf](http://www.clemson.edu/ces/documents/ideas-spring09.pdf)

- **Proposals, Whitepapers, Grants**
  - Proposal: US Department of Transportation Next-Generation Shared-Usage Broadband Networks Based on a Public-Private Partnership: A Feasibility Study
  - Whitepaper: DHS: Detecting Intentional and Unintentional Denial of Service in Broadband Wireless Critical Infrastructures
  - PI: J. Martin, M. Westall: Cisco Research, “Broadcasting Video Content in Dense 802.11g Sports and Entertainment Venues”
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• We acknowledge the project equipment sponsors, Cisco and Apple.
• We acknowledge the extremely hard work of all students (at least 20 students have been directly involved), including those that worked on the initial prototype in 2007
• We acknowledge Jim Bottom and his colleagues at Purdue who paved the way for iTiger through their eStadium project.
• We acknowledge other sponsors that indirectly funded the project:
  • NSF grant: PI: Dr Jim Martin, Dr. Eltawil (University of CA, Irvine), “Towards a Unified Wireless Network Involving Reconfigurable Devices”, see http://www.cs.clemson.edu/~jfjmarty/projects/5GNets/5GNets.html
  • Cisco research gift: PIs: J. Martin, M. Westall, “Broadcasting Video Content in Dense 802.11g Sports and Entertainment Venues”