iTiger Summary: Year end 2010



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CLEMSON TIGERS

CLEMSON UNIVERSITY

College of Engineering & Science

CCIT

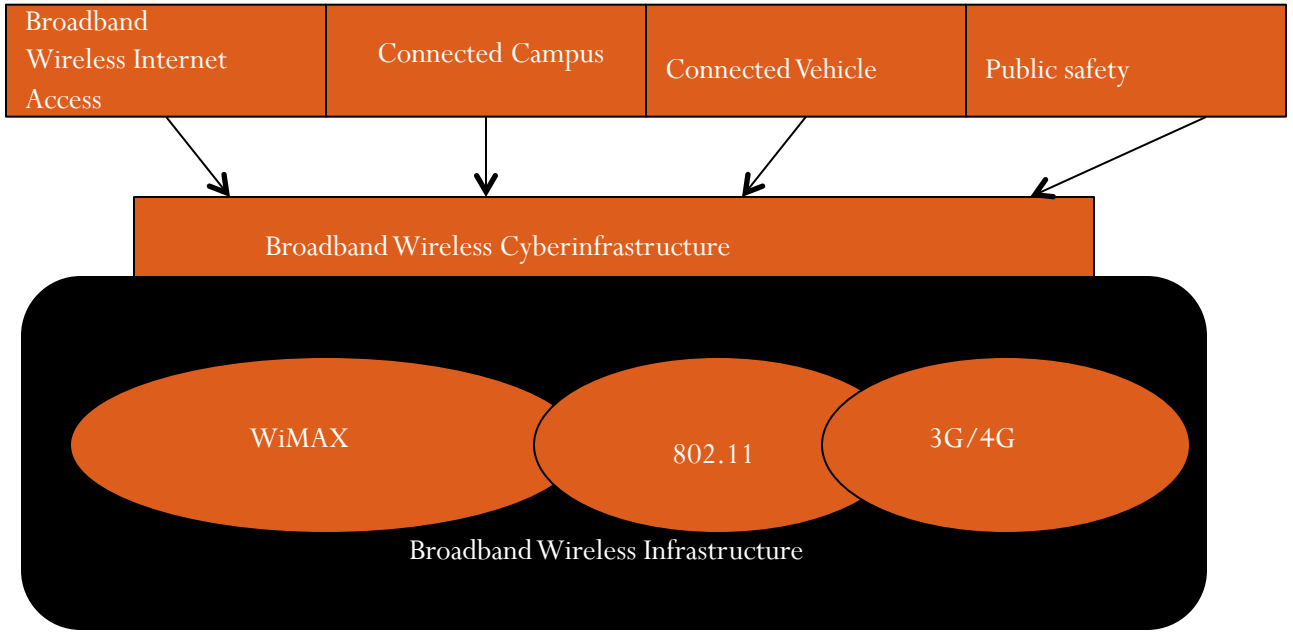
Executive Summary

- 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)
- 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

The 'big picture' …



•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:

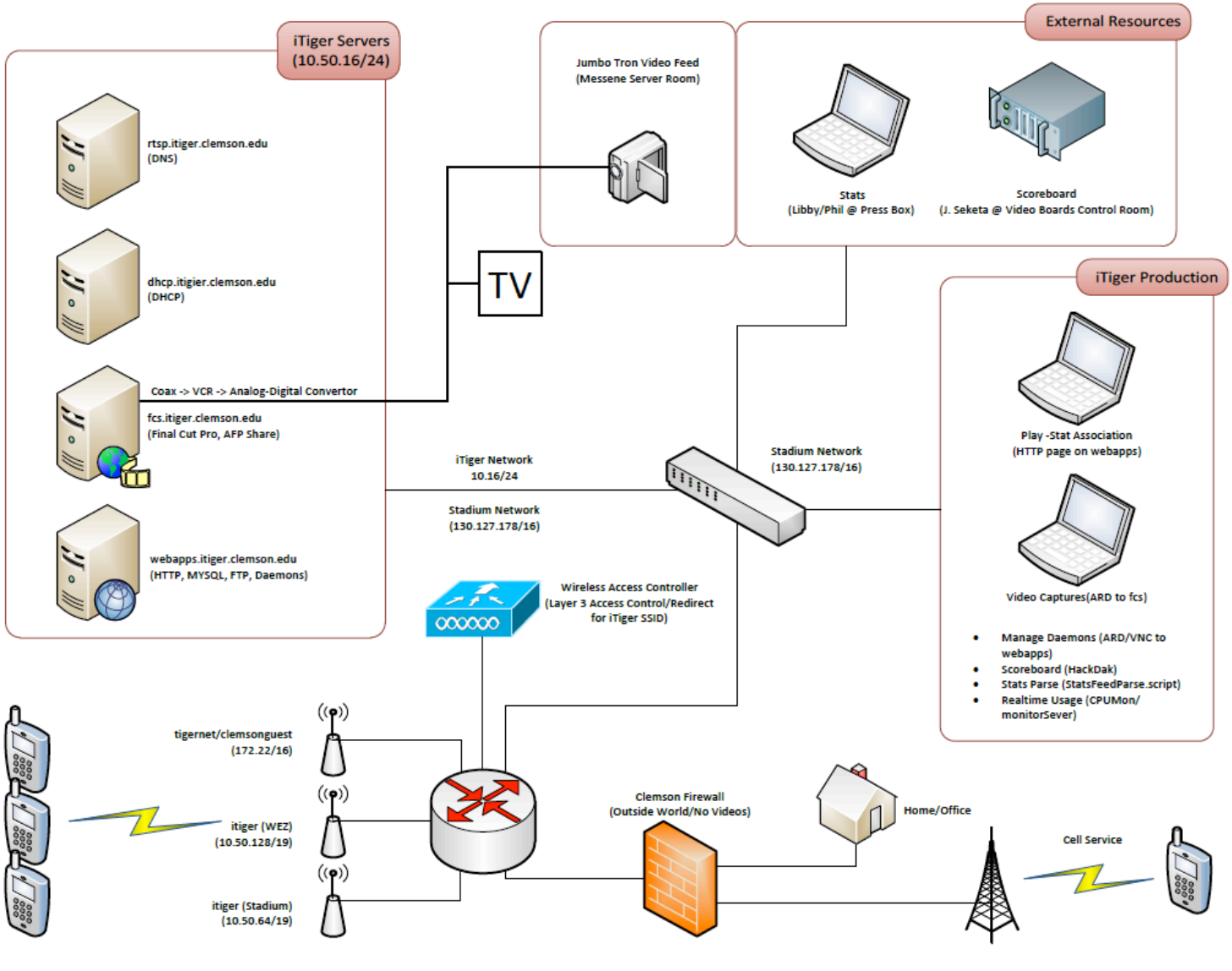
- Football stadium project
  - System opened to all Wifi users in the stadium
  - Usage monitoring capability added
- Creative Inquiry went public, see http://itiger.clemson.edu/creativeinquiry.php
- Additional funding was the goal for the year:
  - Received a grant from Cisco Research (PIs: J. Martin, M. Westall, "Broadcasting Video Content in Dense 802.11g Sports and Entertainment Venues", see http://www.cs.clemson.edu/%7Ejmarty/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/%7Ejmarty/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 Football Project: System Diagram



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.
  - M. Juang, KC Wang, J. Martin, "A Measurement Study on Link Capacity of a High Stress IEEE 802.11b/g Network", Proceedings of the IEEE Conference on Computers and Network Communications (ICCNC 2008), August, 2008.
  - MS Thesis: R. Johnson, Evaluating the Use of SNMP as a Wireless Network Monitoring Tool for IEEE 802.11 Wireless Networks, May 2009.
- Press:
  - Article in Popular Science: http://www.popsci.com/brett-zarda/article/2008-10/i-tiger
  - Article in Clemson CES Ideas: http://www.clemson.edu/ces/documents/ideas-spring09.pdf
  - Local news: http://www.wyff4.com/sports/17573595/detail.html
- 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: NSF Award, "Towards a Unified Wireless Network Involving Reconfigurable Devices"
  - PI: J. Martin, M. Westall: Cisco Research, "Broadcasting Video Content in Dense 802.11g Sports and Entertainment Venues"

Acknowledgements

- The iTiger project acknowledges the financial sponsors (Athletics, CCIT, and the CoES).
- 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/%7Ejmarty/projects/5GNets/5GNets.html
  - Cisco research gift: Pis: J. Martin, M. Westall, "Broadcasting Video Content in Dense 802.11g Sports and Entertainment Venues"