

ITIGER SUMMARY, YEAR END 2009

CLEMSON TIGERS

CLEMSON UNIVERSITY

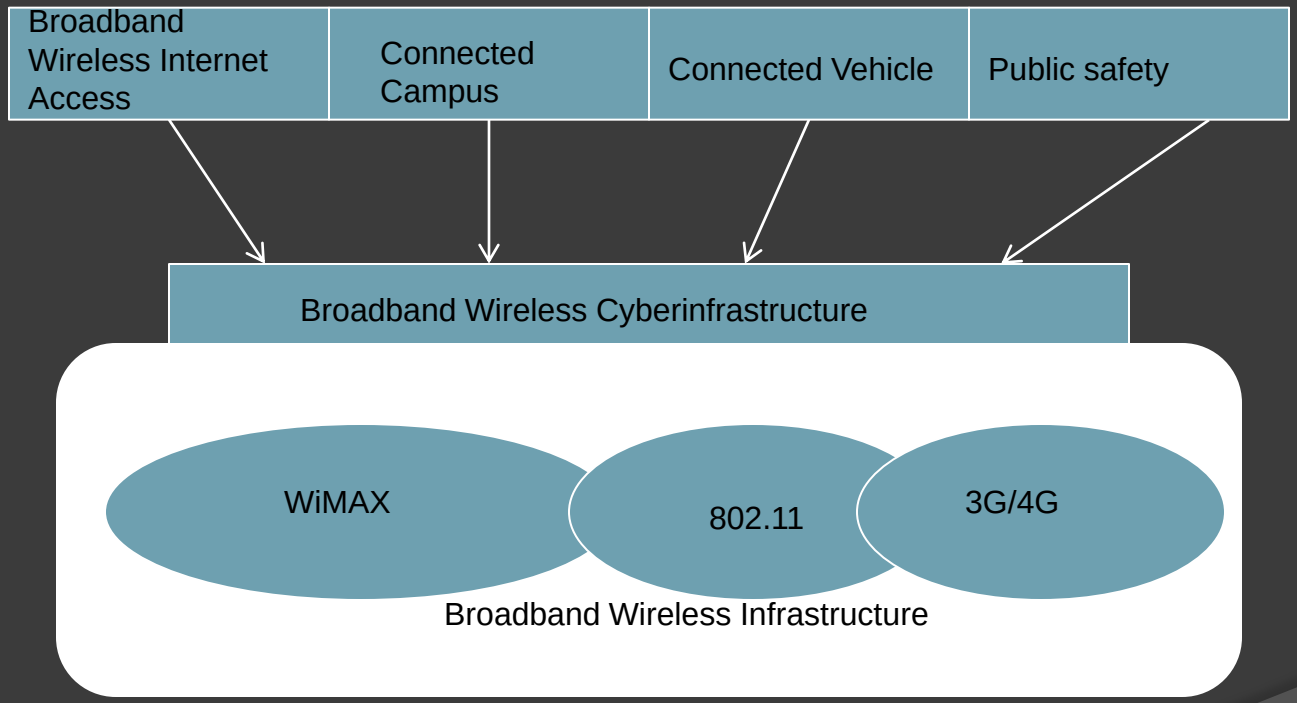
College of Engineering & Science

CCIT

Agenda

- Introduction
  - Original Vision
  - Original Objectives
- 2008/2009 Summary
- iTiger Project by Area of Work
  - Research
  - Football/Sporting Product
  - Campus Product
  - Creative Inquiry
  - Business Development
- Summary

The ‘big picture’ …



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 Project Review: 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 Objectives: New Offerings

- Creative Inquiry Launch
  - ½ Technical, ½ Business Development/Management
- Athletics
  - Scope: The scope of deployment in 2009 will be Internet-wide. Due to logistical concerns there are new user classes: WiFi Premium, General Wifi, Cellular Data, and Remote
  - Apps: Stats, Trivia, Video, Jumbotron interaction, SMS integration
- Campus
  - Apps:
    - Location Aware Apps: person to location routing, person to person routing, CATBUS tracking system
    - Social Networking, Itineraries, etc

iTiger Project, Research: Topics

- Define the next generation in-stadium fan experience. Likely applications involve virtualized environments, Wii-like interactive games but involving thousands of fans, social networks targeting athletic venues.
- Exploring the limits of how and what we can provide in a new mobile computing experience -- think iPhone/WinMo/Linux Mobile Development, etc...
- How can we use location awareness in 802.11 hardware in our networking research?
- Explore large scale 802.11 measurement techniques
- 802.11 performance (802.11n)
- Performance issues with video streaming
- Wireless coverage

iTiger Project, Reseach: Specific Publications and Projects

- Publications :
  - 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.
  - Research Report: K.. Injarapu, J. Martin, “Assessing the performance of 802.11g mobile devices“ (under development).
- Proposals and Whitepapers
  - 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
  - Whitepaper: NSF: Towards a Unified Wireless Network Involving Reconfigurable Devices
- Current Projects
  - Bo Li, Prakyath Rajanna, Will Pressly: Wireless Coverage Tool
    - http://itiger.cs.clemson.edu/CoverageTool/html/mapping.php
  - Abhijit Sribhashyam: Wireless Location
  - Karthik Injarapu: Comparison of 802.11 radios in mobile devices

iTiger Project, Research: Future Topics

- Multichannel, high-quality, high-density video streaming in a stadium
  - Littlejohn Stadium
  - 1000 users, 512 Mbps? Streams
  - 802.11g Challenges
  - Status: awaiting word from Cisco

iTiger Project, Football: Vision

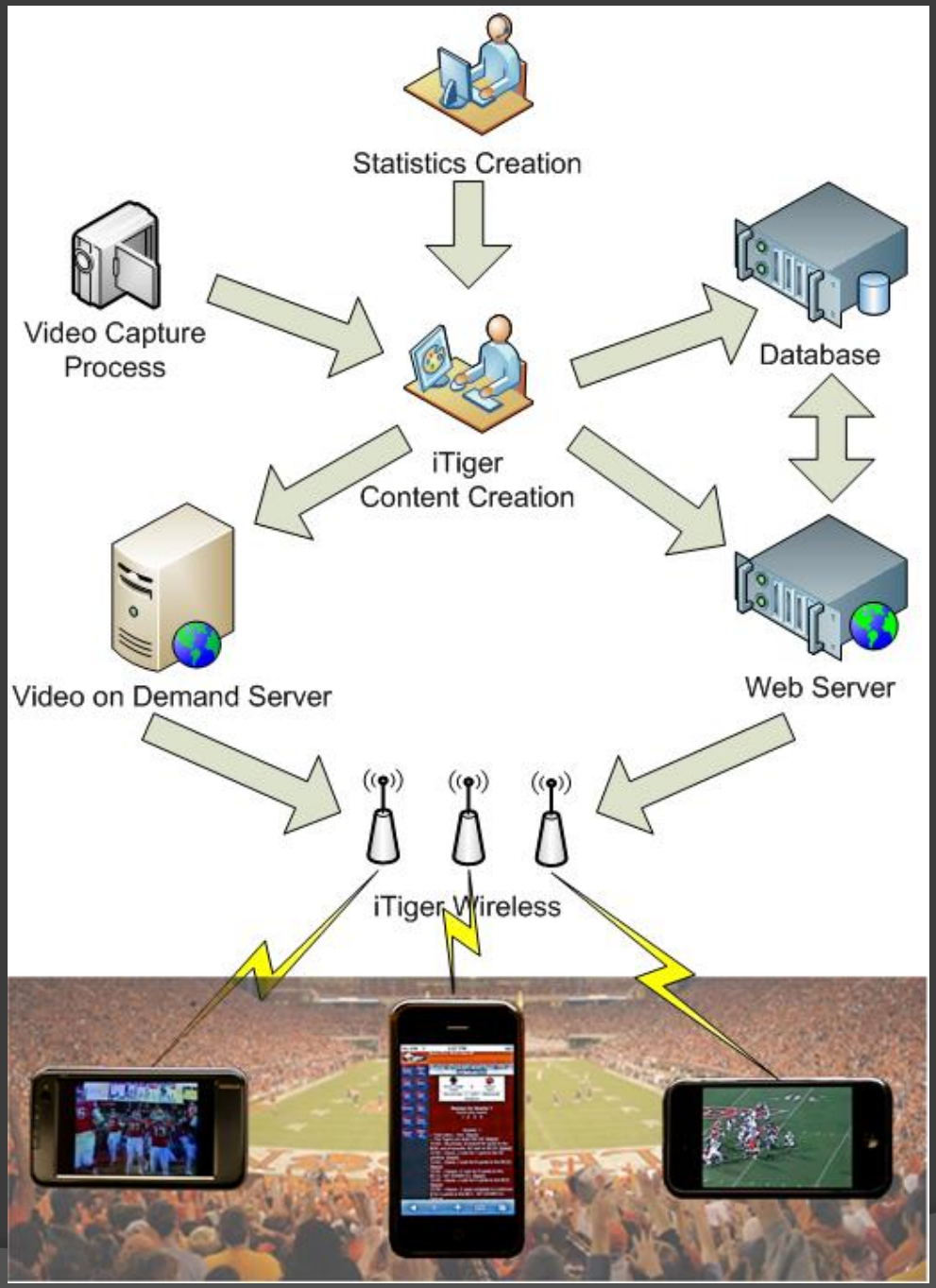
- iTiger is a set of web-based services whose goal is to enhance the Clemson sports experience while achieving the expanded goal of realizing and the shaping a vision of the collegiate stadium of the future.
- The collegiate stadium of the future is an environment where the goals of academics, business, athletics, and industry can combine, complement, and reinforce each other to the benefit of each.

iTiger Project, Football: Demo



What kind of applications does iTiger support?

- **Applications for Fan Experience**: include the ability to view replays, track statistics, interact with players and coaches, and use Clemson specific social networking applications.
- **Applications for Commerce:** include having a traditional e-commerce site for selling Clemson memorabilia, integration with vending at the university, and targeted advertising throughout the system.
- **Applications for the Research Perspective:** include signal/coverage statistics, system monitoring and load testing, and experimental support of content delivery.



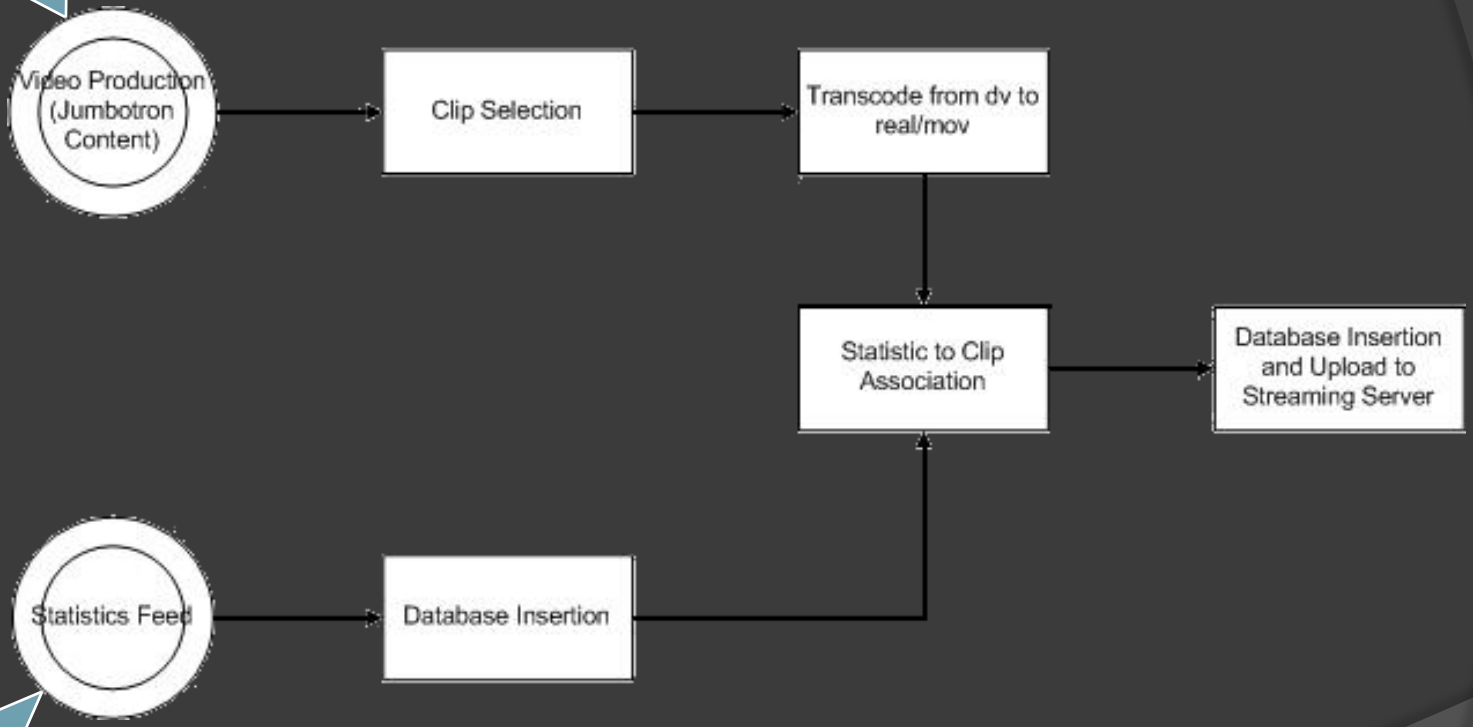
System Overview

iTiger Project, Football: Scripts

- Hackdack.pl: Zach Jones, Will Pressly
  - Intercept UDP broadcasts for scoreboards. Enable this on Ajax.
- iTigerWorkflow.pl: Will Pressly
  - Part of Final Cut Automation
- StatFeedParseDaemon.script: Will Pressly
  - Shell script to receive incoming FTP of game stats and parse/archive them.
- AjaxAuthoring.php: Will Pressly
  - Ajax page that allows authoring of system content by associating plays with stats.

Content Creation Workflow

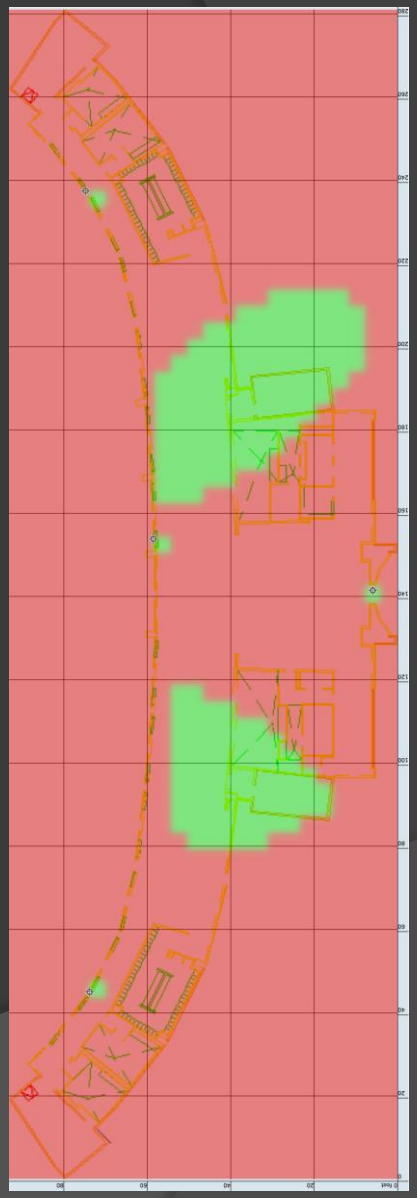
•Athletic department operates all cameras
•If the game is televised video feeds go to ESPN
•All video goes to a video production crew (trailers by the graveyard) who create the video presented on the 'jumbotron'



•Athletic department staff creates the play-by-play stats. Sent out the Internet to ESPN and to cstv.com who provides the game over the web (clemsontigers.cstv.com)

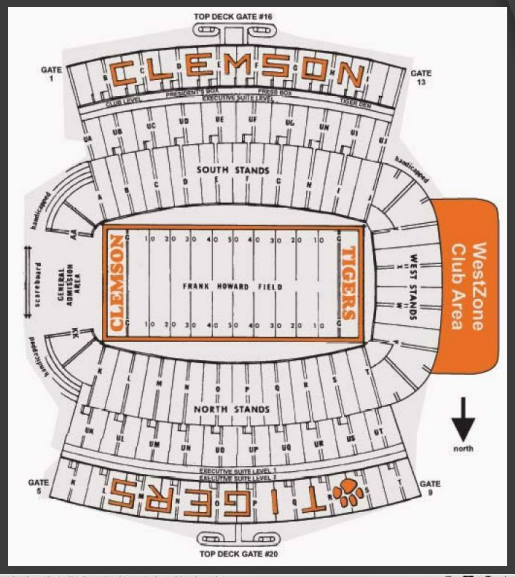
iTiger Project, Football: Wired and Wireless Network

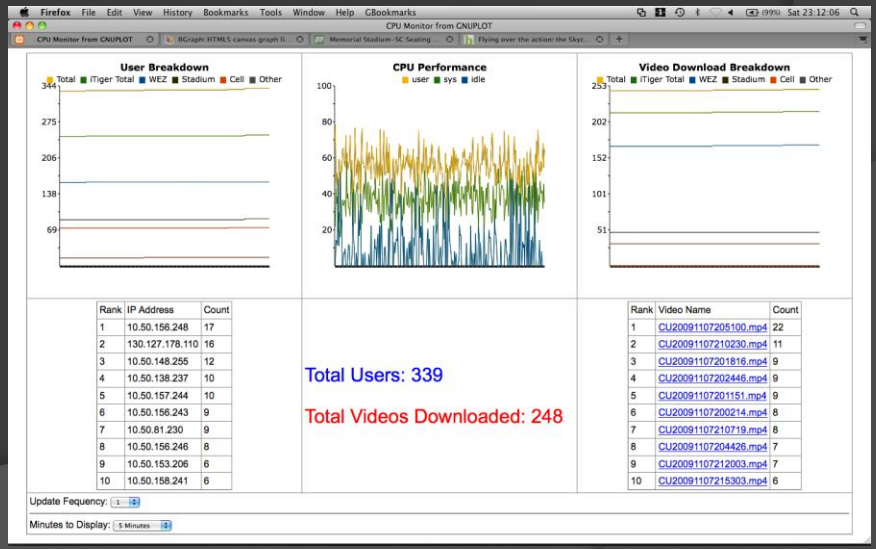
- The wired network at the stadium includes all of the servers that run iTiger. All of the boxes are multihomed in Clemson wired and iTiger subnet (10.50.16.xxx):
  - Webapps.itiger.clemson.edu (Mac Xserve, main web server – outside of CU firewall)
  - Fcs.itiger.clemson.edu (Mac Xserve, video production)
  - Dhcp.itiger.clemson.edu (Dell P4, CentOS 5.3, dhcp server)
  - Rtsp.itiger.clemson.edu (Sun, CentOS 5.3, rtsp streaming server/dns server)
  - Research.itiger.clemson.edu (Dell quad-core, CentOS 5.3, for running research scripts)
- The wireless network runs under the ssid itiger. It is partitioned in such a way that the 4 AP's in the WEZ create their own network (10.50.0.xxx-10.50.128.xxx) -- while the AP's in the stadium issue the range (10.50.129.xxx-10.50.255.xxx). This is to segment the network for automatically determining where a user is for concessions ordering.
  - Everyone's in the WEZ!!
- The wireless also uses Cisco level3 security to redirect the user to the project homepage.



iTiger Project, Football: Usage

- In the last games we have seen the following (look at usage reports):
  - ~400 users
  - Each downloads ~1 video
    - Stddev high. We have a few users that carry the rest.
  - More Access points!





Rank	IP Address	Count
1	10.50.156.248	17
2	130.127.178.110	16
3	10.50.148.255	12
4	10.50.138.237	10
5	10.50.157.244	10
6	10.50.156.243	9
7	10.50.81.230	9
8	10.50.156.246	8
9	10.50.153.206	6
10	10.50.158.241	6

Rank	Video Name	Count
1	CU20091107205100.mp4	22
2	CU20091107210230.mp4	11
3	CU20091107201816.mp4	9
4	CU20091107202446.mp4	9
5	CU20091107201151.mp4	9
6	CU20091107200214.mp4	8
7	CU20091107210719.mp4	8
8	CU20091107204426.mp4	7
9	CU20091107212003.mp4	7
10	CU20091107215303.mp4	6

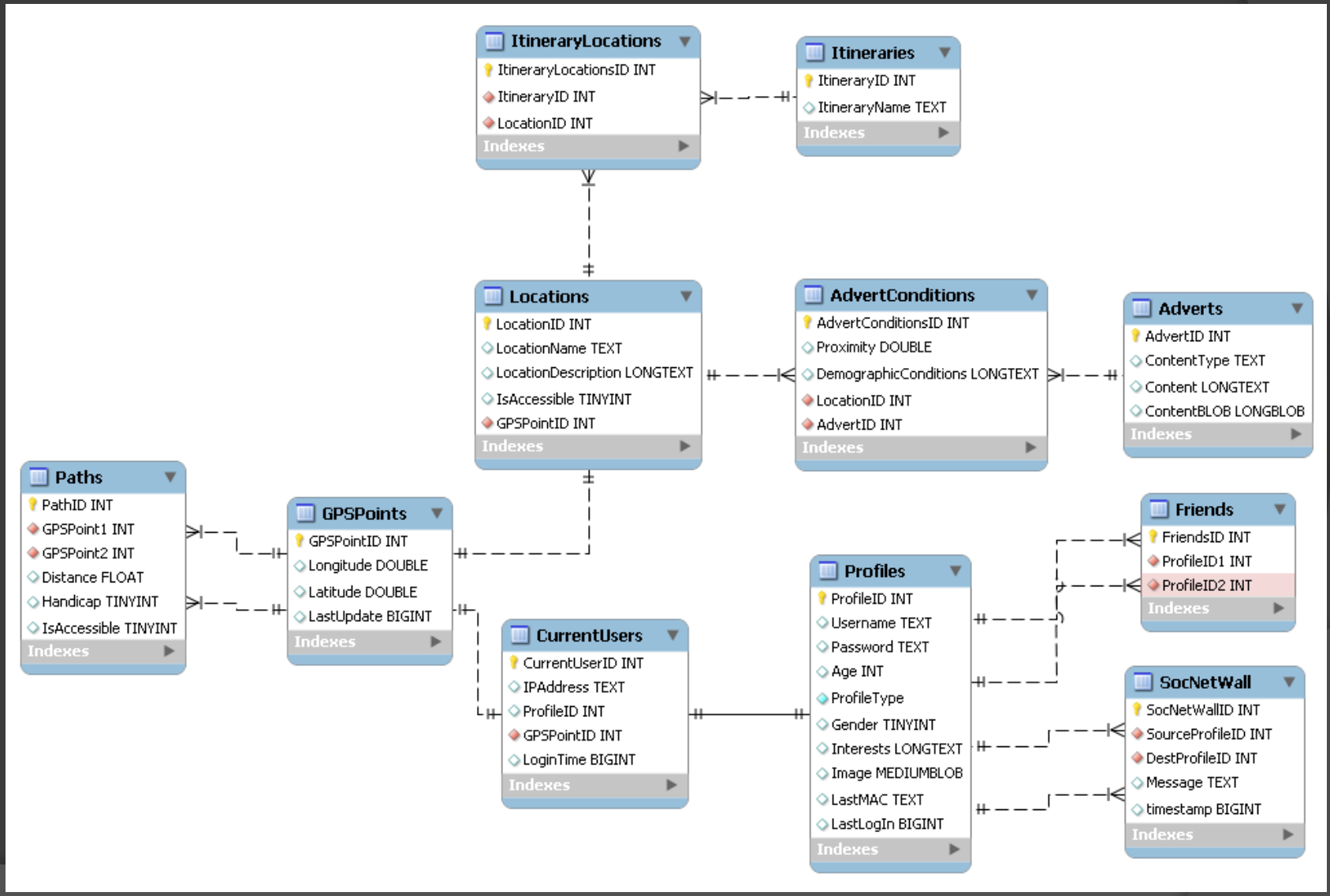
iTiger Project, Campus: Objectives

- What does the Connected Campus of the future look like?
  - Leveraging broadband infrastructure, mobile devices, and the university's cyberinfrastructure, how can we improve the educational/lifestyle experience for Clemson Students?
  - Provide web services to facilitate this content delivery.

iTiger Project, Campus: Objectives

- Prototypes Implemented:
  - iPhone Version, Abhijit Sribhashyam
  - Windows Mobile Version, Will Pressly
  - Web Version/Authoring Tools, Will Pressly: http://webapps.itiger.clemson.edu/myTiger/Authoring/
- Design is totally JSON, HTTP web services based. It is agnostic of front-end
- Current Capabilities:
  - Navigation
    - Location to Location
    - Person to Location
    - Person to Person
  - Location Aware Advertisement/Notification
  - Social Networking
  - Itinerary Creation
  - POI/Friend Finder
  - Profile Creation
- Wish list:
  - Augmented Reality Apps
  - Class room integration
  - Integration with the Cat Bus System
  - Integration with bookstore, etc

iTiger Project, Campus: ERD



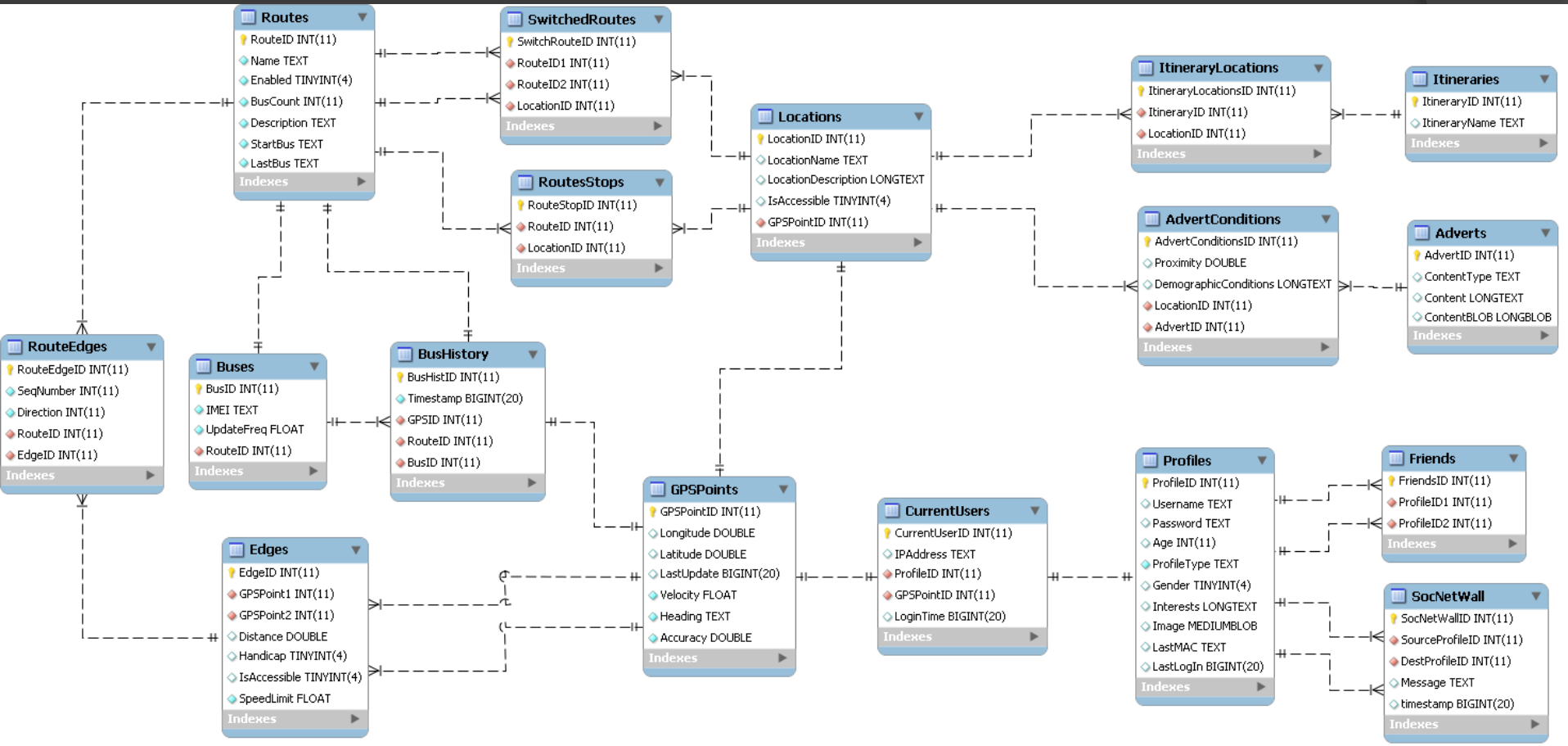
iTiger Project, Creative Inquiry: Overview

- Concept: how can we build a CI that interacts with other CI's?
  - CI's on campus can be rather insular. We want to build a system where we can aggregate/coordinate their efforts of a larger project.
  - The current CI (CPSC 681, iTiger Wireless) is an experiment in how we accomplish this.
- The class is currently composed of 7 students. It is roughly ½ Technical Students (CS, ECE, CIS) and ½ Non-Technical (Management, Business)
- The students are to complete projects related to iTiger.

iTiger Project, Creative Inquiry: Projects

- Steve Hickson (Sophmore, ECE):
  - System Monitoring: http://webapps.itiger.clemson.edu/CPUMonitor/cpuMonWill.html
  - EC2 cloning/load balancing for Web Server load
- Will Pressly (PhD CS), Abhijit Sribhashyam (MS, CS), Stanton Marcum (Junior, CIS):
  - Augmented Reality iPhone App: http://itiger.cs.clemson.edu/testAR/html/testAR.php
- Brian Schneider (Senior, CS):
  - Exploring Credit Card Transactions for Concessions Ordering for the football product
- Caroline Barbee, Mike Wolfe, Ryan Fernandes are doing Business Development, their projects include:
  - A Cat Bus Tracking System: http://webapps.itiger.clemson.edu/CatBus/html/showLocation.php
    - They have secured the GPS devices, the funding, and have maintained communications with Cat Bus.
    - Will Pressly and Abhijit Sribhashyam built and designed the system
  - CoES Up Close Day: They have been collecting digital content and negotiating with the Development office to make iTiger a centerpiece of the Up Close day for the College.

iTiger Project, Creative Inquiry: Updated Campus ERD



iTiger Project, Business Dev: Overview

- In order to make the project a self-sustaining one, we need to develop relationships in the community and in industry to help secure funds. These include:
  - The Clemson Development Office: such as the CoES Up Close Day
  - Corporate Partnerships: such as Cisco and Apple
  - Local Businesses: can be a source of revenue if we sold advertising space in our apps.

iTiger Project, Business Dev: Corporate Sponsors

- Cisco: Total $145K
  - 2 Wireless Controllers
  - 20 WAPs
  - 1 Mobility Services Engine
  - Misc. supporting equipment (licenses, antennae, etc)
- Apple: Total $12.5K
  - 25 iPod Touches
  - 1 MacBook Pro
  - 2 xserve Servers
- BMW: race track venue, connected car concept

iTiger Project, Business Dev: Sustainability

- Sustainability Breakdown (target)
  - Grants: ($50K)
  - Corporate Collaboration: ($50K)
  - Gift in Kind: ($50K)
  - Revenue Generation models from University
    - Concessions Ordering and Delivery for premium seats
    - Advertisements
- Equipment
  - Cisco: Continued Build-Out of Stadium
  - Apple: 2 more xserve Servers
- Student and Faculty Involvement
  - Brainstorming is required!!

iTiger Project, Business Dev: Commercialization

- One approach to getting a lasting corporate partnership to help sustain the project in the future is to build one ourselves!
- A reason for doing this is that this is a way to monetize the project for larger corporations.
  - A startup can leverage other sources of funding that academic institutions cannot such as STTR, and some federal and state Business Development grants.

Summary

- Create a student-run project ecosystem for sustaining the concept into the future.
  - Research
  - Football/Sporting Product
  - Campus Product
  - Creative Inquiry
  - Business Development
- Extend the scope of ‘cyberinfrastructure’ for devices connected by broadband wireless networks.
- Challenges moving forward
  - Funding!!
  - Hardware Infrastructure
  - Getting more of a name and reputation around campus and the community
  - Engaging more students
  - Working will many different CI’s across campus

Questions?