

***GENI / OpenFlow @
Clemson***

PI : KC Wang

Co-PI : Jim Pepin

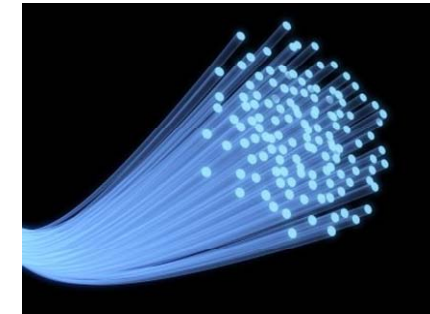
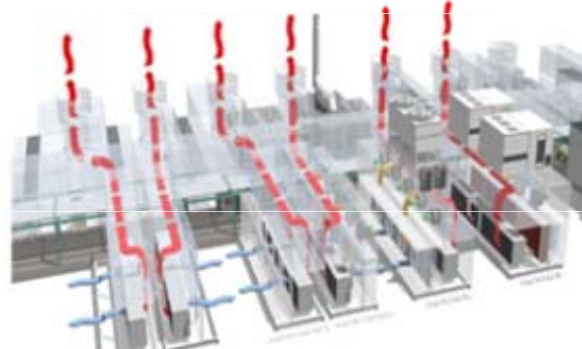
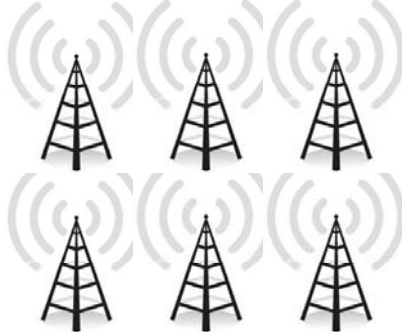
**CCIT: Dan Schmiedt,
Wayne Ficklin**

**Grad Students:
Aaron Rosen, Ke Xu, Fan
Yang, Mrinmay Kalita**

**Undergraduate Students:
Ben Ujcich, Jeff Heider, Ken
Allman, Megan Becvarik**



Our Scope

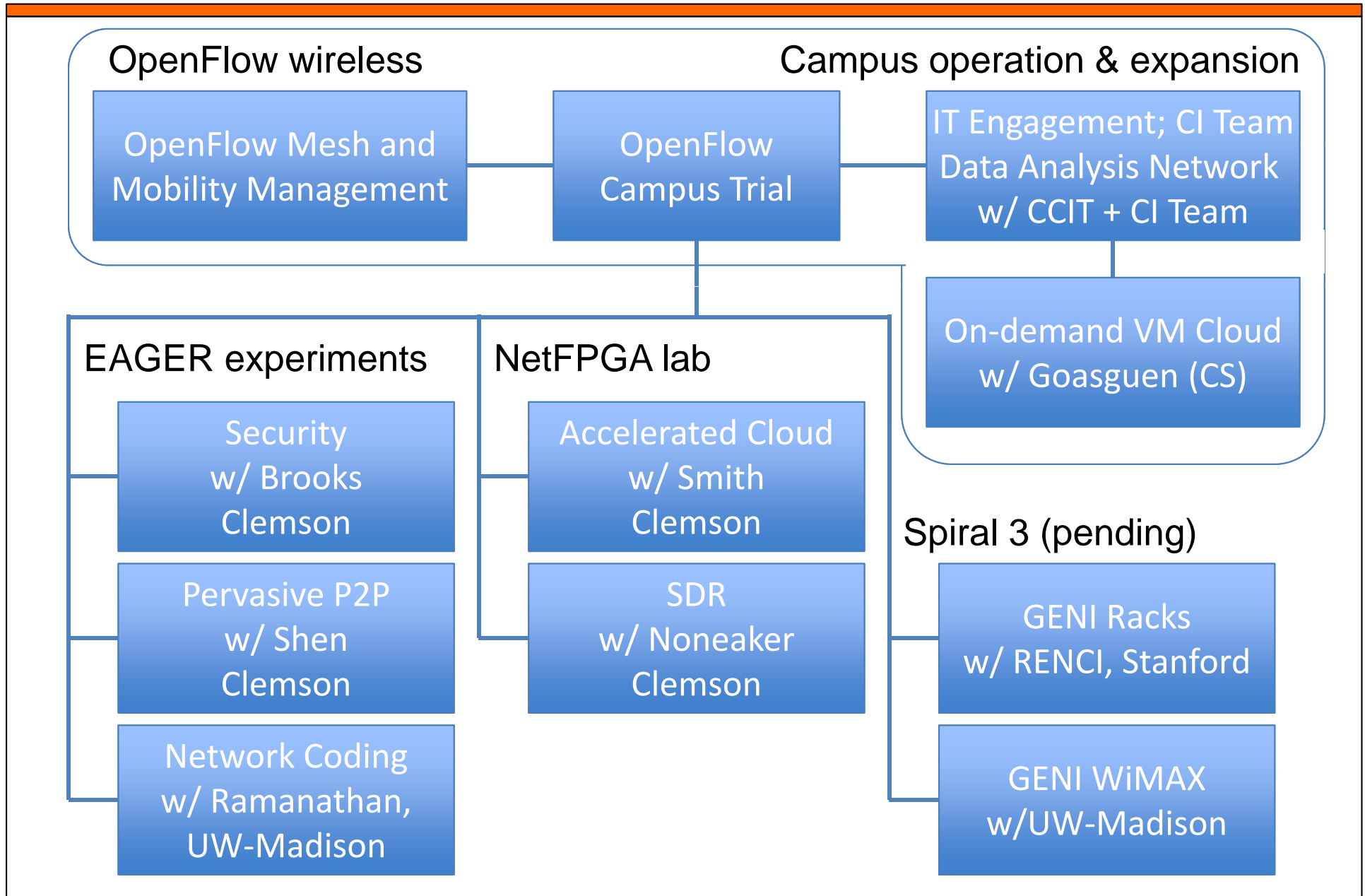


Future Internet = Computing + Connectivity + Clients

Ubiquitous Wireless + Mobile Connectivity

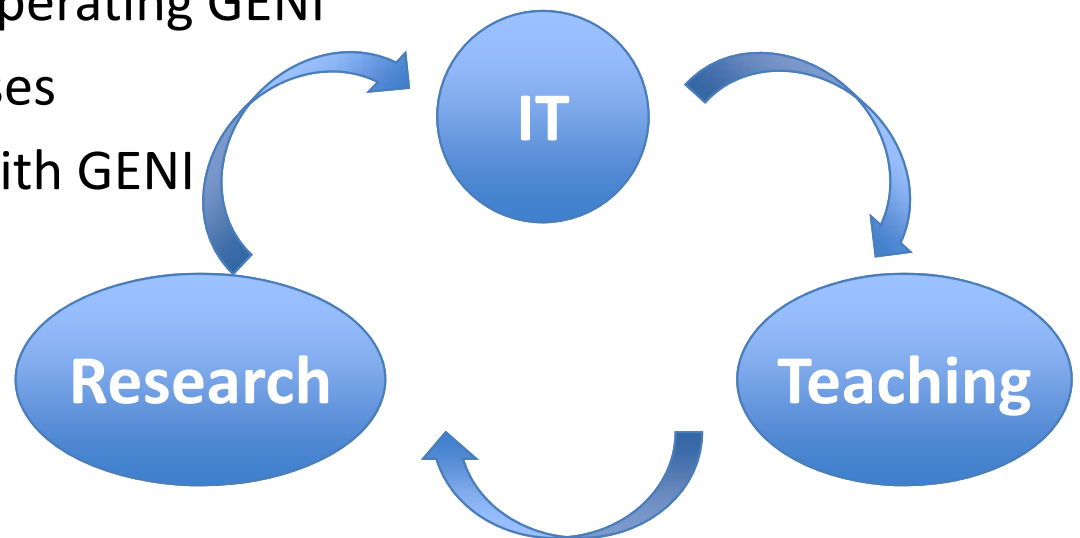
- **OpenFlow on: Ethernet, WiFi Mesh, Datacenter VM Cloud**
- **EAGER Experiments: wired/wireless DDoS, hetero P2P**
 - **IT use cases, NetFPGA lab, surveillance video**

Projects Overview

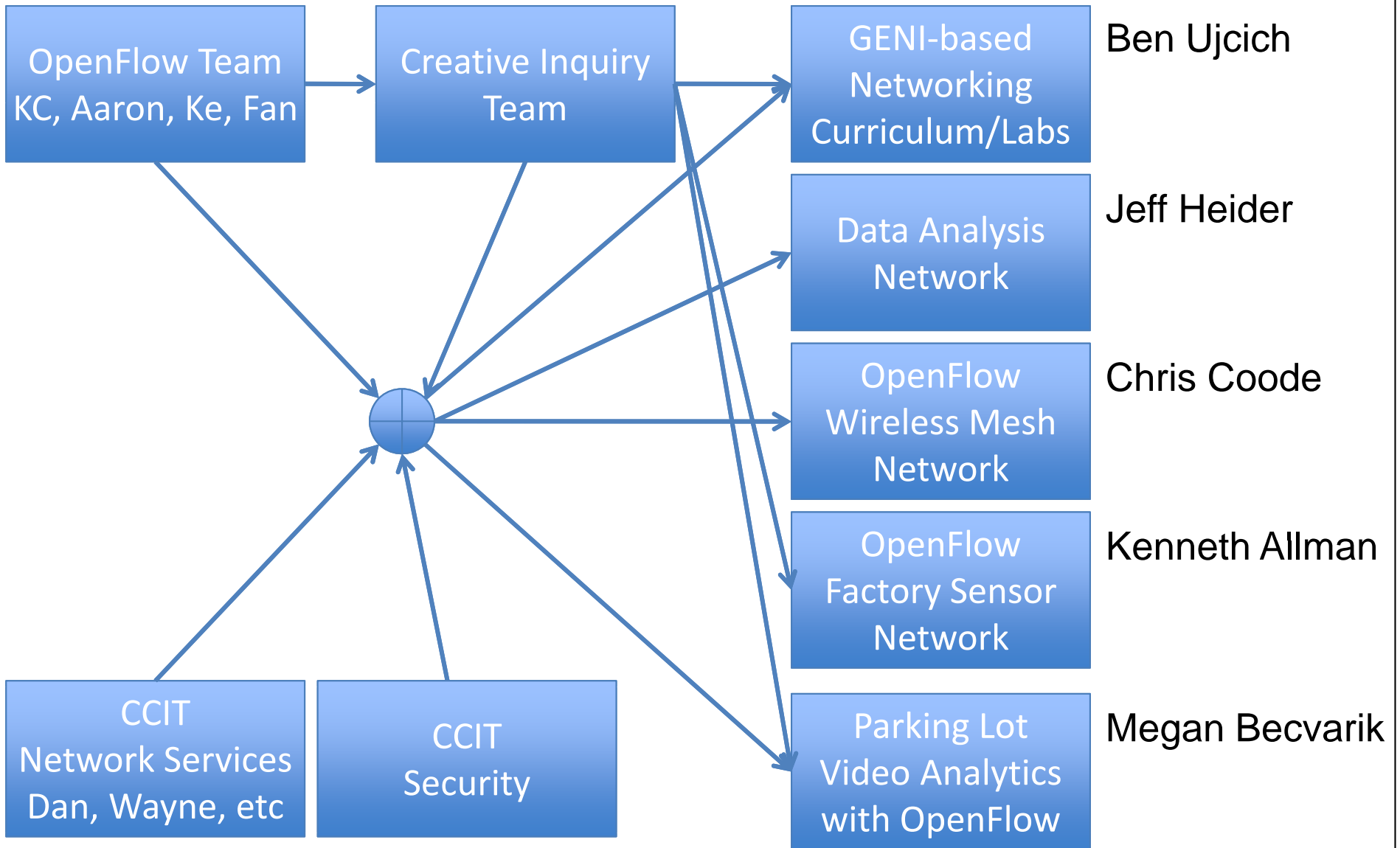


Emphasizing IT Engagement

- To facilitate sustained growth and leverage the power of all parties in University to stay creative, we need a new model.
 - Students
 - GENI experiments
 - Undergraduate research – “Creative Inquiry” program
 - 4-year IT internship program + curriculum
 - Network engineers
 - Help deploying and operating GENI
 - GENI-inspired use cases
 - Engineers innovate with GENI
 - Faculty
 - Research
 - Teaching

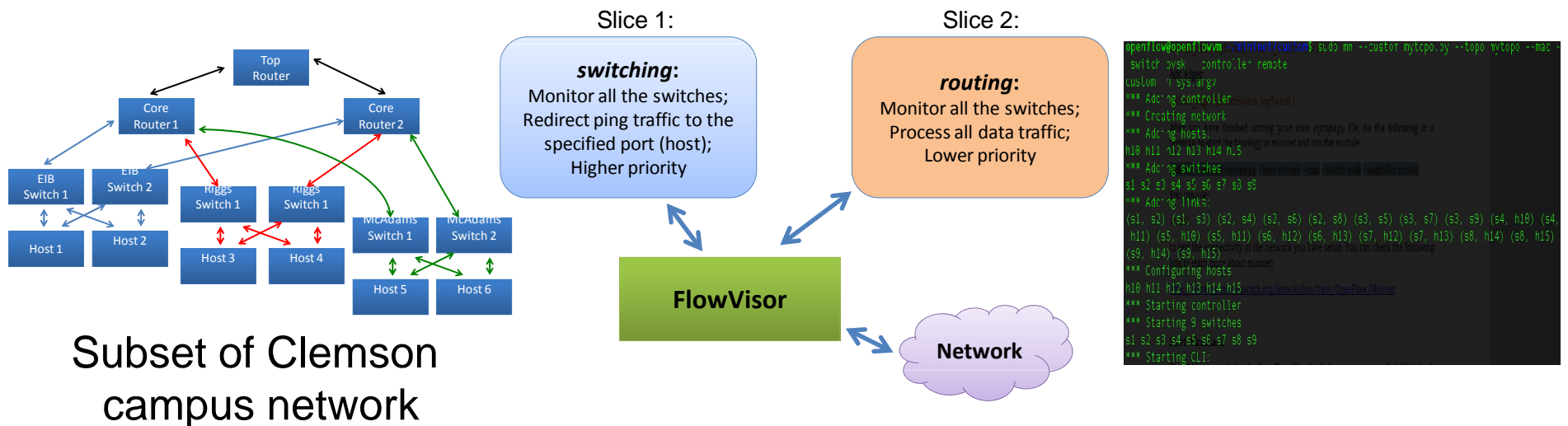


IT Engagement: Undergrad CI Team



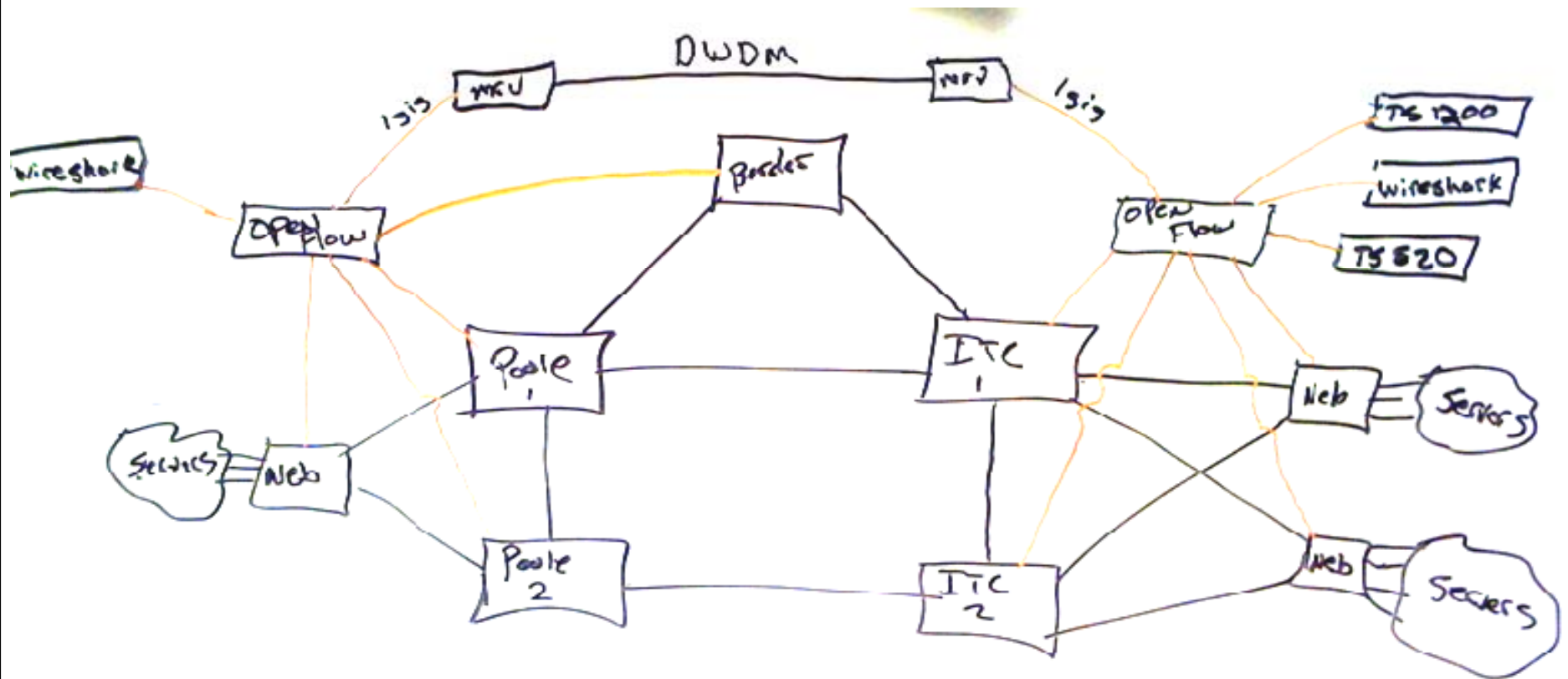
IT Engagement: Tech Meetings and OF Tutorial

- Grad/UGrad students attend weekly IT tech meetings
 - GENI/OpenFlow agenda
 - Brainstorm with engineers
- Grad students design tutorials and use cases to motivate engineers to use OF/GENI tools in campus network operation
 - First use case: Data Analysis Network (DAN) based on OF

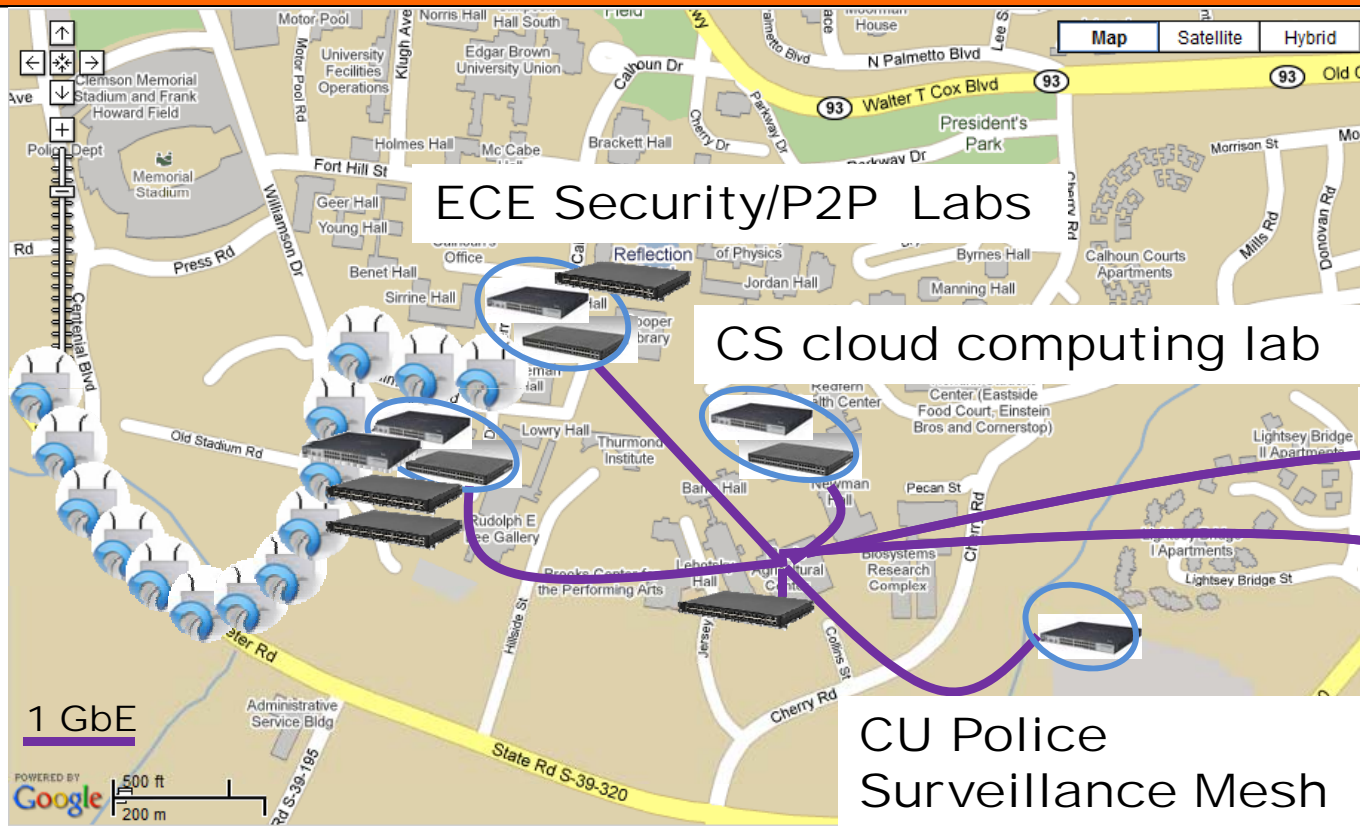


Proposed DAN implementation

Some noodling on the whiteboard...



Clemson OpenFlow Deployment



Campus --- Datacenter
Data Analysis Network
(DAN)



OpenVswitch in VMs
at Palmetto Cluster

ECE Wireless, OpenFlow, NetFPGA
Labs - mobile and mesh networks,
cognitive/software defined radio

OF Ethernet : 4 HP, 3 Toroki, 6 Pronto

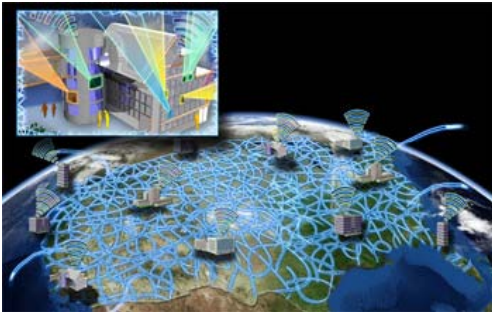
OF mesh: 5 APs deployed, 10+ to come

GENI OF and non-OF core vlans: connected

NetFPGA for Cross-Layer Research

**Network Coding
Multipath Routing**

- KC Wang
- P Ramanathan (UW)



NetFPGA

- 4x 1G Ethernet
- Xilinx Virtex FPGA
- MGIO expansion



Software Defined Radio

- PHY: D Noneaker
- MAC: H Russell
- Higher: KC Wang
- FPGA: M Smith



OpenFlow

- KC Wang
- R Brooks
- H Shen
- S Goasguen



Accelerated Cloud

- M Smith
- KC Wang

GENI Programmable Wireless: Remote Use

- GENI Cognitive Radio

- Clemson partners with Rutgers WINLAB on remote experimentation framework

- GENI Open WiMAX

- GENI is developing campus kits for deployment at universities (Accessing Rutgers BS now)

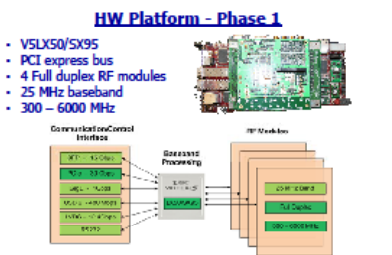
CR-GENI - GENI Open Cognitive Radio Platform

Dirk Grunwald, Peter Wolniansky, Prasanthi Maddala, Khanh Le, Ivan Seskar



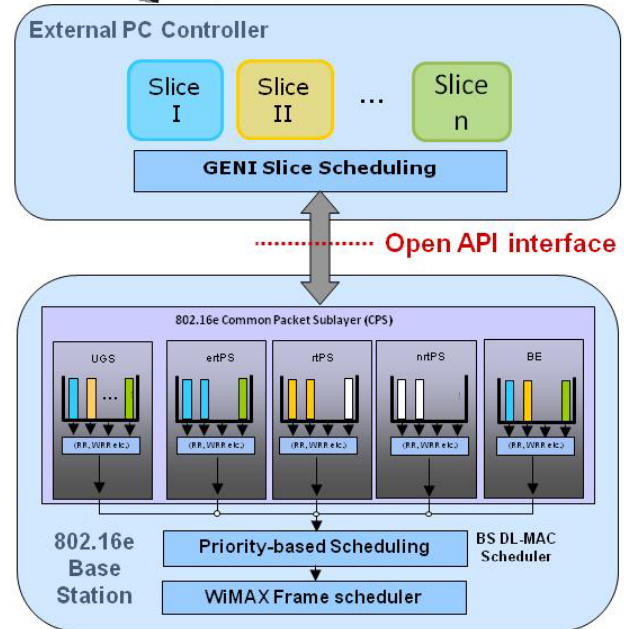
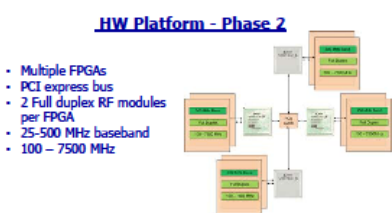
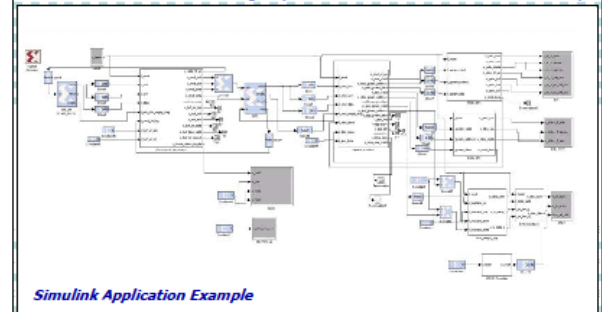
1. Hardware Platform
 - Range of FPGAs
 - Wideband (tuning) radio modules
2. Firmware
 - Easy to use VHDL/ Simulink (drag & drop) blocks
3. Software
 - Functions for real time data transfer and control

- CR-GENI Libraries**
- Basic Building Blocks :**
- Common – DAC IF, ADC IF, SPI IF, Reg Map, ...
 - Networking – Ethernet, PCIe, RS232, ...
 - DSP – Sine wave gen., AWGN, Filters, ...
 - Communication – Mod/Demod, OFDM blocks, ...
- Framework :**
- Complete Radio system with pluggable user app



Usage Example: An Aggressive Radio

- Jams the channel when not communicating
- OCRP control commands sent over Ethernet :
 1. Program SPI registers on DAC, RF
 2. Switch between noise and signal (based on commands from the host controller)



FURTHER QUESTIONS
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