

Clemson OpenFlow Trials

*Enabling Network Traffic Measurement and Control over
Campus Ethernet, Wireless Mesh, and Vehicular Networks*

**Campus Ethernet + Wireless Mesh for Vehicle Access +
Campus Network Operations**

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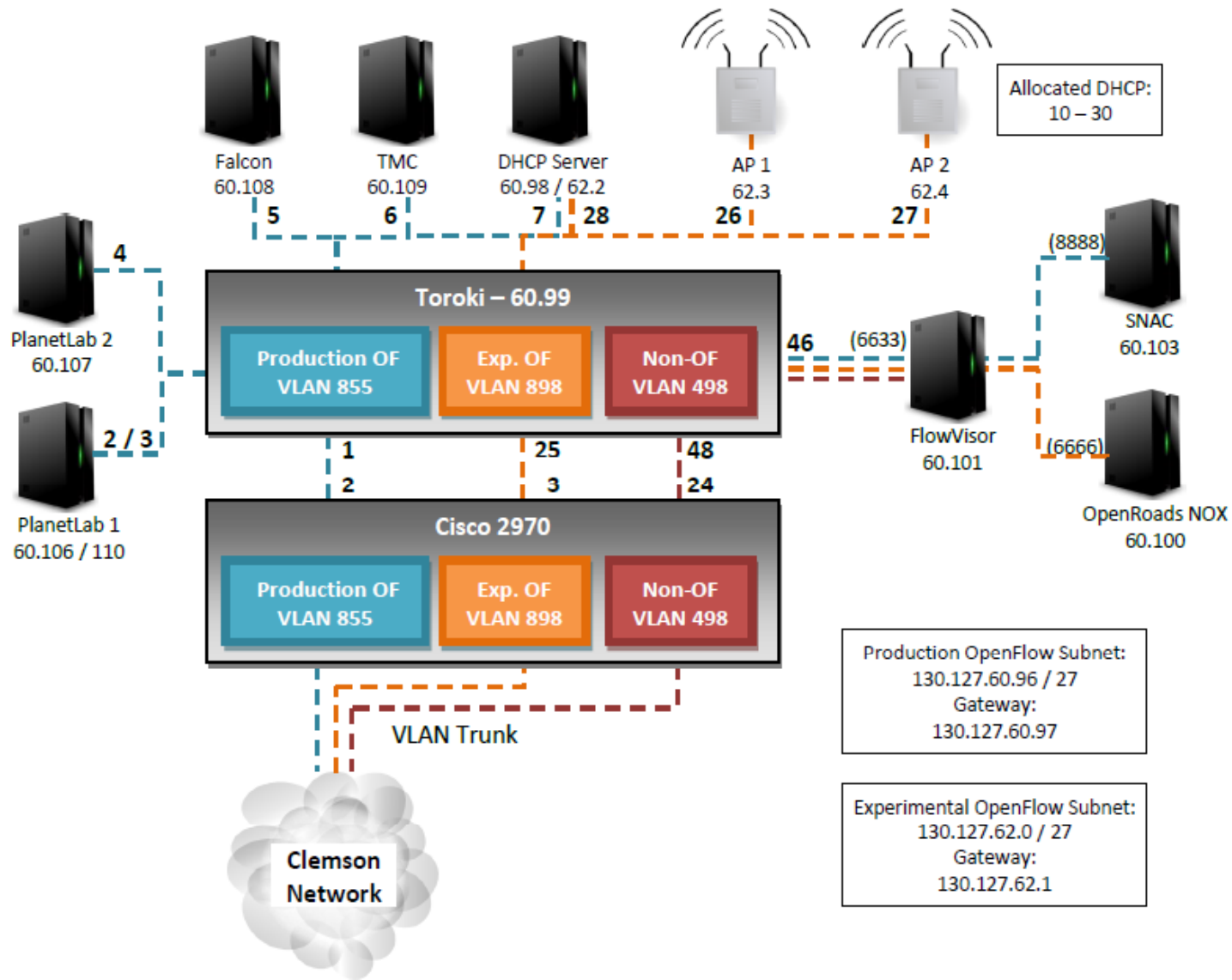
Clemson University

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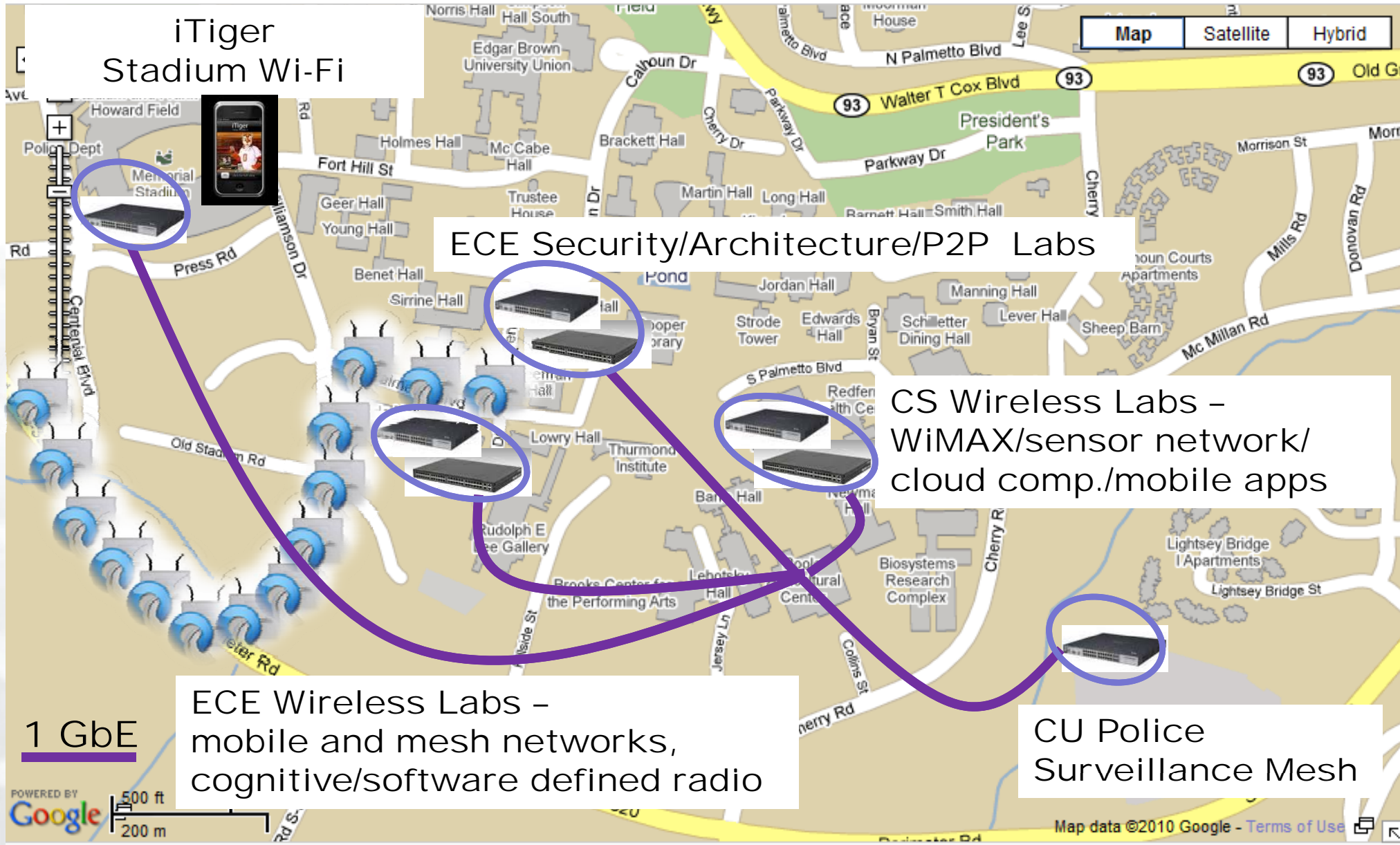
- Scope
 - OF Ethernet switches for campus buildings
 - OF wireless mesh network supporting mobile terminals
 - OF integration with campus Network Operations Center
 - Participation in inter-campus OF trials
- Objective is to establish
 - GENI connectivity
 - Wired and wireless network research infrastructure
 - *Vehicular networks, mesh networks, network security*
 - Network operation tools and policies for conducting research and education experiments on campus network

Staged Deployment Plan

Now: ECE Wireless Lab Test Network

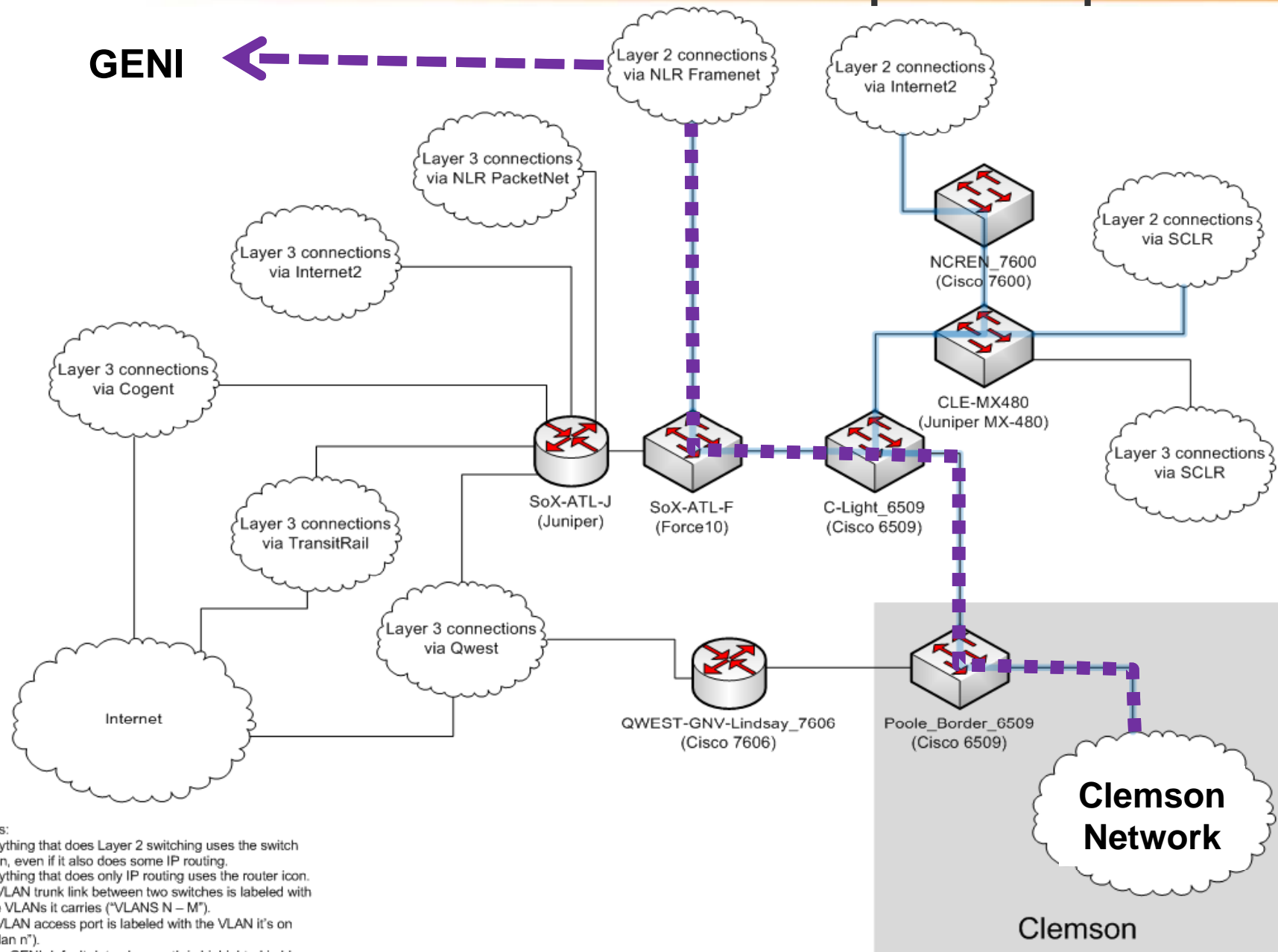


- Setup will be moved to building closet (without Cisco 2970).
- Network will be replicated for other buildings; opt-in user ports to be added.



Staged Deployment Plan

GEC9: Cross-campus Experiments



- Notes:
- Anything that does Layer 2 switching uses the switch icon, even if it also does some IP routing.
 - Anything that does only IP routing uses the router icon.
 - A VLAN trunk link between two switches is labeled with the VLANs it carries ("VLANs N - M").
 - A VLAN access port is labeled with the VLAN it's on ("vlan n").
 - The GENI default data plane path is highlighted in blue.

- What worked
 - SNAC: v0.4, NOX: v0.4 (OpenRoads branch), OF ref. switch: v0.8.9r2 (AP), Toroki switch: v0.8.9r2, Flowvisor: latest from git
 - Demo yesterday
- What has not worked
 - Toroki switch + Flowvisor locks up after some time
 - Work-around: periodic reload of configuration
 - Flowvisor issues
 - Incorrect turn off sequence causes rejection of new flows
 - Version number displayed in error message
 - Fail open with Toroki switch has not worked for us
 - PCEngine AP issue
 - Clients cannot communicate (e.g., ping) with clients connecting to same AP
 - Bridging OF and non-OF interfaces
 - ENVI/LAVI display issues – client unreliable, AP shown as client, high CPU
 - Mesh + OF over two radios

- How do you plan to scale OpenFlow deployment between now and GEC8?
 - Purchase and deploy additional OF Ethernet switches in additional buildings
 - Overcome mesh software issue and begin deployment on campus light poles
- How do you plan to support slices that would carry production and experimental research traffic including GENI?
 - Each switch will support non-OF ports, one production OF slice, and one or more OF experimental slices (initial focus on OpenRoads slice)
 - Start recruiting opt-in users once stable operation achieved
- How do you plan to connect sliceable/Planet Lab computers/clusters directly to OpenFlow network?
 - Two PlanetLab computers are in place (configuration issues remain)
- How do you know your campus installation is successful this summer--
- what are your key metrics?
 - Deployment completion %, switch up time, connectivity loss incident count
- What kind of support do you need from Stanford and the GPO?
 - Need support on PC engine AP configuration/extension for mesh operation and bridging between OF and non-OF interfaces