

# But My 802.11n Is Only 2 Years Old

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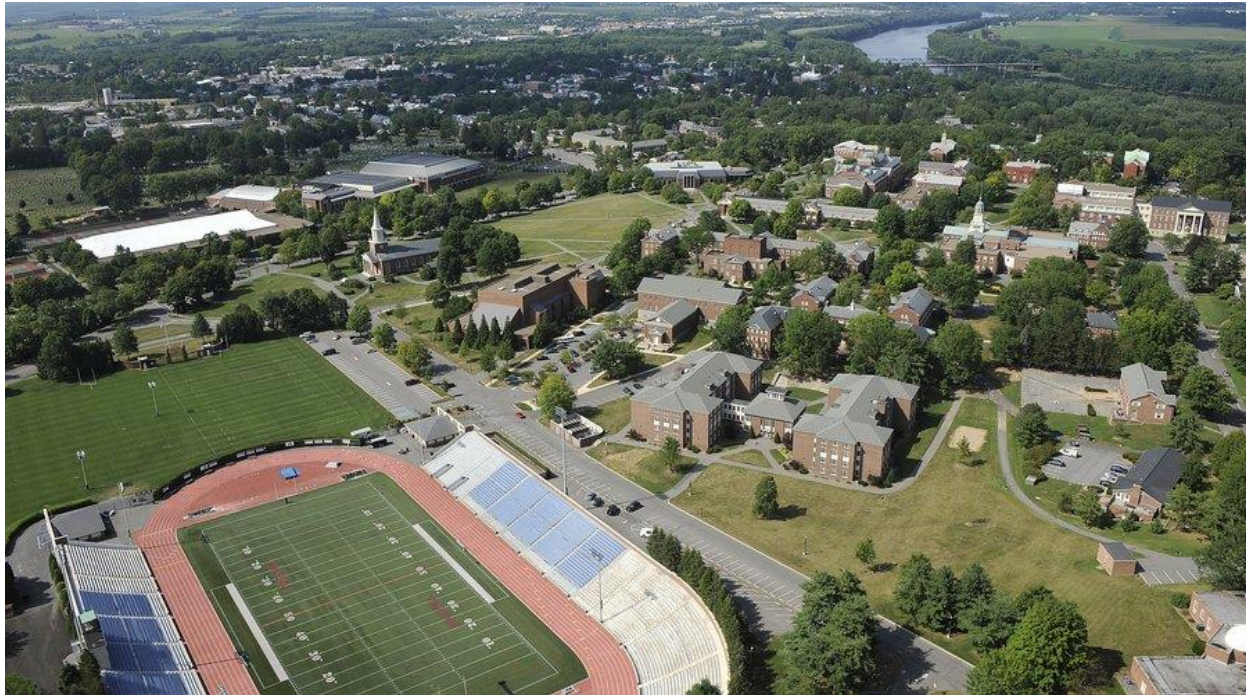
# Disclaimer

- All observations, opinions, and suggestions herein are my own and based on my environments and experiences.
- All environments are different. There are no cookie cutter design solutions.
- I'm not a spokesman for any particular vendor, though some names will inevitably come up.

# Introduction

- About me
  - Matt Williams
  - Veteran of the US Army
  - I've been at Bucknell University for 5 years
  - I have no social life

# Bucknell University



## At a glance...

- America's largest private liberal arts university
  - ~3,500 resident students
  - ~1,400 faculty and staff
    - Three in the Networking Group
- Approximately 90 buildings
- One of the priciest universities in the country
- Division I athletics

# Bucknell's WLAN Background

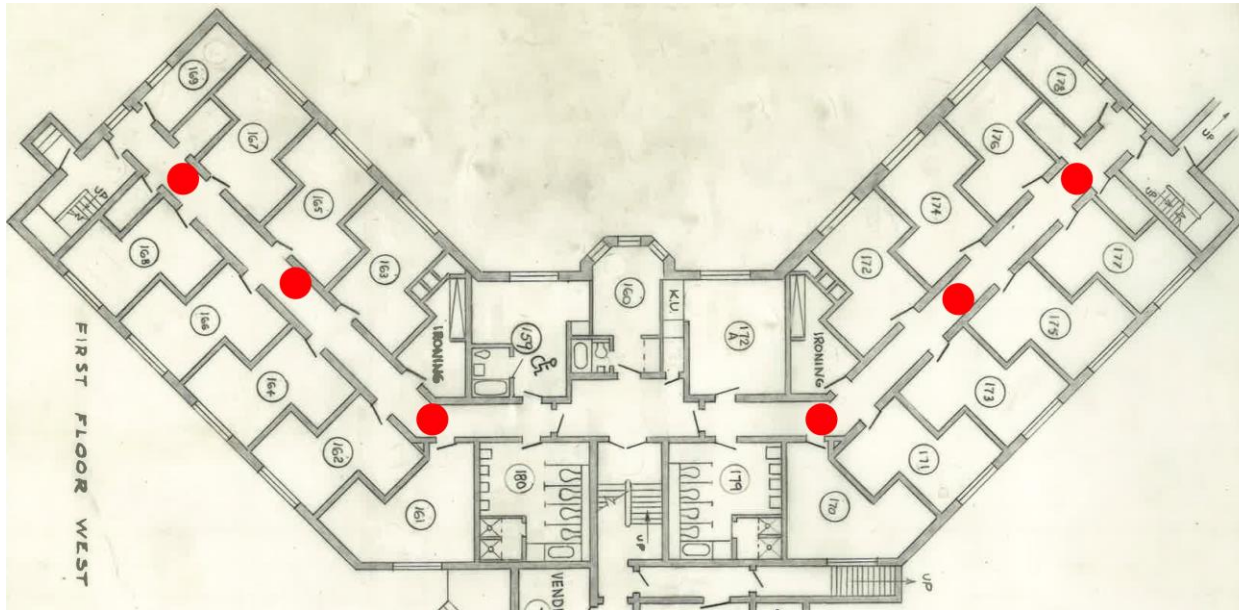
- 2010
  - Began 3 yr. 802.11n project
  - Phase 1
    - 1:1 replacement of a/b/g APs
      - Located in academic spaces and res. hall lounges
      - Approx. 300 APs
        - » High density APs weren't available (not that it would have mattered)
- 2011
  - Phase 2
    - Residence hall room coverage
    - Added about 300 additional APs
  - Started seeing two wireless devices per user

# Bucknell's WLAN Background

- 2012
  - Phase 3
    - Fill any coverage gaps
      - Ended up adding another 250 APs
  - Up to three wireless devices per user



# Bucknell's WLAN





# Intent

- Hallway deployment
  - Easy physical access
- Designed for max coverage
  - Specifically 2.4GHz coverage
  - Specifically for laptops
- Minimize capital costs

# Consequences

- Aggressive roaming from clients
  - Specifically Macs

## Device Events

1-3 ▼ of 3 Device Events Page 1 ▼ of 1 Reset filters Choose columns Export CSV

Time ▼	Type ▼	Source Device ▼	AP/Device ▼	Severity ▼	Facility ▼	Category ▼	Message
7/11/2013 8:30 PM	Syslog	host	-	Debug	local1 (17)	Station Management	moved from AP
7/11/2013 8:24 PM	Syslog	host	-	Debug	local1 (17)	Station Management	Jul 11 20:29:39 2013 Aruba3600 stm[1539]: <501065> <DEBUG> <Aruba3600 192.168.1.3> Client 00:23:6c:90:05:11 moved from AP survey125 to AP AP-125-Mesh-Point
7/11/2013 8:22 PM	Syslog	host	-	Debug	local1 (17)	Station Management	Jul 11 20:22:49 2013 Aruba3600 stm[1539]: <501065> <DEBUG> <Aruba3600 192.168.1.3> Client 00:23:6c:90:05:11 moved from AP AP-125-Mesh-Point to AP survey125
							Jul 11 20:21:19 2013 Aruba3600 stm[1539]: <501065> <DEBUG> <Aruba3600 192.168.1.3> Client 00:23:6c:90:05:11 moved from AP survey125 to AP AP-125-Mesh-Point

1-3 ▼ of 3 Device Events Page 1 ▼ of 1 Reset filters

# Consequences

- AP line of sight
  - Constant Tx power changes
- Can't support high number of client devices
  - AP saturation
  - New coverage gaps
- Massive frustration

# 802.11n Project Summary

- No good deed goes unpunished
- A lot of capital expense
  - And constant “gap filling”
- A *ton* of operational expense
- 802.11ac to the rescue?

# How do we fix this?

- Option 1:
  - Utilize controller features
    - Band steering
    - Data rate limit enforcement
- Option 2:
  - Replace existing APs with high density APs
- Option 3:
  - Select a different vendor or product
- Option 4:
  - Complete Redesign

# Redesign Considerations

- Do we have an accurate view of the RF environment?
- Do you have different requirements for different physical spaces?
  - Academic spaces vs. residence halls
    - Faculty/staff vs. student requirements
  - Sales floor vs. shipping/receiving
  - Dining area vs. register area
- How does 802.11ac fit in?

# Site Surveys

- Most buildings are old
  - Block or poured concrete walls and floors
  - Brick exterior
- Right way and wrong way (in my opinion)
  - Some background on this
- Wrong way
  - Doing them when clients aren't around
  - If Designing – not placing the AP near it's installation location
- Right way
  - Do them during peak usage times!
  - If Designing – get a rig... better yet, get 2 or three



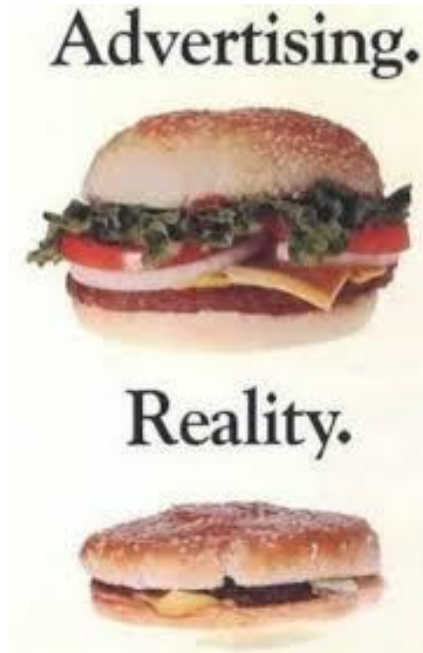
# Balancing Requirements

- How do we support a reasonable quality of life for students?
  - Video streaming, gaming, presence apps, access to campus resources, etc.
- How do we support our faculty research and staff requirements?
  - Access to ERP, wireless IoT research/sensor networks, AirPrint and AirPlay, etc.
- How do we do that while supporting the explosion of wireless devices on campus?
- Outdoor WLAN coverage

# How does 802.11ac fit in?

- Is it worth it to adopt Wave 1?
- Should we limp along until Wave 2 is released?
- Should we just redesign with 802.11n and redesign it again when the next evolution of 802.11 comes out?
- How will ac affect my wired environment?
- What about 802.11ad?

802.11ac



# 802.11ac Propaganda

- Wave 1
  - 1.3Gbps
  - 3 Spatial Streams
  - 20, 40, and 80 MHz channels
- Wave 2
  - 6.93 Gbps
  - 4 Spatial Streams
  - MU-MIMO
  - 20, 40, 80, 80+80, and 160 MHz channels

# 802.11ac Considerations

- Wave 1
  - Political aspect of being an early adopter
  - Negligible cost between 802.11n and ac Wave 1 products
    - Better chipsets and performance for 802.11n clients on ac Wave 1
  - 5GHz attenuation
  - Wired infrastructure implications
    - Do we really need two uplinks to each AP?
    - Do I need new switches with PoE+ and 10GbE uplinks?
    - What does that do to my campus distribution switches?

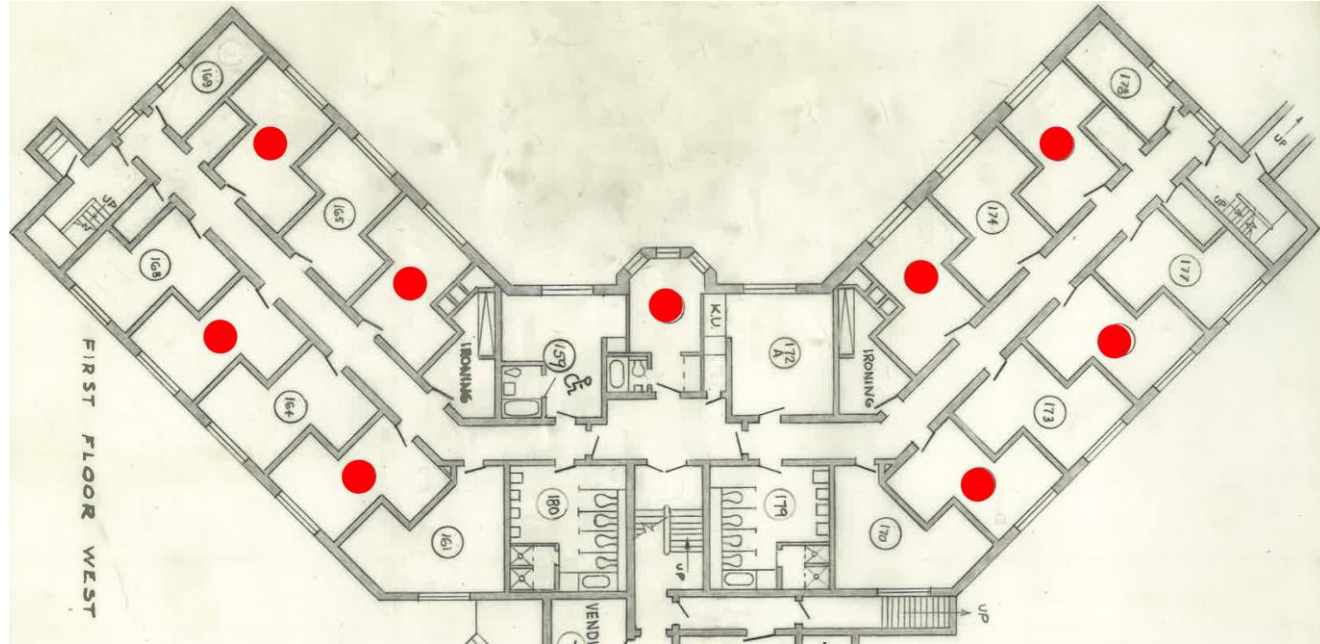
# 802.11ac Considerations

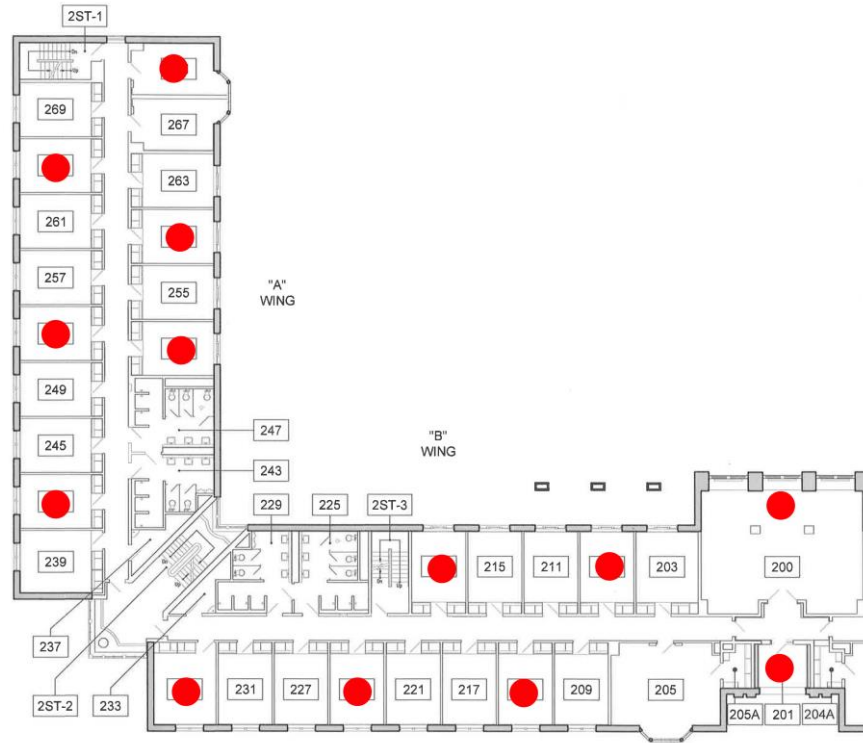
- Wave 2
  - 160 MHz channels deplete number of channels available
  - Wired infrastructure implications
    - How many wires will be needed?
      - 10Gbps to the AP?
      - What about switch uplinks?
  - When will we see client devices that use 4 SS?

# Where We Are Today

- Design decisions
  - Benchmark -65 dBm on smartphone or other handheld device
    - Move APs out of the hallway and into rooms
  - Adopt 802.11ac in academic spaces
    - Support various research initiatives by faculty
    - 802.11ac APs support higher device densities
  - Continue with 802.11n in residence halls
    - Smaller cells reduce associations per AP
    - Repurpose older 802.11n APs elsewhere (\$\$\$\$)







# Where We Are Today

- Infrastructure decisions
  - No new wiring in buildings scheduled for renovations in the next 2 years
  - Reuse existing wiring where possible
  - Install 2 6a station wires in all new locations
  - All new switches are PoE+
    - 24-port switches
    - Switches supporting 802.11ac have 10GbE uplinks (but are currently connected at 1GbE)
    - All others have 1GbE uplinks

# Where We Are Today

- Installation decisions
  - 802.11ac APs
    - Connect both uplinks at the AP, but only 1 to the switch
    - It's easier to turn on the second port in the closet.
  - 802.11n APs
    - Installing them over existing wall plates... for now.
      - All students have 2 wired ports
        - » One for “Voice”, but still Cat6
        - » One for “Data”
      - We'll steal the old “Voice” cables for APs if we need to move them
  - Repurpose as much technology as possible
    - Makes clients happy
    - Saves cash

# My Observations

- Design for what you want out of your network
  - Put 802.11ac in places where it makes sense
- Design for 5GHz at -65 on the device with the crappiest antenna you can find.
- Install infrastructure to aid expansion
  - Pull two wires the first time. It's cheaper that way, even if you don't use it.
  - Try to reuse wiring where possible
  - Deploy switches that make sense for your design
  - 10GbE uplinks sound good, but...

# Lessons Learned

- Stop deploying in hallways
  - Controller software can't mitigate physical construction
  - Work with facilities and be prepared for questions
    - More and more concern about long term affects of Wi-Fi
    - Have a plan in place if there are complaints
- I don't know what the future holds, but...
  - WLAN spectrum use has been cyclical
- Ignore marketing hype
  - You won't see 1.3Gbps from Wave 1 or 6+Gbps from Wave 2
  - You *likely* won't need 10GbE switch uplinks anytime soon
- All environments are different and you need to account for that

# Questions?

