Aruba Networks
Webinar

Dorm Wi-Fi Design in the Era of BYOD

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Assessing Load Requirements

Application	Typical Bandwidth
Haivision (stream)	2.5 Mb/s
DA Learning (stream)	1 Mb/s
AppleTV (stream)	2.5 Mb/s
FaceTime (stream)	900 Kb/s
Hulu/Netflix (stream)	2.5 Mb/s
Skype (stream)	150 Kb/s
Pandora (stream)	100 Kb/s
Blackboard (transaction + multimedia clips)	500 Kb/s
Facebook (transaction + multimedia clips)	500 Kb/s
Twitter (transaction)	50 Kb/s
Email (transaction)	50 Kb/s
Web surfing (transaction)	50 Kb/s

Video-Specific Examples

Service	Bandwidth (H.264-codec)	One-way of Bidirectional over the WLAN	End-to-end Delay Tolerance (Including Network and codec)	Number of Channels (Unique Signals) Available	Simultaneous Viewers per Channel per Access Point
Cable TV	1 to 4 Mb/s (SD) 6 to 10 Mb/s (HD)	One-way, downlink only	Channel changing affected after 300 msec	20 to 200	Occasionally
Live event video streaming	1 to 4 Mb/s (SD)	One-way, downlink only	300 msec target	1	Yes
Surveillance video	500 kb/s to 2 Mb/s	One-way, uplink or downlink	500 msec target	1 to 50 cameras	Seldom
Interactive video conferencing	1 to 2 Mb/s (SD for room scale)	Two-way	150 to 200 msec	Typically 1 to 5 groups	No
On-demand video	1 to 4 Mb/s (SD) 6 to 10 Mb/s (HD)	One-way, downlink only	300 msec target	Hundreds	No

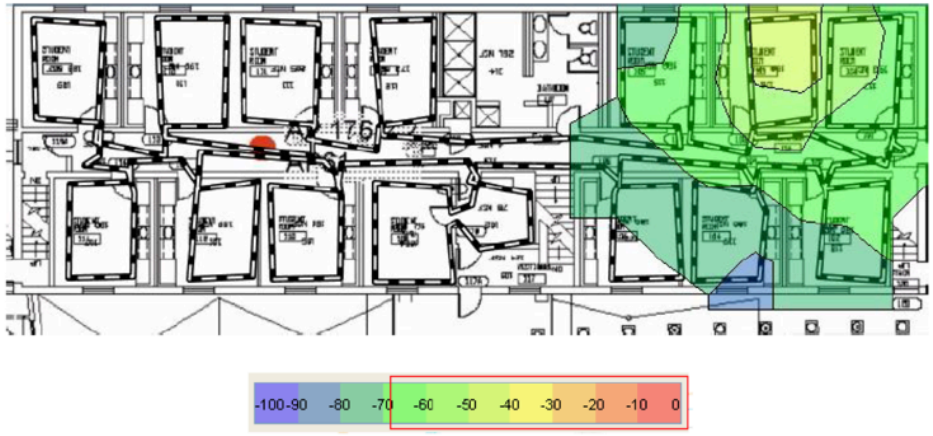
Assessing the Physical Environment

	2.4 GHz	5 GHz
Interior drywall	3 to 4 dB	3 to 5 dB
Cubicle wall	2 to 5 dB	4 to 9 dB
Wood door (Hollow - Solid)	3 to 4 dB	6 to 7 dB
Brick/Concrete wall	6 to 18 dB	10 to 30 dB
Glass/Window (not tinted)	2 to 3 dB	6 to 8 dB
Double-pane coated glass	13 dB	20 dB
Steel/Fire exit door	13 to 19 dB	25 to 32 dB

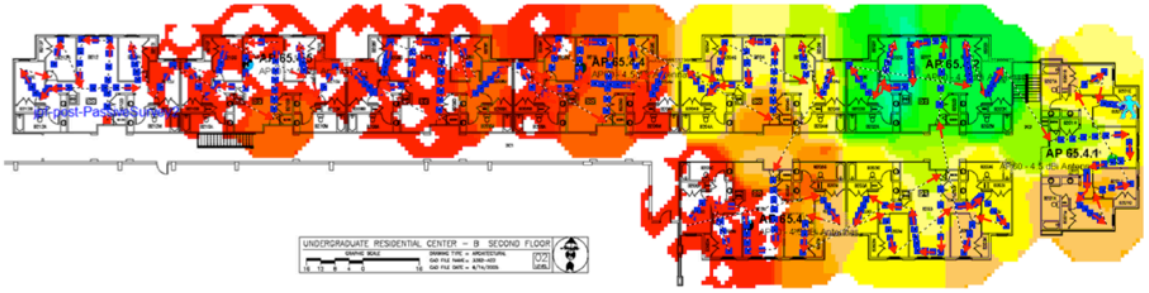
ARUBA networks

Example: 5GHz Attenuation

Concrete Wall Construction

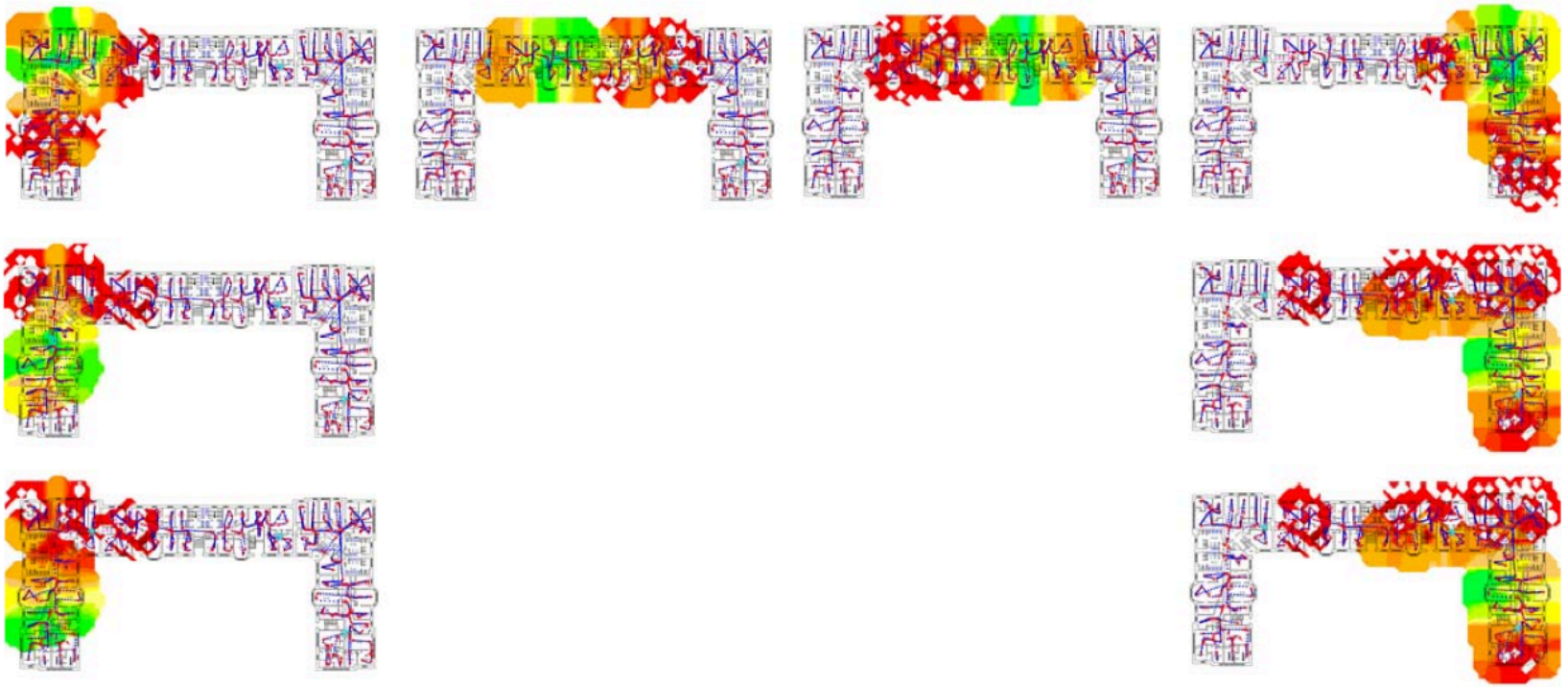


Stud and Wallboard Construction

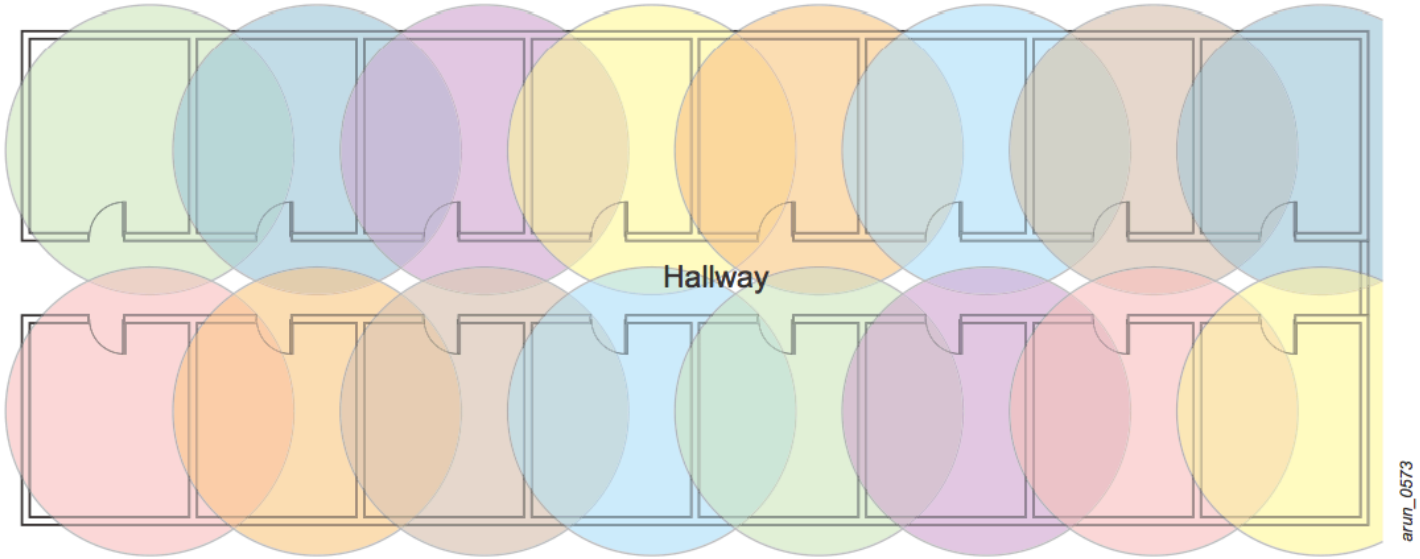


Typical Dorm Design Today

Hallway AP deployment insufficient



Better Design Methodology: Microcell



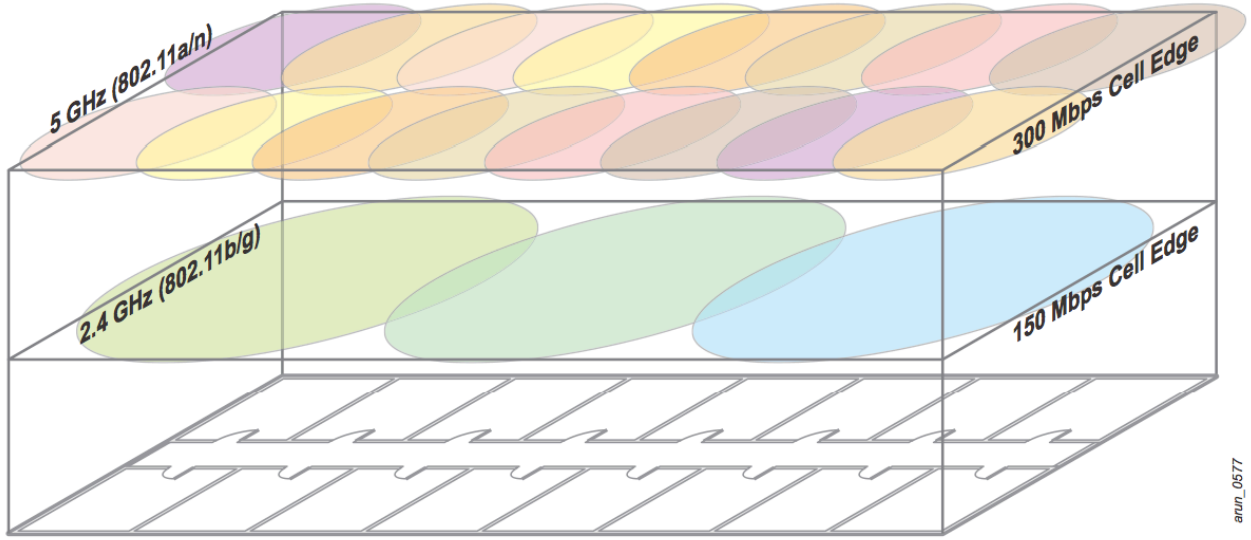
- Small cell radius. ~1AP per room
- Low power per cell

RF Design

Attenuation

Type	Construction Materials	Room-to-Room Attenuation	Floor-to-Floor Attenuation
High Attenuation	Stone, Concrete, Cinder Block, Steel	15 to 20dB	10 to 20dB
Low Attenuation	Wood, Sheetrock	3 to 10dB	10 to 20dB

Channel, Coverage Planning

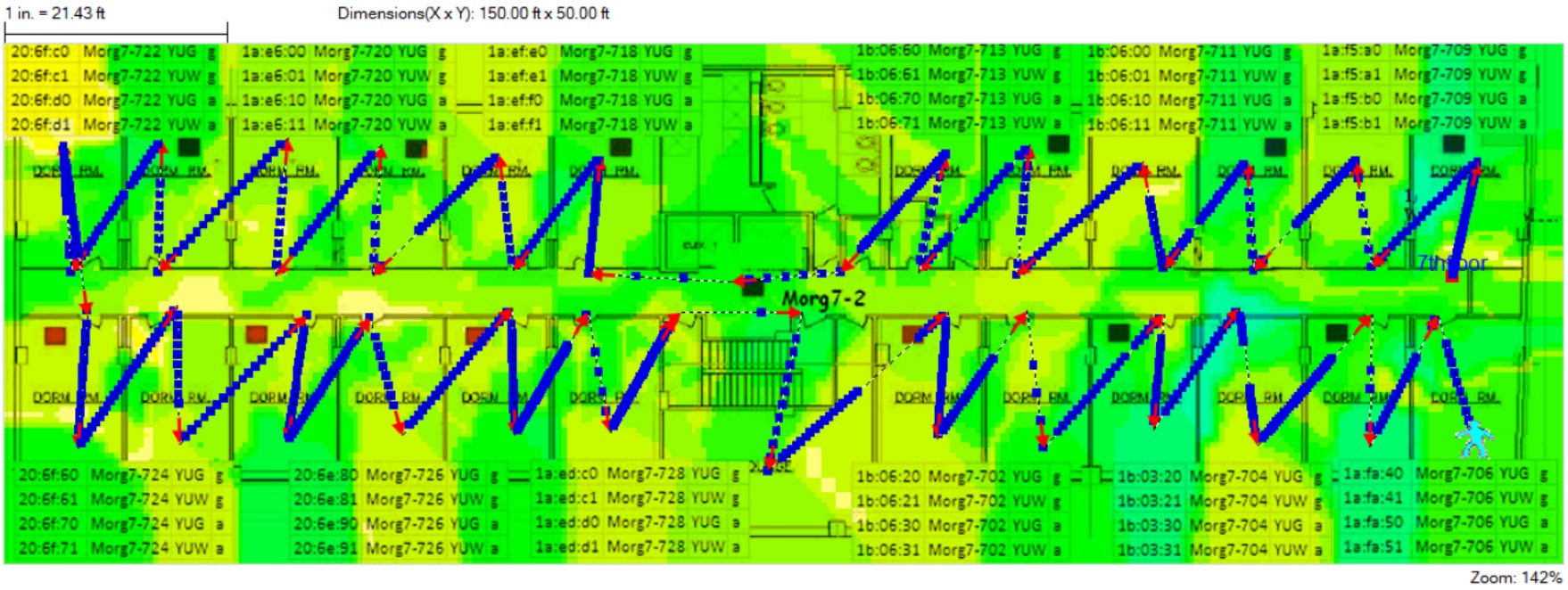


5GHz w/ channel reuse. 2.4GHz overlay for legacy or low-speed devices

AP Selection

		Dual Radios		Single Radio	
Model		AP-135 	AP-105 	AP-93 	AP-93H 
Radios	**MIMO**	3x3:3 MIMO	2x2:2 MIMO	2x2:2 MIMO	2x2:2 MIMO
	Number	Dual Radio	Dual Radio	Single Radio	Single Radio
Max Data Rate		450 Mb/s per radio 900 Mb/s total	300 Mb/s per radio 600 Mb/s total	300 Mb/s	300 Mb/s
100/1000BaseT Interfaces		1	1	1	4 + 1 integrated passthrough port
Minimum PoE Type		802.3af	802.3af	802.3af	802.3af
Antenna		Integrated	Integrated	Integrated	Integrated

Example Microcell Results



DragonFly Residence Hall Wireless

Next Generation Deployment

Matthew Nocifore
Charles Rumford

CTI Network Infrastructure + Telecom
Office of Information Resources +Technology

Aruba Webinar
Dorm Wi-Fi

July 24, 2012

About Drexel…

Drexel University, Philadelphia PA

- Founded in 1891. The nation's 14th largest private university with campuses located in University and Center City Philadelphia

- 25,000 FTE Grad/Undergrad Students
  Including medical, law, and on-line programs

- 5-year UnderGrad “Co-Op” Program
  Offers educational and employment opportunities to students for study and internship. Most UG programs operate on a quarters program using a 10 week term.

Wired Network – Quick Facts

- Commodity Internet Capacity: 20G / Internet2: 5Gbps
- One of only 20 Internet2 direct connectors
- Redundant Routed Network Core (Cisco 6500 VSS)
- Most Campus Buildings Connected by dual 10G fiber links
- 10G Building Aggregation Switch (Cisco 4900M)
- 1G TP/POE Edge Switch / 48 port stackable (HP/ 3Com 5500G)
- 1G Uplink to every 2-switch stack / 10G Uplink to every 4-switch stack
- TP Wire Plant: 2 to 4 Cat5E cables for every wire station
- 15,000 active Ethernet jacks

Drexel Wireless History

2000 First Generation Wireless

DragonFly *brand* is launched

300 Lucent Orinoco AP1000s
Autonomous, Dual B Radios, No POE
Preshared Key / Mac Authentication

2006 Second Generation Wireless

600 Cisco AP1231G -Introduction of B/G Radios and POE

2008 Aruba Selected for 802.11N

DragonFly3 SSID is launched – WPA2/802.1X

1200 Aruba AP125s and Four Aruba M3 Controllers

Deployed late 2008, Early 2009

Rapid Wireless Growth

2009 – 2010 Rapid AP125 Deployment
- Dense coverage in academic spaces

2011 – 2012 Fine Tune the Network
- Configure Aruba for High Density locations
- Deploy "Installation Wizard" for client installation
- Upgrade to AOS 6

TODAY…
- 2000+ AP125s / 8 M3 Controllers
- Redundant Airwave Servers
- 9,000 Simultaneous users
- 22,000+ devices seen daily

Res Halls – Plan New Design

Spring 2012
Need to expand HD success in Residence Halls

Drexel Residence Halls
- 5500+ Students
- 10 buildings (mid-rise/high-rise)
- AP125s all located in common hallways
- 1G Wired Ethernet service per desk and in common room
- 3 Data cables per jack

Res Hall – Challenges

Little Down Time – quarter system

No User Feedback – Hard to get useful information from helpdesk, students, ResLife.

Service in 6 Residence Halls Identified as those that will most benefit from HD deployment

Identification made by… Building design, Trouble ticketing, Word of mouth, Testing

Meeting the Challenge

Need Radical New Thinking!

- ✓ Design
- ✓ Implementation
- ✓ Communication

Major change for networking staff!

-Many spirited conversations

-Aruba releases draft NG Res Hall Architecture

Keys to New Thinking

- APs must go in student rooms
- Design/Install must take place in occupied rooms
- Need new close relationship with ResLife
- Must deploy in small trials
- Must measure performance
- Must survey and “speak” directly to students during all phases of deployment

Goals

Upgrade service in 3 Halls by Fall Term 2012

Upon Completion …

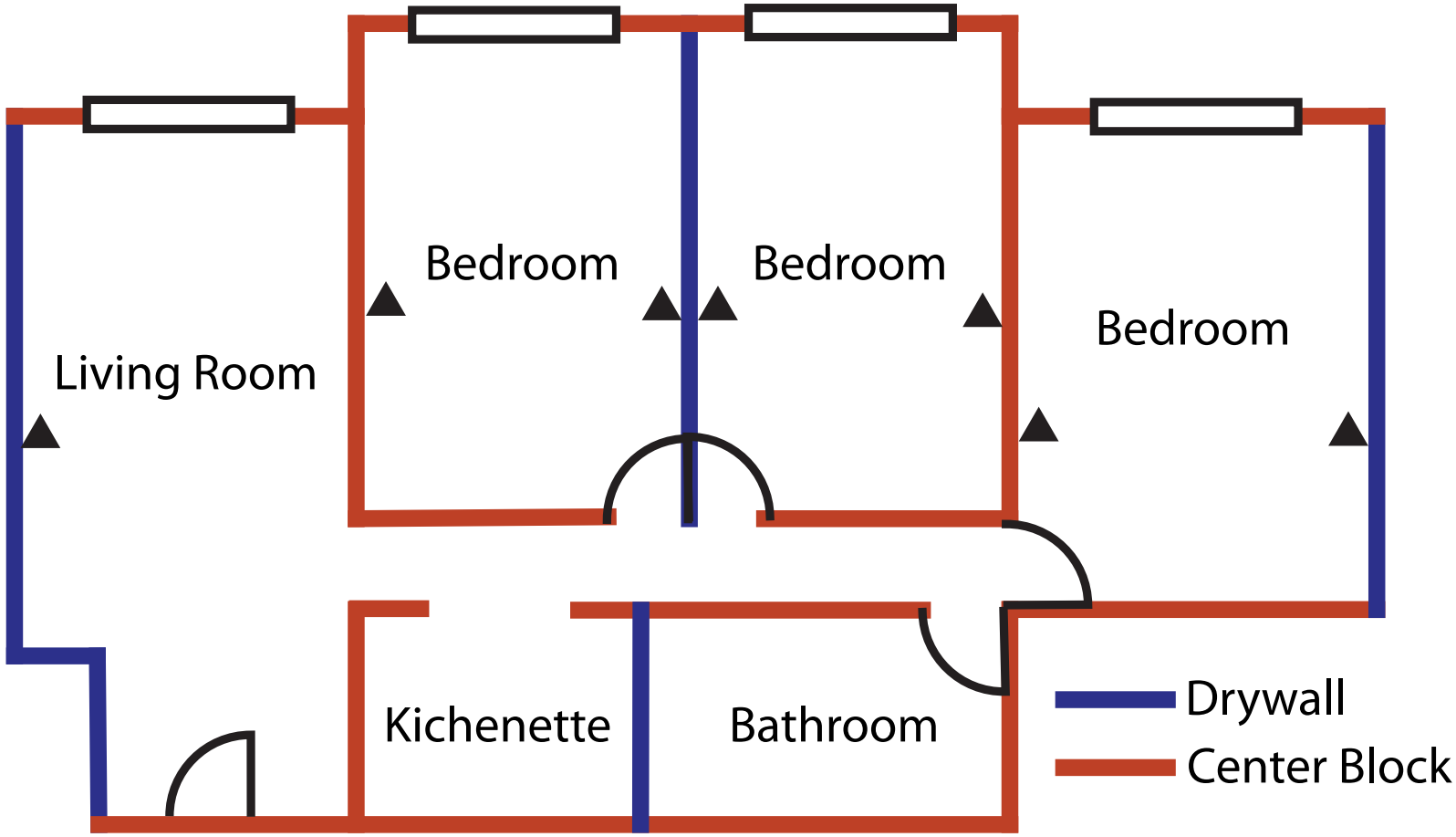
IT staff should be able to hold town hall style, face-to-face meetings in residence halls to discuss wireless and know that our service is excellent.

North Hall – Selected First

Overview of Building Construction

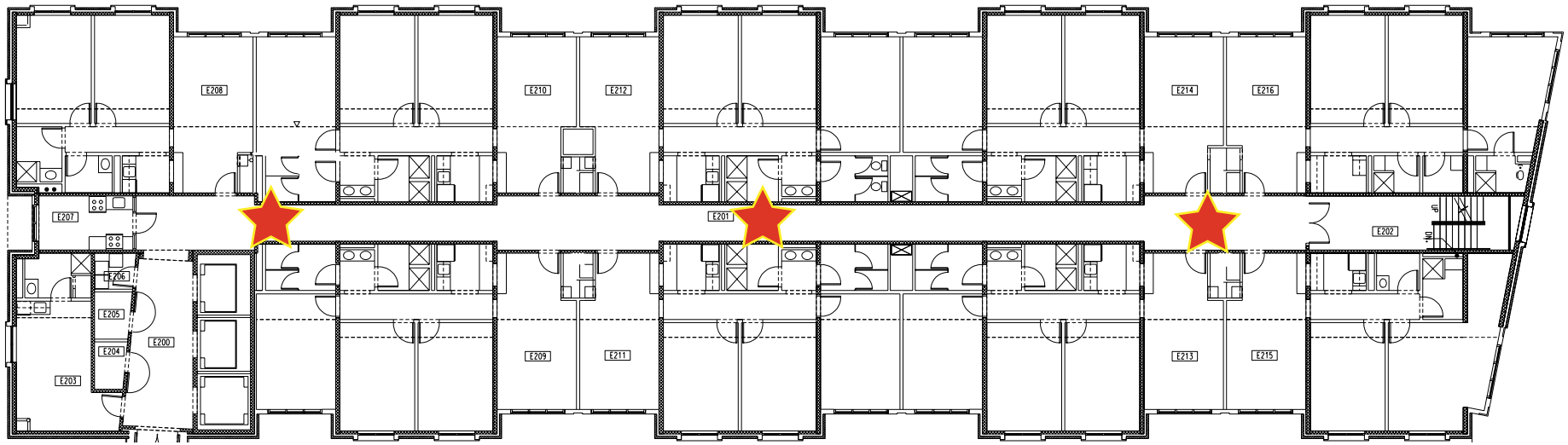
- Large amount of concrete block
  - between all hallways and suites
  - between rooms inside suites
- Some dry wall between rooms inside suites
- HVAC ducts between hallways and suite
- Pipe chases in hallways
- Prefab concrete floors (no metal pan)
- Low signal propagation to rooms from hallways

Typical North Hall Suite



Typical Floor Layout (per wing)

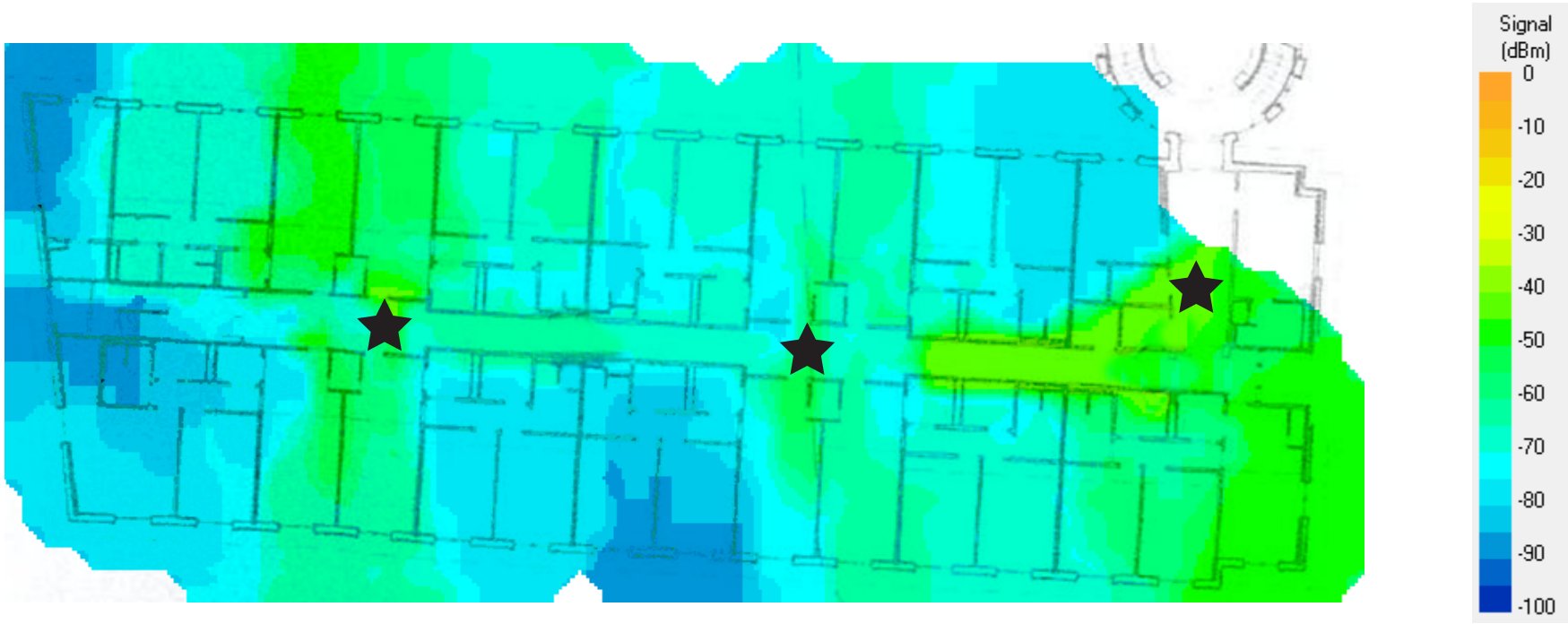
Existing AP125s located in hallway above ceiling



Existing Problems

- AP125s in hallways above ceiling
- Direct Line of sight between APs
  - Co-channel interference
  - ARM ineffective
- Config used to manage current deployment
  - No ARM
  - Static Channel/Power
  - Hard to manage

Coverage Problem of Typical Wing



Data collected with AirMagent

Desired AP Design

Before Survey....

- AP105 selected in lieu of AP125
  - Cost effective
  - Better control of signal propagation
- Get the signal to the user
  - Deploy exposed APs in suites
  - Avoid HVAC and pipe chases
  - Move away from concrete block walls
- Reduce Co-channel interference
- Let ARM run the show
- Configure to disable AP LEDs

Survey RF in Sample Suites

Using AirMagnet…

- Measure RF between rooms in suites
- Measure RF between floors
- Identify AP mounting locations

Arrange Access to Rooms

- Arrange Access with ResLife for Survey
- Clearly communicate details with occupants via direct mail

> On Wednesday, April 25, from 2:00 and 4:00 PM, IRT Networking will perform wireless testing in North Hall room E408, E410, E412 and E310. This testing will include making WiFi radio frequency measurements using laptop computers and WiFi radio transmitters. No construction or installation work will take place during this test. This testing has been scheduled to help plan for a future enhancement to wireless service in North Hall.

- Feedback – Detailed info was appreciated by students and ResLife staff

During Survey

- Be minimally invasive
  - Power from hallway ac outlets
  - Avoid moving furniture

Tripod mounted AP105

- AP in RAP mode
- Power Injector

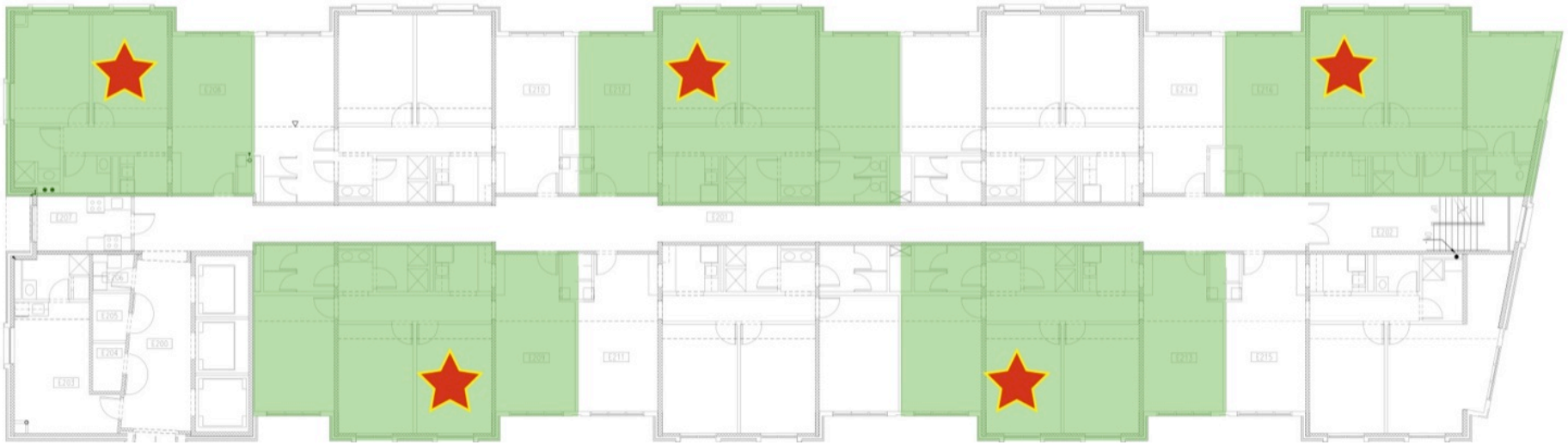
Gather data from all adjacent suites using AirMagnet

Analysis and Deployment Plan

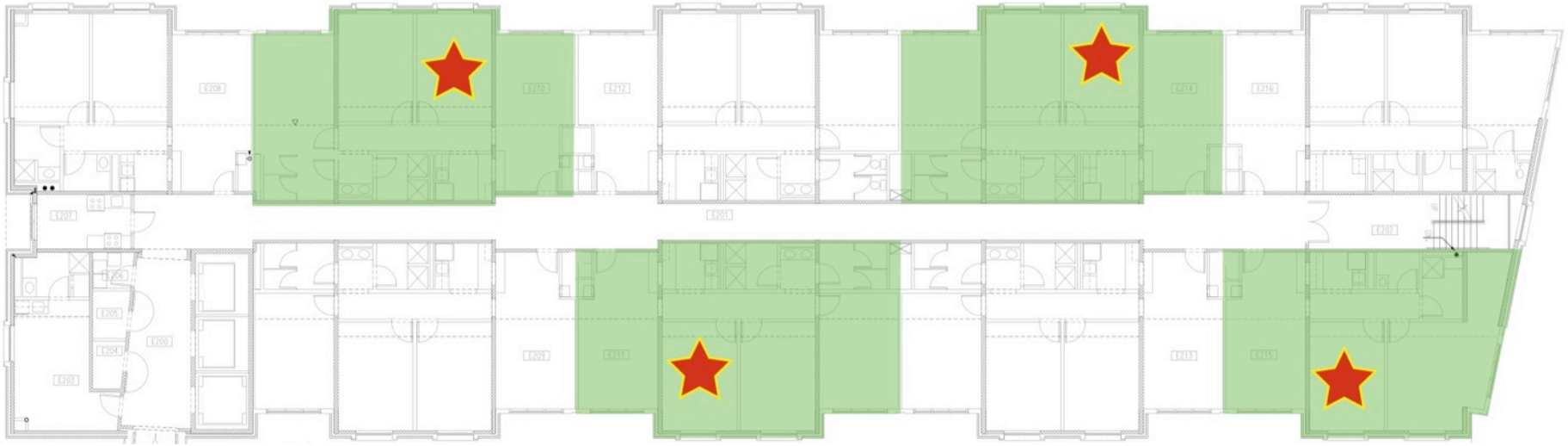
- Review the data collected from survey
  - Run data through Aruba's VisualRF Planner
- Findings
  - Between floor RF propagation was excellent using ceiling mounted AP105
  - RF propagation within suite was excellent
- This suggested a two-floor design with APs in alternating suites

Two Floor Design

Third Floor



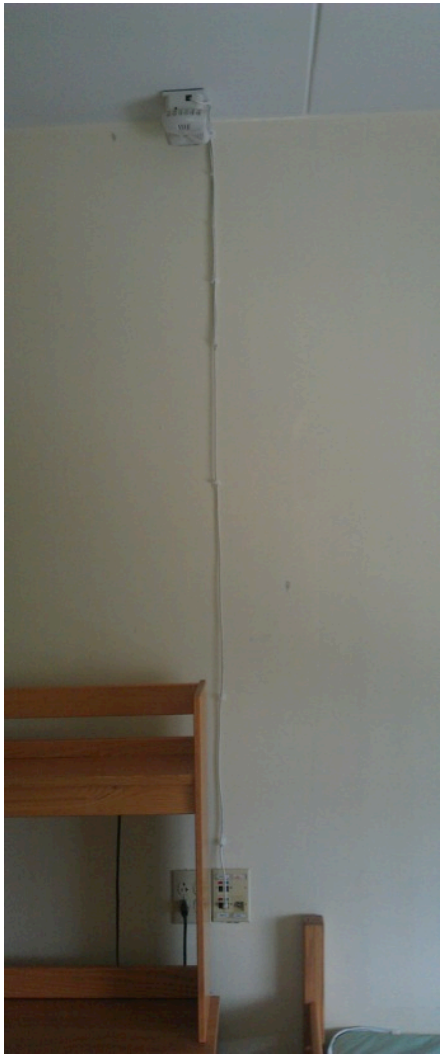
Fourth Floor



Deployment in Occupied Rooms

- One floor at a time
- Fourth Floor, East Wing
- Arrange Access & Email Students
- All aspects of installation temporary
  - AP105 mounted to ceiling with Velcro
  - Cable surface mounted to wall
  - Used existing wiring station for net access
- Existing hallway APs configured as air monitors

Sample Temporary Installation



Repeat Deployment on Next Floor

- Third Floor, East Wing
- Arrange Access & Email Students
- Previous success suggested permanent installation
  - AP permanently mounted to ceiling
  - Cable from existing station re-used
  - New jack installed for AP

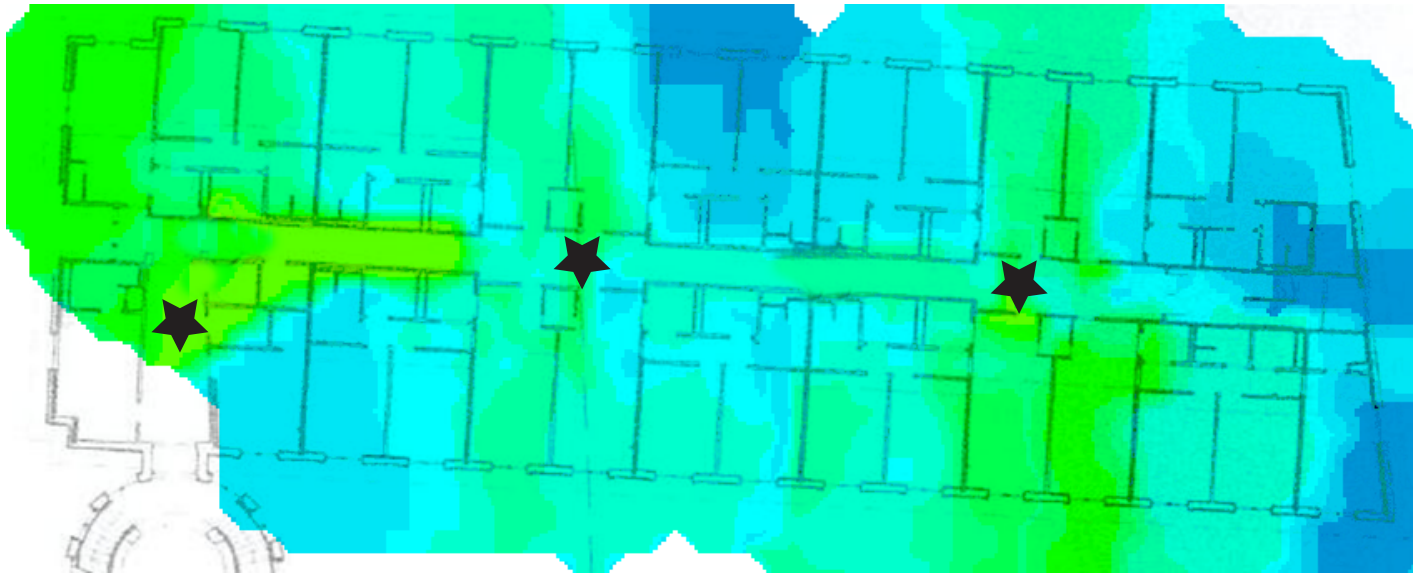
Sample Permanent Installation

Survey New Deployment

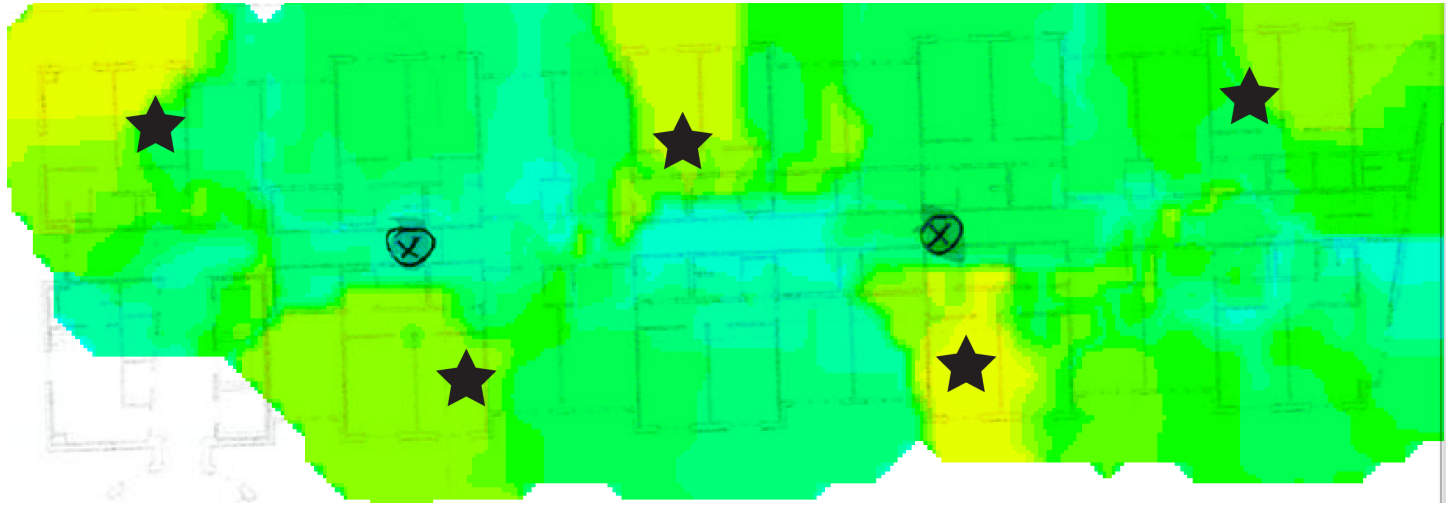
- AirMagnet Survey of both floors
- Airwave Usage Reports
- Student Survey by email

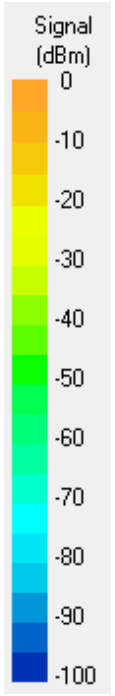
RF Coverage Comparison

Old Deployment



New Deployment





AirWave Results

Validating performance of new AP installations in North Hall, East Wing, Floors 3 and 4

Data collected during the first three weeks of each academic term

	Spring 2012	Summer 2012
Unique MAC Addresses	840	1766
Avg Traffic/Client	475.8 MB	933.0 MB
Avg Traffic/Session	8.8 MB	18.5 MB
Bandwidth/Client	31.0 Kbps	40.7 Kbps
Occupancy	100%	85%
Floors Included	2, 3, and 4	3 and 4

Data for authenticated SSIDs only

Student Survey

12 Responses, 15% of Summer Occupants

9 – Service Improved, NO problem to report

2 – No improvement, PROBLEM to report

Characteristics	Cnt	%
Connect Faster	5	42%
More Reliable	7	58%
Faster Performance	4	33%
Never Disconnect	4	33%
Rarely Disconnect	2	17%
No Change	1	--

- 1 Comment – Concerned about dirt left in room during installation
- 3 students interested in town-hall meeting (matching complaints)

North Hall Conclusion and Next Steps

Initial Deployment Successful

Improve on physical installation
- Be less invasive during install
- Hide RJ45 Jack at AP location

Complete remainder of east wing
- Re-survey students
  - Need more discussions wrt performance
- Repeat in west wing
- Town-hall meeting with entire hall

North Hall AP Count

Building	Floors	Occupancy	Current APs (125)	New APs (105)
North	6	500	37	60
Kelly	11	404	38	est 90
Calhoun	8	364	22	est 56

Remaining summer schedule

- Two building –simultaneous deployment
- Complete by September 15
- Classes begin September 24

Final Conclusion

- IT/Networking returning to student rooms for the first time in 19 years
- New partnerships with ResLife
- Direct dialog with satisfied students
- More skilled at using analysis tools
- Better prepared for future challenges

Questions?


Drexel
UNIVERSITY
You are now entering Philadelphia's CyberZone