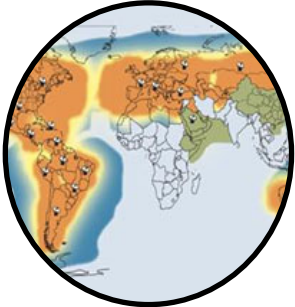




Creating a true carrier-grade WiFi Experience

Colleen Szymanik, Comcast
Darrell DeRosia, NextGen

What does “Carrier Grade WiFi” mean?



Large Coverage Footprint

- Outdoor
- SMB (cafes, shops, restaurants, etc.)
- Venues



Good Bandwidth / Speeds

- Home internet speeds on the go



Security

- 802.1X support
- Federated Access
- Seamless network selection



Reliable

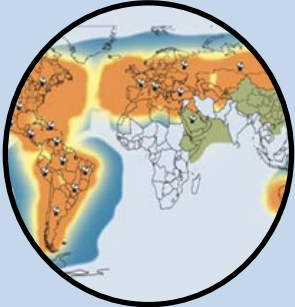
- Ability to connect
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- Supporting fast handoffs (mobility)



Easy to Use

- Rule of 6s

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WiFi deployment approach

Build WiFi coverage in locations where users most likely want to connect



Outdoor

- Aerial strand
- Main streets
- Shop, dine, relax, wait, commute



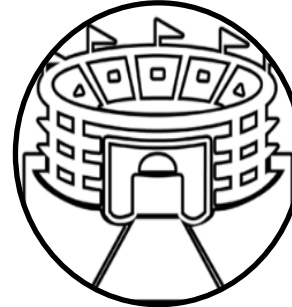
SMB

- Small business
- Seating areas
- Waiting areas



Residential

- WG CPE
- Home network
- XFINITY WiFi



Venues

- High traffic
- Strategic venue
- ROI targets






CableWiFi

- 5 largest MSOs
- Partner sites
- Federations

Each vertical has unique use cases and user base

WiFi Access Point Configurations

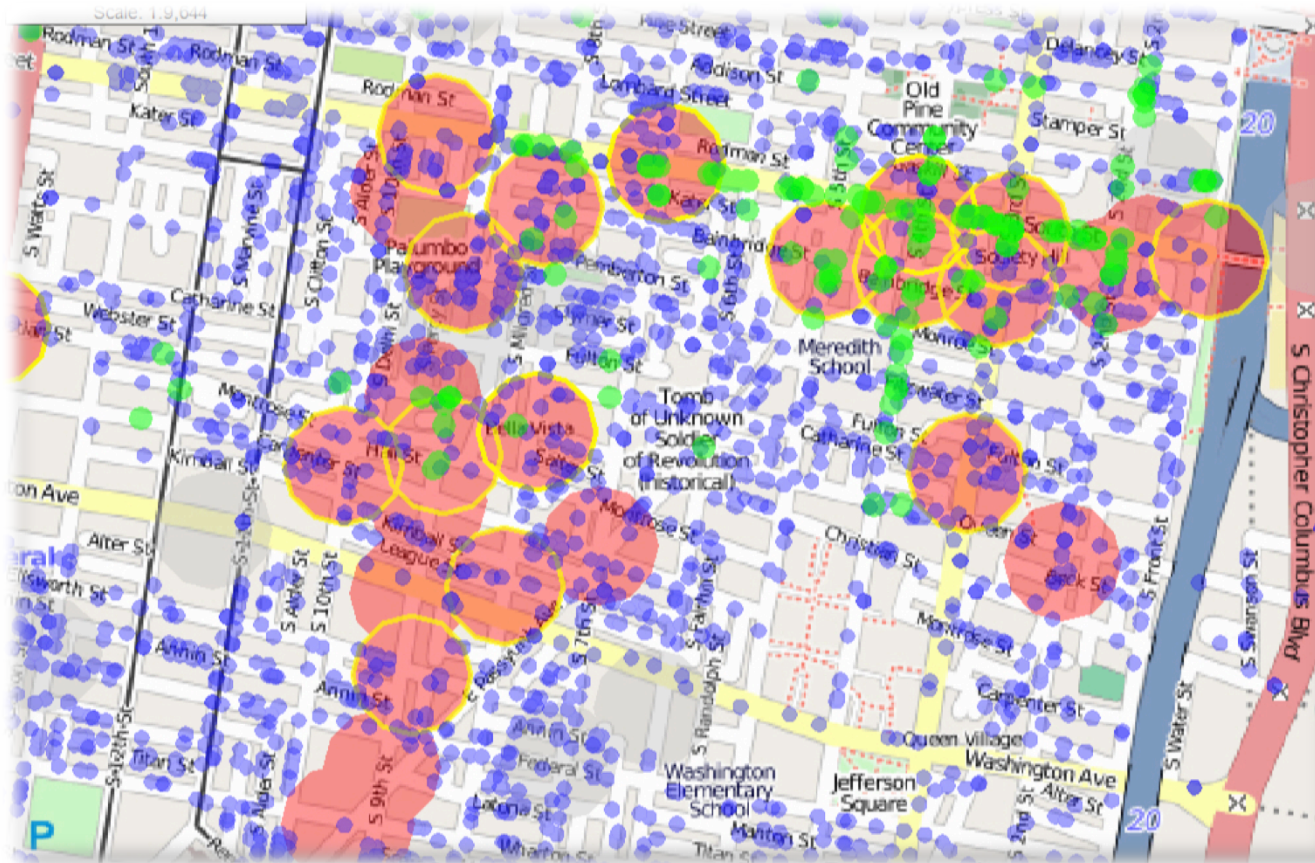
Technologies used to build foundation of carrier class WiFi network

Outdoor	Current Technology	Roadmap
	<ul style="list-style-type: none">• DOCSIS 3.0 cable modem• 802.11n, 2.4 and 5 GHz• 3 x 3 MIMO, smart antenna• Integrated GPS	<ul style="list-style-type: none">• 802.11ac
Vault Mounted	<ul style="list-style-type: none">• DOCSIS 3.0 cable modem• 802.11n, 2.4 and 5 GHz• 3 x 3 MIMO, smart antenna• Integrated GPS	<ul style="list-style-type: none">• 802.11ac• Vault mounting option
	<ul style="list-style-type: none">• DOCSIS 3.0 cable modem• 802.11n, 2.4 and 5 GHz• 3 x 3 MIMO	<ul style="list-style-type: none">• DOCSIS 3.0 cable modem• 802.11ac, 2.4 and 5 GHz• 3 x 3 MIMO
Indoor		
		

Complementary Deployment Environments

small & medium business and home gateways significantly extend WiFi presence

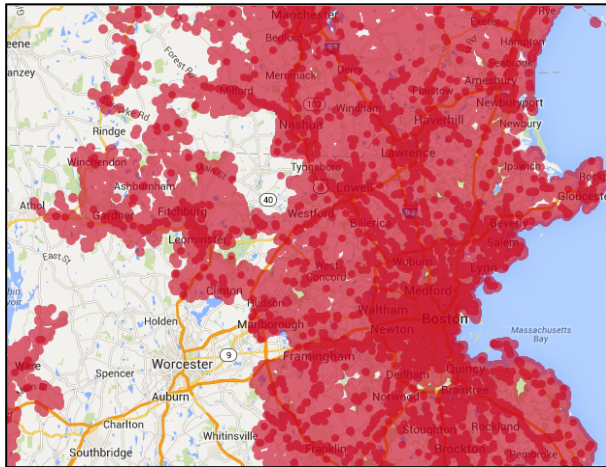
*Approximate Philadelphia Coverage



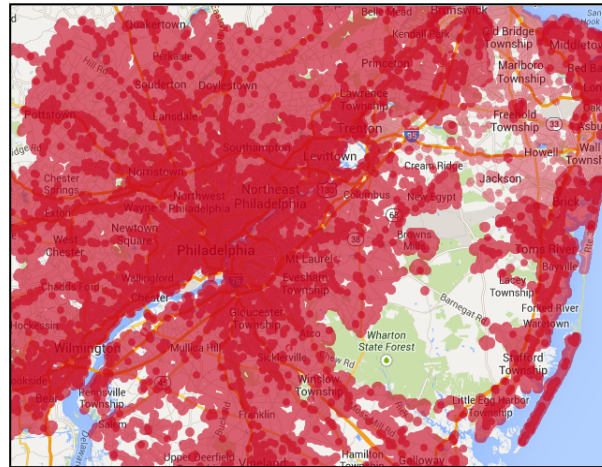
- Outdoor units create initial, essential coverage
- SMB (small & medium business) units extend coverage to indoors and add significant number of new sites
- Home Hotspots utilize home gateways to extend coverage broadly
- Partnerships to extend footprint to out of territory locations

Outdoor SMB Home Hotspot

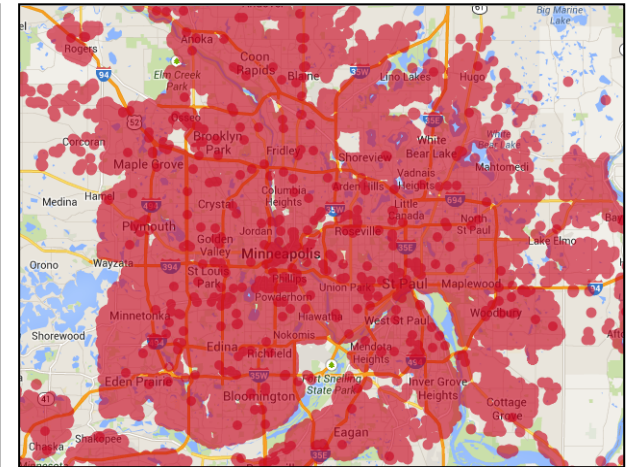
WiFi Deployment Footprint in US



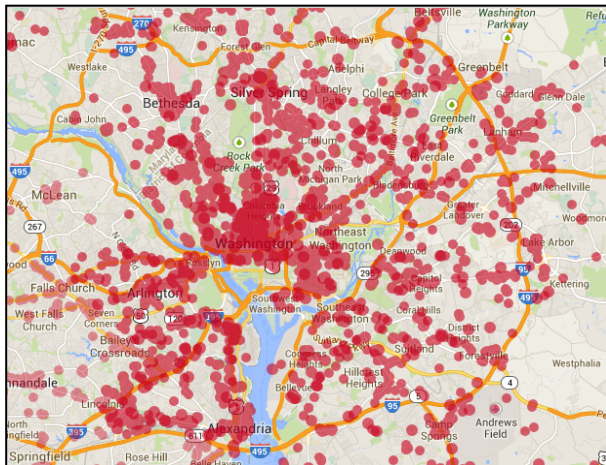
Boston (with HH)



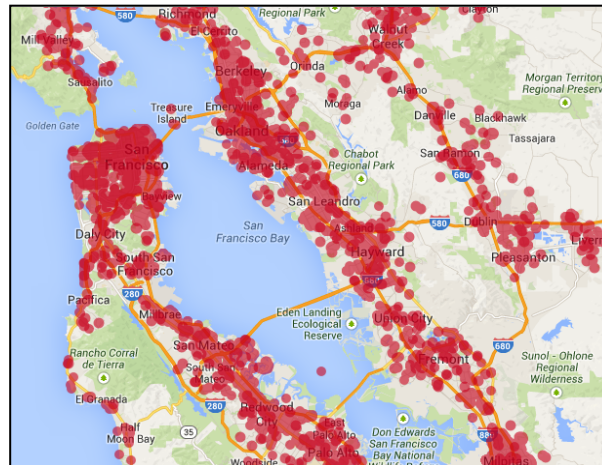
Philadelphia (with HH)



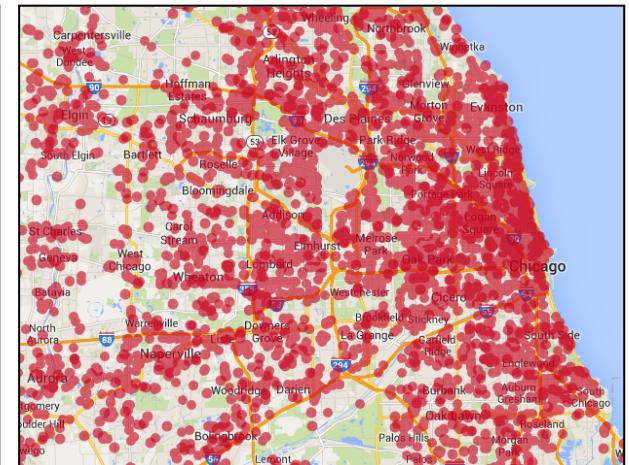
Minneapolis (with HH)



Washington DC

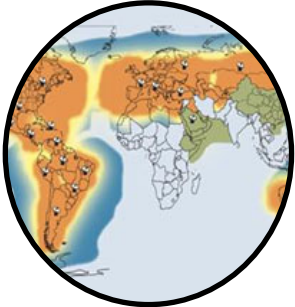


San Francisco



Chicago

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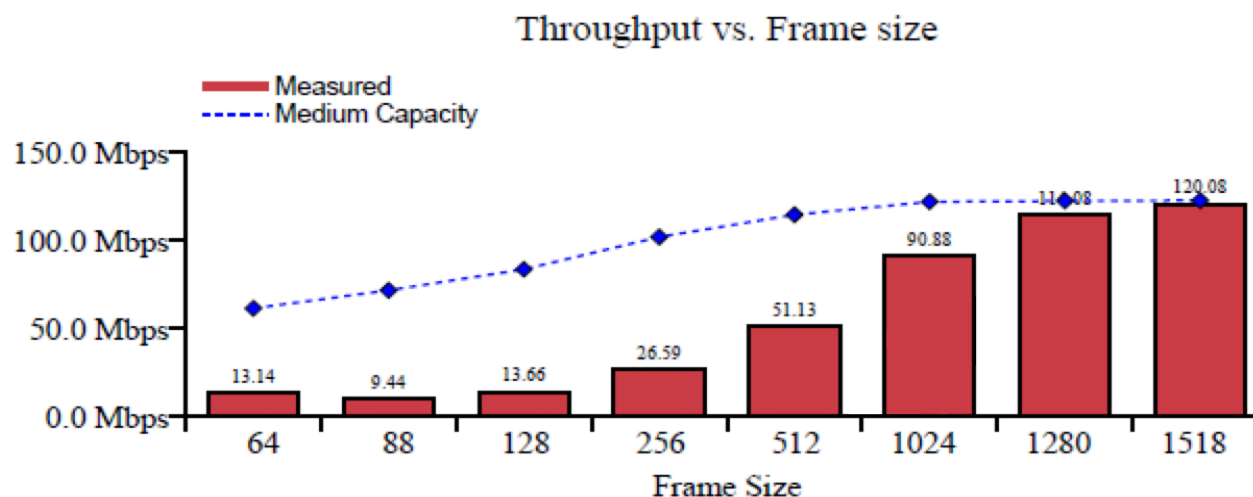
- Rule of 6s

Speed and Throughput

- In the real world... (Some results from simulated tests)

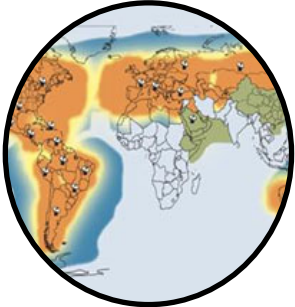
Measured Throughput

The following graph summarizes the measured throughput performance of the SUT at the specified frame sizes in bytes. Higher values indicate better overall performance. If there are more than 15 frame sizes the graph will represent a sample of the frame sizes only.



The theoretical throughput of the system, as limited by the physical media, is also indicated on the above graph. The SUT throughput should ideally be as close as possible to the indicated theoretical throughput values. NOTE: For 11n clients the theoretical maximum assumes the Best Effort AC, AIFS_n of 2, and ECWMin of 4.

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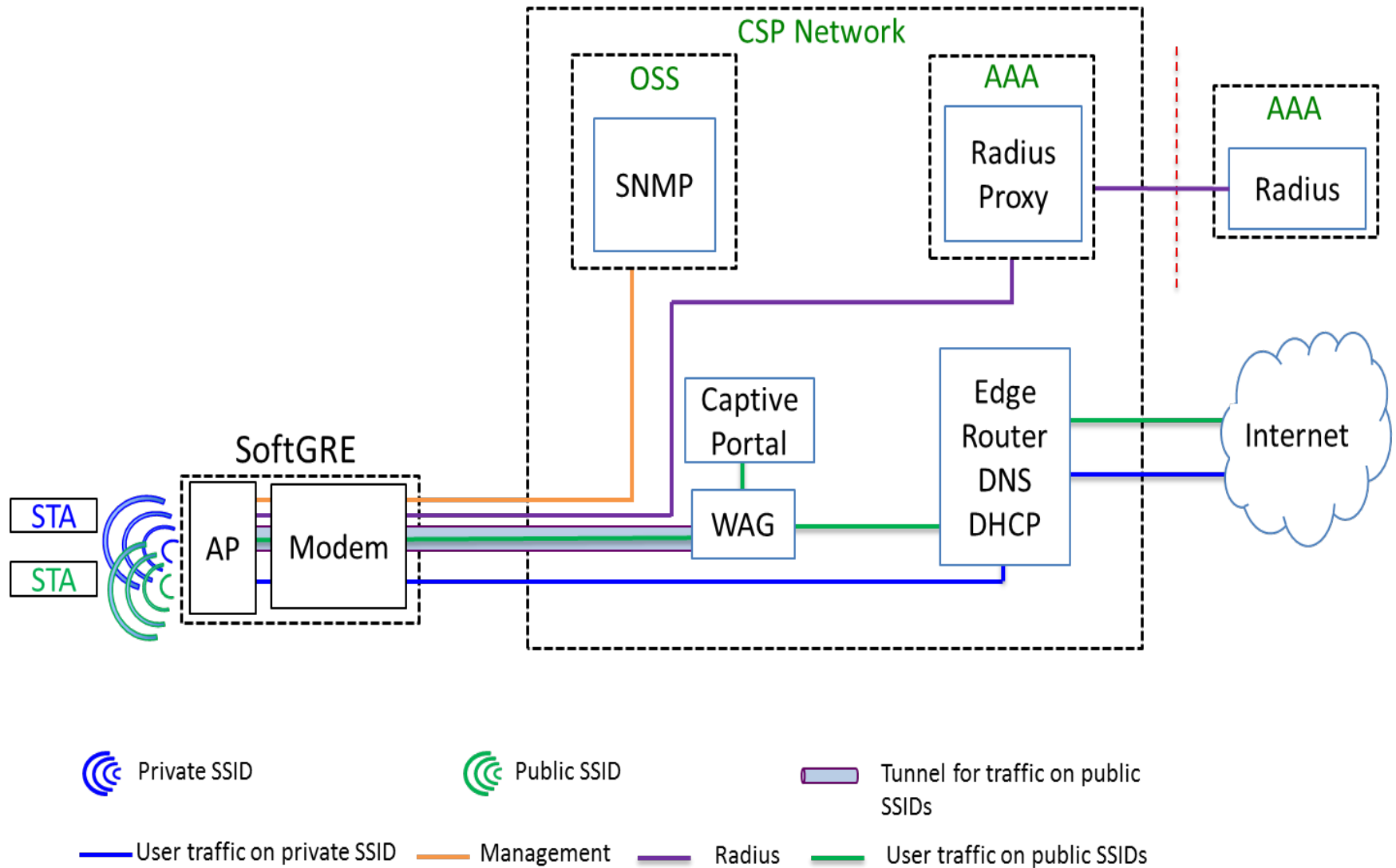
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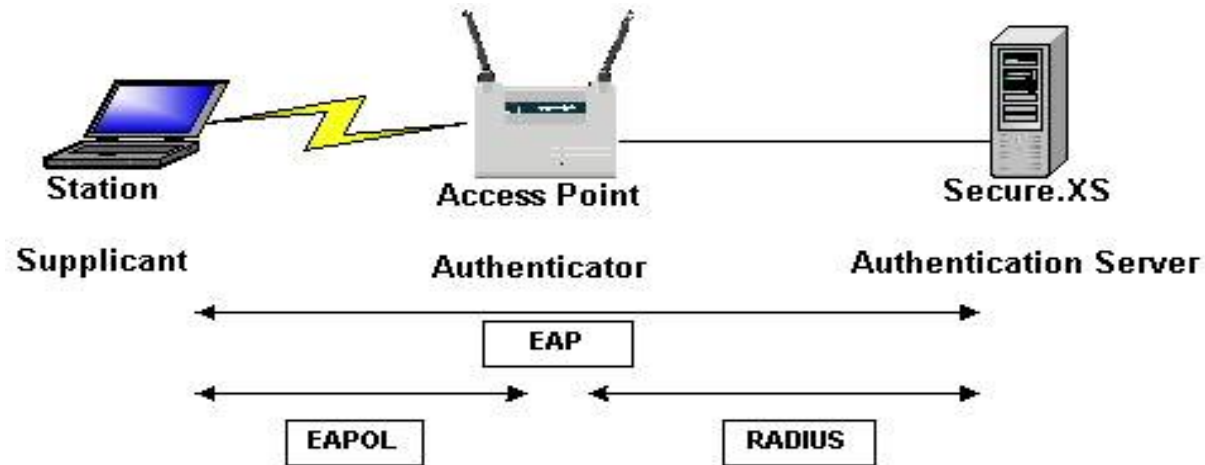
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Sample Soft-GRE Architecture Overview

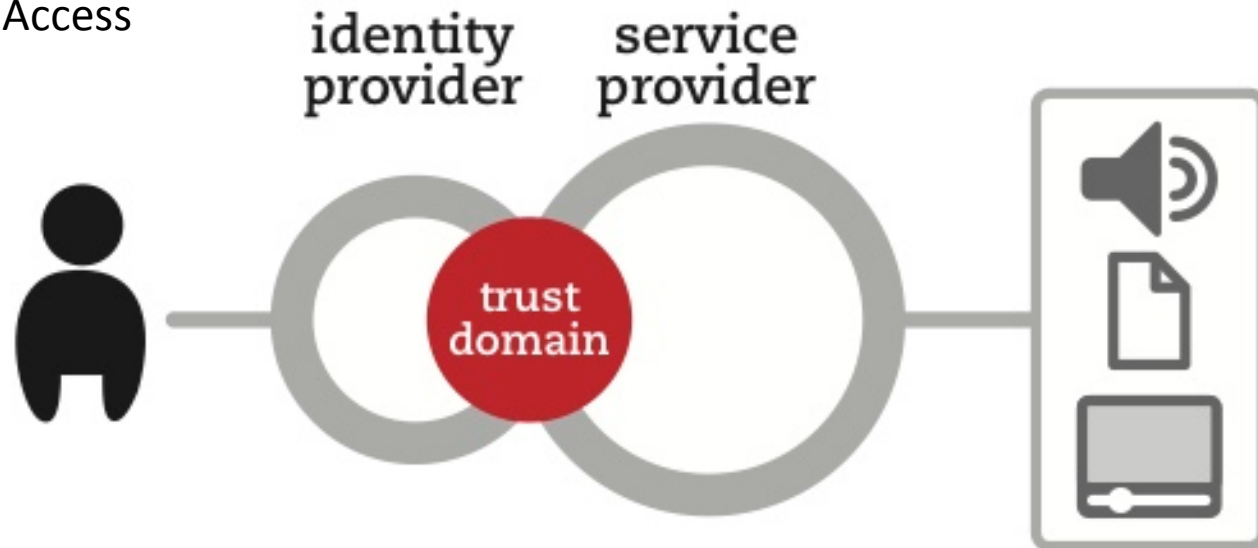


Long term security goals

1. 802.1X

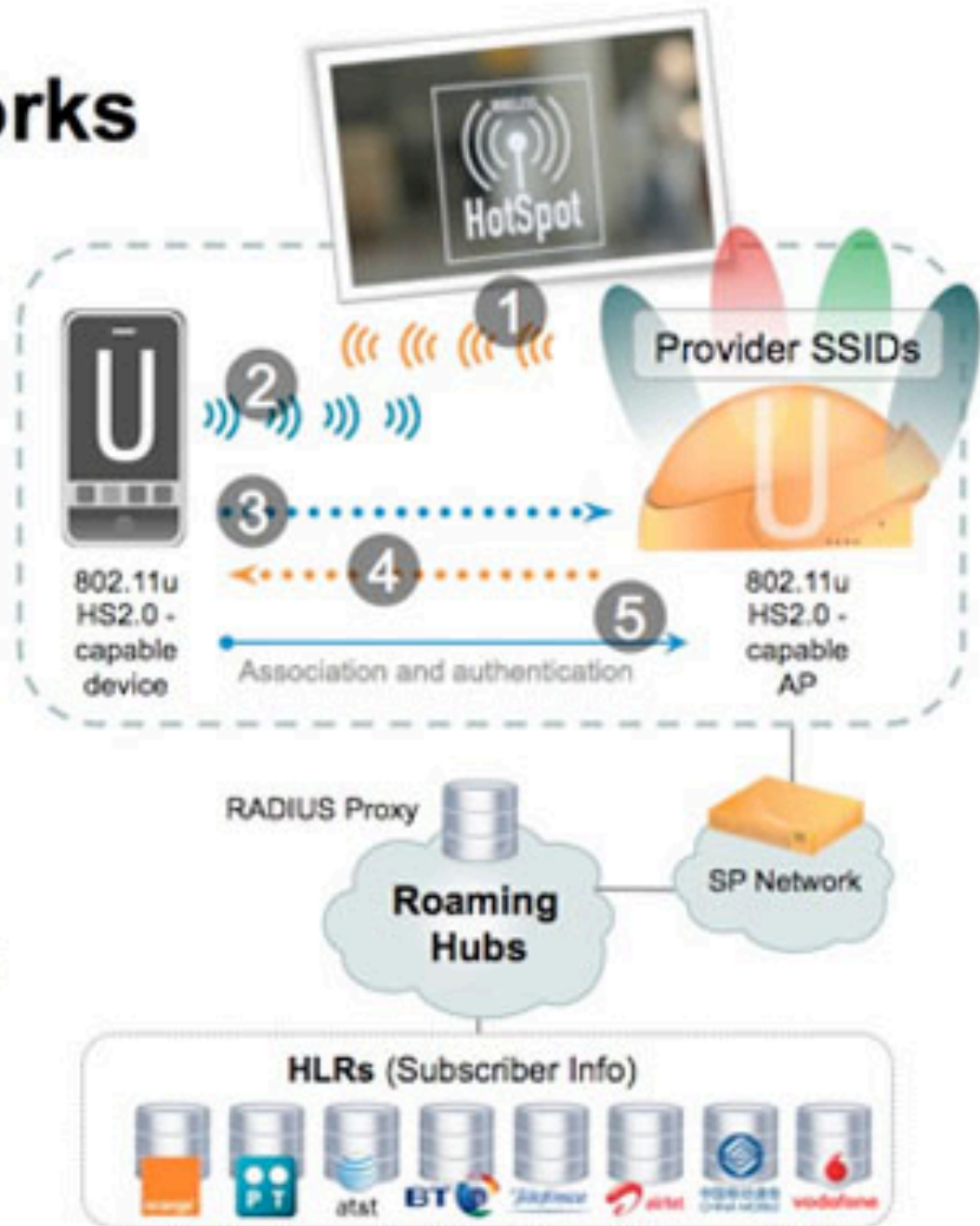


2. Federated Access

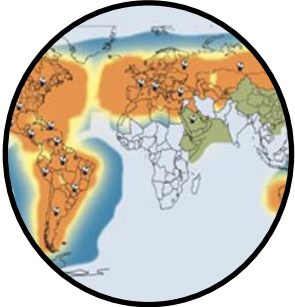


How HS 2.0 Works

1. 802.11u-capable AP beacons with HS2.0 support
2. Device probes with HS2.0 support
3. Device selects AP and performs ANQP request to determine what providers are supported, capabilities of the AP, etc.
4. AP responds to ANQP query with requested information
5. Device compares provisioned profile information against HS2.0 data from APs and associates to the best BSSID



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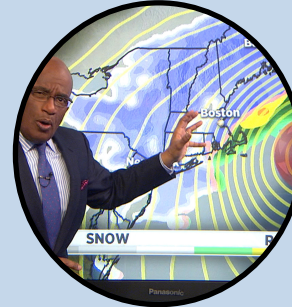
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How to get **good** RF at carrier scale

- How to be good neighbors for public and private wifi
- Unlicensed spectrum / co channel interference
- Large number of devices still widely using 2.4

RF Challenges

- Why can't I connect?
- Dense urban areas have lots of noise!

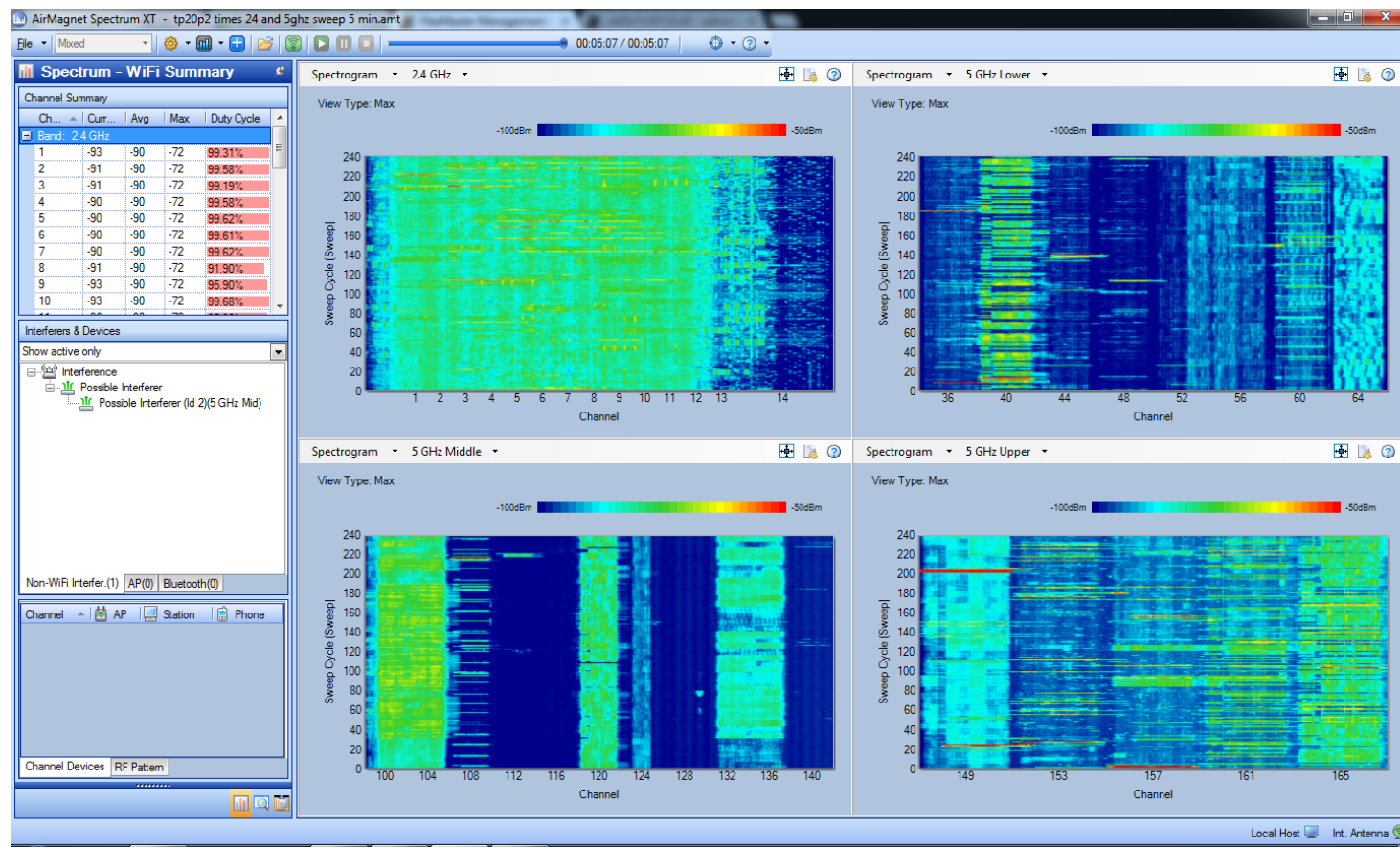


Image Source: Darrell's spectrum capture: Times Square, NYC 2012

Dynamic Environment

- No control over buildings, people, materials...
- I can “see” 30 networks and can’t connect



Device Support



Image Source: <http://cdn.cultofmac.com/wp-content/uploads/2012/06/mobile-intheclassroom.jpg>

Device Breakdown*

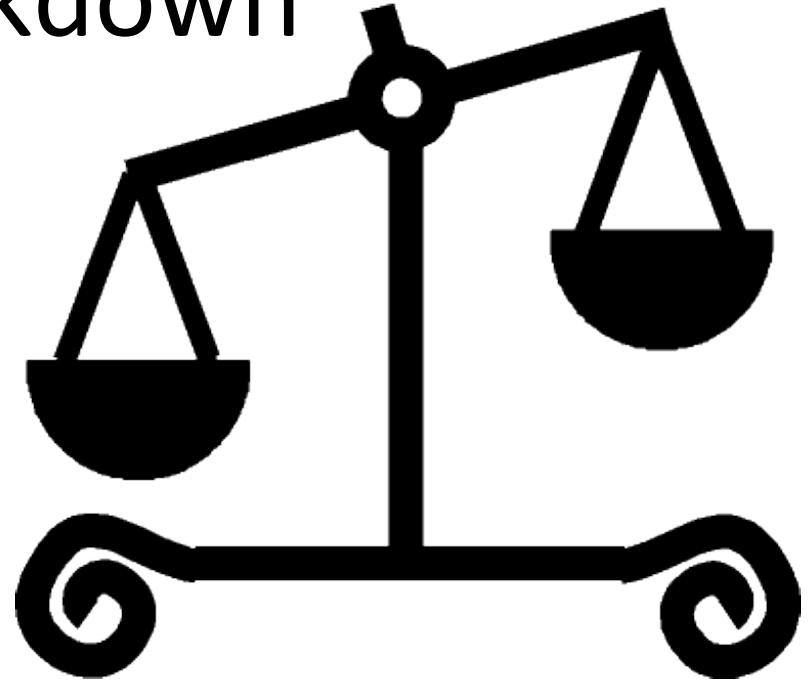
- Device Type Breakdown

- iOS **41.25%**
- Android **35.38%**
- Windows **9.21%**
- MacOS **8.76%**
- Unknown **3.08%**
- Linux **1.62%**
- Windows Phone **0.63%**
- Blackberry **0.08%**

- Display Sizes

- 1024x768 **34%**
- 640x480 **16%**
- 320x240 **47%**
- 0x0 **1%**
- unknown **3%**

Laptops, iPads, Android tablets
Larger Android and iPhone 5/s
Older devices



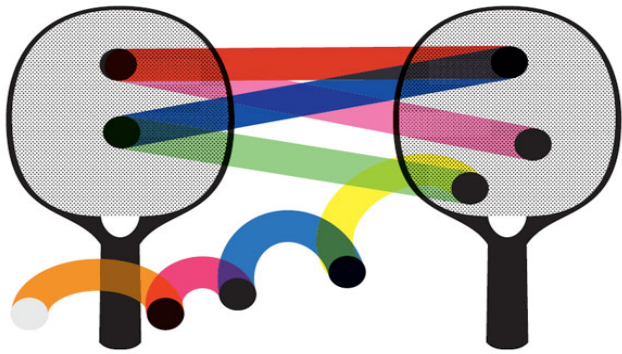
*Sample size is 1 porchlight (in browser notification system) from 4 different regions, Comcast snapshot sample data

Radio Power by Device

Effective Output Power by device category

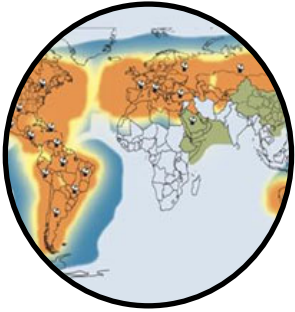
- Smartphone 13-18 dBm
- Tablet 17-23 dBm
- Laptop 20-26 dBm

The case to have good mobility support



- 40-60% of all sessions are defined as a mobility event (a known active MAC address appears on a new tunnel endpoint)
- Need to mature fast transitions for secure WiFi in both controller and controller-less architecture

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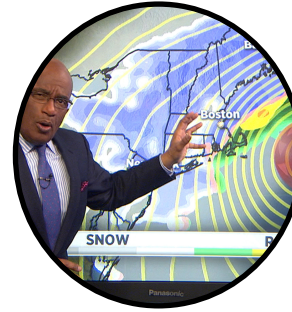
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??? Questions ???



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Darrell DeRosia @Darrell_DeRosia