All Wireless Office (AWO) with .11ac, ClientMatch

June 2013

Agenda

AIRHEADS 2013

BYOD trends & challenges

All Wireless Office (AWO) requirements

RF & Application considerations

.11ac overview

“Smart” .11ac for the AWO

Innovative ClientMatch technology

Visibility into client performance

The New Normal - BYOD Stretching IT Resources

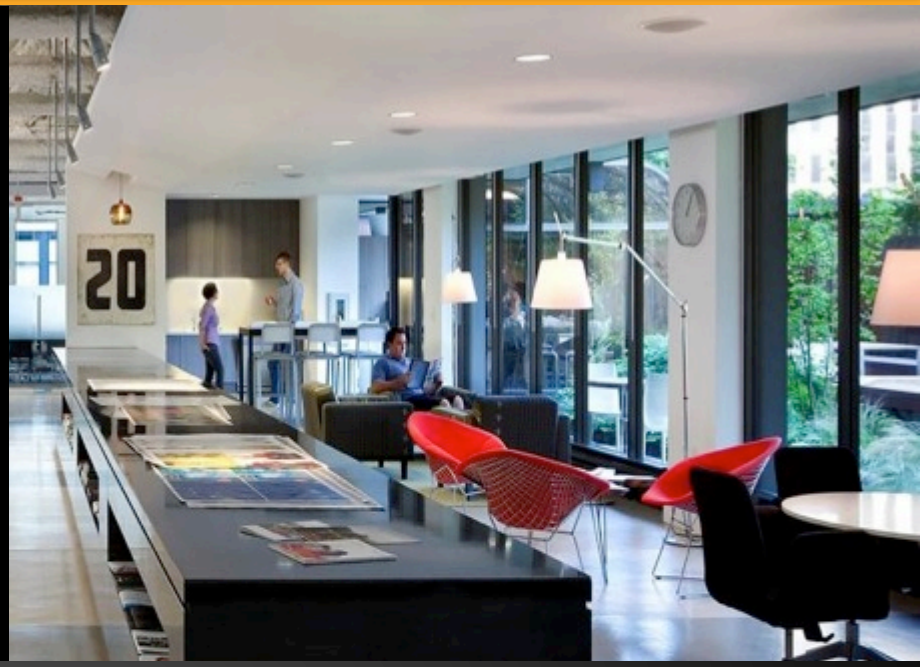
End user devices are predominantly wireless

Enterprise Apps are increasingly cloud based, accessed wirelessly

Collaboration happens wirelessly

No separation of work and personal space

WLAN Challenges for the Next-Gen Workplace



More devices than capacity

Sticky Clients, Poor performance

Unpredictable Voice, Video & UCC

Key requirements for the All Wireless Office

802.11r, .11k, .11v

Airplay, Airprint
802.11ad

All-Wireless

99.999%

Speeds and Feeds - Connectivity Standards & Use cases

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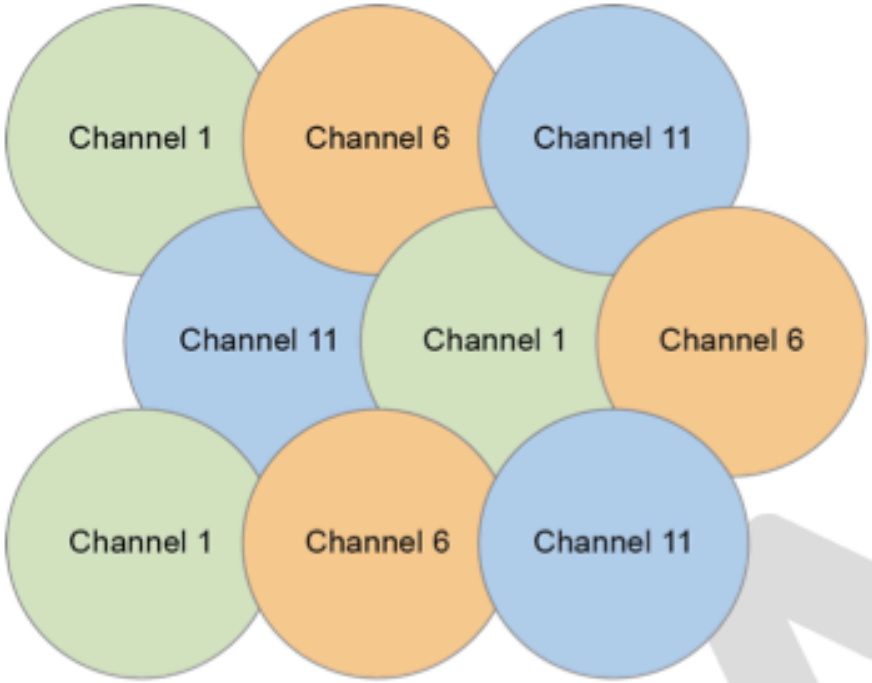
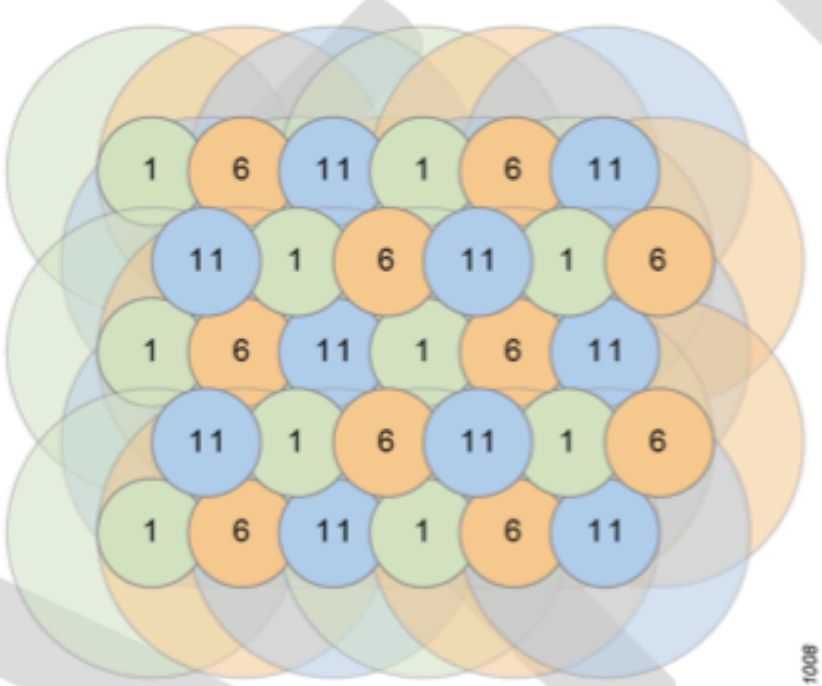
Technology	Spectrum	Max data rate	Max range (ft)	Key use cases
802.11n	2.4 or 5Ghz	600Mbps/ Radio (4 streams)	200 - 250ft	Wi-Fi client access, connectivity
802.11ac	5Ghz	7Gbps	200 - 250ft	Wi-Fi client access, connectivity
802.11ad	60Ghz	7Gbps	30ft	High bandwidth, short range video streaming. For ex. Wireless display monitors, projectors.
802.11mc	2.4 or 5Ghz	NA	NA	Fine Timing Measurement extension for accurate location tracking
Ultra Wide Band	3.1 to 10.6Ghz	1Gbps	50 – 100ft	Accurate location tracking

RF Considerations for the Mostly Wireless Office

Plan for Capacity & Density, NOT “coverage”



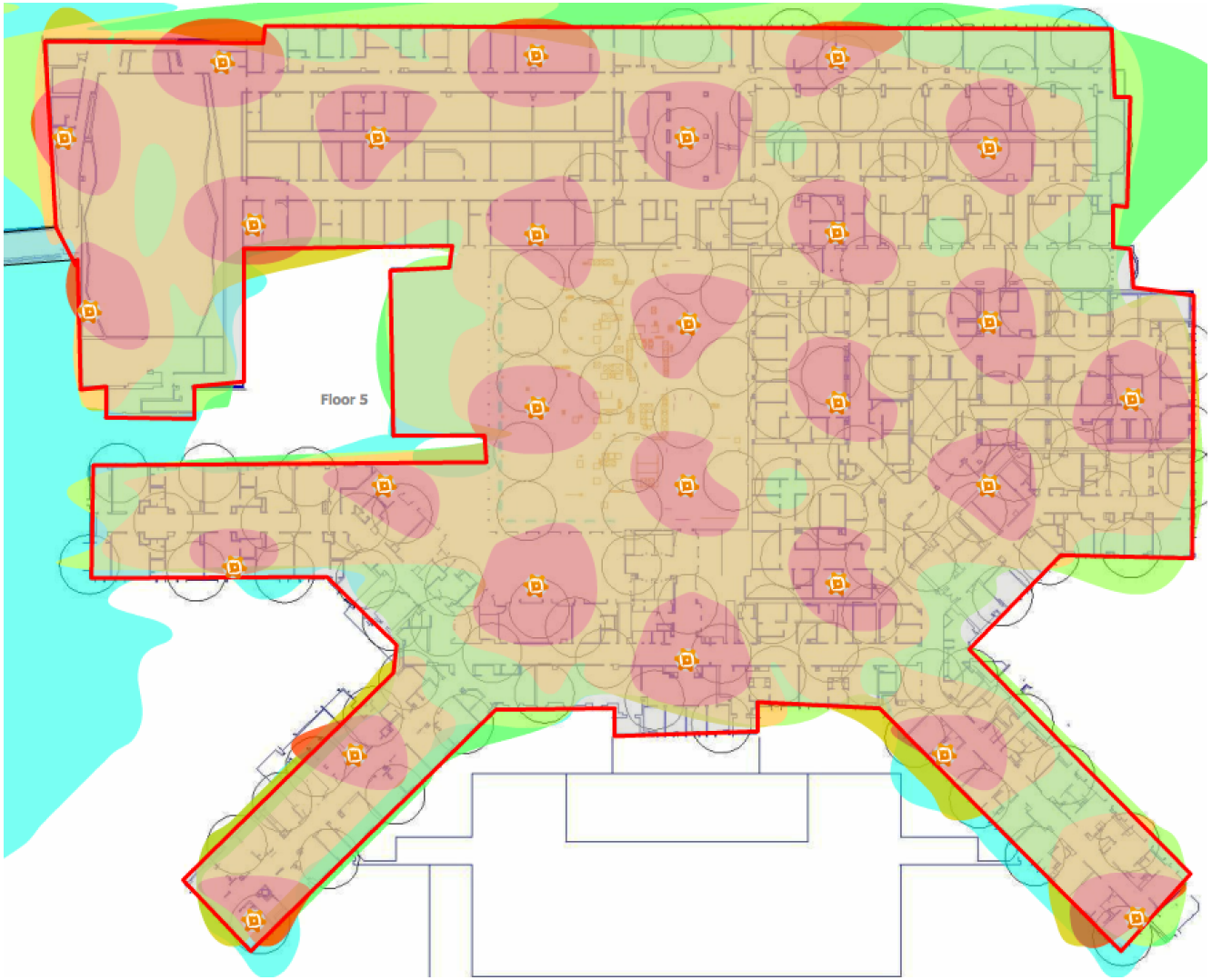
Coverage design with 7.2 Mb/s cell edge



Capacity design with 216.7 Mb/s cell edge

arun_1008

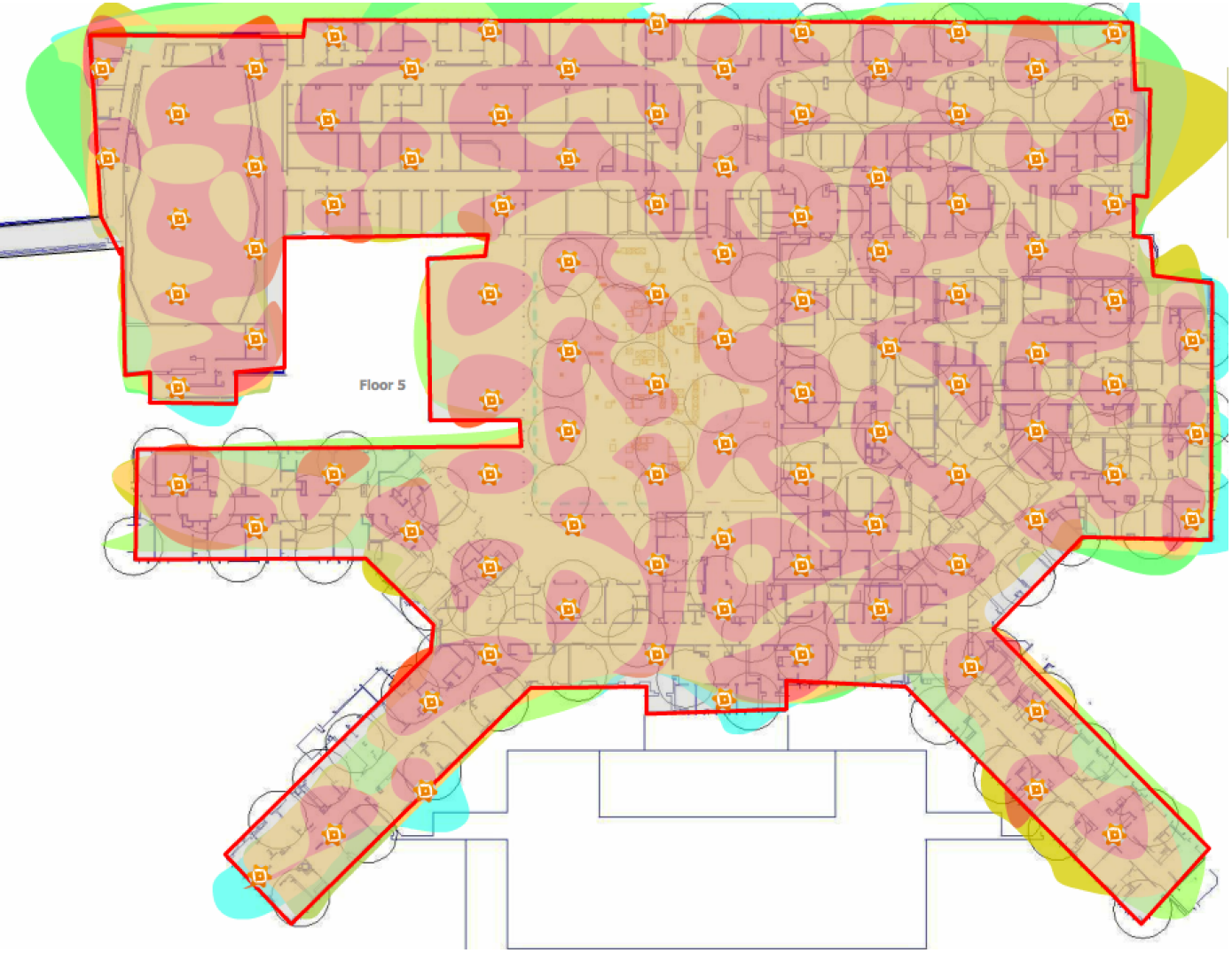
Traditional “low density” coverage



Coverage Model

- Designed to obtain minimum signal level throughout area.
- Typically used for office space with walls and doors
- Laptops are main wireless clients

“High density” coverage for AWO



Capacity Model

- Designed to obtain minimum signal level and maximum clients per radio
- Used for HD and cubicle areas
- Multiple wireless clients per user design
- Plan for a minimum of 25 SNR (ideally 30 SNR)

Cell size reduction with "receive sensitivity" tuning

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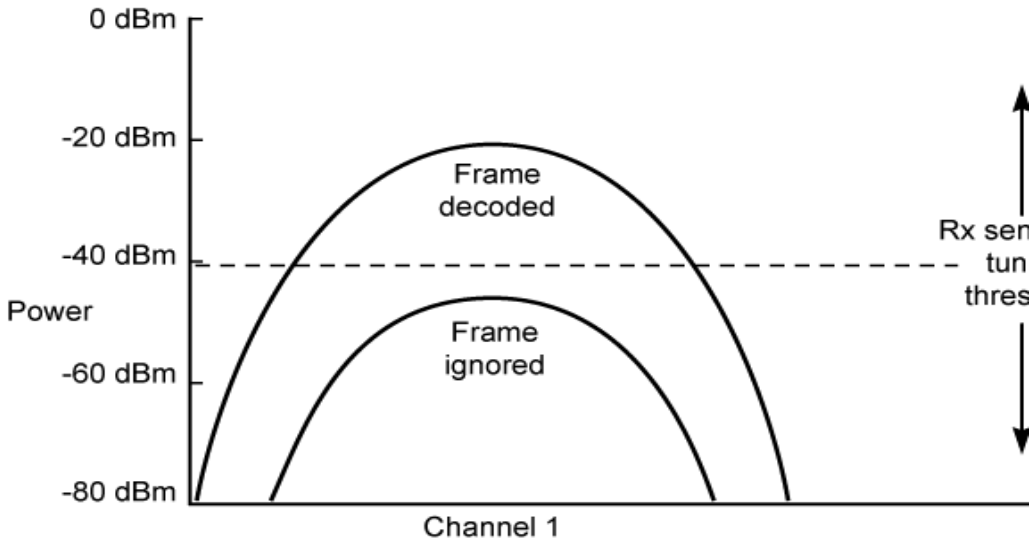
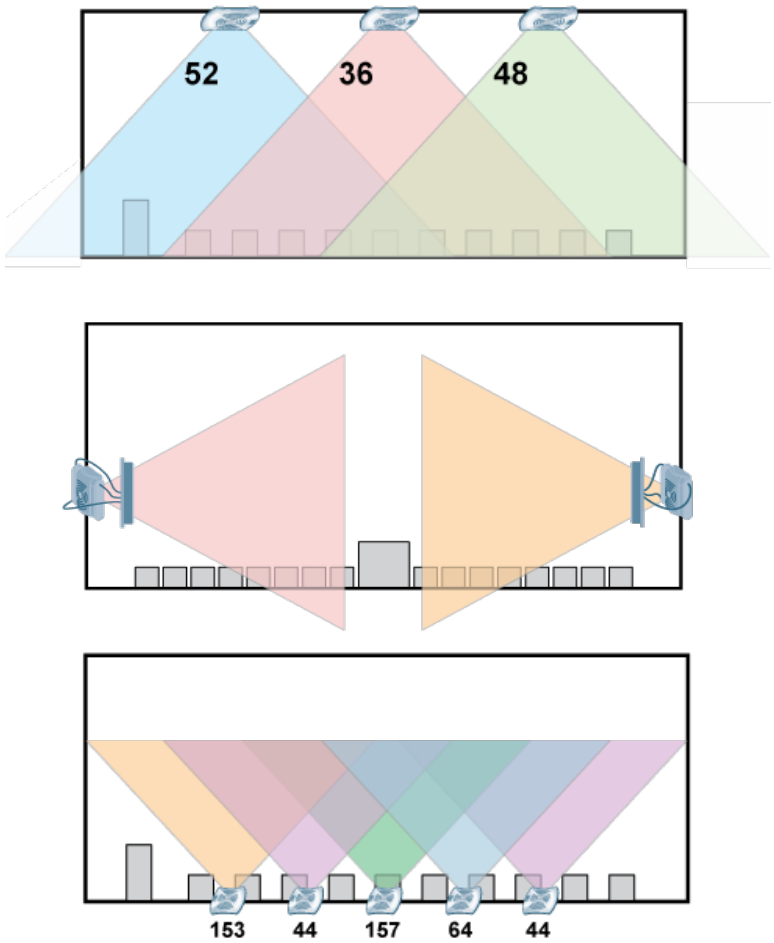
- Adjusting AP receive sensitivity with Cell Size Reduction (CSR), helps the APs to automatically reject interference from co-channel sources outside the high-density coverage area
- CSR can also provide some immunity to ACI sources within the same auditorium or high-density environment



Coverage Strategies for HD Areas



Overhead coverage is a good
when uniform signal is desired
everywhere in the target area

First Choice

Wall installations are most oft
where ceiling or under-floor acc
not possible or too expensive.

Second Choice

Under-floor or on-floor mount
also known as a "picocell" desig
uses very small cells to maximize
reuse.

Third Choice

What type of Apps are on your network ?

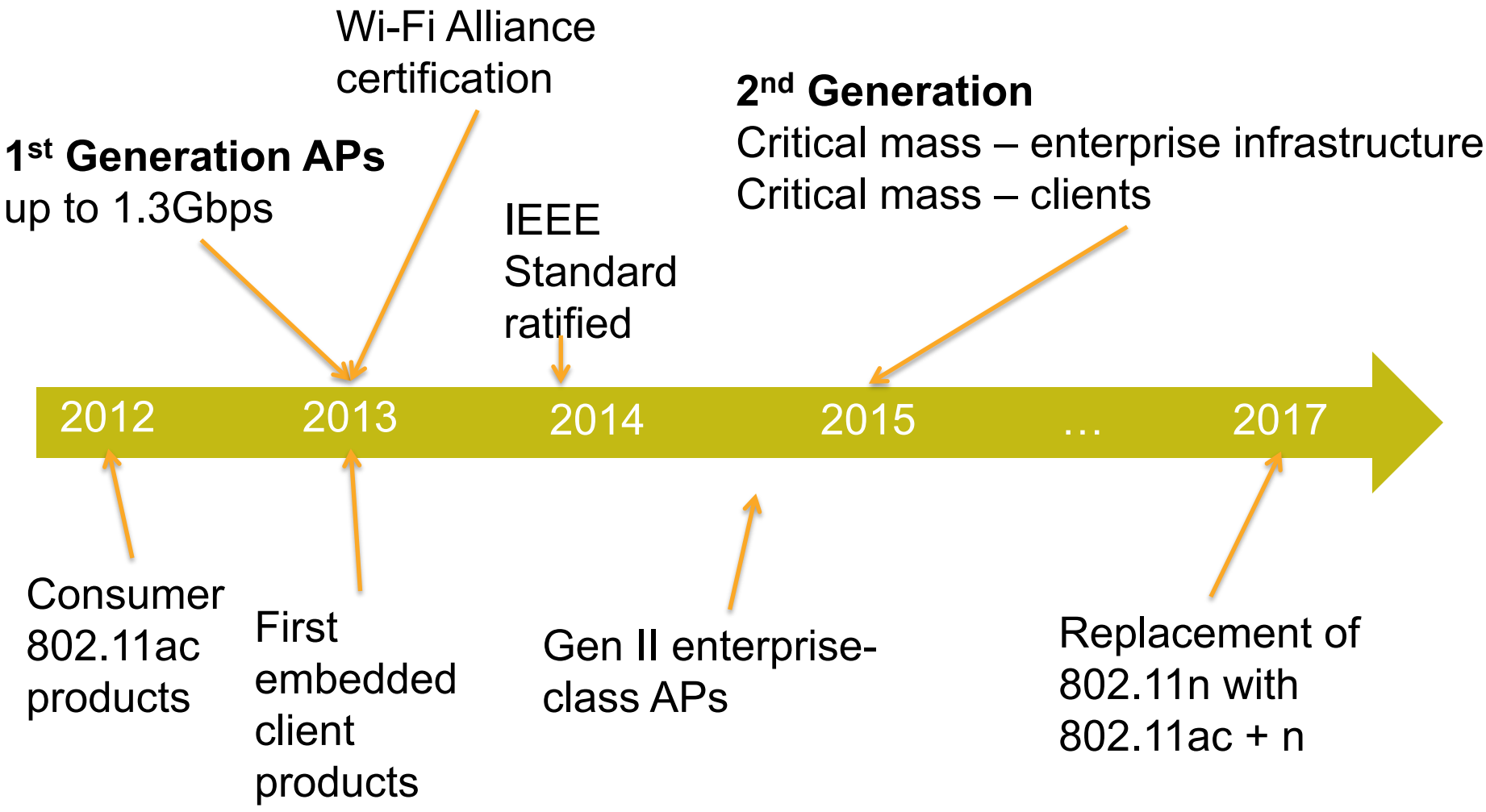
Personal Apps	Throughput Requirements
FaceTime	400 Kbps
AirPlay Video	1 Mbps
Netflix	1.5 Mbps*
Pandora	150 Kbps
YouTube	500 Kbps
Skype	500 Kbps
HTTP	500 Kbps

Corporate Apps	Throughput Requirements
Lync Desktop Sharing	1.5 Mbps
SIP Softphone	90 Kbps
Citrix Internet + Office	150 Kbps
Webex iPad Desktop Share	250 Kbps
WebEx High Quality Video	1.5 Mbps
GoToMeeting Desktop Share	500 Kbps
Desktop Backup	10 – 50 Mbps
Printing	1 Mbps

- Mix of personal and corporate applications
- Design for the highest bandwidth demand that you intend to support
- Multiply this number by the number of connections that you need to support

802.11ac Overview

802.11ac Adoption Timeline



What will 802.11ac offer (initially)?

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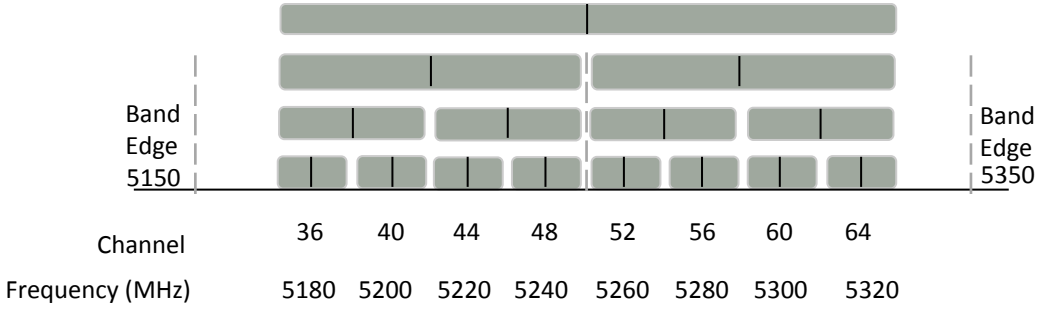
Versus 11n 3SS:

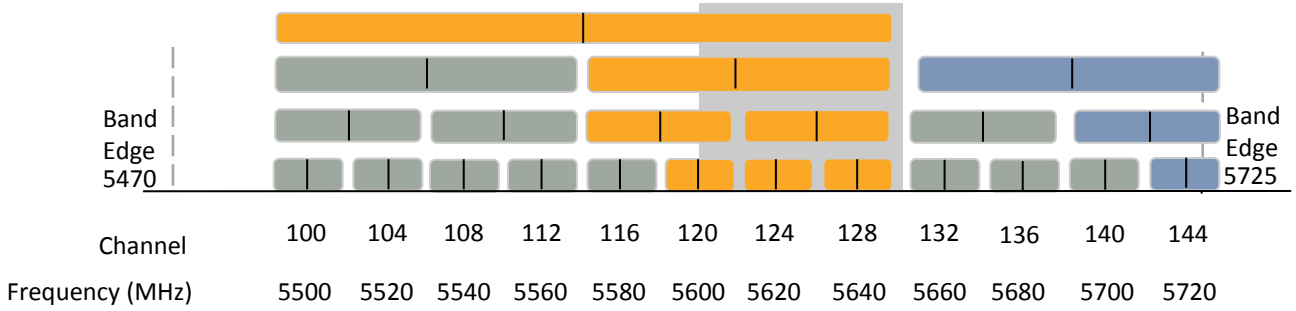
802.11ac is the next step in 802.11 technology

- Higher orders of modulation (256-QAM 3/4 and 5/6) — **1.33x**
- Wider Channel bandwidth
  - Potentially: 160MHz — **4.33x**
  - First generation products: 80MHz — **2.17x**
- Increased numbers of spatial streams
  - Potentially: up to 8 spatial streams — **2.67x**
  - First generation products: 3SS — **1x**
- Potential of delivering real throughputs well in excess of 1Gbps
  - Maximum 802.11ac: 6.933Gbps — **15.4x**
  - First generation products: 1.3Gbps (256-QAM, 80MHz) — **2.89x**
- Multi-user MIMO - not supported in first generation chipsets
- Note: 5GHz only, fully backwards compatible with 802.11n

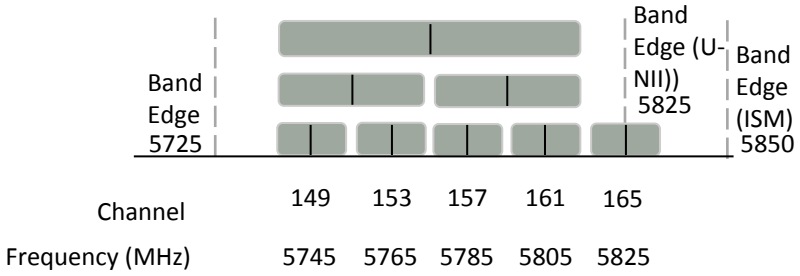
802.11ac Channels in 5 GHz band (FCC)



US U-NII I and U-NII II bands
U-NII I: 5150-5250 MHz (indoors only)
U-NII 2: 5250-5350 MHz
8x 20 MHz channels
4x 40 MHz channels
2x 80 MHz channels
1x 160 MHz channel
U-NII II requires DFS (& TPC if over 500mW / 27dBm EIRP)



US intermediate band (U-NII 2 extended)
5450-5725 MHz
12x 20 MHz channels
6x 40 MHz channels
3x 80 MHz channels
1x 160 MHz channel
- Requires DFS (& TPC if over 500mW / 27dBm EIRP)
- 5600-5650 MHz is used by weather radars and is temporarily not available in the U.S.



US U-NII 3 / ISM band
5725-5825 MHz
5x 20 MHz channels
2x 40 MHz channels
1x 80 MHz channel
- Slightly different rules apply for channel 165 in ISM spectrum

Channels defined for 5 GHz bands (U.S. regulations), showing 20, 40, 80 and 160 MHz channels
(channel 144 is now allowed in the U.S. for one additional 20 MHz, one 40 MHz and one 80 MHz channel)

802.11ac PHY rates

MCS	Lowest rates Mbps (20MHz channel, 1x SS)		Channel width	Spatial streams	Highest rates Mbps (160MHz channel, 8x SS)	
	Long GI	Short GI			Long GI	Short GI
0	6.5	7.2	x2.1 for 40MHz x4.5 for 80MHz x9.0 for 160MHz	x2 for 2 SS x3 for 3 SS x4 for 4 SS x5 for 5 SS x6 for 6 SS x7 for 7 SS x8 for 8 SS	468.0	520.0
1	13.0	14.4			939.0	1040.0
2	19.5	21.7			1404.0	1560.0
3	26.0	28.9			1872.0	2080.0
4	39.0	43.3			2808.0	3120.0
5	52.0	57.8			3744.0	4160.0
6	58.5	65.0			4212.0	4680.0
7	65.0	72.2			4680.0	5200.0
8	78.0	86.7			5616.0	6240.0
9	86.7	96.3			6240.0	6933.3

802.11ac achievable link rates

Channel bandwidth	Transmit - Receive antennas	Typical client scenario	Max individual link rate	Max aggregate link rate
40 MHz	3x3	PC	606 Mbps	606 Mbps
80 MHz	1x1	Smartphone	433 Mbps	433 Mbps
80 MHz	2x2	Tablet, PC	867 Mbps	867 Mbps
80 MHz	3x3	PC	1300 MBPS	1300 MBPS
160 MHz	1x1	Smartphone	867 Mbps	867 Mbps
160 MHz	2x2	Tablet, PC	1.73 Gbps	1.73 Gbps
160 MHz	4x Tx AP, 4 clients of 1x Rx	Multiple smartphones	867 Mbps per client	3.47 Gbps
160 MHz	8x Tx AP, 4 clients with total of 8x Rx	Digital TV, set-top box, tablet, PC, smartphone	867 Mbps to two 1x clients 1.73 Gbps to one 2x client 3.47 Gbps to one 4x client	6.93 Gbps

Real world single client data rates

Standard	Goodput for TCP traffic (approximate)
802.11g	25
802.11a	25
802.11n (HT 20 MHz 1SS MCS 7)	35
802.11n (HT 20 MHz 2SS MCS 15)	80
802.11n (HT 40 MHz 2SS MCS 15)	150
802.11n (HT 40 MHz 3SS MCS 23)	230
802.11n (HT 20 MHz 3SS MCS 23)	140
802.11ac (VHT 80Mhz 3SS)	800Mbps +(TCP) 950Mbps+ (UDP)

- Channel capacity can be the bottleneck, plan for it
- Understand device profiles – what, how many
  - 1SS vs. 2SS vs. 3SS
  - 11n vs. 11ac

“Smarter” .11ac with ClientMatch™

Smarter 802.11ac for the Next-Gen Workplace

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Aruba 220 Series

- 802.11ac speeds for high density
- Leverages legacy PoE Switches

NEW with ArubaOS 6.3

Patented ClientMatch™

- No Sticky Clients
- For 802.11n and 802.11ac

NEW with ArubaOS 6.3

Microsoft Lync Visibility

- Monitor Lync even when encrypted
- QoS for different Lync media

NEW with ArubaOS 6.3

Purpose-built Aruba 220 Series

Controller-managed & Controllerless**

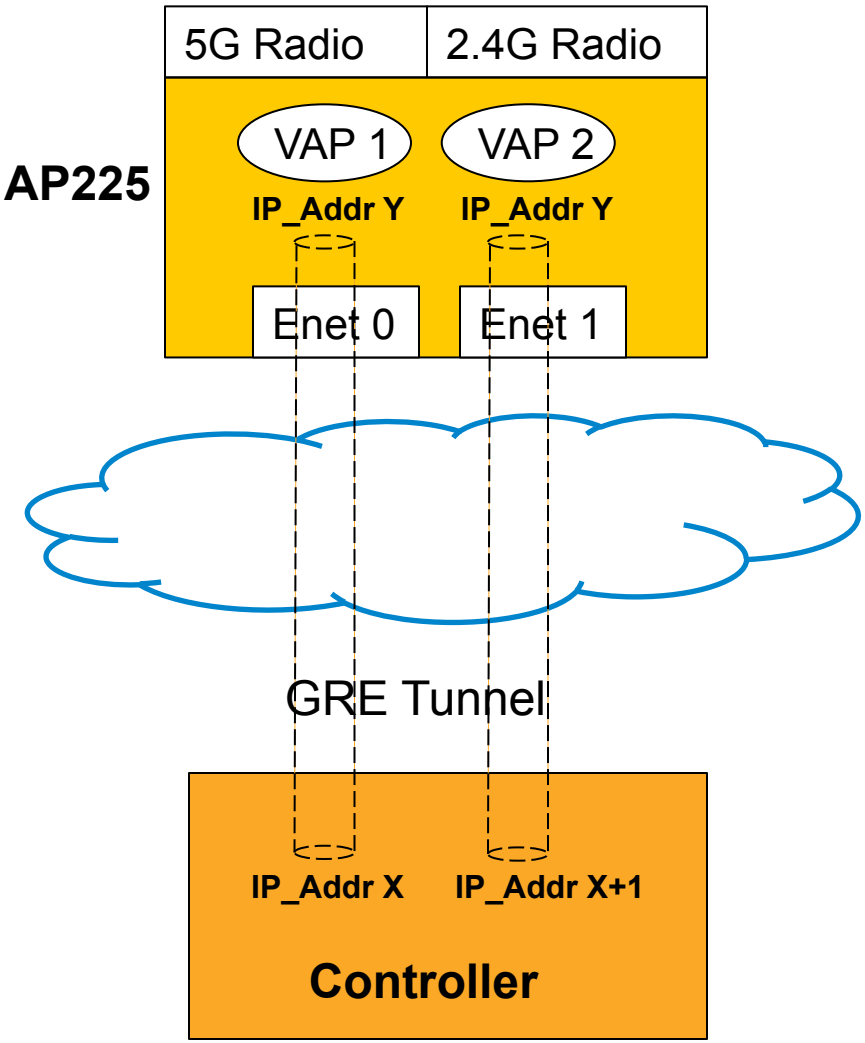
- **3x3:3 Dual Radio**
  - 5GHz 11ac: up to 1.3Gbps
  - 2.4GHz 11n: up to 450Mbps (600Mbps with Broadcom clients)
- **2x GE link aggregation**
  - Enabling >1Gbps throughput
- **Operates with 802.3af,** requires 802.3at for full functionality
- **802.11ac standards based Beamforming**

** Aruba Instant available in Q3 CY2013

Purpose-built = No Design Compromises

Powerful CPU & memory	Custom antenna design	Energy efficient	Smaller & lighter	Cost effective
Higher density	**Better RF coverage**	**15W vs. 25.5W**	**Easier to install**	**Lower capex compared to modular options**

Achieving >1Gbps throughput with AP-22x Dual Ethernet Uplinks from the AP



- AP225 creates a different GRE tunnel for each VAP
- A single IP address is assigned to the AP and used for the AP termination endpoint for all GRE tunnels between the AP and the controller
- Two consecutive IP addresses (X and X+1) are assigned to the controller so that alternate IP addresses can be used for different GRE tunnels between the AP and the controller
- In the existing AP-225 implementation, controller IP address X is assigned to all tunnels corresponding to the VAPs on the 5G radio, while controller IP address X+1 is assigned to all tunnels corresponding to the VAPs on the 2.4G radio
- This ensures traffic from the controller to the AP will have different source IP addresses in the outer IP header based on the destination radio interface
- The Ethernet switch can be configured to perform Etherchannel load-balancing based on source IP
- All 5G traffic will be distributed to Enet 0, while all 2.4G traffic will be distributed to Enet 1
- This will allow AP225 to achieve > 1Gbps throughput in both upstream and downstream directions

ARUBA networks

Aruba ClientMatch™ Enables 802.11ac Wi-Fi

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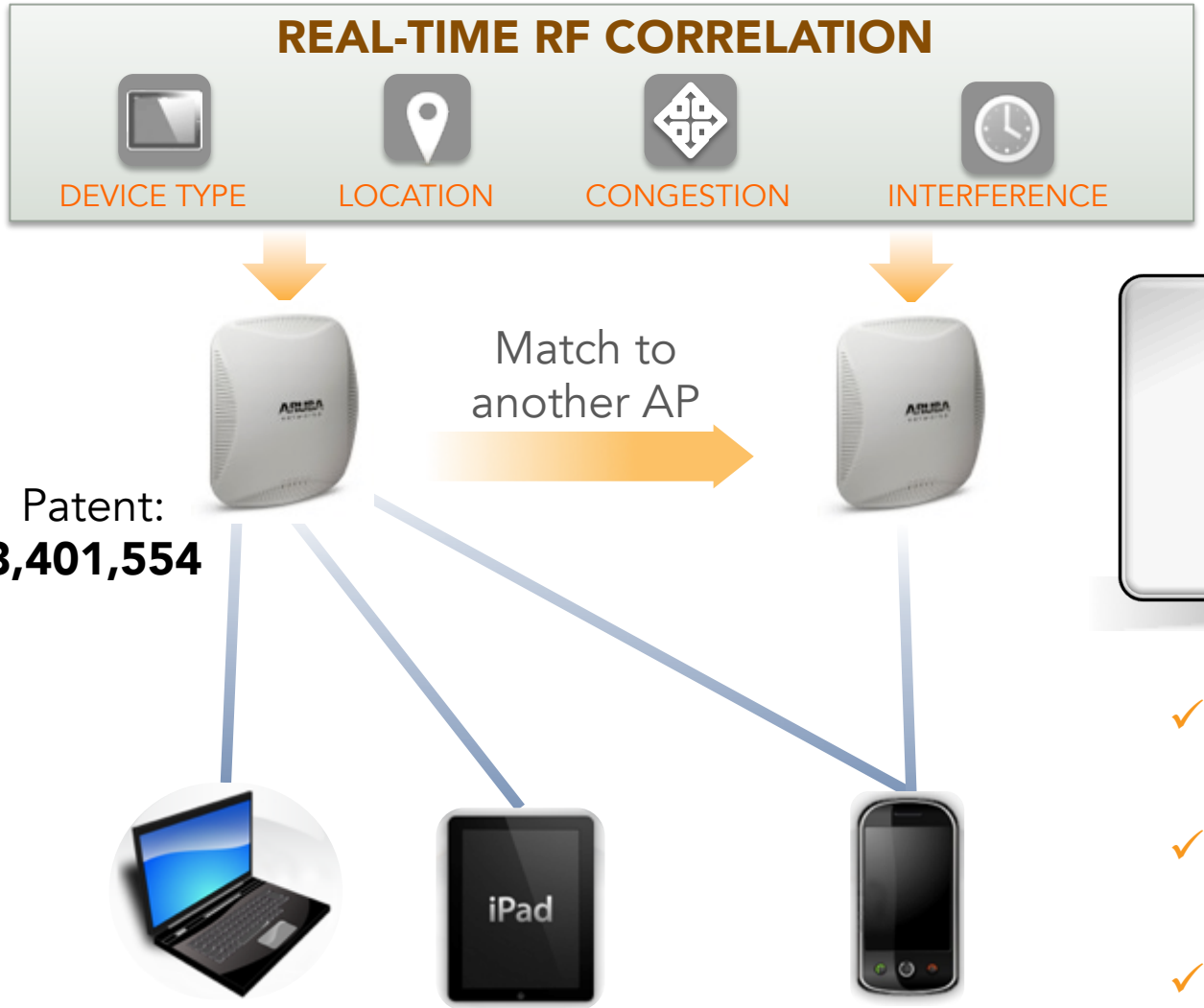

Aruba Patented Technology

No more "sticky" clients

No client software

Must-have for 802.11ac

- ✓ **98%** of mobile devices with higher SNR
- ✓ **94%** better performance for "sticky" clients
- ✓ No client-side software required

ClientMatch for Link Optimization (L1)

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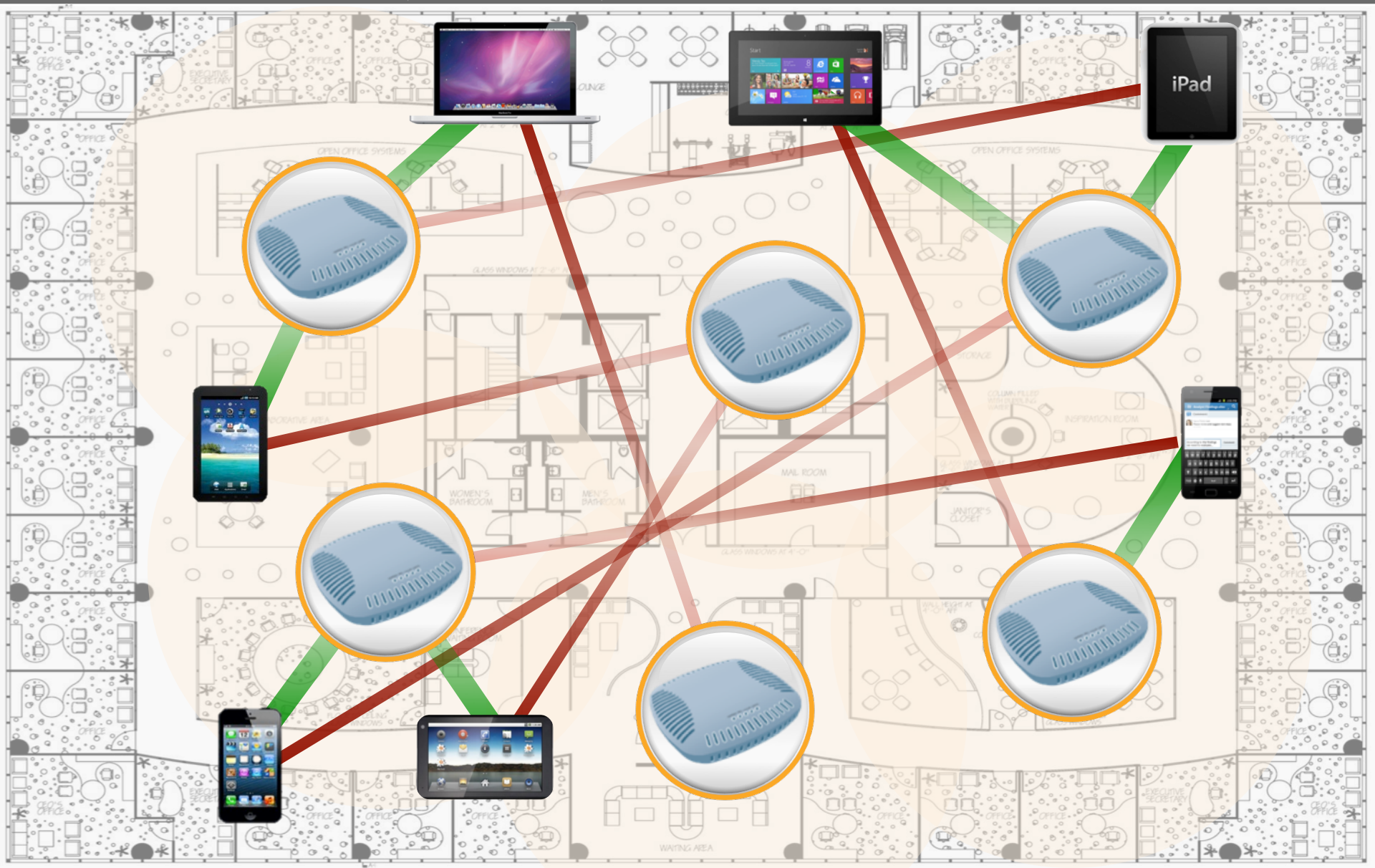
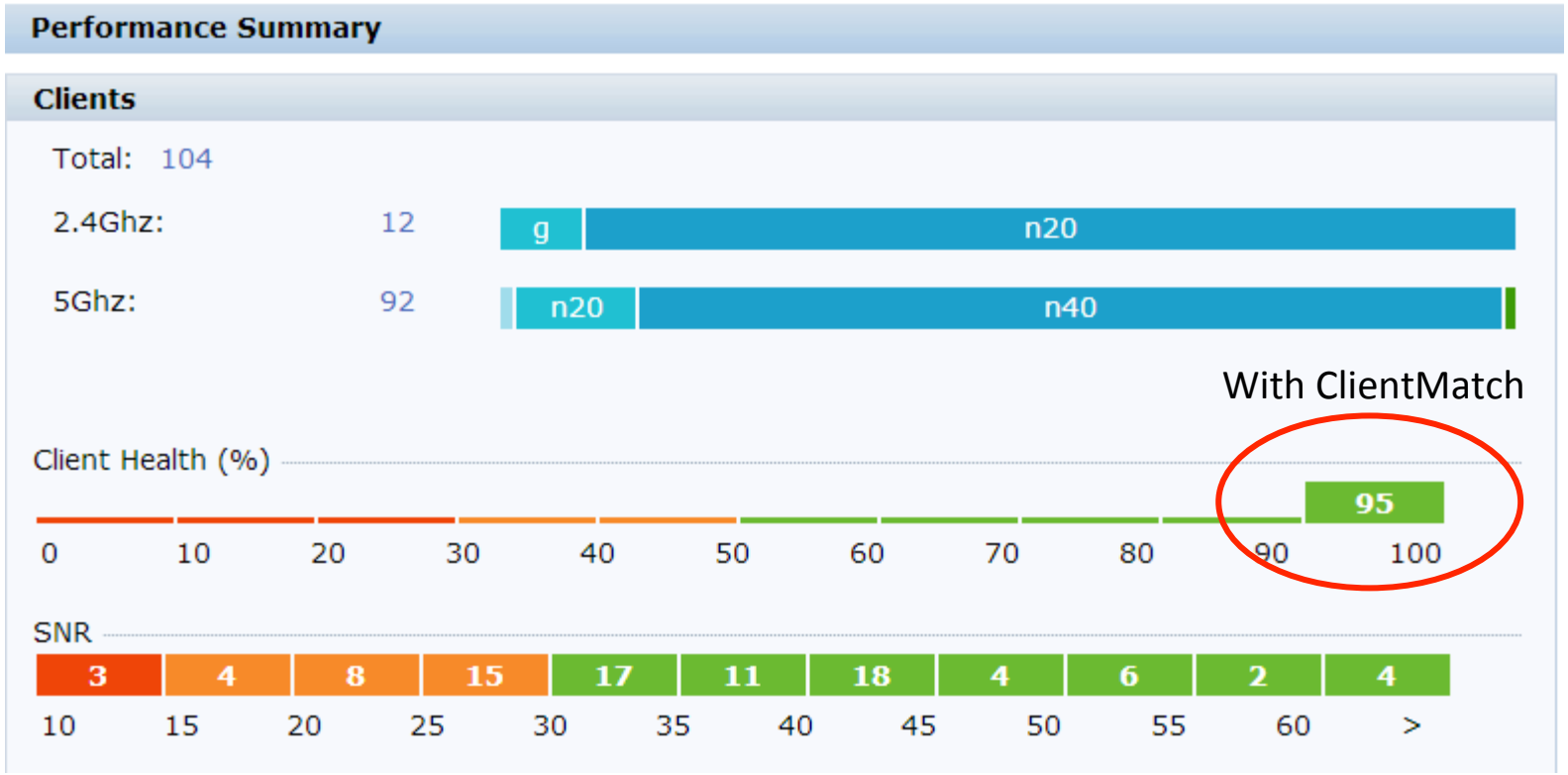


Client Health Visibility



Wireless LAN Visibility in AirWave 7.7

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Steer Events

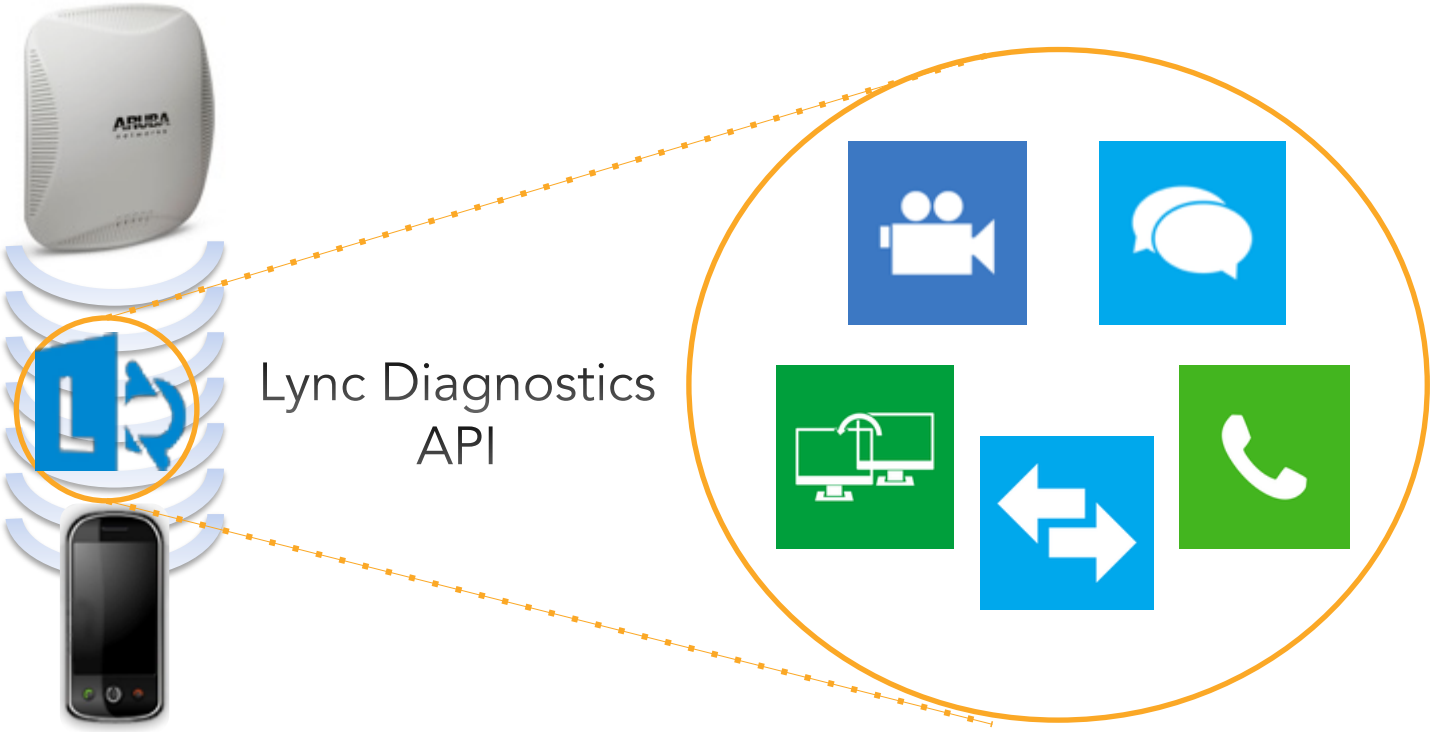
Show 10 entries Search:

Event Time	From AP	To AP	Client	Reason
5/21/13 3:52 PM	1341-AP13 (1341-ap13.arubanetworks.com)	1341-AP73	F0:D1:A9:C2:8F:8E	Sticky Client
5/21/13 3:51 PM	1341-AP15 (1341-ap15.arubanetworks.com)	1341-AP35 (1341-ap35.arubanetworks.com)	F0:D1:A9:C2:8F:8E	Sticky Client
5/21/13 3:46 PM	1344-1-AL37 (1344-1-al37.arubanetworks.com)	EBC-eth3	F0:D1:A9:C2:8F:8E	Sticky Client
5/21/13 3:19 PM	1344-1-AL37 (1344-1-al37.arubanetworks.com)	1344-1-AL4 (1344-1-al4.arubanetworks.com)	F0:D1:A9:C2:8F:8E	Sticky Client
5/21/13 3:14 PM	1341-AP73	1341-AP75	F0:D1:A9:C2:8F:8E	Sticky Client
5/21/13 2:42 PM	1344-1-AL5 (1344-1-al5.arubanetworks.com)	EBC-eth3	F0:D1:A9:C2:8F:8E	Sticky Client
5/21/13 2:27 PM	1341-AP09 (1341-ap09.arubanetworks.com)	1341-AP75	F0:D1:A9:C2:8F:8E	Sticky Client
5/21/13 1:45 PM	EBC-eth1	EBC-eth3	F0:D1:A9:C2:8F:8E	Sticky Client
5/21/13 12:49 PM	1341-AP05 (1341-ap05.arubanetworks.com)	1341-AP05 (1341-ap05.arubanetworks.com)	F0:D1:A9:C2:8F:8E	Band Steer
5/21/13 12:13 PM	EBC-eth2	EBC-eth2	F0:D1:A9:C2:8F:8E	Band Steer

REAL-TIME RF CORELATION

DEVICE TYPE LOCATION CONGESTION INTERFERENCE

Reliable Unified Communications
Lync QoS, Monitoring & Diagnostics



NEW

- ✓ QoS for all Lync flows – not just voice & video
- ✓ Call Admission Control (CAC for Lync flows)
- ✓ Real-time monitoring for voice and video call quality

Visibility to Lync QoS

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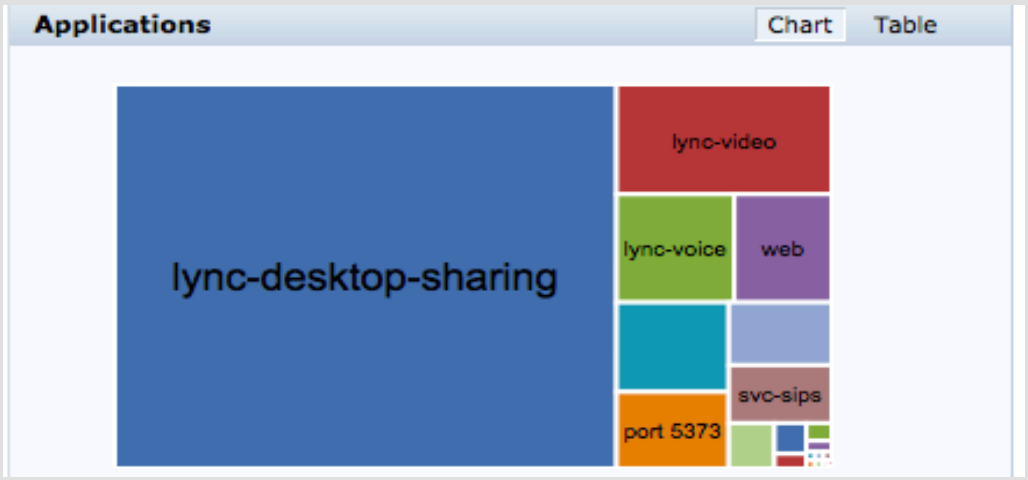
Lync App Details

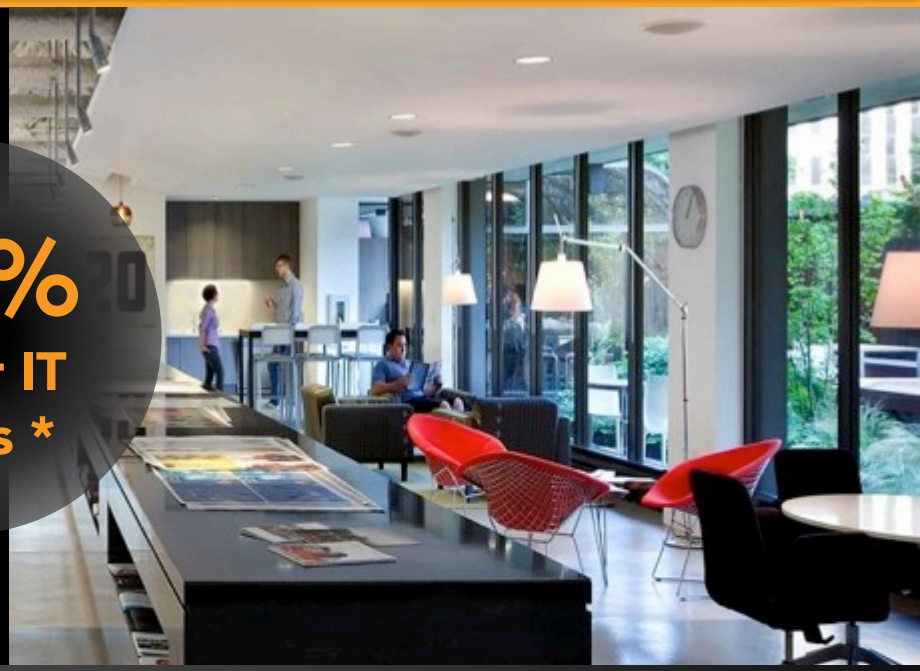


Lync Call Details

CDR Id	Client IP	Client Name	ALG	Dir	Called to	Status	Dur(sec)	Orig time	R-value	Reason	Codec	Band
NA	10.68.1.120	1000	lync	IC	2000	HOLD	851	Apr 12 08:32:38	93		x-msrta	GREEN
	10.68.1.120	1000	lync	IC	2000	HOLD	851	Apr 12 08:32:38	93		x-rtvc1	GREEN
NA	10.68.1.120	1000	lync	OG	2000	CONNECTED	832	Apr 12 08:32:57	NA		x-data	NA
NA	10.68.1.109	5000	lync	OG	1000	HOLD	851	Apr 12 08:32:38	93		x-msrta	GREEN
	10.68.1.109	5000	lync	OG	1000	HOLD	851	Apr 12 08:32:38	93		x-rtvc1	GREEN
NA	10.68.1.109	5000	lync	IC	1000	CONNECTED	832	Apr 12 08:32:57	NA		x-data	NA
	10.68.1.109	5000	lync	OG	2000	CONNECTED	746	Apr 12 08:34:23	NA		g722	NA
	10.68.1.109	5000	lync	OG	2000	CONNECTED	746	Apr 12 08:34:23	NA		NA	NA
						Average Value	820					

Now Possible: Next-Gen Workplace

76%
Lower IT Costs *



Soft phones replace desk phones

Shared wireless projectors & printers

Switches for AP backhaul only

* 3-year capital and operation cost for 1,000 person company

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