

Voice and Video over Wi-Fi

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26th February, 2013

Agenda



Multimedia over WLAN Challenges
Generic Design Recommendations for Multimedia
Aruba Enablers for Voice
Aruba Enablers for Multicast Video
Enterprise Application – Lync

Understanding Mobility Requirements



Mobile Devices



Multimedia



Collaboration



Virtual Desktops



- **Generic Challenges over WLAN**
 - RF Design
 - End-to-End QoS
 - Roaming & Battery Life
 - Scaling Challenges
- **Voice**
 - Bandwidth Management/call admission control
 - Mobility and roaming
- **Video**
 - Unreliability
 - Low speed TX
- **Voice + Video + Data -> ??**

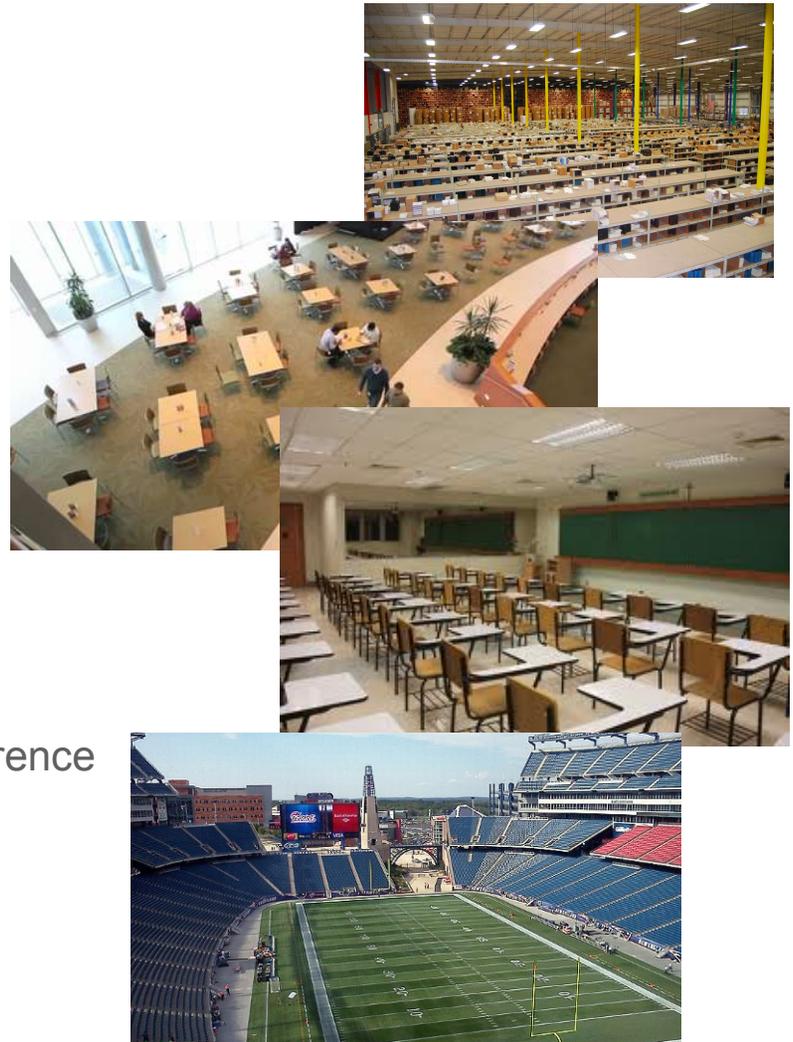


RF Design Consideration



NOT ALL deployments are the same

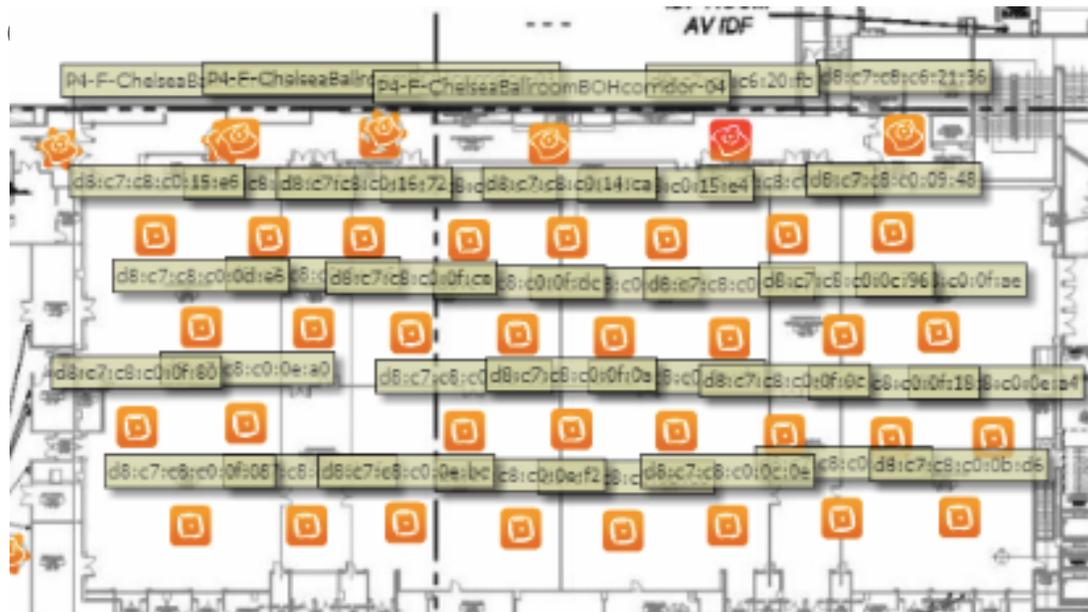
- **Normal vs. Tough**
 - Reflective, Absorptive etc.
 - Height of the ceiling
- **Wall Mount vs. Ceiling Mount**
 - Propagation characteristics vary with orientation
 - Antenna pattern plays a big role
- **Indoor vs. outdoor**
 - Difference in MIMO characteristics
- **Choosing AP's and antennas**
- **Clean vs. dirty RF**
 - Dirty RF can be Non 802.11 and Cellular Interference
- **5 GHz vs. 2.4 GHz**
 - Always use 5 GHz
- **11ac vs. 11n vs. 11abg deployments**
 - Design considerations



RF 101 - Plan for Capacity, "NOT" Coverage



- **Capacity Vs. Coverage**
 - 20 – 30% overlapping coverage
- **Design coverage cells keeping mobile device TX power in mind**
 - ~ -65 dBm



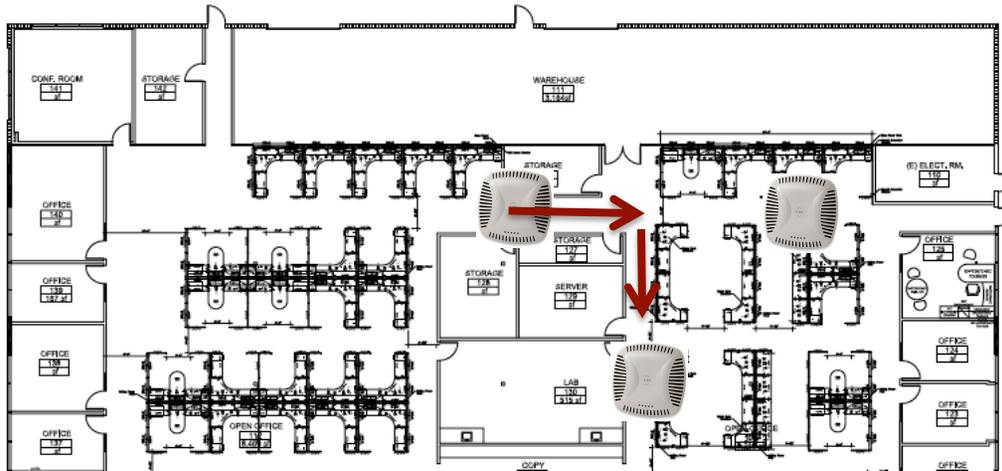
AP Placement – What & What not?



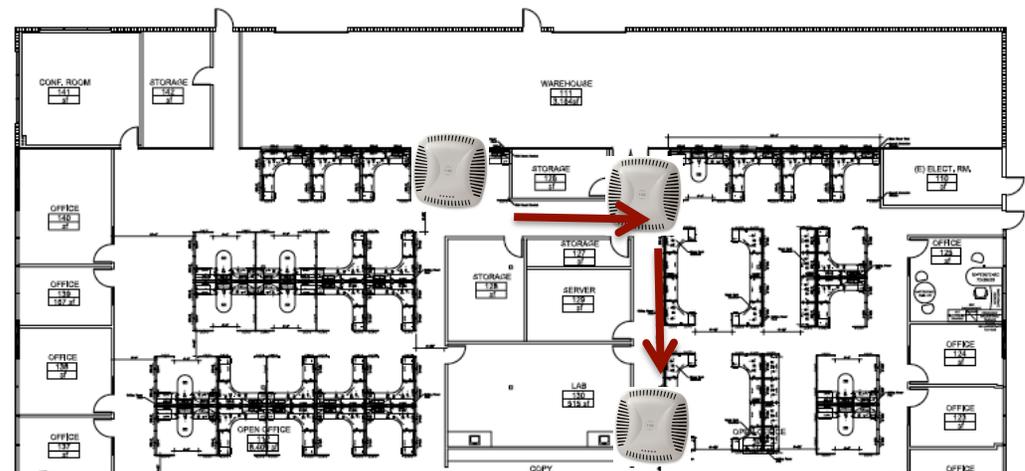
- **Define the coverage area for users**
 - Consider an all wireless, mobile office
- **Never make assumptions**
 - Devices are not tied to cubes anymore
- **Gather Expectations from end users**
 - You will be surprised



AP Placement impacts roam!



- Clients need to scan effectively
- AP placements play a role in successful device scans
- Hidden APs may not be visible to devices



How much bandwidth do I need on my network?



Personal Apps	Throughput
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
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

- **You might have to support more than one app 😊**
 - 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**

What wireless protocol do I need to support these apps?



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

- **Channel is the bottleneck, plan for it**
- **1SS vs. 2SS vs. 3SS**
- **11b vs. 11a/b/g vs. 11n vs. guess what “11ac”**
- **Client devices change maximum throughput, due to inherent capabilities, understand device profile**

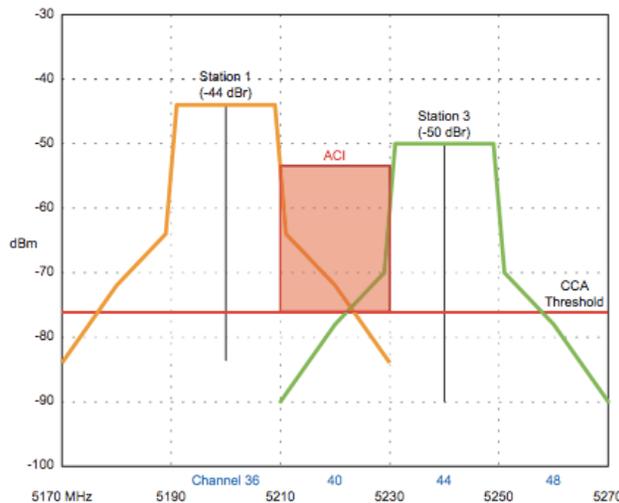
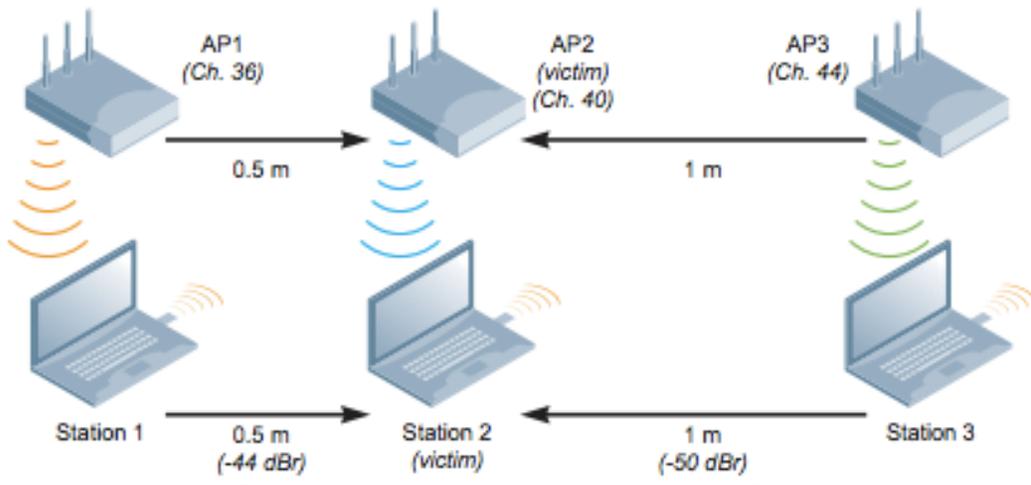
Influence of Data Rates on Bandwidth



802.11a Basic Rates	<input checked="" type="checkbox"/> 6	<input type="checkbox"/> 9	<input checked="" type="checkbox"/> 12	<input type="checkbox"/> 18	<input checked="" type="checkbox"/> 24	<input type="checkbox"/> 36	<input type="checkbox"/> 48	<input type="checkbox"/> 54				
802.11a Transmit Rates	<input checked="" type="checkbox"/> 6	<input checked="" type="checkbox"/> 9	<input checked="" type="checkbox"/> 12	<input checked="" type="checkbox"/> 18	<input checked="" type="checkbox"/> 24	<input checked="" type="checkbox"/> 36	<input checked="" type="checkbox"/> 48	<input checked="" type="checkbox"/> 54				
802.11g Basic Rates	<input checked="" type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 9	<input type="checkbox"/> 11	<input type="checkbox"/> 12	<input type="checkbox"/> 18	<input type="checkbox"/> 24	<input type="checkbox"/> 36	<input type="checkbox"/> 48	<input type="checkbox"/> 54
802.11g Transmit Rates	<input checked="" type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/> 5	<input checked="" type="checkbox"/> 6	<input checked="" type="checkbox"/> 9	<input checked="" type="checkbox"/> 11	<input checked="" type="checkbox"/> 12	<input checked="" type="checkbox"/> 18	<input checked="" type="checkbox"/> 24	<input checked="" type="checkbox"/> 36	<input checked="" type="checkbox"/> 48	<input checked="" type="checkbox"/> 54

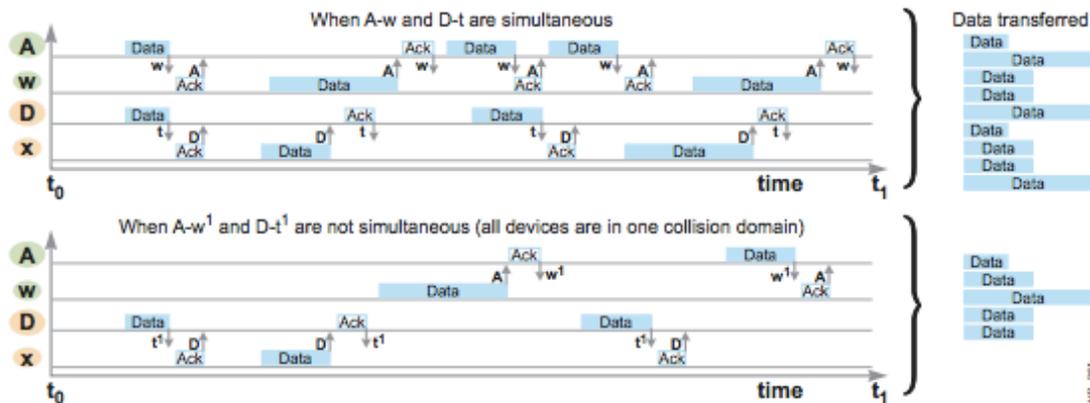
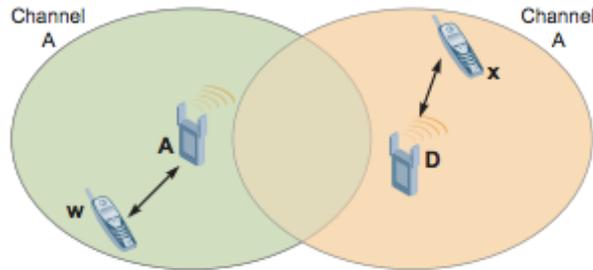
- **The denser the APs, the higher the required data rate**
- **If the AP deployment is not dense, the lower data rates may be necessary to provide Coverage**
 - For e.g. With the G711 codec and the overhead of the 802.11 protocol, the cell throughput does not increase at data rates above 24Mbps

Effect of ACI on a capacity based design



- Good RF Design
- Limit AP transmit power
- ARM adapts to dynamic changes

Effect on CCI on a capacity based design

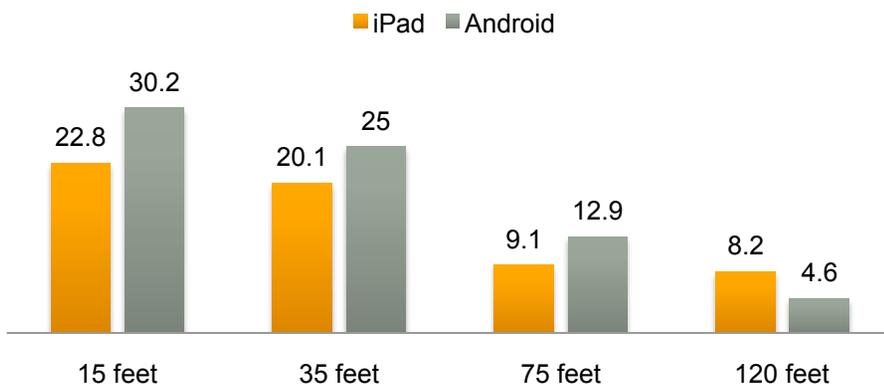


- **Good RF Design**
- **Limit AP transmit power**
- **Channel re-use management**
 - Intelligent rate adaptation

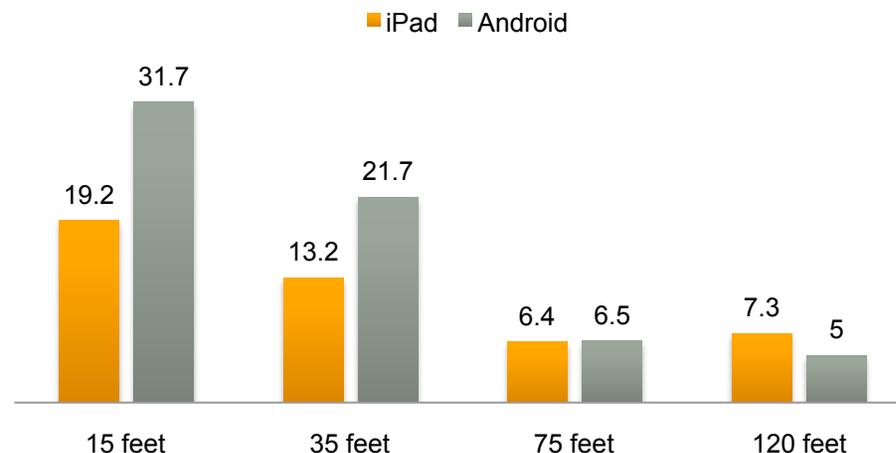
Find out how the devices behave



5 GHz TCP Download



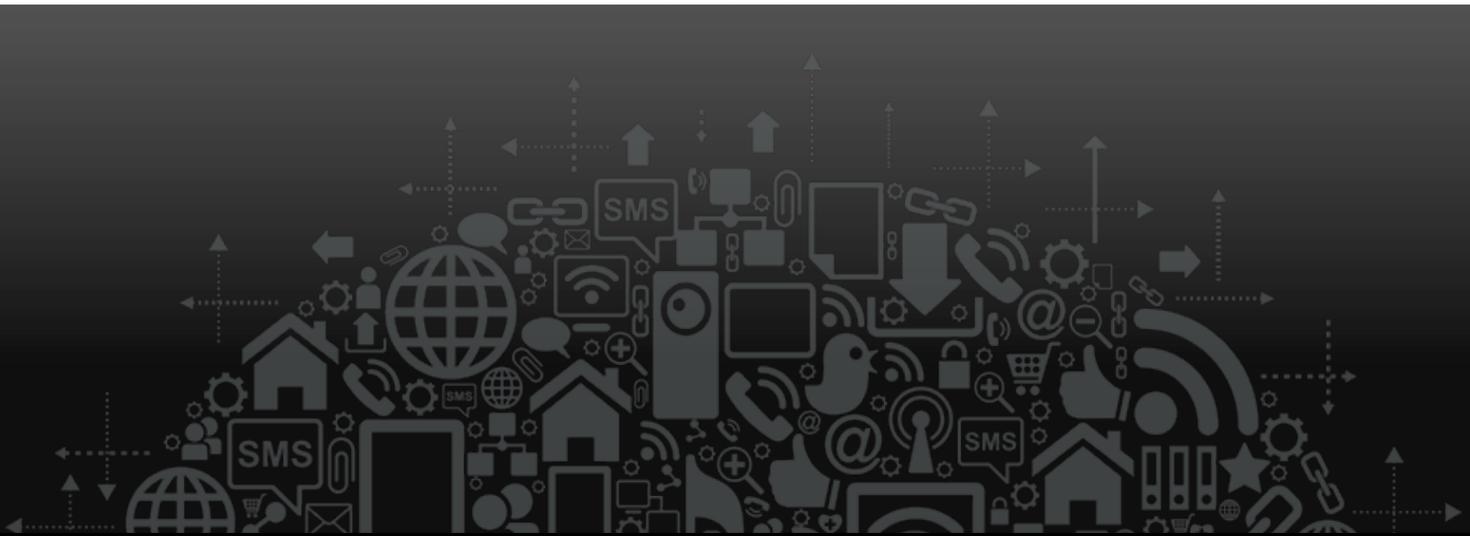
5 GHz TCP Upload



- **BYOD vs. Corporate devices**
- **Identify the devices that are used in the enterprise**
- **1SS vs. 2SS vs. 3SS**
- **TX/Rx Characteristics**
- **Test with the device that you expect to see**

$$\text{SNR} = \frac{P_{\text{signal}}}{P_{\text{noise}}},$$

- **Channel Utilization levels should be kept under 50% on an average.**
- **Noise levels should not exceed -90 - 95 dBm, which allows for a Signal to Noise Ratio (SNR) of 25 dB where a -65 dBm signal should be maintained.**

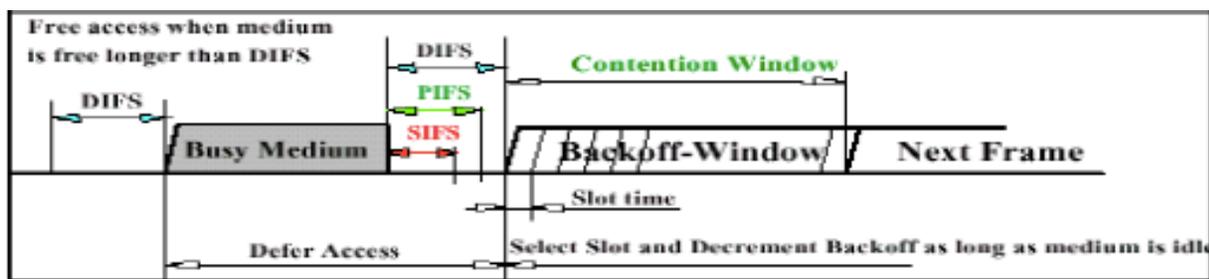


Aruba's QoS Enablers

802.11 Access Rules Basics



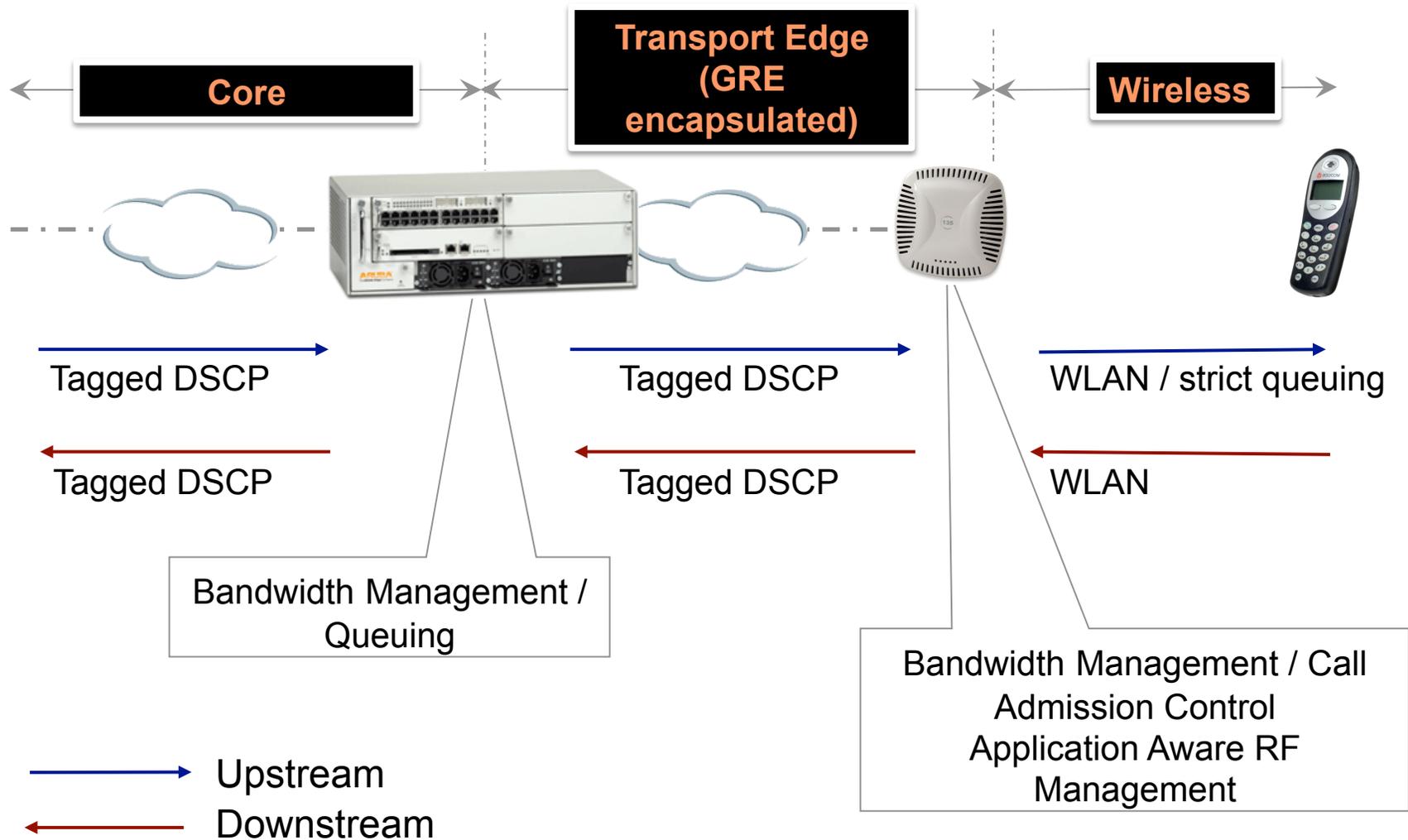
- Distributed Coordinated Function (DCF)
 - Transmission rules followed by all client



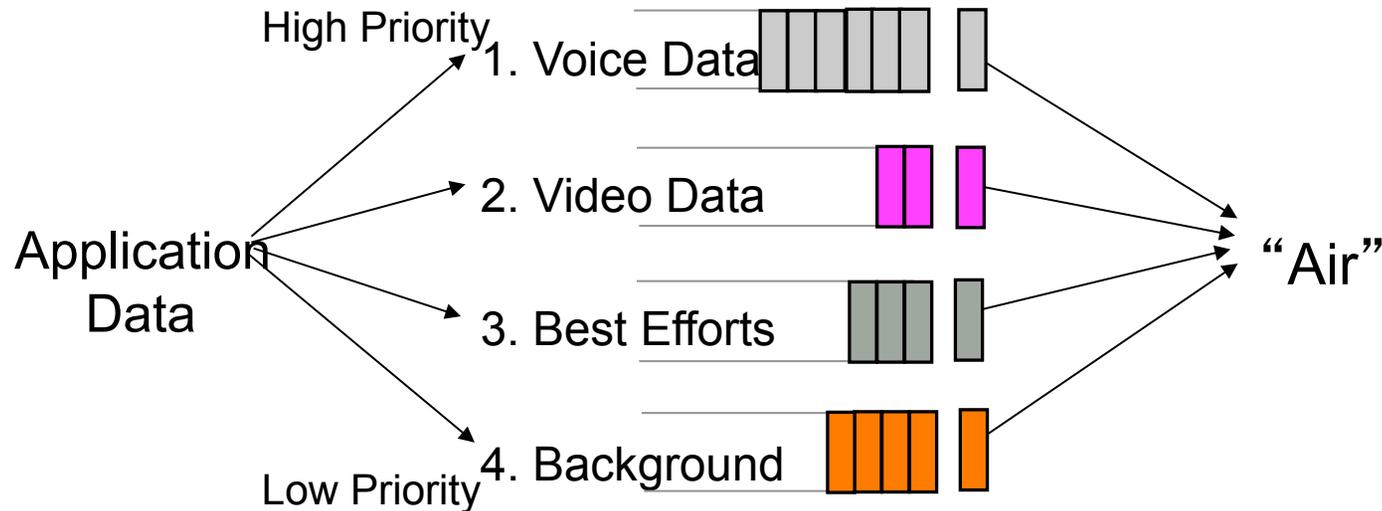
- Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA)
 - Responsible for mediating access to the air



End-to-End QoS



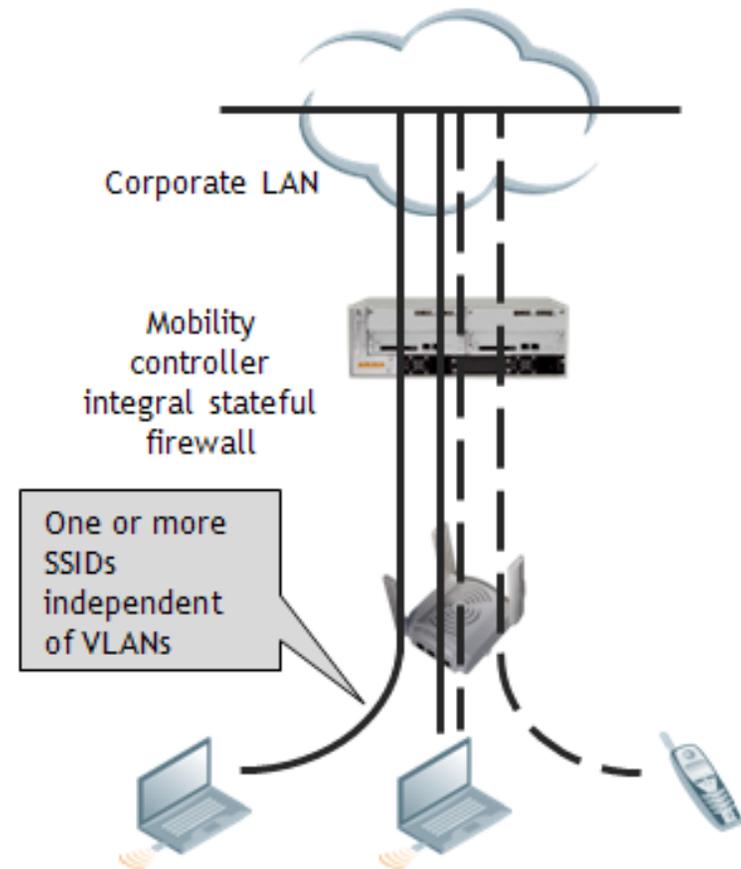
Access Categories with EDCA



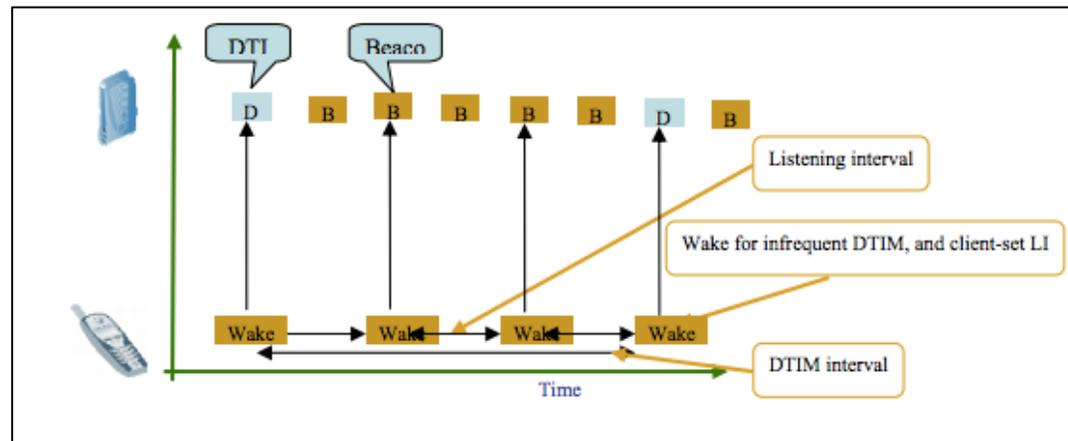
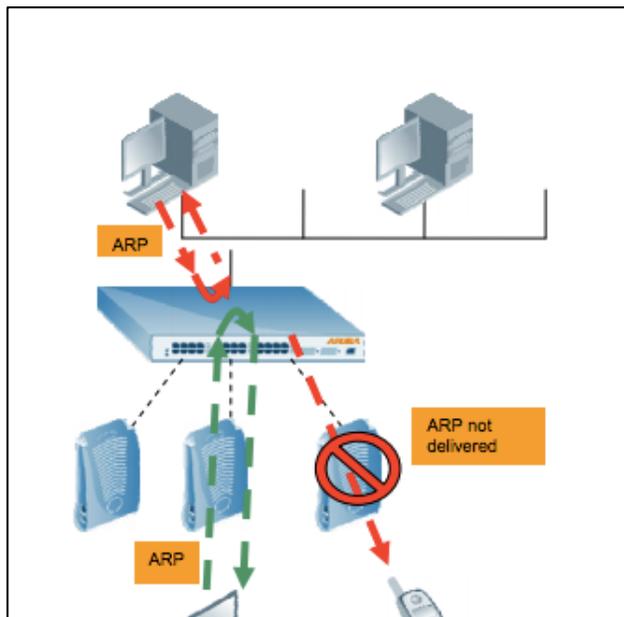
1. WMM Specifies how priority queues map to DSCP and dot1P tags
2. Different access categories, different contention parameters
3. 4 queues per radio; 8 queues total; supported on all APs
4. Voice and video gets priority over data
5. EDCA parameters decides a unique delay and random back off for each queue

ALGs: Voice Separation by Firewall

1. ALG support for most common voice protocols
2. ALGs include - SIP, SCCP, H323, NOE, Vocera etc.
3. Constantly adding newer ALGs

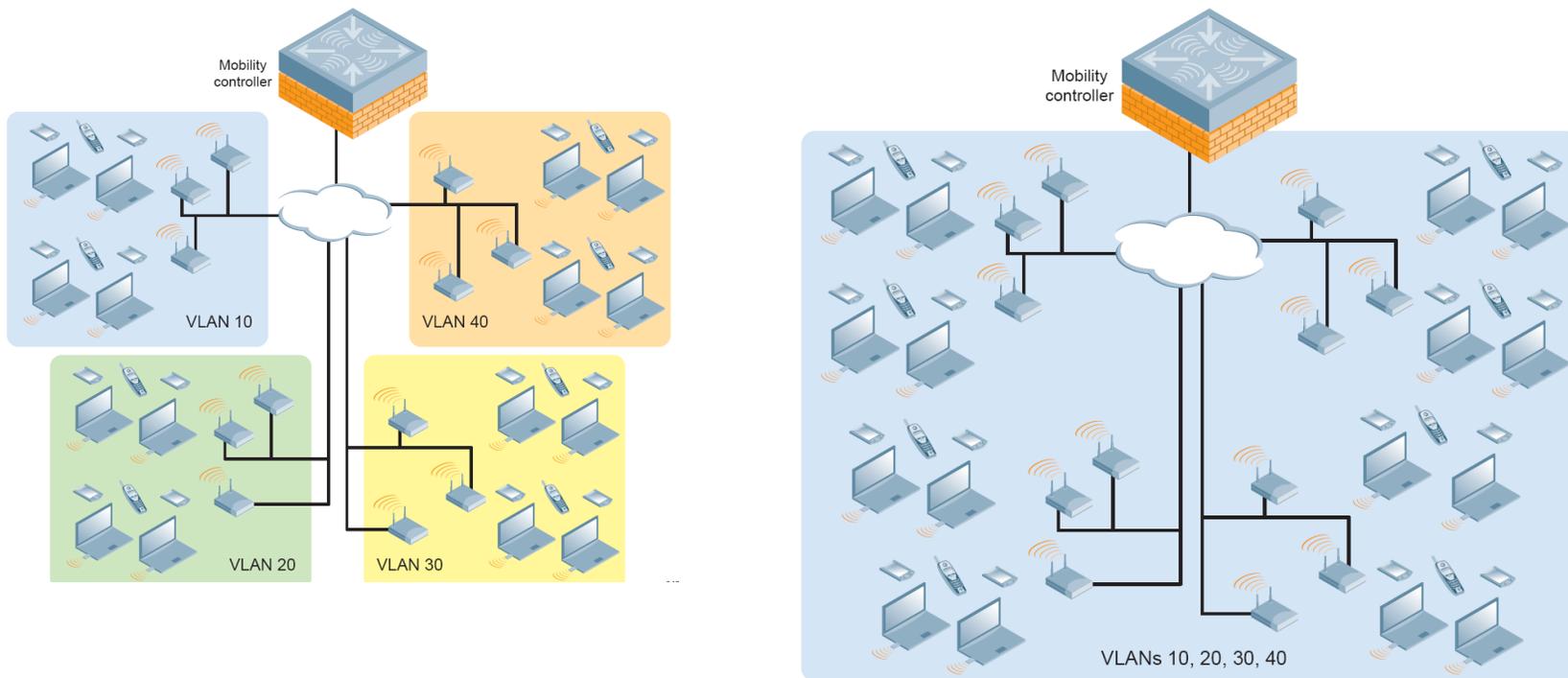


Client Battery Life Challenges



1. WMM UAPSD support – increased power saving, increased cell capacity
2. Distribute TIM so that clients need not receive every beacon frame (~100 ms)
3. With Proxy ARP controller responds to ARP requests enabling clients to sleep longer
4. Traffic filtering at the AP to avoid extraneous multicast/broadcast frames

Scaling Challenges: VLAN Pooling



1. Aruba VLAN Pooling allows a set of VLANs to be assigned to a designated group of users
2. Can use VLANs that already exist in the enterprise
3. Enables IP address and session persistence

Implementation Rules

- Per role-based bandwidth contract
- Per user-based bandwidth contract

Bandwidth Contract

Upstream: Not Enforced

Downstream: Not Enforced

- Per SSID-based bandwidth contract

Enable Shaping Policy	<input type="checkbox"/>	Voice Share	<input type="text" value="25"/> %
Video Share	<input type="text" value="25"/> %	Best-effort Share	<input type="text" value="25"/> %
Background Share	<input type="text" value="25"/> %		



Aruba Enablers for Voice

Voice Aware Firewall



Monitoring **Configuration** Diagnostics Maintenance Plan Events Reports

Wizards
AP Wizard
Controller Wizard
WLAN Wizard
License Wizard

Network
Controller
VLANs
Ports
Cellular Profile
IP

Security
Authentication
Access Control

Wireless
AP Configuration
AP Installation

Management
General
Administration
Certificates
SNMP
Logging
Clock
Guest Provisioning
Captive Portal
SMTP

Security > User Roles > Edit Role(voice)

User Roles System Roles Policies Time Ranges

Firewall Policies

Name	Rule Count
sip-acl	2
noe-acl	1
sip-acl	2
vocera-acl	1
skinny-acl	1
h323-acl	2
dhcp-acl	1
tftp-acl	1
dns-acl	1
icmp-acl	1
denyall	1

Add

What is needed

Rules

Source	Destination	Service	Action	Log	Mirror	Queue	Time Range	Pause ARM Scanning	BlackList	T
any	any	any	deny	Yes		low		No	Yes	

Add

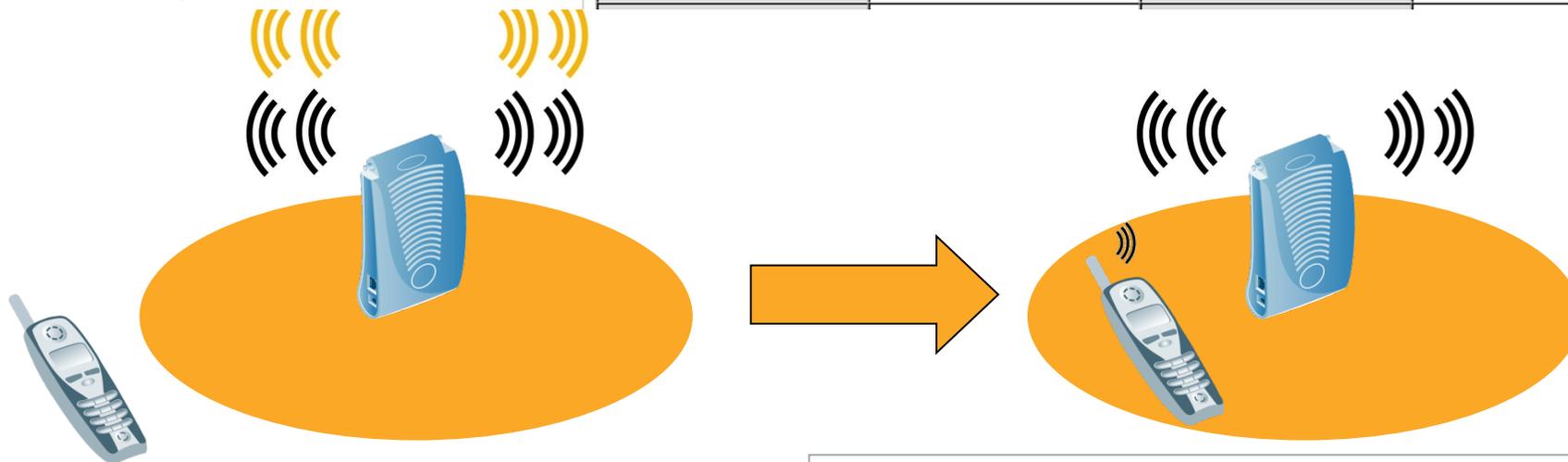
• 13-28

Voice Aware RF Scanning



- [-] RF Management
 - [-] 802.11a radio profile default
 - [-] Adaptive Radio Management (ARM) Profile default
 - [-] High-throughput Radio Profile default-a
 - [-] 802.11g radio profile default
 - [-] Adaptive Radio Management (ARM) Profile default
 - [-] High-throughput Radio Profile default-g
 - [-] RF Optimization profile default
 - [-] RF Event Thresholds profile default

Min Tx EIRP	9	Multi Band Scan	<input checked="" type="checkbox"/>
Rogue AP Aware	<input type="checkbox"/>	Scan Interval	10 sec
Active Scan	<input type="checkbox"/>	Scanning	<input checked="" type="checkbox"/>
Scan Time	110 msec	VoIP Aware Scan	<input checked="" type="checkbox"/>
Power Save Aware Scan	<input checked="" type="checkbox"/>	Ideal Coverage Index	10
Acceptable Coverage Index	4	Free Channel Index	25
Backoff Time	240 sec	Error Rate Threshold	50 %
Error Rate Wait Time	30 sec	Noise Threshold	75 -dBm



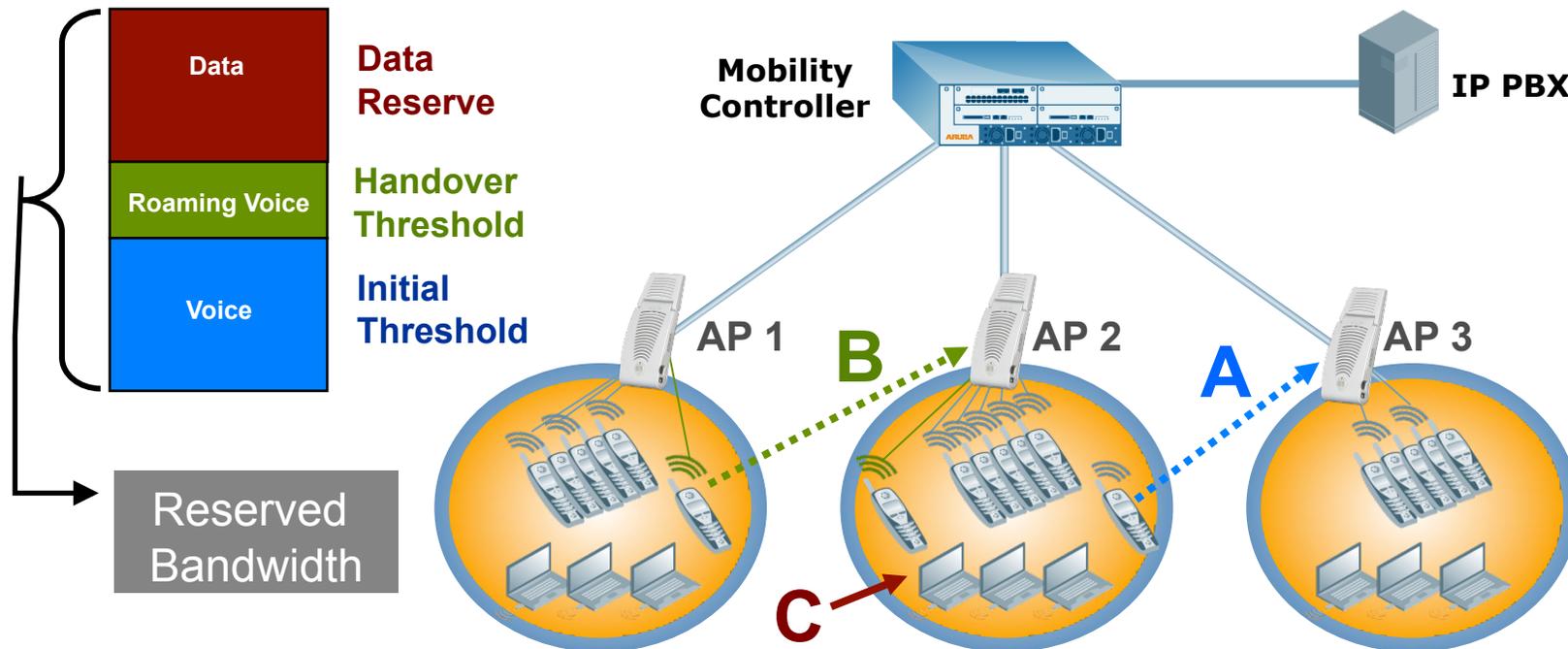
No active voice calls

- scanning on other channels
- No noticeable effects on data clients

Has an active voice call

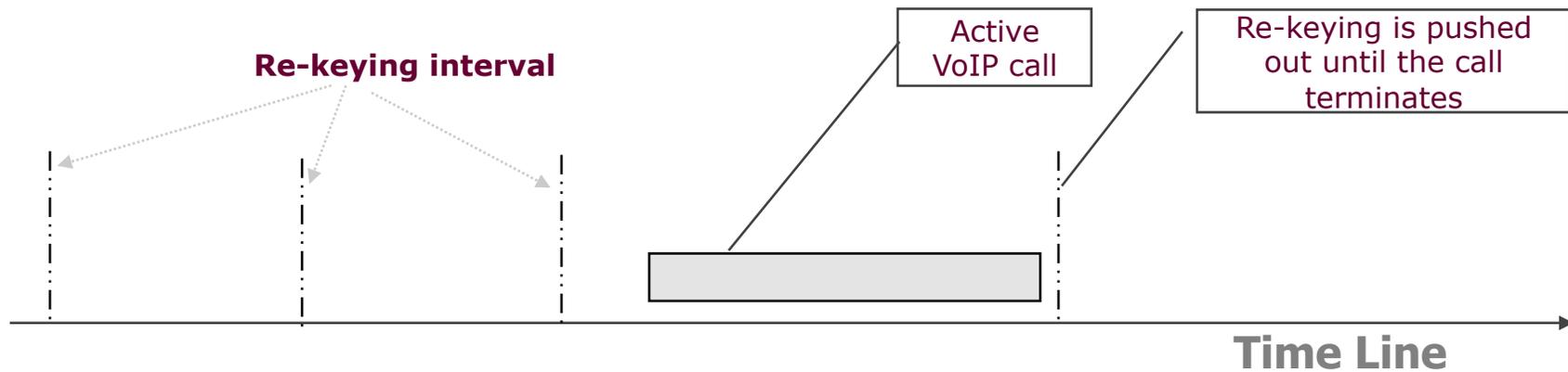
- Suspends RF scanning on other channels
- No noticeable effects on voice calls
- No noticeable effects on data calls

Voice Aware Load Balancing (Advanced CAC)

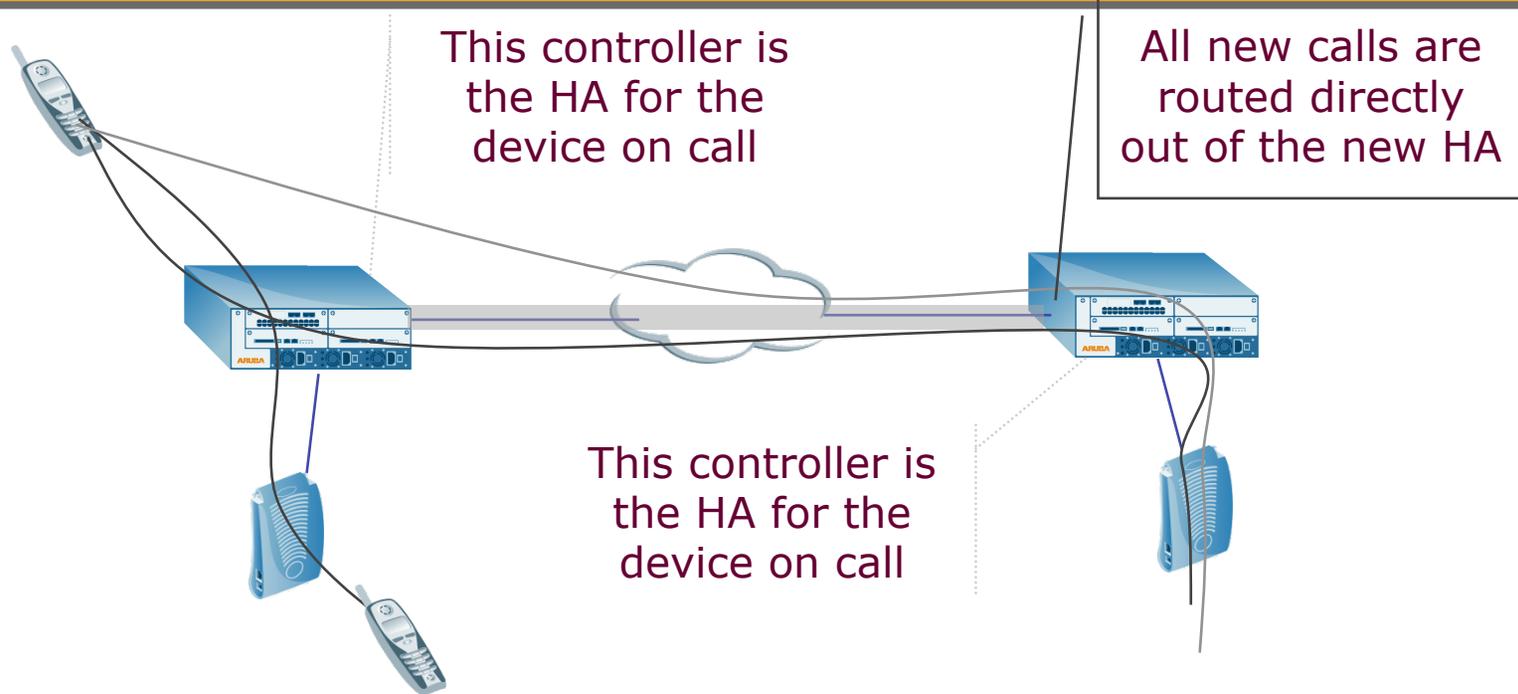


- A. Mobility Controller monitors the number of active (off-hook) voice calls on each AP. Access Point (AP) number 2 reaches the Initial Threshold, so additional VoWLAN devices that initiate calls are load-balanced to adjacent AP until the number of active calls on AP 2 drops below the Initial Threshold value
- B. A VoWLAN device with an active call moves from AP 1 to AP 2. Because bandwidth is reserved for roaming voice (Handover Threshold), the call is seamlessly handed off
- C. A reserve for data clients ensures network availability and performance, even with high VoWLAN activity

Voice Aware 802.1x / 802.11i



Voice Aware Mobility



1/ As the device on call moves, the HA remains the same to ensure security and session awareness

2/ When the call disconnects, the new controller takes over as HA. The client's IP address will also change if the move is a L3 move

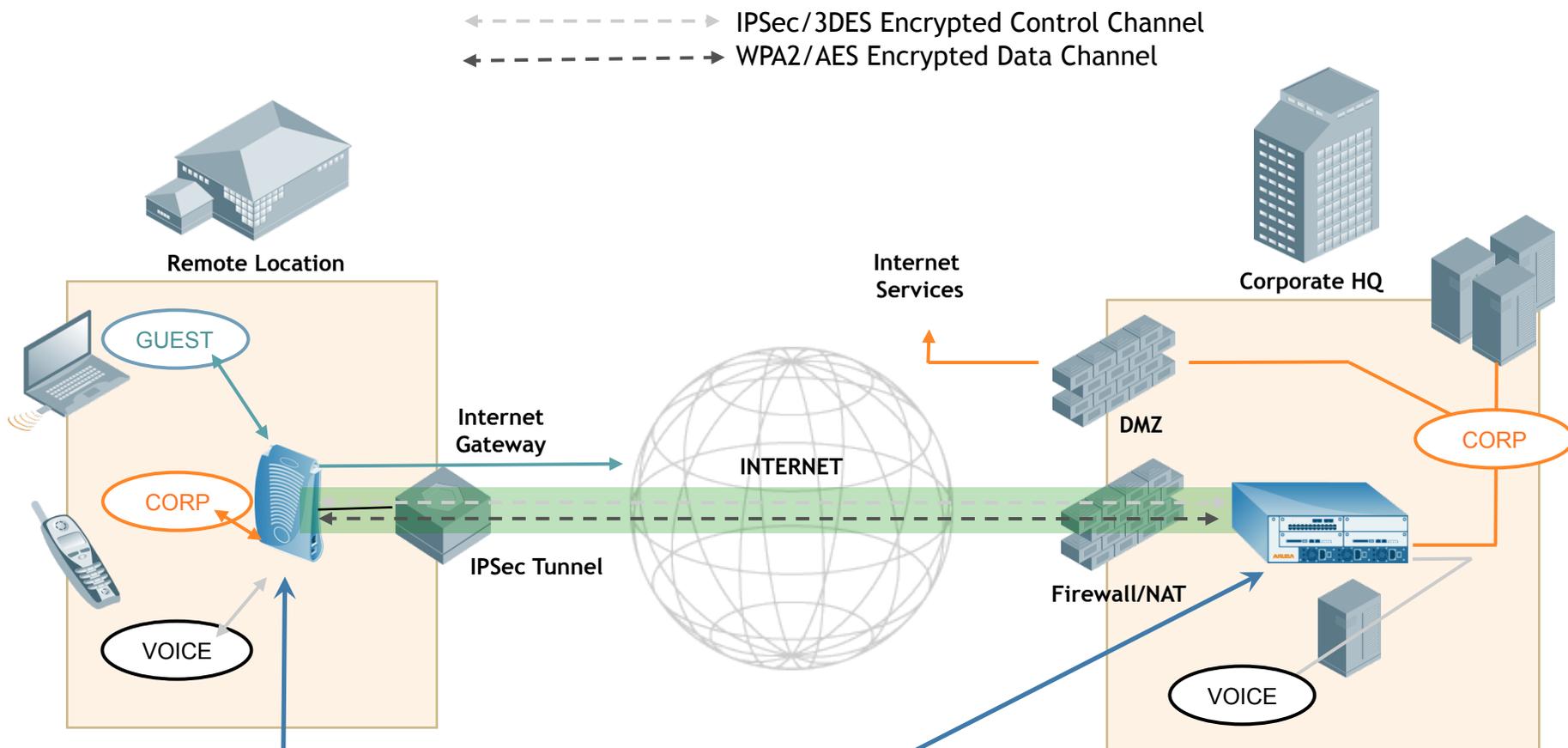
WPA fast handover

- Allows certain WPA clients to use a preauthorized PMK,
- Significantly reducing handover interruption.
- Client devices may/may not support this feature.
- This feature is disabled by default.

OKC (opportunistic key caching) supports WPA2 clients

- Allows WPA clients to use a preauthorized PMK
- Allows clients faster roaming without a full 802.1x authentication
- Client devices should support this feature
- Enabled by default

Extending Voice to Remote Locations



Aruba AP connected to any Ethernet jack with Internet connection

All security policies centrally defined and enforced at the mobility controller

Troubleshooting procedure for Voice



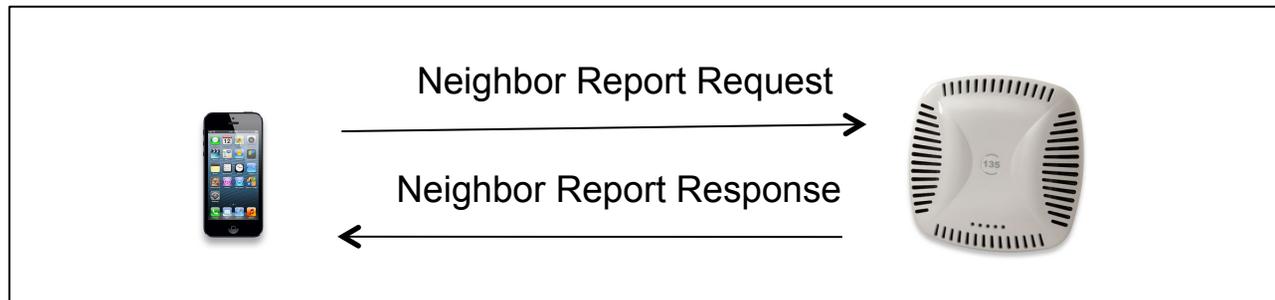
- Audio quality related Issues
 - Check RF health: RSSI for the client, PHY rates being used for transmission, Retry percentage
- Packet-capture
- Location of client
 - Checking on the floorplan for the location of the client and which AP it is associated to.
 - In most cases, voice issues are because of sticky clients.
- Adequate coverage
 - Check the floorplan and ensure adequate coverage in the area where there are user complaints.
- Firewall for Voice
 - Check if the voice protocol is being identified and tagged appropriately by the firewall.
- Check ARM and SSID settings
 - make sure they are right for voice.
- Roaming
 - If the issues are related to roaming, that will show up with auth-tracebuf and show ap debug management-frames debug commands.
- Dropped Calls,
 - looking for CAC related reasons is useful.

Mobility & Roaming: Enterprise Voice Certification (Co-operative Client Control)

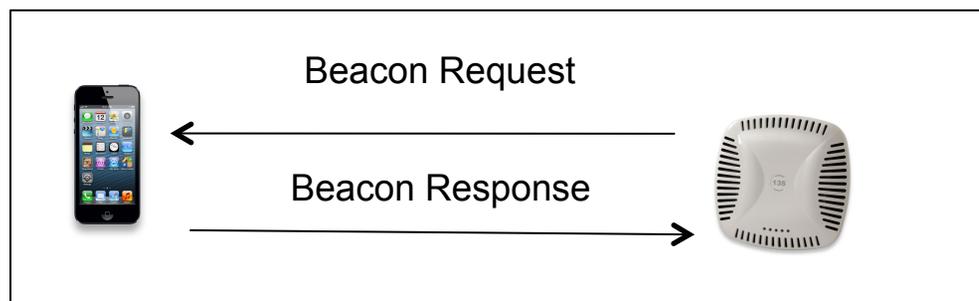


Real time data collection with 802.11k

- Neighbor Report (Client Side)



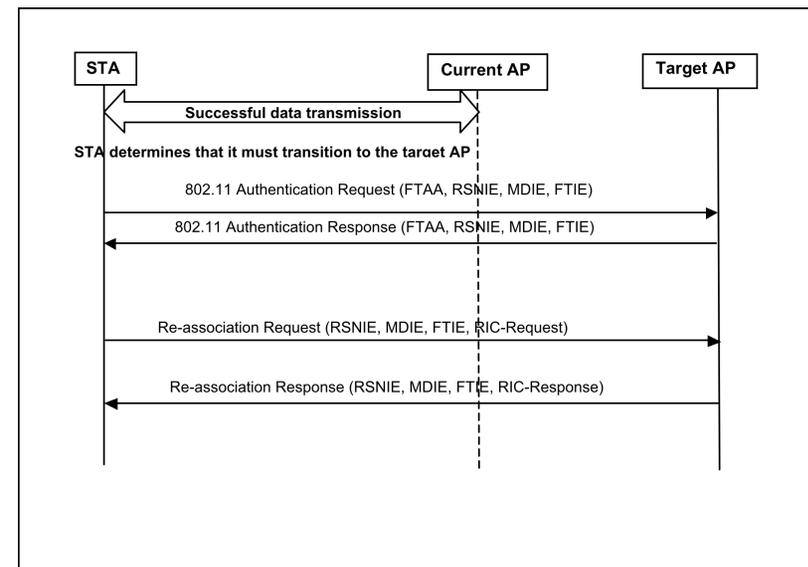
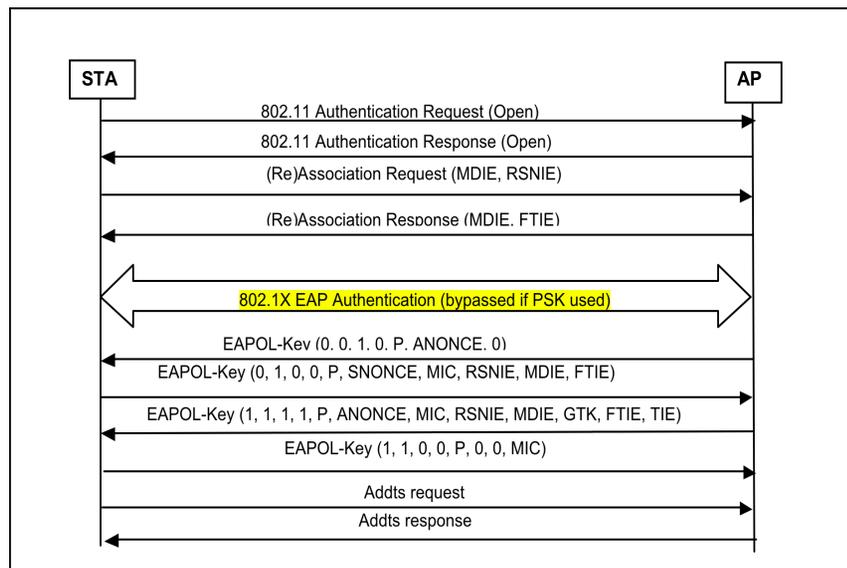
- Beacon Report (AP side)



Mobility & Roaming: Enterprise Voice Certification

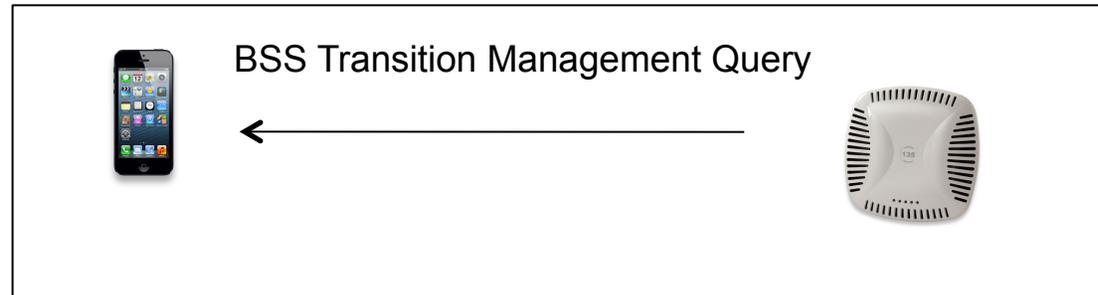


The handover delay from one AP to the other is reduced significantly; security and QoS states synchronized before roam



1. Minimize delay in a clients transition from one BSS to another
2. Establishment of Security and QoS states at the target AP prior to/during association
3. Reduces handover delays to up to 50 ms, enhances voice performance
4. Requires support on the WLAN and the client side

Mobility & Roaming: Enterprise Voice Certification



With 802.11v, AP encourages clients to roam to the best AP utilizing information from 11k, 11r

- Encouraging the client to perform a directed BSS transition
- Uses the system level view obtained by the beacon and neighbor reports from 11k
- Helps in admission control
- Requires WLAN and client support



Aruba Enablers for Video

Benifits



- Efficiency – reduced network traffic, reduced server and CPU load
- Performance – eliminates traffic redundancy
- Application – enabled distributed applications for different verticals

Challenges



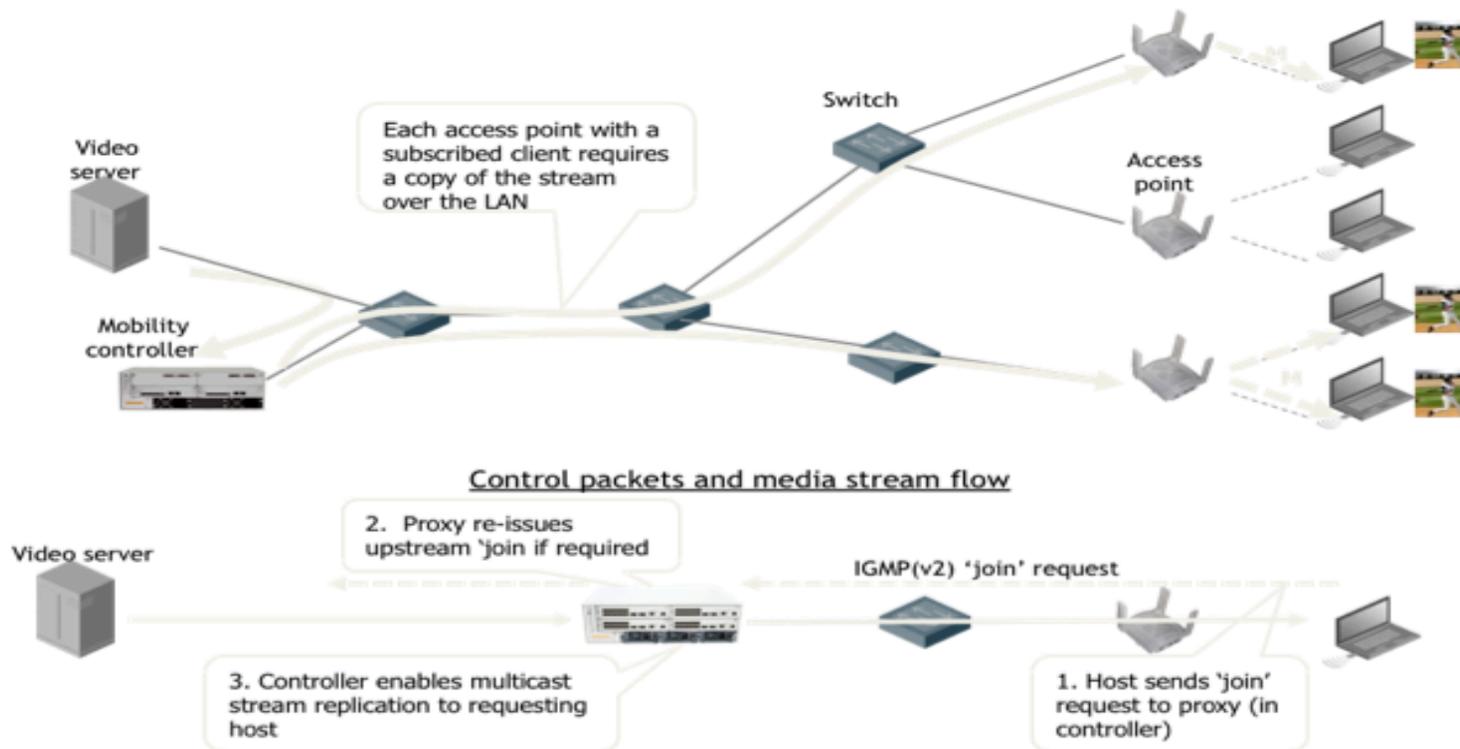
- Best effort Delivery, no QoS guarantees – poor quality, drops are to be expected
- No error correction – fire and forget
- Sent out at low control rates; 1 MB for b/g, 6 Mb for a

Impact

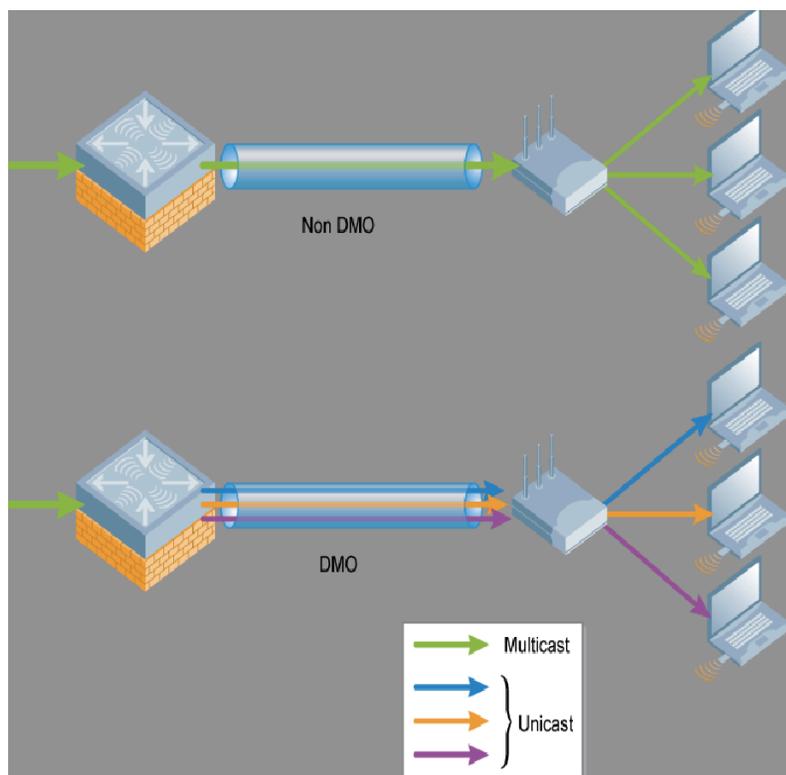
- Does not utilize 802.11 N High Throughput data rates***
- Heavy utilization of channel due to high rate of very slow packets***
- Video delivery is not reliable causing poor Quality of Experience***

Wired Optimization with IGMP

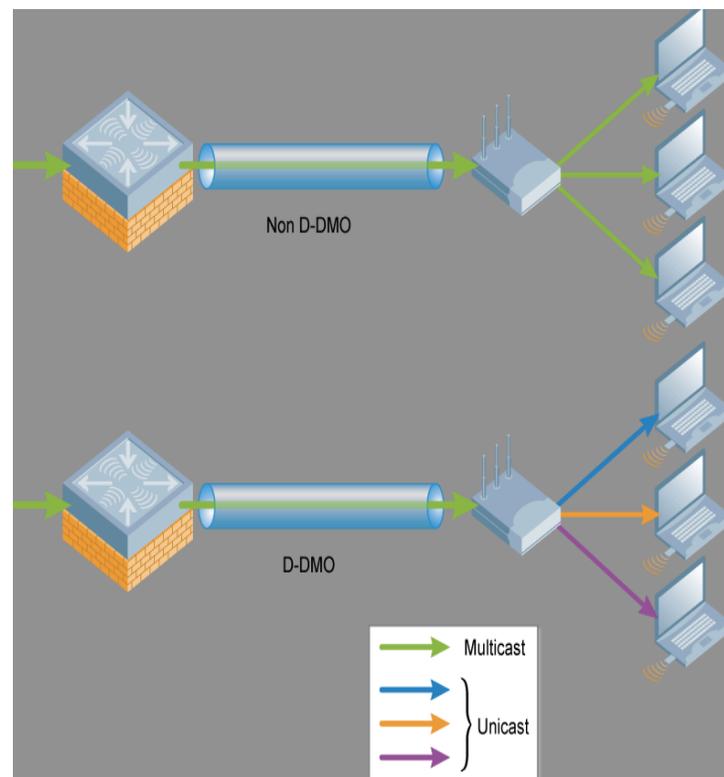
IGMP Proxy and Multicast Streams in a Centralized-Traffic WLAN



Multicast to Unicast Conversion

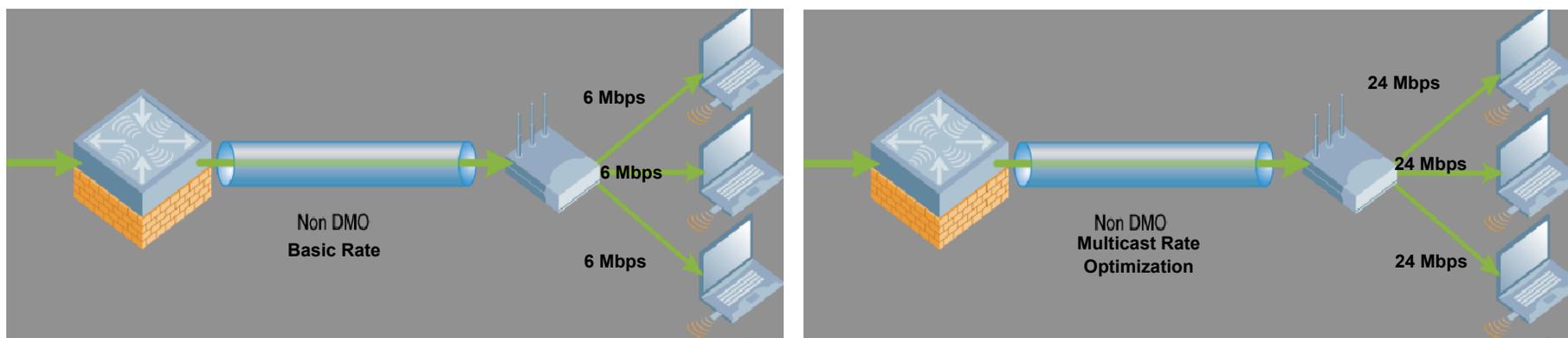


**Dynamic Multicast Optimization
(Conversion at the WLAN Controller)**



**Distributed Dynamic Multicast Optimization
(Conversion at the AP)**

Multicast Rate Optimization



Without any special tuning, multicast packet will be sent at either 'basic rate' or 'support rate' whichever is lower. For example, if I have the following:

802.11a Basic Rates	18	24						
802.11a Transmit Rates	6	9	12	18	24	36	48	54

Multicast/Broadcast packet will be sent at 6 Mbps since it's the lowest of all rates. This applies to 'N' as well.

DMO will not scale in an environment like this..



Troubleshooting procedure for Video

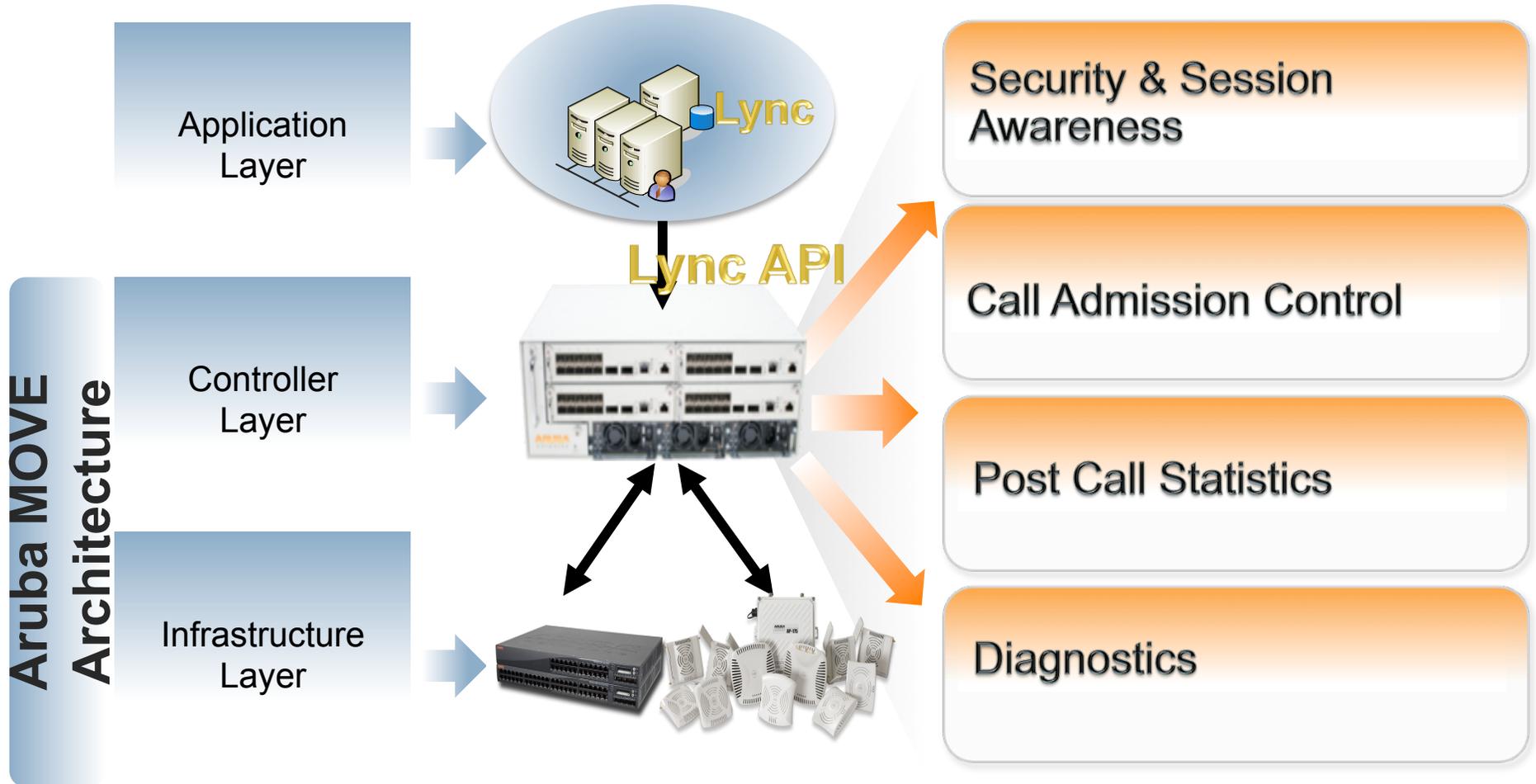


- Video quality related Issues
 - Check RF health: RSSI for the client, PHY rates being used for transmission, Retry percentage
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 - Check the floorplan and ensure adequate coverage in the area where there are user complaints.
- IGMP data
- Firewall for Video
 - Check if the voice protocol is being identified and tagged appropriately by the firewall.
- Video (CBR or bursty)
- Check ARM and SSID settings
 - make sure they are right for voice.



Enabling Enterprise Apps: Lync

Improve Your Lync over Wi-Fi Experience



Improve Lync Integrity & Security



Identify and prioritize Lync voice, video, file sharing and desktop sharing streams



Open Lync traffic ports dynamically and securely



Securely on-board BYOD devices



Securely enable Lync mobile clients

Call Admission Control for Lync

Aruba implements bandwidth-based and call-count based CAC

- **Benefits**
 - Prevents oversubscription
 - Higher data throughput
 - Fewer dropped calls
 - Avert voice traffic congestion



Lync Monitoring on Controller Dashboard



ARUBA networks | Ethersphere-lms3 Help Logout admin

Dashboard Configuration Diagnostics Maintenance Plan 🔥 5 Clients | 6 APs | 12 Alerts

Performance

Usage

Security

Potential Issues

WLANs

Access Points

> Clients

Firewall

[E-mail Support](#)

All Clients > 192.168.1.3

Summary	Charts	Firewall	Mobility Trail	Air Group	Lync
<p>General ^</p> <p>Authentication v</p> <p>Age:</p> <p>Forwarding mode:</p> <p>Association time:</p> <p>Authenticated:</p> <p>Authentication state:</p> <p>Authentication method:</p> <p>Authentication protocol:</p> <p>Authentication server:</p> <p>Bandwidth limits:</p> <p>Role derivation:</p> <p>Roaming status:</p> <p>Frames To/From Client v</p> <p>Air Quality v</p> <p>Tx/Rx Stats v</p>					
	Classification	Timestamp	Rvalue	VMM	DSCP
	Voice	10:15:02 AM	20	2	300
	Video	9:15:02 PM	0		30
	Desk Share	1:27:32 AM	92	3	1400
	File Transfer	11:34:09 PM	37	1	750

Last updated: 01:03:45 am

NETWORK

- Network Summary
- All WLAN Controllers
- All Access Points
- All Mesh Nodes
- All Air Monitors
- All Wired Access Points
- All Routers
- All WLAN Clients

CONTROLLER

- Controller Summary
- Access Points
- Mesh Nodes
- Wired Access Points
- Air Monitors
- IP Routing
- IP Mobility
- IP Multicast
- Clients
- Blacklist Clients
- Firewall Hits
- External Services Interface
- Tunneled Node Ports
- Ports
- Inventory
- Local Events

WLAN

- akvoice1

SPECTRUM

- Spectrum Analysis

VOICE

- Voice Status
- Call Density Report
- Call Detail Report

Voice > Status

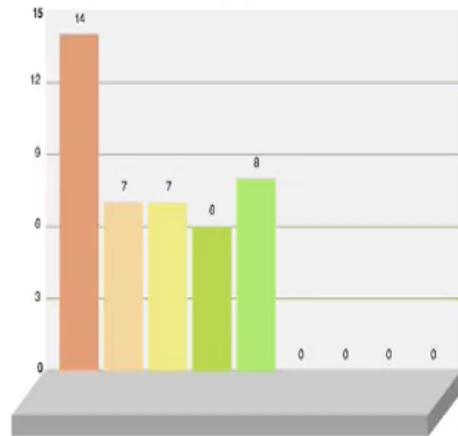
Refresh

Refresh every , or @ 23:10:08 2/12/2013

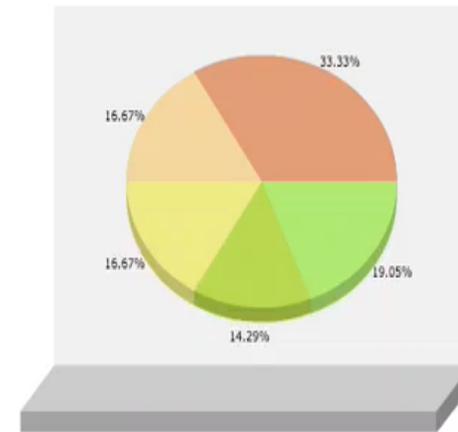
Protocol

Statistics - System Wide Voice Call Counters

Bar Graph



Pie Chart



■ Total: 14
 ■ Call Originated: 7
 ■ Call Terminated: 7
 ■ Active: 6
 ■ Success: 8
 ■ Failed: 0
 ■ Blocked: 0
 ■ Aborted: 0

■ Total: 14
 ■ Call Originated: 7
 ■ Call Terminated: 7
 ■ Active: 6
 ■ Success: 8
 ■ Failed: 0
 ■ Blocked: 0
 ■ Aborted: 0

Connected Calls		Graph <input type="radio"/>
Protocol	Count	
SIP	0	
SCCP	0	
SVP	0	
Vocera	0	
NOE	0	
H323	0	
Lync	2	

APs		Graph <input type="radio"/>
CAC State	Count	
Call Handover Reservation Threshold Reached	0	
Peak Capacity Reached	0	
OK	1	



Thank You



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