Session Abstract

✧ This session focuses on the current wireless trends & reasons for customers to move towards newer technology.
✧ Supremacy of Cisco 802.11ac technology over other vendors.
✧ RF and its properties for current day deployments.
✧ Some examples that are good and some examples gone bad.
✧ Cisco Cloud based Predictive RF Planning tool and its features
✧ Demo of the tool
SESSION AGENDA - Objectives

- Current Wireless Trends
  Reasons for Customers to move to Newer Technology
  Supremacy of Cisco 802.11ac technology
- RF Matters
- Examples of Good and Bad Installation
- Cisco Cloud Based Predictive RF Planning tool
  Demo of the tool
“Wireless Trends”
Cisco Enterprise Networks Vision

Connecting People

Connecting Clouds

Connecting Things

Cisco ONE Enterprise Architecture

Simple
Secure
Business Value
Unified Access Vision & Strategy

- Deployment Modes
  - Wired
    - Traditional Access
    - Instant Access
  - Wireless
    - Centralized
    - Flex
    - Autonomous
  - Wired-wireless
    - Converged Access
  - Cloud Managed

- One pane of glass
  - Wired
  - Wireless

Simple
Secure
Reduced TCO

One Place to Define Policy
Multiple Policy enforcement points
Wireless Standards – Past, Present, and Future

- **Early 2000**
  - 802.11a, 802.11b
  - 11 Mbps

- **2002**
  - 802.11g
  - 54 Mbps

- **2004**
  - 802.11n
  - 450 Mbps

- **2006**
  - 802.11ac-1
  - 1 Gbps

- **2008**
  - 802.11ac-2
  - 3.5 Gbps

- **2010**
  - 802.11ac-3
  - 10 Gbps

- **2012**
  - 802.11ac-4
  - 20 Gbps

- **2014**
  - 802.11ac-5
  - 30 Gbps

- **2016**
  - 802.11ac-6
  - 45 Gbps

**Clients / Bandwidth**

- **Nice to Have**
- **Pervasive**
- **Media Rich Applications**
- **Mission Critical**

**Media Rich Applications**

- 2008
- 2012
- 2014

**Future**

- 2016
Why Gigabit Wi-Fi

802.11ac

- 3X the Performance of 802.11n
- 2X End User Device Battery Life
- Further Range Compared to 802.11n
Why Gigabit Wi-Fi...Now!

802.11ac

Wireless: Primary Means of Access

Wireless (53%) Bypass Wired Traffic (40%) by 2017¹

50% New Devices will be 802.11ac by End of 2014, 75% by 2015²

50% of Traffic will be Voice & Video by 2015³

Need for 802.11ac Driven By Device and Application Growth


- Email / Calendar: 28% Growth
- Collaboration: 45% Growth
- Productivity: 53% Growth
- Custom Business: 63% Growth
- UC / IP Telephony: 64% Growth
- Virtual Desktop: 79% Growth

Mobile Device Growth

- 2014: 73% Growth
- 2018: 100% Growth
Why Cisco for Gigabit Wi-Fi

802.11ac

- Improved Experience on all Devices
- Built for High-Density Environments
- Industries’ Only Modular / Future Proof Access Point
- Broader Portfolio—no Price Premium over 802.11n
Not All Gigabit Wi-Fi Solutions are Created Equal

- Optimized Wi-Fi Network
- Improved Experience on ALL Devices
- Increased Scale and Coverage
- Support Bandwidth Intensive Apps.
- Support More Devices Than 802.11n
- Improved Device Power Efficiency

Cisco is the ONLY SOLUTION with High-Definition Experience Technology (HDX)
Optimizing Network Performance & End-User Experience
Made Possible by Purpose Built Chip Set

- **Turbo Performance**: Scales to support more devices running high bandwidth apps.
- **Optimized Roaming**: Intelligently decides the proper access point as people move.
- **Cisco CleanAir® 80Mhz**: Remediates device impacting interference.
- **Cisco ClientLink 3.0**: Improves performance of legacy and 802.11ac devices.
- **Noise Reduction**: Improves dense access points coexistence/implementation.

*Future*
Cisco Delivers Investment Protection
Future Proof Your Network with Industries’ Only Modular Design

- **802.11ac Wave 1 & 2**: Support for Next-Gen Wireless Standard
- **Wireless Security Module**: Always On Intrusion Protection
- **3G Small Cell**: Cellular Blind Spot Coverage with Wi-Fi
- **Others**: Future Technologies to Meet New Demand

Supported on Cisco Aironet 3600 & 3700 Series

*Future*
What is Radio? Why these Frequencies?

“RF Matters”
Basic Understanding of Radio...

Battery is DC
Direct Current

Typical home is
AC Alternating Current

AC Frequency 50 Hz or 50 CP
S – Cycles Per Second

Waves travel back and forth so fast they actually leave the wire

How fast the AC current goes, is its “frequency”
AC is very low frequency 50 Hz (Cycles Per Second)

Radio waves are measured in kHz, MHz and GHz

The lower the frequency, the physically longer the radio wave –
Higher frequencies have much shorter waves, and as such, it takes
more power to move them greater distances.
This is why 2.4 GHz goes further vs. 5 GHz
(given same amount of RF power).

Popular Radio Frequencies:
AM Radio 520-1610 KHz
Shortwave 3-30 MHz
FM Radio  88 to 108 MHz
Aviation   108-121 MHz
Weather Radio 162.40 MHz
GSM Phones 900 & 1800 MHz
DECT Phones 1900 MHz
Wi-Fi 802.11b/g/n 2.4 GHz
Wi-Fi 802.11a/n   5 GHz
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Wi-Fi 802.11b/g/n 2.4 GHz
Wi-Fi 802.11a/n 5 GHz
Wi-Fi Radio Spectrum 2.4 GHz

Non-Overlapping Channels at 2.4 GHz WLAN

Don’t do it!
Wi-Fi Radio Spectrum 5 GHz

Note: 5 GHz channels do not have the severe overlap that 2.4 GHz channels have but they use DFS to enable sharing of the band.
A Radio Needs a Proper Antenna

Antennas are custom made for the frequency to be used. Some antennas have two radiating elements to allow for both frequency bands (2.4 and 5 GHz) in one antenna enclosure. Cisco AP-3700 3600/2700/2600/1600 use such antennas.

Antennas are identified by color
Blue indicates 5 GHz
Black indicates 2.4 GHz
Orange indicates both

Omni-Directional antennas like the one on the left, radiate much like a raw light bulb would everywhere in all directions.

Directional antennas like this “Patch” antenna radiate forward like placing tin foil behind the light bulb or tilting and directing the lamp shade.

Note: Same RF energy is used but results in greater range as it is focused towards one direction, at the cost of other coverage areas.
Antenna Basics

- Antenna - a device which radiates and/or receives radio signals
- Antennas are usually designed to operate at a specific frequency
- Some antennas have more than one radiating element (example Dual Band)

Antenna Gain is characterized using dBd or dBi
- Antenna gain can be measured in decibels against a reference antenna called a dipole and the unit of measure is dBd (d for dipole)
- Antenna gain can be measured in decibels against a computer modeled antenna called an “isotropic” dipole <ideal antenna> and the unit of measure is dBi the “i” is for isotropic dipole which is a computer modeled “perfect” antenna

WiFi antennas are typically rated in dBi.
- dBi is a HIGHER value (marketing folks like higher numbers)
- Conventional radio (Public safety) tend to use a dBd rating.
- To convert dBd to dBi simply add 2.14 so a 3 dBd = 5.14 dBi
How Does a Omni-Directional Dipole Radiate?

The radio signal leaves the center wire using the ground wire (shield) as a counterpoise to radiate in a 360 degree pattern.
How Does a Directional Antenna Radiate?

Although you don’t get additional RF power with a directional antenna, it does concentrate the available energy into a given direction resulting in greater range.

Also a receive benefit - by listening in a given direction, this can limit the reception of unwanted signals (interference) from other directions for better performance.

A dipole called the “driven element” is placed in front of other elements. This motivates the signal to go forward in a given direction for gain.

(Inside view of the Cisco AIR-ANT1949 - 13.5 dBi Yagi)
Patch Antenna: a Look Inside

Patch antennas can have multiple radiating elements that combine for gain. Sometimes, a metal plate is used behind the antenna as a reflector for more gain.

The 9.5 dBi Patch called AIR-ANT5195-R

Patch and Yagi antennas favor the direction the antenna is pointed – like a flashlight.
Understanding Multipath, Diversity and Beamforming
Understanding Multipath

Multipath can change Signal Strength

▶ As radio signals bounce off metal objects they often combine at the receiver

▶ This often results in either an improvement “constructive” or a “destructive” type of interference

Note: Bluetooth type radios that “hop” across the entire band can reduce multipath interference by constantly changing the angles of multipath as the radio wave increases and decreases in size (as the frequency constantly changes). The downside is that throughput using these “hopping” methods are very limited but multipath is less of a problem.
Evolution to MIMO Technology

- Old WiFi systems used Single Input Single Output (SISO) technology
  - Single transmit stream
    - Single transmit antenna
    - Single receive antenna
  - Severely impacted by multipath signals
    - Performance marginally improved by diversity
MIMO requires at least 2 receivers or 2 transmitters per band

- Uses advanced signal processing to coordinate multiple simultaneous signals from multiple antennas
  - Improved link reliability
Cisco’s ClientLink Technologies
Advanced Beam Forming Technologies Improve Wireless Client Performance
Beam-forming Spatial Streams (ClientLink 3.0)
All the features of ClientLink 2.0 + 3-ss 11ac Clients

The extra radio “D” is used to augment spatial stream data and is used in beam-forming

Note.11n had support for beam-forming but was never adopted so there was no TxBF without ClientLink

Client-Link performs beam-forming on legacy 11a/g/n clients as well as 802.11ac clients 3-ss clients.

Note: Only Cisco APs can beam-form a 3-SS signal as it requires 4 transmitters - most APs on the market don’t have this additional radio for reliability and performance

The additional radio assists in both transmit and receive.
Understanding 802.11ac
Why is 802.11ac important today?

802.11ac comes in 2 waves: Wave-1 (now) et Wave-2 (end of 2015+)

Many 802.11ac equipments exist on the market today (tablets and smartphones).

There is a big ask for more density and more performance from the end-users already.

IDENTIFY 802.11AC EXISTING CLIENTS here:
https://wikidevi.com/wiki/List_of_802.11ac_Hardware#Mobile_general_purpose_computers...28non-PC.29
Spatial Multiplexing – A method for boosting wireless bandwidth by taking advantage of multiplexing which is the ability within the radio to send out information over two or more transmitters concurrently (in parallel) known as “spatial streams”.

Sending side: send more symbols, in parallel (spatial multiplexing)
Understanding Channel Bonding

802.11ac introduced 80 MHz

One method to gain significant throughput (2x or more) is to bond the channels using more bandwidth.

This helps 1, 2 and 3-SS clients.

Single spatial stream clients also realize physical size and battery life benefits.

Bonding actually blends the channels together so you gain a small amount of extra spectrum for data use.
Guidelines when to use Channel Bonding in 5GHz

▶ Use 20 MHz channels
- If using voice only – or the spectrum has lots of radar activity forcing channel changes
- If you have lots of non 11n/ac capable 5 GHz clients (early .11a clients)
- If you have light/medium data requirements
- You have lots of non 11ac APs already @ 20 MHz & no plans to upgrade

▶ Use 40 MHz channels
- If using interactive or streaming video
- If requirements are for moderate or heavy data usage

▶ Use 80 MHz channels
- If using a significant amount of .11ac capable clients
- If you have lots of .11ac smart phones (1-SS) and need faster throughput
- High Definition Video streaming or other multimedia rich content applications
- Heavy data usage for high throughput - Example (CAD or medical documents)

One of the real benefits of bonding is spectrum efficiency and overall system capacity. By allowing the clients to send and receive more data in a shorter period of time, the airwaves clear faster for other users and in some cases even battery life on the client device increases as it spends less time in power draining transmit mode.
A single GbE cable is fine for (Wave-1)

▶ Multiple clients (all connecting at different speeds) will not exceed GbE.

▶ Wave-2 could exceed GbE speeds as it has support for additional spatial streams and up to 160 MHz of bandwidth

▶ So you have 2 options:
  • You can pull two CAT6a cables
  • You can plan for Nbase-T future MultiGigabit ports on Cat3k switches

▶ A pair of CAT6a cables allows you to fall back to using 2 GbE ports for some iterations of (Wave-2) if required. Additionally, if the second cable isn’t needed it can be used to bring the console port back.

▶ CAT5e cables may be used as the 2nd cable pull for cost savings but at least 1 cable should be CAT6a as CAT5 does not support 10GbE.
Choosing the right Access Point Model
Integrated or External antennas?
Integrated Antenna? – External Antenna?

**Carpeted areas**

Integrated antenna versions are designed for mounting on a ceiling (carpeted areas) where aesthetics is a primary concern.

**Rugged areas**

Use for industrial applications where external or directional antennas are desired and or applications requiring higher temperature ranges.
Outdoor–rated APs Used for Indoor Applications

- Harsh environmental conditions (e.g. refrigerated rooms, condensing humidity...)
- 12V DC powered or 100-480V AC
- ATEX Class I Division 2 (potentially explosive areas)
Wall Mounting Access Point with Internal Antennas

Wall mounting is acceptable for small deployments such as hotspots, kiosks, transportation or small coverage areas.

Coverage is always more uniform when installed on the ceiling tile or grid area.

Note: Wall mounting may create unwanted coverage areas on the floor above or below - This is not desirable for voice as it may cause excessive roams and is directional as metal is behind the antennas (backside).
Wall mounting AP-3500e, 2700e & 3700e

Orientation of the Dipoles if Wall Mounting

Note: The ceiling is usually higher and a better location for RF.

If using advanced features like location or voice try to locate the AP on the ceiling, or when mounting the AP on a wall orient the dipoles in this configuration.

Because dipoles on a wall can easily get orientated wrong as people touch and move them. Better still might be to use a Patch antenna or use the Oberon wall bracket. Be aware walls can add directional properties to the signal as they can have wiring, metal 2x4 construction and the wall attenuates the signal behind the AP limiting a nice 360 degree coverage.
Aironet 802.11n/ac Wall Mount (Style Case)
Third Party Wall Mount Option is Available

This optional wall mount best positions the Access Point dipoles for optimum performance – Recommended for Voice applications

If you MUST mount the Access Point on a wall.

Ceiling is a better location as the AP will not be disturbed or consider using patch antennas on wall installations

Oberon model 1029-00 is a right angle mount works with “I” and “e” models
http://www.oberonwireless.com/WebDocs/Model1029-00_Spec_Sheet.pdf
Other Mounting Options?

Different Mounting Options for Ceiling APs

Cisco has options to mount to most ceiling rails and directly into the tile for a more elegant look. Locking enclosures and different color plastic “skins” available from third party sources such as

- [www.oberonwireless.com](http://www.oberonwireless.com)
- [www.terrawave.com](http://www.terrawave.com)
Installation above the Ceiling Tiles
An Optional Rail Above the Tiles May Be Used

Note: The AP should be as close to the tile as practical

AP bracket supports this optional T-bar box hanger item 2 (not supplied) Such as the Erico Caddy 512 or B-Line BA12
Flush mount bracket part number is **AIR-AP-BRACKET-3**
This is a Cisco factory bracket that can be specified at time of order
Full strut on right provides support across two ceiling rails
Making it ideal for safety in (earthquake prone areas)
Antenna Placement Considerations

▶ AP antennas need placements that are away from reflective surfaces for best performance

▶ Avoid metal support beams, lighting and other obstructions.

▶ When possible or practical to do so, always mount the Access Point (or remote antennas) as close to the actual users as you reasonably can

▶ Avoid the temptation to hide the Access Point in crawl spaces or areas that compromise the ability to radiate well

▶ Think of the Access Point as you would a light or sound source, would you really put a light there or a speaker there?

Never mount antennas near metal objects as it causes increased multipath and directionality
A look at some installations that went wrong
Installations that Went Wrong

NEVER EVER MIX
ANTENNA TYPES
Antennas should always cover the same RF cell watch polarity
Installations that Went Wrong

Patch antenna shooting across a metal fence Multipath distortion causing severe retries

Mount the box horizontal and extend the antennas down and not right up against the metal enclosure
When a dipole is mounted against a metal object you lose all Omni-directional properties.

It is now essentially a directional patch suffering from acute multipath distortion problems.

Add to that the metal pipes and it is a wonder it works at all

Tip: Access Points like light sources should be in the clear and near the users

Dipole antennas up against a metal box and large metal pipes. This creates unwanted directionality and multipath distortion – This also creates nulls (dead areas) and creates packet retries.
Above Ceiling Installs that Went Wrong

You Mean it Gets Worse?
Installations that Went Wrong – Really???

Radio waves do not like metal cages.
Installations that Went Wrong - Mesh

Yes that is all METAL IRON
Installations that Went Wrong - Mesh

Building aesthetics matters – Antennas obstructed
Cisco Cloud Based Predictive RF Planning Tool
Cisco Cloud Based Predictive RF Tool Features

• First Cloud based Wireless Tool
• Supports all Cisco Access points – Aironet, Meraki
• Supported on all Browsers
• Cisco Commerce Workspace Integration
• Google Earth Integration
• Simple drag & draw from RF legends provided
• Easy to switch between access points and applications
• Optimized for better access points coverage
• Easy RF proposal generation

FCS
March 2015
Cisco Cloud Based Predictive RF Tool Features (Cont.)

• Multi-floor planning
• Several coverage models (Data, Voice, Location)
• Flexible maps (ability to re-dimension, stretch, edit, copy/add/delete maps, floors, walls)
• Flexible coverage personalization (ability to change number of APs, change AP power, change target band of operation, change AP model)
• Flexible AP positioning (ability to move, add, remove APs)
• User-friendly display (sliding ruler to see the exact edge of a given coverage value, extensible and contextual menus to offer options without clogging screen)
Cisco Cloud Based Predictive RF Planning Tool – Benefits

✓ First Cloud based Wireless Tool with 24x7 availability from anywhere
✓ No Software to Install & No hardware dependency
✓ Supports all Cisco Access points – Aironet, Meraki
✓ Supported on all Browsers
✓ Cisco Commerce Workspace Integration
✓ Google Earth Integration
✓ Simple and Intuitive for end user
✓ Easy & Fast RF proposal generation within less than 15 minutes @ Customer site
Summary

✓ Current Wireless Trends
  ✓ Reasons for Customers to move to Newer Technology
  ✓ Supremacy of Cisco 802.11ac technology

✓ RF Matters

✓ Examples of Good and Bad Installation

✓ Cisco Cloud Based Predictive RF Planning tool
  ✓ Demo of the tool
Thank You
Reference slides
1. 제목을 넣어주세요
클라우드, 보안, 모빌리티 및 프로그래밍 가능한 네트워크에 대한 새로운 소비 모델의 등장과 함께 기술이 급격하게 변화하고 있습니다. 이러한 개념은 새로운 시장과 비즈니스 요구를 창출하며 커뮤니케이션과 정보 공유 방식을 바꾸고 IT의 역할을 크게 변화시키고 있습니다.

2. 제목을 넣어 주세요
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클라우드, 보안, 모빌리티 및 프로그래밍 가능한 네트워크에 대한 새로운 소비 모델의 등장과 함께 기술이 급격하게 변화하고 있습니다. 이러한 개념은 새로운 시장과 비즈니스 요구를 창출하며 커뮤니케이션과 정보 공유 방식을 바꾸고 IT의 역할을 크게 변화시키고 있습니다.
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