

# Who is designing your Wi-Fi network? The cabling or the wireless designer?

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ITILv2 and ITILv3 #819214, CSOEP #100600 (DataCenter, Infrastructure, Process, Management, Security)

IRCA ISO/IEC 20000 ITSM (IT Service Management) #01193718, IRCA ISO/IEC 27001 ISMS (Security Management) #01193718



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# Synopsis

There is an increasing demand to provide Wi-Fi connectivity in buildings which can range from a home, apartment until a large enterprise. The growing demand of mobile devices and Internet of Things / Everything (IoT / IoE) is accelerating it.

But who is designing your Wi-Fi network?

We have to take into account the cabling routing and length limitations for the backhaul, the aesthetics where cables and wireless access points are placed and at the same time provide good Wi-Fi coverage and capacity.



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# What attendees will learn

## Attendees

- BICSI Wireless Subcommittee's current work on an in-building wireless network design
- Learn about the challenges doing a Wi-Fi network design
- How to improve your career in wireless to gain BICSI CECs points by following vendor neutral professional wireless training?
- Understand the relationship between cabling & wireless systems and certifications (read why RCDD certification is important for wireless designers)



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# ICT Infrastructure Network Trends

Wireless users and IoT

drives

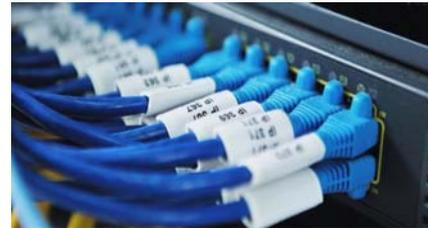
wireless infrastructures

drives

cabling outdoor/indoor

drives

Data Center capacity



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# Where do we want or need Wi-Fi connectivity?



Home  
Apartment  
Shopping mall  
Office  
Manufacturing plant  
Etc.



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# For what purpose is the Wi-Fi network used?

## Data

- Small packets
- Large files



## Voice

## Video

## Communication paths

- 1:1 communication
- To a server in the backend



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# Existing environments, how is the Wi-Fi network provisioned?

## Simple Home Access Point (AP)



## Advanced AP



Enterprise class Wi-Fi equipment

IEEE 802.11 standards used?

2.4 GHz Frequency

- 802.11, 802.11b/g/n

5 GHz Frequency

- 802.11a/n/ac and .11ac MU-MIMO

Security features

- Encryption/Authentication

Roaming features

Transmit power

Dynamic Frequency Selection

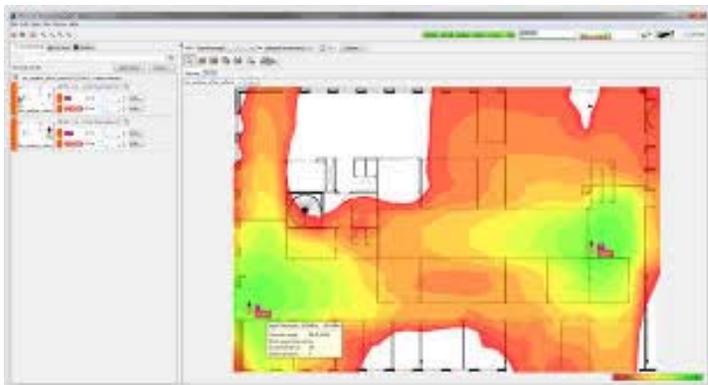
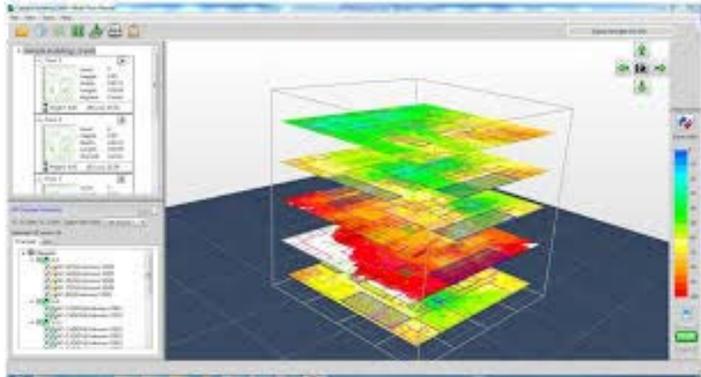


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# Existing environments, how is the RF Coverage and Capacity (empty vs full)

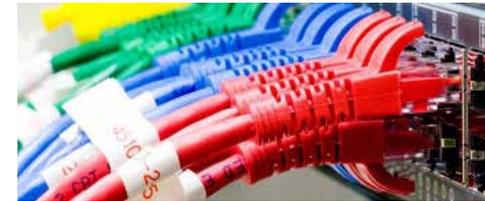


# Existing environments, how is the backhaul network provisioned?



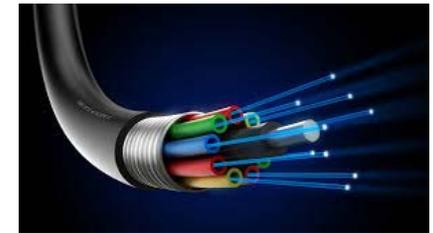
## Power over Ethernet (PoE)

- IEEE 802.3af (15.4W)  
Class 1 to 3
- IEEE 802.3at (30W) PoE+  
Class 4
- IEEE 802.3bt (45W-95W) 4PPoE ~2018  
Class 5 to 8



## Cabling

- Cat 5/5e
- Cat 6
- Cat 8



- Fiber Optic cabling
- Distributed Antenna Systems (DAS)



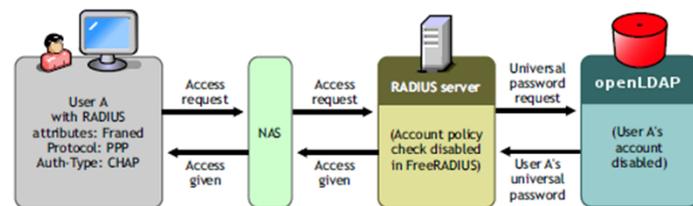
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# Existing environments, all the other equipment which is needed to provide a Wi-Fi service

Firewalls



Internet connectivity / capacity

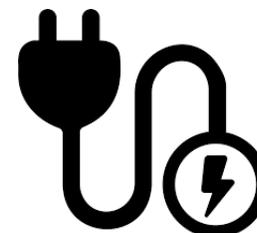


Authentication / Encryption

Servers  
Capacity  
Location



Power  
Cooling



In summary before doing a Wi-Fi design an assessment needs to be done to understand the requirements



- Assess before designing a Wi-Fi network
- Understand the business requirements (for next 5-10 years)
- Understand the vertical market of the customer
- Understand the existing environment
  - anticipate on the changing environment / trends
  - e.g. more Wi-Fi devices, Frequency changes/Neighbors
  - new buildings coming up, etc.



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# Do we speak the same language?

## WAP vs AP

- Wireless Access Point vs Access Point
- Access Point / Telecommunication Outlet (TO) / Equipment Outlet (EO) / data outlet

## Predictive Site Survey vs Predictive Radio Frequency (RF) Planning

## Wireless Broadband

- Cellular / Mobile (e.g. 4G, 5G) or Wireless LAN (.11ac, .11ad)

## Internet of Things (IoT) / Internet of Everything (IoE)

- What is exactly the definition?

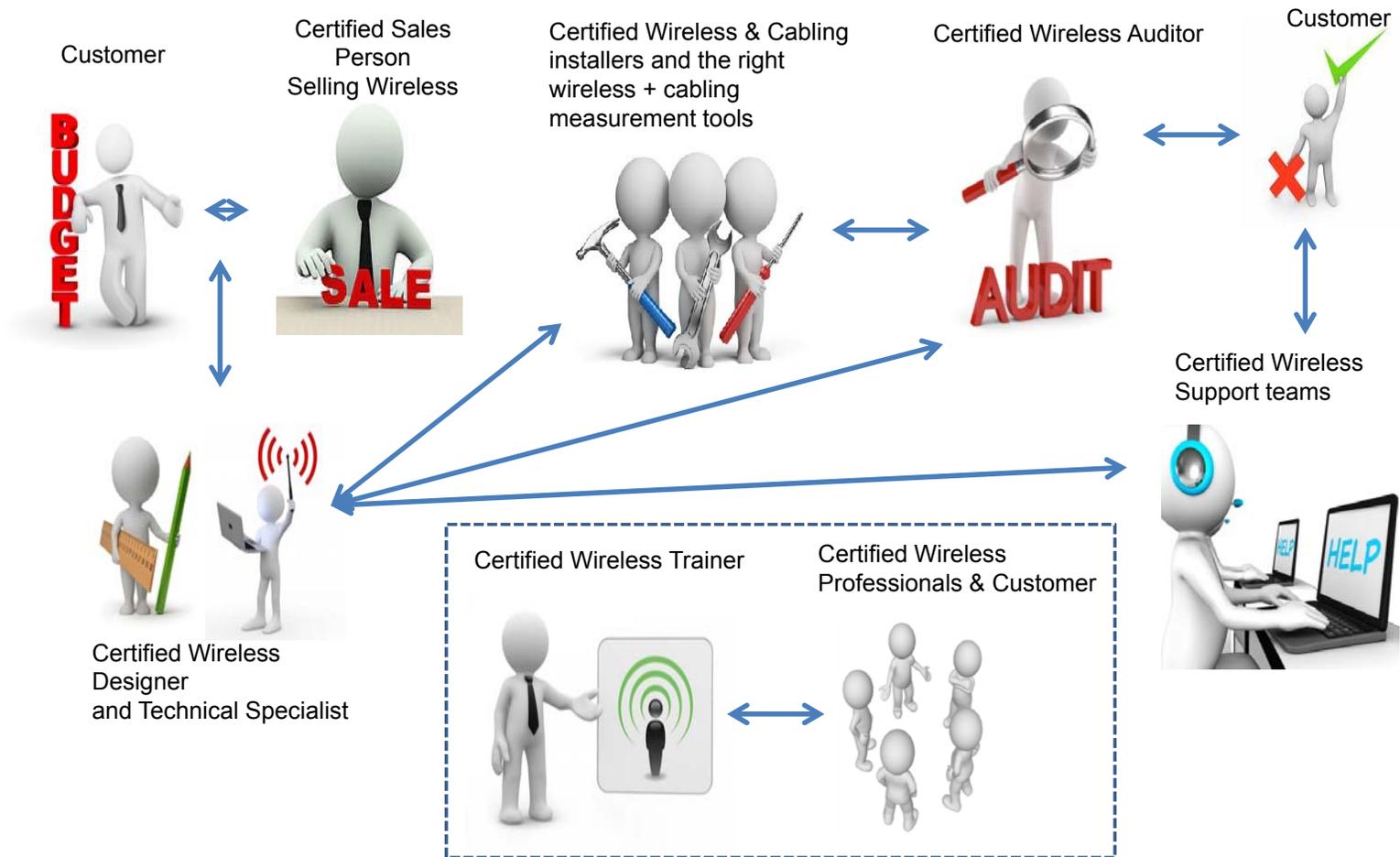


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# Skilled wireless professionals are needed and teams need to be organized



# Wi-Fi tools for the Designer/Installer/Auditor/Support

- Reconnaissance tools 2.4GHz/5GHz, e.g. mobile phone with Wi-Fi analyzer
- Spectrum analyzer supporting 2.4GHz/5GHz (OSI layer 1) Wi-Fi and non-Wi-Fi activity
- Wi-Fi Protocol analyzer (OSI layer 2) 2.4GHz/5GHz for Wi-Fi communication analysis
- Site Survey RF Planning tool. What if scenarios for Wi-Fi RF coverage, capacity
- Manual Site Survey (Passive / Active / Hybrid) Measuring/validating RF
- Automated Wireless Network Management Systems (WNMS) Managing 24x7 monitoring
- Wireless Penetration Testing / Wireless Intrusion Prevention System (WIPS)  
24x7 Security monitoring



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# Wired tools for the Designer/Installer/Auditor/Support

- OSI Layer 1 - Cable testing (e.g. with a DSX-5000 Cable Analyzer)
  - Copper certification
  - Fiber optic loss, OTDR (Optical Time-Domain Reflectometer)
  - testing and fiber end-face inspection
  - Test speed for Cat 6A, Class F<sub>A</sub> and all current cabling standards
  - TIA Category 3, 4, 5, 5e, 6, 6A: 100 Ω
  - ISO/IEC Class C, D, E, EA, F, and FA: 100 Ω and 120 Ω
  - Even with standards based tests the Wi-Fi AP still cannot use PoE !
  - Test DC Resistance Unbalance (see white Paper of Fluke Networks)
- OSI Layer 2 – Cable tests
  - Power Over Ethernet (PoE) Tester
  - Link to the switch,
  - DHCP (Dynamic Host Configuration Protocol) for IP address assignment
  - Gateway and Internet connection
  - Get VLAN, switch name, and port information via Discovery Protocols CDP (Cisco) LLDP (Link Layer vendor neutral) / EDP (Extreme networks) for your managed switches

# Governance – Standardization - Certification

Governance



Standardization



Certified Professionals



Certified Auditors



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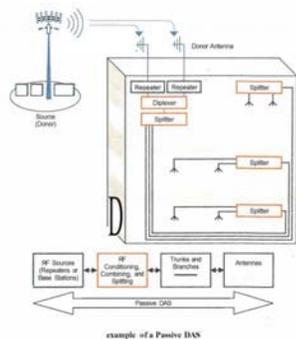
# Where do we start?

## Can we use the ANSI/BICSI 006-2015 DAS Standard for Wi-Fi?

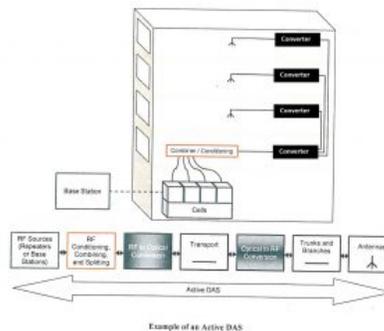
- Wi-Fi RF Coverage (2.4 GHz and 5 GHz)
- Wi-Fi protocol (“Hidden Nodes”)
- PoE connectivity for the Active DAS to power Wi-Fi Access Points
- Backhaul capacity (for Wi-Fi APs connected to Active DAS)

ANSI/BICSI 006-2015: Distributed Antenna System (DAS) – Design and Implementation Best Practices

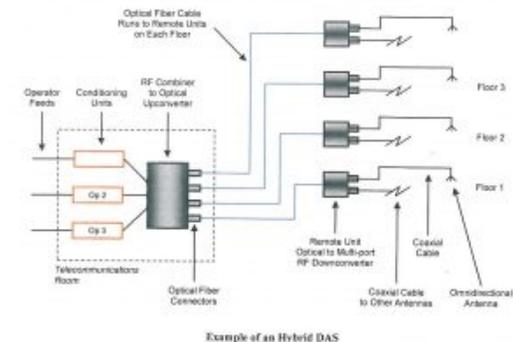
Passive DAS



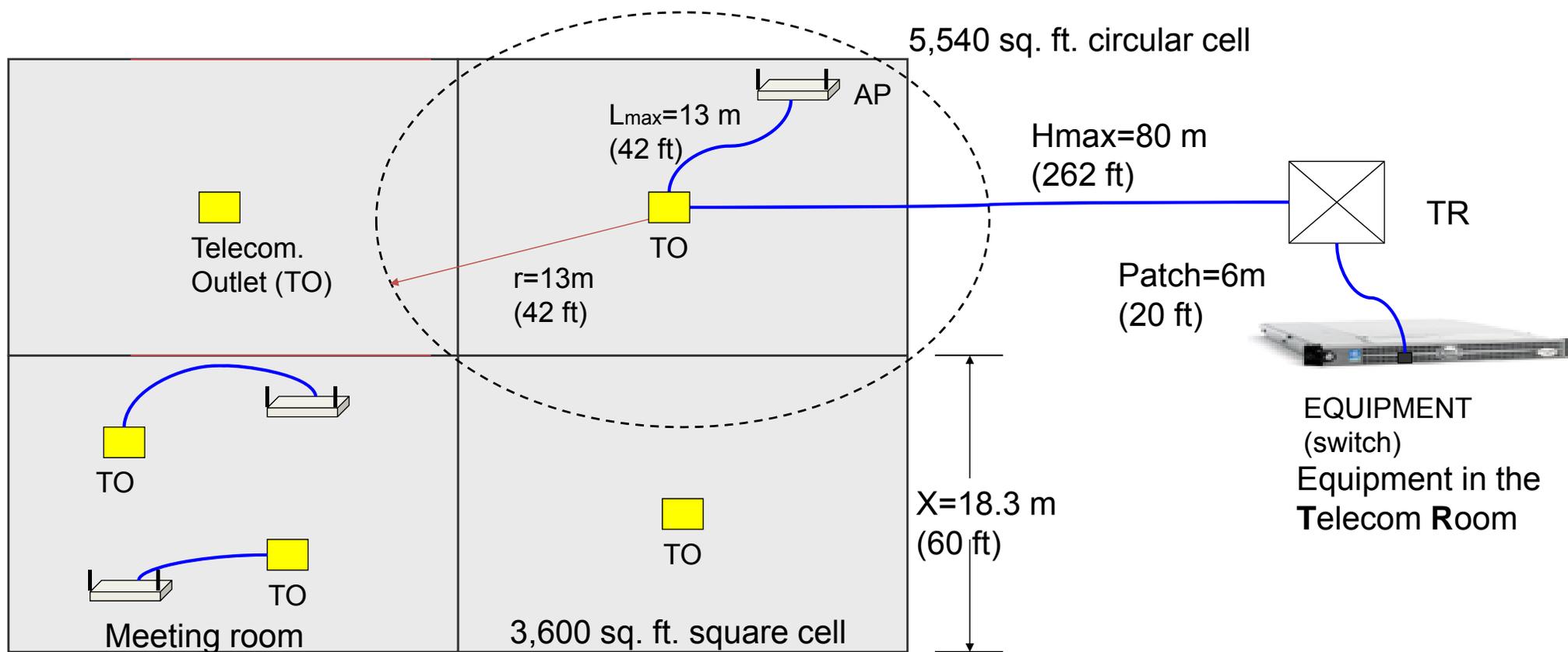
Active DAS



Hybrid DAS



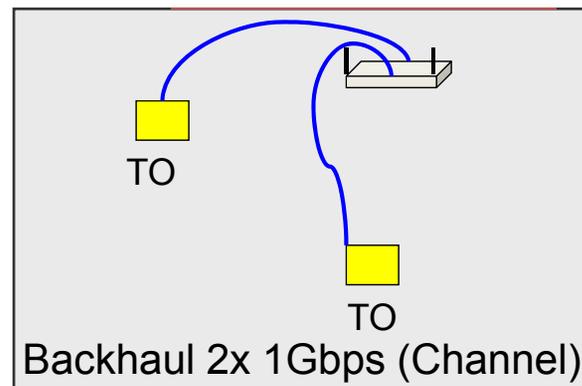
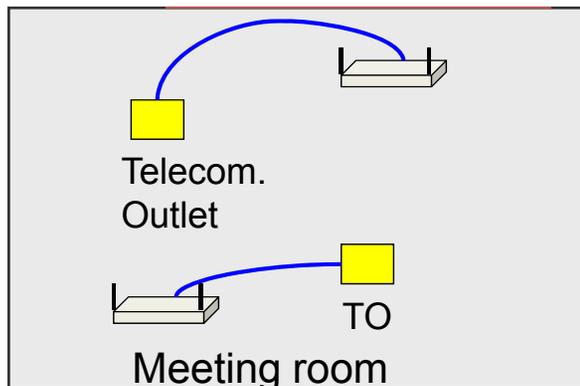
# Can we use the TIA TSB-162-A Standard Pre-Cabling Guidelines for Wireless (Wi-Fi) Access Points ?



# Cabling to the TO (outlet) or directly in the AP? and what about the backhaul capacity?

TSB provides guidelines on the topology, design, installation, and testing of telecommunications cabling infrastructure, in compliance with ANSI/TIA-568-C.0 and ANSI/TIA-569-C, for supporting wireless local area networks (WLANs).

TSB describes the cabling between local area network (LAN) equipment and wireless access points including pathways and spaces to support the cabling and wireless access points.



Ethernet Alliance Roadmap  
<http://www.ethernetalliance.org/roadmap/>

2016 - Higher backhaul speeds

- 2.5 Gb/s
- 5 Gb/s

## Other trends – low voltage cabling in buildings

Low voltage cabling into the buildings for integrated services

- Power over Ethernet (PoE)
- Wi-Fi Access Points (AP)
- IP Camera's
- Fire alarm systems
- Light systems
- Building Management Systems
- Etc.



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# Where do we start?

## Can we use Best Practices for Wi-Fi Designs (vendor neutral)?

### Best Practices for Wi-Fi Designs?

- Vendor neutral - Certified Wireless Design Professional (CWDP) **Sybex** book (note there is a Certitrek CWDP)
- Vendor Specific – e.g. Cisco or Aruba Validated Reference Design (VRD) and many other vendors for High Density Client environments and Very High Density 802.11ac Networks

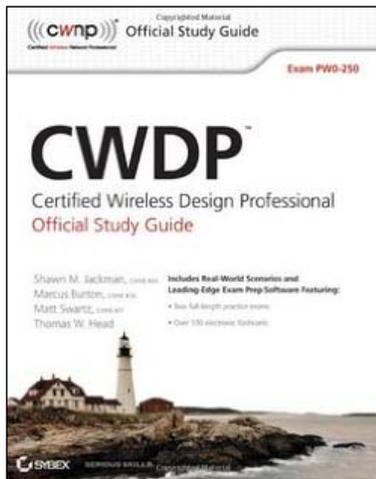


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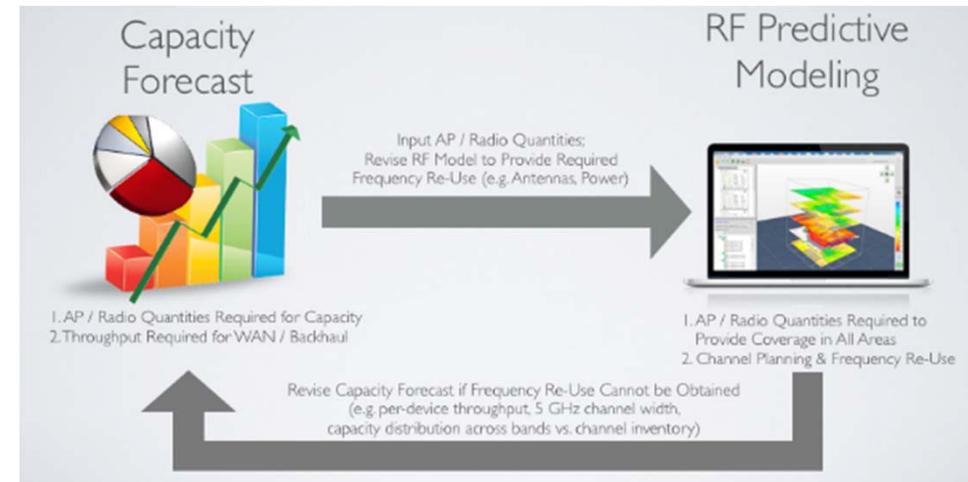
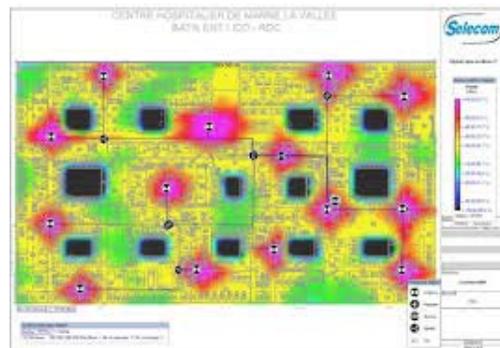
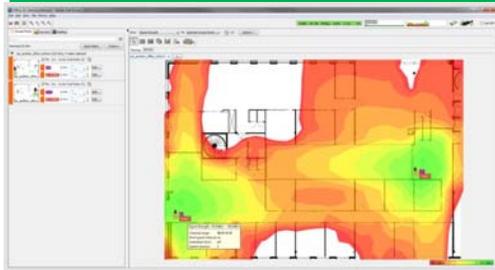
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# Where do we start? Or use vendor neutral or vendor specific tools?

Wi-Fi planning for RF coverage and RF Capacity

It is an **iterative approach!**

**Design/Plan – Install - Measure - Adjust**



<http://www.revolutionwifi.net/capacity-planner/>

# Where do we start?

## Wi-Fi Architect/Designer need to look end-to-end

Wi-Fi Architect / Designer need to look end-to-end

- Decide on which equipment to be used
- IEEE 802.11 technology supported  
(Connectivity / Security / Quality of Service / Backhaul capabilities)
- CPU / Memory
- Architecture (Single MAC / Split MAC / Centralized / Cooperative / Hybrid / Cloud based)
- Features supported by the WLAN vendor
- Vendor preference
- Internal / External antenna's
- Best practice configurations  
(Transmit power settings, Dynamic Frequency Selection, Freq. bands, QoS, etc.)
- \* Wi-Fi Architect need to understand the cabling and pathway limitations



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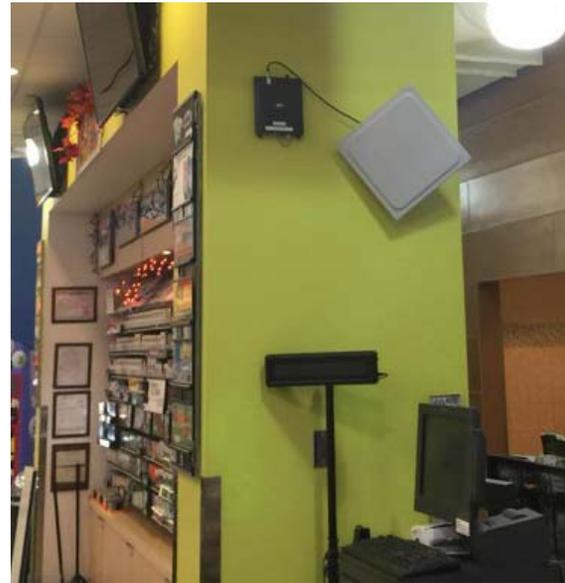
# Where do we start?

## the (cabling) installer needs to understand Wi-Fi

The (cabling) installer needs to understand how to install APs and antennas and how to do initial validation tests



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# Where do we start?

## the (Wi-Fi) installer needs to understand to validate Wi-Fi

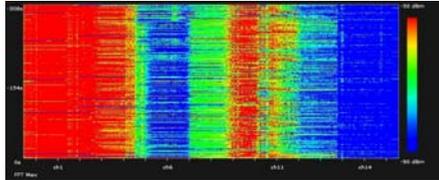
The (Wi-Fi) installer needs to understand how to validate Wi-Fi networks and to do detailed analysis

Basic link tests



Basic Wi-Fi tests  
(Reconnaissance)

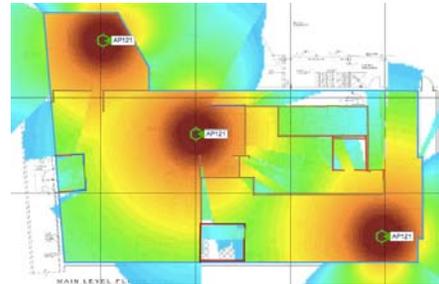
Advanced Spectrum Analysis



Advanced Protocol Analysis



Advanced Site Surveys



Advanced Capacity check

Security (Pen-testing)



Application validation



Specific Devices



# BICSI Standards – Wireless Subcommittee

In progress by BICSI Standards - Wireless Subcommittee

## **Wireless Local Area Network (WLAN) Systems Design and Implementation Best Practices (in-building wireless – “IBW”)**

(Initial release is focused on a smaller footprint like 10.000 sq. ft / 1000 m2 and basic applications like e-mail and web-browsing)



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# Don't Stop Learning – Earn BICSI CECs



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