

# Challenges & Solutions for Maintaining a Modern Wireless LAN Design

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#### INTRODUCTION

## "If you're not confused, you're not paying attention." — *Tom Peters*

An unprecedented level of change is occurring with the Wireless LAN IEEE 802.11 industry as a whole. Designing and deploying successful modern WLAN's is more difficult than ever while trying to protect legacy investments. With so many complexities it is easy to overlook multiple dependencies or fail to account for compatibility with a new standard protocol. Together, Zivaro and Cisco can address these complexities by combining design and knowledge management approaches to WLAN solution creation, while putting organizations in the correct spot with the latest in wireless solutions and properly protecting technology investments that may already be in place. While the design lifecycle is standard across technologies, it is Zivaro's internally developed WLAN Knowledge Base (WKB) that allows for repeatable success when deploying diverse, customized, modern WLAN networks. Coupled with Cisco's broad portfolio of wireless technology, tools and supporting services, organizations can be assured their WLAN journeys will be protected from costly missteps in the planning process.

#### WHERE TEH PROBLEMS LIVE

The first challenge for enterprises is that the IEEE 802.11 standard itself is naturally under a constant state of change and improvement. There have been close to twenty amendents/updates to the 802.11 specifications in the past twenty years. While this is ultimately beneficial for both consumers and organizations, keeping up with the rate of change is challenging and newer standards (like 802.11ax, aka Wi-Fi 6) are not quite solidified. Even more nerve racking is that an emerging Wi-Fi 7 standard is already being worked on, and likely the next 802.11 amendment in the coming year or two. Since Wi-Fi improvements are always forward-looking in capability, organizations are generally not ready to move quickly to the latest standards, particularly given what are likely recent and ongoing investments in items like laptops, printers, smartphones, IoT devices, etc. Older client devices lack the newer radio hardware capable of utilizing these new Wi-Fi standards. We know of more than one organization who has been trying to roll out (pre-802.11ax standard) hardware and is finding they need to turn off .11ax features to ensure legacy client devices keep operating correctly. The endpoint clients need to be capable of leveraging the benefits of a new standard and until they are it is difficult to justify spending on the next generation of wireless infrastructure. Upgrading to the new standard isn't just a software update or patch, it requires new hardware both at the end-node and the WLAN access infrastructure.



The next issue is that many customers are often unable to articulate a complete view of their requirements. This may be due to a lack of operational maturity, political forces, weak tooling for asset visibility, or lack of visibility into future business objectives. Without a repeatable, comprehensive process for drawing out requirements and consistently processing those inputs the wrong or incomplete WLAN solution is often the result. A structured, repeatable design approach and that values collective knowledge is needed to address these challenges. IT teams hear the complaints from users clamoring for seamless coverage and faster speeds, but they find it difficult to draw a line from these tactical requirements to what the target future needs.

The final pain point to touch on is that while Cisco's WLAN portfolio is always evolving for the better, they and every other manufacturer face challenges balancing approaches to the older and newer standards and how to gracefully support customers through a constant state of transition. Nearly all aspects of the Cisco on-premises WLAN portfolio are undergoing major overhauls led by the introduction of the new Catalyst 9800 wireless controller platform and Digital Network Architecture Center (DNA Center, DNAC) management platform. This is in addition to the new 802.11ax and 6Ghz wireless standards being developed that are changing Radio Frequency (RF) design. Changes on the wired access network side with improvements to Power Over Ethernet (POE) and Multigigabit Ethernet (mGIG) interfaces, for example, are creating additional decision points that need to be carefully made to account for access point requirements in the near future. Changes in technology such as Application Programming Interfaces (APIs) and Python based management are driving operational changes.

Customers looking to move to Wi-Fi 6E will require careful evaluation and possible upgrading/re-architecture of their switching infrastructure. It is now risky to take an ad-hoc order-taker approach to WLAN upgrades by counting the previous generation of widget and simply buying the new model hardware. One-for-one "swap-outs" will often run into problems of incompatibility or a missed opportunity to take advantage of the latest advancements. Designing WLANs in this situation requires accounting not only for the components but the relationships between them. When so many pieces of the solution are in flux, relationship dependencies between client and infrastructure rise exponentially.

#### BACKGROUND

Cisco acquired Airespace in 2005 thus validating the controller-based architecture and providing a stable basis for customer WLAN's ever since. Customers have been building on this same AireOS WLAN platform for the past 15 years repeatedly upgrading code to support new access points and standards from 802.11a/b, g, n, ac on through 802.11ax. The management platform has changed names several times (WCS, NCS, Prime) but not its underlying SNMP-based management-plane operation.

Most changes to a Cisco WLAN solution stack could be done incrementally or at least without needing for a wholesale redesign. Throughout this lifecycle, Wireless Access Point (APs) could be upgraded independently of the controller and management layers. APs designed for 5Ghz deployment could be



replaced with the newer 802.11 standards.

But AireOS and its solution stack surrounding it are now reaching the limits of its performance, manageability, and reliability. Jump ahead to 2020 and many customers find themselves in the following situation:

- running a 10-year-old WLC hardware based on a 15-year-old software
- needing to support a diverse range of device types and real-time applications
- running End-of-Life (EoL) IOS APs
- managing environments with SNMP based solutions
- no real-time metrics or visibility of client or network health
- limited or no network programmability
- unprepared and unaware of 802.11ax or Wi-Fi 6E
- RF designed for coverage instead of capacity

To demonstrate the breadth of changes, see Cisco's legacy and future solution stacks courtesy of Cisco PVT 2020:



Beyond the Cisco hardware and software stack other areas including industry standards and design approaches have changed compared to customers' legacy WLAN's:



Legacy	Area	Current/Near Future
802.11ac	802.11	802.11ax
Coverage	Design Driver	Capacity
WPA2/Open	Security	WPA3-Ent/SAE/OWE
5Ghz	Primary Band	6Ghz
Captive Portals	Guest Authentication	OpenRoaming
Gig/POE	Ethernet	mGIG/UPOE
On-prem	Management Plane	On-prem or Cloud
SNMP polling (Prime)	Monitoring	Streaming telemetry (DNAC, Opensource)
SNMP traps/informs	Alerting	Webhooks
Laptop/Smartphones	Devices Types	Legacy + IoT
802.11 based	Devices Types	Bluetooth Low Energy (BLE)
ITIL	Location	DevOPS
GUI, CLI	Interface	API

Enterprises are now also embracing programmability thru Netconf, REST interfaces which the Catalyst 9800 and DNA Center platforms were built from the start to support. This will require new operational processes and skills as well as create implementation challenges and opportunities.

#### Here are some dates (actual and speculative) that will drive the need for change:

- End of Life (EoL) announcement of all AirOS based controllers: expected early 2021 (based on industry speculation, not official from Cisco)
- Cisco Prime retirement announcement in 2021 (no statement from Cisco but widely expected in the industry)
- Estimated final 802.11ax standard ratification: Feb 2021
- Estimated availability of 6Ghz WLAN hardware in the industry: mid-2021 (based on industry speculation from the head of wireless at Aruba (now HPE))
- End-of-Support for Cisco 5508 WLAN controllers: July 2023 (official from Cisco)



What was once a simple discussion just a couple of years ago of replacing APs one-for-one with the newest 802.11 standard, or upgrading WLC's like-for-like, is now a multi-layered analysis where it is easy to overlook a key aspect or account for compatibility between components that could result in a poorly performing WLAN or one that simply does not work together.

Conversely, a move to cloud-based, Cisco Meraki may be the right solution that will simplify some aspects but comes with different design challenges. The RF design considerations remain the same but aspects such as cloud connectivity in secure environments and client roaming can become a challenge. The takeaway is that a design approach is still needed regardless of architecture, it is the design life-cycle content (checklists, templates, lessons learned, etc.), not structure that will adjust once an architecture is selected.

#### THE SOLUTION

"under conditions of complexity, not only are checklists a help, they are required for success." — Atul Gawande, The Checklist Manifesto: How to Get Things Right

Zivaro addresses these challenges with its in-house curated Wireless Knowledge Base (WKB). This is a collection of checklists, scripts, and links containing the collective wisdom from deploying WLAN's across Zivaro's customer base. It is continually updated with new information learned from industry whitepapers, configuration guides, WLAN Professionals community, training, as well as hands-on lab testing.

#### Zivaro's WLAN design framework is outlined as follows:

- 1. A step-by-step high-level design cycle process. This static framework defines the essential sequential nature of the design process.
- 2. The dynamic low-level content contained in the Zivaro WKB containing design questions/ checklists, lessons learned, tips, and links to current information.

Elements of the Zivaro WKB inform decision making across the WLAN lifecycle (design flow from Ekahau) is shown below.





#### The Zivaro WKB consists of the following major sections:

- Design document templates (low-level, high-level templates)
- RF Design (requirements checklist, industry-specific guidance, lessons learned, WLAN architectural overview, links to industry RF design guides, capacity calculator)
- Security (EAP type comparisons, Cisco Identity Services Engine (ISE) policy samples, testing scripts, pentesting checklists)
- Availability (lessons learned, trade-off info)
- Manageability (config examples for SSH, TACACS, Netconf, sample Python programmability scripts)
- Monitoring (sample SNMP configs, gRPC telemetry templates, DNAC deployment checklist, Grafana/InfluxDB docker containers)
- Mobility (tips on 802.11r, devices roaming thresholds)
- Quality (QoS templates)
- Migration Planning (AireOS to 9800 templates, links to IRCM, on-prem to Meraki lessons)
- Validation (survey technique and tools info, checklists)
- Troubleshooting (tools info, troubleshooting flow, Wireshark filters list)
- Health check (checklist, temple, flow diagram)
- Devices (device analysis checklist, links to Apple, Intel, Samsung device specs)
- Inventory (python scripts, sample BOM's)
- Network Infrastructure Integration (PoE info, VLAN/IP/DHCP planning templates)
- Physical space (rack elevation templates, lessons learned info)
- General deployment consideration (go-live templates, validation templates, training guides, test plans, lessons learned questionnaire)

The key is to merge a structured life-cycle (ie: following a progression), combined with the knowledge Zivaro has acquired through real-life enterprise deployments, careful study, and emperical lab experimentation. The process gives structure while the knowledge base provides the content to know the questions to ask and recommendations to provide to customers.

Sitting behind the coverage of Zivaro's systematic design approach are the foundational solutions within Cisco's wireless portfolio and Cisco's extended services resources. These include hardware, software and advanced services (implementation, optimization, Business Critical Services) to augment a customer's successful journey through evolving WLAN architectures. We have engaged with Cisco Services many times in the past decade to co-deliver better customer outcomes and expand our own approaches and thinking when needing to solve challenges in larger, complex client engagements. The combination of these resources creates a safety-net for enterprises which reduces their risk of failure and dramatically increasing the likelihood of a successful WLAN migration.

As what we would consider one of the pioneering technology companies in the wireless realm, Cisco has continuously evolved their solution portfolio over the last 15 years to be more manageable, more future ready, and now capable of intelligence, awareness and automation that did not exist even just a



few years ago. No customer environments will be simple when faced with the outside forces of 802.11 evolution, but it is comforting to build and plan roadmaps with one of the world's best innovators. Through Zivaro or through direct engagement there are a number of resources organizations can tap into to improve knowledge and readiness when preparing for WLAN changes. Just a few of the education materials include:

#### Road to Wi-Fi 6 E-book

https://www.cisco.com/c/en/us/products/collateral/wireless/e-nb-06-preparing-for-wifi-6-ebook-cte-en.html?oid=ebken019104

#### Campus LAN and Wireless LAN Solution Design Guide

https://www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html

#### Catalyst 9800 Non-Fabric Deployment using Cisco DNA Center

https://www.cisco.com/c/dam/en/us/td/docs/solutions/CVD/Campus/Catalyst-9800-Non-Fabric-Deployment-using-Cisco-DNA-Center.pdf

From a product perspective, there is far too much to cover for the purposes of this paper. However, we will touch on a couple Cisco products which represent some of the newer, more progressive functionality on offer for today's networks.

#### DNA Center/DNA Assurance

If a customer has not seriously looked at DNA Center yet, they are overdue. One of the really slick functions within a DNA Center deployment is DNA Assurance, which is a software subscription add-on within the DNA licensing model at the Advantage or the Premier level. These software suites can be attached to access points and controllers, ultimately providing visibility into how the wireless environment is performing and where it might be having performance degradation. The machine learning embedded within the technology can provide insights and decision support that otherwise might be very slow to resolve using traditional troubleshooting techniques.

#### **DNA Spaces**

Certain verticals rely heavily on gathering intelligence of their wireless users (think casinos, university campuses, stadiums) to provide proactive and dynamic network performance and in many use-cases, targeted communications. Through the same software subscriptions discussed above, organizations can activate robust location-based services and analytics of those services. They can also go a step further, integrating with key enterprise application and collaboration systems. Cisco has built digital toolkits and an Application Center to facilitate faster adoption and build-out of business capabilities predicated on the DNA Spaces software. There are numerous use cases beyond hospitality or higher education, and would encourage any organization to explore the possibilities of this product for their needs.



#### CONCLUSION

### *"A great product isn't just a collection of features. It's how it all works together." Tim Cook*

Based on multiple factors that are converging in the market today, customers can no longer incrementally piecemeal upgrades to their WLAN environments. The latest standards and plat-forms are driving new WLAN solution stacks that require holistic design-led analysis to properly develop solutions.

A consistent design approach along with continuous improvement of the design content through the WLAN Knowledge Base from Zivaro is the best way to ensure customers continue to receive excellent results in their technology transformations. Combining the strengths of Zivaro and Cisco, in partnership, gives any enterprise organization best-of-breed advisory, planning and implementation services to ensure a risk-reduced transition into new architectures, further protected by Cisco's long and successful wireless networking track-record building and innovating the market's best solutions.

#### REFERENCES

Zivaro Wireless Knowledge base (WKB): Zivaro Wireless Design KB 1.0.xlsm

Ekahau Design Best Practices

https://www.ekahau.com/blog/category/wi-fi-best-practices/wi-fi-design/

Wireless Catalyst 9800 Platform: Secure, Always On, Deployable Anywhere

https://blogs.cisco.com/networking/wireless-catalyst-9800-platform

#### The Checklist Manifesto

http://atulgawande.com/book/the-checklist-manifesto/