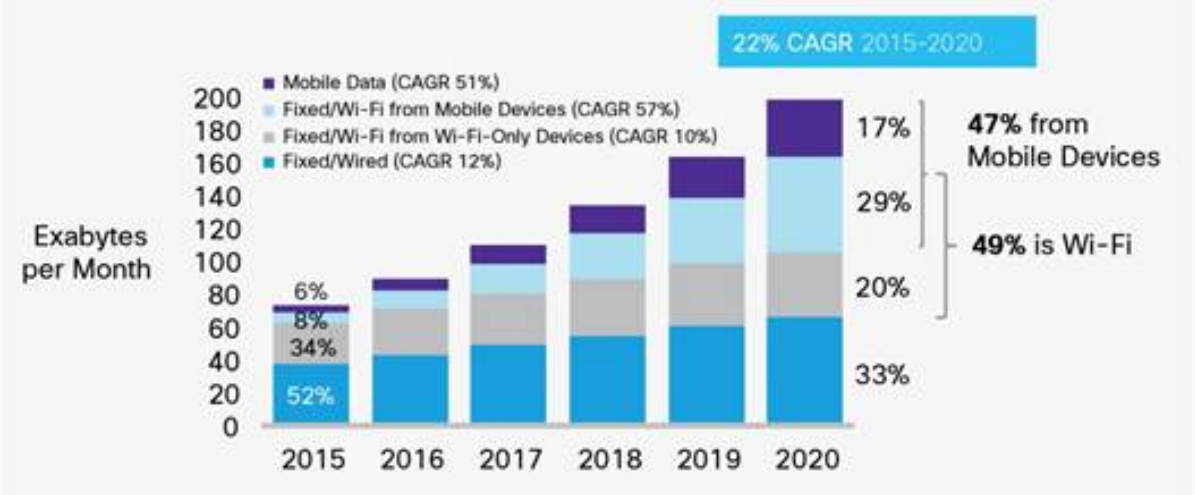
Deploying Wi-Fi Infrastructure in Healthcare Environments

Wi-Fi Trends

Hospitals and Healthcare environments serve an enormous percentage of the population, and as such, are subject to the trends and challenges of supporting a population which demands mobility and connectivity. In addition to satisfying their customers mobile communication needs, Healthcare information technologists are certainly keen to the opportunities posed by mobile and wireless technologies in their facilities. This is all predicated on a robust wireless network, which much be designed to accommodate present and future demands.

Each year Cisco publishes the Visual Networking Index (VNI) which provides a forecast of Internet Protocol (IP) requirements for 5 years. The 2017 VNI provided a forecast for growth in mobile IP as shown in the graph below. For the wireless Network Designer and Integrator (NDI), some key takeaways from this graph are as follows:

- Wi-Fi and mobile IP traffic is growing far faster than fixed (wired) traffic
- Mobile device and offload from mobile network to Wi-Fi will account for 47% of IP traffic
- Wi-Fi traffic from mobile offload to Wi-Fi, and Wi-Fi only devices, grows to 49% of all IP traffic



Source: Cisco VNI Mobile 2017

Clearly, the Wireless designer must plan for growth in coverage and capacity of their Wi-Fi network. This article describes some important considerations, as follows:

- Six important considerations for 2018 and beyond
- A brief on the classifications of wireless utilities as provided by BICSI

- Unique considerations for healthcare environments

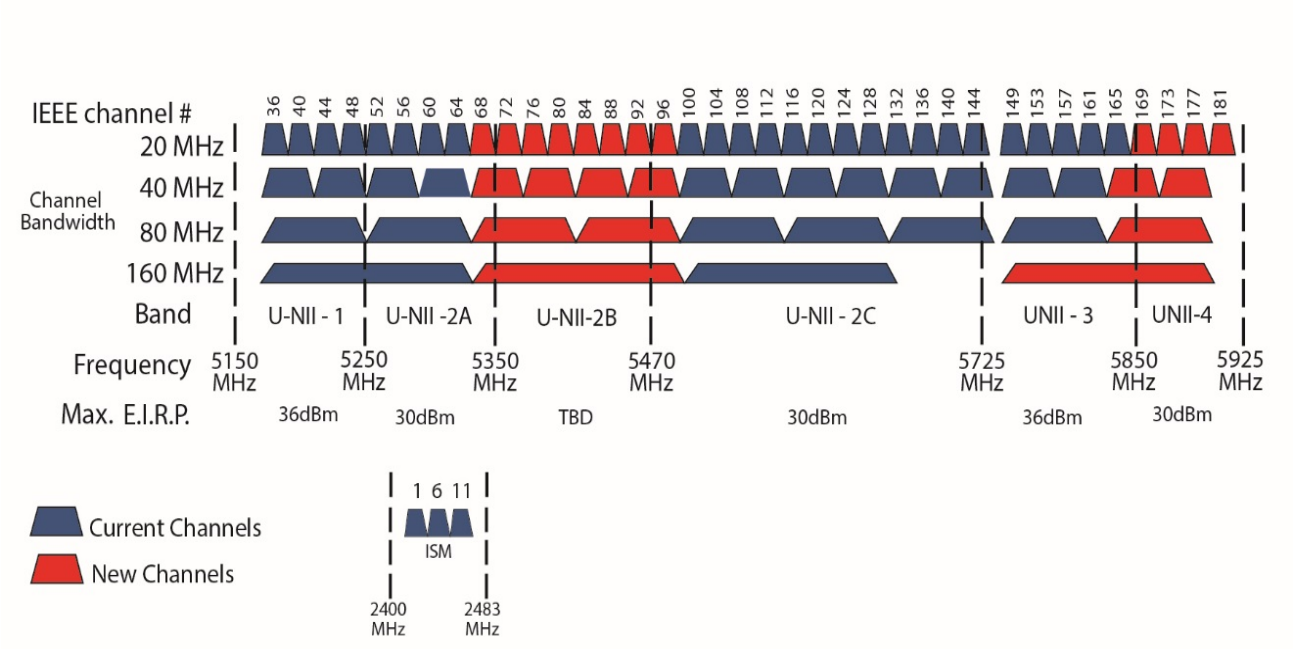
6 IMPORTANT Wi-Fi INSTALLATION CONSIDERATIONS FOR 2018

1. Wi-Fi Access Points (APs) may be replaced every 3 to 5 years

Access points need to be replaced more often than a lot of the other network infrastructure components. One reason is the advancement of wireless standards, based on improvement in technology and additional bandwidth. For example, in 2018, APs operating to the IEEE 802.11ac Wave 1 and Wave 2 standard are prevailing in new installs, and replacing 802.11n APs. Why are APs replaced so frequently? Here are a few reasons:

- Newer standards provide for more antennas and radio transceivers to achieve higher throughput
- New wireless services are integrated into the APs, such as Bluetooth low energy (BLE)
- Additional radio channels become available, requiring either firmware or hardware upgrades.

As an example, the chart below shows that there are twenty-five 20 MHZ channels available for operation in the 5-6 GHz range. In the future there may be 12 additional channels (shown in red). A future technology upgrade may require operation in these new channels.



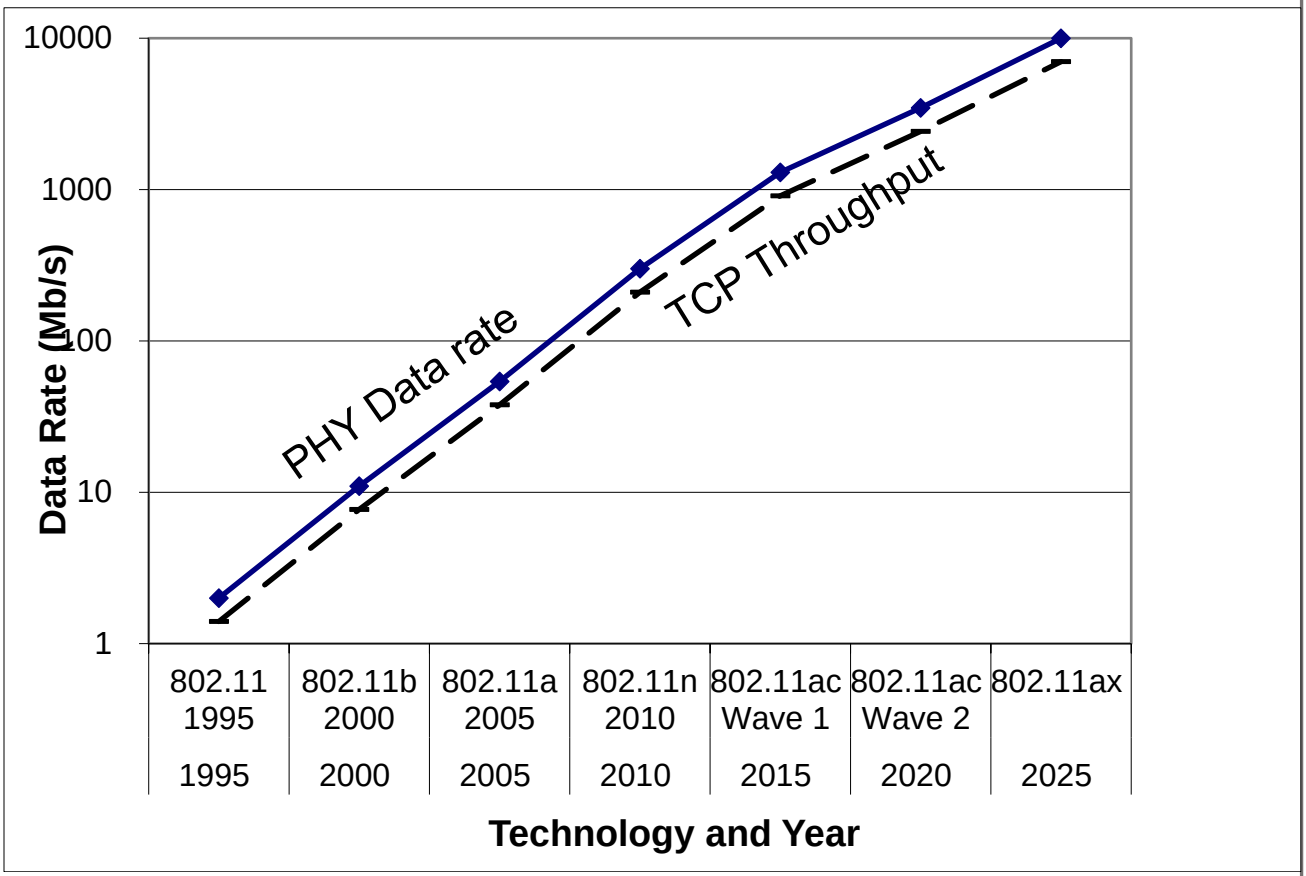
Spectrum Chart for the -B Domain (United States) as defined by the FCC

2. The Wi-Fi Access Points (APs) throughput will increase by a factor of 10, every five to seven years.

Of course, the primary reason to update and replace access points is to improve data throughput. Looking at the chart below, one can see the progression of standard amendments in roughly 5-year increments on the X-axis, and the increase in PHY data rate and TCP Throughput, plotted logarithmically, on the Y-axis. This trend will certainly continue into the near future with the emergence of IEEE 802.11ax compliant access points operating in the 5 GHz band.

What is the impact of more advanced access points on the network? The Wireless NDI must consider the following:

- Data cabling rated to higher throughput speeds in Gbits/sec
- Potentially 2 cables run to each access point
- Switch port capability
- Over subscription rate assumptions on switching backbone



As technology advances, wireless data rates increase by a factor of 10X every 5 to 7 years, continuing through 2025

3. Access Point Density Will Increase

Access point density will increase, for a number of reasons:

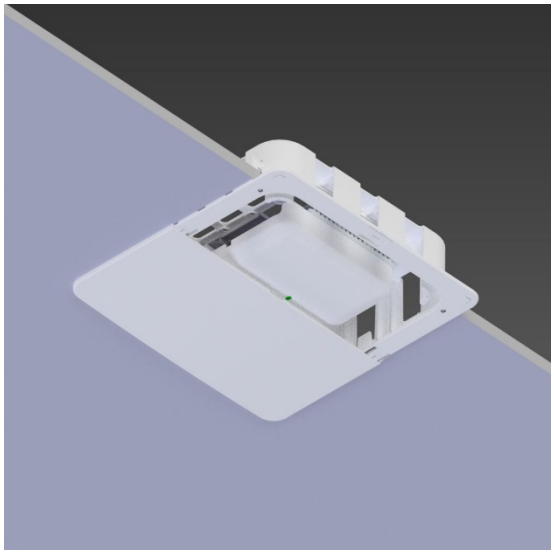
- As the number of client devices and traffic increases, more APs are required to provide access
- Access points operating in the 5 GHz band have a smaller zone of coverage (cell), versus a 2.4 GHz AP, so 5 GHz APs need to be closer together
- Wireless designers will use the smaller 5 GHz cell to reduce co-channel interference, thereby providing greater overall throughput

The Wireless NDI will need to consider the impact on cabling, and also location of the AP with the high-density AP deployment. By their very nature, to provide effective coverage, APs should be on the ceiling, high on walls, or other prominently visible locations. With high density deployments, it will be more important than ever to blend the AP into the environment.

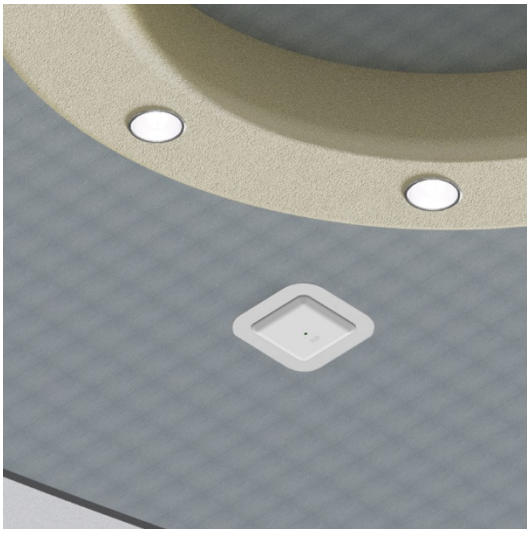
Different environments and construction types are present in all healthcare, education, commercial, government, retail, hospitality, and industrial settings. How will access points be installed in suspended ceilings, hard ceilings, open ceilings, on walls, etc.? More importantly now than ever, how will the AP be installed that's aesthetically or architecturally suitable for the environment? Many building owners, architects, designers, and, in fact, installers are looking for ways to blend the access point into the venue in an aesthetically acceptable manner.

Consider the following installation types and the associated mounting solution, which can help to achieve a balance of performance, aesthetics, and physical security.

Suspended Ceiling AP enclosure

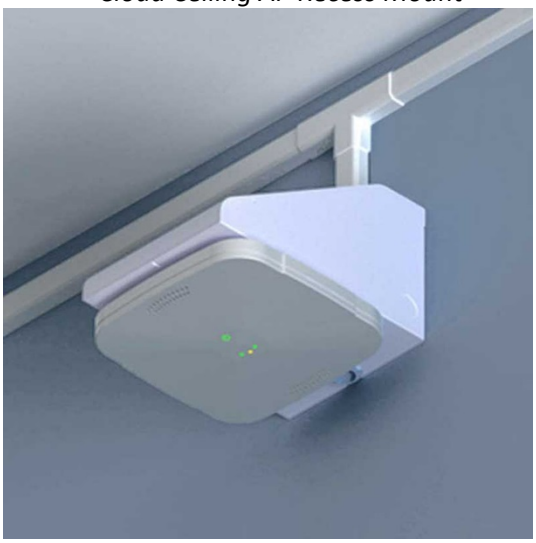


Hard Ceiling AP Recess Mount

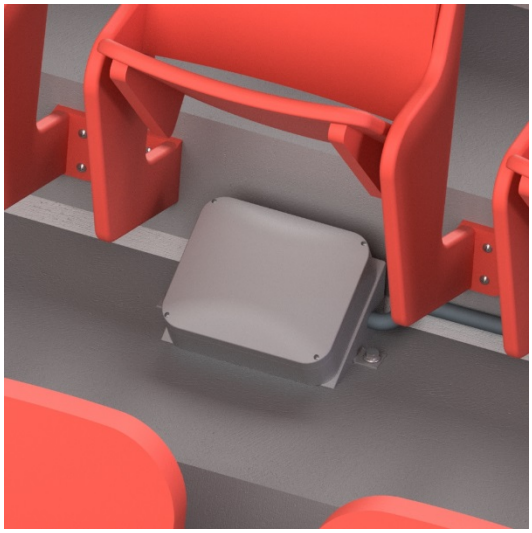


Cloud Ceiling AP Recess Mount

Open ceiling AP Mount



Right angle wall mount for AP



Public Venue Underseat AP Mount

Outdoor Wall mounted AP NEMA4 enclosure

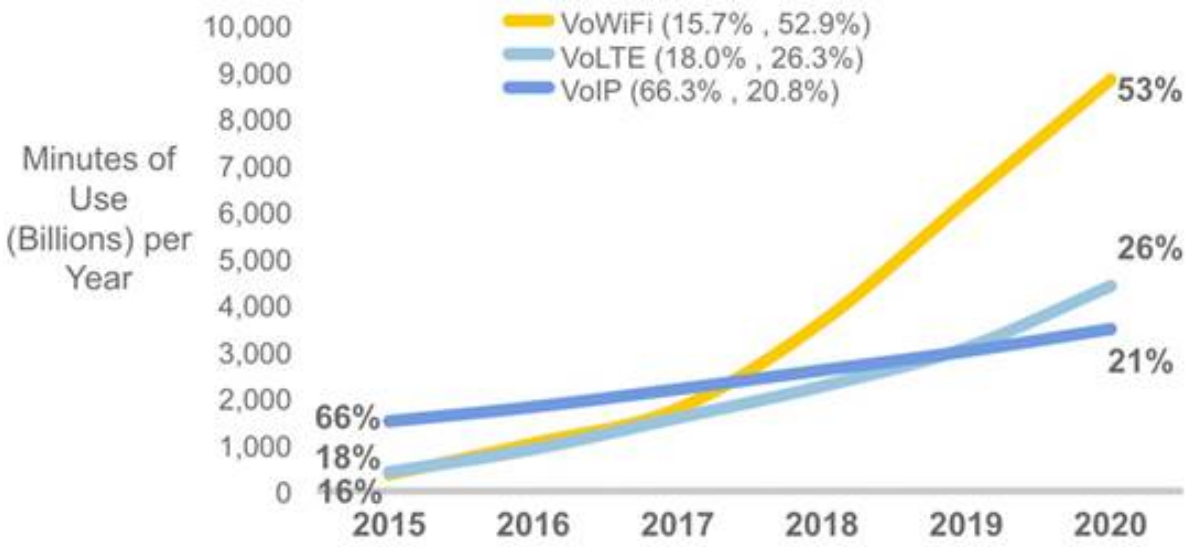
Outdoor Wi-Fi Bollard

4. The Wi-Fi Network will provide additional service

The Wi-Fi network will be required to support many new mobile applications such as the following:

- Voice over the Wi-Fi (VoWiFi)
- 5G services
- First responder services (First Net in US)
- Real Time Location Services (RTLS)
- Wearable wireless services
- Patient monitors and Telemetry
- Asset management

What is the impact of each of these services on the wireless network? Each service will require consideration of reliability, throughput, capacity, coverage, etc. As an example, consider the growth in Voice over Wi-Fi, forecast by the Cisco VNI 2016. VoWi-Fi grows to 53% of use in 2020. Although VoWi-Fi does not use as much bandwidth as other data applications might, it does have more challenging requirements for signal to noise ratio and coverage, so that callers do not drop calls.



Growth in Voice over Wi-Fi (VoWi-Fi) as forecast by Cisco VNI 2016

These new services may also require coverage where it was not necessary before, such as in stairwells, parking lots and garages, mechanical rooms, and outside of facilities. The wireless designer will need to consider how to provide Wi-Fi coverage throughout the facility, and sometimes, in challenging areas.

5. Network PHY and MAC Standards Emerging

The wireless NDI will need to consider the emerging industry and IEEE standards as they relate to the cabling plant and switching network service the wireless network:

- *ANSI/BICSI 008-2018, WLAN Systems Design and Implementation Best Practices* specifies that if balanced twisted-pair cabling is used, the cabling shall, at a minimum, meet Category 6A/Class EA performance. If optical fiber cabling is used, the cabling shall meet, at a minimum, OM3 performance.

- This documents states that for future growth or technology changes, *two* horizontal links are recommended for each AP. Many access points have two data ports to provide for link aggregation, which is further rationale for two cables to each location.

- The use of a hybrid or composite optical fiber with copper conductors can be employed for extended distances, such as outdoor installations.

- The NBaseT standard provides for 2.5 Gb/s and 5 Gb/s Ethernet over *existing* (CAT5e or CAT6) cable plant. This will extend the useful life of some installed

cabling infrastructure. More information is available on NBaseT at www.nbaset.org

6. AP Power is Supplied by Power over Ethernet (PoE)

This trend to power access points with PoE has been on-going for several years, and will continue as standards evolve. APs will advance in capability and will require the power to support additional antenna and radio transceiver channels. The wireless NDI must consider the impact on the wired infrastructure and PoE switches and injectors.

PoE STANDARD	# of PAIRS	POWER AT DEVICE
PoE IEEE 802.3af (802.3at Type 1)	2 pairs	12.95W
PoE+ IEEE 802.3at Type 2	2 pairs	25.5W
PoE++		
IEEE 802.3bt Type 3	4 pairs	49W
IEEE 802.3bt Type 4	4 pairs	96W
Non PoE standards based		
Cisco UPOE	4 pairs	60W
HDBaseT (www.hdbaset.org)	4 pairs	96W

7. HEALTHCARE SPECIAL: *BICSI MEDICAL GRADE WIRELESS UTILITY SUPPLEMENTAL INFORMATION*

BICSI is a professional association supporting the advancement of the information and communications technology (ICT) community. Identifying a need to provide wireless designers with guidance on providing a wireless utility in hospitals, The BICSI International Standards Wireless Subcommittee created the BICSI Medical Grade Wireless Utility Supplemental Information document. This document defines Medical Grade Wireless Utility (MGWU) in hospitals. MGWU is built upon the premise of three grades of service: Medical, Enterprise and Consumer.

- **Medical Grade**—LIFE CRITICAL Medical Grade Services support clinical devices and applications that exist to collect and share life critical medical information with providers of medical care.

- **Enterprise Grade**—MISSION CRITICAL Enterprise grade services support health devices and applications that collect medical information and are intended to “inform and direct”. They are considered mission critical but not life critical.

• **Consumer Grade**—INFORM Generally for use by the public, Consumer Grade wireless service supports consumer devices and applications that make no medical claim and are meant to "inform".

For more information, visit this website:

https://www.bicsi.org/uploadedfiles/pdfs/Sup_002_MGWU.pdf

SPECIAL CONSIDERATIONS FOR DEPLOYING Wi-Fi in HOSPITALS

A healthcare facility's top objective is to protect patients, and this includes protection from airborne infectious disease. Dust, mold, and spores found in the space above a suspended ceiling, or within walls, are components of airborne infectious disease. Specifically, surgery and immuno-compromised patients should be protected from these components of airborne infectious disease.

Poking holes through, or lifting, ceiling tiles to pass antennas or cables is not acceptable in hospitals, as these openings in the ceiling readily pass dust and spores. Wireless access points should be mounted in an enclosure which permits access to the equipment, and connection to the data cable, without lifting or penetrating the suspended ceiling.

These types of openings in the ceiling tile are undesirable in a healthcare environmental

ICRA Procedures

The Joint Commission on Hospital Accreditation has developed procedures for mitigating the spread of infectious disease and contamination in hospitals. These Infection Control Risk Assessment (ICRA) procedures require that areas in which work (such as pulling cable and lifting ceiling tiles) is to be performed must have a barrier in place, and be negatively pressurized,

such that dust and spores are not spread through the facility. These procedures will have a serious impact on access point and cabling installation, moves, adds, and changes.

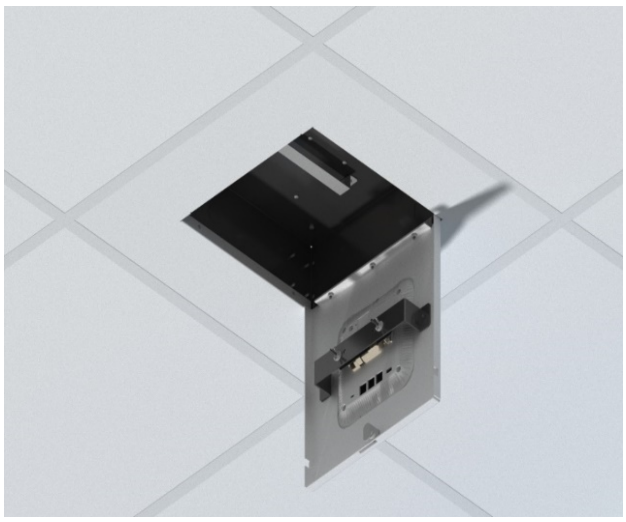
To address some of the special considerations of deploying a wireless network in a healthcare environment, the Telecommunications Industry Association has developed *TIA 1179 – Healthcare Facility Telecommunications Infrastructure* Standard. Among other topics, the standard warns that:

- *Once ceiling tiles are closed, adding or changing cabling could jeopardize infection control measures*
- *Restrictions on removing ceiling tiles impacts adds, moves and changes, and adds significant cost when the need arises to access the ceiling.*
- *It is recommended that the wireless environment be characterized prior to design and installation of cabling*
- *Policies and procedures to mitigate Airborne Infectious Disease shall be adhered to.*

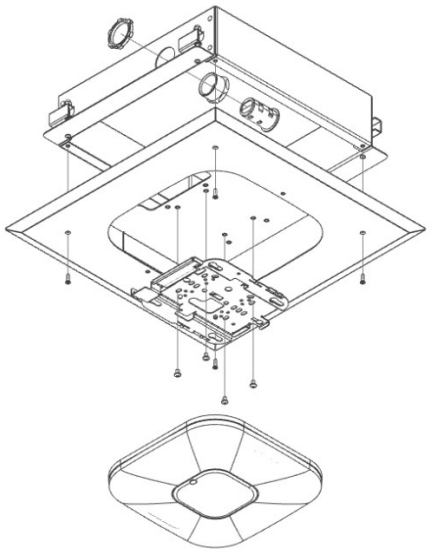
ANSI/BICSI 008-2018, WLAN Systems Design and Implementation Best Practices specifies that APs should be designed and installed so they are accessible for servicing and troubleshooting without need for infectious control protocols. Furthermore, the document states that the wireless access point infrastructure physical design should consider consistency, compatibility, and ease of operational support while lowering overall cost. Design costs should consider both initial installation costs as well as operational costs. The installation should result in minimal operational cost during the lifecycle of the horizontal cable system including cable, components, and associated hardware.

Oberon enclosures provide access to ceiling-mounted wireless LAN access points and networking equipment without entering the area above the ceiling (the “plenum” space), helping to protect vulnerable patients from airborne contaminants and simplifying ICRA procedures.

When ceiling tiles are lifted, and work is being performed, the work area shall be tented and negatively pressurized.



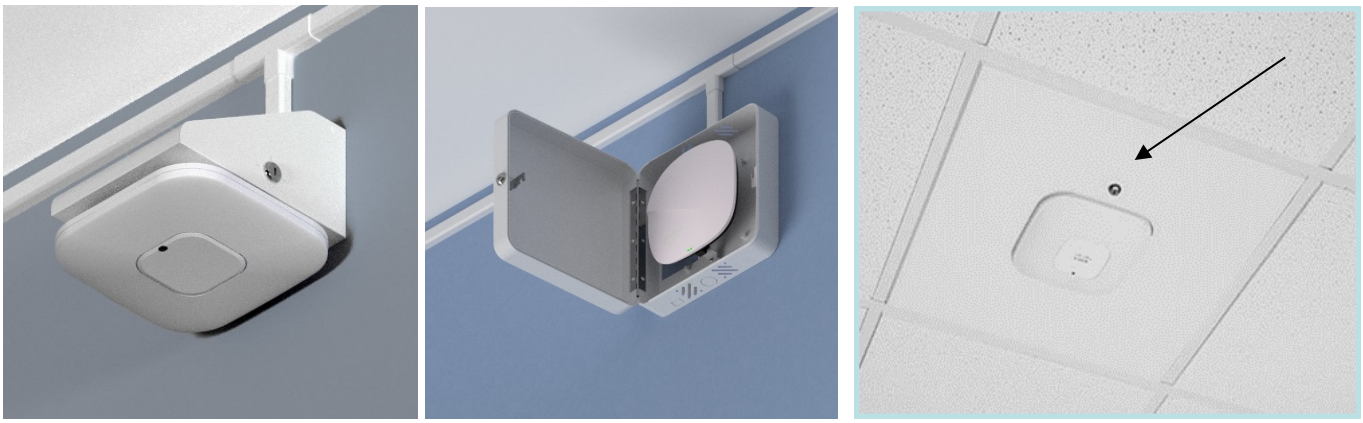
With the access point mounted in an Oberon ceiling enclosure in a suspended ceiling, the AP can be serviced without opening the plenum space.



Oberon's recessed hard ceiling amount mounts permit the access point to be removed without exposing the above ceiling space.

HIPAA Compliance

According to HIPAA section 164.301(a)(1) *implement policies and procedures to limit physical access to its electronic information systems… while ensuring that properly authorized access is allowed,* it seems to be a good idea to lock up access points, not only to avoid theft or tampering with access points, but also to deter access to the data connector. Many of Oberon's enclosures are lockable, so that HIPAA compliance regarding securing endpoints is assured.



Oberon locking mounts and enclosures (locking right angle bracket, surface mount box, suspended ceiling enclosure)

Architectural Considerations

Hospitals are often designed to reflect that values of the community, and whether the hospital is brand new or historically significant, the architectural and aesthetic integrity of the hospital needs to be considered in the pre-design phase. By their very nature, wireless APs are installed on ceilings, high on walls, or other open locations to provide for the best wireless coverage. As such, they are highly visible. The wireless designer needs to consider how the AP will be blended into the environment in a manner that is aesthetically acceptable, without compromising performance.

UL Listing

Oberon's UL Listed installation kits and enclosures also help installations meet the National Electric Code (N.E.C.) article 300.22 and 300.23 requirements for installing equipment above a suspended ceiling. The enclosure's solid back-box creates an effective dust, smoke, and fire barrier, helping to preserve the fire rating of the ceiling system.

Oberon offers a Wi-Fi access point enclosure or mounting solution for virtually every healthcare environment and venue. Oberon's products can help the wireless designer address standards and code compliance, ICRA procedure simplification, and performance and aesthetic challenges in hospitals. Please visit www.oberoninc.com for more information.

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