



Cabling and Infrastructure for Enterprise Wireless Networks

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Healthcare Facility Cabling Standard

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Effective December 28, 2010, BICSI recognizes **Cabling and Infrastructure for Wireless Networks Part II** training for the following BICSI Continuing Education Credits (CECs).

RCDD	RITP	ESS	NTS	OSP	WD	Installer 2 Cu/Fiber	Tech- nician	Cert. Trainer
1	1		1		1	1	1	1

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Oberon manufactures ceiling and wall mounted Telecommunications Enclosures (TEs) for wireless LAN access points and other networking components



Wireless AP enclosure



Workspace Telecom Enclosures

AGENDA



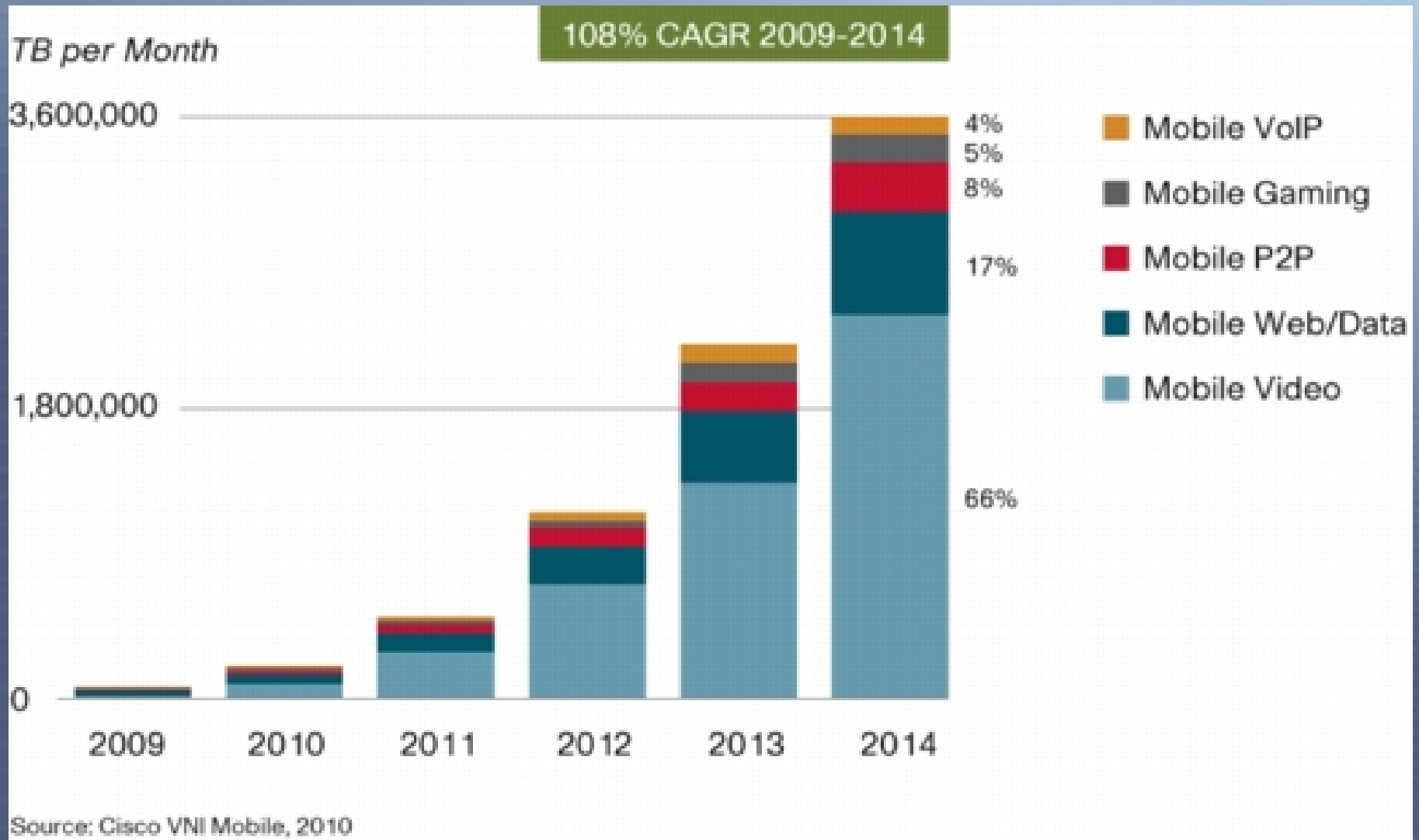
PART 1 December 1 2010

- Wireless Networking design basics
- Cabling the infrastructure - TIA standards
- Power over Ethernet (PoE)

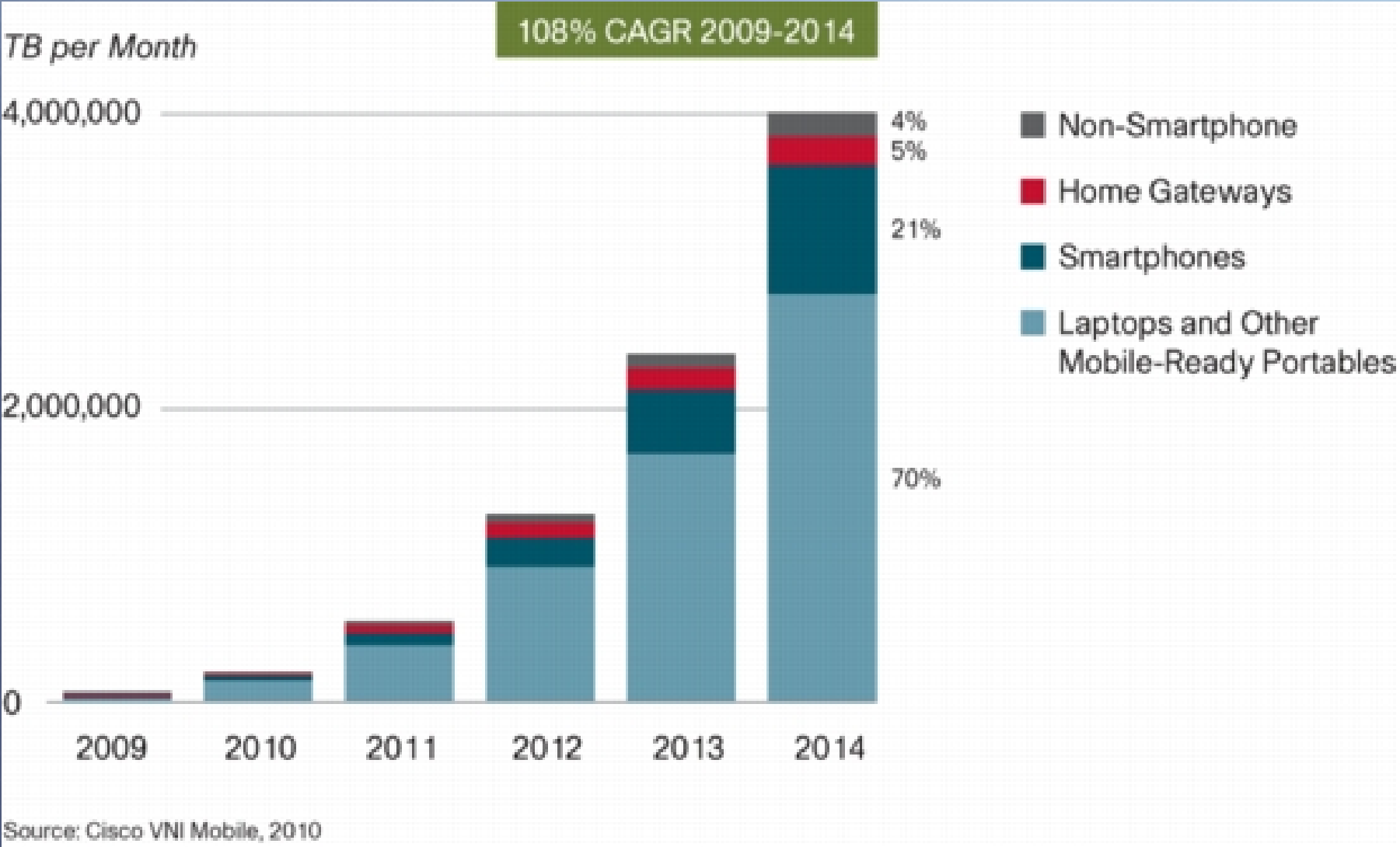
PART 2 February 2 2011

- Cabling for IEEE 802.11n wireless access points
- Installing in the air-handling (plenum) space
- Wireless in Healthcare
- Emerging applications

Growth in Global Mobile Data



Growth in Global Mobile Data





CABLING FOR IEEE 802.11n WIRELESS ACCESS POINTS



Cabling for IEEE 802.11n Access Points



- 802.11n is an amendment to the IEEE 802.11 Standard
- Uses advanced signal processing (Multiple Input/Multiple Output and beamforming) and advanced over the air modulation and coding methods to achieve unprecedented wireless data rates
- Many laptops and access points from leading vendors are 802.11“n” ready. Smart phones (Iphone and Droid) are 802.11b/g only.
- 802.11n devices may operate in the 2.4 GHz band and 5 GHz band. Smart-phones are in 2.4 GHz bands only. Wireless VoIP phones are 2.4 or 5 GHz.
- In mixed mode deployments, 802.11n performance will be degraded somewhat by 802.11 a/b/g clients, but may improve connectivity performance of 802.11 a/b/g clients

Cabling for IEEE 802.11n
Access Points



“SIGNALING” DATA RATE vs. DATA THROUGHPUT

“Signaling” data rate: Over the air modulation rate commonly used to specify the product

Data throughput: effective Ethernet throughput at the connector

Cabling for IEEE 802.11n Access Points



In Practice

Technology	“Signaling” data rate per radio	Nominal data through-put per radio
100Base-T wired Ethernet	100 Mb/s	>90 Mb/s
802.11 b wireless	11 Mb/s	~ 5-6 Mb/s
802.11 a or g wireless	54 Mb/s	~ 20-25 Mb/s
802.11 n wireless	300 Mb/s	~ 90 - 150 Mb/s Or 6 x performance

Cabling for IEEE 802.11n Access Points



“SIGNALING” DATA RATE vs. DATA THROUGHPUT

The difference is that the wireless connection has more packet overhead and lower bit density in the signaling

And remember-

Wireless access points are (somewhat) like Ethernet hubs - they share a collision domain, and they are half duplex.



Cabling for IEEE 802.11n Access Points



TYPICAL PRODUCT DATA RATE

Assume 150Mb/s data throughput rates per radio,
300 Mb/s for two radios

- Requires cabling for 1000Base-T (Gigabit Ethernet) versus 100Base-TX (Fast Ethernet)
- CAT5e or better cabling and connectors
- Is the AP, switch, and/or controller port 1000Base-T (gigabit) capable?

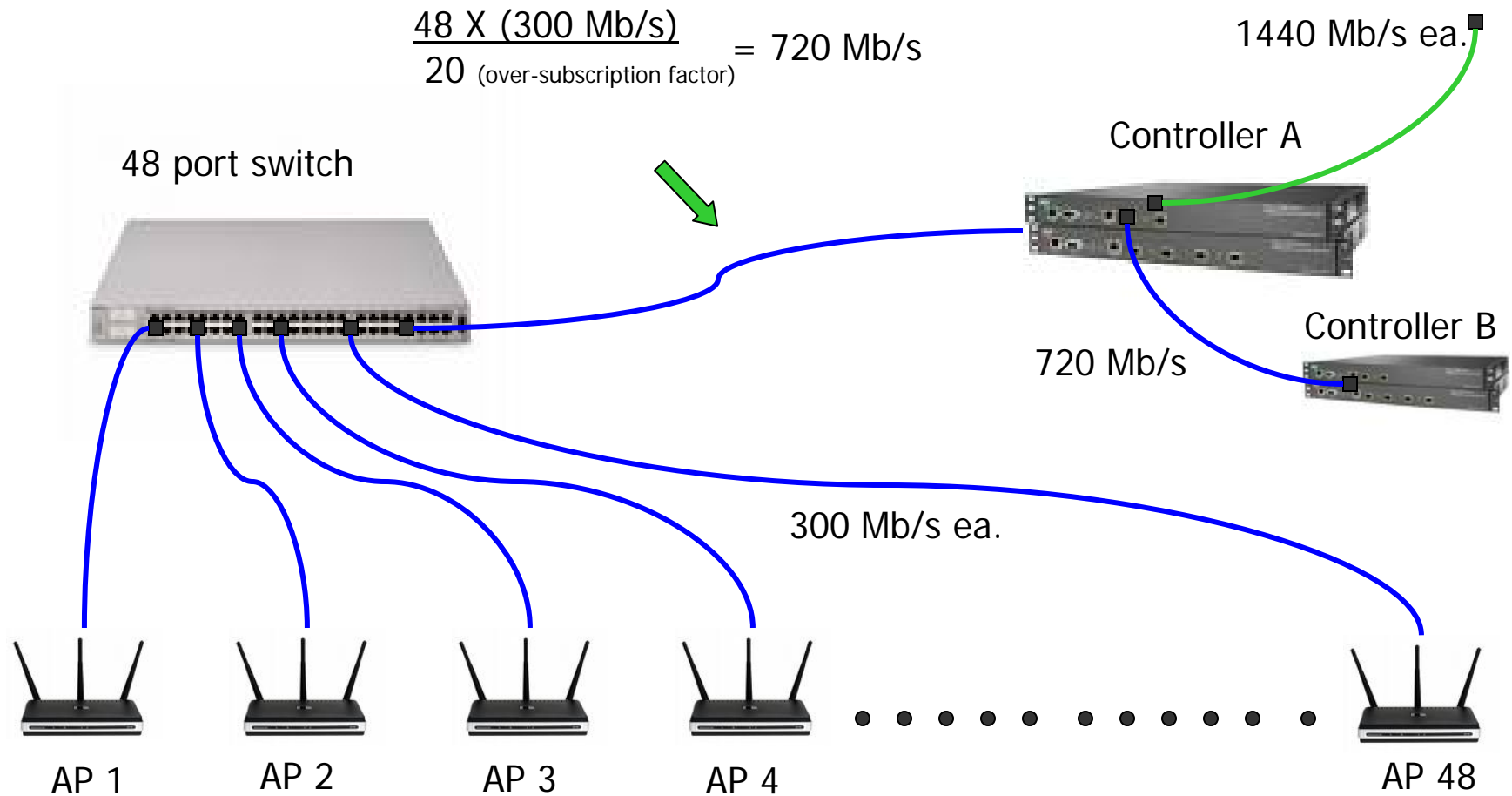


Cabling for IEEE 802.11n Access Points



INFRASTRUCTURE BANDWIDTH

What is the uplink bandwidth required when aggregating multiple APs? (using an over-subscription factor of 20, for example)



Cabling for IEEE 802.11n Access Points



BANDWIDTH REQUIREMENTS IN A GIVEN AREA

- 2.4 GHz, (3) non-overlapping 20 MHz channels, aggregate “real” throughput: ~75 Mb/s
- 5 GHz, (11) non-overlapping 40 MHz channels, aggregate “real” throughput: ~1,500 Mb/s
- Move 802.11n laptops to 5.8GHz, leave smart phones at 2.4 GHz

Cabling for IEEE 802.11n Access Points



Forcing Laptop to operate in 5 GHz Band

- Right-click the **My Computer** icon on the desktop
- Click **Properties**.
- Click **Hardware**.
- Click **Device Manager**.
- Click the **+** sign to expand the **Network Adapters** icon
- Right-click the wireless adapter and click **Properties**
- Click on **advanced**, under **property** go to Wireless mode and select 802.11a.

Cabling for IEEE 802.11n
Access Points

- Consider impact of densely deployed APs to provide the coverage and throughput desired
- Zone cabling approach?
- Edge switches with 10 gig uplinks? Multiple switches with 1 gig uplinks?
- 48 ports of PoE

Cabling for IEEE 802.11n Access Points



WORKSPACE TELECOM ENCLOSURES

Push higher bandwidth closer to the user

Shorten end run cables

Reduce crowding in pathways and spaces

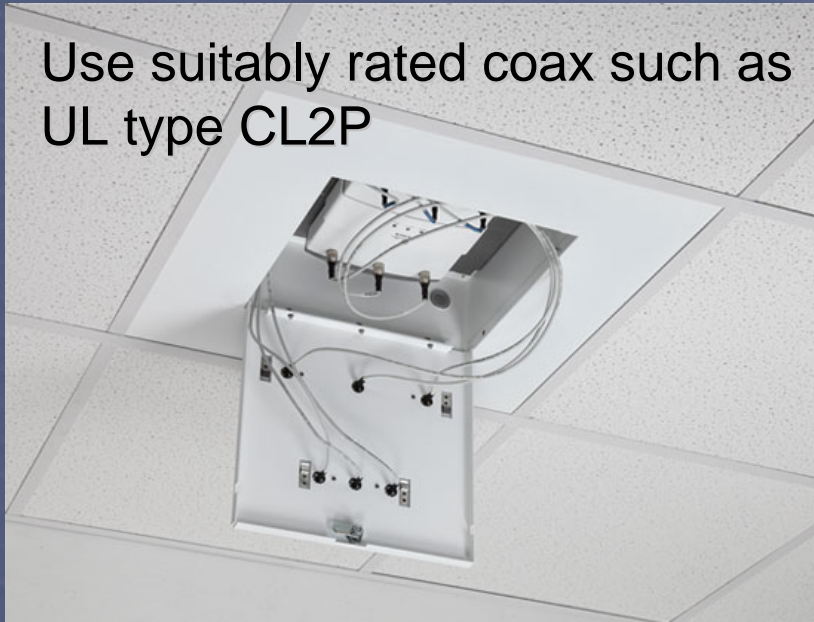
Reduce crowding and heating in telecom room

ANTENNAS



- 802.11n access points may require three to six antennas
- Some access points have non-detachable or body integrated antennas
- Antennas should be spaced about 4" apart (2.4 GHz), and 2" apart (5GHz) or greater. Beyond that, there is *not* a need to "space in increments of a wavelength"

Use suitably rated coax such as UL type CL2P



INSTALLING IN THE AIR HANDLING SPACE

INSTALLING IN THE AIR HANDLING SPACE



BICSI TDMM 12th Edition chapter 5

- “Cabling within ceilings used as a plenum for environmental air must conform to the requirements of applicable code”
- NOTE: Applicable codes, standards, regulations, and AHJ rulings should be consulted for compliance with flame spread and smoke index properties used in cabling pathway systems
- Ceiling panels and T-bars are not proper cabling support, use structural ceilings and walls
- Pathways and cables should be 3” above ceiling tiles

INSTALLING IN THE AIR HANDLING SPACE



NEC?

ICRA?

UL Listed?

- NEC Article 100 defines plenum as “A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system”.

OSHPD?

Plenum?

- Article 300.22(b) “Equipment and devices shall be permitted within such ducts or plenum chambers only if necessary for their direct action upon, or sensing of, the contained air”
- NEC article 300.22(c) *Other Spaces used for environmental air* : “The space over a hung ceiling used for environmental air-handling purposes is an example of the type of other space to which this section applies”.

INSTALLING IN THE AIR HANDLING SPACE



NEC article 300.22(c)(2)
“Electrical equipment with a metal enclosure, (or otherwise listed) shall be permitted to be installed in this other space (air-handling space) unless prohibited elsewhere in this Code”.



NEC article 300.23 *“cables, raceways and equipment installed behind panels, including suspended ceiling tiles, shall be arranged and secured so as to allow removal of panels and access to the equipment.”*

INSTALLING IN THE AIR HANDLING SPACE

What is “Plenum Rated”?

- Equipment is sometimes said to be “Plenum rated” if it is UL2043 listed
- UL2043 “is a fire test method for determining the fire performance response of discrete products (including, but not limited to electrical equipment) intended to be installed in air handling spaces, such as above suspended ceilings or below floors.....”
- Equipment not UL2043 listed should be in a metal enclosure (per NEC article 300.22(C)(2)).

WIRELESS LAN IN HEALTHCARE

TIA-1179 Healthcare Facility Telecommunications Cabling Standard



- This standard specifies requirements for telecommunications infrastructure for healthcare facilities
- Entrance facilities and rooms (2 diverse paths from entrance facility to equipment room)
- Equipment & Telecom rooms (plan for 100% growth)
- Horizontal cabling (work in pathways should not compromise operations- enclosed pathways in air handling spaces?)
- Work Area outlet density (11 work area classifications)

TIA-1179 Healthcare Facility Telecommunications Cabling Standard



- Recognizes that “adding or changing horizontal cabling may cause disruption to occupants and their work once the buildings ceiling and walls are closed”
- Advocates planning well ahead in cabling design and capacity
- Telecommunications enclosures are an option in areas subject to infection control measures
- “It is recommended that the wireless environment be characterized and understood prior to the design, choice, and installation of cabling to ensure satisfactory operation”

Infection Control Risk Assessment (ICRA)



- In Healthcare, the Joint Commission on Hospital Accreditation has established procedures for mitigating the spread of infectious disease and contaminants- limiting access to the air-handling space.
- Infection control risk assessment (ICRA) could have a serious impact on the times and conditions for cabling installation, moves, adds and changes, particularly in the air-handling “plenum” space.
- TIA-1179 advocates use of enclosed pathways in air-handling spaces to avoid disruption of operations.



EMERGING APPLICATIONS

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Distributed Antenna Systems (DAS)

- *Micro or Pico cells* - smaller base-stations distributed throughout a campus (outdoors)

In-building distributions systems (in-building DAS) – may use fiber optic, twisted pair or coaxial cabling in–building for signal distribution in premises

Bi-directional amplifiers- All RF solution, with coaxial cable from outside donor antenna to inside coverage antenna

Femto-cells- residential cellular gateways that plug into the home Internet connection

EMERGING APPLICATIONS



How Does Wi-Fi compare to Cellular in terms of capacity?

Wi-Fi: 11 non-overlapping 5GHz channels and 3 non-overlapping 2.4 GHz channels

- Outfit a 30,000 sq. ft. building with 22 APs = 3,300 Mb/s throughput at 5 GHz, plus, 11 APs have the 2.4 GHz radio on, for an additional 275 Mb/s, for a total of **3,575 Mb/s**

Cellular – what bandwidth does a micro basestation provide?

Current cellular and PCS bandwidth 170 MHz

New bandwidth +377 MHz

Total bandwidth 547 MHz (3 sector multi-carrier BTS)

Bandwidth in 1 sector = $547 \text{ MHz} / 3 = 182 \text{ MHz} \times 1.4 \text{ bps}^* = \mathbf{255 \text{ Mb/s}}$

* LTE Spectral efficiency

CELLULAR CAPACITY MUCH LESS THAN Wi-Fi !

PREPARING FOR THE FUTURE

- Mission critical apps and voice over the Wi-Fi network, enormous amount of video and web content
- Wireless Gigabit Alliance: 7 Gbps wireless networking at 60 GHz band
- IEEE 802.11ad: wireless networking at 60 GHz, based on 802.11
- Gigabit Ethernet to the AP probably adequate for some time into the future
- Consider other RF services such as RFID, RTLS asset location, cellular, first responder, etc.

- PoE calculator

http://www.oberonwireless.com/WebDocs/Partner_Resources/PoE_Calculator.xls

- Cisco and FCC Mobile wireless forecast

http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.html

http://www.fcc.gov/ftp/Daily_Releases/Daily_Business/2010/db1021/DOC-302324A1.pdf



www.oberonwireless.com

Presentation available at

<http://www.oberonwireless.com/webinars.php>

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