

Design, Installation and Implementation of Multiple Low Voltage Systems – A Case Study

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A Case Study

- Design, installation and project management processes are well documented in BICSI, NFPA 70, TIA/EIA publications and numerous other standards and codes.
- In this case study we will touch on the design issues but concentrate on the practical aspects of implementation rather than the design.
- Dealing with the inevitable, never-ending parade of “issues” during the design, management and implementation process.

A Case Study



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The Business

- Quality Distribution Inc. A global logistics / trucking company with 140 locations in seven countries.
- This corporate location houses common services and executive oversight for corporate and affiliate locations and a 24/7 federally mandated 911 information call center due to handling of hazardous materials.
- Quality Distribution's digital resources are largely cloud based with wide range of tech solutions. QDI personnel resources are very lean and efficient demanding complex solutions to support IT personnel.

The Project

- ~60,000 square feet ,
 - housing ~270 employees
- Fast track project
 - 6 month build-out
- Existing building
 - unimproved first floor



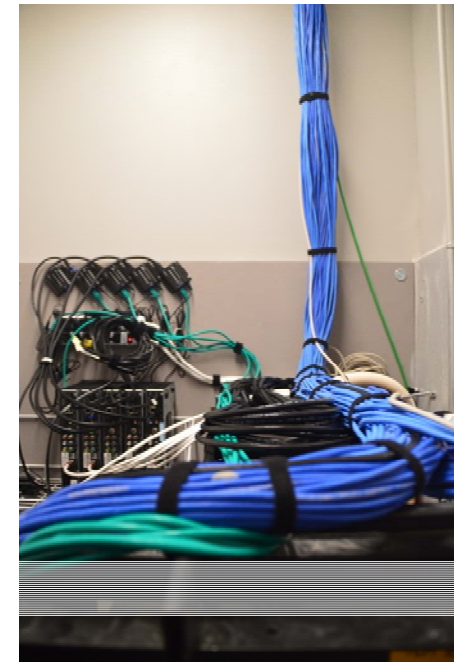
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Low Voltage Systems

- IP voice
- IP data
- 802.11ac Wave 2 wireless
- Audio visual and CCTV
- Digital signage, displays and scheduling boards
- Surveillance video
- Access control



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Low Voltage Systems

- Sound masking
- Public address
- HVAC control
- Fire alarm and public safety



- All low voltage systems were cabled with CAT6 UTP, 125/50mm fiber, RG-11 Coax or composite access control cable (banana peel)

Contract Management

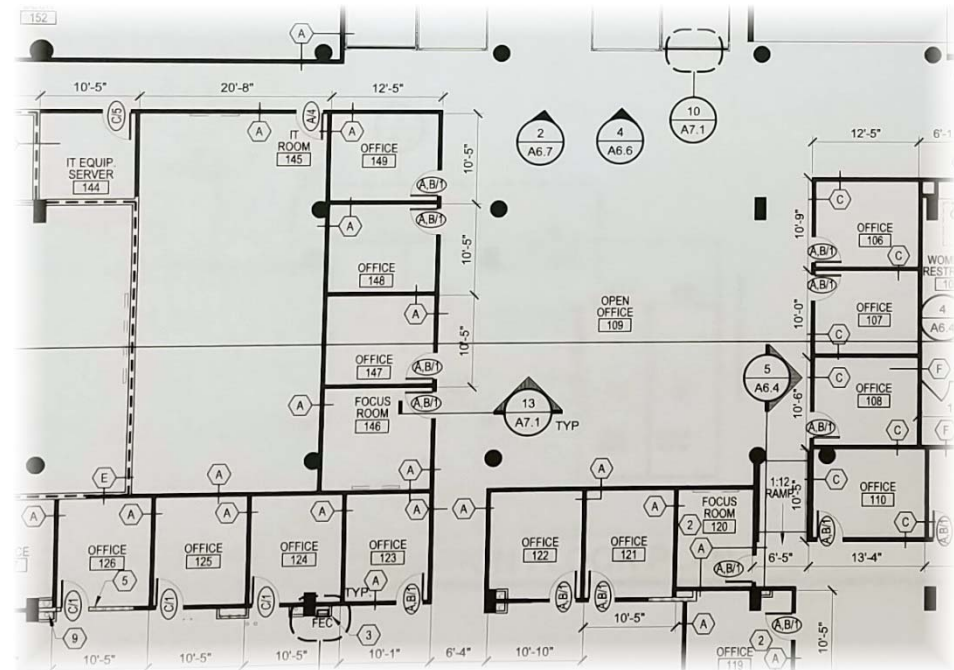
- Low voltage contractor was selected by a closed bidding process. Three contractors well known to me were invited to bid.
- To the extent possible all low voltage cabling for any systems / vendors were moved to the prime low voltage contractors responsibility.
- A single cable contractor avoided duplication of effort and afforded more control over timing and schedule.

Contract Management

- Contractors working directly for QDI and who lacked material or manpower to perform critical tasks in a timely manner had a portion of their work transferred to the prime low voltage contractor as needed.
- Days of delays and the cascade effect of those delays were mitigated by this policy by reinforcing the need to have materials and manpower available when the work schedule demands it.
- An abbreviated change order process helped facilitate contract management.

Pathways and Spaces

- 12' to 38' ceilings most walls don't go to ceiling level.
- Blocks of offices are unconnected to each other.
- Initial MDF and IDF sizes were insufficient for equipment.



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Pathways and Spaces

- Free standing office cubicles, power poles not an option requiring under slab conduit.
- Under slab conduit is defined as a wet location in NFPA 70 article 310.10c requiring “listed” components. This was asserted by the “authority having jurisdiction”.
- A search for such “listed” communications cable found none.

Pathways and Spaces

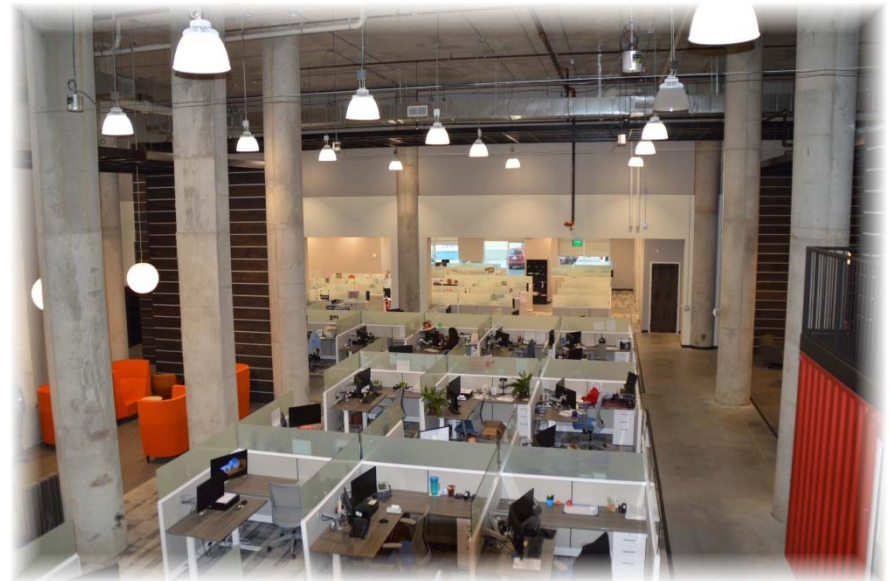
- Referencing NFPA 70 article 800.47 exempts communication cables from the requirements of article 310.10c.
- Mystery solved- no “listed” cables because it is not required. Getting an independent lab to test and list cables for a specific application can cost thousands or tens of thousands of dollars.

Pathways and Spaces

- Electrical contractor opted out of design documents in favor of re-engineering pathways “on the fly” for their ease and benefit.
- Installing only pathways, they were “unaware of 100 meter Ethernet limitations”. (note: this contractor wanted to bid on the low voltage installation)
- Job suspended pending an investigation and coordination meeting.

Pathways and Spaces

- Sound masking speakers hung from ceiling deck with hanger wire and CAT6 cabling was “draped” from speaker to speaker in free space without support.
- The installation was suspended and I insisted on messenger wire which previously was strongly suggested.



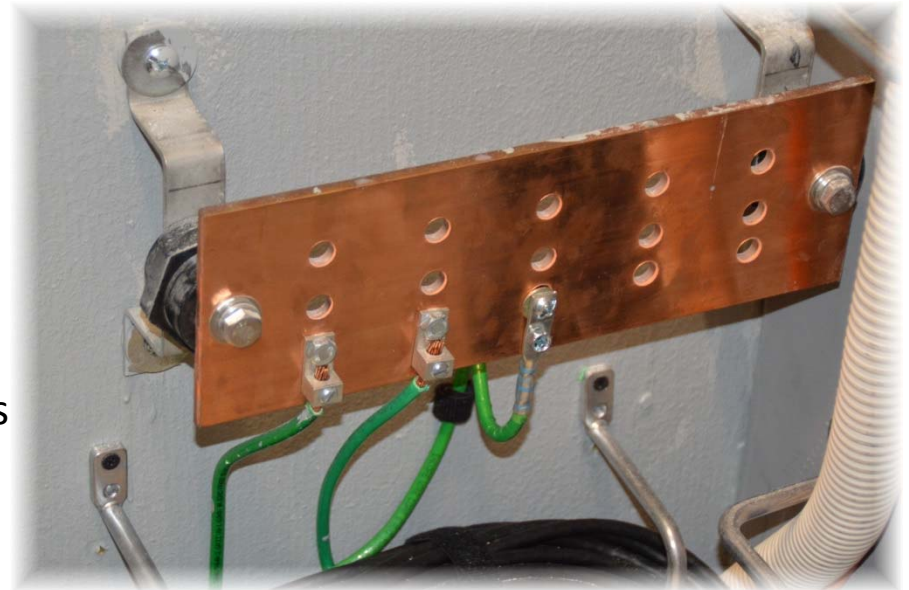
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Telecomm Bonding Backbone

- Components were not installed per plan. Per contractor “not required by NFPA 70”
- Improper size copper conductors
- No exothermic connection to lugs
- One hole lugs substituted for two hole lugs
- Bonding buss bars were installed on wall opposite backboards



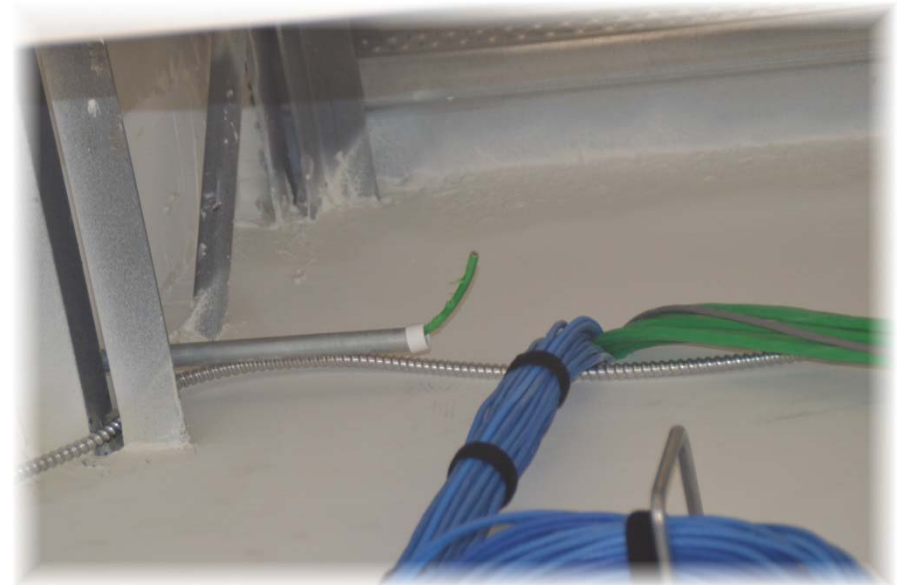
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Telecomm Bonding Backbone

- Improperly installed grounding conductors not compliant with NFPA 70 article 250.64e1
- installed in metallic conduit bonded to conductor on only one end (not NFPA 70 compliant)
- Potentially destructive to electronic equipment and shock hazard.



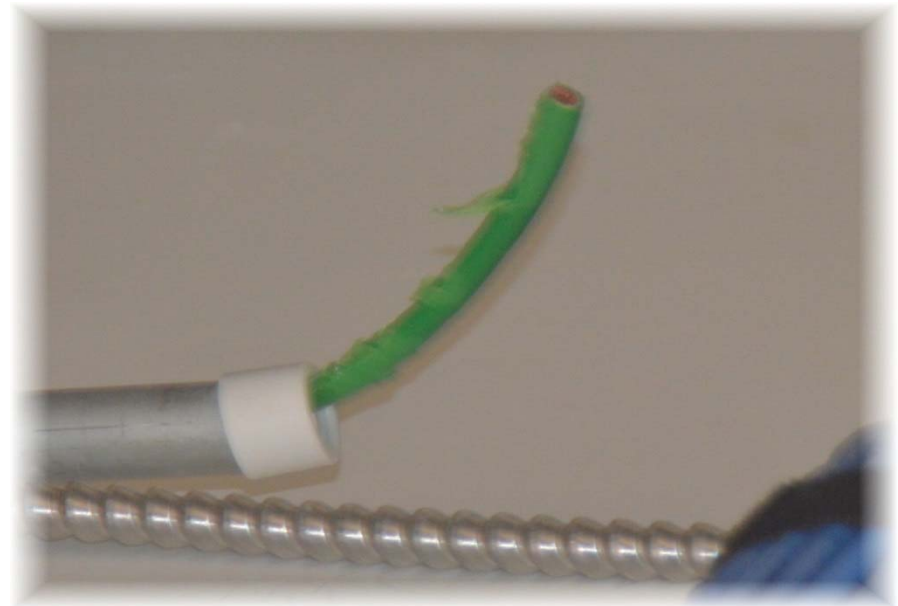
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Telecomm Bonding Backbone

- This connection wasn't specified, improperly installed AND the electrical contractor was unwilling to correct.
- We cut the copper conductor off where it exited the conduit to mitigate the danger.

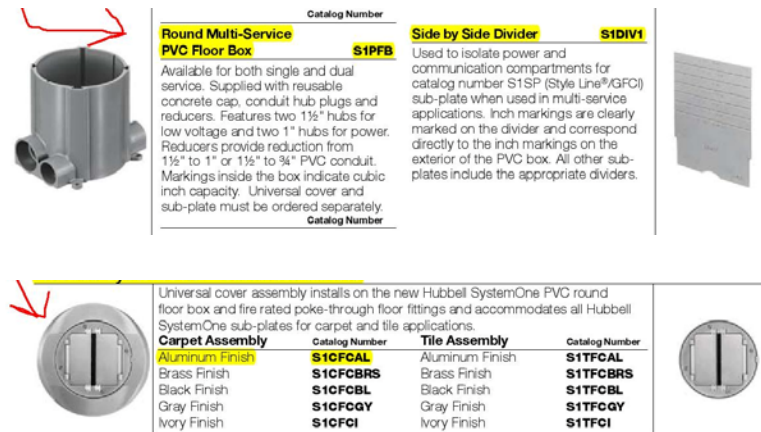


Access Control System

- Low voltage card reader wall boxes had 120v AC circuits installed in them and request to remove the circuits were met with resistance and change order requests.
- Electrical contractor repeatedly ignored requests to install conduit raceway for fire alarm interconnect.

Power / Data Floor Boxes

- When the power and data floor boxes were completed, connecting the modular furniture, the low voltage divider plates were not installed between the low voltage and 120vac sides of the box as required by NFPA 70 (NEC).



Round Multi-Service PVC Floor Box		Side by Side Divider
Catalog Number	S1PFB	S1DIV1
<p>Available for both single and dual service. Supplied with reusable concrete cap, conduit hub plugs and reducers. Features two 1½" hubs for low voltage and two 1" hubs for power. Reducers provide reduction from 1½" to 1" or 1½" to ¾" PVC conduit. Markings inside the box indicate cubic inch capacity. Universal cover and sub-plate must be ordered separately.</p>		<p>Used to isolate power and communication compartments for catalog number S1SP (Style Line®/GFCI) sub-plate when used in multi-service applications. Inch markings are clearly marked on the divider and correspond directly to the inch markings on the exterior of the PVC box. All other sub-plates include the appropriate dividers.</p>

Universal cover assembly installs on the new Hubbell SystemOne PVC round floor box and fire rated poke-through floor fittings and accommodates all Hubbell SystemOne sub-plates for carpet and tile applications.	Carpet Assembly		Tile Assembly	
Catalog Number	Catalog Number	Catalog Number	Catalog Number	
	S1CFGAL	Aluminum Finish	S1TFCAL	
	S1FCBRS	Brass Finish	S1FCBRS	
	S1FCBBL	Black Finish	S1FCBBL	
	S1FCQGY	Gray Finish	S1FCQGY	
	S1FCFI	Ivory Finish	S1FCFI	

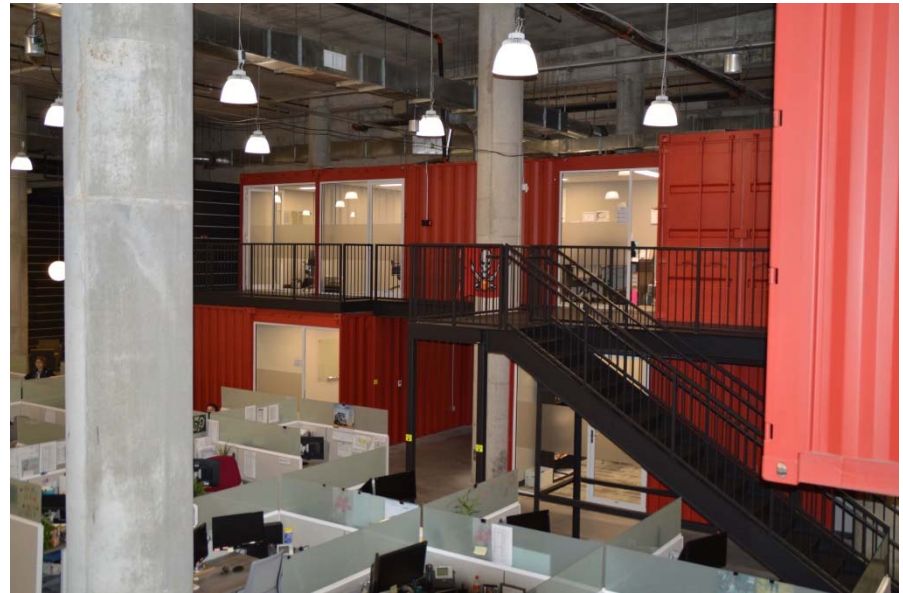
802.11ac Wireless Systems

- The space is a rich environment for multipath, in-band and out-of-band interference and numerous foreign access-points.
- The center of the space is divided by stacked metal shipping containers creating an effective RF barrier.
- Originally estimated to require 5 or 6 APs to provide -65dBm @ 5Ghz or better



802.11ac Wireless Systems

- A full wireless survey was performed after the containers were in place due to the complexity of the RF environment.
- We ended up with a total of 9 - 802.11ac dual band access-points with three spatial streams each to meet our design specification.



WAN Point to Point Circuit

- We had a 1Gb/s production Internet circuit, 500Mb/s non-production lab circuit and our VoIP backup SIP trunk installed and tested prior to move date.
- One point-to-point circuit connecting the new office to our Atlanta data center was not going to be available on our move in date.
- We installed a pair of firewalls in the new location and datacenter and configured a temporary VPN... This was a major problem resolved.



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Successful Outcome

- The project finished on time and on budget.
- All systems commissioned as expected.
- All phone and data equipment, circuits and 270 desktops and peripherals were moved, patched and online and fully functional in 36 hours.
- Our point-to-point circuit was completed and commissioned two weeks after moving to the new location.



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