SPACE AND ENVIRONMENTAL PLANNING FOR PUBLIC SAFETY AND CELLULAR DAS

PRESENTER

- Hollis Heron, PE, LEED AP, GROL
- Engineering Operations Manager
- DAS Simplified

AGENDA

- ANATOMY OF A DAS
- EMERGENCY RESPONDER RADIO COVERAGE DAS
  - DESIGN CRITERION
  - CASE STUDIES
- CELLULAR COVERAGE DAS
  - CRITERION
  - EXAMPLES
- INTERPRETING THE BICSI STANDARDS

DISTRIBUTED ANTENNA SYSTEMS

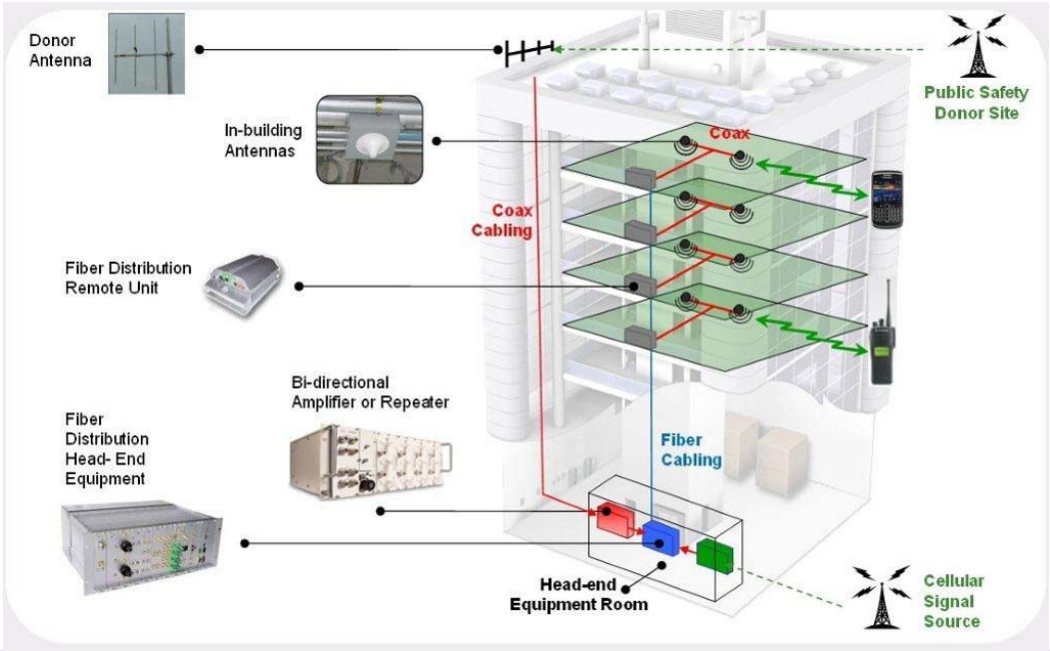
- Two Types
  - Emergency Responder Radio Coverage AKA Public Safety Network (PSN)
  - Cellular Coverage

ANATOMY OF A DAS

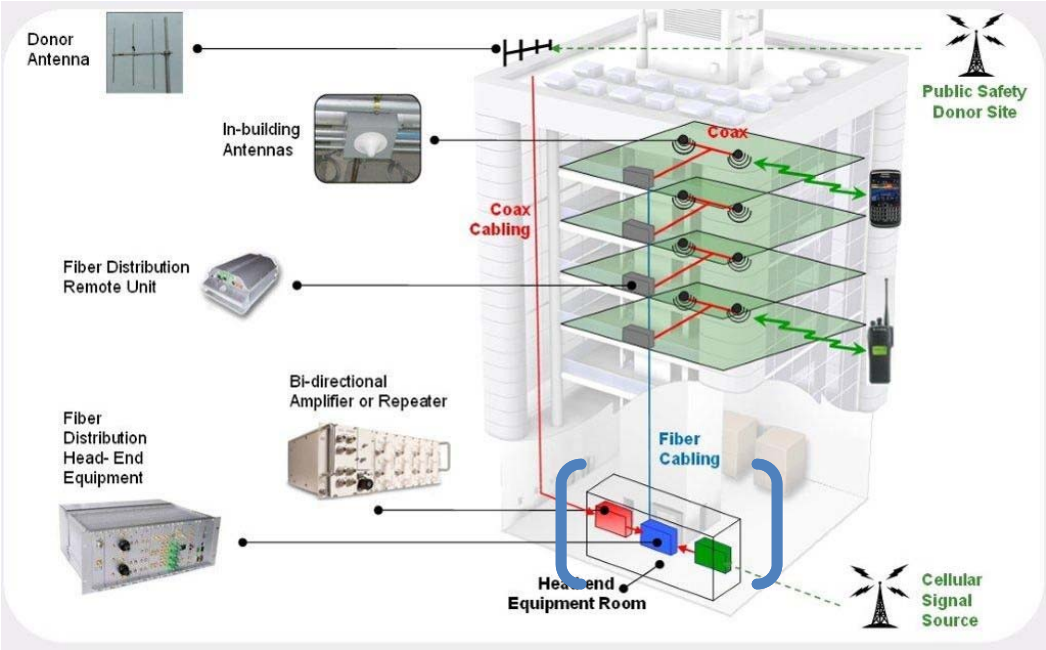
TYPICAL EQUIPMENT

Fiber Fed DAS

Fiber to 50Ω Coax Cable



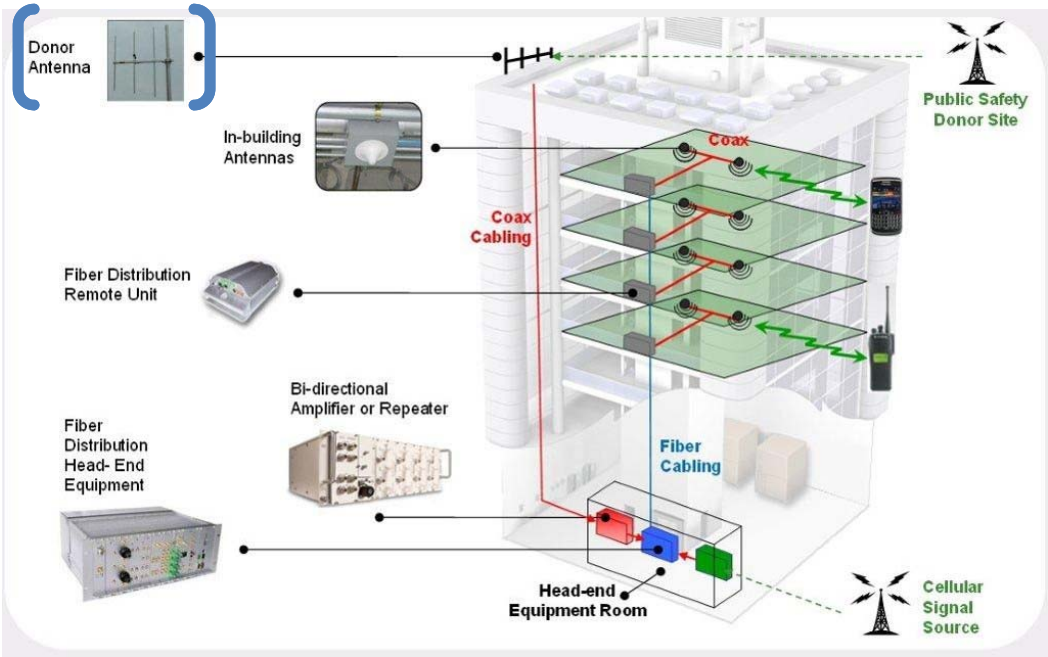
Fiber to 50Ω Coax Cable



BASE TRANSCEIVER STATION

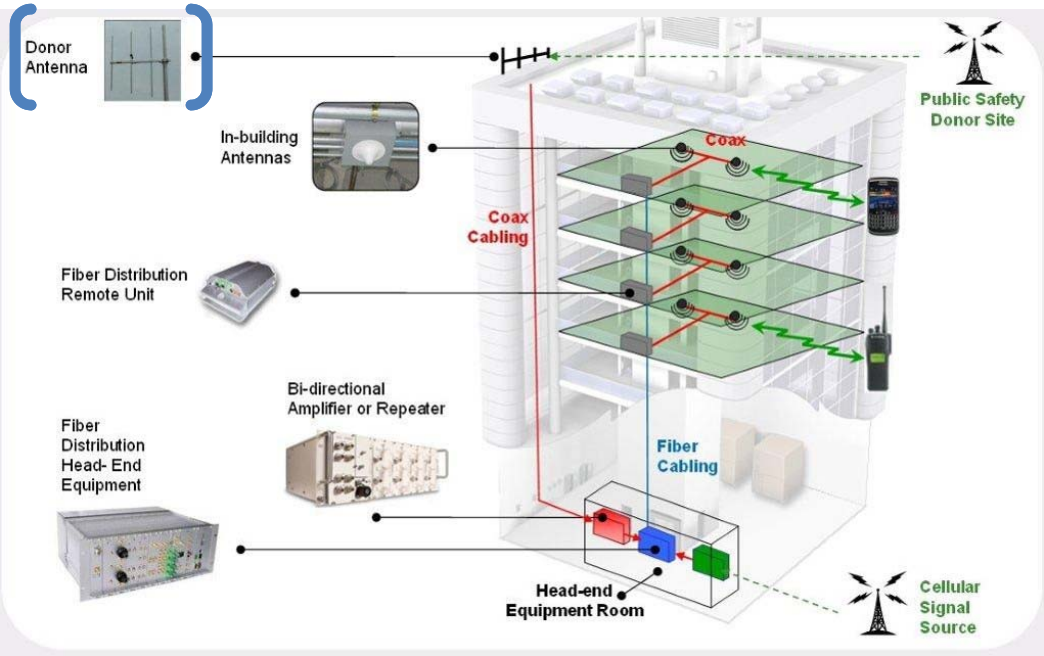
ANTENUATOR TRAY

DONOR ANTENNA

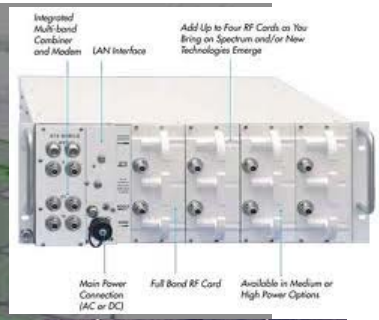


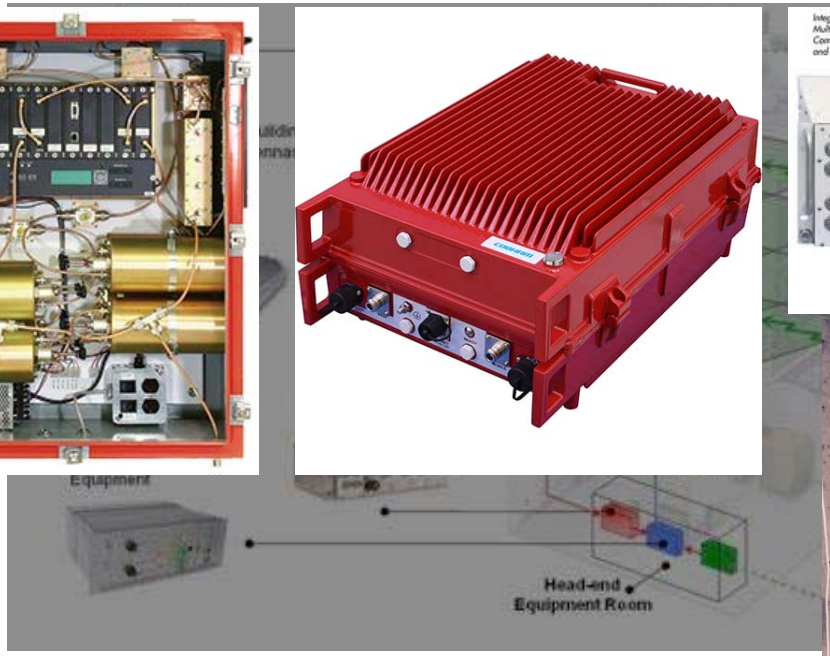
DONOR ANTENNA

Fiber to 50Ω Coaxial Cable

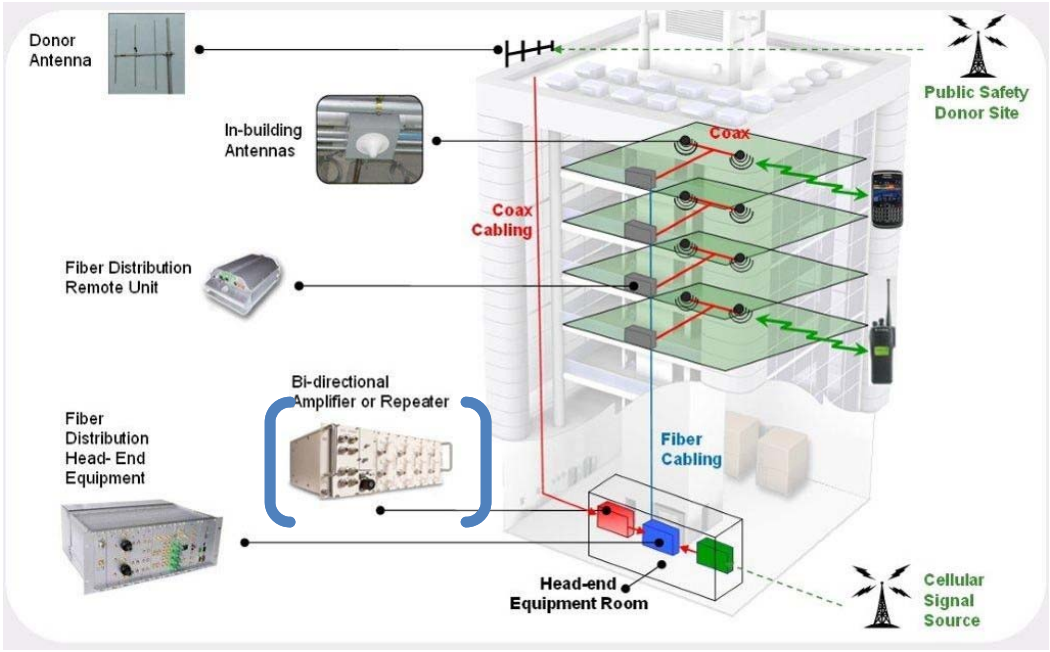


BIDIRECTIONAL AMPLIFIER

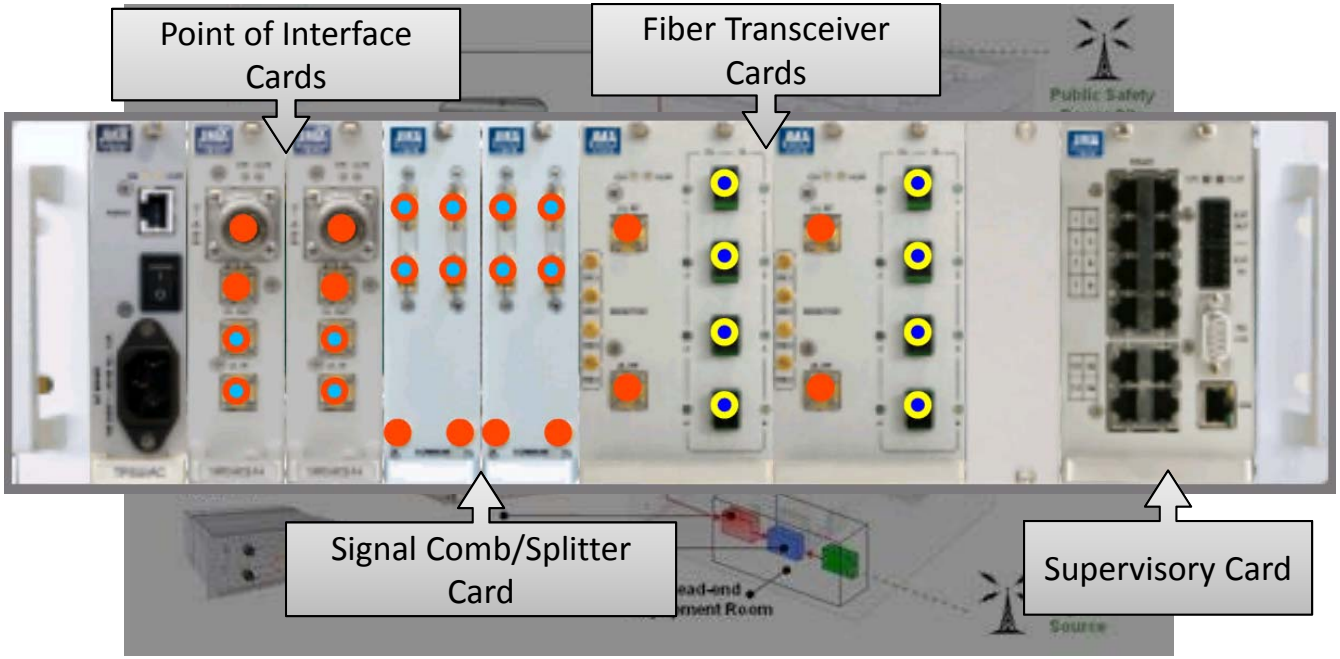




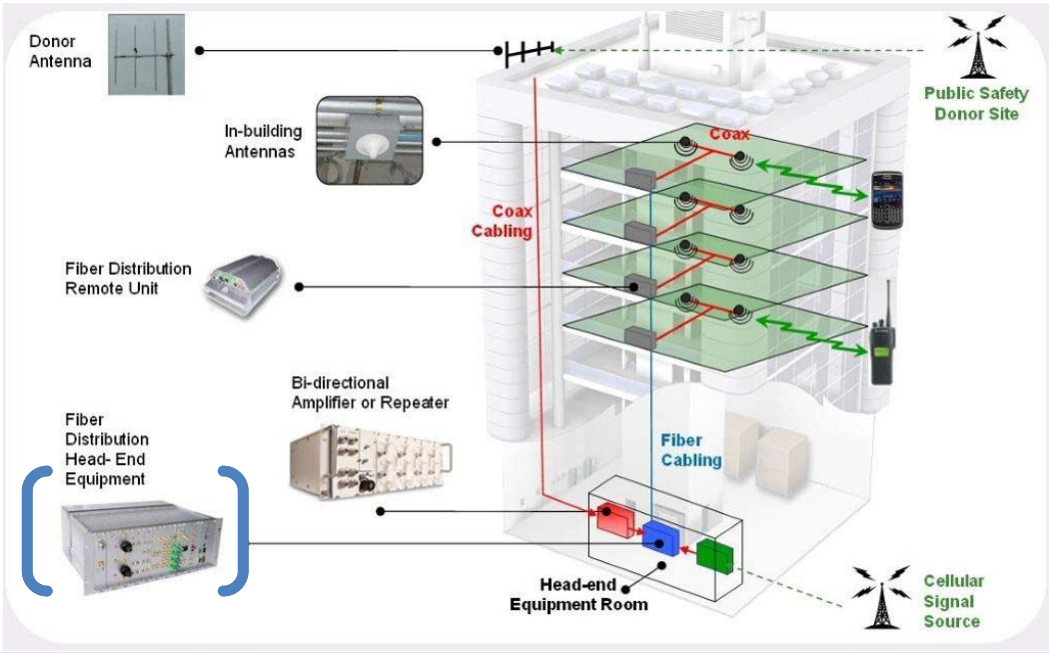
Fiber to 50Ω Coaxial Cable



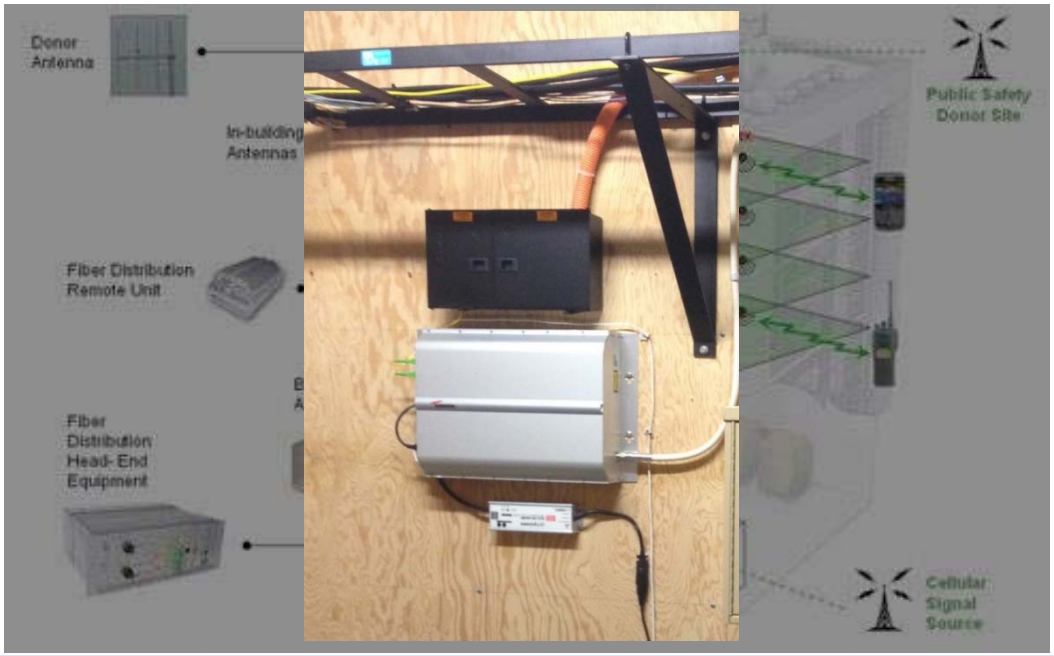
Fiber Transceiver



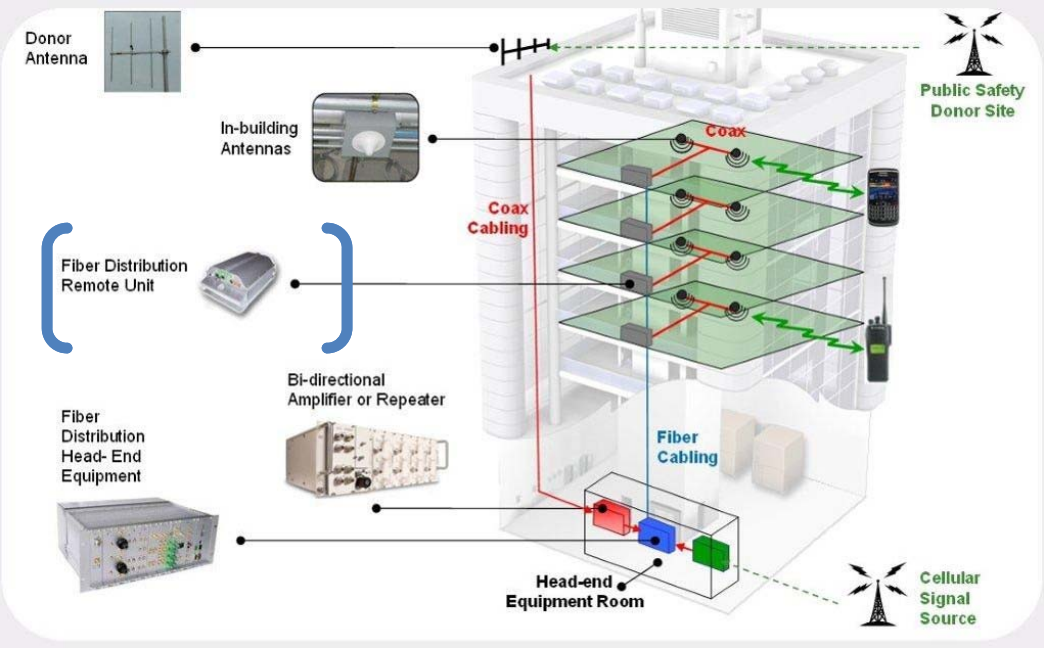
Fiber to 50Ω Coaxial Cable



Fiber Remote



Fiber to 50Ω Coaxial Cable



In building antennas

Low Profile Cell

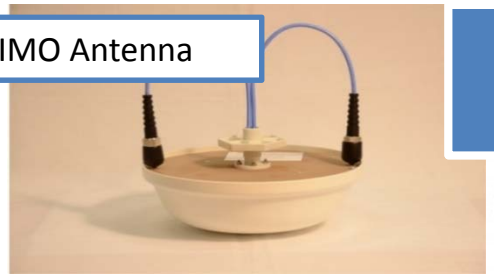
Aesthetically Pleasing

PROFILE VIEW

Lower performance above 1900

DIRECT VIEW FROM BELOW

MIMO Antenna



Low Profile VHF
Aesthetically Pleasing
Large Footprint

Top Hat
Great performance
Low Ugly Factor

Above Ceiling Mount
Good Performance Large Form Factor

EMERGENCY RESPONDER RADIO COVERAGE DAS

- DESIGN CRITERA
  - International Fire Code
  - NFPA 72
  - NFPA 1221
  - RSSI

ERRCS Requirements

Code Section	Technical Requirement
510.4.1.1	A minimum signal strength of -95dBm is required to be received within the building
510.4.1.2	A minimum signal strength of -95dBm is required to be received at the PSN radio tower
510.4.2.1	All signal boosters must be FCC certified.
510.4.2.3	The system shall be supported with 24 hours of Secondary power.

ERRCS Requirements

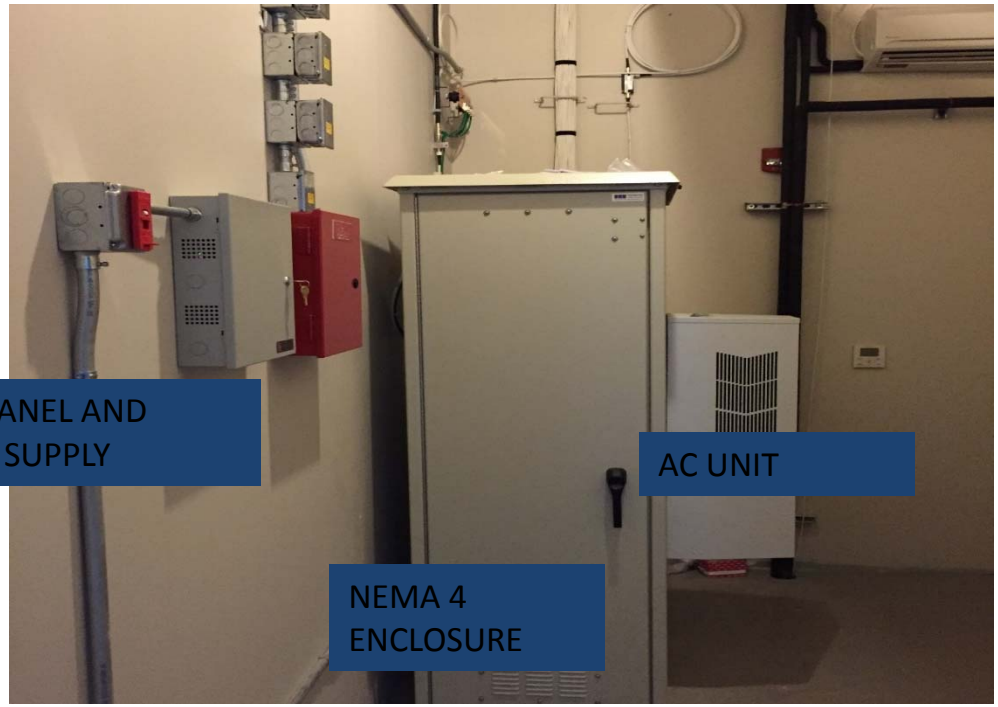
Code Section	Technical Requirement
510.4.2.4.1	All signal boosters shall be installed in NEMA 4 Enclosures
510.4.2.4.2	All battery systems shall be installed in NEMA 4 Enclosures
510.4.2.4.3	The signal booster and battery systems shall be supervised an monitored by a supervisory service.

CASE STUDY 1-SIMPLE PROJECT

La Salle School of Business

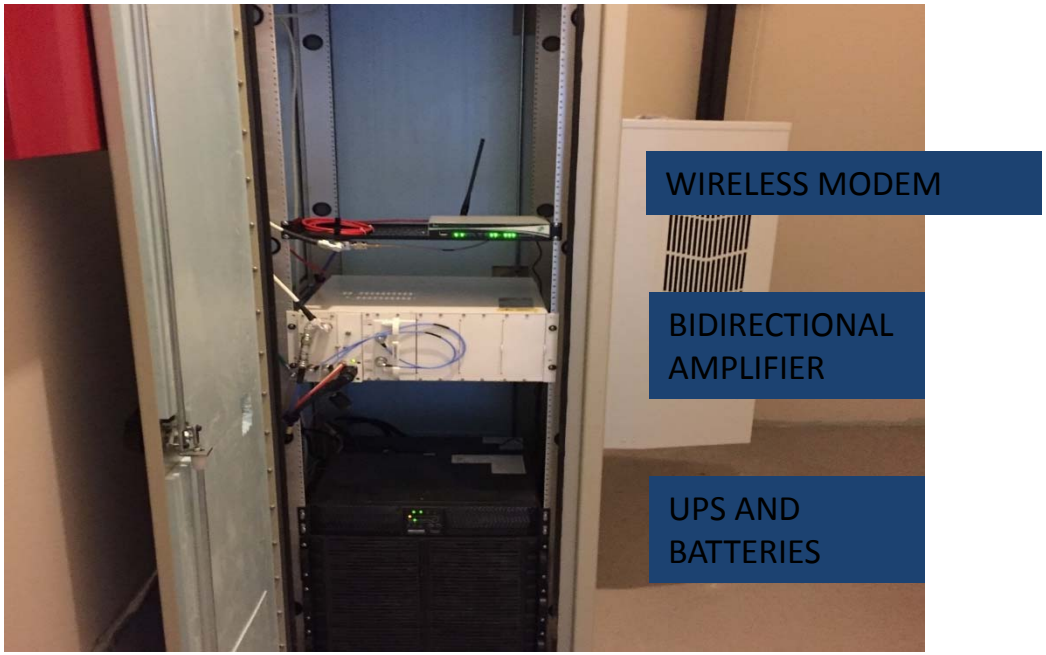
Location:	Philadelphia
Size:	87,000SF
System:	800MHz ERRCS
Code:	2012 IFC
Equipment:	BDA Only
	24 Hour UPS

ALL EQUIPMENT IN A SINGLE RACK



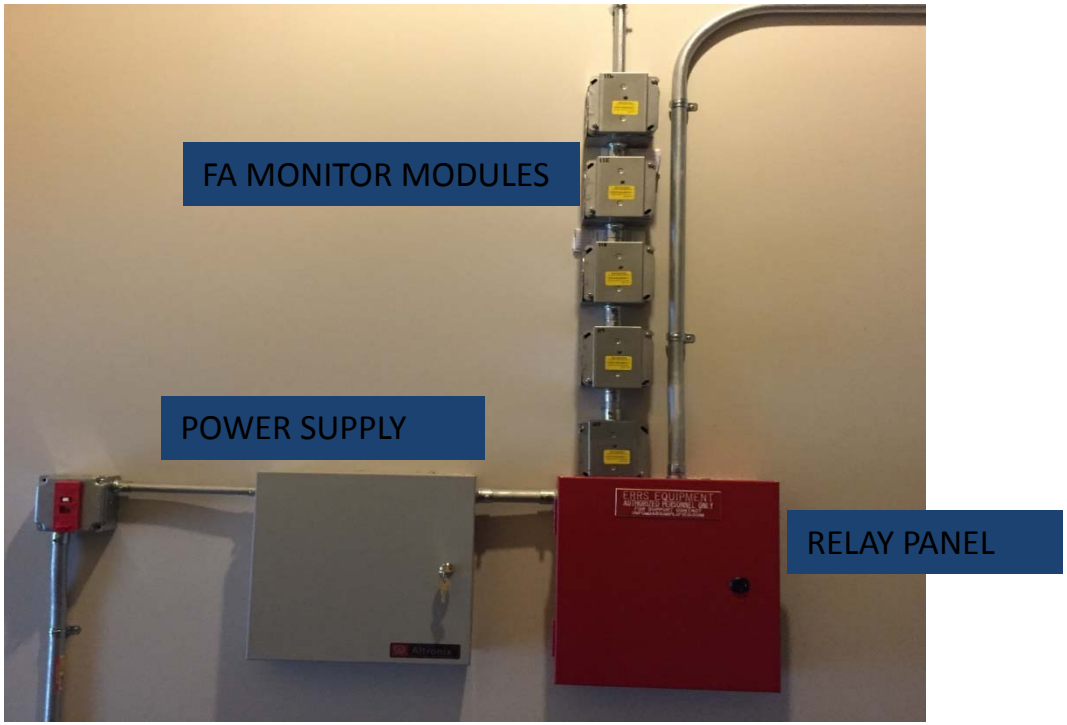
La Salle

La Salle



ALL EQUIPMENT IN A SINGLE RACK

La Salle



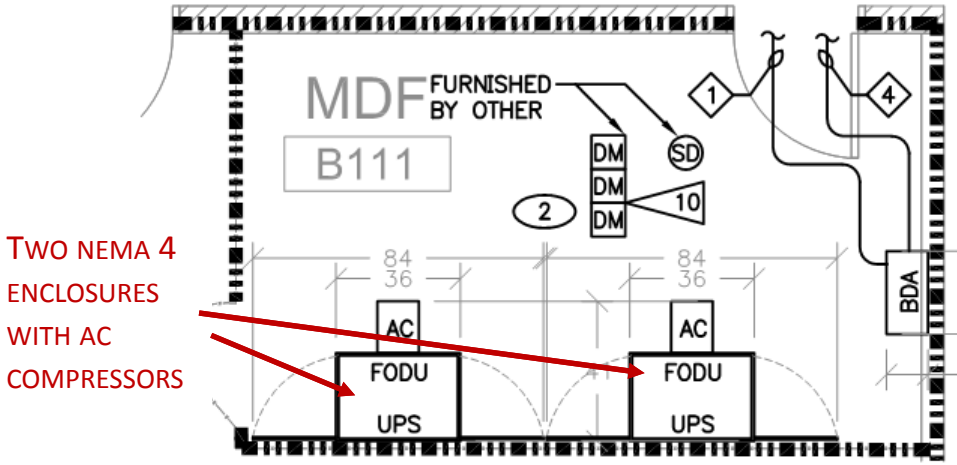
ALARMING COMPONENTS

CASE STUDY 2-large project

Trinity Phase 3

Location:	San Francisco
Size:	997,930 SF
System:	700/800MHz ERRCS
Code:	2010 CFC/2009 NFPA 5000
Equipment:	BDA + 12 PSN RRU
	12 Hour UPS
	Centralized DC Power

ROOM LAYOUT -HEAD END



TWO NEMA 4 ENCLOSURES WITH AC COMPRESSORS

WALL MOUNT BIDIRECTIONAL AMPLIFIER

2 **MDF B111 ENLARGEMENT**

SCALE:1/4"=1'-0"

TRINITY PHASE 3

ACTUAL CABINET LAYOUT

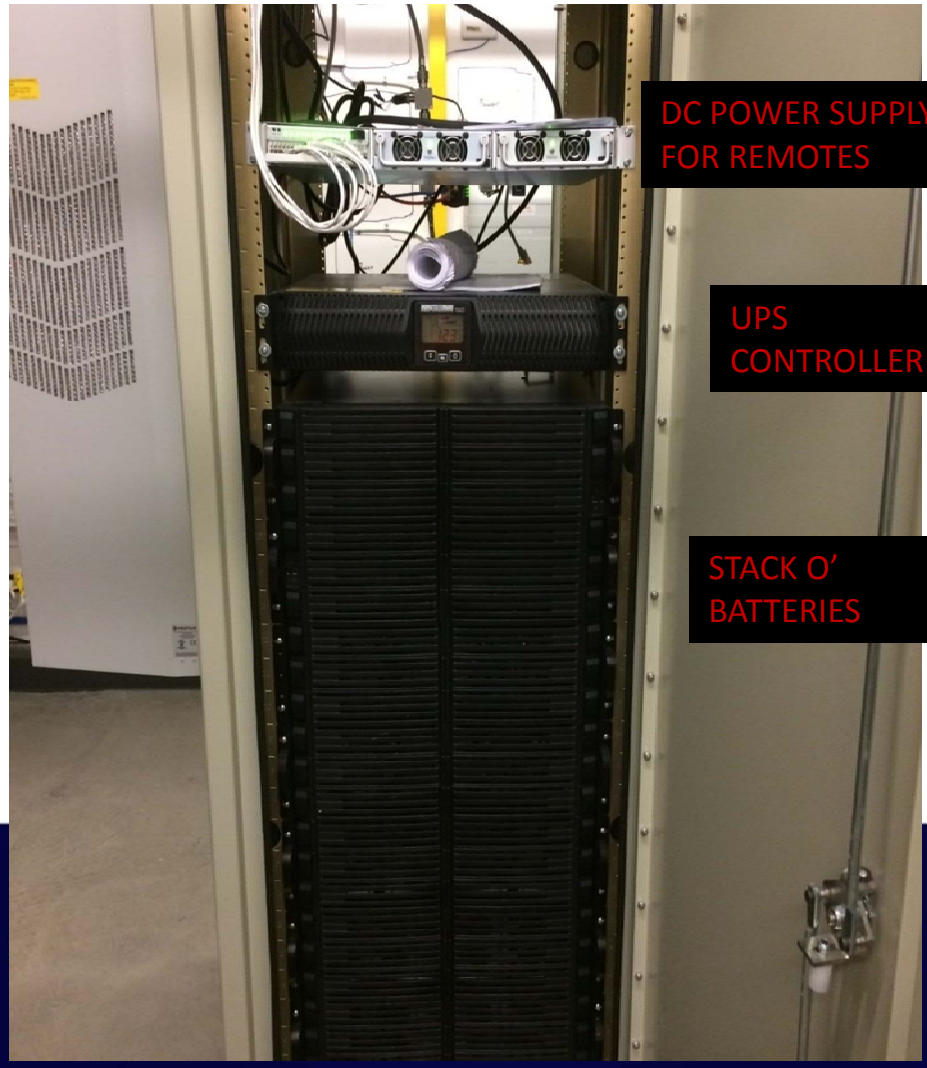
AC COMPRESSOR FOR THERMAL MANAGEMENT OF EQUIPMENT IN ENCLOSURE

SECOND AC UNIT TUCKED BACK HERE

TWO NEMA 4 CABINETS- REQUIRE FRONT AND REAR ACCESS

TRINITY

UPS AND DC
POWER SUPPLY

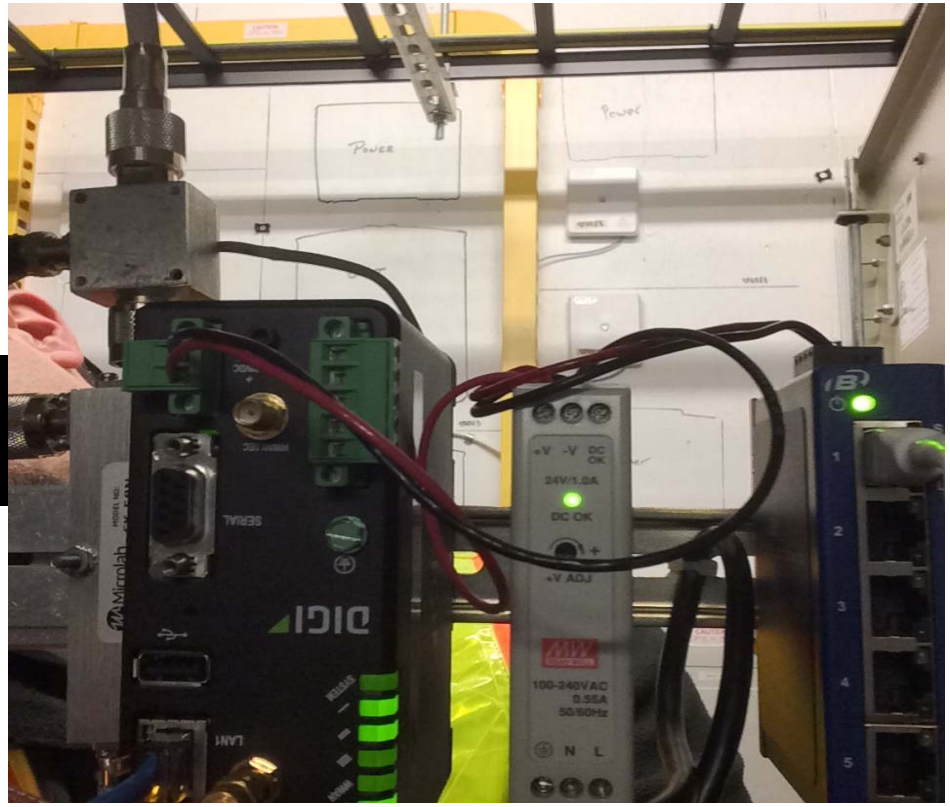


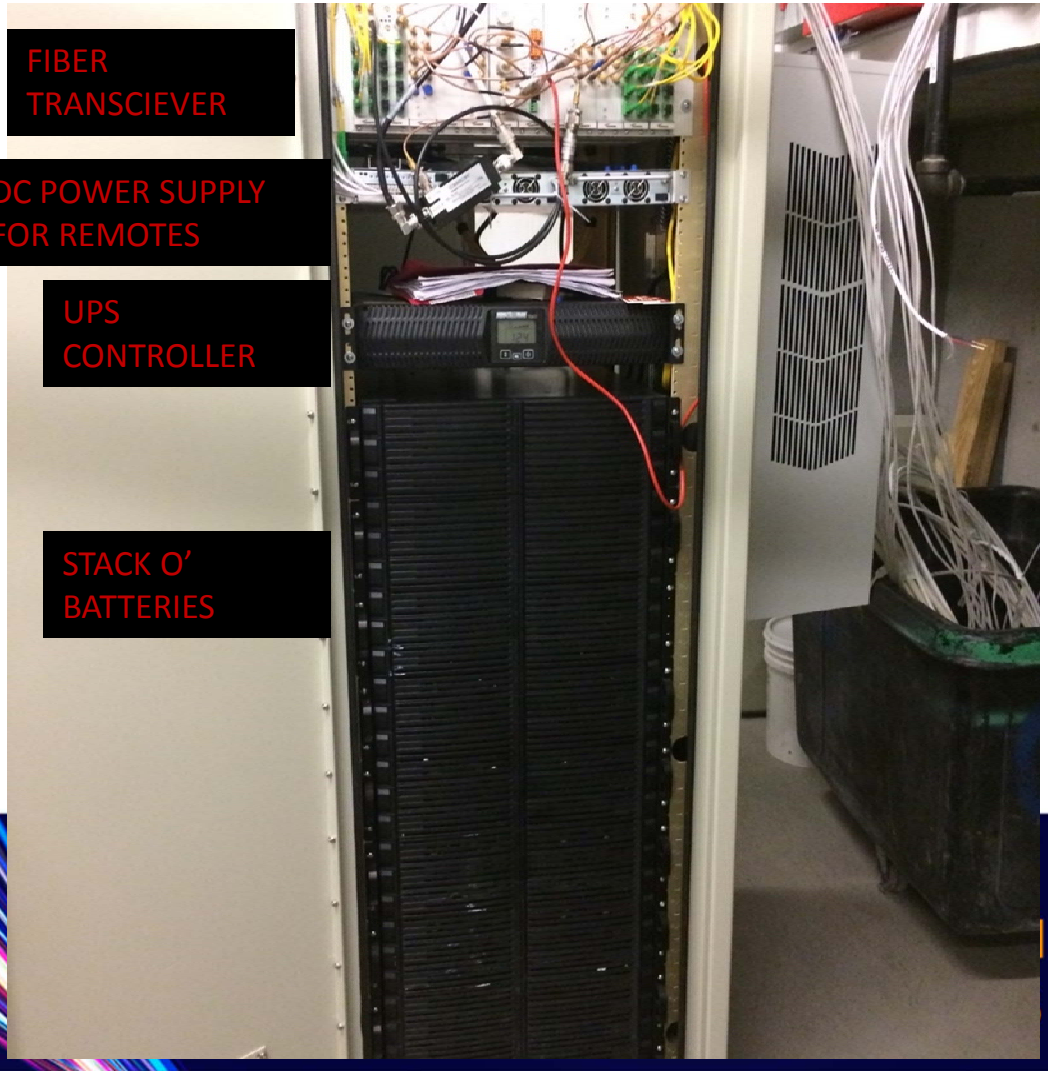
TRINITY

BACKSIDE OF CABINET

TRINITY

WIRELESS MODEM
FOR REMOTE ACCESS
TO SYSTEM



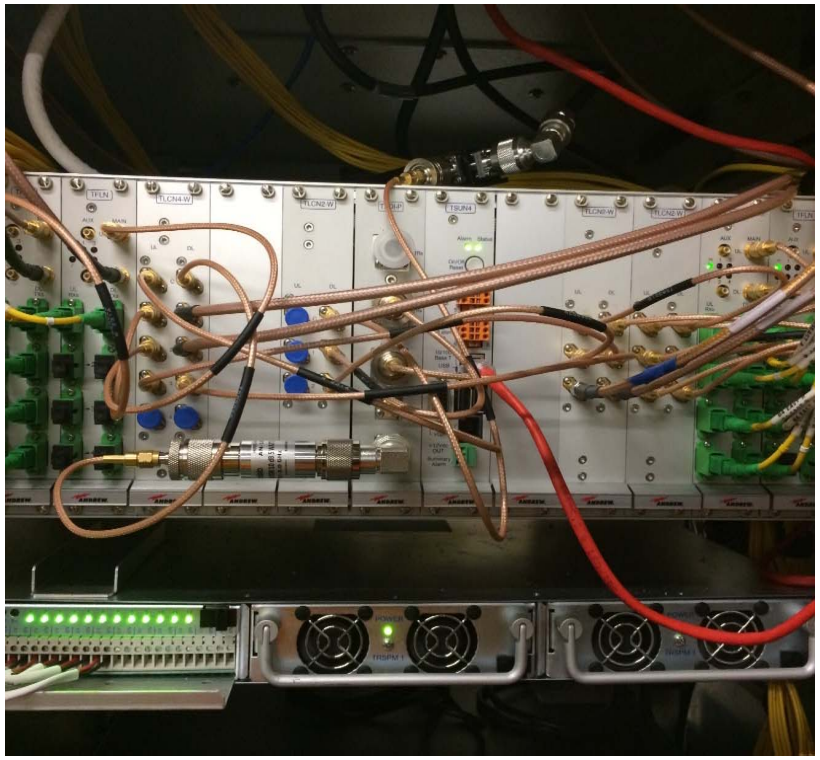


TRINITY

SECOND RACK
FIBER TRANCIEVER
DC POWER SUPPLY
AND UPS

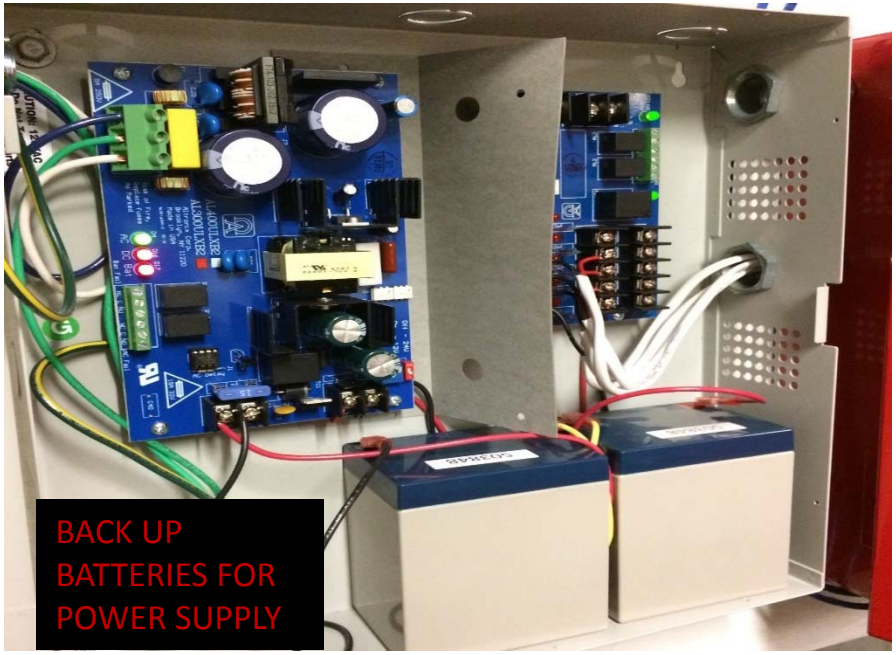
TRINITY

FIBER TRANSCIEVER &
SECOND DC POWER
SUPPLY (SECOND RACK)



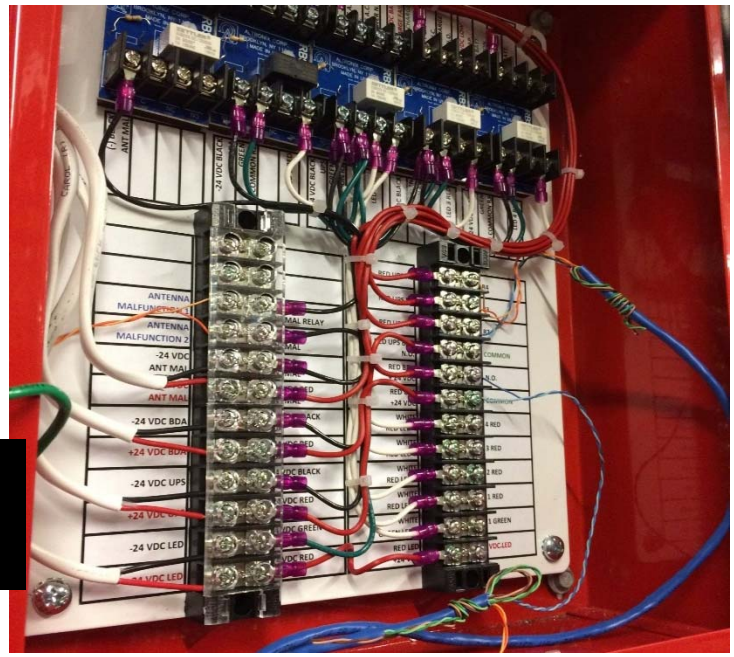
TRINITY

ALTRONIX POWER SUPPLY TO SERVE RELAY PANEL FOR ALARMING



TRINITY

RELAY PANEL TO SUPPORT NFPA REQUIRED ALARM OUTPUTS



WE PROVIDE THIS RELAY PANEL FOR EVERY ERRCS PROJECT THAT ENFORCES NFPA 72

CELLULAR COVERAGE SYSTEMS PLANNING

CELLULAR DAS

- DESIGN CRITERA
  - RSCP (RECEIVED SIGNAL CONTROL POWER -3G)
  - RSRP (RECEIVED SIGNAL REFERENCE POWER- LTE)
  - DOMINANCE

SAMPLE CARRIER REQUIREMENTS- SPRINT

Public Venue & CNS	Pilot	EC/Io Target	EC/Io Limit	Coverage Area	DAS Dominance	SINR	SINR %
CDMA 1900 Voice	<= -85 dBm	>=-7	>=-10 as long as soft handoff doesn't exceed 25% at XXdb	90% of area	6dB stronger Pilot		
CDMA 1900 Data	<= -85 dBm			90% of area	10dB stronger Pilot	>=8	80%
CDMA 800 Voice	<= -85 dBm	>=-7	>=-10 as long as soft handoff doesn't exceed 25% at XXdb	90% of area	6dB stronger Pilot		
	RSRP			Coverage Area	DAS Dominance		
LTE 1900 FDD	>= -98 dBm			90% of area	6dB stronger RSRP	>= 12	3db or greater at cell edge for 10% of area
LTE 800 FDD	>= -98 dBm			90% of area	6dB stronger RSRP	>= 12	3db or greater at cell edge for 10% of area
LTE 2500 TDD Pico							
LTE 2500 TDD BTS (to be confirmed)	>= -98 dBm			90% of area	6dB stronger RSRP	>= 12	TBD

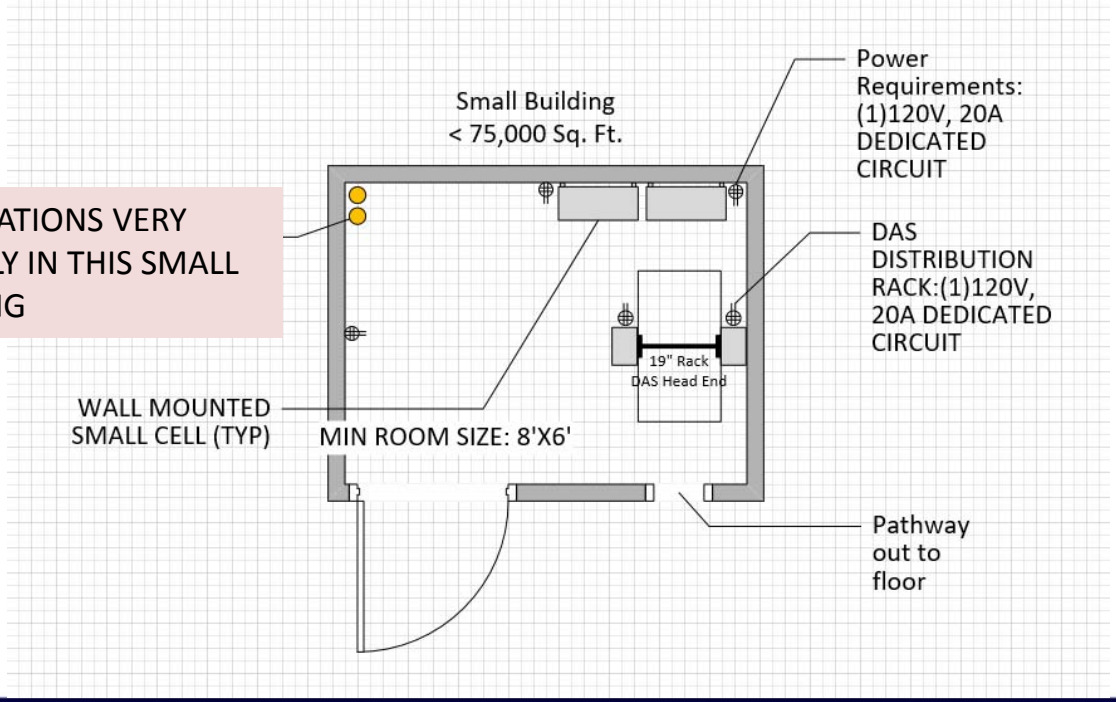
RSRP =RECEIVED SIGNAL REFERENCE POWER= -98dBm

COVERAGE AREA IS 90% OF FLOOR AREA

DOMINANCE 6dB STRONGER THAN MACRO RSRP

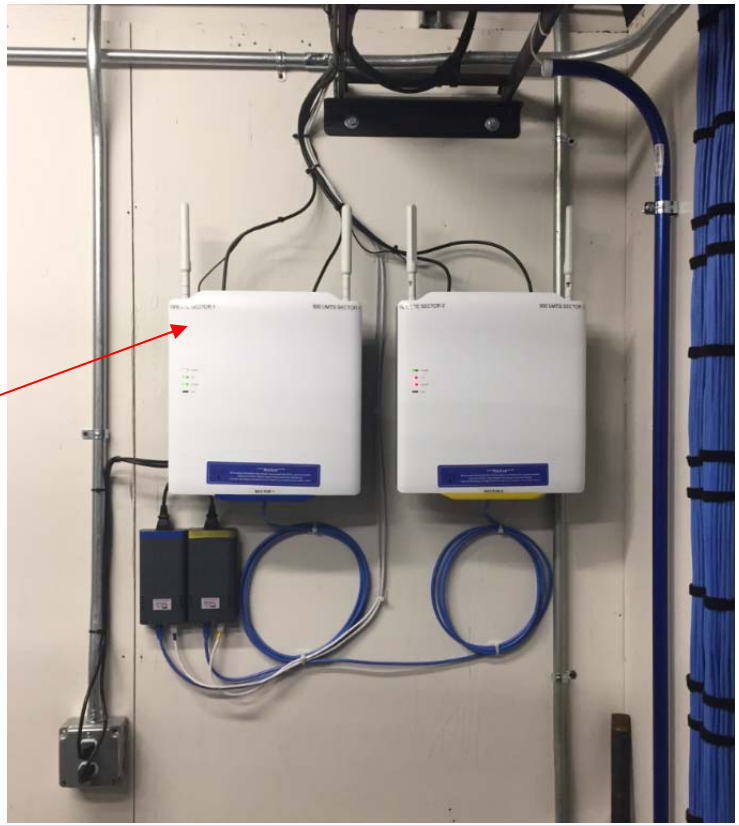
SMALL BUILDING- DAS ROOM

BASE STATIONS VERY UNLIKELY IN THIS SMALL BUILDING

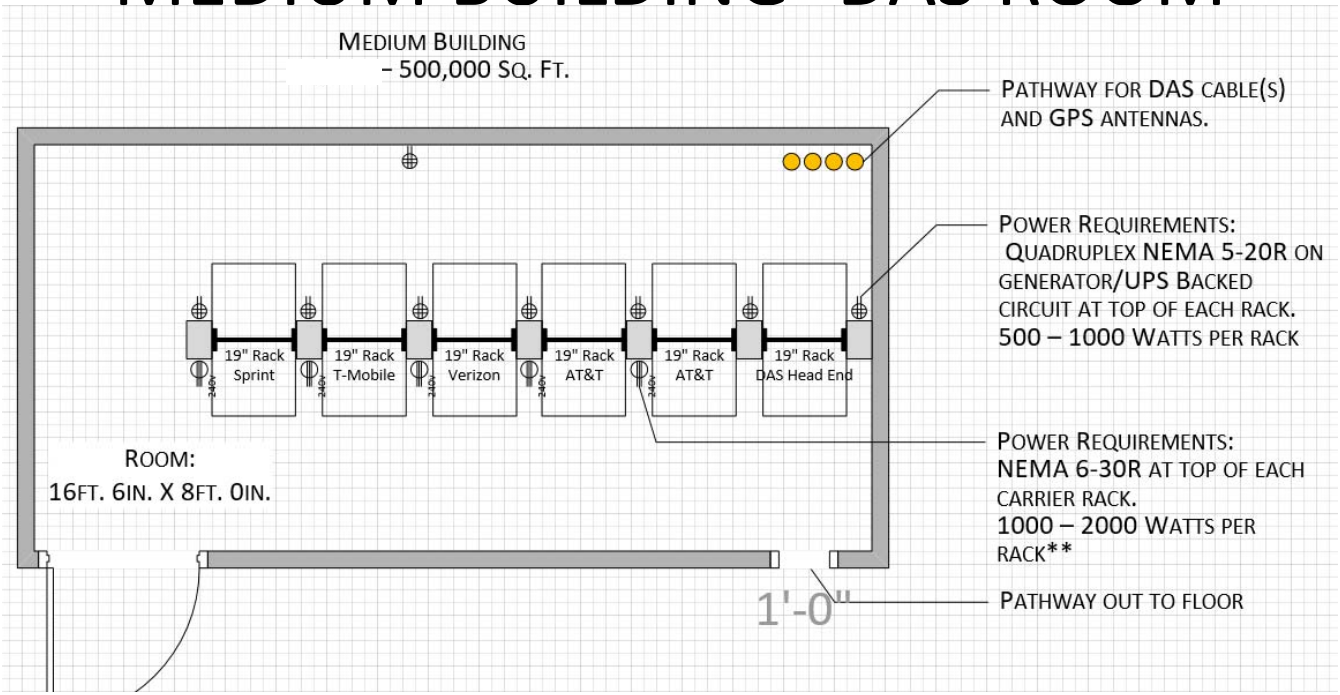


TWO SMALL CELLS

MINIMAL SPACE, MINIMAL POWER, NETWORK BACKHAUL VIA UTP CABLE.



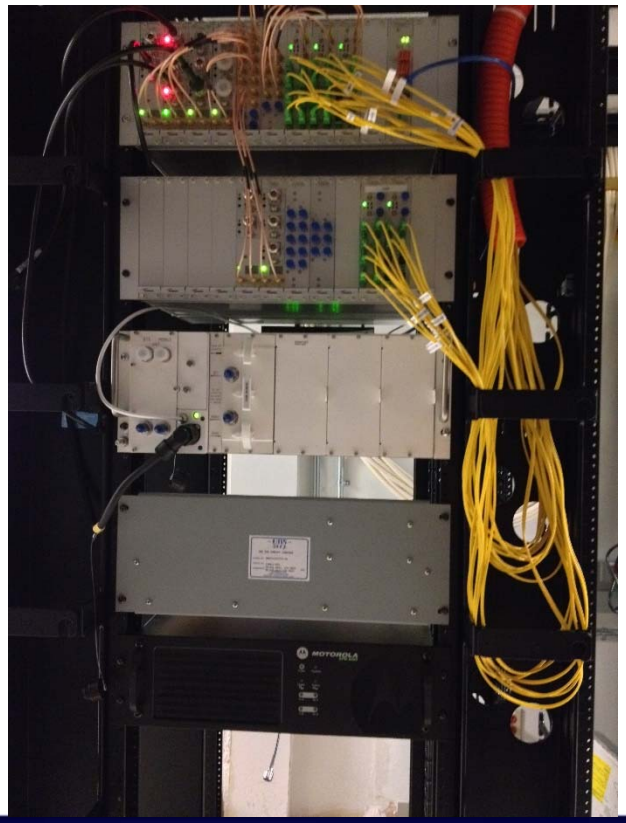
MEDIUM BUILDING- DAS ROOM



CASE STUDY

Location:	AUBURN MULTICARE
Size:	330,000 SF
Systems:	800MHz ERRCS, 900 MHZ PAGING, UHF RADIO, AT&T, VZW, SPRINT (No T-MO)

AUBURN MULTICARE



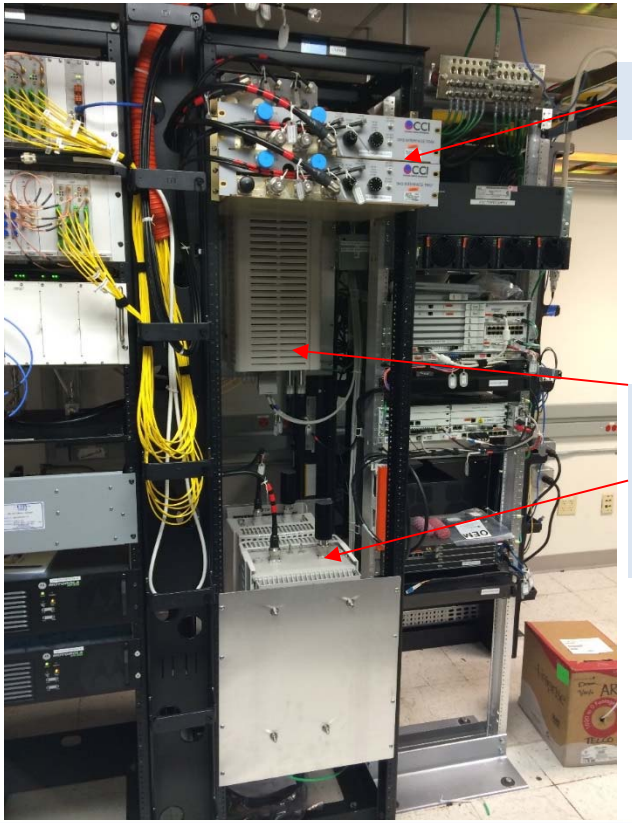
POINT OF INTERFACE AND FO TRANSCIEVER CARDS

OFF AIR ERRCS BDA

FACILITY RADIO BDA

PAGING REPEATER

AUBURN MULTICARE



ATTENUATOR TRAYS

AT&T BASE STATIONS
700 LTE, 850 UMTS,
1900 UMTS

AUBURN MULTICARE

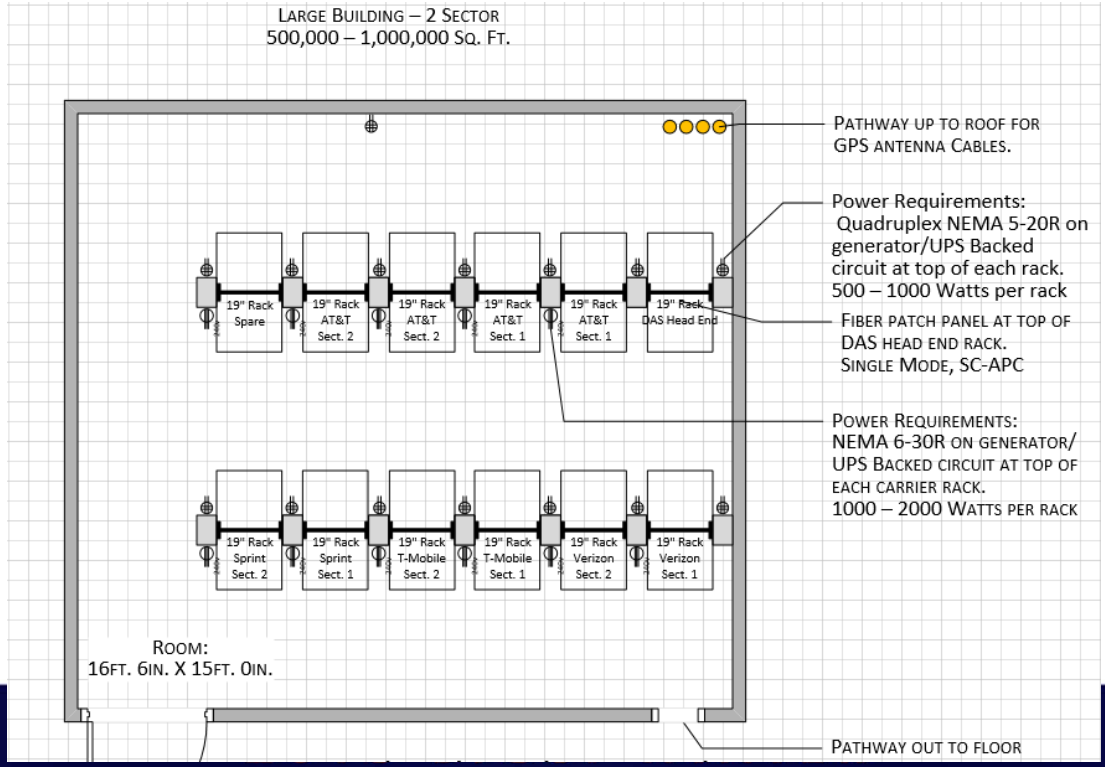
SPRINT E FEMTO

AUBURN MULTICARE

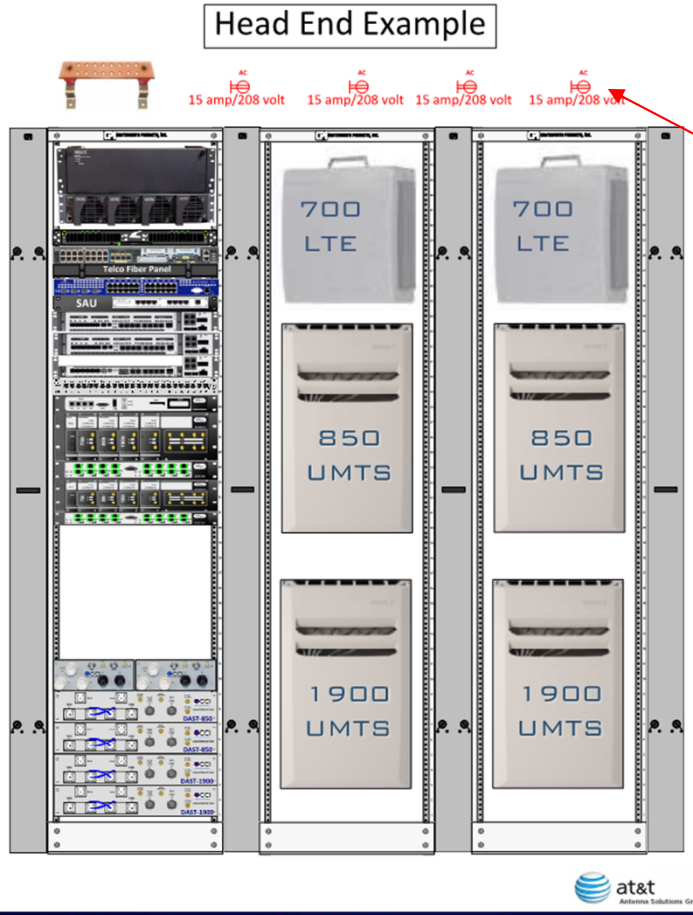
VZW OFF AIR ANTENNAS

800HZ PSN OFF AIR ANTENNA

LARGE BUILDING- DAS ROOM



AT&T– HEAD END



TWO SECTORS OF AT&T EQUIPMENT= 3 RACKS
(4) 208V, 15A CIRCUITS

LARGE WALL FIELD

TWO SECTORS OF DAS EQUIPMENT (RRUS) – 8X8 WALL FIELD

DAS ROOM REQUIREMENTS

INTERPRETING THE 2015
BICSI STANDARD

BICSI STANDARD FOR DAS-PROPOSED SERVICES FOR A SINGLE SECTOR

Table 7-2 Example Wireless Service Provider Equipment Information

WSP	*Element*	*Physical Space (H) × (W) × (D)*	*Heat Dissipation*	*110 V_{AC} Dedicated Circuits (Qty × Amps)*
Internal Wireless	1 Rack	2134 × 482 × 610 mm 84 × 19 × 24 in	1583 kJ/hr 1,500 BTU/hr	1 × 4
Service Provider 1	1 Cabinet	2134 × 914 × 914 mm 84 × 36 × 36 in	39,565 kJ/hr 37,500 BTU/hr	2 × 20 1 × 40 1 × 20
	Battery Backup	2134 × 914 × 914 mm 84 × 36 × 36 in		
	2 Racks	2134 × 482 × 610 mm 84 × 19 × 24 in		
Service Provider 2	2 Cabinets	2134 × 914 × 914 mm 84 × 36 × 36 in	47,478 kJ/hr 45,000 BTU/hr	3 × 20 1 × 60
	Battery Backup	2134 × 914 × 914 mm 84 × 36 × 36 in		
Service Provider 3	1 Cabinet	2134 × 914 × 914 mm 84 × 36 × 36 in	31,652 kJ/hr 30,000 BTU/hr	2 × 20 1 × 40
	Battery Backup	2134 × 914 × 914 mm 84 × 36 × 36 in		
	1 Rack	2134 × 482 × 610 mm 84 × 19 × 24 in		
Service Provider 4	2 Cabinets	2134 × 914 × 914 mm 84 × 36 × 36 in	15,826 kJ/hr 15,000 BTU/hr	2 × 20
	Battery Backup	1524 × 1524 × 914 mm 60 × 60 × 36 in		
Paging	1 Half Rack	1067 × 482 × 610 mm 42 × 19 × 24 in	791 kJ/hr 750 BTU/hr	1 × 2
Public Safety	1 Half Rack	1067 × 482 × 610 mm 42 × 19 × 24 in	396 kJ/hr 375 BTU/hr	1 × 1
UHF Two-way	1 Rack	2134 × 482 × 610 mm 84 × 19 × 24 in	396 kJ/hr 375 BTU/hr	1 × 1
	Totals		**137,687 kJ/hr 130,500 BTU/hr**	**348 Amps**

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	Battery Backup	2134 × 914 × 914 mm 84 × 36 × 36 in		
	2 Racks	2134 × 482 × 610 mm 84 × 19 × 24 in		
Service Provider 2	2 Cabinets	2134 × 914 × 914 mm		3 × 20 1 × 60
	Ba			
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Service Provider 4	2 Cabinets	2134 × 914 × 914 mm 84 × 36 × 36 in	15,826 kJ/hr 15,000 BTU/hr	2 × 20
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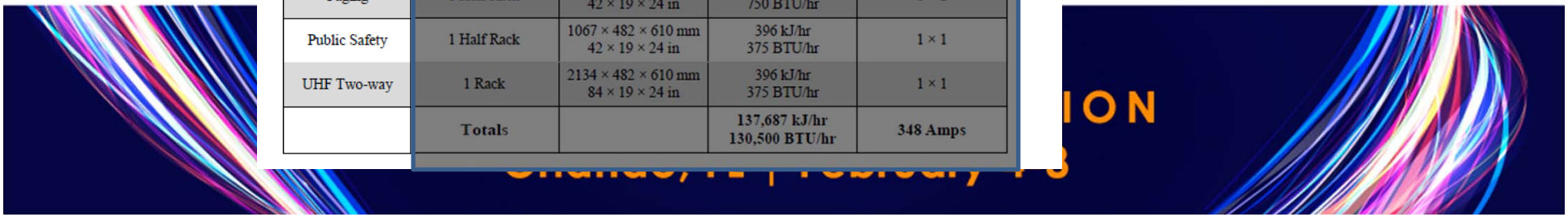
SERVICES:
4 CARRIER, + PSN + UHF 2- WAY RADIO + PAGING

BICSI STANDARD FOR DAS- PROPOSED SERVICES FOR A SINGLE SECTOR



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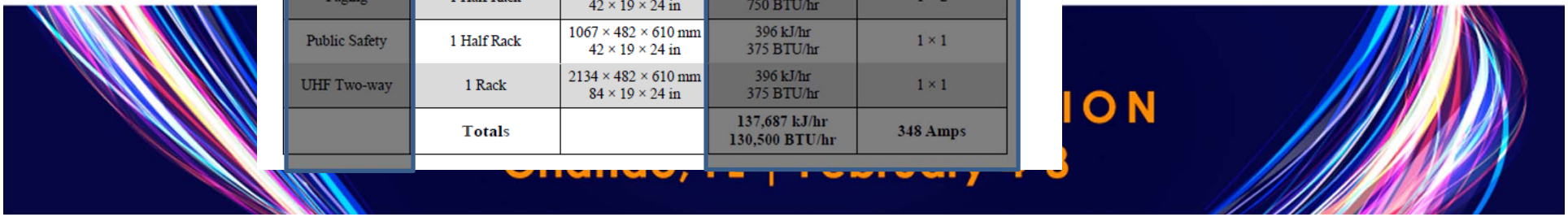
	Totals		**137,687 kJ/hr 130,500 BTU/hr**	**348 Amps**

SPACE REQUIREMENTS:
(6) 19” RACKS
(9) 36”W CABINETS
(1) 60”W CABINET

BICSI STANDARD FOR DAS-PROPOSED SERVICES FOR A SINGLE SECTOR



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	Battery Backup	2134 × 914 × 914 mm 84 × 36 × 36 in		
	1 Rack	2134 × 482 × 610 mm 84 × 19 × 24 in		
Service Provider 4	2 Cabinets	2134 × 914 × 914 mm 84 × 36 × 36 in	15,826 kJ/hr 15,000 BTU/hr	2 × 20
	Battery Backup	1524 × 1524 × 914 mm 60 × 60 × 36 in		
Paging	1 Half Rack	1067 × 482 × 610 mm 42 × 19 × 24 in	791 kJ/hr 750 BTU/hr	1 × 2
Public Safety	1 Half Rack	1067 × 482 × 610 mm 42 × 19 × 24 in	396 kJ/hr 375 BTU/hr	1 × 1
UHF Two-way	1 Rack	2134 × 482 × 610 mm	396 kJ/hr 375 BTU/hr	1 × 1
			137,687 kJ/hr **130,500 BTU/hr**	**348 Amps**

HEAT LOAD:
130,500 BTUH

BICSI STANDARD FOR DAS-PROPOSED SERVICES FOR A SINGLE SECTOR

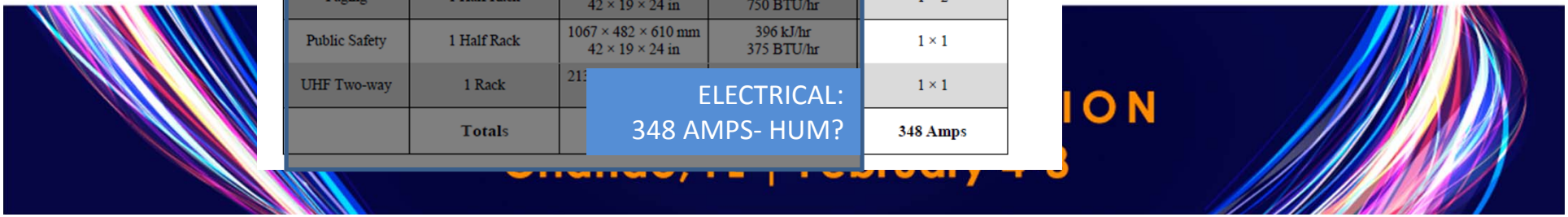
Table 7-2 Example Wireless Service Provider Equipment Information

WSP				110 V_{AC} Dedicated Circuits (Qty × Amps)
Internal Wireles				1 × 4
Service Provider 1	1 Cabinet	2134 × 914 × 914 mm 84 × 36 × 36 in	39,565 kJ/hr 37,500 BTU/hr	2 × 20 1 × 40 1 × 20
	Battery Backup	2134 × 914 × 914 mm 84 × 36 × 36 in		
	2 Racks	2134 × 482 × 610 mm 84 × 19 × 24 in		
Service Provider 2	2 Cabinets	2134 × 914 × 914 mm 84 × 36 × 36 in	47,478 kJ/hr 45,000 BTU/hr	3 × 20 1 × 60
	Battery Backup	2134 × 914 × 914 mm 84 × 36 × 36 in		
Service Provider 3	1 Cabinet	2134 × 914 × 914 mm 84 × 36 × 36 in	31,652 kJ/hr 30,000 BTU/hr	2 × 20 1 × 40
	Battery Backup	2134 × 914 × 914 mm 84 × 36 × 36 in		
	1 Rack	2134 × 482 × 610 mm 84 × 19 × 24 in		
Service Provider 4	2 Cabinets	2134 × 914 × 914 mm 84 × 36 × 36 in	15,826 kJ/hr 15,000 BTU/hr	2 × 20
	Battery Backup	1524 × 1524 × 914 mm 60 × 60 × 36 in		
Paging	1 Half Rack	1067 × 482 × 610 mm 42 × 19 × 24 in	791 kJ/hr 750 BTU/hr	1 × 2
Public Safety	1 Half Rack	1067 × 482 × 610 mm 42 × 19 × 24 in	396 kJ/hr 375 BTU/hr	1 × 1
UHF Two-way	1 Rack	21		1 × 1
	Totals			**348 Amps**

FYI: 110VAC IS AN EQUIPMENT RATING, NOT A SYSTEM VOLTAGE

ELECTRICAL: 348 AMPS- HUM?

BICSI STANDARD FOR DAS- PROPOSED SERVICES FOR A SINGLE SECTOR



BICSI STANDARD

INTERPRETTING THE STANDARD

WSP	VOLTS	AMPS	QUANTITY CKTS	LOAD (W)	HEAT (BTU)	TOTAL BTU/HR
INTERNAL	110	4	1	440	1500.4	1500.4
WSP#1	110	20	2	4400	15004	
	110	40	1	4400	15004	
	110	20	1	2200	7502	37510
WSP#2	110	20	3	6600	22506	
	110	60	1	6600	22506	45012
WSP#3	110	20	2	4400	15004	
	110	40	1	4400	15004	30008
WSP#4	110	20	2	4400	15004	15004
PAGING	110	1	1	110	375.1	375.1
PUBLIC SAFETY	110	1	1	110	375.1	375.1
UHF	110	1	1	110	375.1	375.1
GRAND TOTALS				38170		130159.7
		AMPS AT 208V, 3 PHASE		106.03		

BICSI STANDARD

INTERPRETTING THE STANDARD

WSP	VOLTS	AMPS	QUANTITY CKTS	LOAD (W)	HEAT (BTU)	TOTAL BTU/HR
INTERNAL	110	4	1	440	1500.4	1500.4
WSP#1	110	20	2	4400	15004	
	110	40	1	4400	15004	
	110	20	1	2200	7502	37510
WSP#2	110	20	3	6600	22506	
	110	60	1	6600	22506	45012
WSP#3	110	20	2	4400	15004	
	110	40	1	4400	15004	30008
WSP#4	110	20	2	4400	15004	15004
PAGING	110	1	1	110	375.1	375.1
PUBLIC SAFETY	110	1	1	110	375.1	375.1
UHF	110	1	1	110	375.1	375.1
GRAND TOTALS				38170		130159.7
		AMPS AT 208V, 3 PHASE		106.03		

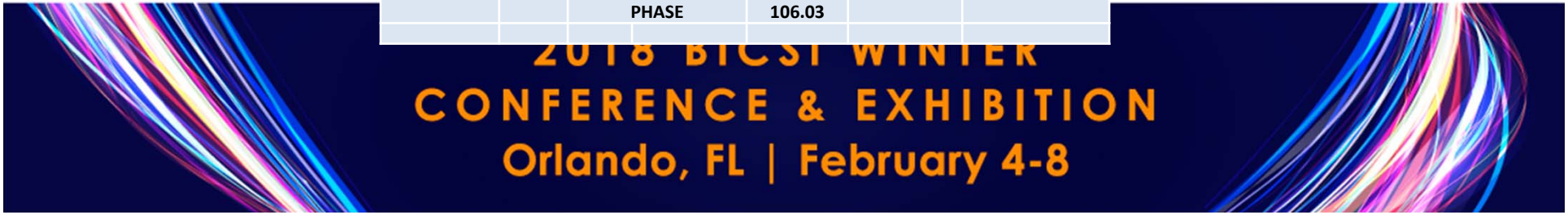
WATTS= VOLTS X AMPS

BICSI STANDARD

INTERPRETTING THE STANDARD

WSP	VOLTS	AMPS	QUANTITY CKTS	LOAD (W)	HEAT (BTU)	TOTAL BTU/HR
INTERNAL	110	4	1	440	1500.4	1500.4
WSP#1	110	20	2	4400	15004	
	110	40	1	4400	15004	
	110	20	1	2200	7502	37510
WSP#2	110	20	3	6600	22506	
	110	60	1	6600	22506	45012
WSP#3	110	20	2	4400	15004	
	110	40	1	4400	15004	30008
WSP#4	110	20	2	4400	15004	15004
PAGING	110	1	1	110	375.1	375.1
PUBLIC SAFETY	110	1	1	110	375.1	375.1
UHF	110	1	1	110	375.1	375.1
GRAND TOTALS				38170		130159.7
		AMPS AT 208V, 3 PHASE		106.03		

BTU-HR= WATTS X 3.41



BICSI STANDARD

INTERPRETTING THE STANDARD

WSP	VOLTS	AMPS	QUANTITY CKTS	LOAD (W)	HEAT (BTU)	TOTAL BTU/HR
INTERNAL	110	4	1	440	1500.4	1500.4
WSP#1	110	20	2	4400	15004	
	110	40	1	4400	15004	
	110	20	1	2200	7502	37510
WSP#2	110	20	3	6600	22506	
	110	60	1	6600	22506	45012
WSP#3	110	20	2	4400	15004	
	110	40	1	4400	15004	30008
WSP#4	110	20	2	4400	15004	15004
PAGING	110	1	1	110	375.1	375.1
PUBLIC SAFETY	110	1	1	110	375.1	375.1
UHF	110	1	1	110	375.1	375.1
GRAND TOTALS				38170		130159.7
		AMPS AT 208V, 3 PHASE		106.03		

AMPS= WATTS/ 360V

45kVA TRANSFORMER

BICSI STANDARD

INTERPRETTING THE STANDARD

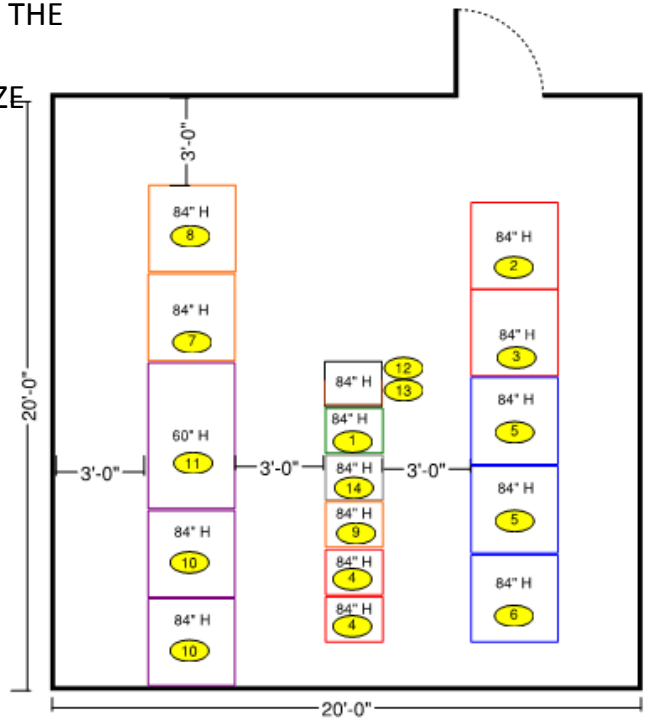
WSP	VOLTS	AMPS	QUANTITY CKTS	LOAD (W)	HEAT (BTU)	TOTAL BTU/HR	BTUH @80% Eff.
INTERNAL	110	4	1	440	1500.4	1500.4	300.08
WSP#1	110	20	2	4400	15004		
	110	40	1	4400	15004		
	110	20	1	2200	7502	37510	7502
WSP#2	110	20	3	6600	22506		
	110	60	1	6600	22506	45012	9002.4
WSP#3	110	20	2	4400	15004		
	110	40	1	4400	15004	30008	6001.6
WSP#4	110	20	2	4400	15004	15004	3000.8
PAGING	110	1	1	110	375.1	375.1	75.02
PUBLIC SAFETY	110	1	1	110	375.1	375.1	75.02
UHF	110	1	1	110	375.1	375.1	75.02
GRAND TOTALS				38170		130159.7	26031.9
		AMPS AT 208V, 3 PHASE		106.03			

SIGNIFICANTLY LESS COOLING

BICSI STANDARD

INTERPRETTING THE STANDARD

FINAL ROOM SIZE



1 EXAMPLE WIRELESS SERVICE PROVIDER EQUIPMENT ROOM LAYOUT

SCALE : 1/4" = 1'-0"

NOTES

1. INTERNAL WIRELESS - 84" x 19" x 24"
2. SERVICE PROVIDER 1 - 1 CABINET - 84" x 36" x 36"
3. SERVICE PROVIDER 1 - BATTERY BACKUP - 84" x 36" x 36"
4. SERVICE PROVIDER 1 - 2 RACKS - 84" x 19" x 24" ea
5. SERVICE PROVIDER 2 - 2 CABINETS - 84" x 36" x 36" ea
6. SERVICE PROVIDER 2 - BATTERY BACKUP - 84" x 36" x 36"
7. SERVICE PROVIDER 3 - 1 CABINET - 84" x 36" x 36"
8. SERVICE PROVIDER 3 - BATTERY BACKUP - 84" x 36" x 36"
9. SERVICE PROVIDER 3 - 1 RACK - 84" x 19" x 24"
10. SERVICE PROVIDER 4 - 2 CABINETS - 84" x 36" x 36" ea
11. SERVICE PROVIDER 4 - BATTERY BACKUP - 60" x 60" x 36"
12. PAGING - 1 HALF RACK - 42" x 19" x 24"
13. PUBLIC SAFETY - 1 HALF RACK - 42" x 19" x 24"
14. UHF TWO-WAY - 1 RACK - 84" x 19" x 24"

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