

Charles Industries Enclosure Solutions for the Utility Market

Feb 2022

Charles Industries LLC

- 50+ Years Servicing Utilities and Telecom Related Projects, now an Amphenol Corp.
- Domestic Manufacturer with 5 Manufacturing Centers in the United States
- Full-Service Engineering, Sales & Marketing and Technical Support Departments
- North American Field Support Team
- World-Class ISO 9001 / TL 9000 Quality System
- Capital Expansion and Collaboration with Amphenol sister companies



U.S. Based Company

Corporate Headquarters



Schaumburg, IL

Manufacturing Centers



Casey, Illinois



Nogales, MX



Rantoul, Illinois



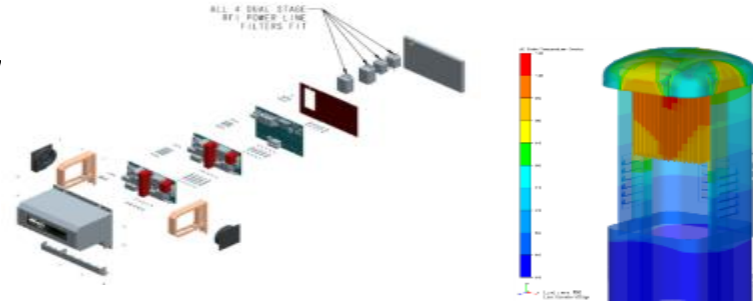
Canton, Missouri



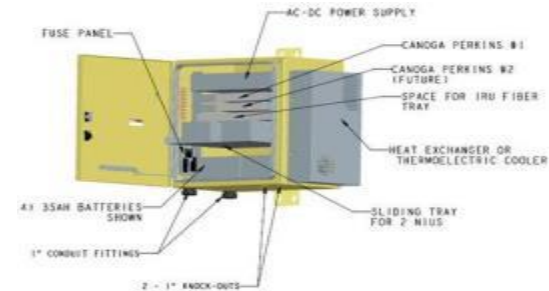
Okeechobee, Florida

Design & Manufacturing

Owning and controlling all aspects of manufacturing enables us to deliver timely prototypes and finished solutions to our customers' most urgent and critical requirements.



- U.S. based manufacturing facilities
- In-house design and development utilizing MCAD, CAD, CAM, CAE
- Product testing capabilities
- Vertically integrated operations
- Supply chain management system with supplier quality tracking system
- Experienced workforce
- Proven on-time delivery record



Charles Universal Broadband Enclosure (CUBE) Overview



A complete line of customizable, environmentally protected OSP cabinets, pre-wired and optimized for fiber and copper electronics. CUBE Cabinets are certified to GR-487 and NEMA 3R or 4X standards.

CUBE Designs Comply with GR-487

- Water Intrusion
- Wind Driven Rain
- Weather Tightness
- Thermal Performance
- Seismic Vibration
- Lifting Detail Strength
- Door Restrainer Strength
- Wind Resistance
- Impact Resistance
- Fire Resistance
- Electromagnetic Interference
- Acoustical Noise
- Generator Exhaust Temperatures
- Transportation Shock
- Installation Shock
- Transportation Vibration
- Ground Current Capacity
- Corrosion Resistance
- Paint Adhesion

CUBE Value-Added Integration

To reduce site turn-up time and sub-equipment planning/ procurement, Charles Integration Services can Engineer, Design and Integrate your specified equipment into any of Charles' CUBE enclosures. All integration is performed to industry and Telcordia standards. All wiring is connectivity tested via power-up and continuity. Leveraging Charles' Supply Chain Management's OEM relationships to achieve turnkey or consigned equipment integration. Additional charges apply for integrated solutions.

- **Equipment & Functionality**
 - Power Distribution and Breaker/Fuse Panels
 - Surge/OVP System
 - Site Monitoring / Alarm Systems
 - Intelligent Access Control and Locking Systems
 - CPRI Monitoring and Fiber Patch Panels
 - AC Load Centers
- **Configuration Management**
 - Region Specific Deployment
 - Site Specific
 - Unique codes identify different configurations
- **Thermal Solutions**
 - AC/DC HVAC Systems
 - Heat Exchangers
 - Fan Systems
- **Cable & Wire Harness Manufacturing**



Applications Served

- **Fiber to the Substation**
 - Outdoor Enclosures
 - Indoor Enclosures
 - Power Upgrade Solutions
- **Wireless - Field Area Network (FAN) / Private LTE**
 - Head End
 - Remote

Fiber to the Sub Station Single Bay Outdoor Cabinet

- 74" H x 32" W x 32" D
- 39 RU Pad Mount Enclosure
- Thermal Management Options
 - 1880W – 3500W HX
 - 4K BTU Air Conditioner (AC and DC)
- Front & Rear Access Doors
- GFCI (prewired on cabinets with AC load center)
- Mounting Rails in Front & Rear
- Knockouts for Ø1.25", Ø2", and Ø3" conduit fittings
- Space around, above, and below for cable routing
- Options
 - 12-30 Position AC Load Center
 - 6" Plinth
 - Battery Compartment
 - Integrated Power
 - Rear Panel (in lieu of hinged door)
 - Top Hat



Fiber to the Sub Station Dual Bay Outdoor Cabinet

- 92" H x 64" W x 32" D
- (2) 31RU equipment bays with front and rear doors
- Support for (4) NiCD battery strings
- Includes AC load center & laptop tray
- Thermal options
 - AC or DC Powered 4K or 10K BTU HVAC
 - 6,000W CTMS
 - 750-1880W Heat Exchanger
- Can be mounted to 2-Bay Macro CPAD
 - Shown in pictures at right
- Optional integrated power plant
- Retractable solar shield
- Powder coat grey color



Modular Cabinet

- Modular cabinet can be factory or field augmented to support a range of applications
- Several standard compartments - Power, Electronics, Passive and Battery
- Combine compartments in a variety of ways to support application
 - Most common are 2, 3 and 4 bay
 - Additional compartments may be added in the field
- Various heights – 61” & 72” most common

Compartment Types	Features
Power/Splice Chamber	AC Power, Fiber Cable Entry Supports Load Center Kits on side of cabinet
Electronics	Thermal System on Door (HVAC, CTMS) Rack Rails Front and Rear Means to close off airflow to other compartments
Passive Fiber	Rack Rails Front and Rear Will support Fiber Panels - Typically 12-14" Deep
Battery	Support 12V Monoblock batteries, up to 200AH Rackmount or Tray Style As Many Trays as Possible in Given Size Battery Disconnect Breaker

Height (In)	72	62	40
Width (In)	32	32	32
Depth (In)	32-36	32	36
RU (Front/Back)	39	31	20



10 x 10 Walk in Cabinet (WIC) Application & Benefits

- **Applications**
 - Flood Plain – Helical or platform mounted
 - Urban – Clean look, can be painted/wrapped
 - Remote locations
 - Multiple Fiber Terminations
- **Advantages**
 - Lighter weight (compared with concrete) solution
 - Closed loop thermal solution (no maintenance)
 - Exterior Equipment Mounting
 - Rear wall and cable entry ports
 - Multiple Cable Entry Ground Ports
 - WIC False Floor
 - Add racks in field without leakage concerns



Inside Plant Fiber Infrastructure



Fiber to the Substation Indoor Rack / Cabinet



- 89" H x 35" W x 27" D
- 6RU 23" Rack for Integrated Power Plant
- 27RU 19" Rack Swing-out
- Din Rail Mounted DC-DC Converters
- CFRS Fiber Tray
- Battery Chamber for NiCd or VRLA 180 Ah batteries
- Slide out Battery Tray
- 100A Breaker Battery Disconnect

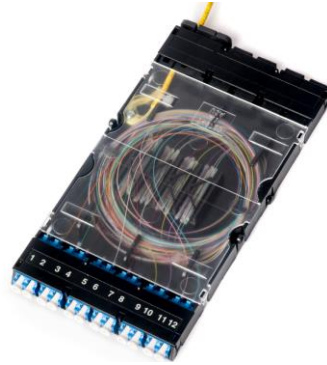


Fiber Patch Panels

C2E
1RU



144 LC TERMINATIONS
BASE 12 MODULE CAPACITY: 12
BASE 8 MODULE CAPACITY: 18



C2X
1RU



36 SC TERMINATIONS
SLIDING TRAY
MODULE CAPACITY:
8 SINGLE
4 DUAL

CIBR Indoor/Outdoor Power/Battery Rack

- 84" H x 29" W x 27" D
- CIBR Power/Battery Rack - Supports VRLA and NiCd options
- 6RU 23" Top Rack for Optional Integrated Power Plant
- 8RU 23" Equipment Rack
- 4 Tray Configuration
(Can support 2-5 Tray Configurations)
- D-Clips for wiring
- 100A Breaker Disconnects
- Battery Monitoring



Wireless Network Diagram

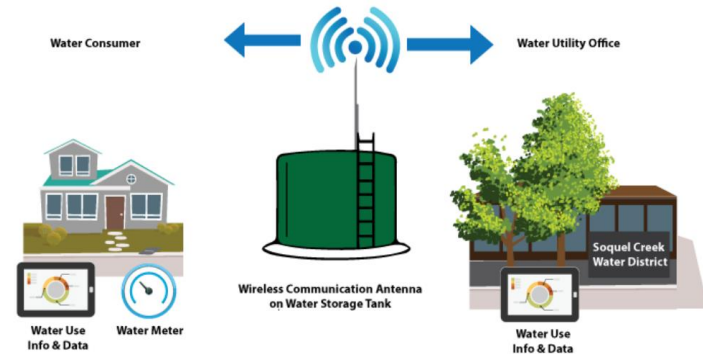
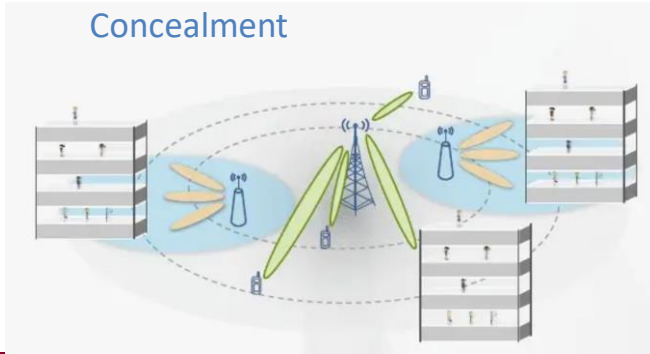


LEGEND

	Wireless Connectivity
	Substation/Facility
	Wireless Base Station
	Video / Security
	Land Mobile Radio
	Distributed Generation
	T&D Equipment
	Crew Vehicles
	Customers/Meters
	Water Facilities
	Mobile Computing
	Home Area Networking / Demand Response

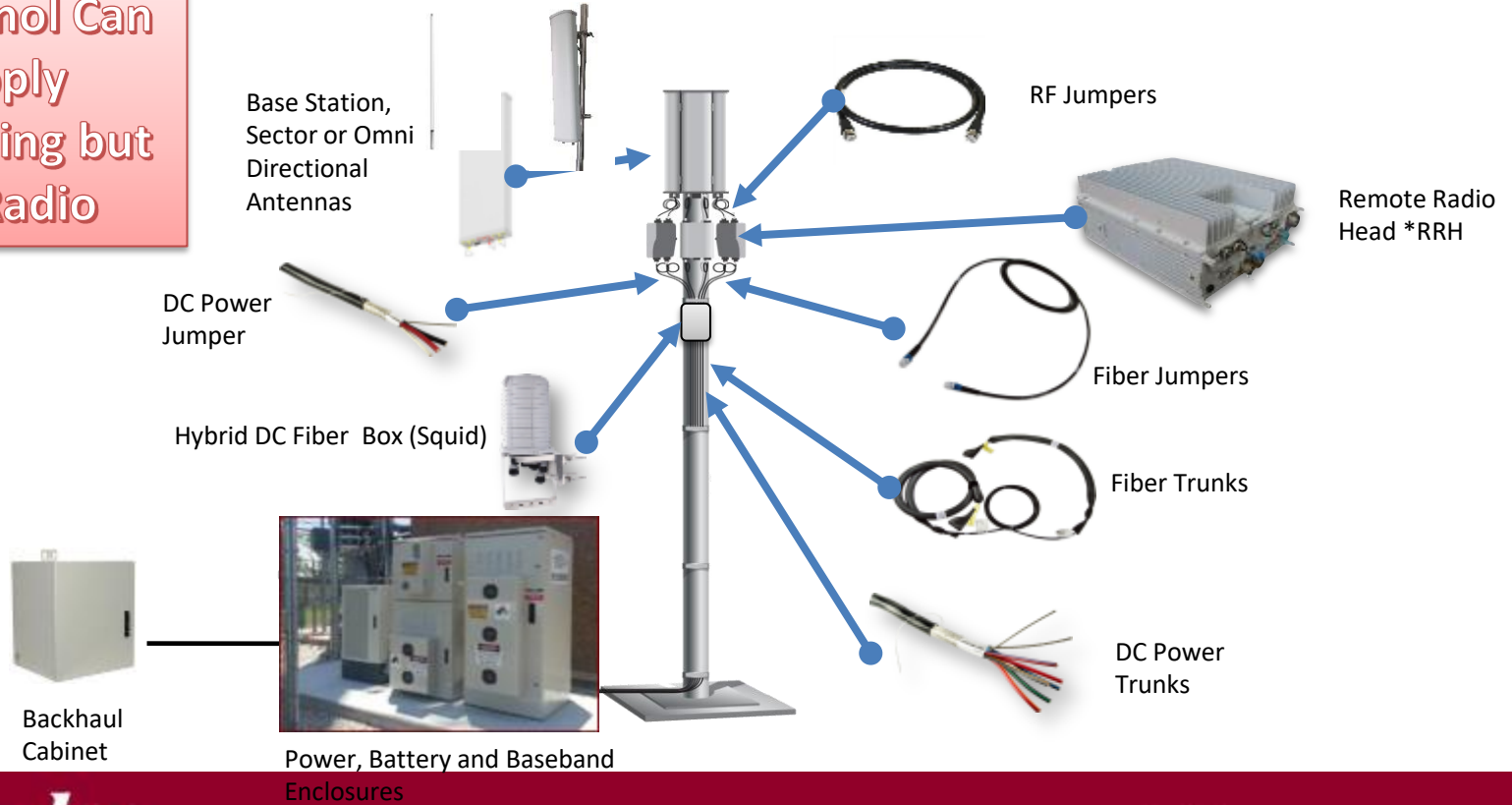
Macro Site, Small Cell Site, Private LTE

- Macros may not reach to where utilities companies have their IoT devices
- Private LTE Networks at Utility for Smart Grid Communication
- CI – Enclosure deployments at over 12,000 macro sites
- CI – Enclosure deployments at over 18,000 small cell sites
- CI – Experts in Wireless – Fiber Back Haul Cabinets and Concealment



Cell Tower Components

Amphenol Can Supply Everything but the Radio



One Amphenol Solution – Private LTE

Antennas – Base Station, Sector, Omni Directional and Dual Band

RF Cable – a large variety of loss rated RF cable and all adaptors

Hybrid Cable – Power and Fiber in single sheath. Guideline #6 CU for under 300' and #4 CU for longer

Fiber Back Haul Cabinets - CUBE-SS4C2285Q3

Amphenol Antenna – Base Station

HEX545CU000X

696-960 / 1695-2400 / 1695-2400 MHz Base Station

- Tri Band, Hex Port, Panel Antenna, 45 degree, 15.1/17.8 DBI, Variable Tilt

Product features:

- Ultra wide-band, AWS-3 Ready
- 4x4 MIMO high band compatible
- Patented internal RET actuator adds no additional length to antenna
- Can be ordered with MDDU with 2 separate inputs for independent control over each band
- PIM -153 dBc
- Wind survival 150mph or 241km/h
- Fixed Downtilt 0-14 degrees



Amphenol Antenna – Omni Directional

4240.03-875-Txx & 4240.06-875-Tx

4240.03-875-Txx colinear antenna

- Heavy Duty LTE Omni antenna low PIM for all LTE networks inc. Anterix Band 8

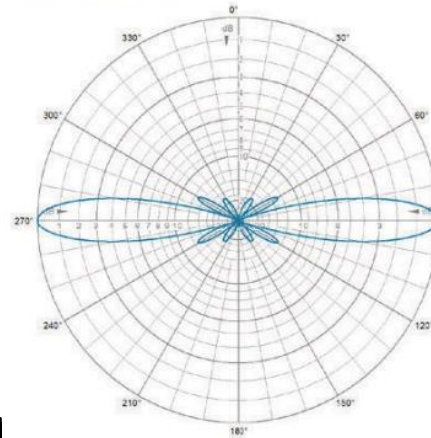
Product features:

- 790-960MHz
- 3 or 6dBd of gain
- Max input 350W
- Peak instantaneous Power 25kW
- PIM -153 dBc
- Wind survival 186mph or 300km/h
- Fixed Downtilt 0-10 degrees

Application Network Infrastru

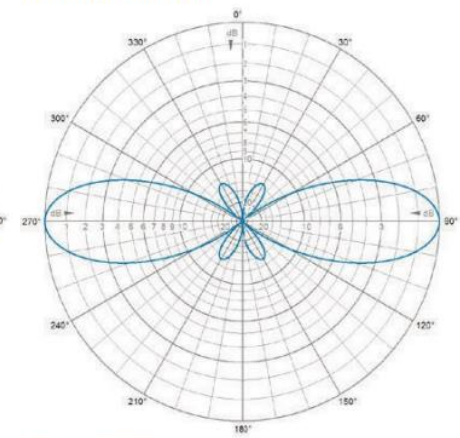
Smart Utilities ▪ IoT ▪ Public Safety ▪ LTE Networks ▪ Anterix

RADIATION PATTERN



E-Plane | 875 MHz

RADIATION PATTERN



E-Plane | 875 MHz



Amphenol Antenna – Omni Directional 42450.09-875-Tx Featuring Null Fill

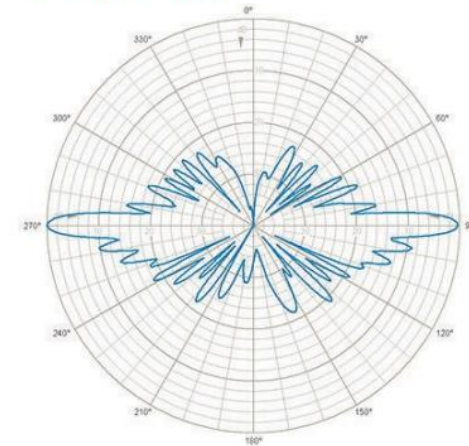
4240.03-875-Txx colinear antenna

- Heavy Duty LTE Omni antenna low PIM for all LTE networks inc. Anterix Band 8

Product features:

- 790-960MHz
- Null Fill
- 9dBd of gain
- Max input 400W
- Peak instantaneous Power 25kW
- PIM -153 dBc
- Wind survival 186mph or 300km/h
- Fixed Downtilt 0-10 degrees

RADIATION PATTERNS



E-Plane | 875 MHz | 0°



Innovation – ProNexus

PRONEXUS Market leading Mobile antenna

- High-performance 4x4 MIMO LTE and 4X4 or 6X6 Wi-Fi 617-960/1710-72000MHz with 2x GNSS
- WiFi at 2.4 & 5.0GHz and Wi-Fi 6(E)

Applications ▪ Public Safety ▪ Smart Fleet management
▪ Public transport. Automatic Guided Vehicles ▪ Autonomous Mobile Robots

Product features:

- 5G compliant.
- All global Wi-Fi standards inc Wi-Fi 6(E) compliant
- MIMO 4X4 and 6x6 options.
- UN ECE R 118 Compliant Cable Feeds
- IP69K rated
- IK10 rated
- Available in white and black cover
- Single hole mounting
- Ground independent performance



GNSS2020 Active Antenna

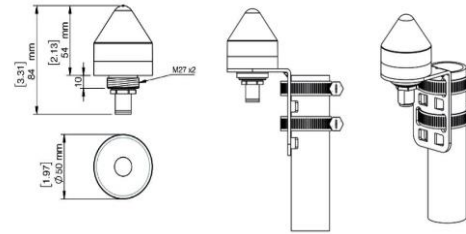
GNSS 2020 – New GNSS antenna

- Active Receiving Antenna for the GPS, GLONASS, BEIDOU and GALILEO

Applications Location or network synchronization in Smart Industry ▪ Smart Utilities ▪ 4G and 5G network rollout

Product features:

- Cover multiple satellite standards
 - Europe's Galileo, USA's (GPS), Russia's GLONASS and China's BeiDou.
- Full hemispherical coverage.
- Built-in high gain, low noise amplifier.
- Input filter for thorough RF-overload protection.
- Right-hand circular polarization (RHCP).
- 3 V - 15 V supply voltage.
- DC supply via RF-connector.



Market Leading - ProFin*Plus*

Applications ▪ Public Safety ▪ Smart Fleet management ▪ Public transport ▪ Automatic Guided Vehicles ▪ Autonomous Mobile Robots

Features

- 617MHz -6.0 GHz covering 4G, 5G, Wi-Fi 2.4 / 5.8
- External Whip
- MIMO 2x2
- GNSS patch option x2
- Environmental IP67
- UN ECE 118

Fully flexible installation options:

- Roof & Cabinet Mount – single stud.



Co-Creation – UWTA-600-6000

UWTA 600-6000 fixed wireless antenna

- High-performance antenna covering 617-6000MHz -LTE 4G, 5G, Wi-Fi CBRS

Applications ▪ End Point Devices ▪ Smart Industry ▪ Smart Utilities ▪ Smart Fleet management ▪ Smart Metering ▪ Automatic Guided Vehicles ▪ Autonomous Mobile Robots

Product features:

- 5G compliant
- IP67 rated antenna and cable / connector
- Wi-Fi 2.4 & 5.8 GHz compliant
- Ground independent performance

Pairs Nicely With ▪ ProGNSS-25 when **embedding** antennas into End Point Devices ▪ Smart Fleet management ▪ Automatic Guided Vehicles ▪ Autonomous Mobile Robots



Innovation ProConnect & ProConnect*Plus*

Applications ▪ End Point Devices ▪ Smart Cities ▪ Smart Industry ▪ Smart Utilities ▪ Smart Fleet management ▪ Public transport ▪ Automatic Guided Vehicles ▪ Autonomous Mobile Robots

Features

- 617MHz -7.2GHz covering 4G, 5G, CBRS, Wi-Fi 2.4 / 5.8 and Wi-Fi 6
- SISO and MIMO 2x2 options
- GNSS patch option x2
- Environmental IP69K & IK10
- UN ECE 118
- Overall size H 116mm and Diameter 55mm

Fully flexible installation options:

- Roof & Cabinet Mount – single stud.
- Cabinet mount – side exit.
- Pole mount – with bracket.



5G	IP69k Rated	Wi-Fi 6(E)	GNSS X2
4G	IK10 Rated	MIMO 2X2	
MIMO 2X2			











RF Cables

▲ Different Types of 50ohm Cable

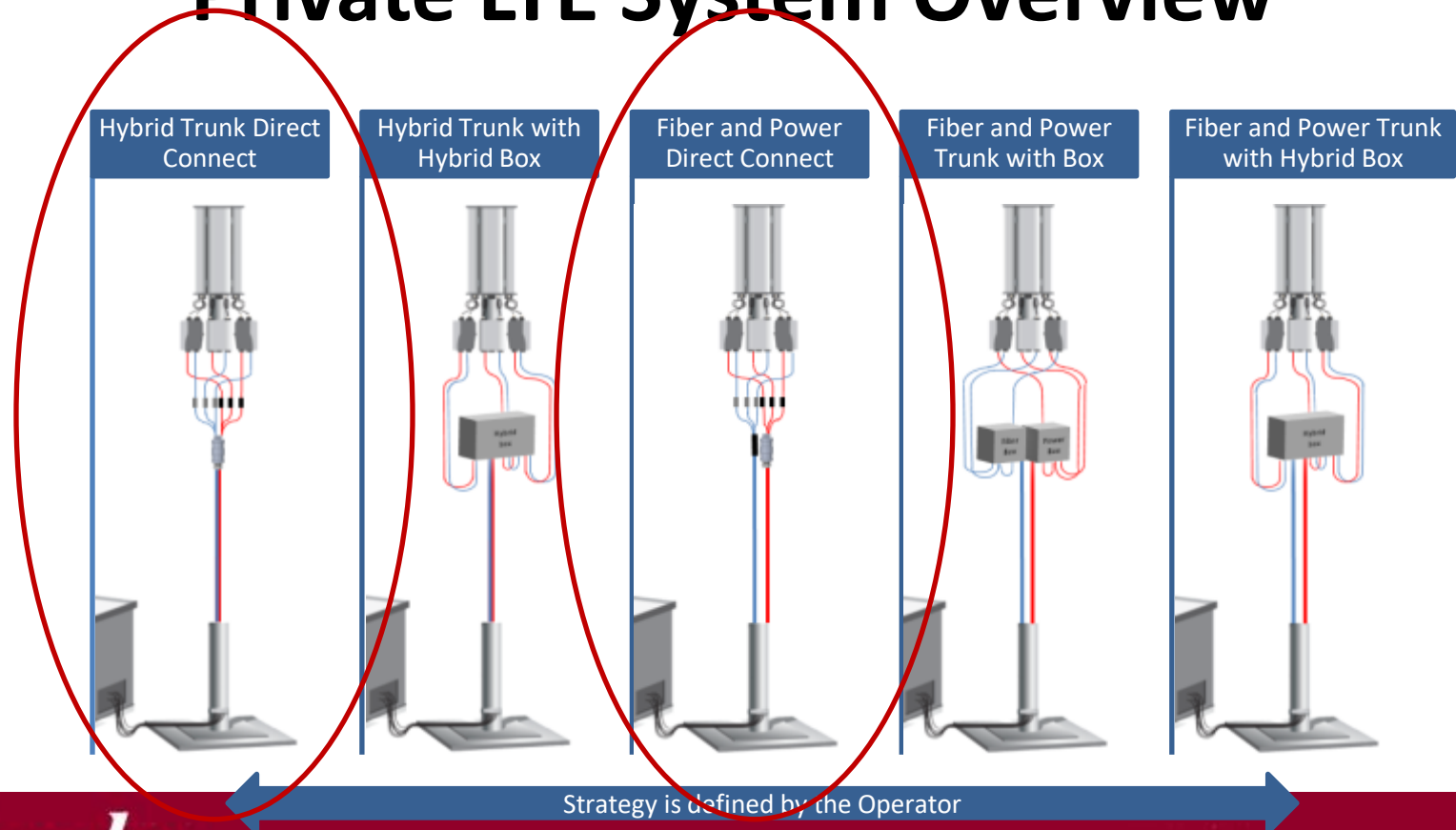
- RG-58 for 10'-25' cable lengths
- LL-195 for 10'-25' cable lengths
- LMR240 for 30'-50' cable lengths
- LMR400 for 40'-75' cable lengths
- LMR600 for 75' plus cable lengths



RF Connectors

Type	Standard		Reverse Polarity	
	male	female	RP male	RP female
SMA	 Threads inside Pin in the middle Diameter: about 6mm	 Threads outside Hole in the middle Diameter: about 5mm	 Threads inside Hole in the middle Diameter: about 6mm	 Threads outside Pin in the middle Diameter: about 5mm
TNC	 Threads inside Pin in the middle Diameter: about 12mm	 Threads outside Hole in the middle Diameter: about 10mm	 Threads inside Hole in the middle Diameter: about 12mm	 Threads outside Pin in the middle Diameter: about 10mm
N	 Threads inside Pin in the middle Diameter: about 17mm	 Threads outside Hole in the middle Diameter: about 14mm	X	X
UHF	 PL-259 Threads inside Pin in the middle Diameter: about 17mm	 SO-239 Threads outside Hole in the middle Diameter: about 14mm	X	X

Private LTE System Overview



Wireless Head End Solution Pictures



**Head End Node Placed
Next to Pole with Antennas**



Front View of Head End Node



**Rear View of Head End Node -
Coax ingress via weather tight ports**

3 Sector Site Example Configuration

39	Empty Space
38	Empty Space
37	
36	AC-DC Power Plant
35	Empty Space
34	Norantel Fuse Panel
33	Empty Space
32	
31	Cisco 2010
30	Empty Space
29	Cisco 2520
28	Empty Space
27	
26	MIMO Max Radio
25	Empty Space
24	
23	MIMO Max Radio
22	Empty Space
21	
20	MIMO Max Radio
19	Empty Space
18	
17	Fiber Tray
16	Empty Space
15	Empty Space
14	Empty Space
13	Rack Mount Tray
12	Empty Space
11	
10	Din Rail
9	Empty Space
8	Empty Space
7	Empty Space
6	
5	Lithium Battery
4	Empty Space
3	Empty Space
2	Empty Space
1	Empty Space



Composite Mounting Pad (CPAD)

- Thousands of enclosures are deployed annually
 - Typical mounting of enclosures is on a concrete pad, either cast-in-place or pre-cast and hauled to site
- Network builds are time compressed and need a solution that enables rapid deployment with minimal on-site project planning and coordination
 - Composite Pads (CPAD) eliminate on-site work, save time, and eliminate injury risk associated with handling and maneuvering heavy concrete slabs
- CPAD is designed to match the cabinet alignment features as well as ingress/egress cabling which eliminates drilling, anchoring and simplifies conduit placement
- Available in multiple sizes to serve your application
- Preconfigured units match Charles outdoor cabinets
- Universal versions available for other manufacturers cabinets and equipment

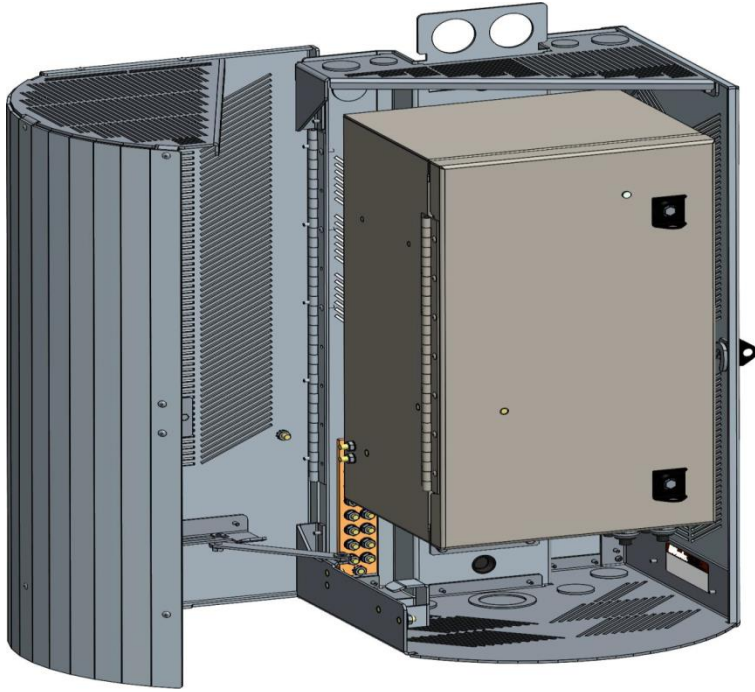


Wireless Remote Cabinet



- Mounts to utility poles or on the side of a utility box, serving as a multi-purpose outdoor enclosure for various electronic components and equipment
- Mounting studs on the rear wall support a customer-supplied aluminum mesh or plywood backplane
- 3 point latch with 216-style padlockable, swinghandle and a door alarm switch
- Optional solar shield kits are available for the enclosures top panel or front door
- Houses (1) Tornado radio to extend coverage into the neighborhood

Wireless Concealment Solution



- **Aesthetic Solution**
- **Multi Purpose Cabinet and Concealment Shroud**
- **Urban Installations**

Concealment Shrouds

For Wireless Radio Networks

Cost-effective, aesthetically pleasing and scalable solutions for concealing Small Cell, DAS and densification equipment and its transition to fiber optic or copper connections.

- Radios
- Power supplies
- Diplexers/combiners
- Fiber termination /slack storage
- Associated cabling
- Power termination



SHRD56



SHRD54



CISH51



SHRD52



SHRD1



SHRD60-401



SHRD60-051

CUBE MP Series

- **Multi-Purpose NEMA Enclosures**
 - Pole Mount
 - Wall Mount
 - Sizes vary from 13" x 10" to 40" x 16"
- **Custom Options**
 - Vents/ Fans
 - Fiber Accessories
 - Wood or Aluminum Backboards



Power Sectionalizer Cabinets

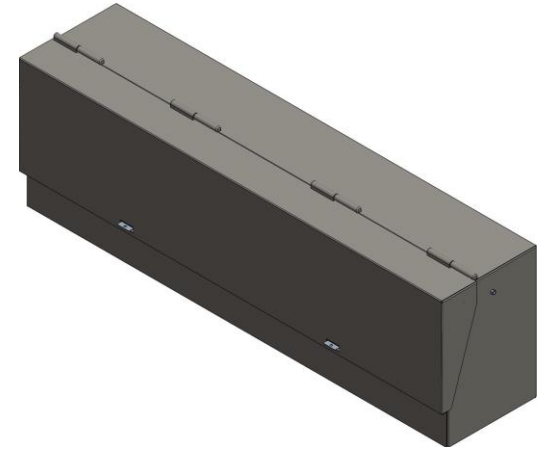
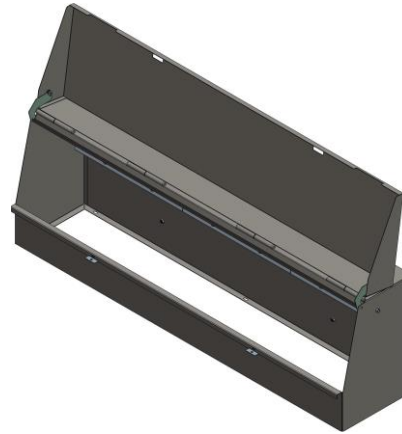
New ACI product

Muncell Green

Single Phase and 3 phase

Backer board or integrated

6-8 week LT



EV Charging Stations

ACI product

Same day install

Safety no rebar





An **Amphenol** Company

“Enabling our customers to better serve their customers”