



Berlin-Boylston Public Schools In-building Off-Air Hybrid DAS Proposal #SO-127175

Berlin-Boylston Public Schools, 1001 Main Street, Boylston, MA 01505

Prepared for:



RSRF Contact:

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Estimate Date:

01 August 2023



About RSRF

On behalf of RSRF, I'm pleased to provide you with this proposal and scope of work for improving cellular coverage in your facility. At RSRF, we take every aspect of deploying an in-building cellular coverage solution seriously. This proposal document aims to do four things:

- Explain the DAS technology we've selected and how we plan to deploy it in your building
- Detail the parts that have been specified by our engineering team for your project
- Explain our scope of work, set standards for our performance, and detail your role during the installation.
- Provide pricing for the core installation and any optional additions

However, I'd like to begin by highlighting some of the advantages of working with RSRF:

Refined deployment process and a focus on communication

At RSRF we believe that a clear deployment process and regular, proactive communication are key to ensuring that deployments go smoothly.

Throughout the deployment of your DAS, our installation and project management teams will reach out to you proactively with updates on progress and to inform you of any issues that may come up during the installation.

Distributed Antenna Systems are our core competency

Since RSRF was founded in 2006, we've installed hundreds of turnkey DAS solutions.

Our team includes experts in every aspect of engineering and installation these systems. When engaging with RSRF, you can be assured of our performance across the spectrum: from communication prior to installation, to the physical deployment of the system, through post-installation support.

The latest technology delivered at a reasonable cost

Residential buildings, hotels, offices, and hospitals don't have the same capacity requirements as sports arenas. Most DAS vendors implement the same high cost solutions intended for stadiums for much smaller buildings.

We've carefully chosen technologies that address the coverage needs of enterprise buildings without compromising performance.

Industry-leading post-installation support

Our support doesn't end upon project completion. We back everything we do with a 1-year warranty for parts and labor, but we'll go above and beyond to support you however we can after your DAS is installed.

We treat our customers the way we want to be treated by our own vendors: we bend over backwards to make sure that any issues you encounter are addressed.

We very much look forward to working with you to ensure that your investment in an in-building DAS pays dividends for all the tenants, visitors, and employees. If you have any questions about this proposal, please feel free to reach out to me or any of our team members directly.



Sina Khanifar, CEO

Project location

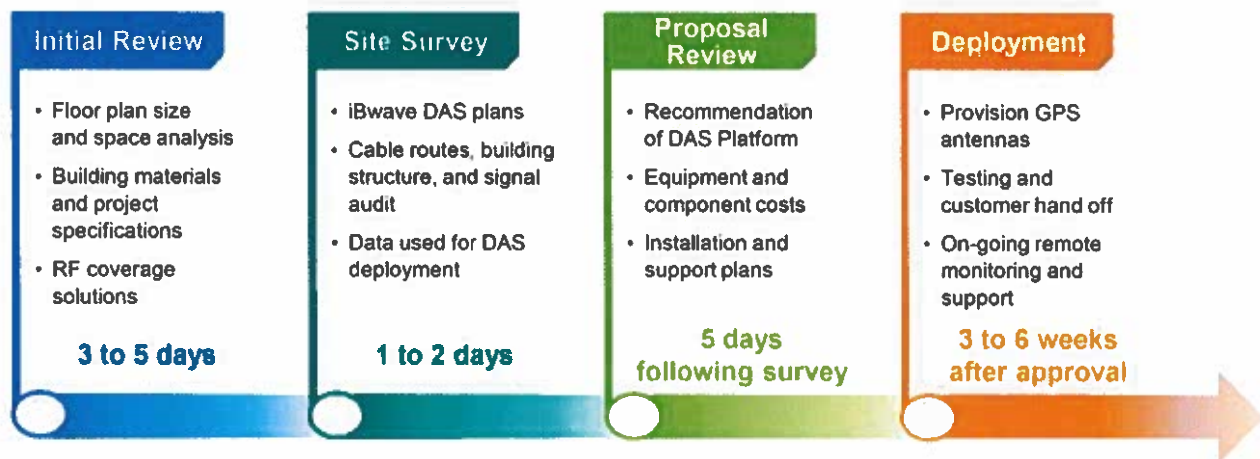
ADDRESS:

Berlin-Boylston Public Schools, 1001 Main Street, Boylston, MA 01505

BUILDING DESCRIPTION:

School

PROCESS:



Objective

The primary objective of this project is to enhance voice and data service for **AT&T**, and **Verizon** throughout the building.



Scope of Work

This project involves the design and installation of a Cellular Enhancement System to be installed by RSRF for BBRSD ("Client") at Berlin-Boylston Public Schools, 1001 Main Street, Boylston, MA 01505 ("Property"). The system will utilize FCC and a carrier approved hybrid distributed antenna system (DAS). The hybrid DAS will collect signal from small cells, condition and digitize those signals, and distribute throughout the building using ethernet cables to address coverage requirements throughout the building.

The project is limited by the information and data contained in this Statement of Work document. If the Property or premises conditions or information change, the Parties will renegotiate in good faith to accommodate those changes. RSRF is not responsible for coverage or capacity deficiencies resulting from changed conditions at the Property, or any other conditions beyond RSRF's control, including without limitation changes to the carrier's macro cellular networks.

Indoor signal coverage is limited by coverage outdoors. By accepting this scope of work, the Client agrees that they have discussed and understood any limitations to donor signal availability and its impact on in-building coverage.

AREAS COVERED BY PROPOSED DAS:

- Entire building

TOTAL COVERAGE AREA:

- Total: **126,204 square feet**

TECHNOLOGIES AND CARRIERS INCLUDED

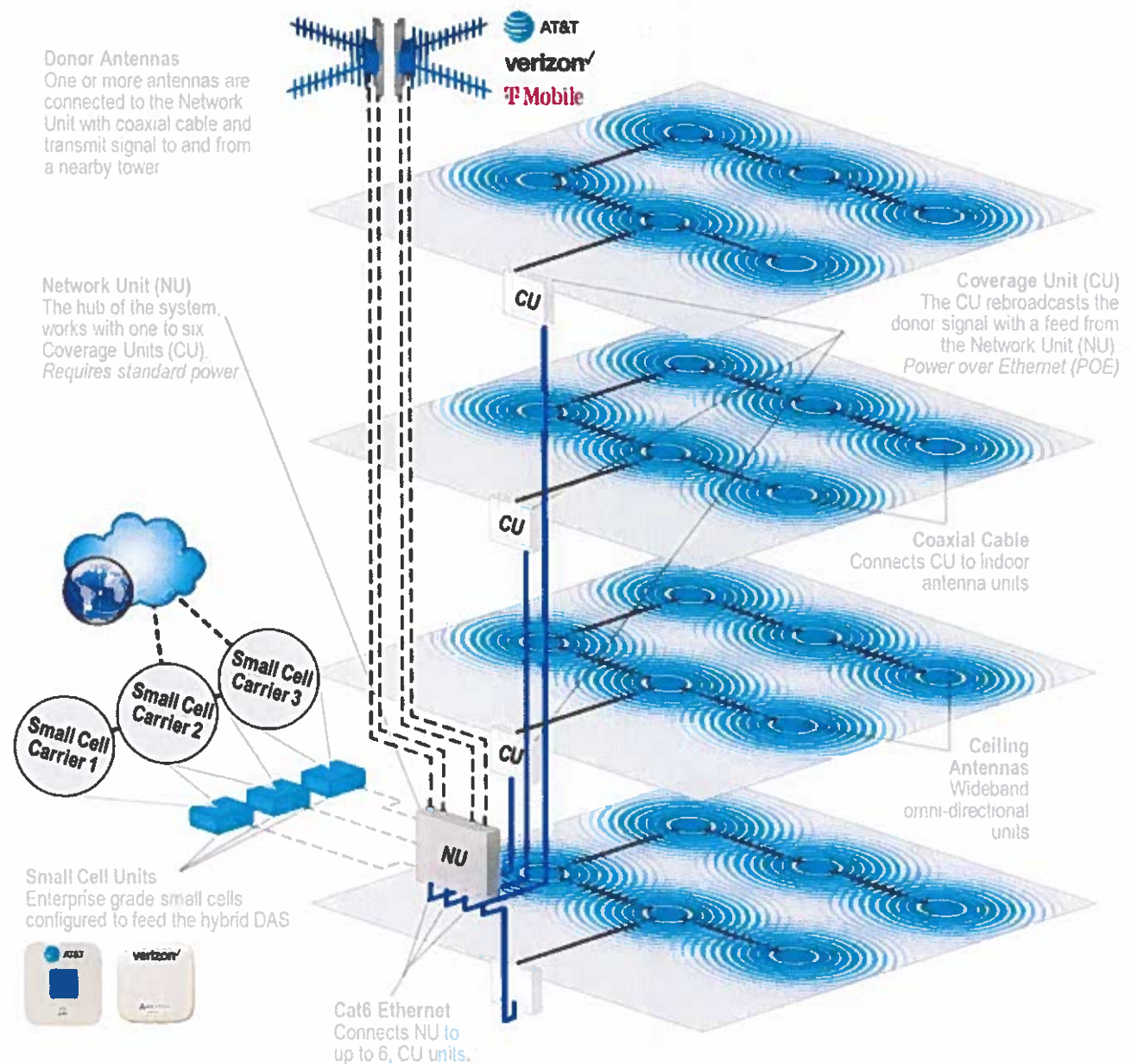
- **AT&T: 3G HSPA+ and 4G LTE**
- **Verizon: 4G LTE Only**



Hybrid DAS Architecture

The proposed deployment will include a hybrid DAS. This system utilizes outdoor antenna(s) and/or enterprise-grade small cell(s) to feed signal to the Network Unit (NU). The NU receives and digitizes signals from each carrier. Signals transmit through Ethernet cables to each CU for retransmission through control units (CU).

- The platform provides the form of an Active DAS – to deliver a solution designed for middleprise buildings.
- An all-digital, scalable, PoE cable-based solution ideal for multi-carrier, or dual carrier environments.
- The diagram below shows a pictographic representation of the overall architecture of the system:



QUATRA 4000 & *4000i Band Combinations

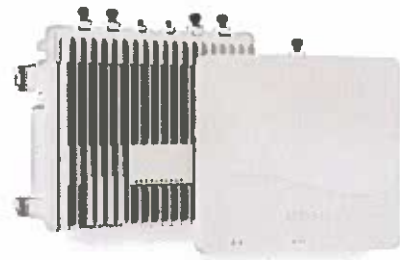
AT&T	12 & 5 12 & 25 12 & 4 12 & 2 (30 & 5)* (30 & 25)* (30 & 4)* (30 & 2)*
Verizon	13 & 25 13 & 4 13 & 2
T-Mobile	25 & 4 25 & 12 4 & 12 2 & 4 2 & 12 (2 & 71)* (4 & 71)* (25 & 71)*
T-Mobile (Sprint)	5 & 25 5 & 2 (26 & 25)* (26 & 2)* (41 & 26)* (41 & 25)* (41 & 2)* (41 & 5)*

**These specs are applicable only for the QUATRA 4000i*

EQUIPMENT FEATURES:

- Carrier-Grade, FCC-certified Smart Signal Booster
- Support for AT&T, Verizon, T-Mobile, and Sprint
- Relays two (2) bands per operator, simultaneously
- Independent donor ports for each operator allows for independent antenna optimization
- Single combined (CU) server port enables driving either a serving antenna or passive DAS field
- 100 dB max system gain
- 140MHz total relay bandwidth
- Support for up to six (6) CUs (twelve with a HUB)
- N-type RF connectors (donor and server)
- Internal modem for remote management (SIM slot access)
- Industrial aluminum powder-coated housing
- Up to 100m cable distance between NU and CU (using Cat5e), or 150m using 22/23AWG CAT6/7
- QUATRA Range Extender (QRE) doubles CU cable length (up to 300m)
- 20-22 dBm uplink power per operator per band
- 16 dBm downlink power per operator per band

DAS EQUIPMENT:



Cel-Fi QUATRA 4000 System

- An in-building enterprise-grade cellular system
- Hybrid, all carrier off-air/ small cell DAS
- Utilizes CAT6 cabling for RF and Power over Ethernet
- Carrier approved and guaranteed network safe
- Up to 100dB Max Gain



Cel-Fi QUATRA 4000 Network Unit

- Provides coverage in the Cel-Fi QUATRA system (up to six per Network Unit)
- Power delivered by Power-Over-Ethernet from the Network Unit
- Connects via ethernet or LTE Modem for remote monitoring and management
- Dimensions 12.99" x 10.70" x 3.34"



Cel-Fi QUATRA 4000 Coverage Unit

- Provides coverage in the Cel-Fi QUATRA system (up to six per Network Unit)
- Power delivered by Power-Over-Ethernet from the Network Unit
- Self-configuring and self-optimizing and only compatible with Cel-Fi QUATRA 4000 NU
- Dimensions 11.29" x 10.03" x 2.24"

COAXIAL AND STRUCTURED CABLING:



Cat6 Ethernet Cable

- Improves upon Category 6 specification with better crosstalk mitigation.
- (250MHz), 4 Pair, 23 AWG Solid Bare Copper Conductors, F/UTP - Foil Shielded, Plenum-CMP, PVC-LS Jacket
- The lossless cable can be run for 100m without the need for a range extender.
- Allows digital transmission of cellular signals without loss.
- Easier to run than coaxial cable.

COAXIAL AND STRUCTURED CABLING:



CommScope Plenum Air Aluminum Cable

- CommScope HELIAX® coaxial cable is a high quality cable designed for 20-year outdoor service
- The cable is encased in an off-white 1/2 inch PVC jacket
- Approved for use in plenum space

MISCELLANEOUS PARTS:

- RSRF will install any other passive components necessary to complete to the existing cabling and antenna system. This may include:
 - Taps and couplers
 - Signal splitters
 - Coaxial crimps
 - Attenuation (as required)

RSRF RESPONSIBILITIES:

- DAS headend: Installation and provisioning of QUATRA network unit
- In-building antennas: RSRF will install QUATRA coverage units and any necessary ceiling-mounted dome antennas and wall-mounted panel antennas.
- Structured cables: RSRF will install ethernet cable in risers and above ceiling tiles.
- Coaxial cables: RSRF will install coaxial cable in risers and above ceiling tiles.
- Passive components: RSRF will install all taps, couplers, and splitters required to distribute the signal.
- Termination of cables: RSRF will terminate all coaxial and ethernet cables.
- Fire caulking: RSRF will replace any fire-caulking removed when riser cables are run.
- Cleaning and repair: RSRF installation team will clean, to the best of their ability, all areas where they work. Any ceiling tiles damaged during the installation process will be replaced.

CLIENT RESPONSIBILITIES:

- Conduit, raceway, trim or rooftop penetrations or repairs required for the installation or by the client are not included or covered in this proposal, and must be provided by the Client unless otherwise agreed in writing.
- Internet connection: During the commissioning process, communication through a LAN to the Quatra WAVE Portal may be required.
- Power requirements: If not already present, client will provide 110V electrical outlets as needed in electrical/IDF/telecom closets.

CLIENT RESPONSIBILITIES:

- Power requirements: If not already present, client will provide 110V electrical outlets as needed in electrical/IDF/telecom closets.
- The client will provide access to the building during normal business hours (Monday to Friday, 8am to 5pm). Client will allow after-hours work to maintain schedule when necessary.
- Drywall and hard ceiling breaches: In some cases, penetrations to drywall ceilings or walls may be necessary to complete installation. RSRF will notify the client prior to making such penetrations.
- Client will be responsible for any patching or painting required to cover penetrations that they have been notified of.

LABOR REQUIREMENTS:

- a) Union labor: Union labor is not required and will not be utilized. If union labor is required, deal terms may be altered.
- b) Any additional incurred labor or project management costs required to meet Client's responsibilities as detailed in this document will be paid by the Client.
- c) Client affirms that there are no special approvals required for RSRF or its contractors to perform installation work.
- d) Client affirms that there are no restricted areas or areas that require training, drug screening, or background checks for access.

CHANGE ORDERS:

The client may, without invalidating this Agreement, request changes to the Statement of Work (SOW) or the Responsibilities section of this proposal.

- RSRF shall submit a description of the proposed scope change, details, and impact of the requested changes, including the impact on costs and completion date.
- This Change Order proposal will be delivered to the Client within five (5) working days after the Client's request, or a mutually acceptable reasonable period of time thereafter.
- Any adjustment in the contract amount shall be authorized by a Change Order and all such Work shall be executed under the terms of the Agreement.
- The client will review RSRF's proposal within five (5) working days after its receipt or a mutually acceptable reasonable period of time thereafter, and will promptly respond to RSRF.

No such change shall be binding upon either party hereto until both RSRF and Client have agreed upon and signed a Change Order and amended or new Purchase Order which shall constitute an amendment to this Agreement.

PERMITTING AND SAFETY REQUIREMENTS:

The Client believes that no other permitting or safety requirements must be met for this project in the project's jurisdiction, including but not limited to the location and installation of any outdoor antennas, indoor antennas, cables, or amplifiers. Client understands that any additional requirements, or changes in equipment, may result in additional charges, if agreed to in advance in writing by client.

POST INSTALLATION TESTING:

After installation is completed, RSRF will test DAS performance to ensure correct operation of the installed system.

Testing includes:

- Verification of signal output at indoor antennas.
- Verification of coverage and signal quality.
- Balancing of signal levels between amplifiers and floors (where applicable).

MONITORING AND MAINTENANCE:

RSRF's Monitoring and Maintenance services ensure that the Cellular Enhancement System is performing correctly and meets the signal coverage and performance requirements of the Client and that any downtime, alarms, or Client-initiated Trouble Tickets are resolved expeditiously. Complete details are included in the *Cellular Enhancement System Monitoring and Maintenance Service-Level Agreement*.

- **Monitoring** includes the remote online access of the specified DAS components and automated review of their operational health from RSRF's Network Operations Center NOC.
- **Maintenance** shall mean necessary and reasonable activities required so that the DAS operates in conformity in all material respects with the descriptions and specifications of the DAS as defined in the Scope of Work.
- **Repairs** shall refer to the testing equipment following a failure of the equipment; diagnostic examination of the equipment above and beyond identifying a failure; testing to address performance issues that may have arisen due to a failure; repairing or correcting any issues that have occurred due to a failure in the installed equipment; and/or replacement of any equipment that may have failed.
- **Support** shall mean activities including, but not limited to: remotely addressing and resolving any diagnostic alarms raised remotely from the Supplier's Network Operations Center; providing diagnostic assistance to the Client's designated on-site system administrators in response to reported coverage issues.

Monitoring and Maintenance services are provided as a separate line item in the Pricing section of this Proposal.

Pricing

Description	Price	Quantity	Subtotal
QUATRA 4000 Hybrid, AT&T & Verizon Small Cell Distributed Antenna System - Equipment	\$99,838.57	1	\$99,838.57
QUATRA 4000 Hybrid, AT&T & Verizon Small Cell Distributed Antenna System - Installation	\$39,179.17	1	\$39,179.17
			\$139,017.74
Taxes and Shipping			
Freight/Shipping Shipping and freight costs will be calculated when your order is shipped. Your invoice will reflect the updated charge.	\$2,750.00	1	\$2,750.00
			\$2,750.00

Monitoring and Maintenance	Price	Years	Subtotal
Cellular Enhancement System, Service Level Agreement Monitoring, maintenance, repairs and support from Supplier's Network Operations Center NOC. (5-Year Plan)	\$5,000.00	5	\$25,000.00
			\$25,000.00

PAYMENT TERMS

- Pricing is valid from 30 Days of date of proposal
- 50% payment within 14 days of signing purchase agreement
- 50% payment within 14 days of project completion

Assumptions & Exclusions

- No permit costs are included in above pricing. Client will be responsible for any permits required
- Power for IDF locations is assumed available or being provided by others
- No UPS is included in price
- No Conduit is included in price (Excluding Parking Garage, non-rigid conduit to be used)
- No roof penetrations are included in price
- No coring or x-raying is included in price
- Patch and Paint is not included in price
- On-site in building storage will be available for material staging throughout the duration of the project
- No escort fees have been included in price
- No Union Labor and no Prevailing Wage
- Pricing is not inclusive of any venue mandated subs/contractors
- Work Day is defined as 8 AM to 5 PM – Night and Weekend Work will result in a Change Order
- The terms of the proposal include one deployment for the completion of the project. Any delays caused by the venue or customer will result in a Change Order
- Any change in the Scope of Work will result in a Change Order
- Any delays as a result of the venue or the customer will be billed to customer
- Troubleshooting outside of the Scope of Services are available at additional costs
- Power and Grounding are based on availability within 10' of installed equipment
- Handling of hazardous materials is not included
- Additional labor or equipment not included in the Scope will require a change order
- Any additions exceeding 10,000 square feet to the design or configuration during or post installation, will be invoiced separately
- No additional requests or out of scope services will begin until a change order PO has been received
- All materials provided by others will be delivered directly to the venue
- Installation of component locations will meet design specification as building structure permits
- Commissioning and Integration are planned to be completed in one visit. Otherwise a re-deployment fee will be charged for integration phase if the customer decided to shift it to a separate visit.

Trusted by the best

We've deployed hundreds of DAS projects around the country, and take pride in ensuring that every single customer is completely happy with the solutions we install.



**La Jolla
Institute**
FOR ALLERGY AND
IMMUNOLOGY

"With RSRF's fast, expert assistance, we greatly improved access for our users at our site."

- Michael Scarpelli, Director of IT, La Jolla Institute

"It was a pleasure doing business with RSRF. They are a wonderful partner to work with and stand behind their work 100%. I would not hesitate recommending them as a provider of in-building cellular solutions!"

- Teri Conner, IT Manager, Scotsman Ice Systems

Scotsman®
Ice Systems



"Our experience working with RSRF on the DAS for our new hospital was refreshingly positive. RSRF worked within our time constraints and was able to satisfy our needs from supplying all materials, to a crew of excellent installation technicians. If only more of my projects went as well as this. Recommended!"

- John Howell, Architect & Telecoms Specialist, State of New York

Site Audit Report

Prepared for:



Client:

Paul Mara
Network Manager

Project:

Berlin-Boylston Public Schools
1001 Main Street, Boylston, MA 01505

Date:

01 August 2023

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Executive Summary

Overview

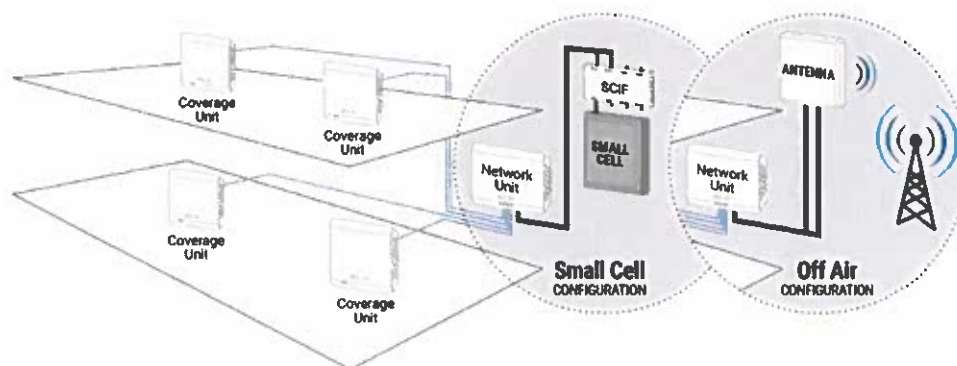
RSRF performed a site survey for Berlin-Boylston Public Schools in June of 2023. The interior space and rooftop areas of the building was surveyed for all carriers. An analysis of the RF cellular signal conditions at the site are profiled in this report.

Outdoor signal values were measured from the Rooftop. Specifically RSRP (signal strength) and SINR (signal quality). These values are used to determine the type of signal source required to feed the DAS solution.

RSRP and SINR signal values were measured inside the Berlin-Boylston Public Schools space area. These values benchmark the specific areas that exhibit strong signal and the areas with poor signal coverage. This information helps determine the antenna placement in order to ensure dominance over the macro signal coming from the outside.

Summary of Findings

- All major carriers exhibit poor signal strength and quality throughout the indoor coverage area.
- AT&T signal is the worst performing carrier overall. The measured signal is weak and, in some cases, non-existent.
- Rooftop signal readings indicate that the existing signal is also poor for all 3 carriers.
- Therefore, the off-air signal cannot be used to feed the DAS.
- Small Cells for AT&T and Verizon will be used as signal sources to feed the DAS.
- T-Mobile will not be included in the design.



RSRF Recommendation

- Based on the overview above, RSRF recommends installing a new Nextivity Cel-Fi Quatra 4000 system to solve the indoor coverage issues.
- Small Cells for AT&T and Verizon will be installed in the Main Equipment Room and connected to the Network Unit (NU) through coaxial cable.
- A GPS antenna will be installed at the Roof and connected to the Small Cells on Level 2.
- The NU is wall mounted and will be connected to multiple Coverage Units (CU) through CAT-6 cable.
- Each CU will be connected to multiple Dome Antennas installed on the ceiling through coaxial cable.
- The CUs are PoE, so they can be installed right next to the antennas that they will be feeding.
- This will lead to a reduction in the coaxial cable runs, increasing the output power per antenna.

Signal Readings

ROOF - SUMMARY

Strength	AT&T	Verizon	T-Mobile
Excellent Signal	0% (0)	0% (0)	0% (0)
Very Good Signal	0% (0)	0% (0)	0% (0)
Good Signal	0% (0)	0% (0)	0% (0)
Acceptable Signal	2% (8)	5% (30)	4% (28)
Poor Signal	36% (119)	53% (344)	38% (244)
No Signal	62% (206)	42% (270)	57% (366)
No Reading	0% (1)	1% (6)	1% (8)

Average	AT&T	Verizon	T-Mobile
Average RSRP	-116 db (348)	-111 db (660)	-114 db (646)
Average RSRQ	-16 db (348)	-16 db (660)	-17 db (644)
Average SINR	-2 db (264)	-1 db (618)	-3 db (562)

RSRP	-85	-100	-115
SINR	>15	5	<-5
	Good	Fair	Poor

RSRP

LTE signal strength is measured by RSRP, while LTE signal quality is measured by SINR. RSRP stands for Reference Signal Received Power. RSRP is a measure of LTE signal strength. Strong signal is around -70 or -80 dBm RSRP, while weak signal is around -100 dBm RSRP.

RSRQ

Reference Signal Received Quality. This only applies to 4G LTE networks and is a measure of the signal quality of a cellular connection. RSRQ is typically displayed in a range from 0dB (highest quality) to -20dB (lowest quality). Typically better signal quality results in a more reliable connection.

SINR

Signal to Interference plus, Noise Ratio. SINR is a measure of LTE signal quality. Clear signal has a SINR of over 10 dB, while moderate quality signal has a SINR of under 5 dB, and it gets continually worse as SINR readings go below 0.

Signal Readings

LEVEL 2 - SUMMARY

Strength	AT&T	T-Mobile	Verizon
Excellent Signal	0% (0)	0% (0)	0% (0)
Very Good Signal	0% (0)	0% (0)	0% (0)
Good Signal	0% (0)	0% (0)	0% (0)
Acceptable Signal	0% (0)	0% (0)	0% (0)
Poor Signal	0% (1)	4% (18)	5% (22)
No Signal	53% (136)	20% (88)	29% (140)
No Reading	47% (120)	76% (337)	67% (325)
Average	AT&T	T-Mobile	Verizon
Average RSRP	-126 db (138)	-120 db (107)	-122 db (166)
Average RSRQ	-17 db (138)	-17 db (103)	-17 db (166)
Average SINR	-3 db (136)	-2 db (72)	-1 db (118)



RSRP

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SINR

Signal to Interference plus, Noise Ratio. SINR is a measure of LTE signal quality. Clear signal has a SINR of over 10 dB, while moderate quality signal has a SINR of under 5 dB, and it gets continually worse as SINR readings go below 0.

Signal Readings



LEVEL 2 SIGNAL READINGS



Signal Summary	Percentage (Number) of Readings
Excellent Signal	0% (0)
Very Good Signal	0% (0)
Good Signal	0% (0)
Acceptable Signal	0% (0)
Poor Signal	5% (22)
No Signal	29% (140)
No Reading	67% (325)



Signal Readings



LEVEL 2 SIGNAL READINGS



Signal Summary	Percentage (Number) of Readings
Excellent Signal	0% (0)
Very Good Signal	0% (0)
Good Signal	0% (0)
Acceptable Signal	0% (0)
Poor Signal	0% (1)
No Signal	53% (136)
No Reading	47% (120)



Signal Readings



LEVEL 2 SIGNAL READINGS



Signal Summary	Percentage (Number) of Readings
Excellent Signal	0% (0)
Very Good Signal	0% (0)
Good Signal	0% (0)
Acceptable Signal	0% (0)
Poor Signal	4% (18)
No Signal	20% (88)
No Reading	76% (337)



Signal Readings

LEVEL 1 - SUMMARY

Strength	AT&T	Verizon	T-Mobile
Excellent Signal	0% (0)	0% (0)	0% (0)
Very Good Signal	0% (0)	0% (0)	0% (0)
Good Signal	0% (0)	0% (0)	0% (0)
Acceptable Signal	0% (0)	0% (0)	0% (0)
Poor Signal	0% (0)	0% (0)	0% (0)
No Signal	16% (63)	10% (44)	4% (18)
No Reading	84% (332)	90% (396)	96% (397)
Average	AT&T	Verizon	T-Mobile
Average RSRP	-126 db (64)	-126 db (44)	-125 db (18)
Average RSRQ	-17 db (64)	-17 db (44)	-16 db (18)
Average SINR	-3 db (55)	-2 db (38)	-1 db (5)



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RSRQ

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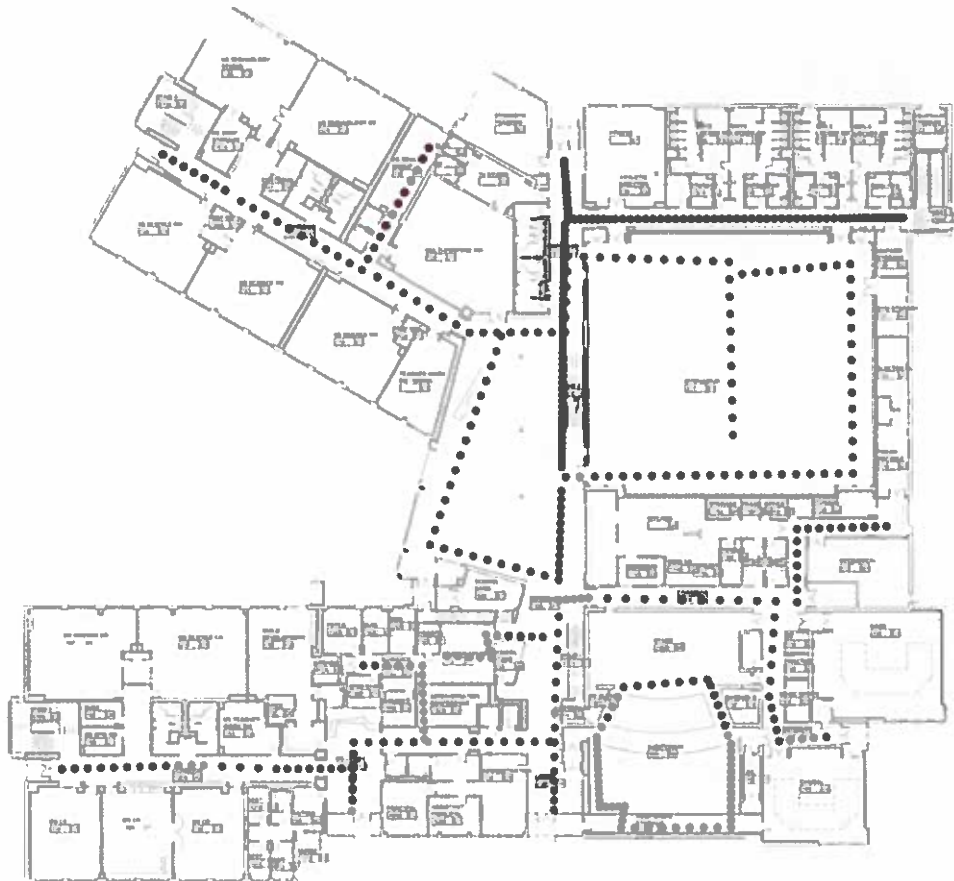
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Signal to Interference plus, Noise Ratio. SINR is a measure of LTE signal quality. Clear signal has a SINR of over 10 dB, while moderate quality signal has a SINR of under 5 dB, and it gets continually worse as SINR readings go below 0.

Signal Readings



LEVEL 1 SIGNAL READINGS



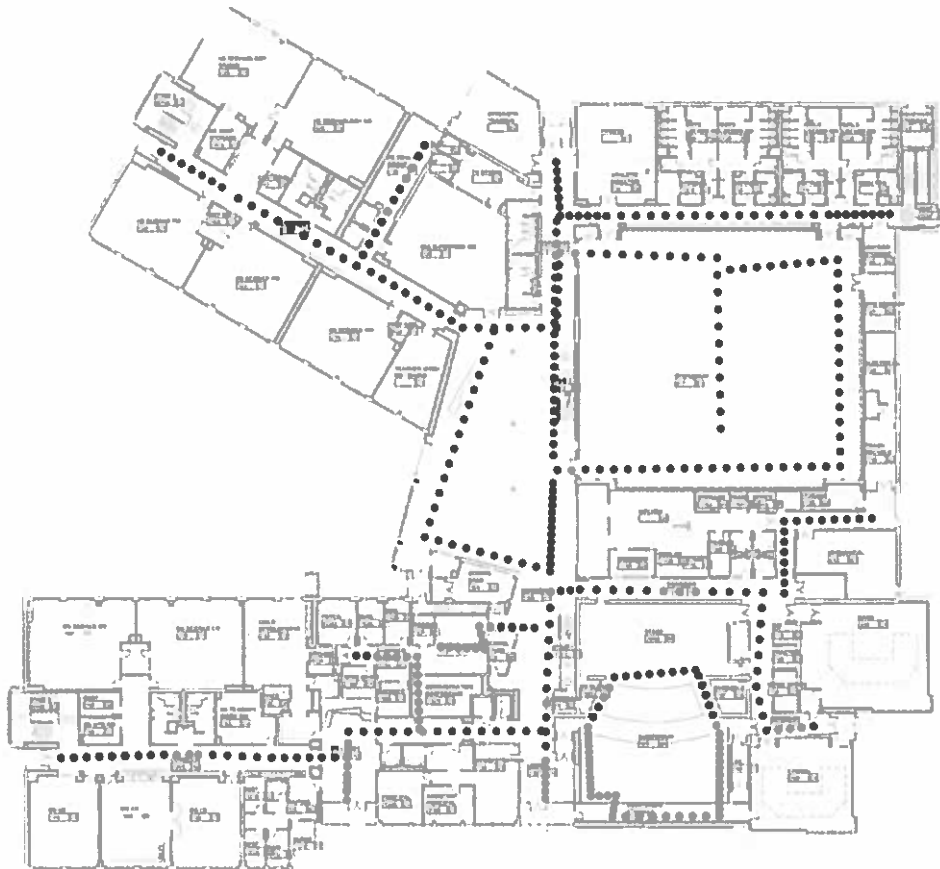
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Signal Readings



LEVEL 1 SIGNAL READINGS



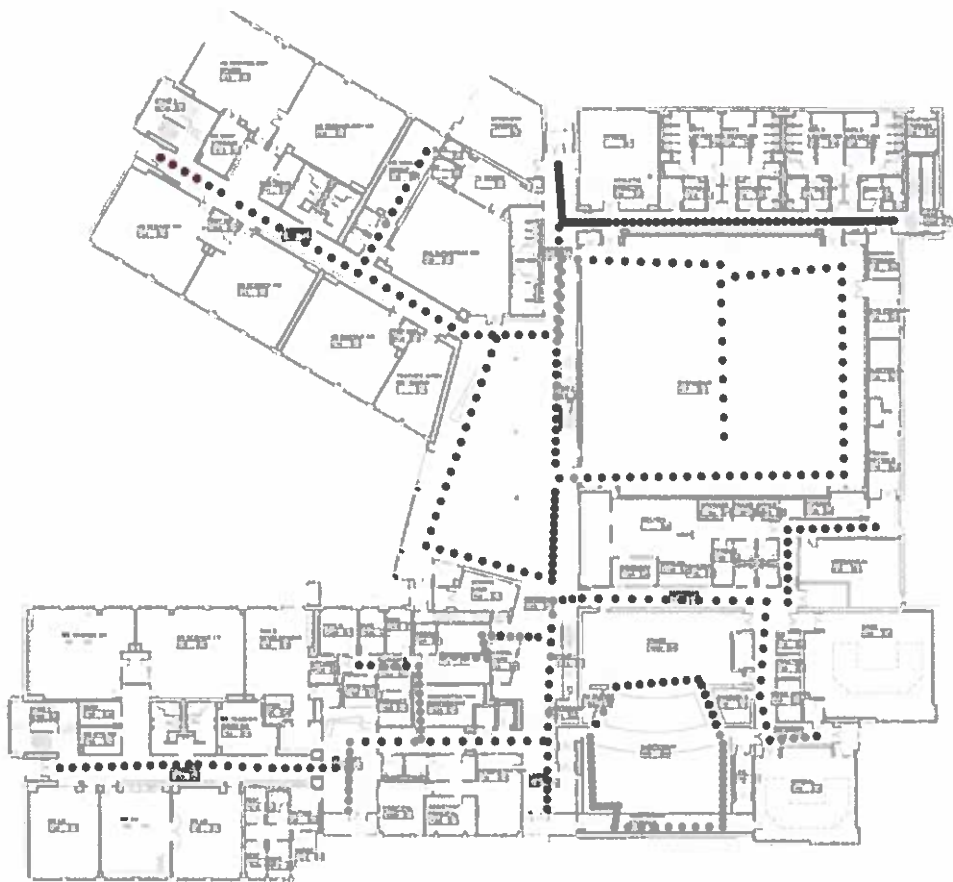
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Poor Signal	0% (0)
No Signal	16% (63)
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Signal Readings



LEVEL 1 SIGNAL READINGS



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Excellent Signal	0% (0)
Very Good Signal	0% (0)
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Acceptable Signal	0% (0)
Poor Signal	0% (0)
No Signal	4% (18)
No Reading	96% (397)



Survey Photos

ROOF



Figure 1: Photo of the Roof Penetration that will be used to connect the GPS antenna to the Small Cells.

Survey Photos

EQUIPMENT ROOM



Figure 2: Photo of the other end of the Roof penetration inside the Main Equipment Room.

Survey Photos

CORRIDOR - LEVEL 1



Figure 3: Photo of a corridor on Level 1 where a Dome Antenna will be installed on the ceiling.

Survey Photos

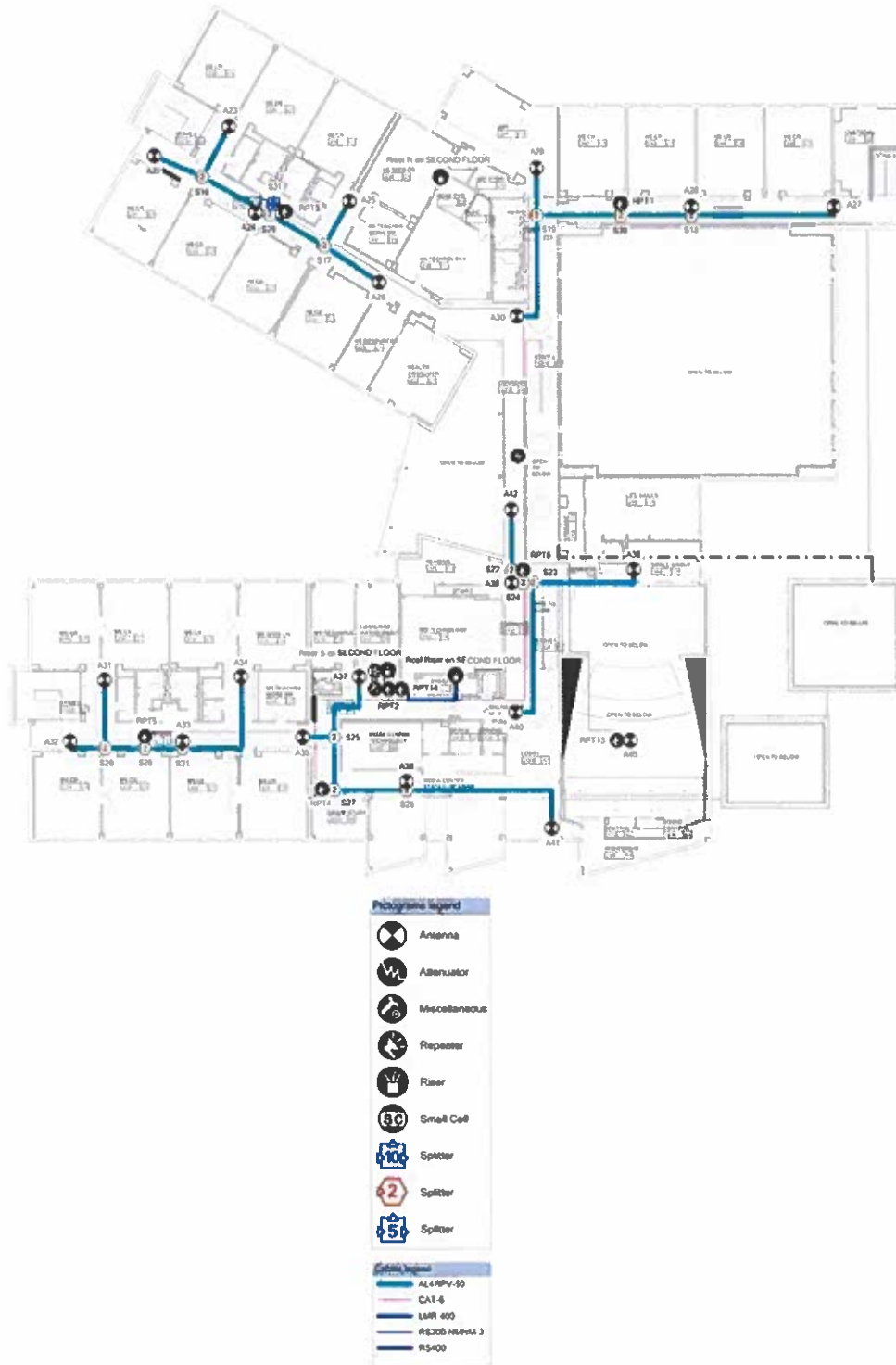
CORRIDOR - LEVEL 2



Figure 4: Photo of a corridor on Level 2 where a Dome Antenna will be installed on the ceiling.

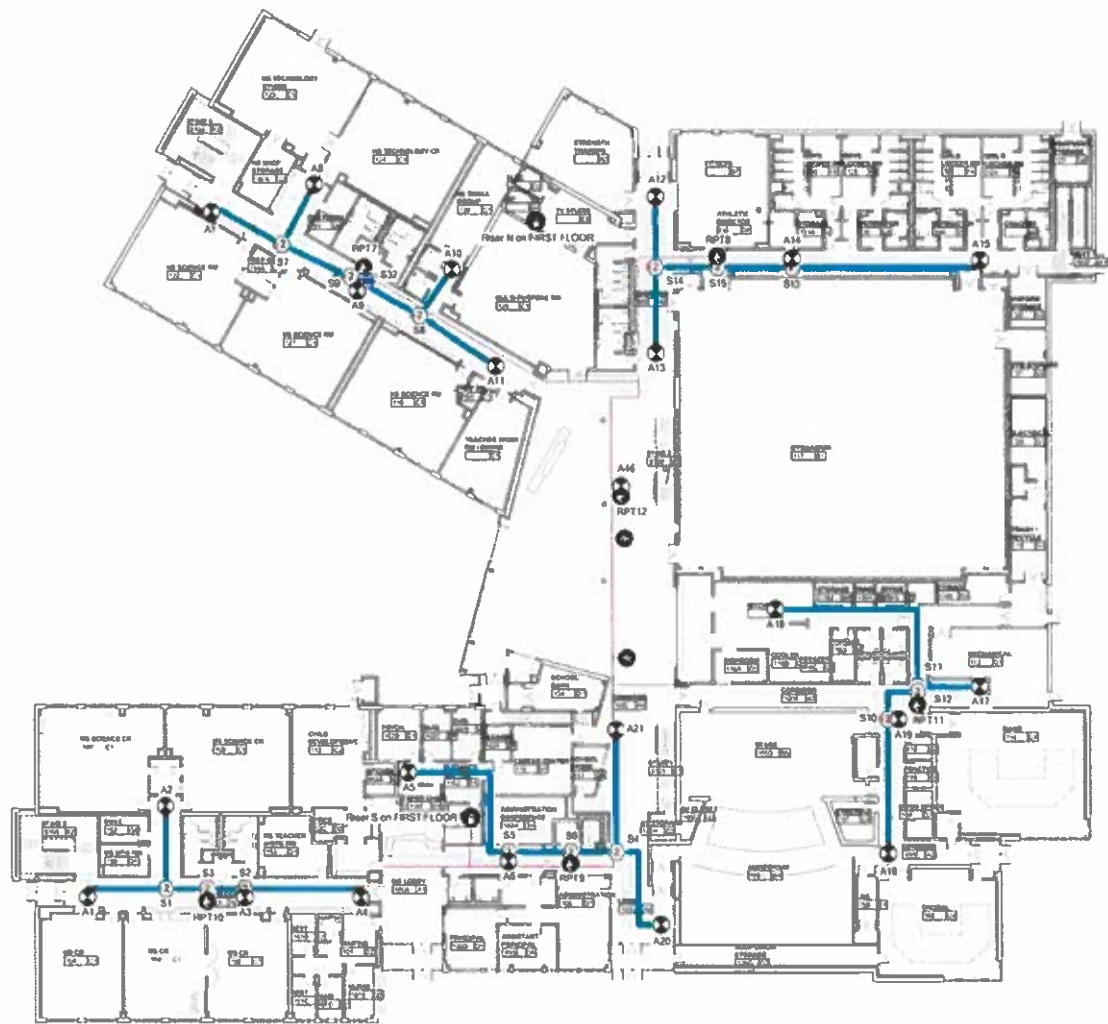
Design Layout

LEVEL 2



Design Layout

LEVEL 1



Pictograms legend

Antenna

Attenuator

Repeater

Riser

Splitter

Splitter

Cables legend

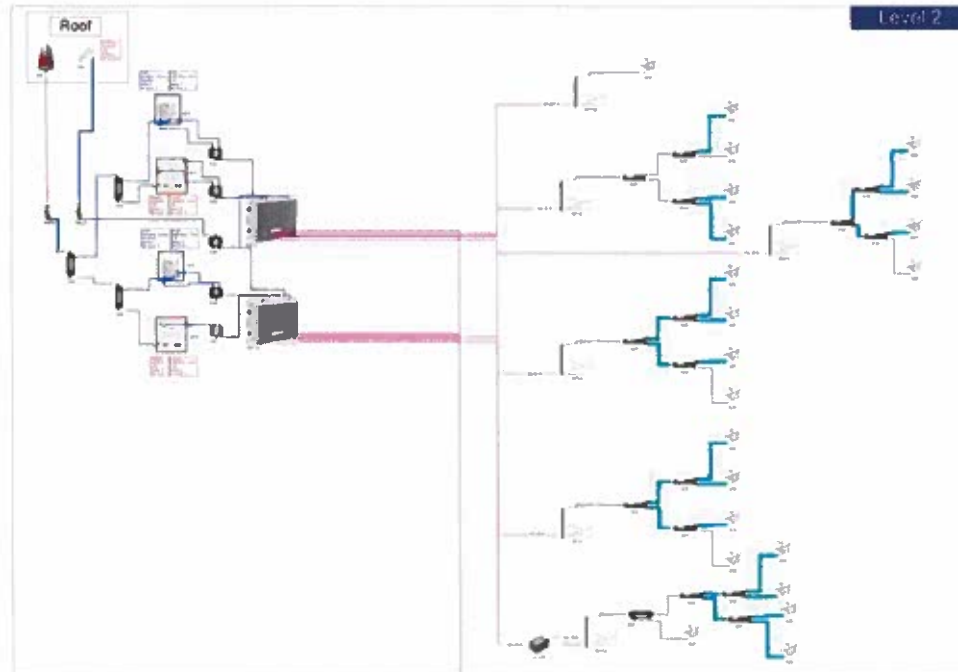
ALARPV-50

CAT-6

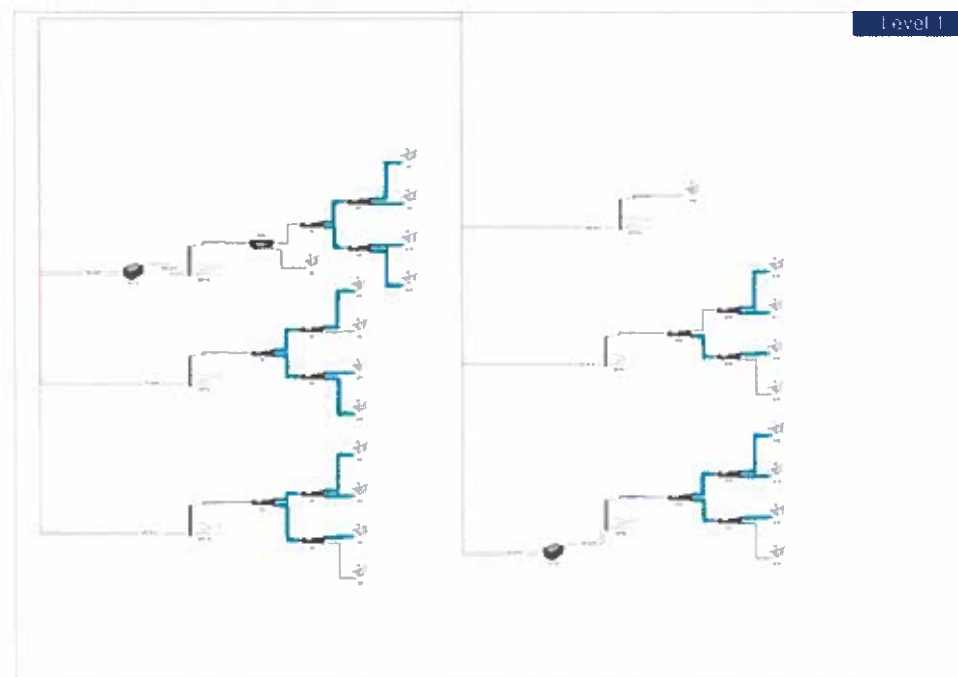
RS700-MMH-3

Schematic Diagram

LEVEL 2



LEVEL 1



Datasheets

CEL-FI QUATRA 4000 (1/2)

DONOR ANTENNAS

One or more antennas are connected to the Network Unit with coaxial cable and transmit signal to a nearby cell tower.

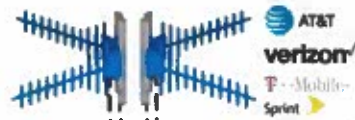
NETWORK UNIT (NU)

The hub of the system, works with one to six Coverage Units (CU).



SMALL CELL UNITS

Enterprise grade small cells configured to feed the hybrid DAS.



COVERAGE UNIT (CU)

The CU that rebroadcasts the donor signal and works with the Network Unit NU.

Coaxial Cable
Connects CU to indoor antenna units.

Ceiling Antennas
Wideband
omni-directional
units.

Cat6 Ethernet
Connects NU to up
to 6, CU units.

CEL-FI QUATRA 4000 (2/2)

CEL-FI QUATRA 4000 | 3G / 4G / 5G

In-building Cellular Solution

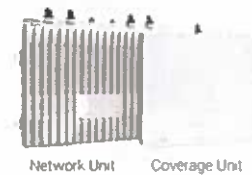
DATA SHEET

QUATRA 4000 MODEL NUMBER
 NU Q44-1234CNU
 CU Q41-5ECU
QUATRA 4000 MODEL NUMBER
 NU I44-1234CNU
 CU I44-5ECU

Cel-Fi QUATRA 4000 is an Active DAS Hybrid that solves the problem of indoor cellular coverage. Cel-Fi QUATRA 4000 delivers a cellular signal that is up to 1000x stronger, utilizing CAT 5e cabling for RF and Power over Ethernet. Cel-Fi QUATRA 4000 can be installed in just days, and at a price point that meets the middleprise budget. Cel-Fi QUATRA 4000 is carrier-grade, carrier-approved, and guaranteed network safe.

Benefits:

- Scalable All-Digital PoE Cat5e Active DAS Hybrid for Middleprise
- Up to 100 dB (1000x Stronger Signal)
- Four Operator Solution
- 3G / 4G / 5G for Voice and Data
- Coverage Unit Ethernet cable lengths up to 300m
- Independent Donor antenna or Small Cell input per operator
- Supports Cel-Fi WAVE Portal Cloud Management
- Carrier-Approved and Unconditionally Network Safe
- FCC Part 20 and Part 90 variants available



QUATRA 4000/4000i			
OPERATOR'S CONFIGURATIONS	OPERATORS SUPPORTED	AT&T, Sprint, Verizon, T-Mobile	Band Combinations Available *QUATRA 4000i-only
RELAY CONFIGURATIONS (one configuration per operator)	OPERATOR 1	Verizon Bands	13 & 25
			13 & 4
			13 & 2
			12 & 5
	OPERATOR 2	AT&T Bands	12 & 25
			12 & 4
			12 & 2
			(30 & 5)*
	OPERATOR 3	Sprint Bands	(30 & 25)*
			(30 & 4)*
			(30 & 2)*
			25
	OPERATOR 4	T-Mobile Bands	(26 & 25)*
			(41 & 26)*
			(41 & 25)*
			25 & 4
			25 & 12
			4 & 12
			2 & 4
			2 & 12
			(2 & 71)*
			(4 & 71)*
			(25 & 71)*
TRANSMIT EVM	UL	8.5% 8.5%	16 QAM with full RB allocation E-TM3.1
REGULATORY CERTIFICATIONS		Part 15	Yes
		Part 20 (QUATRA 4000)	Yes
		Part 90 (QUATRA 4000i)	Yes
		Part 22	Yes
		Part 24	Yes
		Part 27	Yes

GPS ANTENNA

GNSS ANTENNAS

GPS Timing Reference Antennas

GPSGL-TMG-SPI-40NCB



40 dB GPS L1/GLONASS L1/GALILEO E1 Timing Antenna with Integrated Lightning Protection

The GPSGL-TMG-SPI-40NCB timing reference antennas are specifically designed for long-lasting, trouble-free deployments in congested cell-site applications. The low noise, high gain amplifier is well suited to address attenuation issues associated with applications requiring longer cable runs.

The proprietary quadrifilar helix design, coupled with multi-stage filtering provides superior out-of-band rejection and lower elevation pattern performance than traditional patch antennas. This multi-band antenna covers GPS L1, GALILEO L1 as well as GLONASS E1 frequencies.

Their unique radome shape sheds water and ice, while eliminating problems associated with bird perching. The antenna comes with surge compliant mounting that addresses industry grounding requirements. Custom models or site kit options are also available.

This antenna is made of materials that fully comply with provisions stipulated by EU directives RoHS 2002/95/EC. The antenna provides integrated, on-board lightning protection capability that alleviates the need for downstream, in-line surge suppressors. The antenna also features ESD, reverse polarity protection and transit voltage suppression.



GPSGL-TMG-SPI-40NCB

STANDARD CONFIGURATION

Model	Connector	Mount	Radome
GPSGL-TMG-SPI-40NCB	N Female (one - bottom fed)	Fits pipes of 1"-1.45" (25-37 mm) maximum diameter. Medium duty mount (GPS-TMG-MMD), grounding screw, and lug nut included.	Color: White

ELECTRICAL SPECIFICATIONS - GNSS ANTENNA

Frequency Range	LNA Gain	Element Gain	Polarization	Out of Band Rejection
1590 ± 30 MHz	40 dB ± 4 dB @ GPS L1 & GALILEO E1 38 dB ± 4 dB @ GLONASS L1	≥ 3 dBic	Right hand circular	≥ -60 dB @ f ≤ 1530 MHz ≥ -60 dB @ f ≥ 1660 MHz

ELECTRICAL SPECIFICATIONS - GNSS ANTENNA, continued

Noise Figure	Current Draw	DC Voltage	VSWR	Nominal Impedance
< 2.5 dB @ +25°C including pre-selector (maximum)	< 40 mA	2.8-9.0 V (operating) ≤ 28.0 V (survivability)	< 2.0:1	50 ohms

MECHANICAL & ENVIRONMENTAL SPECIFICATIONS

Dimensions	Weight	Housing Material	Lightning Protection	Temperature Range	Humidity
7.25"H x 3.20"D (184 x 81 mm)	0.75 lbs (0.34 kg)	ASA	Per EN61000-4-5 Level 4	-40°C to +85°C	95%

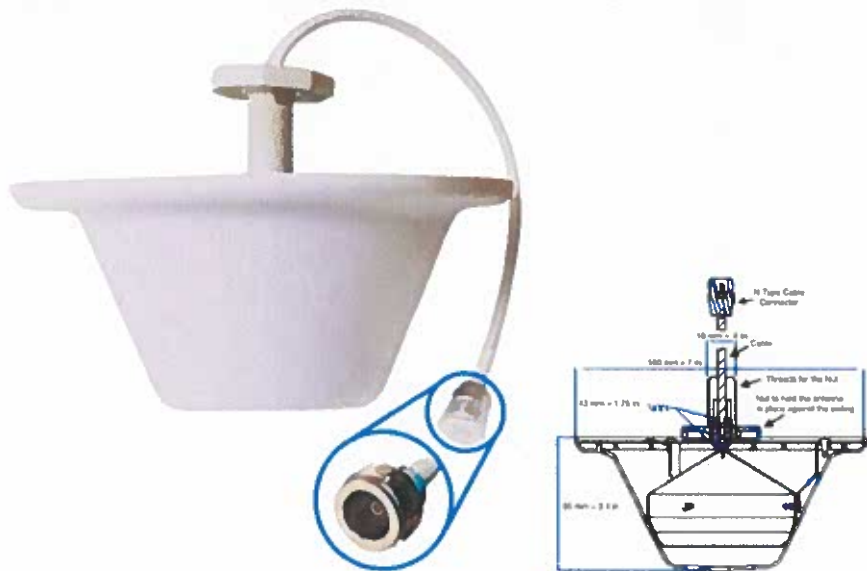
RSRF INDOOR DOME ANTENNA

Dome Antenna
WAVEFORM

SKU: ANT627NF-DOME

Main Features:

- Dome Antenna
- 50 Ω
- 3.0-5.5 dBi
- 600-6000 MHz



Specifications:

Electrical:			
Frequency Range	600-960 MHz	1710-2700 MHz	2700-6000 MHz
Gain (Peak)	3.0 dBi \pm 1 dB	5.5 dBi \pm 1.5 dB	5.0 dBi \pm 1 dB
Horizontal Beamwidth	360 deg		
Vertical Beamwidth	90 deg		
VSWR	\leq 1.7	\leq 1.5	\leq 1.5
Input Impedance	50 Ω		
Polarization	Vertical		
PIM (IM3)	\leq -140dBm @ 33 dBm*2		
Maximum Power	50 W		

Mechanical:	
Type	Omnidirectional
Radome Color	White
Radome Material	UV-Protected ABS
Dimensions	186 mm \varnothing x 86 mm
Connector Type	N-Female
Cable Type	RG58
Cable Length	30 cm (12 inch)
Net Weight	275 g
Mounting Type	Ceiling
Mounting Material	Plastic (ABS)

Environmental:	
Protection Class	IP52
Operating Temperature	-40 to +60 deg C
Limit Temperature	-55 to +70 deg C
Lightning Protection	DC Ground

Datasheets

COAXIAL CABLE



AL4RPV-50, HELIAX® Plenum Rated Air Dielectric Coaxial Cable, corrugated aluminum, 1/2 in, off white PVC jacket

- This product is part of the CommScope Wired for Wireless® Solution

Product Classification

Product Type	Air coaxial cable
Product Brand	HELIAX®
Product Series	AL4-50
Ordering Note	CommScope® standard product (Global)

General Specifications

Flexibility	Standard
Jacket Color	Off-white

Dimensions

Diameter Over Jacket	15.748 mm 0.62 in
Inner Conductor OD	4.572 mm 0.18 in
Outer Conductor OD	14.046 mm 0.553 in
Nominal Size	1/2 in

Electrical Specifications

Cable Impedance	50 ohm ±2 ohm
Capacitance	75.459 pF/m 23 pF/ft
dc Resistance, Inner Conductor	1.575 ohms/km 0.48 ohms/kft
dc Resistance, Outer Conductor	1.575 ohms/km 0.48 ohms/kft
dc Test Voltage	4000 V
Inductance	0.19 µH/m 0.058 µH/ft
Insulation Resistance	100000 MOhms-km
Jacket Spark Test Voltage (rms)	5000 V
Operating Frequency Band	1 – 6000 MHz
Peak Power	40 kW
Power Attenuation	2.325

RSRF Project Process

Item	Description of Services
Site Survey	On-site building survey to develop construction and design details for formal quote. Measure and collect RF environment by recording ambient signal levels using spectrum analyzer and/or ported or rooted test phone platforms with band lock and frequency functionalities. Document test results and provide coverage assessment or needs analysis report with test data.
Design Services	Develop RF system design specifications and documentation for "ground-up" developments or "add-on" modifications. Specify components guaranteed to meet or exceed system specifications. Provide design package in iBwave format: RF schematic, floor layouts, bill-of-materials, cross reference report, cable schedule, link budget report, prediction maps, and product specification requirements - TO BE USED FOR WSP APPROVAL.
Installation, Rentals & Travel	Complete install of all DAS components and perform manufacturer's acceptance test planning, (ATP) end-to-end. Includes mounting of all components (i.e. head-end and/or remote-end fiber optic equipment, equipment racks, power supply, filters, diplexers, duplexers, combiner/splitters, couplers, antennas, cables, connectors, etc.) Install and test earth ground loops, bus bars, and lightening protection circuitry. Test, measure and report on all 50ohm cable assemblies for insertion loss, input return loss, and PIM compliance on each antenna line segment and total system antenna branch. Weather seal all exposed components and connectors as necessary per manufacturer standards.
Project Management & Travel	Coordinate signal source BTS or RRU equipment installation and integration to DAS. Verify installation quality. Review all system level test reports (ground loops, buss bars, DC/AC power circuits, optical links, coaxial cable/load-VSWR/DTF/PIM). Sample test and measure antenna network for insertion and return loss (and isolation when necessary) at the source POI.
Commissioning & Travel	Establish TCP/IP connection to interface controller. Set IP address and initialize system GUI. Program system password, tune/align RF band-pass filters, program/enable RF channels and set UL/DL attenuation levels. Sample drive/walk test server/coverage areas and adjust antenna azimuth and down tilt angles as necessary. Walk test under antenna near beam and record worst-case test points. Verify with wireless carrier that macro or small cell parameters (i.e. noise floor) are within specifications. Make necessary adjustments to BDA/DAS/DRAN until system signal source is statistically acceptable.
Final ATP & Travel	Grid test data collection, adjustments & close-out package to building owner. If BDA or Small Cell, verify with wireless carrier that macro site service are not effected and no noise floor degradation occurred. Make necessary adjustments to the system as needed to verify coverage area has adequate signal balance to satisfy BTS/RAN statistical KPI targets.