

# CleanBeam™ MetaLens

Precision *Beam Shaping* for High Traffic Environments

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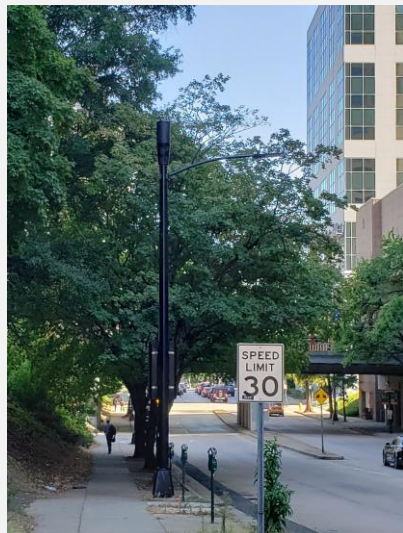




# Antennas for Dense Urban Environments

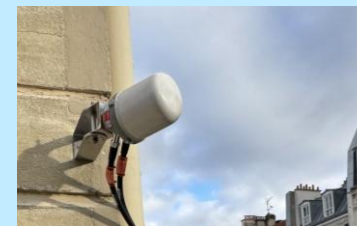
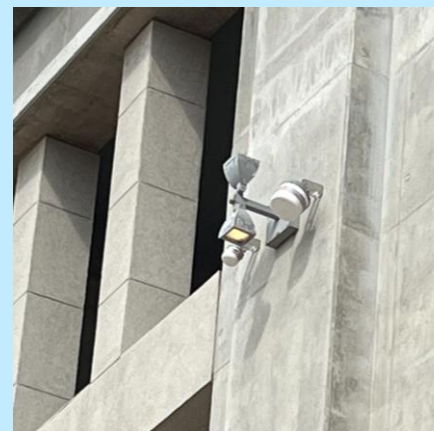


*Traditional Street Furniture*



*Minimal visual impact required, and where possible merging into the urban infrastructure*

## New CleanBeam Technology in Action



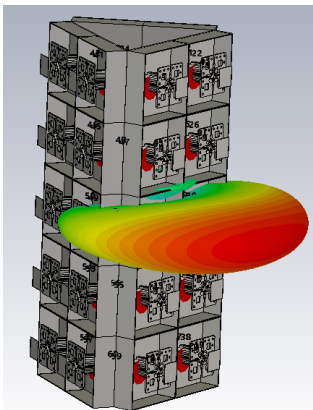
*Put the energy where you want it while remaining discreet*

*High performance connectivity is essential- but where and how we deploy matters*

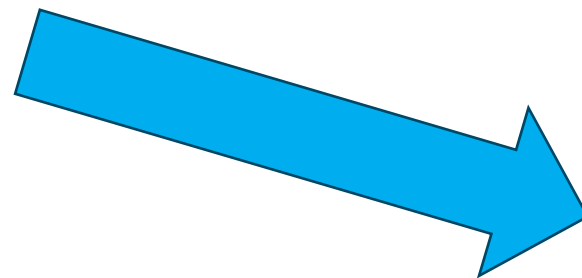
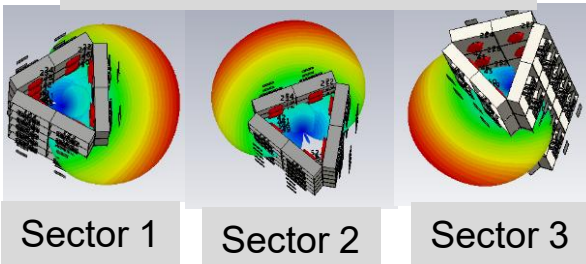


# Recap: Capacity v Antenna Pattern Shape

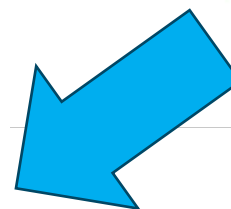
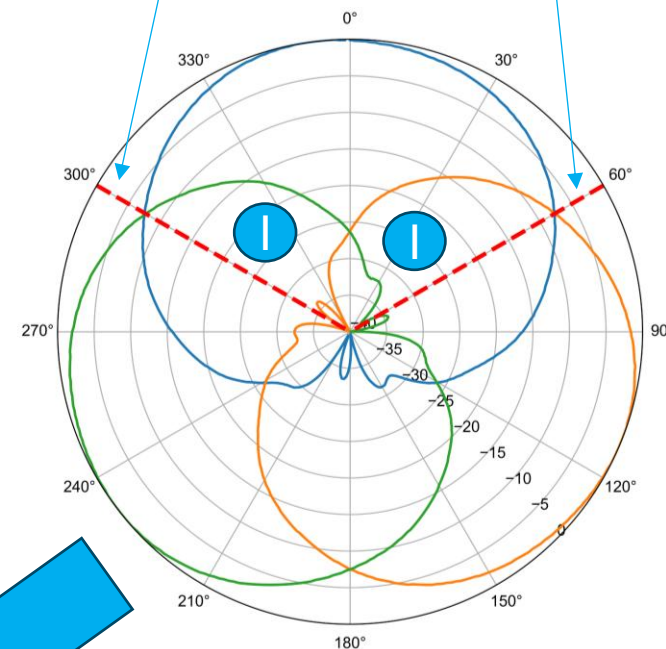
Tri-Sector



Energizing each sector

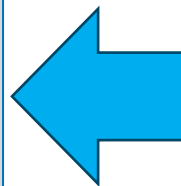
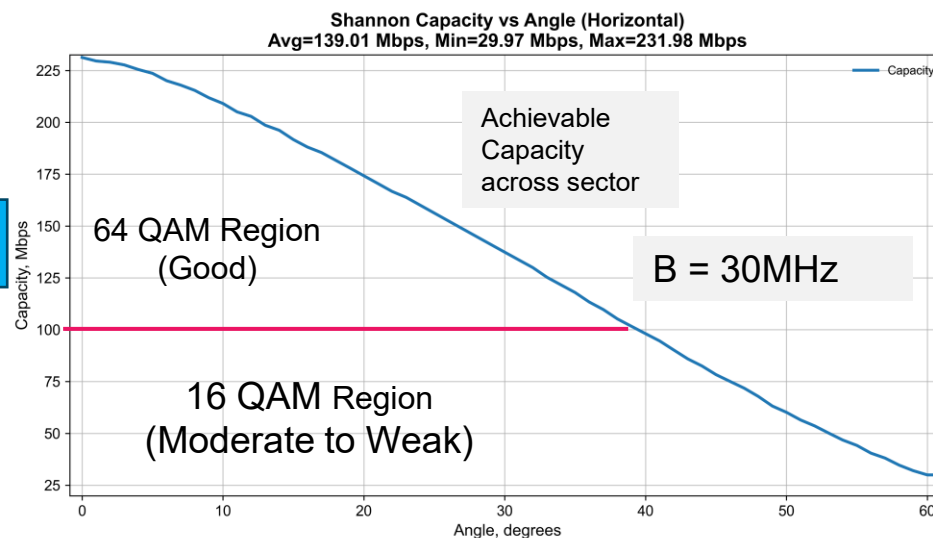


Sector of interest



$$C = B \log_2 (1 + SINR_{linear})$$

where:  
 $C$  = Channel capacity (bps)  
 $B$  = Channel bandwidth (Hz)  
 $SINR$  = Signal-to-Interference-plus-Noise Ratio (linear, not dB)

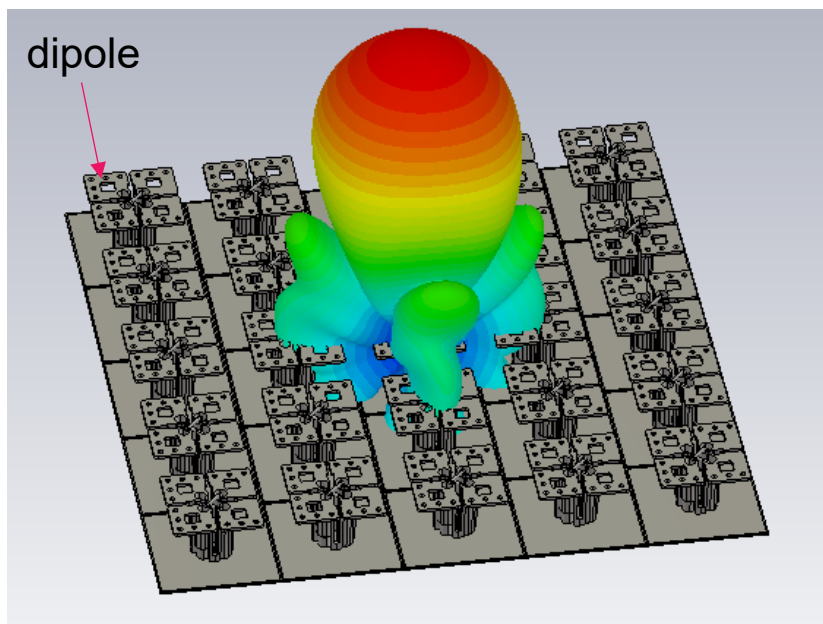


- Depending on the sector configuration, beam shaping can be used to improve capacity.
- More consistent capacity across the sector can be achieved through beam shaping.

# Beam Shaping to Improve Capacity

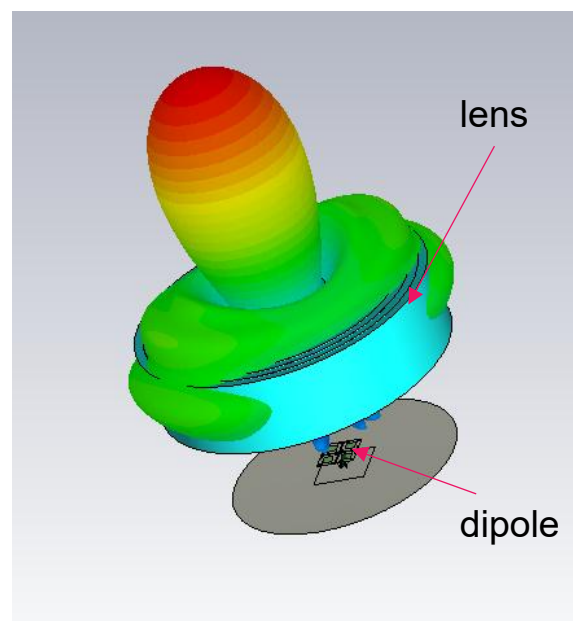
Evolving

## Array Technique



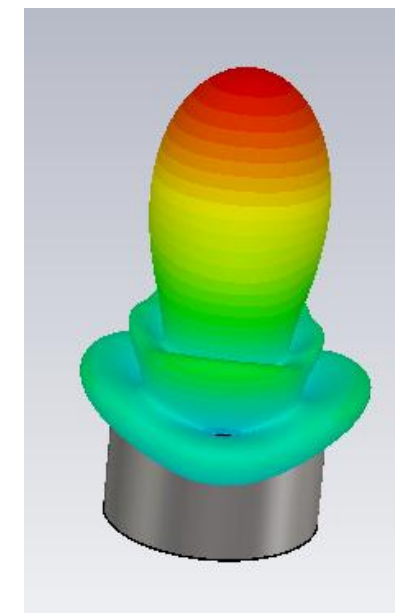
A planar array of dipole elements fed by a corporate feed network offers beam shaping in a low-profile design, but with increased feed and element complexity.

## GRIN Technology



A Graded Index (GRIN) lens antenna uses a single feed, with beam shaping performed via a lens. The lens is constructed of a 'plastic' material which can be dense and heavy..

## CleanBeam Technology



A **CleanBeam** lens antenna uses a single feed with beam shaping achieved through stacked metamaterial surfaces. It provides GRIN-like performance with lower weight

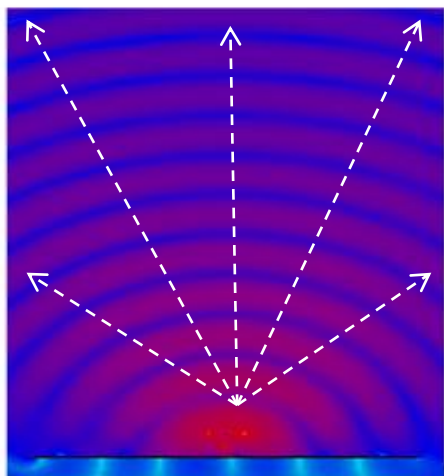




# The Innovation: CleanBeam metaLens

“Lens-grade performance without the lens complexity”

8 dBi gain

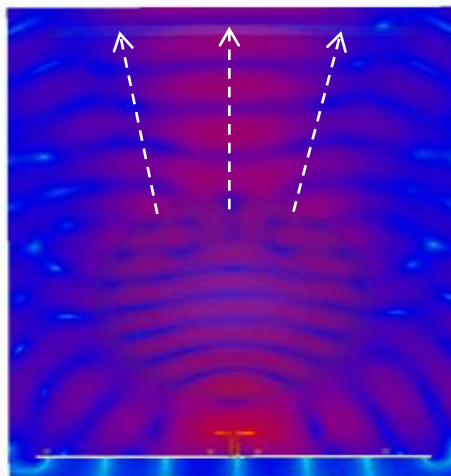


Dipole

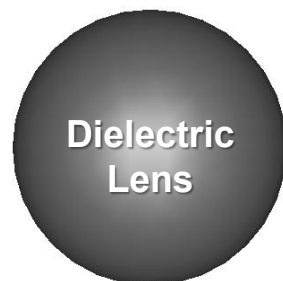
No  
Lens



18 dBi gain

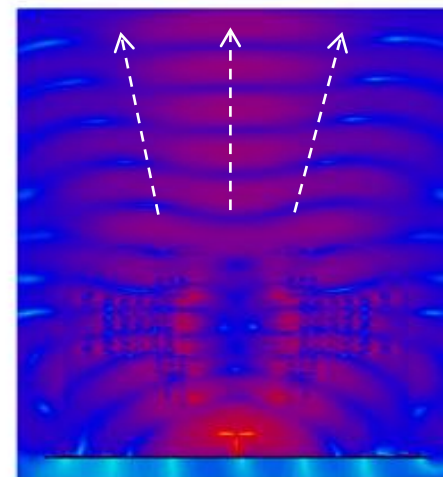


Dipole

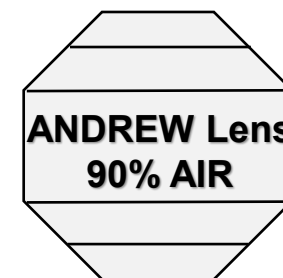


Dipole

18 dBi gain



Dipole



Dipole

Unique, patented  
**MetaLens Technology**



# CleanBeam Antennas

**IDEAL FOR:** stadiums, transit hubs, dense city streets, tunnels, railways, and roads!

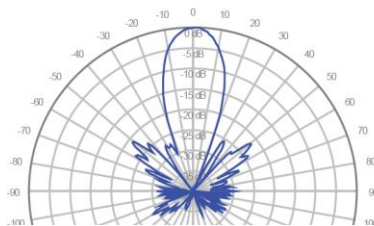
*Designed to blend into the environment but still offer optimum performance*



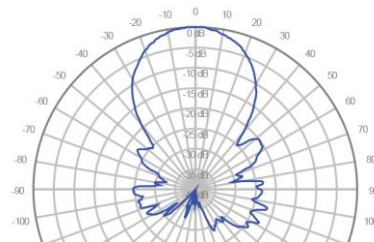
## BEAMWIDTH

- Beamwidth and pattern 'roll off' controlled by number of metamaterial lens layers
- Current BWs offered:
  - 17°, 35°, 37°, 40°, 54°
- Other beamwidths easily accommodated
- Depth/diameter increases as beam narrows
- Beam shaping options:
  - Flat-top patterns
  - Extremely sharp roll-off
  - Low Front to Back Ratios

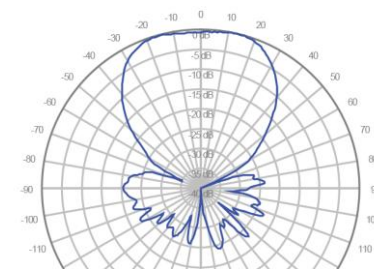
**V17**  
19 dBi Gain



**V37 / V40**  
13 dBi Gain



**V54 Flat-Top**  
11 dBi Gain



## FEATURES

- Excellent sidelobe suppression, 1<sup>st</sup> and beyond
- 3300-4200 and 1695-2690 models currently available with possibility for Lowband in the future
- Mechanical downtilt/pan for easy deployment
- Dual Band and MIMO configurations

## BENEFITS

- Minimal interference between sectors, pattern quality
- Simplified layout of venue coverage, place where needed
- 'Lego Brick' approach so easy to mix and match for optimum network performance
- Cost competitive - save money without sacrificing performance

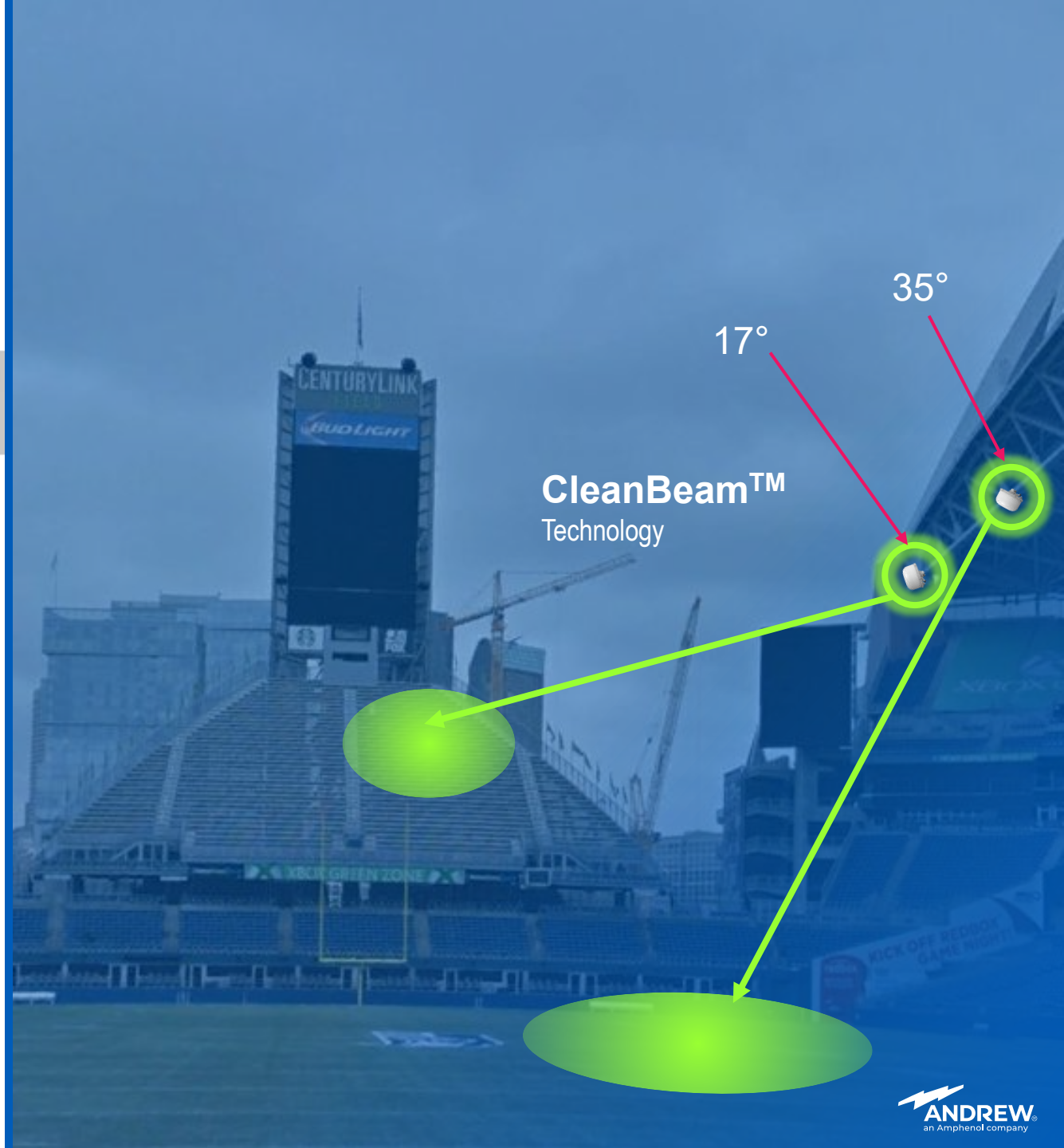


# CleanBeam lens

Useful in DAS deployments

Cost-competitive, **precise coverage** with controlled beams and reduced interference

- Ideal for targeting hard to cover areas within stadiums, like corners and end-zones
- Configured for tunnels, railways, roadways, transit hubs, and street-level coverage
- Multiple beamwidths available for flexibility in design



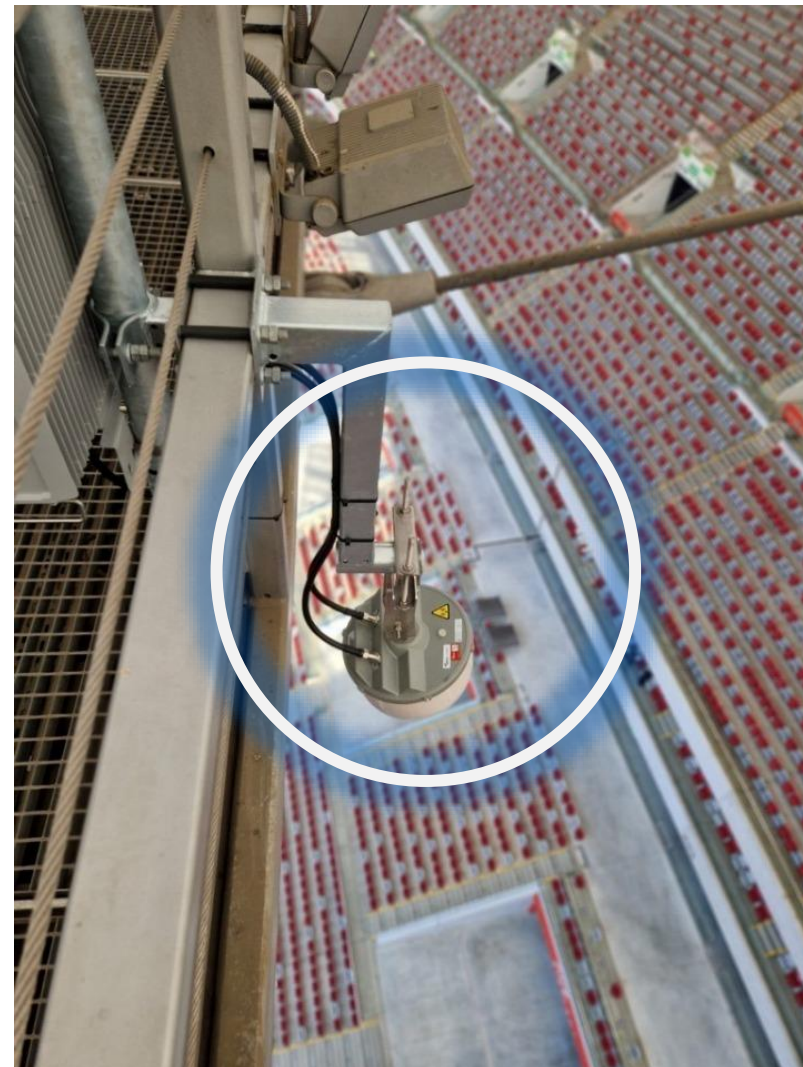
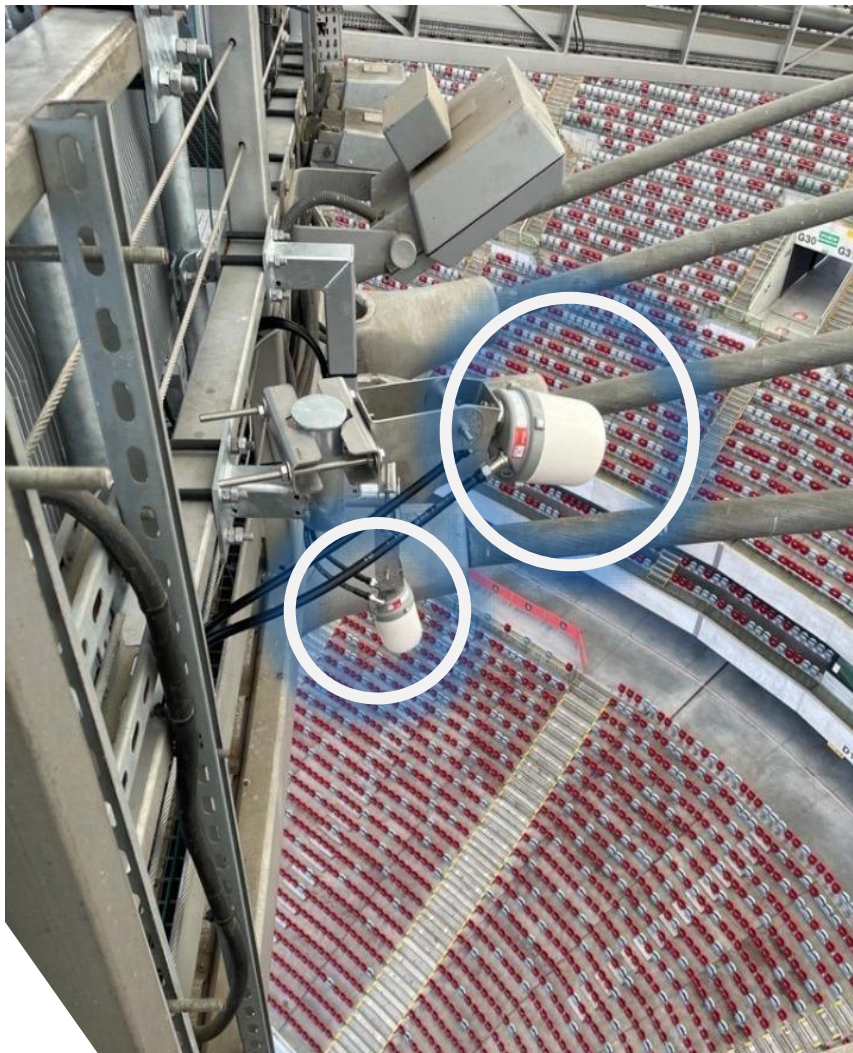




# Inside Stadium Deployment

Direct power  
***exactly***  
where it's  
needed

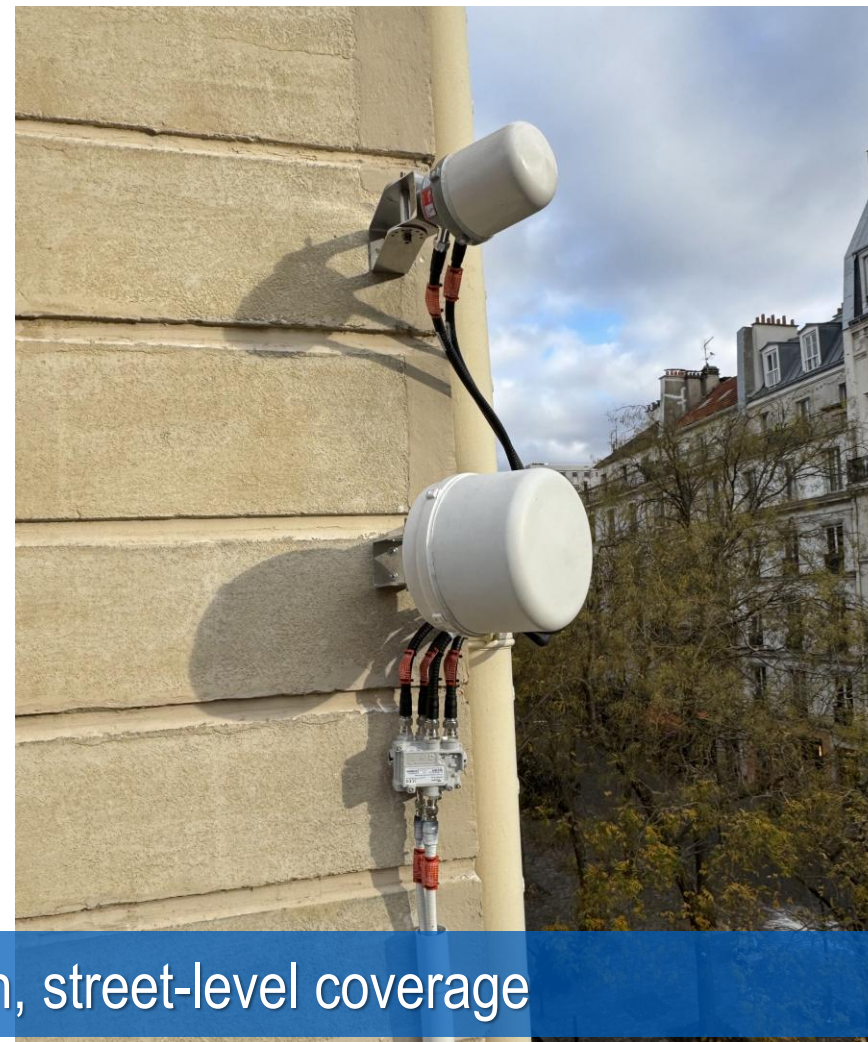
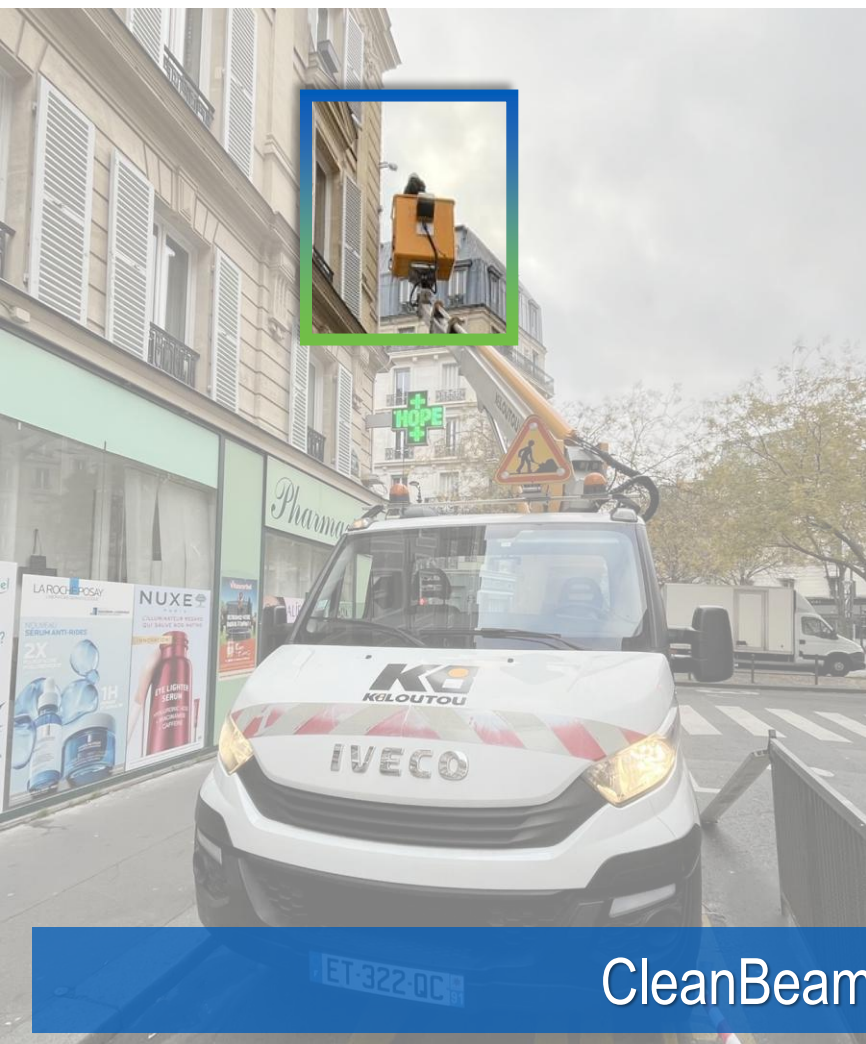
Spot beams offer  
maximum flexibility







# Street Level Deployment

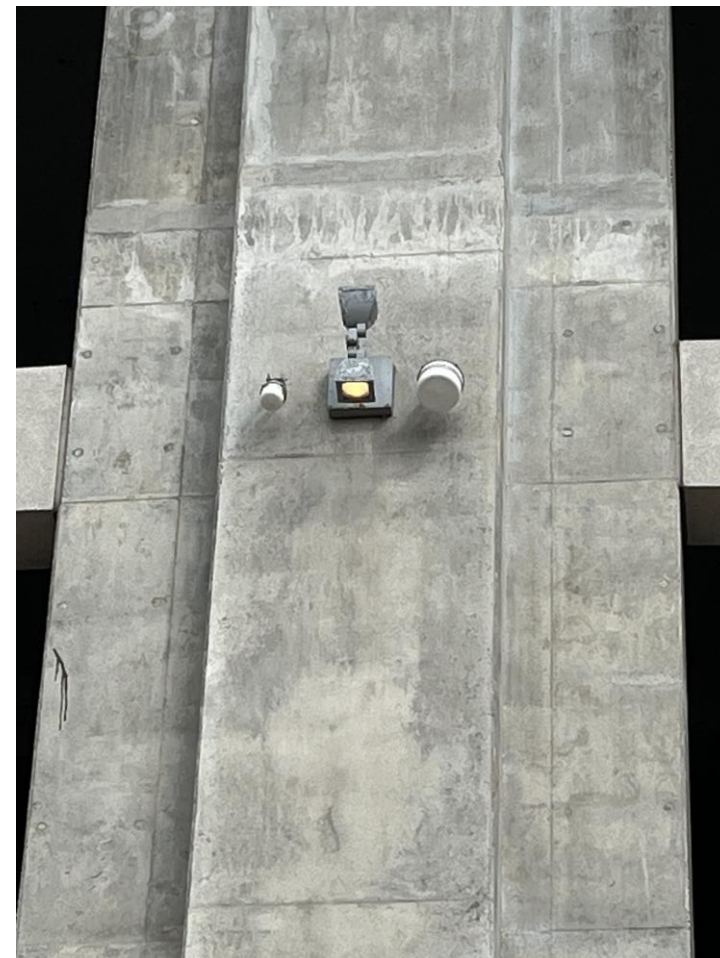


CleanBeam antennas are also for fill-in, street-level coverage





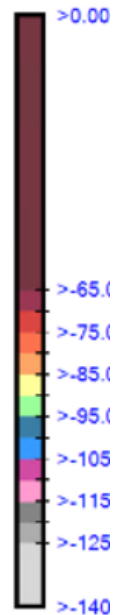
# Outside Stadium Deployments



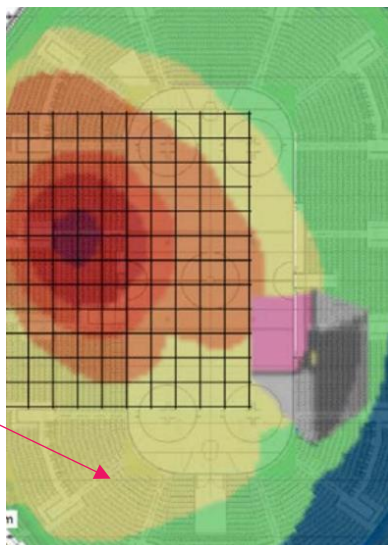




# Working with the Customer to Optimize



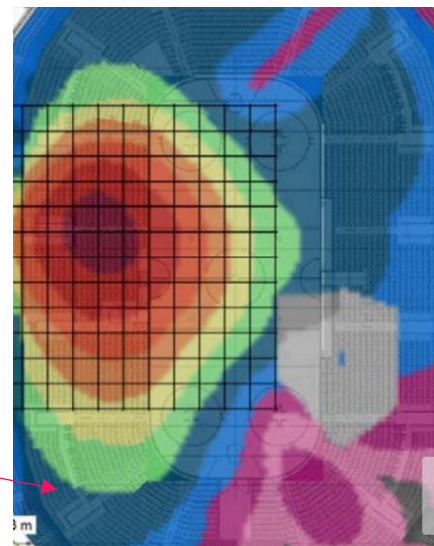
Spurious energy



Coverage Maps

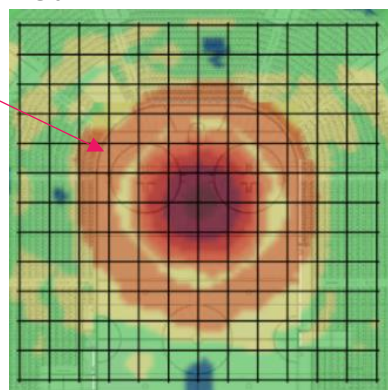
Optimized

Reduced!



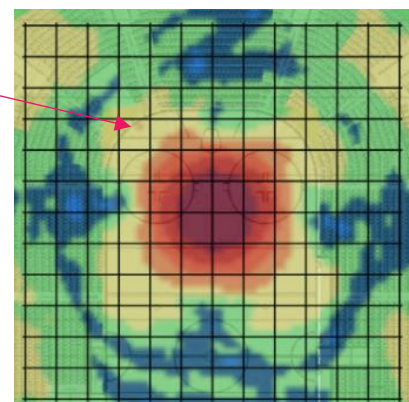
*35-degree beamwidth design whereby the lens was adjusted to provide fast roll off pattern to reduce interference in adjacent cells*

Oblique angle energy



Optimized

Reduced!



*17-degree beamwidth design whereby the lens was adjusted to reduce stray energy that would otherwise be seen as interference in adjacent cells*

This slide shows two examples where the CleanBeam lens design was tailored to meet specific customer requirements

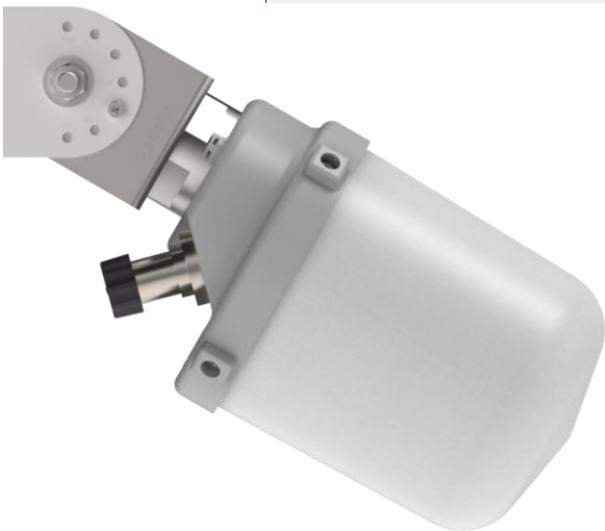


# Reconfigurable port counts to meet customer demands

2tr/4tr support

## 2 port

- **Core** 2-port single band models



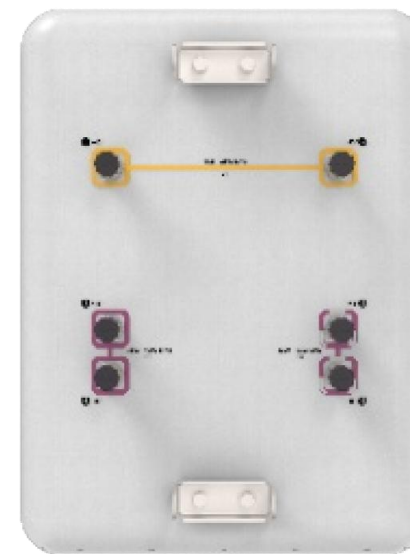
## 4 port

- Adds 4-way MIMO capacity where needed



## 6 or 8 port

- 6 or 8 port models offers new configurations giving 2tr or 4tr support as required
- Easily reconfigured to support new or existing customer networks





# Our Current CleanBeam Collection

*Ever growing for customer needs*

## C-Band



## Mid-Band



## C-Band & Mid-Band

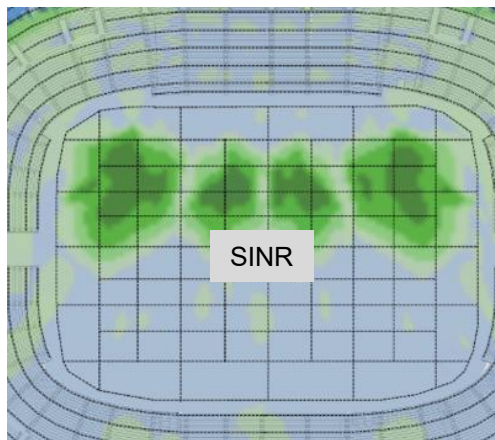
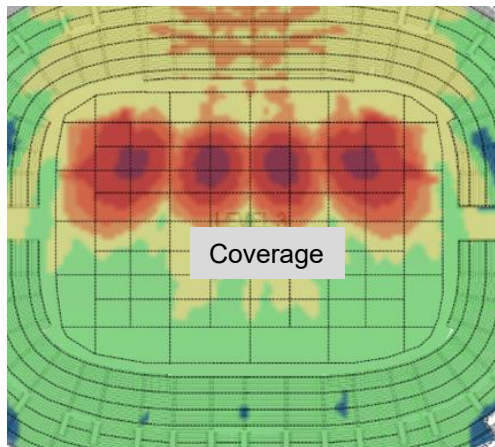




# Multibeam Lens Antennas

High-capacity coverage from a single mounting point

*Early Results (only middle 4 beams energized)*



## 6V6SS-120MB-SR

*First multibeam lens antenna in the CleanBeam lineup*

- 6 beams (1695 to 2700MHz)
- 12 beams (3300 to 4200MHz)
- Each beam supports a +/-45 slant polarizations
- Independent RET motor per beam via AISG
- 36 ports





# Conclusion

- In conclusion, we have discussed the growing capacity challenge and demonstrated, through the Shannon–Hartley law, the importance of antenna pattern control in improving network capacity.
- We introduced the new **CleanBeam** technology, describing the evolution from traditional array architectures to GRIN lenses, and now to advanced metamaterial-based **CleanBeam** solutions.
- We reviewed the current **CleanBeam** product portfolio and highlighted the flexibility of the technology to address a wide range of customer requirements.
- We also presented successful field deployments, demonstrating the technology operating effectively in real-world environments.
- Finally, we touched on future developments, including extensions toward single-point multi-beam systems.
- Thank you for your attention, and please come and speak with us at our exhibition stand.