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Macro Cell developments that support LTE evolution and 5G deployments

Cambridge Wireless

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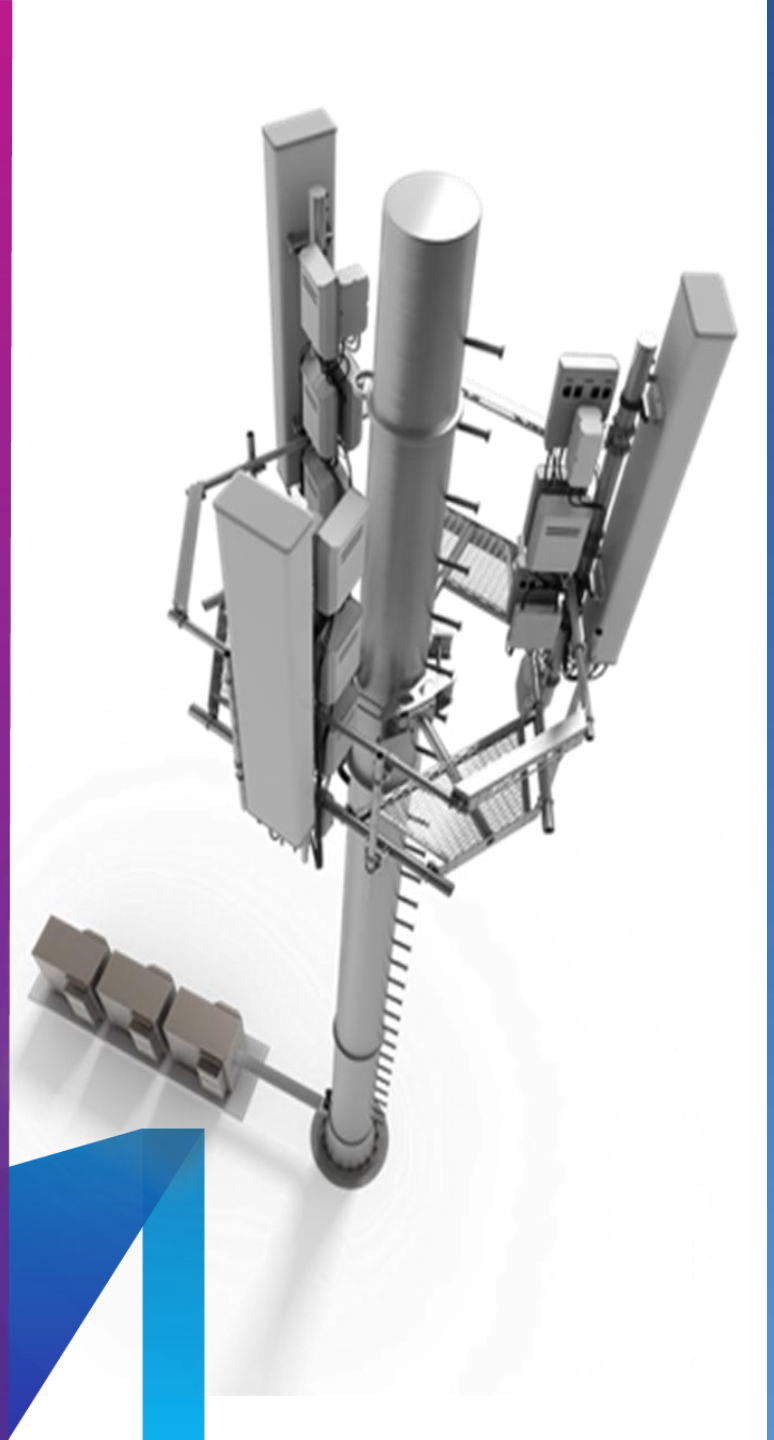
Macro cells

A critical role in RAN Networks

The backbone of Wireless Networks:

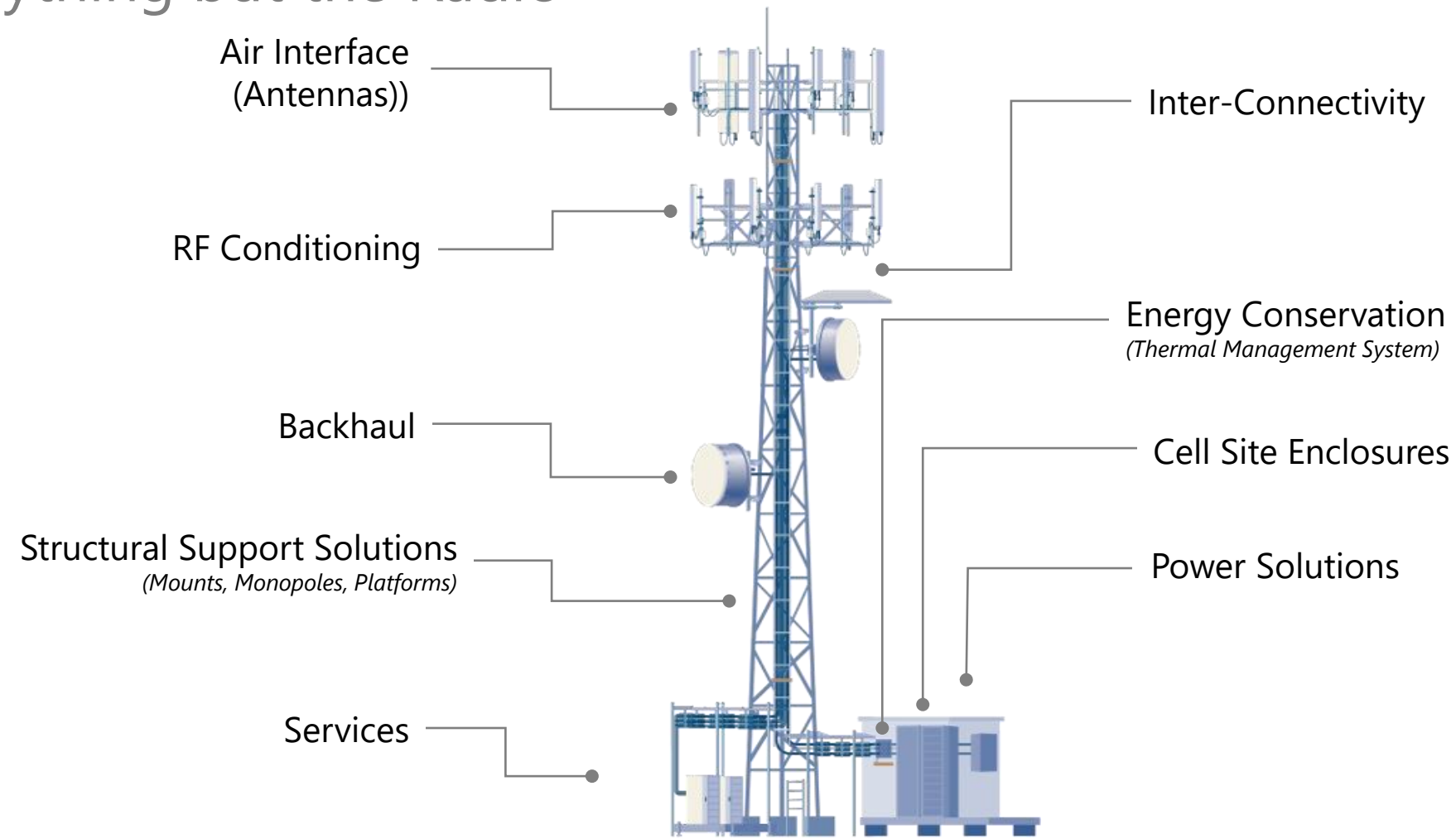
- Basis for building coverage
- Supports multiple bands
- Supports multiple RAT
- Mechanically secure platform for tower equipment
- Flexible architecture for CRAN and MEC

Cost effective and efficient way to deliver roll-outs



The Anatomy of a Macro Cell

-"Everything but the Radio"



CommScope provides a full suite of products and services for site infrastructure needs

Understanding the Operators Challenges

Two Main Challenges…….

1. **Deliver enhanced performance on 4G-LTE networks:**
   - Enabled by the evolution of LTE standards (LTE Advanced and Advanced Pro)
   - LTE in unlicensed spectrum
   - Support for Cat 16 devices
   - Re-farming current 2G/3G spectrum and enabling greater carrier aggregation
2. **Deploy 5G-NR onto new spectrum allocations**
   - Understand the business case and develop appropriate deployment strategies
   - Acquire the optimal spectrum allocation
   - Make the correct economic technology decisions
   - Master new customer positioning

Deployment / Co-existence of new bands/technologies

- Legacy bands/technology
- Mix of OEM hardware
- Interference
- Radio planning / optimization trade-off's

Tower Space / Loading

- Site upgrades
- Additional operators

Access to new sites

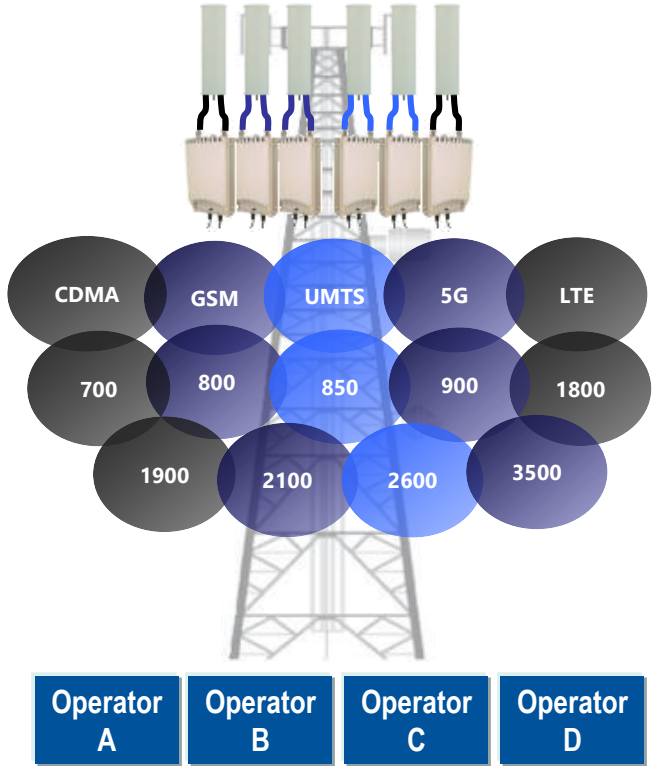
- Zoning approvals

Declining ARPU vs increasing data demand

- New spectrum license fees
- Technology upgrade / Infrastructure costs

Enabling Network / Infrastructure Sharing

Time to market for new services



Spectrum + Efficiency → Higher array/port density

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Drivers

- Performance demands
- New spectrum
- Site limitations

Impacts

- 4-8 ports per radio
- Extra bands/arrays
- No antenna adds

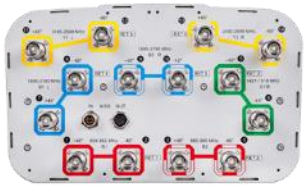
2014

10-Port

2015

12-Port

2016

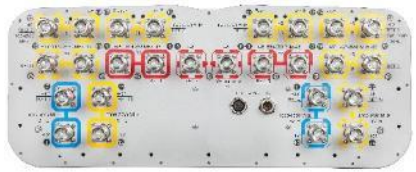


14-Port

2017

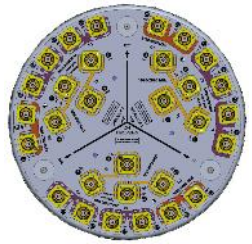
16-Port

2018



26-Port

2019



30-Port

THE TREND WILL CONTINUE TO ACCELERATE!

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What to expect at the Tower?

Up to 8-9 bands will co-exist

Remote radio heads preferred option, but not always possible

OPEX pressure in operators to reduce tower rental fees

8 port baseline for TDD count per band

New bands and MIMO driving more ports (4T4R in FDD is expected even in low bands)

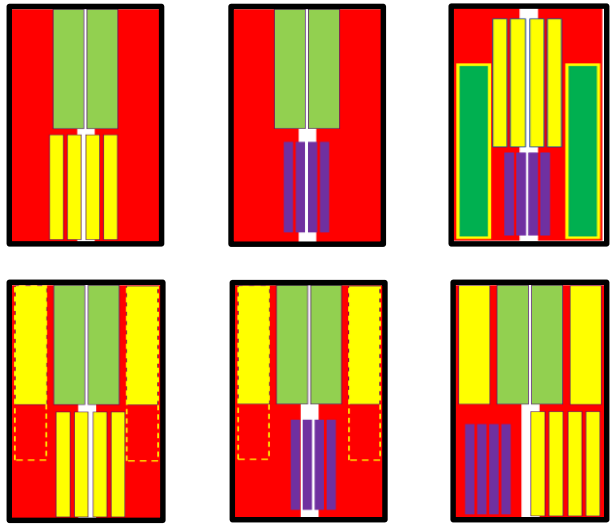
Operators adapting to market conditions

- Sell tower assets
- Build towers or move sites if rental unaffordable

Band	Antenna port count (no dual band radio, no active sharing)	Antenna port count (dual band radios, no active sharing)
700 (B28): LTE/5G NR	2	2
800 (B20): LTE	2	
900 (B8): GSM and WCDMA	2	2
1400 (B32): LTE	2/4	2/4
1800 (B3): LTE	4	4
2100 (B1): WCDMA and LTE	4	
2300 (B40): LTE	4/8	4/8
2600 (B7): LTE	4	4
2600 (B38): LTE	4/8	4/8
3500 (B42/B43/n78): LTE/5G NR	8	8
Total	36/46	30/40

Full portfolio and roadmap for multiband TDD antennas

- Typically deployed with 8-port radios
- 2300,2600, 3600MHz support
- 2L2H and 2L4H configurations



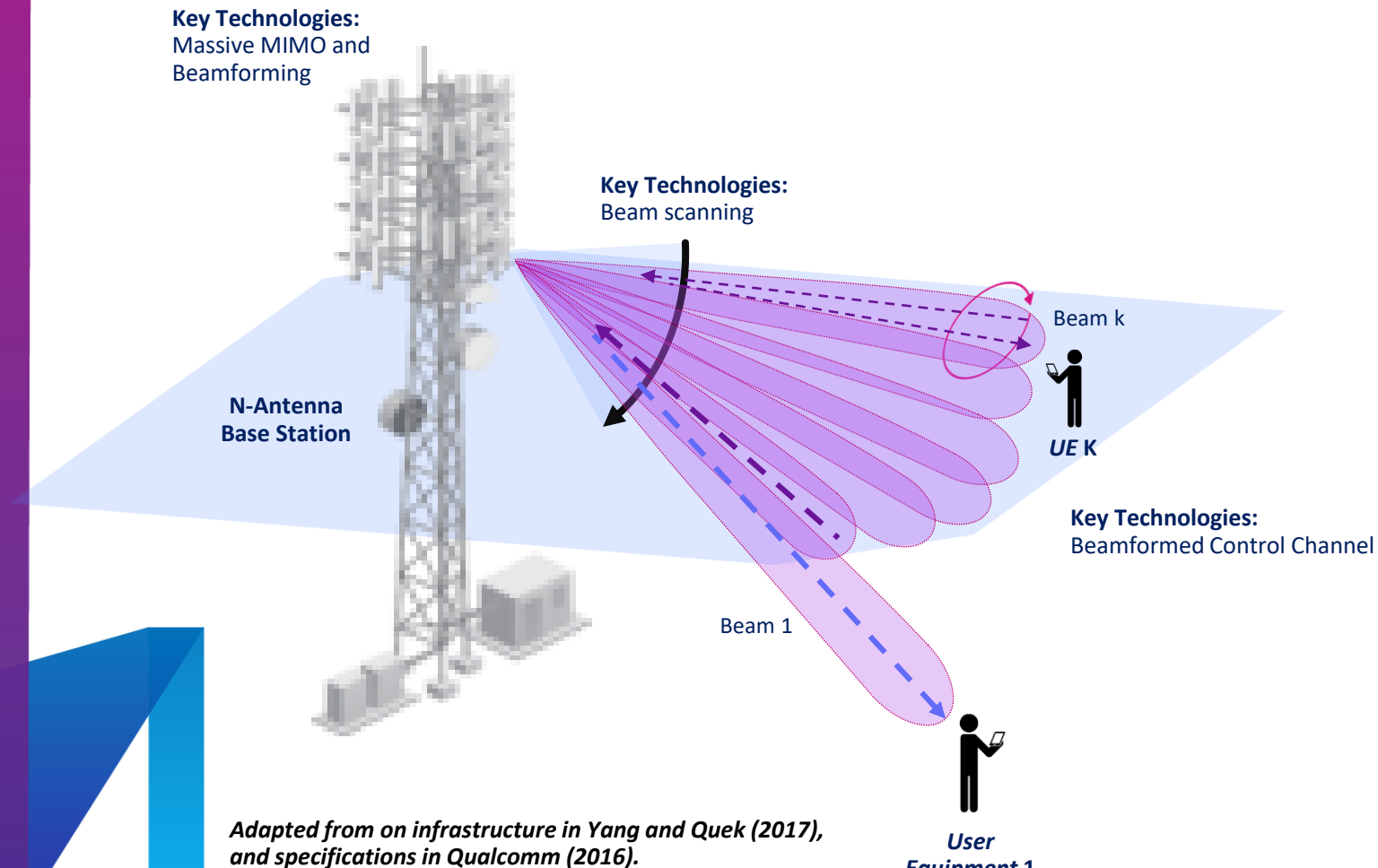
How do we evolve our existing sites to meet these requirements efficiently?

Active Antennas:
MIMO and Beamforming

- Active Antennas (AA) contain both the Radio Unit and Radiators within a single Radom.
- The AA is fed with power and digital signal via fiber.
- AA have been deployed in 4G systems but are expected to become common in 5G.
- Active Antennas support MIMO and Beamforming
  - MIMO: uses the scattering effect of the Radio environment to increase throughput and capacity
  - Beamforming focusses RF energy to increase gain and cell capacity

Macro Cell: Deployment Scenario

5G would allow for widespread adoption of 3.5 GHz products at the macro site level.



Adapted from on infrastructure in Yang and Quek (2017), and specifications in Qualcomm (2016).

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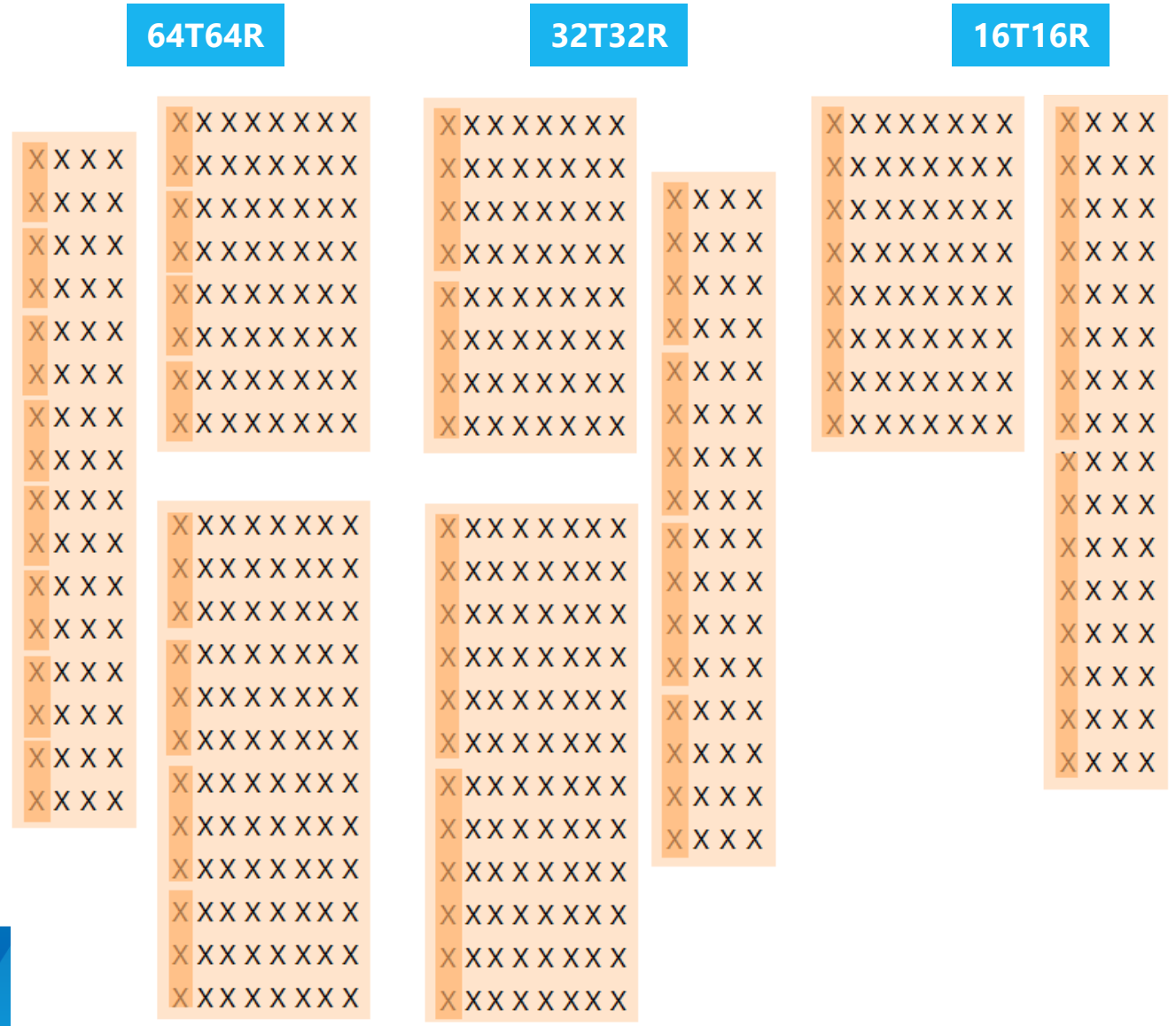
Massive MIMO
Multiple configurations

Multiple configurations are possible with same number of transceivers

Differences in patterns exist amongst them



When to Massive MIMO?

5G NR spectrum (e.g. 100MHz in 3.5GHz) | 5G terminal penetration | Data consumption

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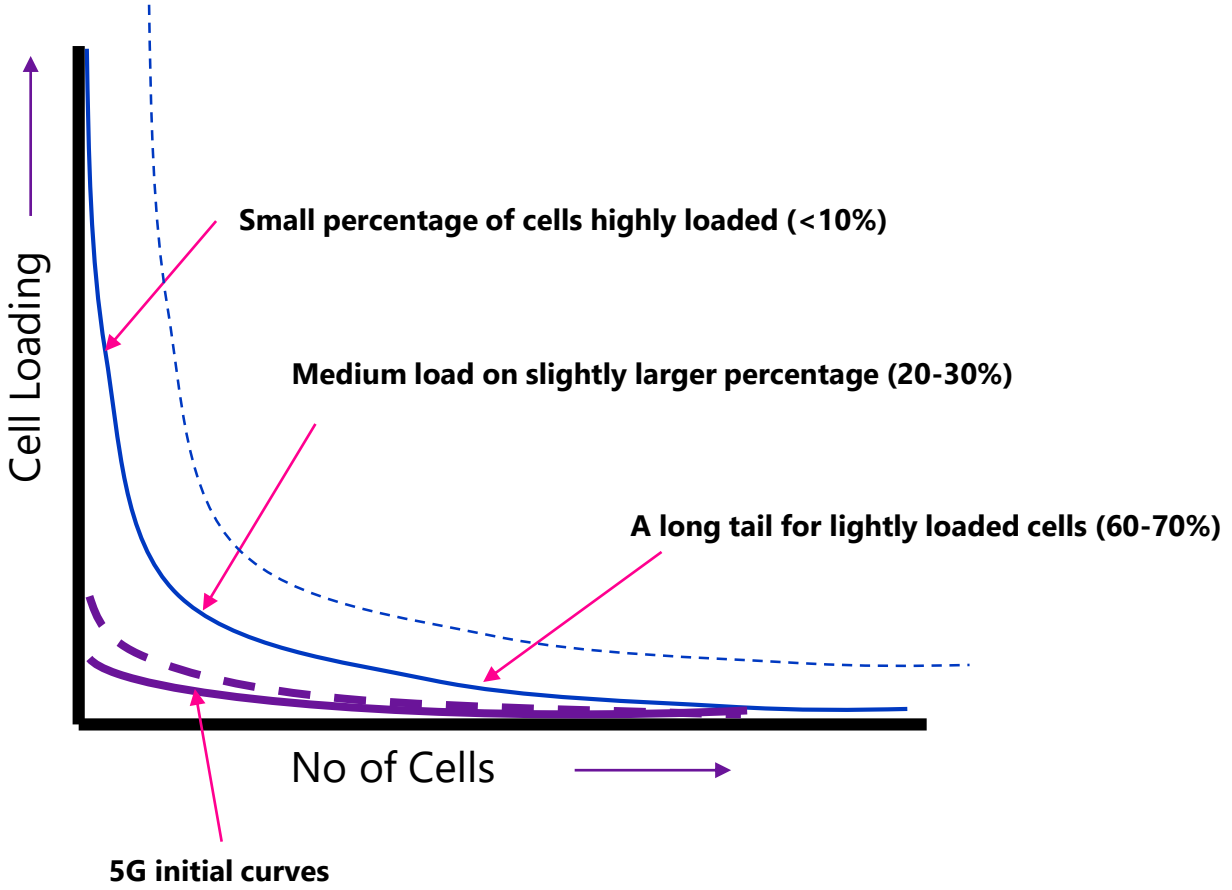
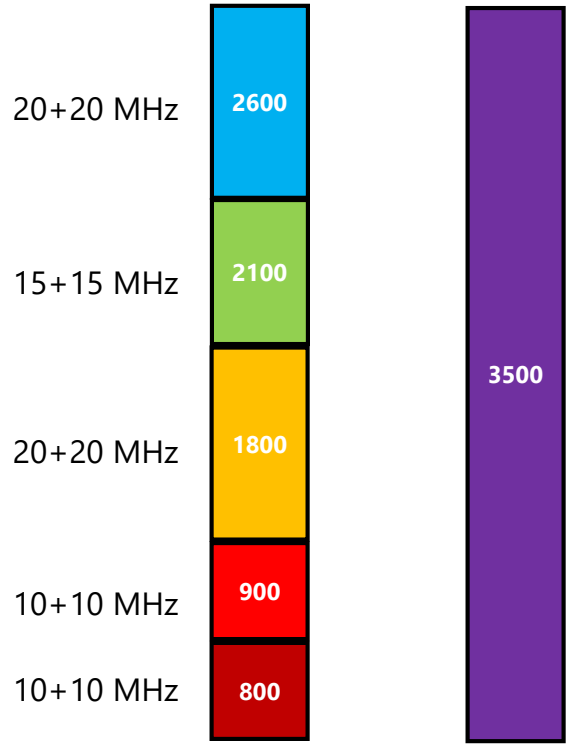
Typical Cell vs Load Distribution During Busy Hour





5G NR 20% more efficient than LTE

8T8R brings x1.5 times more capacity than 2T2R

We expect Massive MIMO capacity gains will not be required in the initial years of 5G deployments. As data consumption and 5G penetration expands Massive MIMO solutions may be adequate in some congested sites

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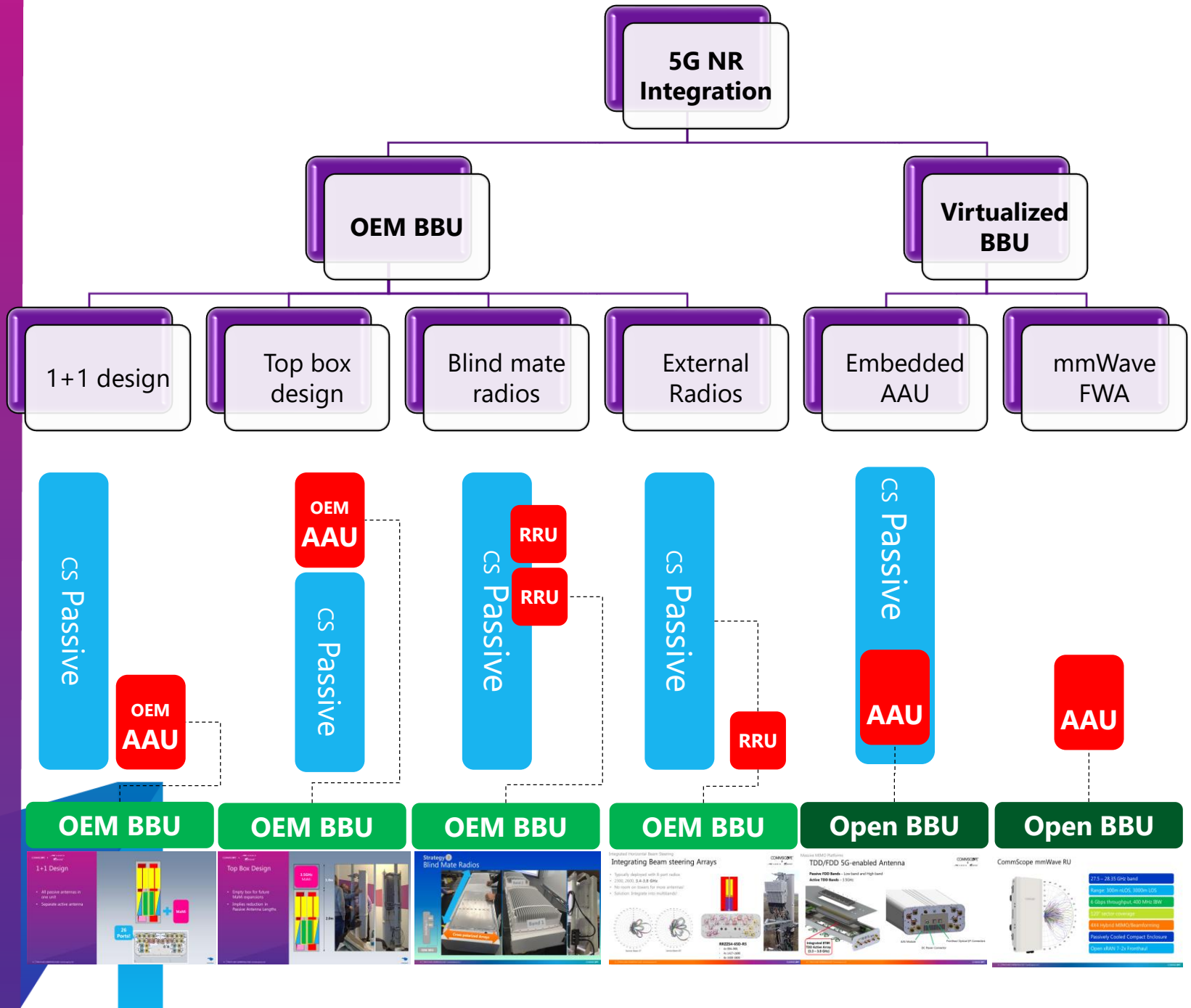
5G NR Integration Strategies

5G NR Integration Strategies

- OEM MaMIMO
- CommScope Designs



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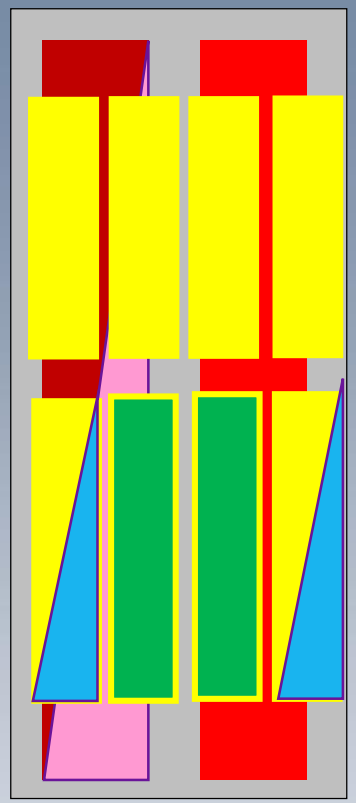
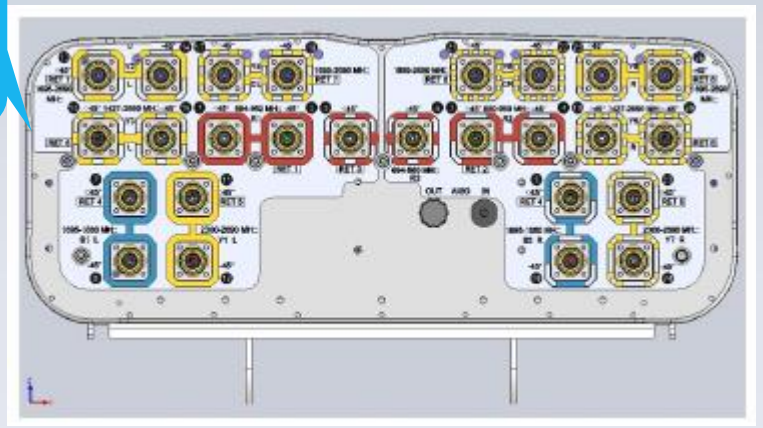
1+1 Design

- All passive antennas in one unit
- Separate active antenna



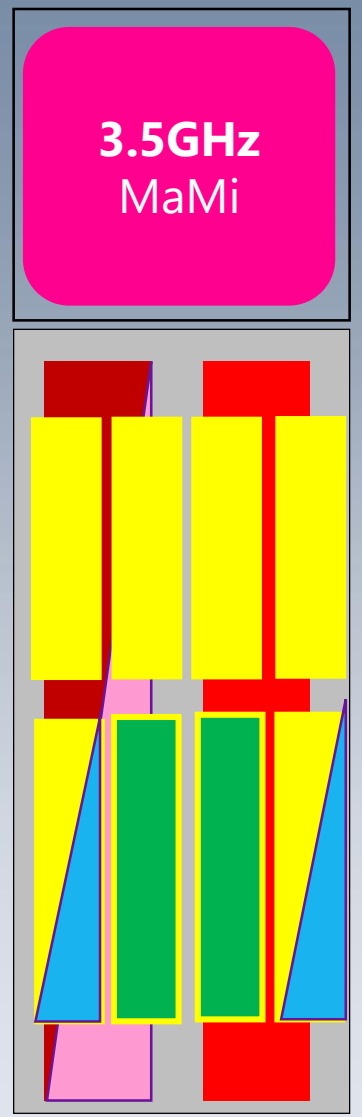
+ MaMi

26 Ports!

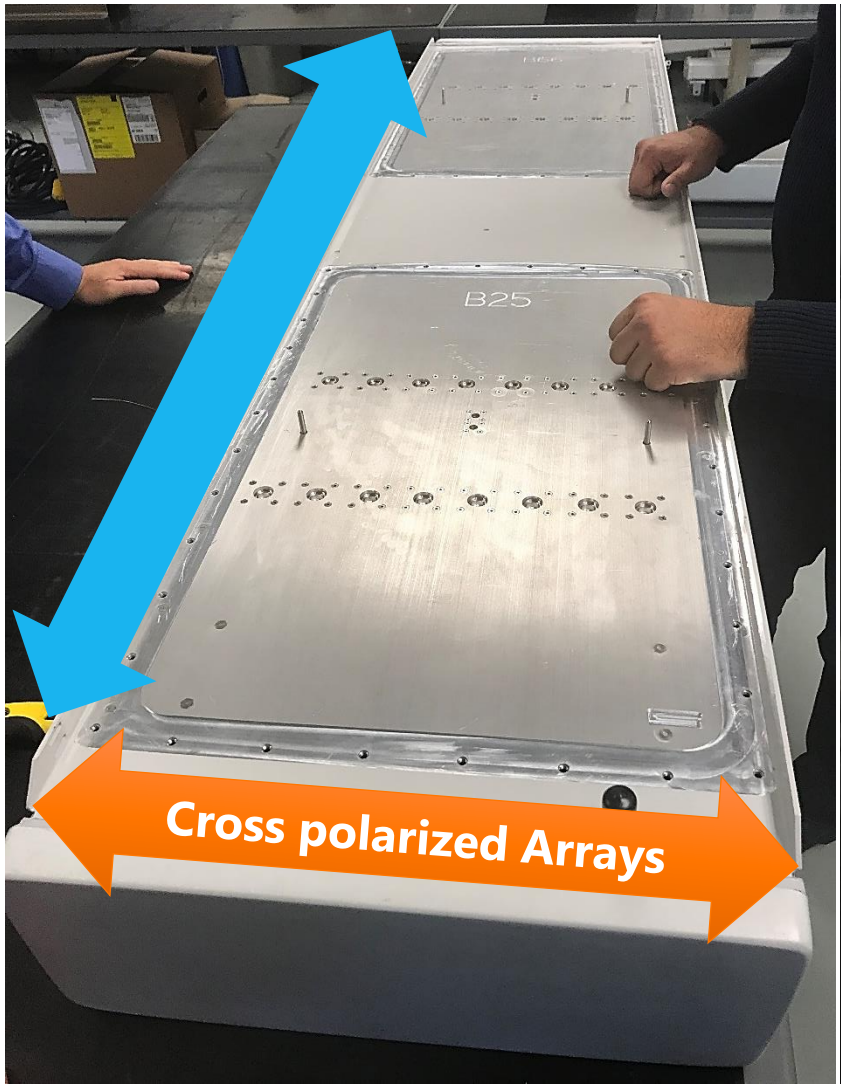


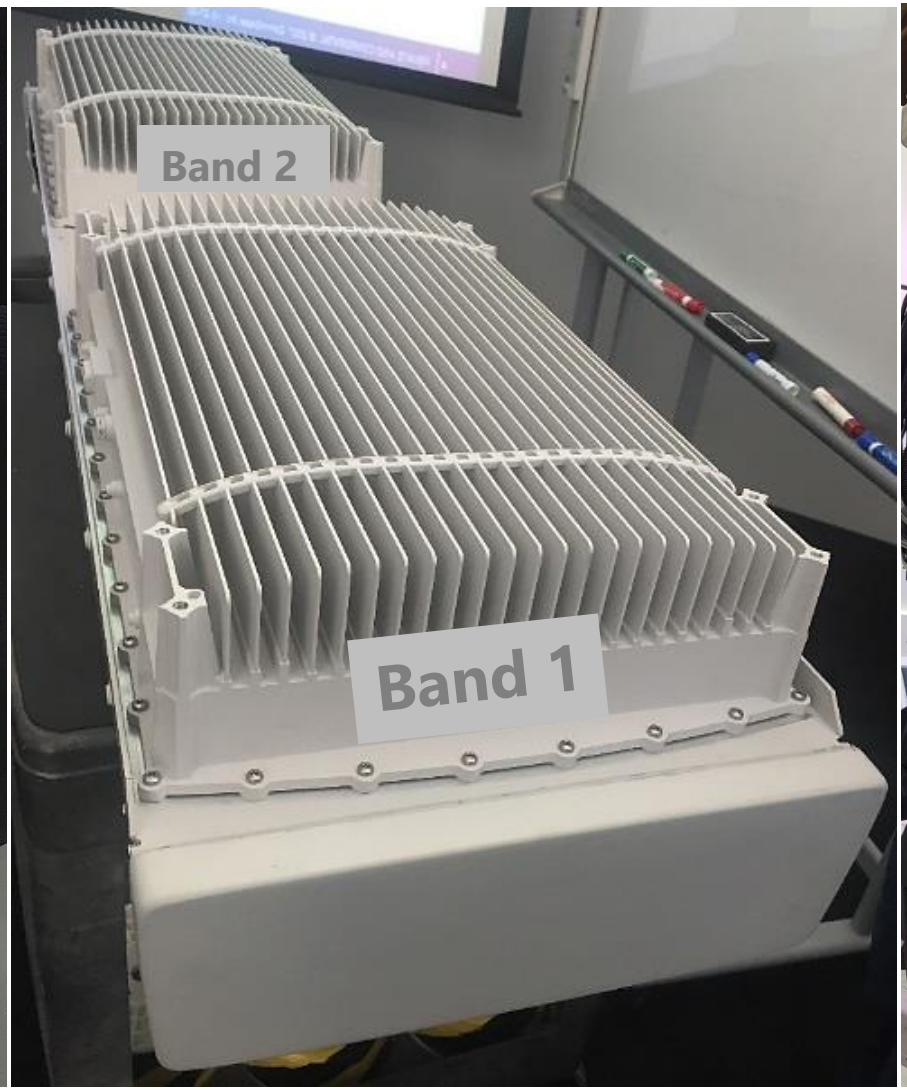
Top Box Design

- Empty box for future MaMi expansions
- Implies reduction in Passive Antenna Lengths



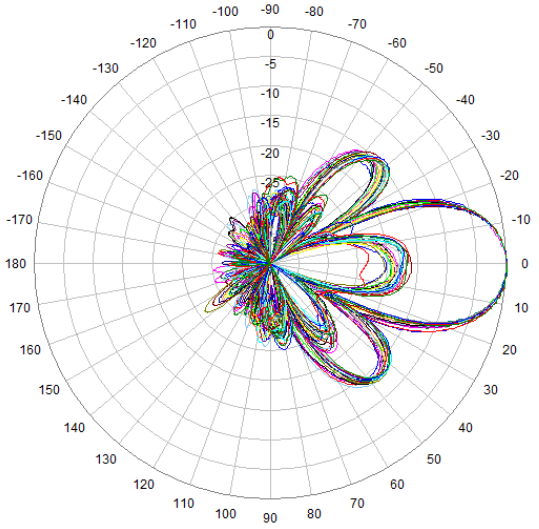
Massive MIMO Platforms



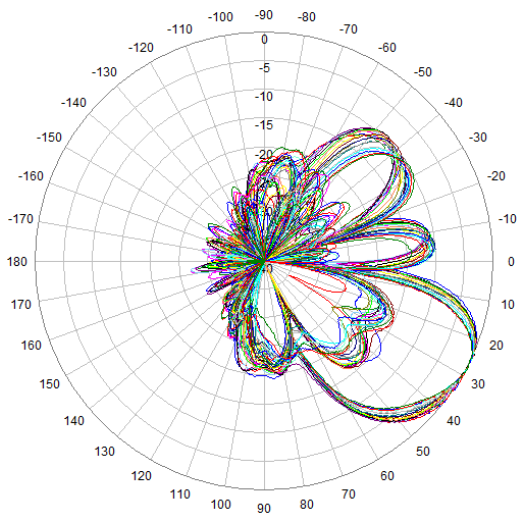


Integrating Beam steering Arrays

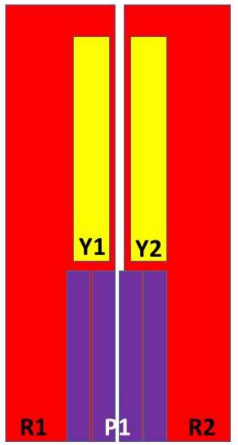
- Typically deployed with 8-port radios
- 2300, 2600, **3.4-3.8 GHz**
- No room on towers for more antennas!
- Solution: Integrate into multibands!



Service Beam 0°



Service Beam 30°



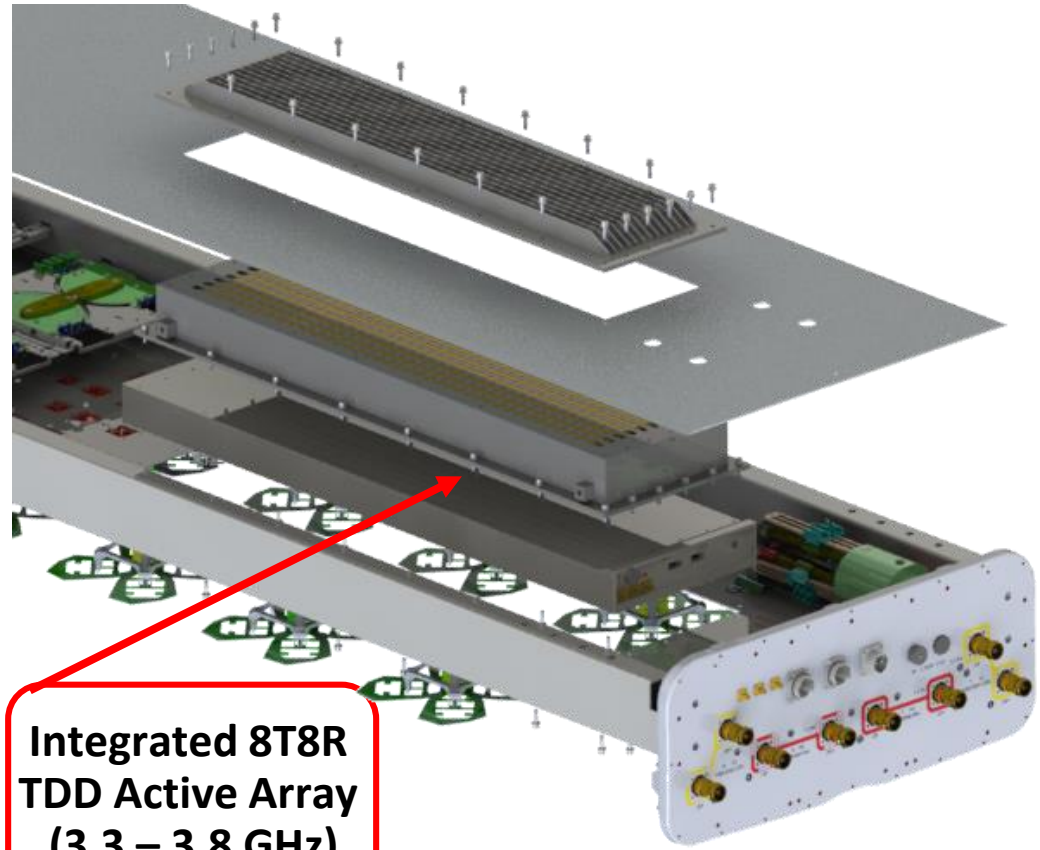
RRZZS4-65D-R5

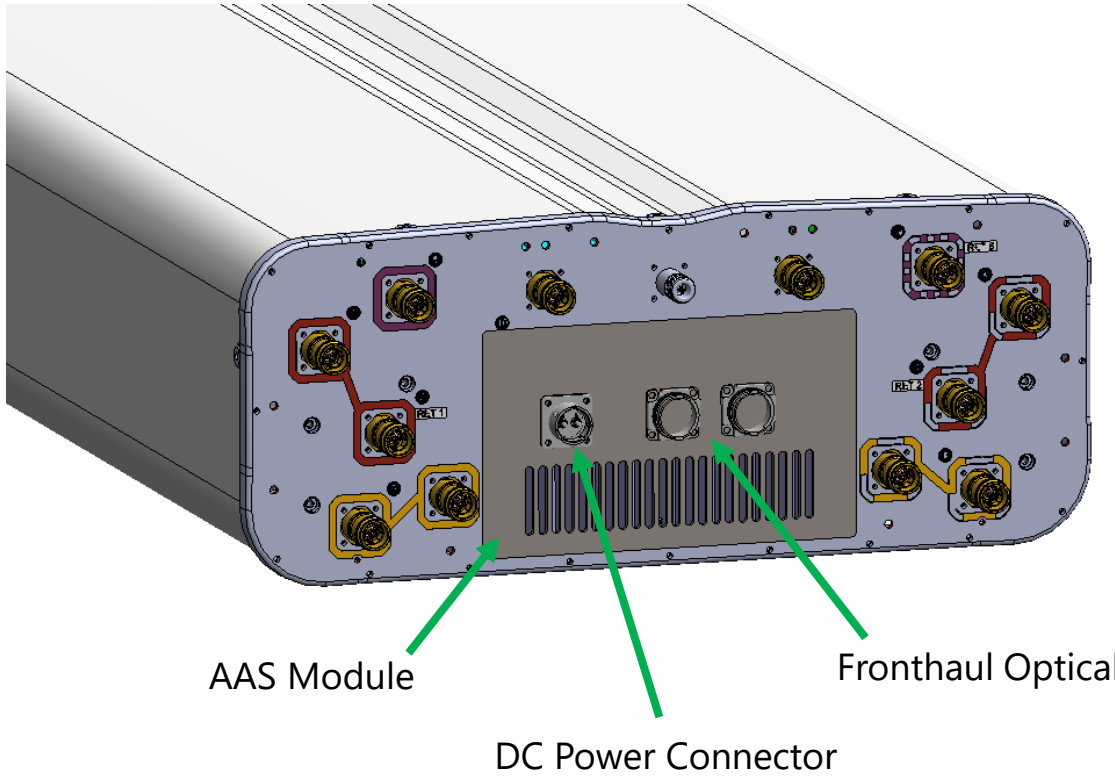
- 4x 694–960,
- 4x 1427–2690
- 8x 3300-3800

TDD/FDD 5G-enabled Antenna

Passive FDD Bands – Low band and High band

Active TDD Bands – 3.5GHz





Other Considerations

Tower Loading

- Will legacy infrastructure support additional weight/wind loading?
- Will local municipalities permit an additional antenna?
- Will landlords allow an additional antenna without renegotiating leasehold agreements?

Site Sharing

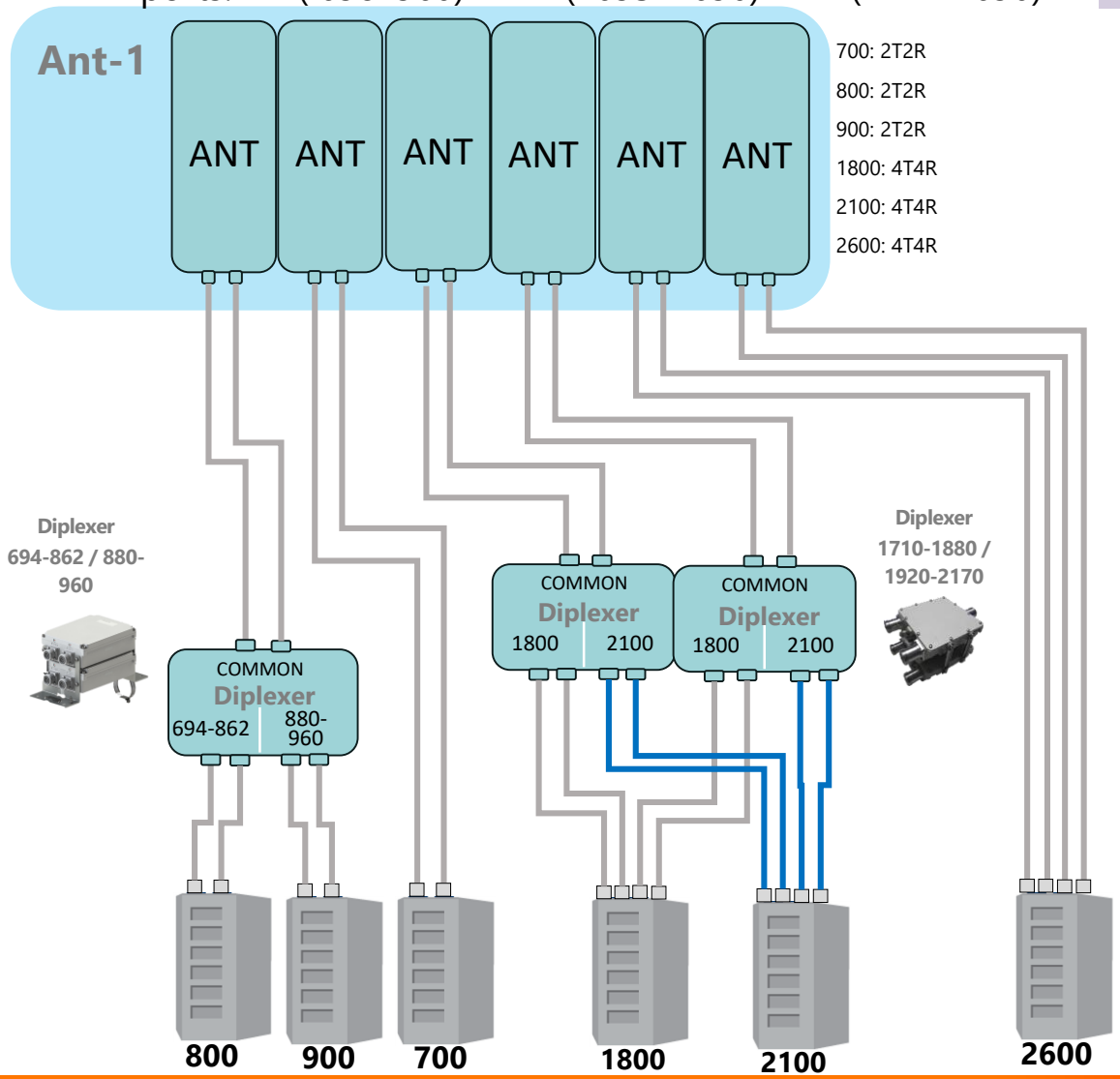
- Is there a need to share the site with other operators?
- Will the site support more than one active antenna per sector?
- Is there a risk for signal interference?

Power

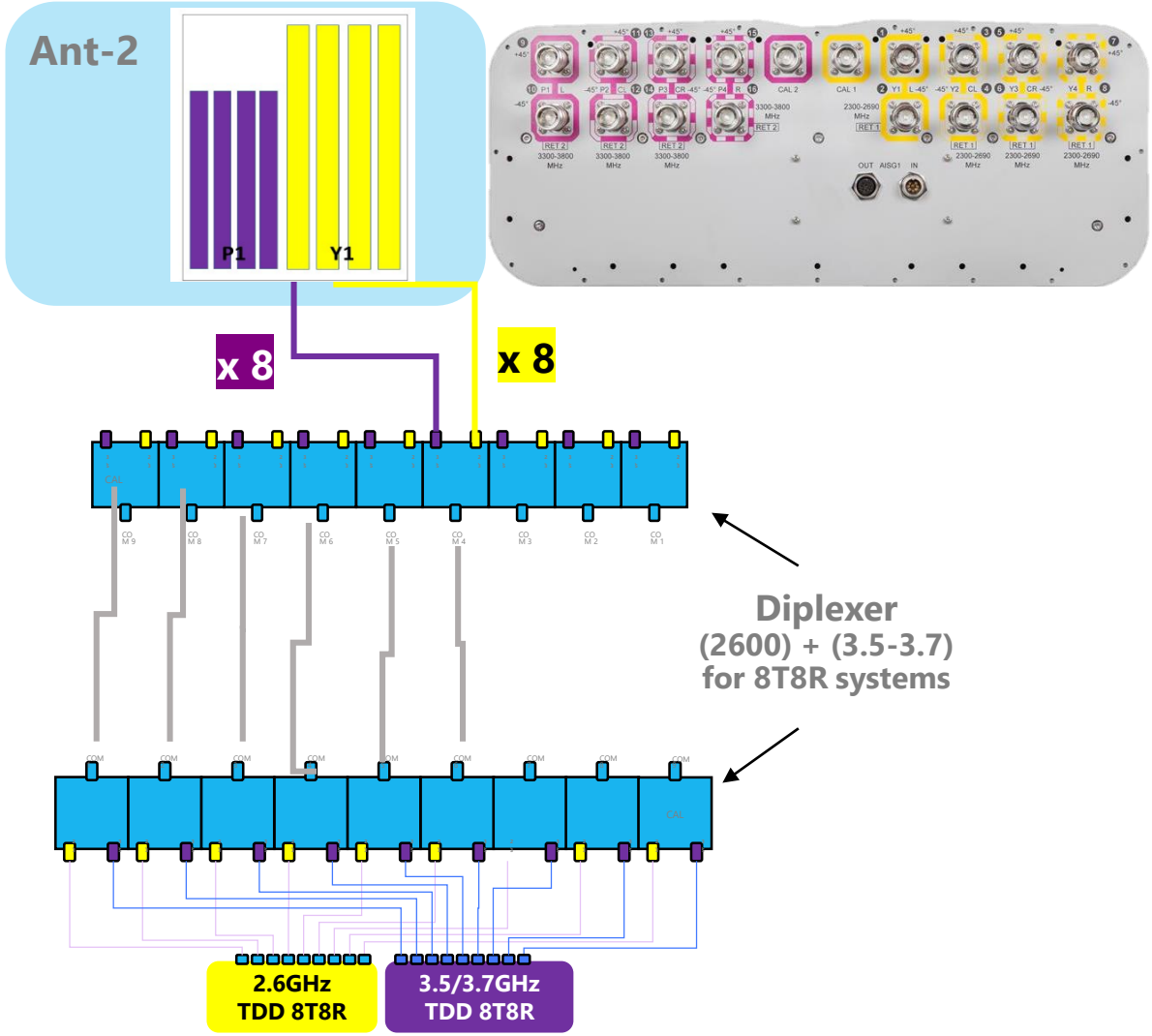
- Can power be economically delivered to the 5G tower top?

Full RF Path Solution

12 ports: 4 x (698–960) + 4 x (1695–2690) +4 x (1427-2690)



T4S4-90A-R2 | 16-port, 8x 2300-2690MHz, 8x 3300-3800MHz



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PowerShift®

First intelligent, plug-and-play DC power solution designed to optimize electrical draw of an RRU by dynamically adjusting voltage to provide the proper power level

- Increases battery backup time
- Addresses high power mMIMO radio requirements
- Saves CAPEX using existing cables during radio upgrades and allows for smaller gauge cables in new deployments

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What will your 5G-NR RAN really look like?

- There is no single 5G RAN **upgrade path** or shape, for indoors and outdoors.
- Always Balance **Cost** and **Performance** with **Timing,** for Beam Formers configurations.
- **Open RAN** architectures promise flexibility to operators.
- **CommScope** are here to support in selecting your best 5GNR RAN evolution path.

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Questions & Comments

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