Small Cell vs MIMO

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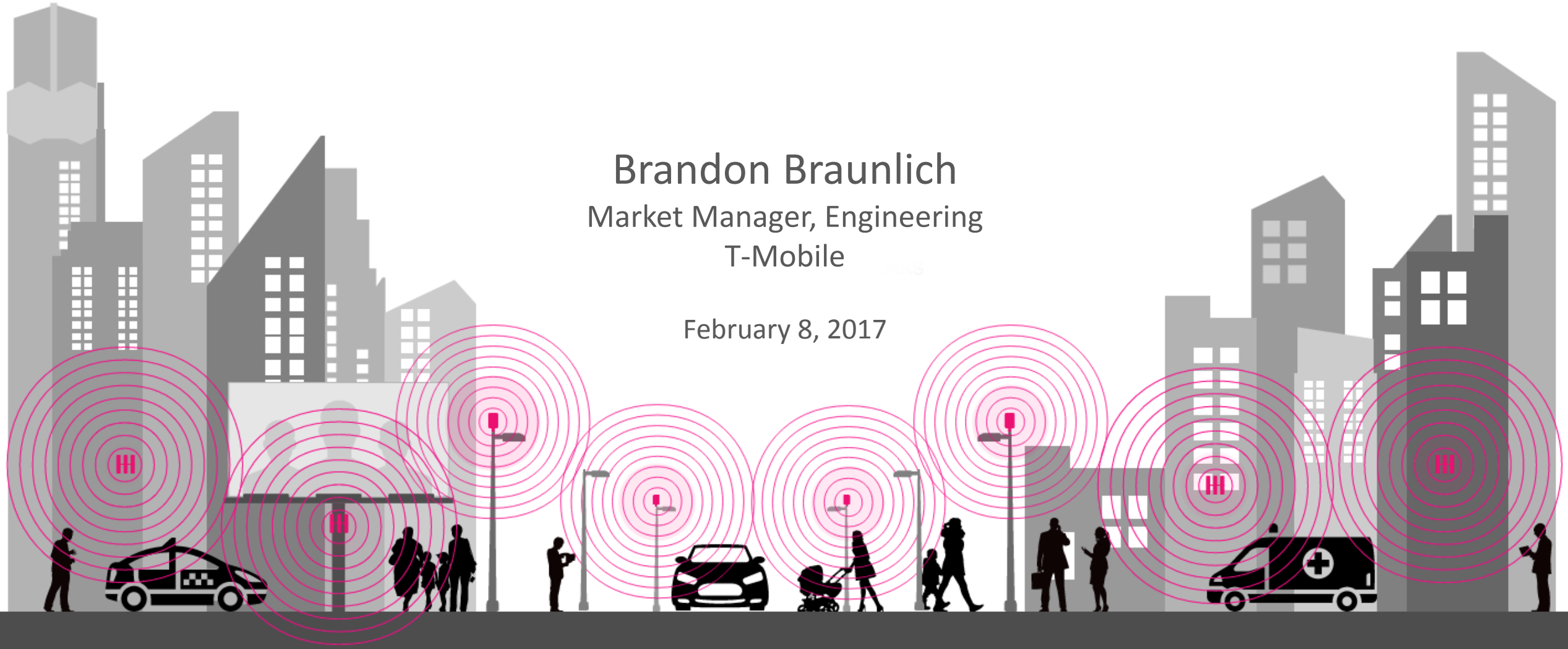

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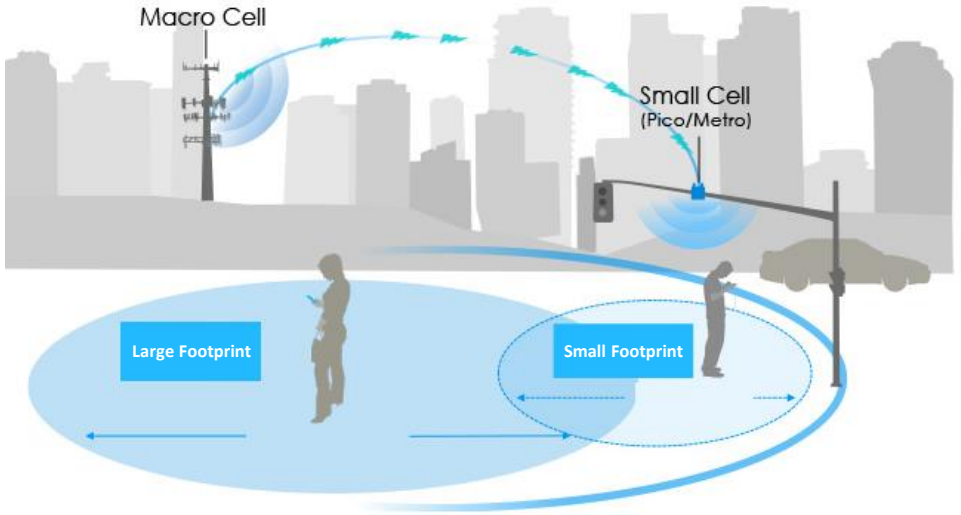


What are Small Cells?

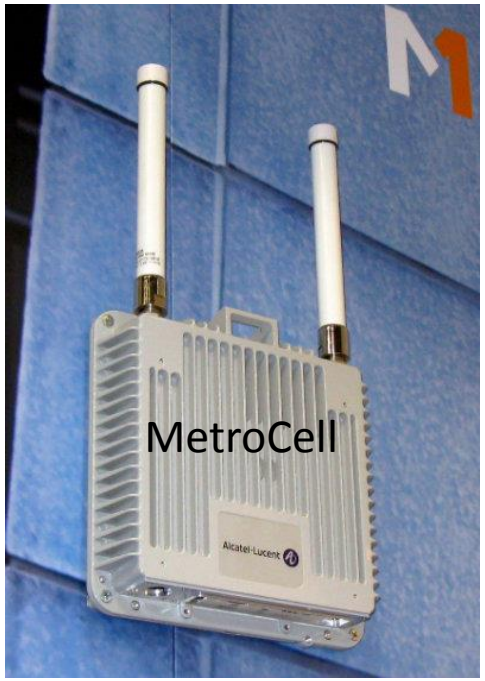
Small cells are low-powered radio access nodes that operate in licensed and unlicensed spectrum that have a range of 32 feet to 1 mile. They are "**small**" compared to a mobile macrocell, which may have a range of ~20 miles. Located “in the clutter” of the existing network.

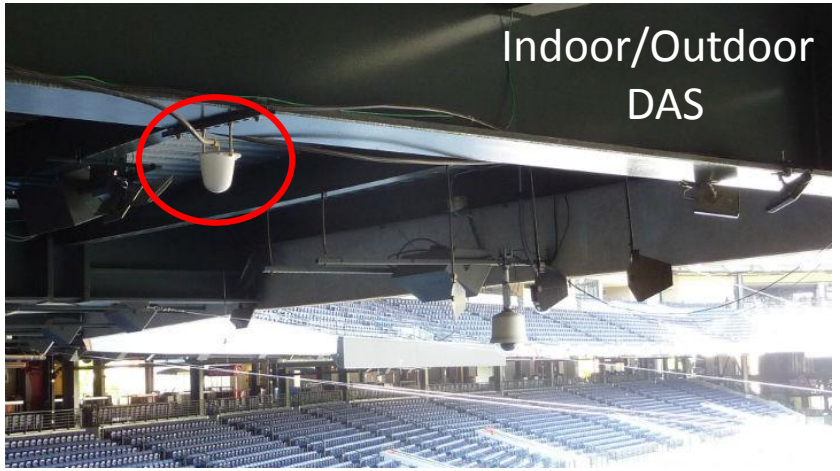
- Outdoor DAS
- Indoor DAS
- Microcell
- MetroCell
- Picocell
- Wifi
- Femtocell

Small Cell Type	Cell Radius	Power Level (Watts)	Approximate Number of Users
Outdoor DAS	1 mile	20	3,000 per sector
Indoor DAS	Up to 200 feet per antenna	2	2,500-3,000 per sector
Microcell	1 mile	10	1,800 per baseband unit
Metrocell	500-1,000 feet	5	200
Picocell	750 feet	1	32
Wi-Fi	50-60 feet	0.1	Up to 200 per access point
Femtocell	50-60 feet	0.1	4–6

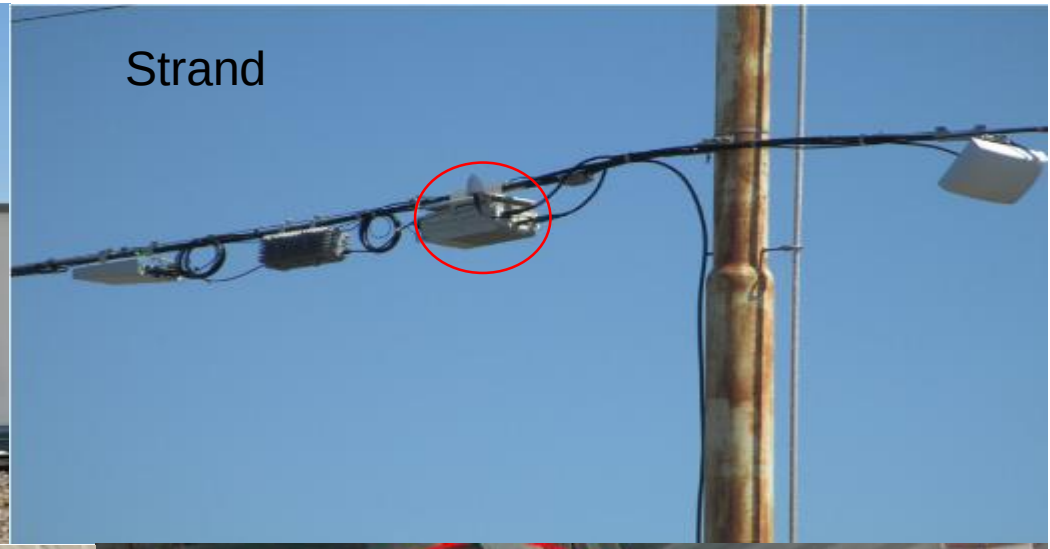
**http://www.commscope.com/Blog/CommScope-Definitions-What-Is-a-Small-Cell/ by Patrick Lau on Aug 27, 2015*

Small Cell - Examples:





Small Cell - Examples:



Outdoor Small Cell Configuration:

Nokia Installation on a City of Chicago Lightpole

Location: Randolph & N Wells (NW corner), train tracks on N Wells

Installation type: 30ft Light pole, no pole replacement required

Small Cell: Flexi Zone, AWS, 10MHz, 5+5W, F1/F1 scenario

Antenna: External Kathrein XPol Omni 1710-2690MHz 5dBi

Backhaul: DragonWave Avenue Link (58GHz) , 300ft to donor site

Power: ComEd, 40ft trenching to manhole required

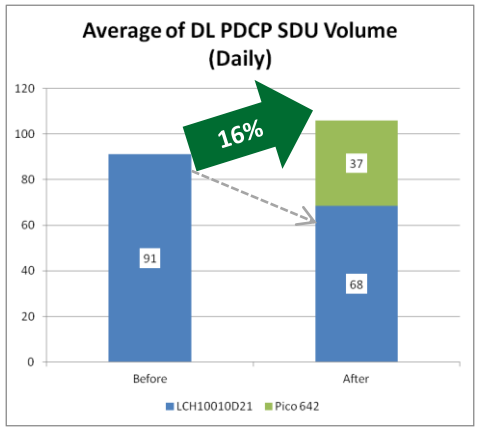
Synchronization: GPS

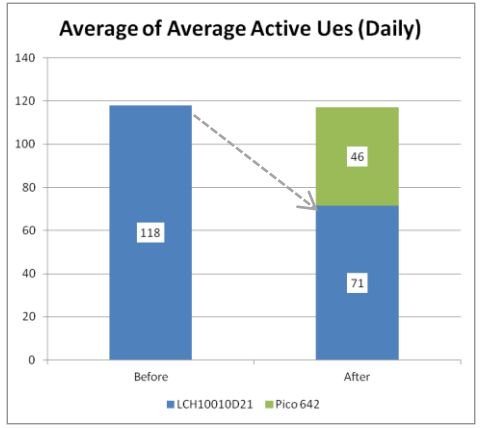
Total weight of added equipment: 50lbs

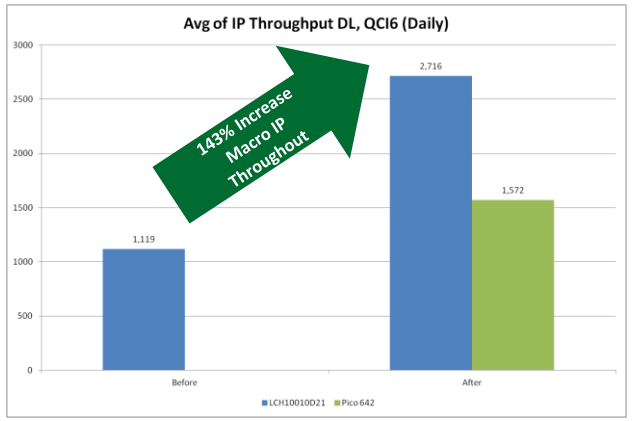
1. Antenna, 2. Microwave, 3. Flexi Zone, 4. AC panel

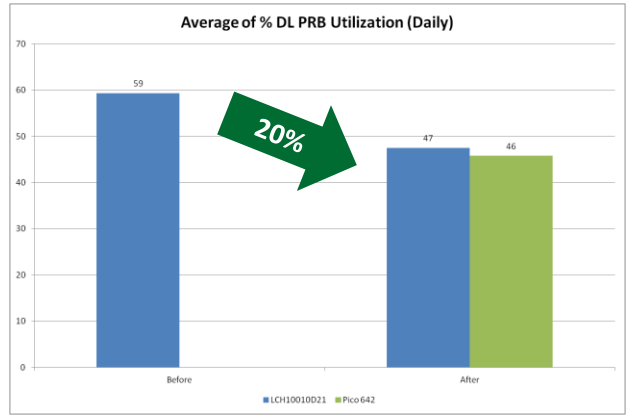
Outdoor Small Cell Performance:

Small Cell performance based on one live small cell









Macro offload – data volume

22%

Macro offload – Active UEs

32%

Traffic Increase

15%

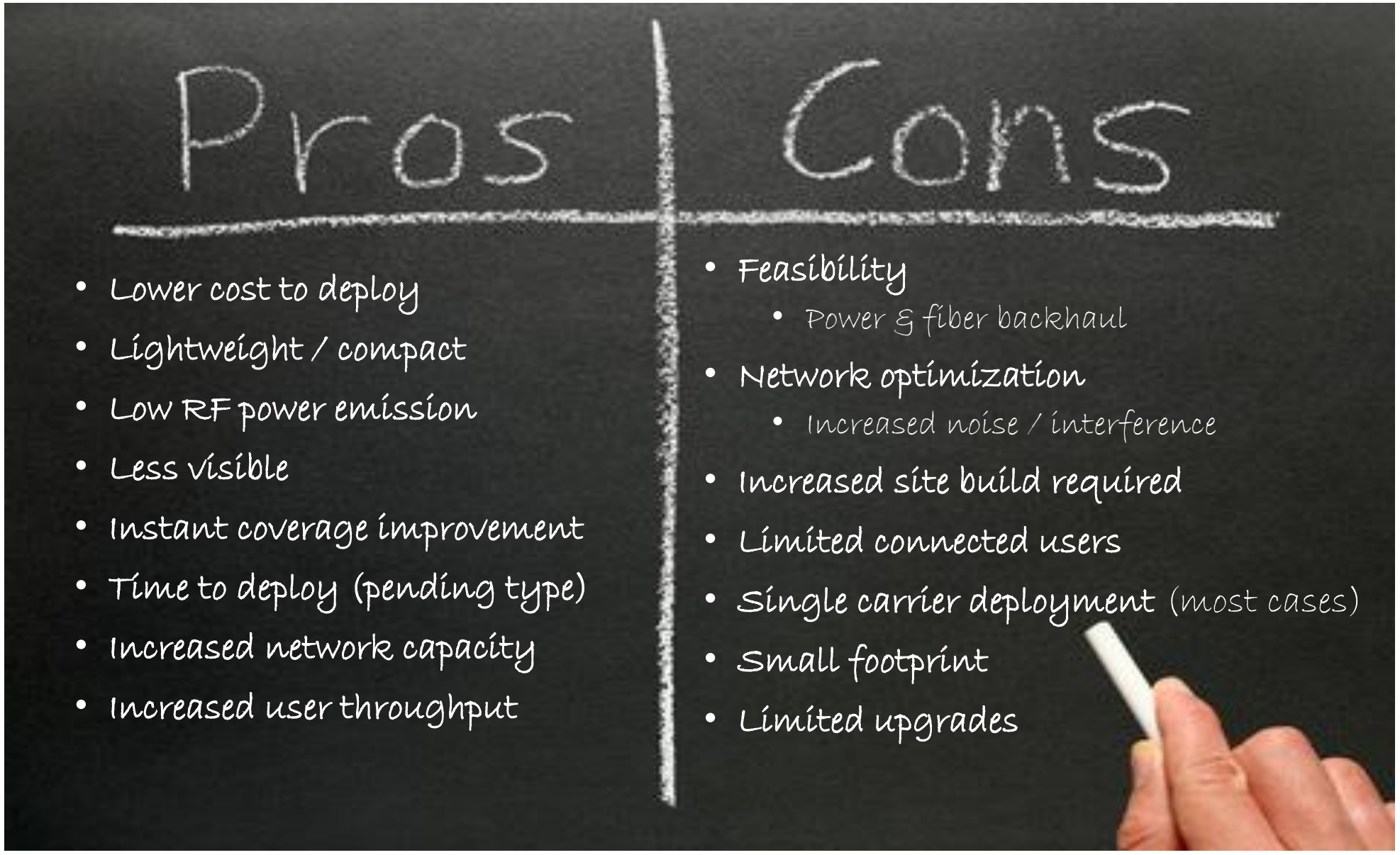
End User Experience – Higher IP Thput

143%

Resource Utilization improvement

20%

Small Cells – Pros & Cons:



What is MIMO?

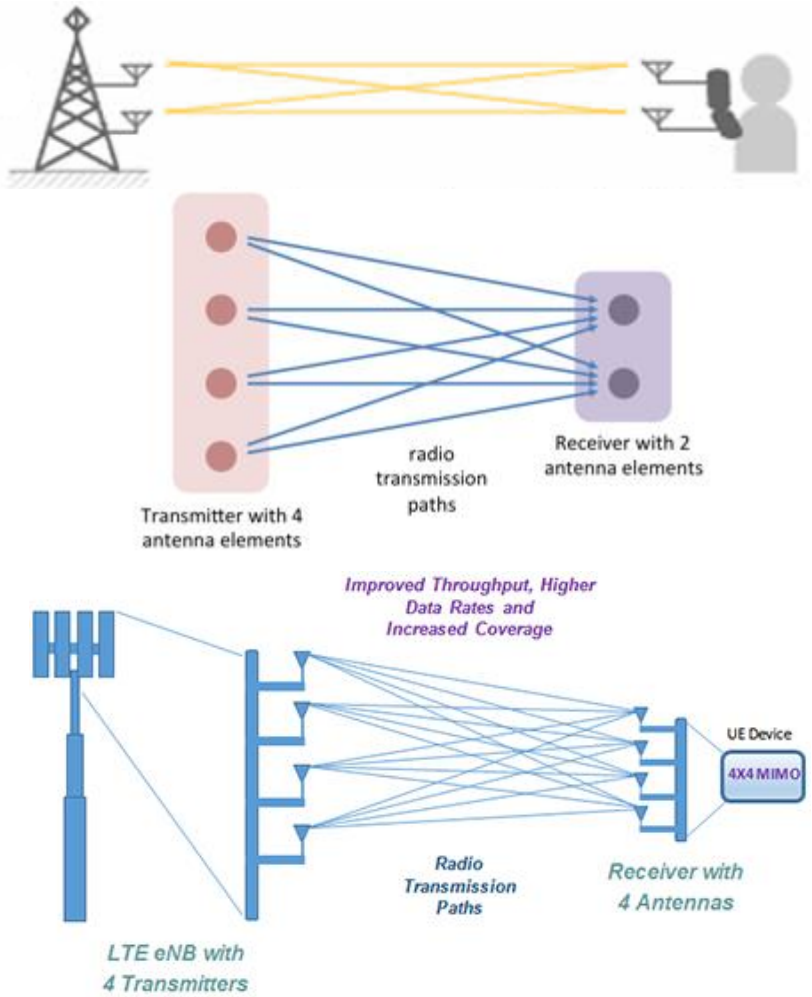
MIMO stands for **Multiple Input/Multiple Output**. Simply put, it is a data transfer accelerant by using more than one antenna to receive and transmit data. MIMO enables a variety of signal paths to carry data to and from a wireless device.

Spatial diversity: Multiple transmit and receive antennas improve the signal to noise ratio by reducing signal fade

Spatial multiplexing: Provides additional data capacity by utilizing the different paths to carry additional traffic resulting in increased throughput.

MIMO – Examples:

Types of MIMO 2x2, 4x2, 4x4



Achievable LTE Peak Data Rates

Achievable LTE Peak Data Rates

Accounts for overhead at different bandwidths & antenna configurations

	DL		UL
Bandwidth	2x2	4x4	1x2
5 MHz	37 Mbps	72 Mbps	18 Mbps
10 MHz	73 Mbps	147 Mbps	36 Mbps
20 MHz	150 Mbps	300 Mbps	75 Mbps

Massive MIMO Antenna

MIMO – Network Gain:

Single Stream (4 Antennas) ~75 Mbps

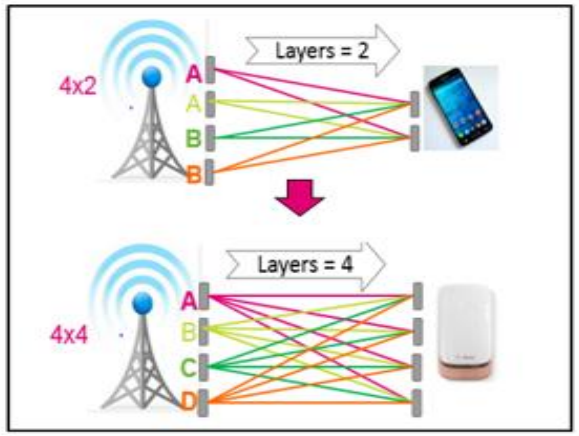
↓

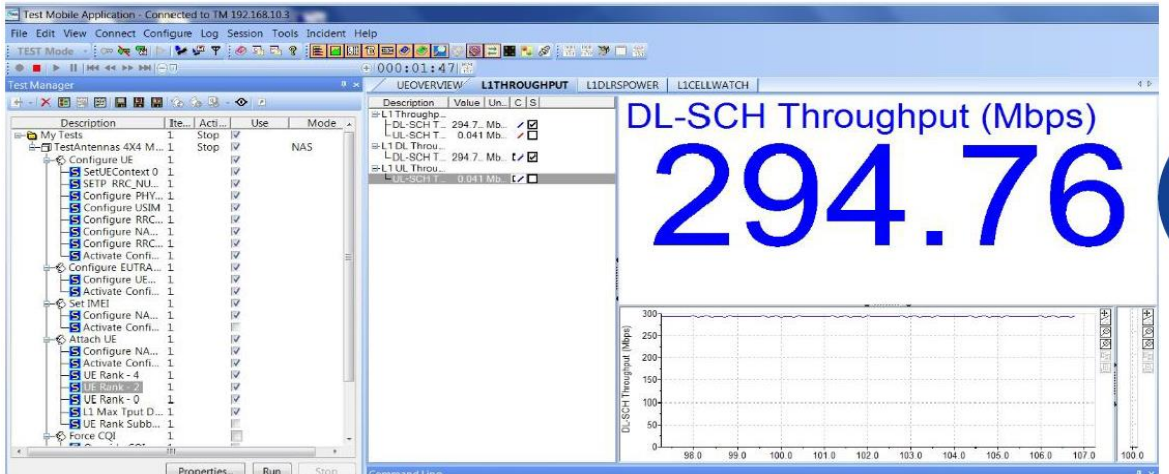
Dual Stream MIMO (4x2) ~150 Mbps

↓

Quad Stream MIMO (4x4) ~300 Mbps

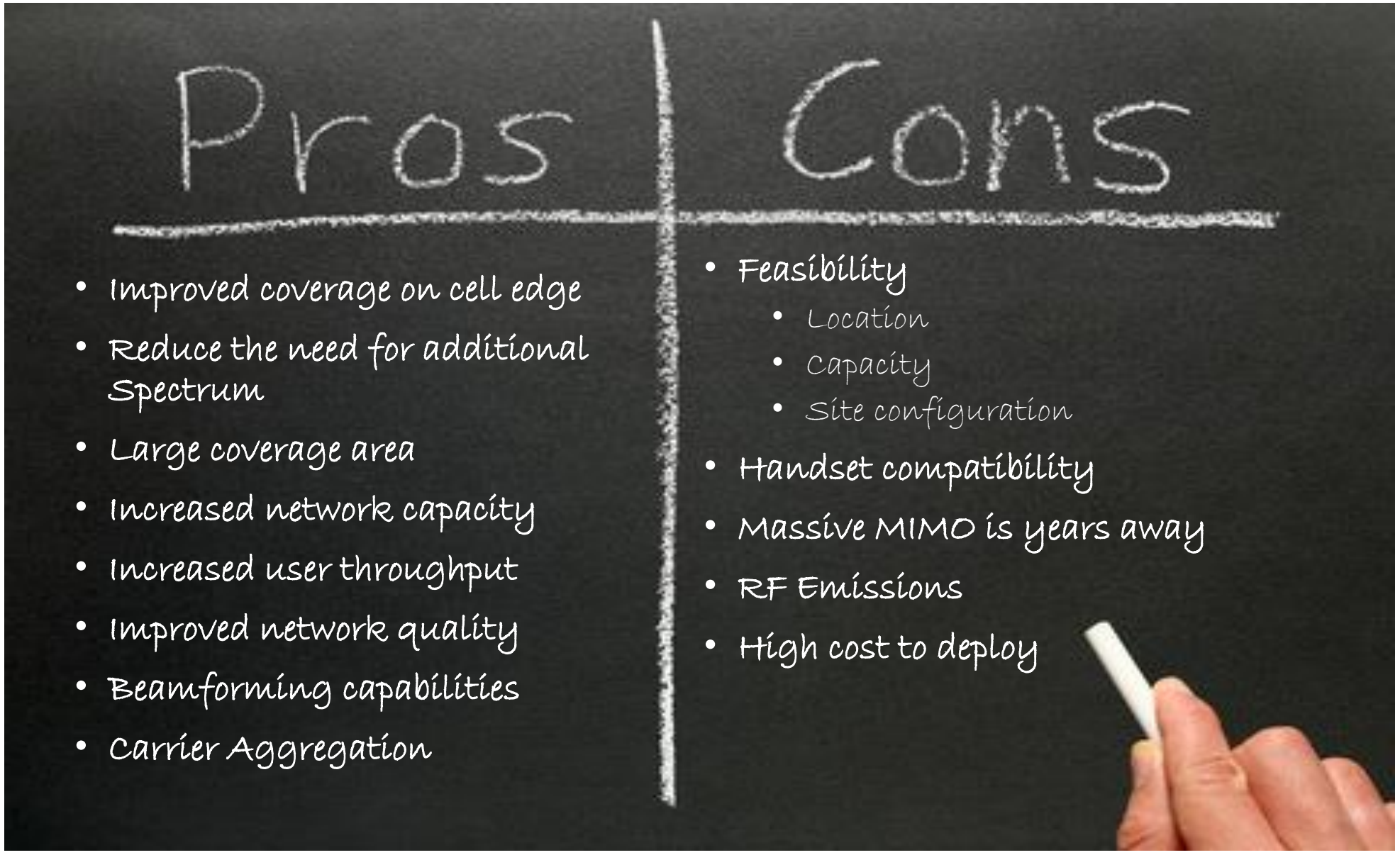
	TX-Antenna eNodeB (#)	RX-Antenna UE (#)	Peak Speeds on 20MHz (Mbps)	Unique Streams (#)
2x2 MIMO	2	2	150	2
4x2 MIMO	4	2	150	2
4x4 MIMO	4	4	300	4
4 Way Rx Diversity UE	4	4	150	2



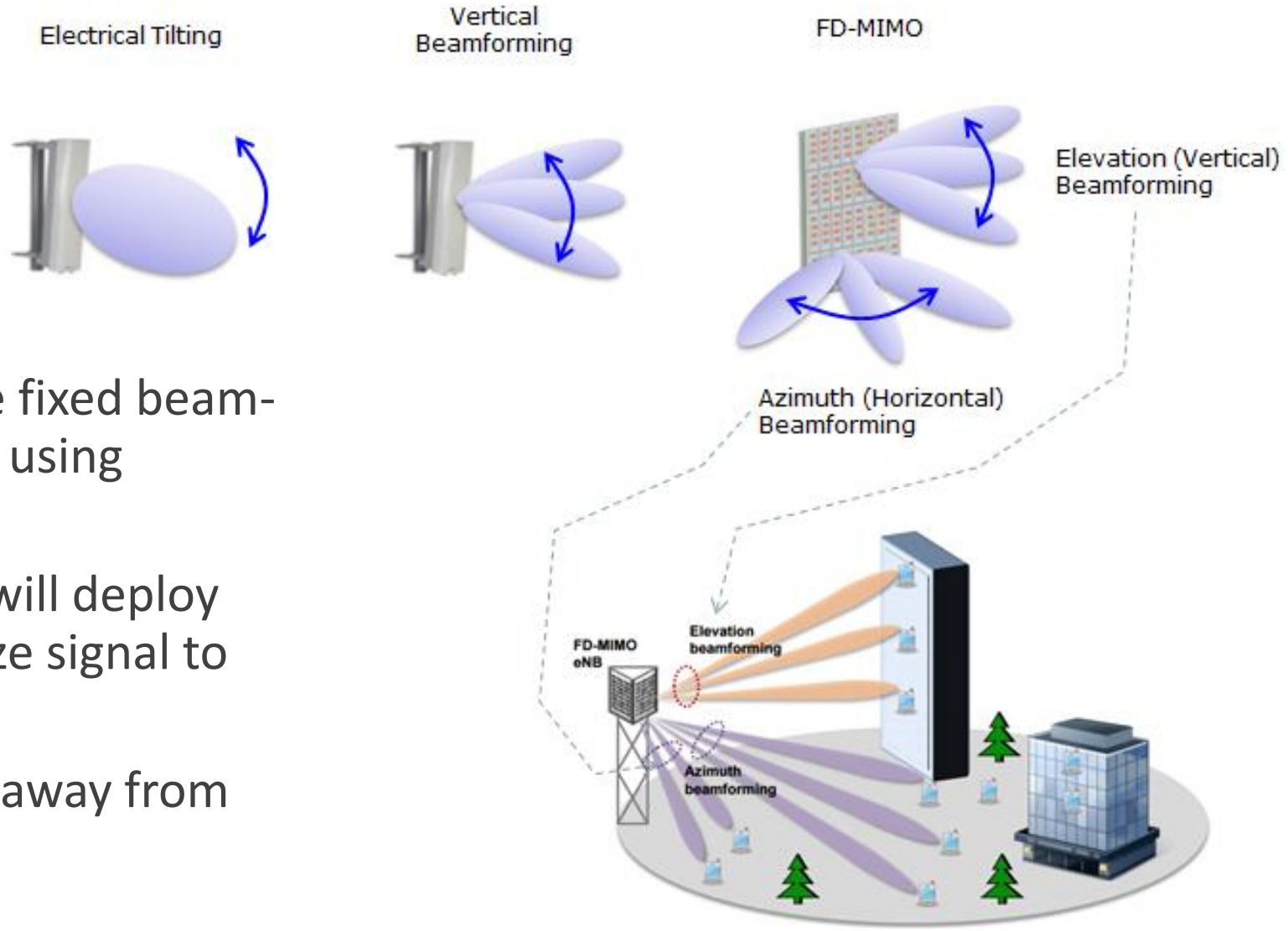


Peak DL throughput of 294+ Mbps with 20MHz BW

MIMO - Pros & Cons:



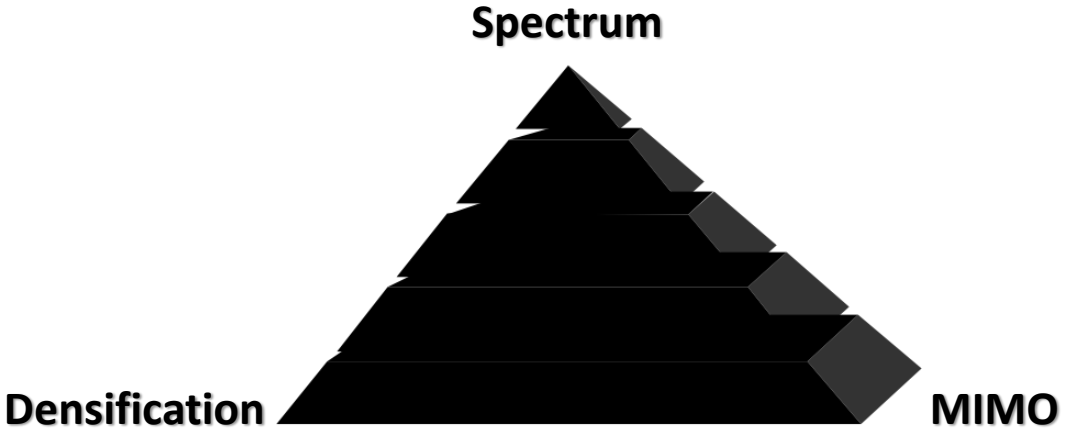
MIMO of Tomorrow:

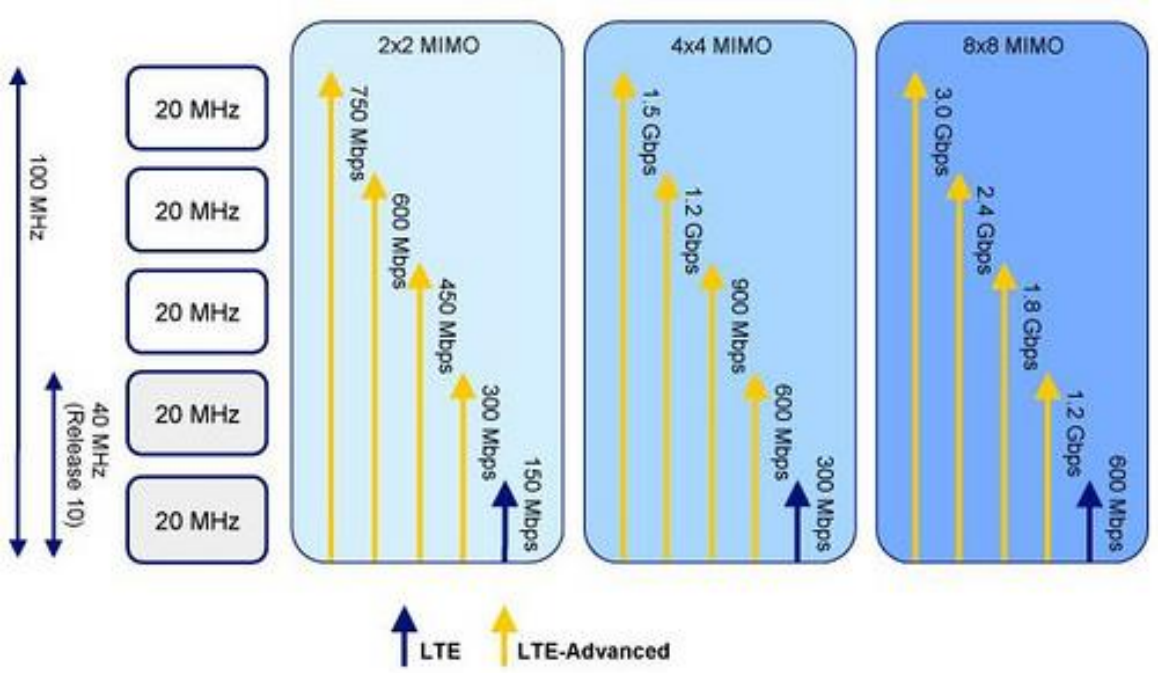


- Current passive antennas have fixed beam-widths to cover a specific area using separate transmit paths
- Future antenna deployments will deploy active beamforming to optimize signal to each user
- Full Dimension MIMO is years away from network deployment

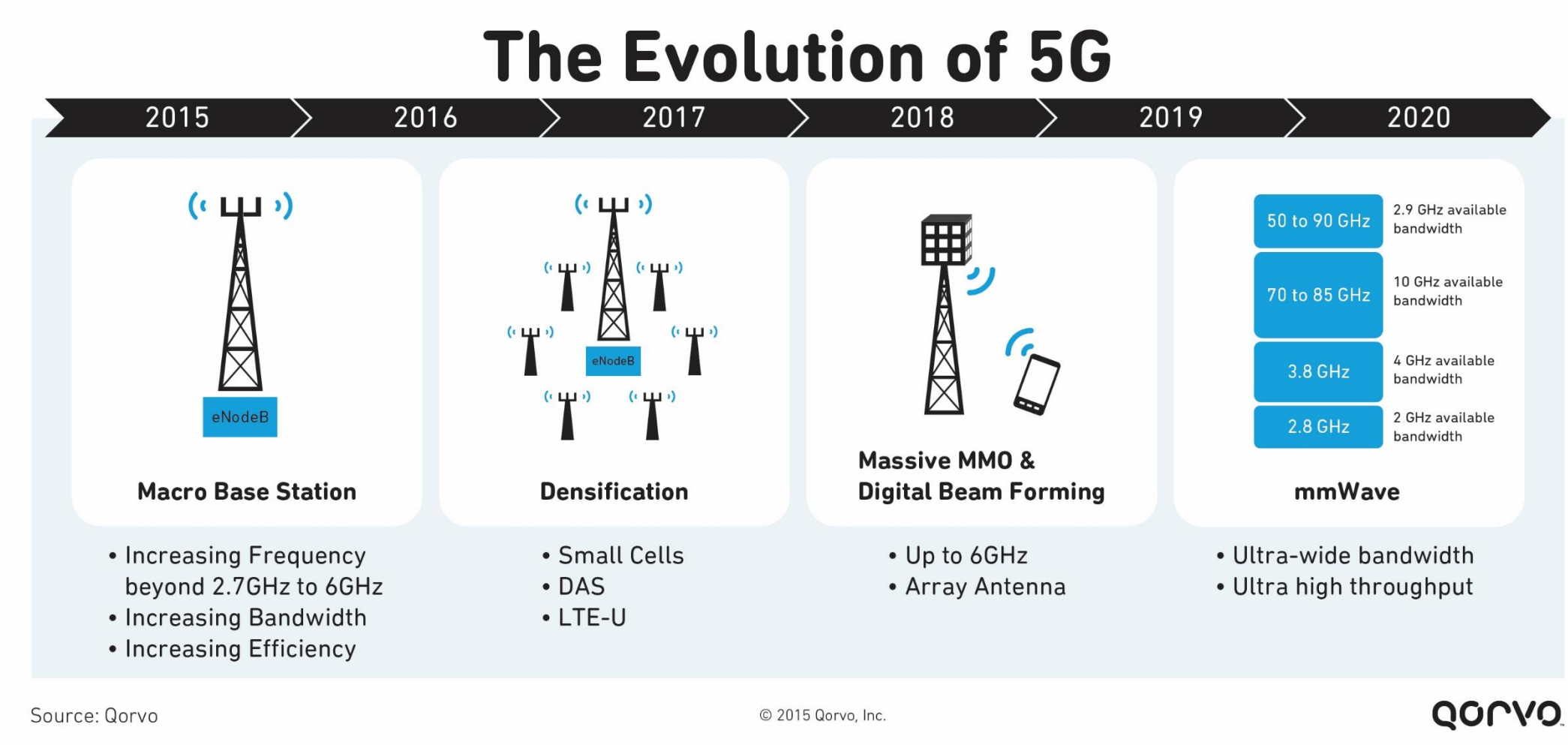
Coexistence of Small Cell & MIMO:

Wireless Carriers require 3 things to things to remain successful; **Spectrum**, **Densification**, and **MIMO**. Carriers continually monitor existing technologies, refarm spectrum to LTE, and deploy “Carrier Aggregation” where possible.





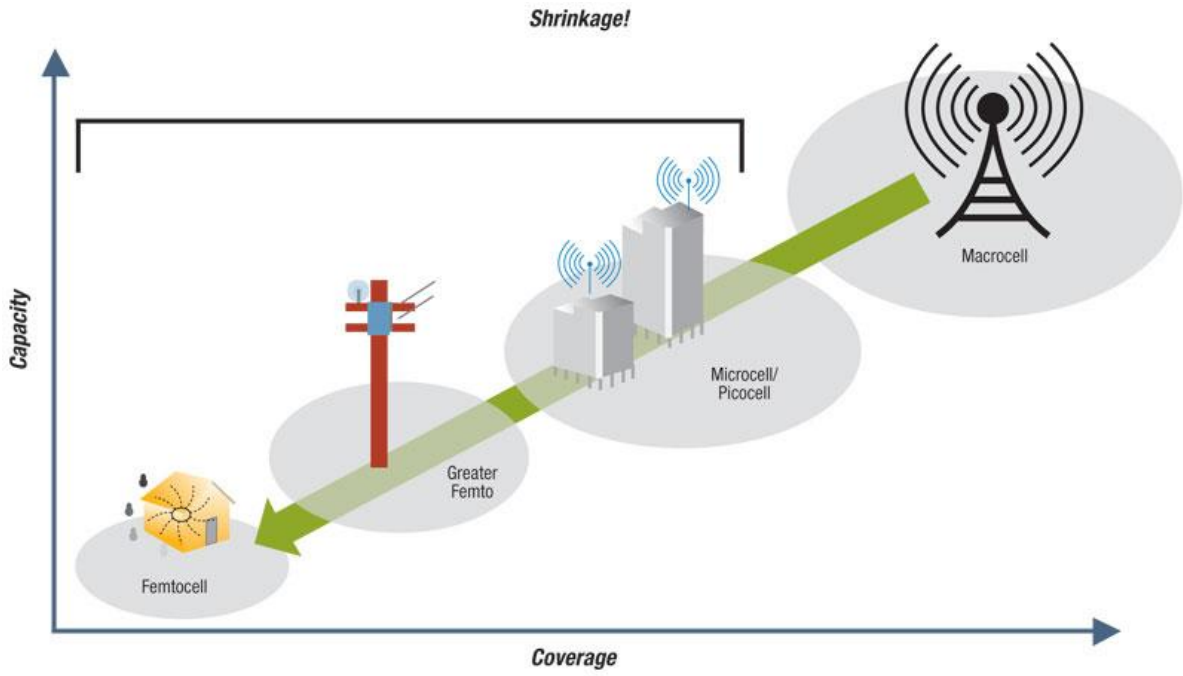
Future / Coexistence of Small Cells & MIMO



*http://mwrf.com/active-components/small-cells-help-keep-5g-connected

Conclusion:

- Customers data demand for increased network capacity will be a continued challenge for Wireless Carriers.
- Carriers need 3 things to be successful; Spectrum, Densification, and MIMO.
- Small Cells and MIMO (including Massive MIMO) can work seamlessly together.



Question & Answer: