

# 5G and Spectrum



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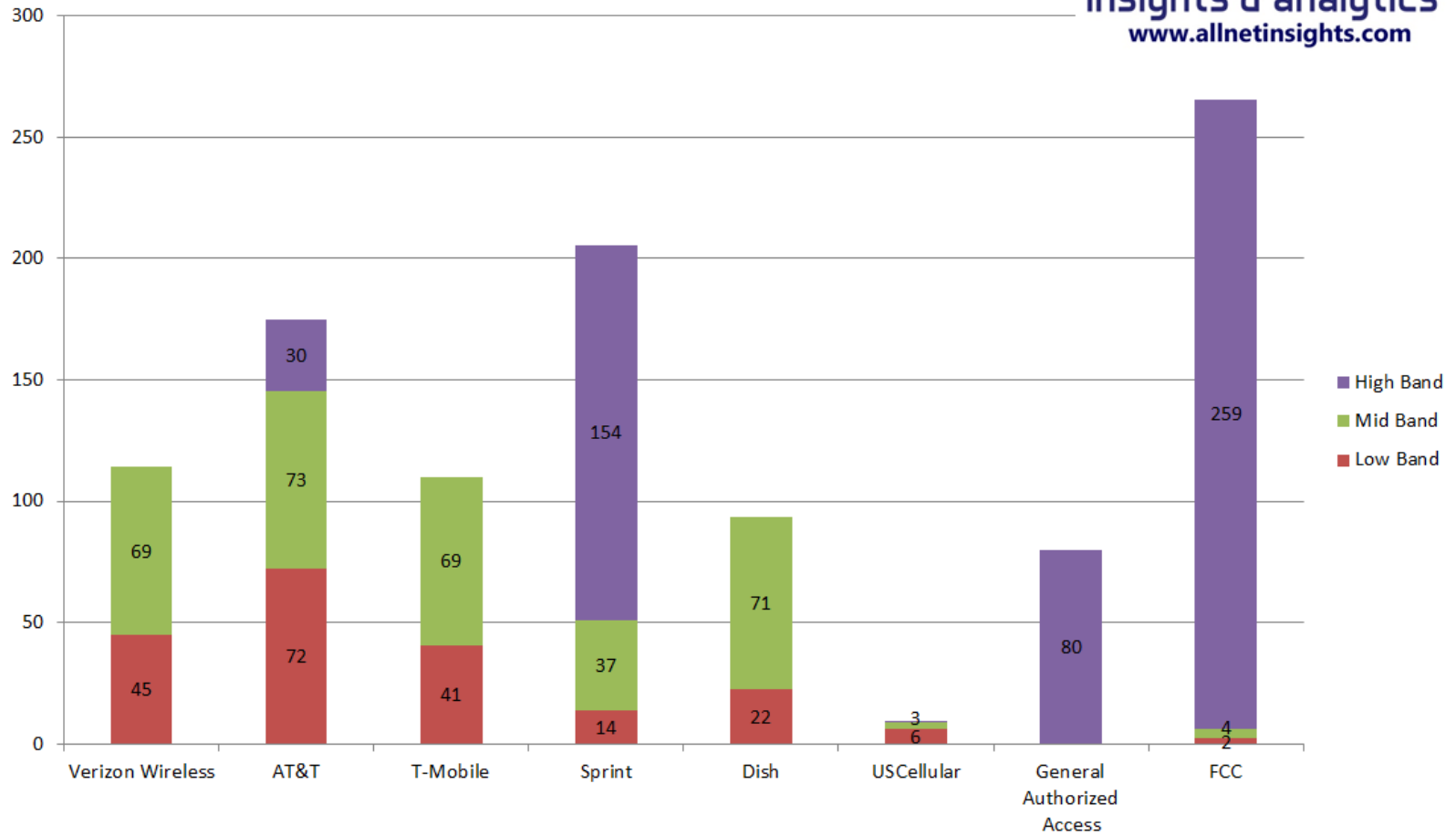
# Spectrum to be Deployed for 5G

5G will be deployed in all of the existing US carrier bands:

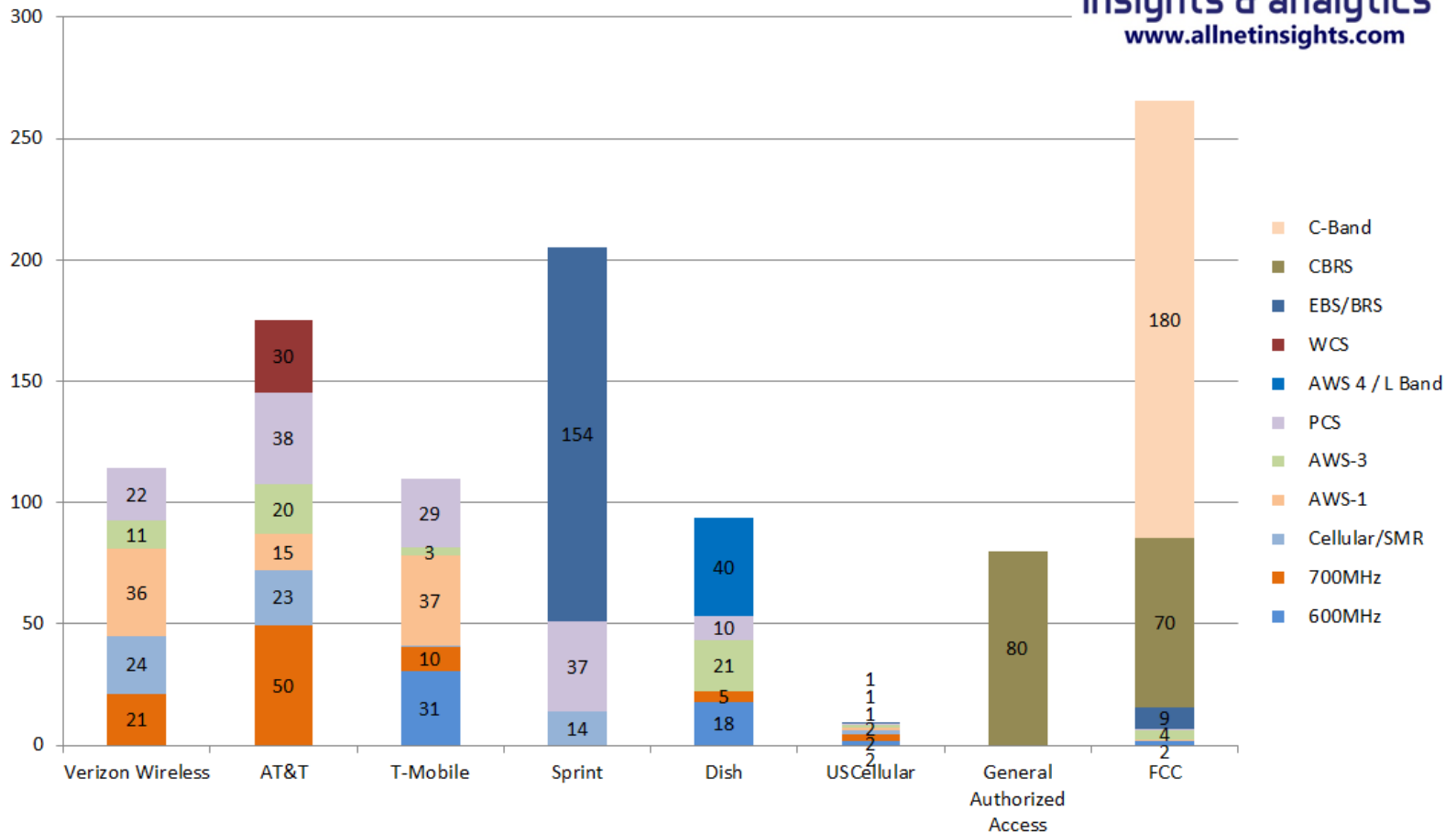
- Low Band (wide coverage, limited capacity)
  - 600MHz, 700MHz, and Cellular
- Mid Band (reasonable coverage, reasonable capacity)
  - PCS, AWS1, AWS2, AWS3, AWS4, and WCS
  - Sprint's 2.5GHz (excellent capacity)
  - CBRS and C-band satellite
- High Band (limited coverage, massive capacity)
  - 24GHz, 28GHz, 37GHz, 39GHz, and 47GHz



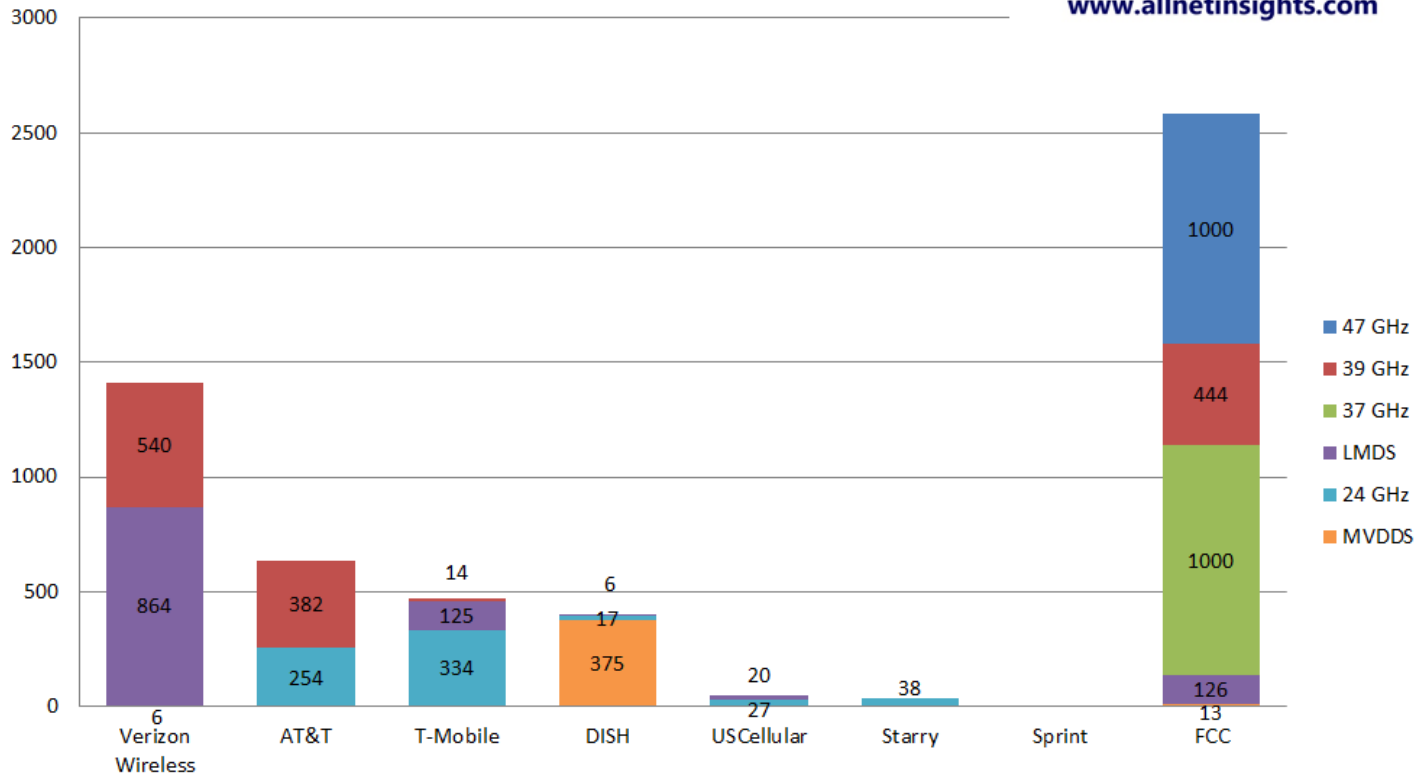
# Mobile Carrier National Weighted Average Spectrum Depth (MHz) by Band Classification



## Mobile Carrier National Weighted Average Spectrum Depth (MHz) by Frequency Band



# Millimeter Wave National Weighted Average Spectrum Depth (MHz) Detailed by Frequency Block



# 5G – Low Band Channel Size (Coverage)

Market (CMA)	Verizon	AT&T (700MHz)	T-Mobile (600MHz)	Sprint
Los Angeles	10 DL x 10 UL	20 DL x 10 UL	15 DL x 15 UL	-
New York	10 DL x 10 UL	20 DL x 10 UL	10 DL x 10 UL	-
Dallas-Fort Worth	10 DL x 10 UL	20 DL x 10 UL	10 DL x 10 UL	-
Houston	10 DL x 10 UL	15 DL x 10 UL	10 DL x 10 UL	-
Philadelphia	10 DL x 10 UL	20 DL x 10 UL	15 DL x 15 UL	-
Seattle	10 DL x 10 UL	15 DL x 10 UL	15 DL x 15 UL	-

CMA – Cellular Market Area

Also known as Rand McNally Metropolitan Statistical Areas (MSA)



# 5G – Mid Band Channel Size (Coverage/Capacity)

Market (CMA)	Verizon	AT&T	T-Mobile	Sprint (2.5GHz)
Los Angeles	-	-	-	40MHz TDD
New York	-	-	-	40MHz TDD
Dallas-Fort Worth	-	-	-	40MHz TDD
Houston	-	-	-	40MHz TDD
Philadelphia	-	-	-	40MHz TDD
Seattle	-	-	-	40MHz TDD

TDD (Time Division Duplex) - Both the cell site and the phone utilize the same channel. Access to the channel is provided by a time scheduler.

# 5G – Millimeter Wave Channel Size (Capacity)

Market (CMA)	Verizon (28GHz)	AT&T (39GHz)	T-Mobile (28GHz)	Sprint
Los Angeles	200MHz	400MHz	100MHz	-
New York	200MHz	400MHz	50MHz	-
Dallas-Fort Worth	200MHz	200MHz	100MHz	-
Houston	400MHz	400MHz	200MHz (24GHz)	-
Philadelphia	200MHz	400MHz	100MHz	-
Seattle	400MHz	400MHz	200MHz (24GHz)	-





# Verizon NFL Cities

NFC East	NFC North	NFC South	NFC West
<b>Dallas</b> (2x200MHz)	<b>Chicago</b> (2x400MHz)	<b>Atlanta</b> (2x200MHz)	<b>Arizona</b> (2x400MHz)
<b>New York</b> (2x200MHz)	<b>Detroit</b> (2x200MHz)	<b>Carolina</b> (2x400MHz)	<b>Los Angeles</b> (2x200MHz)
<b>Philadelphia</b> (2x200MHz)	<b>Green Bay</b> (0 MHz)	<b>New Orleans</b> (2x400MHz)	<b>San Francisco</b> (2x200MHz)
<b>Washington</b> (2x400MHz)	<b>Minnesota</b> (2x400MHz)	<b>Tampa Bay</b> (2x200MHz)	<b>Seattle</b> (2x400MHz)

AFC East	AFC North	AFC South	AFC West
<b>Buffalo</b> (2x400MHz)	<b>Baltimore</b> (2x400MHz)	<b>Houston</b> (2x400MHz)	<b>Denver</b> (2x400MHz)
<b>Miami</b> (2x200MHz)	<b>Cincinnati</b> (0 MHz)	<b>Indianapolis</b> (2x400MHz)	<b>Kansas City</b> (2x400MHz leased)
<b>New England</b> (2x200MHz)	<b>Cleveland</b> (0 MHz)	<b>Jacksonville</b> (2x200MHz)	<b>Los Angeles</b> (2x200MHz)
<b>New York</b> (2x200MHz)	<b>Pittsburgh</b> (2x400MHz)	<b>Tennessee</b> (2x400MHz)	<b>Oakland</b> (2x200MHz)

**Green Cities** – Launched Stadiums  
Maximum Channels (Quantity x Channel Size)





# Upcoming Spectrum Auctions

- Auction 103 (December 2019)
  - 37GHz, 39GHz, and 47GHz
- CBRS Auction (June 2020)
  - 3.5GHz
- 2.5GHz Whitespace Auction
- C-band Satellite Spectrum
  - 3.7-4.2GHz

