Spectrum Deep Tracks:
DISH's Spectrum Portfolio
An Overview and Considerations

A collaborative analysis from

Spektrum Metrics

and

sunstone ASSOCIATES

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Abstract:
DISH continues to be in the news. Beating the betting odds, DISH has successfully met both an initial and interim performance requirement to deploy their spectrum portfolio as a condition of the T-Mobile/ Sprint merger. More recently, they successfully renegotiated the purchase of 800 MHz from T-Mobile and DISH has continued to be a spectrum success story.

However, a question continually posed by many analysts is "what if". More specifically, should DISH be unsuccessful in their mobile network aspirations, **for whom would their spectrum portfolio be most valuable?** This is a fair question which deserves thoughtful answers.

While the authors of this report do not wish to opine on DISH's ultimate success – DISH has achieved an impressive series of milestones -- the question does provide a platform to help industry analysts, investors, vendors, and partners better understand the DISH portfolio and how to think about utility and, ultimately, value.

Thus, this report discusses DISH's major mobile Frequency Range 1 (FR1) bands and considerations of who might find these valuable. A discussion of the specific transactional mechanism to transfer that spectrum (e.g., federal auction, individual transactions, partnership, etc.) is outside the scope of this report. However, the authors highlight who are the operators to most likely find value in a specific band.

The authors assembled the report from the unique insights and tools available from Spektrum Metrics to demonstrate holdings at a national and individual market level and by band. Further, using the Spektrum Metrics web tools, we will compare holdings on a geographic basis via map or in total for comparison with other operators. The authors use this information to provide an analysis of potential band opportunities based on positioning and holdings by other incumbents in those markets.

The contents of this ~60-page document are intended to aid financial analysts, investors, and management consultants in developing perspectives to aid their individual firms and clients. It also is of benefit for anyone in the industry with curiosity of how to think about spectrum value and potential "what if" scenarios to support their own planning efforts. The analysis and graphics contained in this report are obtained from authentic sources, analyzed, and cross-validated where possible.

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3 The 700 MHz E Block – A small block with a long history

3.1 Overview

Representing only a 6 MHz channel, the lower 700 MHz E block has limited capacity but an outsized impact on the history and operations of the lower 700MHz band. The entire 700 MHz band, shown in Figure 9 below, was originally repurposed from TV broadcast channels 52-69 (prior to the 600 MHz Broadcast Incentive Auction). The E, and its erstwhile partner the D block, are sandwiched between the paired ABC blocks. Both the D&E and are permitted to use in a "downlink only" configuration (tower to handset).

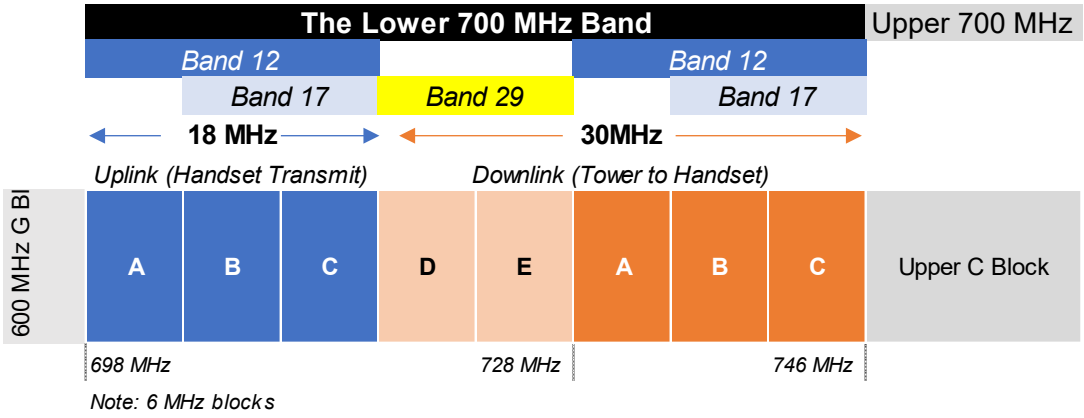


Figure 1 – 700 MHz Band plan

A summary of DISH's 700 MHz Holdings is shown below:

Table 1 – DISH 700 MHz Summary

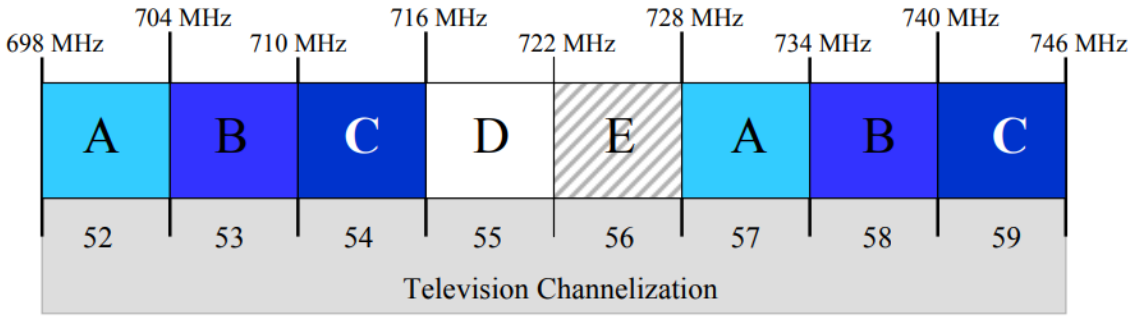
DISH Band Summary	
Band	700 MHz
License Areas	Economic Areas (EAs)
Nationwide, average MHz	5 MHz
Total MHz-Pops	1,558,769,598
Carrying Amount ($K)	$711,871
Interim Buildout	N/A
Final Buildout Benchmark	70% of Pops in each EA
Final Buildout	June 14, 2025
Expiration Date	June 2025*

Source: DISH 3Q 2023 10Q; Spektrum Metrics

** DISH indicated FCC has accepted their timely filing and will be extending license term to June 2025*

3.2 Brief History

The history of the band goes back to nearly the turn of the century. In 2002, the FCC initiated the first auctions on the lower 700 MHz band (currently captured in Figure 10) after relocating television broadcast channels 52 – 59.



Block	Frequencies (MHz)	Bandwidth	Pairing	Geographic Area Type	No. of Licenses
A	698-704, 728-734	12 MHz	2 x 6 MHz	700 MHz EAG	6
B	704-710, 734-740	12 MHz	2 x 6 MHz	700 MHz EAG	6
C	710-716, 740-746	12 MHz	2 x 6 MHz	MSA/RSA	734
D	716-722	6 MHz	unpaired	700 MHz EAG	6
E	722-728	6 MHz	unpaired	700 MHz EAG	6

Figure 2 – FCC 700 MHz Band plan showing original television channelization

3.2.1 Auction 44/49

Starting in 2002, the FCC auctioned the lower 700 MHz C and D blocks in FCC Auction 44 which raised $116M[1]. As a result of that auction, the C block was generally secured by Aloha Partners (later sold to AT&T[2]) while the D block went largely unsold except for a large regional license for the Pacific area covering the West Coast from Washington to California and some areas of Nevada. A year later, in Auction 49, the remaining unsold licenses were reauctioned. Importantly, the D block was acquired by Qualcomm for $38M and the D block now had an owner[3].

3.2.2 Auction 73

In 2008, the FCC conducted Auction 73 for the entire remainder of the 700 MHz band. This auction included the lower 700 MHz A and B blocks, the 700 MHz E Block, the upper 700 MHz C block, and the upper 700 MHz D block (for public safety).

[1] See https://www.fcc.gov/auction/44.
[2] "AT&T to pay $2.5 Billion for Wireless Spectrum", New York Times. October 2007
[3] See https://www.fcc.gov/auction/49.

Due to concerns over interference from TV broadcast in channel 51 (adjacent to the A block), demand for the A block was muted which resulted in a fragmented ownership structure with many smaller carriers purchasing the spectrum. The E block went largely to DISH (aka "Frontier Wireless") for $712M[4] and to Qualcomm for $555M.

3.2.3 The D block sale

After the auction, Qualcomm attempted to use their D and E block holdings for Media FLO ("Forward Link Only"), an early form of video to mobile handsets. However, in 2010, AT&T acquired Qualcomm's entire portfolio of D&E blocks for $1.925B[5]. In its press release, AT&T indicated it had purchased ~12MHz over 70M people and 6 MHz over ~230M people[6]. In its approval of the transaction, the FCC imposed some restrictions on D block operations to minimize impact to adjacent block holders as a condition of approval[7].

3.2.4 The Interoperability Order

Given the E block is a "downlink" or "tower to handset" frequency that operates at a high power, there was risk of interference to the directly adjacent A block. As a result the overall industry (and A block holders in particular) had difficulty launching and scaling operations in the band. As a byproduct of this issue, the industry standardized a fragmented set of band classes with one band class for only B&C blocks (Band 17, benefiting AT&T as the largest B&C holder) and another band class for all other holders (Band 12). This technical issue prevented economies of scale and interoperability benefits for the band. To resolve this issue, the industry created a proposed solution to which AT&T and DISH committed. Specifically, operations in the D&E blocks could occur with power limitations and all operations were limited to downlink only. This was enshrined in an FCC order promoting interoperability in the 700 MHz band[8].

3.3 Technical Characteristics & Uses

As a result of the 2013 interoperability order, the industry aligned on the 3GPP Band class 12 for the lower paired blocks (ABC) and 3GPP Band class 29 for the unpaired blocks (DE). Importantly, the order restricted power to a maximum of 1kW in urban areas and 2kW in rural areas (compared to 50kW typical); however, the FCC also indicated that operators could use higher power subject to operator-to-operator agreements. Given the E block's adjacency to the A block, the primary coordination is with the A block holder. Across most of the U.S. this is T-Mobile (an example is shown in Figure 11 for areas of New York, Los Angeles, Chicago, and Philadelphia from the Spektrum Metrics Spectrum Grid Tool).

[4] Note: Dish's acquisition translates to ~$0.55/ MHz-Pop based on auction values
[5] "AT&T Agrees to Acquire Wireless Spectrum from Qualcomm", Qualcomm press release. December 2010
[6] Rough math equates to a price of ~$0.87/ MHz-Pop
[7] See "FCC approves AT&T's $1.93B purchase of Qualcomm's 700 MHz spectrum", FierceWireless. December 2011.
[8] See FCC WT Docket No. 12-69, Report and Order adopted October 25, 2013

a			LTE Band Class		12	12	12	29	29	12	12	12	13	103	14	14
b			TDD			17	17				17	17				
c			FDD - Downlink													
d			FDD - Uplink													
i			Stop Frequency		704	710	716	722	728	734	740	746	757	758	763	768
j			Start Frequency		698	704	710	716	722	728	734	740	746	757	758	763
k				J	700AEAU	700BCMAU	700CCMAU	700DEAGD	700EEAD	700AEAD	700BCMAD	700CCMAD	700CREAGD	700AMEAD	700NATD	700PSN
l			Down/Up/link/TDD		U	U	U	D	D	D	D	D	D	D	D	D
m			Frequency Band		700	700	700	700	700	700	700	700	700	700	700	700
n			County	ck	A Block	B Block	C Block	D Block	E Block	A Block	B Block	C Block	Upper C	Upper A	PSBB	PSB
o			Bandwidth		6	6	6	6	6	6	6	6	11	1	5	5
FipsCode	CMA	State	County	U	_700AEAU	_700BCMAU	_700CCMAU	_700DEAGD	_700EEAD	_700AEAD	_700BCMAD	_700CCMAD	_700CREAGD	_700AMEAD	_700NATD	_700PSN
34003	1	NJ	Bergen County		TMO	ATT	ATT	ATT	ATT	TMO	ATT	ATT	VZW	BPC	ATT	ATT
34013	1	NJ	Essex County		TMO	ATT	ATT	ATT	ATT	TMO	ATT	ATT	VZW	BPC	ATT	ATT
34039	1	NJ	Union County		TMO	ATT	ATT	ATT	ATT	TMO	ATT	ATT	VZW	BPC	ATT	ATT
36061	1	NY	New York County		TMO	ATT	ATT	ATT	ATT	TMO	ATT	ATT	VZW	BPC	ATT	ATT
36087	1	NY	Rockland County		TMO	ATT	ATT	ATT	ATT	TMO	A		VZW	BPC	ATT	ATT
36119	1	NY	Westchester County		TMO	ATT	ATT	ATT	ATT	TMO	A		VZW	BPC	ATT	ATT
06059	2	CA	Orange County		TMO	ATT	ATT	ATT	ATT	TMO	A		VZW	HSR	ATT	ATT
06065	2	CA	Riverside County		TMO	ATT	ATT	ATT	ATT	TMO	A		VZW	HSR	ATT	ATT
06037	2	CA	Los Angeles County		TMO	ATT	ATT	ATT	ATT	TMO	A		VZW	HSR	ATT	ATT
06071	2	CA	San Bernardino County		TMO	ATT	ATT	ATT	ATT	TMO	A		VZW	HSR	ATT	ATT
17089	3	IL	Kane County		TMO	ATT	ATT	ATT	DSH	TMO	ATT	ATT	VZW	BPC	ATT	ATT
17097	3	IL	Lake County		TMO	ATT	ATT	ATT	DSH	TMO	ATT	ATT	VZW	BPC	ATT	ATT
17111	3	IL	McHenry County		TMO	ATT	ATT	ATT	DSH	TMO	ATT	ATT	VZW	BPC	ATT	ATT
17197	3	IL	Will County		TMO	ATT	ATT	ATT	DSH	TMO	ATT	ATT	VZW	BPC	ATT	ATT
17031	3	IL	Cook County		TMO	ATT	ATT	ATT	DSH	TMO	ATT	ATT	VZW	BPC	ATT	ATT
17043	3	IL	DuPage County		TMO	ATT	ATT	ATT	DSH	TMO	ATT	ATT	VZW	BPC	ATT	ATT
42017	4	PA	Bucks County		TMO	ATT	ATT	ATT	ATT	TMO	ATT	ATT	VZW	BPC	ATT	ATT
42029	4	PA	Chester County		TMO	ATT	ATT	ATT	ATT	TMO	ATT	ATT	VZW	BPC	ATT	ATT

TMO A block holder

Figure 3 – Spectrum grid example for the 700 MHz band

Historically the block has primarily been used for LTE operations – given its generally small size and the smaller channel needs of LTE, it has been a better fit for 4G LTE versus 5G which benefits from larger channel sizes. A key point to note is that given LTE standards, if an operator holds either the D or E block, the maximum channel size they can use in their network is 5 MHz (vs. the total 6 MHz available). If a company holds both blocks, as AT&T does, the maximum channel size benefit is 10 MHz, not 12 MHz.

Because the band is downlink only, it is normally paired with another band that can provide the uplink through carrier aggregation (e.g., Band 12, Band 71, or Band 5). Importantly, even if an operator has Band 12 devices in their network that have downlink operations directly adjacent to the D and E blocks, they still must use carrier aggregation because the D and E blocks are not supported in Band 12.

DISH has utilized the 5G band class, n29, within its network for its 5G operations. As context, this band class is available on many Android devices and in the iPhone 15. The FDD-LTE Band 29 is present in many prior iPhone models.

Given the 700 MHz E block is only 6 MHz in size, for any mobile operator its most immediate use is likely for incremental capacity needs. Other uses that would include two-way operations would require another channel to use as the uplink or would require technical rule changes from the FCC.

On a final point, as part of the FCC timeline extension there is a further nuance to the 700 E block. Specifically, if DISH fails to serve any area with 700 E, the license terminates automatically for the unserved areas AND DISH will be ineligible to regain it if the FCC makes the license available later.

3.4 Band Ownership

From Figure 12 below it is evident that AT&T can only utilize their 10MHz of supplemental downlink over a population of only 75M people across their 5 license areas vs. ~330M people across the U.S. Acquiring the DISH portion of this channel would increase the population served by a 10MHz channel to nearly the entire US population.

	700MHz							
	A	B	C	D	E	700_PS	700_UA	700_UC
% of Country	0.75%	90.3%	94.59%	99.98%	22.49%	100%	0%	0%
ATT Licensed POPs	2,507,731	302,947,412	317,335,189	335,419,100	75,456,777	335,502,585	0	0

Source: Spektrum Metrics

Figure 4 – AT&T Licensed Population coverage across the lower 700 MHz band

DISH's percentage of 700E holdings is shown in Figure 13.

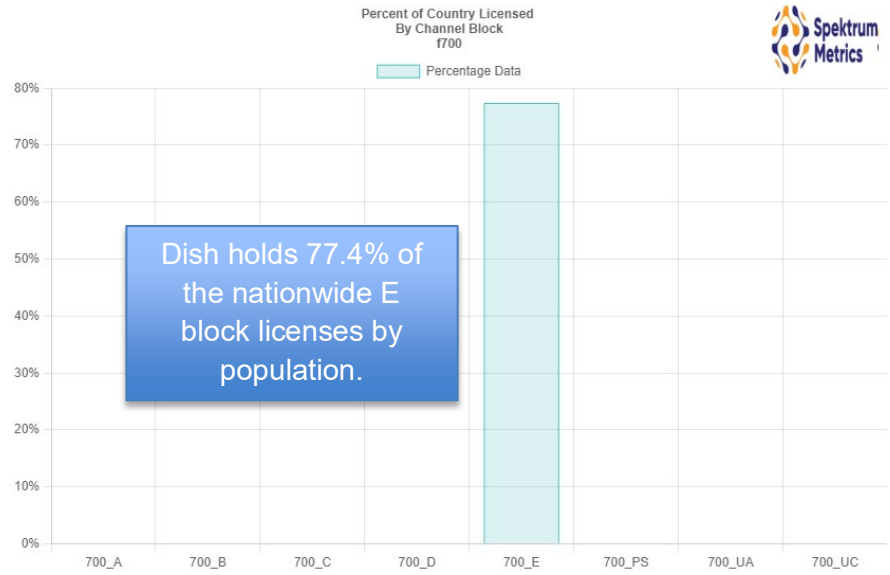


Figure 5 – DISH nationwide 700E licensed coverage

To better illustrate this fit, the following geographic views are instructive from the Spektrum Metrics web mapping tools. Figure 14 shows AT&T's nationwide D block coverage. As the map shows, AT&T owns every license across the country. Figure 15 and Figure 16 demonstrate the impact of combining AT&T and DISH's 700 E block holdings.

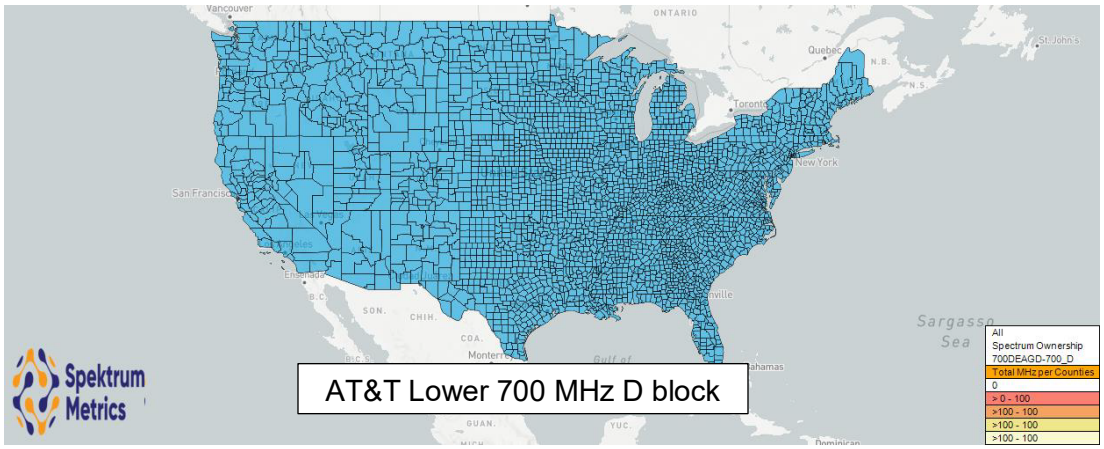


Figure 6 – Map of AT&T's nationwide Lower 700 MHz D Block holdings

The two primary holders in the E block are shown below to demonstrate the complementarity of the holdings. Essentially, AT&T holds large markets of Boston, New York, Philadelphia, Los Angeles, and San Francisco while DISH holds the rest of the country.

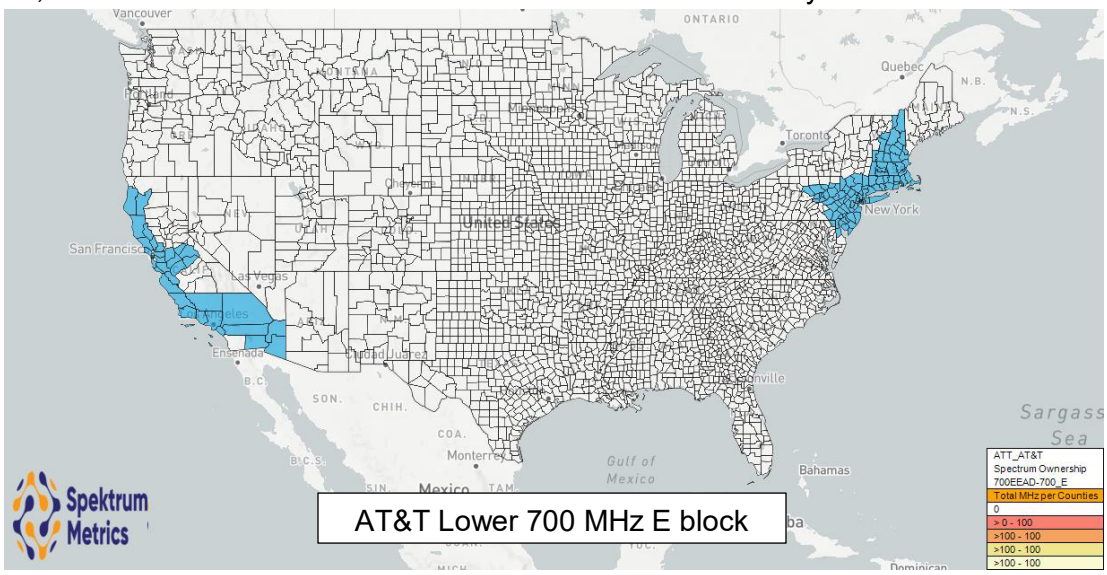


Figure 7 – Map of AT&T's nationwide Lower 700 MHz E Block holdings

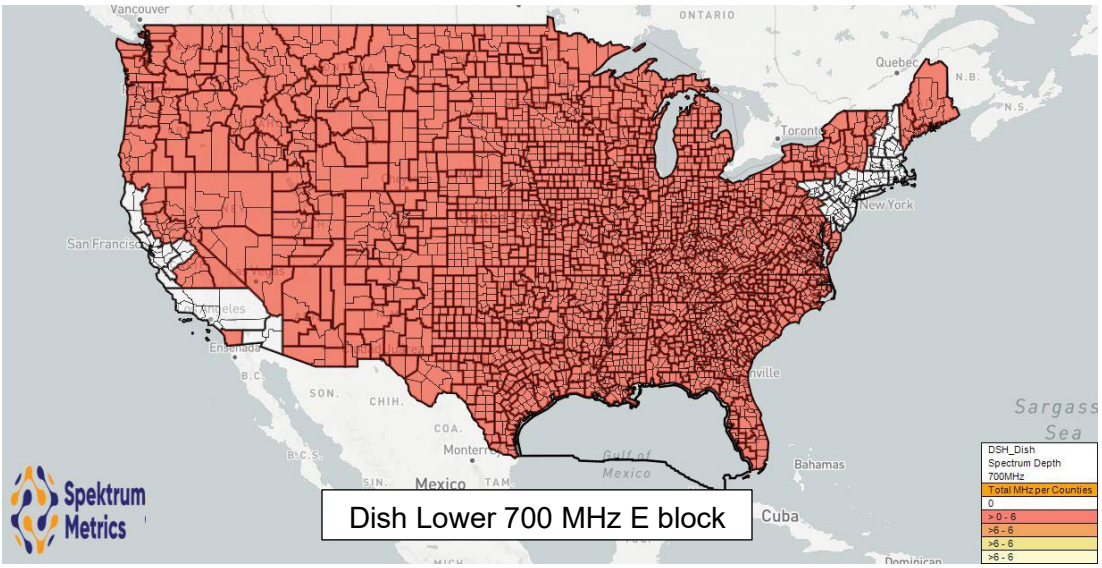


Figure 8 – Map of DISH's nationwide Lower 700 MHz E Block holdings

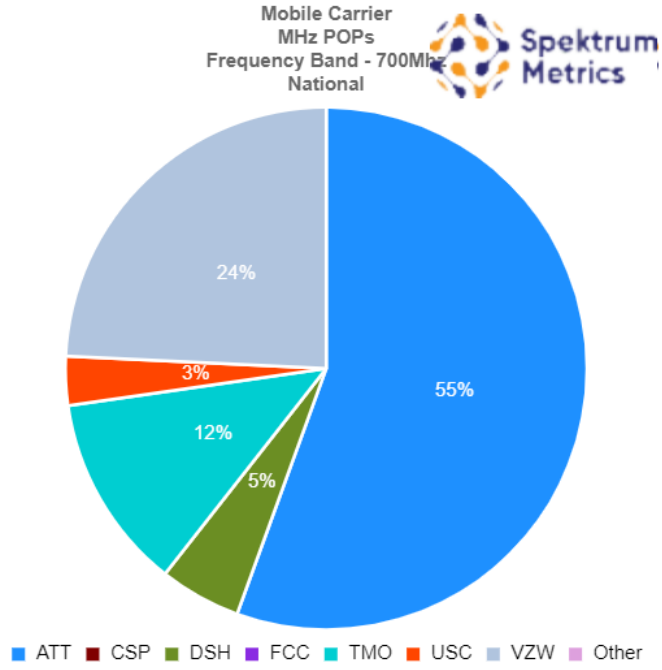


Figure 9 - MHz-Pop concentration among 700 MHz Holders

If DISH were to part with the E block to a mobile carrier, AT&T would be the only likely buyer based on holdings today; however, AT&T's appetite and the overall impact of E block on the AT&T network is likely limited and uncertain.

As noted in the

Figure 17 from the Spektrum Metrics National Band Ownership tool, AT&T is the largest holder of 700 MHz spectrum including their lower 700 MHz B,C, D, and E (in some locations) blocks as well as the FirstNet Upper 700 MHz D block. **The question is – do they need it?**

3.5 Value Considerations & Outlook

The points below are intended to aid in summarizing some key factors which could bolster or discount the value of any set of licenses, with summary thoughts to follow.

Value Drivers:

- **Maturity and Scale of Deployment:** Radio equipment and devices for use of Band 29/n29 already exist. Thus, activating this spectrum in the network could be accomplished with minimal efforts (i.e., no new radios or tower climbs in most instances).
- **Downlink Utility**: According to a recent Ericsson study for a North American carrier, nearly 92% of all mobile traffic was downlink implying a higher utility for downlink spectrum[9].
- **Band Scale:** Should an operator like AT&T acquire the E block, they would have a significant level of control on a nationwide basis over the entire lower 700 MHz band representing benefits of network scale and standardization in their network.
- **Low band:** Notwithstanding its capacity, the block is one of the lowest frequencies available suggesting better coverage and in-building penetration relative to higher frequency "mid-band".

Value Considerations:

- **Power limitations:** As covered previously, the band continues to have technical rules that can limit power output. Due to the "operator-to-operator" agreement requirements, utilizing the E block could require more coordination activities with existing 700MHz A block holders. However, given these rules are nearly ten years old, the authors expect most of those issues have likely been resolved.
- **Capacity:** The band represents only ~5 MHz of capacity benefit and is limited to areas not already owned. Thus, the actual capacity or performance lift could be minimal.
- **5G suitability:** The band's small size with downlink only usages as a FDD block potentially limits its utility in a 5G context where TDD channels of a larger size are often more attractive.
- **Precedent transactions/ Pricing impacts:** Since the band was acquired nearly ten years ago, the most obvious comparable transaction is the AT&T/ Qualcomm D & E block acquisition that saw a price of ~$0.87/ MHz-Pop. However, since 2010, there have been multiple auctions for more critical, higher utility spectrum for 5G operations that have a much lower average price placing this comparable transaction value in question.
- **Limited Buyers:** With only 1 logical buyer, the band does not benefit from competitive demand potentially lowering overall value.

[9] Ericsson Mobility Report, November 2023, pp.14

What's possible?

Given the band has only one logical owner at this stage, the question is if and when AT&T would want to acquire it. Since DISH would lose rights to the block and the ability to reacquire it, AT&T could wait for the process to unfold. Alternatively, should DISH largely meet their build in this band, it could be used as a bargaining tool with AT&T for other transactions. Regardless, given the small size of the frequency and limited impact, any activity on this band is unlikely under current scenarios.

9 About the Authors

In our research and analysis papers, Sunstone Associates and Spektrum Metrics combine their collective wireless carrier experience with analysis outputs from the leading spectrum ownership analysis tool.

Terry Chevalier is the Managing Director of Sunstone Associates. Prior to founding Sunstone Associates, Terry was heavily involved in spectrum strategy efforts for AT&T including leading the analytics and strategy team for multiple spectrum auctions. This experience includes establishing bid teams, assessment tools, objectives, priorities, valuation, mock auctions, bidding & reporting tools, impairments or coordination requirements, and auction execution, representing ~$20B in spectrum acquisition. He also led business strategy efforts for multiple spectrum bands, supported advocacy efforts, and has presented spectrum matters to a variety of audiences.

Brian Goemmer is the President of Spektrum Metrics, formally Allnet Insights & Analytics. Prior to Spektrum Metrics, Brian held multiple executive engineering and operations positions at Western Wireless and Clearwire and led spectrum management efforts at both companies. Spektrum Metrics' Spectrum Ownership and Analysis Tools detail current and future spectrum ownership in the United States, Canada, and Mexico through a collection of 23 analysis modules.