NewStreet Research

Introducing SpectrumHub

NSR Global Spectrum Database

February 2024

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Introducing SpectrumHub

Unique insight into the global spectrum market

8 February 2024

Wireless spectrum is one of the most valuable commodities in the telecoms market. But who owns it all and how much is it worth?

Today, we launch SpectrumHub, the beta version of our Global Spectrum Database. We believe this new product offers differentiated and unique information on the global spectrum market to help clients have an up-to-date detailed picture of global spectrum market.

Spectrum positioning and value is a critical piece of any telecoms analysis: For anyone trying to properly analyse the telecoms sector, ascertaining the right spectrum position is critical – not just for potential competitive differentiation (for example in the US, the standard deviation of spectrum holdings is one of the highest globally); but also, for looking at licence renewals outside the US. For credit investors, the timing of licence renewals (€34bn potentially to come in the main 5 EU markets in the next decade) can have a critical balance sheet impact, and for equity investors, the NPV of spectrum renewals can be up to 1x EBITDA – which needs to be considered in asset valuations. And then in special situations like DISH, understanding the details of their spectrum holdings and potential valuations are essential.

We aim to pull all of this together in **SpectrumHub** and we hope users find it as helpful as we have already during our own internal trial use.

Launching SpectrumHub – Beta Version 1.0

NewStreet Research

1

New Product

We are delighted to launch **SpectrumHub**, our **Global Spectrum Database** in a **beta version** today.

We believe this new product provides a genuinely unique insight into the state of play of the global wireless spectrum market.

2

Free Trial Period

SpectrumHub, which sits outside our regular telecoms subscription, will be available to all our clients for free during a several-month **trial period** and after that it will be put behind a **separate paywall**.

We also aim to add other valuable data sets behind this paywall soon.

3

Access

SpectrumHub consists of a Tableau interactive dashboard and is **accessible over our website**.

For clients interested in accessing the full database directly, **please contact Jose Anguis** and clients will be given a separate log-in for the platform

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4

Feedback & Version 2.0

During the beta phase, we would love to hear from users of the platform on feedback on product and future areas of improvement in advance of a rollout of Version 2.0.

At the back of this presentation, we run through some of the key features a short tutorial – albeit we hope users to find it relatively easy to navigate.

5

Launch Webinar

We will be running a separate webinar to highlight both the findings of this report and to run through how to use the database in detail.

When:
Wednesday 14th February, 3pm UK time, 10am EST

To register for this webinar, please click HERE.

Source: New Street Research analysis

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1) How spectrum drives differentiation

Spectrum costs are one of the largest costs the industry faces

The allocation of spectrum across the world has led to some of the biggest spending decisions by telecoms companies and in most markets outside the US. Spectrum has been allocated on a leasehold basis, i.e., a licence period with a finite duration, which means that spectrum renewal will be an ongoing cost for the industry (and one we think people often ignore until it is too late). In the US though, all spectrum has been issued on a freehold basis, with high upfront costs involved, but less future spectrum cost risk (even though there can be secondary trading in the spectrum).

Some Context

- **Value embedded in US spectrum is close to $400bn**: The market price paid for US spectrum by the mobile carriers is $385bn (at an average of $0.95/MHz.pop), representing 78% of the market value of T-Mobile, Verizon, AT&T and DISH. This also compares against aggregate wireless industry capex running at c.$35bn/ annum

- **Cost to renew EU spectrum remains high**: In Europe, the aggregate cost of current licences is much lower at just $0.18/MHz.pop, or €53bn among the Big 5 markets – which at 324m pops, is like the US market size of 330m pops) , the catch for the European carriers is that these spectrum licences tend to be 15-20 year duration so the constant overhang of renewals lurk. **We estimate that €34bn of spectrum renewals could come due in the next decade in the big 5 European markets alone**.

- **Comparative US vs. Europe Spectrum Valuations:** Even adjusting these licences to the equivalent price for a freehold licence (i.e., a US price), the equivalent cost would still be $0.28/ MHz.pop, 30% of US price levels, showing that spectrum prices in Europe have been lower, in part also reflecting the lower ARPU. However, the NPV of the future renewal fees would equate to a significant 0.8-1.3x sector EBITDA, so need to be considered when thinking about asset valuations.

Source: New Street Research analysis

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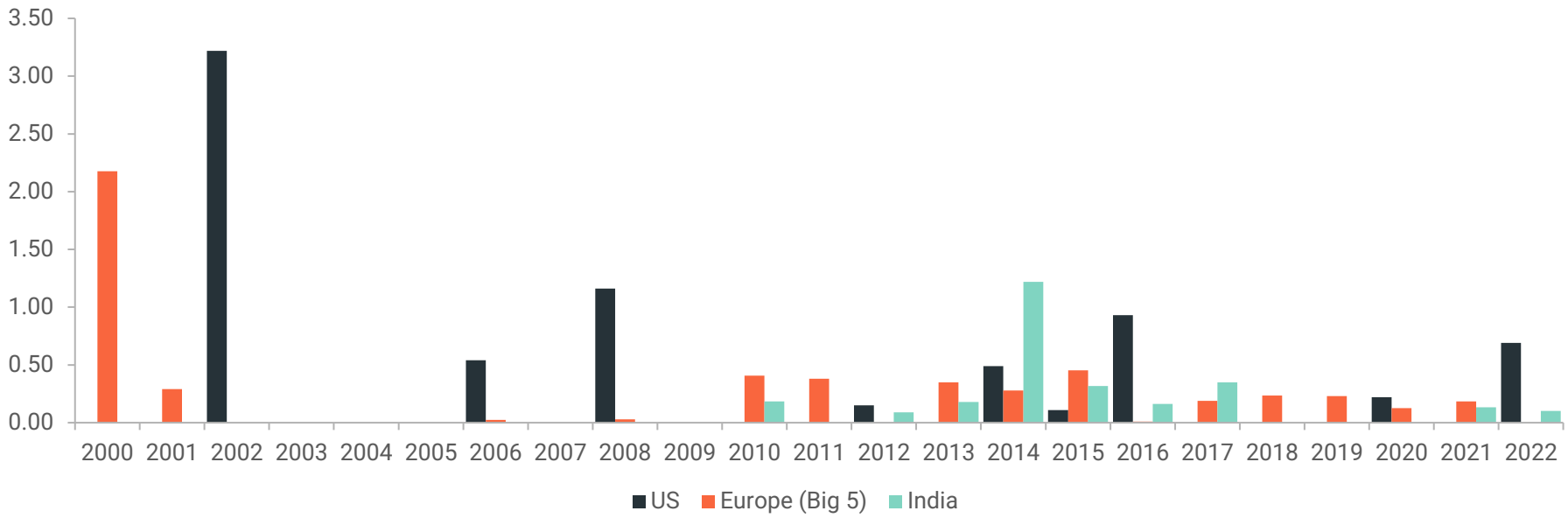
Spectrum auctions have come thick and fast over the past 15 years

Spectrum auctions have been a regular occurrence over the past 15 years to meet ever rising cellular demand as Governments have cleared bands using legacy technologies to allow them to switch to cellular. Ongoing improvements in spectral efficiency have opened new higher frequency bands with greater bandwidth to offer even more capacity. This arms race has had a huge impact on both the balance sheets of the telecom companies and their commercial differentiation, particularly in the US and India. Therefore, assessing how spectrum is both distributed and what future costs might be incurred is of critical importance.

Global spectrum auction prices paid since 2000

Price paid per MHz.pop in USD



Source: New Street Research analysis

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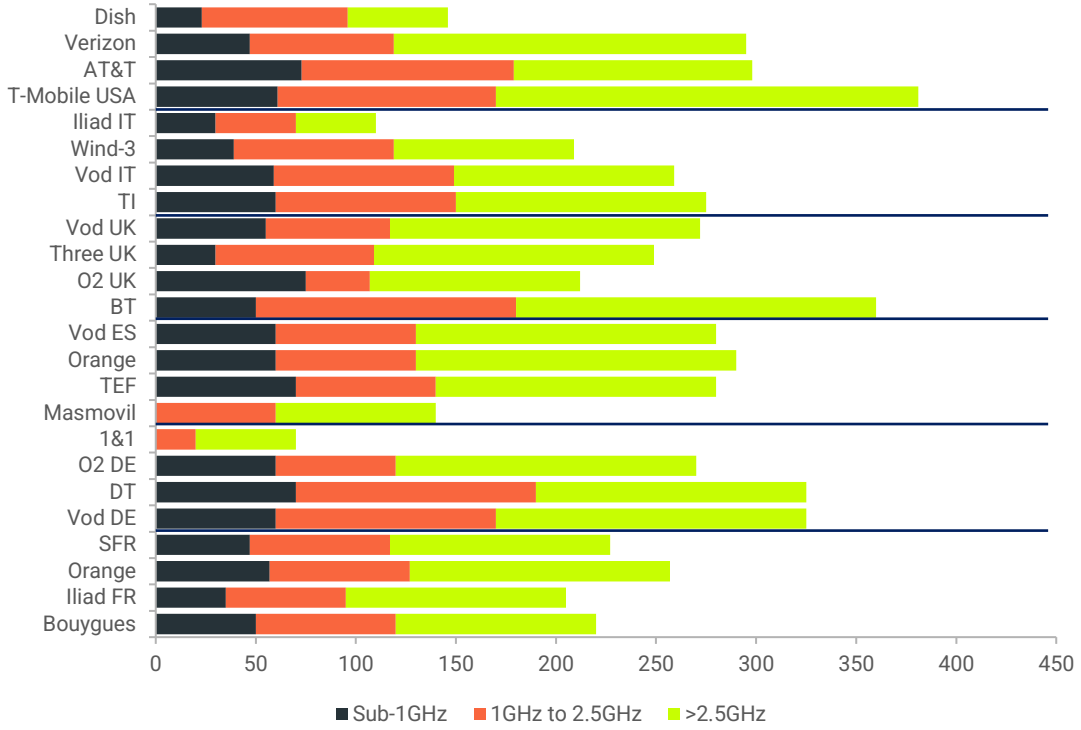
US spectrum is freehold, so existing distribution is critical for success

In the US market, spectrum distribution is notably uneven among major players, leading to higher prices compared to other markets, alongside factors like freehold nature and higher ARPUs. Prior to the C-Band auction, there was a remarkably high standard deviation in spectrum holdings, likely contributing to the subsequent high auction prices as AT&T and Verizon sought to rebalance. Despite the C-Band auction, the standard deviation remains high, potentially benefiting T-Mobile in the long term. Additionally, the UK market stands out with BT holding significant spectrum advantage, positioning them for successful competition in the medium term

Europe vs. US Spread of Spectrum Holdings: US Far Higher than Europe

Standard deviation in holdings (MHz)	Sub-1GHz	1GHz-2.5GHz	>2.5GHz	Total
France	9	5	13	27
Germany	6	32	10	48
Spain	6	0	10	16
UK	18	41	31	91
Italy	12	6	18	35
US (now)	13	21	46	80
US (pre-C Band auction)	13	21	91	**124**

Distribution of Existing Spectrum between Major Carriers



Source: New Street Research analysis

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In Europe, spectrum renewals are the bigger issue – could be €53bn over the next round

In Europe, where the spectrum distribution between carriers is more evenly distributed, it is the issue of renewals that is of critical importance given that spectrum is sold on a leasehold usually over a 15-20 year horizon. To put this in context, our new spectrum database shows that for the Big 5 markets in Europe, and based on most recent market rates, the future costs to renew the carriers' owned spectrum will be €53bn, which is equivalent to **1.8x mobile EBITDA, and 0.8x total sector EBITDA.**

In our New Street target prices, we fully include the perpetual renewal of all these spectrum obligations as liabilities alongside net debt.

Cost to Renew: Spectrum renewals will continue to be a huge deal for operators in Europe

€ bn	Cost to renew existing spectrum portfolio	Mobile EBITDA	Sector EBITDA	Cost as multiple of Mobile EBITDA	Cost as multiple of Sector EBITDA
France	11.8	6.9	14.8	1.7x	0.8x
Germany	17.0	7.6	19.0	2.2x	0.9x
Spain	13.5	4.0	7.7	3.3x	1.7x
UK	5.0	4.3	7.7	1.2x	0.6x
Italy	6.1	6.3	16.7	1.0x	0.4x
Total	**53.4**	**29.0**	**65.9**	**1.8x**	**0.8x**

Source: New Street Research analysis

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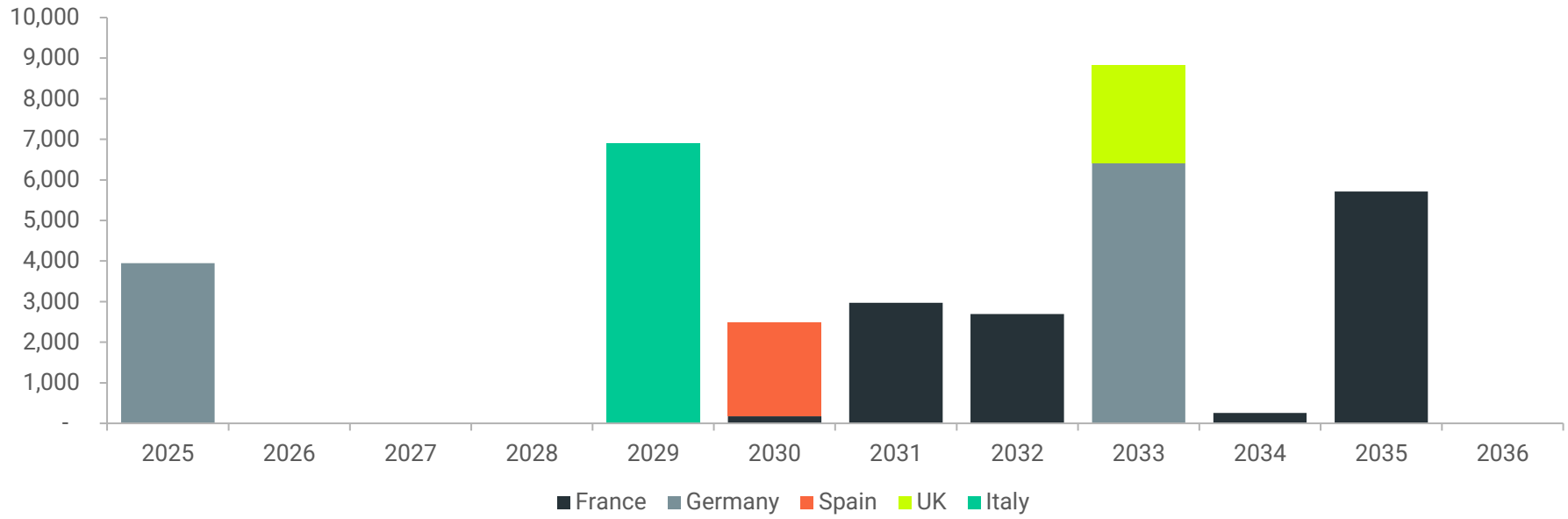
Even if they might not be imminent, don’t forget about them

Since the pre-Covid 3.5GHz auctions, the European carriers have been in a relative “spectrum lull” over the past few years. However, investors should remain vigilant to some major spectrum renewals as we approach the end of the decade. Using SpectrumHub, we show the future renewal schedule based on a repeat of historic auction prices. The renewal dates for all the spectrum licences in these major markets are shown in our database. €34bn out of €53bn in renewals are coming over the next decade and should be considered in potential balance sheet scenarios. We await the outcome of the 2025 German auction (potentially delayed) and the next major renewal in Italy in 2029

Likely Renewal Spectrum Cycle for the Major 5 European Markets

€M expected auction spend



Source: New Street Research analysis

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Assessing future spectrum renewal costs: risk to the downside on expected costs

In our models, we assume that the spectrum renews at the historic cost, but we think that given the evolving regulatory environment in Europe, the risk on renewal cost is likely to be to the downside for several key reasons

Factors Contributing to Decreased Expected Costs

1. **Slight gradual decline in pricing:** Although hard to draw a precise trend, as we show in the slides on the following pages, the average cost per MHz.pop in Europe has gradually been slightly declining at time has gone on. This has arguably been driving by declining ROCE in the sector implying operators can't afford to pay as much, and more spectrum licences include capex obligations which means some of the "licence cost" is now transferred into capex obligations.

2. **Auction structures less onerous:** Some past spectrum auctions have been influenced by regulators trying to use spectrum auctions to create artificial scarcity or have specifically reserved spectrum for new entrants. Although this can't be ruled out in future, for the time being, we think this is less likely.

3. **Potential shift to annual licence fees:** As we have seen in the UK, it is also possible that upfront auctions could be changed into annual licence fees to help smooth the cost.

4. **Delayed renewal:** The other option that regulators are considering to be more lenient on the sector is the idea of a temporary postponement in the auction (in return for an annual fee over the intervening period) as is currently being discussed in the German 2025 auction. This is also an option being proposed by the Spanish Government to extend all existing licences to 40-year terms, which would push out the renewals we show here for Spain by 15 years into the 2040s. We also saw in Spain that the 2100MHz renewal in 2021 was pushed out by 10 years at no incremental charge.

Source: New Street Research analysis

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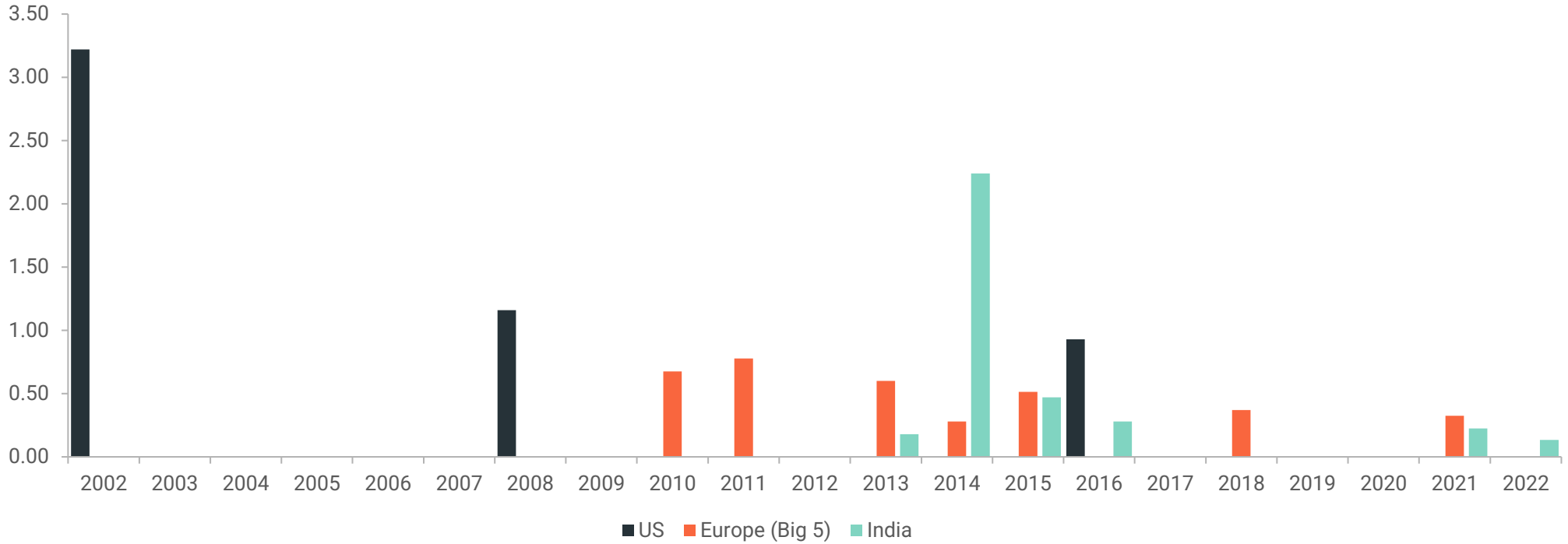
Spectrum auction prices for sub-1GHz spectrum

Spectrum Auction Prices for Low Band Spectrum

Price paid per MHz.pop ($)



Source: New Street Research analysis

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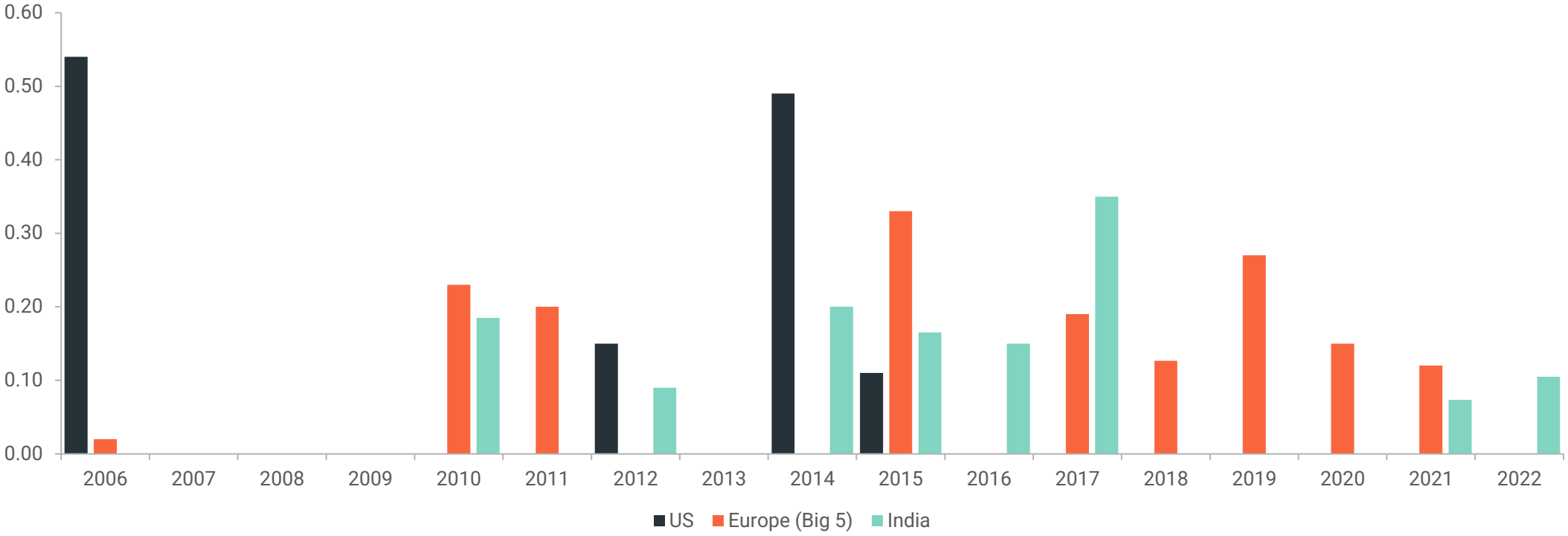
Spectrum auction prices for 1GHz – 2.5GHz spectrum

Spectrum Auction Prices for Mid Band - Lower Spectrum

Price paid per MHz.pop ($)



Source: New Street Research analysis

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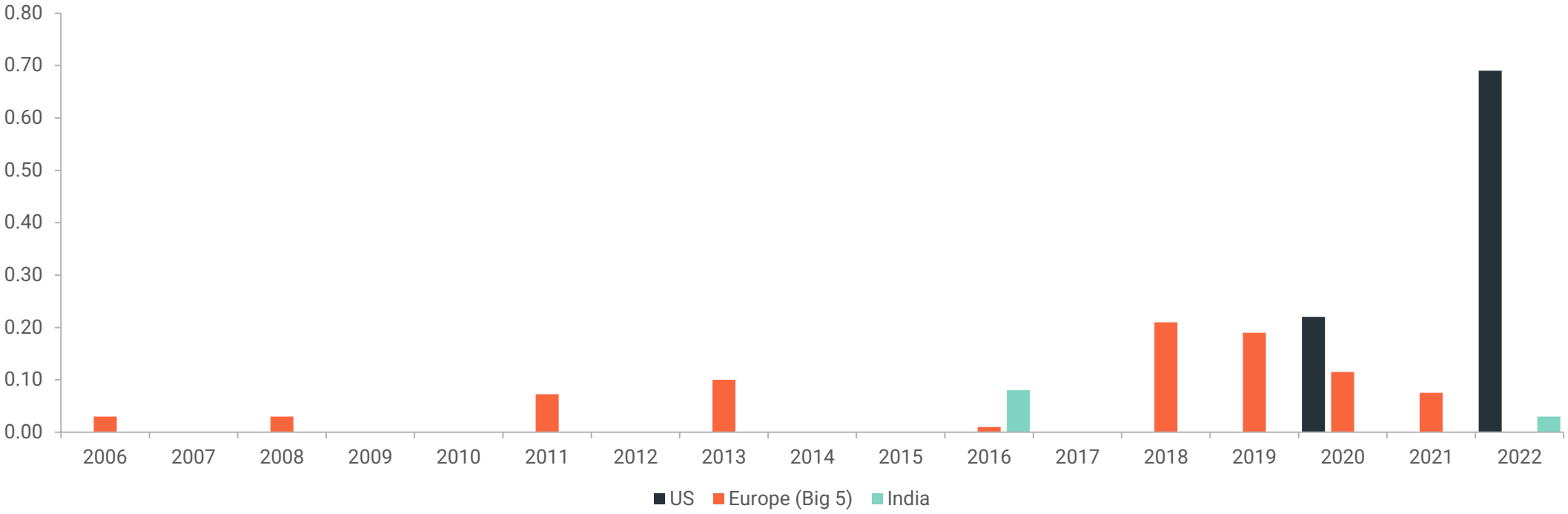
Spectrum auction prices for 2.6GHz - 4.0GHz spectrum

Spectrum Auction Prices for Mid Band - Upper Spectrum

Price paid per MHz.pop ($)



Source: New Street Research analysis

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Are there other spectrum bands to come? Upper-6GHz?

Our spectrum database currently covers all the auctioned bands, but ever improving spectral efficiency techniques suggest that new spectrum bands may soon be up for auction. Specifically, we believe that the upper-6GHz spectrum band (6.4-7.1GHz) could be the next licenced spectrum to be auctioned. In the US, this risk is very low as the FCC has designated this band as a WiFi (along with other markets like Canada, Brazil and South Korea). However, in Europe, the recent WRC-23 suggested that the major usage for this band should be for cellular operators. We believe it could be made available for auction towards the end of this decade.

Potential Auction Cost if Upper-6GHz in Europe is Fully Auctioned

Potential cost if upper-6GHz in Europe is fully auctioned

Metric	Value
Pops in Big 5 EU markets (m)	324
EU price for 3.5GHz (€ per MHz.pop)	0.16
Bandwidth of 3.5GHz band (MHz)	400
Bandwidth of 6.4-7.1GHz band (MHz)	700
Discount for upper-6GHz vs. 3.5GHz	-75%
Potential price per MHz.pop (€)	0.04
Auction cost (€bn)	**9.3**

Implications

- **For the carriers, this is obviously a mixed blessing:**
  - **No-one likes the risk of a potential new spectrum auction** for an untested band and in some markets like Italy and the US, we saw extremely high prices being paid for the 3.5GHz C-Band spectrum.
  - **However, the extra 700MHz of bandwidth** (with potential propagation of c.500-800m?) **could unleash significant extra capacity**, saving future densification capex and keeping it out of the hands of potential unlicenced competitors.
- **Extra potential cost of €9bn:** Based on an assumed cost of €0.04/MHz.pop, we estimate that in the Big-5 EU markets, this extra cost across the whole industry could be c.€9bn towards the end of the decade. However, this is notoriously difficult to forecast, and not all the spectrum will necessarily be made available for cellular licences.

Source: New Street Research analysis

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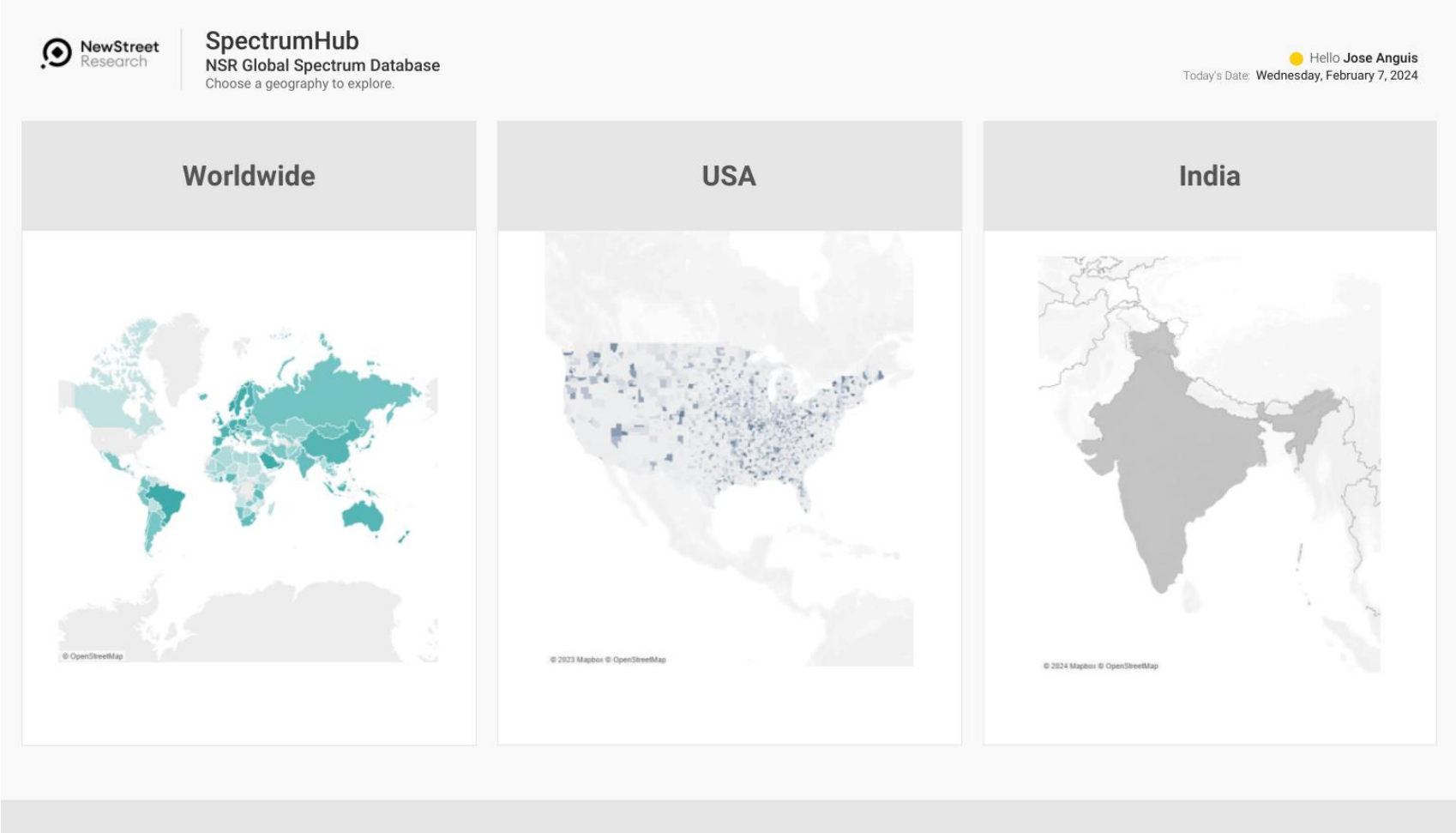
2) Introducing SpectrumHub

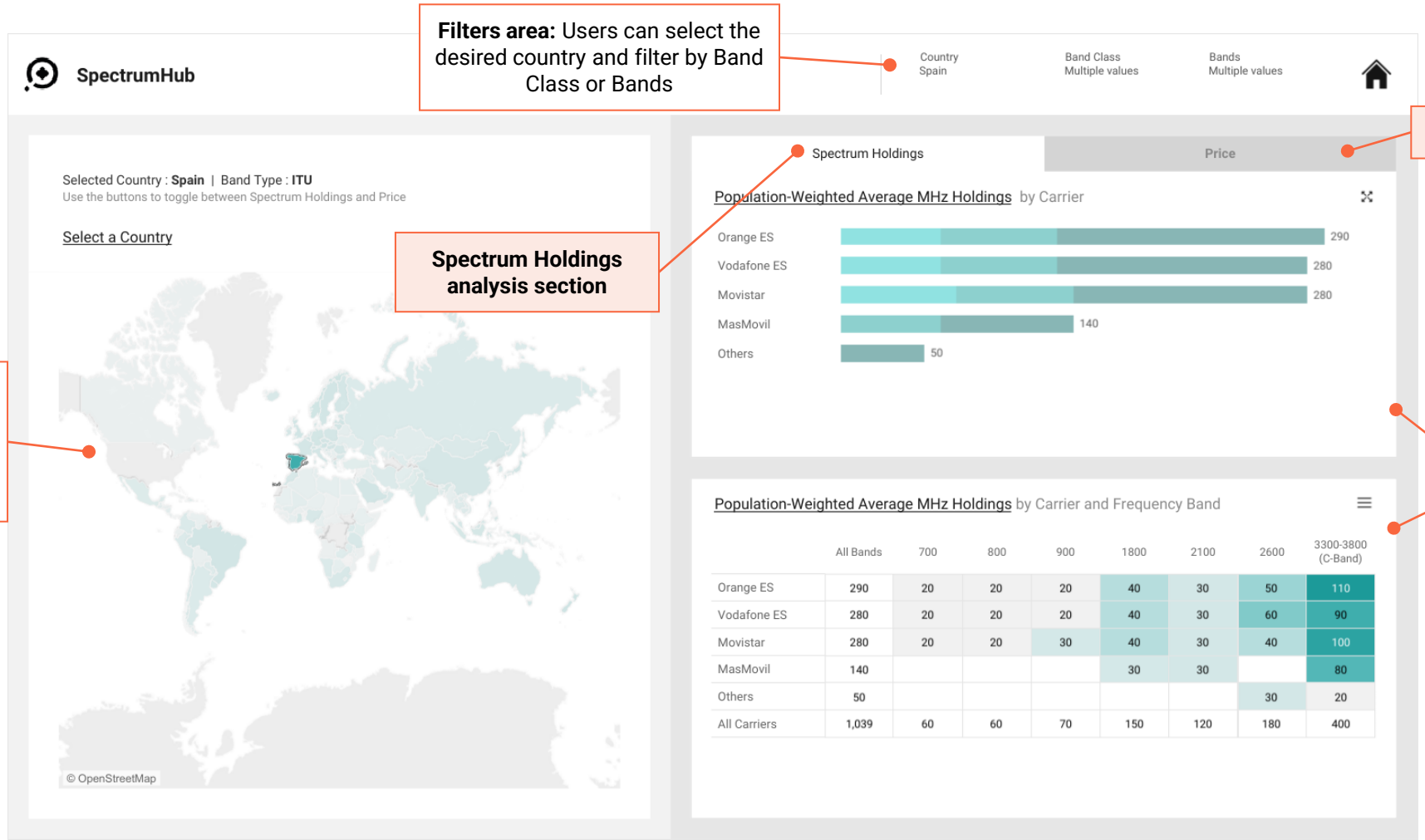
Three starting options: US, India and then everywhere else

SpectrumHub is structured in 3 big dashboards: US, India and Worlwide. Given the importance of spectrum costs and the regional variations, we have split out the US and India as two critical markets where readers can do a much more detailed deep-dive. For the rest of the world, users can then access all other countries separately and all the data from the first section of this note was drawn directly from **SpectrumHub**.



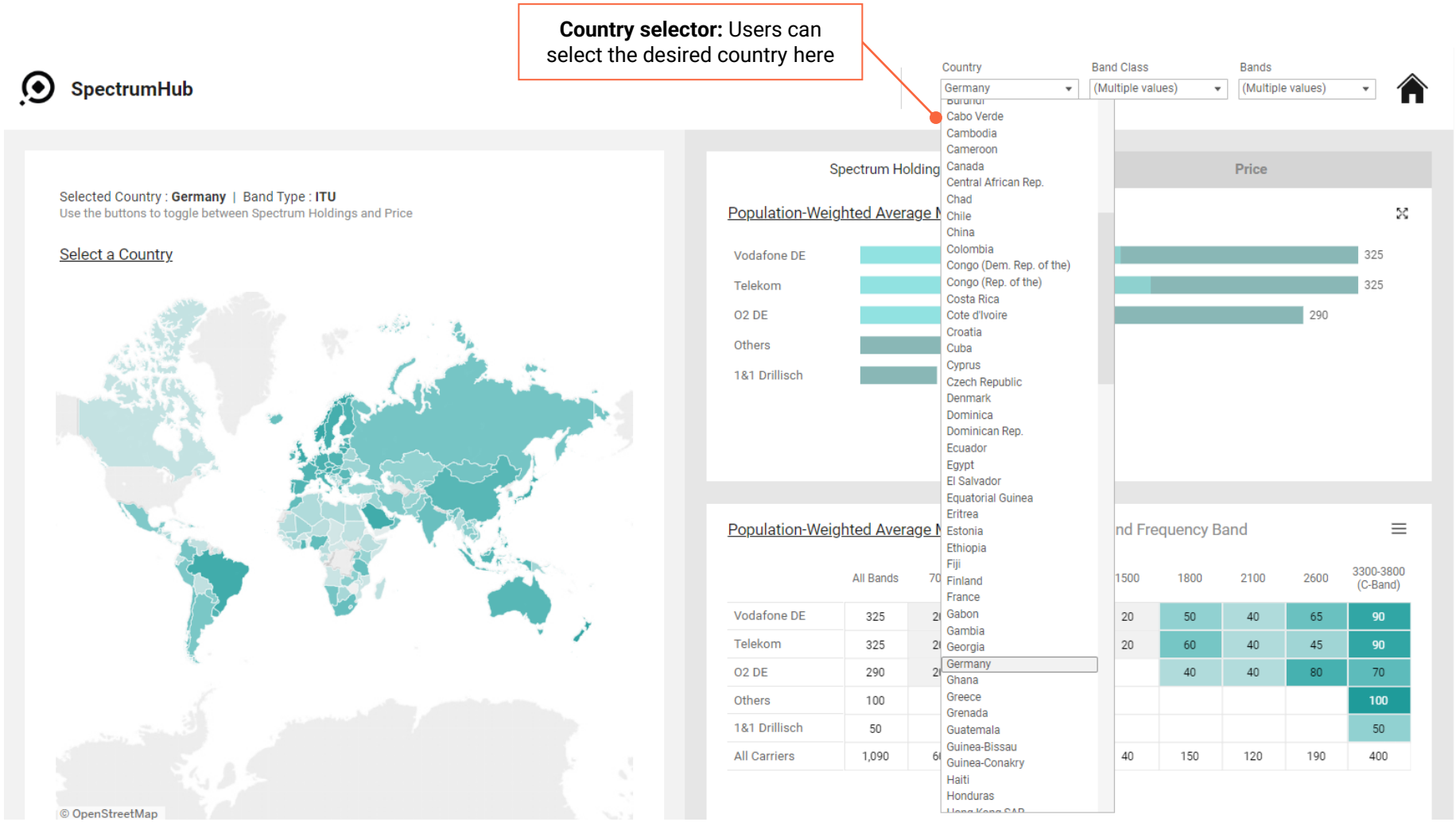
Each of the three dashboards follows the same structure, with 2 clear differentiated sections

Each of the three dashboards has the same structure, consisting of two tabs containing the two main analyses included for now: 1) Spectrum Holdings tab, which provides detailed MHz breakdowns by band and carrier for each country; and 2) Price tab, which offers $ per MHz population analysis by band and carrier for each of the countries, and pricing comparisons among different countries



Complete global spectrum ownership mapped out

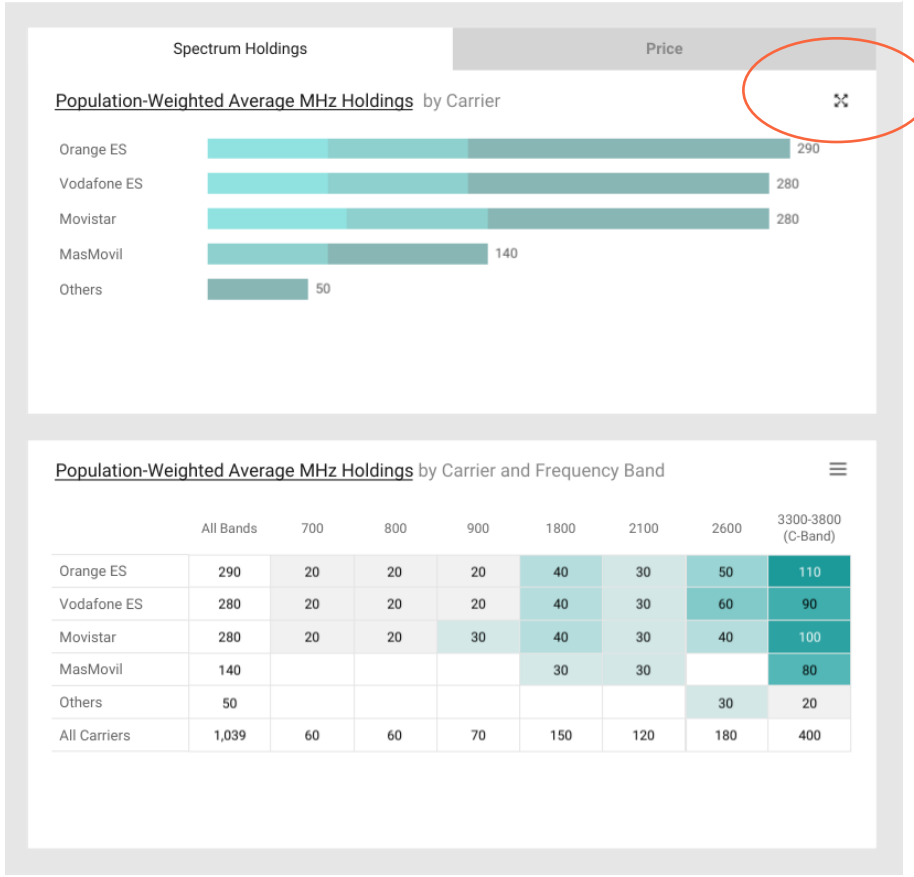
Clicking through to the Worldwide option, then offers a dropdown menu to allow users to pick out practically **any market globally** and to see who owns what spectrum and at which frequencies.



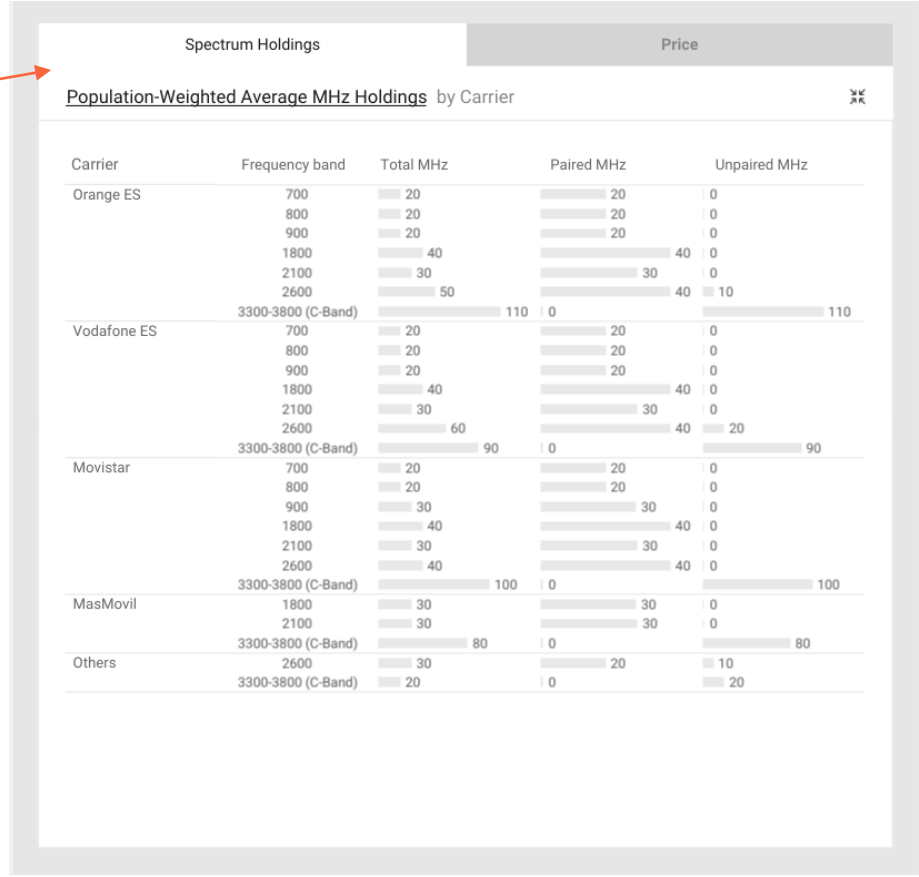
Spectrum holdings by carrier and band, and further subdivision of spectrum available

The top chart shows the total spectrum holdings by carrier. Users can access additional details by toggling the switch next to the chart, revealing a table that breaks down the spectrum holdings by paired (FDD) and unpaired (TDD) MHz for each band.

This breakdown is crucial for understanding carriers' spectrum ownership across various frequencies.



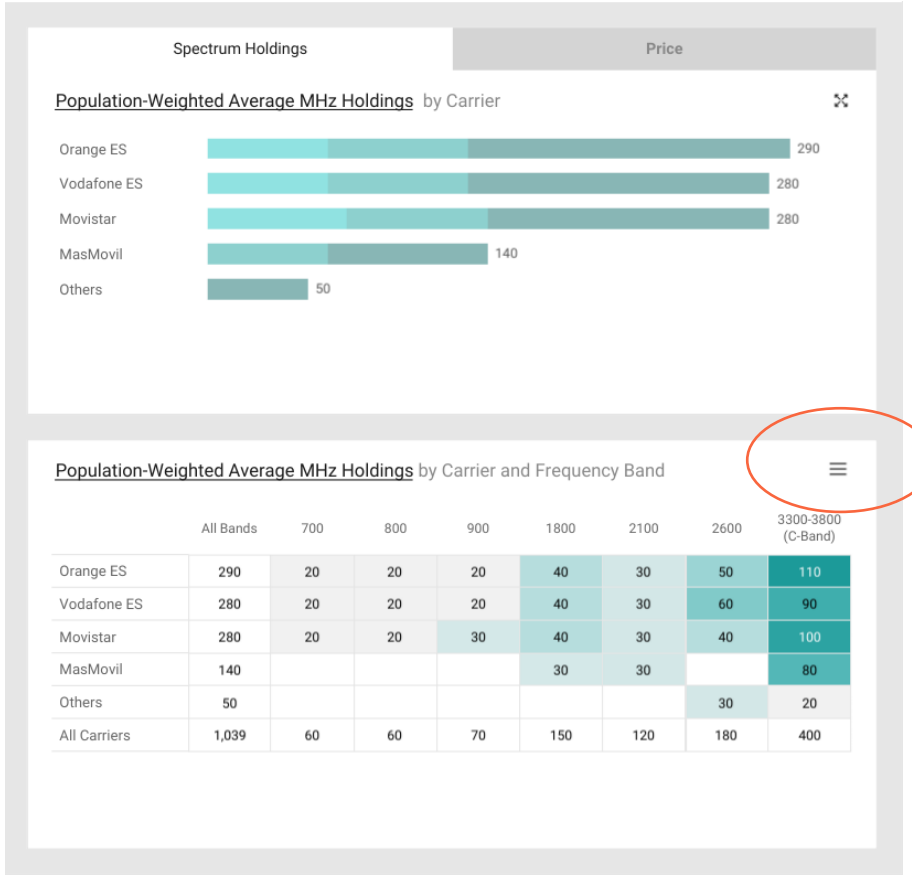
	All Bands	700	800	900	1800	2100	2600	3300-3800 (C-Band)
Orange ES	290	20	20	20	40	30	50	110
Vodafone ES	280	20	20	20	40	30	60	90
Movistar	280	20	20	30	40	30	40	100
MasMovil	140				30	30		80
Others	50						30	20
All Carriers	1,039	60	60	70	150	120	180	400



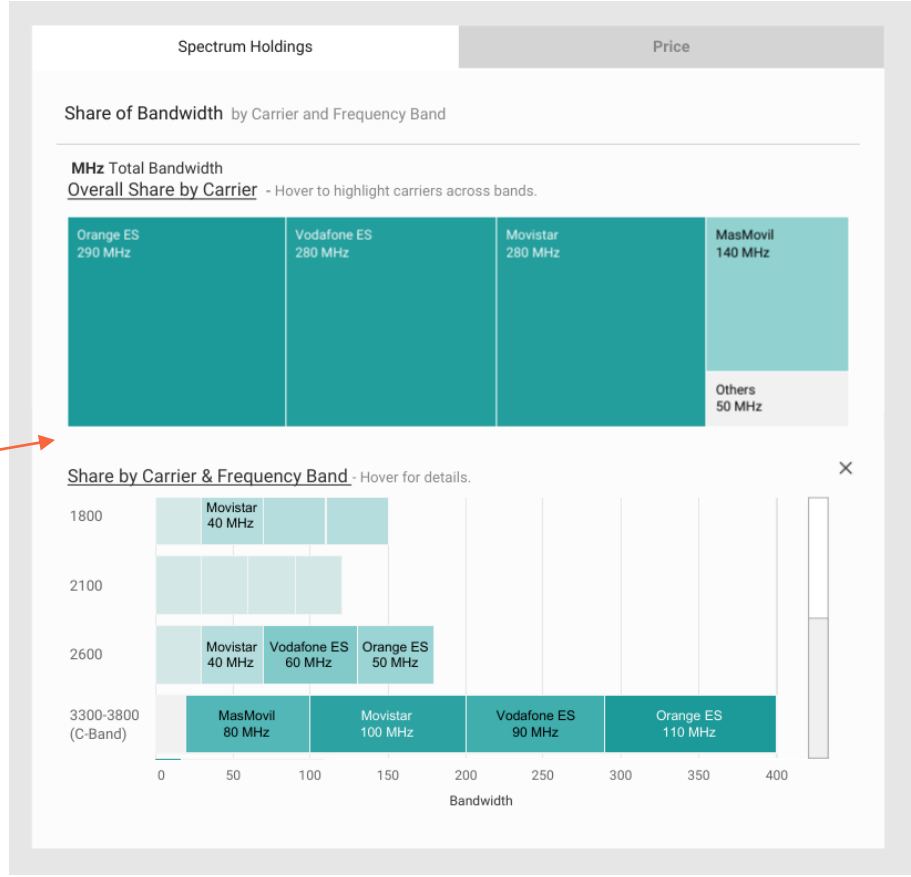
Carrier	Frequency band	Total MHz	Paired MHz	Unpaired MHz
Orange ES	700	20	20	0
	800	20	20	0
	900	20	20	0
	1800	40	40	0
	2100	30	30	0
	2600	50	40	10
	3300-3800 (C-Band)	110	0	110
Vodafone ES	700	20	20	0
	800	20	20	0
	900	20	20	0
	1800	40	40	0
	2100	30	30	0
	2600	60	40	20
	3300-3800 (C-Band)	90	0	90
Movistar	700	20	20	0
	800	20	20	0
	900	30	30	0
	1800	40	40	0
	2100	30	30	0
	2600	40	40	0
	3300-3800 (C-Band)	100	0	100
MasMovil	1800	30	30	0
	2100	30	30	0
	3300-3800 (C-Band)	80	0	80
Others	2600	30	20	10
	3300-3800 (C-Band)	20	0	20

Graphical display of spectrum holdings also available

The bottom table displays the aggregate spectrum holdings of each carrier across different frequency bands. Users can visualize the same data graphically using the switch located above the table.



	All Bands	700	800	900	1800	2100	2600	3300-3800 (C-Band)
Orange ES	290	20	20	20	40	30	50	110
Vodafone ES	280	20	20	20	40	30	60	90
Movistar	280	20	20	30	40	30	40	100
MasMovil	140				30	30		80
Others	50						30	20
All Carriers	1,039	60	60	70	150	120	180	400



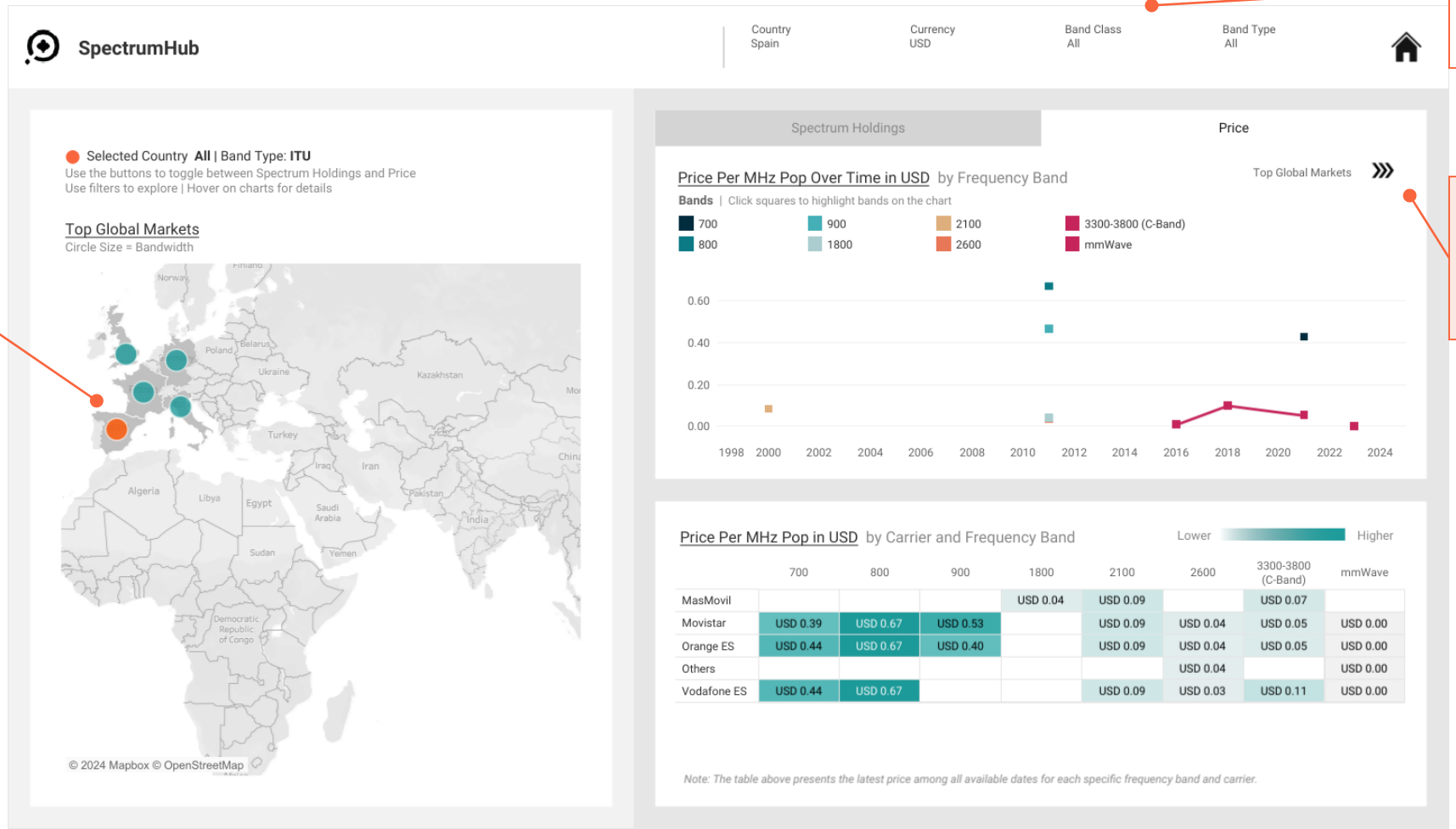
SpectrumHub includes a price analysis section: a critical feature for financial investors

The price section delivers a detailed price analysis, encompassing historical pricing data (top chart) and most recent pricing data (bottom table) for each band and carrier. While currently available for seven countries (Germany, Italy, Spain, France, UK, US and India), we are committed to expanding this feature to other countries in upcoming product versions.

One can select the country, choose between local currency or USD and filter by bands with these drop-down menus

The map highlights the current countries with price analysis available. US and India pricing analysis can be found in their corresponding sections

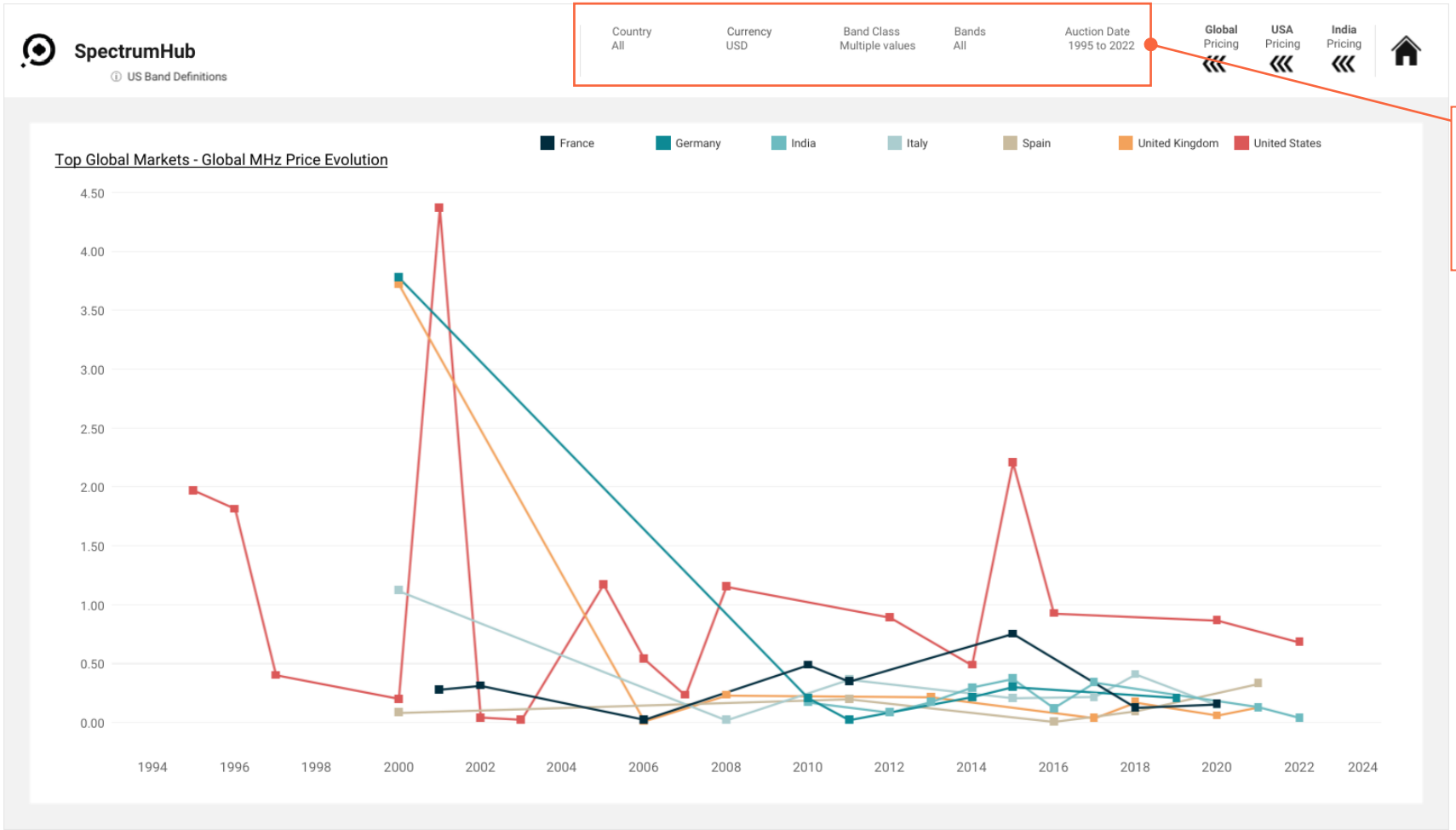
Pressing "Top Global Markets" toggle, we open the cross-market pricing comparisons (see next slide)



	700	800	900	1800	2100	2600	3300-3800 (C-Band)	mmWave
MasMovil				USD 0.04	USD 0.09		USD 0.07	
Movistar	USD 0.39	USD 0.67	USD 0.53		USD 0.09	USD 0.04	USD 0.05	USD 0.00
Orange ES	USD 0.44	USD 0.67	USD 0.40		USD 0.09	USD 0.04	USD 0.05	USD 0.00
Others						USD 0.04		USD 0.00
Vodafone ES	USD 0.44	USD 0.67			USD 0.09	USD 0.03	USD 0.11	USD 0.00

Price analysis can be done across different countries

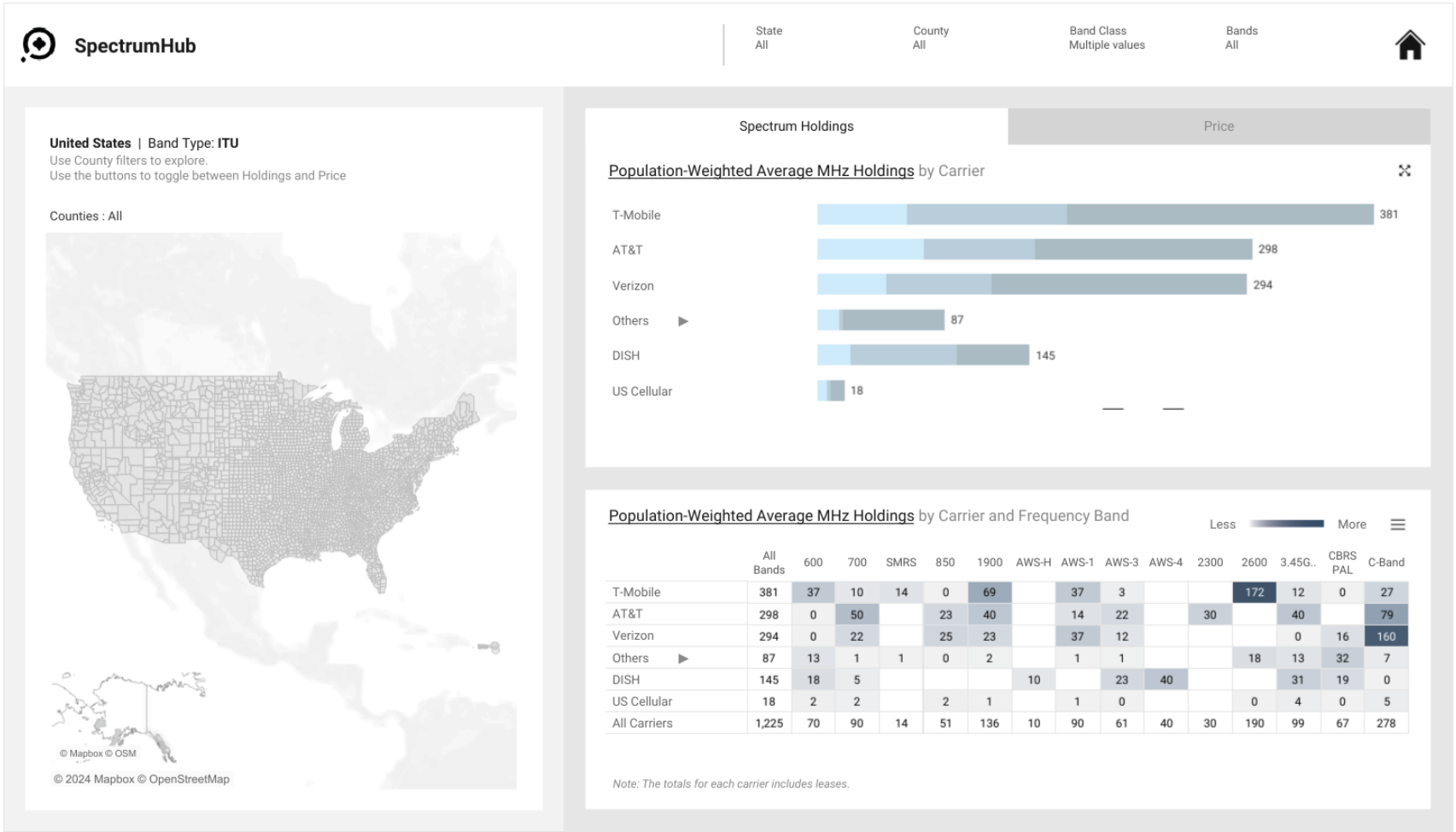
The price section delivers a detailed price analysis, encompassing historical pricing data (top chart) and most recent pricing data (bottom table) for each band and carrier. While currently available for seven countries (Germany, Italy, Spain, France, UK, US and India), we are committed to expanding this feature to other countries in upcoming product versions.



By selecting different countries, bands and dates, one can then explore specific auctions in more detail

In the US section, the national view displays spectrum holdings weighted by the total country population

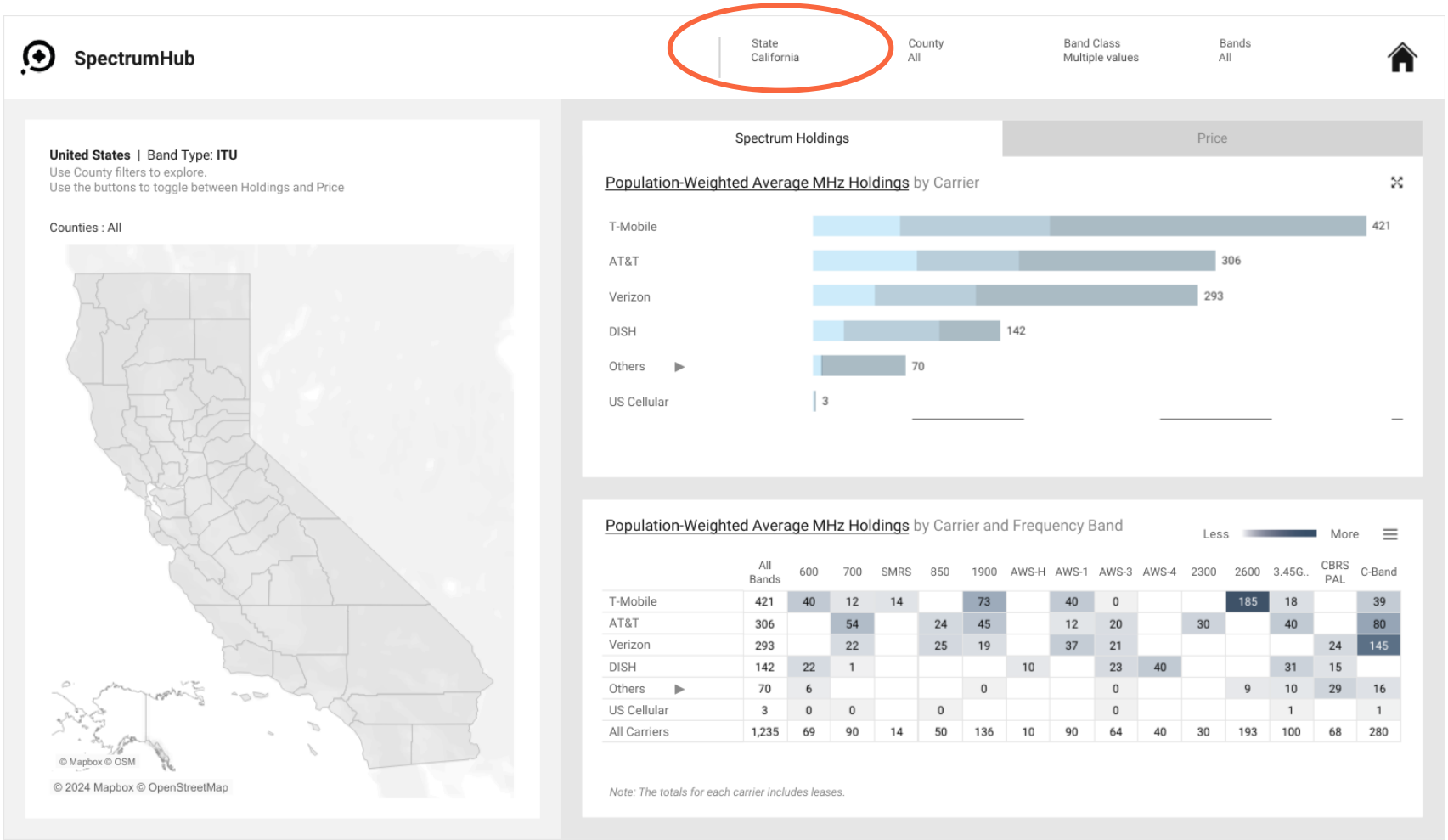
The structure of the US section mirrors that of the Worldwide dashboard. However, unlike the Worldwide dashboard, the US section includes views at both the county and state levels due to the unique characteristics of its licenses, which are at the market level rather than the national level. The national view displays a population-weighted average of spectrum by band and carrier. Thanks to this view, we can address questions such as the spectrum ownership of DISH and provide band-specific detail.



	All Bands	600	700	SMRS	850	1900	AWS-H	AWS-1	AWS-3	AWS-4	2300	2600	3.45G..	CBRS PAL	C-Band
T-Mobile	381	37	10	14	0	69		37	3			172	12	0	27
AT&T	298	0	50		23	40		14	22		30		40		79
Verizon	294	0	22		25	23		37	12				0	16	160
Others	87	13	1	1	0	2		1	1			18	13	32	7
DISH	145	18	5				10		23	40			31	19	0
US Cellular	18	2	2		2	1		1	0			0	4	0	5
All Carriers	1,225	70	90	14	51	136	10	90	61	40	30	190	99	67	278

SpectrumHub also offers a state-level perspective of the spectrum holdings in the US

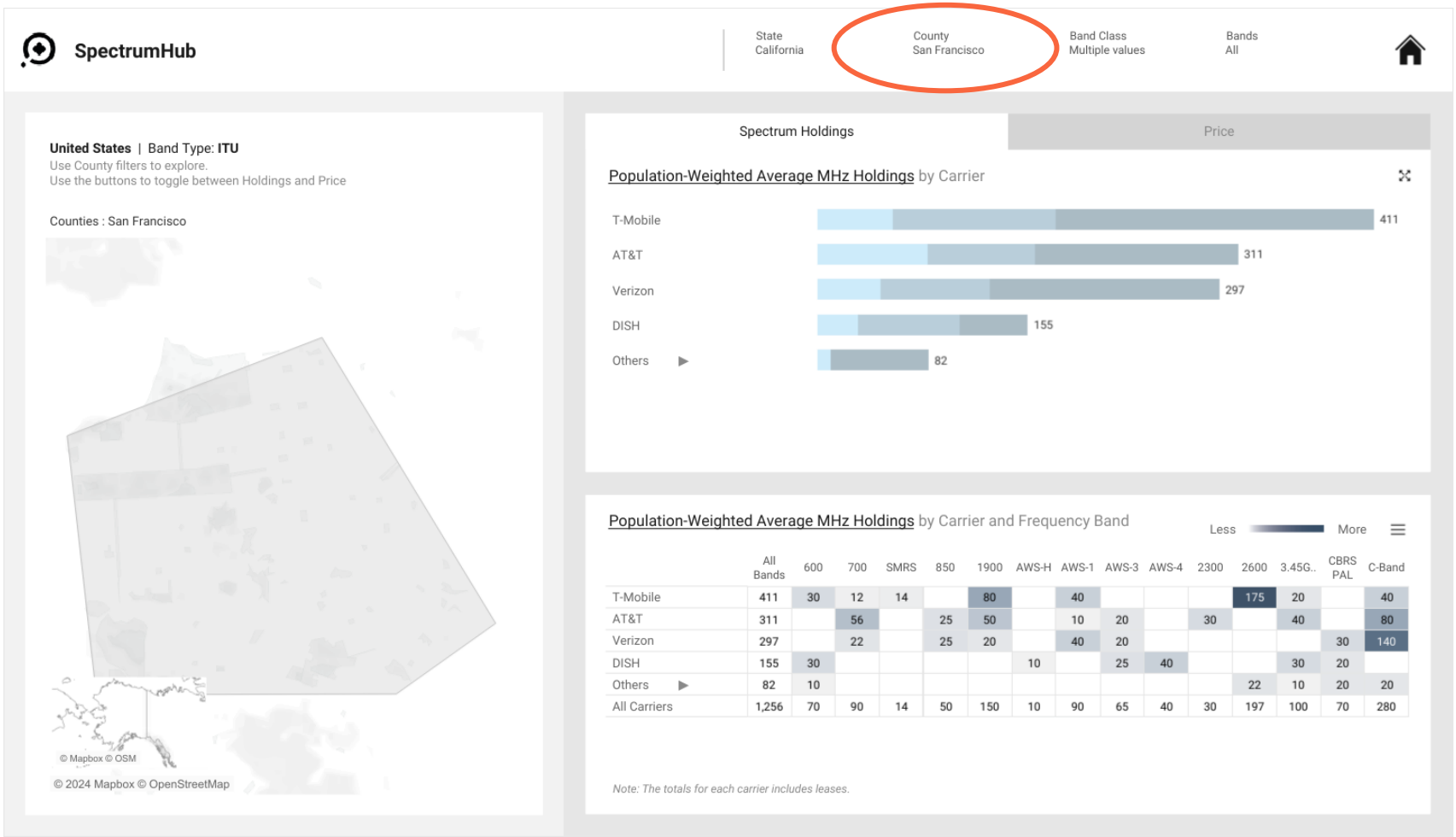
The state view displays a population-weighted average of spectrum by band and carrier in that specific state.



	All Bands	600	700	SMRS	850	1900	AWS-H	AWS-1	AWS-3	AWS-4	2300	2600	3.45G..	CBRS PAL	C-Band
T-Mobile	421	40	12	14		73		40	0			185	18		39
AT&T	306		54		24	45		12	20		30		40		80
Verizon	293		22		25	19		37	21					24	145
DISH	142	22	1				10		23	40			31	15	
Others ▶	70	6				0			0			9	10	29	16
US Cellular	3	0	0		0				0				1		1
All Carriers	1,235	69	90	14	50	136	10	90	64	40	30	193	100	68	280

Users can also go further into individual counties for key holdings

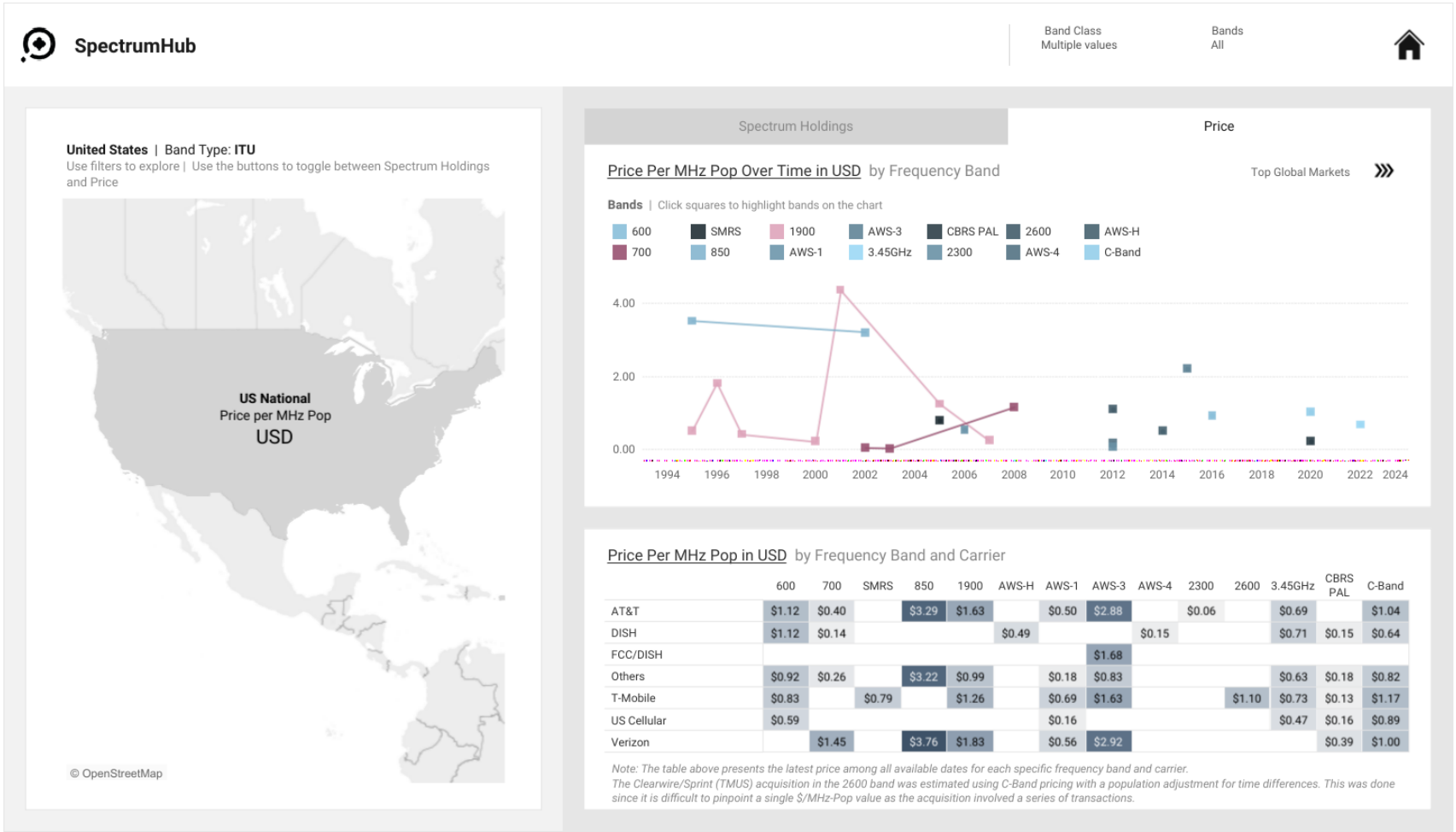
The county view displays a population-weighted average of spectrum by band and carrier in that specific county.



	All Bands	600	700	SMRS	850	1900	AWS-H	AWS-1	AWS-3	AWS-4	2300	2600	3.45G..	CBRS PAL	C-Band
T-Mobile	411	30	12	14		80		40				175	20		40
AT&T	311		56		25	50		10	20		30		40		80
Verizon	297		22		25	20		40	20					30	140
DISH	155	30					10		25	40			30	20	
Others ▶	82	10										22	10	20	20
All Carriers	1,256	70	90	14	50	150	10	90	65	40	30	197	100	70	280

US price section includes auction prices for every band

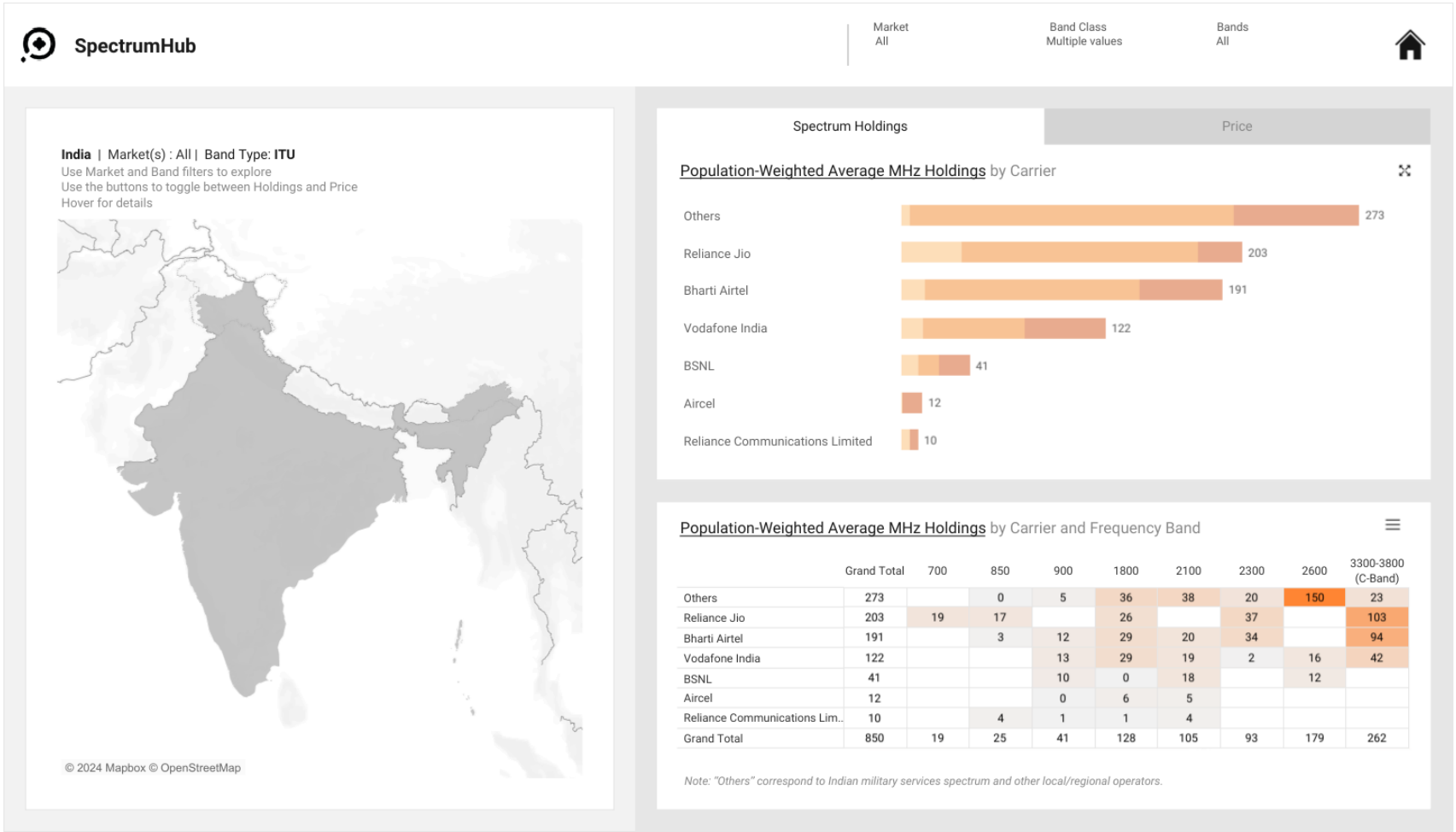
We will enhance this view by adding the most relevant secondary transactions and the portfolio valuation of each carrier's spectrum.



	600	700	SMRS	850	1900	AWS-H	AWS-1	AWS-3	AWS-4	2300	2600	3.45GHz	CBRS PAL	C-Band
AT&T	$1.12	$0.40		$3.29	$1.63		$0.50	$2.88		$0.06		$0.69		$1.04
DISH	$1.12	$0.14				$0.49			$0.15			$0.71	$0.15	$0.64
FCC/DISH								$1.68						
Others	$0.92	$0.26		$3.22	$0.99		$0.18	$0.83				$0.63	$0.18	$0.82
T-Mobile	$0.83		$0.79		$1.26		$0.69	$1.63			$1.10	$0.73	$0.13	$1.17
US Cellular	$0.59						$0.16					$0.47	$0.16	$0.89
Verizon		$1.45		$3.76	$1.83		$0.56	$2.92					$0.39	$1.00

India section

As with the US, India offers a regional view alongside the national view due to the existence of telecom circles for spectrum licenses



	Grand Total	700	850	900	1800	2100	2300	2600	3300-3800 (C-Band)
Others	273		0	5	36	38	20	150	23
Reliance Jio	203	19	17		26		37		103
Bharti Airtel	191		3	12	29	20	34		94
Vodafone India	122			13	29	19	2	16	42
BSNL	41			10	0	18		12	
Aircel	12			0	6	5			
Reliance Communications Lim..	10		4	1	1	4			
Grand Total	850	19	25	41	128	105	93	179	262

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