Declaration of Peter Cramton

I, Peter Cramton, hereby declare the following:

Qualifications

1. I am Professor of Economics at the University of Maryland and Chairman of Market Design Inc. My specialty is the design of complex auction markets. Since 1993, I have contributed extensively to the development of spectrum auctions. I have advised ten governments on spectrum auctions, including the United States. I am currently advising the United Kingdom, Canada, and Australia on 4G auctions. I have advised 36 bidders in major spectrum auctions around the world. I have written dozens of widely-cited practical papers on spectrum auctions. This research is available at www.cramton.umd.edu/papers/spectrum.

Summary

2. I have been asked by T-Mobile USA, Inc. to comment on the FCC's spectrum screen as it should be applied to Verizon's proposed acquisition of spectrum from SpectrumCo and Cox.

3. The current screen is ineffective in measuring the competitive effects of spectrum acquisitions, especially since the screen is meant to establish a safe-harbor presumption of no anticompetitive effect. The screen must be revised to address its chief flaw: the screen treats all mobile broadband spectrum as equal regardless of its frequency.

4. In fact, the different bands have quite different propagation characteristics, which make them more or less valuable for providing mobile broadband service. The low-frequency spectrum below 1 GHz allows much improved coverage depth (within buildings and other obstructions) and breadth (in less populated areas) compared with the spectrum above 1 GHz. This coverage advantage is an important competitive advantage, which makes the low-frequency spectrum much more valuable than the high-frequency spectrum. The value per MHz can differ by a factor of 10 or more, as demonstrated in recent auctions in Germany and Italy. Thus, a provider having a relatively smaller allocation of high-quality spectrum can be in an advantageous position compared to a provider with only lower-quality spectrum, even if the latter has considerably more spectrum than the former measured in MHz.

5. While purporting to establish a presumption of no competitive harm, the current screen in fact permits, and even encourages, an unlimited concentration of the most valuable spectrum, such as the cellular and 700 MHz bands, in the hands of a few carriers. Unless the screen is improved, it will allow this trend to continue.

6. A simple and beneficial revision to the screen is to weight the spectrum holdings in different bands by relative values. Value-based measures are used in many industries where quantities alone are misleading due to substantial quality differences of the product.

7. The relative value differences across bands are well-understood by market participants and industry experts and are reported in investment banking studies that analyze the competitive advantages to

the holders of the different bands. They are also fairly stable. Under a value-based screen the FCC would assign weights to each band, such as the following (explained later in the declaration):

Band	Value weight
Cellular	1.7
700 MHz	1.5
SMR	1.5
AWS/PCS	.75
BRS	.20

8. Then the carrier's total spectrum holdings would be calculated as the value-weighted sum of its holdings. The spectrum screen is triggered in any region where the carrier's value-weighted sum exceeds a threshold, such as one-third of the total of all spectrum calculated on the same weighted basis.

9. The value-based screen greatly improves the measurement of the capability of the spectrum holdings and therefore improves the screen's usefulness as a proxy for competitive effects. With this improved measure, the screen can be adjusted to increase the chance that problematic transactions are identified.

10. In sum, consistent with practice in past proceedings, the FCC should revise the spectrum screen to improve its ability to detect problematic spectrum aggregation. The screen should be value-weighted to reflect substantial differences in the quality of the spectrum in different bands.

The spectrum screen is flawed and must be revised

11. The FCC has used a variety of spectrum caps and spectrum screens over the years as a policy tool to encourage effective competition. This policy has consistently recognized that allowing any carrier to acquire an excessive share of the essential spectrum input could result in higher prices and less consumer benefit from wireless service.

12. Since 2004, the spectrum screen has been the primary instrument used in evaluating whether spectrum transactions should be subject to in-depth scrutiny for potential anticompetitive impact in a given market. Unfortunately, the spectrum screen in its current form is a poor instrument for this purpose. The screen can be improved to ameliorate its greatest flaw: its failure to measure the relative competitive value of different bands of spectrum.

13. The screen serves as a safe harbor guideline. Transactions that would result in spectrum holdings that fall below the screen are deemed presumptively to be in the public interest without further market evaluation. The effectiveness of such a screen depends on how well the screen measures competition concerns. This will happen only if it ensures that the safe harbor covers only acquisitions that pose no competitive concerns. Since the screen is not a cap and does not establish a presumption of competitive harm, companies have an opportunity to argue the merits of a transaction that exceeds the screen. Since 2004, the screen has been revised several times as part of

spectrum acquisition reviews. The current screen is 145 MHz—approximately one-third of the available mobile broadband spectrum. However, the FCC recently alluded to its interest in reducing the screen to 141 MHz in the context of AT&T's purchase of 700 MHz spectrum from Qualcomm.

14. To illustrate the problem with the current screen, note that the screen as currently applied would allow a single carrier to hold *all* the low-frequency spectrum—700 MHz, SMR, and Cellular—since the low-frequency spectrum comprises less than one-third of the total on a per MHz basis. In contrast a value-based screen where the bandwidth is weighted by relative values would give the correct answer in such a situation—the screen would be triggered.

The spectrum screen should not treat all spectrum the same

15. The value of the spectrum varies a great deal based on the frequency band. These value differences have grown as additional bands have been made available to address the rapid increase in mobile broadband demand.

16. The different bands have much different propagation characteristics that make the spectrum more or less suitable for mobile broadband use. To illustrate, Figure 1 shows the coverage for three different bands, 800 MHz, 1800 MHz, and 2.6 GHz, as a function of the number of cell sites in the UK to achieve a downlink speed of at least 1.2 Mbps with 20 MHz of spectrum. With 800 MHz, 98% coverage is achieved with only 2,000 sites. With 1800 MHz, more than 10,000 sites are required to achieve 98% coverage. With 2.6 GHz, even 20,000 sites are not enough to achieve 98% coverage. The low-frequency spectrum allows a high level of coverage with a small fraction of the number of sites, and hence much less capital expense. These technical differences among the bands create substantial value differences.

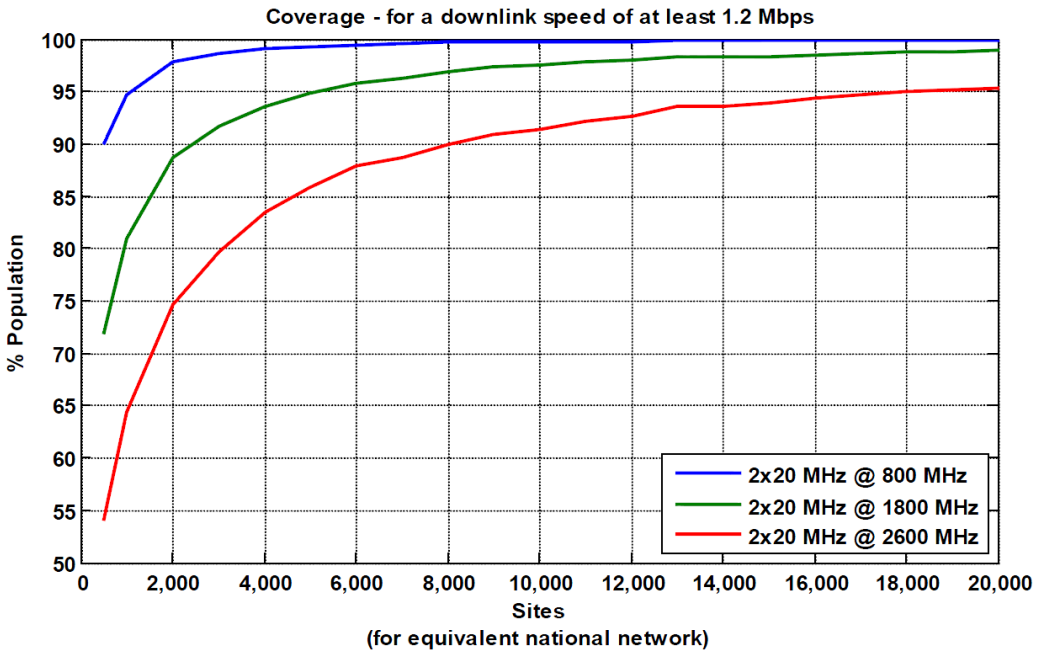

Figure 1. Coverage as a function of the number of sites for three different bands. Source: Ofcom's second consultation on assessment of future mobile competition and proposals for the award of 800 MHz and 2.6 GHz spectrum and related issues (2012).

17. The substantial value difference among the bands is well understood by all market participants and is reflected in market valuations and spectrum prices. Both the FCC and the DOJ have recognized the substantial differences in the value of the different bands for mobile service: "As the Commission and DOJ have recognized, spectrum resources in different frequency bands can have widely disparate technical characteristics that affect how the bands can be used to deliver mobile services. The more favorable propagation characteristics of lower frequency spectrum, (i.e., spectrum below 1 GHz) allow for better coverage across larger geographic areas and inside buildings." (FCC 11-188 at pp. 21-22)

18. Recent multi-band auctions in Europe illustrate the substantial value difference across the bands. The 2010 auctions in Germany and Italy were the most recent large competitive auctions. The prices of 2x5 MHz lots of 800 MHz and 2.6 GHz spectrum in these auctions are shown in Figure 2. In Germany, each 2x5 MHz lot of 800 MHz sold for about €600 million; whereas each 2x5 MHz lot of 2.6 GHz sold for less than €20 million. In Italy, each 2x5 MHz lot of 800 MHz sold for about €500 million; whereas each 2x5 MHz lot of 2.6 GHz sold for about €36 million. In these recent competitive auctions, the bidders valued the 800 MHz spectrum at 15 to 30 times more than the 2.6 GHz spectrum.

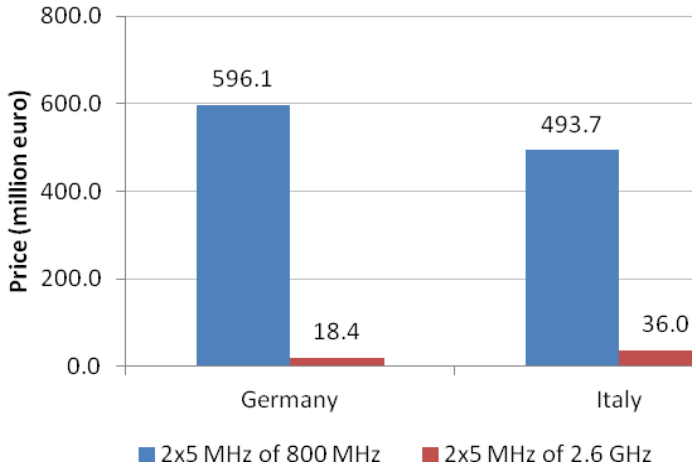

Figure 2. Price of 2x5 MHz of 800 MHz and 2.6 GHz in Germany and Italy 4G auctions of 2010.

19. Recent US auctions and other transactions discussed later also confirm the disparity of spectrum values across bands.

20. The implication of these market facts is that it makes little sense to use a screen that treats all spectrum the same for the purpose of competitive analysis. Rather the screen should be value based. Such an approach is typically taken in industries where there is substantial heterogeneity in value. For example, when evaluating market shares in diamonds the shares are always in value terms, rather than carats (weight). Similarly, real estate shares are stated in value terms, rather than acres. In all three industries, value differences are so large that a pure quantity-based measure (MHz, carats, or acres) would be misleading.

21. Treating all spectrum as equal is an improper simplifying assumption. This may have been a useful assumption when the original spectrum cap was introduced in 1994. Then we had little information about relative values and there was less disparity among the bands. However, with the introduction of more spectrum both above and below 1 GHz, dramatic changes in the mobile broadband market, and much better information about relative values, including many auctions and secondary market transactions, this simplistic approach has long become counterproductive.

22. Verizon's strong position in the wireless market has to a large extent come from the better coverage it has been able to offer as a result of holding such a dominant position in the low-frequency spectrum. By 2000 Verizon held roughly one-half of the low-frequency spectrum, about 25 MHz of cellular spectrum. In 2008, this dominance was threatened with the 700 MHz spectrum auction. Verizon understood this potential threat and bid aggressively for and won 49% of the 700 MHz spectrum as shown in Figure 3. This purchase, which did not trigger the simplistic screen, let Verizon sustain its dominant position in the low-frequency spectrum.

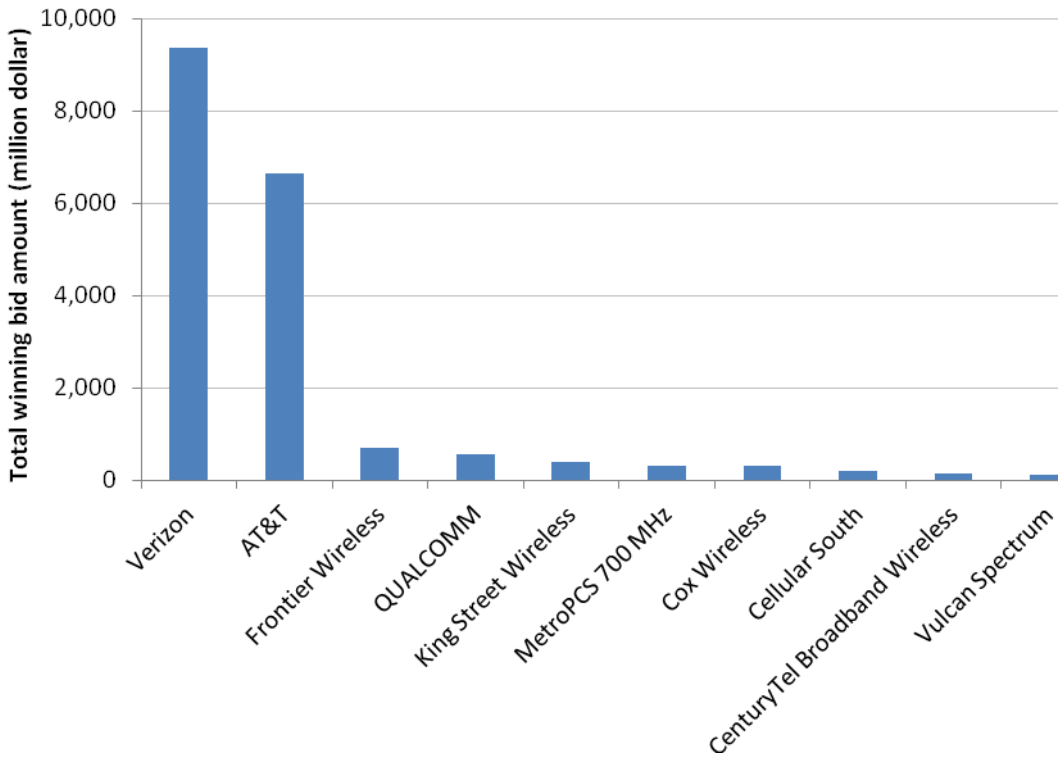

Figure 3. Top-10 bidders by total winning bid amount in US 700 MHz spectrum auction of 2008.

23. Indeed, the simplistic screen has likely motivated Verizon to invest heavily in the low-frequency spectrum. Verizon can weaken the impact of the spectrum constraint by acquiring higher quality spectrum. The better (low-frequency) spectrum enables Verizon to provide more communications at lower cost and therefore gives it a disproportionate spectrum capability under the current unweighted screen.

24. Unfortunately the resulting domination in the low-frequency spectrum is not healthy for competition. It means that Verizon can provide better depth of coverage (inside buildings) and

better breadth of coverage (in less populated areas) at much lower cost than smaller rivals. Customers value the better coverage and many switch to Verizon. This puts Verizon in an even more dominant market position, enabling Verizon to take advantage of further scale economies in network infrastructure, backhaul, and equipment.

25. Other countries have had similar experiences. Market success often hinges on holding spectrum below 1 GHz, since this spectrum allows better coverage. For this reason, regulators in other countries, such as Australia, United Kingdom, France, Germany, Ireland, Italy, Spain, Portugal, Sweden, and Switzerland, have adopted competition policies that recognize the differences among the bands.

A value-based screen is easy to construct and a better measure of capacity

26. An effective way to account for the greater value of spectrum below 1 GHz is to adopt the value-based screen proposed here. This is a simple and common approach to address large value differences. We simply weight the spectrum holdings in each band by relative value. A key advantage of this approach is that it is a straightforward revision of the existing screen.

27. The change clearly provides a better measure of competition concerns, and therefore is an appropriate and essential change in evaluating future spectrum acquisitions, such as Verizon's proposed acquisition. In assessing past transactions, the FCC has routinely made revisions to the screen, whenever the revision would improve the screen's ability to measure spectrum aggregation. The weighting I propose is just such an improvement, and a very important one.

28. To show how easy it is to use a value-based screen, I will construct one. Only a single new input is required: the relative value weights for each band. There is now reliable information on relative values for the various bands. For example, a recent J.P. Morgan analysis provided the following relative values of wireless spectrum:[1]

Band	Relative value ($/MHz-pop)
Cellular	1.70
700 MHz	1.37
PCS	0.76
AWS	0.76
MMDS	0.25
2.5 GHz	0.19

[1] J.P. Morgan, "Spectrum Valuation Overview – Carrier by Carrier Base-Case Spectrum Value Across Wireless Industry," Telecom Services and Towers, North American Equity Research, 30 November 2011.

29. Deutsche Bank equity research estimates values of large spectrum auctions and transactions as follows:[2]

Band	Year	Transaction	Relative value ($/MHz-pop)	Average band value ($/MHz-pop)
700 MHz	2008	FCC Auction 73	1.28	1.07
	2008	Sale of 700 MHz by Aloha Partner to AT&T	1.06	
	2010	Sale of 700 MHz by Qualcomm to AT&T	0.87	
PCS	2005	FCC Auction 58	0.98	0.98
AWS-1	2006	FCC Auction 66	0.54	0.61
	2011	Pending sale of AWS-1 by SpectrumCo/Cox to Verizon	0.67	
2.5 GHz	2007	Sale of 2.5 GHz by AT&T to Clearwire	0.17	0.17

30. The prices per MHz-pop from US AWS-1 and 700 MHz spectrum auctions are shown in Figure 4. These auctions are especially relevant in assessing relative values, since they are the only two major US auctions of mobile broadband spectrum in recent years (AWS-1 in 2006 and 700 MHz in 2008).

Figure 4. Price per MHz-pop in AWS-1 and 700 MHz spectrum auctions.

31. Relative values thus can be assessed from equity research, recent auctions and other arms-length transactions, as well as engineering studies of the capabilities of the different bands. Based on this information, the following value weights seem plausible and even conservative in that if anything they likely understate relative value differences:

[2] Deutsche Bank, "Key Updates on Major Spectrum Deals," US Telecom Services, Market Research, 5 February 2012.

Band	Value weight
Cellular	1.7
700 MHz	1.5
SMR	1.5
AWS/PCS	.75
BRS	.20

32. These weights are all that is needed in determining and applying the spectrum screen. The table below shows the construction of the value-based screen. It assumes 14 MHz of SMR spectrum, consistent with FCC arguments in the recent decision on the AT&T acquisition of Qualcomm spectrum. It also adds 10 MHz for the PCS G Block.

Band	Price	Weight	MHz	Value
Cellular	$1.70	1.7	50	85
700 MHz	$1.37	1.5	70	105
SMR		1.5	14	21
AWS/PCS	$0.76	0.75	220	165
BRS	$0.19	0.2	55.5	11
Total			409.5	387
One-third screen			137	129

33. Assuming a trigger equal to one-third of total spectrum value, based on previous FCC decisions triggering the screen at approximately one-third of available spectrum, the screen is found by dividing the total available of 387 (value weighted) by 3, to yield a threshold of 129.

34. One critique of the weighted screen is that it requires the FCC to make a judgment about the relative values of the bands. However, the current unweighted screen implicitly has the FCC making the judgment that all the bands are equal in their capability for providing mobile service—a judgment that all parties, including the FCC and DOJ, agree is wrong. Substituting a reasoned judgment for an incorrect one results in an improved measure of the competitive impact of a carrier's spectrum holdings. Such judgments are inevitable in setting any spectrum screen.

35. Figure 5 applies the weighted screen to the current spectrum holdings of the top-5 carriers in the top-25 markets. The holdings reflect the recent transfer of spectrum from AT&T to T-Mobile as part of the breakup, as well as the recent AT&T and Qualcomm transaction. Verizon's holdings are *before* its proposed acquisition of spectrum from SpectrumCo and Cox, but include the Verizon-Leap transaction.

36. Figure 6 shows Verizon's holdings both *before and after* the proposed SpectrumCo/Cox acquisition. The Verizon acquisition triggers the weighted screen in many major markets, suggesting that the acquisition raises important competition concerns.

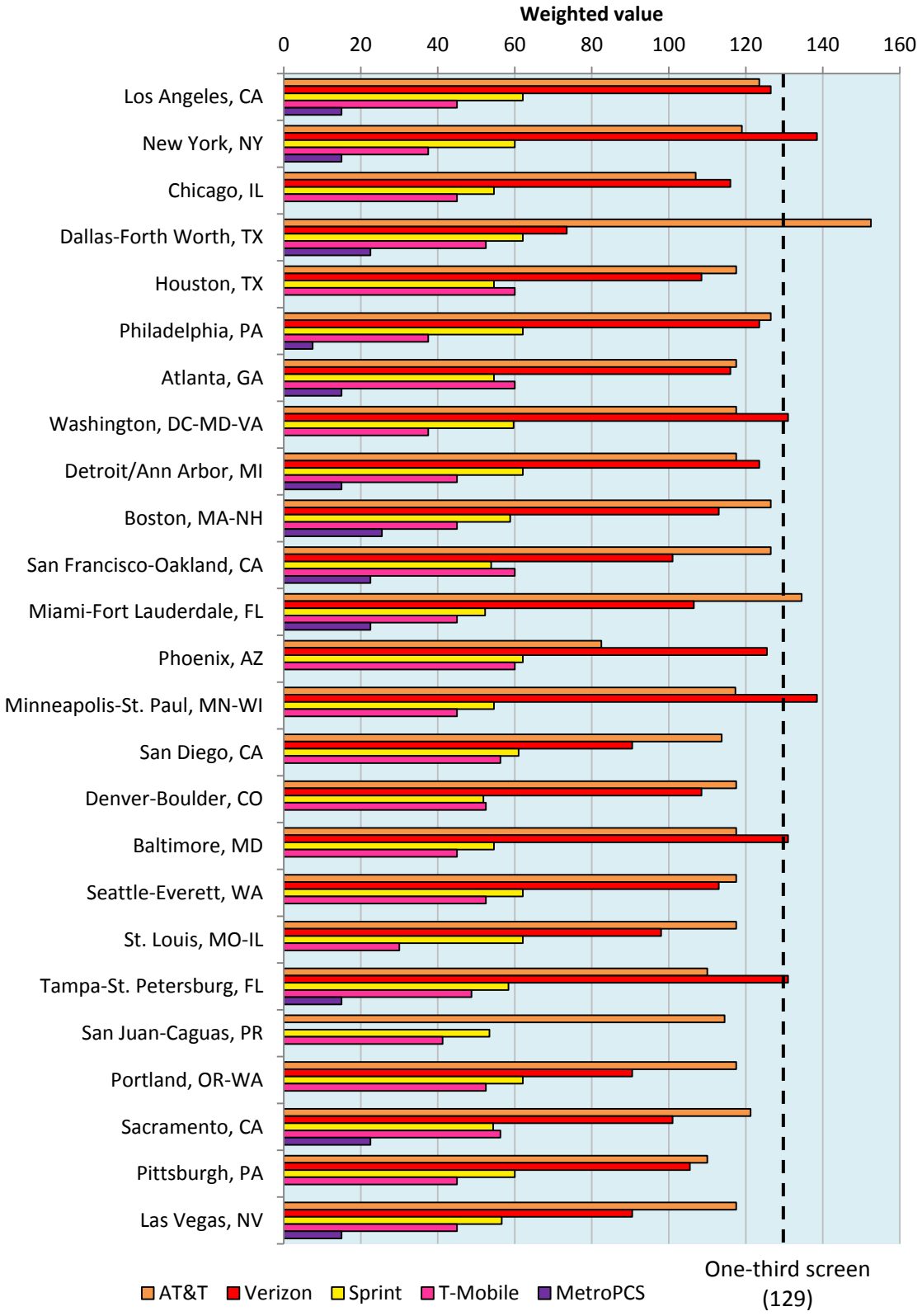

Figure 5. Screen applied to current spectrum holdings of top-5 carriers in top-25 markets.

Note: Verizon holdings prior to the pending Verizon-SpectrumCo/Cox transaction; Verizon-Leap and AT&T-T-Mobile transactions included *pro forma*.

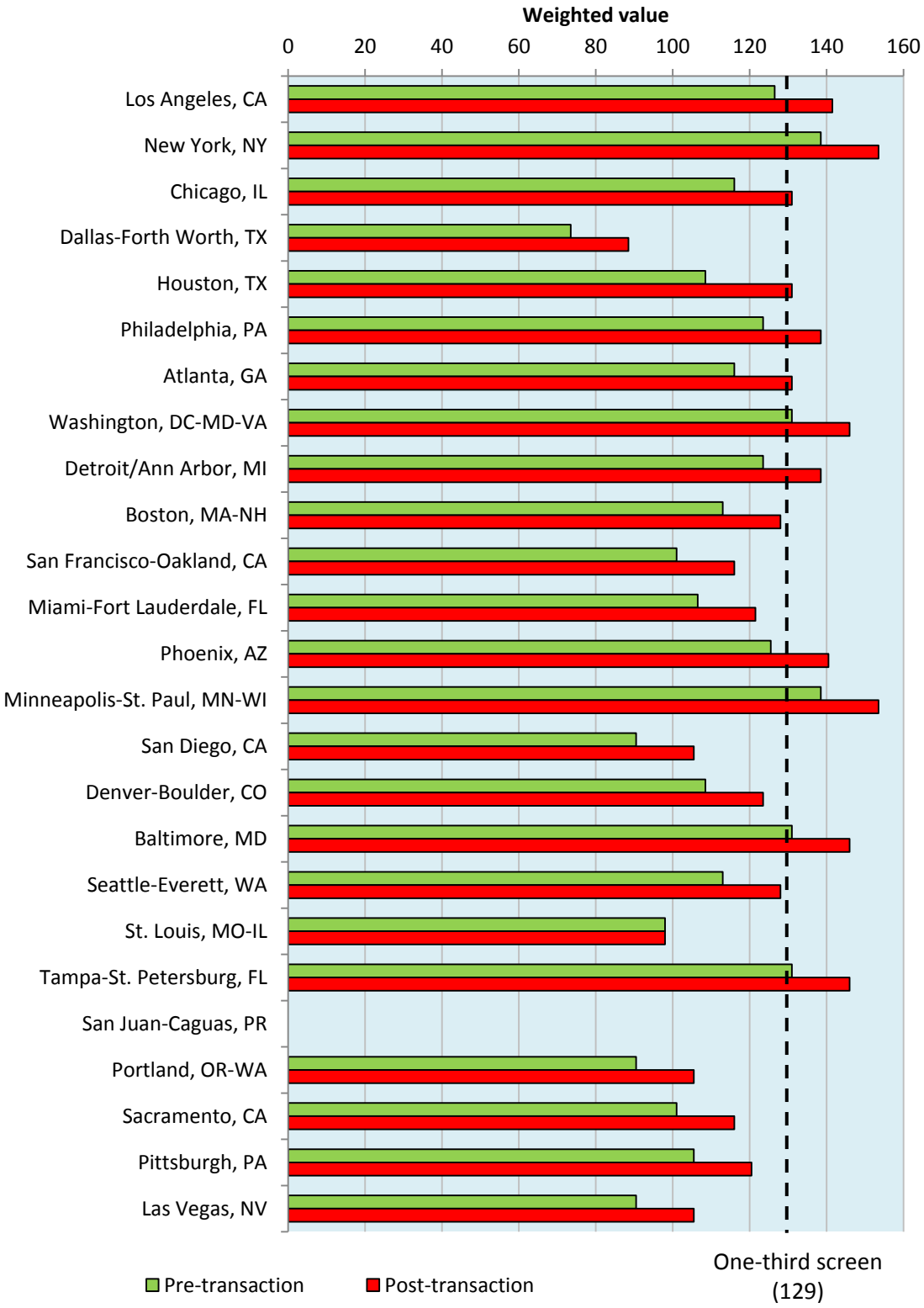

Figure 6. Screen applied to Verizon holdings before and after transactions with SpectrumCo and Cox.

Note: Verizon post-transaction holdings *pro forma* SpectrumCo, Cox, and Leap transactions.

37. Without such value-weighting, the spectrum screen fails to identify potentially harmful concentrations of scarce spectrum resources. Weighting spectrum by value provides a better measure of the market's view of the capability of spectrum resources essential for mobile broadband. With the improved weighted measure, the FCC can safely adjust the screen. With the poor (unweighted) measure, any reduction in the screen level has two undesirable consequences: 1) it encourages greater concentration of the most valuable spectrum as the largest carriers seek to relax the constraint of the screen, and 2) it limits the aggregation of less valuable spectrum by the smaller carriers, which would be an efficient way for them to seek to compete with the holders of "beachfront" spectrum.

Conclusion

38. The current spectrum screen, by treating all spectrum as equal, provides a poor measure of the competitive impact of spectrum acquisitions. The screen is easily fixed by weighting spectrum according to relative values, as is done in other industries. Doing so greatly improves the screen's effectiveness as a diagnostic tool to prevent an excessive concentration of spectrum and therefore safeguard the public interest.

39. With a better measure of competitive impact the improved screen can effectively be adjusted to improve the FCC's approach to identifying markets that need a heightened level of competitive scrutiny, and where divestitures may be required to satisfy the public interest.

I declare under penalty of perjury that the foregoing is true and correct.

Peter Cramton

Executed on 20 February 2012