Before The
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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| In the Matter of | ) | |
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| Improving Public Safety Communications In the 800 MHz Band | ) | WT Docket No. 02-55 |
| | ) | |
| Consolidating the 900 MHz Industrial/Land Transportation and Business Pool Channels | ) | |

**COMMENTS OF VERIZON WIRELESS**

## SUMMARY

The public safety community serves a vital role for the nation, at the local, state, and federal levels. The availability of reliable radio communications systems is an important factor in the ability of public safety agencies to adequately protect the safety of lives and property. Verizon Wireless welcomes this opportunity to offer assistance to the Commission in its efforts to examine the potential for harmful interference to public safety systems operating in the 806-824 MHz / 851-869 MHz ("800 MHz") band and to develop effective measures for eliminating or mitigating this interference.[1]

There is a potential for interference to occur between public safety and commercial systems operating in the 800 MHz band that principally results from the

[1] *In the Matter of Improving Public Safety Communications in the 800 MHz Band, Consolidating the 900 MHz Industrial/Land Transportation and Business Pool Channels*, Notice of Proposed Rulemaking ("NPRM"), FCC 02-81 (rel. Mar. 15, 2002).

disparate designs of these systems. Practical experience indicates that harmful interference is much more likely to occur in that portion of the band where public safety and Specialized Mobile Radio ("SMR") licensees are interleaved. Although there is some potential for interference from cellular systems operating in adjacent bands, Verizon Wireless has conducted an extensive assessment of its cellular operations and the actual occurrence of interference to public safety, and has found no cases of interference where Verizon Wireless is a significant contributor.

Given the nature of the interference in the 800 MHz band, the right course at this time is to implement immediately specific palliative measures, including those set forth in the *Best Practices Guide* jointly developed by public safety and industry. These actions should significantly alleviate much of the specific interference problems that exist.

The wrong course would be to embark on a disruptive and extremely costly realignment process that yields no significant benefit – particularly a process as unjustified and self-serving as Nextel's proposal to realign the 800 MHz band. Verizon Wireless urges the Commission to reject Nextel's proposal for three independent reasons: (1) it would provide only minimal reductions in interference, while imposing huge disruptions and costs on 800 MHz incumbents; (2) it would unlawfully grant a considerable spectrum windfall to Nextel (the primary source of interference to public safety); and (3) it would unfairly and unlawfully require other licensees to bear most of the enormous financial burden of relocating public safety licensees.

## I. CONDITIONS EXIST IN THE 800 MHz BAND THAT CAN RESULT IN INTERFERENCE BETWEEN PUBLIC SAFETY AND COMMERCIAL WIRELESS SYSTEMS.

As the Commission notes, there is a potential for interference to occur between public safety and commercial wireless systems that is a direct result of the differences in the designs of these systems and their close proximity in frequency.[2] Public safety systems are typically designed to provide communications to a relatively small group of users over a large geographical area. The traditional way to design a mobile radio communication system that meets these criteria is to use a single base station with a high-site antenna that provides broad coverage over the area. As a result, the transmitted signal is strongest near the base station and weakest in locations on the edge of the service area.

Conversely, commercial mobile wireless operators serve large numbers of customers with large volumes of communications traffic. As a result, they construct their mobile radio communications networks in a cellular architecture comprised of a large number of base stations, each with a low-site antenna that is designed to cover a relatively small geographical area. This cellular architecture allows commercial operators to make the most intensive and efficient use of their assigned radio spectrum to meet the expanding needs of their customer base.

It is this disparity in network designs, coupled with the limited filtering capability of public safety receivers that is the real cause of the interference between public safety and commercial systems. The potential for interference exists when public safety users

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[2] NPRM at ¶ 10 and at ¶ 15.

on the edge of their service area, attempting to receive relatively weak signals from distant base stations, are located near commercial antenna sites where the signal is relatively strong. The strength of the commercial signal relative to the public safety signal, the close proximity of the commercial frequency to the public safety frequency, and the inability of the public safety receiver to sufficiently reject undesired signals can combine to produce harmful interference.

### A. Receiver Overload And Intermodulation Are The Primary Types Of Interference To Public Safety Operations In The 800 MHz Band.

As a nationwide cellular carrier that operates networks throughout the United States including 97 of the top 100 markets, Verizon Wireless has extensive experience with operations in the 800 MHz band and first-hand knowledge of the potential for interference with public safety. Attached to this filing is a technical declaration from William H. Stone, Jr., Executive Director Network Strategy for Verizon Wireless, ("Declaration") which describes the company's experiences with interference in the 800 MHz band.[3] Mr. Stone also makes several recommendations for ways to mitigate interference that may occur.

As the Commission notes, harmful interference into public safety can manifest itself in three ways: receiver overload, intermodulation interference, and out-of-band emissions.[4] In his Declaration, Mr. Stone concludes that the predominant cause of interference is receiver overload – i.e., the overload of the front-end amplifiers of the

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[3] *Declaration of William H. Stone, Jr.* ("Declaration"), filed in WT Docket No. 02-55, May 6, 2002.

[4] NPRM at ¶ 15.

public safety mobile receivers.[5] This occurs when a public safety receiver, operating near the edge of its service area, is in the presence of a strong, nearby undesired signal. If the undesired signal is passed through the radio frequency ("RF") filter in the front-end of the public safety receiver, and the signal is strong enough, it can overload the low noise amplifier in the receiver. Mr. Stone states that interference from receiver overload cannot be substantially reduced unless the public safety receivers are designed to employ new RF filters that do not pass undesired signals.[6]

Public safety receivers can also experience intermodulation interference. Intermodulation ("IM") occurs when two or more signals operating at different frequencies combine to produce new signals, called intermodulation products, at different frequencies. If the interfering signals are strong enough and the intermodulation products fall on or near the desired public safety signal, harmful interference can result. Mr. Stone indicates that, as is the case for receiver overload, IM is only a problem if the undesired signals are passed by the RF filter in the front-end of the public safety receiver.[7]

### B. Out-Of-Band Emissions Is Not A Significant Contributor To The Interference Problems Experienced By Public Safety.

All transmitters produce energy outside of their assigned frequencies. This is a necessary product of the modulation process. While there is a potential for the out-of-band emissions of commercial transmitters to cause interference to public safety receivers, Mr. Stone concludes that this type of interference is not a significant

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[5] Declaration at 4.

[6] *Id* at 6.

[7] *Id.*

contributor to the problems experienced by public safety.[8] Generally, commercial transmitters produce only low levels of emissions outside of their frequency bandwidths. It is unlikely that this level of emissions will be strong enough relative to the public safety signal to degrade the performance of the public safety system. To the extent that out-of-band emissions is a problem, Mr. Stone notes that it is more likely to occur in the portion of the 800 MHz band where public safety licensees and Nextel are interleaved.[9]

## II. VERIZON WIRELESS IS NOT CONTRIBUTING TO THE INTERFERENCE PROBLEMS EXPERIENCED BY PUBLIC SAFETY.

Verizon Wireless has conducted a substantial investigation of the interference that occurs between its cellular operations and public safety operations in the 800 MHz band. A report on these findings is included in Mr. Stone's Declaration. Verizon Wireless operates cellular networks throughout the United States, with many thousands of base stations deployed. As Mr. Stone indicates, Verizon Wireless has been contacted by public safety agencies regarding very few cases of potential interference, and none of these have determined that Verizon Wireless is a significant contributor to the interference.[10]

Verizon Wireless employs Code Division Multiple Access ("CDMA") technology throughout most of its network. Current CDMA systems employ a large spreading bandwidth of 1.25 MHz, which results in a lower power spectral density as compared to

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[8] *Id.*

[9] *Id.*

[10] *Id* at 7-17. In some cases, interference from Verizon Wireless has been measured, but the level of interference has been determined to be negligible, e.g., raising the noise floor of the public safety system by 1-2 dB.

other technologies. Moreover, Verizon Wireless employs power control techniques to reduce the potential for intra-system interference and make the most efficient use of its assigned radio spectrum. As Mr. Stone notes in his Declaration, the use of CDMA technology and power control techniques reduces the likelihood that Verizon Wireless will cause harmful interference to public safety operations.[11] Our experience in the field bears this out.

### A. APCO's "Interim Report To The FCC" Does Not Accurately Represent The Interference Problems Involving Verizon Wireless.

The commercial wireless industry has been working with the Association of Public-Safety Communications Officials ("APCO") and other public safety entities to address potential interference problems under APCO's Project 39. On December 24, 2001, APCO submitted an *Interim Report to the FCC* ("*Interim Report*") that describes its preliminary findings. Verizon Wireless applauds APCO and others supporting Project 39 for their efforts in attempting to resolve the interference issues in the 800 MHz band. As we expected, the *Interim Report* shows that the primary source of interference is Nextel. However, we note that it includes some inaccurate data regarding interference involving Verizon Wireless. Most involve inaccurate information provided to APCO by Nextel. As noted in Table 2 of Mr. Stone's Declaration, Nextel identified six cases of interference that it claimed involved Verizon Wireless. In four of those cases, however, we have never been contacted by any public safety agency. In the remaining two cases, results of testing show that Verizon Wireless was at most a negligible contributor to the interference described by APCO in its *Interim Report*. We urge APCO to correct its

[11] *Id* at 17.

report, and ask the Commission to consider this updated information in its ongoing assessment of the 800 MHz band.

## III. THE COMMISSION SHOULD ENCOURAGE THE USE OF "*BEST PRACTICE*" PRINCIPLES TO RESOLVE INTERFERENCE.

The Commission posits that realignment of the 800 MHz band – e.g., by eliminating the interleaved channels and providing segmented contiguous spectrum for incumbent licensees – is one option for resolving interference to public safety operations and it seeks comments on ways to realign the band.[12] It also suggests that realignment may not be a complete solution, and that "complementary solutions" may be necessary in addition to realignment.[13] By focusing on band realignment first, however, the Commission is "putting the cart before the horse." Worse, the "cart" is not likely to be a solution that will work. Any band realignment proposal is likely to be expensive and burdensome to incumbents. The Commission should pursue less radical, costly, and disruptive measures for eliminating or mitigating interference before considering a wholesale realignment of the band.

Verizon Wireless believes that a realignment of the 800 MHz band would not substantially reduce the potential for interference, unless these "complementary solutions" are implemented.[14] In fact, many of these measures, if implemented, would themselves substantially improve the interference situation, without the need for band realignment. In December 2000, a working group of subject matter experts from the

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[12] NPRM at ¶ 20.

[13] *Id* at ¶ 73.

[14] Declaration at 3.

wireless industry and the public safety community developed a *Best Practices Guide* that includes various palliative measures for addressing interference.[15] Verizon Wireless believes that the implementation of these principles is the best means for mitigating interference, at least in the near-term.

### A. The Best Means For Reducing Interference To Public Safety Is To Improve The Robustness Of Public Safety Communications.

The *Best Practices Guide* states that one means to eliminate or mitigate interference is to increase "the robustness of public safety communications transmissions by adding more proximate base stations, increasing power levels or deploying more interference-resistant public safety handset and mobile receiver units."[16] Verizon Wireless believes that this is, in fact, the best means for mitigating interference. In his Declaration, Mr. Stone states that receiver overload and intermodulation interference, the two primary types of interference to public safety operations, cannot be significantly reduced unless the public safety receivers are designed to employ new RF filters that do not pass undesired signals.[17] Moreover, if these new filters were employed, much of the interference experienced by public safety systems would be mitigated, without the need for additional measures. Mr. Stone also concludes that improved IM rejection in the public safety receivers would provide significant reductions intermodulation interference.

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[15] *Avoiding Interference Between Public Safety Wireless Communications Systems and Commercial Wireless Communications Systems at 800 MHz – A Best Practices Guide* ("*Best Practices Guide*"), December 2000, compiled by APCO, the Cellular Telecommunications and Internet Association ("CTIA"), Motorola, Inc., Nextel Communications, Inc., and the Public Safety Wireless Network ("PSWN").

[16] Best Practices Guide at 11.

[17] Declaration at 5.

Consequently, Verizon Wireless recommends the adoption of a minimum receiver IM rejection standard of 75 dB.[18]

We concur with the Commission's finding that "interference could be reduced if public safety systems provided a more robust signal in areas in which interference from cellular architecture digital SMR systems is anticipated."[19] In some cases, this could be accomplished by increasing the effective radiated power of the public safety base station. However, in most cases, the construction of additional base stations or repeaters would be required. While the costs of such an undertaking are not insignificant, they would likely be considerably less than the costs associated with a wholesale realignment of the 800 MHz band. Importantly, the evolution of public safety networks from a "single base station / high-site" architecture to a "multiple base station / low-site" architecture will allow public safety agencies to improve in-building coverage and make the most efficient use of precious public safety spectrum resources, in addition to substantially reducing the potential for harmful interference.[20]

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[18] NPRM at ¶ 74.

[19] *Id* at ¶ 76.

[20] The Commission has previously required licensees to implement such equipment modifications and upgrades to achieve more intensive and efficient use of spectrum and to decrease interference potential. *Amendment of Parts 2 and 78 of the Commission's Rules and Regulations to Expand the Frequencies Available for Use by Cable Television Relay Service Stations*, Second Report and Order, 82 FCC 2d 354 (1980); *Replacement of Part 90 by Part 88 and to Revise the Private Land Mobile Radio Services*, Report and Order and Further Notice of Proposed Rulemaking, 10 FCC Rcd 10,076.

### B. The Commission Should Not Impose More Stringent Out-Of-Band Emissions Limits On Commercial Licensees, Because This Would Not Correct The Problem.

The Commission tentatively concludes that interference to public safety licensees in the 800 MHz band could be substantially improved if it imposed more stringent limits on the out-of-band emissions of commercial transmitters, and asks what level of emissions would provide sufficient interference protection.[21] Verizon Wireless does not believe that the investigations of the commercial wireless industry and the public safety community regarding the interference experienced in the 800 MHz band support the Commission's tentative conclusion. As Mr. Stone indicates in his Declaration, interference from out-of-band emissions is not a significant contributor to the problems experienced by public safety, at least not with regard to cellular operations.[22] Consequently, the imposition of more stringent out-of-band emission limits on cellular transmitters would not produce any significant benefits, while imposing substantial unnecessary burdens on commercial licensees.

Verizon Wireless has previously noted the impact of overly restrictive out-of-band emissions limits on commercial licensees.[23] Such limits can place substantial financial and operational burdens on commercial operators and significantly reduce the amount of useable commercial spectrum. These limits would be particularly harmful to

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[21] *Id* at ¶ 75.

[22] Declaration at 19.

[23] *See* Ex Parte Communications of Verizon Wireless, (filed Jan. 25, 2002), *In the Matter of Service Rules for the 746-764 and 776-794 MHz Bands, and Revisions to Part 27 of the Commission's Rules* ("*700 MHz Proceeding*"), WT Docket No. 99-168, at 2; *see also* Opposition of Bell Atlantic Mobile, Inc. to Petition for Reconsideration of APCO ("BAM Opposition") (filed Mar. 10, 2000), in the *700 MHz Proceeding*, at 1.

the use of wideband technologies that will support the emergence of broadband data services.[24] Such restrictive limits are unwarranted, particularly given that out-of-band emissions is not a significant contributor to the interference experienced by public safety licensees. We urge the Commission not to impose more stringent out-of-band emissions limits on commercial licensees.

## IV. THE COMMISSION SHOULD REJECT NEXTEL'S PROPOSAL.

Nextel proposes to resolve interference through realignment of the 800 MHz and 900 MHz bands, eliminating the interleaved channels and providing contiguous blocks of spectrum for incumbent services. In the process, Nextel would receive a substantial spectrum windfall, while other licensees would be faced with massive disruption and/or considerable relocation costs. This proposal is clearly designed to benefit Nextel. It is not in the public interest and should be rejected.

### A. Nextel's Proposal Would Not Eliminate The Potential For Interference To Public Safety Systems.

As discussed supra, the realignment of the 800 MHz band, based on Nextel's proposal or any other, would not substantially reduce the potential for harmful interference to public safety operations unless additional measures are taken, e.g., improving the robustness of public safety communications systems and utilizing public safety mobile receivers that are less susceptible to interference. In contrast, implementing those measures would provide substantial improvement <u>without</u> realigning the band. While a band realignment could offer some improvements, the potential for

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[24] *See* BAM Opposition at 2; *see also* Ex Parte Notification of Motorola, Inc., (filed Dec. 6, 1999), in the *700 MHz Proceeding*, at 4.

interference due to receiver overload and intermodulation still exists as long as public safety receivers are employed with wide RF front-ends.[25] The Commission would thus be ordering a massive realignment of entire services and spectrum bands, at enormous cost, yet not be solving the basic problem.

### B. Nextel's Proposal, If Implemented, Would Yield A Substantial Spectrum Windfall To Nextel.

Nextel proposes to realign the 36 MHz of spectrum in the 806-824 MHz / 851-869 MHz band into two separate contiguous paired blocks of spectrum. Public safety would receive 20 MHz of this band – i.e., 806-816 MHz / 851-861 MHz – while the remaining 16 MHz – i.e. 816-824 MHz / 861-869 MHz – would be used for digital SMR, namely Nextel.[26] Nextel already occupies 10 MHz of this upper band – i.e., 816-821 MHz / 861-866 MHz. To facilitate the implementation of this plan, Nextel proposes to "contribute" 8 MHz of SMR spectrum at 800 MHz, 4 MHz of SMR spectrum at 900 MHz, and 4 MHz of Guard Band spectrum at 700 MHz. In exchange, it would receive an additional 6 MHz of contiguous spectrum at 800 MHz (for a total of 16 MHz) plus 10 MHz of contiguous spectrum in the 2.1 GHz Mobile Satellite Service ("MSS") band.

Nextel's characterization of its proposal as an even "trade" of spectrum is dead wrong, because the spectrum that Nextel proposes to trade-in is encumbered and non-contiguous. For example, the 4 MHz of spectrum currently licensed to Nextel in the

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[25] Verizon Wireless notes that moving public safety out of the 800 MHz band altogether, as opposed to a band realignment, would substantially eliminate the potential for interference. The 700 MHz band might offer a viable option, since 24 MHz of that band has already been allocated for public safety use.

[26] Nextel suggests that a guard band, e.g., 2 MHz, might be necessary to separate the public safety and digital SMR bands. This would reduce the public safety allocation to 18 MHz. *See* NPRM at ¶ 23.

SMR General Category band (806-809.75 MHz / 851-854.75 MHz) is encumbered with private mobile, SMR, and public safety licensees. Nextel purchased its licenses in this band at Auction #34 in September 2000. Under the terms of the auction, Nextel is required to protect incumbents from harmful interference, and is not authorized to relocate incumbents out of this band. As a result, much of the band is unavailable for Nextel's use. Importantly, Nextel knew this when it purchased these licenses at auction. There is no lawful basis for allowing it to "trade" this encumbered spectrum now for clear contiguous spectrum, particularly if the costs of relocation are subsidized by others.

The 4 MHz of spectrum licensed to Nextel in the Lower 80 Channel SMR band (809.75-816 MHz / 854.75-861 MHz) is similarly encumbered. It is also interleaved with Public Safety, Business, and Industrial Land Transportation licensees. Nextel purchased its licenses in this band at Auction #36 in December 2000. Again, the FCC's rules do not permit Nextel to relocate incumbent licensees. And again, Nextel was well aware of these rules when it purchased these licenses at auction.

Nextel's proposal to "trade" encumbered, non-contiguous spectrum for an equal amount of exclusive-use, contiguous spectrum (including 6 MHz of spectrum adjacent to its 800 MHz licenses and 10 MHz in the MSS band) would thus yield a substantial and totally unjustified windfall to Nextel. Nextel's proposal is also in direct conflict with positions it has taken before the Commission in other proceedings. For example, Nextel has previously acknowledged the greater value of unencumbered, contiguous spectrum. In response to the Commission's ongoing review of the commercial mobile radio services ("CMRS") spectrum cap, Nextel argued that the Commission couldn't equate SMR channels that are encumbered and largely non-contiguous with exclusive-use, contiguous

cellular channels available throughout a wide geographic area.[27] The Commission had expressly agreed with this premise when it set a maximum attribution limit of 10 MHz of SMR spectrum under the CMRS spectrum cap, even though Nextel had acquired substantially more than 10 MHz of SMR spectrum, because "SMR spectrum is not available as a contiguous block." It reasoned that 10 MHz was the correct amount, because it was "equivalent to the largest possible block of contiguous SMR spectrum."[28] If, as Nextel has previously said (and the Commission agreed), its current encumbered, non-contiguous spectrum is of significantly less value and use than unencumbered, contiguous spectrum, granting it 16 MHz of contiguous spectrum would be a blatant windfall, and would appear to violate Section 309 and other provisions of the Communications Act.

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[27] *See* Comments of Nextel Communications, Inc. (filed Apr. 13, 2001), *In the Matter of 2000 Biennial Regulatory Review, Spectrum Aggregation Limits For Commercial Mobile Radio Services*, WT Docket No. 01-14, at 3-4; *see generally* Comments of Nextel Communications, Inc. (filed Jun. 20, 1994), *In the Matter of Implementation of Section 3(n) and 332 of the Communications Act, Regulatory Treatment of Mobile Services*, GN Docket No. 93-252, and Reply Comments of Nextel Communications, Inc. (filed Jul. 11, 1994), in GN Docket No. 93-252.

[28] *In the Matter of Implementation of Section 3(n) and 332 of the Communications Act, Regulatory Treatment of Mobile Services*, Third Report and Order,9 FCC Rcd 7988, 8113-14 (1994) (emphasis in original). Nextel also relied on the fact that spectrum was licensed on a station-by-station basis at the time. Yet, even though SMR spectrum has been subsequently licensed on a geographic basis, the Commission continued to treat all SMR holders as "capped" at 10 MHz regardless of the actual amount held, making clear that it was the non-contiguous characteristic of the spectrum that entitled it to a "discount."

### C. Nextel's Proposal Would Impose Unfair And Unlawful Burdens On Other Licensees.

Under Nextel's proposal, it would agree to pay $500 million toward the relocation of public safety systems in the 800 MHz band. It argues that cellular carriers and other incumbent licensees should pay for the remaining relocation costs, which are likely to be an order of magnitude higher. Moreover, the Business and Industrial Land Transportation licensees that also occupy the band would be required to move to another band at their own expense. We understand why Nextel would be willing to pay a small portion of the relocation costs in exchange for a spectrum windfall that is likely to be valued in the billions of dollars. However, we are amazed that Nextel would have the gall to propose to leave the huge balance of the relocation bill to private mobile radio and cellular licensees, even though it is Nextel that is primarily responsible for the interference and Nextel that will benefit from the band realignment.[29]

There is no precedent or legal authority that could support a decision by the Commission to impose relocation costs on cellular licensees. To the contrary, the Commission has dealt with the costs of relocation in two ways, neither of which support Nextel's proposal. In some circumstances, it has left the cost of relocation to the licensees who are moving to new spectrum bands.[30] In other cases, it has required

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[29] Verizon Wireless notes that Nextel might be able to affect a partial realignment of the band through voluntary channel swaps with other licensees within the 800 MHz band. The affected parties could negotiate the costs of such an arrangement privately. Verizon Wireless believes that private negotiations of this sort are in the public interest. To the extent that the Commission's rules need to be modified to facilitate such negotiations, we would support such modifications.

[30] E.g., *Inquiry Relative to the Future Use of the Frequency Bands 806-960 MHz*, First Report and Order and Second Notice of Inquiry, 19 RR2d 1663 (1970).

applicants for a new service, as a condition to being licensed in the new service, to agree to pay the costs to clear the band, reasoning that this relocation cost can be factored into the applicant's decision to acquire the license.[31] Neither approach would authorize the imposition of public safety's relocation costs on cellular licensees.

## CONCLUSION

Verizon Wireless urges the Commission to reject Nextel's band realignment proposal, because it does not significantly eliminate the potential for interference to public safety operations, grants a substantial windfall to Nextel, and imposes substantial and unjustified costs and burdens on other licensees. Moreover, it is likely that any realignment of the 800 MHz band is unwarranted because the costs of such a plan and the operational burdens on incumbents are likely to be substantial while the benefits of realignment would be minimal.

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[31] E.g., *Redevelopment of Spectrum to Encourage Innovation in the Use of New Telecommunications Technologies*, First Report and Order and Third Notice of Proposed Rulemaking, 7 FCC Rcd 6886 (1992).

The Commission should take steps as set forth in the *Best Practices Guide* to resolve interference problems in the 800 MHz band as they arise. Moreover, public safety and commercial licensees should work together to implement palliative measures that will prevent interference from occurring in the first place. This includes changes to public safety systems and equipment that will make them less susceptible to interference and better positioned to meet their communications needs in the future.

Respectfully submitted,

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Dated: May 6, 2002

## Certificate of Service

I hereby certify that on this 6th day of April copies of the foregoing "Comments of Verizon Wireless" in WT Docket 02-55 were sent by hand delivery to the following parties:

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**Declaration of William H. Stone, Jr.**

I, William H. Stone, Jr., hereby declare as follows:

My full name is William H. Stone, Jr. I am Executive Director Network Strategy for Verizon Wireless. I offer this declaration in support of the Comments of Verizon Wireless in the above-captioned proceeding.

## I. Background and Qualifications

1. As the Executive Director Network Strategy for Verizon Wireless, the largest wireless carrier in the U.S., I am responsible for assessing advanced technologies, coordinating technology trials, planning the deployment of new technologies, coordinating Verizon Wireless' participation in various standards bodies and industry forums, and providing technical support to other Verizon Wireless organizations.

2. I was previously Executive Director Network Operations for Bell Atlantic Mobile's Northern New Jersey Region where I was responsible for network

engineering, operations, and performance. Prior to leading the Northern New Jersey Network team, I served as Director Digital Deployment for Bell Atlantic Mobile where I coordinated the deployment of the nation's first digital CDMA network.

3. In the course of my 13+ year career, I have acquired extensive experience in RF engineering and operations. This includes direct involvement in resolving suspected interference issues between my company's cellular systems and other radio communications systems. I have a Bachelors of Science degree in Electrical Engineering from Virginia Tech.

4. My team has worked very closely with Verizon Wireless network operations organizations throughout the country, as well as the Cellular Telecommunications and Internet Association (CTIA) and its members, to investigate the potential for interference to public safety systems operating in the 806-824 MHz / 851-869 MHz (800 MHz) band.

## II. Summary of Conclusions

5. I am submitting this declaration to provide information regarding Verizon Wireless' experiences with interference to public safety licensees in the 800 MHz band. My declaration addresses the following points:

6. First, the interference problems experienced by public safety licensees in the 800 MHz band are a result of operating "noise-limited" public safety systems in frequency bands that are near to bands used for "interference-limited" commercial systems. In some situations, harmful interference can result in the form of receiver overload, intermodulation interference, and out-of-band

interference. The potential for such interference to occur is greatest in the interleaved portions of the band where Nextel shares spectrum with various public safety licensees.

7. Second, Verizon Wireless is aware of few interference problems caused to public safety licensees by the operation of its cellular systems. In the event that harmful interference does occur, Verizon Wireless makes every reasonable effort to assist public safety licensees in resolving the interference in a timely manner.

8. Finally, the potential for harmful interference can be greatly reduced by redesigning public safety networks, increasing the signal strength of the desired signal levels above local noise levels, and employing newer public safety receivers that are less susceptible to interference. A realignment of the 800 MHz band alone will not significantly reduce the potential for harmful interference.

## III. Receiver Overload And Intermodulation Are The Primary Causes Of Interference To Public Safety.

9. The potential for interference between public safety and commercial systems stems from the fundamental differences in the way that each system is designed. Public safety systems are designed to serve relatively small groups of users over a wide geographic area. Consequently, these systems are designed to provide extensive coverage from a single base station with little or no frequency reuse, and mobile receivers are designed to operate at low signal levels where the limiting factor in receiver performance is thermal noise. Thus, public safety systems are referred to as "noise-limited" systems.

10. In contrast, commercial wireless systems are designed to serve a large number of customers with much greater traffic volumes. Consequently,

commercial operators must make much more intensive use of their assigned spectrum by deploying large numbers of base stations in a cellular architecture with each cell site covering a relatively small area. The high cell density increases the potential for interference from other base stations operating on the same frequency. As a result, interference is the limiting factor in receiver performance and these systems are called "interference-limited" systems.

11. When "noise-limited" systems and "interference-limited" systems are close both geographically and spectrally, the potential for interference exists. Harmful interference into public safety receivers can manifest itself in three ways; receiver overload, intermodulation interference, and out-of-band emissions. Each of these interference mechanisms is discussed in more detail in the following sections.

12. *The predominant cause of interference is the overload of the front-end amplifiers of the public safety mobile receivers.* Receiver overload can occur when a public safety receiver operates near the edge of its service area, with a weak received signal, and is in the presence of a strong, nearby undesired signal. If the undesired signal is passed through the bandpass filter in the front-end of the public safety receiver, and the signal is strong enough, it can overload the low noise amplifier in the receiver. The undesired signal, if strong enough, reduces the receiver dynamic range, due to the activation of automatic gain control (AGC) loops or limiters. This affects the ability of the receiver to properly demodulate and detect the desired signal over the original (no interference)

range of recommended receive signal levels. This effect is called receiver desensitization.

13. Interference resulting from receiver overload can be reduced through frequency separation and/or increasing the relative difference between the power levels of the public safety and commercial signals (i.e., by increasing the level of the desired public safety signal or reducing the level of the undesired commercial signal). However, significant reductions in interference cannot be guaranteed unless the public safety receivers are designed to employ new bandpass filters that do not pass the undesired signal.

14. Intermodulation interference (IM) occurs when two or more signals operating at different carrier frequencies are present at the input of a nonlinear device. The input signals are mixed and generate new signals, called intermodulation products, at different frequencies. For public safety receivers, this mixing takes place inside the receiver when interfering signals that are passed by the broad radiofrequency (RF) receiver bandwidth are subsequently processed by the non-linear characteristics of the front-end RF amplification stage. For example, consider a public safety receiver that receives two undesired input signals (within the receiver's operating bandwidth) operating at frequencies $f_1$ and $f_2$, respectively. After RF front-end filtering and non-linear amplification, intermodulation occurs at frequencies $nf_1 + mf_2$ and $nf_1 - mf_2$ where n, m = 1, 2, 3, 4, etc. The sum n+m determines the order of the intermodulation product. Thus, the third order component (n+m = 3) is given by IM3 = $2f_1 - f_2$, $2f_2 - f_1$, $2f_1 + f_2$, $2f_2 + f_1$. If the intermodulation products that are produced fall on or

near the desired public safety signal, interference can occur. As is the case for receiver overload, IM is only a problem if the undesired signals are passed by the RF filter in the front-end of the public safety receiver and incident at the input of the public safety receiver amplifier.

15. Out-of-band emissions (OOBE) from commercial transmitters can also be a potential source of interference to public safety receivers. All transmitters produce energy outside of their assigned frequencies; referred to as transmitter sideband noise. This is a necessary product of the modulation process. If the level of emissions produced in an adjacent public safety band is comparable to or stronger than the desired public safety signal, performance degradation can occur. Unlike the receiver overload and intermodulation examples discussed previously, these emissions cannot be filtered by the public safety radios, since they are occurring on frequencies that the radios are attempting to receive. Generally, commercial transmitters produce only low levels of OOBE and this type of interference is not a significant contributor to the problems experienced by public safety. To the extent it is a problem, it is more likely to occur in the portion of the 800 MHz band where public safety licensees and Nextel are interleaved.

## IV. Verizon Wireless Has Experienced Very Few Problems With Interference To Public Safety Operations.

16. Verizon Wireless has deployed one of the most sophisticated and spectrally-efficient networks in the industry. We have deployed digital technology throughout our network, utilizing Code Division Multiple Access (CDMA) technology – the most efficient mobile technology currently available. In addition to deploying efficient technologies, we design our networks using a cellular architecture and power control techniques to make the most efficient use of spectrum and manage interference. We continue to upgrade our network to meet the increasing demands of our customers and the business.

17. Verizon Wireless is the nation's leading provider of wireless communications services. We operate the largest wireless network in the nation, covering 97 of the top 100 markets and serving approximately 30 million customers. We have deployed many thousands of cell sites throughout these markets and we are not aware of any cases where Verizon Wireless has been found to be a significant contributor to harmful interference to public safety.

18. Verizon Wireless' network operations organizations are segmented into four areas; Northeast, South, Midwest, and West. These operations areas have responsibility for operating the network in their respective areas, ensuring network system performance, and addressing any local interference issues that may arise with other spectrum licensees. The Network System Performance directors and managers in all of Verizon Wireless' operations areas have been solicited for information regarding potential interference problems with public safety operations. A summary of the findings is provided in Table 1.

## Table 1. Verizon Wireless Experience With Public Safety Interference

| Region | State | City / County | Agency Name | Status / Notes |
|---|---|---|---|---|
| **Northeast Area** | | | | |
| New England | Connecticut | N/A | N/A | No cases reported. |
| | Maine | N/A | N/A | No cases reported. |
| | Massachusetts | N/A | N/A | No cases reported. |
| | New Hampshire | N/A | N/A | No cases reported. |
| | Rhode Island | N/A | N/A | No cases reported. |
| | Vermont | N/A | N/A | No cases reported. |
| Upstate New York | New York | N/A | N/A | No cases reported. |
| New York Metro | New Jersey | N/A | N/A | No cases reported. |
| | New York | N/A | N/A | No cases reported. |
| Philadelphia Tri-State | Delaware | N/A | N/A | No cases reported. |
| | New Jersey | N/A | N/A | No cases reported. |
| | Pennsylvania | N/A | N/A | No cases reported. |
| Wash. / Balt. / Virginia | District of Columbia | N/A | N/A | No cases reported. |
| | Maryland | Anne Arundel County | Anne Arundel County Police Department | Interference at various locations in County. Tests conducted to date indicate that the root cause is IM, main source of interference is Nextel and Cingular, and interference from VZW is negligible. |
| | Virginia | N/A | N/A | No cases reported. |

## Table 1. Verizon Wireless Experience With Public Safety Interference (cont)

| Region | State | City / County | Agency Name | Status / Notes |
|---|---|---|---|---|
| **South Area** | | | | |
| Carolina | North Carolina | N/A | N/A | No cases reported. |
| | South Carolina | N/A | N/A | No cases reported. |
| Florida | Florida | N/A | N/A | No cases reported. |
| Georgia | Georgia | N/A | N/A | No cases reported. |
| New Orleans / Houston / Mississippi Coast | Alabama | N/A | N/A | No cases reported. |
| | Louisiana | N/A | N/A | No cases reported. |
| | Mississippi | N/A | N/A | No cases reported. |
| | Texas | N/A | N/A | No cases reported. |
| Mid-South | Alabama | N/A | N/A | No cases reported. |
| | Kentucky | N/A | N/A | No cases reported. |
| | Tennessee | Memphis | City of Memphis | Interference analysis incomplete. However, form of interference indicates that Verizon Wireless is not the source of interference. |
| Central Texas | Arkansas | N/A | N/A | No cases reported. |
| | Louisiana | N/A | N/A | No cases reported. |
| | Texas | N/A | N/A | No cases reported. |
| | West Virginia | N/A | N/A | No cases reported. |

## Table 1. Verizon Wireless Experience With Public Safety Interference (cont)

| Region | State | City / County | Agency Name | Status / Notes |
|---|---|---|---|---|
| **Midwest Area** | | | | |
| Dakotas / Minn. / Iowa | Iowa | N/A | N/A | No cases reported. |
| | Minnesota | N/A | N/A | No cases reported. |
| | North Dakota | N/A | N/A | No cases reported. |
| | South Dakota | N/A | N/A | No cases reported. |
| Kansas / Missouri | Kansas | N/A | N/A | No cases reported. |
| | Missouri | N/A | N/A | No cases reported. |
| Illinois / Wisconsin | Illinois | N/A | N/A | No cases reported. |
| | Wisconsin | N/A | N/A | No cases reported. |
| Michigan / Indiana | Indiana | N/A | N/A | No cases reported. |
| | Michigan | N/A | N/A | No cases reported. |
| Penn. / W. Va. / Ohio | Ohio | N/A | N/A | No cases reported. |
| | Pennsylvania | N/A | N/A | No cases reported. |
| | West Virginia | N/A | N/A | No cases reported. |

## Table 1. Verizon Wireless Experience With Public Safety Interference (cont)

| Region | State | City / County | Agency Name | Status / Notes |
|---|---|---|---|---|
| **West Area** | | | | |
| Desert Mountain | Arizona | N/A | N/A | No cases reported. |
| | Nevada | N/A | N/A | No cases reported. |
| Desert Mountain | New Mexico | N/A | N/A | No cases reported. |
| Hawaii | Hawaii | Maui | Maui Police Department | Tests show no significant interference from VZW. |
| Mountain | Colorado | N/A | N/A | No cases reported. |
| | Idaho | N/A | N/A | No cases reported. |
| | Montana | N/A | N/A | No cases reported. |
| | Utah | N/A | N/A | No cases reported. |
| | Washington | N/A | N/A | No cases reported. |
| | Wyoming | N/A | N/A | No cases reported. |
| Northern California / Nevada | California | N/A | N/A | No cases reported. |
| | Nevada | N/A | N/A | No cases reported. |
| Pacific Northwest | Idaho | N/A | N/A | No cases reported. |
| | Oregon | Portland | City of Portland | Tests show no significant interference from VZW. |
| | Oregon | Bremerton | Washington County Cons. Comm. Agency | Tests show no significant interference from VZW. |
| | Washington | N/A | N/A | No cases reported. |
| Southern California | California | Orange County | Orange County | Orange County report concludes that interference from VZW is not significant. More than 150 cell sites and no problems requiring modifications. |

19. The Northeast Area includes operations in the New England, Upstate New York, New York Metro, Philadelphia Tri-State, and Washington / Baltimore / Virginia regions. In the Northeast Area, only one region reported an ongoing potential problem with interference into public safety – in Anne Arundel County, Maryland. Verizon Wireless is the B-band cellular licensee in the Baltimore, Maryland MSA that includes Anne Arundel County. Public safety authorities have reported interference problems at various locations in the county, and have been working with Nextel, Cingular, and Verizon Wireless to conduct tests and evaluate the cause of the interference. Tests conducted to date indicate that the root cause of the interference is IM and that the main sources of interference are Nextel and Cingular (the A-band cellular licensee). These tests also indicate that Verizon Wireless introduces negligible IM interference. Additional tests are likely to be conducted in the future, though none have been scheduled. We will continue to cooperate fully with public safety authorities in Anne Arundel County and other commercial providers.

20. The South Area includes the MidSouth (Alabama, Kentucky, Tennessee), New Orleans / Houston & Mississippi Coast, Dallas / Fort Worth / San Antonio / Austin, Carolina, Georgia, and Florida regions. In the South Area, only one incident of potential interference to public safety operations has been reported to Verizon Wireless personnel; in Memphis, TN. Verizon Wireless has been working with the City of Memphis to identify the source of interference. While we do not believe that Verizon Wireless is responsible for the interference, no final conclusion has been reached.

21. The Midwest Area includes the Dakotas / Minnesota / Iowa, Kansas / Missouri, Illinois / Wisconsin, Michigan / Indiana, and Pennsylvania / West Virginia / Ohio. In the Midwest

Area, no incidents of potential interference to public safety operations have been reported to Verizon Wireless personnel.

22. The West Area includes the Pacific Northwest, Southern California, Northern California / Nevada, Desert Mountain, Hawaii, and Mountain regions. In the West Area, four cases of potential interference problems with public safety have been reported: Orange County, California; Portland, Oregon; Bremerton, Oregon; and Maui, Hawaii.

23. In Orange County, engineers employed by the county have been working with Nextel, AT&T Wireless, and Verizon Wireless to document and mitigate interference with some success. The results of these efforts are summarized in a report entitled "Wireless Communications Company Interference Report", that was released by the Orange Country Sheriff's Department on September 27, 2001. The report concludes that there is no significant interference from Verizon Wireless. Notably, Verizon Wireless operates more than 150 cell sites in the area, and there have never been any problems requiring modifications to these sites.

24. Representatives from the City of Portland have been working with Nextel and Verizon Wireless to assess the interference problems there. The test results show that Nextel is the main source of interference and that Verizon Wireless is not a contributor.

25. Verizon Wireless has been working with public safety personnel in Washington County, Oregon (outside Portland) to evaluate interference into systems operated by the Washington County Consolidated Communications Agency. Testing shows that the interference is primarily due to IM caused by Nextel and AT&T, and that Verizon Wireless is not a significant contributor.

26. Verizon Wireless engineers have worked with the Maui Police Department to conduct tests on a site co-located with the Police Department that is about 100 yards away from an AT&T Wireless site. Test results show that Verizon Wireless is not the cause of interference.

27. *APCO's Interim Report to the FCC does not accurately represent the interference problems involving Verizon Wireless.* The Association of Public-Safety Communications Officials (APCO) has been working with the wireless industry and various public safety agencies to resolve interference problems under a program it calls Project 39. On December 24, 2001, APCO submitted an "Interim Report to the FCC" that describes the preliminary findings of Project 39 regarding the kinds of interference problems that public safety agencies have experienced. While Verizon Wireless cannot comment on the accuracy of all of the data included in the Interim Report, much of the data involving Verizon Wireless is inaccurate. A summary of corrections that should be made to the report is provided in Table 2.

28. In the Interim Report, information provided by Nextel identifies six cases of interference into public safety that involved Verizon Wireless. In four of these cases, Verizon Wireless has never been contacted by any public safety representative regarding potential interference. Consequently, we believe that these cases have been inaccurately reported by Nextel. We are familiar with the potential for interference in two of the identified cases: Orange County, California; and Anne Arundel County, Maryland. We have worked closely with public safety personnel in both of these counties to assess the source of the interference problem. As noted in the previous sections, Verizon Wireless was not found to be a significant contributor to the interference in either case.

## Table 2. Corrections to APCO "Interim Report to the FCC"
## Interference Cases Involving Verizon Wireless

| State | County | City | Agency Name | Identified Source | Status / Notes |
|---|---|---|---|---|---|
| **Cases Reported By Nextel (Verizon Wireless Directly Named)** | | | | | |
| California | Los Angeles | Los Angeles | Los Angeles County | Nextel, AT&T, Verizon | Verizon Wireless is B-band licensee.<br>VZW has not been contacted by LA County. |
| California | Los Angeles | Downey | Los Angeles County | Nextel, AT&T, Verizon | Verizon Wireless is B-band licensee.<br>VZW has not been contacted by LA County. |
| California | Orange | Orange | Orange County Sheriff's Department | Nextel, AT&T, Verizon | Verizon Wireless is B-band licensee.<br>VZW has been working cooperatively with Orange County engineers to document and mitigate interference. Orange County report concludes that interference from VZW is not significant. More than 150 cell sites and no problems requiring modifications. |
| Maryland | Anne Arundel | Annapolis | Anne Arundel County | Nextel, Cingular, Verizon | Verizon Wireless is B-band licensee.<br>VZW working w/ County, Nextel, and Cingular to conduct tests. Results indicate that root cause is IM, main sources are Nextel and Cingular, and interference from VZW is negligible. |
| Maryland | Worcester | Ocean City | Ocean City | Nextel, Cingular, Verizon | Verizon Wireless is B-band licensee.<br>VZW has not been contacted by Ocean City. |
| Virginia | York | Newport News | Newport News | Nextel, Cingular, Verizon | Verizon Wireless is B-band licensee.<br>VZW has not been contacted by Newport News. |

## Table 2. Corrections to APCO "Interim Report to the FCC" (cont)

## Interference Cases Involving Verizon Wireless

| State | County | City | Agency Name | Identified Source | Status / Notes |
|---|---|---|---|---|---|
| **Cases Reported By APCO (Verizon indirectly named)** | | | | | |
| California | Los Angeles | Monterey Park | Monterey Park Police Department | Commercial provider | Verizon Wireless is B-band licensee.<br>VZW has not been contacted by Monterey Park Police Department. |
| Georgia | Douglas | Douglasville | City of Douglasville | Cell towers | Verizon Wireless is A-band licensee.<br>VZW has not been contacted by City of Douglasville. |
| Georgia | Fulton | Atlanta | Fulton County Emergency Comm. | Cellular providers | Verizon Wireless is A-band licensee.<br>VZW has not been contacted by Fulton County Emergency Communications. |
| Hawaii | Maui | Lahaina and Kihei | Maui County Police Department | Bldgs. w/ large cellular transmitter population | Verizon Wireless is B-band licensee.<br>VZW has worked w/ Maui Police Department to conduct test on site collocated w/ Dept. that is 100 yards away from AT&T site. Test results show that VZW is not the cause of interference. |
| Michigan | Livingston | Howell | Michigan State Police Department | Cellular | Verizon Wireless is A-band licensee.<br>VZW has not been contacted by Michigan State Police Department. |

28. APCO did not specifically name Verizon Wireless as a source of interference in any other cases identified in the Interim Report. However, there were five cases of interference identified in the Interim Report that suggest the possible involvement of Verizon Wireless (e.g., by identifying the source as "cellular" in a market where Verizon Wireless is a cellular operator). In four of these cases, Verizon Wireless has never been contacted by any public safety representative regarding potential interference. The only case identified where we are aware of a potential interference problem is with the Maui Police Department. As discussed in the previous sections, testing concluded that Verizon Wireless is not the cause of this interference.

29. *Verizon Wireless' use of CDMA technology and power control techniques makes it an unlikely source of interference*. As noted previously, Verizon Wireless employs power control techniques as an essential component of its CDMA wireless systems. The power radiated from every base station and handset is kept at a minimum to reduce the potential for intra-system interference. Since the potential for commercial operations to interfere with public safety operations is related to the relative power levels of the two systems, our use of these power control techniques reduces the likelihood of creating interference to public safety systems.

30. Cellular operators using CDMA transmit less interfering power in a victim's receiver bandwidth. Current CDMA systems employ a large spreading bandwidth of 1.25 MHz. This leads to a lower interfering power spectral density in a victim's receiver bandwidth as compared to other cellular technologies. As a result, CDMA is less likely to cause intermodulation interference than other technologies. Under a worst case scenario, when there is intermodulation interference and assuming equal received total interfering powers for

CDMA and narrowband technologies (e.g., TDMA or iDEN), narrowband technologies produce 10 x log(1.25/0.030) = 16 dB more interference power, in a 30 KHz bandwidth (comparable to the typical 25 KHz channel bandwidths used by public safety radios), at the input of a PS receiver amplification stage compared to CDMA, which would produce a 3rd order intermodulation product that is 48 dB greater and a 5th order intermodulation product that is 80 dB greater after receiver amplification. With regard to receiver overload, the bandwidth characteristics of the interfering signals are of secondary nature and both CDMA and narrowband technologies could equally overload the PS receiver, but as explained earlier, the use of power control techniques in CDMA reduces the potential for interference.

## V. The "Best Practices Guide" Provides A Useful Framework For Resolving Interference Problems With Public Safety.

31. In December 2000, a group of subject matter experts from the wireless industry and the public safety community developed a "Best Practices Guide" that described the potential for harmful interference between commercial and public safety operations and proposed several measures that both public safety and commercial licensees could take to mitigate interference in existing deployments and prevent interference in future deployments. Verizon Wireless believes that, at least for the near-term, the vast majority of interference problems can be resolved by following these guidelines.

32. In some circumstances, modifications or refinements to the commercial operations is an appropriate means for resolving interference problems. This might include reducing the power of the commercial base station or changing the height or alignment of the transmitting antenna. However, as noted previously, Verizon Wireless already employs power control techniques to reduce the potential for interference.

33. The best means for reducing the potential for harmful interference to public safety is to improve the robustness of public safety communications by improving the local signal strength of the public safety communications system or deploying more interference-resistant mobile receivers. The signal strength received by the public safety mobiles can be improved by adding more proximate base stations, adding repeaters, increasing the power levels of the transmitters, or providing better transmission antennae. This can help to reduce the potential for harmful interference stemming from receiver overload, intermodulation, and out-of-band emissions.

34. Improvements can also be obtained by deploying mobile receivers with better filtering and improved IM rejection. Enhancements to public safety mobile receivers, with a minimum of 75 dB IM rejection, will provide significant improvements.

35. *Realignment of the 800 MHz band, as proposed by Nextel, will provide only modest reductions in interference.* Unless the public safety equipment modifications discussed above are implemented, interference due to receiver overload and intermodulation will not be reduced through band realignment. As a result, segregation of public safety and commercial frequency assignments within the 800 MHz band will not provide significant improvements. Moreover, any benefits of such a realignment plan would be substantially outweighed by the costs and disruption of such a plan.

## VI. Conclusion

36. In summary, Verizon Wireless is not a significant contributor to the interference experienced by public safety licensees. When the rare case of interference does arise, it can be resolved through the application of the mechanisms outlined in the "Best Practices Guide." In particular, the potential for interference can be greatly reduced through the

redesign of public safety networks and equipment to be more spectrally-efficient and less susceptible to interference. Conversely, a realignment of the 800 MHz band without these modifications will not provide substantial reductions in the interference caused to public safety systems.

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

Date: May 6, 2002

**William H. Stone, Jr.**

Executive Director Network Strategy
Verizon Wireless
/s/